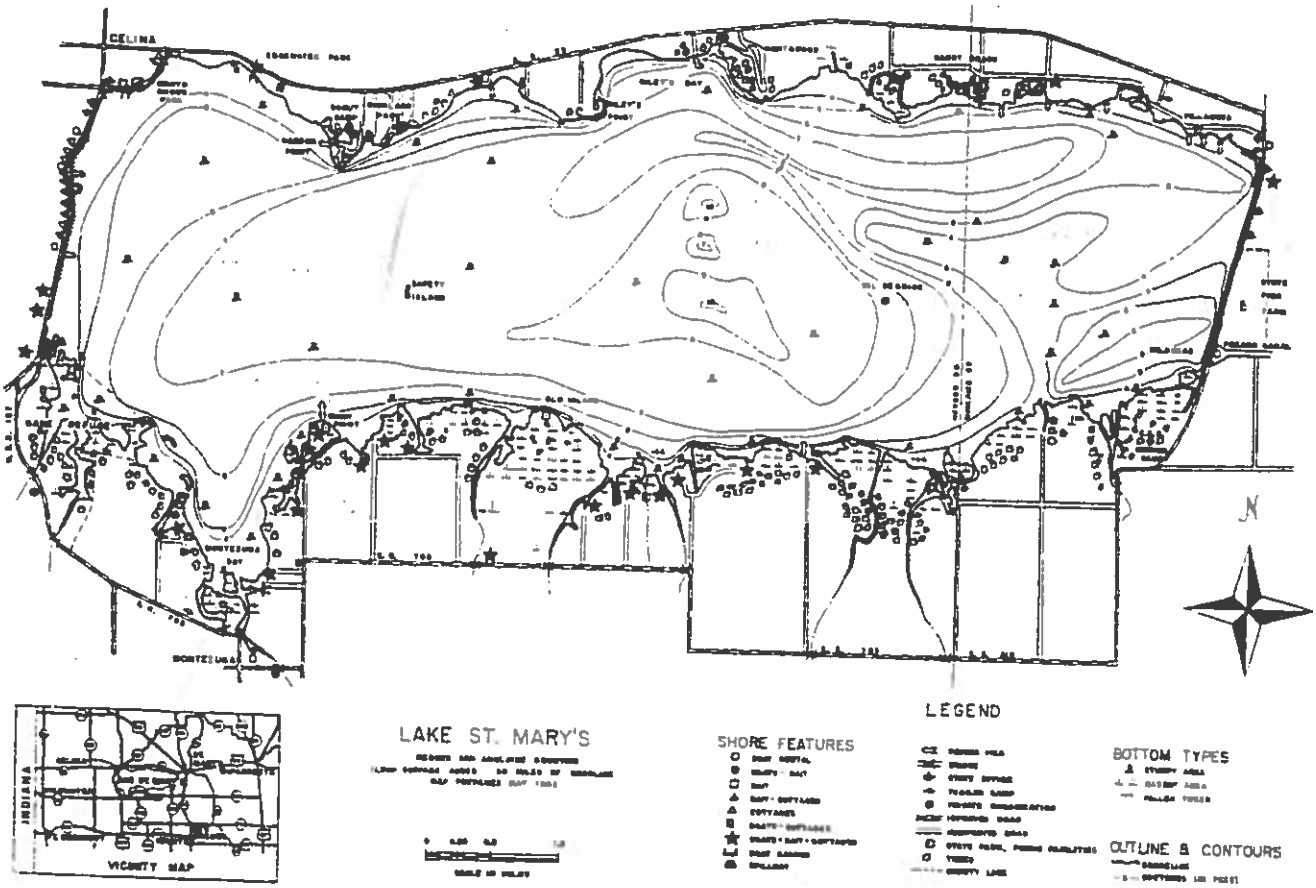
LAKE ST. MARYS
AND
ITS MANAGEMENT

by

Clarence F. Clark



Ohio Department of Natural Resources

Division of Wildlife

1960

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Mr. John S. Glass of the U. S. Soil Conservation Service generously loaned a copy of the report of the sedimentation survey of the lake to supply this type of data for the report.

Dr. Henry van der Schalie, Curator of Mollusca, Museum of Zoology of the University of Michigan checked the identification of all mollusks. Mr. Rendall Rhoades as Curator of Collections of the Cleveland Museum identified the crayfish. Dr. Percy Moore of the University of Pennsylvania identified the leeches, Dr. Ralph Dexter, Kent State University, the phyllopods, Dr. Minna K. Jewell, Thornton Junior College, and Dr. Marcus C. Old, Hofstra College, the sponges, and Dr. Mary Rogick, College of New Rochelle, the bryozoa.

PHYSIOGRAPHY

Lake St. Marys is located in the eastern part of Mercer and the western part of Auglaize counties, Ohio (Figure 1 - Cover). Celina is located on the northwest corner of the lake at the junctions of State Routes 197 and 29 and U. S. Route 127. St. Marys lies near the northeast corner of the lake at the junctions of U. S. 33 and State Routes 29, 116, and 66.

Lake St. Marys is an artificial lake created by damming the headwater streams of the Wabash and St. Marys rivers and flooding the dividing area between them. It was constructed in the years 1837 to 1845 (Scranton 1907) at a cost of $528,222.07 for the purpose of supplying water to the Miami-Erie Canal.

The uses of the lake to the people of Ohio have been varied and numerous. In its original use, it aided in lowering the transportation rates from 75 cents per hundred for wagon rates on produce from Dayton to Cincinnati to 7½ cents per thousand pounds on the canal in 1851 (Lloyd, Falconer & Thorne, 1918). Canal boats carried produce across the lake in the early days and timber was floated across it and out the canal to market. Approximately 100 commercial fishermen obtained a livelihood from the sale of fish harvested from the lake, and market hunters sold untold thousands of ducks, geese, and snipe when such activities were permitted (Clark 1951).

The greatest value of the lake at present lies in its recreational importance to hundreds of thousands of users. During the years 1946 through 1950, anglers from all of Ohio's 88 counties, from 28 other states, and from 2 foreign countries were known to have enjoyed angling in its waters. Although not comparable to that of early days, waterfowl hunting attracts hundreds of hunters to the area. In 1955, over 2,900 boat licenses for row boats, sail boats, and inboard motor boats were sold at the lake. The suitable habitats along the lake harbor muskrat, coon, and mink and provide an annual harvest of many thousands of dollars in furs. The state has provided over 200 acres of parks, equipped with various types of facilities, for public use.

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Part I
INTRODUCTION

When we consider the age of the old canal reservoirs and the money spent on their maintenance and improvement, we wonder what benefit has been received from the years of work and the funds expended. To obtain a fair idea as to the progress which has been made and the value of the work, it is necessary to have as near a complete background as can be obtained in order to properly appraise any changes.

Investigations of many types have been made at Lake St. Marys during the past half-century, but the scattered nature of this information prevents its proper use. This report is an effort to bring together all the available data which may shed any light upon the fisheries of the lake's past, present, or future, and which may assist in developing a sound fisheries program for this recreational area.

ACKNOWLEDGEMENTS

In the course of assembling and accumulating this data, I have been greatly and generously assisted by many persons. Mr. E. L. Wickliff, former Fish Management Supervisor for the State of Ohio, and his Assistant, Mr. John Z. Pelton, have loaned the Division of Wildlife's files and aided through their suggestions. Mr. Lee S. Roach, while assistant to Mr. Wickliff, initiated lake reports of this type and gave freely of his time and guidance in obtaining the data and compilation of the same. Every fisheries employee of Wildlife Conservation District #2 has in some manner aided in either collecting or compiling information. Mr. Darrell Allison, Mr. Roger McElroy, Mr. Dean Now, Mr. Arlie Rhodes, and Mr. John Young, of the Division of Wildlife, offered the greater contributions. Mr. M. A. Durbin, of the Division of Parks, supplied considerable information on his field of activities.

Acknowledgements are due to a large number of "old-timers", living and dead, who contributed their time and memories to give us a better mental picture of the lake as it was in the days of their early life in this vicinity. Mr. Guy Heap, Mr. John W. Thompson, Mr. F. B. Magill, Mrs. Peter Rudolph, Mr. Boyd Anderson, Mr. Wilshire Riley, Mr. Zura Riley, Mr. Edward Frey, Mr. Henry Koehn, Mr. William Swartz, Mr. Wilbur Mallory, and Mr. Arnold Yingling supplied data on the lake as it was in the days of "long ago".

Mr. Frank Shelly and the late Mrs. Peter Rudolph loaned many of the pictures which illustrate many of the facts supplied by the "old-timers".

ERRATA

FOR: "Lake St. Marys and Its Management" by Clarence F. Clark, Ohio Department of Natural Resources, Division of Wildlife, 1960, pp. 1-107

Page 7, paragraph 2, line 2, change "quoted" to "cited".

Page 13, paragraph 4, line 8, add "inches" at the end, following 16.

Page 18, paragraph 2, line 2, add "numbers of" following the word increased.

Page 26, paragraph 1, line 5, add "drilling" following the words oil well.

Page 29, paragraph 5, line 1, change "station" to "section".

Page 30, paragraph 1, place quotation marks at the end of the paragraph.

Page 42, figure 21, change "length-figuring" to "length-frequency".

Page 53, paragraph 4, line 2, change "nitches" to "niches".

Page 61, Table 14

* New data	should be	*1. New data
** Roach & Evans 1948	should be	**2. Roach & Evans 1948
*** Erickson & Zarbock 1954	should be	***3. Erickson & Zarbock 1954

Page 65, Table 17, ***Smith & Mow 1944 should be ***Smith & Moe 1944.

Page 83, paragraph 2, line 5, change "Figure 37 to Figure 38" and "Figure 38 to Figure 37".

Page 84, figures 37 and 38, the titles should be reversed.

Page 95, paragraph 4, last line, change "protion" to "portion".

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In addition to its recreational uses, the lake is of considerable value to the municipalities and industries in the villages of Celina and St. Marys. The uses of the water vary from cooling purposes in industry, to drinking water for the population, to water supplies for minnow propagation. Celina, St. Marys, and Delphos benefit from the waters held in the lake and released through the canal.

Both Auglaize and Mercer counties are rural communities with a population in 1950 of 30,637 and 28,311 respectively. Due to the fact that the lake attracts anglers from such an extensive area, it is impossible to consider any one area as a working area or unit for the economic effects on a community.

The drainage area lies almost wholly on the south side of the lake and consists of 113.5 square miles (Sherman 1932). The lake occupies 20.9 per cent of the total drainage area. Due to the location of the lake near the crest of the divide between the Ohio and St. Lawrence drainage basins at an elevation of 870 feet above sea level, the tributary streams are short and none exceed ten miles in length. Coldwater Creek and Beaver Creek (Montezuma Creek) enter near the southwest corner of the lake, Chickasaw Creek near the south central portion, and Behrn's Creek near the southeast corner of the lake. Other smaller tributaries supplement the above-mentioned drainage, but are relatively insignificant by comparison. No tributaries enter the lake along the north shore, and the east and west ends are man-made levees. The lake has outlets into the Miami-Erie Canal and thence into the St. Marys River at the east end of the lake, and into Beaver Creek and thence into the Wabash River at the west end. Thus the waters from Lake St. Marys flow into both the Ohio and the St. Lawrence rivers.

The drainage area lies in both Auglaize and Mercer counties in a gently rolling terrain consisting of moraines and their interlying lowlands. According to Sanderson (1948), land uses of the drainage area are divided into 67 per cent cultivated crops, 2 per cent idle land, 10 per cent pasture, 17 per cent woods, and 4 per cent urban.

The soils of the drainage area are composed of two dominant types (Conrey 1945) of which Crosby silty clay loam covers approximately two-thirds of the area and Miami silty clay loam the remainder (Figure 2). These soils were described by Geib (1910) as ones which drained poorly but provided good general farming when properly drained. Slightly to moderate sheet erosion, no gully erosion, and only moderate stream-bank erosion were reported for the drainage in the sedimentation study of the lake made by the U. S. Soil Conservation Service (Brune 1941). Soil samples from the drainage area indicated that the cultivated soils had an average pH of 6.8 and contained an average per acre of 11.7 pounds of nitrogen, 47.5 pounds of phosphorus and 301.5 pounds of potassium. Pasture lands had an average pH of 7.3, and contained per acre 13.8 pounds of nitrogen, 52.3 pounds of phosphorus, and 262 pounds of potassium. Woodland soils revealed an average pH of 6.3, and contained per acre 8.6 pounds of nitrogen, 41 pounds of phosphorus, and 262 pounds of potassium (Table 1).

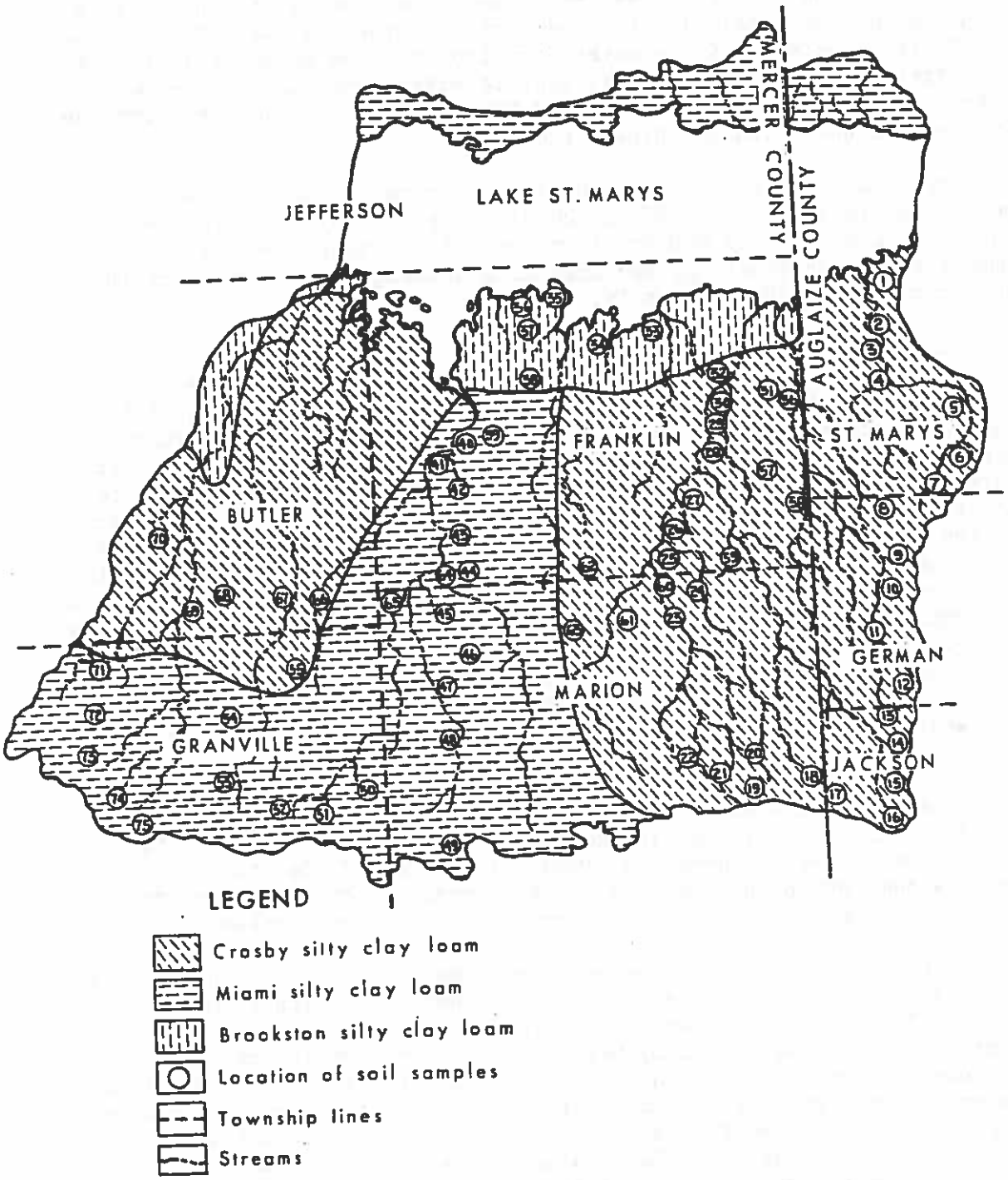


FIGURE 2. GENERALIZED SOILS MAP OF THE LAKE ST. MARYS DRAINAGE AREA, AND THE LOCATIONS OF THE 75 SOILS SAMPLES TAKEN.

TABLE 1
Analysis of soils taken from the Lake St. Marys drainage area

	pH			Nitrogen			Phosphorus			Potassium		
	H*	L*	A*	H*	L*	A*	H*	L*	A*	H*	L*	A*
Pasture	7.4	5.2	7.3	44	4	13.8	75	25	52.3	400	120	262
Cultivated	7.8	5.2	6.8	60	2	11.7	150	10	47.5	400	100	301
Woods	7.6	5.0	6.3	30	2	8.6	100	10	41.0	400	000	246

* H-High, L-Low, A-Average

PART II
LIMNOLOGY

Precipitation

Lake St. Marys lies in an area which is well supplied with total precipitation, and that precipitation is fairly well distributed throughout the year. (Table 2) Rainfall for the past 16 years averaged about 37 inches per year. During the years 1946 through 1950, compiled to compare with water transparencies, an average of 2.42 inches of rain fell in April, 3.67 in May, 4.75 in June, 3.79 in July, 2.82 in August and 2.9 in September. The most rainfall recorded for any one 24-hour period was 4.60 on September 30 and October 1, 1950. The heaviest rains usually occurred in June. During the 1940-1955 period, the area received an average of about 26 inches of snow per year. In 1950, 50.1 inches of snow fell in the area and 36.4 inches in 1951. The heaviest snowfall for a 24-hour period was 15.5 inches on December 10-11, 1944. The weather data is taken from the Ft. Wayne, Indiana station, which is the nearest to this area.

The normal rainfall is such that the water level is relatively stable, with the normal fluctuations which occur in times of drought and heavy rainfall.

Due to the fact that the lake is seldom covered with ice for any length of time, the heavy snowfalls have little relation to the lake other than its effects on the precipitation.

Samples of rainfall were collected at the St. Marys Fish Farm from January through April, 1950. The pH ranged from 4.5 to 6.4, with an average of 5.3 for the four months.

TABLE 2

Weather data from the Ft. Wayne, Indiana Station

	Air Temperature, Fahrenheit			Total Precipitation, Inches					Snow, Inches		
DATE	MEAN	HIGHEST	DATE	LOWEST	DATE	TOTALS	HIGHEST	DATE	TOTALS	HIGHEST	DATE
1940	49.0	98.0	7/24	14	1/19	28.91	1.70	6/28	32.7	11.2	2/26, 27
1941	51.4	99.0	10/11	0	2/19	25.73	1.80	6/11	12.7	5.4	1/2, 2
1942	49.5	95.0	7/17	2	1/8	42.51	2.49	7/19	24.9	6.2	11/29
1943	48.3	94.0	6/25	13	1/20	35.92	2.48	9/6	18.5	11.7	1/18, 19
1944	49.8	99.0	6/27	8	2/13	30.70	2.72	4/10, 11	32.0	15.5	12/10, 11
1945	48.4	94.0	6/24	8	1/2	40.25	2.64	9/30 & 10/1	24.6	2.8	1/5, 6
1946	51.1	95.0	7/18	7	1/22	30.20	2.40	6/12, 13	12.9	3.8	1/4
1947	49.1	100.0	8/6	2	3/8	38.62	2.96	10/18	20.7	4.6	12/15, 16
1948	49.9	96.0	8/27	7	3/12	37.26	2.41	7/13	23.3	5.9	3/10
1949	50.3	95.0	7/1	0	1/30	33.64	2.40	1/18	26.3	3.1	1/11
1950	50.3	91.0	6/23	8	12/27	51.78	4.60	9/3 & 10/1	50.1	7.0	11/25, 26
1951	48.9	98.0	8/31	17	2/2	42.63	2.44	7/8, 9	36.4	5.9	1/31
1952	51.0	99.0	6/29	5.0	1/24	39.69	1.72	4/22, 23	21.9	7.7	2/6
1953	52.3	100.0	9/2	2	1/6	25.99	2.15	3/3, 4	28.3	4.9	2/16
1954	51.7	103.0	7/14	3.0	1/13	41.94	2.43	8/18, 19	23.7	4.2	2/4
1955	51.6	101.0	7/4	9	1/29	41.09	3.47	7/14, 15	30.3	6.1	3/25, 26

WATER TRANSPARENCY

In general, the public is prone to consider high turbidity in a water area as a direct result of precipitation. The average transparency readings obtained by the creel census takers at Lake St. Marys during the summers of 1946 through 1950 do not completely substantiate this opinion (Figure 3). The average transparency for the five years increased until the maximum was reached in August and was then followed by a decrease through September and October. The lowest average transparencies of April were accompanied by low average rainfall, and the gradual increase in average transparency through May and June were accompanied by the highest average rainfalls for any of the months considered. A gradual decrease in the rainfall (Figure 4) from June through August was accompanied by a gradual increase in transparency, but the leveling off of the rain during August and September was accompanied by decreases in the transparencies. The greater rainfalls of June, July, and August produced less run-off because of the more absorbing nature of the soil at that time of the year, the mechanical slowing down of the run-off by the abundance of vegetation, the transportation of moisture from this vegetation, evaporation, and other allied factors.

The transparency of the lake can be more closely correlated with wind and wave action. Numerous examples can be quoted from daily records of the creel census takers to illustrate this point. For example, Secchi disc transparency for Lake St. Marys averaged 11 inches on July 9, 1946; however, a strong wind produced white-capped waves in the late afternoon and reduced the transparency to 8.75 inches by the following day. On July 5 to 7, 1948, the transparency averaged 10.75 inches and was accompanied by low waves. The reduction of low waves to ripples during the next two days was accompanied by an increase in transparency to 14 inches on July 10, 1948. The return of low waves on July 10 reduced the transparency to 12 inches in 24 hours. The large expanse of open water and the direction of the prevailing winds, which parallel the main axis of the lake, permit a nine to ten mile sweep of the winds. The shallowness of the lake permits the entire water area to be stirred from top to bottom. No transparency of more than 24 inches has been recorded for the lake.

This factor of water transparency is probably one of the greatest in controlling the life and productivity of Lake St. Marys. Tremendous silt loads are carried into the lake by the tributary streams (Section on Lake Bottom), and wind and wave action distributes it over the lake. Langlois (1941) attributes changes in fish population in Lake Erie to habitat changes, resulting from heavy silt loads introduced by tributary streams. Similar changes had their affects on the shifts in the fish population as reported for Lake St. Marys by Clark (1951).

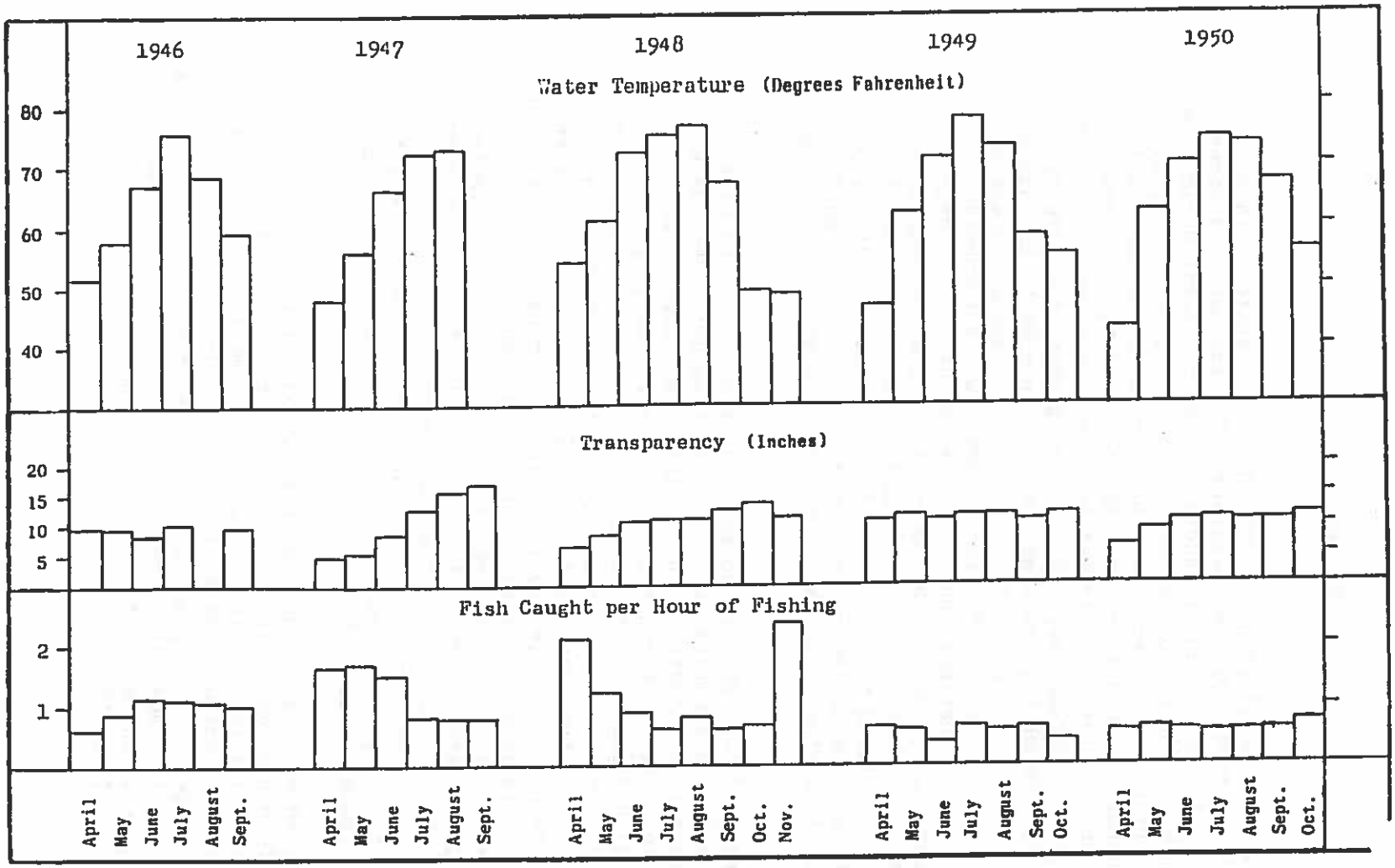


FIGURE 3. PHYSICAL FACTORS AND FISHING SUCCESS

WATER TEMPERATURE

Water temperatures were obtained at the same time and stations as were transparencies when collected by the creel census men during 1946 through 1950. Average temperatures for the period are given in Table 3. This data indicates a gradual rise in average water temperatures from April to July, a stabilization throughout July and August, and a small decrease in September (figure 5). A sharp drop was noted for October. The average temperatures for each month of each year correlate closely with the five year averages. Extremes in water temperatures were noted during July 1 to 7, 1949 with an average of 82° Fahrenheit and 83° Fahrenheit as the highest for two separate days. During the period from August 25 to 29, 1948 the temperature averaged 81.4° Fahrenheit with one reading of 85° on July 13, 1948. In general, the temperatures correlated closely each year.

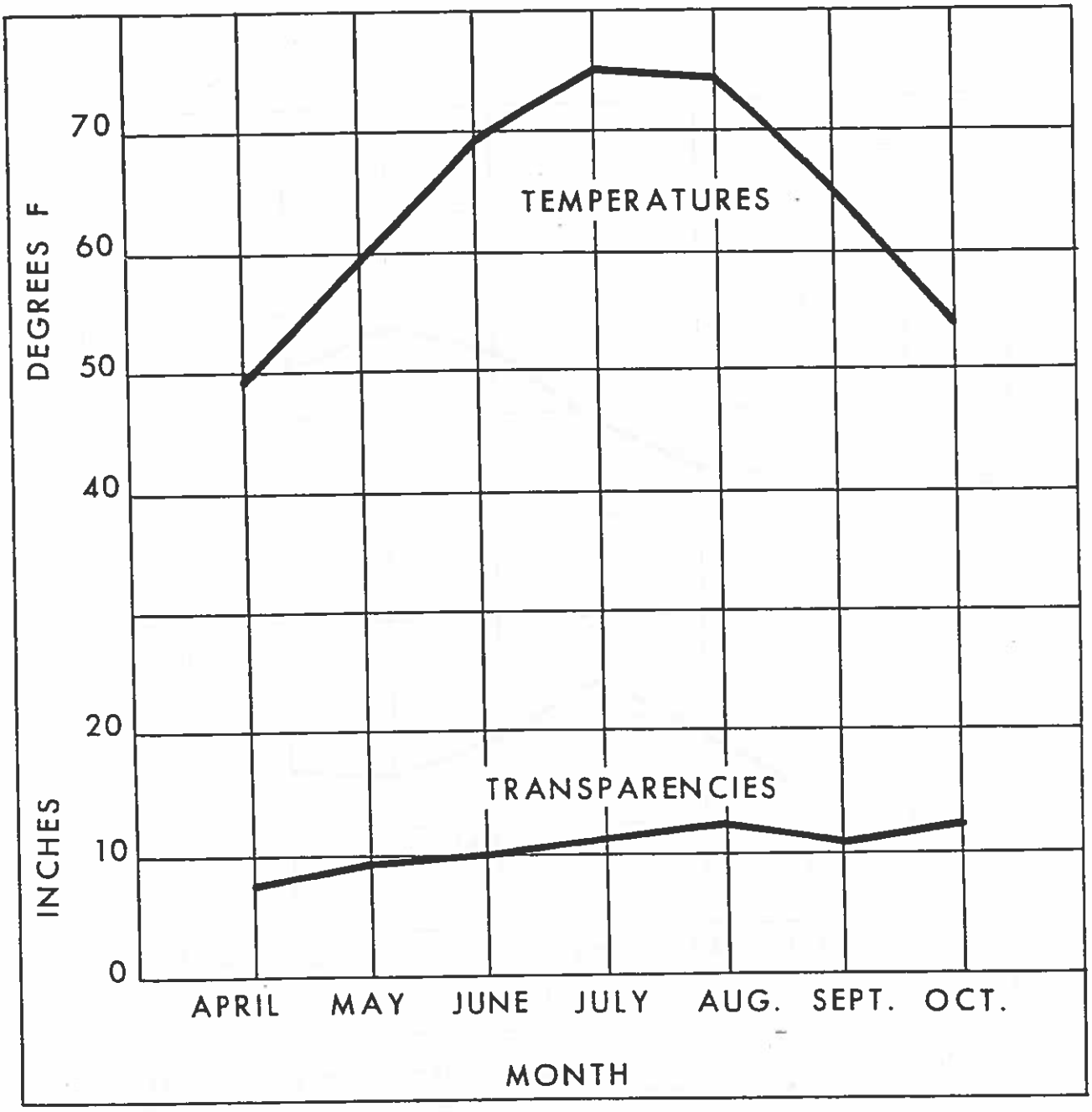


FIGURE 5. A COMPARISON OF THE AVERAGE TEMPERATURES PER MONTH AT LAKE ST. MARYS WITH THE AVERAGE TRANSPARENCIES FOR THE SAME MONTHS, 1946 THROUGH 1950.

WATER LEVELS OF THE LAKE

Some of the many arguments concerning the size of Lake St. Marys possibly stem from the changes in water level. With the completion of the east levee in 1845, the lake was to have covered 17,603 acres at spillway level. Yet, during the period from 1843 to 1845, a lake covering less than half of the present one was in existence (Brune 1941). The spillway elevation was lowered in 1856, thus reducing the size of the lake to about 15,748 acres.

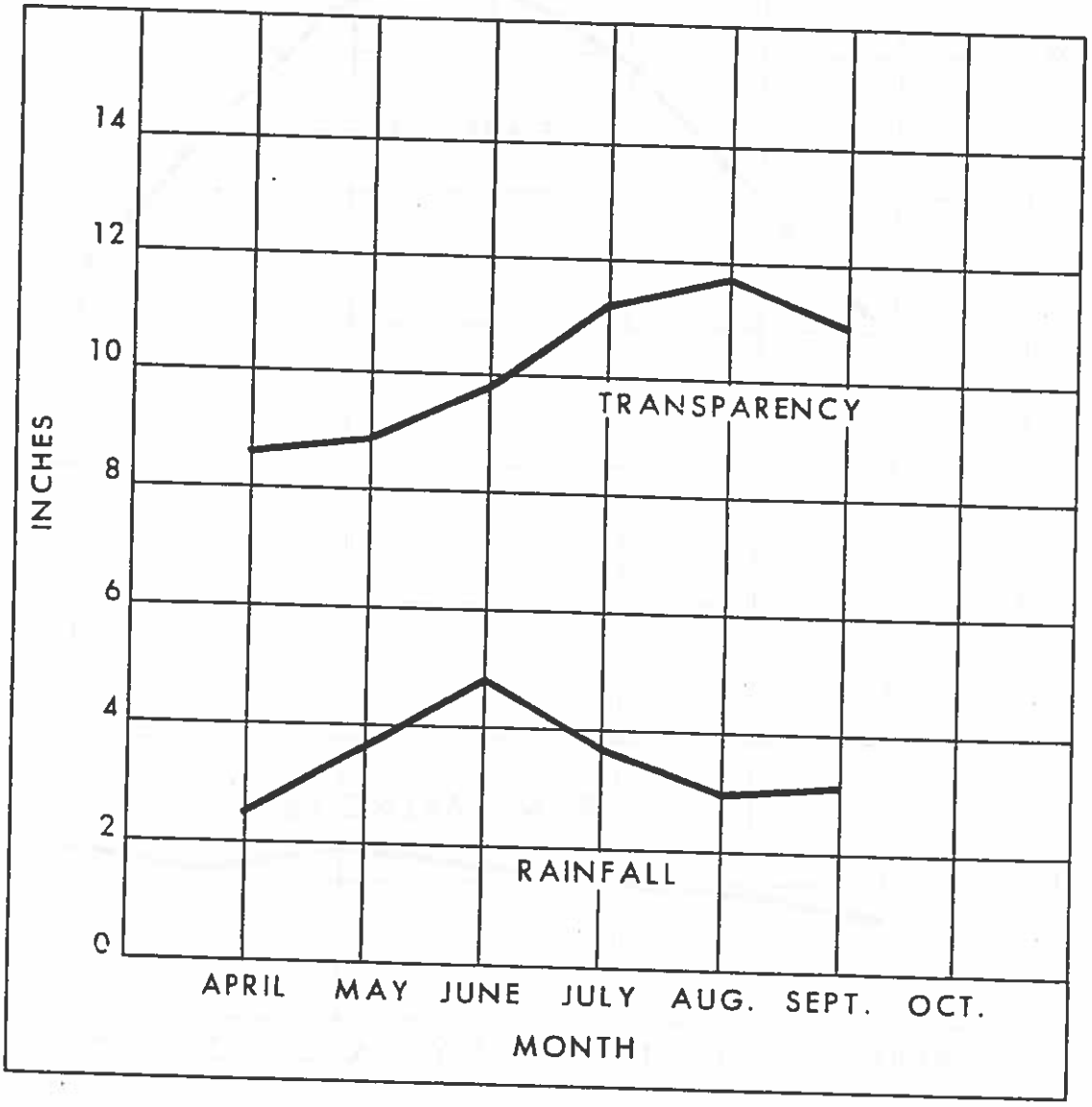


FIGURE 4. A COMPARISON OF THE AVERAGE TRANSPARENCIES PER MONTH, AT LAKE ST. MARYS, WITH THE AVERAGE RAINFALL FOR THE SAME MONTHS, 1946 THROUGH 1950.

TABLE 3

Average water temperatures at Lake St. Marys, 1946 through 1950, degrees fahrenheit

YEAR	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
1946	52.0	58.0	67.2	76.0	74.0	69.8	
1947	48.0	56.6	66.9	72.3	77.5		
1948	54.0	61.0	72.7	75.0	76.8	77.6	49.4
1949	47.1	62.5	71.0	78.0	73.0	68.4	55.0
1950	43.1	60.6	69.8	74.5	73.7	67.0	56.1
Average	48.8	57.7	69.5	75.2	75.0	70.7	53.5

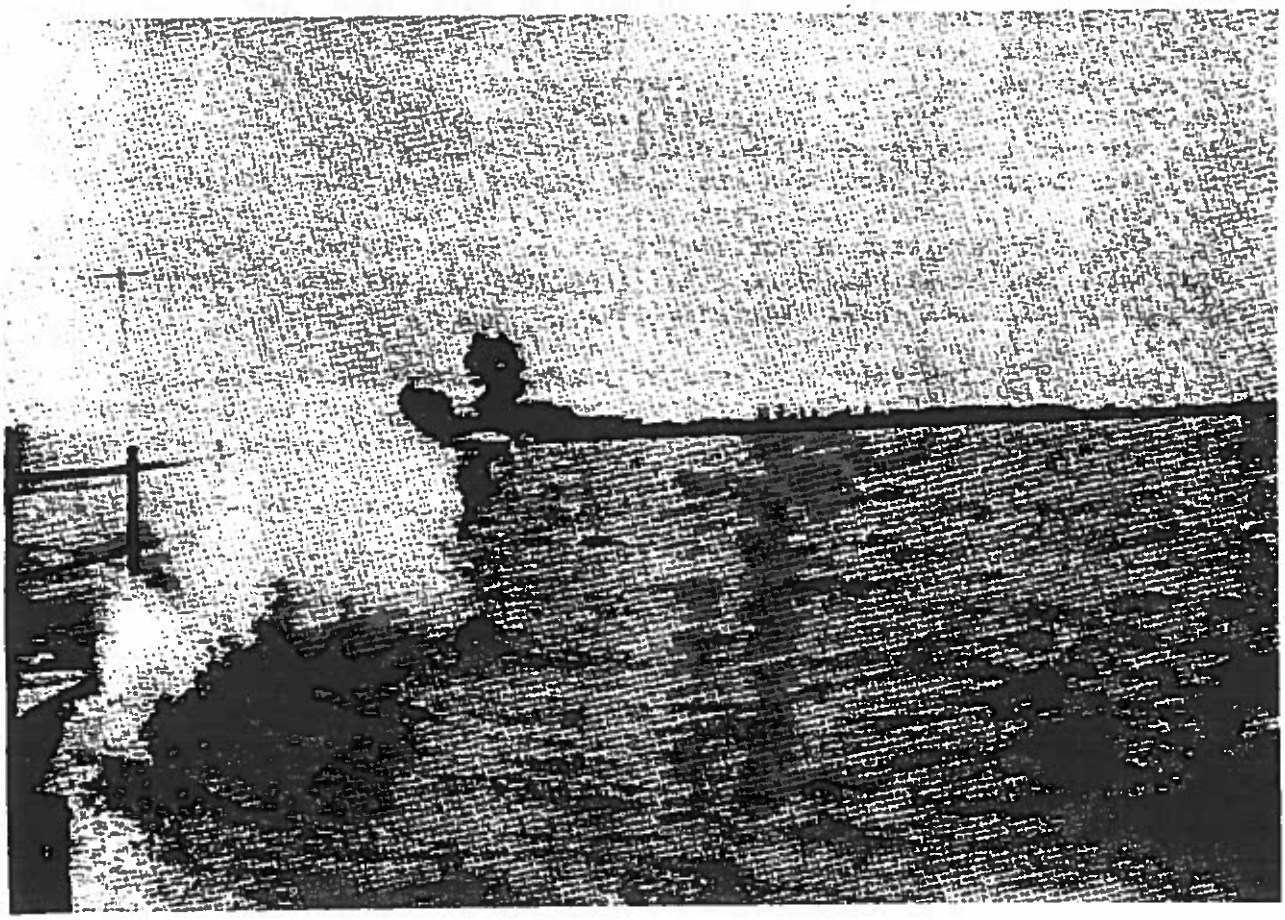


FIGURE 6. HEAVY WAVE ACTION AGAINST THE EAST BANK OF LAKE ST. MARYS.

Wind seiches have raised the water level in the lake as much as 11 inches in 24 hours. Such seiches flood dry shorelines and in receding leave saturated shorelines which in turn lose their moisture through evaporation. Such losses of water from miles of saturated shoreline, during the hot summer months, add to the problems of maintaining water levels.

Heavy wave action adds to the oxygen supply in the water, but the loss of water through evaporation from the surface of the lake is greatly increased.

The Ohio Department of Public Works attempts to maintain water levels in such a manner as to anticipate the periods of heavy rainfall and lower the lake to accommodate them, and to hold the water level high to withstand periods of light rainfall. The large size of the lake as compared to the size of the drainage area has created serious problems in these attempted methods of water level stabilization. When abnormally heavy rains fall and the lake has been held high to withstand a normal dry period, it has flooded. When drawn down to receive the normally anticipated rainfall which does not come, the lake has dropped to 53 inches below spillway level. The lack of facilities to rapidly draw down the flood waters prevents stabilization in flood times, but if such facilities were available the floods would seriously affect the flat farmlands bordering the small outlet streams. Table 2 illustrates the variations in rainfall from year to year and indicates the difficulties of water level stabilization.

Brune (1941) recorded the average seasonal drawdown below spillway level as being from 18 to 20 inches, and estimated that water flowed over the spillway 15 per cent of the year.

Temporary changes in water levels such as wind seiches are discussed in the section of Wave and Ice Action.

A drought period between 1890 and 1900 is credited by "old-timers" to have lowered the water so that it was necessary to dig a ditch nearly one and one-half miles long to obtain water for the canal. These same "old-timers" reported heavy losses of fish resulting from the low waters. No reports of fish losses due to low water since that time have come to my attention, other than losses in small isolated areas of negligible importance. The annual large production of young fish would indicate that the water fluctuations have had no detrimental effects on the fish population.

WAVE AND ICE ACTION

The exposed nature of the lake and its location with its longest axis paralleling the direction of the prevailing winds results in severe wave and ice action. Strong winds whip the lake into a mass of whitecapped waves, which oftentimes break against the east bank and send showers of spray across the highway (Figure 6). Before the new breakwater was installed over 500 young shad have been counted between three telephone poles along the east bank of the lake, where they were thrown out by severe wave action. Organic debris from the cattail swamp is carried across the lake and piled along the wave-swept shorelines. While some areas are being filled as a result of this transported debris, others are being eroded severely. Hard clay shores and sand beaches result from this erosive action. Projecting points are rapidly disappearing and a shallowing of the lake necessarily accompanies such a process.

Almost annually, heavy wind and wave action result in the loss of one or more lives in the lake.

Only occasionally has the lake been completely frozen over for any period of time during the past 19 years. It usually has large areas of open water. Twenty-four inches of ice have been measured on Lake St. Marys. Usually, within a few days after the ice cover forms, the expansion and contraction of the ice opens wide cracks which appear as open water channels staggering across the lake. Strong winds move the ice masses to such extent that ice covered areas may become open water areas by afternoon and vice-versa. The breaking of the ice in the open lake, coupled with strong winds, has many times piled ice 10 to 15 feet high along the margin of the solid ice cake. These ice jams are sometimes pushed into shore where they fill the lake from top to bottom with ice or pile up on the shoreline (Figures 7-8-9). Such movements scour the exposed shoreline, erode away the banks and destroy the beds of vegetation. Trees 16 inches in diameter have been uprooted by ice masses which cut into the shoreline during one of these ice movements. Such ice action prevents the installation of permanent structures in most of the lake.

Ice, frozen around the cattails in the marshes, is oftentimes lifted by a rise in water level and the plants are torn loose and floated across the lake. Bands of cattails in the ice are not unusual sights (Figures 10-11). This debris is rapidly filling the northwest corner of the lake and piling up on other shores.

CHEMICAL CHARACTERISTICS OF THE WATER

Little chemical data is available for the waters of Lake St. Marys. Early data obtained by Roach in 1932, 1934, 1935, and 1936 comprises a large share of the available information. Collection stations for all data are located by Figure 12. Free carbon dioxide averaged 5.5 ppm. for all samples taken by Roach in the four years, but reached a peak of 12.8 at one station in 1935 where organic debris was abundant. Oxygen varied from 2.8 to 9.8 ppm., but averaged 7.1 for the four years. No oxygen deficiencies were found by Roach, but no samples were taken from deep in the cattail marshes. The pH varied from 7.1 to 8.4. Both extremes in pH were recorded for both surface and bottom samples at some time during the investigations.

The oxygen data in Table 4 reveals greater amounts of this gas in 1953 and 1954 than found in previous years, but these samples were taken at times of heavy wave action. This might account for the difference, and no such data is available for the earlier samples. The lowest of the pH readings was made under the ice cover in 1951. The heavy ice cover of that year was suspected as a source of chemical difficulties and sampling was done to check on the chemical changes which did not occur. The chemical conditions illustrated in this table for February 1936 under 16, and for January 1951 under eight to ten inches of ice, do not indicate unfavorable conditions for fish life. Isolated areas with heavy organic deposits may have varied widely from the above representative samples, but such areas would have been limited in their influence of the over-all picture.

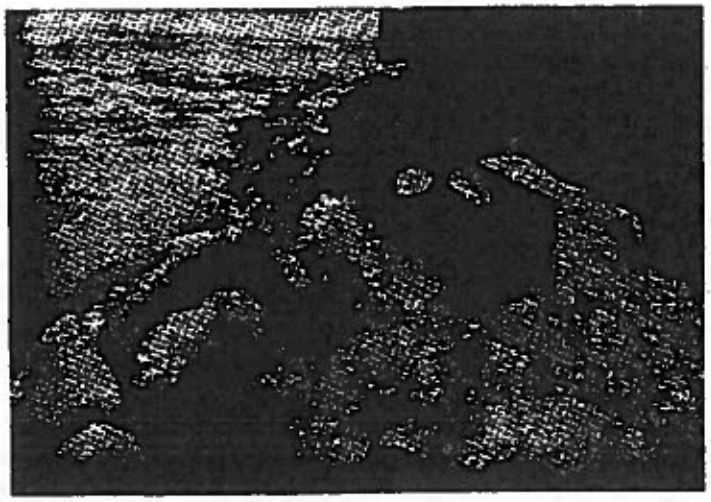


FIGURE 7. EIGHT INCH ICE RAISED THIS BOULDER, THREE FEET IN DIAMETER, UP AN EIGHT FOOT BANK.

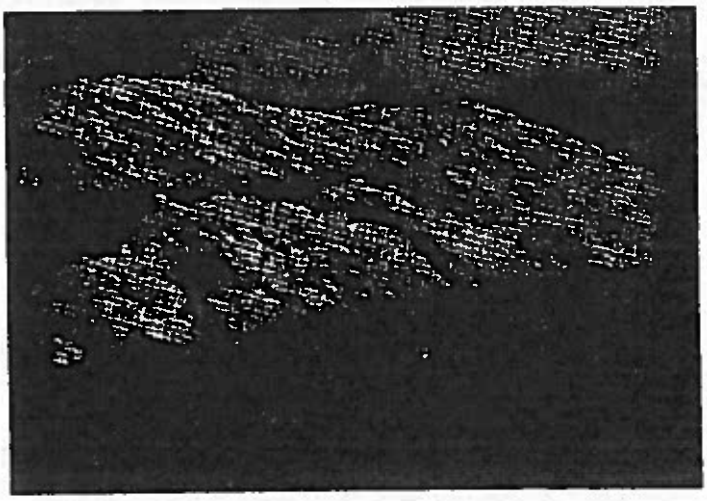


FIGURE 8. ICE PILED ON THE WEST SIDE OF HARBOR POINT AS A RESULT OF ICE MOVEMENT ON THE LAKE.

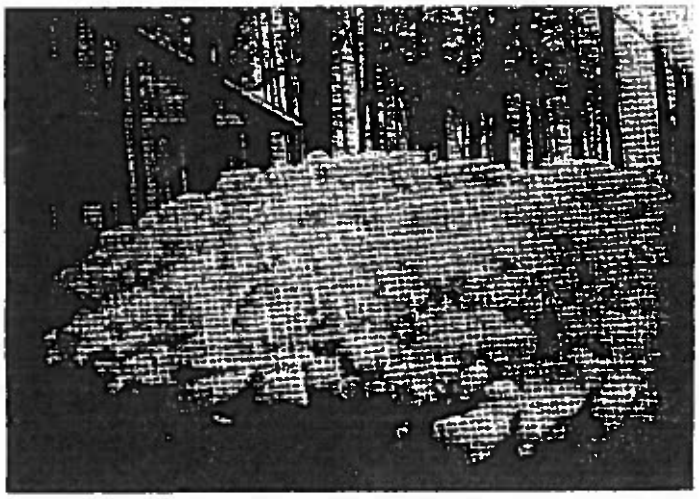


FIGURE 9. ICE PILED AT NORTHWOOD AS A RESULT OF ICE MOVEMENTS ON THE LAKE.

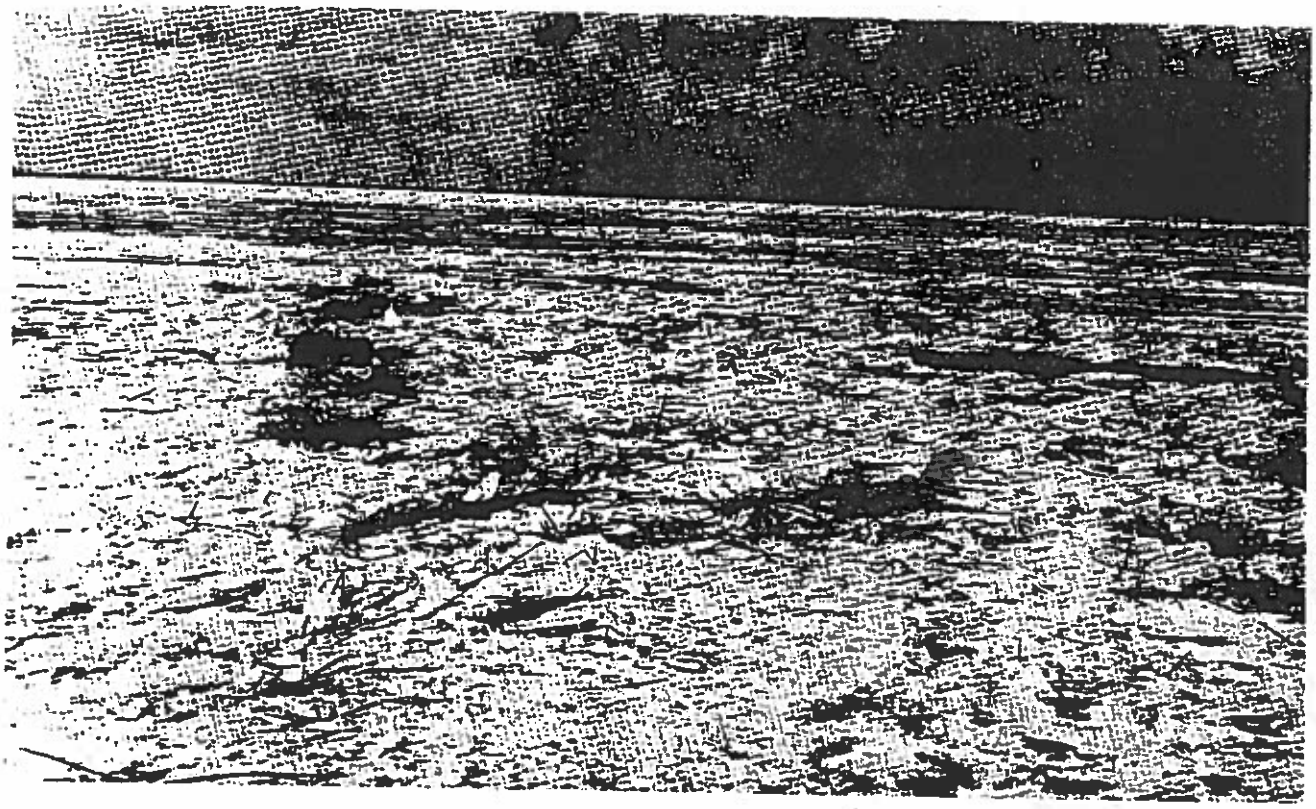


FIGURE 10. CATTAILS ARE UPROOTED BY THE ICE AND CARRIED ACROSS THE LAKE.

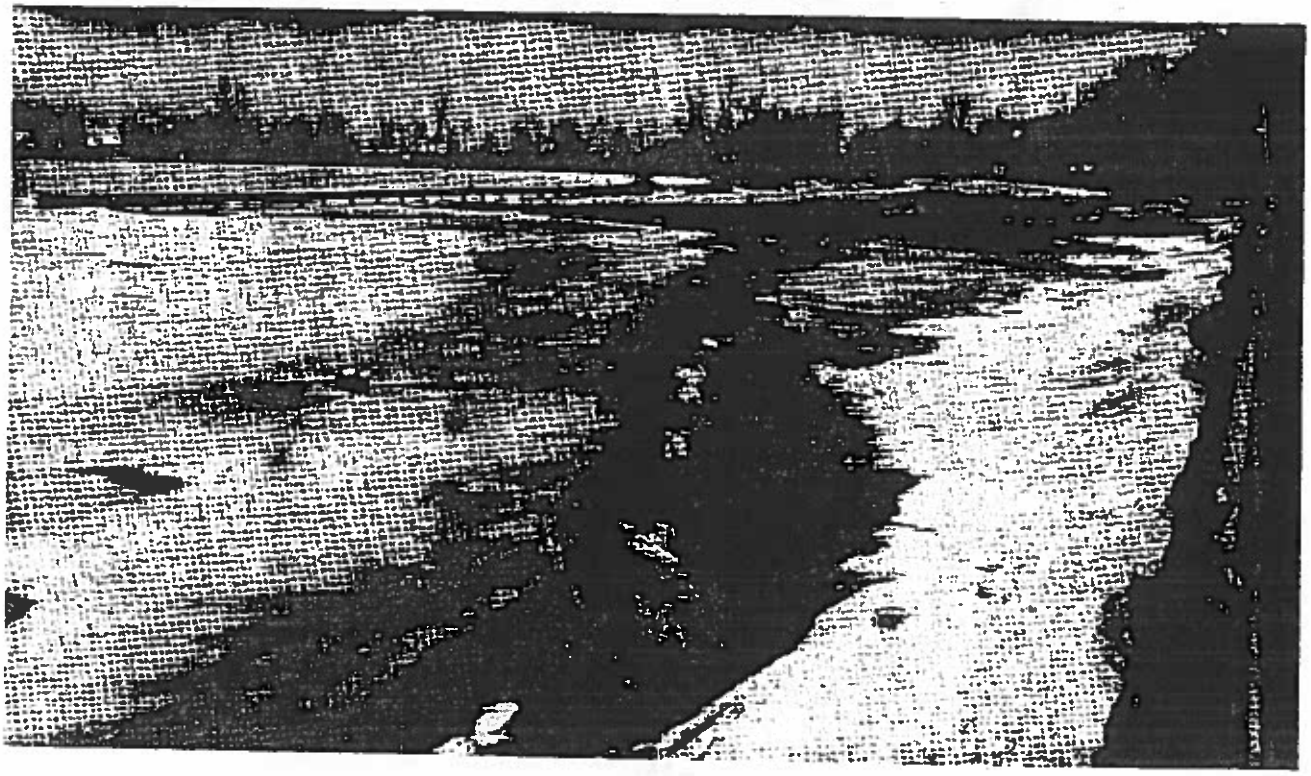


FIGURE 11. THE ORGANIC DEBRIS, CARRIED ACROSS THE LAKE BY THE ICE, IS DEPOSITED ON THE SHORELINE AT THE NORTHEAST CORNER OF LAKE ST. MARYS.

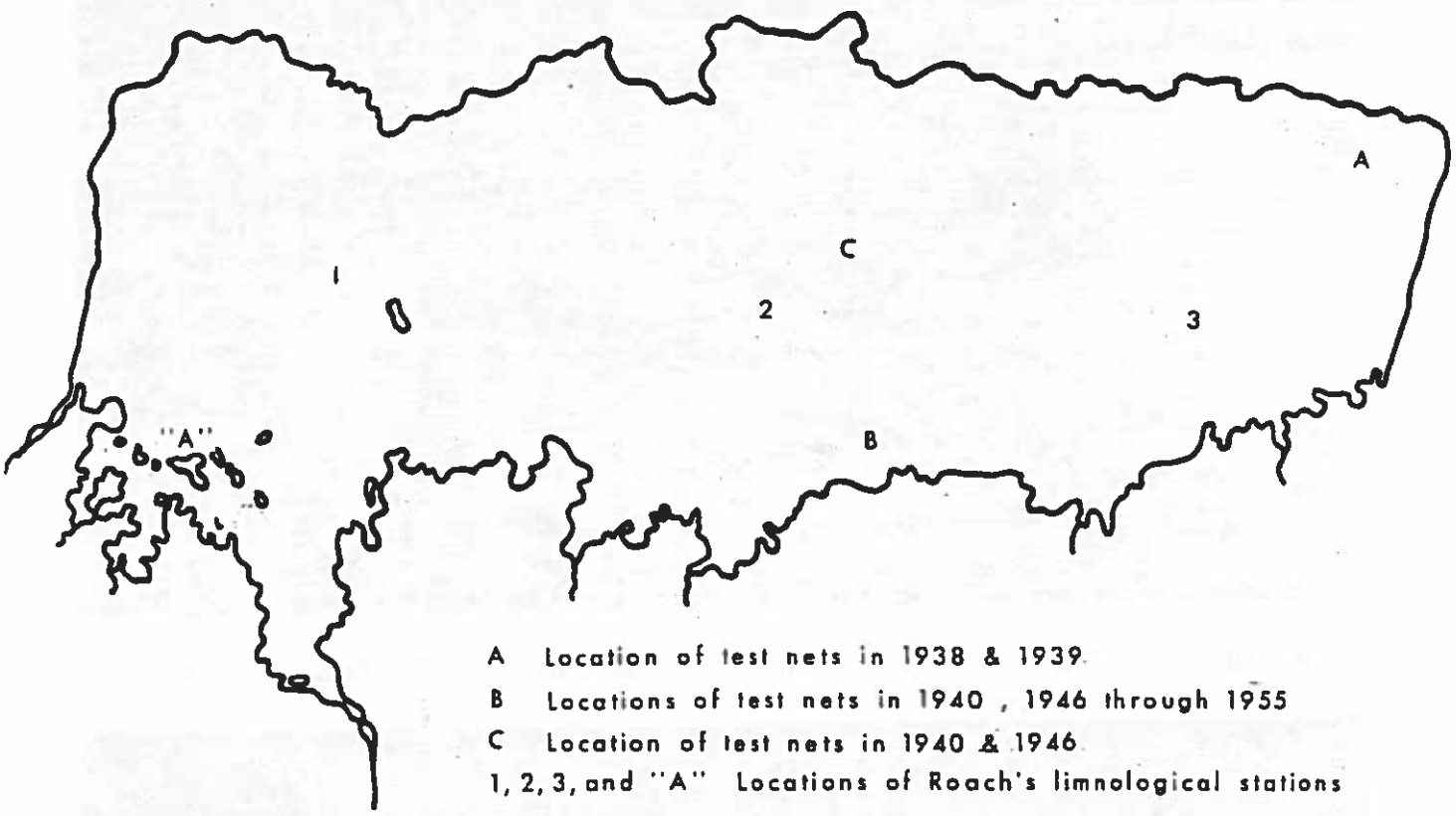


FIGURE 12. LAKE ST. MARYS LOCATIONS OF TEST NETS AND LIMNOLOGICAL INVESTIGATIONS.

A series of 26 water samples were collected from the lake in August of 1950. The composite revealed an average of 28.5 mg. of calcium per liter, 2.25 mg. of ammonia, 1.7 mg. of magnesium, 0.11 mg. of phosphorus, and no nitrates or potassium.

TABLE 4
LAKE ST. MARYS CHEMICAL DATA

	Oxygen			Carbon Dioxide			pH		
DATE	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM	SURFACE	MIDDLE	BOTTOM
8/1932	8.6	9.0	8.0			1.0	8.4	8.3	8.0
8/1934	4.4	4.7	4.7		6.0		8.4	7.7	8.1
8/1935	7.9	2.8	6.8		12.8		8.4	7.1	8.4
2/1936	9.8	5.6	9.0	2.2	5.0	2.7	7.1	7.2	7.3
5/1947	9.8	8.1	7.3				8.4	8.3	8.2
8/1950	9.1	7.8	8.7				8.1	8.2	8.1
1/1951	7.8	6.6	4.6		3.7	4.0	7.6		6.3
6/1953	10.2								
7/1953	9.3								
8/1953	13.0								
9/1953	7.8								
10/1954	9.3								
11/1954	13.0								

According to the classification of lakes on the basis of calcium by Ohl (1934), quoted by Rawson (1939), lakes containing above 25 mg. per liter are considered rich in this basic nutrient. However, little incrustation on aquatic plants observed by Nauman (1932), as quoted by Rawson (1939), in lakes of high calcium content, has been found in Lake St. Marys. The richness of the lake in this nutrient aids in classifying it as an eutrophic body of water. Moyle (1949) indicated that calcium is not a critical factor in the productivity of waters having a total alkalinity of greater than 15 ppm.

The average of 0.11 mg. of phosphorus per liter is well above the 0.05 mg. found in average waters by Rawson (1939) and thus could not be considered as a limiting factor in the production of plankton. However, Moyle (1954) states that phosphorus content of waters varies throughout the year. Thus, shortages might occur at critical periods in the development of plankton crops in Lake St. Marys, but would not be revealed by the type of sample reported here.

Rawson (1939) stated, "The amounts of inorganic nitrogen in natural waters are relatively small with nitrates usually less than 0.05 mg. per liter, nitrates less than 0.1 mg. and ammonia also scarce but capable of increase if oxygen is reduced". This statement implies that the normal ammonia content of water is approximately 0.1 mg. per liter. On this interpretation, the 2.25 mg. per liter at Lake St. Marys can be considered as high. However, if we exclude one sample which contained 40 mg. of ammonia per liter, the other samples would average 0.26 per liter. Most samples were devoid of ammonia and would thus postulate shortages in many parts of the lake. Moyle (1954) stated that ammonia in summer surface waters is usually below 0.2 ppm. and that nitrogen tends to accumulate below the thermocline in summer. The fact that no thermocline has been found in Lake St. Marys would suggest that such accumulations might not occur and that a uniform distribution, vertically, should occur in the waters.

The fact that neither nitrates or potassium were found in any of the samples would postulate a below-average condition for these nutrients in the lake water.

Carlander (1955) revealed significant correlation between standing crops of fish and total carbonate. Such published data would indicate the need for increased water areas to be investigated in Ohio to determine if this nutrient might be a factor controlling fish production and its use as a tool in management.

SHORES AND BEACHES

The shores of Lake St. Marys are, in most places, a gradual rise from the lake bottom and thus very near the lake level. The east and west banks, the levees constructed to form the lake, stand approximately 5½ feet above the normal lake level. A few such areas as Riley Point and Harbor Point are higher than the normal shorelines and result from the erosion of projecting highlands in the lake. These banks range from four to six feet in height. Most of the north shore is composed of sand or hard clay beaches interspaced by protected areas of swamplands. The south shore is chiefly marshland with some open sand or clay beaches.

The lake is inaccessible at most points along the south shore except through numerous channels dredged to the open water. Some of these channels are about one-fourth of a mile in length.

LAKE BOTTOM

Thick glacial drift covers the bed rock in the entire drainage area of the lake and the underlying preglacial Teays River, which flows beneath the lake. Because of the nature of the lake, the underlying soils are of the same types found in the drainage area. Winchell (1874) describes the St. Marys moraine, which forms the north shore, as, "....simply a broad undulation, or thickening of the drift....", and remarked that it was composed of coarse, heavy clay.

Sand: As previously mentioned in the description of shores and beaches, numerous fine sand areas are widely scattered around the lake. Most of these are found on the north side and extend outward into the lake into depths of about five feet of water.

Gravel: A few gravel bars in the vicinity of Montezuma Bay become visible in extremely low water stages. The bars are located in the open lake near the west portion of the mouth of the bay and are composed of large gravel and rubble. Small amounts of gravel are widely scattered throughout the lake bottom in areas of negligible size.

Clay: Numerous hard beaches of clay exist on the north side due to the erosive action of waves and ice on exposed projecting points of land. Some of these beaches extend outward as much as a half mile into the lake.

Sediment: According to Brune (1941) in reporting sediment deposits in Lake St. Marys, "The modern sediment was in most instances a loose, bluish-grey, fine silt or clay. This was underlain usually by from one to four feet of brownish-black muck, grading from loose, undecomposed, organic matter at the top to highly decomposed organic matter at the bottom. Beneath this, where it was penetrated, was a grey clay subsoil. At other places, the sediment was underlain by a dark grey silty clay loam with a light grey clay subsoil (probably Brookston). These facts indicate that, before the lake was formed by the dams at each end, its basin was a low swampy, upland tract".

Peat: This term has been used to include the heavy deposits of organic matter deposited in the cattail marshes. Such deposits include some silt and in many places are three and four feet deep (Brune 1941).

According to Brune (1941), Lake St. Marys had lost 18.1 per cent of its original storage capacity due to sedimentation. He stated that the greatest deposition of silt, 7.2 feet. was found in the northwest corner of the lake near the outlet. This probably occurred in the old bed of Beaver Creek. The greatest average depth of deposits was found at the extreme west and east ends, 2.7 and 2.3 feet, respectively. The central area near the oil derrick contained the least silt. It was estimated during Brune's survey that the average rate of loss of soil by erosion in the watershed of the lake is between seven and eight tons per acre per year. It was estimated that an average of five tons of sediment were deposited per acre in Lake St. Marys each year. Sanderson (1948) estimated that it would require 526 years to fill the lake with sediment at the present rate of accumulation.

Forty-four bottom samples, collected during the summer of 1940, indicate that the bottom soils are high in calcium, but contained only a moderately low amount of nitrogen (NH_3). The organic content was not exceptionally high. The pH averaged from 5.6 to 7.6 and in most cases the subsoils were found to be low in basic nutrients. The need for increased amounts of potassium and nitrogen were indicated by the analysis of these samples. This need was also indicated in the discussion involving analysis of water samples.

SHORE DYNAMICS

The subject of shore dynamics might well have been included in either the section on Wave and Ice Action or that of Higher Aquatic Plants. The processes of shore-building and shore-cutting take place in all lakes at all times and may follow one after the other in the same area.

Shore-building is chiefly the action of the encroachment of marshes and the deposition of silt in the quiet water of the marsh, but may also be brought about by the building of beaches and dunes by waves, and bars by the action of currents. The process of shore-building is that process which works toward the aging or filling in of a water area, thus developing swamps or marshes and later dry land. In Lake St. Marys, this process is chiefly the result of encroaching marshes. Measurements on the extension of the cattail marsh in 1940 indicated that pioneer plants advanced as much as 20 to 50 feet in one year. Additional favorable seasons result in filling in the spaces between the pioneer plants and the formation of a dense stand of cattails, which break the wave action and cause the deposition of sand and debris. Sand ridges are oftentimes formed in the outer edges of marsh where the sand is deposited. The accumulations of years of partially decomposed plants and silt and debris soon fill in the shallow areas of the lake. The sedimentation data quoted in the section on Lake Bottom describes heavy organic deposits of three or four feet in thickness in the marshes of Lake St. Marys. Boyd Anderson tells of fishing in the area east of his landing, prior to 1900, in water three or four feet in depth. This bay is now a marsh and rapidly approaching dry land. A bay of approximately two acres in area and two feet in depth, on the west side of Chickasaw Creek, harbored several hundred ducks in the fall of 1938. It now is dry land which occasionally floods in high water stages. Boyd Anderson recalls that he assisted in drilling an oil well in the area behind Elm Island, on the south side of the lake, prior to 1900. He states that the water then was about ten feet in depth. Today, the area is a marsh with a water depth of seldom more than three feet.

Shore-building may be a continuous process in some of the more sheltered areas, but it may meet with a reversal in more exposed sites. The action of waves and ice may completely wipe out the results of years of shore building. The section on Habitat Improvement relates that numerous holes were cut into the cattail marsh for use by hunters and anglers, but that wave and ice action reduced the extent of the marsh in eight years so that few of the holes were visible.

Shore-cutting is evident on all exposed projections into the lake and along the higher banks along the north shore. The miles of concrete walls and stone rip-rap indicate the severity of this process.

Both the process of shore-cutting and shore-building ultimately result in the aging of the lake by cutting down the high banks around the lake and filling in the sheltered bays and the deeper sections. The soil cut from the shoreline is carried by the waves, along with the incoming sediment, and deposited on the bottom where it gradually shallows the lake and makes the conditions more suitable for the encroachment of marsh plants. Shore-building by plants in marshes not only affects the immediate area of the marsh, but the debris is floated across the lake with the waves and fills in vast areas with deep deposits of organic debris, such as those in the northeast corner of the lake. Aging of a lake, like the aging of human beings, is a natural process. It may be temporarily halted or slowed down, but the process cannot be stopped.

POLLUTION

The discussion of oil well pollution in the lake prior to 1900 is included in the section on higher aquatic plants and is, therefore, not repeated here.

The greatest form of pollution, and yet the one which is usually not considered in this category, is silt. The sedimentation of Lake St. Marys is discussed in the section, Lake Bottom. The effects of silt covering the spawning beds, destroying feeding grounds, and the turbidity of the water in connection with the growth of underwater vegetation cannot be overlooked in a fisheries program.

Domestic pollution enters the lake from toilets at various locations along the lake. The problem has not become serious, as yet, but in one location the odors from such pollution have caused serious criticism.

RECOMMENDATIONS

1. The transparency problem seems to focus on the necessity for the control of wave action.
2. The control of wave action must of necessity result in the control of ice action.
3. The reduction of incoming silt, from farm lands or from shore erosion, is highly desirable in improving water conditions and to slow down the aging of the lake.
4. High water temperatures might be lowered by measures effective in reducing the turbidity to encourage the growth of aquatic meadows.
5. Chemical analyses indicate that the organic debris from the marshes is not detrimental to the water quality of the lake, but are beneficial in that they help to increase deficiencies which exist.
6. The indication of shortages of certain basic nutrients in the lake water and bottom soils raises the question as to the relationship between these nutrients and the fish crop; however, the large size of the lake makes the question of fertilization impractical under present costs.
7. The cleaning and deepening of backwater areas so as to permit the growth of underwater vegetation and provide sheltered fishing areas is highly recommended.
8. Pollution in public recreational bodies of water should not be tolerated.

PART III
FLORA AND FAUNA OTHER THAN FISHES

PHYTOPLANKTON

The limited data available on phytoplankton from Lake St. Marys was collected by Lee S. Roach during routine checks of lakes during 1932, 1934, 1935, and 1936 for the Bureau of Scientific Research of the Ohio Division of Conservation. Only one or two days were spent in study at this lake, during any of these years. Roach established stations for the collections as indicated in Figure 12.

During the 1932 investigations, 19 genera of phytoplankton were found. Of these, "....seven were greens, six diatoms, four bluegreens and Euglena, Synura and Peridinium completed the list" (Roach 1932). The diatoms were the dominant group. No particular algal group or form was found in exceptionally large numbers. A summary of the four years of investigations provides an average of 4,514 bluegreen algae, 15,914 greens, and 129,794 diatoms taken per liter of water each year. The most productive year was 1935 when the totals were at least five times those of any other year investigated.

HIGHER AQUATIC PLANTS

McMurray (1923) stated, "The whole of what is now reservoir was covered with accumulations of growth of years of decayed grasses, leaves and fallen timber". Appropriations were made by the legislature to clear the tract of land to be flooded as a reservoir, but for unknown reasons this plan was not completed. Howe (1902) pictured the lake when first flooded and showed a band of trees in the water along both the north and south shores. He (Howe) also remarked about the odors arising from the partially decayed vegetation.

Within the memory of living individuals, snags and stumps stood in abundance in the shallow waters along the north and south shores and log jams filled many of the shallow bays and piled up on the beaches (Figures 13 and 14). The older residents state that within this band of standing snags, and extending outward approximately one-half to one mile into the lake, was a very dense growth of underwater plants locally known as "moss". Mr. Wilshire Riley of Celina stated that in about 1890 the "moss" was so dense that it fouled the paddle wheels of their boats before they could reach open water. The center of the lake, once a wet prairie, was an open water area with little underwater vegetation.

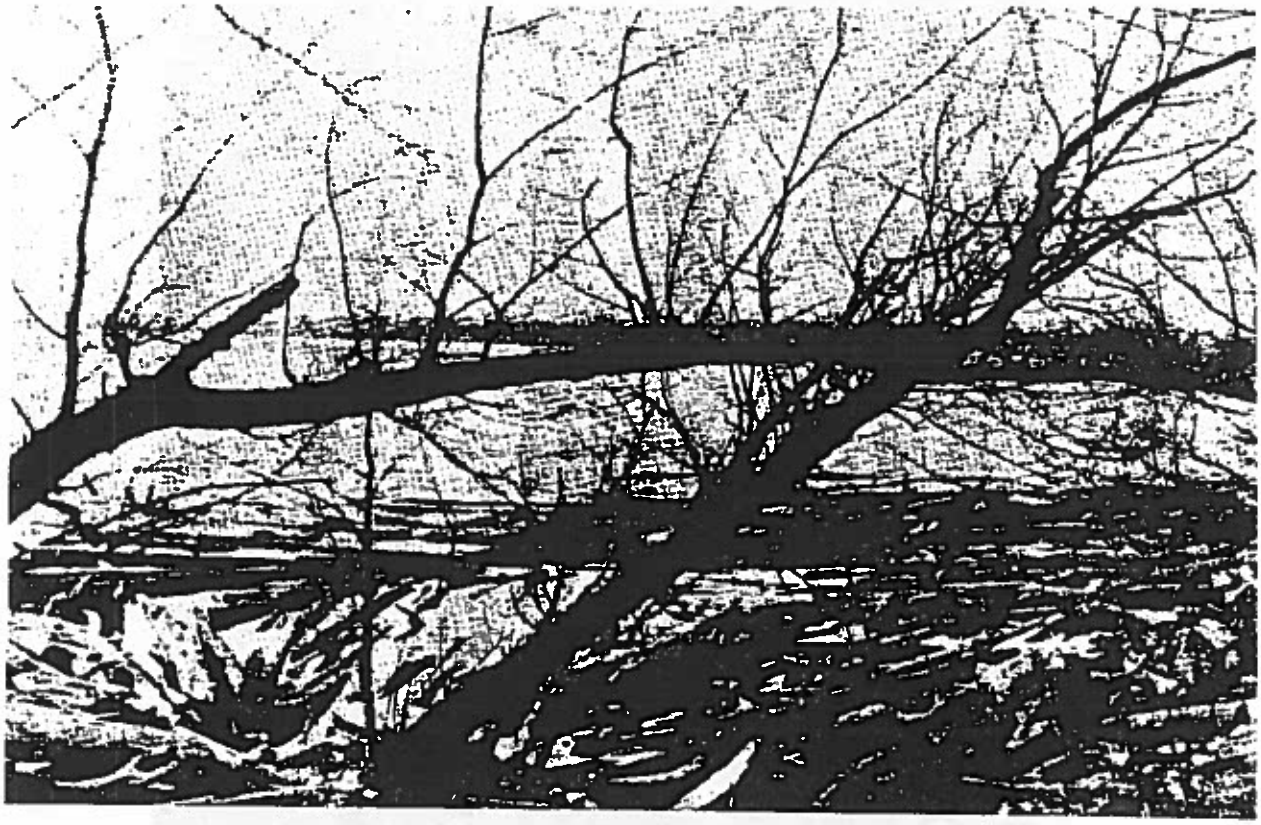


FIGURE 13. A LOG JAM ALONG THE EAST BANK OF LAKE ST. MARYS BETWEEN 1890 AND 1900.

FIGURE 14. LOG JAM NEAR PETER RUDOLPH'S BOAT HOUSE, ALONG THE EAST BANK OF LAKE ST. MARYS, DURING LOW WATER, PRIOR TO 1900.

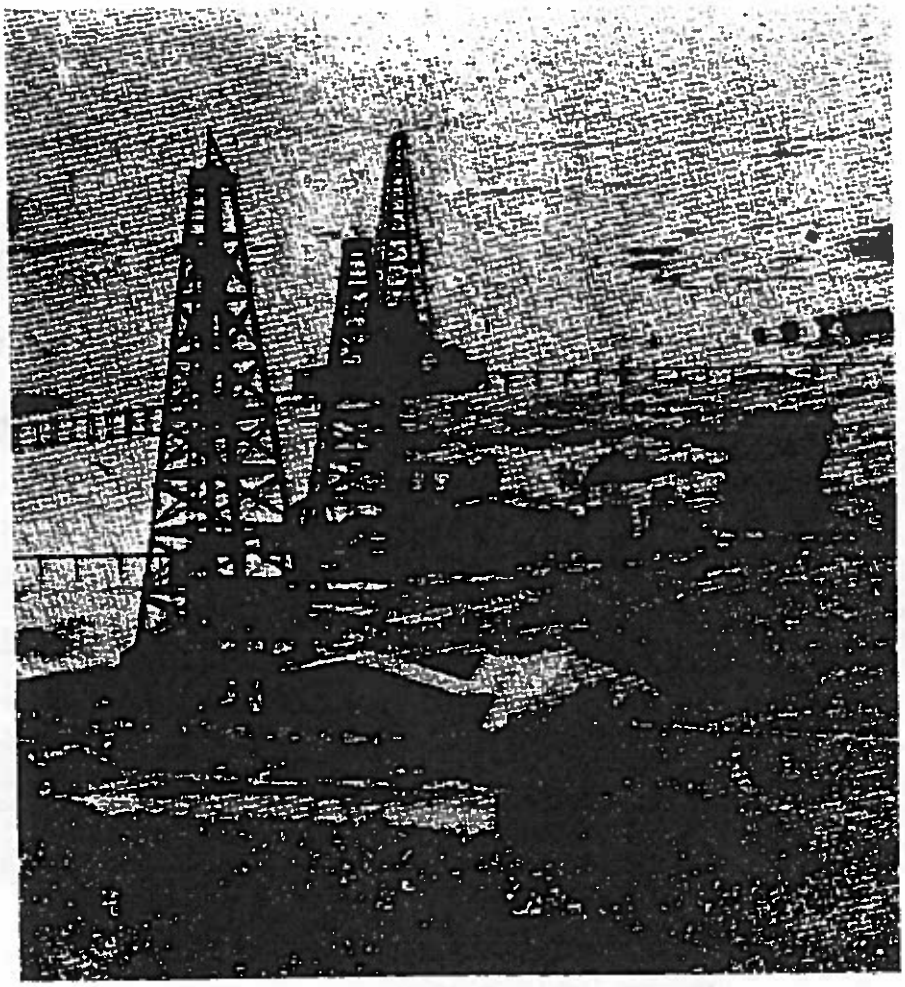


FIGURE 15. OIL DERRICKS NEAR THE NORTHEAST CORNER OF LAKE ST. MARYS DURING THE OIL BOOM.

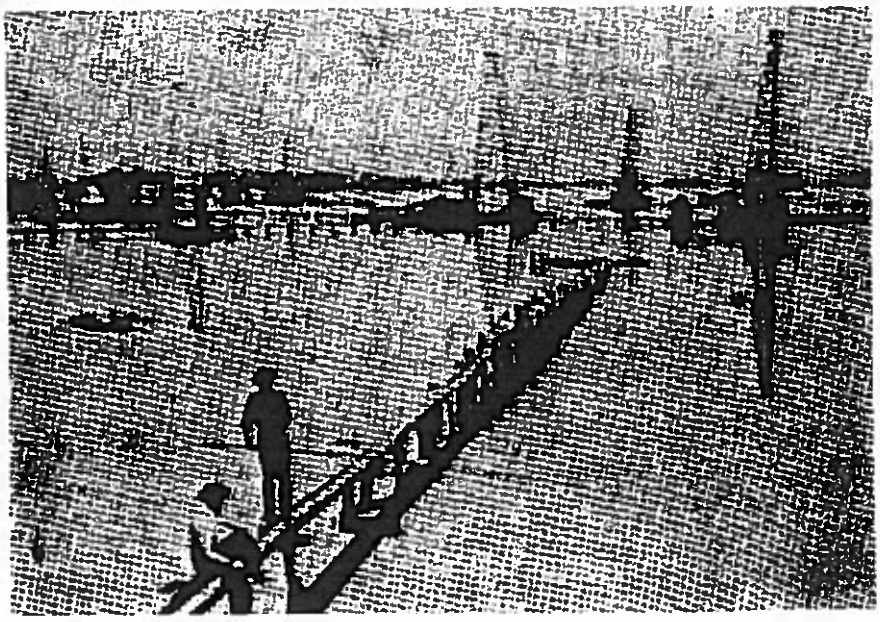


FIGURE 16. OIL DERRICKS IN LAKE ST. MARYS.

Discussions with some of the "old-timers" revealed many accusations concerning the loss of the "moss", and several possible causes seem to have existed for its disappearance. The introduction of carp received the most comment. Yet, a severe drought period between 1890 and 1900 was described as so severe that it was necessary to dig a ditch to supply water to the canal. Edward Frey recalls of wading across the lake in hip boots from Villa Nova to the south shore. Henry Koehn stated that he walked out to a spot west of the oil derrick, where he built a duck blind on fallen timber in the exposed soft mud bottom. Hundreds of acres of corn were planted in the exposed lake bed and thousands of feet of lumber were cut from snags and logs removed from the lake bed. Heavy ice during the winters of the drought period resulted in tremendous losses of fish. It was during, or immediately after this drought, that the carp and white crappies became abundant. Oil well pollution also received its blame for the killing of the aquatic meadows, but these "old-timers" described the vegetation as being dense around the derricks from which they fished in their spare time. The prolonged exposure of the lake bottom and the removal of the standing timber may also have had their effects. When the lake filled, heavy winds whipped up the waves which were no longer held in check by standing timber or beds of vegetation, and the lake became turbid as it was stirred up from top to bottom (Clark 1951).

According to the estimates of several older residents in the vicinity of the lake, nearly 75 per cent of the land around the lake was covered with timber prior to 1890. The extensive use of all types of wood, especially for barrel manufacturing, and the ease with which it was transported through the canals, brought about a rapid exploitation of the timber resources and the conversion of the land into farms.

In the latter part of the 19th century, between 200 and 300 oil wells were drilled in Lake St. Marys (Figures 15 and 16). The greater numbers seem to have been located in the east end of the lake. According to the late Mrs. Peter Rudolph, the wells were so close together along the east bank of the lake that the mud road was lighted by the burning gas flames from the derricks. Mr. Guy Heap stated that an occasional storm would tear down a derrick and the broken equipment would allow the oil to flow into the lake. Mr. Zura Riley told of one severe storm and ice push that took out from 30 to 40 oil derricks in one night. According to others, all oil wells poured their wastes into the lake. Many of the oil men state that numerous wells were pulled and not capped. Yet, in spite of all these examples of oil pollution, these same men told of the difficulties of traveling to and from the derricks because of the abundance of vegetation. They also related what today would be considered as "tall tales" of the fish they took from these derricks.

Thus we find that as the land around the lake was gradually cleared and converted into crop land the lake was severely lowered by a drought, the standing timber and log jams were removed, carp were introduced, and together with crappies became abundant, the "moss" disappeared, wave action increased, the oil well was in full swing and the lake changed from a clear, cool body of water to a roily, warm water area. Thus we find a set of factors which probably acted together in the elimination of the aquatic meadows which formerly filled the shallows of Lake St. Marys.

The shallow water meadows of early days have been to a great extent replaced by cattail (Typha latifolia and T. angustifolia) marshes, which are receding in the past few years. During a survey of the lake by Dr. L. H. Tiffany in 1920, he described large areas of Typha latifolia and T. angustifolia, Scirpus americanus, Sparganium eurycarpum and Potomageton natans and smaller areas of Sagittaria latifolia, Pontederia cordata, Dianthera americana, Polygonum pennsylvanicum, Salix longifolia, Carex spp., Potomageton perfoliatus and P. pectinatus and Chara spp.. Other species such as Myriophyllum heterophyllum and Juncus effusus were noted.

At present small beds of lotus (Nelumbo lutea (Willd) Pers.) and sweet flag (Acorus Calamus L.) occur along the south shore. Small patches of coontail (Ceratophyllum demersum L.), white water lily (Castalia tuberosa (Paine) Green), yellow water lily (Nuphar spp.), pondweed (Potomageton americanus Champ. & Schl.) and P. foliosus Raf.), water weed (Anacharis spp.), star duckweed (Lemna trisulca L.) and lesser duckweed (L. minor L.), bushy pondweeds (Najas flexilis (Willd.) Rostk & Schmidt) and bladderwort (Utricularia spp.) are found scattered around the lake.

Practically the entire south shore and a few stretches of the north side are outlined by cattail marsh. In some areas this marsh was one-half a mile in depth, but it has greatly receded in late years.

ZOOPLANKTON

Zooplankton counts were made by Roach during the summers of 1932, 1934, 1935, and 1936, from collections made at the same stations as were the plankton counts reported in a previous section of Part III.

A summary of the work for the four years indicates a small zooplankton population, both in numbers and individuals per liter of water. He found an average of 69.7 copepods and 10 cladocera per liter of water. Cladocera were chiefly Daphnia and Diaphonosoma. Anura was the only rotifer found and it occurred in small numbers near the bottom.

BOTTOM ORGANISMS

Bottom organisms were also collected by Roach during the same summers listed for plankton work. The samples were taken at the same locations as were the other data. Chironomidae seemed to have been the most abundant bottom organism, but they were not found in abundance at any station. The average number of bottom organisms found per square foot of bottom for the four years, was 223. Culicidae were also represented in the counts.

Only three species of crayfish have been collected in the lake. Orconectes immunis immunis (Hagen) is found in greatest numbers. Occasional specimens of Cambarus diogenes Girard and C. fodiens (Cottle) have been collected in the flooded woodlands or neighboring fields. Procambarus blandingi acutus (Girard) is taken in the tributary streams of Lake St. Marys, but as yet none have been collected from the lake.

The naiad fauna of the lake is fairly abundant, but the species are few in number. Clams are occasionally seen along the beaches where they have been washed by heavy wave action. Little use of these mussels by muskrats has been noted at Lake St. Marys, although they are an important winter food supply at other lakes. Some use by raccoon has been observed. Quadrula quadrula (Raf.), Anodonta grandis Say, and Uniomerus tetralasmus Ortman (Clark 1944) are the most abundant species, but Anodonta imbecillus Say and Carunculina parva (Barnes) are also found.

FROGS AND TURTLES

Frog and turtle hunting is a favorite sport of many individuals at Lake St. Marys. Although cricket frogs (Acris crepitans Baird), striped chorus frogs (Pseudacris nigrita triseriata Wied), bullfrogs (Rana catesbeiana Shaw), green frogs (Rana clamitana Latreille) and leopard frogs (Rana pipiens Schreber) are taken at the lake, only the bullfrogs are of prime importance. In the early days during commercial fishing, the fishermen shipped frogs to markets in Cincinnati and St. Louis along with their fish. Probably every known method of taking frogs has been tried at the lake with each hunter having his favorite trick to fill his bag. Takes of 75 frogs have been made per night in recent years by two men, but smaller catches are the rule. The use of small frogs as bait has received little attention by the anglers at Lake St. Marys.

The most important turtle at the lake is the snapping turtle, Chelydra serpentina (Linne). Large numbers of this turtle are taken, but only a few are reported. Some "snappers" weighing 15 to 25 pounds have been observed. The spiny soft-shelled turtle (Amyda spinifera (Le Sueur) is also present in the lake. Painted turtles, Chrysemys bellii marginata Agassiz, are fairly abundant, and the presence of the stinkpot, Sternotherus odoratus (Latreille), in connecting waters suggests the possibility of its presence in the lake.

LEECHES

Leeches have been observed in numbers on both channel catfish and snapping turtles, and thus are subject to considerable discussion by anglers. Although they have been reported as having damaged fish in other states, no infestations large enough to harm fish have been noted in Lake St. Marys.

Two species, Helobdella fusca (Castle) and Placobdella rugosa (Verrill) have been identified by Dr. Percy Moore of the University of Pennsylvania.

FAIRY SHRIMP

Although the fairy shrimp, Eubranchipus vernalis (Verrill) is not of importance to the fishery at Lake St. Marys, its abundance in the shallows during spring merits its being included in the animal life known from the lake.

FRESHWATER SHRIMP

No freshwater shrimp (Palaemonetes exilipes) have been found in the diets of any of the fishes of Lake St. Marys, but its presence postulates its possible use as a food item. It is fairly abundant in some parts of the lake where beds of vegetation provide shelter.

FRESHWATER SPONGES

This little-known group has some connection with the fisheries of Lake St. Marys because of its nuisance value in the St. Marys Fish Farm which obtains its water from the Lake. They grow in the circulating screens and pipes at the Fish Farm. Unlike the marine forms with which we are familiar, these are brittle and almost pulverize between the fingers when thoroughly dried.

Spongilla fragilis Leidy and Carterius tubisperma Mills were identified by Dr. Minna E. Jewell and Heteromeyenia repens Potts and Ephydatia fluviatilis (aucterum) by Dr. Marcus C. Old.

So far as is known to the author, these are the first freshwater sponges to be reported from this section of Ohio.

BRYOZOA

This group is as little known as the sponges, but they are of a greater nuisance in the fish farm than the sponges. The growth of colonies of bryozoa in the inlet and circulating pipes is oftentimes so dense and so abundant that the water supply is stopped in the eight inch pipes.

Plumatella repens variety emarginata, P. r. variety e. phase Benedeni and P. r. variety typica Kafka have been identified by Dr. Mary Dora Rogick. Another specimen was tentatively identified as Stolella indica Annandale by the same authority.

The large Pectinella magnifica Leidy is quite common and known to most of the local people as "jelly fish".

RECOMMENDATIONS

1. The limited plankton information suggests that a shortage of this type of food exists and such a shortage correlates with the age-growth data in that the growth of the first year is below the averages given for the state for white crappies, bluegills, and largemouth bass. The black crappie growth raises a question as to this shortage in that its growth appears to approximate the state average in the first year. A study should be made to determine if a plankton shortage actually exists and if it is reflected in the growth of the fishes of Lake St. Marys.

2. Control of wave and ice action is recommended in another station of this report, but must be included here as a means of encouraging the re-establishment of aquatic meadows.

3. Cleaning or dredging of backwater pools should also be included here as a means of encouraging the growth of submerged aquatic plants and the increase of plankton.

4. Increased submerged aquatics would create more favorable conditions for such species as bass, bluegills, and frogs.

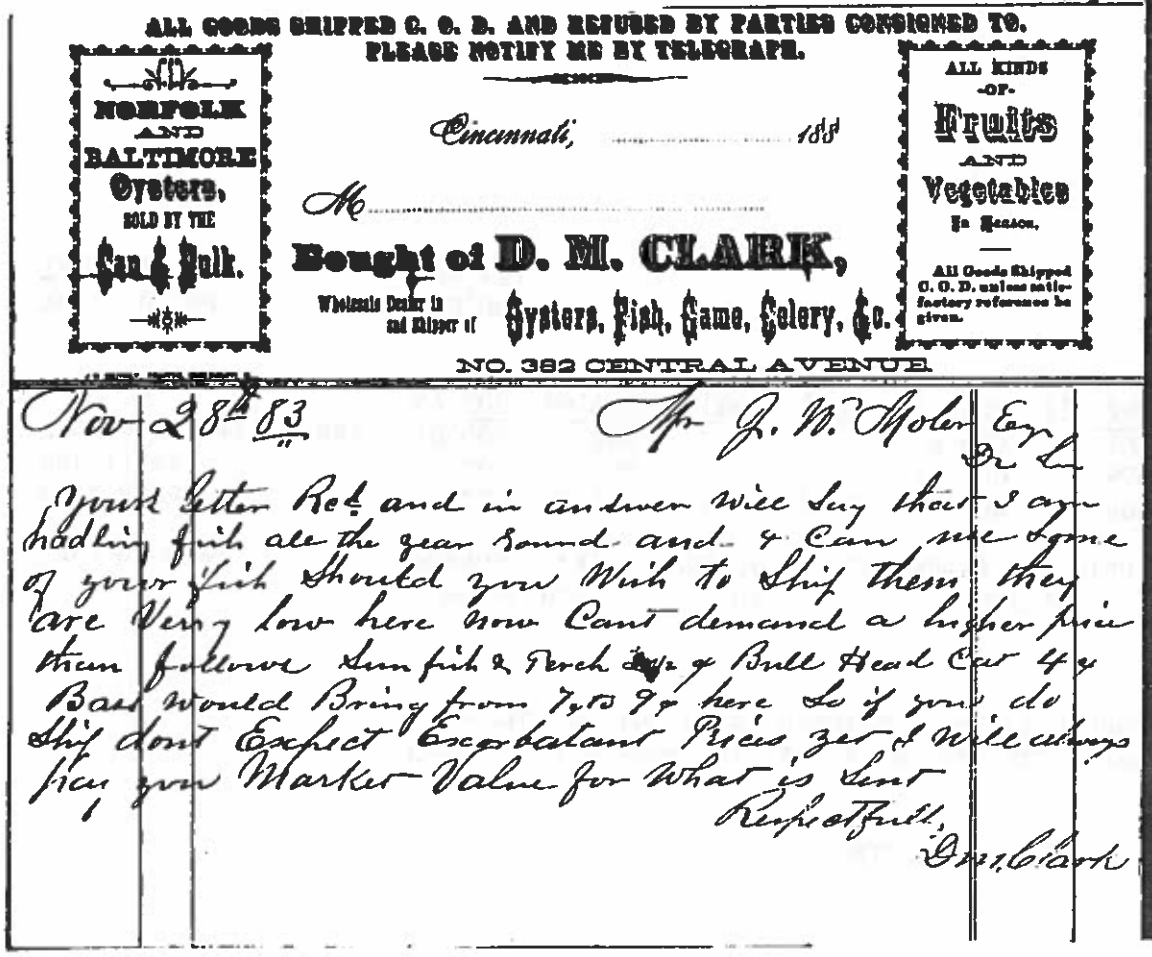
PART IV
THE FISHES OF LAKE ST. MARYS

INTRODUCTION

In describing the fishes of Lake St. Marys, as he knew them in 1867, Charles Dury (1930) made the following statements: "The most valuable food fishes, at that time, were the largemouth bass, (Micropterus salmoides) bluegill sunfish, (Lepomis pallidus) and pumpkinseed sunfish, (Eupomis gibbosus), the latter called "Roach" by the people. The bass attained a large size; I captured one on a trolling spoon that weighed 7 pounds and 14 ounces. Three and four pounders were common. A point of land that projected into the lake in the town of Celina was called Roach Point. Around this point sunfish swarmed. Using a small rod with worms for bait, one could catch as many as desired. In the spring and fall these were delicious pan fish, and the supply seemed inexhaustible.

In the commercial fishing days prior to 1900, it was estimated that 100 commercial fishermen set as many as 60 nets each in Lake St. Marys and harvested and shipped hundreds of thousands of fish (Clark 1951). Wilbur Mallory recalls that as a boy he rode in fishermen's boats which were loaded to the seats with fish from their nets. Mr. J. W. Thompson, one of the early leaders in Ohio's wildlife work, remembered visiting the fishing docks of the Molers on the south side of the lake. Mr. Thompson stated that the Molers had their hog lot fenced into 18 to 20 inches of water with fine chicken-wire mesh fence. He watched the fishing boats return with their catch, sort the large fish from the smaller ones, and saw the smaller ones thrown into the hog lot for feed. Molers employed 10 to 12 men in their commercial fishing activities. William Swartz told of taking 300 largemouth bass in 11 nets in 24 hours and selling them for five cents per pound. The late Guy Heap recalled that Albert Durbin and Fred Helm took four to five barrels of fish from three nets in 24 hours. Figures 17 and 18 illustrate shipments of fish and the prices paid at that time. The report of the U. S. Commission of Fish and Fisheries for the year 1896 states that Lake St. Marys, "....maintains fisheries that are almost as extensive as those of all the rest of the state". Table 5 is taken from this U. S. report to illustrate the size of the fishery and its value which must be considered in accordance to the time for which it is reported. This does not include the local use which must have been large, for, according to the stories, every bar in the vicinity served free fish with their drinks.

The changes in the lake discussed throughout this report indicate the changes which have taken place in the fish population as the habitats of the various species either disappeared or altered from that of early days. A list of all fish which have been known to occur in the lake is given in Table 6.



ALL GOODS SHIPPED C. O. D. AND REFUSED BY PARTIES CONSIGNED TO.
PLEASE NOTIFY ME BY TELEGRAPH.

NORFOLK AND BALTIMORE Oysters, SOLD BY THE Can & Bulk.

Cincinnati, ... 188

M .....

Bought of D. M. CLARK,

Wholesale Dealer in and Shipper of Oysters, Fish, Game, Celery, &c.

ALL KINDS -OF- Fruits AND Vegetables In Season.

All Goods Shipped C. O. D. unless satisfactory references be given.

NO. 382 CENTRAL AVENUE.

Nov 28th 83

Mr J. W. Moler Esq

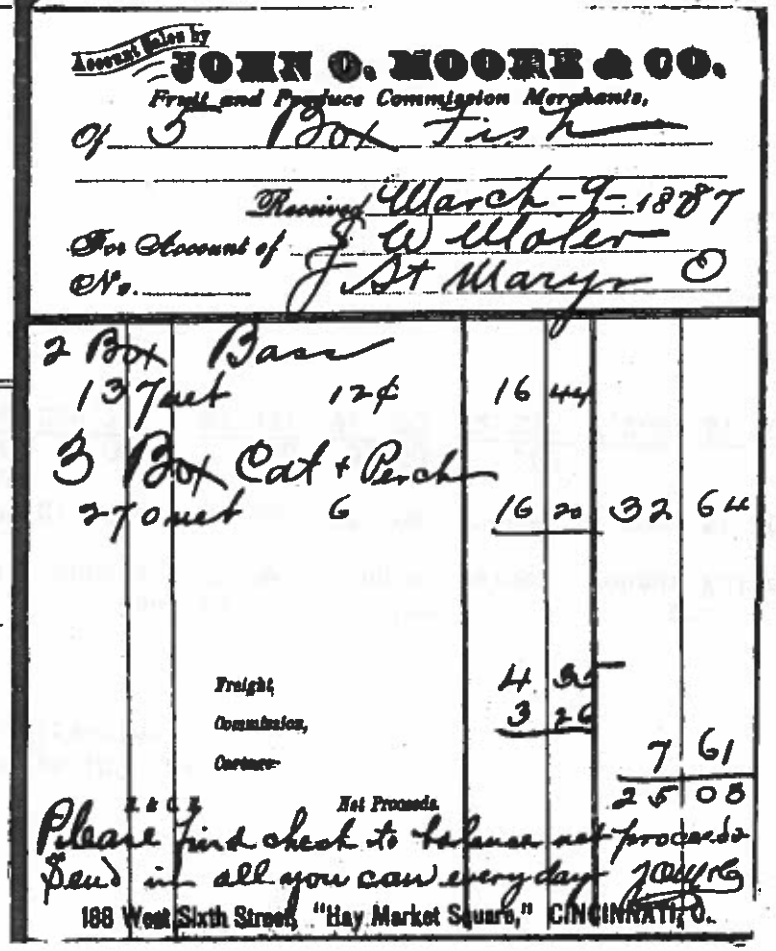
Dr

Yours Letter Rec'd and in answer will say that I am handling fish all the year round and I can use some of your fish should you Wish to Ship them they are Very low here now Cant demand a higher price than follows Sun fish & Perch 3½ Bull Head Cat 4½ Bass would Bring from 7½ to 9½ here So if you do Ship dont Expect Excorbatant Prices for I will always pay you Market Value for What is Sent

Respectfull,

D. M. Clark

FIGURE 17. PRICES OF FISH OFFERED TO COMMERCIAL FISHERMEN AT LAKE ST. MARYS IN THE YEAR 1883.



Account Sales by

JOHN O. MOORE & CO.

Fruit and Produce Commission Merchants,

Of 3 Box Fish

Received March 9 1887

For Account of J. Moler

No. ..... St Marys O

2 Box Bass					
13 Net	12¢	16	44		
3 Box Cat & Perch					
270 net	6	16	20	32	64
Freight			4	85	
Commission,			3	26	
Cartage					7 61
E. & O. E. Net Proceeds				25	08

Please find check to balance net proceeds Send in all you can every day Yours

188 West Sixth Street, "Hay Market Square," CINCINNATI, O.

FIGURE 18. INVOICE OF FISH SHIPPED FROM LAKE ST. MARYS BY J. W. MOLER.

TABLE 5

Commercial harvest of fish from Lake St. Marys in 1894 as reported by the U. S. Commission of Fish and Fisheries

Type of Gear	Black Bass		Carp		Catfish		Sunfish		Perch		Frogs	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Fyke nets	37,200	$2,976	5,000	$100	196,500	$10,395	219,776	$7,061	83,000	$2,075	7,200	$1,200
Set lines	2,000	160			11,500	660						
Hand and drift lines	10,000	800			3,875	192	9,000	270	8,750	262		
	49,200	$3,936	5,000	$100	211,875	$11,247	228,776	$7,331	91,750	$2,337	7,200	$1,200
Total Pounds	593,801											
Total Value	$ 26,151											

TABLE 6
A LIST OF FISH RECORDED FROM LAKE ST. MARYS

1.	Gizzard Shad	Dorosoma cepedianum (Le Sueur)
2.	Quillback	Carpiodes cyprinus cyprinus (Le Sueur)
3.	White Sucker	Catostomus commersonii commersonii (Lacepede)
4.	Hog Sucker	Hypentelium nigricans (Le Sueur)
5.	Golden Redhorse	Moxostoma erythrurum (Rafinesque)
6.	Carp	Cyprinus carpio (Linnaeus)
7.	Goldfish	Carassius auratus (Linnaeus)
8.	Creek Chub	Semotilus atromaculatus atromaculatus (Mitchell)
9.	Hornyhead Chub	Nocomis biguttatus (Kirtland)
10.	Blacknose Dace	Rhinichthys atratulus meleagris (Agassiz)
11.	Pugnose Minnow	Opsopoedus emiliae megalops (Forbes)
12.	Golden Shiner	Notemigonus crysoleucus auratus (Rafinesque)
13.	Redfin Shiner	Notropis umbratilis cyanocephalus (Copeland)
14.	Common Shiner	Notropis cornutus chrysocephalus (Rafinesque)
15.	Spotfin Shiner	Notropis spilopterus (Cope)
16.	Sand Shiner	Notropis deliciosus stramineus (Cope)
17.	Mimic Shiner	Notropis volucellus volucellus (Cope)
18.	Suckermouth Minnow	Phenacebius mirabilis (Girard)
19.	Silverjaw Minnow	Ericymba buccata (Cope)
20.	Fathead Minnow	Pimephales promelas promelas (Rafinesque)
21.	Bluntnose Minnow	Hyberhynchus notatus (Rafinesque)
22.	Stoneroller	Campostoma anomalum pullum (Agassiz)
23.	Channel Catfish	Ictalurus lacustris lacustris (Walbaum)
24.	Black Bullhead	Ameiurus melas melas (Rafinesque)
25.	Brown Bullhead	Ameiurus nebulosus nebulosus (Le Sueur)
26.	Yellow Bullhead	Ameiurus natalis natalis (Le Sueur)
27.	Tadpole Madtom	Schilbeodes mollis (Hermann)
28.	Grass Pike	Esox vermiculatus (Le Sueur)
29.	Northern Pike	Esox lucius (Linnaeus)
30.	American Eel	Anguilla bostoniensis (Le Sueur)
31.	Black Stripe Topminnow	Fundulus notatus (Rafinesque)
32.	White Bass	Lepibena chrysops (Rafinesque)
33.	Yellow Perch	Perca flavescens (Mitchill)
34.	Yellow Pikeperch	Stizostedion vitreum vitreum (Mitchill)
35.	Blackside Darter	Hadropterus maculatus (Girard)
36.	Log Perch	Percina caprodes caprodes (Rafinesque)
37.	Sand Darter	Ammocrypta pellucida (Baird)
38.	Johnny Darter	Boleosoma nigrum nigrum (Rafinesque)
39.	Barred Fantailed Darter	Poecilichthys flabellaris flabellaris (Rafinesque)
40.	Northern Greensided Darter	Etheostoma blennoides blennoides (Rafinesque)
41.	Smallmouth Bass	Micropterus dolomieu dolomieu (Lacepede)
42.	Largemouth Bass	Micropterus salmoides (Lacepede)
43.	Green Sunfish	Lepomis cyanellus (Rafinesque)
44.	Pumpkinseed Sunfish	Lepomis gibbosus (Linneaus)
45.	Bluegill	Lepomis macrochirus macrochirus (Rafinesque)
46.	Orangespotted Sunfish	Lepomis humilis (Girard)
47.	Great Lakes Longear Sunfish	Lepomis megalotis peltastes (Cope)
48.	Rockbass	Ambloplites rupestris rupestris (Rafinesque)
49.	White Crappie	Pomoxis annularis (Rafinesque)
50.	Black Crappie	Pomoxis nigro-maculatus (Le Sueur)
51.	Brook Silversides	Labidesthes sicculus sicculus (Cope)

YOUNG FISH POPULATIONS

Shore seining has been carried on in some manner at Lake St. Marys during many of the summers from 1932 through 1954. Seine hauls during various months of the year have aided greatly in obtaining information on the better spawning areas, hatch or survival of young, habitats of the young of the various species, growth, and food of fry and fingerlings. Early data obtained by Mr. E. L. Wickliff on the growth of fingerling from the lake is presented in Table 7. Later growth data are illustrated in Tables 8 and 9.

TABLE 7
Average lengths of fish taken in shore seining at Lake St. Marys in 1932 and 1934

	June 15, 1932 Average Length Inches	August 4, 1934 Average Length Inches
Gizzard Shad	2.5	2.25
Quillback		1.50
Carp		2.75
Spotfin Shiner		2.50
Suckermouth Minnow		.75
Silverjaw Minnow		2.25
Bluntnose Minnow		1.50
Stoneroller Minnow		2.75
Channel Catfish		1.75
Black Bullhead		1.50
Brown Bullhead		3.00
Top Minnow (Black Stripe)		1.25
White Bass		.75
Yellow Perch		2.75
Largemouth Bass		2.50
Pumpkinseed Sunfish		1.50
Bluegill	3.75	2.75
Orangespotted Sunfish	3.75	2.75
White Crappie		2.25
Brook Silversides		2.00

TABLE 8
Growth in inches of fingerling game and pan fish at Lake St. Marys 1938

	June	July	August	October
Black Bullhead	.75			
Brown Bullhead	1.00	1.50		2.75
Largemouth Bass	.75	1.75	2.25	2.75
Bluegill		1.00		1.75
White Crappie	1.50	1.75	1.75	2.75
Black Crappie	1.25			

TABLE 9

Average lengths in inches of Lake St. Marys fish taken in shore seining in the summers of 1938 and 1939.

SPECIES	MAY	JUNE	JULY	AUGUST	OCTOBER	DECEMBER
Gizzard Shad	2.25	1.75	2.25	4.37		2.25
Quillback			2.25			
Carp	12.00		2.00			
Golden Shiner			2.00	2.25	2.50	
Spotfin Shiner			2.25	2.75	2.50	2.75
Fathead Minnow			1.75			2.25
Bluntnose Minnow			2.25		2.25	2.50
Black Bullhead	7.25	1.00				
Brown Bullhead	7.00	1.00	1.75		2.75	
Largemouth Bass		.75	2.25	2.25	2.75	
Bluegill	5.75		1.00		1.75	
Orangespotted Sunfish	4.00		2.75	3.25	1.50	1.75
White Crappie	7.75	1.50	1.75	1.75	2.50	
Black Crappie		1.50	2.25			
Brook Silversides			2.00	2.25	2.50	2.25

Tables 8 and 9 indicate that the population of small fishes varies greatly in shallow waters throughout the year, or that they are not taken efficiently with seines. They also portray the influence of fish movements on the average sizes of the fish taken. Also, the average sizes of fish may vary from month to month; shad in December averaged smaller than in August (Table 9). Many factors may be responsible for such confusing data. Some of the young fish of certain species are taken with greater ease than those of other species. Largemouth bass fingerling are usually taken readily as compared with great difficulty in taking crappie fingerlings in most lakes. Vegetation tends to concentrate fry and fingerlings of certain kinds, but many waters lack this factor. The longer spawning seasons for some species may result in tremendous late hatches as compared with a poor early hatch and thus pull down the average sizes of the fingerlings taken in the seine. The movements of some fish from shallow water to deeper water as they increase in size, results in the scarcity of larger fingerlings in the fall and thus decreases the average size of those taken.

Although crappies seem to be the most abundant pan fish in Lake St. Marys, their fingerlings are very difficult to take in seines. Largemouth bass fingerlings can always be found, but this species comprises only a small portion of the total population of the lake. Bluegills are so rare that a representative sample of the fry and fingerlings has not been taken. The schooling habits of bullheads result in possibly one or two schools comprising the take in the seine, but a lack of intermingling of the schools prevents the seiner from obtaining a true picture of the over-all population. Channel catfish is one of the most abundant fishes in the lake, but very few fingerlings are taken in seines.

Concentrations of fry and fingerlings may be found near the better spawning or feeding grounds. The dredged channels at Lake St. Marys appear to be some of the better spawning grounds for largemouth bass. As many as 50 schools of bass fry have been counted in 100 feet of channel. Many of what appear to be good spawning areas for this species have been checked against the channels for largemouth bass production. In every instance, the channels produced more schools of fry per unit of surface area.

It is interesting to note that in spite of what appears to be a large population of adult carp in Lake St. Marys, few carp fry are taken in seines. Special effort has been made to locate concentrations of the fingerlings, but none have been found.

THE ADULT FISH POPULATION

This group is comprised of the species of larger sizes, or the larger members of the fish population. It is upon this large fish population that man depends for his angling. Information on this group has been obtained chiefly by means of standard type test nets described by Roach (1942) and which have been altered very little in design or construction since that date.

Many methods of obtaining information on fish populations have been used throughout the country. The value of such methods might be summarized in statements from Cleary and Greenbank (1954), "There is seemingly no simple panacea of fixed operating procedure which can be generally recommended...". They further state, "...reasonably accurate trends in river populations can be obtained if surveys are of a continuous nature to allow for comparison of annual data". The use of the same type of net, in the same lake, in the same general area, at approximately the same season of the year or when conditions are comparable to previous years, over a period of years has been considered as giving the reasonably accurate trends mentioned by Cleary and Greenbank (1954). Funk and Campbell (1953) wrote, "...the selectivity of different devices may be compensatory, and certainly the use of several methods will give a more accurate picture of the variety of the fish population than will the exclusive use of one method". Test nets, seines, and creel census are means used in obtaining data on the fishes of Lake St. Marys. Of the many difficulties of obtaining adequate or representative sampling of a fish population, discussed throughout fisheries literature, the size of the water area involved presents one of the major problems. The number of nets necessary to obtain the sample, the general mixing of the population, and the restricted habitat niches of the lake are problems which increase in magnitude with the size of the water area. Thus, the possibilities of obtaining a true sample decreases as the size of the water area increases, because of the number of nets and stations needed to obtain this true sample. For example, Cooper (1953) operated eight nets continuously in a 180 acre lake, for a period of 43 days. Forty stations were fished by a systematic rotation of nets, following four consecutive nights at each station. If such were necessary to adequately

sample the population of a 180 acre lake, the size of Lake St. Marys, would make the procedure impractical. However, in light of the quotations above by Cleary and Greenbank (1954) and the existing correlations within our own data, it is believed that our data indicates the existing trends in the fish population.

Test nets (Figures 19 and 20) have been operated in Lake St. Marys during 14 summers of the past 24 years, with continuous summer netting from 1946 through 1955. One of the greatest benefits derived from these nets has been the demonstration to anglers that large populations may exist in spite of poor angling success.

Table 10 permits a comparison of all test net periods, for the major species of fish, compiled on the basis of annual totals, percentages and averages. The data reveals great differences in the total hours fished each year, the total catch, catch per hour and composition of the catch. The numbers of fish checked each year varied from 799 in 1932 to 113,862 in 1947. The number taken per net hour of fishing ranged from 9.4 in 1940 to 131.6 in 1947. The greatest number taken in any one 24 hour netting period by a single net was 12,759 on April 10, 1947. A total of 19 species have been taken by these nets.

In spite of variations in the annual data, certain trends and facts are revealed. Crappie-channel catfish-shad-carp have remained the dominant combination of species throughout all the years except for the netting by Wickliff in 1932. In general, the take increased from our earliest data up to 1947, decreased to 1953 and began a recovery which carried through 1955. This rise and fall in total net take was chiefly due to correlating fluctuations in the take of crappies. Although rough fish are considered by the public to be over-abundant, they have not dominated the net catches. Creel census adds proof to the dominance of the panfish species (Table 11). The fluctuations would indicate that stability in populations is not the normal course of events, but that a continuous shifting and changing is the typical trend. Although average sizes of most species varied little from year to year, the percentages of length group distribution varied greatly (Figures 21 through 28).

Crappies: The crappie population, as indicated by test net catches was characterized by considerable annual variation in its proportional size to the fish population as a whole, in the shifts in percentages of the two species comprising this group, and in the length groups of both species (Table 10 and Figures 21 and 22).

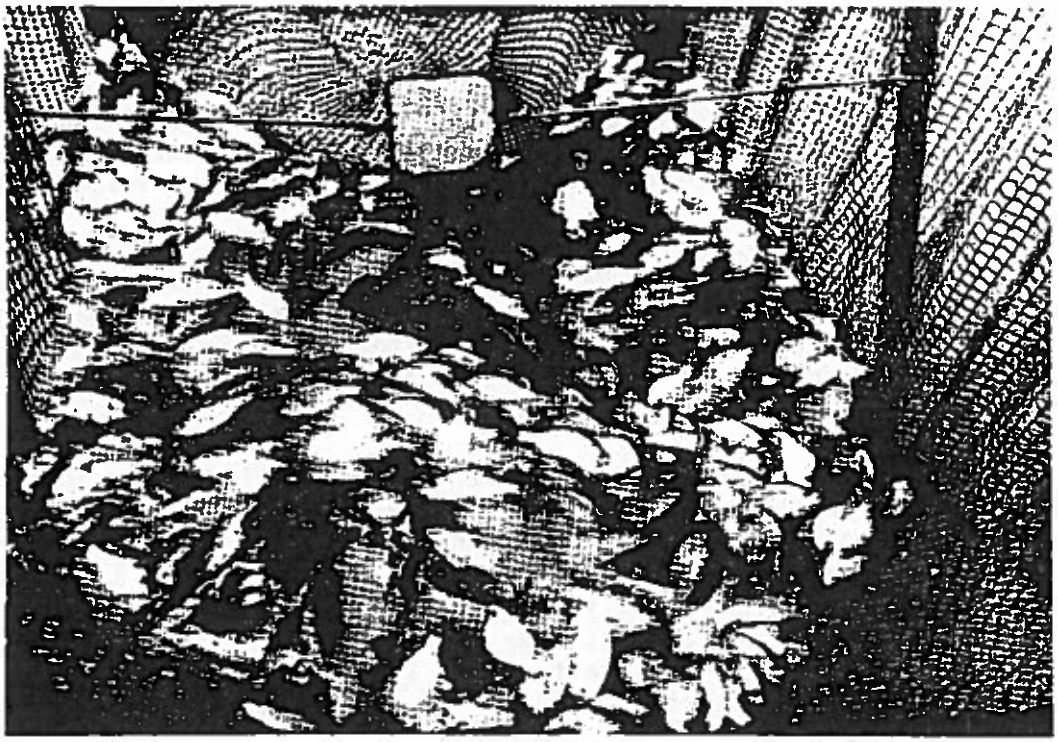


FIGURE 19. A TWENTY-FOUR HOUR CATCH OF FISH IN A TEST NET AT LAKE ST. MARYS.

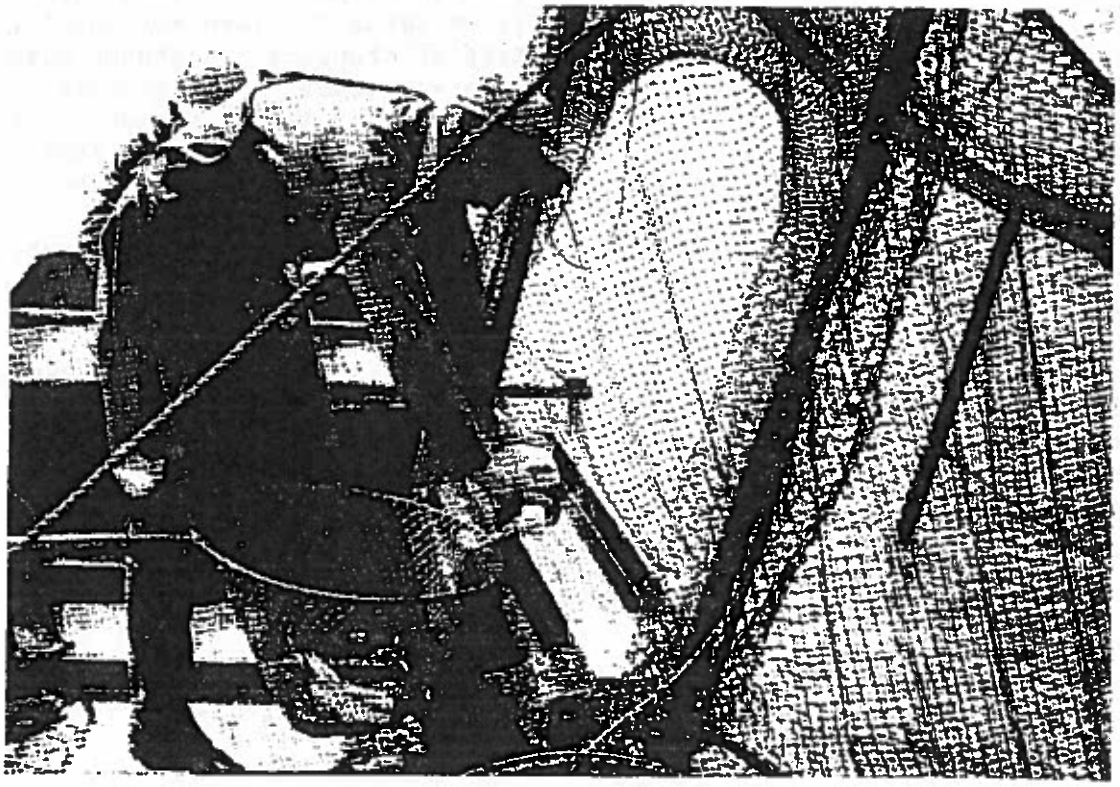


FIGURE 20. FISH FROM TEST NET CATCHES ARE MEASURED TO DETERMINE THE GENERAL WELFARE AND STATUS OF THE OVER-ALL POPULATION.

TABLE 10

Comparisons of annual test net summaries for Lake St. Marys given in numbers of fish taken each year, percentages of the total take, and the average lengths of each species.

YEAR	1932	1938	1939	1940	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
MONTH	7	6	7	4	4-6-8	4-5-11	6	6	6-8	5	4	6	6-7	6-7
NUMBER OF NETS	1	1	1	2	2	1	1	1	1	1	1	2	1	1
TOTAL HOURS FISHED	136	144	77	203	565	865	306	336	397	156	193	250	99.5	92
TOTAL FISH CAUGHT	799	1995	2864	1907	32270	113862	19412	25808	16328	10584	11716	3941	2117	3635
CATCH PER HOUR	22.0	13.8	37.2	9.4	57.3	131.6	63.4	77.7	41.1	67.8	60.7	15.8	21.3	39.5
Species														
BLACK CRAPPIE	260	211	1692	471	13008	65033	10206	5295	8549	2272	3399	1092	919	195
% of total	32.5	10.6	59.0	24.8	39.7	57.1	51.6	20.5	52.4	21.5	29.0	27.7	43.4	5.3
Average Length	8.0	7.3	7.5	8.5	6.1	7.0	7.1	7.1	6.5	7.3	7.0	7.6	6.0	6.5
WHITE CRAPPIE	95	1191	960	370	4549	9540	5287	2988	3059	2946	4160	1257	841	1420
% of total	12.0	60.0	33.5	19.6	14.1	8.4	26.7	11.6	18.7	27.8	35.5	3.9	39.7	39.0
Average Length	8.0	8.0	7.0	8.0	6.8	7.5	7.8	8.8	8.1	8.5	8.0	9.6	7.0	5.5
CHANNEL CATFISH	8	31	40	722	4565	3813	1877	13911	1127	1491	754	845	142	384
% of total	1.0	1.5	1.4	37.3	14.1	3.3	9.7	53.9	6.9	14.1	6.4	21.4	6.7	10.5
Average Length	12.5	14.0	9.8	8.7	10.7	10.7	11.3	11.5	12.2	11.5	10.0	11.1	10.5	9.0
SHAD		98	3	3	8015	20651	135	1856	2619	2299	251	217	89	1497
% of total		4.9	.2	.2	24.8	18.2	.7	7.2	16.0	21.7	2.1	5.5	4.2	41.1
Average Length		13.0	9.8	10.5	8.6	9.9	10.8	7.0	9.1	10.0	11.5	9.7	10.0	5.5
CARP	417	203	52	130	823	10166	324	300	438	632	1811	69	72	88
% of total	52.3	10.1	1.8	6.9	2.6	8.9	1.7	1.2	2.7	6.0	15.5	1.8	3.4	2.4
Average Length	10.0	11.0	11.0	11.0	13.8	11.7	11.8	13.1	11.6	12.0	11.5	11.8	11.0	11.5
QUILLBACK	18	143	60	12	1023	4261	1477	603	330	840	1027	172	18	31
% of total	2.3	7.2	2.1	.6	3.2	3.7	7.5	2.3	2.0	7.9	8.8	4.4	.8	.8
Average Length		13.0	13.8	14.5	16.2	16.3	16.1	16.3	16.1	17.0	16.5	13.9	16.0	15.3
BULLHEADS		25	36	76	421	118	105	589	57	71	201	96	17	2
% of total		1.3	1.3	4.0	1.3	.1	.5	2.3	.3	.7	1.7	2.4	.8	
Average Length		9.0	9.0	9.0	8.2	8.6	8.7	8.2	8.4	8.3	8.5	8.6	8.0	9.0
BLUEGILL	6	86	19	107	53	56	365	248	131	17	16	151	16	4
% of total	.8	4.3	.7	5.6	1.6	.1	1.8	1.0	.8	.2	.1	3.8	.7	.1
Average Length	6.0	6.0	6.3	6.0	5.8	7.0	7.1	7.0	6.8	7.0	6.8	6.0	6.0	5.8

(Continued Next Page)

TABLE 10 (Continued)

	1932	1938	1939	1940	1946	1947	1948	1949	1950	1951	1953	1954	1955
LARGEMOUTH BASS	1	7	1	4	3	56	3	4	3	5	14	3	
% of total	.1	.4		.1		.1				.1	.1	.1	
Average Length	14.5	15.0	15.5	12.5	17.5	17.0	17.0	15.8	17.5	18.5	16.0	17.0	
WHITE SUCKER				2	11	151	3	8	8	7	54	16	1
% of total				.1		.1				.1	.5	.4	
Average Length				10.9	13.9	13.3	13.7	13.3	12.7	14.0	12.0	12.6	11.0
PUMPKINSEED SUNFISH			1	1		3	4	3	6	3	5	8	
% of total												.2	
Average Length			4.5	6.5		6.3	5.5	5.3	5.4	5.5	5.0	5.0	
YELLOW PERCH				3		5		2	1		15	6	
% of total				.1							.1	.2	
Average Length				7.3		5.0		6.5	6.0		6.0	7.3	
GOLDFISH					1			3		1	1		
% of total													
Average Length					12.5			14.5		14.0	14.0		
GOLDEN SHINER					1	1		1			1	8	
% of total												.2	
Average Length					6.5	6.5		7.0			8.5	7.3	
NORTHERN PIKE											2	1	
% of total													
Average Length											23.5	20.5	

TABLE 11

Comparisons of annual creel census summaries for Lake St. Marys during the years of intensive creel census, 1946 through 1950, and spot checks through 1955.

YEAR	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Number of anglers contacted	7,840	14,124	26,787	24,326	21,159	434	851	2,094	2,094	3,550
Average hours fished per angler	3.5	3.8	3.2	3.8	3.8	3.8	3.2	3.4	3.7	3.9
Catch per hour	1.0	1.3	.9	.6	.6	1.9	1.7	1.1	1.1	1.3
Catch per angler	2.8	3.9	2.5	1.8	1.9	7.1	5.6	3.6	3.9	5.1
Per cent of non-resident anglers	4.4	8.0	6.3	5.5	6.5					
Anglers taking no fish (%)	27.6	31.0	41.0	43.0	43.0					
Anglers taking a bag limit (%)	1.5	2.4	3.1	.6	.8					
Total estimated anglers present	521,430	86.100	178,788	179,546	171,891					
Total estimated fish taken	1,806,755	435,149	526,351	382,073	406,282					
Total estimated pounds harvested	371,847	84,830	100,481	106,248	115,340					
Estimated pounds taken per acre	33.8	7.7	9.1	9.7	10.5					
Fisherman hours per acre	165.9	29.7	52.0	62.0	59.3					
Fish harvested per acre	164.2	39.6	47.9	34.7	36.9					
SPECIE HARVEST										
Crappies, black and white										
% of total harvest	64.6	79.9	80.5	58.0	66.0	60.0	66.0	68.2	58.0	69.5
Average length in inches	5.8	7.0	7.5	7.8	7.6					
Channel Catfish										
% of total harvest	19.9	11.7	12.4	30.0	22.3	13.2	20.0	19.5	20.5	13.8
Average length in inches	10.8	10.3	10.3	10.1	10.6					
Bullheads										
% of total harvest	8.1	4.7	1.8	2.8	2.0	9.4	5.7	20.6	12.5	5.8
Average length in inches	8.8	8.0	8.4	9.1	9.7					
Bluegills										
% of total harvest	2.7	.8	1.1	1.0	1.5					
Average length in inches	5.6	5.2	6.5	6.5	6.5					
Carp										
% of total harvest	2.8	.8	1.9	5.0	6.2	8.4	4.7	1.9	3.5	4.1
Average length in inches	14.0	11.5	11.7	11.8	13.0					
Largemouth Bass										
% of total harvest	1.2	.2	.3	.6	.8	6.4	.9	1.2	1.5	3.4
Average length in inches	14.6	12.5	13.5	13.2	13.3					

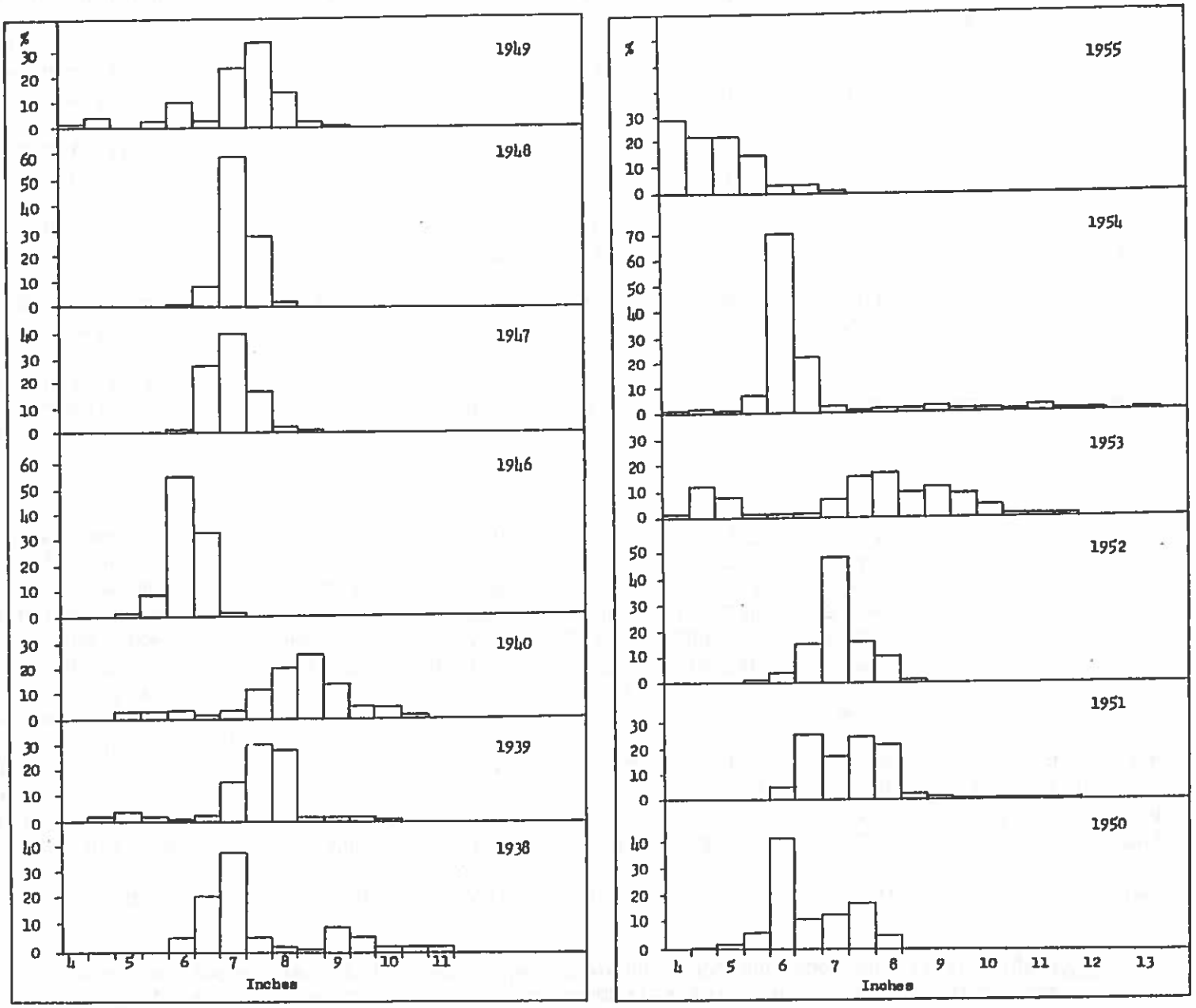


FIGURE 21. LENGTH-FIGURING DISTRIBUTION OF THE BLACK CRAPPIE AT LAKE ST. MARYS.

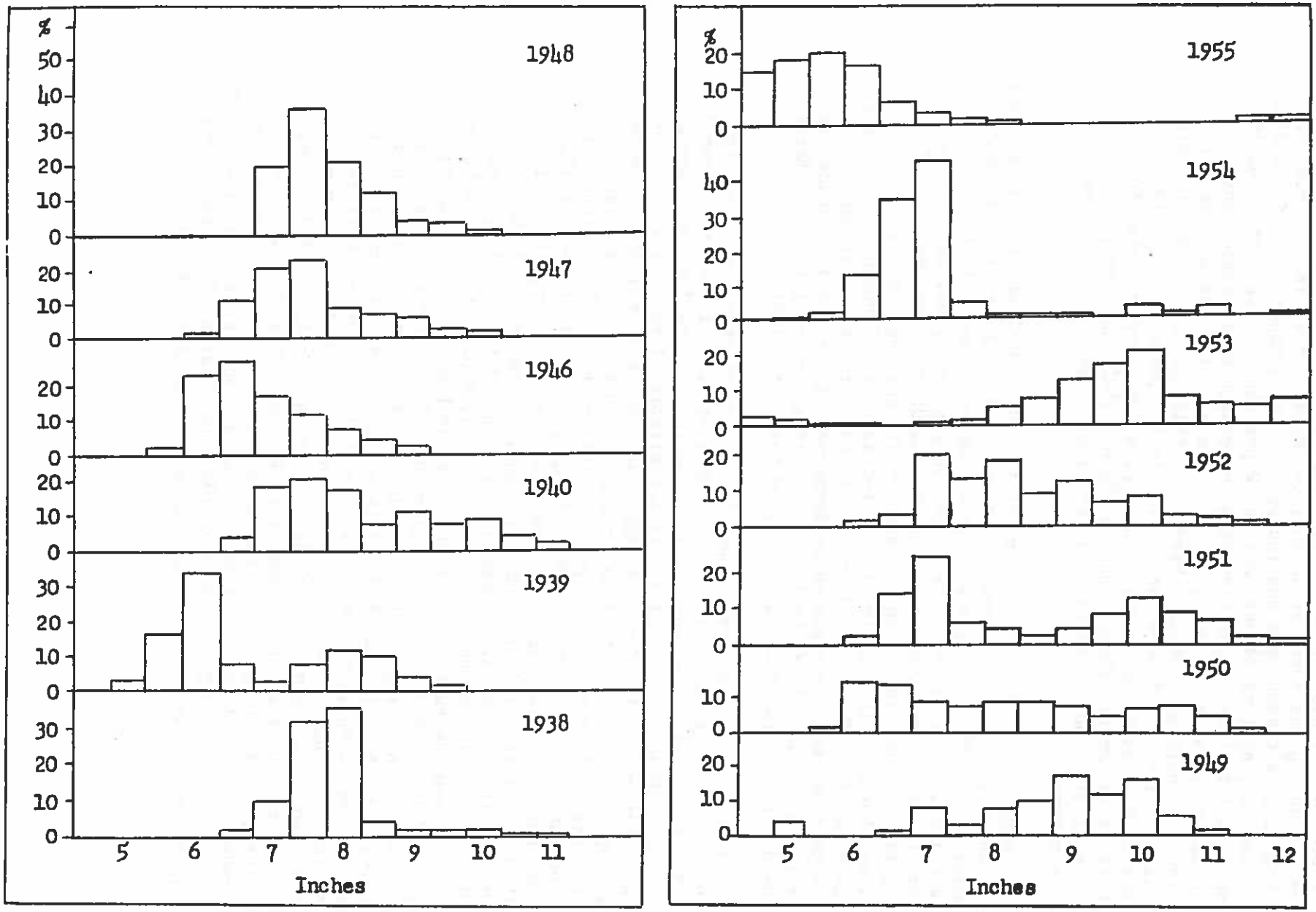


FIGURE 22. LAKE ST. MARYS LENGTH FREQUENCY DISTRIBUTION OF WHITE CRAPPIE.

Table 10 includes the percentage composition of the test net catches by species during the years of accumulated data. It is readily observed that crappies have made up a substantial or even a major part of the fish population ranging from 44 per cent to 92 per cent of the fish taken in the nets, but that their position on a percentage basis varied annually. On the basis of catch per hour, Table 12 presents the annual summaries from the test nets and anglers' harvest. Variation in the take by both methods is evident, but some correlation in the peaks and lows is also apparent. Changes in the population complex have been reported for crappies by Eschmeyer, Manges, and Haslbauer (1947) and Stroud (1948). Thompson (1941) reported catches of ten times as many fish in some years than in others.

A comparison of the percentages of the individual species of crappies taken annually (Table 10) reveals that the 1938 catch was largely white crappies. In 1939, black crappies became dominant and held this dominance through 1953. Then in 1954, the blacks only slightly outnumbered the whites, but they were overwhelmed by the abundance of whites in 1955. Hanson (1951) found that hoop net samples did not necessarily indicate the true abundance in relation to the two species. Chapman (1955) reported for Sandusky Bay, Ohio, that increases in the percentages of one species in the test net were accompanied by decreases of the other. Changes in percentages of harvest of the two species of crappies at Lake St. Marys followed closely with that observed from test net catches.

Distinct annual changes in the size distribution of both species of crappies were noted in the test net catches at Lake St. Marys. Figures 21 and 22 portray the percentages of each length group during the years of the study. These figures illustrate the effects of year classes which dominate the population for a few years and then pass out of existence. According to the age-growth data from Roach and Evans (1948), the six and six and one-half inch black crappies in the graph for 1946 (Figure 21) were hatched in 1943. In following the graphs from 1946 through 1949, it may be seen that this year class dominated the black crappie population. In 1950, the hatch of 1947 comprised roughly 50 per cent of the black crappies taken in the nets. Similar year class data is illustrated in Figure 22 for white crappies. Langlois (1937) reported that the hatch of 1931 formed the bulk of the fish caught in Lake St. Marys during the summers of 1933, 1934, and 1935. Thompson (1941) suggested that a single year class in an Illinois lake was able to consume most of the young crappies and other fish hatched for three to four years, and that this year class would dominate the population until its numbers were reduced sufficiently to permit the survival of another large brood. Thompson (1941) also stated that the crappie thus produced a cycle of its own, but also imposed it on other members of the lake population. It may, therefore, be stated that large annual crops of fingerling are not needed to produce good fishing except as they act as food for some dominate year classes. Langlois (1938), Thompson (1941) and Hansen (1951) described broods or year groups which postulated a four to five year cycle.

Figure 21 suggests that the black crappie population of Lake St. Marys will be composed largely of small crappies every four years or larger ones at similar intervals of time. Figure 22 does not postulate year class dominance for white crappies of such extremes as noted for the black crappies in Figure 21. The majority of the white crappies in 1946 were in the six and six and one-half inch groups. In 1951, these length groups encompassed the largest percentages of the population, but did not reach the magnitude of the 1946 population. A comparison of Figures 21 and 22 indicate that the Lake St. Marys black crappies do not produce the numbers of larger sizes of fish that are produced in the white crappie population. The years 1940 and 1949 through 1953 are remembered by anglers as those years of big crappies. This correlates with the data in Figure 22 which reveals that the white crappie supplied the large sizes in these years.

Channel Catfish: In importance to anglers this species at Lake St. Marys ranks second in numbers, but first in the poundage taken (Clark, Now, and Flinn, 1946). Prior to 1940, "channels" appeared as a very small percentage in the take of test nets and in the angler's creel. The heavy plantings of breeders during the years 1938 through 1941 inclusive, seem to have supplied the brood stock necessary to firmly establish this species. Test net catches (Tables 10 and 12) do not indicate the wide variations in take annually as noted for other species. The abnormal catches of 1949 should be eliminated from this discussion. In that year all rough fish taken from the test nets were killed, cut in pieces, and dropped into the lake while checking the contents of the net. This acted in the same manner as baiting the net, and thus altered greatly the take.

Harrison (1955) reported fluctuations from year to year in his population estimates of channel catfish in the Des Moines River, Iowa. He also found his catch per hour to fall in direct proportions with the size of the population. As stated by Harrison (1955), his test nets indicated trends in the population. It may thus be presumed that since 1951, the production of young channel catfish has been increased (Figure 23) or the survival has been more successful, and that the population may be comprised of a larger percentage of small fish. This condition existed in 1939 and 1940 after which larger sizes dominated the catches (Figure 23). No prediction can be made as to the number of years during which these more successful rearing seasons may last, but all evidence indicated that they swell the numbers of small fish and are followed by years of poorer production and larger sizes of catfish. The lack of age-growth information on the channel catfish in Ohio prevents accurate calculations as to the ages of the 1955 net catch. Judging from the work of Hall and Jenkins (1952), on lakes over 500 acres, the bulk of the 1955 take was in the second and third years of age.

TABLE 12

A comparison of the catch per hour, by species, of test nets and anglers' harvest at La,e St. Marys.

	1946		1947		1948		1949		1950		1951		1952		1953		1954		1955	
	TN	A	TN	A	TN	A	TN	A	TN	A	TN	A	TN	A	TN	A	TN	A	TN	A
Crappies	30.8	.63	86.2	1.07	50.5	.74	24.9	.32	29.2	.40	33.3	1.11	38.6	1.13	9.3	.71	17.6	.59	21.0	.69
Channel Catfish	8.0	.19	4.4	.16	5.6	.11	41.9	.16	2.8	.14	9.5	.24	3.9	.34	3.4	.20	1.4	.20	2.9	.13
Carp	1.4	.02	11.7	.01	1.0	.02	.8	.03	1.1	.04	4.0	.15	9.3	.09	.2	.02	.7	.03	.7	.05
Bullheads	.8	.08	.1	.06	.3	.01	1.8	.01	.1	.01	.5	.17	1.1	.09	.4	.02	.2	.15		.06
Bluegills	.8	.02	.1	.01	.3	.01	1.8		.1	.01	.5	.02	1.1	.01	.4	.01	.2	.03		.03
Largemouth Bass		.08	.1	.06		.01		.01		.01		.12	.1	.01		.01		.01		.03
Shad	14.1		23.8		.4		5.5		6.3		14.7		1.3		.8		.8		11.3	
Quillback	2.0		4.9		3.6		1.8		.8		5.3		5.3		.5		.2		.2	
Perch						.01		.01		.02		.03		.05		.02				

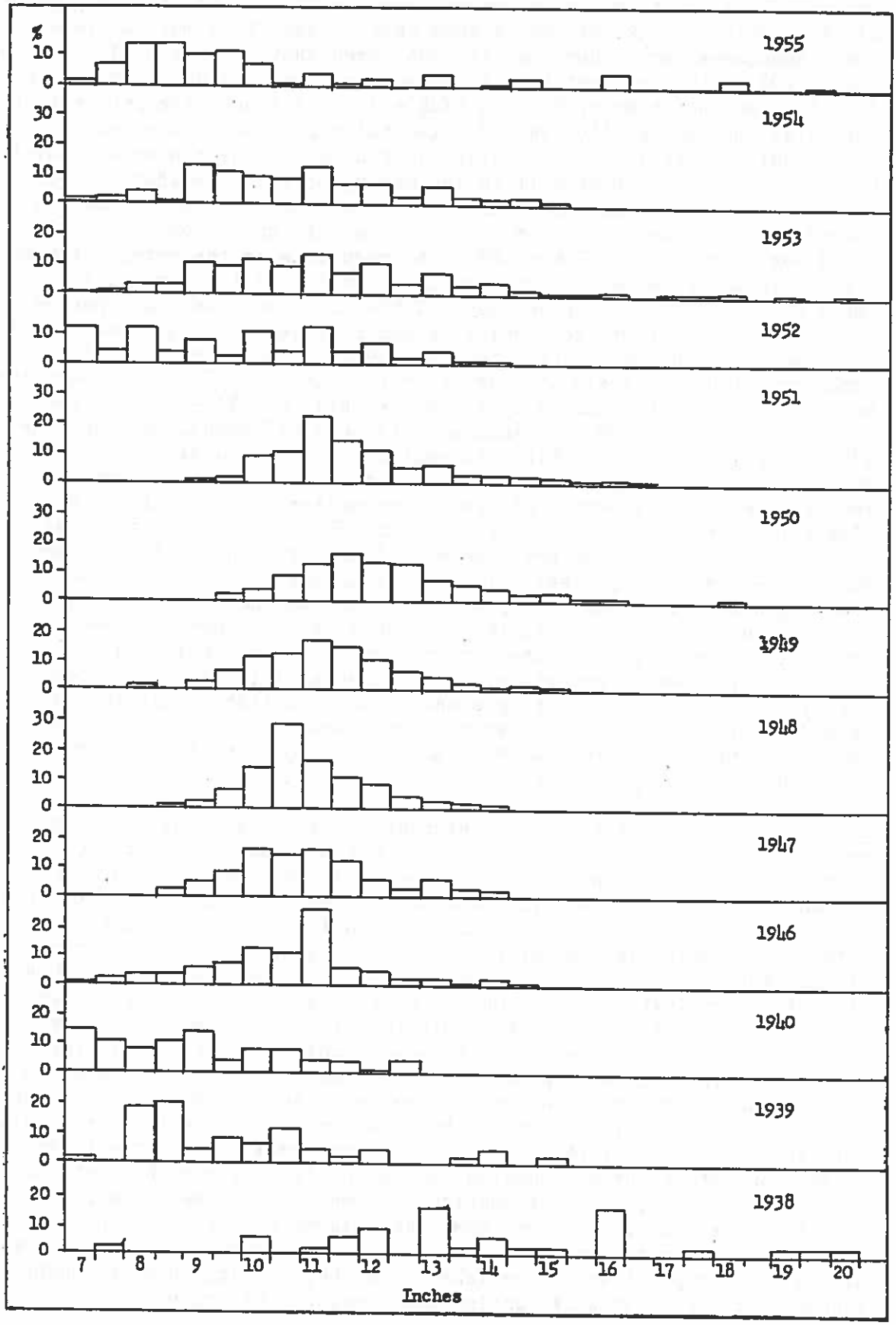


FIGURE 23. LENGTH FREQUENCY DISTRIBUTION OF THE CHANNEL CATFISH AT LAKE ST. MARYS.

Gizzard Shad: Although gizzard shad are of no recreational value to the angler, their great abundance demands consideration. In the early years of the studies on Lake St. Marys shad were a novelty to most anglers. Their abundance became apparent in 1946, when they comprised 24.5 per cent (Table 10) of the test net take in numbers and were caught at the rate of 14.1 fish per net hour of fishing (Table 12). Although the per cent of the total take was smaller in 1947, the catch per hour increased. The huge population of 1947 was drastically reduced in the winter of 1947-1948 by the most severe winter kill in the memory of local residents. Winter kills of shad are common, but the severity of the 1947-48 kill may be judged by the reduction of the catch per hour by nets from 23.8 in 1947 to .4 per hour in 1949 (Table 12). The reduction in the catch per hour appears to be reflected in the size distribution of the population. In those years of lowest take per hour (Table 12), the size distribution seems to indicate that the population was composed of larger individuals. The size distribution of this fish in 1949 and 1955 reveals populations comprised almost entirely of young fish (Figure 24). These followed the serious reduction in numbers by the winter kill of 1947-1948 and the removal by nets of 2,245,170 shad weighing 667,847 pounds between June 1953 and February 1955. This data postulates a reproductive capacity and a survival quality which permits a population of fish to rapidly recover, following a period of drastic reduction. The catch per hour (Table 12) for the years 1948 to 1949 and 1953 to 1955 substantiates this theory of rapid recovery. Bennett (1954) stated for the largemouth bass, "There was no apparent relationship between the number of bass of spawning age in the lake in any given season and the number of fry produced in that season". Table 10 reveals that, in general, when crappies represented the highest percentages of the population, shad were at their lowest percentages. The value of this fish, as a food supply on which St. Marys crappie and channel catfish populations are dependent, is a matter for grave consideration. This question should be studied before any radical programs are inaugurated for serious reductions in shad populations.

Carp: This is one of the most controversial species of Ohio fishes, not because of its value to the angler, but because of the criticisms directed toward it. In the Annual Report of the Commissioners of Fish and Game for the year 1904 is a statement, "Now it (Lake St. Marys) contains only carp, which cannot be taken by the usual methods, and which are literally starving in the waters they have usurped". This same report stated that the Commission had entered into contracts with two fishing firms to exterminate the carp on St. Marys, Indian, and Buckeye lakes. This early interest reveals the beginning of the controversy of the species and its abundance in early days. Tables 10, 11, and 12 indicate little relationship between the peaks or lows in the take of carp and panfish, nor do the carp appear to have represented a major portion of the population in any year other than the early data for 1932 by Wickliff. This species is one of the few fish which congregates in large schools in shallow waters during spawning season and is thus one which attracts the most attention. The information, accumulated on the fisheries of Lake St. Marys, would indicate that these large numbers of carp seen concentrated over the spawning grounds actually comprise a small percentage of the total population of the lake, when they are scattered throughout the thousands of acres of water during the remainder of the year.

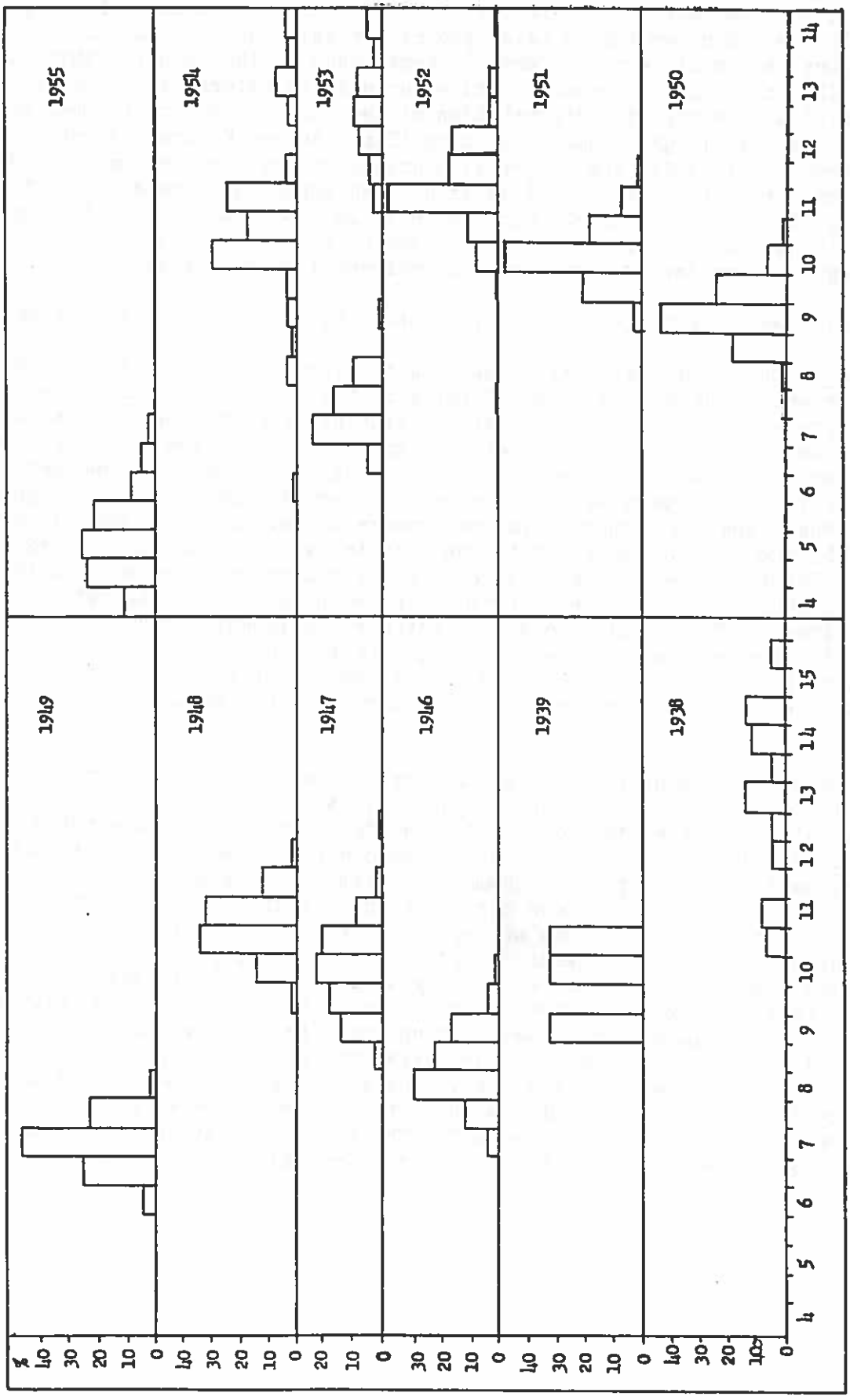


FIGURE 24. LENGTH FREQUENCY DISTRIBUTION OF GIZZARD SHAD AT LAKE ST. MARYS.

The small average size of the St. Marys carp was suggested by the above quotation for the year 1904. Wickliff's 1932 records indicate small carp, as do all available records on this species for this lake. Figure 25 illustrates the small average sizes. A comparison of the data in Tables 10, 11, and 12, and Figure 25 reveals little correlation between the size of the population and the size distribution of the carp. However, it must be observed that the largest numbers of carp (Table 10 and Figure 21) occurred in the same years as did the larger size groups of the black crappies. Also, the largest percentage of carp of 14 inches and longer was present in 1955 following the removal of 21,334 carp weighing 25,348 pounds. This limited removal is not considered sufficient to have been a contributing factor in resulting in these larger sizes, only coincidental to this event.

Our data would indicate that the population is rather static in nature.

Quillback: Quillback were little known to the local residents of the area until the operation of test nets. Reports of the "old-timers" indicate it was not present in the days of commercial fishing in numbers sufficient to be recalled. It has never represented a large portion of the catch per hour or percentage of the total composition of the catch in numbers. However, if weight instead of numbers was considered, they would rate high as a component of the population. A reduction in the numbers of quillback in Lake St. Marys since 1951 and 1952 is suggested by the data in Tables 10 and 12. An examination of Tables 10 and 12, and Figure 26 reveals a correlation between the catch per hour and percentage of total catch with the size distribution of the quillback. The lowest rate of net catches and lowest percentages of the total takes were accompanied by the greatest range of size distribution and, with the exception of 1951, the larger numbers of the bigger fish. The data does not indicate any material changes in this population in the near future.

Although very few quillback are taken by anglers, this species represents possibilities as a food fish superior in quality to carp, The inability to harvest this crop means the loss of tons of food annually. Those taken in the test nets in the peak year, 1947, weighed nearly five tons. Although their numbers may not support a commercial fisheries, proper utilization of all natural resources is good conservation. In discussing the commercial fisheries in the T. V. A. lakes of the south, Wiebe and Bryan stated, "...nothing man can do will entirely eliminate existing populations of commercial and rough fish species". They also stated that to prevent fishing for the market would mean wasting a good share of the productivity of the T. V. A. impoundments. Net fishing would be most practical for this species, in Lake St. Marys, only during the well-developed movements of schools in late May and early June. These schools have been described by Cleary (1954) as, "...probably a sex motivated phenomenon similar to the spawning schools of other species". The large percentage of ripe males and females in the catches at Lake St. Marys from such schools would substantiate Cleary's theory.

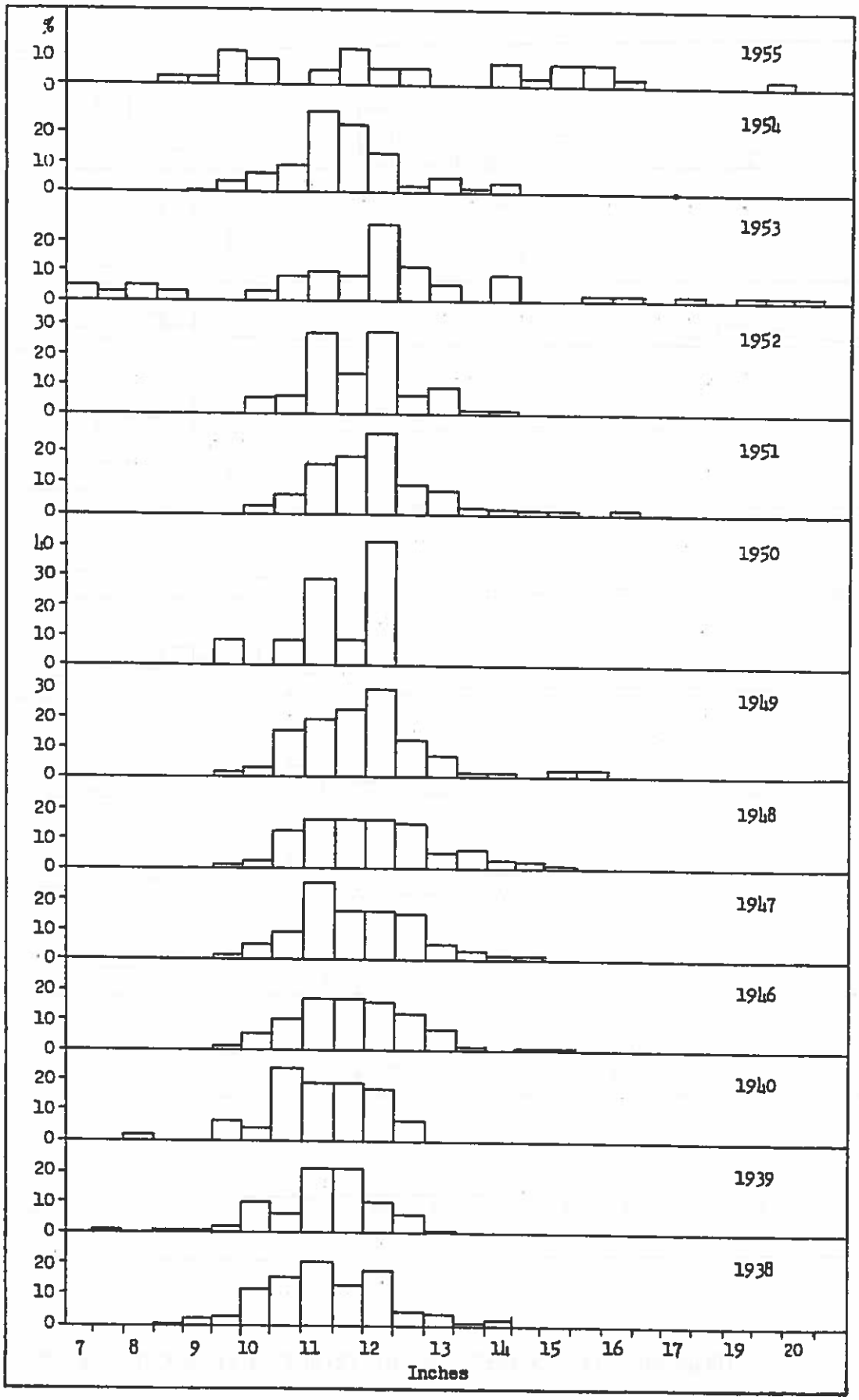


FIGURE 25. LENGTH FREQUENCY DISTRIBUTION OF THE CARP AT LAKE ST. MARYS.

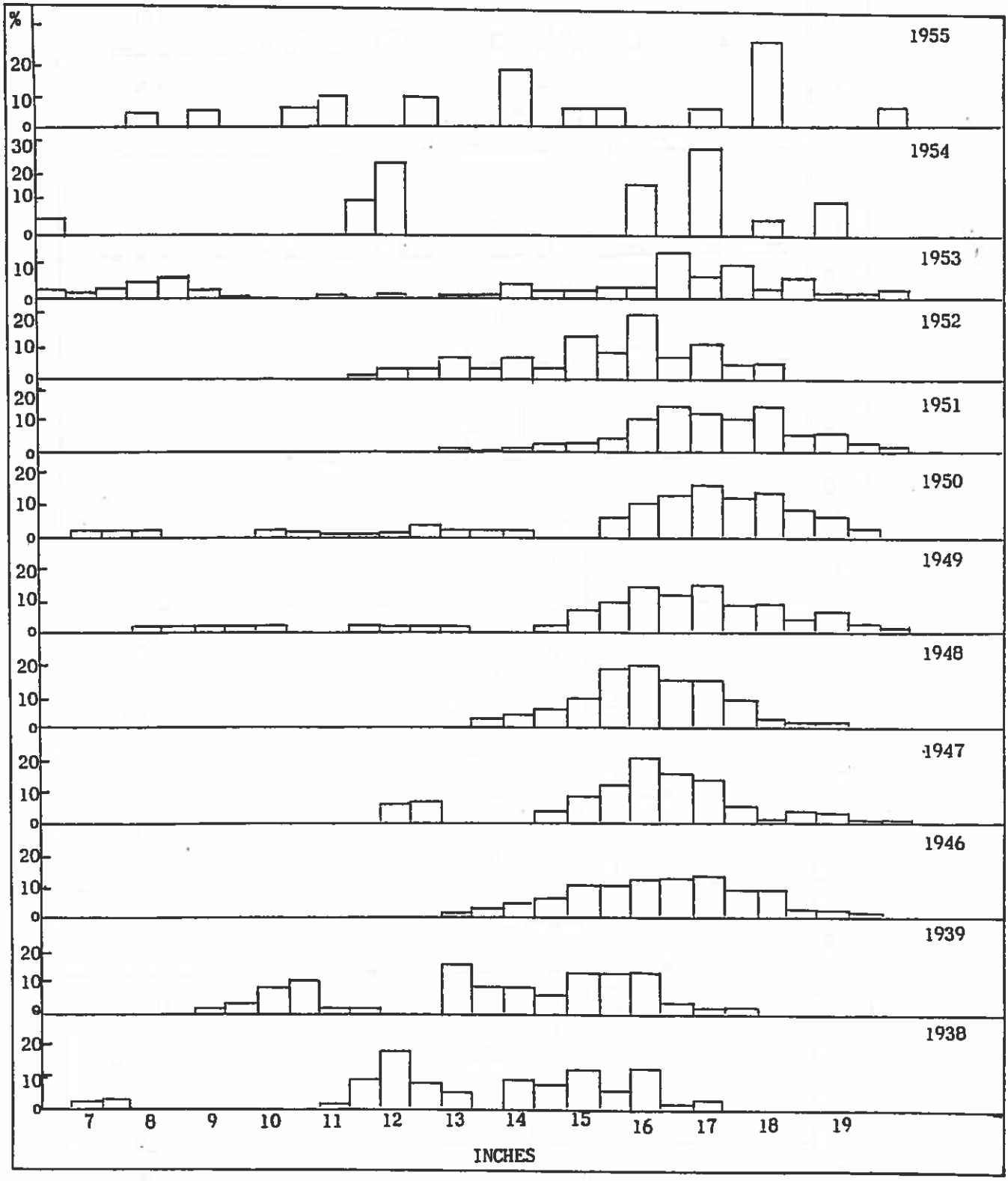


FIGURE 26. LENGTH FREQUENCY DISTRIBUTION OF THE QUILLBACK.

Bullheads: The bullhead population of Lake St. Marys includes browns, blacks, and yellows, but the browns or "marble catfish" comprise the bulk of this group. According to test net data (Tables 10 and 12) this group is one of the smaller components of the over-all fish population, but one which is very accessible to the angler (Table 11). The percentage rating of bullheads in the test net catches and the catch per hour by nets and anglers has varied greatly throughout the period under consideration. No correlation in the take is revealed by a comparison of the data on the test net catches and the angler harvest. Figure 27 suggests some effects of strong year classes on the brown bullhead population, but also postulates good annual hatches which have maintained a well-balanced distribution for this species.

Bluegill: The population of this highly desirable panfish, in Lake St. Marys, represents a small percentage of the total population. (Table 10). Wide variations in the annual populations are indicated by the test net data (Tables 10 and 12). Some correlation exists between the size distribution of the bluegill and the catch per hour by test net, but not in the catch by angler (Figure 28 and Tables 10 and 11). The limited age-growth data from 1946 and 1947 indicates that the population from 1947 through 1952 was made up chiefly of bluegills of six years of age or older (Figure 28 and Table 16). The 1953 through 1955 catches of younger, or three and four year old fish, accounts for the reduction in the size distribution for those years (Figure 28).

Largemouth Bass: In comparison to the populations of the dominant species of fish in Lake St. Marys, this prize fish represents a very small percentage of the total (Tables 10 and 12). Test net data is not a good indication of the size of the population, for bass are not readily taken in nets. Barnickol and Starrett (1951) stated, "It is difficult to determine the abundance of the largemouth bass (Micropterus salmoides) from net and seine collections. As anyone who has attempted the netting of this bass realizes, it is not easily taken in numbers, even where a large population may be present". Roach (1950) found the removal of largemouth bass from Meander Lake, Ohio varied from 210 to 1,722 per year over a period of 12 years. Bennett (1954) reported in a study of this species in Illinois that there was no relationship between the numbers of bass of spawning age in the lake in any given season and the number of bass fry produced in that season. This would imply that in spite of what appears to be a small population of bass in Lake St. Marys, favorable or unfavorable conditions, and not the number of breeders, are the controlling factors of the population.

Orangespotted Sunfish: Although too small to be taken by the test nets, a sizeable population of this sunfish exists in habitat nitches around the lake. It would outrank bluegills in total numbers. This sunfish is not native to Ohio, but has been widely scattered throughout the State. It competes with all other members of the sunfish family for food (Clark 1943), and especially with the bluegill for the more highly desirable nesting areas.

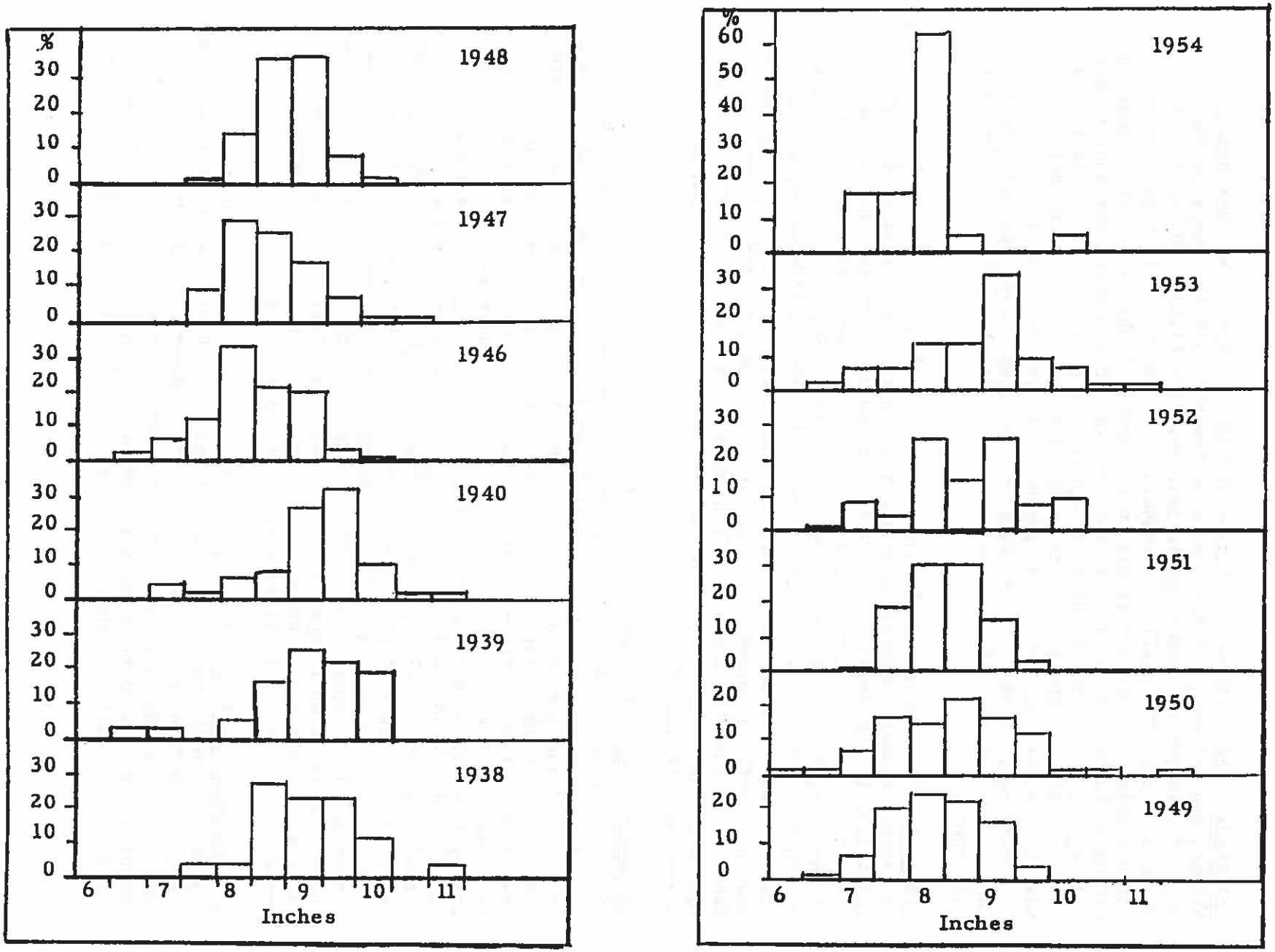


FIGURE 27. LENGTH FREQUENCY DISTRIBUTION OF THE BROWN BULLHEAD.

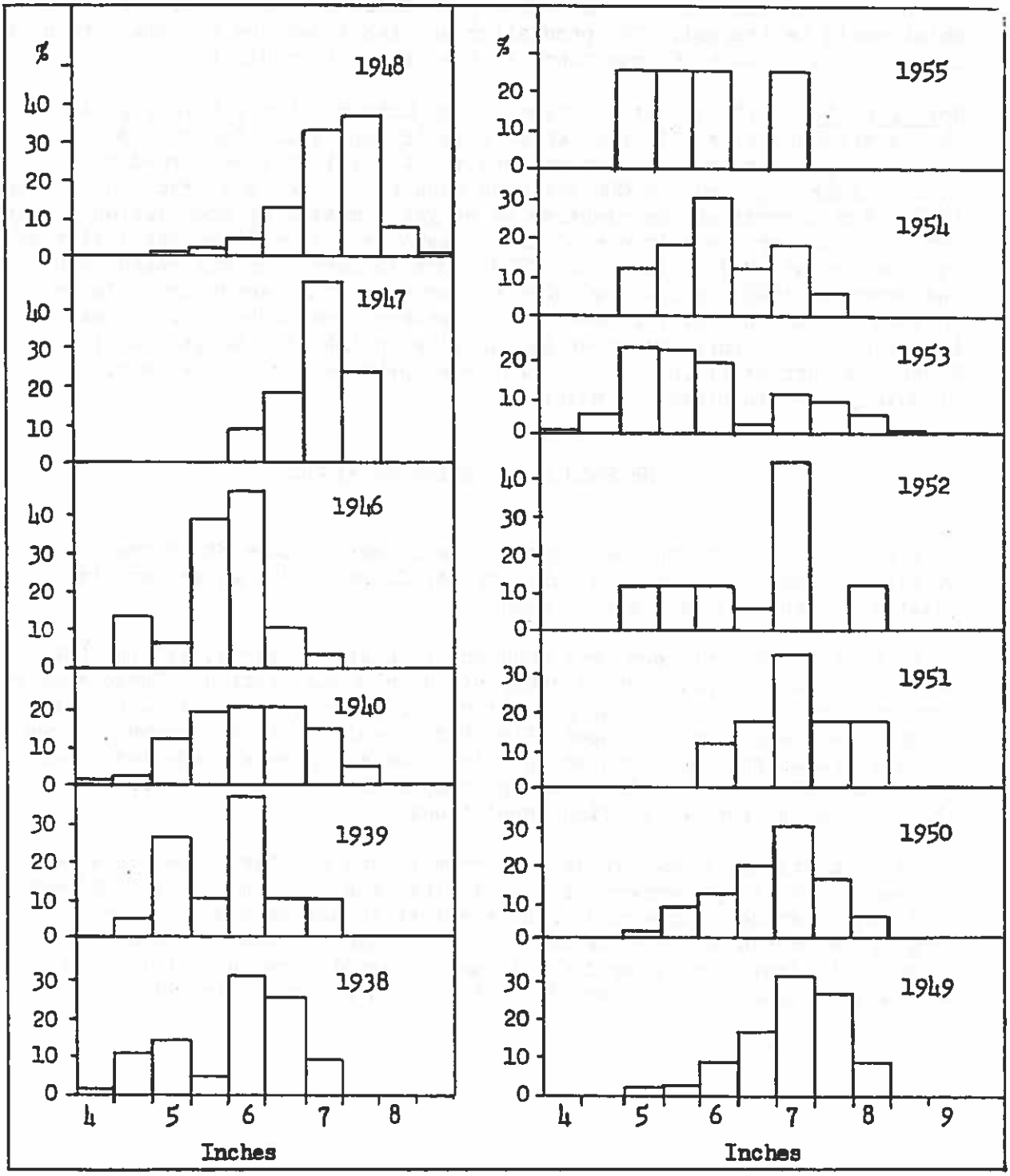


FIGURE 28. LENGTH FREQUENCY DISTRIBUTION OF BLUEGILL AT LAKE ST. MARYS.

Perch: Perch was an important member of the fish population in the early days (Table 5). Test net data reveals few perch during the course of this study. A comparison of the small average size of those taken by anglers to the size of mesh in the test nets, postulates a loss of most of those which would be trapped. The population and the sizes are too small to give this species a place of importance in the over-all population.

Northern Pike: The latest addition to the Lake St. Marys fish population is the northern pike. It existed as a relic population for an indefinite number of years after the lake was built. A total of 1,582 breeders, 3,731 fingerling, and 824,000 fry were planted in the lake from 1951 through 1955. The success of the stocking is as yet a matter of speculation. A net, set to check carp runs in one of the tributaries, took 90 northern pike adults in a period of 22 days in March, 1954. One 45 inch pike was found dead along the beach in 1955. A few are taken by anglers. Shad comprises a large portion of the food of the pike in the marshes along Lake Erie and may thus be subjected to heavy predation by the pike in Lake St. Marys. Moyle, Kuehn and Burrows (1950) consider northern pike as the most valuable predatory fish in Minnesota waters.

THE FOOD AND FEEDING OF FISHES

Little information on the foods of the fishes of Lake St. Marys is available other than the data published by Clark (1943) which pertains chiefly to the smaller sizes of fish.

At no time have minnows been abundant in Lake St. Marys, yet the Lake supports a large population of crappies and channel catfish. These species feed on other fish. No large populations of other fish exist in the lake except the rough species, especially shad on which both are known to feed. It thus seems logical to assume that the shad may play an important role in the dynamics of the lake as the principal forage species to support the crappie and channel catfish populations.

It is mentioned elsewhere in this report that northern pike are expected to feed on the large numbers of shad in the lake. It should be mentioned that this feeding is expected to be heaviest in spring and fall, at which times pike should be more available to the anglers. Limited evidence seems to indicate that pike discontinue, or greatly reduce, their feeding when water temperatures exceed 75 to 80° F. in northwestern Ohio.

AGE AND GROWTH OF LAKE ST. MARYS FISHES

Many of our misunderstandings concerning fish populations have been due to a lack of knowledge concerning the age and growth of the species under consideration, in their respective environments. Older ideas of overfishing were oftentimes based upon observations of large numbers of small fish, or large catches of small fish and a scarcity of large ones. More recent cries of over-population are sometimes based on tremendous numbers of fish of one or two year classes, which make up the bulk of the population, but which are growing at a normal rate. Disappearance of large fish has been blamed on overfishing when a check on ages would have revealed their age and indicated their possible death in the near future. The absence of large fish may be normal in some water areas. As is known in the peoples of different countries, a difference in the life span may be found from water areas. Growth may be normal, or even rapid, but a short life span might result in a small fish as compared to an older fish with the same annual growth in other waters.

If a fish population is stunted, it is necessary to recognize this fact that management efforts can be initiated. Since the lives of fish are relatively short and the unused surpluses of fish do not pile up from old age, we must know the ages of fish to properly harvest the crop with the least possible loss of the product involved. For example, if white crappies normally lived only seven years and our nets indicated 30 per cent of the population were of this age, we would expect to lose during the coming season 30 per cent of the fish if they were not harvested.

Total length measurements are used in Ohio and measurements to the nearest one-half inch were recorded in collecting the scale samples which form the basis of this section on age-growth. Calculations were made to the nearest tenth-inch in calculating the length at each annulus.

The data in this section is presented in a manner which makes it comparable to the data of Roach and Evans (1947 & 1948) on age-growth of fishes from other Ohio waters.

BLACK CRAPPIE

The black crappie is the most important fish, to the angler, in Lake St. Marys. Information for this section is based on scale samples aged by Mr. Lowell Binkley, former Fish Management Supervisor II of the Ohio Division of Wildlife, reports by Roach and Evans (1948) and by Erickson and Zarbock (1954).

According to Table 13, the growth of the first year represented approximately 21 per cent of the total growth. Roach and Evans (1948) and Erickson and Zarbock (1954) found comparable growth for the first year group. The data (Figure 29) indicates a reduction in increment from the first year of life to the fifth year, during which a considerable increase was noted. Roach and Evans (1948) recorded a similar decrease and corresponding increase at these ages. Erickson and Zarbock (1954) found the same to be true from the scale samples collected in 1953, but the small number of samples from older fish in the 1954 collection would not permit a comparison of the data. Stroud (1948) in reporting on the age and growth of black crappies from Tennessee, illustrates this increased growth in the fifth year of life, in Table 35 of his report.

A comparison of the growth of Lake St. Marys black crappies with that reported for this species from other states indicates that Lake St. Marys crappies grow more slowly (Table 14).

Figure 21 illustrates the percentage of the size groups of black crappies as taken in the test nets in Lake St. Marys during the years 1938 through 1955. This figure reveals that the population is periodically dominated by certain size groups. Thus, if fishing is to be enjoyed for this species, the anglers must be permitted to take what is available. Information on the trends and age-growth may assist in shortening the space between the years when large crappies are available.

TABLE 13
Average calculated total lengths of various age groups of Lake St. Marys black crappies taken in test nets.

	Annuli						
Age Group	1	2	3	4	5	6	7
7	2.60	4.32	6.72	8.65	10.45	11.50	12.25
6	2.42	4.06	5.82	7.32	8.65	9.62	
5	2.35	4.75	6.53	7.13	8.66		
4	1.93	3.99	5.68	6.52			
3	2.97	5.33	6.18				
2	3.29	5.00					
Average Size	2.59	4.59	6.19	7.40	9.25	10.56	12.25
Increment	2.59	2.00	1.60	1.21	1.85	1.31	1.69

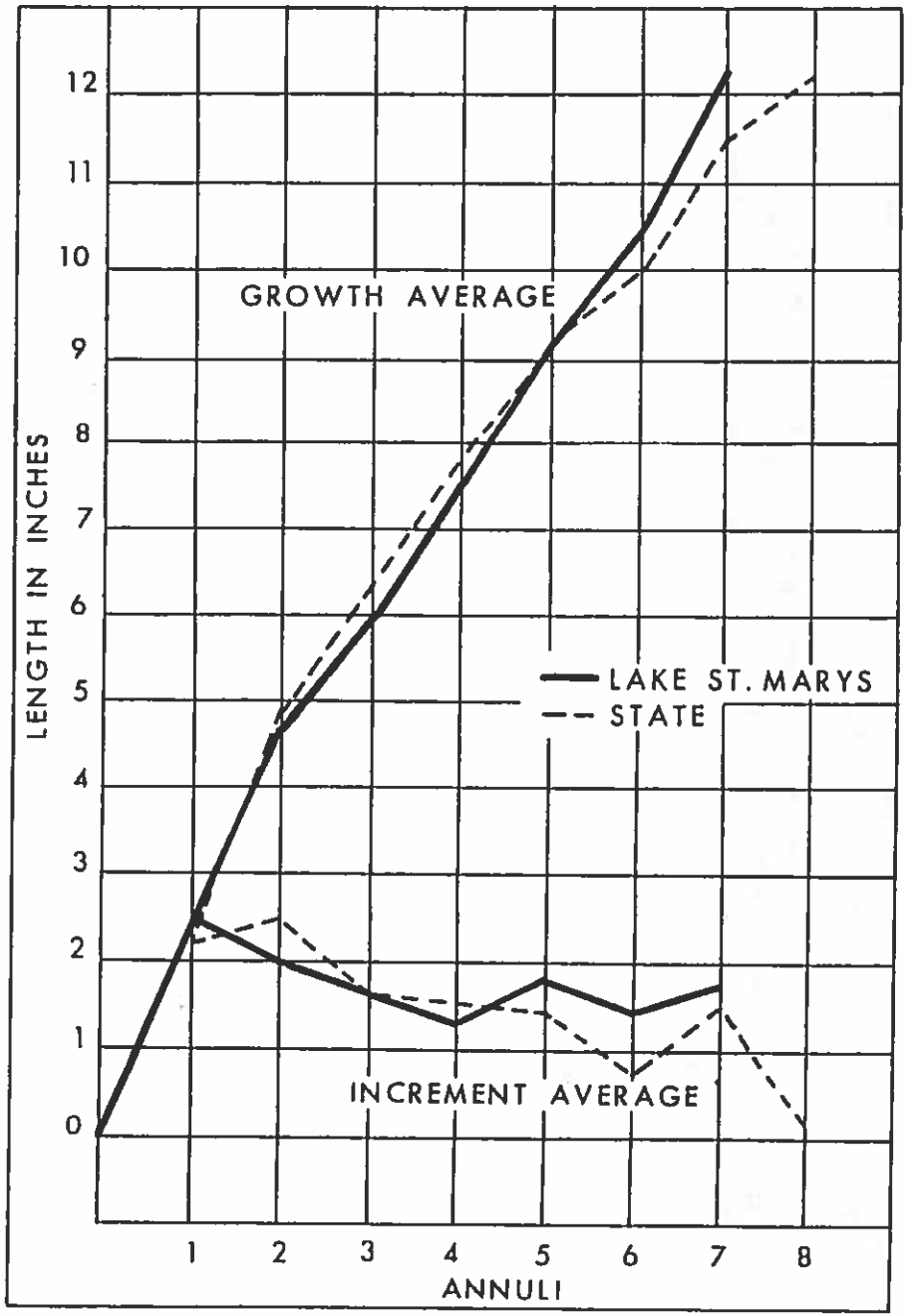


FIGURE 29. GROWTH OF LAKE ST. MARYS BLACK CRAPPIES.

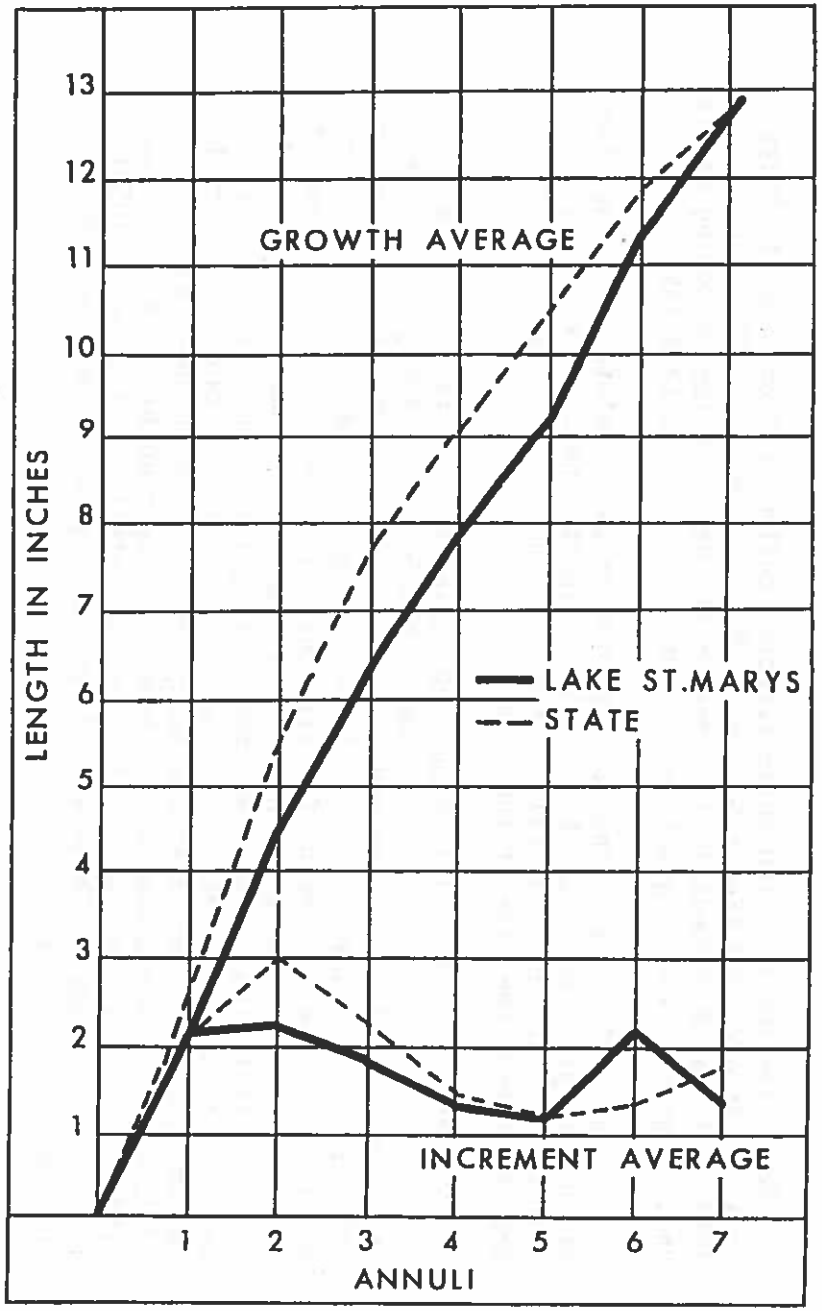


FIGURE 30. GROWTH OF LAKE ST. MARYS WHITE CRAPPIES.

WHITE CRAPPIE

Scale samples from 100 white crappies collected from Lake St. Marys during 1946 and 1947 (Roach & Evans 1948), 113 taken in 1953, and 73 in 1954 (Erickson & Zarbock 1954), provide the data for the following remarks on the age and rate of growth of the white crappie in this lake.

Hansen (1937) found annulus formation to be correlated with the size of the crappie; Roach and Evans (1948) reported that the majority of Ohio white crappies apparently formed their annuli in July and August, dependent upon the size of the fish.

The data illustrated in Figure 30 would indicate that the growth of Lake St. Marys white crappies is below the State average given by Roach and Evans (1948). Erickson and Zarbock (1954), on samples collected in 1954, reported growth above the State average for the one and two year old fish, but below average for all other ages. However, this group of crappies revealed better growth for all age groups than had been found prior to that time. The growth made during the second year of life exceeded that of any other year, except for two fish reported by Erickson and Zarbock (1954) which showed exceptional growth in their sixth year of life. The second peak of increment was reported by Roach and Evans (1948) for the sixth year of life, and by Erickson and Zarbock (1954) for the fourth year. These second spurts in growth almost equaled the increments of the second year.

Table 15 offers for comparison, age growth data for white crappies from two other states and one other Ohio water area only 35 miles from Lake St. Marys. The crappies from St. Marys reveal a slower growth than reported from the other water areas.

Considerable variation is displayed in the growth of the white crappie from Lake St. Marys in the data in Table 15. Hansen (1951) reported variations in age-growth relationship of white crappies from year to year.

TABLE 14

A comparison of the growth of Lake St. Marys black crappies with that reported from waters of other states - Lengths in inches.

Age Group	Michigan *	Minnesota **	Tennessee ***	Indiana ****	1953 St. Marys *1	1953 St.Marys *2	1953 St. Marys *3	1954 St. Marys *3
2	5.90	5.00	2.50	2.90	4.60	4.50	4.50	4.30
3	8.00	6.90	9.00	5.80	6.20	6.20	5.70	6.20
4	9.00	8.70	11.50	7.60	7.40	7.50	6.60	7.90
5	9.90	10.40	12.70	9.30	9.30	8.70	8.80	9.30
6	10.70	11.80	14.20		10.60	9.70	8.80	9.90

* Beckman 1946
** Smith & Moe 1944
*** Stroud 1948
**** Ricker & Lagler 1942

* New data
* Roach & Evans 1948
* Erickson & Zarbock 1954

TABLE 15

A comparison of the growth of Lake St. Marys white crappies with that reported for this species from other water areas.

Age Group	Iowa *	Tennessee **	Indian Lake Ohio *1	Lake St. Marys *1	Lake St. Marys *2	Lake St. Marys *3
1	3.10	2.35	1.58	2.57	2.11	2.40
2	7.60	4.70	4.35	5.60	3.80	2.57
3	8.40	7.05	7.20	7.72	5.46	6.85
4	9.90	9.43	9.30	9.20	7.35	8.53
5	11.20	10.13	11.40	10.40	8.75	10.15
6	12.10	11.26	12.38	11.80	9.55	10.86
7		12.43		13.50	10.30	
8		13.74		14.60	12.40	

* Lewis 1950
** Schoffman 1940
*1 Roach and Evans 1948
*2 Erickson and Zarbock 1954

BLUEGILL

Due to the scarcity of bluegills in Lake St. Marys, and the fact that the only bluegill scale samples which have been read from Lake St. Marys were collected in 1946 and 1947, the data from only 19 scale samples form the basis for this discussion.

When averaged and plotted, the age-growth from these samples present a fairly uniform curve (Figure 31). This curve somewhat parallels the average State growth for this species reported by Roach and Evans (1947), but remained approximately 3/4 to 1 inch below until the seventh year of life. It is evidenced by the increment curve in Figure 31 that the small increment in the second year was responsible for the shorter size of Lake St. Marys bluegills as compared to the State average. Table 16 and Figure 31 both depict a slightly greater growth during the third year of life than during the first. The increments from the formation of the third annulus to the sixth were almost identical to those of the State average. The small sample on which this discussion is based is inadequate to properly evaluate the bluegill growth in Lake St. Marys, but is included because it is all that is available.

A comparison of the differences in growth portrayed in Table 17 reveals slow growth of Lake St. Marys bluegills as compared to other water areas. This slow growth indicates that conditions certainly are not favorable for this species in Lake St. Marys, and that additional stocking would not favor the present population. Food studies of this species might offer some explanation for this slow growth.

LARGEMOUTH BASS

Lake St. Marys, like most northwestern Ohio lakes, contains a small number of largemouth bass in proportion to the other species of fish present. The difficulty in obtaining scale samples is evidenced by the small number (26) used in this study. Roach and Evans (1948) and Eschmeyer (1939) reported that annulus formation, in largemouth bass, seemed to depend upon the size of the fish and extended over a long period of time.

Figure 32 depicts the age-growth for Lake St. Marys largemouth bass. As indicated by Roach and Evans (1948), the growth was fairly regular, but below the State average established by Roach and Evans (1948). The annual growth increments reveal an exceptional growth during the fourth year of life, after which, it followed the general State pattern. Food studies might reveal that bass in their fourth year reach a size at which a greater variety of foods can be included in their diets, or can be used by them.

The calculated lengths of various ages varied greatly (Table 18). It would appear from this table that some fish, in some years, may exceed the State averages, but the reverse is also apparent.

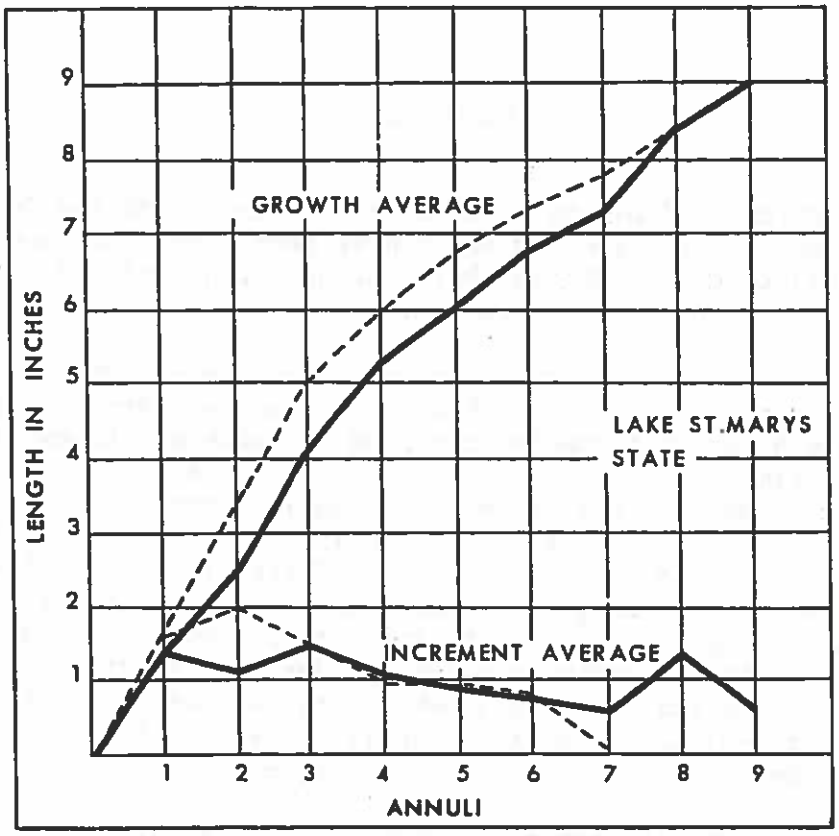


FIGURE 31. GROWTH OF LAKE ST. MARYS BLUEGILLS.

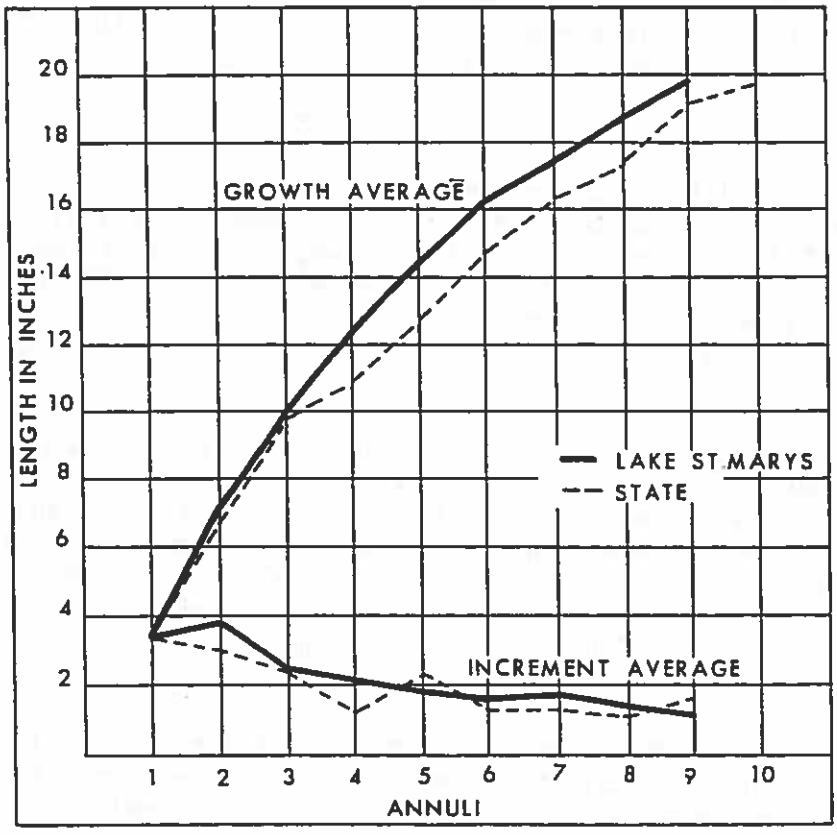


FIGURE 32. GROWTH OF LAKE ST. MARYS LARGEMOUTH BASS.

TABLE 16

Average calculated total lengths of various age groups of Lake St. Marys bluegills taken in test nets - Lengths in inches.

Age Group	Annuli								
	1	2	3	4	5	6	7	8	9
5	1.48	2.59	4.47	5.51	6.17				
6	1.55	2.76	3.85	4.90	6.09	7.00			
7	1.20	2.27	3.60	4.50	5.24	5.70	6.00		
8	1.50	2.42	3.90	4.90	5.80	6.90	7.45	8.25	
9	1.22	2.42	4.32	5.70	6.76	7.35	8.16	8.65	9.00
Average Size	1.39	2.49	4.03	5.11	6.01	6.74	7.21	8.45	9.00
Increment	1.39	1.10	1.54	1.08	.90	.73	.53	1.24	.45

TABLE 17

A comparison of the growth of Lake St. Marys bluegills with that reported from waters of other states - Lengths in inches.

Age Group	Michigan*	Wisconsin**	Lake St. Marys	Minnesota***
2	4.30	5.60	2.49	3.80
3	5.40	6.30	4.03	5.30
4	6.60	6.80	5.51	6.60
5	7.30	7.60	6.01	7.70
6	7.70	8.50	6.74	9.20
7			7.21	10.70
8			8.24	11.70

*Beckman 1946 - **Mackenthun 1947 - ***Smith and Mow 1944

TABLE 18

Average calculated total lengths of Lake St. Marys largemouth bass, in inches, at the formation of each annulus.

Age Group	1	2	3	4	5	6	7	8	9	10	11
4	2.74	5.34	8.11	9.00	.	.					
5	3.33	6.20	8.15	10.27	11.42						
6	3.83	6.98	9.27	10.94	12.20	13.25					
7	4.13	7.25	9.87	11.67	13.12	14.14	15.17				
8	4.01	9.12	8.88	10.54	12.60	14.11	15.34	16.31			
9	3.95	5.70	8.60	10.80	13.20	15.40	16.75	17.60	18.50		
10	4.42	8.25	11.35	13.56	14.92	16.52	17.50	18.67	19.43	19.95	
11	3.24	4.83	8.10	9.70	12.16	14.00	15.84	16.80	17.72	18.36	19.00
Average Length	3.48	6.73	9.25	10.96	13.03	14.74	16.21	17.55	19.05	19.68	19.00
Increment	3.48	3.25	2.52	1.71	2.07	1.71	1.47	1.34	1.50	.63	-----

Not only is the growth of Lake St. Marys largemouth slower than the average for Ohio, but it is exceeded by that reported from most other water areas in other states (Table 19). Only the growth reported from Wisconsin (Bennett 1937) compares favorably with that from Lake St. Marys. Ohio's longer growing season should produce more rapid growth than that reported from Wisconsin. The fact that the St. Marys largemouth grow slowly in the early years of their life possibly indicates the need for food studies. Limitations of food for fry and fingerlings may be the controlling factor in both the survival and growth of this species. Relatively small amounts of both phytoplankton and zooplankton were indicated by the limited limnological studies of Roach, reported in an earlier section of this report.

FISH PARASITES

Little is known concerning the parasites and diseases of Lake St. Marys fish. No known studies have been made on this phase of fisheries management at the lake, but a few observations have been noted by fisheries workers.

The "anchor parasite", Lernaea carassii Tidd, has been found on the spotfin shiner, brown bullhead, largemouth bass, orange-spotted sunfish and bluegill. No infections of this parasite have been noted to have caused losses of fish in the lake.

Orange-spotted sunfish are oftentimes afflicted with growths which were described by Dr. Hans G. Schlumberger (1948) as representing goiters (hyperplasia of the thyroid gland).

Lymphocystis has been observed on white crappies, orange-spotted sunfish and largemouth bass.

The bass tapeworm, Proteocephalus ambloplitis, has been identified from Lake St. Marys largemouth bass by Dr. Ralph Bangham of Wooster College, Wooster, Ohio.

Pseudomonas hydrophilas, which is characterized by reddish spots under the skin which appear to be broken blood vessels, has been found on many of the bait minnows which have been used in the lake. As yet no native fish from the lake have been observed to be affected by this disease, but the use of affected ones as bait postulates its occurrence.

The eye fluke, which causes what is oftentimes called "popeye" by many local anglers, has been observed on largemouth bass, bluegills, bluntnose and fathead minnows, and carp.

Black grubs or the black spots in the skin of fishes is a familiar sight to all anglers. Bluntnose, fathead, and creek chub minnows, perch black and white crappies, and white suckers seem to be the most affected by this parasite in Lake St. Marys.

Other diseases such as fin and tail rot, fusion of gill filaments and orange grubs have been noted by fisheries workers who could offer no better terminology.

TABLE 19

A comparison of the calculated total lengths of Lake St. Marys largemouth bass, in inches, to those of this species from water areas of other states.

STATE	Annuli										
	1	2	3	4	5	6	7	8	9	10	11
Wisconsin (Bennett 1937)	3.3	7.4	10.5	12.5	14.0	15.1	16.3	17.4	18.1	18.7	19.5
Illinois (Thompson 1939)	3.8	8.1	11.4	13.3	14.9	16.6	19.6	19.5			
Missouri (Weyer 1940)	4.8	7.7	10.5								
Nebraska (Bennett 1937)	3.6	7.6	10.9	13.5	15.8	17.6	18.9	19.8	20.4	22.1	
Connecticut (Webster 1942)	5.1	8.3	10.7	12.9	14.7	16.2	17.5				
Indiana (Ricker & Lagler 1942)	4.0	7.2	9.4	14.6							
Minnesota (Smith & Moyle 1944)	3.9	6.2	11.5	13.8	15.3	16.3	16.9	18.0	19.8	21.7	23.3
Tennessee (Stroud 1948)	6.9	12.4	14.7	16.1	17.5	19.3	20.8				
Ohio (Roach & Evans 1948)*	3.5	7.2	10.0	12.5	14.5	16.1	17.7	18.9	19.8		
Lake St. Marys (Present data)	3.5	6.7	9.3	11.0	13.0	14.7	16.2	17.6	19.1	19.7	

*State Averages

WINTER KILLS OF FISH

The most serious kill of fish at Lake St. Marys occurred in January of 1942. The loss was first noted about January 26, when huge numbers of fish were reported to be frozen in the ice along the south and west shores. A check of the conditions revealed dead fish floating under and adjacent to the ice in shallow water. Mr. Lowell Gilbert and Game Protectors Frank Milinski and Arlie Rhodes assisted in making the investigation. Hundreds of fish were found in a proportion of approximately 50 shad to 5 crappies to 1 largemouth bass and 1 bluegill. All fish were of the larger size groups. Largemouth bass ranged from 12 to 24 inches, crappies over 8 inches and bluegills over 6 inches. Oxygen tests, made under the ice cover at the time of the inspection, revealed 8 ppm of oxygen.

The discovery of these fish took place some time after the loss occurred for a majority of the fish had fungus on the gills, or the gills had very little color. The loss was noted about two weeks after severe cold weather, when air temperatures dropped from 22° F. to -2° F. on January 6, and later to -10° F. on January 8, 1942.

Winter kills of gizzard shad are almost an annual occurrence. The largest kill, in recent years, took place during the winter of 1947-1948 (Figure 33), and accounts for a large portion of the rough fish removed during the year 1948 (Part V, Rough Fish Removal). However, the poundage removed during rough fish removal operations represented only a small portion of those killed. Windrows of shad were piled on the beaches and were hauled away by the dump truck load. Test net catches for 1948 indicate the severity of the kill, but also indicate the rapid recovery of this species by 1949 and 1950 (Table 10).

The most recent winter kill of any consequence was the one of 1953-1954. When the ice went off the lake in the spring of 1954, hundreds of dead crappies lined the shores. The advanced stages of decomposition indicated that the loss had taken place at some time in the late winter and that the ice cover had prevented the loss being noticed at an earlier date. All of these crappies were of the larger size groups from eight inches and over. Based on earlier fish kills and the size groups of the fish in the nets the following year, it was postulated in the spring of 1954 that the crappies would average much smaller and that the larger ones would be very scarce.

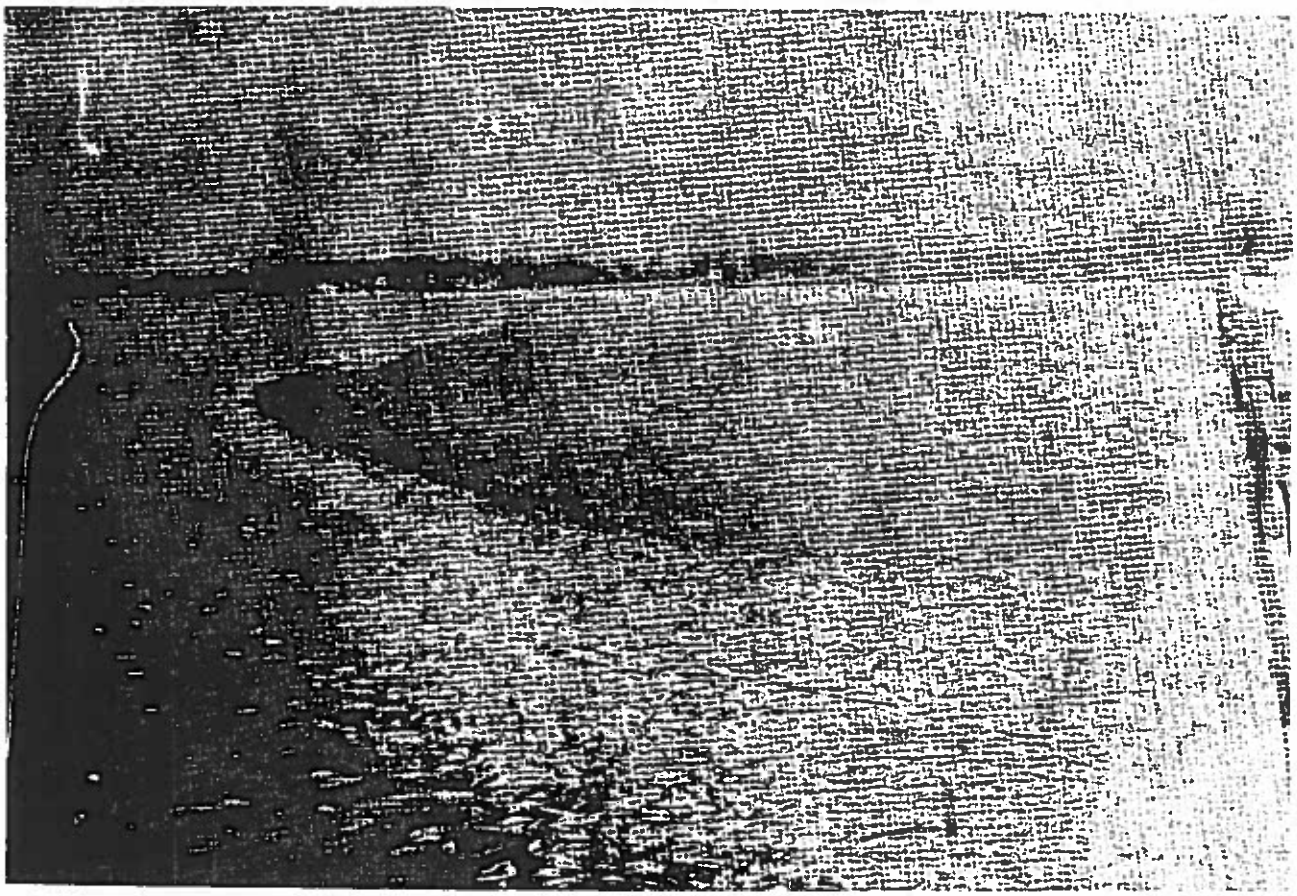


FIGURE 33. A SMALL SAMPLE OF THE SHAD KILL DURING THE WINTER OF 1947- 1948.

COMPETITION IN FISH POPULATIONS

The problem of competition in fish populations is probably best publicized by the old story of the carp destroying the nests of game fish, and gar and dogfish eating the young. This problem of competition is a complex one involving the everyday activities of all species in the lake. Bass compete with other bass, bass with crappies, crappies with crappies, crappies and bass with bluegills, bluegills with other bluegills, and thus the competition ends only with the end of the list of fish living together in Lake St. Marys. Fry compete with fry, fry with fingerlings, fingerlings with fingerlings, fry and fingerlings with adults, and adults with adults. No stage in the life history of any species, or any species in the lake, is without its affects on the other members of the fisheries community.

The presence of large numbers of hybrids in a fish population has been cited as an indication of intensive competition between species for spawning area (Hubbs and Eschmeyer 1938). If this measurement is a true one, little competition between species of the same genera exists in Lake St. Marys, for few hybrids have been reported. Competition between fish of the same genera may exist, but shore seining of fry and fingerling does not indicate this to be a factor in reproduction.

Carp receive their full share of criticism for eating eggs, but other species are being overlooked. Members of the sunfish family, other than basses, have been observed to readily and intentionally feed on eggs. Observations on bluegills have been made in both hatchery ponds and in natural waters. A group of bluegills will crowd around a nest which is guarded by an adult bass. The bass attempts to chase away these intruders, but can leave by only one side of the nest at a time. This permits bluegills to enter from the opposite side and devour the eggs until the guardian returns to drive them away. Observations prove that nests may be completely destroyed by such procedure in bass-bluegill ponds. Many farm pond owners have found that their bluegills control the bass rather than the bass controlling the bluegills. Carp, like all other bottom feeders, consume eggs in their normal feeding habits, but they should not be considered as the only species guilty of this habit.

Competition for food is a complex problem. The fry of nearly all species feed on the same types of food. This means that regardless of the species present in a water area, they compete with each other for food in the early stages of their life. Minnows introduced into a pond as food for bass, compete with bass fry for food. Adult minnows as well as adults of such species as shad and crappies use foods which are food of fry of all species. This reveals competition between adults of some species with fry of all species. Fingerlings of most fish use insects, in various stages of development, in their diet. Adults of the sunfish family use the same foods and thus compete with fingerling of many species for the same type of food.

The use of fish for food by pike, walleye pike, bass and channel catfish is known by anglers, but few realize that bullheads and bluegills also take live fish. Large individuals of most game and pan species include other fish in their diet. Cannabilism is a common practice among fish. Adults are not immune to the use of their own young for food. Most older hatchery men recall of having seen a bass feed from the school of fry that it was guarding, and what bass can identify its own young after they have reached the fingerling stage. An understanding of the intricate food relationships might assist in unraveling some of the mysteries of changing fish populations in Lake St. Marys.

Normally, we are prone to think of predators as undesirable individuals which must be removed for the benefit of the population in general. However, in the world of fishes, anglers clamor for the predators such as muskellunge, pike, walleye pike, bass and crappies. Game men hear loud condemnation of the predators such as fox, hawks, and owls, but in 19 years of fisheries work in Ohio, I have received no requests for control or removal of these predatory game or pan fish. In fact, new emphasis has been placed on the use of predatory fish as a means of maintaining a balance in fish populations. Introductions of predatory fish to control stunted populations of bluegills and crappies are being tried in many states.

Experimental stocking of various combinations of species of fish are being tried in an attempt to solve some of the complexities of competition by limiting the number of species in a water area. Indiscriminate stocking in water areas may ruin such experiments by introducing species detrimental to the existing populations. For example, the orange-spotted sunfish feeds on the same foods as all other members of the sunfish family, but it is of no value to anglers or as forage (Clark 1943). Perch and bluegills have a tendency to become stunted in many waters, and reproduce in such numbers that they destroy angling for other species. The elimination of fish populations from many water areas has been accomplished at considerable expense, only to have some well meaning, but uninformed, individual restock the fish which formerly caused the damage. Stocking of fish should be made only after thorough investigations indicate favorable results from the planting. Removal programs of various types are being investigated as a remedial or improvement measure. The benefits of the carp removal at Lake St. Marys between 1932 and 1934 is a controversial subject.(Table 20). Test net records reveal that some of the greatest catches, by nets, followed shortly after this removal (Table 10). The heavy winter kill of shad in 1947-1948 and the removal of shad in 1953-1954 were followed by tremendous populations of small shad (Table 10). The reproduction replenished the population in short order.

TABLE 20
Rough fish removal from Lake St. Marys.

YEAR	1932	1933	1934	1948	1949	1953	1954	1955
SPECIE DATA								
Carp								
Numbers						14,848	6,486	
Pounds	316,465	265,969	288,645	750	1,700	18,395	6,953	
Pounds per acre	28.77	24.19	26.24	.07	.16	1.67	.63	
Shad								
Numbers								
Pounds						94,985	1,676,685	473,500
Pounds per acre				80,770	800	24,337	396,600	247,000
				7.34	.07	2.21	36.54	22.45
Quillback								
Numbers						3,815	4,972	
Pounds				21,030	16,554	9,125	14,153	
Pounds per acre				1.9	1.59	.83	1.28	
Suckers								
Numbers						702	752	
Pounds				20	20	477	748	
Pounds per acre				--	--	.042	.068	
TOTAL POUNDS	316,465	265,969	288,645	102,570	19,074	52,334	418,454	247,000
TOTAL POUNDS PER ACRE	28.77	24.19	26.24	9.31	2.02	4.75	38.41	22.45

Competition for space has, until recently, received little consideration in fisheries management. Poultry raisers, in the production of eggs, state that a definite area of floor space per hen is required regardless of the amount of food, water, or light. We have long realized that a small goldfish, in a small bowl, remains small irrespective of the amount of food it is given. Mr. Harold Wascko, Curator of the Toledo Zoo Aquarium, has experimented with this space factor in the aquarium. His experiments indicate that the size of the aquarium limits the size of the fish in spite of the food which it receives. If moved to a larger aquarium, the fish would grow rapidly on the same amount of food until another maximum size was reached. The effect of this space factor is not understood but may be imposing far-reaching controls on fish populations. Roach and Evans (1948) indicated a relationship between the size of the water area and the growth rate of bass.

The problems of competition and inter-relations in a fish population might be compared to a community of human beings. The problems of human relations are so involved and so intricate that we can easily understand why fisheries problems are not well understood. In our striving to solve the problems of human relations, we can readily understand the difficulties involved in attempting to solve problems of a fish population of which the members cannot assist in our endeavors.

RECOMMENDATIONS

1. Every effort should be made to restore the conditions which existed in the early days when fish were of the desirable species, sizes, and abundance.
2. Correlated studies of age-growth and foods should be made to determine the causes for the slow growth found in the early life of most, and throughout the life of many, of the game and pan fishes in Lake St. Marys.
3. Test nets should be continued to follow the trends in the fish population so as to predict future happenings in the population.
4. Test netting on a monthly basis throughout a season would provide better information as to when the best samples of the fish population might be obtained.
5. The simultaneous occurrence of peaks of both rough and pan fish populations suggest a possible inter-relationship which should be investigated. Is the crappie population dependent upon the rough fish population?
6. Rough fish populations should be properly utilized.
7. The importance of gizzard shad in fish populations, and on angling needs to be investigated.
8. Stocking of northern pike should be continued until a sufficient population has been built up to prove good spawning movements. Then, it should not be stocked for a period of time to determine the possibilities of reproduction.
9. The limited information available on fish diseases and parasites indicates a need for study of this field to determine its importance in the fisheries management program of the lake, and in the fish farm which obtains its water supply from the lake.

10. The lack of understanding of the inter-relationships in fish populations reveals a need for such information in any management practices such as remedial stocking, liberalized angling, rough fish removal or partial removal of desirable fish populations.
11. The introduction of species of fish not native to Lake St. Marys should be stocked only on the recommendations of qualified personnel after thorough investigations have been made.
12. Life history studies should be conducted to better understand the individual species of fish which we are attempting to manage.
13. Studies of the harvest should be made in proportion to the populations of the fish living in the lake to determine the best possible use of the crop.

PART V
FISHERIES MANAGEMENT AT LAKE ST. MARYS

STOCKING OF FISH

One of the earliest forms of fisheries management, practiced at Lake St. Marys by a State agency, was the stocking of fish. What and how many fish were stocked prior to 1932 is conjecture, but records are available from that date to the present. When liberalized fishing was started in 1946, stocking of all species inhabiting the lake at the time was suspended to check the effects of this tool in fisheries management. Table 21 lists the species and numbers of fish and fish foods stocked during the period 1932 to 1955 inclusive.

The annual fish stocking report for 1953, issued by the Ohio Division of Wildlife, lists a number of fish of several species as being stocked in the lake. These were tagged fish stocked behind the breakwater, at the east end of the lake, in an attempt to see if the flumes were open to permit free movement of the fish to and from the lake proper. The scarcity of tag returns lead us to believe that the escape was very small and thus contributed very little to the population of the lake proper. Therefore, they are omitted from this discussion.

According to Table 21, 56.74 per cent of the total stocking of fish was comprised of game and pan species and 43.26 per cent of forage species. This discussion considers the percentages of the fish stocked as those stocked before liberalized angling. Bluegills comprised 58.6 per cent of the total pan and game fish stocked, and largemouth bass only 5.74 per cent of the total. In spite of this heavy stocking of bluegills, Lake St. Marys has never been known to present-day anglers as a bluegill lake. Only 3.8 per cent of the fish stocked were crappies and 2.8 per cent channel catfish, but this lake has long been known for these species.

TABLE 21

Stocking of fish and fish food in Lake St. Marys, 1932-1955

GAME AND PAN FISH

Species	Prior to liberalized angling		After or during liberalization
	Number	Per Cent	Number
Largemouth Bass	243,503	5.6	0
Bluegill	2,546,409	58.6	0
Crappie	144,204	3.8	0
Black Bullhead	526,191	12.0	0
Brown Bullhead	501,706	11.5	0
Yellow Bullhead	45,981	1.6	0
Perch	23,276	.5	0
Channel Catfish	121,669	2.8	0
Green Sunfish	46,400	1.1	0
Pumpkinseed Sunfish	25,652	.5	0
White Bass	2,400	.05	0
Rockbass	480	.01	0
Walleye Pike	56	.001	0
Suckers	40	.0009	0
Smallmouth Bass	690	.015	0
Mixed Fish	800	.019	0
Northern Pike			829,333
TOTAL	4,229,457		829,333

FORAGE FISH AND FISH FOOD

Minnows	2,928,299
Tadpoles	538,961
Crayfish	278,670
Shad	110,614
TOTAL	3,856,544

An examination of Tables 22 and 23 reveals that the species stocked in greatest numbers were not those taken in greatest numbers by either the test nets or anglers. Over one-half of the game and pan fish stocked were bluegills, but the take by test nets or anglers did not exceed six per cent of the total take of fish in any one year, and in most years represented less than three per cent. Bullheads ranked second in the percentage of fish stocked. This group, in no year, represented more than 4 per cent of the take in test nets, and ranged only from 1.8 per cent to 11.5 per cent of the harvest by anglers from 1946 through 1950. Largemouth bass comprised 5.6 per cent of the total fish stocked, but supplied only 1 per cent or less of the take by nets and less than 3 per cent of those fish harvested. Crappies ranked fourth in the percentages stocked, but always rated first or second in the catches of test nets and anglers. The channel catfish rated second in the take of both nets and anglers. Yet it ranked fifth in the percentages of fish stocked. So far as is known, no carp have been stocked in the lake, other than the original introductions made prior to 1900. Yet, they have made up from 1 per cent to 15.5 per cent of the fish taken in test nets and about 1 per cent to 8 per cent of those harvested by anglers. Only 110,614 known shad have been introduced in the lake, but in approximately 20 months of rough fish removal in 1953-1954, 2,245,170 were removed.

Few anglers have paused to consider the results of a stocking program because few facts have been available for comparison. How did Lake St. Marys produce good fishing in the "good-old-days" when it also maintained a commercial fishery, almost as extensive as those of all the rest of the State combined? No stocking was done in those days. A reported harvest from Lake St. Marys of 49,200 pounds of black bass, 211,875 pounds of catfish, 228,776 pounds of sunfish including bluegills, and 91,750 pounds of perch was made to the U. S. Commission of Fish and Fisheries, by the commercial fishermen of Lake St. Marys for the year for 1895 (Table 5). No records or stories of the "old-timers" reveal any stocking of the lake up to that time. A lack of attempts to evaluate, and a lack of compiled data on the subject prevented this fisheries tool from being considered in its proper place. Stocking remains in Ohio's fisheries program as an important tool, but it does not hold the all-important position it once held in the past.

The northern pike has been stocked in recent years in an effort to establish a large game fish in Lake St. Marys where a definite lack of large predatory species exist. It was introduced only after studies were made on the habitat requirements of the pike, and the existing habitat conditions in the lake. The stocking of this species cannot be justly evaluated at present.

TABLE 22

Stocking of game and panfish in Lake St. Marys as compared to the takes by nets.

SPECIES	NUMBER STOCKED TO 1955	PER CENT STOCKED TO 1955	Percentages of take by nets. 1932	1938	1939	1940	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Bluegill	2,546,409	58.6	.8	4.3	.7	5.6	.2	.1	1.9	1.0	.8	.1	.1	3.8	.7	.1
Largemouth Bass	243,503	5.6	.1	.4		.1						.1	.1	.1		
Crappies	144,204	3.8	44.5	70.6	92.5	44.4	53.65	65.8	70.3	32.1	74.4	49.8	65.0	59.5	83.1	44.3
Bullheads	1,073,878	25.1		1.3	1.3	4.0	1.4	.1	.5	2.3	.4	.7	1.7	2.4	.8	
Perch	23,276	.5				.1							.1	.2		
Channel Catfish	121,669	2.8	1.0	1.5	1.4	37.25	13.1	3.3	9.7	54.0	6.95	14.1	6.4	21.4	6.7	10.5
Shad	110,614	2.6		4.9	.2	.2	24.5	19.2	.7	7.4	16.0	21.7	2.1	5.5	4.2	41.1
Carp			52.3	10.1	1.8	6.9	2.4	8.9	1.7	1.2	2.3	5.9	15.5	1.8	3.4	2.4
Pumpkinseed Sunfish	25,652	.5												.2		
Walleye Pike	56															
White Bass	2,400															
Rock Bass	480															
Smallmouth Bass																
Green Sunfish	46,400															
Quillback			2.3	7.2	2.1	.6	3.6	3.7	5.7	2.4	2.0	7.9	8.7	4.4	.8	.8
White Suckers						.1		.1				.1	.5	.4		

TABLE 23
Stocking of game and pan fish in Lake St. Marys
as compared to the take by anglers.

SPECIES	Percentage Stocked 1932 - 1955	Percentage Taken By Anglers 1946	1947	1948	1949	1950
Bluegill	58.6	2.7	.8	1.1	1.0	1.5
Largemouth Bass	5.6	1.2	.2	.3	.6	.8
Crappie	3.8	64.4	79.9	80.5	58.0	66.0
Black Bullhead*	12.0	8.1	4.7	1.8	2.8	2.0
Brown Bullhead*	11.5					
Yellow Bullhead*	1.6					
Perch	.5	.5	.1	1.9	2.2	1.5
Channel Catfish	2.8	19.9	11.7	12.4	30.0	22.3
Shad	2.6					
Carp		2.8	.8	1.9	4.9	6.2
Walleye Pike	.001					
White Bass	.05					
Northern Pike**						

* All bullheads taken by anglers are grouped under black bullheads.

** Northern pike stocking is not included because it had no influence on the take, due to the small sizes of the fish present.

REGULATIONS

Next to stocking, legal regulations are the oldest known tools of fisheries management used in Ohio. In 1884, laws were passed to prevent the taking of fish in inland waters by any means other than by hook and line. This was a blow to the commercial fishermen at Lake St. Marys, but due to difficulties in enforcement, it was not until about 1900 that commercial fishing was stopped. Annually, since this early beginning, legal regulations have been added and withdrawn, with emphasis on the addition, until hundreds of regulations have been placed on Ohio fishing. For nearly 70 years regulations have been used to maintain and improve our fisheries resources. The general idea behind these regulations has been to hold down the harvest of fish so that ample brood stock would be carried over into the next year to continue the crop, and to permit this brood stock to spawn before being removed by angling. The large numbers of unharvested fish taken in test nets after the angling season was over; the tremendous hatch of young, the fact that the closed seasons did not always correspond with the actual spawning seasons of the fish, that fish stocked in greatest numbers were not those caught in greatest numbers, and that far more breeders were found in the lake than were used per acre in hatchery ponds, were facts which led fisheries workers of the Ohio Division of Wildlife to question the value of many of the old regulations. In order to test the value of some of these regulations, a program of liberalized angling was inaugurated. Liberalized angling was a program in which legal lengths, bag limits, and closed seasons were suspended in order to check the results of the regulations. The results are discussed under the section on Fish Harvest by Anglers.

SANCTUARIES OR SPAWNING GROUNDS

Another of the oldest practices used to better the fish population at Lake St. Marys was the closing of certain portions of the lake as sanctuaries throughout a spawning season, usually May 1 to June 15. As many as ten such areas, totaling hundreds of acres, were closed each year for many years (Figure 34). In one year, 48,900 feet of wire were requested by Division employees to enclose such sanctuaries at Lake St. Marys. Test seining and close observation disclosed no greater populations of young fish in these areas than were found in other portions of the lake.

This practice was discontinued when liberalized angling began.

ROUGH FISH REMOVAL

Rough fish, especially carp, have long been considered by many Ohio anglers to be one of the major causes of poor fishing in some Ohio waters. As was stated under the discussion of the larger fishes of Lake St. Marys, the State entered into contracts for the extermination of carp in the lake in 1904. The public pressure again became critical in 1932, when a carp removal project was inaugurated by the Ohio Division of Wildlife, then known as the Division of Conservation (Figure 35). Table 20 reveals that between 24 and 28 pounds of carp per surface acre were removed per year from 1932 through 1934. Due to unforseen difficulties, the project was discontinued in 1934. Again in 1948, a permit was granted to a private individual, Mr. Lowell Gilbert of Celina, to remove rough fish such as carp, gizzard shad, quillback, buffalo and gars. In 1948, Mr. Gilbert removed from Lake St. Marys, nine pounds of rough fish, chiefly shad, per surface acre of water. During test net operations, in 1949, the rough fish were removed from the lake by killing them at the site of the net, and returning their bodies to the lake. The last effort to reduce the numbers of rough fish in Lake St. Marys came in 1953, when the Ohio Division of Wildlife set up a Federal Aid project for this purpose. Table 20 permits a comparison of the removal in all years. Many areas around the lake were worked during the last effort, but the majority of the fish were removed from the warm water area at the outlet from the Celina power plant (Figure 36).

No attempts were made to evaluate the removals, other than the last. It can be stated that the catches of carp in test nets by Wickliff in 1932 exceeded those taken at any time after the 1932-1934 removal. The effects of the 1932-1934 removal are as yet a subject of debate among the older residents.

The last removal project lasted from June, 1953 to February, 1955. This project also included an evaluation of the work. The removal was not considered to have been sufficient to have caused a distinct effect on the desirable fish population. Erickson and Zarbock (1954) found that white crappies of equal lengths were slightly heavier in 1954 than in 1953 prior to the removal, that they were longer in 1954 at the same age, and that there was definite increase in the annual increment. They also found similar increases in the status of the black crappie in Lake St. Marys.

FIGURE 34. SANCTUARIES CLOSED AT LAKE ST. MARYS DURING THE SPAWNING SEASON OF 1933.

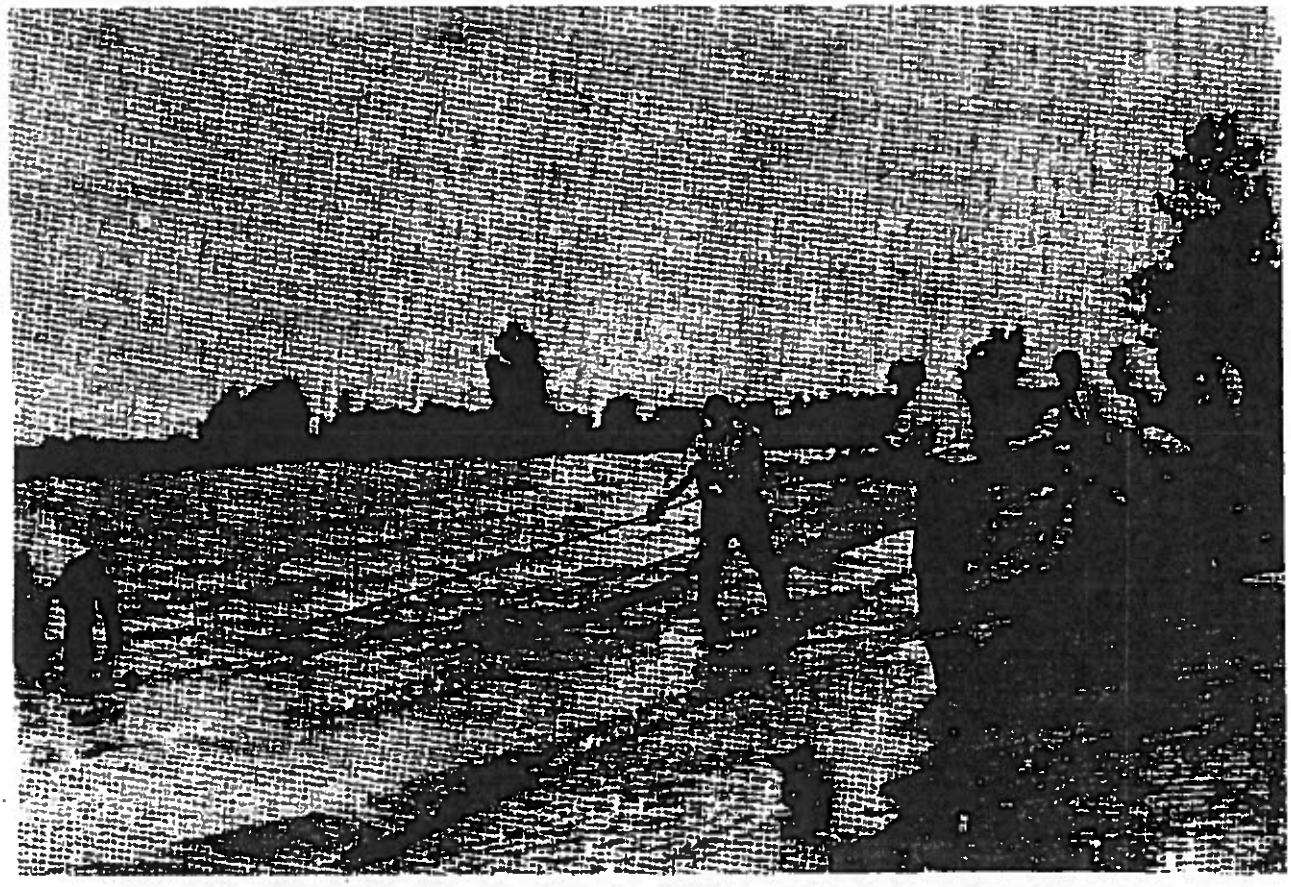


FIGURE 35. DURING THE YEARS 1932 THROUGH 1934, AREAS WHICH HAD BEEN CLEANED AND BAITED WERE SEINED TO REMOVE THE CARP IN AN ATTEMPT TO REDUCE THE POPULATION.

FIGURE 36. AS MANY AS 20 TONS OF SHAD WERE TAKEN IN ONE DRAW OF THE SEINE IN THE WARM-WATER AREA AT THE OUTLET OF WATER USED FOR COOLING AT THE CELINA LIGHT PLANT.

The annual removal of rough fish in the 1953-1955 project did not exceed 38.41 pounds per acre per year in 1954, the only full year of the project. Results from this small removal are questionable, for even though the major portion of the removal was prior to the 1954 spawning season, the test net catches of that year revealed that about 25 per cent of the crappie population was comprised of breeders of 8 to 13 inches in length. The catch per hour of crappies in 1954 was approximately the same as in 1953, after 12 months of rough fish removal. Table 10 and Figure 24 reveal a tremendous hatch of shad which resulted in one of the highest records of catch per hour for test nets in any one year. These shad were small fish ranging from four through seven inches in length. The 1955 shad population was made up of the smallest shad found in the data on the lake. Figure 24 suggests that the shad, in 1953, would possibly have been of the larger sizes in spite of the removal, but that a large group of small and young fish entered the population. The length frequency distribution (Figure 24) reveals an advance of these young fish from 7 to 8 inches in 1953 to the 10 to 11 inch groups in 1954, similar to the growth which took place from 1946 to 1947 in the absence of removal. The length frequency distribution of 1955 (Figure 24) is unique in the records of this species in Lake St. Marys and may have been a definite result of the removal. A reduction in the numbers of larger adult and sub-adult fish from the population may have permitted a much greater survival of young because of the reduced competition. However, such a population of small shad was not noted in the years following the tremendous kill of shad in the winter of 1947-1948.

The differences in the crappies as to the slightly larger size and weight for fish of the same age in 1954, as compared to 1953, might be answered by the fact that the catch per hour of crappies reached a low in 1953. Populations are being reduced to bring about increased growth of the species removed, and such may have been responsible for the differences in the crappies before and after the removal. A smaller population of an individual species in a lake should provide better conditions for the welfare of that remaining population for existence. Variations in increment for fish of the same age from year to year is not unusual (Carter 1955). The fact that 1953 appears to have been the last year for the majority of a year class of both black and white crappies (Figures 21 and 22), and that a new year class or classes of younger fish of more vigorous nature made up the bulk of the take in 1954, may have been responsible for the increase of increment noted for these species by Erickson and Zarbock in 1954.

It was the opinion of Erickson and Zarbock that the lake did not support a population of carp large enough to justify a removal effort on this species. All test net data testifies that such an opinion is correct.

Swartz (1950) in discussing carp removal in Illinois stated, "Few actual beneficial results from intensive netting operations have been noted, and these improvements were of temporary nature".

In an effort to improve angling, the use of nets and seines was outlawed. Anglers are selective in their angling, and harvest the more desirable species in greater numbers. Less desirable or rough species are taken in smaller numbers because of the smaller fishing pressure, and in some cases, because of inadequate legal means of harvest. Quillback can only be taken in large numbers by the use of nets. Therefore, preventing the use of nets means to prevent the harvest of this fish and to encourage its presence in the lake. The error in this limiting of methods of harvest was hinted in "The Annual Report of the Commissioners of Fish and Game" for the year 1904, which is quoted in the Adult Fish Populations section of this report.

HABITAT IMPROVEMENT

For many years, the Ohio Department of Public Works, the Division of Parks, and the Division of Wildlife have been working to control shore erosion at Lake St. Marys, in an effort to reduce the turbidity of the lake. Miles of shorelines have been rip-rapped with stone (Figure 37) and thousands of feet of concrete walls (Figure 38) have been installed by the Division of Parks to control wave and ice erosion on the shoreline. In spite of these efforts, unusual wave and ice action tear loose the installations or break over them and cut behind them. One island (Figure 39) was built in the west central part of the lake as a part of a project to reduce wave and ice action, but the cost of such an extensive project was found to be prohibitive. The cooperating State agencies, chiefly the Division of Parks, have dredged numerous channels to provide access to the open water of the lake, and to obtain fill dirt for low areas along the shore. These channels were also constructed to provide more fishing for shore fishermen. The maintenance of these channels with their periodic cleaning necessitates extensive operations on the part of the Division of Parks, but the value of the work is readily recognized by all interested in the lake. Such channels, with their hard banks, provide excellent quiet water spawning areas as well as fishing areas during heavy wave action.

Many attempts have been made by private individuals and the Division of Wildlife to re-establish "moss" underwater vegetation in the lake. This "moss" has become established in some of the clearer, quiet backwater areas without the assistance of man. One effort, made by the Division, involved the construction of a 14 foot square enclosure in an open, turbid portion of the lake. The enclosure was constructed of one-fourth inch wire mesh. Intensive seining removed every fish possible from the enclosure, and the wire was trampled into the soft bottom and staked to hold it in place. This prevented any possible effects from a fish population. Enough "moss" was placed in the enclosure to completely cover the surface of the water, and then the stems were weighted down by balling them in clay. The area was checked for two years, but the vegetation did not become established. Similar plantings in clearer, quiet water flourished.

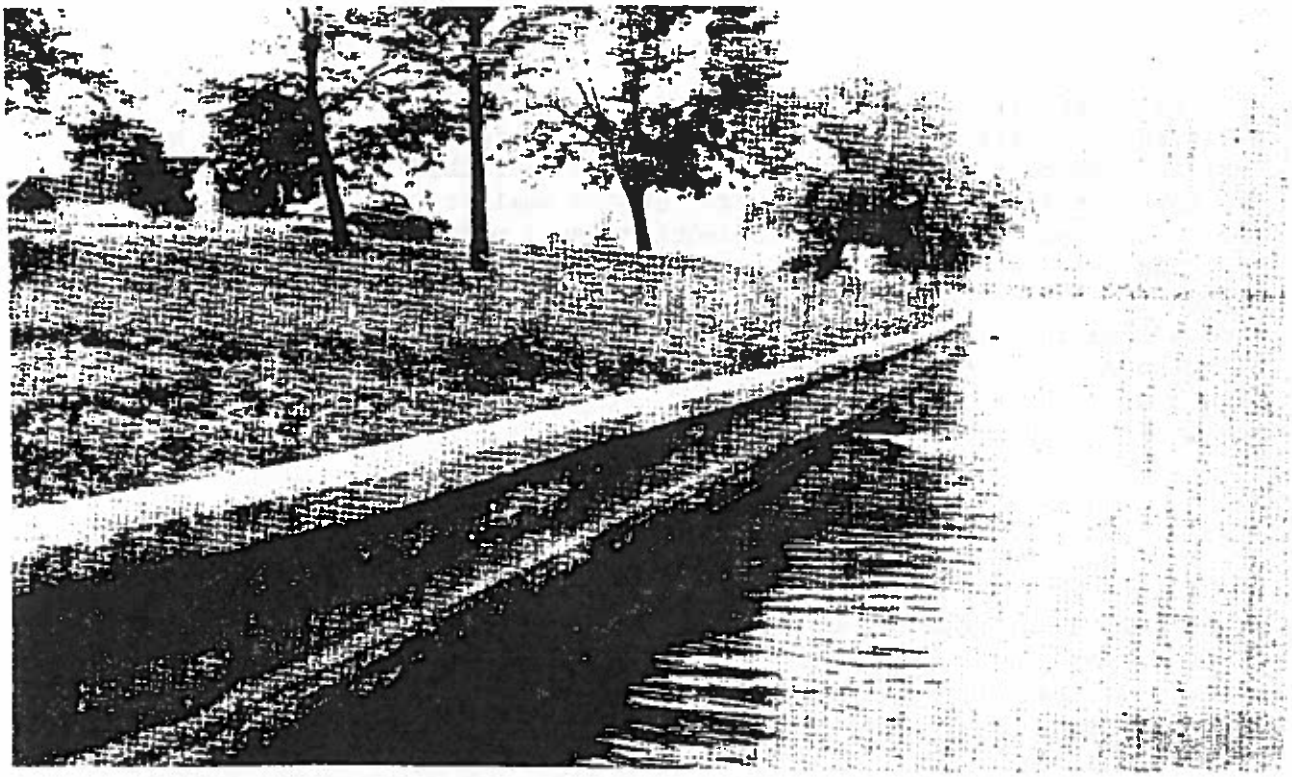


FIGURE 37. SHORELINES AT LAKE ST. MARYS ARE BEING RIP-RAPPED BY THE OHIO DIVISION OF PARKS IN AN EFFORT TO CONTROL THE EROSION BY WAVES AND ICE ACTION.

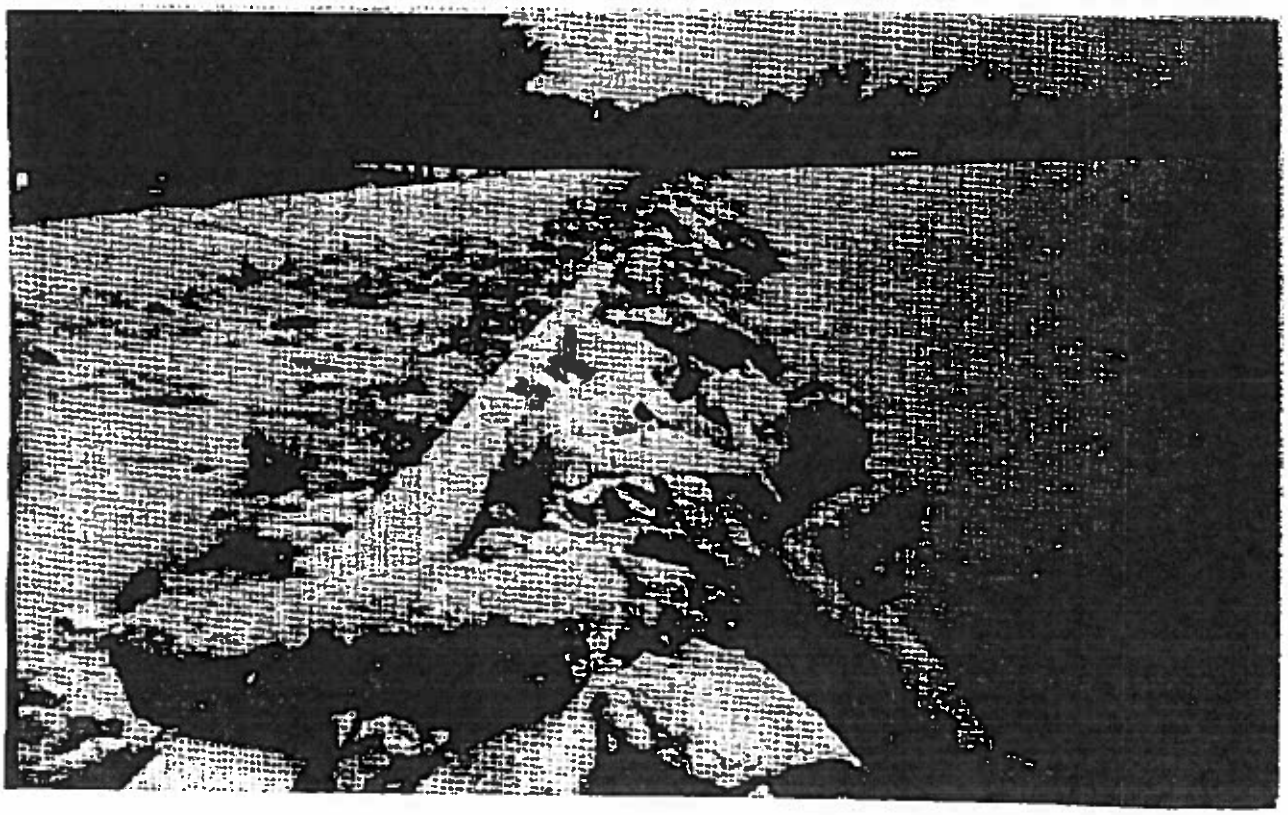


FIGURE 38. CONCRETE WALLS HAVE BEEN INSTALLED IN SOME AREAS TO PREVENT THE CUTTING ACTION OF WAVES AND ICE ON THE BANKS.

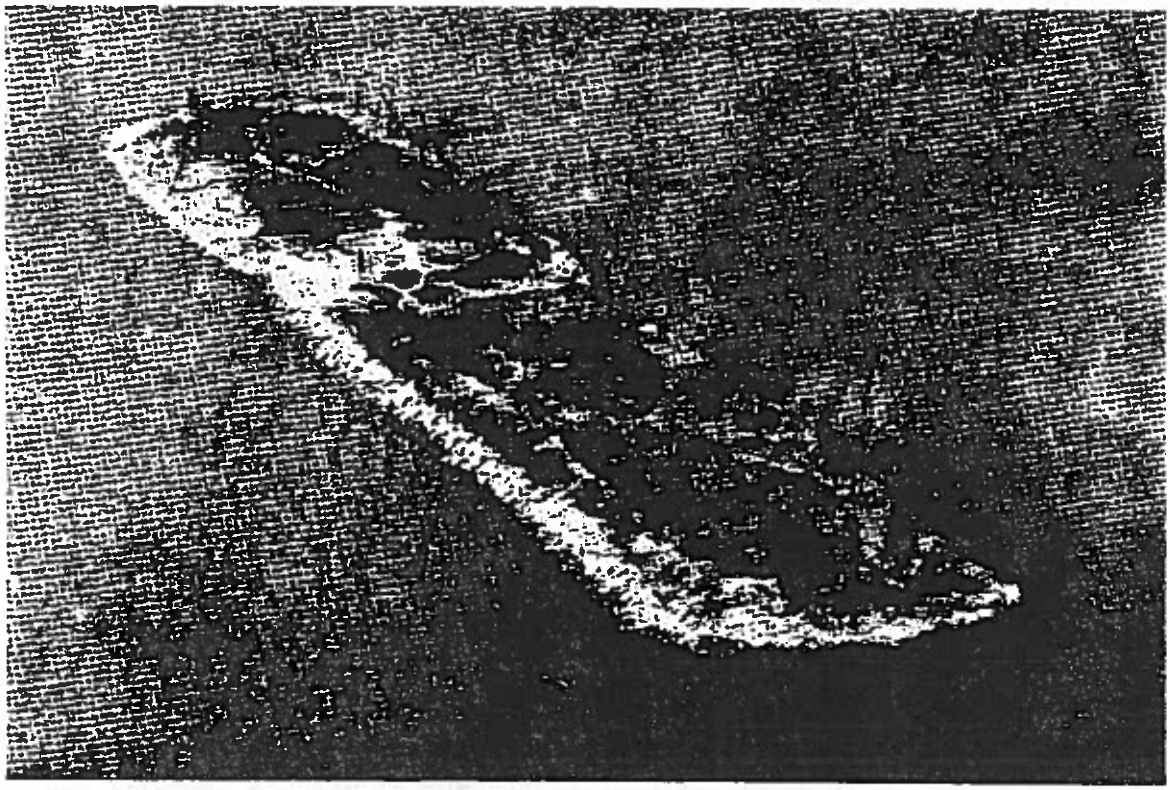


FIGURE 39. SAFETY ISLAND - BUILT BY THE DIVISION OF PARKS.

During the summers of 1940 and 1941, an attempt was made to control the rapid expansion of the cattail marsh in many sections of the lake, and to create holes in the marsh for duck hunters and anglers (Figures 40, 41, 42, and 43). About 100 of these pools were created by means of a mechanical cutter (Figure 44). Due to heavy wave and ice action, the marsh has retreated in the past few years and only a few of these pools remain. "Moss" became established in the pools which were relatively clear.

The idea of backwater pools created by vegetation cutters was expanded into the creation of backwater pools by means of a dredge or dragline (Figure 45). It was thought that good fishing areas could be created by cleaning out some of the small bays which had become filled with silt and marsh. Several of these pools have been created and have furnished good fishing, especially during the first few years after being created. Shallow backwater areas were considered as a means of creating clearer water and encouraging the growth of underwater vegetation, thereby creating better conditions for bass and bluegills. The dredged areas produced bass fry in a similar manner to all other dredged areas around the lake. Bluegill production in these pools was negligible, probably because the pools were dredged too deep. Also, each area was connected to the lake by a large channel. In every case where a large channel is connected with a backwater pool, the pool becomes muddy. Clear water pools have been connected to the lake with the same results.

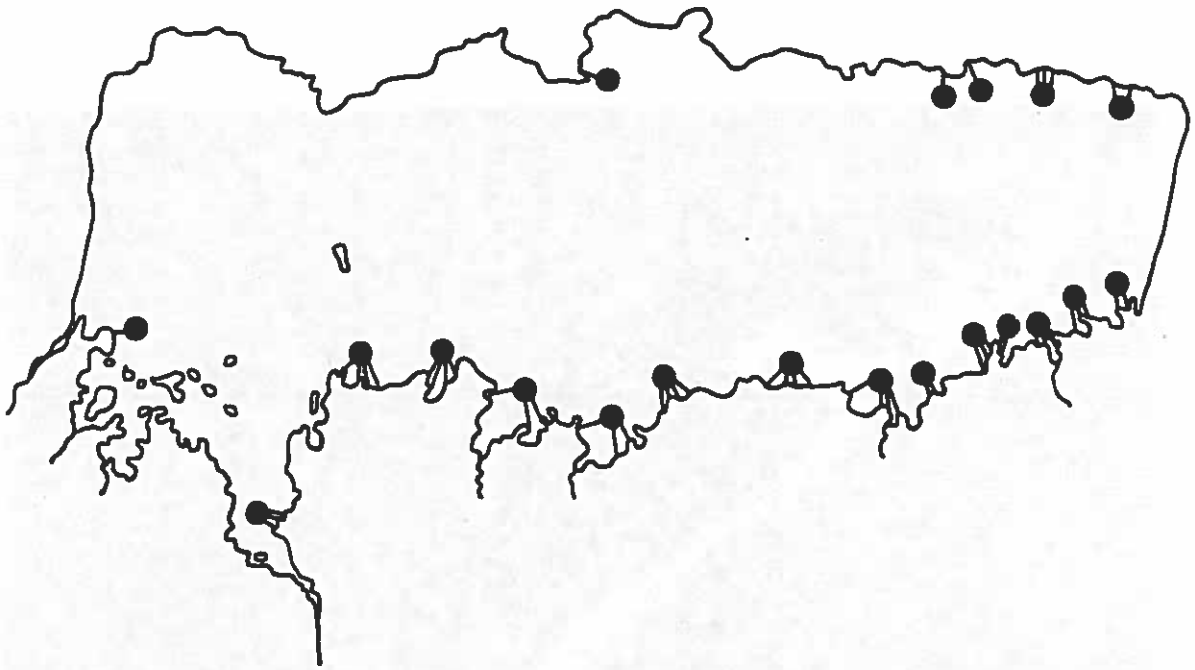


FIGURE 40. LOCATIONS OF AREAS CREATED OR CLEANED BY THE VEGETATION CUTTER AT LAKE ST. MARYS.

One of the early practices of fish management was the installation of gravel beds with the idea in mind of encouraging increased spawning and better survival of fry. Following this practice, the Division of Wildlife selected the outer Frey channel, near the northeast corner of the lake for an experiment in 1940. The ends of the channel had been cleaned by the suction dredge the previous year, and the cattails along the banks of the channel had been mowed. The unmolested portion of the channel was blanketed with a growth of "moss", Ceratophyllum spp., Myriophyllum spp., and Elodea spp.. Secchi disc readings of 24 inches of transparency had been made during late August and September of 1939. The lake was 19.5 inches below spillway level, and a considerable portion of the channel bottom was exposed when the work was started in January, 1940. Rough hardwood frames of two sizes, three feet square and two feet square and six inches deep, were staked into the bottom and filled with assorted gravel (Figure 46). The boxes were approximately three to four feet from the normal water line and approximately 16 feet apart. All spawning boxes were placed so as to be covered by approximately 24 inches of water during the normal spawning season. All accumulated debris was removed from the area. Forty of the 60 boxes were enclosed by wire netting at each end of the channel. Into this enclosure, 50 breeder largemouth bass were introduced in the spring of 1940. Ten of these breeders died soon after being stocked. The heavy regrowth of cattails in the area and the high spring turbidity during the spawning season prevented a fair evaluation of the spawning. However, 12 schools of bass containing an estimated 15,000 fry were observed in the enclosure. Five schools of bass fry were observed in the portion of the channel outside of the enclosure. The dredging of the area in 1941 prevented a continuation of the project.

FIGURE 41. THE FALLEN CATTAIL STEMS, LEFT AFTER CUTTING, MADE MOST AREAS ALMOST USELESS FOR SEVERAL WEEKS AFTER CUTTING.

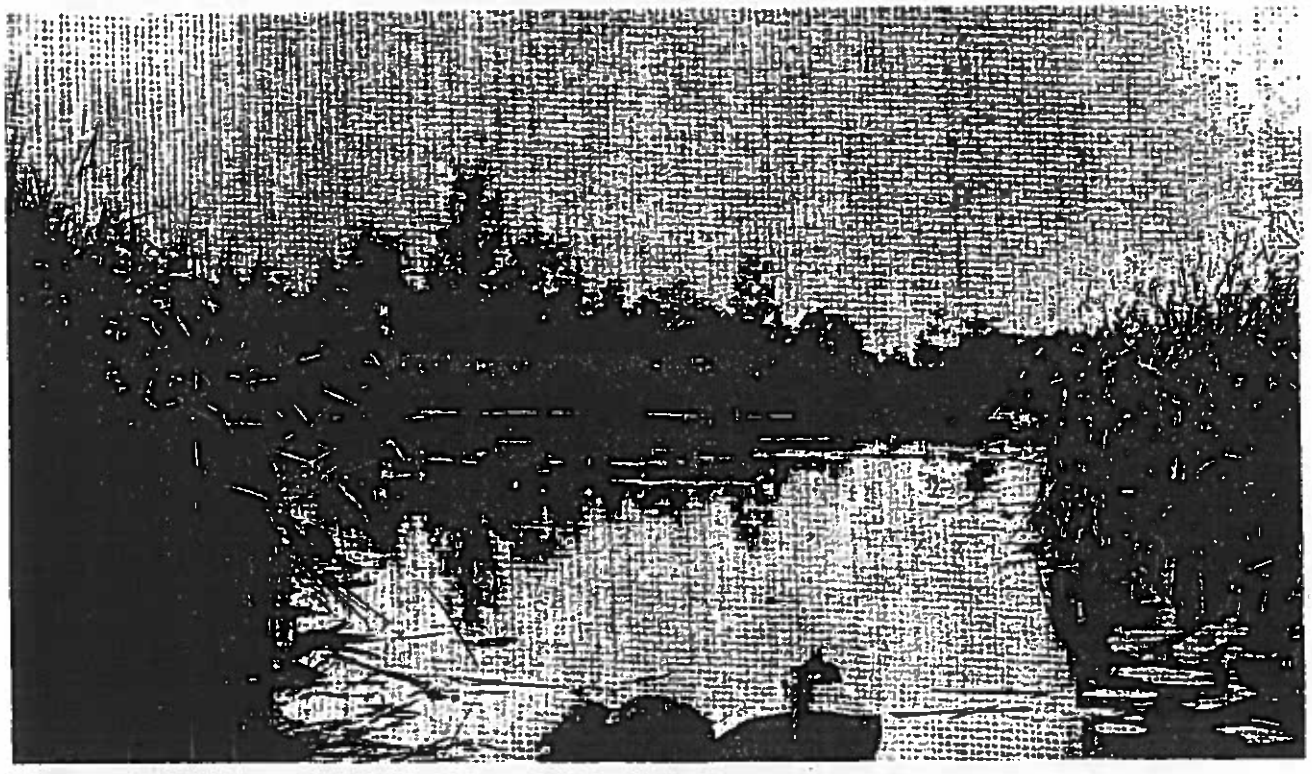


FIGURE 42. POOLS, CUT INTO THE CATTAILS, TOOK ABOUT A YEAR TO RID THEMSELVES OF THE FALLEN STEMS AND TO PRESENT THE APPEARANCE OF A NATURAL OPENING IN THE VEGETATION.

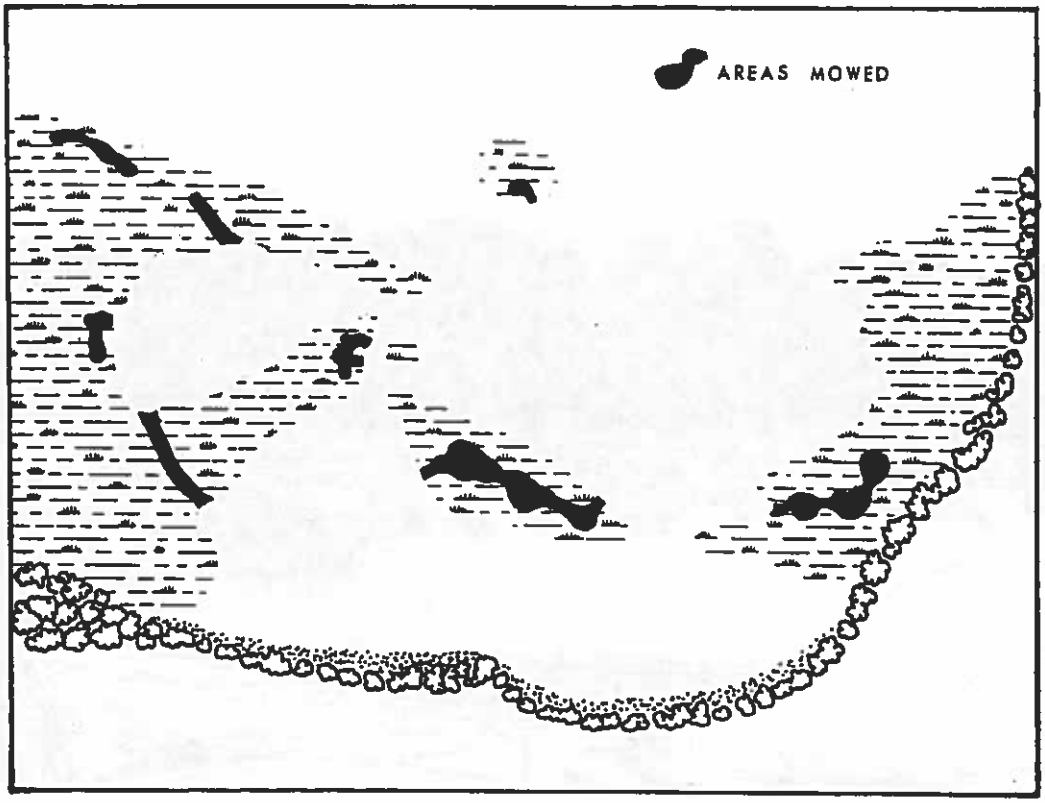


FIGURE 43. AREAS CUT WITH THE VEGETATION CUTTER IN MARSH WEST OF HARMON'S LANDING, LAKE ST. MARYS.

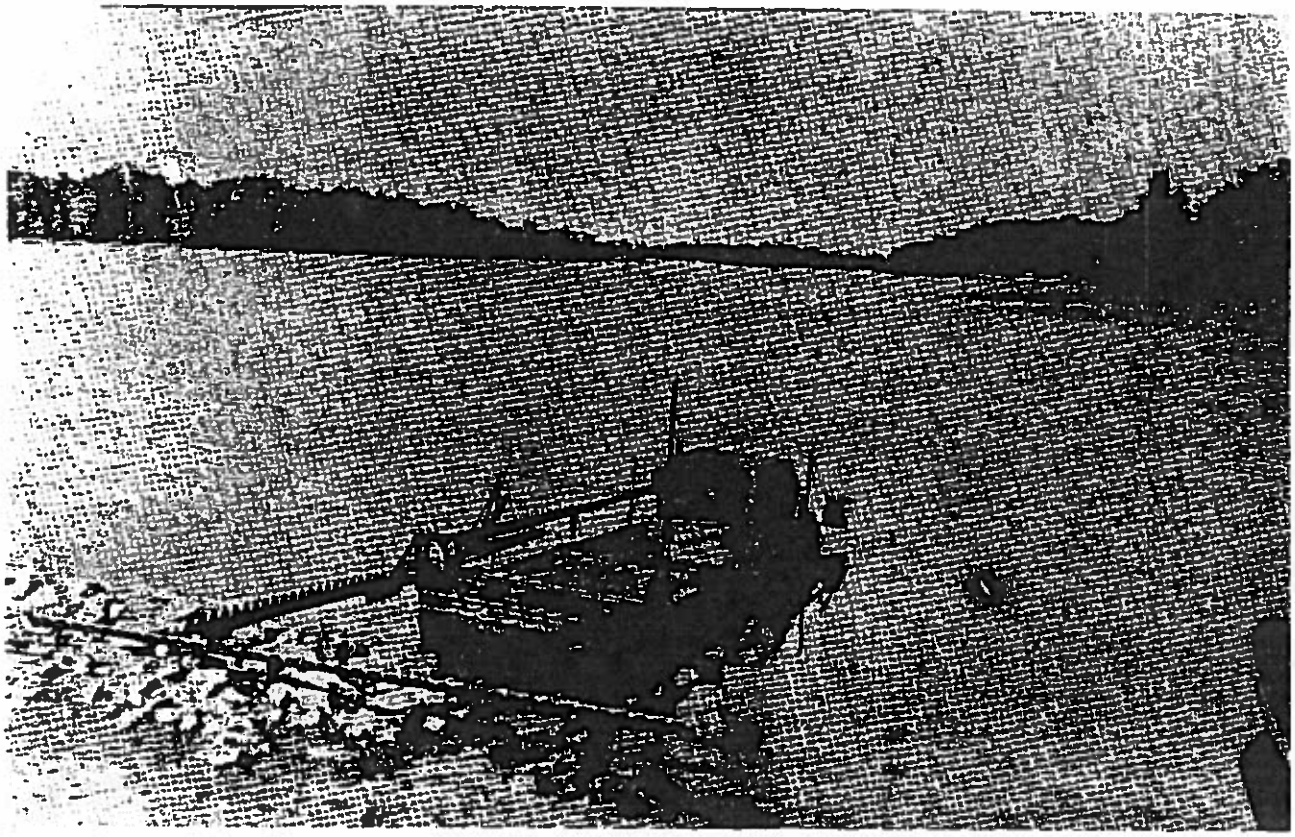


FIGURE 44. THIS VEGETATION CUTTER WAS PURCHASED IN AN ATTEMPT TO PROVIDE SOME MEANS TO CONTROL THE EXPANDING CATTAIL MARSH.

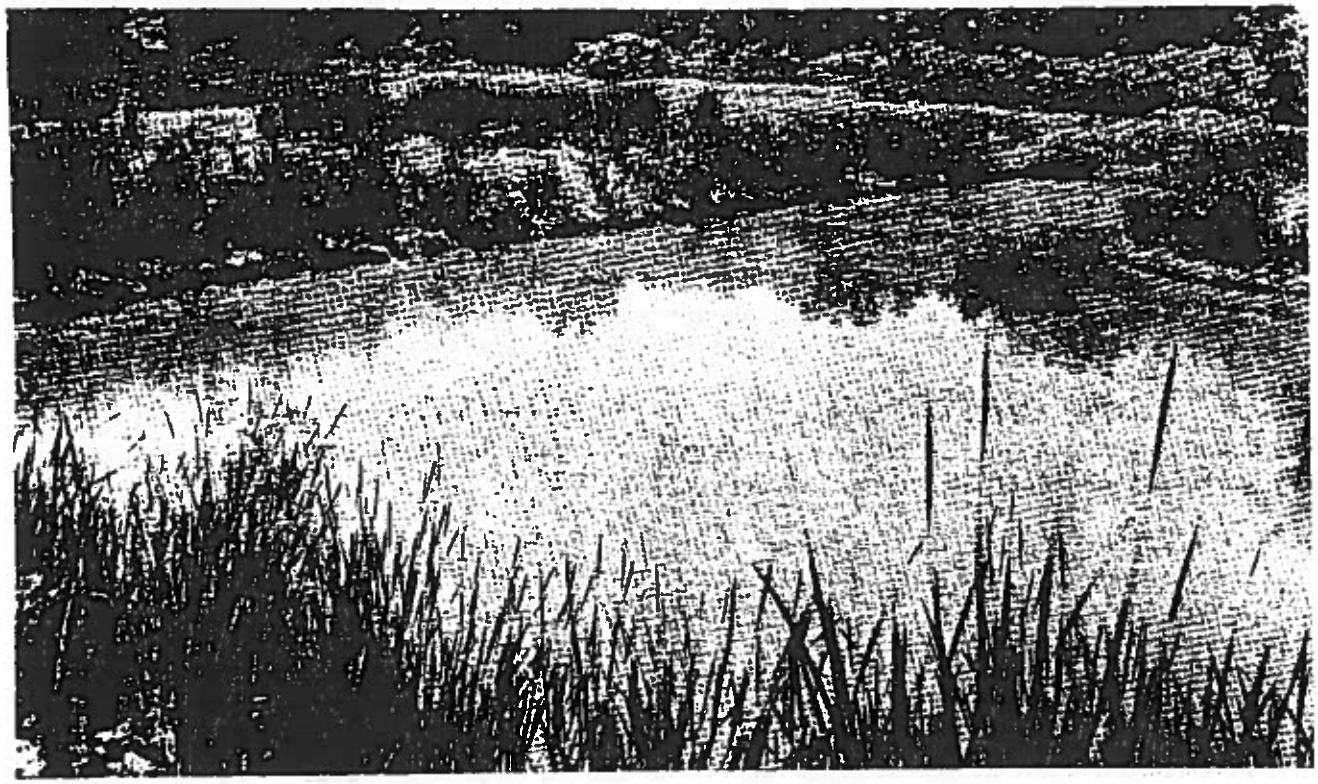


FIGURE 45. BACKWATER POOL CREATED BY A DRAGLINE.

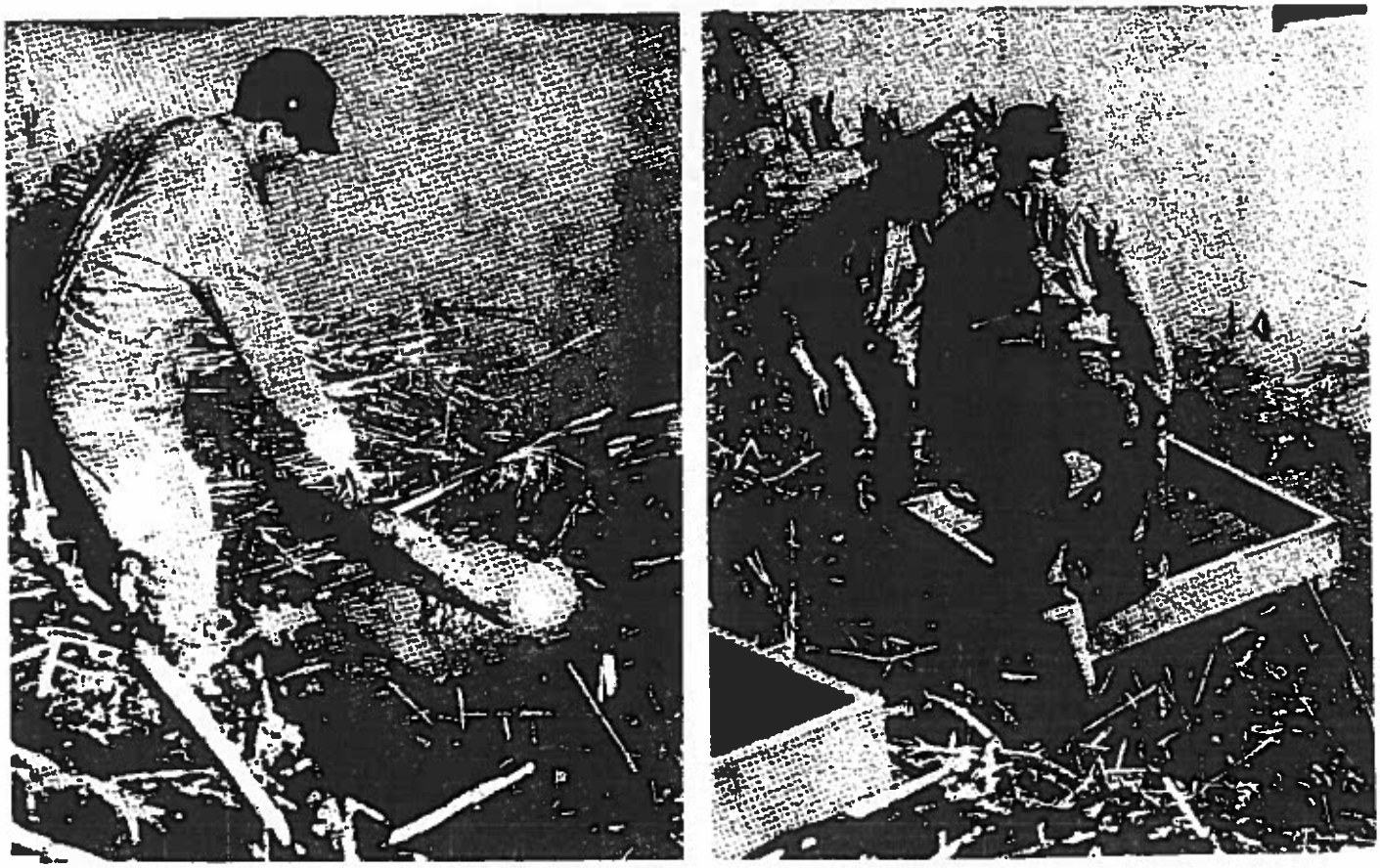


FIGURE 46. PREPARING SPAWNING BOXES IN FREY'S CHANNEL AT LAKE ST. MARYS.

During the winters of 1940 to 1942, 100 tons of gravel were introduced into backwater pools created by the vegetation cutter, and into naturally sheltered coves of Lake St. Marys. At the same time, logs, stumps and brush shelters were installed in an effort to add cover and increase the production and survival of bass and bluegills (Figures 47, 48, 49, 50, and 51). Test seining in these supposedly improved areas produced no more bass and bluegill fry than unimproved areas. The logs, stumps, and brush did offer some benefits to anglers by providing fishing sites to which the crappies were attracted.

In 1951-1952, a fishing pier was constructed through the cooperation of the Mercer County Sportsmen's Association and the Ohio Division of Wildlife. (Figure 52). This pier was built at the warm water outlet from the Celina power plant in such a manner as to permit a greater utilization of the open water by anglers during the colder months of the year.

For many years the opinion has been expressed that the lake should be broken into sections to control wave and ice action, and thereby reduce the turbidity so that more underwater vegetation would develop. With this thought in mind, and the attempt to increase fishing possibilities, the idea of a breakwater-fishing pier developed. Such a pier was started in 1954, when a 790 foot section was installed (Figure 53). A 780 foot extension was added in 1955. This pier, extending outward 1,570 feet into the lake, breaks the wind and wave action near Windy Point, and offers considerable protection to a large area of water to the east of the pier. The increased transparency may encourage the growth of underwater vegetation, and the more favorable conditions aid in increasing those species which are better adapted to vegetated areas. The effects of this pier are to be checked to determine the value of such installations in future planning.

One of the first projects at most state lakes, for the benefit of the anglers, was to install screens at the outlets. It was thought that the large numbers of fish lost from the lakes, in times of high waters, would seriously reduce the fish populations. Truck loads of dead fish have been removed from such screens, where they have been carried and crushed by the excaping water. Screens have been clogged and even broken by the resulting pressure. A study made of the loss of fish over the spillway at Lake Loramie, for a period of two years, indicated that the numbers of fish lost were in relation to the abundance of the species in the lake (Clark 1942). If shad comprised the bulk of the fish population in the lake, they were lost in greatest numbers. These screens are not being used as much as they were in past years.

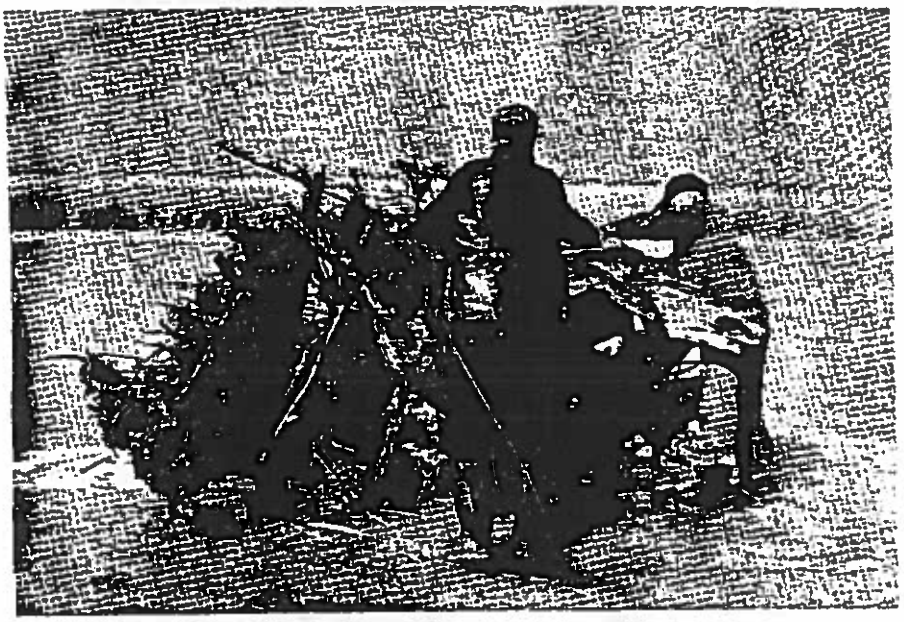


FIGURE 47. FISH SHELTER CONSTRUCTED AT LAKE ST. MARYS.

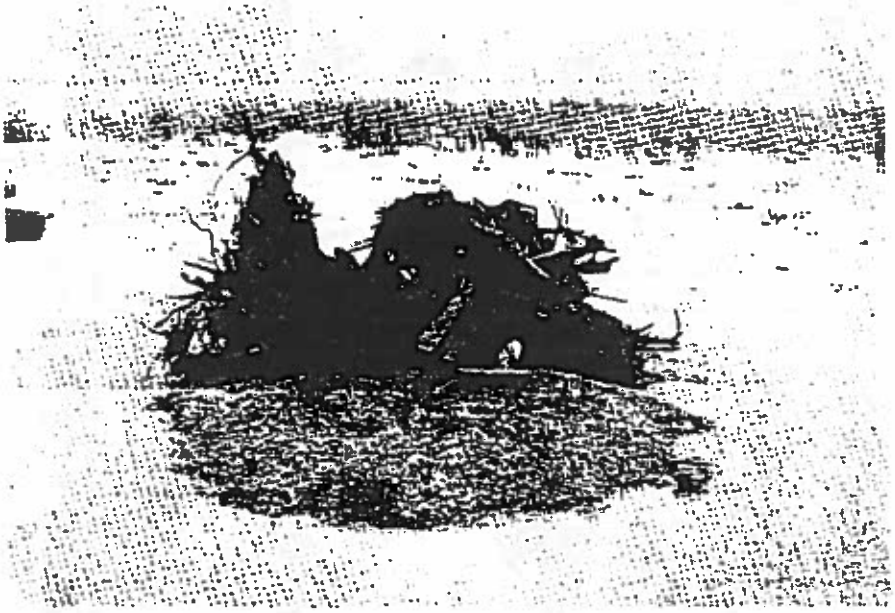


FIGURE 48. FISH SHELTERS CONSTRUCTED AT LAKE ST. MARYS.

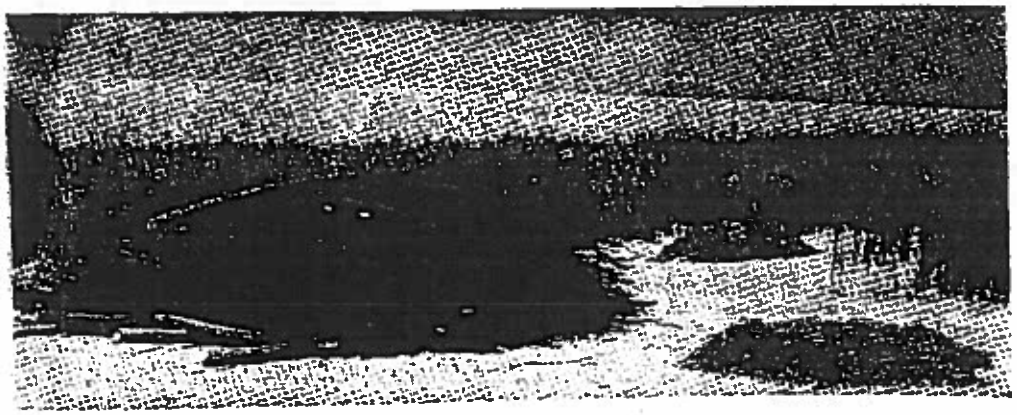


FIGURE 49. FISH SHELTERS CONSTRUCTED AT LAKE ST. MARYS.

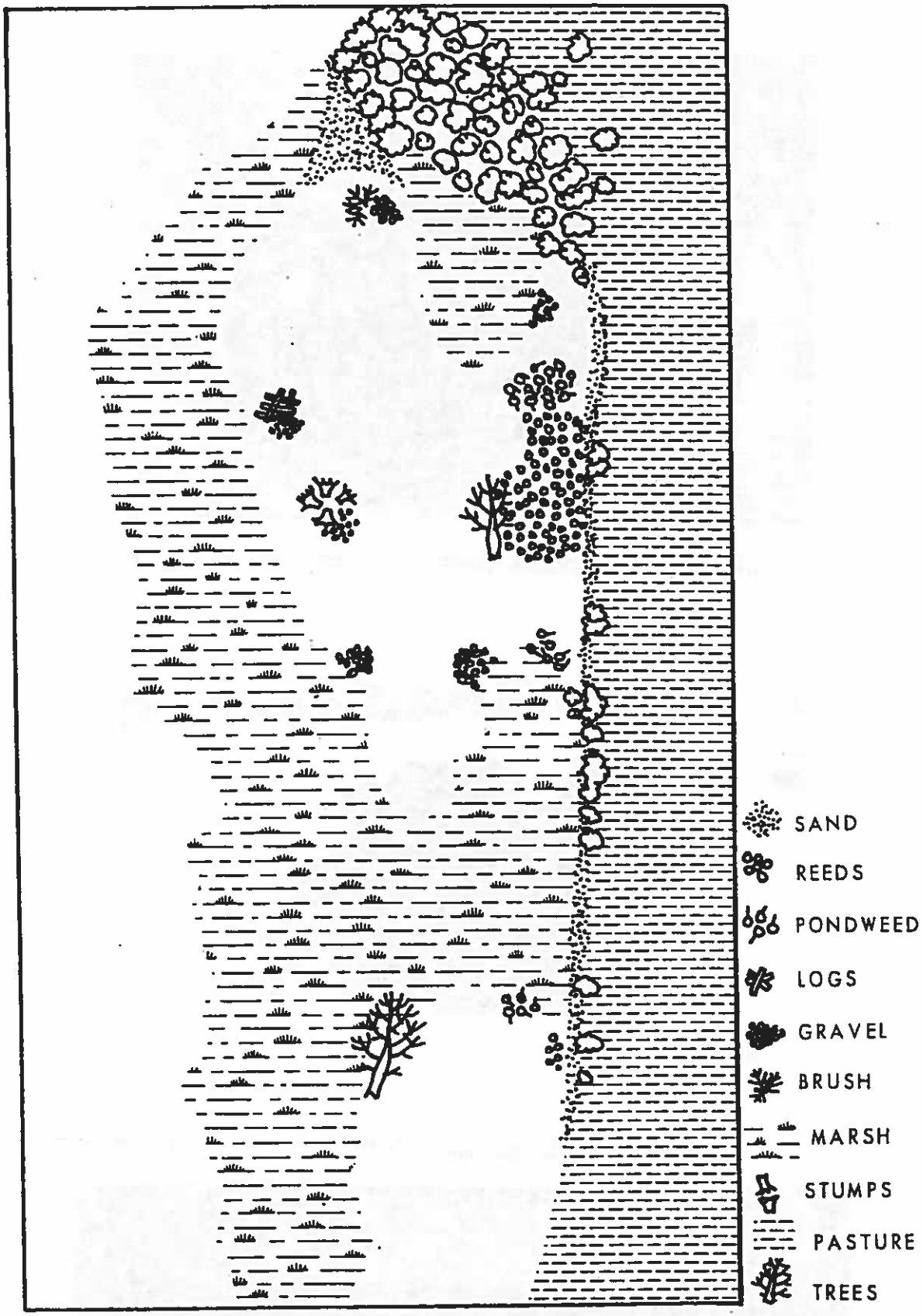


FIGURE 50. IMPROVEMENT DEVICES INSTALLED IN THE SMALL BAY THAT EXISTED ALONG THE EAST SIDE OF THE TIP OF RILEY POINT.

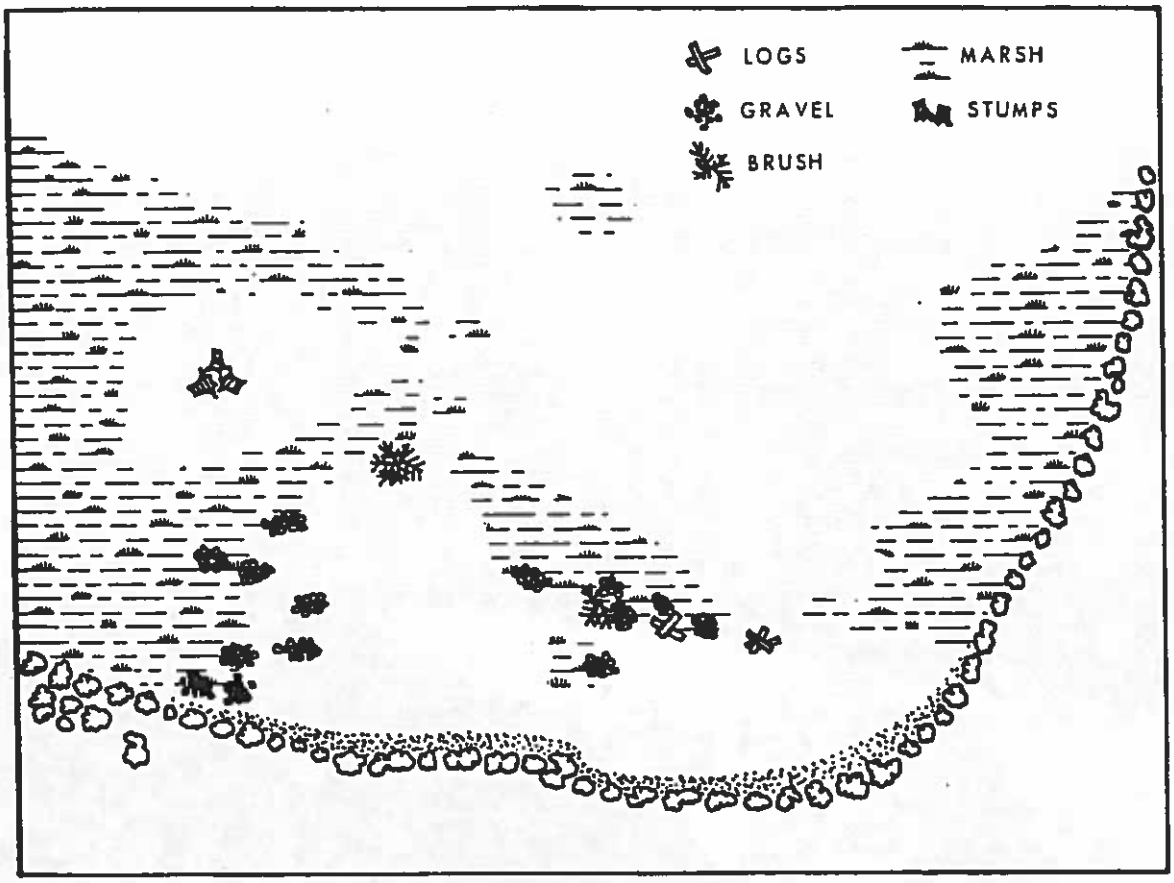


FIGURE 51. IMPROVEMENT DEVICES INSTALLED IN THE AREA WEST OF HARMON'S LANDING, LAKE ST. MARYS.

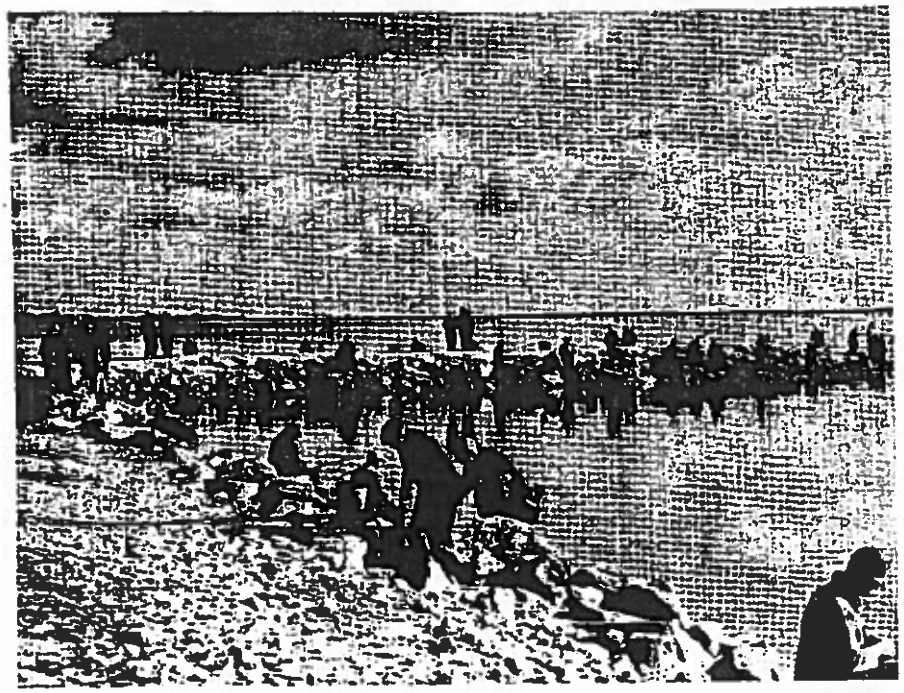


FIGURE 52. THE FISHING PIER AT THE WARM WATER OUTLET FROM THE LIGHT PLANT AT CELINA IS AN EXCELLENT EXAMPLE OF DIVISION-SPORTSMAN COOPERATION IN PROVIDING FACILITIES FOR ANGLERS.

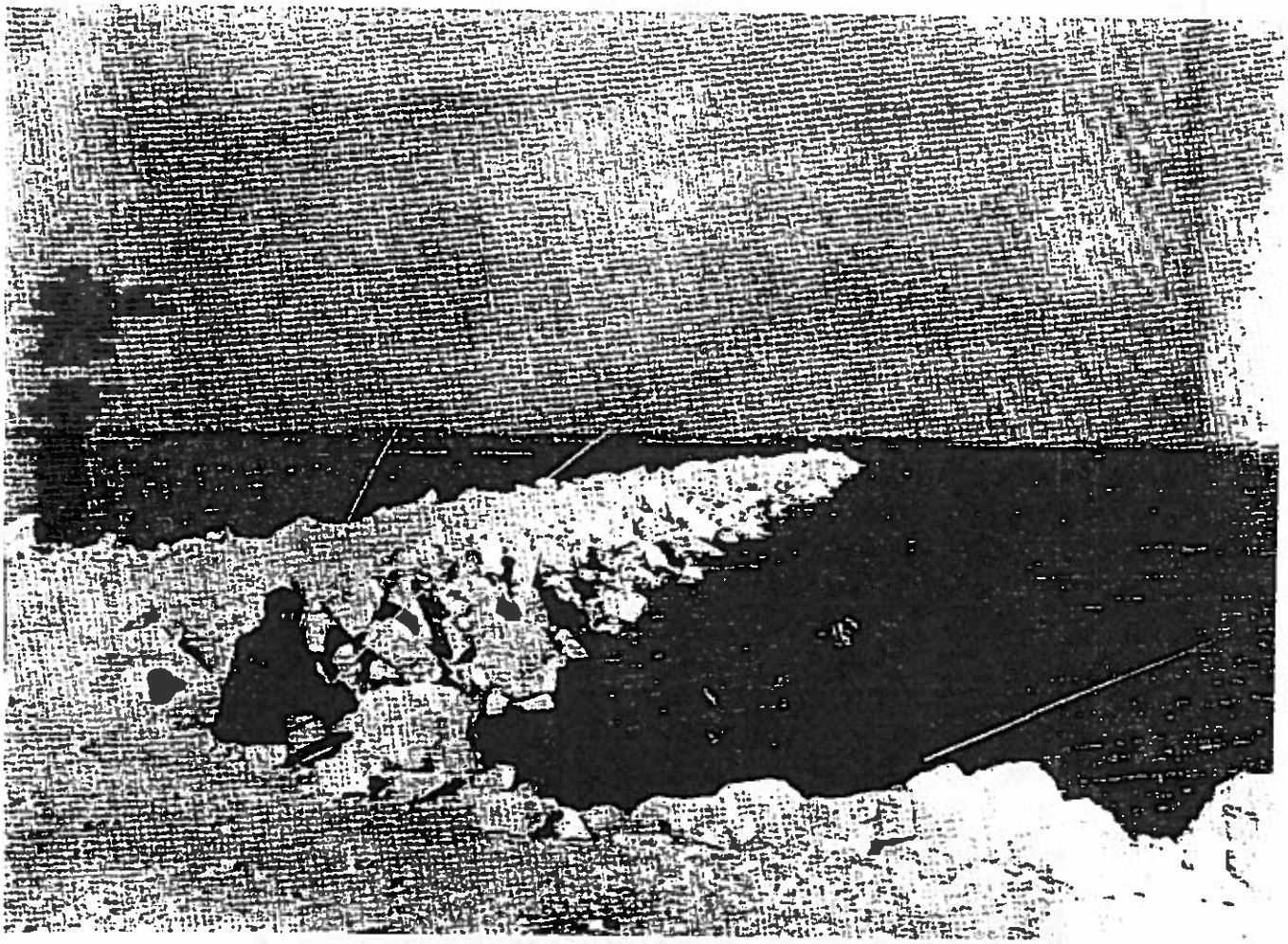


FIGURE 53. THE BREAKWATER-FISHING PIER BUILT AT WINDY POINT ON LAKE ST. MARYS.

FISH HARVEST BY ANGLERS

Creel census at Lake St. Marys has always been conducted in such a manner that most of the anglers were contacted while in the act of fishing, rather than at the end of their fishing day. Such a method has been criticized, but the data obtained in this manner correlates closely with data obtained from those who had completed their fishing trip. During the period of intensive creel census activities at Lake St. Marys, from 1946 through 1950, the data for both complete and incomplete fishing days were obtained for comparative purposes. Of 94,236 creel census contacts, only approximately five per cent had completed their fishing day. The major differences between the two sets of data were the length of time fished, and the number of fish taken. This data is significant in attempting to estimate fishing pressure and total harvest (Clark, Now, and Flinn 1948). This method of contacting fishermen, in the act of angling, was found to be representative of the total catch by Di Costanzo (1955) for Clear Lake, Iowa.

A Game Protector Creel Census was organized by Mr. E. L. Wickliff in 1935, and was carried out for that year only. The returns from individual water areas were few, but serve as a limited picture of fishing at that time. One hundred and twelve anglers were reported for Lake St. Marys. They had fished a total of 558.9 hours or an average of 4.99 hours per angler. They took 856 fish or 7.64 fish per angler at the rate of 1.53 fish per hour of angling. Crappies comprised 34 per cent of the total take, channel catfish 25 per cent, bullheads 15.2 per cent, bluegills (which included all sunfish) 8.4 per cent, smallmouth bass 5.7 per cent, and largemouth bass 4.2 per cent of the total reported harvest.

As a part of a state-wide program to learn something about the harvest of fish by anglers from public waters, an intensive program was started at Lake St. Marys in 1946 and continued through 1950. Special creel census takers gathered the information. Creel census returns were obtained from 94,236 anglers. It was learned that Lake St. Marys was fished by anglers from all of Ohio's 88 counties, as well as visitors from 28 other states and two foreign countries. Non-residents comprised an average of 6.2 per cent of the total anglers contacted each year for the five years.

The best fishing season, based on the catch per hour of all species, was found to be early spring and fall. However, when based on individual species, the take varied greatly, both seasonally and annually.

Anglers have considered water temperatures and transparencies as controlling factors in angling success. In an attempt to check these theories, water temperatures and transparencies were obtained at various stations around the lake, each day, during the intensive creel census of 1946-1950. Figure 3 compares these data with the catch per hour, on a monthly basis. Comparisons for individual years indicate possible correlation of possibly one factor, but the generalized picture for the five years reveals little to indicate that these factors are of prime importance in the over-all harvest. Silvey and Harris (1947) found no correlation between climatic conditions and fish harvest. This data must be considered as applying to those species which comprised the major protion of the harvest; crappie and channel catfish.

A creel census was conducted from 1951 through 1955 by the county representatives of the Ohio Division of Wildlife as a part of their daily routine activities. It must be remembered that changes in work loads for these men may be responsible for increased census activities in some seasons and little or no reports from other seasons. This may introduce some error in the catch records.

Table 11 presents a generalized summary of the creel census data for the years 1946 through 1955. This data reveals considerable variation in the catch per hour, catch per angler, and in the composition of the catch from year to year. Table 11 also reveals considerable variation in the take per hour of each species throughout all years in which the harvest data was obtained. The catch per hour for all species (Table 11) reveals a peak in 1947, which was followed by three years of poorer fishing, another peak in 1951 and 1952, followed by lower catches for two years, and another peak in 1955.

The catch per hour (Table 11) of crappies follows the same pattern and indicates the influence of this species on the angling success at Lake St. Marys. The catch per hour of channel catfish was high in both 1951 and 1952, and materially contributed to the high angling success of those years. In the percentage composition of the harvest (Table 11) bullheads would rank in third place, but angling success for these fish was very erratic. Carp did not represent a large per cent of the total take. On the basis of catch per hour, they were taken at relatively the same rate of harvest in all years, except 1951 and 1952 when the harvest was two to three times that of other years. Perch harvest data indicates a low rate of harvest which contributed small percentages of from .67 per cent to 6.9 per cent of the total harvest. Although the largemouth bass is the most desired game fish in the lake, it represented a small percentage of the total harvest at Lake St. Marys (Table 11). Largemouth bass represented 6.4 per cent of the total harvest of fish in 1951, the largest percentage recorded in the data. This high rate of harvest is in direct relation to the seasons of the year during which most of the census was taken, and thus is not indicative of the true harvest over the angling season. The 1955 data may be somewhat influenced by the same fact, but not to the same extent. It thus appears that bass fishing has remained about the same for the past ten years, and that spot checks made in 1938 and 1939 revealed data similar to that obtained during the 1946-1955 period.

Little correlation exists between the catch per hour, by species, Table 12, and the catch per hour by test nets. In 1947, the test nets took the largest number of crappies, per test net hour, on record. Yet the anglers' harvest was greatest in 1951 and 1952, when test net catches were low. The poorest crappie fishing in the 1946-1955 period was in 1949 when only .32 fish per hour were taken, but test net catches per hour equalled those of 1951 and 1952, the years of the best angling success. It may thus be seen that the data from these two tools supplement each other rather than replace each other. Average lengths of the crappies show little difference in the years of good or poor angling, and little correlation exists between the percentages of the two species in the population (Table 11).

Angling pressure, as portrayed by the five years of intensive census, appeared to vary considerably. However, the heavy pressure of 1946 came with the opening of liberalized angling, the fact that Lake St. Marys was one of only nine liberalized lakes, and that the anglers thought they could take unlimited numbers of fish if given the opportunity. The low pressure (Table 11) in 1947 resulted from the small average size of the crappies caught in 1946, not in the catch per hour. The fishermen thought that liberalized angling would permit outlandish harvests, but were disappointed when they took only small fish in 1946. From 1948 through 1950, the total estimated anglers who used the lake was relatively stable. Harvest from the lake was estimated to vary little over the three years during which the angling pressure was relatively stable. A comparison of the harvest at Lake St. Marys, with those from other lakes, indicates that it ranks about average in catch per hour, and based on the 1946-1950 estimates, about average in the pounds of fish harvested per acre (Tables 24 and 25).

TABLE 24

A comparison of the catch per hour of fish by anglers at Lake St. Marys, with those reported from water areas of other states.

WATER AREA	STATE	DATE OF CENSUS	CATCH PER HOUR	SOURCE OF INFORMATION
Foots Pond	Indiana	6/25-8/22/1940	.28	Lagler & Lagler 1942
Clearwater Lake	Missouri	1949-1952	.34-.65	Kathrein 1953
Waterloo Mill	Michigan	6/25-11/30/1936	.4	Hazzard & Eschmeyer 1938
Lake Glendale	Illinois	5/15-8/29/1942	.4	Hansen 1942
Wappapello	Missouri	1946-1950	.45	Patriarche 1952
Mud Lake	Michigan	6/25-11/30/1936	.5	Hazzard & Eschmeyer 1938
Lake Chautauqua	Illinois	1941-1942	.7-1.0	Hansen 1942
Kegonsa	Wisconsin	5/15-9/25/1939	.82	Frey & Vike 1941
Sugarloaf	Michigan	6/25-11/30/1936	.9	Hazzard & Eschmeyer 1938
Clear Lake	Michigan	6/25-11/30/1936	1.0	Hazzard & Eschmeyer 1938
Rinaker	Illinois	1932-1939	1.0-2.1	Hansen 1942
Lake St. Marys	Ohio	1946-1955	.6-1.9	Present report
Waubesa	Wisconsin	5/15-9/15/1939	1.5	Frey & Vike 1941
Green Lake	Michigan	6/2-11/30/1936	1.7	Hazzard & Eschmeyer 1938
Cassidy	Michigan	6/2-11/30/1936	2.0	Hazzard & Eschmeyer 1938
Mirror Lake	Michigan	6/2-11/30/1936	3.3	Hazzard & Eschmeyer 1938

TABLE 25

A comparison of the estimated pounds of fish harvested from Lake St. Marys with those reported from waters of other states.

WATER AREA	STATE	POUNDS PER ACRE	SOURCE OF INFORMATION
Island Lake	Minnesota	2.56	Eddy 1941
Pike Lake	Wisconsin	2.8	Elkins 1937
Lake Wappapello	Missouri	6.3	Patriarche 1953
Yellowwood Lake	Indiana	10.0	Ricker 1945
Waukesa Lake	Wisconsin	13.5	Frey & Vike 1941
Lake St. Marys	Ohio	14.16	Present report
Lake Alma	Ohio	14.2	Pelton 1950
Ferndale Lake	Texas	30.0	Silvey & Harris 1947
Shoe Lake	Indiana	46.0	Ricker 1942
Sugarloaf Lake	Michigan	52.0	Cooper 1953
Clear Lake	Minnesota	56.1	Moyle 1949
Fork Lake	Illinois	162.0	Bennett, Thompson & Parr 1940
Ritter's Pond	Oklahoma	170.6	Leonard 1950

In general, few conclusions can be drawn from this census data. The data is characterized by continuous changes or shifts in the catches which, according to Moyle (1949) are characteristic of fish populations. Such fluctuations were also reported by Smith and Krefting (1954).

Test net data correlates closely with the harvest data in illustrating the fact that Lake St. Marys is a crappie-channel catfish-shad-carp or bullhead lake in spite of all the attempts to change it. Creel census and test net records prove that there will be peak years in the take by both anglers and by nets, but they may not come in the same years. In stating that 300 pounds of fish could be harvested from Ferndale Lake, Texas, as effectively as the 30 pounds are being currently harvested, Silvey and Harris (1947) point to the fact that harvest does not always reflect the size of the fish population. Small crappies have dominated the take in test nets and by anglers during some years, but these have been followed by years when larger sizes predominated. The small sizes of the crappies in 1955 were not due to overfishing because of liberalized fishing. The discussion on crappies in the section on the larger fishes of the lake illustrates this point. Cooper and Latta (1954) found the rate of exploitation of black crappies in a Michigan lake to have been only an average of 35 per cent of the available fish, during a five year study.

Over the period of ten years of liberalized angling at Lake St. Marys, the catch per hour by anglers has varied, but remained average with the harvests reported from other water areas under strict regulations. The years of poorer fishing have been followed by years of better fishing.

Tables 22 and 23 compare the take of fish by nets and by anglers with the fish stocked in the lake. The value of stocking was not reflected in the harvest, other than the possible effects in establishing the channel catfish.

POPULATION BALANCE OF LAKE ST. MARYS FISH

In comparison with published ideas of well-balanced water areas, the population of carnivorous fish in Lake St. Marys is somewhat higher than reported as ideal. According to Davison (1947), about one-third of the total weight harvested from a bass-bluegill pond should be bass or carnivorous fish. In considering the relative sizes of the two species, this means that very few bass should be harvested in comparison to the number of bluegills. According to Chance (1950), Swingle estimated that bluegills make up 65 per cent to 75 per cent of the fish caught from a bluegill-bass-shellcracker combination, and even higher percentages in a bass-bluegill pond. Chance (1950) includes crappies with bass as a part of the carnivorous component of the population. The creel census data from Lake St. Marys indicates that crappies and bass have comprised from 30 per cent to 70 per cent of the total weights of the fish taken for the years 1946 through 1950. In spite of the fact that the general public is most interested in carnivorous species of fish, such a harvest might be considered as too high to maintain a well-balanced population. However, when we consider that the harvest of fish from Lake St. Marys has been comprised chiefly of crappies for a period of from 15 to 25 years, the harvest cannot be considered as a factor in lowering the quality of the angling.

Swingle's F. C. ratio or forage ration (oral discussion) represents a measure of the ratio of forage fish to carnivorous fish. This ratio is obtained by dividing the weight of the forage fish by the weight of the carnivorous fish. In some of Swingle's well-balanced ponds this ratio varied as much as 6.5 over a period of years. The F. C. ratio for the harvest from Lake St. Marys from 1946 through 1950 varied only 1.4 and thus might be considered as well balanced if the other forage species of the lake were not considered.

RECOMMENDATIONS

1. Management recommendations should be concerned chiefly with those species best adapted to the conditions existing in Lake St. Marys, with minor emphasis on those less adapted to the area.

2. Stocking of fish should be made only after thorough investigation has proven such introductions to be in accord with the habitat requirements of the fish and the management program for the area.

3. Stocking northern pike should be accelerated.

4. Regulations on the fisheries should be biologically sound, but tempered with good judgment as to what will best serve the public needs.

5. Sanctuaries or closed spawning areas are not needed except in cooperation with other conservation programs such as the Goose Project area.

6. Rough fish populations should be utilized in the best interests of conservation.

7. Control of wave and ice action to increase water transparency and encourage the growth of underwater aquatic plants is highly desirable.

8. The cleaning of backwater areas to create clear, quiet water pools would encourage underwater vegetation and fishes adapted to such areas, such as bass and bluegills.

9. The lack of beneficial results from improvement devices such as gravel, brush and logs in increasing bluegill and bass populations indicate that such practices should not be continued for this purpose, but similar devices will increase the harvest of fish by concentrating them for the angler to take.

10. Due to the annual and seasonal differences found in fishing success, and the lack of information on the relation of variations of fishing success on a fish population, an intensified creel census should be continued on Lake St. Marys to better understand these factors.

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