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Effects of Regulations on the Fisheries of Michigan Lakes, 1946-65

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Preface

This report summarizes a series of studies, begun in 1946, in which creel census information was used to evaluate the effects of fishing regulations on the fisheries of Michigan lakes. Also compiled here, as available, are creel census data collected earlier. Thus, for one of the lakes, records spanning 31 years are presented.

These studies were directed initially by Henry E. Predmore; later (beginning in 1949) by Kenneth E. Christensen. Some of the data were presented in early reports, but the bulk of it was stored in files of the Institute for Fisheries Research until now.

Many members of the Institute staff contributed to the collection and analysis of the information and to the preparation of this report. The census and statistical clerks who served for several to many years were the following: R. C. Barber, S. E. Miles, G. F. Myers, D. E. Parsons, C. A. Pfitzmaier, J. R. Ryckman, R. N. Schafer, R. Scholma, F. E. Simonis, D. F. Thomas, and H. E. Wilson, Jr. This report was edited by W. C. Latta, illustrated by A. D. Sutton, and typed by M. S. McClure.

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES
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EFFECTS OF REGULATIONS ON THE FISHERIES OF MICHIGAN LAKES, 1946-65[1]

By James C. Schneider and Roger N. Lockwood

Abstract

Creel census statistics and related data, collected 1946-65, are presented for 22 Michigan lakes where sport fishing regulations were tested. The main objective was to determine if increased fishing opportunity could be provided without damaging the populations or their fisheries. For panfish, removal of the closed spring season, removal of the 6-inch size limit, and removal of creel limits were tested. For game fish, length of the closed spring season, both high and low size limits, and a ban on northern pike spearing were tested. For rainbow trout stocked in lakes, spring and winter fishing seasons were tested. Most of the lakes were of the largemouth bass-bluegill type.

It was difficult to accurately discern the effects of the fishing regulations because of imprecise statistics, a large increase in fishing pressure following World War II, a widespread increase in fishing for bass coupled with a decrease in fishing for panfish during the 1950's, irregular recruitment, and other uncontrolled events. It is clear that, in general, no dramatic changes in fisheries or populations resulted; however, some experienced a gradual deterioration which may or many not be linked to the tests. It is recommended that game fish size limits and closed seasons be retained on most lakes in Michigan.

Pumpkinseeds, rock bass, black crappie, and in some lakes largemouth bass and smallmouth bass, were especially vulnerable to spring fishing. Size limits typically had strong effects on the catches of bass and northern pike, as predicted by Latta (1972, 1974, 1975).

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[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

Introduction

Fishing regulations have long been an important tool for the management of Michigan's lake fisheries (Christensen 1953). Initially, the regulations were selected without careful scientific testing of their effects on fisheries or fish stocks. They were too liberal at first, but then became too restrictive. By the early 1940's, a baseline period for this report, nearly all warm water sport fish were protected from April 1 (or earlier) to June 24, and rainbow trout[2] (stocked in certain suitable lakes) from December 1 to late April. For panfish (including bluegill, pumpkinseed, yellow perch, black crappie, rock bass, bullheads, suckers, and warmouth bass) there was a creel limit of 25 fish per day (maximum of 15 bluegills) and a minimum size limit of 6 inches. For game fish (largemouth bass, smallmouth bass, northern pike, and walleye) there was a creel limit of 5 fish per day and minimum size limits of 10 inches on bass and 14 inches on pike and walleye. For rainbow trout, the creel limit was 10 per day and the size limit was 7 inches.

In these years the Institute for Fisheries Research began to measure the fisheries and populations of representative lakes. It was discovered that native fish populations were relatively large and fecund, that fishing mortality was relatively light in all seasons, and that the effects of fishing by non-residents (considered a problem in certain lakes near the southern boundary) were negligible (Clark 1941; Christensen 1953). Consequently, a trend toward more liberal regulations was begun. Beginning in 1945, year-around fishing was permitted for "other" panfish (the panfish listed above exclusive of bluegill and pumpkinseed) at all lakes in the northern two-thirds of the state. In subsequent years statewide restrictions on panfish were greatly relaxed, whereas northern pike were given greater protection.

Between 1946 and 1965, a variety of liberal and restrictive fishing regulations was tested at a number of lakes (Table 1). Some of the tests were set up by experimental design; others because statewide changes in regulations took place. Results were primarily evaluated by means of

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[2] The common names used in this report follow the American Fisheries Society Special Publication No. 6, "A List of Common and Scientific Names of Fishes from the United States and Canada" (3rd ed. 1970).

creel census, but in some instances, also by fish population studies. It was presumed that the census estimates of fishing pressure, catch, and catch per hour would adequately reflect any important changes in the fisheries or the fish stocks. For some of the tests "before" or "control" data were not collected on the premise that the regulation's effects would show up as long-term trends in fishing. Some lakes were used in more than one test.

Information derived from the studies at the experimental regulation lakes was used for revising statewide fishing regulations as it became available. However, the results of many of the tests have not been recorded in a complete or permanent manner. Partial results were given principally by Predmore (1948, 1949), Christensen (1953), Hazzard and Christensen (1953), and Taube (1964). The purpose of this report is to present all these data and make a final analysis of results. The first section of results gives a synopsis of fishery statistics; the second summarizes and evaluates the overall results for each regulation; the third section describes in greater detail the fishery at each test lake.

Methods

Creel census

Estimates of fishing pressure, catch, and other statistics were derived from a part-time creel census which sampled 20% (1946) or 10% or less (1947-65) of the anglers. The census methods were modified slightly through the years and that sometimes gave rise to estimates which differed slightly. The most notable changes were the stratification of estimates by seasons (beginning in 1950) and the improvement in the method for censusing ice shanties (beginning in winter 1953-54). The published (1953) and subsequent estimates prepared by K. E. Christensen were used whenever possible and all data have been taken at face value. The main features of the method used since 1954 are described below and in the Appendix (Christensen 1953 and 1954; Taube 1965).

A random schedule was designed to obtain a representative sample of all fishing. Usually two lakes were assigned to a census clerk. He

worked a 6- or 8-hour shift, either morning or afternoon, and alternated his duty between the lakes. The year was divided into four census seasons as follows: spring--last Saturday in April to the third Saturday in June; summer--third Saturday in June through Labor Day; fall--Tuesday after Labor Day to November 1; winter--the period of ice fishing, usually late December to mid-March. Field records were entered on forms that had been prepared especially for this census (Appendix).

Three kinds of fishing were covered by the census: open-water, open-ice, and on ice from shanties. A particular sampling and calculating procedure was used for each kind (Appendix). On open-water, estimates of fishing pressure and catch were obtained from counts of fishing boats at 2-hour intervals and from interviews with as many anglers as possible at the conclusion of their trips. The interviews provided information on number of anglers per boat, duration of the trip, numbers and kinds of fish caught, fish lengths, methods, residence, sex, and (after 1950) type of fish sought. For the fishing done in the open on ice, the clerk counted anglers at 2-hour intervals and interviewed as many of them as possible after they quit fishing. For fishing done from shanties, the clerk kept a record of the shanties in use at any time during the census day. People were interviewed as they fished; the shanty census form was partially filled in by the clerk, and then was left with the fisherman who was requested to complete the form and leave it at the shanty at the conclusion of the trip. The clerk collected the records later. Once the estimates of fishing pressure were obtained, they were multiplied by the catch rate (from interviews) to obtain catch estimates.

Estimates of fishing pressure are expressed in number of angler trips and number of hours. Estimates of catch are in numbers of fish, and in a few instances, they were converted to pounds based on samples of lengths and Beckman's (1948) average length-weight relationships.

Statistical analysis

Confidence limits were calculated for six representative sets of data (Bear Lake--1959; Bear, Duck, and Sugarloaf lakes--1958; Fine Lake--1957; and Pontiac Lake--1956). The analysis indicated that the estimates of

annual fishing pressure and total catch (all species) were quite reliable with 95% confidence limits falling between 7% and 23% of the means. The seasonal estimates and all the game fish estimates had broad limits--as described below--due to relatively small interview samples. However, the reliability of these estimates was greatly enhanced by their year-to-year consistency.

The estimates of angling pressure and catch in the spring season were of special importance on the lakes where year-round fishing for game species was allowed. In the two examples, confidence limits for the estimates in the spring seasons ranged from ±30% to ±60%. The ratio of the catch of largemouth bass in the spring to the annual catch had confidence limits of ±84% to ±112%. The one example for smallmouth bass had a confidence limit for the ratio of ±84%; for northern pike and walleye the confidence limits for their ratios ranged from ±158% to ±182%.

The confidence limits on the estimates of the annual harvest of game species ranged from ±37% to ±195%. A set of data from Sugarloaf Lake, one of the three lakes which had the higher size limits imposed, had confidence limits of ±74% on the estimate of largemouth bass 16 inches or more total length and ±56% on the estimate of northern pike 24 inches or more total length.

The portions of the total catches of the game species which were made up of fish less than "legal" size were of primary importance in the data from the three lakes where size limits were removed. The estimates of largemouth bass less than 10 inches in total length had confidence limits of ±62% to ±96%. The ratio of largemouth bass less than 10 inches in total length to bass of all sizes had confidence limits of ±76% to ±100%.

Other methods

Supplemental studies were made at some lakes with seines or trap nets to verify the presence of natural reproduction, or to estimate the size, structure, and growth of the fish populations.

Synopsis of fishery statistics

Estimates of pressure, catch per hour, and catch of important species were averaged for each of the 22 creel census lakes to provide an overview of the character of the fisheries (Table 2). Some of the averages are biased by restrictive or liberal restrictions on game fish. All lakes were located within the lower peninsula, but otherwise are fairly representative of Michigan's inland fisheries.

The combination of bluegill and largemouth bass predominated in all but five lakes. In those five lakes yellow perch, pumpkinseed, or northern pike were the primary species of fish. Smallmouth bass, walleye (some stocked), and stocked rainbow trout supplemented the fisheries of some lakes. Catch averaged 106 fish per acre of all species but ranged widely, from 12 to 334. Since fishing pressure averaged 90 hours per acre, the average catch rate was 1.06 fish per hour. The summer fisheries were the most important; the winter fisheries ranged from nil to equal in importance.

Two important trends of statewide significance were detected among the lakes with many years of census records. First, there was a pronounced increase in fishing after World War II, as compared to the late 1930's and early 1940's (at 7 out of 8 lakes). Northern lakes, which depended more heavily on tourism, were strongly affected. For some of the southern lakes fishing peaked in the late 1940's or early 1950's, then declined; for other lakes it stabilized at the higher level. There is some evidence of a corresponding decline in the average size of fish caught (three lakes). Second, there was a decrease in the amount of fishing for panfish and an increase in the amount of fishing for game fish during the 1950's (10 out of 12 lakes). This was reflected in both the type of fish the angler said he was after and in his methodology. These changes (and others--such as naturally caused fluctuations in fish abundance and growth) made evaluation of fishing regulations very difficult.

Evaluation of fishing regulations

Panfish

Two basic questions were posed: (1) Could increased fishing be provided--without damage to fishing quality or stocks--by removing (a) the closed spring season, and (b) the 6-inch minimum size limit; and (2) could stunted panfish (i.e., panfish growing at a rate well below the state average) fisheries and growth rates be helped by removing angling restrictions? In summary, the study results indicate the answer to question (1) is a qualified yes, and to question (2) no.

Initially (beginning in 1946), these questions were tested by experimental regulations at study lakes. (Also, there was some concurrent liberalization at northern "designated pike lakes".) After an analysis of early results (Predmore 1948 and 1949), the 6-inch size limit was removed statewide (September 23, 1949) and the closed season was reduced to an insignificant length (1952) and, finally (1955), eliminated from all Michigan waters. Thus census data from 18 lakes can be utilized.

The bluegill was the major panfish in all the study lakes except three; consequently, those regulations which affected the bluegill fishery were the most important to the overall fishery.

Spring season.--The effect of removing the closed spring season (approximately ice-out to June 24) on panfish was evaluated by comparing the spring fishery to the annual fishery. The data collected from 1952 to 1964, when there was little or no closed season statewide, were the most useful because data from 1946-49 were not stratified by season (with the exception of catch per hour) and only one study lake (Fife) was open in spring 1951.

Data from 17 lakes, assembled from this report and from the report by Christensen (1953), are summarized in Table 3. The opportunity to fish for panfish (plus, to a lesser extent, other species in some lakes) in the spring generated only a modest amount of fishing pressure--an average of 16% of the annual hours. Generally, the lowest spring pressures were at the more northerly lakes which had fewer year-around residents

and harsher weather. Even at southern lakes very little angling occurred during April. The overall quality of fishing--measured by catch per hour--was only slightly higher in the spring (1.17) than in all seasons combined (1.09). Spring fishing was consistently good at some lakes but consistently poor at others--depending on the interest of the anglers and the vulnerability of the fish. It was presumed that bluegills would be easily caught off their redds (and that was true in some lakes) but, overall, the spring bluegill catch matched the spring effort: 17% as compared to 16%. Yellow perch were usually hard to catch, whereas, pumpkinseeds, rock bass, and black crappies were taken readily. For the latter three species, over 30% of their annual catch was made in the spring at certain lakes.

6-inch size limit.--The panfish harvest was increased substantially more by the removal of the 6-inch minimum size limit than by the removal of the closed spring season. This conclusion was derived from the records on the numbers of small (less than 6.0 inches long) panfish in the catches for 20 lakes (Table 4). Most of the records were collected in the early 1950's, right after the size limit was dropped statewide. The ratio of small-to-large panfish in the catch varied greatly among lakes and species, but was often in excess of 30%. Anglers were able and willing to take large numbers of small pumpkinseeds, bluegills (especially in "stunted" lakes), and yellow perch (especially in northern lakes); whereas few small black crappies or rock bass were taken. Most of these small fish represent a net addition to the harvest because, at typical (low) exploitation rates and survival rates, few would have been taken at a larger size.

Discussion.--The elimination of both size limit and closed season probably had an important effect on statewide harvest, and possibly on populations. By summing the averages in Tables 3 and 4, increases in harvest rates can be projected at roughly 50% for bluegill (17% + 33%), 31% for yellow perch (13% + 18%), 68% for pumpkinseed (30% + 38%), 22% for black crappie (21% + 1%), and 45% for rock bass (28% + 17%). The empirical data suggest the observed increases in harvest were less, but these data are difficult to interpret for the reasons cited above and below.

Year-to-year trends in catch and pressure were examined for evidence of overfishing (see figures in the section, "Analysis of each lake"). It is clear that no species became extinct in the study lakes and that no important population was seriously harmed. If the liberal regulations had more subtle effects on fisheries and populations, they cannot be detected because of lack of control waters, environmental changes, irregular recruitment, a decline in interest in fishing for panfish at some lakes, and changes in other regulations. However, it was noted that there were more declines in pressure and catch than there were increases. For example, catches of both black crappie and rock bass declined in six lakes, remained steady in six or seven lakes, and increased in no lakes. Big Portage, Fine, and Pontiac lakes had noteworthy decreases in fishing pressure, catch per hour, and bluegill catch which were linked to a slowing of bluegill growth, and possibly, liberalized regulations on panfish and game fish.

For Turk and Saddle lakes, elimination of size limits, creel limits, and closed season bolstered the harvest but did not alleviate the problem of slow bluegill growth.

Game fish

Game fish regulations tested were high size limits, no size limits, both reduction and removal of the closed spring season, and a ban on northern pike spearing. Eventually adopted on a statewide basis were reductions in the closed seasons on bass (1962) and on northern pike and walleye (1952), and an increase in the northern pike size limit from 14 to 20 inches (1960).

In most of the study lakes largemouth bass were more abundant than smallmouth bass, walleye, or northern pike. Consequently, the data on largemouth bass are generally more reliable than the data for the rarer species.

In addition to the tests on regulations, some study lakes were used to evaluate the contribution of stocked fish to the creel (Christensen and Cooper 1955; Schneider 1969). Walleye fingerlings were stocked in five of the lakes; smallmouth bass in three.

Largemouth bass size limits.--Size limits of 0, 14, and 16 inches were tested against the normal 10-inch limit. The tests involved six lakes and periods of 5 to 8 years.

The results were in line with expectations (Table 5). As compared to catch with a 10-inch size limit, catch increased when the size limit was completely dropped and decreased when it was raised. The changes in numbers caught roughly followed the predictions of Latta's model (Latta 1974, Table 8, $\mu = 0.35$), which were as follows: +50% with an 8-inch limit (probably equivalent in effect to no size limit), -75% with a 14-inch limit, and -88% with a 16-inch limit.

However, to obtain the best quantitative measure of the effect of the size limit subtle changes in fishing pressure should be considered. At most of these lakes--as at most of the study lakes--total pressure declined in the test years (1954-63), but that was more than offset by an increase in the proportion of anglers fishing specifically for bass. Therefore an index, pounds per bass hour, was generated by dividing pounds of bass caught by the product of total fishing pressure and the proportion of summer anglers fishing for bass.

The index indicates pounds per hour declined 13-28% with no size limit, 26-49% with a 14-inch limit, and 28-59-67% with a 16-inch limit (Table 5). These figures are reasonably close to the declines predicted by Latta's model (Latta 1974, Table 6, $\mu = 0.35$) of 10%, 38%, and 62%, respectively. The highest yield was observed under the 10-inch limit, as predicted.

Bass less than 10 inches long were readily taken at the three lakes without a size limit. They comprised 31, 40, and 41% of the total bass catch.

No marked changes in the fish populations resulted from the size limit changes. Mark-and-recapture estimates at two lakes did not detect a buildup in bass populations. Bass growth changed at four lakes but not in the expected direction for two of them. There was a deterioration in growth and catch of the panfish in Fine and Big Portage lakes, but it cannot be resolved if the removal of bass size limits contributed to those problems.

Largemouth bass season. --The January 1-June 24 closed season on bass was removed from three test lakes for 8 to 10 years. In addition, some information is available from four other lakes which were being censused in 1962 when the closed season was reduced to January 1-June 1 statewide.

Allowing spring fishing for bass increased pressure and catch substantially (Table 6). Spring pressure increased by 67% or more, and 32-40% of those anglers were now fishing for bass specifically. Between 21% and 51% of the annual bass catch was made in the spring. Spring fishing, plus increased bass fishing in the summer, resulted in a net increase in the annual catch at two lakes; however, at the third lake, Pontiac, the annual catch fell by 5% and the spring fishery seemed to detract from the summer fishery.

Census records indicate that bass catch was negligible between January 1 and May 1, and that the entire spring catch was about equally divided between May 1-31 and June 1-24. Based on these data, statewide annual catch should have increased 10 to 25% when the opening of the season was advanced to June 1 in 1962. However, the modest amount of data available for four lakes (Fife, Fletcher Floodwater, Otsego, and Sugarloaf) show a decline in bass catch. Presumably the decline was caused by random fluctuations in fishing pressure and year class strength.

There were important long-term trends in the three test lakes with no closed season. Bass catches eventually declined to a noticeable degree in two, and bass catch-per-hour rates in all three lakes declined because the available bass had to be split among increasing numbers of bass anglers. Bass growth increased in two lakes. The decline in catch at Bear Lake--which once afforded a modest fishery--was likely due to a temporary and unrelated slump in spawning success. The decline in catch at Pontiac Lake --which once afforded a good fishery--may have been linked to spring fishing, an increase in macrophytes, stunting of panfish, or other changes.

Smallmouth bass size limits.--Size limits of 0, 14, and 16 inches were tested against the normal 10-inch limit for smallmouth bass while similar tests were made for largemouth bass. No information was derived from four lakes because smallmouth bass were absent or rare; fair data were derived from Duck Lake (no size limit) where the species was uncommon; and fairly good data were obtained from Fife Lake (high size limits) where smallmouth bass were fairly abundant.

Again, the results were pretty much in line with expectations (Table 7). Relative to the harvest with a 10-inch limit, there was a substantial increase in numbers but little change in weight with no size limit, and large decreases in both numbers and weight with the high size limits. As before, the pounds-caught-per-bass-hour index is the best for comparing observed and expected results because it compensates for changes in bass fishing pressure. Latta's (1975) prediction that maximum yield would be obtained with size limits of 8 to 10 inches is substantiated by the field data.

Sample measurements indicate that only 5% of the smallmouth bass caught during the no-size-limit period were less than 10 inches long. Therefore, part of the increase in observed catch must have been due to strong year classes or to other causes.

There is no indication that the smallmouth populations were harmed or helped by the size limit changes. The fisheries were stable, and for Fife Lake, returned to normal when the 10-inch limit was reinstated. Mark-and-recapture studies at Fife Lake suggested the population did not stockpile but rather that it declined. If true, the decline seems to represent the continuation of a trend begun long before the test.

Smallmouth bass season.--The January 1-June 24 closed season on smallmouth bass (as well as largemouth bass) was removed from three test lakes for 8 to 10 years. Smallmouth bass were rare at Pontiac Lake, common at Whitmore Lake, and fairly abundant at Bear Lake (Manistee County). Therefore, only the last two lakes provided some useful information. This was supplemented by data obtained at Fife Lake and Otsego Lake when the statewide closed season was shortened to January 1-June 1 in 1962.

As pointed out in the section on largemouth bass, the opportunity to fish for bass in the spring generated a significant fishery, both in terms of added hours and in the proportion of anglers seeking bass (Table 8). This pressure was directed mainly at largemouth bass, the more abundant of the two species in the test lakes, but smallmouth were easily taken. Fully 33% of the smallmouth catch was made in the new season. However, total annual catch increased only 14% or less.

At Bear Lake, smallmouth bass were surprisingly vulnerable to the few anglers fishing in April. There the spring catch of 33% was equally divided among April, May, and June 1-24. At Whitmore Lake, on the other hand, 1% of the annual catch was in April, 9% in May, and 26% in June 1-24. Based on these data, statewide annual catch should have increased 11% to 26% when the opening day was advanced to June 1 in 1962. The available field data show a 2% increase at Fife Lake and an 86% decrease at Otsego Lake.

The fishery at Whitmore Lake showed no ill effects from the test but the smallmouth (as well as largemouth) fishery at Bear Lake experienced a gradual decline. At Bear Lake the possibility that spring fishing disrupted spawning and reduced recruitment cannot be discounted, but natural causes such as unfavorable weather at spawning or expanding populations of northern pike and walleye seem to be more likely explanations.

Northern pike size limits.--Minimum size limits of 0, 20, and 24 inches were tested against the normal 14-inch limit. Estimates of the number of pike harvested were obtained at nine lakes during test periods of 1 to 9 years. Sometimes enough pike were measured so that weight harvested could be calculated also.

Data from five of the lakes (Big Portage, Duck, Fine, Minnewaukon, and Otsego) were not very useful because the pike populations were sparse (hence the estimates were imprecise), fast growing, and unstable. At the other extreme, the pike population in Fletcher Floodwater (and to a lesser extent, Houghton Lake) was large and slow growing. Fife Lake (average growth) and Sugarloaf Lake (fast growth) provided useful and representative information. Added complications were concurrent changes in other

regulations, total fishing pressure, and in the amount of effort directed at pike and other game fish.

All things considered, the results were in line with the predictions from Latta's (1972) model (Table 9). Generally, catches were highest with a 14-inch limit or no limit (pike less than 14 inches long were rarely taken anyway), intermediate with the 20-inch limit, and markedly lower with the 24-inch limit. The degree of response was related to growth of pike. In the faster-growing populations, the 20-inch size limit did not reduce harvest much (circa 20%) because few of the available pike were less than 20 inches anyway, and more growth potential was realized. In the slower-growing populations (especially Fletcher Floodwater), the high limit cut harvest considerably (58-96%) because few pike reached 20 inches and natural mortality exceeded the growth potential.

The advantage of the 20-inch size limit is that it should assure an adequate brood stock without cutting harvest drastically (Latta 1972). However, catch statistics give no indication that pike populations were affected by size limits. Furthermore, results of mark-and-recapture studies at Fife and Sugarloaf lakes showed no clear-cut response occurred in the pike populations (Table 45; Laarman and Schneider 1979). Growth of pike could not be linked to regulations either. Most notably, the reduction from 20 to 14 inches at Fletcher Floodwater (coupled with an increase in creel limit from 5 to 10 fish per day) did not alleviate the slow growth of pike.

Northern pike season. --During the 20 years of creel census the statewide closed season on northern pike (and walleye) began on March 15 and extended to either April 25, May 15, or June 24. Some data were obtained at 10 lakes (lakes listed in panfish studies 1 and 2 of Table 1, plus Devils Lake and Fletcher Floodwater). In addition, year-around fishing for pike (and other species) was tested at Bear Lake (Manistee County), Pontiac Lake, and Whitmore Lake, Unfortunately, these three had mediocre pike populations and fisheries, and did not provide good tests.

It was expected, of course, that lengthening the fishing season would increase pike harvest, but such was not true. Estimated catches

decreased more often than they increased. This seemed to be partly due to most of the populations being high in the late 1940's and low in the 1950's. At Whitmore Lake (and others around the state) the pike showed a long-term decline, presumably due to loss of spawning habitat to real estate development.

Other data from the three test lakes indicated that pike were not actively sought nor readily caught in the spring. There was virtually no pike fishing in March or April, and only 1-10% of the May anglers and 4-7% of the June anglers were fishing specifically for pike. About 25% of the annual catch was made during the spring period, mostly in June.

Northern pike creel limit.--Creel limits were not rigorously tested because the long-standing limit of five was rarely achieved by anglers at average waters. However, over 10,500 interview records were compiled for the unique pike fishery at Fletcher Floodwater in years when the minimum size limit was 14 inches. In the open-water seasons, the percentage of the anglers catching various numbers of pike was: 0 pike--59.8%; 1 pike--24.0%; 2 pike--9.0%; 3 pike--3.2%; 4 pike--2.2%; 5 pike--1.8%. Fishing was better in the winter: 0 pike--30.0%; 1 pike--27.1%; 2 pike--18.6%; 3 pike--10.4%; 4 pike--6.9%; 5 pike--7.0%. Thus, even at this lake, which had an over-abundance of slow-growing pike, few anglers caught as many as five pike.

Northern pike spearing.--There has been a long-standing debate on whether or not the spearing of pike from ice shanties harms the pike population and detracts from the open-water fisheries. Latta (1972) predicted that, in general, spearing would not harm reproduction but that it would compete with summer fishing because the natural mortality of pike is low during winter and most of the fish not taken then would be available later. Census data from Fife Lake and Fletcher Floodwater provide some empirical information which supports Latta's prediction. Data from five other lakes were not useful for this analysis because a ban on spearing was coupled with a change in size limit, or because the ban was in effect throughout the census.

Pike spearing was a popular pastime on Fife Lake and Fletcher Floodwater. During the spearing ban, the total winter fishing hours dropped

44% and 39%, respectively, and at Fife Lake, the hours of shanty use fell 60%. Many spearers switched to the open-ice style of fishing, or relied on tip-ups, or fished for panfish. Total winter pike catch declined 49% at Fife Lake and 31% at Fletcher Floodwater; and at Fife Lake the harvest of pike from shanties fell 82%. This was offset by higher pike catches in the open-water seasons--157% at Fife Lake and 30% or more at Fletcher Floodwater. Thus the summer fishery appeared to benefit from the restrictions on the winter fishery. On the other hand, winter fishing is a legitimate and important form of recreation.

Walleye.--Walleye fishing regulations were not adequately tested. Of the lakes at which the March 15 to April 25 closed season was removed, only Bear Lake (Manistee County) supported a significant walleye fishery. Removal of the closed season on Bear Lake did not affect catch or catch rate, and did not stimulate angler interest, possibly because the walleye spawning area is not well known. Big Portage, Duck, and Fine lakes supported a few stocked fingerling walleyes and very small fisheries. Removal of the 13-inch size limit at these lakes had no detectable effect on total catch, but it was observed that 15% of the walleyes taken were less than 13 inches long.

Rainbow trout season.--The closed season on rainbow trout was reduced or eliminated at three test lakes to encourage harvest of the planted fish. The time of year when trout were stocked was also varied.

Both management techniques had a strong influence on the trout fishery. At Birch Lake, advancing the opening day from June 25 to May 15 stimulated fishing effort and catch, and increased the rate of return from 17% to 47%. A significant ice fishery (producing 27% of the annual catch) was generated in one winter when a large number of trout were available because of a December planting. At Corey Lake, just 7% of the trout were caught in the winter because most of the trout were stocked in early spring. However, the combination of winter fishing, plus biennial stocking, increased the yearly harvest from Corey Lake by 82%. At Big Twin Lake, only a few trout were caught in the special winter season because the trout population was low.

Census data for 72 other lakes (Christensen and Ryckman 1960) show that substantial winter fisheries were developed.

Analysis of each lake

This section of the report presents in detail the results at each experimental lake. Included are the basic creel census statistics, relevant data on population size and growth, and a discussion of the change in each fishery.

Bear Lake (Hillsdale County)

Bear Lake, Hillsdale County, is small (117 acres), relatively deep (maximum depth 53 feet), and has the abrupt dropoff of a typical marl lake. Its fishery was studied from the winter of 1937-38 through the winter of 1953-54 and its fish population was studied intensively in 1940 and 1941. Initially, the purpose of the census study was to assess the impact of winter bluegill fishing on the summer fishery (June 25-October 15). Ironically, closer examination revealed that the winter fishery was not especially large and that little impact could be expected (Clark 1941). Later, 1946-50, the creel census assessed the effect on panfish (mostly bluegill) of removing the 6-inch minimum size limit, the creel limit on "sublegals", and the closed spring season. In 1951, regulations on bluegill and pumpkinseed reverted back to a closed season April 1-June 24, but the no-size limit was retained (statewide). In 1952 and 1953, the closed season was reduced to April 1-25.

Results were reported, in part, by Clark (1941) and Christensen (1953). Additional data found in files are compiled here as well (Tables 10 and 11). In 1937-45, virtually all fishermen were contacted, so the census was nearly a complete one. Afterwards, the sampling type of census was used. In 1946, 76% of the anglers were interviewed but after that 6-10%.

Fishermen.--Bear Lake attracted large numbers of fishermen from nearby Ohio. In the open-water season, 49% of the anglers were from outside of Michigan, 39% resided in Hillsdale County, and 12% lived elsewhere in Michigan. In the winter, 77% of the fishermen were "locals", 20% lived in

other Michigan counties, and 3% were from other states (non-resident, non-property owners were banned). Men and boys made up 75% of the anglers in summer and 94% of the participants in winter.

Methods.--Nearly all fishing was done from boats or through the ice, mostly for bluegills. The length of the average trip varied some from year to year but was about 3 hours long in all seasons. In the open-water fishery (1946-53, for example), 74% of the anglers used still-fishing techniques, 12% used fly or bait casting, 1% trolled, and 13% used a combination of methods. The winter fishery was directed entirely at panfish because northern pike were not present in the lake.

Pressure.--Fishing pressure increased from 60 hours per acre (1939-45) to 136 (1946-50) when restrictions on size and season were eliminated for panfish (Fig. 1). However, this was partially due to a surge in fishing activity at the end of World War II as well as to changes in regulations. In 1946, for example, only about 20% of the total angling hours were expended in the new spring season. We also note that total fishing pressure remained high when the extended closed season was enforced again in 1951 (the no size limit was then in effect statewide).

The summer fishery was the most important. In the last 2 years of census, 1952 and 1953, 62% of the total hours and 62% of the total catch took place in the June 24-September 15 period. Spring fishing (only slightly restricted by the April 1-25 closure on bluegill and pumpkinseed) was 16% of the total hours and 22% of the total catch. In the fall, 6% of the total hours were expended and 6% of the catch was made. Ice fishing added 15% of the total hours and 10% of the total catch. The ice fishery in earlier years (1939 and 1940) was of similar magnitude.

Catch.--Fish were caught at the annual rate of 61 per acre prior to liberalized regulations and 118 per acre in 1946-53. About 25% of the increase was due to the harvest of bluegills less than 6 inches long (Christensen 1953, Table 9), the remainder to increased harvest of larger fish as a result of

increased fishing pressure. Catch per hour remained at about 1.0 throughout the study (Table 10).

The catch was comprised of bluegills (66%), yellow perch (16%), largemouth bass (6%), and pumpkinseed (5%), plus miscellaneous panfish (Table 11). A few smallmouth bass and cisco (in winter of 1945) were reported.

The size-frequency of the bluegills in the catch varied some from year to year, probably reflecting the recruitment of weak or strong year classes (Table 12). In 1948, the bluegills were small, mostly in the 5-inch group. In the late 1930's (Clark 1941) and again early 1950's (Table 12), the average size was about 7.5 inches. Most of the bass caught were in the 10-inch size group (Table 13).

The creel limit of 25 panfish (but not more than 15 large bluegills) was rarely reached. Only 1% of the 1,133 fishermen interviewed in the summer of 1945 had met (or exceeded) the panfish limit. Of the fishermen who caught bluegills, 75% had 1-5, 21% had 6-10, 4% had 11-15, and 0.2% had taken more than 15. Of the fishermen who caught perch, 87% had 1-5, 10% had 6-10, 2% had 11-15, and 1% had 16-20.

Population studies. --Bear Lake was also the site of one of the early attempts to estimate a fish population by the mark-and-recapture technique. Fish were caught in commercial trap nets and either fin clipped or jaw tagged in May 1940, October-November 1940, June 1941, and September-October 1941. Estimates of larger fish were computed and some were published (Clark 1941). Estimates ranged as follows: bluegill, 10,300-22,800; largemouth bass, 487-2,817; pumpkinseed, 485-1,051; black crappie, 49-789; rock bass, 125-131; warmouth bass, 354-583; yellow perch, 190; brown bullhead, 356-544; yellow bullhead, 120-440; and bowfin, 125. The high variability in the bluegill estimates was probably due to uneven recruitment; the perch estimate is probably the least reliable because it is difficult to sample perch with trap nets.

During the population study in the fall of 1941, 1,960 bluegills and 57 largemouth bass were fin clipped. The intensive (about 99%) creel census in the following 12 months recorded 142 marked bluegills and 4 marked bass. Thus the rate of exploitation by anglers was about 7% for both species.

Conclusions.--Liberalization of regulations on panfish, combined with a two-fold increase in fishing pressure and catch, had no detrimental effect on the population or fishery (Christensen 1953). Catch and catch-effort showed no immediate or progressive decline. (The slump in bluegill catch which occurred in the seventh year [1953] was likely due to the chance occurrence of weak year classes.) The new spring fishery was of modest size, and angling quality was not significantly better in that season than in the others (Christensen 1953). Total exploitation was relatively low, probably increasing from about 7% to 14%.

Bear Lake (Manistee County)

Bear Lake, Manistee County, is large (1,744 acres) and shallow (maximum depth of 23 feet). Most of its shoreline is rimmed by cottages and resorts. Walleyes were successfully introduced in 1900 and by the 1920's, an excellent population and fishery had been established (Hubbs and Eschmeyer 1932). In the 1950's, the walleye catch was only 0.5 walleye per acre per year.

A creel census was conducted from the summer of 1951 through the summer of 1965 to evaluate the effects of: (1) removing the closed seasons on game fish (1954-63) and (2) restricting fishing for northern pike (1959-63) (Table 14). Also, the census was used to evaluate the success of fingerling walleyes planted in 1960-63 (Schneider 1969). The census clerk contacted about 2% of the fishermen in the summer season, 6% in the spring and fall seasons, and up to 25% of the anglers fishing through the ice.

Fishermen.--Beginning in 1953, Bear Lake attracted large numbers of tourists from Indiana and other states. For example, in the open-water seasons of 1959-65, over 65% of the anglers were from out-state, less than 10% resided in Manistee County, and about 25% were from southern Michigan. However, during the winter, 96% of the anglers using shanties and 68% of the anglers standing on open-ice resided locally. Men and boys made up over 80% of the participants during the summer and about 90% of the anglers in the other seasons.

Methods.--Nearly all fishing was done from boats or through the ice. The average trip lasted 2.5 hours in the spring and fall, 2.7 hours in the summer, and 5.0 hours in the winter--regardless of whether a shanty was used or not!

Over 90% of the ice fishermen sought walleye and northern pike. In a typical winter (1957-58, for example) 36% of the fishermen used hook-and-line tackle (mostly tip-ups) exclusively, 29% speared pike exclusively, and 35% used both methods. The banning of spearing in the winter caused only a temporary drop in shanty effort (Table 14).

During the early 1950's, about 50% of the anglers in boats still fished exclusively while the other 50% cast, trolled or used a combination of techniques. By the mid-1960's, only 40% of the anglers used the still-fishing technique exclusively. A corresponding change took place in the kind of fish sought. In the early years of the study, about 35% of the anglers sought panfish only, 40% sought only game fish, and the balance, 25%, sought both kinds of fish. By the end of the study there was a much greater interest in catching "the big ones." These proportions had become 25%, 65%, and 10%, respectively.

Pressure.--Fishing pressure remained close to 41 hours per acre per year throughout the census (Table 14 and Fig. 2). Most of the fishing--63 to 85%--occurred in the summer. Angling through the ice, which accounted for about 5% of the hours during the 1950's, increased to over 10% of the annual hours during the 1960's. About 6% of the fishing took place in the spring during the early years of the study. This figure increased to 10% in the years of liberalized regulations, then to over 15% by the end of the census.

Catch.--Fish were caught at the annual rates of 21 fish per acre and 0.53 fish per hour (Table 14). About 50% of the boat fishermen and 25% of the ice fishermen were successful at catching at least one fish. These rates are considerably less than those for 12 other Michigan lakes (Christensen 1953).

Bluegills were usually the predominant species in the catch, however more rock bass, yellow perch or pumpkinseeds were caught in some years

(Table 15 and Fig. 2). Largemouth and smallmouth bass were the prevailing game fish until 1963, when a decline in bass and an increase in walleye and northern pike took place. Bowfins and bullheads were caught occasionally.

All species of fish in Bear Lake, but especially the northern pike and walleye, grew faster than the state average rates and most entered the catch at age II (Tables 16 and 17). For the panfishes, the catch was predominantly age groups IV or V. About 30% of the panfish kept by anglers were less than 6.0 inches long. For bass and pike, age group III comprised 32-40% of the catch. Most of the walleyes in the catch were relatively old (ages IV-VI) and large. An important exception was the 1962 year class of walleyes, which made up 36% of the walleye catch in 1964.

Most of the fluctuations in catch can be traced with the aid of scale samples to natural fluctuations in recruitment. For example, the large catch of rock bass in 1956 and 1957 was due to an extremely large year class in 1952. Among the game species the picture is not as clear because changes in fishing regulations affected catch.

Bass.--The catch of both largemouth and smallmouth bass gradually increased under year-around fishing, then underwent a long decline (Fig. 2). Possibly the decline was the result of overfishing but it seems more likely that it was related to the increase in pike and walleye (see below). A breakdown of the catch to a monthly basis shows that 20% of the smallmouth bass catch and 10% of the largemouth bass catch were made in April and May--the months when bass fishing was prohibited statewide (Fig. 3). During June, when bass spawned, 12% of the smallmouth bass catch and 26% of the largemouth bass catch was made. Thus roughly 25% of the bass catch was made prior to spawning. Smallmouth bass experienced a steady decline in recruitment after the no-closed season went into effect; largemouth bass produced three strong year classes before their decline began.

The opportunity to fish for bass year around did not alter the winter fishery at Bear Lake and the spring fishery only increased from 6 to 10% of the annual total. However a large fraction (40%) of the spring-time anglers were seeking bass and their catch per hour was high (Figs. 4 and 5).

Smallmouth bass in particular were readily caught just after the ice went out in April.

Walleye.--Changes in the catch of walleyes are attributed to naturally caused variations in recruitment and to hatchery plantings. The catch, catch rate, and angler interest were all low in the mid-March to April period when walleye fishing is traditionally closed (Figs. 3-5). This may have been due, in part, to the lack of a well known spawning concentration. The sharp decline in the catch in 1959 and 1960 was due to weak year classes in the mid-1950's--years when the populations of largemouth, smallmouth, and rock bass were high. Also, these classes grew less rapidly than other year classes of walleyes. The increase in the catch in the 1960's is attributed to strong native year classes in 1958-59, supplemental plantings of hatchery fingerlings in 1960-62, and to an increased interest in fishing for walleyes (Schneider 1969).

The rapid growth of walleyes and the measurable (albeit small) success of hatchery fingerlings indicate that the walleye population of Bear Lake was at a reduced level due to poor reproductive success. It is reported that there is only one small area of rubble substrate suitable for spawning.

Northern pike.--Changes in the fishery and population of pike were more difficult to interpret because both fishing season and minimum size limit were altered during the census. The catch of pike was much higher at the end of the census than at the beginning (Fig. 2). This was due to strong year classes in 1959-61. The interim dip in the catch of pike suggests that the reproductive success of this population was impaired by the no-closed season and enhanced by the restrictive season and size limit; however this correlation may be purely coincidental for the following reasons:

1. Few pike were caught in early spring when pike are usually protected (Fig. 3). The increase in the catch during the first 2 years of year-around fishing was due to fairly strong year classes in 1951 and 1952. It should also be noted that few anglers fished for pike at that time of year and that pike were not easier to catch (Figs. 4 and 5).

2. The increased catch during the initial years of the extended closed season and higher size limit can be traced to moderately strong year classes in the last 2 years of liberalized fishing restrictions.

On the other hand, because this population grows so rapidly, the higher size limit (20 inches) may result in more yield (in pounds) to anglers than the old 14-inch size limit. A 20-inch size limit would also provide some protection to the spawning stock (Latta 1972); however in this lake pike recruitment appears to be limited more by a paucity of marshy habitat suitable for spawning.

Big Portage Lake

Big Portage is an unproductive marl lake in Jackson County. Maximum depth is about 40 feet. In February 1957, a 3-foot dam increased the lake's area from 360[3] to 437 acres and boosted the growth of bluegills, largemouth bass, and black crappies for a couple of years (Merna 1963). Temporary increases in fishing pressure and in the catch of bluegills, yellow perch, and largemouth bass resulted in 1958 (Fig. 6).

In the fall of 1953 and the spring of 1954, the lake was intensively sampled with trap nets in an attempt to estimate the size of the fish population (Cooper et al., unpublished manuscript). Few recaptures were obtained and estimates could not be derived; however it was noted that the catch rate for bluegills was about one-fifth that obtained in Whitmore and Sugarloaf lakes.

Special fishing rules were in effect 1946-50 and 1954-61. Over the 15 years of census the fishing regulations were liberalized in three major steps. First (1946) the closed season on bluegill, pumpkinseed, yellow perch, and other panfish was completely removed (the season was reinstated for 1951, then virtually eliminated). Also, the closed season on northern pike and walleye (uncommon) was reduced first from 13 weeks to 8 weeks, then to 5 weeks. Second (beginning in September 1949), the 6-inch size limit on panfish was

[3] The figure of 360 acres prior to impoundment is based on the hydrographic map; Merna derived estimates of 335 acres (pre-impoundment) and 437 acres (post-impoundment) from a land contour map.

eliminated (statewide). Third (1954-58), the size limit on game fish was eliminated also. For pike, a 14-inch limit was applied in 1959 and 1960-61. Christensen (1953) summarized census methods and some of the early results. The census clerk interviewed 1 to 8% of the anglers each year.

Creel census was also taken in 1936-38 (Hazzard and Eschmeyer 1938; Clark 1940). Based on estimated interview rates of 50% for winter 1935-36 and 90% for other periods, these records have been expanded and are included in Tables 18 and 19 for comparison.

Fishermen.--Michigan residents comprised 94% of the fishermen and out-of-state residents, 6%. The sex ratio of anglers was 83% male and 17% female.

Methods.--Virtually all fishing was done from boats. The shore and ice fisheries were of very minor importance and in some years the ice fishery was too small for statistical estimation (Table 18). The length of an average fishing trip was about 3 hours during the experimental years; this is considerably less than the 4.5 hours recorded in 1938 (Clark 1940).

Liberalizing the fishing regulations (most notably the removal of size limits on game fish in 1954) had no noticeable effect on fishing methods or the species sought. However, during the 1950's there was a gradual shift in interest from panfish to game fish at Big Portage Lake, as there was at many other lakes. The proportion of anglers fishing for panfish exclusively declined from about 45% to 25%, whereas the proportion of anglers seeking bass increased from 15 to 25%. No trends were evident in the proportions of anglers seeking pike (5%) or a combination of species (typically about 50%).

Corresponding trends in fishing methods between 1947 and 1959 were a decline in still fishing from 75 to 40% and an increase in the use of combination methods from 10 to 40%. No change occurred in the amounts of casting (10%), trolling (5%), and casting plus trolling (5%).

Pressure.--Annual fishing pressure averaged 38 hours per acre (range, 21 to 62). The special regulations probably increased pressure by

20-30%. The spring fishery, created in 1946-50 and 1952-61 by the relaxed seasons on panfish and pike, contributed 22% of the annual hours; and the removal of size limits in late 1949 and in 1954 caused temporary and modest increases (Fig. 6). Most of the two-fold increase between 1939 and the late 1940's reflects increased fishing statewide. The long-term decline in pressure after 1950 appears to be correlated with declining bluegill catch, as discussed below.

Catch.--Fishing was poor at Big Portage Lake, even under liberal rules. Catch rates for all species were 20 fish per acre per year (range, 7-59). In 1946-61, fish were caught at the rate of 0.49 per angler hour (annual range, 0.15-1.04), a decline from the 0.8-0.9 recorded in the 1930's (Table 18). Catch-per-hour rates averaged 0.23 in winter, 0.56 in spring, 0.50 in summer, and 0.52 in fall.

The composition of the catch was bluegill, 59.2%; yellow perch, 16.0%; largemouth bass, 9.0%; black crappie, 5.2%; pumpkinseed, 4.3%; northern pike, 2.0%; rock bass, 1.4%; walleye, 0.5%; plus some bullheads, carp, and smallmouth bass.

The opportunity to fish in the spring (i.e., prior to the third week in June) resulted in a modest harvest. The average percentages of the annual harvest made in the spring (data for 1950, 1952-61) were: bluegill, 30%; pumpkinseed, 18%; yellow perch, 12%; black crappie, 14%; northern pike, 14%; and walleye, 6%. Undoubtedly, some of these fish would have been caught in other seasons if spring fishing had remained prohibited; however the data are inadequate (only for 1951) to measure the net effect of spring fishing on total harvest.

Panfish.--Catches of bluegills and, less significantly, rock bass declined (Fig. 6 and Table 19). Catches of bluegills averaged 6,700 in 1936-38, 9,150 in 1946-50, and only 2,250 in 1951-61. This decline is linked to declining fishing pressure, a decline in catch per hour (of all species combined, Table 18), reduced interest in still fishing for panfish, and reduced growth (Table 20). It cannot be resolved to what extent this chain

of events was caused by spring fishing (beginning in 1946), removal of the 6-inch size limit (beginning in late 1949), random fluctuations in the bluegill population, or unrelated changes in angler behavior.

Overfishing in this unproductive lake is a tempting explanation, but it somehow would have to be causally linked to the reduction in growth, which was presumably the result of increased (not decreased) recruitment. Exploitation rate was not measured and the increase in fishing mortality due to the liberal regulations can only be roughly estimated. Of the total catch of bluegills, 30% were caught in the spring and about 35% were less than 6 inches. However the total, 65%, is a high estimate of the increase in bluegill mortality under liberal rules because anglers were now allowed to keep fish which would have died from natural causes or which would have been caught later anyway.

Game fish. --Game fish catches and populations were not damaged by the removal of size limits or, in the case of pike and walleye, by allowing some fishing in the spring.

For largemouth bass, increased interest in fishing for bass plus the removal of 10-inch size limit tended to counterbalance the decline in total fishing pressure. As a result the catch was relatively stable at about 2 per acre (Fig. 6). Catch rose in 1958, due to a strong year class and the higher water level. The census clerk examined 124 bass when the no-size limit was in effect and found that 41% of them were less than 10 inches long. Bass growth increased in the 1950's (Table 20).

The catch of northern pike was less than 1 per acre per year. It failed to rise when the 14-inch size limit was removed in 1954, and it declined to near zero in the 1960's in spite of the increase in water level (Fig. 6). The decline cannot be attributed to the liberal regulations because none of the 25 pike examined by the census clerk was less than 14 inches long and the spring catch was not large (Table 19). The decline in pike may have been related to an increase in carp; approximately 10 tons of carp were killed when the lake was poisoned in 1964.

A total of 1.1 million walleye fry were planted between 1935 and 1942. The resultant catch from 1937 to 1961 averaged 35 per year (251 in

best year, 1951). Thus, total harvest was about 875 walleyes. If all had been survivors of the fry plants, return rate would have been about 0.08%; however, the presence of some small and young walleyes in the later years indicates that some contribution was made via natural reproduction. It is not known if walleyes were native to the lake. None of the eight walleyes measured was less than 14 inches long.

Big Twin Lake

Big Twin Lake, Kalkaska County, has an area of 215 acres and a maximum depth of 90 feet. Cold water and high dissolved oxygen favor the survival of rainbow, brown, and lake trout, which have been planted on top of populations of warmwater species in various years. Yellow perch, rock bass, pumpkinseed, and cisco are common native species; bluegill, smallmouth bass, and largemouth bass are present also.

Reports of good fishing from plantings of small fingerling rainbow trout led to the experimental removal of the closed season on trout. A sampling-type census was begun when the ice formed in December 1952, and was carried through for one full year. About 15% of the ice fishermen and about 3% of the open-water anglers were contacted. No fishing boats were observed in fall (September) and only three were seen in spring.

Fishing pressure was found to be very light in all seasons, totaling just 14 hours per acre for the entire year (Table 21). The catch per hour was 1.66 fish, but consisted almost entirely of yellow perch, pumpkinseed, and rock bass (Table 22). Only seven rainbow trout were estimated to have been caught--all in the special winter season. Netting in July 1953 revealed that the rainbow trout population had become sparse; therefore the study was discontinued at Big Twin Lake and later resumed at Corey Lake.

Big Twin Lake was open to the sport netting of ciscoes from November 16 through December 10, 1952. Christensen (letter dated July 13, 1953, from A. S. Hazzard to F. A. Westerman) reported that the catch from 36 net sets was 243 cisco, 16 suckers, 4 rainbow trout, 1 bluegill, and 1 pumpkinseed.

Birch Lake

Birch Lake, Cass County, has an area of 295 acres and a maximum depth of 95 feet. It was one of the first lakes in Michigan to be successfully managed for both warmwater species and planted rainbow trout.

A creel census of the sport fishery was conducted in 1941-50 and 1953-61. In addition, a special study was made of the cisco population and fall gill net fishery in some years (Clady 1966). The purpose of the creel census was to evaluate the harvest of rainbow, lake, and brown trout (planted according to several schedules) and of planted smallmouth bass. Special extensions of the fishing season were made to encourage greater use, and panfish harvest was aided by statewide liberalizations of laws. Taube (1965) gave some of the information on rainbow trout returns and Christensen and Cooper (1955) reported on smallmouth bass returns.

The census estimates are based on interviews with the following percentages of the total number of anglers: 1941, 51%; 1942, 73%; 1943-46, 100%; 1947-61, 3-11%.

Fishermen.--Most (about 70%) of the anglers resided in other states, principally Indiana. The balance (about 30%) were about equally divided between those who lived in Cass County, and those who resided in other Michigan counties. The winter fishery, which by law was banned to non-Michigan residents except Michigan property owners, attracted Cass County residents and other Michigan residents in equal proportions. The ratio of males to females was 9:1.

Methods.--Virtually all fishing was done from boats. The ice fishery for warmwater species of fish was small (due to low catch rates and frequently hazardous ice conditions) and was not censused until 1958-59 (Table 23). Ice fishing picked up slightly when trout could be taken. The average length of a boat trip in the open-water seasons was about 3.0 hours.

Fishing methods did not change significantly over the 20 years of census. About 75% of the anglers still-fished, 11% trolled, 5% cast, and 9% used a combination of these techniques.

The type of fish sought by anglers (recorded after 1954) varied seasonally. In spring, 31% exclusively fished for trout and 65% for panfish. In summer, only 9% sought trout, as compared to 52% for panfish and 35% for bass. In fall, 24% were after trout, 50% panfish, and 21% bass. In winter (e.g., 1959-60), 69% fished for trout and 20% for panfish. Unlike some other experimental lakes, there was no steady increase in bass fishing during the 1950's on Birch Lake.

Pressure.--Fishing pressure doubled in the 1940's, declined, then stabilized at about 60 hours per acre (Fig. 7). The increase was mostly due to the special May 15-June 24 spring season because summer and fall pressure increased only slightly (Table 23). The reason for the temporary drop in effort in 1954 is not known.

Considerable additional fishing was generated by regulations which permitted (1) trout fishing through the fall months (since 1941), in the spring (since 1946), and in the winter (since 1959-60), and (2) panfishing in spring (after 1946, and 1955). By the last 2 years of the census, when the most liberal laws were in force, the spring fishery was generating 21% of the annual hours, the summer fishery 57%, the fall fishery 20%, and the ice fishery 2%. However, the summer fishery had declined some by then.

Catch.--Fish were caught at the relatively low rates of 33 per acre (annual range, 12 to 63) and 0.53 per hour (range, 0.24 to 1.08). Winter fishing quality was generally poor, but there was no consistent difference among the other seasons.

The composition of the hook-and-line catch was as follows: bluegill, 50.1%; rainbow trout, 14.6%; yellow perch, 11.8%; largemouth bass, 8.4%; rock bass, 7.0%; pumpkinseed, 4.2%; black crappie, 1.6%; smallmouth bass, 1.2%; and bullhead, 0.7%. A few lake trout, brown trout, cisco, suckers, and green sunfish were taken (Table 24). Strangely, black crappie was not recorded from the lake until 1958.

Large numbers of ciscoes were harvested in gill nets in a special fall season. This catch declined from 20,750 in 1939, to 37 in 1950.

Clady (1966) could not link this decline to trout stocking, overfishing, or other factors.

Fishing quality (catch per hour) was best in the spring (Table 23). For the important panfish species, 21% of the annual effort produced 19-25% of the annual catch. For rock bass, 44% of the yearly catch was made in the spring.

Trout.--Rainbow trout were heavily stocked, beginning in 1938 (Table 25). Typically, fin-clipped, legal-size fish were stocked in both spring and fall at the rate of about 20 per acre per year.

The rainbows grew and survived well. The average length of angler-caught fish varied between 10.6 and 12.6 inches in 1941-45. A representative length-frequency is shown in Table 26. Rainbows caught in the winter of 1959-60 (in the first year after planting) averaged 11.4 inches. "Carry-over" fish, larger in size, sustained the fishery in 1957, 1958, 1960, and 1961.

Results of the rainbow trout experiments were as follows:

1. The spring plants (data for 1943-50) gave a better rate of return, 26.3%, than the fall plants (data for 1941-49), 17.1% (letter from Walter R. Crowe and C. M. Taube to C. T. Yoder, dated January 26, 1956).

2. The special spring season (opening May 15 instead of June 25) increased the rate of return from 17% in 1941-45 to 47% in 1946-50 (Taube 1965). This resulted from greater fishing effort rather than a higher quality of fishing because trout caught per hour (by all types of anglers) was unchanged at 0.086 (Table 25).

3. Concern that the trout fishing was declining because the food supply was overgrazed prompted the stocking of rainbows every third year at the same rate, 20 per acre per year, beginning in 1956 (Table 25). Returns increased to 56%, but catch rate fell very low by the third year.

4. Winter fishing resulted in a significant rainbow harvest in one winter (1959-60) but not in two others (Table 24). This was mainly due to the stocking schedule and the availability of fish to the anglers (Table 25). Results at a large number of other lakes were summarized by Christensen and Ryckman (1960).

Lake trout were stocked in 1907-10 (40,000 fry), 1937 (10,000 9-month-old fingerlings), and in 1940 (790 adults). The last two plantings yielded an estimated catch of 174 fish in 1941-46. The rates of return were less than 1% for the fingerlings and about 18% for the adults. The plants earlier in the century probably supported the lake trout fishery which reputedly existed there in earlier years.

The lake supports a few native brown trout. Hatchery-reared yearlings were added at the rate of 5,000 per year in 1947-50. Only about 92 of these (0.4%) were harvested.

Yearling brook trout (1,000) were stocked in 1938. Two were caught in 1941, the first year of the census.

Panfish.--Bluegill and other warmwater panfish were the most sought after type of fish and made up the bulk of the catch. However, catch was low because of the unproductive character of Birch Lake. The catches of most species increased slightly during the census (Fig. 7). This may have been due to the spring fishing opportunity and the removal of size limits. The fish were of good size (Table 26).

Bass.--Largemouth bass were more prevalent than smallmouth bass. Fin-clipped smallmouth fingerlings, totaling 20,500, were stocked in 1946-48. None of these were observed in the creel, and total catch did not improve (Fig. 7, and Christensen and Cooper 1955).

Corey Lake

Corey Lake, St. Joseph County, has an area of 630 acres and a maximum depth of 80 feet. It has a reputation for good fishing. Like Birch Lake, it was managed both for native warmwater fish and for planted rainbow trout, beginning in 1949.

A sampling-type creel census was used to estimate harvest from the winter of 1954-55 through the winter of 1961-63 (Table 27). Study objectives

were to determine the amount of harvest generated by a special winter trout season (beginning January 1, 1957) and to compare returns from annual (December) versus semiannual (December and early spring) stocking schedules. Taube (1965) has already summarized much of the data on trout.

About 6% of the boat fishermen and roughly 25% of the ice fishermen were interviewed. This produced 95% confidence limits of about ±10% for the annual estimates of number of angler trips (about ±15% for those seasonal estimates) and of about ±35% for the annual estimates of trout catch (±31 to 100% for those seasonal estimates).

Fishermen.--Corey Lake was heavily fished by non-residents because it is close to the Michigan-Indiana border. In summer, 93% of the anglers resided in other states, 5% lived locally, and 2% were from elsewhere in Michigan. Winter fishing by non-residents who did not own property in Michigan was banned by law in the study years; therefore only about 12% of the ice anglers were non-residents and nearly all of the remaining 88% were local residents. The ratio of male anglers to female anglers was 4:1 in summer and 19:1 in winter.

Methods.--Fishing was done from boats or through the ice, as the lake affords little opportunity for shore fishing. The average length of a boat trip was about 3.7 hours, and tended to be shorter in summer than in spring or fall. An ice fishing trip was about 3 hours long whether a shanty was used or not.

The methods used by anglers varied seasonally. In summer and fall, 85% still-fished, 5% trolled, 6% cast, and 4% used a combination of these techniques. In spring, still-fishing was 60%, trolling 25%, casting 2%, and fishing by a combination of methods 13%. Winter fishing gear was 96% hook-and-line and 4% spear.

The type of fish sought varied seasonally also. The percentages of anglers fishing for panfish exclusively were spring, 50%; summer, 80%; fall, 76%; and winter 96%. Corresponding figures for trout were spring, 45%;

summer, 6%; fall, 8%; and winter, less than 1%. Corresponding figures for bass were summer, 13%; and fall, 11%. A few percent of the anglers sought a combination of species in each of the seasons. We conclude from these data that the special winter season on trout did not create a significant special fishery but simply allowed anglers to take trout incidental to panfish.

Pressure. --Annual fishing pressure was fairly stable at 142 hours per acre (Fig. 8). Of this total, 52% was in summer, 20% in fall, 17% in spring, and 11% in winter. Winter pressure was 8% higher in the winters in which trout could be taken.

Catch. --Fish were caught at the rates of 170 per acre (annual range, 108 to 388) and 1.20 per hour (annual range, 0.83-1.34). Fishing was good in all seasons but especially in winter (Table 27).

The composition of the catch was bluegill, 87.1%; yellow perch, 5.8%; pumpkinseed, 3.1%; largemouth bass, 2.0%; and rainbow trout, 1.8%; plus a few black crappies, smallmouth bass, cisco, mud pickerel, and white suckers (Table 28). Nine (9) brown trout were estimated to have been caught in the summer of 1959, but none had been stocked in the lake so far as is known.

Trout. --Rainbow trout were stocked beginning in 1949, typically at the rate of eight legal-size fish per acre per year (Table 29). They were caught in the open-water seasons (especially the spring) when they were legal but also during the winter. In the winter of 1954-55, it was estimated that about 1,000 were hooked and released; in 1955-56, fewer than 100 were taken. An experimental winter season was begun in 1956-57 and, in conjunction, the planting schedule was split into December and early spring. "Before" census data includes 2 full years (winter of 1954-55 through fall 1956); "after" census data includes 5 full years plus the winter of 1961-62.

Harvest was 82% higher when winter fishing was permitted and trout were stocked twice a year. The catch in the "before" years was 1,532 and 899, for an average of 1,216, as compared to an average of 2,224 in the "after" years. The winter harvest averaged 139 trout (range, 66 to

230), or just 6.9% of the annual total. Thus about 75% of the improved harvest was due to better catches in the open-water seasons. That can probably be attributed to planting most of the trout in early spring rather than planting them all in December.

The overall rate of return from split-season stocking and liberal fishing was about 45% (2,224 ÷ 5,000). No consistent differences in rates of return were evident between December and spring plantings, nor between plants of small (8-inch) and large (11-inch) trout. However, interpretation of data was complicated by regeneration of clipped fins and probably, incomplete marking.

While most trout were caught within their first two seasons in the lake, some survived more than a year and reached lengths of more than 16 inches (Table 30). The average length of trout creeled was 12.2 inches from the December plants and 11.8 inches from the spring plants.

Other fish.--Bluegills, yellow perch, and largemouth bass were the most sought-after species and made up the bulk of the catch. The catches varied considerably from year to year but without long-term trends (Fig. 8). No changes in fishing regulations took place during the census. The fish were of large size (Table 31) and their growth was excellent (Table 32).

Craig Lake

Craig Lake, Branch County, has an area of 122 acres and a maximum depth of 25 feet. Fish migrate freely between this lake and other lakes in the Coldwater River chain. Exceptional fishing results when bluegills concentrate in Craig Lake in the winter.

Creel census was conducted from winter 1938-39 through summer 1940, and again from spring 1946 through fall 1951. Only the 1951 data have not been reported previously by Clark (1941) or Christensen (1953). Their conclusions, that winter fishing should not be restricted to favor summer fishing and that spring fishing for (primarily) yellow perch and black crappies is not detrimental, are not changed. The early data were based on interviews with about 80% of the anglers (expanded to 100% in

Tables 33 and 34) whereas the estimates for the later period were based on interview rates of 5-13%.

In conjunction with the census, mark-and-recapture population estimates were made in certain years (Table 35). These estimates are quite rough due to fish migration, and to the species and size selectivity of the trap nets used to capture the fish. The data were adequate, however, to safely conclude that overexploitation was not a problem (Beckman 1948a).

Fishermen. --Only 2% of the winter anglers were non-residents due to a legal restriction. In the summer this figure rose to about 83%. The sex ratio was 75% male and 25% female.

Methods. --Among boat fishermen, 73% still-fished, 10% cast, 3% trolled, and 14% used a combination of these methods. Among ice fishermen, nearly all used hand lines for panfish. Poor ice conditions often precluded the use of shanties.

Pressure. --Fishing pressure averaged 243 hours per acre in 1946-50, which was about the same as in 1938-40. The lack of increase after World War II probably reflects the fact that most resort development had already been completed in this area. The summer and winter fisheries were of similar magnitude.

Catch. --Fish were caught at the annual rates of 334 per acre (range, 212-502) and 1.37 per hour (range, 0.92-1.74) after World War II. Catch-per-hour rates in the winter were two to four times better than in summer (Christensen 1953). The pre-war figures were similar.

The catch was comprised of bluegill (77.7%), yellow perch (9.5%), pumpkinseed (4.3%), black crappie (3.4%), rock bass (0.1%), largemouth bass (1.6%), northern pike (0.5%), bullhead (1.6%), warmouth bass (1.1%), and miscellaneous species (0.2%) (Christensen 1953).

The annual catches of yellow perch, black crappie, and northern pike did not increase perceptively under year-around harvest (Table 34).

However, removal of the 6-inch size limit (September 1949) greatly affected the pumpkinseed fishery. Data for 1950 and 1951 indicate the following percentages of "small" fish: pumpkinseed, 57%; bluegill, 8%; yellow perch, 5%; and black crappie, 0%.

The average size of bluegills harvested varied between 6.5 and 7.5 inches from 1938 to 1949. Other data on fish size are given by Clark (1941). Bluegill growth was equal to the state average (Beckman 1941).

Devils Lake

Devils Lake, Lenawee County, has an area of 1,330 acres and a maximum depth of 63 feet. The lake provides good fishing. Special panfish regulations were applied beginning January 1, 1950, for a period of 5 years, to replicate experiments being conducted at Bear (Hillsdale County), Saddle (Van Buren County), and Hess (Newaygo County) lakes. Year-around fishing was permitted for all panfish, and the creel limit on panfish smaller than 6.0 inches was removed (Table 36). The 6-inch size limit had been removed in 1949 (statewide).

Census records were collected for 4 full years, spring 1950 through winter 1953-54. Estimates are based on interviews with 2-4% of the open-water anglers, 6-10% of the open-ice anglers, and voluntary reports by 7-49% of the shanty users. No "before" data are available for comparison and the data series is not long enough to detect trends in the catch, but the census does document the status of the fishery.

Fishermen.--The lake and its fishery attracted a large number of non-residents. In 1953, for example, 59% of the summer anglers were from Ohio and Indiana, as compared to 32% from Lenawee County, and 9% from elsewhere in Michigan. Even in winter anglers from Ohio and Indiana comprised 31% of all fishermen, as compared to 43% from Lenawee County, and 26% from other Michigan counties. Men and boys comprised 85% of the anglers in summer and 95% in winter.

Methods.--Fishing was done from boats, from shanties, or upon the open ice. Some pike were speared from shanties, but the pike fishery was small in all seasons. The typical fishing trip lasted 2.8 hours in the open-water seasons, 3.5 hours on the open ice, and 5.2 hours if a shanty was used. Boat anglers still-fished (81%), cast (6%), trolled (5%), or used a combination of methods (8%).

Pressure.--Annual fishing pressure was nearly constant at 79 hours per acre (Table 36). Exactly 50% of the fishing was done in summer. The popular winter fishery produced 28% of the total hours. The spring fishery, created in 1950 by the special regulation, generated 12% of the total effort.

Catch.--Fish were caught at the annual rates of 82 per acre (range, 57 to 132) and 1.04 per hour (range, 0.76 to 1.62). Catch rates were especially good throughout 1952 due to a large take of yellow perch (Table 37).

The composition of the catch for all years was bluegill, 43.8%; yellow perch, 39.4%; rock bass, 6.0%; pumpkinseed, 5.8%; largemouth bass, 3.6%; northern pike, 0.6%; smallmouth bass, 0.3%; brown and yellow bullhead, 0.2%; black crappie, 0.1%; plus a few warmouth bass, white bass, and gar. The presence of a white bass population is a novelty because Devils Lake is not closely connected to the Great Lakes. The census data suggest that black crappie and smallmouth bass were on the decline; however these species have been captured in more recent samples.

The special spring season increased the harvest of panfish by a modest amount. The following percentages of the yearly harvest were made in the spring (April 1-June 24): bluegill, 15%; yellow perch, 3%; pumpkinseed, 31%; and rock bass, 22%. Since the spring fishery generated 12% of the total effort, these data suggest that pumpkinseed and rock bass are relatively easy to catch in the spring and yellow perch are not.

Likewise the removal of the 6-inch minimum size limit and the creel limit on "sublegals" had no important effects because few small panfish were caught and kept anyway. In 3 years of observation only 8% of the bluegills, 1% of the yellow perch, 14% of the pumpkinseeds, and 6% of the rock bass were less than 6 inches long.

Duck Lake

Duck Lake, Calhoun County, has an area of 630 acres and a maximum depth of 51 feet.[4] It has long been noted for its excellent population of warmwater fish and good fishery. Fishing regulations were liberalized at Duck Lake (and also Fine Lake) in four major steps. First, in 1946, the lake was partially opened to spring fishing for northern pike, walleye (uncommon), yellow perch, crappies, rock bass, bullheads and "rough" species (lakes in southern Michigan had not been opened to any spring fishing since 1929). Second, in September 1949, the 6-inch size limit on panfish was eliminated (statewide). Third, in 1952, the closed spring season on bluegill and sunfish was virtually eliminated (statewide). Fourth, 1954-59, the size limit on game fish was also eliminated (except for a 20-inch size limit on northern pike in 1959). Christensen (1953) summarized methods and some early results. In most years the census clerks interviewed about 4%, 2%, 4%, 11%, and 25% of the spring, summer, fall, open ice, and shanty fishermen, respectively.

Fishermen.--Almost all (96%) of the anglers resided in Calhoun, Eaton, Ingham, or Jackson counties. Few anglers came from other Michigan counties (2%) or other states (2%). Males predominated (90%), but females comprised 20% of the summer anglers and were surprisingly well represented in all seasons.

Methods.--Virtually all fishing was done from boats or through the ice. The average trip was about 3 hours for boat and open-ice anglers, and 3.8 hours for shanty users.

Liberalizing the fishing restrictions had little or no effect on fishing methodology and the shift in interest from panfish to game fish observed elsewhere in the 1950's was not pronounced at Duck Lake. About 60% of the open-water anglers fished for panfish exclusively, 13% for bass (20% in summer), 2% for northern pike (5% in spring), and 25% for a combination of species. Still-fishing predominated (about 65% of the anglers), followed by

[4] Another estimate of area, based on a U.S. Geological Survey topographic map, is 457 acres (Marsh and Borton 1974).

casting and/or trolling (25%), and a combination of techniques (10%). Shanty fishermen sought northern pike (25%), panfish (10%), or any kind of fish (65%) and about 10% used spears exclusively. Most (90%) open-ice anglers were after panfish.

Pressure. --Fishing pressure averaged 117 hours per acre per year (range, 92 to 148). The changes in regulations seemed to have had no important effect on total pressure (Table 38 and Fig. 9). A spring season was created in 1946 and enhanced in 1952 and 1955; still it generated only 10% of the total hours. Total pressure increased by 22% in 1954, when all size limits were removed, but subsequently it varied within the usual range (Fig. 9).

Catch. --Fish were caught at the rates of 100 per acre per year and 0.86 per hour (range, 0.4-1.39). Fishing quality, in terms of catch per hour, was higher in the spring (1.24) than in summer (0.93), fall (0.89), or winter (0.76 for open-ice anglers, 0.25 for shanty anglers); it was unaffected by removal of size limits.

The composition of the catch was bluegill, 63.8%; yellow perch, 17.8%; largemouth bass, 5.5%; black crappie, 4.7%; pumpkinseed, 4.3%; rock bass, 2.7%; northern pike, 0.5%, bullheads, 0.1%; smallmouth bass, 0.1%; walleye, 0.1%; and "other" (mostly warmouth bass), 0.4% (Table 39).

The opportunity to fish in the spring resulted in a modest harvest. For northern pike (data for 1950-59), 14% of the total catch was taken in the spring (as compared to 44% in the winter); for the panfishes (data for 1952-59) the spring catch was 16% for bluegill, 16% for yellow perch, 23% for pumpkinseed, and 25% for black crappie.

Panfish. --The panfish populations did not seem to be harmed by the increased harvest and the possible disruption of spawning by anglers--except perhaps black crappie. The catch of crappie declined in the late 1940's, and remained at a low level (Fig. 9). The catch of bluegill varied widely, but without long-term trend, and was not closely related to regulations.

Judging from the length-frequency of the fish taken (Table 40), removal of the 6-inch size limit may have increased the harvest of bluegills by 12% and of pumpkinseeds by 33%.

Game fish. --The harvest of all game fishes was markedly higher in the years without size limits. These increases were partly due to the harvest of small fish, but also to higher fishing pressure and, apparently, increases in the fish populations. There is no indication the populations were harmed by the liberal regulation.

The harvest of largemouth bass was 63% higher by number and 17% higher by weight in the years without a size limit (Table 41). In part, this can be attributed to 31% of the catch being less than 10 inches long and to an 8% increase in total fishing pressure (there was also a small increase in effort specifically directed at bass). The unaccounted for increase in harvest (about 20% by number), plus the slowing of bass growth in 1954-59 (Table 42), suggest that the bass population was relatively high in 1954-59.

Smallmouth bass catches, consistently low, increased by 33% when size limits were dropped (Table 41) but, again, this is probably an overestimate of the effect of the regulation as only 1 in 22 was small.

Northern pike catches increased 37% by number and even more by weight (Table 41). This was mostly due to an upswing in the population because only 1% of 222 pike measured were less than the old 14-inch size limit and the average size of pike actually increased (Table 40). Conversely, when the size limit was raised to 20 inches in 1959, pike catch did not decline by about 25% --as would be predicted from the data in Table 40.

A few very large walleyes were taken (Tables 39 and 40). The very sparse population was supplemented with hatchery-reared fingerlings in 1951 (825) and 1955 (29,000), but no improvement in catch was detected by the census. In more recent years, a handful of anglers have consistently taken some large walleyes through the ice.

Fife Lake

Fife Lake, in Grand Traverse and Kalkaska counties, has an area of 628 acres and a maximum depth of 60 feet. Creel census information spans 31 years--winter of 1933-34 through summer of 1937, and spring 1946 through summer 1965--the longest record for any lake in the state. In the early years, with "normal" regulations, CCC personnel interviewed 86-98% of all the fishermen whereas in the later years, with special regulations, estimates of catch were based on interview rates of about 4% in the open-water seasons and about 30% in the winter. Data from the 1930's were summarized in numerous reports by R. W. Eschmeyer (principally, 1935, 1937, 1939) and have been expanded to 100% here (Tables 43 and 44); data for the 1940's were previously summarized by Christensen (1953).

Several population studies using the mark-and-recapture method have been conducted at Fife Lake (Table 45). The three estimates in the 1964-74 period were directed at walleye, whereas the estimates conducted in the 1950's were aimed at all species. This lake is difficult to sample effectively, so confidence limits are broad and these estimates afford only a rough idea of fish abundance. In particular, the much greater abundance of bluegills, indicated by the 1950 data as compared to 1956 and 1958 data, is open to question.

Changes in fishing regulations have been complex (Table 43). The changes of primary importance were the opening of the lake to fishing in the spring and the higher size limits on bass and pike. More specifically the changes were as follows. For panfish, the long closed season (January 1-June 24) was removed beginning in 1946 (for bluegill and pumpkinseed it was reinstated in the early 1950's, then eliminated), and the 6-inch size limit was removed beginning in September 1949. For largemouth and smallmouth bass, size limits of 10 inches (1934-53 and 1964-65), 16 inches (1954-58), and 14 inches (1959-63) were tested, and the first 3 weeks of June were opened beginning in 1962. For northern pike, tested were: (1) size limits of 14 inches (1933-53), 24 inches (1954-58), and 20 inches (1959-65); (2) the banning of spearing (winter 1959-60 through winter of 1962-63); and (3) the stepwise shifting and shortening of the closed season to allowing harvest in

May and June. For walleyes (which support only a minor fishery), size limits were reduced from 14 to 13 inches in 1950, and the closed season was shifted in the same manner as for pike. Some of the same regulations were tested at Sugarloaf and Minnewaukon lakes.

Fishermen.--Fife Lake attracted a large number of tourists, especially after World War II. In the summer 1946-65, 10% of the anglers lived locally, 54% lived elsewhere in Michigan, and 36% lived in other states. These three groups of anglers were about equally represented prior to World War II (Eschmeyer 1937). In the winter, 72% of the anglers were "locals", and 28% were "down-staters", and "out-staters" were scarcely represented. In spring and fall, the percentages were intermediate. Males comprised 77% of the anglers in the open-water seasons and 95% in the winter.

Methods.--Nearly all fishing was done from boats or through the ice. The average length of a boat trip remained close to 2.6 hours from 1934 to 1964, except for the late 1940's to early 1950's when it went as high as 3.4 hours. The winter fishing trip was more variable in length, but was approximately 4 hours long.

At Fife Lake during the 1950's, as at many other study lakes, interest in game species gradually increased while interest in fishing for panfish gradually declined. This was true in both summer and winter, and was not related to fishing regulations or to catches of the species concerned. Considering first the summer period, the percentage of anglers fishing for game species slowly increased from 20% in 1952 to 53% in 1961, then slowly declined to 20% in 1965. In 1974, a comparable figure was 32% (Pettengill 1975). In the winter, the percentage of anglers seeking game fish rose from 60% in 1952 to over 90% in 1959, and stayed at that level through the end of the census.

Basic methods used by summer anglers did not change greatly in 31 years. Annually, 1 to 8% cast, 5 to 21% trolled, 4 to 17% used a combination of techniques, and 51% (1961) to 90% (1947 and 1950) still-fished. The increased fishing for game fish was mostly brought about by a subtle change

in still-fishing techniques. There was less use of small baits which are selective for panfish (80% in 1952 versus 57% in 1961) and more use of large minnows which are selective for game fish (15% in 1952 versus 30% in 1961). Methods used by winter anglers (lines, tip-ups, and spears) appropriately reflected the shift in interest from panfish to game fish and, in addition, the ban on spearing in certain years (discussed later).

Pressure.--Fishing pressure jumped from 15 hours per acre in 1933-35 to 76 hours per acre (annual range, 41 to 101) in 1946-64 (Fig. 10). Presumably this was due to increased tourism after World War II. The spring fishery, which began in 1946, generated about 13% of the total hours. The dip in pressure in 1951 was due to the prohibition of fishing that spring. The other changes in regulations had no effect on fishing pressure.

Catch.--The annual catch of all species rose from 19 per acre in 1933-35 to 48 per acre (range, 11 to 95) in 1946-64. However, fishing quality, as measured in catch per angler hour, deteriorated from over 1.0 to 0.61 (range, 0.24 to 1.06).

Between the first period of census and the second, there was a pronounced shift in composition of the catch from yellow perch to bluegill and crappie, and from bass and walleye to northern pike (Table 44). The composition of the catch during 1933-37 as compared to 1946-64 was bluegill, 33.2-47.7%; pumpkinseed, 12.7-14.4%; yellow perch, 22.6-13.4%; rock bass, 16.4-12.4%; black crappie, trace-5.7%; northern pike, 1.0-4.1%; largemouth bass, 3.8-1.0%; smallmouth bass, 6.6-0.9%; walleye, 1.2-0.3%; plus a few bullheads and suckers in each period.

The opportunity to fish in the spring resulted in a modest harvest. The percentages of the yearly catch made in the spring (about third week in April to the third week in June) were bluegill, 2%; pumpkinseed, 7%; yellow perch, 5%; black crappie, 19%; rock bass, 28%; walleye, 18%; and northern pike, 13%. Statistics indicate that angling in the spring (0.70 fish per hour) was only slightly better than the yearly average (0.61 fish per hour).

Panfish.--The catch of all species of panfish declined during the census (Fig. 10). While the decreases in total fishing pressure and in the fraction of anglers fishing for panfish were contributing factors, there is no doubt that the bluegill population fell very low after 1961. This is confirmed by the statistics on the number of bluegills caught per hour of panfishing, population estimates (Table 45), and accelerated growth (Table 46).

It seems more likely that this decline was caused by poor recruitment due to natural causes than to liberal regulations and overfishing. As pointed out above, the spring catch was light. Furthermore removal of the 6-inch minimum size limit late in 1949 caused no marked increase in total harvest (Fig. 10). On the other hand, appreciable numbers of "small" panfish were harvested (Table 47). The percentages of "small" fish taken in the early years, 1950-52, were bluegill, 34%; yellow perch, 28%; pumpkinseed, 49%; black crappie, 1%; and rock bass, 29%.

Some deterioration in the fisheries for bluegill and sunfish was evident even before the size limit change (Table 48). For bluegill, the average length at harvest fell from 7.1 inches in 1934-36 to 6.9 inches in 1946-49 to less than 6.5 inches in 1950-63 (6.7 if only bluegills larger than the old limit of 6.0 inches are included in the calculation). For pumpkinseed, average length fell from 6.7 inches in 1934-36 to 6.2 inches already by 1946-49. Possibly these changes resulted from the increased exploitation following World War II. As regards the other species, yellow perch have tended to be small throughout the years, whereas black crappies have been unusually large (Table 47).

Smallmouth bass.--Pronounced changes occurred in the harvest of smallmouth bass as a result of size limits and other changes (Table 49). The fishery was much better in terms of both total catch and catch per effort in the 1930's than in later years. This decline may have been due to the apparent increase in northern pike (Fig. 10). The decline in smallmouth bass took place even though 25,710 fin-clipped fingerlings were stocked in 1946-48 (Christensen and Cooper 1955). None of these bass were observed in the harvest but 5 of them were among a sample of 198 netted during the 1950 population study.

The higher size limits cut the harvest drastically (Table 49). As compared to the 1946-53 period, catch with the 16-inch size limit was only 12% by number and 30% by weight, and harvest with the 14-inch limit was only 20% by number and 27% by weight. When the 10-inch limit was reinstated in 1964-65, harvest returned to the "normal" level. The population data (Table 45) suggest that standing crop was lower (rather than higher) during the years of greater protection. Paradoxically, growth was better in the 1930's than during the 1950's (Table 46).

Largemouth bass.--Changes in the largemouth bass fishery and population are more difficult to interpret. Total catch in 1946-53 was similar to 1934-35, however catch per effort was much better in the earlier years (Table 49). Thus for both species of bass the data suggest that anglers compete for the available fish.

Harvest was not greatly reduced by the higher size limits (Table 49). Pounds caught remained within 82% of the 1946-53 level and pounds per 1000 hours of fishing (all types) did not change. The number caught fell to 58% of the 1946-53 level with the 16-inch limit and to 70% with the 14-inch limit. However, harvest did not resume the normal level when the 10-inch limit was reinstated. Thus it appears that the buildup in the adult stock indicated by the population data (Table 45) had reversed by 1963.

The difference in response to the higher size limits between smallmouth bass and largemouth bass is particularly striking because their growth rates are similar (Table 46). A comparison of survival cannot be made from the accompanying age-frequency data because recruitment has been irregular.

Northern pike.--As pointed out earlier, the northern pike was of minor importance in the 1930's as compared to later years (Table 49). The reason for its increase is not known.

Length of closed season, size limits, and winter spearing were tested. Unfortunately their effects were confounded by changing more than one regulation at a time, uneven recruitment of pike, and changes in

fishing pressure. It appears that size limits had the greatest impact on the fishery.

Size limits of 14, 20, and 24 inches were tested. In the post World War II era, the highest catches by number and weight were made under the 14-inch limit and the lowest under the 24-inch limit--50% lower in terms of pounds per hour. Actually the catch under the 20-inch limit would have been nearly as high if spearing had not been prohibited. Length-frequency information (Table 47) suggests the catch should have dropped 20-30%. Since these pike grow at a rate similar to the Michigan average (Table 46), a 20-inch limit should assure an adequate brood stock (Latta 1972).

Spearing of pike (always done from shanties) was permitted in all winters except 1959-60 through 1962-63. It was a popular pastime on Fife Lake. In the winter of 1958-59, for example, the year before the ban, 52% of the fishermen used a spear exclusively or in combination with hook-and-line methods. The year the ban on spearing began the hours of shanty use dropped to 61% of the 1958-59 figure (Table 43). When the ban went off (winter 1963-64) shanty use jumped to an all time high but quickly declined to a level typical of the no-spearing period. Pike harvest was 50% lower in the no-spearing winters as compared to the winters of 1963-64 and 1964-65. Pike catch in the other seasons increased 157%--substantially more than expected. In the average year 42% of the pike were caught in winter and 58% in the open-water seasons; thus, at best, 21% (42% $\times$ 50%) more pike should have been available to the open-water anglers.

The length of the protected spawning period was varied from the end of ice fishing to June 25, May 15, or late April (Table 43). Even under the most liberal regulation (late April) the spring catch was only 13% of the annual total. Catch per hour was generally best in the spring but fishing pressure was low.

A special study of pike migration was conducted in March-April of 1957, 1958, and especially 1959. A total of 457 adult pike moving down the Fife Lake outlet to spawn were trapped in a weir, given a Monel jaw tag, and released downstream. Anglers caught 54 of these in the first 12 months (for a minimum exploitation rate of 12%), 6 after 12 to 24 months, and 4 after

24 to 36 months at liberty. Two tags were out for 1,304 days. Three other tagged pike were recaptured in seines in 1958. Most (51) of the recaptures were made in Fife Lake, but tags were reported in the outlet waters and up and down the Manistee River system from Lake Margarethe to the Hodenpyle Backwater.

Walleye.--A small walleye population and fishery have been maintained by a limited amount of natural reproduction plus stocking. The species has access to the lake via the outlet but the spawning habitat is marginal and reproduction is poor. Returns from stocking have been mediocre. In 1926, Langlois and Moody surveyed the lake and stated (perhaps overstated): "Wall-eyed pike have been planted for 15 years [actually 1.6 million fry were planted from 1891 to 1925] and none have ever been caught. No more should be planted, as its non-suitability seems proven." Nevertheless 130 were observed in the 1934 creel census, and in 1935-42 another 1.6 million fry were planted. Fingerling plants were made in 1961, 1962, and in every year since 1969.

Subsequent annual harvests ranged between 16 and 502 (Table 44). Pettengill (1975) reported a similarly low level of 350 in 1974. In 1964, 1965, and again in 1974, the population was estimated at between 1,000 and 1,400 and exploitation at 5 to 6% (Table 45; Pettengill 1974; Schneider 1969). Typically, growth was rapid (Table 46) and average size very large (24.0 inches), except in 1963-64 when many of the fish planted in 1961 entered the catch (Table 47). Consequently, lowering the size limit from 14 to 13 inches was unimportant. As pointed out in the section on "catch", 18% of the annual walleye harvest was made between the third week in April to the third week in June.

An artificial spawning reef for walleyes was placed near Florence Island in March of 1950. The use it received by walleyes was not carefully evaluated but it is clear that the walleye fishery was not improved significantly.

Fine Lake

Fine Lake, Barry County, has an area of 320 acres and a maximum depth of 48 feet. Fishing is considered to be good but bluegills tend to grow slowly. Fine Lake was matched with Duck Lake in a four-step evaluation of relaxing fishing restrictions. First, in 1946, the lake was partially opened to spring fishing for northern pike, walleye (uncommon), yellow perch, crappies, rock bass, bullheads, and "rough" species (lakes in southern Michigan had not been opened to any spring fishing since 1929). Second, in September 1949, the 6-inch size limit on panfish was eliminated (statewide). Third, in 1952, the closed spring season on bluegill and sunfish was virtually eliminated (statewide). Fourth, in 1954-59, the size limit on game fish was also eliminated (except for a 20-inch size limit on northern pike in 1959). Christensen (1953) summarized methods and some early results. In typical years the census clerks interviewed about 9%, 5%, 5%, 14%, and 15% of the spring, summer, fall, open-ice, and shanty fishermen, respectively.

A mark-and-recapture estimate of the fish population was attempted in fall 1955 (Cooper et al. 1957). Recaptures were too few for all species except three. Estimates were 458 largemouth bass (10+ inches), 10,785 black crappies (6+ inches), and 5,620 bullheads (6+ inches).

Fishermen.--Nearly all of the fishermen lived relatively close to the lake. In the summer, 91% were local residents, 3% lived elsewhere in Michigan, and 6% came from other states. In the other seasons, 93 to 100% of the anglers lived nearby. Males predominated (78%), but females comprised 22% of the anglers and were well represented in all seasons.

Methods.--Nearly all fishing was done from boats, or through the ice with line or spear. The average fishing trip was 2.6 for both boat and shanty users, and about 2.4 hours for open-ice anglers.

Changing the fishing regulations (most markedly in 1954) had no effect on fishing methodology (Fig. 11). However, the gradual shift in interest from panfish to game fish observed at certain Michigan lakes during the 1950's occurred at Fine Lake as well, especially in 1958 and 1959. The

percentage of summer anglers fishing for panfish exclusively declined from 85 to 55, and the percentage of bass anglers increased from 3 to 20. Pike anglers remained at about 4%. Corresponding decreases in still-fishermen and increases in casters and trollers took place. In the winter, open-ice anglers fished for panfish (yearly range, 53% to 80% with a decreasing trend), northern pike (range, 5% to 27% with an increasing trend), or a combination of fish types (ranges, 9% to 30% with no trend). Parallel, and numerically similar, changes took place in their use of ice rods, tip-ups, and a combination of these two types of gear. Shanty fishermen fished (without trend) for panfish (average, 10%), pike (35%), or a combination of fish types (55%). As regards gear of the shanty fishermen, 12% used rods or hand lines exclusively, 22% only spears, 0.4% only tip-ups, and 66% used a combination of these.

Pressure.--Fishing pressure hovered around 150 hours per acre from 1946 to 1954, but by 1959 it had declined to 59 hours per acre (Table 50 and Fig. 12). The decline was not correlated with fishing regulations nor with fishing quality--as measured by either the catch of all species per hour (Table 50) or the catch of bluegills per hour by panfish anglers (obtained by dividing bluegill catch by the product of total hours times percentage of anglers fishing for panfish exclusively). This decline in fishing pressure was probably due to a decline in the average size of bluegills brought about by a decline in their growth (see below).

Relaxing the size limit on game species in 1954 did not affect total fishing pressure nor the type of fish sought (Figs. 11 and 12). The gradual relaxing of restrictions on panfish angling created, as indicated by the last 5 years of the study, a spring fishery which averaged 16% of the total hours.

Catch.--Fish were caught at the exceptionally high annual rates of 220 per acre (range, 106 to 380) and 1.70 per hour (range, 1.32 to 2.40). As pointed out above, catch was declining at the end of the study but catch per hour remained good (Table 50). Up until 1957, catch rates were higher in summer than in any other season; however in the last 3 years spring fishing was the best.

The composition of the catch was 81.1% bluegill, 8.1% pumpkinseed, 4.7% yellow perch, 2.6% black crappie, 1.3% largemouth bass, 0.3% northern pike, 0.02% rock bass, 0.02% walleye, and 1.9% bullhead and other species (Table 51). Smallmouth bass were present in the lake but few were caught.

The progressively increasing opportunity to fish in the spring resulted in a modest harvest and probably was not detrimental to the fish stocks. Spring harvest of bluegill was usually about 13% (but it doubled in the last 2 years), of yellow perch about 12%, of northern pike about 13%, and of pumpkinseed and black crappie about 33%. The effects of size limits will be discussed below.

Panfish.--Bluegill catch varied from 310 per acre in 1953, to 77 per acre in 1959, and was not closely related to seasons or size limits (Fig. 12). The decline in the fishery after the mid-1950's appears to have been entirely due to a growing disinterest in fishing for bluegills which was aggravated by their declining growth (Table 52). Presumably, their average size and desirability also declined, but this was not reflected in scale samples collected by the census clerk. (Note: Almost all of these samples were caught by the clerk and he sorted out the larger specimens. Other anglers expressed difficulty in catching the larger bluegills.) Scale samples indicate that an exceptionally strong, slow-growing bluegill year class developed in 1952; thus the problem cannot be logically tied to the 1954 removal of size limits on predators or to other changes in regulations.

Among the other panfish, the catch of pumpkinseeds made a pronounced increase in the early 1950's which can, only in part, be attributed to the onset of spring fishing (Fig. 12). Other causes are not known. Pumpkinseed growth has been consistently below the state average. Black crappie, which like the pumpkinseed are easily caught in the spring, appeared to be on a long-term decline at Fine Lake--as at some other experimental lakes. This may be a symptom of overfishing but it is probably just indicative of the population establishing a lower equilibrium level, or a reflection of changing angler interests. Trap nets captured large numbers of slow-growing crappies in 1955 and 1958.

Game fish. --Removing the 10-inch size limit on largemouth bass in 1954-59 greatly increased the catch but apparently did not harm the population. Anglers were not attracted to the lake and pressure on bass declined overall (Figs. 11 and 12). Bass catch went up 57% by number, decreased slightly by weight, and increased about 40% in terms of weight caught per hour of total fishing effort (Table 53). Of the 480 bass inspected by the census clerk, a large fraction, 40%, were under 10 inches. Nevertheless, there is no clear evidence of overfishing (such as declines in total catch, catch of larger bass, or catch per hour), but the time series is relatively short (6 years) and fishing pressure did relax. Growth of bass was rapid at the end of the study (Table 52) but that more likely reflects changes in forage or low reproduction due to natural causes rather than overfishing.

The catch of northern pike averaged just 0.7 fish per acre and 13.6 pounds per 1,000 hours (Table 53). Pike catch was cyclic, probably reflecting varying year class strength (Fig. 12). Consequently, the catch statistics do not accurately reflect the effects of size limit changes. Length-frequency measurements of 120 pike caught during the years of no size limit show that only 2% were less than 14 inches and 28% were less than 20 inches. Pike growth was relatively rapid and the population might benefit from the greater protection.

The total catch of walleyes was estimated at 303, or just 0.07 per acre per year. Probably all were survivors from the 20,925 fingerlings planted in 1943, 1944, 1951, and 1955 (scale samples suggest natural reproduction in other years but the ages are questionable). Thus returns were about 2% at best. A high fraction (6 out of 14) of the walleyes harvested were less than 13 inches long but specimens up to 27.3 inches long were taken.

Fletcher Floodwater

Fletcher Floodwater, an 8,970-acre impoundment in Alpena and Montmorency counties, was created in 1931 by a dam with a head of 12.5 feet. Exceptional fishing for northern pike and other species was experienced

until the late 1940's (Christensen and Williams 1959). Productivity tapered off then but pike recruitment remained high and, as a result, the forage base was overgrazed and pike began to grow slowly. The relatively few pike which grew to a larger size were intensively exploited by anglers.

Data on catch and growth were collected intermittently, 1948-1965, to monitor changes in the fishery and stock (Tables 54-56). In 1960, the size limit on pike was raised from 14 to 20 inches statewide. For 1963 through 1966, in an attempt to improve the growth of pike in Fletcher Floodwater by encouraging anglers to catch more pike, the 14-inch size was reinstated and the creel limit was increased from 5 to 10 per day. Also, spearing was banned in January and February to "save" larger pike for hook-and-line anglers. The census clerks contacted 1-6% of the open-water fishermen and 7-14% of the ice anglers in the years censused.

The length of a summer fishing trip gradually declined from 5.4 hours in 1948, to 3.2 hours in 1965; the average winter trip was 4.4-5.5 hours. In the open-water season, about 4% of the anglers lived in Alpena or Montmorency counties, 71% lived in other Michigan counties, and 25% lived in other states. In the winter, local residents made up 29-46% of the anglers, in-state residents 51-70%, and out-state residents 1-3%.

Pressure.--Angling pressure fell from 22-28 hours per acre in 1948-56 to about 11 in 1961-62, when the size limit on pike was raised. With the return to the 14-inch limit, total pressure rebounded to 27-30 hours per acre in 1963-64, but winter fishing hours remained lower than normal (39%) due to the ban on spearing. In 1965, pressure jumped to 49 hours per acre for no apparent reason.

Catch.--Annual catch rates were highly variable--0.15 to 0.60 fish per hour and 1.7-20.8 fish per acre--depending mainly on pike regulations. When the size limit was low, pike usually predominated. In some years large catches of pumpkinseed, yellow perch, or largemouth bass were made. Those fish which evaded pike predation grew fast and reached a large size.

Pike.--With a 14-inch size limit, the annual catch of pike was about 4.7 per acre, except in 1965, when it was 11.4 pike per acre. With the 20-inch limit, catch was only 0.2 per acre because so few pike reached that size. In 1965, for example, 11.4% of the catch was 14.0-15.9 inches, 51.3% was 16.0-17.9 inches, 28.6% was 18.0-19.9 inches, and 8.7% was 20.0-30.0 inches.

Winter fishermen were more successful at catching pike than summer fishermen. In winter, only 30.0% of all anglers caught no pike at all and 7.0% caught their limit of five (Table 57). In summer, 59.8% of all anglers did not catch any pike and only 1.8% took five. The difference could be attributed, in part at least, to a higher percentage of the winter anglers fishing for pike exclusively (and a lower percentage fishing for other species) and to longer trips in the winter. The ban on winter spearing cut winter pike harvest by 31%, but summer catch increased by a similar amount.

Growth of pike did not improve despite the liberal regulations and an intensive fishery (Table 56). The pike population was estimated at 96,000 in the spring of 1956 (Christensen and Williams 1959). By fall of that year, 18% had been caught and it is likely that another 18% or so were taken that winter. Exploitation must have been even higher in 1965.

Houghton Lake

Houghton Lake, Roscommon County, has an area of 20,044 acres and a maximum depth of 20 feet. It has long been known for its good fishing for warmwater species but during the last 50 years the fishery has experienced pronounced shifts in composition (Laarman 1976). The northern pike fishery predominated in the late 1920's, but it has been of lesser importance since the mid-1930's. The bluegill population and fishery rose to prominence and peaked in the early 1950's. Other species have been relatively stable. Between the mid-1930's and the mid-1950's, winter fishing effort increased about 12-fold and catch increased even more (Table 58). Changes in the summer fishery have not been documented but it probably increased less.

The purpose of this report is to evaluate the change in northern pike size limit from 14 to 20 inches which took effect December 1, 1957, from creel census records collected December 1956 through March 1961. There is 1 full year of "before" data and 3.5 years of "after" data. Christensen (1957, 1958) described the census methods and some of the early results. Two census periods, "winter" (mid-December through March) and "summer" (June through September), covered nearly all fishing activity. The census clerk contacted about 2% of the anglers in winter and 0.25% in summer.

Fishermen.--Most of the anglers traveled considerable distances to fish Houghton Lake. In the summer, 6 to 10% of the anglers came from Roscommon County, 68 to 78% came from other Michigan counties, and 14 to 26% came from other states. In the winter, the corresponding percentages were 12 to 16, 72 to 84, and 2 to 10, respectively. The sex ratio was about 80% male to 20% female in summer, and about 87% male to 13% female in winter. Very similar statistics were reported for the 1928-46 period (Loeb 1949).

Methods.--Virtually all fishing was from boats and through the ice with lines. Winter spearing of northern pike has been prohibited since 1940. Summer fishing methods included still-fishing (60%), trolling (15%), casting (3%), and a combination of techniques (22%). The average fishing trip lasted 2.7 hours in summer and 4.9 hours in winter.

The types of fish sought by winter anglers were the same types sought by summer anglers. In both seasons, about 30% of the anglers fished for game species (principally northern pike and walleye), 23% for panfish, and 47% for both types of fish.

Pressure.--Annual fishing pressure averaged 44 hours per acre (Table 58). Most of the fishing took place in the open-water season ("summer"). Winter fishing, which is strongly promoted by the local merchants, made up 31 to 44% of the total effort.

Increasing the minimum size limit on pike from 14 to 20 inches did not adversely affect total fishing pressure or angler behavior. Summer effort was higher after the size limit change; winter effort dipped slightly the first two winters but then recovered. Also, the percentage of anglers explicitly fishing for pike (and/or walleye) did not change.

Catch.--Annual catch averaged 28 fish per acre (range, 24 to 31) and 0.63 fish per hour (range, 0.58 to 0.69). Catch-per-hour rates were higher in winter than in summer (Table 58). The catch was composed of bluegill (44.8%), yellow perch (26.1%), pumpkinseed (11.4%), rock bass (7.0%), northern pike (5.2%), walleye (2.6%), black crappie (1.3%), largemouth bass (0.7%), bullheads (0.6%), and smallmouth bass (0.2%), plus a few suckers and bowfins (Table 59). Generally, more northern pike and bluegill were caught in winter than in summer.

Pike.--The annual catch of northern pike ranged between 1.0 and 2.6 per acre during 1956-60. Christensen (1957) made an interesting comparison between the winter catches for 1935-36 and 1936-37, and the winter catch for 1956-57. Fishing pressure for all species had increased 12-fold, catch of all species had increased 20-fold, catch of pike had increased 13-fold, and the quality of pike fishing had increased from 7 or 8 pike per 100 hours of fishing to over 9. Thus pike fishing was as good as, or better than the mid-1930's. However, the average size of pike caught apparently had declined from 21.2-21.6 inches (Eschmeyer 1936, 1937) to 19.2 inches.

Raising the size limit on pike from 14 to 20 inches reduced pike harvest by about one-half. Annual catch fell 58% by number, 45% by weight, and 52% by weight harvested per fishing hour (Table 60). The impact of the higher size limit was relatively great because most pike were relatively small. With the low (essentially no) size limit, pike kept by anglers averaged 19.2 inches and 67% of them were 14 to 20 inches long; with the 20-inch size limit, average length was 20.7 inches and 33% were 14 to 20 inches long (Table 61). The observed decrease in harvest was somewhat greater than might be expected based on these proportions and Latta's (1972)

general analysis of pike dynamics, probably because growth of pike was slow (see Christensen 1957), and natural mortality of pike increased before they reached 20 inches. The higher size limit may have benefited the pike population by increasing the spawning stock and the probability of stable recruitment; however such benefits have not been detected. Catches of pike per trap net lift were similar in 1955 and 1972 (0.7 as compared to 0.8--Laarman 1975), and average size of pike in the spawning run seems to have declined based on the following data: 1939, 21.9 inches; 1940, 21.2 inches; 1942, 21.4 inches; 1967, 18.1 inches; and 1970, 20.7 inches (Carbine 1941, 1942, and unpublished data).

Other species.--Houghton Lake supports one of the best walleye populations in Michigan. During the census years the average walleye harvest was 0.73 fish and roughly 1.0 pound per acre. Growth rate of walleyes has been consistently below the state average (Laarman 1976).

The bluegill fishery had reputedly diminished by 1956-60, but it still yielded an average of 12.4 bluegills per acre. Some were over 10 inches long (Table 61).

Yellow perch were harvested at the rate of 7.2 per acre per year. Their average size was small (Table 61). Beginning in 1956-57, the creel limit of 25 perch was removed during the winter in an attempt to stimulate harvest, effect a reduction in the perch population, and improve perch growth. After four winters of observation it was clear that few anglers (0.3%) caught and kept more than 25 perch anyway, and that the harvest rate was too low to affect perch growth (Christensen 1957; and letter from G. P. Cooper to M. A. Hunt, dated July 22, 1960). Likewise the higher size limit on pike did not alter perch growth (Laarman 1976).

Lobdell Lake

Lobdell Lake, Genesee and Livingston counties, is an impounded lake with an area of 545 acres and a maximum depth of 78 feet. During the 1940's, it was managed as a two-story trout lake; however only a few of the planted rainbow trout were ever caught. Walleye fry (430,000) were stocked in the 1930's, but none are known to have survived.

A creel census was conducted from spring 1946, through fall 1952, to evaluate year-around fishing for yellow perch, black crappie, rock bass, and bullheads (Table 62). Also, the seasonal opening of pike fishing was advanced from June 25 to May 15. Other lakes with the same experimental regulations were Craig, Duck, Fine, Pontiac, and Whitmore. Christensen (1953) reported the results of the study up through 1950.

The census clerks contacted 15% of the anglers the first year and about 5% in later years.

Fishermen.--The residence of anglers was as follows: Genesee County, 60%; other Michigan counties, 39%; other states, 1%. There was no important seasonal difference in this breakdown. The sex ratio of anglers was 73% male to 27% female.

Methods.--The duration of an average fishing trip varied between 2.5 and 4.6 hours among the seasons and the years. Typically, a summer boat trip lasted about 4 hours.

Methods used by boat anglers were still-fishing (70%), casting (6%), trolling (6%), casting plus trolling (2%), and a combination of these techniques (16%). In the spring season trolling was more popular (16%). Most of the ice fishing was done without the aid of shanties.

Pressure.--Annual fishing pressure averaged 123 hours per acre, but it was extremely irregular, ranging from 50 to 212 hours per acre. It was not linked to the fishing regulations and no explanation for its variability is offered.

Catch.--Fish were caught at the annual rates of 136 per acre (range, 43 to 286) and 1.05 per hour (range, 0.83 to 1.34). The fluctuations in catch followed those in pressure, with the net result that catch-effort was relatively stable (Fig. 13 and Table 62).

The catch was composed of the usual mixture of bluegill (63.1%) and other warmwater species (Tables 63 and 64). Some smallmouth bass,

warmouth bass, and bullheads were included. The size of the fish harvested was typical of southern Michigan lakes except that largemouth bass were relatively large, 14.0 inches (Table 64). Samples taken in 1941 indicated that growth of all species was slow (Funk 1942a).

Catches of all species of panfish dropped off markedly in the 1950's (Fig. 13). This was surely due to natural causes rather than spring fishing in the 1940's because the spring fishery had excluded bluegills and pumpkinseeds. Judging from 1952 data (Table 63), the spring take of yellow perch was light; however substantial numbers of black crappies were harvested. Removal of the 6-inch minimum size limit late in 1949 may have bolstered the harvest of bluegills by 21% (Table 64).

The harvest of largemouth bass paralleled the trends in fishing pressure (Fig. 13). The catch of the relatively rare northern pike also declined but this is of doubtful significance. Roughly 13% of the pike caught by boat anglers were taken in the spring season.

Minnewaukon Lake

Minnewaukon is a seepage lake in St. Joseph County subject to large fluctuations in water level. Maximum depth is about 25 feet and area about 126 acres.

A creel census was conducted from 1946 through 1958, to evaluate (1) year-around fishing for bluegill and sunfish (and other panfish), (2) an increase in the largemouth bass size limit from 10 inches (1946-53) to 16 inches (1954-58), and (3) an increase in the northern pike size limit from 14 inches (1946-53) to 24 inches (1954-58). A fourth important change in regulations was the removal (statewide) of the 6-inch minimum size limit on panfish (Table 65). The same regulations were tested at Sugarloaf and Fife lakes. Christensen (1953) reported some of the early results.

The creel census clerks interviewed about 9% of the anglers during the open-water seasons and about 28% of the ice fishermen.

Fishermen

Most (70%) of the anglers resided locally, 30% lived elsewhere in Michigan, and less than 1% came from other states. Men and boys comprised most of the anglers in summer (73%) and in winter (93%).

Methods.--The majority of anglers used boats, although some fishing was done from shore or through the ice. Shanties were not used for ice fishing in certain years (Table 65). The length of an average fishing trip was 2.8 hours for open-water anglers, 2.6 hours for open-ice anglers, and 3.8 hours for anglers in shanties.

Records for 1951-58 document some changes in type of fish sought by anglers and in fishing methods which were not closely tied to changes in regulations. In the summer fishery, the proportion of anglers seeking panfish remained steady at about 63%, whereas bass fishermen increased from about 20 to 35% (despite the higher size limit), and anglers seeking both types of fish declined from about 17 to 2%. Less than 1% of the anglers were after pike exclusively. The increase in fishing for bass has been noted at other lakes, but at those lakes it was offset by a decline in panfishing. As regards methods used in the summer, still-fishing remained at about 64%, casting increased from about 20% to about 30%, and trolling varied between 2 and 9%. A combination of methods was used by 3 to 14% of the anglers. In the winter, fishing for panfish fluctuated between 56 and 88% (with an increasing trend), pike fishing varied between 3 and 26% (without trend), and fishing for a combination of panfish and game fish varied from 0 to 19% (decreasing trend).

Pressure.--Annual fishing pressure fluctuated between 81 and 141 hours per acre (average, 110), but without an overall trend (Fig. 14). The changes in pressure were unrelated to the fishing regulations. The spring fishery (created in 1946, rescinded in 1951, then reestablished in 1952) generated 17% of the total hours.

Catch.--Fish were caught at the high annual rates of 226 per acre (range, 136 to 354) and 2.04 per hour (range, 1.57 to 2.78). The opportunity to fish in the spring resulted in a modest harvest for all target species except pumpkinseed. The percentages of the total catch made in the spring were: bluegill, 23%; pumpkinseed, 63%; yellow perch, 16%; black crappie, 22%; and northern pike, 9% (as compared to 18% in

winter). The spring catch of pumpkinseeds tended to be high at some other experimental lakes as well. Fishing success for all species, as measured in catch per hour, was much higher in the spring than overall (3.17 versus 2.04).

Bullheads (brown and yellow) were an unusually large component of the harvest (Table 66). The composition of the catch was bluegill, 67.4%; bullhead, 10.9%; pumpkinseed, 8.4%; yellow perch, 5.9%; black crappie, 5.0%; largemouth bass, 1.4%; and northern pike, 0.07%. Rock bass and smallmouth bass were recorded, but so few as to be of doubtful reliability.

Panfish.--The catches of panfish fluctuated greatly, obscuring the effects of liberal regulations (Fig. 14). Some increase in catch took place when the 6-inch size limit was removed. In 1950, these percentages of the catch were less than 6 inches long: bluegill, 51%; pumpkinseed, 71%; yellow perch, 3%; and black crappie, 0%. Again, as was true in spring-time fishing, the catch of pumpkinseed was markedly increased by a liberal regulation. The scarcity of pumpkinseeds in the later years may reflect overharvest or simply poor environmental conditions for spawning.

Growth of bluegills tends to be slow in Minnewaukon Lake, but was considerably better in the census period than formerly (Table 67). The best growth occurred in the early 1950's, when catch was high, rather than in 1954-58, when the predatory bass and pike were protected by high size limits. Growth was probably linked to year-class strength and environmental fluctuations.

Game fish.--Raising the size limit from 10 to 16 inches reduced the harvest of largemouth bass drastically--67% by number and 44% by weight (Table 68). As noted earlier, the percentage of anglers fishing for bass did not decrease, rather it increased due to the widespread upsurge in popularity of this species. Bass growth has been consistently above average and, surprisingly, was even better during the years of a high size limit (Table 67).

The catch of northern pike was always so light (Table 66), pike growth so rapid (average length at age III = 27.9 inches), and the fish so large (Table 69) that the size limits of 14 and 24 inches had no important effect. Thus, the marked decline observed in the catch of pike under the higher size limit (Table 68) was mostly coincidental. The factors which limit the pike population have not been determined.

A plant of 870 fingerling walleyes was made in 1943. None of these were observed in the census, but three (23.0-26.2 inches long) were taken by netting in 1949, and one was found dead in 1957.

Otsego Lake

Otsego Lake, Otsego County, has an area of 1,964 acres and a maximum depth of 20 feet. Special regulations there were designed to protect the dwindling population of northern pike (the principal game fish) and restrict the winter fishery to promote the summer fishery and tourism. The principal purposes of the creel census in 1952-56 and 1959-64 were to evaluate the success of the managed pike spawning marsh and to measure the effects of pike spearing. Actually, the latter was not tested because the ban on spearing was not lifted. The managed marsh, built to compensate for the gradual loss of marsh habitat to real estate development, began producing fingerling pike in 1959.

Controversy over whether or not winter spearing was depleting the pike population and harming the summer fishery began in the early 1930's. Hubbs (1934) concluded that (1) the winter fishery consisted almost entirely of pike spearing, (2) substantial numbers of pike (probably several thousand) were being speared, (3) the average size of the pike harvested was rather small (19.1 inches) despite satisfactory growth, and (4) reducing the winter harvest would alleviate symptoms of overfishing and probably improve the summer fishery. A ban on spearing began in 1937, and continued through the census years. Hook-and-line fishing was also banned in the winters of 1953-54 and 1954-55, but that fishery was insignificant. Minimum size limits in effect on pike were 14 inches (1929 to 1958), 20 inches (1959 to 1961), 24 inches (1962 to 1964), and 20 inches (1965). The

census clerk contacted about 1% of the anglers each year. Estimates of catch and effort are summarized in Tables 70 and 71.

Fishermen. --The importance of tourism to the economy of the area was reflected in the statistics on residence of the fishermen. In the summer months, only 3-5% of the anglers lived in Otsego County, while 70-86% lived elsewhere in Michigan, and 10-25% came from other states. In the spring and fall, the proportion of out-of-state anglers was about the same as in the summer, but local and in-state fishermen were about equally represented. Local residents virtually had the lake to themselves in the winter. About 85% of the anglers were males and 15% were females.

Methods. --Fishing was done from boats and, to a limited extent, through the ice. Compared to other lakes the average trip was short--about 2 hours in each of the open-water seasons and 3-4 hours in the winter.

At Otsego Lake, as at lakes throughout the state, a gradual shift in target species and fishing methods took place during the census years. In 1952, the target species were panfish (61% of the anglers) and pike and bass (24% of the anglers). By 1964, 22% of the anglers were seeking primarily panfish and 41% sought pike and bass. Corresponding changes in methods occurred. In 1952, 76% of the anglers still-fished, 13% cast or trolled, and 11% used a combination of passive and active techniques. By 1964, 54% still-fished, 15% cast or trolled, and 31% used both types of methods. In the winter, 94% of the anglers used shanties (but fishing gear was restricted to hook and line).

Pressure. --Fishing pressure averaged 41 hours per acre. The seasonal breakdown of pressure for representative years was 86% in summer, 6% in spring, 4% in fall, and 4% in winter. Pressure declined steadily from 62 to 29 hours per acre during the census years (Fig. 15). The decline was principally in the summer fishery and was not related to restrictions on the winter fishery or to changes in pike size limits. It paralleled the decline in catch per hour and probably reflected the growing disinterest in fishing for small panfish.

Catch.--Annual catch averaged 44 fish per acre (range, 11 to 120) and 0.99 fish per hour (range, 0.35 to 1.93). Both catch and catch-effort declined greatly during the census. The catch was composed of yellow perch (61.0%), pumpkinseed (22.4%), bluegill (12.3%), largemouth bass (1.9%), rock bass (1.3%), northern pike (0.6%), smallmouth bass (0.4%), and bullhead (0.1%). The proportion of game fish was appreciably higher in the 1960's than in the 1950's although the actual catch of game fish was about the same.

Pike.--The pike catch and population remained depressed from 1952 to 1964 (Fig. 15). The highest estimated catch, 1,216 pike per year, compares unfavorably with the 866 pike actually observed during a partial winter census in 1934-35 (Hubbs 1935). The pike population was supplemented by adult pike stocked in 1953 (100), 1954 (577), 1959 (266), and 1960 (230). In 1954, 25% of the harvest was due to adults planted that year (Christensen et al. 1955). If the planted pike were as vulnerable to angling as the natives, then pike exploitation was about 55% and the total population numbered only about 2,000. Only 5 years earlier (1949), gill netting results had suggested that pike were still abundant (Taube 1950).

Pike produced in the managed spawning marsh had not improved the harvest rate significantly by the time the census ended in 1964 (benefits reportedly have appeared since then). Between 1959 and 1962, 123,879 fingerlings were released. They should have entered the catch 2 to 3 years later (Table 72). The lack of response in harvest may have been due, in part, to the more protective size limits in effect then; however pike growth was so rapid that the higher size limits would not have restricted harvest much (Table 73).

Other fish.--The catches of yellow perch, the predominant panfish, declined from 64 to 8 per acre per year. A similar trend occurred in other panfishes. During the census years perch grew very slowly, and their average size was quite small (Tables 72 and 73). Unfortunately, comparable perch data are not available for other years, when pike were more abundant.

The catches of largemouth and smallmouth bass have fluctuated in the range of 0 to 2 per acre (Fig. 15). The harvest data do not show an increasing trend as a result of the higher fishing pressure on game species.

Pontiac Lake

Pontiac Lake, Oakland County, has an area of 585 acres but a maximum depth of only 34 feet. The lake was enlarged to its present size in 1924 by a dam placed at the lake's outlet.

A creel census was conducted from spring 1946, through winter 1961-62, to evaluate several changes in fishing regulations. First (1946-50), the closed spring season (up to the third Saturday in June) was removed on yellow perch, black crappie, and all other panfish except bluegill and pumpkinseed. Later (1954-58), the closed seasons were removed for all species including bass and northern pike. The no-closed season was continued through 1961 for all species except pike, which were protected from 1959-61 by a long closed season (March 1 to third Saturday in June), a higher size limit (20 inches instead of 14 inches), and a ban on winter spearing. Other changes which occurred at Pontiac Lake (and statewide) were the dropping of the 6-inch size limit on panfish in September 1949, and the reduction of the closed season on sunfishes, first to 3 weeks in April (1952-53), and then (1954-61) completely. For the panfish test, no pre-data were collected, so declines in catch or catch-effort from year to year were to be the primary evidence for overfishing.

The census clerks interviewed 11% of the estimated total anglers in 1946, 5% in 1947, 4% in 1948, and about 3% in other years. Somewhat higher percentages were contacted in the spring and winter than in the summer and fall.

Fishermen. --Many anglers came from the Detroit metropolitan area to fish Pontiac Lake in the open-water seasons. However, as the human population of Oakland County expanded, the proportion of local anglers increased from 13% in summer 1946, to 36% in summer 1954.

Visitors from other states comprised 1-5% of the annual totals. Men and boys made up about 80% of the anglers.

Methods.--Most fishing was done from boats or through the ice. The average trip lasted about 4.4 hours in the spring, 4.2 hours in the summer, 3.8 hours in the fall, and 3.6 hours in the winter.

Considerable change took place in fishing methods as a result of the experimental regulations and a gradual shift (statewide) in interest from fishing for panfish to fishing for game fish. During 1946-53, over 80% of the anglers (in all seasons) were primarily seeking panfish. However, by 1959, only 38% of the spring anglers and 62% of the summer anglers were after panfish. Summer anglers seeking bass increased gradually from 7% in 1951, to 32% in 1959. In addition, the spring bass fishery was created, which started with 18% of the anglers in 1954, and grew to 52% by 1959 (Fig. 16).

Fishing methods changed correspondingly. In 1946, 71% of the anglers still-fished, 11% cast or trolled, and 18% used a combination of passive and active techniques. By 1959, just 48% still-fished, 44% cast or trolled, and 8% used both kinds of methods.

Pressure.--Total fishing pressure soared to 383 hours per acre in 1947, then gradually declined to 85 hours per acre in 1960 (Fig. 17). The liberalized regulations on panfish may have attracted a few more fishermen to Pontiac Lake in the early years but no drop in pressure occurred in 1951-53 when special regulations ended. Likewise, no increase took place in 1954 when the special regulations on game fish went into effect. Pressure was highly correlated with catch of bluegills, the predominant species, and as a result, catch per hour of all species was stable (until the mid-1950's) at about 1.0 (Table 74).

During the census years there was a marked shift in the seasonal distribution of fishing pressure. In 1946-50, the new spring fishing season received 10% of the hours. In 1954-60, 29% of the total hours were spent in the spring. Winter fishing remained relatively light at about 10% of the annual total.

Catch.--Catch rates varied from 123 to 547 fish per acre and from 0.7 to 1.7 fish per hour. The composition of the catch in 1946-50 was 80% bluegill, 7% black crappie, 6% yellow perch, 2% pumpkinseed, 2% bullhead, 1.1% largemouth bass, and 0.3% northern pike (Christensen 1953). In 1954-60, bluegill had slipped to 72%, and pumpkinseed, largemouth bass, and northern pike had risen to 11%, 2.9%, and 0.5%, respectively (Table 75).

Bluegill.--Among the experimental lakes, the catch of 449 bluegills per acre at Pontiac Lake in 1947 was second only to the record catch from Craig Lake in 1948. The 6-inch minimum size limit was in effect in both instances. After the size limit was dropped in late 1949, the average bluegill caught from Pontiac Lake declined from 6.9 to 6.1 inches because 48% of the bluegills being kept were 4.0-5.9 inches.

Growth of bluegills gradually declined (Table 76). At age V, for example, the mean length of angler-caught fish was 6.9 inches in 1947, 6.4 inches in 1959, and 5.5 inches in 1975. It is doubtful that this change was related to the decreased protection afforded bass because bass harvest did not increase significantly.

Other panfish.--The removal of the spring closed season in 1946 had no no major impact on the fishery or the stocks of yellow perch, black crappie, bullheads, and other species of minor importance. The liberalized regulations generated a spring fishery in which, since 1952, 14% of the bluegills, 15% of the perch, 26% of the pumpkinseeds, 49% of the crappie, 33% of the rock bass, and 11% of the bullheads were caught. The stocks of all species (except perhaps rock bass) held up over the 16-year study (Fig. 16).

Bass.--The lake supported a good fishery for largemouth bass. The average catch was 4.8 bass per acre in 1946-60. In addition, some smallmouth bass were caught in the spring of 1955 (27) and the spring of 1957 (127).

Year-around fishing greatly altered some attributes of the bass fishery but its effect on the population was not clear. Harvest increased

5% in the first 5 years, but then declined 30% or more (Table 77). The catch was still low in 1974 and 1975 (about 2,100 bass--J. R. Ryckman, personal communication), suggesting that a permanent decline in the bass population had taken place. Possibly, bass recruitment was affected by spring fishing, but the relatively small increase in harvest, and other data, suggest that the decline was not closely related to the liberalized regulations.

Average size of bass creeled (Table 76) apparently increased in the first 5 years of liberalization, then declined, but these samples may be biased. However, it is clear that larger bass (16-21 inches) were well represented in all three periods--20% in 1946-53, 38% in 1954-58, and 13% in 1959-62. If these lengths are truly representative, then the weight of bass harvested increased 21% in 1954-58, then fell 47% below the 1946-53 level in 1959-60.

Although total fishing pressure declined at Pontiac Lake during the study, the increased interest in fishing for bass resulted in a net two-fold increase in angling pressure on bass in 1956-59 as compared to 1951-53 (Fig. 16). The summer fishery was largely replaced by a spring fishery but total catch remained relatively stable (until 1960). However, the bass catch-effort index[5] steadily declined. For anglers seeking bass, the decline was very real: from 0.25 bass per hour in 1952, to 0.05 bass per hour in 1960.

Whether the bass population has declined substantially (in a manner parallel to the catch-effort index), or only slightly (as the total catch data suggest)--and why--cannot be resolved satisfactorily. Growth of bass increased some suggesting that bass density declined modestly (Table 76). It is apparent that fishermen were strongly competing for bass and that by the late 1950's, the springtime anglers were beating the summer anglers to "the annual quota." Ironically, catch per unit of effort was higher in the summer at the start of the test. The decline in bass catch-effort began prior to liberalized bass regulations (Fig. 16). On the other hand, the

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[5] This index is the estimated catch of bass by all anglers divided by the calculated number of hours spent by anglers fishing only for bass. It is not a precise measure of bass fishing quality because a few bass were caught by anglers seeking other species.

high fishing pressure during the experimental period may have prevented recovery from what would have been a temporary slump. It is also likely that the slow-growing bluegill population reduced bass recruitment in later years.

Northern pike.--Pike fishing was not very important at this lake. The catch of pike averaged a modest 1.0 fish and 2.4 pounds per acre per year, 1946-62. Even in the winter, the percentage of anglers seeking pike reached only as high as 24-29% on two occasions.

Allowing fishing for pike during March and April did not generate a fishery or harm the stock. Only 1% of the anglers censused during the entire spring period, 1954-58, were fishing for pike exclusively. Harvest actually decreased because of a downswing in the long-term natural cycle (Table 77 and Fig. 17).

Conversely, giving pike more protection by increasing the minimum size limit from 14 to 20 inches, extending the closed season from March 1 to the third Saturday in June, and prohibiting winter spearing had no marked effect on the fishery or the population in the 3 years of observation. The average size of the pike caught increased from 21.5 to 24.3 inches, but contrary to expectations, both total catch and catch by shanty fishermen increased slightly (Tables 75 and 77). Pike grew rapidly at Pontiac Lake (Table 76), so the higher size limit would be biologically sound (Latta 1972).

Saddle Lake

Saddle Lake, Van Buren County, has an area of 292 acres and a maximum depth of 32 feet. It was selected for experimental management and study because of its over-abundant, slow-growing bluegill population.

First (1946-53), it was paired with Bear Lake, Hillsdale County, in a test of liberalized panfish regulations. The 6-inch size limit, closed spring season, and creel limit on "sublegals" were removed and the fishery was monitored by means of creel census. Second, when no improvement was detected, 20-40% of the fish in Saddle Lake were eliminated with rotenone in 1956 (Hooper et al. 1964). A partial census in August and

September of 1957, indicated that: (a) fishing pressure had dropped 30%, (b) catch per hour of game fish plus larger (6.0 inches and longer) panfish was unchanged at about 1.0, (c) the proportion of larger bluegills had increased from 45% to 79%, and (d) a majority of the anglers believed fishing had improved. Third, since growth of the survivors improved for only about a year, the lake was completely poisoned out and restocked in 1958. A census was taken again in 1959-60 for comparison with the earlier data. Census was not taken during the winter months because angling pressure was very light. In the other seasons, 37% of the anglers were interviewed in 1946, and 3-9% of the fishermen were surveyed in the other years.

Fishermen.--In the initial years of study, the proportions of anglers from Van Buren and Allegan counties, other Michigan counties, and other states were about equal. By 1960, the fishermen were about equally divided between local residents and out-of-state residents. The proportion of male anglers remained close to 82% throughout the study.

Methods.--The length of an average fishing trip declined steadily from 3.8 hours in 1946, to 2.1 hours in 1960. Still-fishing from boats for panfish was used by 85% of the anglers in 1946. However by 1952, only 54% used that method exclusively and the percentage using casting techniques had risen from 13 to 27. Trolling was very popular (57%) in the spring of 1959, when planted trout were available.

Pressure.--Fishing pressure declined from 128 hours per acre in 1947, to 73 hours per acre in 1952 (Table 78). Possible reasons for the decline include a natural slump in bluegill abundance, a lessened interest in fishing for small panfish (reflected in the decreased use of still-fishing methods) and the relaxation of restrictions on panfishing at all Michigan lakes in 1951.

Rehabilitation of the population with toxicants generated a fishery of only 40 hours per acre in 1959-60. Fishing should have been of "higher quality" then, due to the temporary improvement in growth.

Catch.--Catch rates averaged 202 fish per acre and 2.18 fish per hour in 1946-52 (Table 78). After the second chemical reclamation, the harvest was 28 fish per acre at a rate of 0.7 fish per hour--a seven-fold drop in catch and a three-fold drop in catch per hour. Bluegills (79.2%), pumpkinseed (9.4%), and yellow perch (4.7%) predominated in the pre-years; bluegill (72.2%), pumpkinseed (20.8%), and largemouth bass (3.1%) predominated in 1960 (Table 79). Bluegills larger than 6.0 inches in length made up 44% of the harvest in 1946-52 and 62% in 1960.

The relaxation of regulations on panfishing did not alter the fish population or the fishery significantly except for allowing greater harvest. Catch per hour of larger bluegills remained close to 1.0 even though the harvest of bluegills of very small size was intensive (Christensen 1953; and Table 80). Growth remained slow, and in fact, may have declined between 1949 and 1956. This suggests that the decline in bluegill catch in the early 1950's was not due to a permanent decline in bluegill abundance. About 5 years were required for a bluegill to reach 6 inches long and less than 1% of those caught by anglers (in 1949-50) had lived as long as 7 years.

Sugarloaf Lake

Sugarloaf Lake, Washtenaw County, has an area of 180 acres and a maximum depth of 18 feet. Intensive studies have been made of the fish populations (Cooper 1953; Cooper and Latta 1954; Cooper et al. 1957; Laarman and Schneider 1979) and angling (Hazzard and Eschmeyer 1938; Clark 1940; Christensen 1953).

Creel census information extends from 1936 through 1963 with two gaps (Tables 81 and 82). The data from the 1930's are of limited value because a partial fish kill occurred in the winter of 1935-36, and fishing did not begin to return to normal until 1939 (Clark 1939).

Fishing regulations have been complex. The most important changes were (1) the reduction of the closed spring season (beginning in 1946) and the elimination of the 6-inch size limit (since September 1949) on bluegill, pumpkinseed, yellow perch, and other panfish; and (2) the raising of the size limits on largemouth bass and northern pike. Bass size limits were

increased from 10 to 16 inches in 1954, then were reduced to 14 inches in 1959; pike size limits went from 14 to 24 inches in 1954, then to 20 inches in 1959. High size limits were also tested at Fife and Minnewaukon lakes.

In 1946-63, the census clerk interviewed these percentages of the anglers in the various seasons: spring, 6-19%; summer, 6-15%; fall, 6-9%; winter, open-ice, 18-32%; and shanty, 23-67%. In the 1930's, interview rates were about 50% for the winter 1935-36, and 90% for the other periods; consequently these rates were used to expand the records of observed fishing (Clark 1939) into estimates of total fishing.

Fishermen.--Most of the fishermen using Sugarloaf Lake lived in Washtenaw or Jackson counties, but there was a high proportion of anglers from other areas of Michigan in certain years. During the open-water seasons, the location of residence broke down as follows: local, 57%; out-state, 32%; and out-of-state, 11%. During the winter season these proportions were 85%, 14%, and 1%, respectively. Males comprised 79% of the anglers and females 21%.

Methods.--Nearly all fishing was done from boats or through the ice. The length of an average fishing trip varied widely from year to year but averaged as follows: spring, fall and open-ice, 3.6 hours; summer, 4.1 hours; shanty, 4.8 hours.

Records of fishing methods and species sought collected from 1950 to 1963, indicate some changes in the character of the fishery. As at other lakes, interest in panfish waned (from 55% to 30%) as did use of the still-fishing method (also from 55% to 30%). However, interest in game species did not increase here, as it did elsewhere, but remained between 15 and 30%. Rather, there was increased effort directed at a combination of panfish plus game fish (from 25% to 40%) with a combination of methods (increase from 20% to 55%). There were similar trends in interest in the ice fishery but panfish remained the primary targets. Raising the size limits on bass and pike caused only relatively small and temporary losses in interest.

Pressure. --Post-World War II fishing pressure averaged 107 hours per acre per year (range, 77-146) and was stable (Fig. 18). It was two to three times higher than in the 1930's. The changes in regulations probably had no important effect on total pressure. The spring fishery created in 1946 and enhanced in later years (except for 1951), generated 15% of the total hours. Eliminating the size limit on panfish (late in 1949) or changing the size limits on game fish (1954 and 1959) did not alter total fishing pressure.

Catch. --Fish were caught at the annual rates of 117 per acre (range, 85 to 212) and 1.04 per hour (range, 0.66 to 1.65).

The opportunity to fish in the spring resulted in a modest harvest. The percentages of the total catch made in the spring, by species, were: bluegill, 23%; yellow perch, 11%; pumpkinseed, 38%; and black crappie, 16%. Five percent (5%) of the northern pike were taken in the spring, under a partial relaxation of the closed season (as compared to 54% in the winter). Furthermore, fishing success was not exceptionally better in the spring: catch-per-hour rates were 1.17 in spring, 0.90 in summer, 1.05 in fall, 1.60 for open-ice anglers, and 0.84 for anglers in shanties.

Overall, the composition of the catch was bluegill, 45.2%; yellow perch, 34.5%; pumpkinseed, 8.6%; rock bass, 4.1%; largemouth bass, 2.2%; black crappie, 1.4%; warmouth bass, 1.2%; northern pike, 0.7%; bullhead, (brown and yellow), 0.7%; plus some bowfin and gar pike. Warmouth bass were unusually common during the 1950's.

Panfish. --The catch of panfish fluctuated, but without a downward trend, suggesting that year-around fishing and no size limit were not detrimental to the stocks (Fig. 18). Unusually high catches of bluegill and yellow perch (also largemouth bass) were made in 1949 and 1950, but they were apparently due to high fish abundance rather than changes in regulations. The 6-inch size limit was removed late in 1949, but small fish made up a relatively small portion of the harvest--18% for bluegills in 1950. The length-frequency distribution of angler-caught fish is given in Table 83.

The greater protection afforded predatory fish by higher size limits in 1954-63 did not benefit the panfish (Laarman and Schneider 1979). On the contrary, panfish growth declined.

Game fish.--Raising minimum size limits greatly reduced the harvest of largemouth bass but only slightly reduced pike harvest (Table 84). For bass, as compared to harvest under a 10-inch size limit, harvest was reduced to 35% by number and to 73% by weight with a 14-inch limit, and to 11% by number and 23% by weight with a 16-inch limit. For pike, as compared to harvest under a 14-inch size limit, harvest was reduced to 79% by number with a 20-inch limit, and to 57% by number with a 24-inch limit. However under the higher size limits, the catch of large pike increased and the pounds harvested per unit effort remained unchanged because the good growth potential of pike was realized. In Sugarloaf Lake pike reach 24 inches during age III--about a year ahead of the state average.

Estimates of the numbers of bass and pike in the lake were made periodically, 1948-62 (Laarman and Schneider 1979). Population increases due to the more protective size limits could not be detected but the survival of largemouth bass may have improved slightly.

Townline Lake

Townline Lake, Montcalm County, has an area of 247 acres and a maximum depth of 41 feet. The lake was experimentally treated with rotenone in June 1957, to thin by about 50% the abundant, slow-growing bluegill population. Followup management included treatment of bluegill redds with copper sulphate, construction and operation of a northern pike spawning marsh, and banning the harvest of northern pike to protect the brood stock.

The success of the management program has been largely dealt with in another report (Hooper et al. 1964); the purpose here is to permanently record the creel census estimates derived from a 4% sample in 1959 (June 9-September 7) and a 9% sample in 1962 (May 15-September 26).

In those years there was no size limit or closed season on panfish, bass had a 10-inch size limit and were protected January 1-May 31, and pike were completely protected.

Considering the 1962 data to be most typical for the lake, fishing pressure was 37 hours per acre, total catch was 26 fish per acre, and catch per hour was 0.71 (Table 85). As these figures represent the bulk of the year's fishing, they indicate that fishing was poor compared to similar lakes. The composition of the catch was bluegill, 78.3%; pumpkinseed, 11.0%; largemouth bass, 3.3%; yellow perch, 2.6%; bullhead, 2.4%; black crappie, 1.8%; and miscellaneous other species, 0.6% (Table 86). The bluegill fishery was slightly better in 1959 due to the spurt in growth after the thinning operation. Nevertheless, 94% of the bluegills harvested were less than 6.0 inches long.

Turk Lake

Turk Lake, Montcalm County, has an area of 159 acres. It has two basins, each 20 feet deep. Fishing has been consistently poor due to an over-abundance of small bluegills. Management has been directed at thinning the panfish populations.

First (1946-50), experimental fishing regulations were tried. The size limits and the creel limits on small (less than 6.0 inches) panfish were removed but the closed season on bluegill from April 1-June 24 was retained. Hess Lake had the same regulations, and similar relaxations of size and creel limits were made at Bear (Hillsdale County), Saddle, and Devils lakes. Records of catch and effort were voluntarily kept by fishermen at Turk Lake, but they were not complete and probably under-represented the unsuccessful fishing trips. These records show 2,055 hours of fishing, a total catch of 9,588 fish, and a catch rate of 4.67 fish per hour. The catch was comprised of 76% bluegill, 13% yellow perch, 6% pumpkinseed, 3% black crappie, 2% largemouth bass, and less than 1% northern pike and other species. A large fraction of the panfish (64% of the bluegills) were less than 6.0 inches long. After 1950, the no-size-limit rule was continued (statewide); the stunting problem continued as well.

Second, (August 1956), the lake was treated with rotenone to remove about 90% of the fish population. This thinning, plus a burgeoning population of northern pike (estimated at 85 per acre in 1958), resulted in improved bluegill growth until 1961 (Hooper et al. 1964). However, results of summer creel census in 1958, 1959, and 1962, indicate the fishery did not change substantially--within wide confidence limits (Tables 87 and 88). In those years, northern pike were completely protected from harvest (a special regulation), bass had a 10-inch size limit and a closed season from January 1 to June 1 (1958-59) or 20 (1962), and panfish species had no size limits or closed seasons.

An average effort of 43 hours per acre yielded a catch of 37 fish per acre, for a catch per hour of 0.86. These statistics are unimpressive considering that they represent the bulk of the annual catch. The composition of the catch was bluegill, 52.3%; yellow perch, 26.0%; largemouth bass, 7.1%; pumpkinseed, 5.0%; bullhead, 2.5%; plus a few rock bass, black crappie, bowfin, and miscellaneous sunfishes.

Compared to the pre-treatment data of 1946-50, the composition of the catch shifted from bluegill towards yellow perch and largemouth bass, but the overall catch rate fell substantially and the fish were still of small size. In 1958, bluegills averaged 6.5 inches and 30% of them were less than 6.0 inches. In 1959, bluegills averaged only 5.2 inches and 75% of them were small. Thus the documented benefits to the fishery from the rotenone treatment are limited to a small improvement in bluegill size for a year or two.

Whitmore Lake

Whitmore Lake, in Washtenaw and Livingston counties, has an area of 677 acres and a maximum depth of 69 feet. Both the fish population and the fishery have received much study. The fish were intensively sampled with trap nets in 1953-58, and population estimates were made in 1953-56 (Cooper and Schafer 1954; Cooper, Latta, and Schafer 1957; and Latta 1959). The fishery was studied in 1934-38 (Trautman 1941), in 1945 (Predmore 1947), and from 1945 to 1961 (reported in part by Predmore 1948, and Christensen 1953).

Experimental fishing regulations began in 1946 with the removal of the closed spring season (March 1-June 24) on yellow perch, black crappie, rock bass, and "rough" fish. In 1954-58, year-around fishing was permitted for all species, including bass and pike. This was extended until 1961 for all species except northern pike; they were given more protection by a March 1-third Saturday in June closure, a 20-inch size limit, and a ban on spearing. Statewide changes in panfish regulations which went into effect at Whitmore Lake were the discontinuation of the 6-inch size limit on panfish in September 1949, and the reduction of the closed season on bluegill and pumpkinseed from April 1-June 24 to April 1-24.

The census clerks contacted 12.9% of the anglers in 1946, and 2-10% of the anglers in the other years. Generally, they interviewed about 8% of the fishermen in the open-water seasons, about 16% of the open-ice anglers, and about 30% of the shanty users. The census estimates are presented in Tables 89 and 90.

Fishermen.--In the early 1950's, Whitmore Lake was fished almost exclusively by residents of Livingston and Washtenaw counties. By 1959, the percentage of anglers from elsewhere in Michigan had increased from 4 to 30% and out-of-state anglers had increased from 0 to 2%. These increases occurred in all seasons and were not simply because spring bass fishing was permitted. Men and boys made up over 80% of the anglers in each season.

Methods.--Nearly all fishing was done from boats or through the ice. The average fishing trip lasted 3.7 hours in each of the open-water seasons, 2.8 hours for open-ice anglers, and 3.4 hours for shanty anglers.

Shanty users sought only northern pike in the early 1950's, but the pike population dwindled and by the early 1960's only about 20% were seeking pike exclusively, 50% were after panfish exclusively, and 30% were fishing for both types of fish. Most (80 to 100%) of the open-ice anglers sought panfish in the 1950-61 period.

Open-water anglers also changed their target species and their methodology. Prior to the removal of all closed seasons in 1954, 0% of the spring anglers, 16% of the summer anglers, and 9% of the fall anglers were fishing for bass (Fig. 19). After liberalization (but not necessarily because of it), up to 40% of the anglers sought bass in each of those seasons. Interest in catching panfish declined correspondingly while anglers after both types of fish remained at about 10% of the yearly total. Anglers interested in catching pike fell from about 5% in the early 1950's to near zero.

Pressure.--Fishing pressure varied between approximately 34 (1950) and 149 (1948) hours per acre (Fig. 20). The average was 91 hours per acre. Allowing spring fishing for perch, crappie, and species of minor importance created a fishery amounting to just 8% of the total for the open-water seasons in 1946-47 (data of Predmore 1948). Allowing spring fishing for game species in 1954-61 did not cause an increase in total annual pressure, but it stimulated more springtime fishing. Total fishing pressure on bass increased markedly because a greater proportion of the anglers were fishing for them in the open-water seasons (Fig. 19). Actually, the trend toward more fishing in the spring began in the early 1950's, when the bluegill closed season was reduced. After 1954, a large amount of fishing interest and effort was occurring in May, but the April fishery was negligible (Fig. 21).

Catch.--Fish were caught at the average rates of 110 fish per acre and 1.16 fish per hour. These statistics varied greatly from year to year, primarily in synchrony with bluegill catch and abundance (Fig. 20).

The species composition of the catch varied some from year to year, but averaged 68.0% bluegill, 13.2% perch, 7.5% pumpkinseed, 3.1% crappie, 3.0% largemouth bass, 0.2% smallmouth bass, 1.1% rock bass, 2.8% bullheads, and 1.1% northern pike. Warmouth bass, suckers, and other species were of minor importance. The average monthly catches and the average monthly catch rates (total number caught divided by total number

of fishing hours) are shown in Figures 22 and 23 for years when closed seasons were removed.

Bluegill.--The catch of bluegills averaged 75 per acre and 0.78 per hour. The highest catches and the highest catch rates were in July. Most were 6.0-6.9 inches long (Table 91).

As the predominant species, fluctuations in bluegill abundance due to uneven recruitment had the greatest effect on the fishery at Whitmore Lake. Year-to-year changes in the fishery were observed in the 1930's by Trautman (1941), and during the 1946-61 period, bluegill catch varied 11-fold--from 8,500 (in 1950) to 95,000 (in 1957). Population studies of bluegills longer than 6.0 inches in 1953-56 indicated densities as low as 29,000 in 1953 and as high as 110,000 in 1956 (Cooper and Schafer 1954; Latta 1959). Density changes were reflected in bluegill growth rate but to a lesser degree (Table 92).

Any effects caused by the removal of the closed spring season or the 6-inch size limit were obscured by these natural fluctuations. However, the amount by which catch might be increased or decreased by closing or opening various months can be judged from Figure 22. For example, insignificant numbers of bluegills were caught in March and April, but about 10% of the yearly catch was taken in May. Actually closure of the month of May to fishing would result in less than a 10% drop in catch because some of those bluegills would be caught in other months.

Other panfish.--The removal of the closed spring season probably had no important effect on the populations of yellow perch or black crappie, or their fisheries. The perch catch has fluctuated without trend, but the crappie catch has gradually declined from a peak in 1950 (Fig. 20). Perch are not very vulnerable to angling in the spring, but May is the peak month for crappie harvesting (Figs. 22 and 23). Since 1952, 16% of the perch and 27% of the crappie were taken in the spring season. The perch and crappies were mostly of small size (Table 91).

Bass.--Harvest rates of bass averaged 3.1 largemouth per acre and 0.1 smallmouth per acre. No overall trend in catch took place (Fig. 20). Population estimates of legal-size largemouth bass varied from 3.2 to 7.6 per acre, 1953-56 (Cooper and Schafer 1954; Cooper, Latta, and Schafer 1957; Latta 1959).

Year-around fishing had no effect on the total catch of smallmouth bass; but for largemouth bass, it resulted in increases of 34% by number and 27% by weight (Table 93). These increases are not statistically significant because of the large variations in catch. On the average, about 33% of the catch of each species was made in the January 1-third week in June period (Fig. 22). Thus most of the increase in the annual harvest of largemouth bass can be attributed to the new spring fishery. Unlike the events at Pontiac Lake, the spring fishery did not displace the summer fishery. Both catch and catch rate remained highest in the summer (Fig. 19).

At Whitmore Lake, like many other lakes in the state, there was a large increase (about four times) in fishing pressure on bass in all the open-water seasons during the late 1950's (Fig. 19). Because the increase in pressure was much greater than the increase in harvest, a considerable decline in the catch-effort index occurred after the mid-1950's; however the index did not fall below an earlier level (Fig. 19). Changes in catch-effort were likely due to uneven recruitment and, also, competition among anglers for available bass. Growth of age-V and older bass increased some between 1953 and 1958 (Table 92), but it is not clear if it was due to increased exploitation (and, hence, reduced density) or to the large changes in the stocks of other fish. The size-frequency distribution of the catch did not change significantly (Table 91).

Pike.--The catch of pike steadily declined from 2.9 per acre in 1946 to near zero. No doubt the decline was due mainly to loss of nearly all the marsh spawning habitat to residential development. Changes in fishing regulations had no important effects on the fishery or the stock. The catch was negligible from March 1 to June 1 (Figs. 22 and 23) and pike grew so rapidly (Table 92) that the 20-inch size limit did not restrict the catch much (Table 93).

Table 1.--Synopsis of studies on fishing regulations at Michigan lakes, 1946-65.

Regulation change[a]	Lake	County
Panfish studies		
1. No closed season on bluegill, sunfish, all "other" pan fish	Big Portage	Jackson
	Fife	Grand Traverse
	Minnewaukon	St. Joseph
	Sugarloaf	Washtenaw
2. No closed season on yellow perch, crappie, and the "other" panfish (exclude bluegill and sunfish)	Craig	Branch
	Duck	Calhoun
	Fine	Barry
	Lobdell	Genesee
	Pontiac	Oakland
	Whitmore	Livingston
3. For all panfish: No closed season, no minimum size limit, and no creel limit on small (less than 6 inches) sizes	Bear	Hillsdale
	Devils	Lenawee
	Hess[b]	Newaygo
	Saddle	Van Buren
	Turk[c]	Montcalm
4. Removal of 6-inch size limit in September 23, 1949	Statewide	
Game fish studies		
5. No size limits	Big Portage	Jackson
	Duck	Calhoun
	Fine	Barry
6. High size limits: 14 or 16 inches on bass; 20 or 24 inches on pike	Fife	Grand Traverse
	Fletcher Floodwater	Alpena
	Houghton	Roscommon
	Minnewaukon	St. Joseph
	Otsego	Otsego
	Sugarloaf	Washtenaw
7. No closed season	Bear	Manistee
	Pontiac	Oakland
	Whitmore	Livingston
8. Ban on pike spearing	Fife	Grand Traverse
	Fletcher Floodwater	Alpena

(continued, next page)

Table 1.--concluded

Regulation change[a]	Lake	County
Game fish studies, continued		
9. No harvest of pike	Townline	Montcalm
10. Reduced closed season on bass, and on pike and walleye	Statewide	
Rainbow trout studies		
11. Closed season reduced or eliminated	Birch	Cass
	Corey	St. Joseph
	Big Twin	Kalkaska

[a] Original statewide regulations were:

Panfish--closed season April 1 or May 1 to June 24; 6-inch minimum size limit.

Bass--closed season January 1 to June 24; 10-inch minimum size limit.

Northern pike--closed season from early spring to June 24; 14-inch size limit.

Rainbow trout in lakes--closed season December 1 to late April; 7-inch minimum size.

[b] No data were collected for Hess Lake.

[c] At Turk Lake the bluegill season remained closed until June 24.

Table 2.--Average fishing pressure (hours per acre), catch per hour per angler (CPH), and catch per acre at the study lakes, 1946-64. [a]

Lake	Hours	CPH	Number caught										
			Total	Blue-gill	Yellow perch	Pump-kin-seed	Black crap-pie	Rock bass	Small-mouth bass	Large-mouth bass	Wall-eye	North-ern pike	Rain-bow trout
Bear (Hills-dale County)	136	0.87	118	77	22	7	1	2	tr	6.2			
Bear (Manistee County)	40	0.53	21	6	3	3		4	1.2	1.7	0.4	0.4	
Big Portage	38	0.49	20	12	3	1	2	tr	tr	1.8	0.1	0.4	
Big Twin	14	1.66	23		15	7		tr					tr
Birch	66	0.53	33	17	4	1	1	2	0.4	2.8			4.8
Corey	142	1.20	170	148	10	5	tr		0.1	3.4			3.1
Craig	243	1.37	334	260	32	14	11	tr		5.3		1.7	
Devils	79	1.04	82	36	32	5	1	5	0.2	3.0		0.5	
Duck	117	0.86	100	64	18	4	5	3	0.1	5.5	0.1	0.5	
Fife	76	0.66	48	23	6	7	3	6	0.4	0.5	0.1	2.0	
Fine	134	1.70	220	178	10	18	6	tr	tr	2.9	tr	0.7	
Fletcher Flood-water	28	0.42	12	tr	2	4		tr		0.3		4.7	
Houghton	44	0.63	28	13	7	3	tr	2	0.1	0.2	0.7	1.5	
Lobdell	123	1.05	136	86	17	10	17	tr	0.1	2.2		0.8	
Minnewaukon	110	2.04	226	152	13	19	11	tr	tr	3.2		0.2	
Otsego	41	0.99	44	5	27	10		1	0.2	0.8		0.3	
Pontiac	180	1.22	216	162	14	16	16	1	tr	4.6		1.0	
Saddle	92	2.18	202	160	14	19	3	tr		2.0		tr	
Sugarloaf	107	1.04	117	53	40	10	2	5		2.6		0.8	
Townline	37	0.71	26	20	1	3	tr	tr		0.9			
Turk	43	0.86	37	19	10	2	tr	tr		2.6			
Whitmore	91	1.16	110	75	15	8	3	1	0.2	3.3		1.2	
Average	90	1.06	106	71	14	8	4	2	0.1	2.5	0.1	0.8	0.4
Range	14-243	0.42-2.18	12-334	0-260	1-40	1-19	0-17	0-5	0.0-1.2	0.0-5.5	0.0-0.7	0.0-4.7	0.0-4.8

[a] Data used for Birch Lake began in 1941; only data for 1962 used for Townline Lake; only data for 1946-52 used for Saddle Lake.

tr = trace = less than 0.5 fish per acre for panfish, and 0.05 fish per acre for game fish.

Table 3.--Average percentage of the annual fishing pressure and catch occurring in the spring season, and average catch per angler hour in spring as compared to the annual total, for lakes with year-around fishing for panfish.

Study, and lake	Number of years[a]	Pressure	Catch					Average catch per hour	
			Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Spring	Total
Study No. 1									
Big Portage	11, 14	18	30	12	18	14	14	0.57	0.44
Fife	14, 18	7	2	5	7	19	28	0.68	0.60
Minnewaukon	7, 11	17	23	16	63	22	--	2.65	1.95
Sugarloaf	12, 16	16	23	11	38	16	28	1.07	1.07
Study No. 2									
Duck	8	8	16	16	23	25	28	1.37	0.93
Fine	8	16	17	12	33	31	--	2.01	1.81
Lobdell	1	23	16	22	23	34	26	0.95	1.08
Pontiac	9	23[b]	14	15	26	49	33	0.93	1.29
Whitmore	9	24[b]	19	16	25	27	25	0.98	1.28
Study No. 3									
Bear (Hillsdale County)	2, 7	16	23	27	41	0	19	0.74	0.85
Devils	4	12	15	3	31	--	22	1.25	1.04
Saddle	3, 8	27	27	5	39	0	0	2.33	1.80
Other studies									
Bear (Manistee County)	13	11[b]	10	8	10	--	21	0.63	0.53
Big Twin	1	6[b]	--	3	55	--	75	5.80	1.66
Birch	9	21[b]	23	24	19	25	44	0.82	0.69
Corey	7	17[b]	10	13	39	10	--	0.86	1.20
Otsego	10	6	8	5	12	--	23	0.91	0.94
Average[c]		16	17	13	30	21	28	1.17	1.09
Range		6-24	2-30	3-27	9-63	0-49	0-75	0.57-5.80	0.44-1.95

[a] Where two numbers are given, the first is the number of years of data used for computing average pressure and average catch; the second is the number of years of data available for computing average catch per hour. Data collected prior to 1952 have not been used except for lakes in studies No. 1 and No. 3 (see Table 1), where special regulations allowed spring harvest of all species of panfish.

[b] Part of this pressure due to concurrent spring fishing for game species or trout.

[c] The averages for catch per hour exclude Big Twin Lake; and the averages for panfish catches exclude those lakes where a species was not caught (indicated by --).

Table 4.--Percentage contribution of panfish smaller than 6.0 inches to the total catches of their respective species in years of no size limits.

Lake	Species of panfish				
	Bluegill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass
Bear (Hillsdale Co.)	33	15	56		13
Bear (Manistee Co.)	30	41	30		
Big Portage	35	47	43	0	14
Corey	21	7			
Craig	8	5	57	0	
Devils	8	1	14		6
Duck	12	0	33	2	
Fife	34	28	49	1	29
Fine	53	8	88	1	
Houghton	18	54	12	0	6
Lobdell	21	13	24	2	
Minnewaukon	51	3	71	0	
Otsego	29	51	44		70
Pontiac	16	3	6	2	0
Saddle	56				
Sugarloaf	15	0	42		0
Townline	94				
Turk	64				
Whitmore	11	7	7	0	16
Average	33	18	38	1	17
(Number of lakes)	(20)	(16)	(15)	(10)	(9)

Table 5.--Percent change (as compared to a 10-inch size limit) in numbers caught, pounds caught, and pounds caught per bass-hour (Index) for largemouth bass under three size limits.

Lake	No size limit			14-inch size limit			16-inch size limit		
	Numbers	Pounds	Index[a]	Numbers	Pounds	Index[a]	Numbers	Pounds	Index[a]
Big Portage	+33	--[b]	--						
Duck	+63	+17	-13						
Fine	+57	-6	-28						
Fife				-30	-18	-49	-42[c]	-6[c]	-28[c]
Minnewaukon							-67	-43	-59
Sugarloaf				-65	-27	-26	-89	-77	-67

[a] Index = pounds caught ÷ total pressure × proportion of summer anglers fishing for bass or game fish.

[b] Measurements of average bass size were insufficient to estimate pounds caught.

[c] The unexpectedly high catches at Fife Lake under the 16-inch limit can be traced to strong year classes.

Table 6.--Fishery statistics at three test lakes where spring fishing for largemouth bass was allowed.

Statistic	Bear Lake (Manistee Co.)	Pontiac Lake	Whitmore Lake
Percent change in spring pressure	+67	+67	+177
Percent of spring anglers fishing for bass species	40	32	32
Percent of largemouth bass catch in spring	21	51	33
Percent change in annual largemouth bass catch	+117	-5	+34

Table 7.--Percent change (as compared to a 10-inch size limit) in numbers caught, pounds caught, and pounds per bass-hour (Index) for smallmouth bass under three minimum size limits.

Size limit and characteristic	Observed	Predicted [a]
No size limit (Duck Lake)		
Numbers caught	+62	+58
Pounds caught	+22	+4
Index [b]	-10	+4
14-inch size limit (Fife Lake)		
Numbers caught	-80	-64
Pounds caught	-73	-38
Index [b]	-83	-38
16-inch size limit (Fife Lake)		
Numbers caught	-88	-88
Pounds caught	-70	-71
Index [b]	-77	-71

[a] Predicted from Latta (1975, Tables 5 and 7, $\mu = 0.25$).

[b] Index = pounds caught ÷ total pressure × proportion of summer anglers fishing for bass or game fish.

Table 8.--Fishery statistics at two test lakes where spring fishing for smallmouth bass was allowed.

Statistic	Bear Lake (Manistee Co.)	Whitmore Lake
Percent change in spring pressure	+67	+177
Percent of spring anglers fishing for bass species	40	32
Percent of smallmouth bass catch in spring	33	36
Percent change in annual smallmouth bass catch	+14	-12

Table 9.--Percent change (as compared to a 14-inch size limit) in numbers caught, pounds caught, and pounds per 1000 fishing hours (total pressure) for northern pike under three size limits.

Lake	No size limit			20-inch size limit			24-inch size limit		
	Numbers	Pounds	Pounds per 1000 hours	Numbers	Pounds	Pounds per 1000 hours	Numbers	Pounds	Pounds per 1000 hours
Big Portage	-7	--	--	-62	--	--			
Duck	+37	+158	+133	+33	--	--			
Fine	-28	-36	-8	-72	--	--			
Minnewaukon							-76	-70	-62
Otsego				-82	--	--	+38	--	--
Fife				-22	-31	-14	-71	-55	-50
Sugarloaf				-21	+17	+4	-41	0	0
Fletcher Floodwater				-96	--	--			
Houghton				-58	-45	-52			

Table 10.--Fishing regulations, and estimates of pressure and total catch for Bear Lake (Hillsdale County), winter of 1937-38 through winter of 1953-54.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1937					
Winter	311	-	238	0.3	All panfish: Apr 1-June 24; 6 inches
					Bass: Apr 1-June 24; 10 inches
1938					
Summer	3,342	-	8,301	0.6	
Winter	202	559	547	1.0	
Total	3,544	-	8,848	-	
1939					
Summer	2,698	8,154	6,409	0.8	
Winter	254	574	195	0.3	
Total	2,952	8,728	6,604	0.8	
1940					
Summer	1,834	5,063	3,616	0.7	
Winter	401	740	1,127	1.5	
Total	2,235	5,803	4,743	0.8	
1941					
Summer	2,223	7,738	8,060	1.0	
Winter	254	608	985	1.6	
Total	2,477	8,346	9,045	1.1	
1942					
Summer	1,857	5,895	5,580	1.0	
Winter	124	244	274	1.1	
Total	1,981	6,139	5,854	1.0	
1943					Bluegill and pumpkinseed: Mar 1-June 25
Summer	1,797	5,188	6,818	1.3	
Winter	242	602	1,008	1.7	
Total	2,039	5,790	7,826	1.4	
1944					
Summer	2,050	6,791	7,339	1.1	
Winter	168	452	601	1.3	
Total	2,218	7,243	7,940	1.1	
1945					
Summer	1,133	5,916	5,537	1.0	
Winter	251	762	746	0.9	
Total	1,384	6,678	6,283	1.0	

(continued, next page)

Table 10.--concluded

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a] Species; closed season; minimum size
1946					*All panfish: none; none; no creel limit for fish less than 6 inches long Bass: Jan 1-June 24
Total	3,887	14,420	12,111	0.84	
1947					
Total	6,490	18,760	17,871	0.95	
1948					
Total	5,140	17,150	15,766	0.92	
1949					
Total	5,430	16,730	18,449	1.10	
1950					
Total	4,800	11,690	8,977	0.85	
1951					All panfish: Apr 1-June 25; none
Spring	Fishing prohibited				
Summer	4,414	10,852	9,767	0.90	
Fall	621	1,319	1,833	1.45	
Winter	597	1,574	1,053	0.77	
Total	5,632	13,745	12,660	0.92	
1952					Bluegill and pumpkinseed: Apr 1-25 Other panfish: no closed season
Spring	1,600	4,086	4,209	1.03	
Summer	4,427	11,384	10,701	0.94	
Fall	350	722	426	0.69	
Winter	2,167	4,761	2,714	0.67	
Total	8,540	20,953	18,050	0.96	
1953					
Spring	884	1,752	1,261	0.72	
Summer	3,904	9,912	4,064	0.41	
Fall	631	1,224	575	0.57	
Winter	463	978	244	0.25	
Total	5,882	13,866	6,144	0.44	

[a] Only important regulations and their changes are noted. Asterisk (*) denotes special regulations.

Table 11. --Observed (1937-45) and estimated (1946-53) catch of fish from Bear Lake, Hillsdale County.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Bull-head	War-mouth bass	Other species
1937									
Winter	496	228		1	8	8	7	27	10
1938									
Summer	5,317	688	320	116	468	651	414	96	225
Winter	455	15	23	7		4	1	42	
Total	5,772	703	343	123	468	655	415	138	225
1939									
Summer	4,092	885	148	76	228	418	392	79	89
Winter	16	90	4	3	46		1	26	76
Total	4,108	975	152	79	274	418	393	105	165
1940									
Summer	1,291	612	133	10	135	541	792	36	66
Winter	1,057	39	11	9		5	1		5
Total	2,348	651	144	19	135	546	793	36	71
1941									
Summer	5,700	669	219	39	244	565	534	53	37
Winter	963	6	15				1		
Total	6,663	675	234	39	244	565	535	53	37
1942									
Summer	4,133	498	138	29	128	318	285	33	18
Winter	252		10	3		4		4	1
Total	4,385	498	148	32	128	322	285	37	19
1943									
Summer	4,946	461	290	38	134	469	369	100	11
Winter	889	89		1				29	
Total	5,835	550	290	39	134	469	369	129	11
1944									
Summer	5,221	1,091	102	40	157	397	285	14	32
Winter	482	112	244	1	4	2			
Total	5,703	1,203	346	41	161	399	285	14	32
1945									
Summer	3,300	1,305	244	14	172	356	145	2	1
Winter	496	228		1	8	8	1		2
Total	3,796	1,533	244	15	180	364	146	2	3
1946									
Total	6,588	3,488	872	85	279	351	279	61	109

(continued, next page)

Table 11.--concluded.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Bull-head	War-mouth bass	Other species
1947									
Total	12,545	1,537	1,573	161	393	1,269	125	143	1,197
1948									
Total	13,133	962	489	47	95	741	126	110	79
1949									
Total	12,269	2,029	2,564	314	498	590	74	92	18
1950									
Total	6,683	1,202	224		341	179		323	18
1951									
Total	8,267	3,482	291		51	443	25	38	63
1952									
Spring	2,062	1,360	194		177	152	17	76	177
Summer	6,795	2,183	375	11	278	845	118	11	75
Fall	85	284				57			
Winter	1,466	1,140		11	11			60	24
Total	10,408	4,967	569	22	466	1,054	135	147	276
1953									
Spring	483	739	39						
Summer	1,053	1,540	41		81	1,109	167	69	
Fall	216	305				54			
Winter	128	108		4			4		
Total	1,880	2,692	80	4	81	1,163	171	69	

Table 12.--Length-frequency distributions (number of fish) of bluegills harvested by anglers at Bear Lake, Hillsdale County, 1946-53.

Year	Inch group[a]							
	3	4	5	6	7	8	9	10
1946			1	66	31	19	5	
1947	1	18	75	91	26	21	5	3
1948	2	39	226	195	83	26		
1949		4	39	142	38	10		
1950			20	23	28	22	3	
1951-53		1	10	16	16	15	7	2

[a] Inch groups: 3 = 3.0-3.9; 4 = 4.0-4.9; etc.

Table 13.--Length-frequency distribution of largemouth bass caught by anglers from Bear Lake, Hillsdale County.

Years	Inch group										
	9	10	11	12	13	14	15	16	17	18	19-21
1946-53	4	59	31	20	9	7	4	6	2	2	3

Table 14.--Fishing regulations, and estimates of pressure and total catch for Bear Lake (Manistee County), 1951-65.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1951					Bass: Jan 1-June 24; 10 inches
Spring		No census			Pike: Mar 16-May 15; 14 inches
Summer	8,255	22,669	14,668	0.65	Walleye: Mar 16-May 15; 13 inches
Fall	3,235	5,593	1,706	0.30	Bluegill and pumpkinseed: Apr 1-June 24; none
Open ice	69	300	62	0.20	
Shanty	363	1,768	962	0.54	Other panfish: no closed season; none
Total	11,922	30,330	17,398	0.57	
1952					Pike and walleye: Mar 16-Apr 25
Spring	2,551	6,368	4,333	0.68	Bluegill and pumpkinseed: Apr 1-25
Summer	20,718	57,256	22,753	0.40	
Fall	2,420	6,010	849	0.14	
Open ice	191	1,164	139	0.12	
Shanty	481	1,615	249	0.15	
Total	26,361	72,413	28,323	0.39	
1953					
Spring	1,416	3,604	4,715	1.31	
Summer	24,822	57,832	24,469	0.42	
Fall	2,910	4,001			
Open ice	109	445	24	0.05	
Shanty	548	2,295	326	0.14	
Total	29,805	68,177	29,534	0.43	
1954					*All species: no closed season
Spring	3,450	10,181	5,870	0.58	
Summer	25,241	63,813	34,899	0.55	
Fall	2,208	5,959	1,371	0.23	
Open ice	223	1,944	96	0.05	
Shanty	732	3,475	396	0.11	
Total	31,854	85,342	42,632	0.50	
1955					
Spring	2,882	7,956	4,814	0.61	
Summer	23,657	57,687	32,905	0.57	
Fall	2,953	7,902	2,167	0.27	
Open ice	276	2,241	93	0.04	
Shanty	544	1,240	47	0.04	
Total	30,312	77,026	40,026	0.52	
1956					
Spring	2,290	5,955	4,771	0.80	
Summer	26,115	59,206	42,670	0.72	
Fall	3,636	8,963	3,538	0.39	
Open ice	254	2,147	58	0.02	
Shanty	368	1,297	148	0.11	
Total	32,663	77,568	51,185	0.66	

(continued, next page)

Table 14.--continued

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1957					
Spring	3,500	9,559	7,460	0.78	
Summer	25,717	60,335	43,610	0.72	
Fall	3,055	6,812	2,221	0.32	
Open ice	164	937	98	0.11	
Shanty	639	2,243	138	0.06	
Total	33,075	79,886	53,527	0.67	
1958					
Spring	2,904	7,603	5,798	0.76	
Summer	24,679	58,114	37,094	0.64	
Fall	2,133	4,816	1,030	0.21	
Open ice	37	140	11	0.08	
Shanty	396	1,180	88	0.07	
Total	30,149	71,853	44,021	0.61	
1959					Walleye: Mar 16-Apr 25; 13 inches
Spring	2,125	6,327	3,859	0.61	*Pike: Mar 1-June 19; 20 inches;
Summer	19,871	47,379	34,544	0.73	no spearing
Fall	2,011	4,753	2,739	0.58	
Open ice	97	418	20	0.05	
Shanty	97	331	97	0.29	
Total	24,201	59,208	41,259	0.70	
1960					
Spring	3,138	8,141	3,808	0.47	
Summer	23,226	50,168	45,367	0.90	
Fall	2,624	6,244	2,086	0.33	
Open ice	149	594	97	0.16	
Shanty	283	1,359	158	0.12	
Total	29,420	66,506	51,516	0.77	
1961					
Spring	2,782	8,097	2,631	0.32	
Summer	24,311	53,903	32,540	0.60	
Fall	2,320	6,148	1,929	0.31	
Open ice	233	947	82	0.09	
Shanty	540	2,620	174	0.07	
Total	30,186	71,715	37,356	0.52	
1962					
Spring	2,883	8,279	4,534	0.55	
Summer	24,724	57,265	29,738	0.52	
Fall	2,082	5,753	1,075	0.19	
Open ice	428	2,034	93	0.04	
Shanty	946	5,356	291	0.06	
Total	31,063	78,687	35,731	0.45	

(continued, next page)

Table 14.--concluded

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1963					
Spring	3,404	11,062	4,887	0.44	
Summer	20,802	44,662	12,566	0.28	
Fall	2,073	5,201	1,575	0.30	
Open ice	332	2,269	142	0.06	
Shanty	1,392	8,216	752	0.09	
Total	28,003	71,410	19,922	0.28	
1964					Pike: Mar 16-Apr 24; spearing
Spring	4,691	12,496	2,819	0.23	Bass: Jan 1-June 1
Summer	17,534	41,207	13,105	0.32	
Fall	1,767	4,285	1,515	0.35	
Open ice	168	1,347	733	0.54	
Shanty	1,131	6,190	714	0.12	
Total	25,291	65,525	18,886	0.29	
1965					
Spring	4,050	9,872	1,954	0.20	
Summer	13,658	33,537	11,963	0.36	
Sub-total	17,708	43,409	13,917	0.32	

[a] Only important regulations and their changes noted. An asterisk (*) denotes a special regulation.

Table 15. --Estimated number of fish caught from Bear Lake, Manistee County, 1951-65.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Rock bass	Largemouth bass	Smallmouth bass	Walleye	Northern pike
1951								
Spring				No census				
Summer	6,971	1,587	898	2,985	898	1,294		
Fall	427		213	427		639		
Open ice	16	19					19	8
Shanty		196					709	57
Total	7,414	1,802	1,111	3,412	898	1,933	728	65
1952								
Spring	766	838	125	2,425			179	
Summer	11,179	2,037	592	3,288	2,367	2,696	396	132
Fall	364	91		91	151	61	30	61
Open ice		23					31	85
Shanty							166	83
Total	12,309	2,989	717	5,804	2,518	2,757	802	361
1953								
Spring	1,375	395	294	2,161			491	
Summer	6,754	5,038	2,104	4,762	3,154	1,715	166	443
Fall								
Open ice								24
Shanty		57					75	194
Total	8,129	5,490	2,398	6,923	3,154	1,715	732	661
1954								
Spring	1,306	331	210	2,522	630	540	60	270
Summer	14,357	6,558	2,408	7,758	1,577	1,452	499	248
Fall	158	404	18		299	70	246	176
Open ice							82	14
Shanty	13	83			6		160	134
Total	15,834	4,376	2,636	10,280	2,512	2,062	1,047	842
1955								
Spring	612	561	136	1,786	374	1,173	102	69
Summer	11,165	2,780	2,938	9,088	2,938	3,172	550	234
Fall	452	283	56	302	641	226	207	
Open ice							82	11
Shanty		5				3	11	25
Total	12,229	3,629	3,130	11,176	3,953	4,574	952	339

(continued, next page)

Table 15.--continued.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Rock bass	Largemouth bass	Smallmouth bass	Walleye	Northern pike
1956								
Spring	959	277	341	1,299	639	1,001	149	106
Summer	14,486	2,774	4,348	15,852	2,193	2,483	248	81
Fall	413	118	118	1,828	354	589		118
Open ice							48	10
Shanty	23	34			6		45	40
Total	15,881	3,203	4,807	18,979	3,192	4,073	490	355
1957								
Spring	774	1,238	774	2,321	1,486	557	248	62
Summer	12,795	5,443	4,845	14,327	4,038	1,487	253	126
Fall	126	126		209	922	796		
Open ice	23	8			8	23	23	15
Shanty	5	15				21	15	76
Total	13,723	6,830	5,619	16,857	6,454	2,884	539	279
1958								
Spring	1,450	268	362	1,481	1,056	914	220	47
Summer	11,121	6,881	4,781	9,722	2,760	1,595	37	78
Fall	330	137	14	371	110	14	27	27
Open ice							11	
Shanty		9					33	46
Total	12,901	7,295	5,157	11,574	3,926	2,523	328	198
1959								
Spring	1,004	189	163	1,239	888	285	92	
Summer	8,463	7,923	6,497	6,824	3,761	439	22	366
Fall	437	982	40	306	605	254	6	215
Open ice					7		2	7
Shanty		93				1		1
Total	9,904	9,187	6,700	8,369	5,261	979	122	589
1960								
Spring	598	626	437	1,097	600	376	42	
Summer	20,261	9,006	6,326	5,042	3,244	535	62	231
Fall	375	639	215	151	449	99	12	146
Open ice		97						
Shanty		58			9		35	56
Total	21,234	10,426	6,978	6,290	4,302	1,010	151	433
1961								
Spring	485	423	103	507	528	226	327	
Summer	14,704	6,380	6,346	1,792	1,989	460	158	433
Fall	1,201	101	201		143	84	62	137
Open ice		50					24	8
Shanty							77	97
Total	16,390	6,954	6,650	2,299	2,660	770	648	675

(continued, next page)

Table 15. --concluded.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Rock bass	Largemouth bass	Smallmouth bass	Walleye	Northern pike
1962								
Spring	1,659	149	828	108	583	964	243	
Summer	8,597	5,769	9,697	2,607	1,560	692	184	233
Fall	269	121		41	115	393	53	83
Open ice							66	27
Shanty						8	149	134
Total	10,525	6,039	10,525	2,756	2,258	2,057	695	477
1963								
Spring	2,427	57	1,175	311	260	495	162	
Summer	2,682	5,076	2,503	380	316	364	664	3,436
Fall	697	180	350		46	20	37	245
Open ice		15					30	97
Shanty		42					145	565
Total	5,806	5,370	4,028	691	622	879	1,038	4,343
1964								
Spring	71	120	152	457	35	51	414	1,329
Summer	1,999	6,633	1,002	1,297	106	635	651	689
Fall	961	358	43			103		50
Open ice	9	397					59	268
Shanty		49	15				63	587
Total	3,040	7,557	1,212	1,754	141	789	1,187	2,923
1965								
Spring	316	843	64	140	47	150	145	211
Summer	3,452	3,737	771	994	652	883	439	724
Sub-total	3,768	4,580	835	1,134	699	1,033	584	935

Table 16.--Age composition (number of fish) of the sport catch at Bear Lake, Manistee County, 1951-65.

Species	Age							
	II	III	IV	V	VI	VII	VIII	IX and older
Bluegill	8	41	180	175	71	25	13	7
Yellow perch	26	50	36	16	2	1		
Pumpkinseed		12	46	54	24	5	1	
Rock bass	1	35	82	116	49	11	4	2
Largemouth bass	22	255	126	96	78	29	5	17
Smallmouth bass	35	239	181	61	37	29	14	7
Walleye	88	70	104	107	86	39	18	4
Northern pike	51	70	52	28	15		5	

Table 17.--Average length in inches, by age group, for fish taken by anglers from Bear Lake, Manistee County, 1951-65. (Sample sizes in Table 16)

Species	Age							
	II	III	IV	V	VI	VII	VIII	IX
Bluegill	4.4	5.5	6.4	7.0	7.5	7.9	8.6	8.8
Yellow perch	6.3	7.1	8.0	9.4	11.0	12.0		
Pumpkinseed	4.4	5.2	5.9	6.4	6.9	7.3	7.8	
Rock bass	4.5	5.6	6.5	7.4	8.2	8.9	9.6	9.9
Largemouth bass	10.5	11.4	12.7	14.0	15.0	16.4	17.6	18.5
Smallmouth bass	10.5	11.4	13.3	14.7	16.3	17.6	18.6	19.1
Walleye	14.8	17.4	20.5	21.3	22.2	23.2	24.5	25.7
Northern pike	22.2	25.1	26.2	29.6	33.3		40.5	

Table 18.--Fishing regulations, and estimates of pressure and total catch for Big Portage Lake, 1936-1961. Data for 1936 from Hazzard and Eschmeyer (1938); data for 1939 from Clark (1940).

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1936					All panfish: May 1-June 24; 6 inches
Winter	728	-	2,698	0.8	Pike and walleye: May 1-June 24; 14 inches
Summer	2,374	10,733	10,340	0.9	Bass: Jan 1-June 24; 10 inches
Total	3,102	10,733	13,038	0.9	
1939					
Winter	653	2,940	1,323	0.4	All panfish: Apr 1-June 24
Summer	1,817	8,357	7,200	0.9	Pike and walleye: Apr 1-June 24
Total	2,470	11,297	8,523	0.8	
1946					*All panfish: none; 6 inches
Total	5,050	14,940	8,680	0.58	*Pike and walleye: Mar 16-May 15; 14 inches
1947					
Total	6,710	21,100	14,020	0.66	
1948					
Total	6,990	22,250	14,400	0.65	
1949					All panfish: no size limit after Sep 23
Total	2,800	9,880	7,570	0.77	Walleye: 13 inches
1950					
Spring	1,541	4,524	5,298	1.17	
Summer	3,212	10,751	12,768	1.19	
Fall	1,192	4,268	2,242	0.53	
Open ice Shanty	261	1,013	999	0.99	
Total	6,206	20,556	21,307	1.04	
1951					All species: Mar 15 or Apr 1-June 24
Spring	Fishing prohibited				
Summer	2,667	9,659	3,426	0.35	
Fall	447	1,373	815	0.59	
Open ice Shanty	120	383	323	0.84	
Total	3,234	11,415	4,564	0.40	
1952					Pike and walleye: Mar 15-Apr 25
Spring	647	2,216	1,344	0.60	Bluegill and pumpkinseed: Apr 1-25
Summer	2,148	7,697	2,911	0.38	Other panfish: none
Fall	1,004	3,196	658	0.21	
Open ice Shanty	92	203	96	0.47	
Total	3,891	13,312	5,009	0.38	

(continued, next page)

Table 18.--continued

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1953					
Spring	444	1,533	1,902	1.24	
Summer	2,429	7,691	3,332	0.43	
Fall	614	1,841	118	0.06	
Open ice	522	1,495	141	0.09	
Shanty	393	1,914	87	0.04	
Total	4,402	14,474	5,580	0.39	
1954					*All species: no size limit
Spring	1,689	4,672	528	0.11	Bass: Jan 1-June 17
Summer	3,213	9,374	2,148	0.23	
Fall	965	2,413			
Open ice	164	383	60	0.16	
Shanty	339	1,017			
Total	6,370	17,859	2,736	0.15	
1955					All panfish: none
Spring	953	2,984	1,709	0.57	
Summer	2,888	8,914	2,383	0.27	
Fall	223	580			
Open ice	140	354	4	0.01	
Shanty	13	46			
Total	4,217	12,878	4,096	0.32	
1956					
Spring	824	2,311	233	0.10	
Summer	2,899	7,939	1,814	0.23	
Fall	311	1,035	690	0.67	
Open ice	208	594	21	0.10	
Shanty					
Total	4,242	11,879	2,758	0.23	
1957					
Spring	734	1,860	30	0.04	
Summer	1,709	5,536	2,309	0.42	
Fall	376	1,612	1,397	0.87	
Open ice	258	406	39	0.10	
Shanty					
Total	3,077	9,414	3,775	0.40	
1958					
Spring	640	1,576	1,132	0.72	
Summer	3,787	13,615	7,532	0.55	
Fall	1,462	4,141	3,488	0.84	
Open ice	88	197	44	0.22	
Shanty					
Total	5,977	19,529	12,196	0.62	

(continued, next page)

Table 18.--concluded

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1959					Bass: 10 inches
Spring	924	2,542	3,045	1.20	Walleye: 13 inches
Summer	2,003	6,574	2,180	0.33	Pike: 14 inches
Fall	533	2,200	1,100	0.50	
Open ice					
Shanty					
Total	3,460	11,316	6,325	0.56	
1960					Pike: 20 inches
Spring	459	1,478	675	1.47	
Summer	2,352	8,072	1,857	0.23	
Fall	547	2,426	721	0.30	
Open ice					
Shanty					
Total	3,358	11,976	3,253	0.27	
1961					
Spring	844	2,016	258	0.13	
Summer	1,571	5,640	3,934	0.70	
Fall	743	1,826	350	0.19	
Open ice					
Shanty					
Total	3,158	9,482	4,542	0.48	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 19.--Estimated number of fish caught from Big Portage Lake, 1936-61.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Wall-eye	North-ern pike	Other species
1936									
Winter	92	124	500	660	1,104	4	2	142	70
Summer	8,512	321	328	267	151	417		183	127
Total	8,604	455	828	927	1,255	421	2	325	197
1939									
Winter	127	89	61	171	635	6	7	112	121
Summer	5,944	381	251	163	81	219	18	66	58
Total	6,071	470	312	334	716	225	25	178	179
1946									
Total	6,744	677	226	200	139	408	52	182	52
1947									
Total	9,520	1,767	547	953	308	645	14	210	56
1948									
Total	8,827	1,915	490	2,045	230	562	14	259	58
1949									
Total	4,693	674	659	235	273	742	8	151	135
1950									
Spring	4,234	108	527	35	35			12	347
Summer	9,479	1,233	697	18	286	786	36	18	214
Fall	1,580	158	158	31		189		95	31
Open ice	691	51	34	148	42			21	12
Shanty									
Total	15,984	1,550	1,416	232	363	975	36	146	604
1951									
Spring				Fishing	prohibited				
Summer	2,482	144	282	44	44	287	5	77	61
Fall	432	349			17	17			
Open ice	174	28	32	51	28			5	5
Shanty									
Total	3,088	521	314	95	89	304	5	82	66
1952									
Spring	656	44	133	478	11			22	
Summer	1,704	227	227	156	14	355	29	185	14
Fall	489	69				69		35	
Open ice	28	56	4					8	
Shanty	100							15	
Total	2,977	396	364	634	25	424	29	265	14

(continued, next page)

Table 19. --continued

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Wall-eye	North-ern pike	Other species
1953									
Spring	1,228	79	357		40		26	53	119
Summer	1,243	811	190	104		690	225	52	17
Fall				59		59			
Open ice	101			40					
Shanty	29							29	29
Total	2,601	890	547	203	40	749	251	134	165
1954									
Spring	447							81	
Summer	1,028	93		31	93	779	31	62	31
Fall									
Open ice		50						10	
Shanty									
Total	1,475	143		31	93	779	31	153	31
1955									
Spring	451	997	167	47				47	
Summer	265	993	132	66		662	33	232	
Fall									
Open ice		4							
Shanty									
Total	716	1,994	299	113		662	33	279	
1956									
Spring	133						33	67	
Summer	1,024			29		527	29	88	117
Fall	633							57	
Open ice	3	5	3		10				
Shanty									
Total	1,793	5	3	29	10	527	62	212	117
1957									
Spring		30							
Summer	1,314	746				142		36	
Fall	538	698	107		27				27
Open ice		39							
Shanty									
Total	1,852	1,513	107		27	142		36	27
1958									
Spring	950	146							36
Summer	3,380	2,321		41		1,140		81	569
Fall	760	1,521		89		760	45		313
Open ice	6	32		6					
Shanty									
Total	5,096	4,020		136		1,900	45	81	918

(continued, next page)

Table 19.--concluded.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Wall-eye	North-ern pike	Other species
1959									
Spring	2,501	396							148
Summer	669	495	25			595	25	49	322
Fall	105	576		105		105			209
Open ice									
Shanty									
Total	3,275	1,467	25	105		700	25	49	679
1960									
Spring	541	74		24					36
Summer	848	134		55		585		125	110
Fall	202	370		33		83			33
Open ice									
Shanty									
Total	1,591	578		112		668		125	179
1961									
Spring		168				90			
Summer	293	1,638		1,112		824			
Fall		228				122			
Open ice									
Shanty									
Total	293	2,034		1,112		1,036			

Table 20.--Average length in inches, by age group (number of fish sampled in parentheses), of bluegill and largemouth bass in Big Portage Lake, 1946-58 (lake level raised in 1957). Data for 1946-50 from netting and creel; data for other years from trap netting.

Species, year and season	Age I	II	III	IV	V	VI	VII	VIII
Bluegill								
1946-47 Summer	2.0 (33)	3.4 (36)	5.8 (22)	6.2 (73)	6.8 (30)	7.8 (22)	8.8 (8)	9.8 (1)
1953 Fall[a]			4.4 (9)	5.6 (87)	5.5 (205)	6.2 (36)	7.3 (11)	8.8 (6)
1954 Spring		4.2 (1)	4.8 (7)	5.5 (7)	6.0 (104)	6.6 (12)	8.0 (4)	9.5 (2)
1958 Spring		4.4 (6)	5.6 (35)	6.2 (23)	7.3 (8)	8.4 (8)	8.5 (7)	
Largemouth bass								
1946-50 Summer	3.9 (22)	5.8 (27)	10.2 (11)	11.0 (5)	12.7 (4)	15.8 (3)	17.4 (2)	
1953 Fall[a]		8.5 (61)	10.9 (53)	12.7 (14)	14.4 (6)	14.9 (2)	18.4 (2)	
1954 Spring		9.4 (9)	11.4 (45)	13.3 (14)	14.4 (4)	15.2 (5)	16.0 (2)	17.2 (1)
1958 Spring	6.5 (25)	8.3 (1)	13.9 (1)	14.5 (19)	15.3 (6)	16.4 (3)	16.7 (1)	

[a] An annulus added to facilitate comparison to spring collections.

Table 21.--Fishing regulations, and estimates of pressure and total catch for Big Twin Lake, winter 1952-53 through fall 1953.

Season	Pressure		Total	Catch	Regulations
	Trips	Hours	catch	per hour	Species: closed season; size limit
Open ice	110	239	515	1.29	*Rainbow trout: none; 7 inches
Shanty	173	419	308	1.23	Pumpkinseed: Apr 1-24; none
Spring	70	174	1,009	5.80	Other panfish: none; none
Summer	759	2,190	3,176	1.45	
Fall	0	0	0	0.00	
Total	1,112	3,022	5,008	1.66	

* A special regulation.

Table 22.--Estimated number of fish caught from Big Twin Lake, winter 1952-53 through fall 1953.

Season	Season				
	Yellow perch	Pumpkin-seed	Rock bass	Rainbow trout	Cisco
Open ice	308				
Shanty	501			7	7
Spring	105	870	34		
Summer	2,364	701	111		
Fall					
Total	3,278	1,571	145	7	7

Table 23.--Fishing regulations, and estimates of pressure and total catch for Birch Lake, 1941-50 and 1953-61.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1941					*Trout: Dec 1-June 25; 7 inches;
Summer	4,506	14,625	9,269	0.63	5 creel limit
Fall	401	986	653	0.66	Bass: Jan 1-June 25; 10 inches
Winter	No winter fishing				All panfish: Apr 1-June 25; 6 inches
Total	4,907	15,611	9,922	0.64	
1942					Bluegill and pumpkinseed: Mar 1-June 25
Summer	4,559	13,430	8,355	0.62	
Fall	580	1,713	764	0.45	
Total	5,139	15,143	9,119	0.60	
1943					
Summer	2,875	9,928	4,410	0.44	
Fall	391	1,256	405	0.32	
Total	3,266	11,184	4,815	0.43	
1944					
Summer	3,113	10,292	4,422	0.43	
Fall	646	2,314	471	0.20	
Total	3,759	12,606	4,893	0.39	
1945					
Summer	4,277	14,564	4,814	0.33	
Fall	1,075	3,922	934	0.24	
Total	5,352	18,486	5,748	0.31	
1946					*Crappie, perch, rock bass:
Spring	2,419	10,000	1,834	0.18	Apr 1-May 14
Summer	4,244	14,980	3,861	0.26	*Trout: Dec 1-May 14
Fall	1,207	5,034	1,646	0.33	
Total	7,870	30,014	7,341	0.24	
1947					
Spring	2,071	11,794	2,931	0.25	
Summer	6,178	18,820	4,754	0.25	
Fall	688	2,118	516	0.24	
Total	8,937	32,732	8,201	0.25	
1948					
Spring	1,731	6,098	1,690	0.28	
Summer	5,287	13,315	5,274	0.40	
Fall	896	3,118	506	0.16	
Total	7,914	22,531	7,470	0.33	

(continued, next page)

Table 23.--continued

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1949					All panfish: no size limit after Sep 23
Spring	1,805	7,508	1,635	0.22	
Summer	6,422	17,638	6,591	0.37	
Fall	985	3,465	1,441	0.42	
Total	9,212	28,611	9,667	0.34	
1950					Bluegill and pumpkinseed: Apr 1-June 25; 6 inches
Spring	3,226	11,481	1,807	0.16	
Summer	6,924	17,310	5,430	0.31	
Fall	659	2,620	669	0.26	
Total	10,809	31,411	7,906	0.25	
1953					Trout: Dec 1-Apr 24; 7 inches
Spring	1,435	5,436	2,070	0.38	Bluegill and pumpkinseed: Apr 1-25
Summer	3,507	9,337	5,540	0.59	Other panfish: none
Fall	881	3,564	2,067	0.58	
Total	5,823	18,337	9,677	0.53	
1954					Bass: Jan 1-June 17; 10 inches
Spring	1,062	3,470	2,040	0.59	
Summer	823	1,863	902	0.48	
Fall	705	2,135	571	0.27	
Total	2,590	7,468	3,513	0.47	
1955					All panfish: no closed season
Spring	1,091	2,758	1,867	0.68	
Summer	5,439	12,366	8,411	0.68	
Fall	928	1,517	970	0.64	
Total	7,458	16,641	11,248	0.68	
1956					
Spring	1,164	2,186	1,764	0.81	
Summer	5,021	10,284	6,308	0.61	
Fall	1,791	5,644	3,030	0.54	
Total	7,976	18,114	11,102	0.61	
1957					
Spring	1,775	4,395	3,959	0.90	
Summer	4,554	10,971	5,196	0.47	
Fall	1,242	2,966	1,624	0.55	
Total	7,571	18,332	10,779	0.59	
1958					
Spring	1,011	2,432	2,636	1.08	
Summer	4,781	10,590	9,991	0.94	
Fall	1,602	3,375	5,277	1.56	
Winter	289	599	515	0.86	
Total	7,683	16,996	18,419	1.08	

(continued, next page)

Table 23.--concluded

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1959					Trout: Mar 1-Apr 24
Spring	1,492	3,585	4,983	1.39	
Summer	4,153	9,879	9,362	0.95	
Fall	1,318	3,200	2,986	0.93	
Winter	597	2,093	1,180	0.56	
Total	7,560	18,757	18,511	0.99	
1960					
Spring	1,895	4,716	3,693	0.78	
Summer	4,447	10,812	6,094	0.56	
Fall	1,724	4,719	2,936	0.62	
Winter	151	367	59	0.16	
Total	8,217	20,614	12,782	0.62	
1961					
Spring	1,470	3,255	2,479	0.76	
Summer	3,592	9,035	3,178	0.35	
Fall	1,266	2,818	4,426	1.57	
Winter	110	231	15	0.06	
Total	6,438	15,339	10,098	0.66	

[a] Only important regulations and their changes noted. Special regulations marked with an asterisk (*).

Table 24.--Estimated number of fish caught from Birch Lake, 1941-50, and 1953-61.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Rain-bow trout	Brown trout
1941									
Summer	4,979	938	158		603	483	120	1,864	10
Fall	404	50	19		27	55	20	11	
Total	5,383	988	177		630	538	140	1,875	10
1942									
Summer	5,382	914	40		603	400	80	806	3
Fall	309	222	2		80	101	3	41	1
Total	5,691	1,136	42		683	501	83	847	4
1943									
Summer	2,114	292	74		504	412	51	866	1
Fall	88	69	27		47	124	17	20	1
Total	2,202	361	101		551	536	68	886	2
1944									
Summer	2,045	163	130		684	631	28	692	4
Fall	41	78	10		79	102	3	132	1
Total	2,086	241	140		763	733	31	824	5
1945									
Summer	1,335	357	213		815	496	33	1,480	2
Fall	59	271	28		96	35	6	369	1
Total	1,394	628	241		911	531	39	1,849	3
1946									
Spring		260			607			859	2
Summer	676	427	138		477	437	53	541	
Fall	189	1,091	13		108	82	9	111	
Total	1,865	1,778	151		1,192	519	62	1,511	2
1947									
Spring		127			120			2,646	6
Summer	1,245	375	75		345	1,215	105	1,364	
Fall	22	153			90	9	4	238	
Total	1,267	655	75		555	1,224	109	4,248	6
1948									
Spring		295			517			853	
Summer	2,447	456	91		517	836	122	745	
Fall	75	140	15		40	5		225	
Total	2,522	891	106		1,074	841	122	1,823	

(continued, next page)

Table 24.--continued.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Rain-bow trout	Brown trout
1949									
Spring		305			234			1,078	18
Summer	3,279	313	283		188	706	32	1,726	16
Fall	160	720			93	26		442	
Total	3,439	1,338	283		515	732	32	3,246	34
1950									
Spring		415			146			1,226	
Summer	3,509	308	118		213	854	71	332	24
Fall	223	106	59			12	12	258	
Total	3,732	829	177		359	866	83	1,816	24
1953									
Spring	478	573	191		127			701	
Summer	1,911	986	1,352		532	310	227	111	28
Fall	318	1,181	68		204	204	46	46	
Total	2,707	2,740	1,611		863	514	273	858	28
1954									
Spring	1,477	106	53		299				
Summer	545	70	107		41	123	8		
Fall	360	40	47		47	58	6		
Total	2,382	216	207		387	181	14		
1955									
Spring	915	18	37		860				
Summer	6,228	173	422		397	992	173		
Fall	664	19	47		134	85	15		
Total	7,807	210	506		1,391	1,077	188		
1956									
Spring	1,276	115	129		43			100	14
Summer	3,481	443	359		338	1,161	148	253	
Fall	898	657	64		16	192	96	1,106	
Total	5,655	1,215	552		397	1,353	244	1,459	14
1957									
Spring	1,576	211	58		884			1,134	
Summer	3,397	250	166		150	966	50	200	
Fall	817	524	21		73	42	42	42	
Total	5,790	985	245		1,107	1,008	92	1,376	

(continued, next page)

Table 24.--concluded.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Rain-bow trout	Brown trout
1958									
Spring	1,577	409	409		72				
Summer	7,696	636	290	444	96	617	174	39	
Fall	3,113	1,625	179	84	116	32	95		
Winter	408	86		22					
Total	12,794	2,756	878	550	284	649	269	39	
1959									
Spring	2,638	668	285	114	106			1,172	
Summer	7,368	234	324	162	162	629	108	377	
Fall	1,608	889	190	80	20	70	10	80	
Winter	265	222	67		5			616	5
Total	11,879	2,013	866	356	293	699	118	2,245	5
1960									
Spring	883	291		1,162	160			1,197	
Summer	3,300	182	365	55	168	1,588	118	318	
Fall	1,601	1,043	77		20	137	2	56	
Winter	28	31							
Total	5,812	1,547	442	1,217	348	1,725	120	1,571	
1961									
Spring	1,061	280	358	556	224				
Summer	1,995	171	296	14	179	413	42	38	
Fall	3,921	283	19			203			
Winter	3	12							
Total	6,980	746	673	570	403	616	42	38	

Table 25.--Records on creel census and plantings of rainbow trout for Birch Lake, 1940-61.

Year	Creel census			Plantings	
	Estimated hours of fishing	Estimated rainbow trout caught	Trout per hour	Spring	Fall
1940		No census		2,000	5,000
1941 [a]	15,611	1,875	0.12	None	4,786
1942 [a]	15,144	846	0.06	None	2,510
1943 [a]	11,184	887	0.08	2,495	3,000
1944 [a]	12,605	824	0.07	3,000	2,763
1945 [a]	18,486	1,849	0.10	2,763	3,026
1946	30,014	1,511	0.05	3,003	3,000
1947	32,732	4,249	0.13	3,000	3,000
1948	22,531	1,823	0.08	3,000	3,000
1949	28,611	3,247	0.11	3,000	3,000
1950	31,411	1,816	0.06	3,000	3,000
1951		No census		3,000	3,000
1952		No census		3,000	3,000
1953	18,337	858	0.05	3,000	None
1954	7,468	None		None	None
1955	16,641	None		None	None
1956	18,114	1,459	0.09	3,000	3,000
1957	18,332	1,376	0.08	None	None
1958	16,397	39	0.002	None	None
1959 [b]	18,757	2,245	0.12	3,000	3,000
1960 [b]	20,614	1,571	0.08	None	None
1961 [b]	15,339	38	0.002	None	None

[a] There was no spring-season fishing from 1941 through 1945.

[b] Ice fishing permitted.

Table 26.--Length-frequency (number of fish) of angler-caught fish from Birch Lake, 1945-58 (rainbow trout data all from 1945).

Inch group	Species							
	Blue-gill	Yellow perch	Rock bass	Smallmouth bass	Largemouth bass	Brown trout	Lake trout	Rainbow trout
4	3							
5	39	1	4					
6	70	16	11					
7	88	7	10					
8	56	6	15				1	
9	18	1	8			1		10
10			2	7	22		1	28
11		2		12	47		1	32
12		4		7	38		2	25
13		2		6	14	3	4	12
14		2		1	13		5	11
15				2	21	1		8
16				1	13	1	4	15
17					9	2	3	19
18				1	5	2	1	11
19				1	5	2	2	2
20					1	1	2	1
21					1	1	2	
22						6	2	
23						1	2	
24							2	
25							2	
26								
27								
28								
29							1	

Table 27.--Fishing regulations, and estimates of pressure and total catch for Corey Lake, winter of 1954-55 through winter of 1961-62.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1954					Rainbow: Dec 1-Apr 27; 7 inches
Open ice	2,727	8,026	14,429	1.80	Bass: Jan 1-June 17; 10 inches
Shanty	612	1,347	4,281	3.18	All panfish: no closed season; none
Sub-total	3,339	9,373	18,710	2.00	
1955					
Spring	3,863	17,461	16,373	0.94	
Summer	15,545	57,560	83,269	1.45	
Fall	5,545	20,918	19,472	0.93	
Open ice	2,492	7,220	17,324	2.40	
Shanty	583	1,181	3,343	2.83	
Total	28,028	104,340	139,781	1.34	
1956					* Rainbow: Dec 1-31, Mar 16-Apr 27
Spring	3,841	17,106	12,517	0.73	
Summer	14,438	56,833	60,188	1.06	
Fall	4,097	14,260	17,600	1.23	
Open ice	2,965	9,692	11,335	1.17	
Shanty	359	886	1,540	1.74	
Total	25,700	98,777	103,180	1.04	
1957					
Spring	4,288	16,886	6,827	0.40	
Summer	12,610	45,177	45,295	1.00	
Fall	3,337	12,943	6,996	0.54	
Open ice	2,106	6,609	7,613	1.15	
Shanty	460	941	1,425	1.51	
Total	22,801	82,556	68,156	0.83	
1958					
Spring	2,826	12,210	6,851	0.56	
Summer	12,858	45,832	49,834	1.09	
Fall	4,244	15,007	16,265	1.08	
Open ice	3,522	10,506	25,398	2.42	
Shanty	457	1,048	2,829	2.70	
Total	23,907	84,603	101,177	1.20	
1959					
Spring	3,763	15,064	16,582	1.11	
Summer	8,955	33,141	41,017	1.24	
Fall	4,357	16,145	21,446	1.33	
Open ice	3,152	9,684	19,901	2.06	
Shanty	140	237	465	1.96	
Total	20,367	74,271	99,411	1.34	

(continued, next page)

Table 27.--concluded

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1960					
Spring	3,020	11,793	11,570	0.98	
Summer	13,145	47,172	61,634	1.31	
Fall	3,620	13,892	17,420	1.25	
Open ice	2,591	7,718	14,967	1.94	
Shanty	178	489	1,329	2.72	
Total	22,554	81,064	106,920	1.32	
1961					
Spring	4,507	17,156	22,392	1.31	
Summer	11,937	43,840	57,040	1.30	
Fall	6,931	28,125	36,406	1.29	
Open ice	3,323	8,805	15,397	1.75	
Shanty	263	1,014	1,088	1.07	
Total	26,961	98,940	132,323	1.34	

[a] Only important regulations and their changes noted. Asterisk (*) denotes special regulations.

Table 28.--Estimated number of fish caught from Corey Lake, winter 1954-55 through winter of 1961-62.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Large-mouth bass	Small-mouth bass	Rain-bow trout	Other species
1954								
Open ice	13,761	319	266		16			67
Shanty	4,020	166	55	11				29
Sub-total	17,781	485	321	11	16			96
1955								
Spring	13,635	646	1,082				1,010	
Summer	79,088	1,408	873		1,513		387	
Fall	16,042	1,137	707		1,451		135	
Open ice	16,099	1,065	91		69			
Shanty	3,162	112	45					24
Total	128,026	4,368	2,798		3,033		1,532	24
1956								
Spring	8,942	691	2,271				613	
Summer	51,238	4,969	1,572		2,103	93	213	
Fall	15,704	1,314	186		315	8	73	
Open ice	7,571	3,514	111	7			110	22
Shanty	1,321	119	7				30	63
Total	84,776	10,607	4,147	7	2,418	101	1,039	85
1957								
Spring	3,946	560	1,091				1,230	
Summer	38,792	2,632	1,615		1,342	112	802	
Fall	4,374	1,182	884		443	30	83	
Open ice	6,399	796	150	39			195	34
Shanty	1,300	37	11	24			35	18
Total	54,811	5,207	3,751	63	1,785	142	2,345	52
1958								
Spring	4,250	939	443	16			1,203	
Summer	44,038	2,689	447		1,832	54	774	
Fall	13,771	1,602	324	31	357	7	173	
Open ice	24,237	632	168	26	72		193	70
Shanty	2,787	11	8	3			20	
Total	89,083	5,873	1,390	76	2,261	61	2,363	70

(continued, next page)

Table 28.--concluded.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Large-mouth bass	Small-mouth bass	Rain-bow trout	Other species
1959								
Spring	11,197	1,492	1,824	52			2,017	
Summer	35,372	3,804	566	33	737		496	9
Fall	18,664	2,105	169	19	410		79	
Open ice	17,316	2,007	386	92			100	
Shanty	8,915							
Total	91,464	9,408	2,945	196	1,147		2,692	9
1960								
Spring	7,972	729	1,320	11			1,538	
Summer	57,588	1,219	1,061		1,193	19	456	98
Fall	15,873	895	321	11	299	4	17	
Open ice	13,772	882	248	4	21		40	
Shanty	1,261	5	8	29			26	
Total	96,466	3,730	2,958	55	1,513	23	2,077	98
1961								
Spring	18,356	499	2,280				1,257	
Summer	50,444	1,969	2,680		1,701		246	
Fall	33,872	952	610		972			
Open ice	14,083	957	270				87	
Shanty	837	152		99				
Total	117,592	4,529	5,840	99	2,673		1,590	

Table 29.--Rainbow trout planted in Corey Lake, 1949-61.

Year	Month	Number	Average length (inches)	Fin clip
1949	Mar	5,000	8	None
	Dec	2,800	9	None
1950	Apr	2,200	7	None
1951	June	5,000	8	Right pectoral
1952	Mar	5,000	8	None
	Dec	5,000	8	None
1953	Dec	5,000	8	None
1954	Dec	5,000	9	None
1955	Dec	5,000	9	Left pectoral
1956	Dec	1,000	9	Right pelvic
1957	Mar	4,000	11	Left pelvic
	Dec	1,000	10	Right pectoral
1958	Feb	4,000	8	Left pectoral
	Dec	1,000	8	Dorsal
1959	Mar	4,000	10	Anal
	Dec	1,000	10	Right pelvic
1960	Apr	4,000	9	Left pelvic
	Dec	1,000	8	Right pectoral
1961	Apr	4,000	8	Left pectoral
	Dec	1,000	10	Right pelvic

Table 30.--Seasonal returns (as percentage of total estimated catches), and average lengths (inches) of rainbow trout caught from plants in December as compared to early spring, Corey Lake, 1956-61 (five plants of each type).

Season after planting	December plants		Spring plants	
	Percent of total catch	Average length	Percent of total catch	Average length
Winter	23.9	9.9		
Spring	35.3	11.8	71.2	11.3
Summer	22.7	12.9	21.4	12.1
Fall	7.1	13.5	2.3	14.4
Winter	1.5	15.9	0.8	15.1
Spring	6.4	16.6	3.8	16.3
Summer	3.1	16.0	0.3	17.7
Fall				
Winter				
Spring			0.2	18.4
Total	100.0	--	100.0	--

Table 31.--Length-frequency distribution (in numbers) of fish harvested by anglers at Corey Lake, 1953-61.

Inch group	Species			
	Bluegill	Yellow perch	Rainbow trout	Largemouth bass
3	1			
4	15			
5	179	5		
6	420	13		
7	195	9	1	
8	96	5	20	
9	27	14	17	
10	8	19	23	3
11		9	37	6
12		1	22	4
13		1	8	3
14			5	2
15			1	3
16			1	2
17			1	10
18			1	2
19				4
20				1
21				
22				1
23				1
24				

Table 32.--Average length in inches, by age group, for four species of fish caught by anglers from Corey Lake. (Number of scale samples in parentheses.)

Species, month and year	Age II	III	IV	V	VI	VII
Bluegill						
May-June 1955	4.6 (6)	6.1 (65)	8.0 (27)	8.8 (6)	9.7 (1)	
Dec-Mar 1953-59	5.8 (17)	6.2 (250)	6.8 (197)	8.1 (40)	8.9 (11)	10.0 (6)
Largemouth bass						
May-Sep 1955-58	10.4 (1)	10.9 (28)	12.4 (19)	13.8 (14)	15.7 (1)	
Yellow perch						
All months 1953-59		8.6 (33)	9.6 (11)	10.9 (8)	11.0 (4)	12.3 (2)
Pumpkinseed						
All months 1955-59	6.0 (2)	6.4 (10)	6.9 (5)	7.9 (1)		

Table 33.--Fishing regulations, and estimates of pressure and total catch for Craig Lake, 1938-40 and 1946-51.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
	Trips	Hours			
1938-39					All panfish: Apr 1-June 25; 6 inches
Winter	3,098	10,534	41,036	3.90	Bass: Jan 1-June 25; 10 inches
Summer	4,681	15,664	17,206	1.10	Pike: Apr 1-June 25; 14 inches
Total	7,779	26,198	58,242	2.22	
1939-40					
Winter	3,359	11,248	37,040	3.29	
Summer	3,995	10,823	13,825	1.28	
Total	7,354	22,071	50,865	2.30	
1946					Bluegill and pumpkinseed: Mar 1-June 25; 6 inches
Total	9,000	26,270	40,310	1.52	*Other panfish: none; 6 inches
					*Pike: Mar 16-May 14; 14 inches
1947					
Total	7,910	25,510	43,800	1.69	
1948					
Total	12,300	35,100	61,310	1.74	
1949					All panfish: no size limit after Sep 23
Total	10,070	33,230	32,700	0.98	
1950					Bluegill and pumpkinseed: Apr 1-June 25
Total	9,420	28,230	25,852	0.92	
1951					All panfish: Apr 1-June 25
Spring	Fishing prohibited				Pike: Mar 16-June 25
Summer	7,449	18,767	18,767	1.00	
Fall	1,561	3,437	3,815	1.11	
Winter	No census				
Sub-total	9,010	22,204	22,582	1.02	

[a] Only important regulations and their changes noted. An asterisk (*) denotes a special regulation.

Table 34. --Estimated number of fish caught from Craig Lake, 1938-51.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Largemouth bass	Bullhead	Warmouth bass	Northern pike	Other species
1938-39									
Winter	25,612	290	264	156	8	12	1,371		55
Summer	5,032	2,074	874	156	1,069	1,538	102	158	145
Total	30,644	2,364	1,038	312	1,077	1,550	1,473	158	200
1939-40									
Winter	27,454	428	154	586	20	20	89	54	7
Summer	2,832	1,785	524	130	735	1,216	99	102	120
Total	30,286	2,213	678	716	755	1,236	188	156	127
1946									
Total	34,385	2,015	967	480	845	1,088	120	160	254
1947									
Total	34,558	4,249	1,577	2,190	394	263	569	170	43
1948									
Total	52,980	1,960	675	3,555	800	550	550	184	60
1949									
Total	22,563	4,905	2,093	196	719	1,014	294	719	197
1950									
Total	13,188	6,465	3,310	724	517	414	750	335	157
1951									
Spring				Fishing prohibited					
Summer	5,754	6,850	3,438	1,501	407	484	178	77	77
Fall	2,529	910	288	66				22	
Winter				No census					
Total	8,283	7,760	3,726	1,567	407	484	178	99	77

Table 35.--Summary of population estimates for Craig Lake (Beckman 1948).

	Spring 1940	Fall 1940	Spring 1941	Summer 1947
Total fish caught	7,990	8,603	8,860	2,739
Total number marked	7,424	7,774	6,569	2,231
Total number recoveries	567	985	746	47
Percentage recoveries	4	13	11	2
Population estimates				
Bluegill	52,956	167,072	47,402	100,996
Pumpkinseed	996	2,275	1,037	No recoveries
Largemouth black bass	5,854	8,860	2,200	843
Black crappie	15,151	8,526	4,497	32,790

Table 36.--Fishing regulations, and estimates of pressure and total catch for Devils Lake, 1950-53.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1950					*All panfish: none; none; no creel limits
Spring	4,937	14,203	8,597	0.61	Bass: Jan 1-June 24; 10 inches
Summer	19,249	56,358	37,388	0.66	Pike: Mar 16-June 24; 14 inches
Fall	4,588	12,540	12,892	1.03	
Open ice	6,028	18,856	22,627	1.20	
Shanty	-	5,182	4,297	0.83	
Total	-	107,139	85,801	0.80	
1951					
Spring	5,952	15,103	12,264	0.81	
Summer	19,600	52,001	33,847	0.65	
Fall	5,715	9,044	4,886	0.54	
Open ice	4,739	19,219	21,045	1.10	
Shanty	-	4,530	4,015	0.89	
Total	-	99,897	76,057	0.76	
1952					Pike: Mar 16-Apr 25
Spring	2,483	9,172	18,436	2.01	
Summer	16,996	51,790	88,560	1.71	
Fall	3,071	11,106	6,997	0.63	
Open ice	8,487	31,000	53,010	1.71	
Shanty	-	5,502	8,666	1.58	
Total	-	108,570	175,669	1.62	
1953					
Spring	2,495	6,219	9,702	1.56	
Summer	19,353	51,383	52,924	1.03	
Fall	4,403	13,668	11,754	0.86	
Open ice	5,180	17,966	17,068	0.95	
Shanty	2,669	13,930	7,244	0.52	
Total	34,100	103,166	98,692	0.96	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 37.--Estimated number of fish caught from Devils Lake, 1950-53.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	North-ern pike	Bull-head
1950									
Spring	5,590	561	1,623		801	20			
Summer	14,682	4,988	5,264	404	8,053	2,912	744	123	153
Fall	10,554	1,861	48			286		143	
Open ice	20,002	2,308	269		48				
Shanty	2,632	1,558				15		91	
Total	53,460	11,276	7,204	404	8,902	3,233	744	357	153
1951									
Spring	5,764	834	2,845		2,084				
Summer	14,662	6,394	2,897		5,066	3,980	179	484	121
Fall	2,932	597	190		54	841		272	
Open ice	15,424	4,988	421		78	86		19	
Shanty	1,683	1,998	20	2	12	10			
Total	40,465	14,811	6,373	2	7,294	4,917	179	775	121
1952									
Spring	11,622	2,341	2,048		2,091				42
Summer	19,900	57,892	4,481		3,914	1,772	148		567
Fall	679	5,796				261		261	
Open ice	28,752	23,452	679		16	95			16
Shanty	2,699	5,507	26		26	8			3
Total	63,652	94,988	7,234		6,047	2,136	148	261	628
1953									
Spring	5,880	1,715	1,340		670			16	
Summer	15,359	26,928	2,530		3,048	4,800	74	111	74
Fall	1,841	9,200	207		69	437			
Open ice	8,909	7,780	319			15		45	
Shanty	1,463	4,940						840	
Total	33,452	50,563	4,396		3,787	5,252	74	1,012	74

Table 38.--Fishing regulations, and estimates of pressure and total catch for Duck Lake, 1946-59.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1946					Bluegill and sunfish: Mar 1-June 24; 6 inches
Total	21,000	61,000	54,000	0.88	*Walleye and pike: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
1947					*Other panfish: none; 6 inches
Total	30,000	89,000	87,000	0.98	
1948					
Total	26,000	80,000	65,000	0.81	
1949					All panfish: no size limit after Sep 23
Total	25,000	83,000	35,000	0.42	
1950					Walleye: 13 inches
Spring	670	2,640	554	0.21	Bluegill and sunfish: Apr 1-June 24
Summer	14,748	39,404	27,882	0.71	
Fall	5,149	14,654	12,267	0.84	
Open ice	2,410	6,440	2,794	0.43	
Shanty	69	292	46	0.16	
Total	23,046	63,430	43,543	0.69	
1951					All species: Mar 15 or Apr 1-June 24
Spring	Fishing prohibited				
Summer	11,085	37,142	14,099	0.38	
Fall	2,841	7,054	1,888	0.27	
Open ice	3,128	9,271	5,393	0.58	
Shanty	238	1,208	223	0.18	
Total	17,292	54,675	21,603	0.40	
1952					Bluegill and sunfish: Apr 1-25
Spring	1,429	4,603	2,478	0.54	Pike and walleye: Mar 15-Apr 25
Summer	13,830	39,827	30,667	0.77	Other panfish: none
Fall	2,419	6,295	3,101	0.49	
Open ice	1,962	6,271	3,865	0.62	
Shanty	534	2,136	406	0.19	
Total	20,174	59,132	40,517	0.70	
1953					
Spring	2,386	5,955	9,864	1.66	
Summer	12,796	38,231	41,098	1.08	
Fall	2,420	7,179	5,624	0.78	
Open ice	4,698	14,320	12,536	0.88	
Shanty	789	3,109	1,272	0.41	
Total	23,089	68,794	70,394	1.02	

(continued, next page)

Table 38.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1954					*All species: no size limit
Spring	3,409	9,591	14,320	1.49	Bass: Jan 1-June 17
Summer	17,114	47,521	41,647	0.88	
Fall	3,024	10,008	4,230	0.42	
Open ice	3,841	10,831	5,014	0.46	
Shanty	1,545	6,226	2,537	0.41	
Total	28,933	84,177	67,748	0.80	
1955					Bluegill and pumpkinseed: none
Spring	3,963	10,791	13,119	1.22	
Summer	12,489	38,571	37,198	0.96	
Fall	3,319	10,776	10,224	0.95	
Open ice	8,353	27,409	26,389	0.96	
Shanty	1,467	5,545	977	0.18	
Total	29,591	93,092	87,907	0.94	
1956					
Spring	2,640	6,638	6,222	0.94	
Summer	13,233	35,227	26,610	0.76	
Fall	4,017	13,037	11,981	0.92	
Open ice	5,109	13,922	5,927	0.43	
Shanty	1,585	5,516	830	0.15	
Total	26,584	74,340	51,570	0.69	
1957					
Spring	1,772	5,116	5,336	1.04	
Summer	7,930	22,038	27,301	1.24	
Fall	3,584	11,655	7,647	0.66	
Open ice	5,692	19,670	15,234	0.77	
Shanty	1,114	4,255	785	0.18	
Total	20,092	62,734	56,303	0.90	
1958					
Spring	3,345	9,861	17,219	1.75	
Summer	10,652	33,504	24,629	0.74	
Fall	5,066	14,561	16,227	1.11	
Open ice	6,116	18,868	23,306	1.24	
Shanty	1,033	4,886	1,445	0.30	
Total	26,212	81,680	82,826	1.01	
1959					Pike: 20 inches
Spring	2,422	7,453	17,545	2.35	
Summer	7,255	22,077	27,177	1.23	
Fall	2,598	9,520	17,795	1.87	
Open ice	4,694	15,975	17,424	1.09	
Shanty	778	2,964	908	0.31	
Total	17,747	57,989	80,849	1.39	

[a] Only important restrictions and their changes are given. Special regulations are denoted by an asterisk (*).

Table 39.--Estimated number of fish caught from Duck Lake, 1946-59.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Smallmouth bass	Walleye	Northern pike
1946									
Total	35,000	6,000	1,000	8,000	2,000	1,306	54	54	490
1947									
Total	58,000	7,000	3,000	11,000	4,000	3,317		175	349
1948									
Total	46,000	6,000	1,000	5,000	3,000	3,264	65		392
1949									
Total	22,000	3,000	1,000	4,000	1,000	2,090	70		313
1950									
Spring				362	43				149
Summer	11,861	8,602	3,533		1,628	1,810		89	
Fall	9,847	645	645		968	162			
Open ice	1,983	658	51	34	51				
Shanty									
Total	23,691	9,905	4,229	396	2,690	1,972		89	149
1951									
Spring			Fishing prohibited						
Summer	6,518	4,321	1,346		921	567			213
Fall	216	1,241	216		216				
Open ice	2,889	1,797	230	107	312				33
Shanty		10							33
Total	9,623	7,369	1,792	107	1,449	567			279
1952									
Spring	1,996	260	105	17	72				28
Summer	15,870	6,986	1,898	310	1,491	3,699	205	104	
Fall	670	1,199	176		141	775	70		70
Open ice	1,210	2,408	97	6	110				17
Shanty									
Total	19,746	10,853	2,276	333	1,814	4,474	275	104	115
1953									
Spring	4,411	3,747	909	332	421				
Summer	22,591	9,087	3,407	119	1,410	4,040	25	70	45
Fall	1,364	3,706	184	37		277			37
Open ice	9,942	2,102	322	65	92				13
Shanty	390	761	6	3	17				86
Total	38,698	19,403	4,828	556	1,940	4,317	25	70	181
1954									
Spring	8,852	3,304	1,140	83	743				66
Summer	26,138	8,350	2,066	242	970	3,398			150
Fall	1,410	2,244	115			374			86
Open ice	2,826	1,869	5	188	68				58
Shanty	839	1,461	26	42	26				132
Total	40,065	17,228	3,352	555	1,807	3,772			492

(continued, next page)

Table 39.--concluded.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Smallmouth bass	Walleye	Northern pike
1955									
Spring	8,007	2,539	1,313	462	426				18
Summer	23,148	4,773	1,585	1,161	766	5,096	223	26	149
Fall	8,344	675	96	48		1,013	48		
Open ice	18,810	5,283	483	1,481		66			108
Shanty	339	249		94		28			239
Total	58,648	13,519	3,477	3,246	1,192	6,203	271	26	514
1956									
Spring	2,867	2,483	384	296	177				
Summer	16,716	2,480	1,652	593	258	4,212	130		130
Fall	6,482	4,188	255	109	73	802		36	36
Open ice	4,249	1,059	193	357	14				41
Shanty	344	351	5	16	5				104
Total	30,658	10,561	2,489	1,371	527	5,012	130	36	311
1957									
Spring	3,166	1,007	751	350	62				
Summer	20,231	1,231	1,518	573	314	2,979	57	27	57
Fall	5,358	1,014	203	29		956			58
Open ice	12,831	1,391	599	187	104	6			67
Shanty	643	71	14		5				52
Total	42,229	4,714	3,085	1,139	485	3,941	57	27	234
1958									
Spring	15,476	711	498	320	107				71
Summer	13,450	5,921	1,921	628	158	2,197	39	39	158
Fall	7,007	8,251	305	55	83	498			28
Open ice	13,477	8,371	415	804	124	49			26
Shanty	446	823	9	37		5		5	115
Total	49,856	24,077	3,148	1,844	472	2,749	39	44	398
1959									
Spring	13,563	1,721	951	898	309				51
Summer	18,974	3,174	1,256	628	63	2,764	95		95
Fall	15,198	1,096	183	586	37	621	37		
Open ice	12,877	3,307	551	591	182				21
Shanty	1,341	282	18						212
Total	61,953	9,580	2,959	2,703	591	3,385	132		379

Table 40.--Length-frequency distribution (in numbers) of fish harvested by anglers at Duck Lake.

Inch group	Species and minimum size limit[a]									
	Blue-gill	Pump-kin-seed	Yellow perch	Black crappie	Small-mouth bass	Wall-eye	Largemouth bass		Northern pike	
							none	10 inches	none	14 inches
5	114	17		2						
6	457	26	11	7			1			
7	194	9	26	3			6			
8	168		18	18	1		20			
9	38		8	23			34	4		
10	13		2	17			59	20		
11			3	8	1		31	19		
12			2	3	2	1	24	12		
13			2	5			24	9	1	
14			1	1	1	1	9	2	2	
15					1		6	11		3
16					2		5	2	2	2
17					1		4	1	1	
18					1	1	4	4	6	
19						1	1	3	6	1
20									6	1
21						1			6	1
22						3			7	
23									8	
24						1			6	
25									7	
26						2			3	
27						5			4	
28						1			2	
29									1	
30+						2			11	

[a] Data are for years when no size limits were in effect except as noted.

Table 41. --Effect of size limits on the fisheries for largemouth bass, smallmouth bass, and northern pike at Duck Lake.

Species and test period	Size limit (inches)	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Range			
Largemouth bass						
1946-53	10	2,663	567-4,474	12.7	2,598	37
1954-59	None	4,177	2,749-6,203	11.6	3,045	40
Smallmouth bass						
1946-53	10	61	0- 275	15.6	120	2
1954-58	None	99	0- 271	14.4	146	2
Northern pike						
1946-53	14	284	115- 490	19.6	442	6
1954-58	None	390	234- 514	23.9	1,140	14
1959	20	379	--	--	--	--

Table 42. --Average length in inches, by age group, for northern pike and largemouth bass taken by anglers from Duck Lake when normal 14-inch or 10-inch size limits were in effect (1946-53) and when no size limits were in effect (1954-59).

Species and size limit	Age								
	I	II	III	IV	V	VI	VII	VIII	IX
Northern pike									
14-inch	16.5 (4)	17.7 (3)	24.2 (4)						
None	16.0 (7)	20.0 (47)	24.0 (41)	27.0 (24)	28.6 (8)	30.7 (3)	32.5 (1)	31.0 (1)	
Largemouth bass									
10-inch		10.1 (5)	10.6 (24)	12.0 (28)	14.0 (15)	16.5 (8)	17.0 (6)	18.0 (1)	18.4 (1)
None		8.5 (12)	10.1 (63)	11.8 (68)	13.0 (19)	14.1 (9)	15.9 (7)	17.4 (7)	18.2 (3)

Table 43.--Fishing regulations, and estimates of pressure and total catch for Fife Lake, 1933-65.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
1933					All panfish: May 1-June 24; 6 inches
Winter	467	2,098	286	0.13	Bass: Jan 1-June 24; 10 inches
					Pike and walleye: May 1-June 24; 14 inches
1934					
Spring	Fishing prohibited				
Summer, Fall	2,580	6,708	11,458	1.71	
Winter	No census				
Sub-total	2,580	6,708	11,458	1.71	
1935					
Spring	Fishing prohibited				
Summer	3,685	9,213	11,607	1.26	
Winter	191	1,003	136	0.14	
Total	3,876	10,216	11,743	1.15	
1936					
Spring	Fishing prohibited				
Summer	4,875	12,675	13,315	1.05	
Winter	No information				
Sub-total	4,875	12,675	13,315	1.05	
1937					
Spring	Fishing prohibited				
Summer	4,751	12,352	12,100	0.98	
Winter	No information				
Sub-total	4,751	12,352	12,100	0.98	
1946					*All panfish: no closed season
Total	11,940	40,890	19,260	0.47	Pike and walleye: Mar 16-May 15; 14 inches
1947					
Total	13,070	43,810	32,630	0.74	
1948					
Total	17,400	58,510	41,260	0.71	
1949					All panfish: no size limit after Sep 23
Total	19,370	63,720	48,170	0.76	
1950					Walleye: 13 inches
Spring	1,815	5,671	6,648	1.15	
Summer	10,553	38,929	42,102	1.08	
Fall	738	2,177	2,488	1.14	
Open ice	39	127	119	0.94	
Shanty	1,120	4,532	3,129	0.69	
Total	14,265	51,436	54,486	1.06	

(continued, next page)

Table 43.--continued

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1951					Bluegill and sunfish: Apr 1-June 24
Spring		No census			Other panfish: none
Summer	11,989	35,979	24,376	0.68	
Fall	1,447	3,219	2,209	0.69	
Open ice	446	1,555	876	0.56	
Shanty	1,035	4,797	4,411	0.92	
Total	14,917	45,550	26,872	0.70	
1952					Pike and walleye: Mar 15-Apr 26
Spring	1,926	4,493	6,321	1.41	Bluegill and pumpkinseed: Apr 1-25
Summer	17,914	46,029	25,463	0.55	
Fall	1,486	3,610	6,655	1.84	
Open ice	198	782	836	1.07	
Shanty	937	4,451	1,408	0.32	
Total	22,461	59,365	40,683	0.69	
1953					
Spring	1,148	3,240	2,755	0.85	
Summer	17,795	48,414	49,600	1.01	
Fall	1,706	6,223	4,605	0.74	
Open ice	249	607	384	0.63	
Shanty	1,282	4,837	2,393	0.49	
Total	22,180	63,321	59,737	0.94	
1954					*Bass: 16 inches
Spring	815	2,316	1,757	0.76	*Pike: 24 inches
Summer	15,334	37,539	30,440	0.81	
Fall	1,293	3,869	1,266	0.33	
Open ice	279	626	264	0.42	
Shanty	688	2,294	329	0.14	
Total	18,409	46,644	34,056	0.73	
1955					All panfish: no closed season
Spring	1,261	3,131	1,381	0.44	
Summer	14,775	36,651	19,443	0.53	
Fall	1,095	2,483	1,539	0.62	
Open ice	207	494	76	0.15	
Shanty	1,136	4,305	455	0.11	
Total	18,474	47,064	22,894	0.49	
1956					
Spring	657	1,668	716	0.43	
Summer	13,973	36,690	31,462	0.86	
Fall	1,671	3,271	1,151	0.35	
Open ice	306	878	1,205	1.37	
Shanty	1,373	4,786	1,306	0.27	
Total	17,980	47,293	35,840	0.76	

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Table 43.--continued.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1957					
Spring	1,495	4,354	3,419	0.79	
Summer	15,657	37,797	24,685	0.65	
Fall	1,712	4,571	1,012	0.22	
Open ice	198	727	125	0.17	
Shanty	1,160	4,280	530	0.46	
Total	20,222	51,729	29,771	0.58	
1958					
Spring	1,598	3,575	1,193	0.33	
Summer	14,105	34,742	21,547	0.62	
Fall	1,419	3,656	1,448	0.40	
Open ice	356	1,454	204	0.14	
Shanty	908	3,550	154	0.04	
Total	18,386	46,977	24,546	0.52	
1959					*Bass: 14 inches
Spring	896	2,720	1,731	0.64	*Pike: 20 inches; no spearing
Summer	13,750	33,585	20,946	0.62	
Fall	2,109	4,772	1,526	0.32	
Open ice	475	2,067	877	0.42	
Shanty	889	3,750	543	0.25	
Total	18,119	46,894	25,623	0.57	
1960					
Spring	1,104	2,330	2,444	1.05	
Summer	17,669	41,658	24,021	0.58	
Fall	1,788	4,095	1,700	0.42	
Open ice	516	1,918	107	0.06	
Shanty	435	2,019	138	0.07	
Total	21,512	52,020	28,410	0.55	
1961					
Spring	826	2,076	780	0.38	
Summer	11,744	29,442	15,667	0.53	
Fall	738	2,614	675	0.26	
Open ice	510	2,125	232	0.11	
Shanty	77	252	39	0.15	
Total	13,895	36,509	17,393	0.48	
1962					Bass: Jan 1-June 1
Spring	1,092	2,582	1,885	0.73	
Summer	10,107	24,660	9,715	0.39	
Fall	1,539	4,943	1,827	0.37	
Open ice	467	2,170	1,091	0.50	
Shanty	312	2,033	56	0.03	
Total	13,517	36,388	14,574	0.40	

(continued, next page)

Table 43.--concluded.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
	Trips	Hours			
1963					
Spring	970	2,622	1,092	0.42	
Summer	9,798	25,357	6,267	0.25	
Fall	1,390	4,077	1,612	0.42	
Open ice	541	2,839	522	0.18	
Shanty	1,652	7,501	865	0.12	Pike: spearing after Jan 1, 1964
Total	14,351	42,396	10,358	0.24	
1964					Bass: 10 inches
Spring	1,292	2,857	1,101	0.39	
Summer	6,575	17,351	5,087	0.29	
Fall	676	1,638	260	0.16	
Open ice	383	1,680	150	0.09	
Shanty	662	2,661	509	0.19	
Total	9,588	26,187	7,107	0.27	
1965					Pike: Mar 1-May 15
Spring	724	1,972	748	0.38	Walleye: Mar 15-Apr 22
Summer	6,034	17,394	8,390	0.48	
Sub-total	6,758	19,366	9,138	0.47	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 44. --Estimated number of fish caught from Fife Lake, winter 1933-34 through summer 1965.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Wall-eye	North-ern pike
1933									
Winter		133						6	116
1934									
Spring				Fishing prohibited					
Summer, Fall	2,272	4,374	1,200	16	2,354	316	1,138	130	59
Winter				No census					
Sub-total	2,272	4,374	1,200	16	2,354	316	1,138	130	59
1935									
Spring				Fishing prohibited					
Summer	3,771	2,388	1,446	6	2,432	479	797	157	54
Winter	2	94							40
Total	3,791	2,482	1,446	6	2,432	479	797	157	93
1936									
Spring				Fishing prohibited					
Summer	5,241	2,796	1,627		2,057	485	680	127	173
Winter				No information					
Sub-total	5,241	2,796	1,627		2,057	485	680	127	173
1937									
Spring				Fishing prohibited					
Summer	5,214	1,425	2,042		1,330	586	650	176	501
Winter				No information					
Sub-total	5,214	1,425	2,042		1,330	586	650	176	501
1946									
Total	6,202	1,618	1,752	2,754	3,544	443	270	308	2,369
1947									
Total	12,268	4,796	6,036	3,099	4,241	391	522	195	1,109
1948									
Total	23,642	2,022	3,796	4,209	4,085	660	742	165	1,980
1949									
Total	23,794	6,599	3,998	4,962	5,058	289	963	96	2,409

(continued, next page)

Table 44. --continued.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Wall-eye	North-ern pike
1950									
Spring	1,554	617	2,810	297	982			23	342
Summer	23,270	3,831	5,524	4,741	3,288	455	391		602
Fall	1,163	535	139	523	23		12	23	70
Open ice	37	77							5
Shanty	1,061	227	3	1,068				6	764
Total	27,085	5,287	8,476	6,629	4,293	455	403	52	1,783
1951									
Spring	Fishing prohibited except pike opener May 15								
Summer	9,836	3,583	2,986	2,518	4,685	168	261	20	244
Fall	1,542	83	292	83	125	42			
Open ice	635	127	14	67	13				20
Shanty	1,736	797	329	188					939
Total	13,749	4,590	3,621	2,856	4,823	210	261	20	1,203
1952									
Spring	2,201	678	1,076	99	2,052			16	166
Summer	15,670	2,982	3,820	262	2,284	109	173		153
Fall	699	2,130	699		2,728	33	100		266
Open ice	137	59	8	5					22
Shanty	331	294	83	359					323
Total	19,038	6,143	5,696	725	7,064	142	273	16	930
1953									
Spring	266	1,198	700	16	482			16	62
Summer	24,562	12,360	7,599	238	3,229	550	273		789
Fall	1,305	1,919	960	38	115	38	38		192
Open ice	239	128							17
Shanty	743	1,124		52					460
Total	27,115	16,729	9,259	344	3,826	588	311	16	1,520
1954									
Spring	185	590	254	336	385			7	
Summer	14,560	4,907	5,555	1,239	4,018	79	28	27	27
Fall	111	823	16	32	95	79	47	16	47
Open ice	82	158	5						19
Shanty	72	113	5	67					70
Total	15,010	6,591	5,835	1,674	4,498	158	75	50	163

(continued, next page)

Table 44. --continued.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Wall-eye	North-ern pike
1955									
Spring	248	189	228	159	527			2	30
Summer	10,069	1,870	4,089	74	2,668	200	51	74	348
Fall	863	319	206	94		19			38
Open ice	20	43							10
Shanty	27	284				2		5	137
Total	11,227	2,705	4,523	327	3,195	221	54	81	563
1956									
Spring	61	21	61	82	389				102
Summer	14,623	3,395	8,341	909	3,823	132	25	25	187
Fall	822	41			82	206			58
Open ice	521	49	30	575	5				25
Shanty	353	449		387					117
Total	16,380	3,955	8,432	1,953	4,299	338	25	25	489
1957									
Spring	344	74	664	25	2,115			25	172
Summer	13,335	1,957	4,248	1,538	2,935	279	57	27	309
Fall	363	248	248		38	19	38		69
Open ice		42						6	77
Shanty	57	87		267	3				116
Total	14,099	2,408	5,160	1,830	5,091	298	95	58	743
1958									
Spring	122	77	168	214	566				46
Summer	11,875	1,765	4,923	43	2,527	131	22	43	218
Fall	813	414	152						59
Open ice	154			11					39
Shanty	31	10							113
Total	12,995	2,266	5,243	268	3,093	131	22	43	475
1959									
Spring	393		157	11	935				235
Summer	14,516	320	2,535	96	1,988	259	123	19	1,063
Fall	935	168	101		96	36		29	113
Open ice	631	29	4	7		5			201
Shanty	83	61							399
Total	16,558	578	2,797	114	3,019	300	123	48	2,011

(continued, next page)

Table 44.--concluded.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Wall-eye	North-ern pike
1960									
Spring	377	63	121		1,869				14
Summer	15,620	611	3,349	1,003	2,633	292	116		397
Fall	1,168		288		80	31			133
Open ice		76				2			105
Shanty								2	60
Total	17,165	750	3,758	1,003	4,582	325	116	2	709
1961									
Spring	90		118		383				189
Summer	10,242	1,052	1,651	23	1,648	443	30	98	480
Fall	334	50			48	34	9		200
Open ice		21							211
Shanty									39
Total	10,666	1,123	1,769	23	2,079	477	39	98	1,119
1962									
Spring	47	37	120	157	1,234	9		15	266
Summer	3,940	3,175	1,011	84	706	63	79	18	639
Fall	17	1,135		20	110	45	64		436
Open ice								4	207
Shanty									56
Total	4,004	4,347	1,131	261	2,050	117	143	37	1,604
1963									
Spring	37	223	153	36	434	49		17	143
Summer	1,366	2,374	790	130	866	91	48	175	427
Fall	497	594	225	10	131	20		63	72
Open ice		164						3	355
Shanty		271						4	590
Total	1,900	3,626	1,168	176	1,431	160	48	262	1,587
1964									
Spring		38	31		666	118	121	28	99
Summer	2,420	953	372	20	614	55	323	19	311
Fall		155	8			38	13		46
Open ice		42				3		4	101
Shanty		292							215
Total	2,420	1,480	411	20	1,280	214	457	51	772
1965									
Spring	35	35		13	272		32		45
Summer	4,016	1,650	161	113	1,600	285	359	47	159
Sub-total	4,051	1,685	161	126	1,872	285	391	47	204

Table 45.--Mark-and-recapture estimates of the populations of some species in Fife Lake, 1950-74.

Species and minimum length (inches)	1950[a]		Number				
	Number	Pounds per acre	1956[b]	1958[c]	1964[d]	1965[d]	1974[e]
Bluegill (6 inches)	56,511	21.6	10,961	13,536		2,252	
Yellow perch (6 inches)			345				
Pumpkinseed (6 inches)	14,186	5.4	4,223				
Black crappie (6 inches)	13,673	11.5	3,039	3,537			
Rock bass (6 inches)	4,845	1.8		11,519			
Bullheads (6 inches)	424	0.5	544				
Largemouth bass (10 inches)	1,789	3.7	2,642	3,236			
Smallmouth bass (10 inches)	7,264	11.4	753	543			
Walleye (13 inches)			75		1,397	1,087	1,129
Northern pike (14 inches)			7,888	3,936			
White sucker	364	1.0					

[a] Cooper (1951). Estimates of pounds per acre were adjusted for revised estimate of lake area (from 575 acres to 628 acres).

[b] Cooper et al. (1957).

[c] Christensen (1960).

[d] Schneider (1969).

[e] Pettengill (1975). The walleye estimate shown is an average of the independent estimates 1,009 and 1,248.

Table 46.--Average length in inches, by age group (sample size in parentheses) of fish in Fife Lake. Data for 1936, 1956, 1958, 1964-65, and 1974 obtained by netting (spring); data for 1946-58 obtained mainly from anglers' catches (year-around).

Species and year	Age II	III	IV	V	VI	VII	VIII	IX	X	XI+
Bluegill										
1936			6.7 (5)	6.4 (58)	7.2 (6)					
1956		4.7 (21)	6.0 (501)	6.8 (27)	7.6 (44)	7.7 (180)	8.3 (16)	8.8 (6)		
1958		4.6 (79)	5.7 (105)	7.1 (52)	7.9 (67)	8.0 (21)	8.9 (8)			
1946-58	4.1 (27)	5.2 (215)	6.2 (621)	6.7 (583)	7.1 (175)	7.9 (45)	8.3 (14)	9.6 (7)		
1965	3.8 (8)	5.5 (31)	7.0 (81)	8.4 (41)	9.1 (24)	9.7 (17)	10.0 (7)			
Yellow perch										
1936		6.2 (16)	6.5 (54)	7.0 (9)	13.4 (1)					
1956		6.0 (1)	7.3 (3)	10.3 (9)	10.9 (17)	11.6 (14)	11.7 (1)			
1946-58	4.8 (35)	5.4 (59)	6.1 (105)	6.9 (119)	7.4 (84)	8.4 (29)	10.7 (6)			
Pumpkinseed										
1956		4.8 (15)	5.8 (224)	6.7 (32)	7.3 (3)	7.4 (36)	8.9 (1)			
1958		4.7 (10)	6.1 (21)	6.5 (25)	7.2 (10)	7.8 (1)	8.6 (2)	9.5 (1)		
1946-58		5.3 (63)	5.8 (135)	6.4 (86)	7.0 (19)					

(continued, next page)

Table 46.--continued.

Species and year	Age II	III	IV	V	VI	VII	VIII	IX	X	XI+
Rock bass										
1956			5.7 (200)	6.8 (149)	7.6 (66)	8.5 (165)	9.0 (71)	9.1 (53)	9.4 (29)	9.8 (6)
1958		4.5 (8)	5.5 (26)	6.5 (79)	7.4 (102)	8.2 (89)	9.1 (44)	10.1 (24)	10.1 (10)	10.2 (1)
1946-58		4.0 (4)	5.4 (14)	6.3 (58)	7.0 (73)	7.4 (37)	8.3 (10)	10.0 (1)		
Black crappie										
1936		11.4 (2)	12.5 (1)							
1956	6.2 (60)	8.5 (260)	10.5 (46)	11.8 (4)	12.5 (5)	12.7 (5)		13.3 (1)		
1958	6.1 (1)	9.1 (124)	10.3 (38)	11.4 (38)	12.2 (6)	13.4 (2)				
1946-58	7.8 (28)	9.4 (47)	10.3 (58)	11.2 (21)	11.6 (10)	12.6 (2)				
Largemouth bass										
1936		11.4 (17)	13.9 (6)	14.9 (2)					18.7 (1)	
1956	8.6 (5)	11.1 (52)	12.8 (233)	13.9 (30)	14.9 (49)	15.5 (115)	16.3 (77)	17.0 (28)	17.4 (15)	18.3 (13)
1958		10.1 (28)	12.4 (36)	13.8 (46)	14.6 (53)	15.5 (17)	16.7 (14)	18.0 (5)		
Smallmouth bass										
1936	9.4 (1)	10.2 (27)	13.5 (6)	14.6 (9)	14.8 (1)					
1956		9.7 (25)	11.8 (128)	13.7 (77)	15.1 (27)	16.0 (39)	17.6 (18)	18.0 (4)	19.2 (1)	
1958		10.6 (4)	11.5 (16)	13.0 (65)	14.5 (53)	15.5 (14)	17.4 (8)	17.4 (1)	19.6 (1)	

(continued, next page)

Table 46.--concluded.

Species and year	Age II	III	IV	V	VI	VII	VIII	IX	X	XI+
Northern pike										
1956	17.7 (73)	21.2 (188)	23.6 (50)	27.0 (4)	30.0 (3)					
1958	17.3 (34)	21.2 (43)	23.5 (24)	24.6 (8)				31.4 (1)		
Walleye										
1946-63	14.3 (9)	17.8 (29)	21.4 (6)	22.5 (18)	23.3 (20)	25.3 (8)	24.8 (10)	25.6 (10)	28.6 (2)	
1964-65	14.9 (13)	16.8 (148)	18.5 (88)	20.2 (4)						
1974		14.9 (44)	17.3 (73)	18.8 (56)	20.2 (7)	24.4 (1)	25.9 (1)			
White sucker										
1956	10.9 (1)	15.3 (17)	16.8 (87)	18.1 (44)	19.8 (10)	20.7 (6)				

Table 47.--Length-frequency distribution (in numbers) of fish harvested by anglers at Fife Lake in relation to minimum size limits (none on panfish), 1950-65.

Inch group	Species and size limit							
	Blue-gill	Yellow perch	Pumpkin-seed	Rock bass	Black crappie	Largemouth bass		
						10 inches	14 inches	16 inches
4	22		15					
5	259	38	113	25				
6	497	137	102	69	3			
7	223	59	20	43	22			
8	24	22	1	22	13			
9	2	16		10	41			
10		4		1	37			
11	1	2			28	3		
12		1			4	2	2	
13		1			4	1	1	
14					1	3	23	
15						4	12	
16						1	10	23
17						1	3	12
18						1	1	14
19							1	6
20						1	3	1

(continued, next page)

Table 47.--concluded.

Inch group	Species and size limit							
	Smallmouth bass			Northern pike			Walleye (13 inches)	
	10 inches	14 inches	16 inches	14 inches	20 inches	24 inches	1936-62	1963-64
10	4							
11	3							
12	3							
13	2	2						2
14	1	1		1				6
15	1	14		3				7
16	3	2	5	4				12
17	2	2	6	7				6
18	1		5	13	1		3	4
19	1		4	19	15			1
20			1	15	65	1	2	
21				12	30	3	7	1
22				14	17	2	11	1
23				22	7	19	12	3
24				16	7	83	18	
25				15	4	44	9	
26				11	1	25	10	
27				5		20	3	
28				1		8	3	
29				2		10		
30				1	1		1	
31						4		
32				1	1	1		
33						1		
34						2		
35					1	1		
36								

Table 48. --Average length in inches (sample size in parentheses) of panfish caught by open-water anglers at Fife Lake in five time periods, under two minimum size limits.

Species	6-inch limit		No size limit		
	1934-36	1946-49	1950-53	1954-58	1959-63
Bluegill	7.1 (5,814)	6.9 (303)	6.4 (462)	6.5 (497)	6.1 (65)
Rock bass	7.7 (4,673)	7.0 (19)	6.7 (66)	7.0 (94)	7.8 (32)
Pumpkinseed	6.7 (3,602)	6.2 (71)	5.9 (78)	6.0 (152)	6.3 (18)
Yellow perch	7.4 (6,378)	7.6 (45)	6.6 (171)	7.4 (109)	
Black crappie		10.6 (20)	10.0 (70)	9.7 (84)	

Table 49. --Effect of size limits on the fisheries for largemouth bass, smallmouth bass, and northern pike at Fife Lake.

Species, and test period	Size limit (inches)	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Annual range			
Largemouth bass						
1934-35[a]	10	399	316- 481	13.6	458	48
1946-53	10	397	142- 660	14.7	596	11
1954-58	16	229	131- 338	17.4	562	12
1959-63	14	276	117- 477	15.6	488	11
1964-65	10	249	214- 285	--	--	--
Smallmouth bass						
1934-35[a]	10	934	802-1,066	12.6	934	97
1946-53	10	468	261- 963	13.9	633	12
1954-58	16	54	22- 95	18.8	192	4
1959-63	14	94	34- 143	15.4	174	4
1964-65	10	424	391- 457	--	--	--
Northern pike						
1934-35[a]	14[b]	134	93- 175	21.6	283	29
1946-53	14	1,663	930-2,409	22.4	3,960	74
1954-58	24	487	163- 743	25.7	1,769	37
1959-64	20[c]	1,300	709-2,011	21.5	2,749	64

[a] Winter of 1933-34 included to give two complete fishing years.

[b] Also, there was a long closed season from ice out until June 25.

[c] Also, there was a ban on spearing in some winters.

Table 50.--Fishing regulations, and estimates of pressure and total catch for Fine Lake, 1946-59.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
	Trips	Hours			
1946					Bluegill and pumpkinseed: Mar 1-June 24; 6 inches
Total	15,000	42,000	67,000	1.60	*Pike and walleye: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
					*Other panfish: none; 6 inches
1947					
Total	15,000	38,000	60,000	1.58	
1958					
Total	22,000	60,000	90,000	1.50	
1949					All panfish: no size limit after Sep 23
Total	22,000	65,000	94,000	1.45	
1950					Walleye: 13 inches
Spring	917	2,435	722	0.30	Bluegill and pumpkinseed: Apr 1-June 24
Summer	11,341	30,810	64,445	2.09	
Fall	2,392	6,311	8,416	1.33	
Open ice	344	668	1,108	1.66	
Shanty	193	762	524	0.69	
Total	15,187	40,986	75,215	1.84	
1951					All species: Mar 15 or Apr 1-June 24
Spring	Fishing prohibited				
Summer	17,207	52,778	72,464	1.37	
Fall	2,910	6,093	5,559	0.91	
Open ice	394	1,007	1,194	1.19	
Shanty	237	886	925	1.04	
Total	20,748	60,764	80,142	1.32	
1952					Bluegill and pumpkinseed: Apr 1-25
Spring	3,020	8,241	1,235	1.48	Other panfish: none
Summer	10,376	28,685	62,599	2.18	Pike: Mar 16-Apr 25
Fall	2,056	5,058	5,492	1.09	
Open ice	662	1,736	1,891	1.09	
Shanty	190	662	405	0.61	
Total	16,304	44,382	71,622	1.61	
1953					
Spring	2,988	7,580	18,163	2.40	
Summer	12,401	33,776	89,888	2.66	
Fall	2,381	6,526	10,893	1.67	
Open ice	896	1,792	2,379	1.33	
Shanty	235	952	337	0.35	
Total	18,901	50,626	121,660	2.40	

(continued, next page)

Table 50.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1954					*All species: no size limit
Spring	2,837	7,563	11,922	1.58	Bass: Jan 1-June 17
Summer	11,561	34,621	64,201	1.85	
Fall	1,761	4,846	3,072	0.63	
Open ice	859	2,170	2,508	1.16	
Shanty	543	1,949	528	0.27	
Total	17,561	51,149	82,231	1.61	
1955					Bluegill and pumpkinseed: none
Spring	2,525	6,851	8,949	1.31	
Summer	8,889	24,457	39,571	1.62	
Fall	1,545	4,024	4,743	1.18	
Open ice	585	1,556	1,295	0.83	
Shanty	632	1,833	533	0.29	
Total	14,176	38,721	55,091	1.42	
1956					
Spring	1,266	3,063	3,814	1.24	
Summer	7,330	18,837	34,142	1.81	
Fall	1,204	3,406	6,256	1.84	
Open ice	546	1,503	1,361	0.91	
Shanty	188	555	448	0.81	
Total	10,534	27,364	46,021	1.68	
1957					
Spring	1,521	4,283	11,297	2.64	
Summer	6,175	19,670	45,933	2.34	
Fall	1,286	3,467	5,169	1.49	
Open ice	835	2,256	1,440	0.64	
Shanty	259	808	157	0.19	
Total	10,076	30,484	63,996	2.10	
1958					
Spring	2,126	5,753	16,649	2.89	
Summer	7,219	18,258	30,352	1.66	
Fall	1,420	3,404	4,295	1.26	
Open ice	626	1,526	3,159	2.07	
Shanty	385	878	1,031	1.17	
Total	11,776	29,819	55,486	1.86	
1959					Pike: 20 inches
Spring	1,385	3,508	8,811	2.51	
Summer	4,325	10,949	17,965	1.64	
Fall	805	2,012	3,177	1.58	
Open ice	615	1,875	2,979	1.59	
Shanty	290	676	951	1.41	
Total	7,420	19,020	33,883	1.78	

[a] Only important regulations and their changes are given. Special regulations are denoted by an asterisk (*).

Table 51.--Estimated number of fish caught from Fine Lake, 1946-59.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Wall-eye	North-ern pike	Bull-head
1946									
Total	55,344	2,427	1,011	4,854		1,011	135	135	2,493
1947									
Total	49,327	4,006	1,196	2,033		658		120	2,450
1948									
Total	80,326	1,705	898	3,949	90	538		628	1,616
1949									
Total	82,298	3,770	1,885	3,394		1,226		471	1,226
1950									
Spring		51		621					50
Summer	54,237	3,506	4,653	748		148		103	1,050
Fall	6,966	530	636	106		142		35	
Open ice	1,044	45	6	13					
Shanty	432			32			1	59	
Total	62,679	4,132	5,295	1,520		290	1	197	1,100
1951									
Spring				Fishing prohibited					
Summer	55,623	3,587	11,551	261		493		65	884
Fall	4,440	559	526						33
Open ice	854	280	30	30					
Shanty	378						2	90	917
Total	61,295	4,426	12,107	291		493	2	90	917
1952									
Spring	8,422	785	1,757	1,157	10	21		21	62
Summer	51,983	4,357	4,132	851		526		56	694
Fall	3,197	1,017	516			29		15	66
Open ice	1,601	197	19	31			6	31	6
Shanty	389						2	14	
Total	65,592	6,356	6,424	2,039	10	576	8	137	828
1953									
Spring	12,852	320	4,204	468					306
Summer	77,034	2,139	8,323	521	9	1,052		45	765
Fall	8,657	580	962	312		212		71	99
Open ice	2,031	59	20	223				39	7
Shanty	167	81	5	19				58	7
Total	100,741	3,179	13,514	1,543	9	1,264		213	1,184

(continued, next page)

Table 51. --concluded.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Walleye	Northern pike	Bullhead
1954									
Spring	8,653	347	2,339	384				25	174
Summer	53,909	2,106	4,552	546	45	1,804		225	1,014
Fall	2,626	136	149			87		74	
Open ice	1,958	233	48	209				54	6
Shanty	277	77		32				137	5
Total	67,423	2,899	7,088	1,171	45	1,891		515	1,199
1955									
Spring	5,966	630	1,903	180				26	244
Summer	30,015	1,076	6,019	435		997	16	63	950
Fall	3,564	432	313	60		254		45	75
Open ice	749	342	35	142				12	15
Shanty	357	88	16	4				64	4
Total	40,651	2,568	8,286	821		1,251	16	210	1,288
1956									
Spring	3,214	120	338	120				11	11
Summer	25,903	2,291	4,131	635		714	17	31	420
Fall	4,113	1,525	276	79		250		13	
Open ice	882	261		176				34	
Shanty	235	206							7
Total	34,347	4,403	4,745	1,010		964	17	89	438
1957									
Spring	6,771	462	3,214	484				28	312
Summer	34,698	2,292	5,884	574		937	41		1,479
Fall	2,381	1,665	284	122		108			609
Open ice	788	497	34	92				19	5
Shanty	123	22		3				3	6
Total	44,761	4,938	9,416	1,275		1,045	41	50	2,411
1958									
Spring	10,876	484	3,888	1,001					400
Summer	24,460	1,575	2,040	525		1,035	49		668
Fall	2,973	1,031	172			66			53
Open ice	2,039	979	20	121					
Shanty	848	109	11	23				34	6
Total	41,196	4,178	6,131	1,670		1,101	49	34	1,127
1959									
Spring	7,221	401	1,163		13				13
Summer	14,599	1,181	1,058	70		729	34		294
Fall	1,079	1,710	185			142		29	14
Open ice	1,960	882	49	49				39	
Shanty	168	8	9	3				1	
Total	25,027	4,182	2,464	122	13	871	34	69	321

Table 52. --Average length in inches, by age group, for bluegill, largemouth bass, and northern pike at Fine Lake. (Number of fish sampled in parentheses).

Species, year and gear[a]	Age 0	I	II	III	IV	V	VI	VII	VIII	IX+
Bluegill										
1946-50 A & S	1.5 (5)	2.3 (27)	3.1 (42)	4.6 (56)	5.9 (83)	6.6 (161)	7.1 (58)	7.3 (3)		
1951-55 A				5.3 (47)	6.1 (381)	6.7 (225)	7.1 (66)	6.6 (2)		
1955, Fall T			4.6 (4)	5.1 (176)	5.9 (54)	6.7 (31)	7.5 (4)			
1956 A				5.7 (1)	6.1 (40)	6.6 (37)	7.0 (23)	7.6 (3)		
1957 A				5.6 (8)	6.1 (105)	6.4 (218)	6.7 (22)	6.9 (1)		
1958 A					6.6 (2)	6.2 (91)	6.5 (91)	7.1 (3)		
1958, Spring T				3.8 (1)	4.5 (54)	5.0 (173)	5.8 (57)	7.1 (4)		
Largemouth bass										
1946-50 A & S	2.7 (21)	4.9 (1)	7.0 (10)	10.0 (4)	11.4 (1)	13.2 (3)				
1951-53 A			7.9 (1)	10.8 (1)	10.6 (12)	12.4 (17)	14.6 (5)	16.9 (1)	18.9 (1)	
1954-55 A			8.1 (10)	9.4 (18)	10.8 (13)	11.5 (24)	12.8 (11)	15.8 (8)	17.7 (2)	18.6 (2)
1955, Fall T			9.1 (29)	12.1 (5)	13.6 (4)	13.7 (6)	15.0 (6)		16.3 (3)	19.0 (8)
1956-58 A			8.5 (6)	9.8 (44)	12.0 (32)	14.0 (14)	15.2 (8)	18.2 (1)		
1958, Spring T					11.4 (16)	13.2 (25)	15.3 (11)	16.3 (11)	16.7 (7)	17.8 (9)

(continued, next page)

Table 52.--concluded.

Species, year and gear[a]	Age 0	I	II	III	IV	V	VI	VII	VIII	IX+
Northern pike										
1946-53				22.0	31.0					
A				(8)	(1)					
1954-55			18.8	23.6	25.6	28.7				
A & T			(19)	(32)	(12)	(7)				
1956-58			19.4	23.8	27.0	31.2	30.5			
A & T			(5)	(8)	(10)	(6)	(1)			

[a] Gear types: A = angling with hook and line (mostly by the census clerk himself in May and June); S = seine; T = trap net.

Table 53.--Effect of size limits on the fisheries for largemouth bass and northern pike at Fine Lake.

Species and test period	Size limit (inches)	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Annual range			
Largemouth bass						
1946-53	10	757	290-1,264	12.9	840	17
1954-59	None	1,187	871-1,891	11.2	795	24
Northern pike						
1946-53	14	249	90- 628	23.0	715	14
1954-58	None	180	34- 515	22.9	461	13
1959	20	69				

Table 54.--Fishing regulations, and estimates of pressure and total catch for Fletcher Floodwater, 1948-65.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1948					Pike: Mar 16-May 14; 14 inches
Winter	9,690	53,435	14,504	0.27	Bluegill and sunfish: Mar 1-June 25; 6 inches
Open water	37,909	204,938	69,910	0.34	Other panfish: no closed season; 6 inches
Total	47,599	258,373	84,414	0.33	Bass: Jan 1-June 25; 10 inches
1955					
Winter	15,177	73,912	23,500	0.32	Pike: Mar 16-Apr 28
Open water	33,900	171,500	124,260	0.72	All panfish: no closed season; no size
Total	49,077	245,412	147,760	0.60	
1956					
Winter	12,750	63,230	19,500	0.31	
Open water	36,100	133,300	109,880	0.82	
Total	48,850	196,530	129,380	0.66	
1961					
Winter	No winter census				Pike: 20 inches
Open water	21,935	77,950	37,400	0.48	Bass: Jan 1-June 17
Subtotal	21,935	77,950	37,400	0.48	
1962					
Winter	7,246	36,114	1,584	0.04	Bass: Jan 1-May 31
Open water	18,483	62,894	13,376	0.21	
Total	25,729	99,008	14,960	0.15	
1963					
Winter	6,957	36,524	19,195	0.53	*Pike: 14 inches; creel limit 10; no spearing
Open water	59,513	205,005	90,326	0.44	
Total	66,470	241,529	109,521	0.45	
1964					
Winter	9,657	49,349	11,542	0.23	
Open water	68,718	220,468	66,864	0.30	
Total	78,375	269,817	78,406	0.29	
1965					
Winter	7,143	30,285	12,961	0.43	
Open water	116,755	404,971	187,298	0.46	
Total	123,898	435,256	200,259	0.46	

[a] Only important regulations and their changes noted. Special regulations are indicated by an asterisk(*).

Table 55.--Estimated number of fish caught from Fletcher Floodwater, 1948-65.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Rock bass	Large-mouth bass	North-ern pike	Bull-head
1948							
Winter						14,504	
Open water		19,240	1,170	2,010	670	34,470	12,350
Total		19,240	1,170	2,010	670	48,974	12,350
1955							
Winter						23,500	
Open water		6,150	83,780	3,020	7,670	15,280	8,360
Total		6,150	83,780	3,020	7,670	38,780	8,360
1956							
Winter						19,500	
Open water	110	5,610	66,760	3,720	8,590	17,930	7,160
Total	110	5,610	66,760	3,720	8,590	37,430	7,160
1961							
Winter			No winter census				
Open water	620	26,710	6,070	570	1,120	980	1,330
Sub-total	620	26,710	6,070	570	1,120		1,330
1962							
Winter		221				1,210	73
Open water	662	4,006	6,119	78	338	581	1,592
Total	662	4,227	6,119	78	338	1,791	1,665
1963							
Winter		769				18,426	
Open water	1,060	10,236	38,069	99	881	27,256	12,725
Total	1,060	11,005	38,069	99	881	45,682	12,725
1964							
Winter	1,284	1,223	15	870		10,258	46
Open water	2,032	11,032	11,131		1,346	31,312	9,141
Total	3,316	12,255	11,146	870	1,346	41,570	9,187
1965							
Winter	2,531	2,366	116			10,430	39
Open water	6,835	13,048	43,435	3,522	6,420	102,594	11,332
Total	9,366	15,414	43,551	3,522	6,420	113,024	11,371

Table 56.--Average length in inches, by age group (sample size in parentheses), of northern pike caught from Fletcher Floodwater by summer anglers, 1948-65.

Year	Age						
	I	II	III	IV	V	VI	VII
1948	18.1 (39)	22.2 (27)	24.2 (6)	27.5 (5)	27.8 (2)		
1954	14.7 (24)	16.7 (45)	17.8 (11)	26.4 (5)		28.5 (1)	
1955	14.9 (43)	16.7 (162)	17.6 (60)	21.4 (3)	23.2 (1)		
1956	14.1 (7)	15.4 (40)	17.5 (65)	18.7 (34)	23.4 (1)		32.7 (1)
1959	15.2 (9)	17.9 (10)	20.5 (4)	21.9 (2)	24.8 (1)		
1965	15.4 (2)	16.4 (126)	17.3 (54)	18.5 (26)	20.0 (13)	21.4 (6)	23.7 (2)

Table 57.--Percentage of anglers interviewed at Fletcher Floodwater in 1948, 1955, and 1956, catching 0 to 5 pike. (A 14-inch size limit and creel limit of 5 pike was in effect.)

Season	Number interviewed	Number of pike caught					
		0	1	2	3	4	5
Open water	6,155	59.8	24.0	9.0	3.2	2.2	1.8
Winter	4,390	30.0	27.1	18.6	10.4	6.9	7.0

Table 58.--Fishing regulations, and estimates of pressure and total catch for Houghton Lake, 1935-37, and 1956-61.[a]

Year and season	Pressure		Total	Catch	Regulations[b]
	Trips	Hours	catch	per hour	Species: closed season; minimum size
1935-36					Pike and walleye: none; 14 inches
Winter	6,881	39,427	7,019	0.18	Bluegill and pumpkinseed: May 1-June 24; 6 inches
					Other panfish: none; 6 inches
					Bass: Jan 1-June 24; 10 inches
1936-37					
Winter	4,614	24,054	17,089	0.71	
1956-57					Pike: Mar 16-Apr 26; 14 inches; no spearing
Winter	70,647	344,000	250,000	0.72	
Summer	365,820	443,000	233,000	0.53	Walleye: Mar 16-Apr 26; 13 inches
Total	436,467	787,000	483,000	0.61	Bass: Jan 1-June 17; 10 inches
					All panfish: none; none
1957-58					
Winter	62,608	314,110	208,470	0.66	*Pike: 20 inches
Summer	236,520	630,000	402,000	0.64	
Total	299,128	944,110	610,470	0.65	
1958-59					
Winter	55,007	274,070	237,660	0.87	
Summer	225,230	622,170	379,440	0.61	
Total	280,237	896,240	617,100	0.69	
1959-60					
Winter	76,149	381,690	247,921	0.65	
Summer	164,701	486,000	251,800	0.52	
Total	240,850	867,690	499,721	0.58	
1960-61					
Winter	74,969	372,200	168,821	0.45	

[a] Data for the 1930's from Christensen (1957).

[b] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 59.--Estimated number of fish caught from Houghton Lake, 1935-37 and 1956-61.[a]

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Small-mouth bass	Wall-eye	North-ern pike
1935-36									
Winter	60	3,244			26			896	2,764
1936-37									
Winter	19	14,711						341	1,963
1956-57									
Winter	127,500	62,500	5,000	7,500	10,000	tr		5,000	32,500
Summer	55,920	48,930	41,940	4,660	41,940	4,660	2,330	11,650	18,640
Total	183,420	111,430	46,940	12,160	51,940	4,660	2,330	16,650	51,140
1957-58									
Winter	128,160	39,980	8,700	8,730	9,720			940	12,140
Summer	128,200	137,000	63,920	2,500	31,360	6,000	400	19,700	10,900
Total	256,360	176,980	72,620	11,230	41,080	6,000	400	20,640	23,040
1958-59									
Winter	182,050	23,200	10,840	580	10,330			2,050	8,530
Summer	142,000	128,600	46,200	1,400	28,200	1,800	400	12,300	13,700
Total	324,050	151,800	57,040	1,980	38,530	1,800	400	14,350	22,230
1959-60									
Winter	153,543	57,320	15,145	944	5,810	118	103	2,315	12,623
Summer	73,000	80,000	59,700	1,700	16,700	1,900		4,700	6,500
Total	226,543	137,320	74,845	2,644	22,510	2,018	103	7,015	19,123
1960-61									
Winter	97,050	32,144	11,806	3,720	7,196	43	72	2,370	14,420

[a] Data for the 1930's from Christensen (1957).

Table 60.--Effect of raising the size limit on northern pike from 14 to 20 inches on the Houghton Lake fishery.

Test period	Size limit (inches)	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Annual range			
Dec 1956-Dec 1957	14	51,140	---	19.2	73,218	93
Dec 1957-Dec 1960	20	21,464	19,123-23,040	20.7	40,280	45

Table 61.--Length-frequency distribution (in numbers) of fish harvested by anglers from Houghton Lake, 1954-60.

Inch group	Species and minimum size limit[a]							
	Northern pike		Wall-eye	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass
	14 inches	20 inches						
3					3			
4				3	16			
5				14	7	3		1
6				35	8	13		1
7				22	5	5	1	4
8				15	5	4	8	11
9				4			5	
10				2	3			
11					1			
12		1						
13			2					
14			3					
15		2	5					
16	2	2	3					
17	5		1					
18	5	5	1					
19	2	4						
20	3	16						
21	1	1						
22	2	6						
23		1						
24		3	1					
25	1							
26								
27								
28								
29		1						
30+		1						

[a] No size limit on panfish; 13-inch size limit on walleye.

Table 62.--Fishing regulations, and estimates of pressure and total catch for Lobdell Lake, 1946-52.

Year and season	Pressure		Total catch	Catch per hour	Regulations [a] Species: closed season; minimum size
	Trips	Hours			
1946					Bluegill and sunfish: Mar 1-June 24; 6 inches
Total	16,090	64,560	53,360	0.83	*Pike: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
					*Other panfish: none; 6 inches
1947					
Total	33,480	107,330	116,280	1.08	
1948					
Total	34,360	115,990	155,840	1.34	
1949					
Total	18,070	63,950	62,420	0.98	All panfish: no size limit after Sep 23
1950					
Total	7,190	30,650	26,540	0.87	
1951					All species: Mar 15 or Apr 1-June 24
Spring	Fishing prohibited				
Summer	6,490	23,312	28,352	1.22	
Fall	129	365	397	1.09	
Open ice	1,449	4,811	5,865	1.22	
Total	8,068	28,488	34,614	1.22	
1952					Bluegill and sunfish: Apr 1-25
Spring	1,457	5,216	4,928	0.95	Other panfish: none
Summer	2,736	12,394	13,493	1.09	Pike: Mar 15-Apr 25
Fall	201	648	613	0.95	
Total	4,394	18,258	19,034	1.04	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 63.--Estimated number of fish caught from Lobdell Lake, 1946-52.

Year and season	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass	Large-mouth bass	North-ern pike	Other species
1946								
Total	29,241	5,443	3,628	10,992	107	1,174	694	2,081
1947								
Total	65,233	24,186	6,977	14,651	349	2,674	349	1,860
1948								
Total	101,608	25,246	6,701	17,142		1,870	468	2,805
1949								
Total	44,880	5,680	7,428	2,746	187	437	437	562
1950								
Total	17,820	1,884	2,547	3,822	239	265	159	563
1951								
Spring		Fishing prohibited						
Summer	18,128	3,516	1,642	3,439		641	51	921
Fall	254	77	22	44				
Open ice	4,392	716	392	324	14		27	
Total	22,774	4,309	2,056	3,807	14	641	78	921
1952								
Spring	2,715	483	390	1,227	37	18	56	
Summer	9,229	905	772	2,013	84	402	66	16
Fall	350	96	131		9	26		
Open ice		No census						
Sub-total	12,294	1,484	1,293	3,240	130	446	122	16

Table 64. --Species and size composition of the catch from Lobdell Lake, 1946-52.

Species	Percent of total catch	Average length (inches) 1947-48 [a]	Percent less than 6 inches long, 1950-52
Bluegill	62.8	6.6	21
Yellow perch	14.9	7.1	13
Black crappie	11.6	8.1	2
Pumpkinseed	6.6	6.2	24
Largemouth bass	1.6	14.0	--
Northern pike	0.5	--	--
Rock bass	0.2	--	0

[a] A 6-inch size limit in effect for panfish. Averages are based on sample sizes of 48 to 758.

Table 65.--Fishing regulations, and estimates of pressure and total catch for Minnewaukon Lake, 1946-58.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1946					*All panfish: no closed season; 6 inches
Total	4,170	11,950	20,550	1.71	*Pike: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
1947					
Total	5,810	14,960	20,890	1.39	
1948					
Sub-total[b]	3,640	10,210	23,520	2.30	
1949					All panfish: no size limit after Sep 23
Sub-total[b]	5,290	11,400	23,930	2.09	
1950					
Spring	1,087	2,309	9,320	4.04	
Summer	3,061	7,561	15,606	2.06	
Fall	1,286	3,279	6,002	1.83	
Winter	175	494	1,113	2.25	
Total	5,609	13,643	32,041	2.35	
1951					All panfish: Apr 1-June 24
Spring	Fishing prohibited				Pike: Mar 15-June 24
Summer	4,259	12,303	36,079	2.93	
Fall	340	1,452	2,781	1.92	
Winter	284	1,023	2,270	2.22	
Total	4,883	14,778	41,130	2.78	
1952					Bluegill and sunfish: Apr 1-25
Spring	1,845	4,787	21,658	4.52	Other panfish: none
Summer	3,357	8,968	18,810	2.10	Pike: Mar 15-Apr 25
Fall	491	1,580	1,840	1.16	
Winter	287	780	2,300	2.95	
Total	5,980	16,115	44,608	2.77	
1953					
Spring	777	2,888	7,459	2.58	
Summer	3,165	10,237	18,200	1.78	
Fall	669	3,325	6,287	1.89	
Winter	335	800	2,201	2.75	
Total	4,946	17,250	34,147	1.98	
1954					*Bass: Jan 1-June 17; 16 inches
Spring	986	2,752	9,404	3.42	*Pike: 24 inches
Summer	4,029	11,224	26,663	2.38	
Fall	980	2,671	6,527	2.44	
Open ice	434	1,094	853	0.78	
Shanty	28	50	40	0.80	
Total	6,457	17,791	43,487	2.44	

(continued, next page)

Table 65.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1955					All panfish: no closed season
Spring	670	1,821	3,981	2.19	
Summer	3,380	9,003	15,980	1.78	
Fall	363	1,844	2,223	1.21	
Open ice	359	836	1,574	1.88	
Shanty	90	314	776	2.47	
Total	4,862	13,818	24,534	1.78	
1956					
Spring	564	1,301	3,652	2.81	
Summer	2,947	8,036	11,297	1.41	
Fall	731	2,062	2,608	1.26	
Open ice	359	836	1,574	1.88	
Shanty	16	58	146	2.52	
Total	4,617	12,293	19,277	1.57	
1957					
Spring	723	2,006	5,313	2.65	
Summer	3,398	8,984	14,383	1.60	
Fall	1,059	3,159	4,948	1.57	
Open ice	294	745	958	1.29	
Shanty	26	107	223	2.07	
Total	5,500	15,001	25,825	1.72	
1958					
Spring	1,195	2,630	5,271	2.00	
Summer	3,189	6,856	10,759	1.57	
Fall	592	1,332	1,196	0.90	
Open ice		No creel census			
Shanty					
Total	4,976	10,818	17,226	1.59	

[a] Only important regulations and their changes are noted. Special regulations are denoted by an asterisk (*).

[b] No winter census in 1948 and 1949.

Table 66.--Estimated number of fish caught from Minnewaukon Lake, 1946-58.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Bull-head	Large-mouth bass	North-ern pike	Other species
1946								
Total	10,296	843	843	123	6,658	349	21	1,417
1947								
Total	12,074	2,110	1,901	272	3,906	522	21	84
1948								
Total[a]	13,453	2,117	2,587	212	4,681	470		
1949								
Total[a]	13,042	2,608	1,244	1,173	4,882	885	72	24
1950								
Spring	5,021	692	2,693	88	771		7	48
Summer	9,514	365	1,856	1,066	2,528	259	9	
Fall	3,847	807		172	912	251		
Winter[b]	322	309	16	412	52	2		
Total	18,704	2,173	4,565	1,738	4,263	512	16	48
1951								
Spring			Fishing prohibited					
Summer	26,847	880	3,799	1,851	2,269	419	14	
Fall	1,515	452	68	633		90	23	
Winter[b]	1,112	515	23	608			12	
Total	29,474	1,847	3,890	3,092	2,269	509	49	
1952								
Spring	13,805	678	6,519	635	21			
Summer	14,380	288	557	1,151	2,282	133	19	
Fall	1,309	18	71	35	248	159		
Winter[b]	545	1,329	37	381	8			
Total	30,039	2,313	7,184	2,202	2,559	292	19	
1953								
Spring	4,692	271	1,790	353	353			
Summer	13,210	558	1,420	1,036	1,390	579	7	
Fall	3,693	754	814	448	346	218	14	
Winter[b]	576	1,038		570		6	11	
Total	22,171	2,621	4,024	2,407	2,089	803	32	
1954								
Spring	6,585	164	1,387	246	1,006		7	7
Summer	22,501	283	450	725	2,616	80		8
Fall	5,797	99	20	286	296	29		
Open ice	301	283	5	212		47	5	
Shanty	40							
Total	35,224	829	1,862	1,469	3,918	156	12	15

(continued, next page)

Table 66.--concluded.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Bull-head	Large-mouth bass	North-ern pike	Other species
1955								
Spring	2,800	76	793	101	194			16
Summer	13,770	148	278	387	1,338	59		
Fall	1,443	156		234	273	117		
Open ice	45	535		10				6
Shanty	148	183		440				5
Total	18,206	1,098	1,071	1,172	1,805	176		27
1956								
Spring	2,070	54	473	974	81			
Summer	9,726	148	270	524	541	79	9	
Fall	2,031	122		200	200	55	3	11
Open ice	72	1,263	11	214				
Shanty	10			136				
Total	13,909	1,587	754	2,048	822	134	12	11
1957								
Spring	3,901	189	277	655	291			
Summer	11,525	167	250	905	1,238	298		
Fall	3,826	306	102	561	85	68		
Open ice	55	815	23	51			5	9
Shanty		202					7	14
Total	19,307	1,679	652	2,172	1,614	366	12	23
1958								
Spring	4,182	14	552	276	247			
Summer	9,656	84	98	70	781	70		
Fall	627	365		146	58			
Sub-total [a]	14,465	463	650	492	1,086	70		

[a] No winter census

[b] Open ice and shanty fishing apparently were not separated by the census clerk.

Table 67. --Average length in inches, by age group (sample size in parentheses) for bluegill and largemouth bass taken from Minnewaukon Lake by netting (1938-41 data of Funk 1942b) or by angling (1946-50, 1951-53, and 1954-58).

Species and year	Age								
	III	IV	V	VI	VII	VIII	IX	X	XI
Bluegill									
1938-41	4.2 (4)	4.7 (19)	4.5 (2)	5.6 (8)	6.2 (12)	7.2 (1)			
1946-50	4.6 (32)	5.6 (160)	6.0 (278)	6.4 (232)	6.8 (66)	6.9 (12)	7.5 (1)		
1951-53	5.0 (6)	5.8 (126)	6.3 (61)	6.9 (27)					
1954-58	5.0 (14)	5.7 (164)	6.1 (540)	6.6 (154)	7.1 (18)	7.2 (1)			
Largemouth bass									
1946-50	10.5 (16)	12.4 (20)	14.6 (13)	15.9 (16)	17.3 (9)	18.6 (19)	19.7 (13)	20.2 (11)	
1951-53	11.8 (19)	13.2 (20)	15.0 (14)	15.7 (9)	16.7 (9)	18.2 (6)	19.7 (2)	21.2 (4)	21.4 (4)
1954-58		13.6 (4)	15.9 (7)	16.3 (12)	18.0 (13)	18.3 (12)	19.6 (6)	21.0 (11)	21.3 (1)

Table 68. --Effect of minimum size limits on the fisheries for largemouth bass and northern pike at Minnewaukon Lake.

Species and test period	Size limit (inches)	Estimated number caught		Mean length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Annual range			
Largemouth bass						
1946-53	10	543	292-885	15.6	960	70
1954-58	16	180	70-366	18.4	547	39
Northern pike						
1946-53	14	29	0- 72	29.9	161	12
1954-58	24	7	0- 12	31.6	48	3

Table 69.--Length-frequency distribution (in numbers) of fish caught by anglers at Minnewaukon Lake.

Inch group	Species and minimum size limit							
	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Northern pike		Largemouth bass	
					14 inches	24 inches	10 inches	16 inches
4								
5	396		87					
6	1407	39	24					
7	32	9		6				
8	1	9		4				
9		1		4				
10				9			15	
11				4			28	
12		1					13	
13				1			22	
14							18	
15							19	
16							25	25
17							6	9
18							23	16
19							16	7
20							16	3
21							5	2
22					1		2	1
23							1	
24					2			
25					1			
26					3			
27					1			
28					1			
29					2	1		
30					2	1		
31					2	1		
32					1	3		
33								
34					2			
35					1	2		
36					2			
37					1			

Table 70.--Fishing regulations, and estimates of pressure and total catch for Otsego Lake, 1952-56 and 1959-64.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1952					Bluegill and pumpkinseed: Apr 1-25; none
Spring	2,162	5,080	4,623	0.91	Other panfish: none; none
Summer	55,824	112,256	228,172	2.03	Pike: Mar 16-Apr 25; 14 inches;
Fall	1,180	2,613	2,611	1.00	* no spearing
Winter	678	2,722	916	0.34	Bass: Jan 1-June 20; 10 inches
Total	59,844	122,671	236,322	1.93	
1953					
Spring	1,182	2,752	1,712	0.62	
Summer	38,417	81,862	104,857	1.28	
Fall	860	1,986	3,002	1.51	
Winter		No fishing			*No fishing: Dec 1-May 15
Total	40,459	86,600	109,571	1.26	
1954					
Spring	2,374	5,002	4,669	0.93	
Summer	41,044	88,341	79,463	0.90	
Fall	1,766	3,752	3,237	0.86	
Winter		No fishing			*No fishing: Dec 1-May 15
Total	45,184	97,095	87,369	0.90	
1955					All panfish: none
Spring	2,515	5,070	2,435	0.48	
Summer	35,106	70,109	67,284	0.96	
Fall	2,160	4,188	3,801	0.91	
Winter	985	4,229	1,283	0.30	
Total	40,766	83,596	74,803	0.90	
1956					
Spring		No estimate			
Summer	18,157	71,307	76,207	1.06	
Fall	1,937	3,680	4,858	1.32	
Winter		No census			
Total	20,094	74,987	81,065	1.08	
1959					*Pike: 20 inches
Spring	2,433	5,287	10,891	2.06	
Summer	35,735	74,357	123,433	1.66	
Fall	995	1,664	333	0.20	
Winter	128	321	931	2.90	
Total	39,291	81,629	135,588	1.66	

(continued, next page)

Table 70.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
1960					
Spring	3,331	5,309	7,763	1.46	
Summer	33,129	62,540	34,771	0.55	
Fall	1,719	3,631	2,137	0.58	
Winter	190	418	237	0.56	
Total	38,369	71,480	44,908	0.62	
1961					
Spring	1,625	3,241	6,063	1.87	
Summer	41,524	59,790	29,752	0.49	
Fall	577	1,283	67	0.05	
Winter	772	2,603	195	0.08	*Pike: 24 inches
Total	44,498	66,917	36,077	0.54	
1962					
Spring	2,377	4,595	1,970	0.42	Bass: Jan 1-June 1
Summer	25,090	45,725	17,217	0.37	
Fall	1,376	2,881	1,202	0.41	
Winter	1,553	4,991	470	0.09	
Total	30,396	58,192	20,859	0.35	
1963					
Spring	3,011	4,832	808	0.16	
Summer	16,279	31,271	18,023	0.57	
Fall	1,546	2,986	3,694	1.23	
Winter		Counts are lost			
Total	20,836	39,089	22,525	0.57	
1964					
Spring	1,490	3,593	501	0.14	
Summer	26,297	46,131	34,589	0.75	
Fall	794	2,507	813	0.32	
Winter	1,034	4,482	486	0.11	Pike: 20 inches
Total	29,615	56,713	36,389	0.64	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 71.--Estimated number of fish caught from Otsego Lake, 1952-56 and 1958-64.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Rock bass	Bull-head	Large-mouth bass	Small-mouth bass	North-ern pike
1952								
Spring	1,466	733	2,086	254				84
Summer	32,583	124,103	67,607	1,871	137	1,323	411	137
Fall	669	536	1,406					
Winter	5	706						205
Total	34,723	126,078	71,099	2,125	137	1,323	411	426
1953								
Spring	222	761	665	32				32
Summer	14,103	54,893	31,929	1,971	105	1,531	325	
Fall		2,796	177	29				
Winter			No fishing					
Total	14,325	58,450	32,771	2,032	105	1,531	325	32
1954								
Spring	297	3,706	395	99				123
Summer	3,528	59,876	10,950	1,573	278	2,138	95	930
Fall	83	2,739	249			83		83
Winter			No fishing					
Total	3,908	66,321	11,594	1,672	278	2,221	95	1,136
1955								
Spring	84	2,015	84					252
Summer	2,537	40,985	14,284	1,689	94	848	659	188
Fall	99	3,503	199					
Winter		1,156						127
Total	2,720	53,659	14,567	1,689	94	848	659	567
1956								
Spring			No census					
Summer	5,772	36,588	29,624	3,648		347	228	
Fall		4,858						
Winter			No fishing					
Total	5,772	41,446	29,624	3,648		347	228	
1959								
Spring	3,373	5,108	2,216	97	97			
Summer	22,761	77,269	18,984	654		2,296	1,308	161
Fall		212	60			61		
Winter		931						
Total	26,134	83,520	21,260	751	97	2,357	1,308	161

(continued, next page)

Table 71.--concluded.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Rock bass	Bull-head	Large-mouth bass	Small-mouth bass	North-ern pike
1960								
Spring	630	2,123	5,010					
Summer	3,668	23,167	6,083	397		1,280	176	
Fall	87	1,671	157	198		24		
Winter		223						14
Total	4,385	27,184	11,250	595		1,304	176	14
1961								
Spring		5,482	175	405				
Summer	2,128	19,838	3,540			3,444	293	490
Fall	27					40		
Winter								195
Total	2,155	25,320	3,715	405		3,484	293	685
1962								
Spring	209	768	732	198				62
Summer	334	14,202	1,413			1,257		
Fall		1,152				50		
Winter		34						435
Total	543	16,156	2,145	198		1,307		497
1963								
Spring		421	129			257		
Summer	238	16,238	1,004	321		104	135	
Fall		3,308	124	30			45	187
Winter				No counts				
Total	238	19,967	1,257	351		361	180	187
1964								
Spring			211		142	106		42
Summer	1,935	22,028	7,084	1,302	390	1,068		782
Fall		780				33		
Winter		94						392
Total	1,935	22,902	7,295	1,302	532	1,207		1,216

Table 72. --Average length in inches, by age group (sample size in parentheses), of northern pike and yellow perch from Otsego Lake.

Species and year	Age							
	I	II	III	IV	V	VI	VII	VIII
Northern pike								
1934 [a]		17.0 (4)	20.4 (6)					
1949 [b]	14.9 (8)	19.7 (61)	23.4 (28)	23.8 (9)	24.4 (8)	25.9 (5)	30.4 (1)	
1952-55 [c]			23.8 (4)	25.7 (6)	28.2 (4)	25.6 (5)	27.5 (1)	29.2 (2)
Yellow perch								
1949 [b]		4.3 (1)	5.7 (35)	6.2 (47)	7.6 (9)	9.4 (2)		
1952-61 [c]	4.2 (1)	5.3 (8)	5.7 (66)	6.4 (33)	7.2 (13)	7.8	7.1	

[a] Winter data by angling (Hubbs 1934)

[b] Summer data by netting (Taube 1950)

[c] Year-around data by angling.

Table 73. --Length-frequency distribution (in numbers) of fish harvested by anglers at Otsego Lake, 1952-56 and 1959-64.

Inch group	Species[a]						
	Northern pike	Largemouth bass	Smallmouth bass	Yellow perch	Bluegill	Pumpkin-seed	Rock bass
3						2	9
4				6	11	9	13
5				64	23	11	8
6		1		55	57	23	11
7				8	12	5	1
8		1		2	10		1
9			1	2	3		
10		1					
11		3	2				
12		6	1				
13		3	1				
14		5					
15		4	1				
16		1					
17		3					
18		2					
19		4					
20							
21	1						
22	1						
23	3						
24	3						
25	3						
26	5						
27	2						
28	1						
29							
30+	3						

[a] Size limits in effect were: northern pike, 14 inches; largemouth and smallmouth bass, 10 inches; and panfish, none.

Table 74.--Fishing regulations, and estimates of pressure and total catch for Pontiac Lake, 1946-62.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1946					Bluegill and pumpkinseed: Mar 1-June 24; 6 inches
Total	21,810	96,780	92,650	0.96	*Other panfish: none; 6 inches
					*Pike: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
1947					
Total	56,920	224,290	320,100	1.43	
1948					
Total	44,740	181,660	209,930	1.16	
1949					
Total	34,390	154,020	117,290	0.76	All panfish: no size limit after Sep 23
1950					
Spring	1,356	5,105	968	0.19	Bluegill and sunfish: Apr 1-June 24
Summer	20,847	96,707	90,073	0.93	
Fall	1,098	5,421	8,495	1.57	
Open ice	2,219	6,470	16,775	2.59	
Shanty		No information			
Sub-total	25,520	113,703	116,311	1.02	
1951					All species: Mar 15 or Apr 1-June 24
Spring		Fishing prohibited			
Summer	27,039	104,776	144,832	1.38	
Fall	1,990	7,343	4,686	0.64	
Open ice	3,186	11,401	13,889	1.22	
Shanty	660	2,940	3,896	1.33	
Total	32,875	126,460	167,303	1.32	
1952					Bluegill and sunfish: April 1-25
Spring	5,927	22,804	19,372	0.85	Other panfish: none
Summer	10,661	43,508	58,322	1.34	Pike: Mar 15-Apr 25
Fall	587	2,225	956	0.43	
Open ice	625	2,040	2,350	1.15	
Shanty		No information			
Total	17,800	70,577	81,000	1.15	
1953					
Spring	1,181	4,452	5,515	1.24	
Summer	20,391	84,111	78,484	0.93	
Fall	1,263	4,670	3,501	0.75	
Open ice	1,995	6,042	8,348	1.38	
Shanty	499	1,577	1,794	1.14	
Total	25,329	100,852	97,642	0.97	

(continued, next page)

Table 74.--continued.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1954					*All species: no closed season
Spring	6,620	25,114	18,082	0.72	
Summer	13,061	44,300	49,297	1.11	
Fall	783	2,601	2,386	0.92	
Open ice	1,615	4,996	5,001	1.00	
Shanty	662	2,581	1,684	0.65	
Total	22,741	79,592	76,450	0.96	
1955					
Spring	4,141	14,161	12,902	0.91	
Summer	8,553	29,035	30,408	1.05	
Fall	3,712	11,350	13,377	1.18	
Open ice	1,629	5,069	7,287	1.44	
Shanty	687	2,502	3,035	1.21	
Total	18,722	62,117	67,009	1.08	
1956					
Spring	11,473	48,005	45,667	0.95	
Summer	12,272	56,063	84,627	1.51	
Fall	2,548	9,481	9,835	1.04	
Open ice	1,632	4,337	21,714	5.01	
Shanty	551	2,077	3,730	1.80	
Total	28,476	119,963	165,573	1.34	
1957					
Spring	5,680	24,486	17,130	0.70	
Summer	9,040	36,464	60,479	1.66	
Fall	1,416	5,607	5,483	0.98	
Open ice	1,209	3,239	5,625	1.74	
Shanty	678	2,770	925	0.33	
Total	18,023	72,566	89,642	1.24	
1958					
Spring	3,282	14,920	13,553	0.91	
Summer	7,965	39,562	84,113	2.13	
Fall	1,049	5,081	6,369	1.25	
Open ice	699	2,117	3,622	1.71	
Shanty	837	3,105	3,900	1.26	
Total	13,832	64,785	111,557	1.72	
1959					*Pike: Mar 1-June 19; 20 inches; no spearing
Spring	4,204	19,722	22,453	1.14	
Summer	6,854	33,454	73,559	2.20	
Fall	1,485	6,661	5,114	0.77	
Open ice	472	1,916	2,935	1.53	
Shanty	929	5,598	10,146	1.81	
Total	13,944	67,351	114,207	1.70	

(continued, next page)

Table 74.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a] Species: closed season; minimum size
1960					
Spring	1,913	10,695	8,954	0.84	
Summer	5,232	27,719	44,815	1.62	
Fall	910	4,080	4,808	1.18	
Open ice	649	2,998	2,840	0.95	
Shanty	909	4,504	10,427	2.32	
Total	9,613	49,996	71,844	1.44	
1961					
Spring		No census			
Summer	4,201	20,934	34,572	1.65	
Fall	758	3,893	3,023	0.78	
Open ice	694	2,799	5,070	1.81	
Shanty	1,166	6,570	3,686	0.56	
Total	6,819	34,196	46,351	1.36	

[a] Only important regulations and their changes are noted. An asterisk (*) denotes special regulations.

Table 75.--Estimated number of fish caught from Pontiac Lake, 1946-62.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Bull-head	Large-mouth bass	North-ern pike	Other species
1946									
Total	43,823	11,396	3,984	30,111	926		1,482	278	650
1947									
Total	262,802	19,846	15,685	15,685	1,280		3,521	320	961
1948									
Total	183,899	6,928	10,706	3,989	840		2,309	840	419
1949									
Total	94,770	5,513	4,692	7,155	938		2,815	586	821
1950									
Spring		106		862					
Summer	67,303	6,422	3,531	7,331	775	1,054	2,819	631	207
Fall	5,105	1,641	802	364			364	219	
Open ice	12,754	1,291	195	2,416	27		40	52	
Shanty				No data					
Sub-total	85,162	9,460	4,528	10,973	802	1,054	3,223	902	207
1951									
Spring				Fishing prohibited					
Summer	110,203	5,677	9,327	14,570	174	87	3,992	797	
Fall	3,136	379	586	241			241	103	
Open ice	7,576	2,529	683	2,896			10	153	10
Shanty	1,374	577	46	1,648	94			111	49
Total	122,289	9,162	10,642	19,355	268	87	4,248	1,164	59
1952									
Spring	10,637	2,092	1,346	4,977	43	43		234	
Summer	46,979	4,024	3,534	1,446	315	47	1,516	461	
Fall	721	50	101	17	17		33	17	
Open ice	1,979	190	75	75				19	9
Shanty				No data					
Total	60,316	6,356	5,056	6,515	375	90	1,549	731	9
1953									
Spring	3,035	291	208	1,940	13		28		
Summer	61,672	5,651	5,510	1,177	94	330	3,532	518	
Fall	525	1,050	350	1,109			292	175	
Open ice	4,944	2,084	367	681				272	
Shanty	1,197	258	30	73				223	13
Total	71,373	9,334	6,465	4,980	107	330	3,852	1,188	13

(continued, next page)

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Bullhead	Largemouth bass	Northern pike	Other species
1954									
Spring	11,171	1,425	1,170	2,848	14	60	1,170	224	
Summer	38,313	3,111	4,205	316	25	389	2,573	365	
Fall	600	1,135	150	284			67	150	
Open ice	3,129	889	439	416			23	81	23
Shanty	1,021	339	18	158				135	13
Total	54,234	6,899	5,982	4,022	39	449	3,833	955	36
1955									
Spring	9,397	484	1,214	1,104		83	454	112	27
Summer	22,343	2,466	2,311	1,052	28	718	1,131	359	
Fall	4,544	2,816	704	4,673		64	512	64	
Open ice	4,869	761	118	1,454	17		17	51	
Shanty	1,442	562	86	893			39	13	
Total	42,595	7,089	4,433	9,176	45	865	2,153	599	27
1956									
Spring	13,102	2,169	10,257	17,518	525		1,722		374
Summer	66,652	5,645	9,047	1,473	186	296	1,329		
Fall	7,958	1,426	451						
Open ice	16,872	380	3,874	528				30	30
Shanty	2,839	151	431	237				65	7
Total	107,423	9,771	24,060	19,756	711	296	3,051	95	411
1957									
Spring	8,532	541	4,012	1,338	127		2,420	33	
Summer	42,196	2,637	12,338	1,458	84	362	1,373	30	
Fall	4,205	492	516	48		25	172		25
Open ice	4,302	1,034	289						
Shanty	551	220		154					
Total	59,786	4,924	17,155	2,998	211	387	3,965	63	25
1958									
Spring	8,518	839	2,162	585	76	127	1,246		
Summer	69,527	707	6,788	3,398		2,910	673	76	34
Fall	5,034	271	890	19		39	116		
Open ice	3,427	139		42			14		
Shanty	3,353	245	43					245	14
Total	89,859	2,201	9,883	4,044	76	3,076	2,049	321	48
1959									
Spring	15,890	231	3,772	258		27	2,223		52
Summer	63,143	1,398	8,489	37		125	287	37	43
Fall	4,050	696	205	81	41			41	
Open ice	1,191	1,424	177	55			11	77	
Shanty	2,119	7,345		530			76	76	
Total	86,393	11,094	12,643	961	41	152	2,597	231	95

(continued, next page)

Table 75.--concluded.

Year and season	Blue-bill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Bull-head	Large-mouth bass	North-ern pike	Other species
1960									
Spring	4,332	310	1,706	2,013		18	575		
Summer	36,888	698	2,633	519		3,346	630	82	19
Fall	4,615			105			88		
Open ice	2,245	200	9	78			16	292	
Shanty	9,296	246		405			117	363	
Total	57,376	1,454	4,348	3,120		3,364	1,426	737	19
1961									
Spring				No census					
Summer	27,403	193	5,966	406	17	95	340	152	
Fall	1,442	40	1,175			26	317	23	
Open ice	3,317	927	362	384			33	47	
Shanty	975	1,621	26	805				259	
Total	33,137	2,781	7,529	1,595	17	121	690	481	

Table 76. --Mean length in inches, by age group (sample size in parentheses), of bluegill, largemouth bass, and northern pike at Pontiac Lake.

Species, year, and gear[a]	Age II	III	IV	V	VI	VII	VIII	IX	X-XII
Bluegill									
1946	3.4	4.5	5.9	6.8	6.6				
N	(46)	(34)	(9)	(7)	(3)				
1947		5.6	6.3	6.9	7.3	7.7	9.5		
A		(4)	(49)	(23)	(17)	(7)	(1)		
1959		5.0	6.3	6.4	6.8	7.5			
A		(1)	(13)	(11)	(19)	(5)			
1975			5.3	5.5	5.9	7.0			
A			(1)	(6)	(6)	(2)			
S			4.4	5.0	5.9				
			(11)	(13)	(1)				
Largemouth bass									
1947-51		11.8	10.9	12.1	14.0	14.7	16.3	17.9	19.0
A		(3)	(13)	(11)	(8)	(6)	(10)	(3)	(3)
1955-59		10.9	11.3	12.8	14.4	15.4	16.9	18.0	19.4
A		(18)	(37)	(19)	(11)	(11)	(8)	(9)	(13)
1975	6.2	8.5	10.5	12.4	15.4	16.1	18.2	19.4	
S	(27)	(31)	(18)	(12)	(2)	(4)	(2)	(3)	
Northern pike									
1946-62	22.0	22.8	26.4	29.2	31.0				
A	(9)	(8)	(9)	(2)	(1)				

[a] Gear types: A = angler hook and line, N = net, S = electric shocker. Note that anglers were catching the faster growing individuals of the younger age groups.

Table 77. --Effects on the fisheries at Pontiac Lake of removing the closed seasons on largemouth bass and northern pike, and increasing the size limit on northern pike.

Species, test period, and closed season	Size limit (inches)	Estimated number caught		Average length (inches)	Average pounds caught
		Average	Annual range		
Largemouth bass					
1946-53 (Jan 1-June 24)	10	2,874	1,482-4,248	14.0	3,736
1954-58 (none)	10	3,010	2,049-3,965	14.6	4,515
1959-60 (none)	10	2,012	1,426-2,597	12.8	1,972
Northern pike					
1946-53 (Jan 1-June 24)	14	751	278-1,188	21.5[a]	1,577
1954-58 (none)	14	407	63- 955	21.5[a]	895
1959-62 (Jan 1-June 24)	20	484	231- 737	24.3	1,491

[a] Measurements for 1946-58 pooled to increase sample size to 13 pike.

Table 78.--Fishing regulations, and estimates of pressure and total catch for Saddle Lake, 1946-52 and 1959-60.

Year and season	Pressure		Total catch	Catch per hour	Regulations [a]
	Trips	Hours			Species: closed season; minimum size
1946					*All panfish: no closed season; no size limit; no creel limit on less than 6 inches
Total	6,920	25,180	55,900	2.22	
1947					Bass: Jan 1-June 24; 10 inches
Total	10,630	37,030	77,090	2.08	
1948					
Total	10,480	33,890	86,860	2.56	
1949					
Total	9,520	26,070	50,500	1.94	
1950					
Total	9,350	27,670	64,540	2.33	
1951					
Spring		Fishing prohibited			All panfish: Apr 1-June 25; none
Summer	6,464	14,641	39,970	2.73	
Fall	1,093	2,397	3,380	1.41	
Winter	-	-	-	-	
Total	7,557	17,038	43,350	2.54	
1952					
Spring	1,121	3,267	10,618	3.25	Bluegill and pumpkinseed: Apr 1-25
Summer	5,294	15,486	19,822	1.28	Other panfish: none
Fall	812	2,332	3,358	1.44	
Winter	-	-	-	-	
Total	7,227	21,085	33,798	1.60	
1959					
Spring	2,040	4,555	2,203	0.48	All panfish: no closed season; none
Summer	2,629	4,799	4,277	0.89	Bass: Jan 1-June 17
Fall	487	861	732	0.85	
Winter	-	-	-	-	
Total	5,156	10,215	7,212	0.71	
1960					
Spring	1,080	2,504	3,872	1.55	
Summer	3,891	8,015	5,027	0.62	
Fall	1,089	1,967	544	0.28	
Winter	-	-	-	-	
Total	6,060	12,486	9,443	0.76	

[a] Only important regulations and their changes are noted. An asterisk (*) denotes special regulations.

Table 79. --Estimated number of fish caught from Saddle Lake, 1946-51 and 1959-60.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	North-ern pike	Rain-bow trout	Other species
1946									
Total	42,260	3,857	6,540	727	tr	391	tr		2,068
1947									
Total	58,126	8,942	6,630	771	77	540	tr		1,850
1948									
Total	72,268	3,996	7,383	782	174	782			1,390
1949									
Total	42,774	1,717	3,636	505		606	tr		1,212
1950									
Total	52,794	3,227	6,454	904	129	774	tr		904
1951									
Spring			Fishing prohibited						
Summer	31,816	2,918	3,118	719		200			919
Fall	2,423	176	57	605		57			57
Total	34,239	3,094	3,175	1,324		257			976
1952									
Spring	8,080	488	1,922						117
Summer	13,182	2,537	1,824	654		694	20		773
Fall	2,529	363	275	20		128			44
Total	23,791	3,388	4,021	674		822	20		934
1959									
Spring	286							1,917	
Summer	1,651		227			449		1,878	77
Fall	732								
Total	2,669		227			449		3,795	77
1960									
Spring	2,513		1,340					19	
Summer	3,890		624			231			282
Fall	424	60				60			
Total	6,827	60	1,964			291		19	282

Table 80. --Length-frequency distribution (in numbers of fish) of bluegills (no size limit) and largemouth bass (10-inch size limit) taken by anglers at Saddle Lake, 1947-50.

Inch group	Bluegill	Largemouth bass
3	52	
4	411	
5	1,163	
6	1,092	
7	172	
8	1	
9		7
10		23
11		18
12		15
13		16
14		19
15		8
16		8
17		4
18+		8

Table 81.--Fishing regulations, and estimates of pressure and total catch for Sugarloaf Lake, 1936-63.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1936					
Winter	22	100	10	0.1	All panfish: May 1-June 24; 6 inches
Summer	1,766	6,200	5,790	0.9	Pike: May 1-June 24; 14 inches
Total	1,788	6,300	5,800	0.8	Bass: Jan 1-June 24; 10 inches
1937	Data not available				
1939					
Winter	697	3,555	3,548	0.99	All panfish: Apr 1-June 24
Summer	1,363	5,043	5,493	1.1	Pike: Apr 1-June 24
Total	2,060	8,598	9,041	1.0	
1946					*All panfish: no closed season; 6 inches
Total	6,110	20,150	17,090	0.85	*Pike: Mar 15-May 15; 14 inches
1947					
Total	4,450	14,330	16,050	1.05	
1948					
Total	5,160	13,880	15,220	1.10	
1949					All panfish: no size limit after Sep 23
Total	6,830	23,160	38,270	1.65	
1950					
Spring	1,992	7,123	8,099	1.14	
Summer	3,251	12,293	15,369	1.25	
Fall	885	3,098	8,703	2.81	
Open ice	397	1,630	3,793	2.33	
Shanty	40	175	277	1.58	
Total	6,565	24,319	36,241	1.49	
1951					
Spring	Fishing prohibited				All species: Mar 15 or Apr 1-June 24
Summer	3,530	13,871	12,059	0.87	
Fall	703	2,722	903	0.33	
Open ice	533	2,373	3,363	1.42	
Shanty	68	171	245	1.43	
Total	4,834	19,137	16,570	0.87	
1952					
Spring	998	3,734	3,914	1.05	Bluegill and pumpkinseed: Apr 1-25
Summer	2,661	9,798	7,273	0.74	Pike: Mar 15-Apr 25
Fall	2,096	6,185	4,129	0.67	Other panfish: none
Open ice	444	1,418	1,597	1.13	
Shanty	91	318	309	0.97	
Total	6,290	21,453	17,222	0.80	

(continued, next page)

Table 81.--continued.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1953					
Spring	725	2,631	2,883	1.10	
Summer	3,432	10,220	9,718	0.95	
Fall	1,310	4,165	4,218	1.01	
Open ice	1,125	3,447	3,891	1.13	
Shanty	309	1,693	932	0.55	
Total	6,901	22,156	21,642	0.98	
1954					
Spring	968	3,750	5,582	1.49	*Bass: Jan 1-June 17; 16 inches
Summer	3,379	10,640	9,090	0.85	*Pike: 24 inches
Fall	1,137	2,776	2,365	0.85	
Open ice	758	2,140	3,716	1.74	
Shanty	82	384	567	1.48	
Total	6,324	19,690	21,320	1.08	
1955					
Spring	662	1,893	1,465	1.16	Bluegill and sunfish: none
Summer	2,728	10,466	12,413	1.19	
Fall	543	2,189	3,916	1.79	
Open ice	685	2,041	3,664	1.80	
Shanty	111	467	208	0.44	
Total	4,729	17,056	21,666	1.27	
1956					
Spring	560	1,238	958	0.77	
Summer	3,313	11,187	12,785	1.14	
Fall	1,030	3,061	2,557	0.84	
Open ice	878	2,556	6,379	2.50	
Shanty	198	938	817	0.87	
Total	5,979	18,980	23,496	1.24	
1957					
Spring	871	2,879	2,888	1.00	
Summer	3,091	10,315	8,714	0.84	
Fall	819	1,921	1,680	0.87	
Open ice	867	2,916	4,063	1.39	
Shanty	252	980	316	0.32	
Total	5,900	19,011	17,661	0.93	
1958					
Spring	1,038	3,469	4,492	1.30	
Summer	3,839	11,987	5,899	0.49	
Fall	819	2,695	1,456	0.54	
Open ice	710	2,740	5,499	2.01	
Shanty	451	2,487	1,916	0.77	
Total	6,857	23,378	19,262	0.82	

(continued, next page)

Table 81--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1959					
Spring	829	3,474	4,525	1.30	*Pike: 20 inches
Summer	2,894	12,600	10,925	0.87	*Bass: 14 inches
Fall	806	2,652	4,072	1.54	
Open ice	563	1,765	5,499	1.32	
Shanty	152	867	707	0.82	
Total	5,244	21,358	25,728	1.20	
1960					
Spring	990	4,127	4,749	1.15	
Summer	3,091	10,923	8,480	0.78	
Fall	1,018	2,835	2,743	0.97	
Open ice	534	1,673	1,331	0.80	
Shanty	103	476	103	0.22	
Total	5,736	20,034	17,406	0.87	
1961					
Spring	645	2,764	3,023	1.09	
Summer	3,745	13,121	8,391	0.64	
Fall	864	2,659	3,611	1.36	
Open ice	727	2,468	4,258	1.72	
Shanty	173	743	1,013	1.36	
Total	6,154	21,754	20,296	0.93	
1962					
Spring	919	2,982	4,397	1.47	Bass: Jan 1-June 1
Summer	3,115	11,408	7,454	0.65	
Fall	3,041	8,786	2,665	0.30	
Open ice	452	1,181	1,639	1.39	
Shanty	441	1,903	1,316	0.69	
Total	7,968	26,260	17,471	0.66	
1963					
Spring	733	2,582	3,064	1.19	
Summer	3,214	12,089	16,514	1.37	
Fall	1,128	3,453	343	0.10	
Sub-total	5,075	18,124	16,921	0.93	

[a] Only the important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 82.--Estimated number of fish caught from Sugarloaf Lake, 1936-63.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	North-ern pike	Bull-head	Other species
1936									
Winter	2			8					
Summer	3,031	681	745	129	192	186	224	554	46
Total	3,033	681	745	137	192	186	224	554	46
1937	Data not available								
1939									
Winter	3,079	340	12	34	12		59	3	8
Summer	3,152	732	558	119	134	223	169	123	269
Total	6,231	1,072	570	153	146	223	228	126	277
1946									
Total	7,964	6,340	564	598	667	308	291	204	154
1947									
Total	8,362	4,109	1,525	385	819	337	144	225	144
1948									
Total	7,930	4,307	807	989	289	426	167	184	121
1949									
Total	18,216	14,198	2,832	344	765	1,072	191	423	229
1950									
Spring	5,724	1,090	804	29	151		29	68	204
Summer	7,195	3,599	1,452		708	1,598	18	183	616
Fall	840	7,475	90	150	90	39		19	
Open ice	1,646	1,757	123	64	107		12		84
Shanty	100	151		2	9		10	2	3
Total	15,505	14,072	2,469	245	1,065	1,637	69	272	907
1951									
Spring			Fishing prohibited						
Summer	6,442	2,532	1,030	39	482	983	83	159	309
Fall	13	877				13			
Open ice	1,781	1,142	139	171	77		9		
Shanty	200	30					14		1
Total	8,436	4,581	1,169	210	559	996	106	159	310

(continued, next page)

Table 82. --continued.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	North-ern pike	Bull-head	Other species
1952									
Spring	2,520	811	572	35	146		6	105	111
Summer	3,298	2,157	465	204	183	655	29	14	120
Fall	1,661	1,822	202	121	81	121			121
Open ice	746	731	15	25	15		55		10
Shanty	155	44					107		3
Total	8,380	5,565	1,254	385	425	776	197	119	365
1953									
Spring	1,460	848	274	59	124		13	13	92
Summer	4,171	3,049	557	65	467	836	57	65	451
Fall	291	3,637	92		76	76		15	31
Open ice	2,301	1,175	136	186	6		81		6
Shanty	318	462			3		146		3
Total	8,541	9,171	1,059	310	676	912	297	93	583
1954									
Spring	3,196	924	558	76	462			58	308
Summer	2,718	4,018	755	45	649	15	75	121	694
Fall		2,249	58						58
Open ice	544	3,167	5						
Shanty		558					2		7
Total	6,458	10,916	1,376	121	1,111	15	77	179	1,067
1955									
Spring	1,034	138	122	8	114		8		41
Summer	6,206	1,894	2,007	99	961	170	57	127	892
Fall	1,636	1,967	147		74	37		18	37
Open ice	1,319	2,269	22	11	16				27
Shanty	159			39			5		5
Total	10,354	6,268	2,298	157	1,165	207	70	145	1,002
1956									
Spring	523	261			174				
Summer	6,495	3,299	1,330	57	863	73	28	28	612
Fall	568	1,813	32	32	48				65
Open ice	1,904	4,121	33	244			51		26
Shanty	267	483		23			38		6
Total	9,757	9,977	1,395	356	1,085	73	117	28	709

(continued, next page)

Table 82.--continued.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Northern pike	Bullhead	Other species
1957									
Spring	1,790	170	405		366		13		144
Summer	5,527	767	1,342	30	413	59	30	207	339
Fall	368	962	76		76			15	183
Open ice	2,975	828	100		10		10		140
Shanty	154	101			7		32		22
Total	10,814	2,828	1,923	30	872	59	85	222	828
1958									
Spring	2,033	888	1,008	17	205			17	324
Summer	3,656	861	504	17	146	81	65	49	520
Fall	463	840	51		34			17	51
Open ice	2,141	3,126	107	59	2		2		62
Shanty	623	1,164		14			109		6
Total	8,916	6,879	1,670	107	387	81	176	83	963
1959									
Spring	2,317	937	751	19	380			74	47
Summer	6,534	1,629	918	110	876	347	27	69	402
Fall	533	2,994	82	27	259			27	150
Open ice	1,099	1,188	8	27	8		8		
Shanty	294	350	11	6			40		6
Total	10,777	7,098	1,770	189	1,523	347	75	170	605
1960									
Spring	2,471	671	953	102	450			51	51
Summer	4,471	1,179	1,191	135	784	327	19	51	315
Fall	638	1,775	81	29	51	34			135
Open ice	824	404	76	8			7		
Shanty	80						23		
Total	8,484	4,029	2,301	274	1,285	361	49	102	501
1961									
Spring	1,732	797	383	14	43			31	23
Summer	3,111	2,440	1,191	104	921	151	151	48	274
Fall	775	2,560	166		15	26		34	35
Open ice	1,807	2,129	242	40			40		
Shanty	268	706		4			35		
Total	7,693	8,632	1,982	162	979	177	226	113	332

(continued, next page)

Table 82. --concluded.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Northern pike	Bullhead	Other species
1962									
Spring	2,104	980	809		459			45	
Summer	3,349	1,054	1,746	86	749	183	110	31	146
Fall	2,343								322
Open ice	617	950	67				5		
Shanty	205	954	7				96		8
Total	8,618	3,938	2,629	86	1,208	183	211	76	476
1963									
Spring	1,642	604	624	61	118				15
Summer	4,535	7,125	3,010	244	680	338	166	126	290
Fall	105	212	20		6				
Sub-total	6,282	7,941	3,654	305	804	338	166	126	305

Table 83.--Length-frequency distribution (in numbers) of fish harvested by anglers at Sugarloaf Lake in years of no size limits (panfish) or experimental size limits (northern pike and largemouth bass).

Inch group	Species and minimum size limit									
	Blue-gill	Yellow perch	Pumpkin-seed	Rock bass	Northern pike (inches)			Largemouth bass (inches)		
					14	20	24	10	14	16
5	144		74							
6	485	205	62	22						
7	299	125	29	18						
8	135	46	8	9						
9	24	26	3	3						
10		5		1				34		
11		4						25		
12								21		
13								18	2	
14					2			18	2	
15					1			12	4	4
16					2			5	7	16
17								8	2	5
18					4			8	1	1
19					2	1		11	2	1
20					2	1		1	2	4
21					1	2		1	2	1
22					4	4			1	
23					4	6				
24					2	12	11			
25					3	11	14			
26						9	10			
27					1	5	9			
28					1	4	2			
29						3	1			
30					1		3			
31						2	2			
32					1	1	2			
33										
34						2				

Table 84. -- Effect of size limits on the fisheries for largemouth bass and northern pike at Sugarloaf Lake.

Species, and test period	Size limit (inches)	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
		Average	Annual range			
Largemouth bass						
1946-53	10	808	308-1,637	13.5	925	47
1954-58	16	87	15- 207	17.2	216	11
1959-63	14	281	177- 361	17.0	675	31
Northern pike						
1946-53	14	183	69- 297	22.6	448	23
1954-58	24	105	70- 176	26.8	435	22
1959-63	20	145	49- 226	25.6	523	24

Table 85. --Estimates of fishing pressure and total catch for Townline Lake in 1959 and 1962.

Year and date	Fishing pressure		Total catch	Catch per hour
	Trips	Hours		
1959				
June 9-Sep 7	5,080	8,167	7,840	0.96
1962				
May 15-Sep 26	4,722	9,126	6,521	0.71

Table 86. --Estimated number of fish caught from Townline Lake in 1959 and 1962. (A special regulation prohibited the harvest of northern pike.)

Year and date	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Large-mouth bass	Bull-head	Other species
1959								
June 9-Sep 7	7,045	403	[a]	98	54	33	44	163 [a]
1962								
May 15-Sep 26	5,098	169	720	119		218	159	37

[a] Other species include pumpkinseed, green sunfish, and bowfin.

Table 87. --Estimates of fishing pressure and total catch (with 95% confidence limits for 1962) for Turk Lake in 1958, 1959, and 1962.

Year and date	Pressure		Total catch	Catch per hour
	Trips	Hours		
1958				
June 8-Sep 14	4,575	6,700	4,973	0.74
1959				
June 8-Sep 10	4,947	6,548	7,619	1.16
1962				
May 15-Sep 26	4,241 ±689	7,038 ±1,055	4,829 ±4,799	0.69

Table 88. --Estimated number of fish caught (with 95% confidence limits for 1962) at Turk Lake in 1958, 1959, and 1962. (A special regulation prohibited the harvest of northern pike.)

Year and date	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Largemouth bass	Bullhead	Bowfin	Other species
1958									
June 8-Sep 14	1,777	2,290	13			193	201	52	447
1959									
June 8-Sep 10	4,378	1,644	113		59	768	164	59	434
1962									
May 15-Sep 26	2,930 ±3,410	611 ±1,393	741 ±1,418	95 ±304	11 ±74	271 ±517	76 ±332		93 ±426

Table 89.--Fishing regulations, and estimates of pressure and total catch for Whitmore Lake, 1946-61.

Year and season	Pressure		Total catch	Catch per hour	Regulations[a]
	Trips	Hours			Species: closed season; minimum size
1946					Bluegills and pumpkinseed: Mar 1-June 24; 6 inches
Total	19,280	68,300	43,630	0.64	Other panfish: none; 6 inches
					*Pike: Mar 16-May 15; 14 inches
					Bass: Jan 1-June 24; 10 inches
1947					
Total	25,430	77,230	69,300	0.90	
1948					
Total	28,720	101,340	84,760	0.84	
1949					All panfish: no size limit after Sep 23
Total	27,430	95,520	96,250	1.14	
1950					
Spring	457	1,558	1,449	0.93	Bluegill and pumpkinseed: Apr 1-June 24
Summer	4,063	14,311	11,364	0.79	
Fall	1,315	4,471	7,316	1.64	
Open ice	387	1,360	1,140	0.84	
Shanty		Data incomplete			
Sub-total	6,222	21,700	21,269	0.98	
1951					
Spring		Fishing prohibited			All species: Mar 15 or Apr 1-June 24
Summer	7,861	39,738	38,009	0.95	
Fall	1,146	3,831	3,582	0.93	
Open ice	570	1,707	1,883	1.10	
Shanty	434	1,904	775	0.41	
Total	10,011	47,180	44,249	0.94	
1952					
Spring	1,241	4,170	3,467	0.83	Bluegill and pumpkinseed: Apr 1-25
Summer	5,170	21,265	19,755	0.93	Other panfish: none
Fall	837	3,261	2,305	0.70	Pike: Mar 15-Apr 25
Open ice	161	463	611	1.32	
Shanty	542	1,663	185	0.11	
Total	7,951	30,822	26,323	0.85	
1953					
Spring	2,605	7,810	7,896	1.01	
Summer	12,037	44,142	42,518	0.96	
Fall	1,641	6,214	4,884	0.78	
Open ice	473	1,455	2,244	1.54	
Shanty	315	1,009	632	0.63	
Total	17,071	60,630	58,174	0.96	

(continued, next page)

Table 89.--continued.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1954					
Spring	4,718	14,297	16,199	1.13	*All species: no closed season
Summer	11,858	36,022	44,394	1.23	
Fall	1,079	3,314	3,316	1.00	
Open ice	835	2,718	2,792	1.03	
Shanty	696	2,749	1,565	0.57	
Total	19,186	59,100	68,266	1.16	
1955					
Spring	4,134	13,601	12,854	0.95	
Summer	5,719	19,375	21,524	1.11	
Fall	2,065	6,850	7,387	1.07	
Open ice	892	3,519	5,185	1.47	
Shanty	1,522	5,846	3,748	0.64	
Total	14,332	49,191	50,698	1.03	
1956					
Spring	4,623	13,805	16,966	1.22	
Summer	9,565	38,325	41,747	1.08	
Fall	1,929	7,029	6,529	0.92	
Open ice	1,144	2,173	3,574	1.64	
Shanty	483	1,492	1,936	1.30	
Total	17,744	62,824	76,752	1.13	
1957					
Spring	6,122	23,272	19,346	0.83	
Summer	10,959	43,396	92,355	2.12	
Fall	3,239	12,130	18,334	1.51	
Open ice	676	2,044	4,531	2.22	
Shanty	135	629	511	0.81	
Total	21,131	81,471	135,077	1.66	
1958					
Spring	4,568	20,848	19,674	0.94	
Summer	9,843	39,344	80,091	2.04	
Fall	2,048	8,095	8,226	1.02	
Open ice	570	1,504	2,939	1.95	
Shanty	714	2,512	3,244	1.29	
Total	17,743	72,303	114,174	1.58	
1959					
Spring	4,124	19,597	20,926	1.07	*Pike: Mar 1-June 19; 20 inches;
Summer	6,447	27,523	53,665	1.95	no spearing
Fall	851	3,594	3,699	1.03	
Open ice	440	1,030	1,340	1.30	
Shanty	520	1,930	1,188	0.62	
Total	12,382	53,674	80,818	1.51	

(continued, next page)

Table 89.--concluded.

Year and season	Pressure: Trips	Pressure: Hours	Total catch	Catch per hour	Regulations[a]: Species: closed season; minimum size
1960					
Spring	2,470	10,996	9,525	0.87	
Summer	5,391	23,281	50,104	2.15	
Fall	1,261	4,177	3,758	0.90	
Open ice	429	1,315	3,988	3.03	
Shanty	473	2,621	3,690	1.41	
Total	10,024	42,390	71,065	1.68	
1961					
Spring		No census			
Summer	4,225	16,090	28,217	1.75	
Fall	1,146	4,017	1,775	0.44	
Open ice	344	1,264	2,873	2.27	
Shanty	608	2,736	5,189	1.90	
Sub-total	6,322	24,107	38,054	1.58	

[a] Only important regulations and their changes noted. An asterisk (*) denotes special regulations.

Table 90.--Estimated number of fish caught from Whitmore Lake, 1946-61.

Year and season	Blue-gill	Yellow perch	Pump-kin-seed	Black crappie	Rock bass	Bull-head	Large-mouth bass	Small-mouth bass	North-ern pike
1946									
Total	22,251	10,471	2,356	2,574	393		1,832	175	1,963
1947									
Total	49,134	6,791	5,475	1,802	1,109		1,940		1,178
1948									
Total	59,925	8,815	5,933	763	2,203		3,306	85	1,610
1949									
Total	54,189	17,325	13,090	6,064	962		2,599	192	866
1950									
Spring	125	725	15	413		164			7
Summer	7,047	2,530	1,084	100	100	141	241		121
Fall	290	696		6,039			58		233
Open ice	987	66	44	44					
Shanty				Data incomplete					
Sub-total	8,449	4,017	1,143	6,596	100	305	299		361+
1951									
Spring				Fishing prohibited					
Summer	21,938	8,829	3,653	1,152	350	741	977	152	194
Fall	2,155	829	166	133		133	100		66
Open ice	857	717	85	209					15
Shanty	48	267		57					388
Total	24,998	10,642	3,904	1,551	350	874	1,077	152	663
1952									
Spring	2,018	893	255	139	70	35			57
Summer	12,300	4,123	1,385	265	429	99	709	49	281
Fall	1,166	778	97	125	28		69		42
Open ice	528	61	11	11					
Shanty	19								161
Total	16,031	5,855	1,748	540	527	134	778	49	541
1953									
Spring	6,086	820	454	174	96	212			48
Summer	31,285	3,355	3,907	408	493	196	2,492	123	259
Fall	2,905	799	399	345		55	345		36
Open ice	1,346	645	90	90					73
Shanty	381	157							89
Total	42,003	5,776	4,850	1,017	589	463	2,837	123	505

(continued, next page)

Table 90.--continued.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Bullhead	Largemouth bass	Smallmouth bass	Northern pike
1954									
Spring	10,529	2,255	1,920	381	15	167	839		31
Summer	35,506	3,738	2,815	124	195	657	1,088	107	142
Fall	1,940	460	419	340	13		131		13
Open ice	1,454	969	217	109			14		29
Shanty	1,085	203	69	152	6				51
Total	50,514	7,625	5,440	1,106	229	824	2,072	107	266
1955									
Spring	10,257	509	1,017	273	36	345	308	73	36
Summer	15,820	1,466	1,623	1,255	280	174	837	17	52
Fall	5,425	459	678	146	24	267	364		24
Open ice	2,799	2,149	13	187			37		
Shanty	2,775	516	12	361	24				60
Total	37,076	5,099	3,343	2,222	364	786	1,546	90	172
1956									
Spring	13,257	480	1,347			1,307	548		
Summer	28,718	2,217	7,715		384	943	1,641		21
Fall	5,427	200	118		50	283	451		
Open ice	464	2,986	124						
Shanty	1,402	355	44		5		5		109
Total	49,268	6,238	9,348		439	2,533	2,645		130
1957									
Spring	9,722	1,946	5,590	30	236	516	1,251	31	
Summer	69,663	7,526	8,469	28	1,413	3,094	1,949	185	28
Fall	12,944	3,014	1,218		328	328	425	77	
Open ice	2,504	2,009	12				6		
Shanty	264	235	6				4		
Total	95,097	14,730	15,295	58	1,977	3,938	3,635	293	28
1958									
Spring	15,871	651	1,471		332	757	557	17	18
Summer	65,638	1,388	5,107			6,264	1,683		11
Fall	6,428	304	830			373	291		
Open ice	1,375	1,553				3	3		5
Shanty	1,435	1,270		260			20		259
Total	90,747	5,166	7,408	260	332	7,397	2,534	17	293
1959									
Spring	15,854	955	1,549	1,096	126	351	849	146	
Summer	47,198	909	3,123		74	1,379	859	111	12
Fall	3,256		23				380	22	18
Open ice	1,049	273		3			15		
Shanty	862	283							43
Total	68,219	2,420	4,695	1,099	200	1,730	2,103	279	73

(continued, next page)

Table 90.--concluded.

Year and season	Bluegill	Yellow perch	Pumpkinseed	Black crappie	Rock bass	Bullhead	Largemouth bass	Smallmouth bass	Northern pike
1960									
Spring	7,706	354	471			734	260		
Summer	43,651	699	699		11	4,112	902		30
Fall	3,212	130			11	16	359	22	8
Open ice	926	3,040	2			2	18		
Shanty	929	2,411	138						212
Total	56,424	6,634	1,310		22	4,864	1,539	22	250
1961									
Spring				no census					
Summer	24,467	327	1,329			1,459	564	22	49
Fall	1,219				16	26	437	17	60
Open ice	230	2,608	21				3		11
Shanty	3,908	1,191					6		84
Partial total	29,824	4,126	1,350		16	1,485	1,010	39	204

Table 91.--Length-frequency distribution (percent) of fish caught by anglers at Whitmore Lake, 1949-61.

Inch group	Species and year [a]						
	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Largemouth bass 1946-53	Largemouth bass 1954-58	Northern pike
5	51		46				
6	104	23	6				
7	45	17	1	59			
8	11	2		87			
9	1	1		36			
10				8	8	30	
11				8	13	20	
12					11	23	
13					6	14	
14					3	11	
15					5	3	
16					6	3	3
17					1	8	
18					2	1	
19					2		5
20						2	3
21							3
22							5
23							2
24							1
25							1
26							1
27							1
28+							6

[a] Minimum size limits in effect were: panfish, none; largemouth bass, 10 inches; and northern pike, 14 inches.

Table 92.--Average length in inches, by age group (sample size in parentheses), for fish taken in trap nets at Whitmore Lake. [a]

Species and year	Age								
	II	III	IV	V	VI	VII	VIII	IX	X+
Bluegill									
1940	3.6 (16)	5.3 (27)	6.5 (7)	6.9 (2)	8.3 (1)	7.8 (2)			
1953		4.8 (10)	6.3 (1698)	7.6 (48)	8.4 (45)	8.6 (28)	8.8 (28)	9.1 (18)	9.2 (2)
1958		4.7 (49)	5.2 (148)	6.2 (104)	6.8 (74)	7.5 (16)	7.6 (1)		
Largemouth bass									
1953	6.6 (2)	9.5 (167)	11.7 (469)	13.1 (285)	14.4 (139)	15.4 (112)	16.5 (58)	17.9 (34)	18.8 (27)
1958		9.1 (14)	10.4 (31)	13.6 (22)	14.9 (10)	16.4 (4)	17.6 (8)	18.2 (4)	19.0 (2)
Pumpkinseed									
1953			5.3 (99)	6.9 (15)	7.4 (32)	8.0 (2)			
1958		3.9 (1)	4.8 (15)	5.5 (16)	6.3 (17)	6.9 (7)	7.8 (2)		
Northern pike									
1953	21.6 (19)	24.2 (45)	26.4 (4)	26.4 (3)	26.7 (2)	24.8 (1)			

[a] Data for 1940 from Brown (1941); data for 1953 from Cooper and Schafer (1954).

Table 93. -- Effects on the fisheries at Whitmore Lake of removing the closed seasons on largemouth bass, smallmouth bass, and northern pike, and increasing the size limit on northern pike.

Species, test period, and regulation	Estimated number caught		Average length (inches)	Pounds per year	Pounds per 1000 hours
	Average	Annual range			
Largemouth bass					
1946-53 (closed season)	1,834	299-3,306	13.0	1,834	29
1954-60 (open season)	2,460	1,539-3,787	12.7	2,330	39
Smallmouth bass					
1946-53 (closed season)	97	0- 192	12.9	103	2
1954-60 (open season)	85	0- 314	13.7	110	2
Northern pike					
1946-53 (closed season, 14 inches)	961	361-1,963	22.5	2,254	36
1954-58 (open season, 14 inches)	158	28- 196	26.8	567	9
1959-61 (closed season, 20 inches)[a]	176	73- 250	--	--	--

[a] A long closed season of March 1 to third Saturday in June; 20-inch size limit; no spearing.

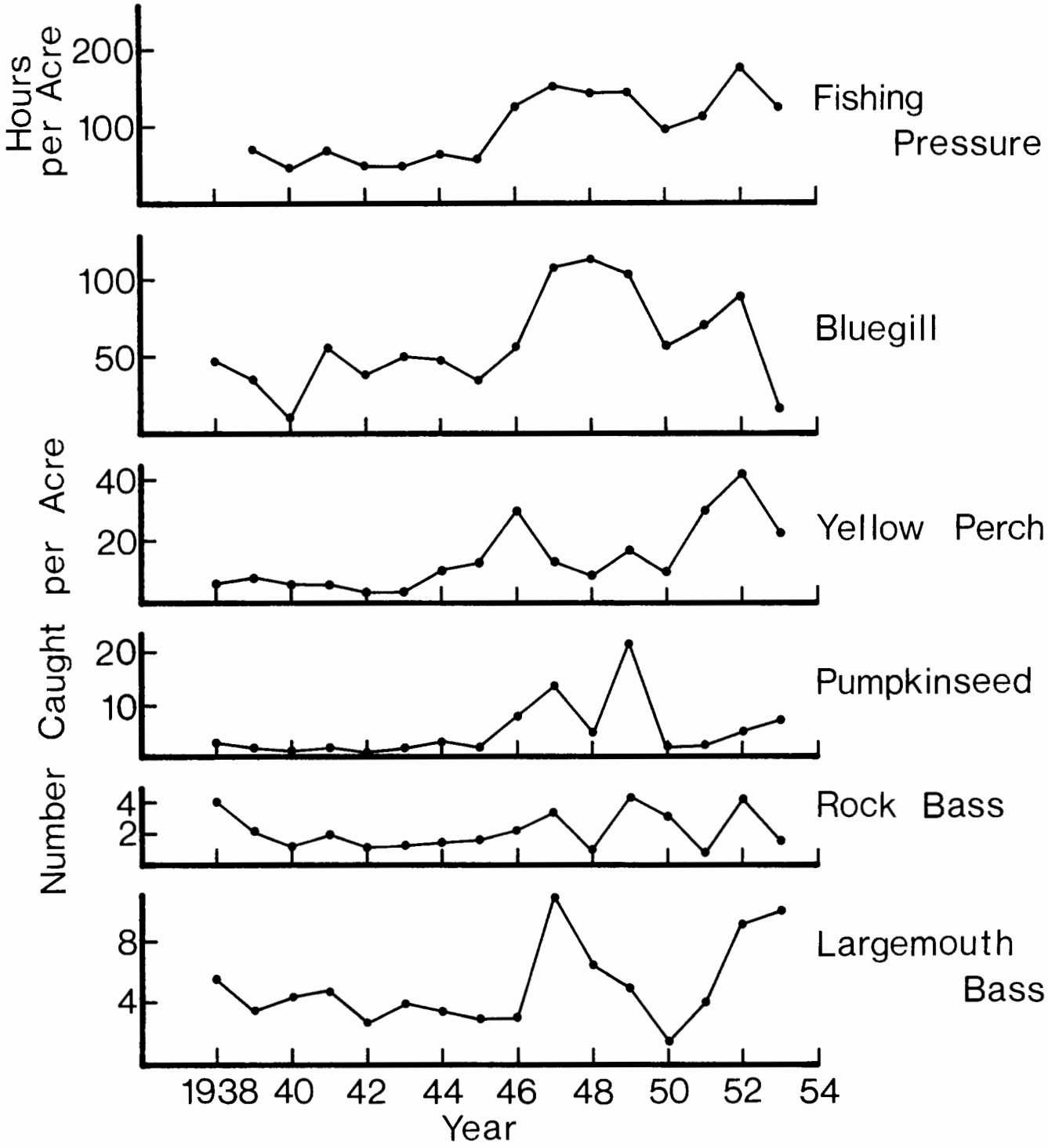

Figure 1.--Estimates of fishing pressure and catch for Bear Lake, Hillsdale County, 1938-53.

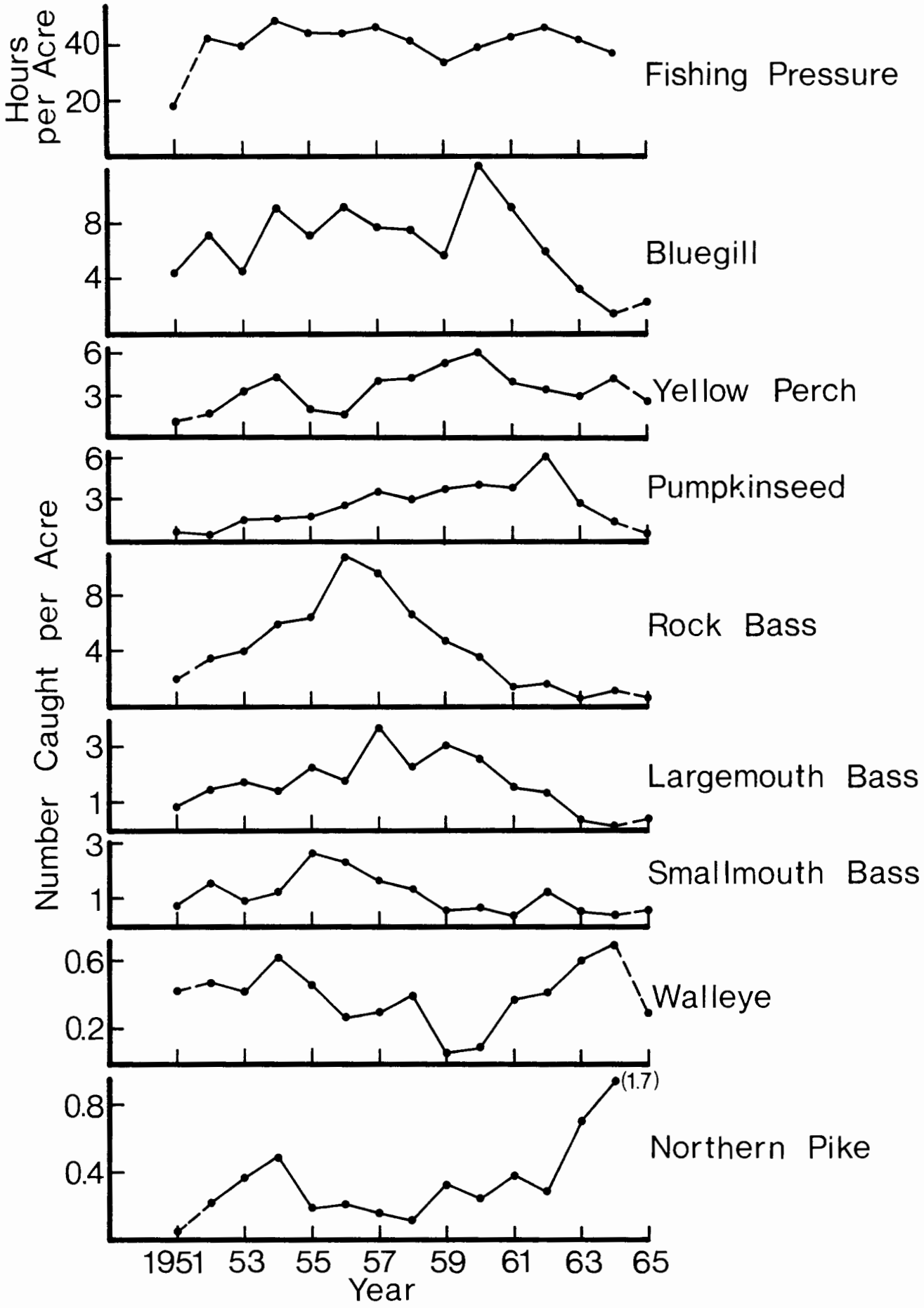

Figure 2.--Estimates of fishing pressure and catch for Bear Lake, Manistee County, 1951-65. Dashed lines indicate slightly incomplete data for 1951 and 1965.

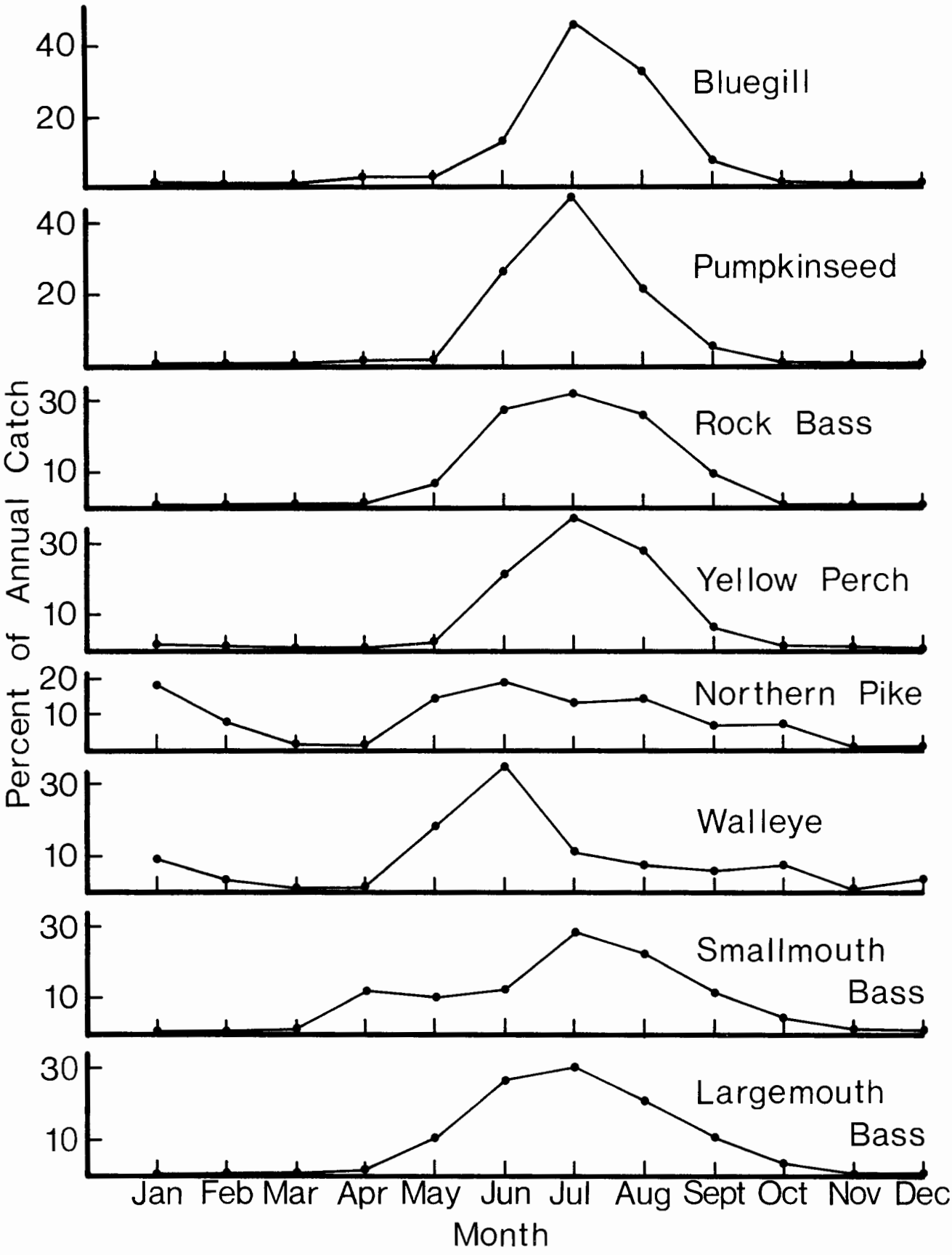

Figure 3.--Average monthly catch (expressed as a percent of the annual catch) from Bear Lake, Manistee County, during years (1954-58) of no closed season.

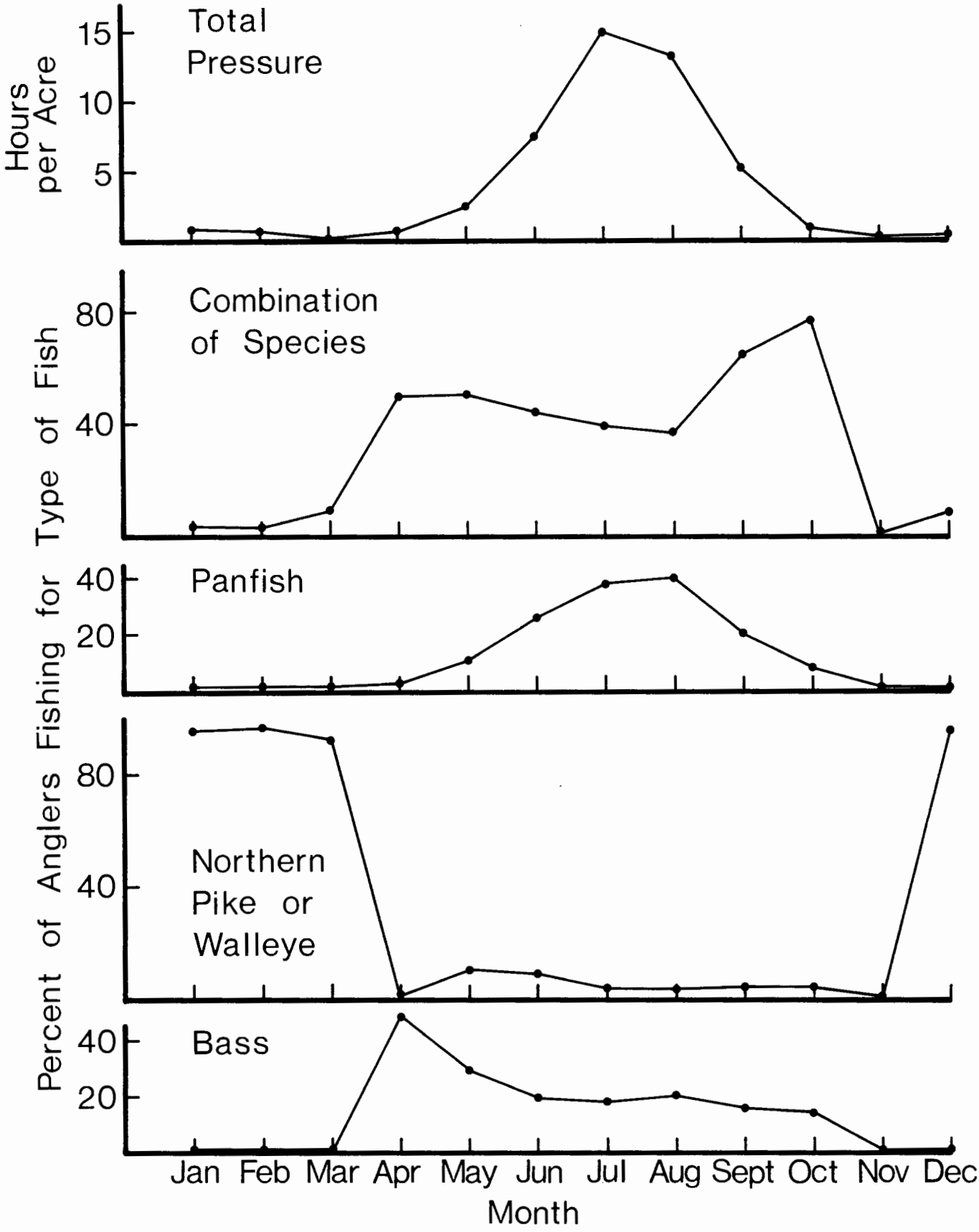

Figure 4. --Monthly averages for fishing pressure and percentage of anglers fishing for bass, pike or walleye, panfish, or a combination of species, during years (1954-58) of no closed season at Bear Lake, Manistee County.

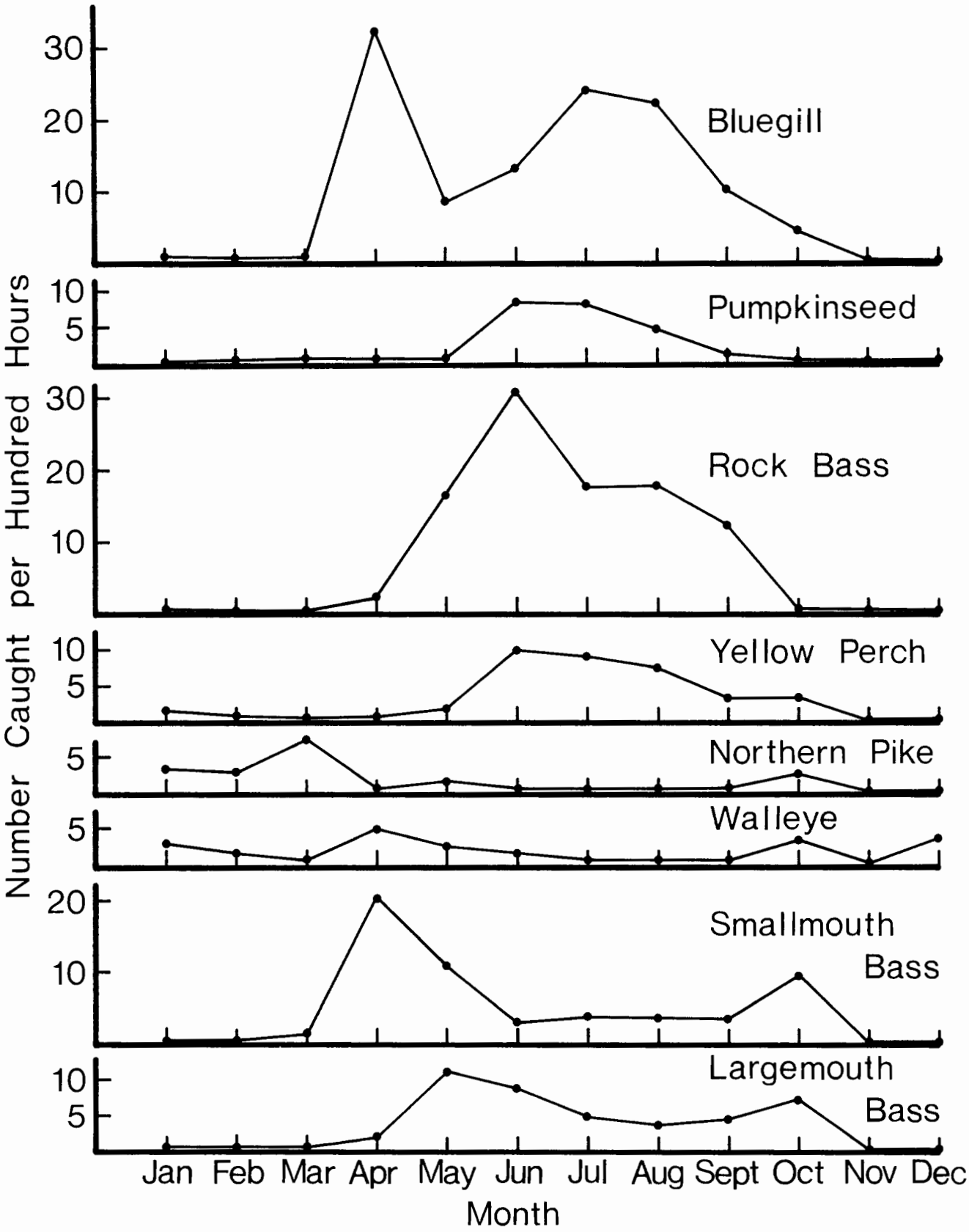

Figure 5. --Average monthly catch rate (number of fish per 100 hours of fishing) for eight species of fish at Bear Lake, Manistee County, during years (1954-58) of no closed season.

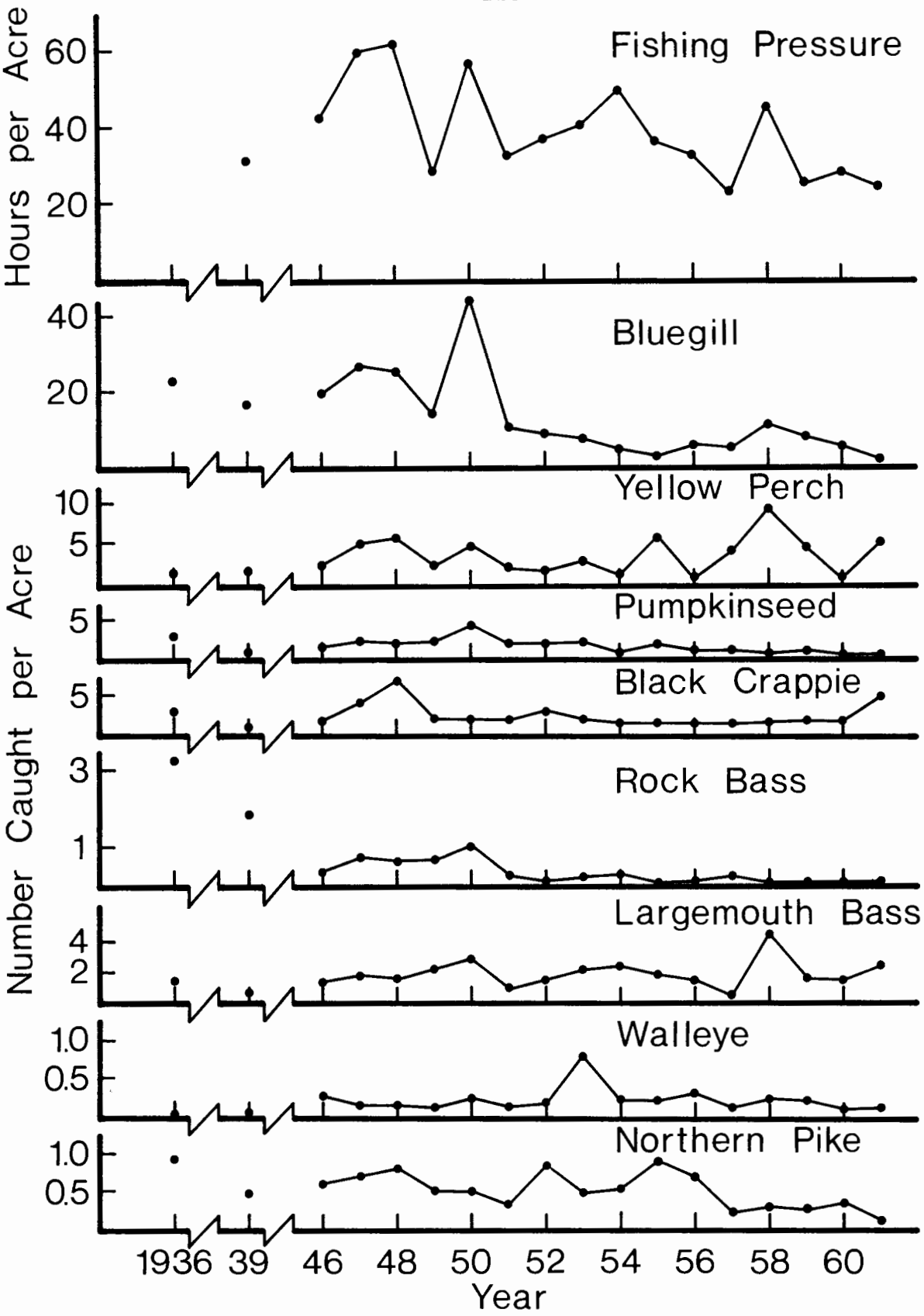

Figure 6. --Estimates of fishing pressure and catch at Big Portage Lake in 1936, 1939, and 1946-61.

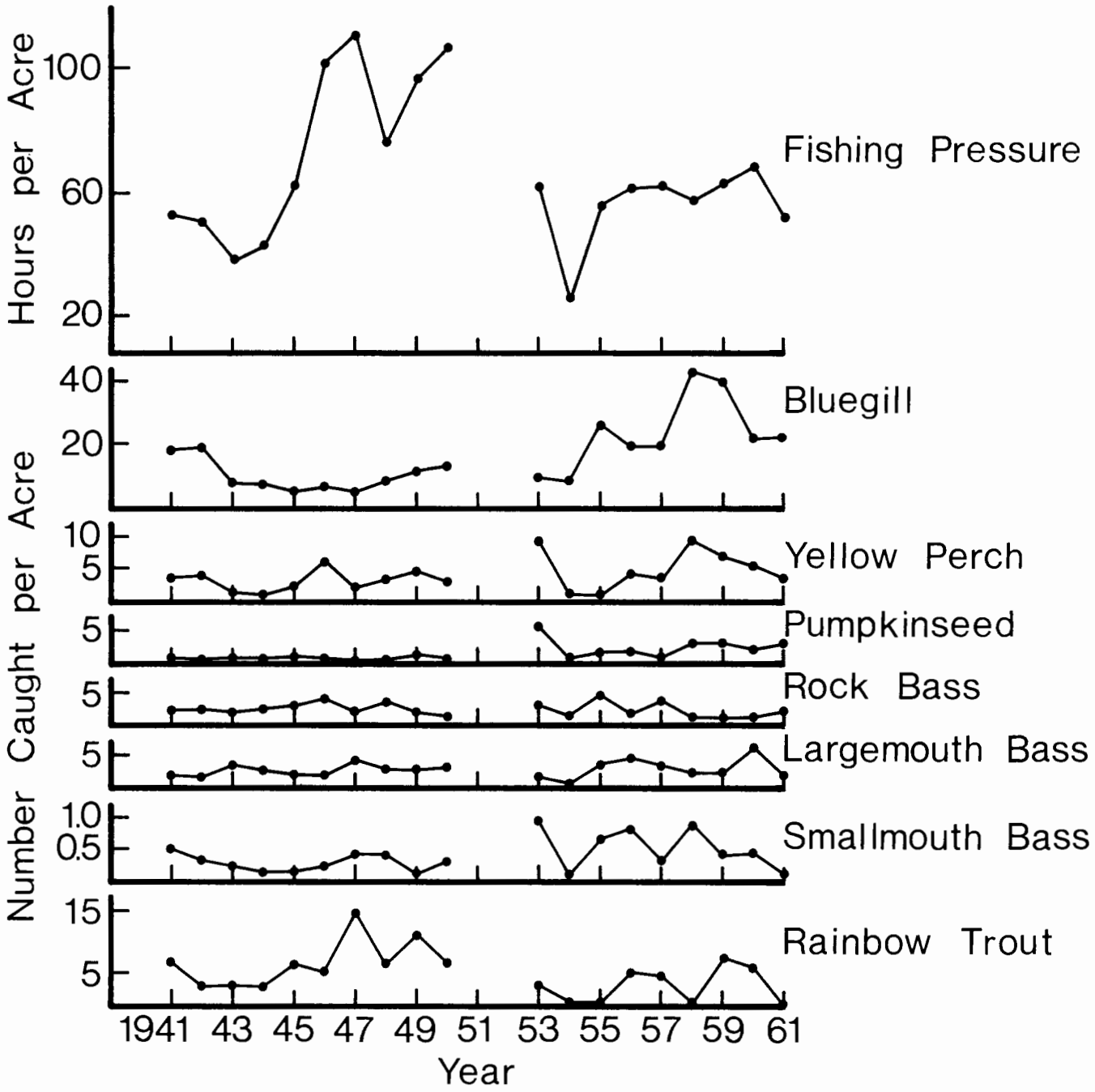

Figure 7.--Estimates of fishing pressure and catch for Birch Lake, 1941-50 and 1953-61.

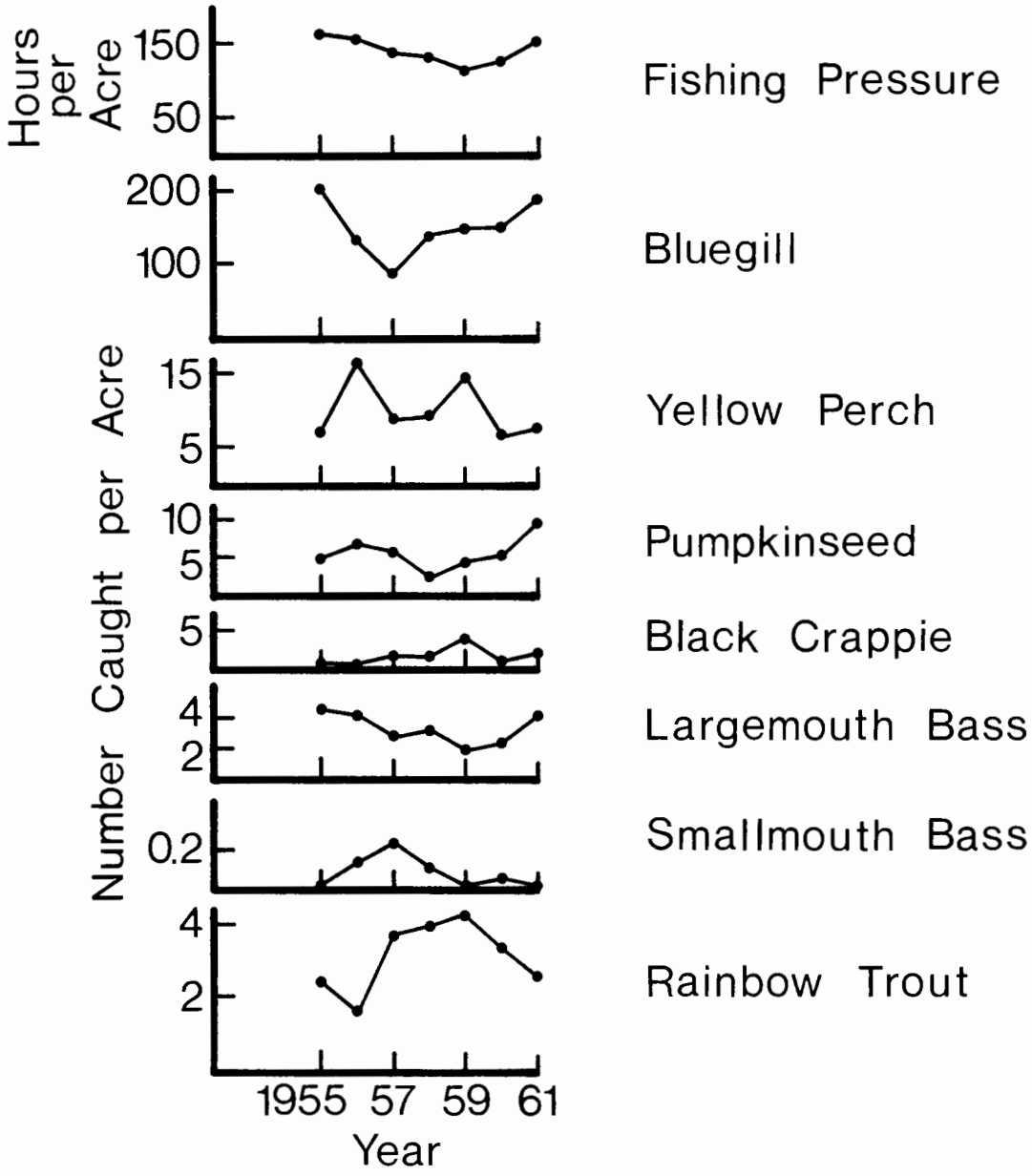

Figure 8.--Estimates of fishing pressure and catch for Corey Lake, 1955-61.

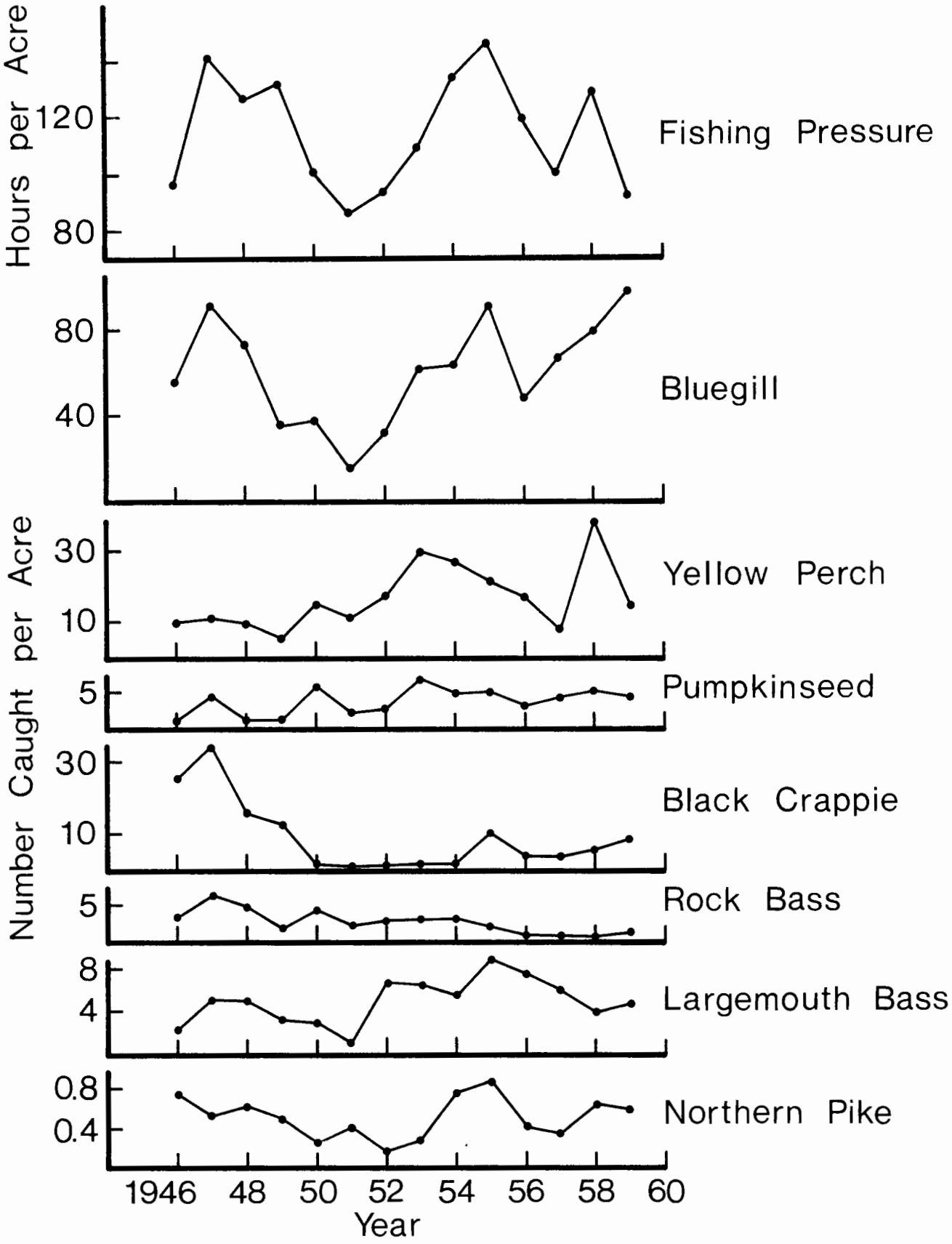

Figure 9. --Estimates of fishing pressure and catch for Duck Lake, 1946-59.

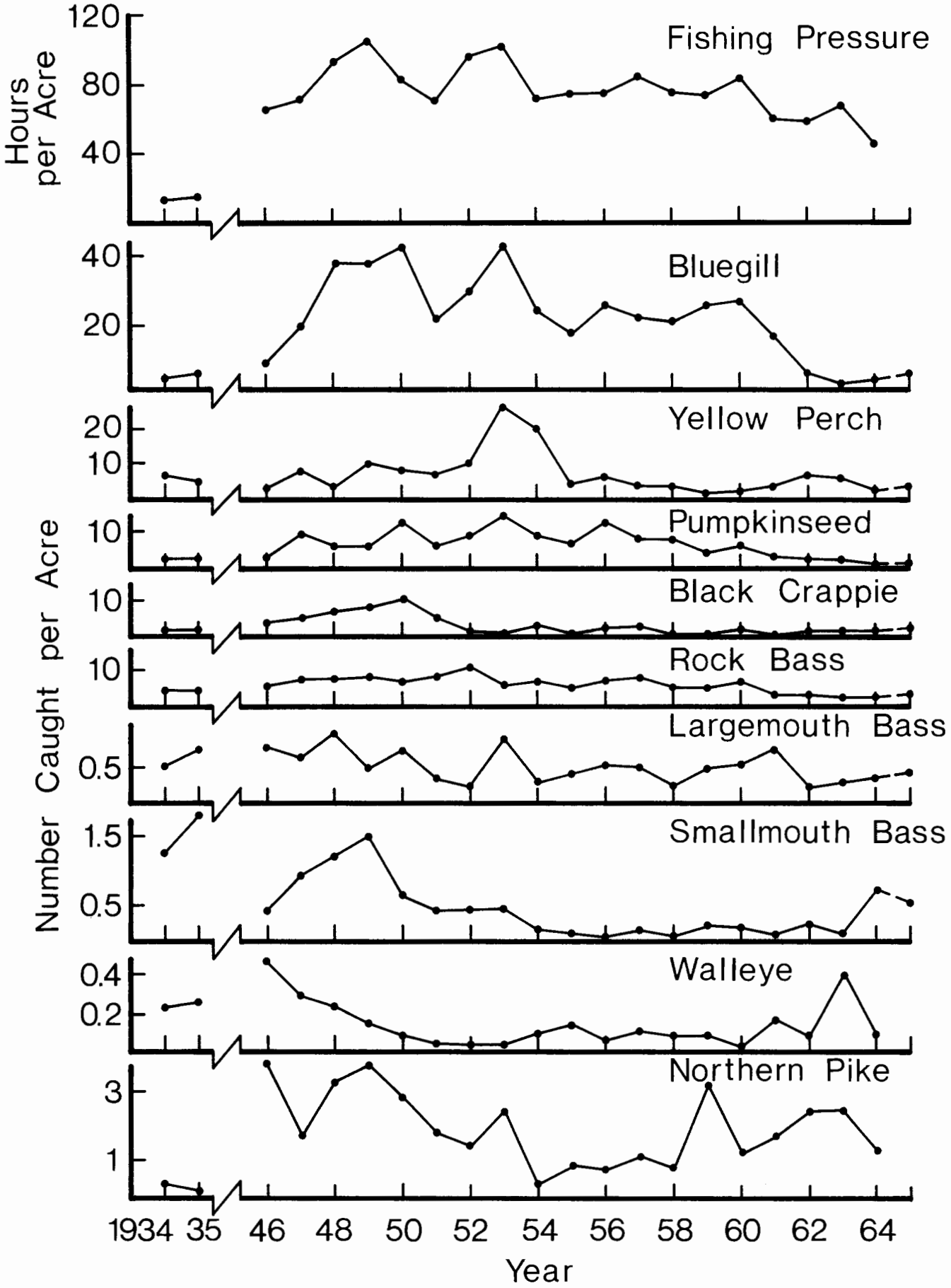

Figure 10. --Estimates of fishing pressure and catch for Fife Lake, winter 1933-34 through fall 1934, spring 1935 through winter 1935-36, and spring 1946 through summer 1965.

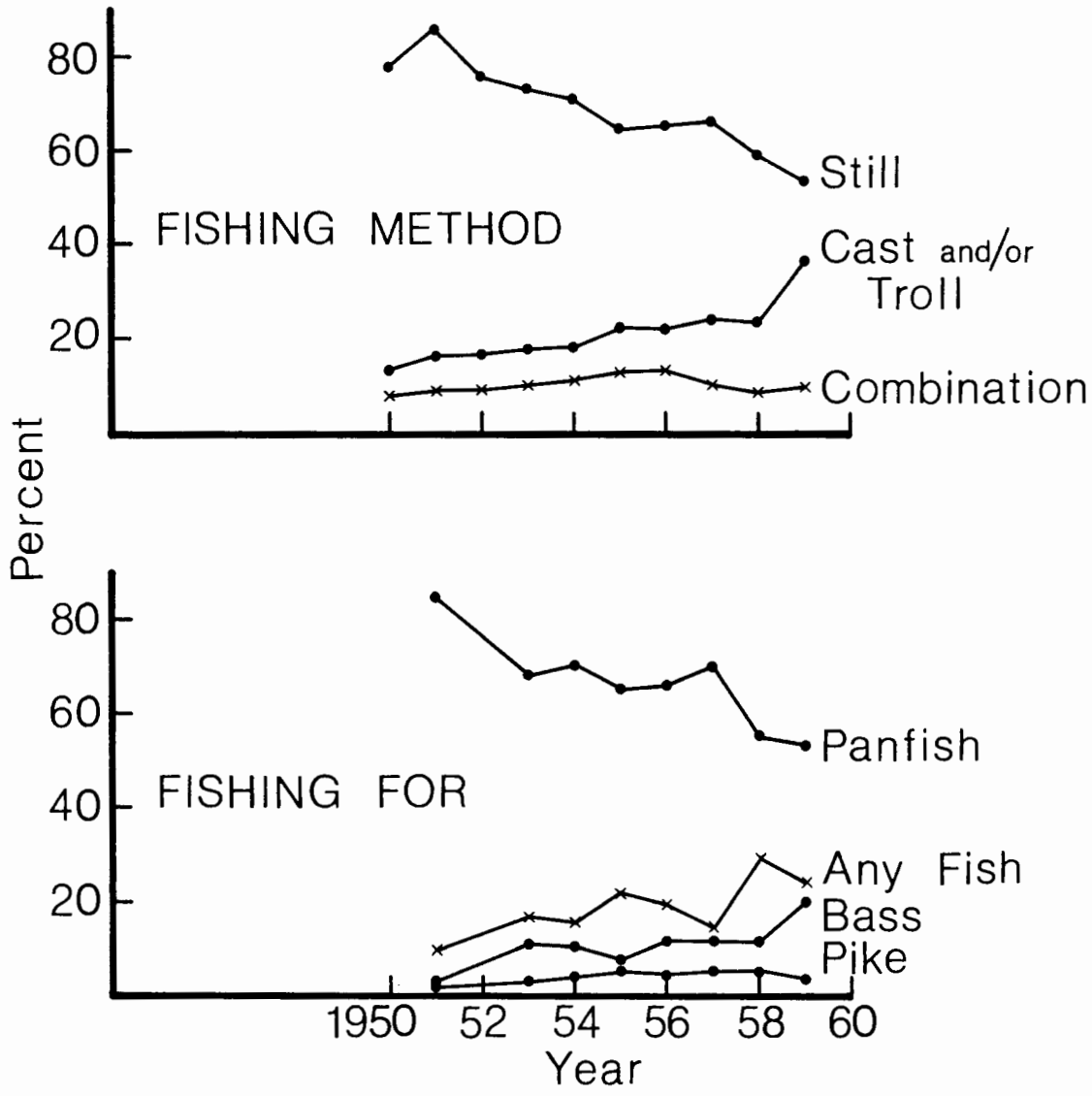

Figure 11.--Fishing methods and type of fish sought ("fishing for") by summer anglers for Fine Lake, 1950-59.

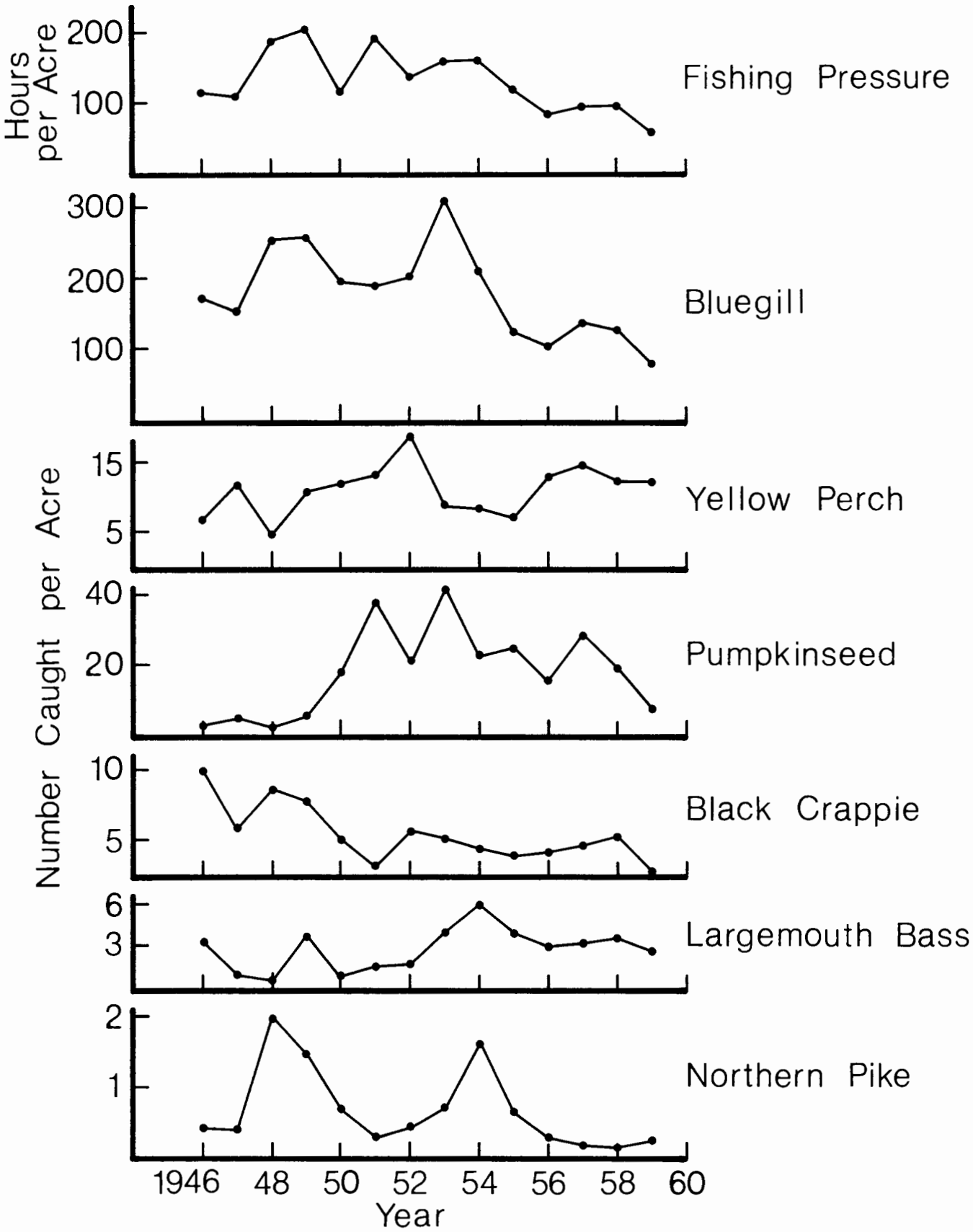

Figure 12.--Estimates of fishing pressure and catch for Fine Lake, 1946-59.

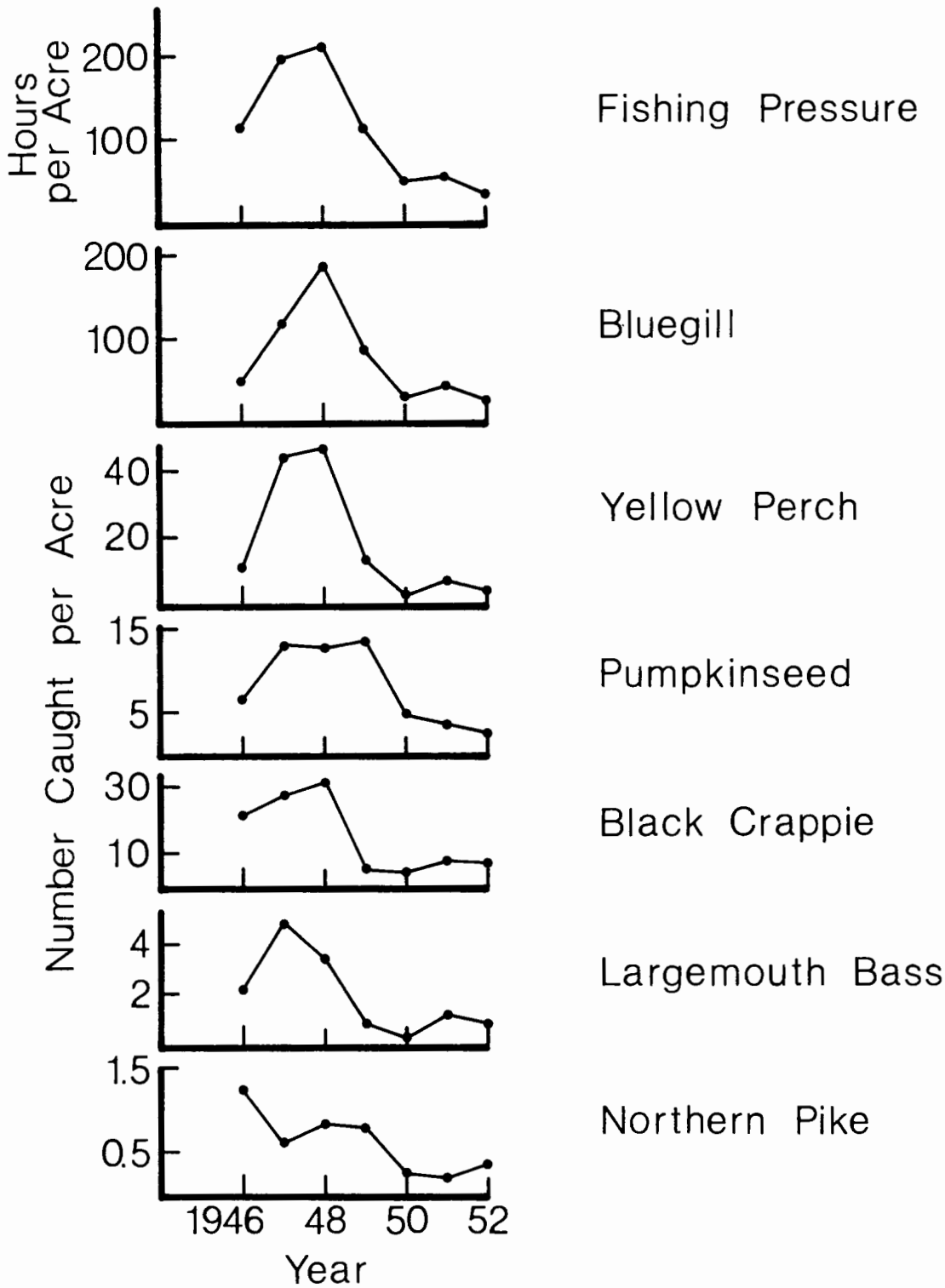

Figure 13.--Estimates of fishing pressure and catch for Lobdell Lake, 1946-52.

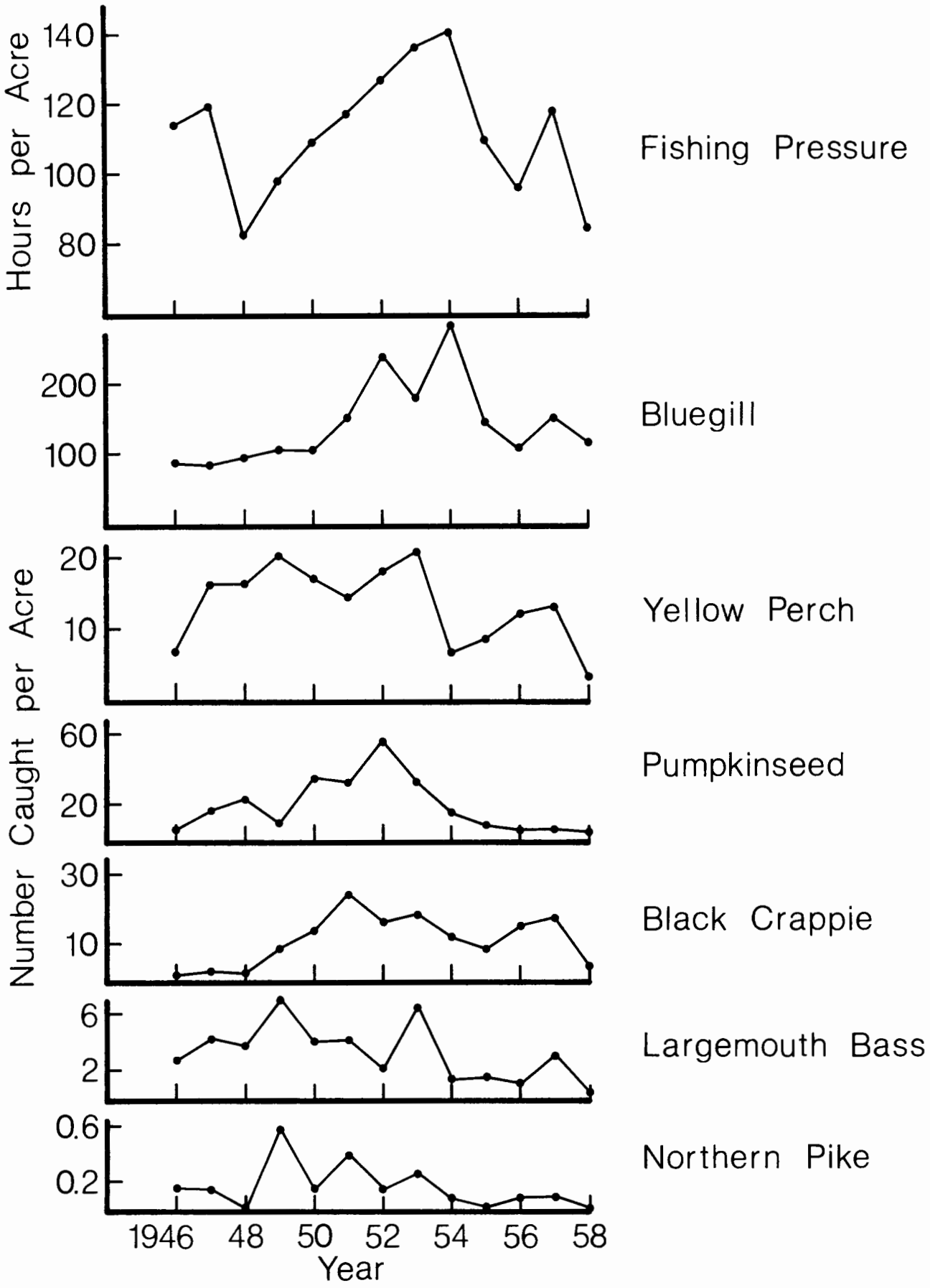

Figure 14.--Estimates of fishing pressure and catch for Minnewaukon Lake, 1946-58.

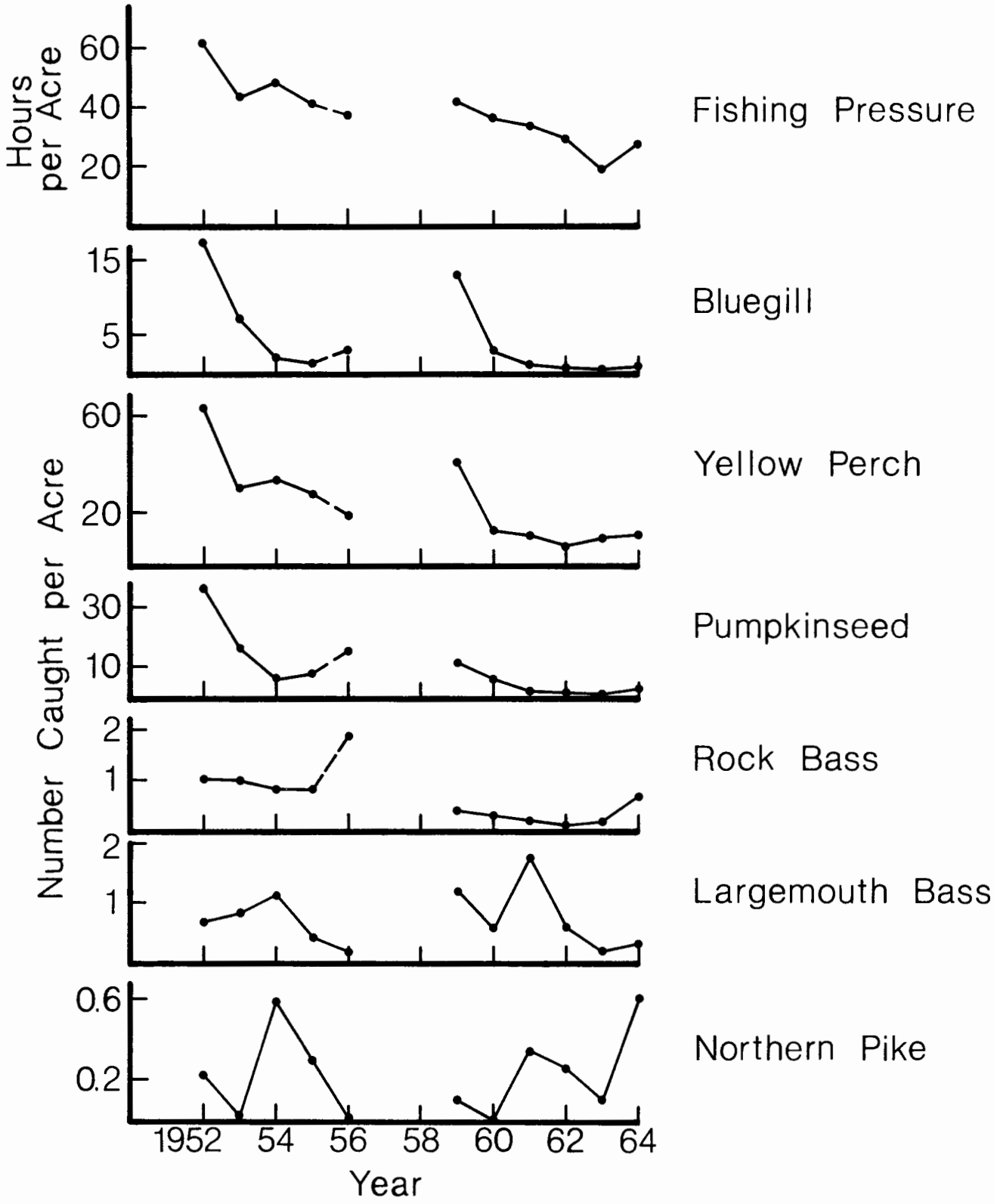

Figure 15.--Estimates of fishing pressure and catch for Otsego Lake, 1952-56 (in part) and 1959-64.

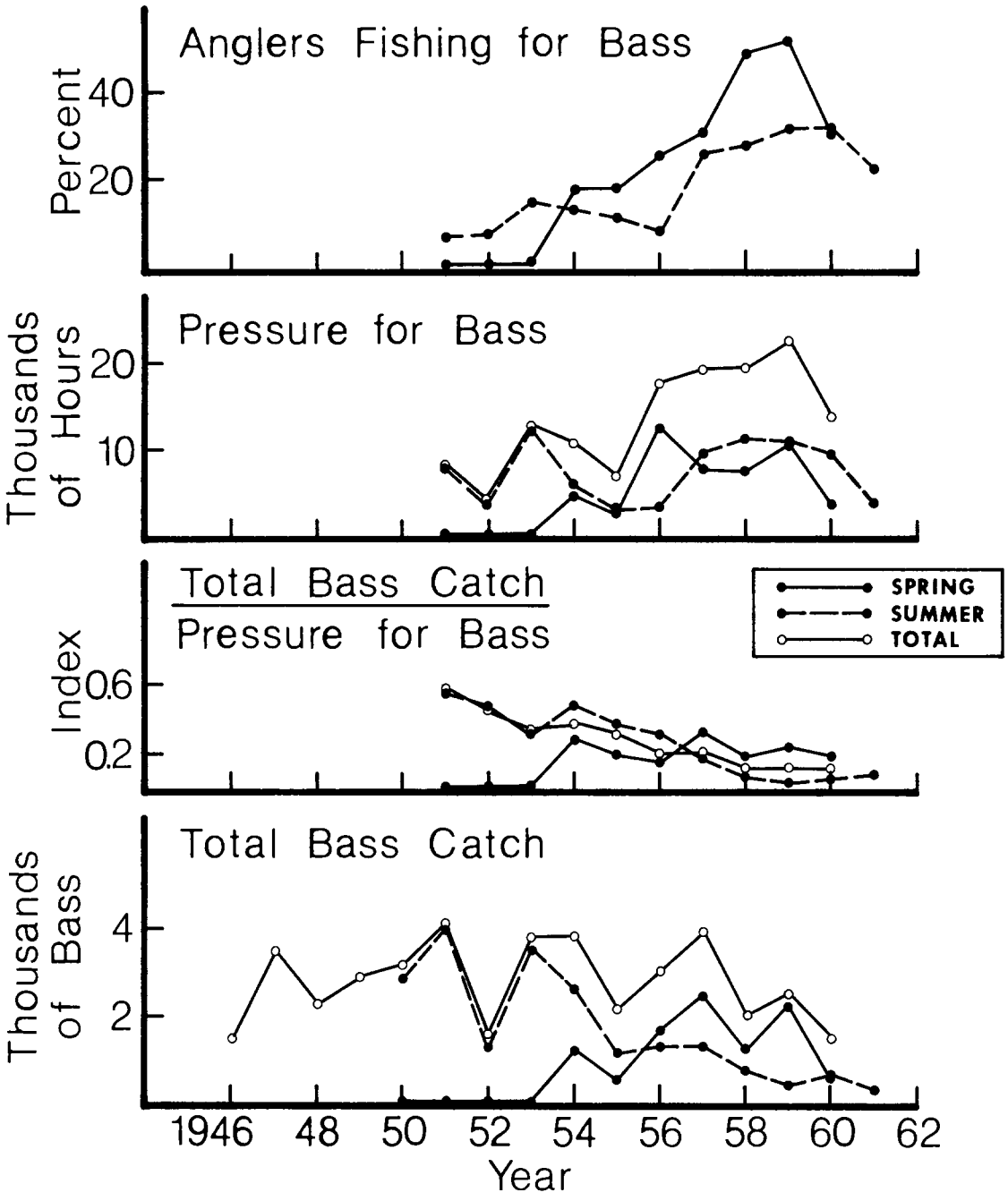

Figure 16.--Changes in the bass fishery at Pontiac Lake, 1946-61 (no closed season 1954-61).

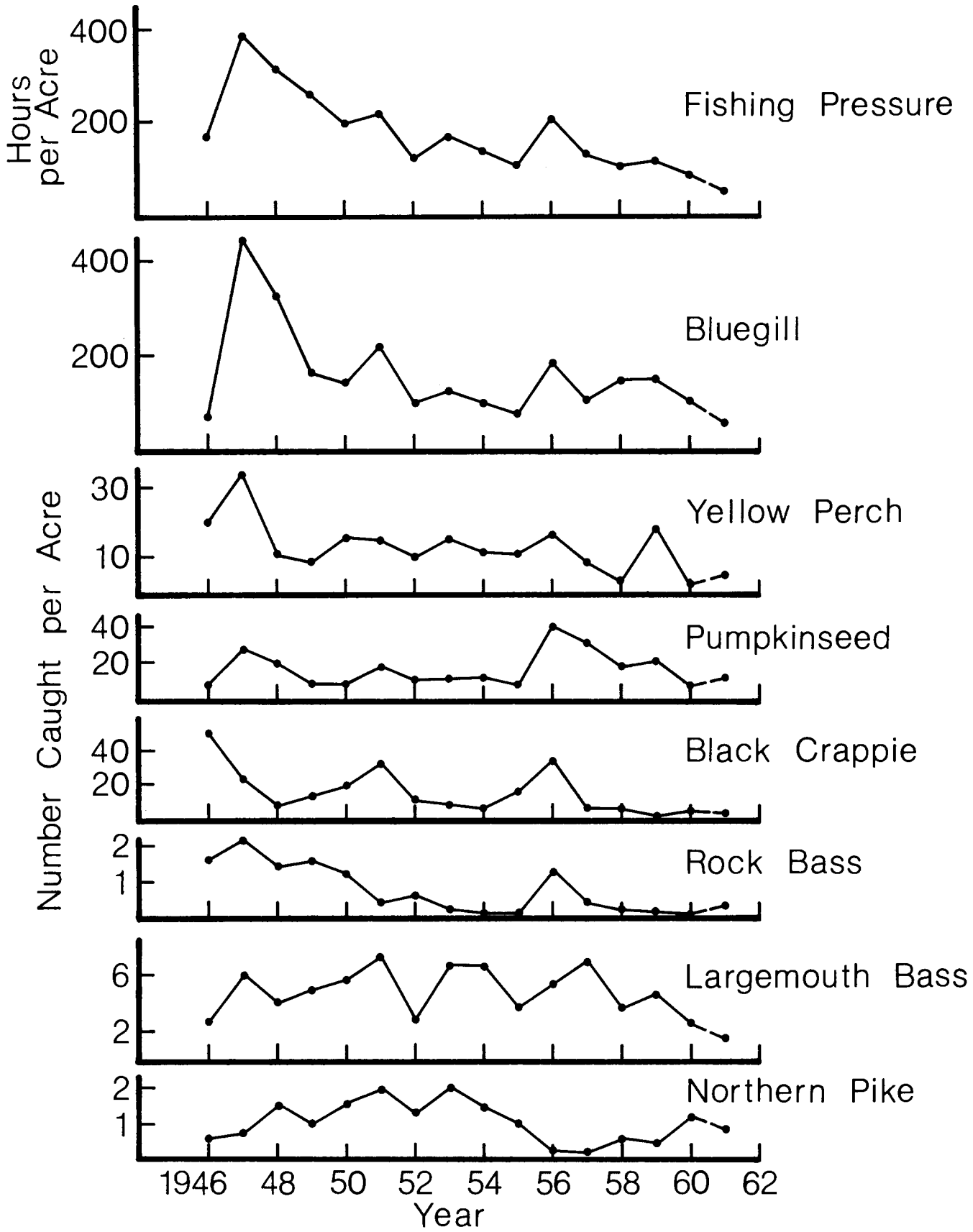

Figure 17.--Estimates of fishing pressure and catch for Pontiac Lake, 1946-61 (except spring 1961).

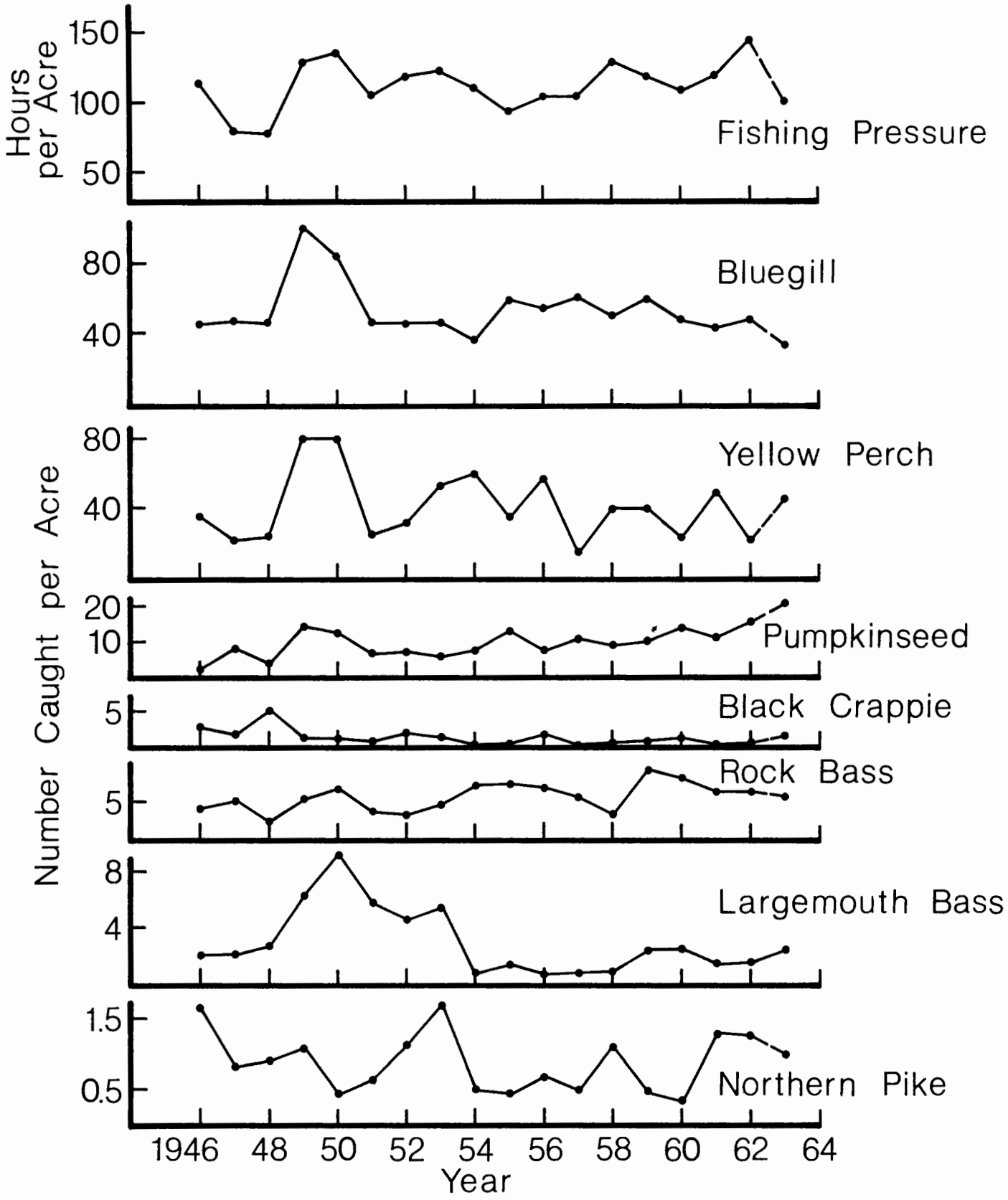

Figure 13.--Estimates of fishing pressure and catch for Sugarloaf Lake, 1946-63.

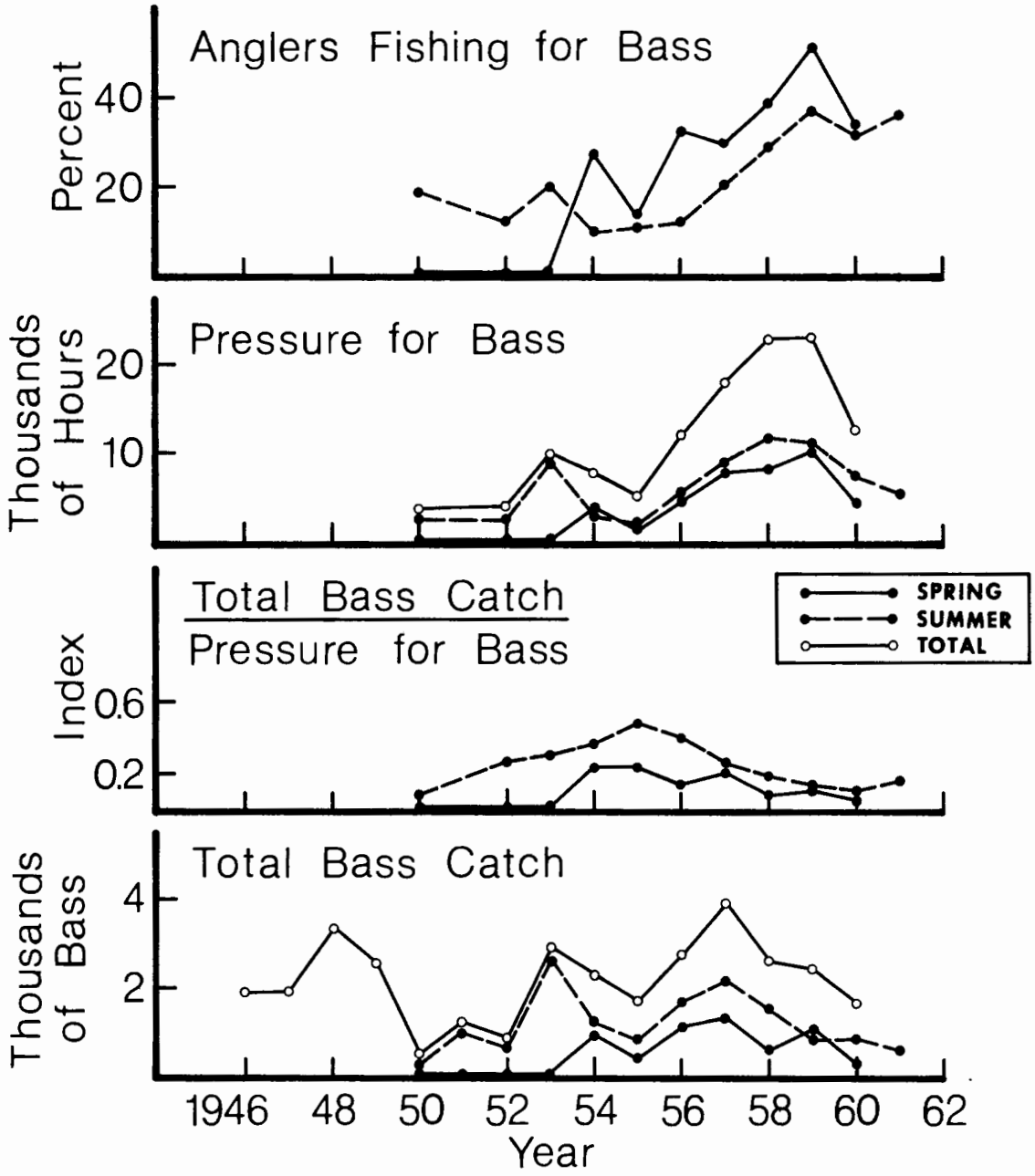

Figure 19.--Changes in the bass fishery at Whitmore Lake, 1946-61 (except spring 1961). (No closed season 1954-61).

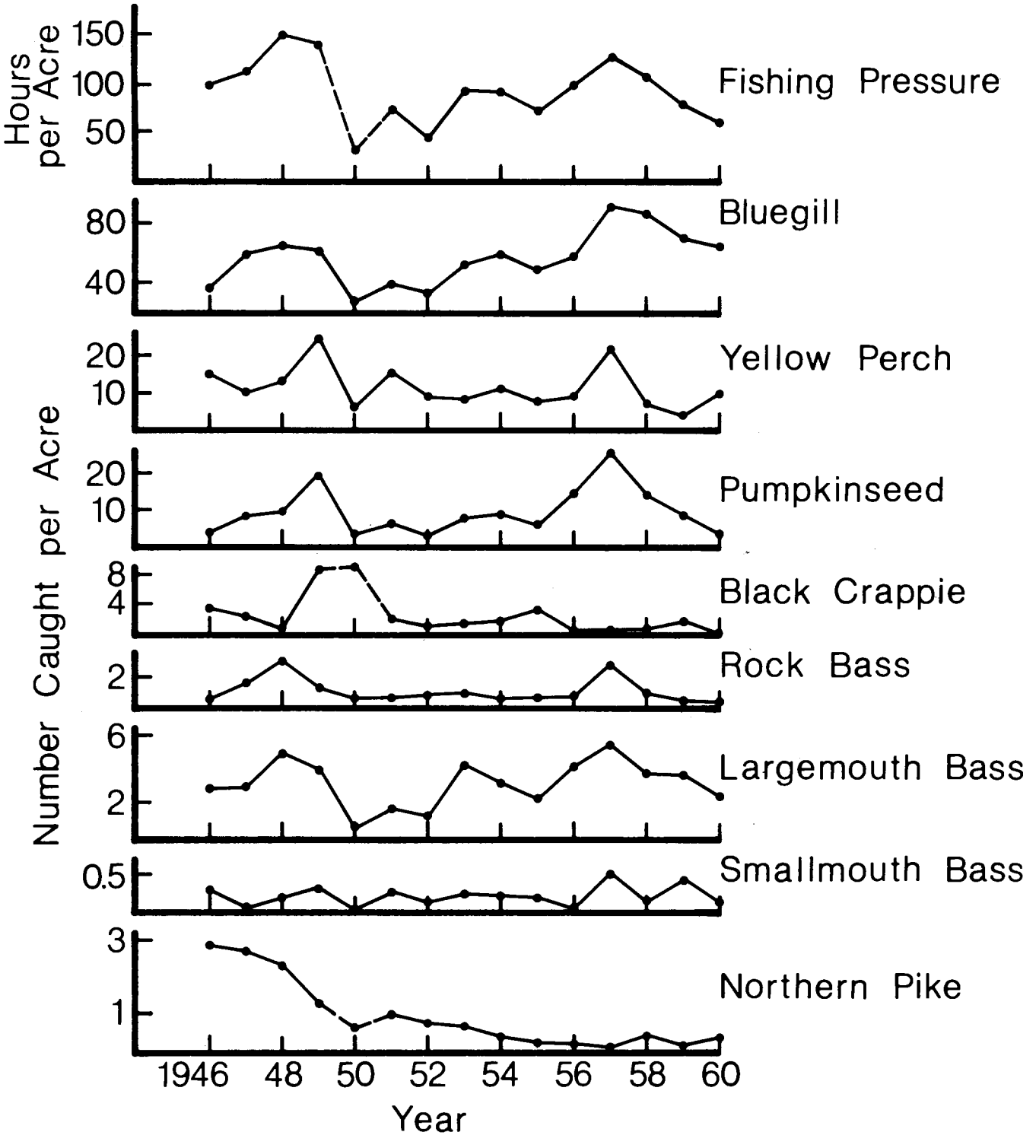

Figure 20.--Estimates of fishing pressure and catch for Whitmore Lake, 1946-60 (data for winter 1950 and spring 1961 are incomplete).

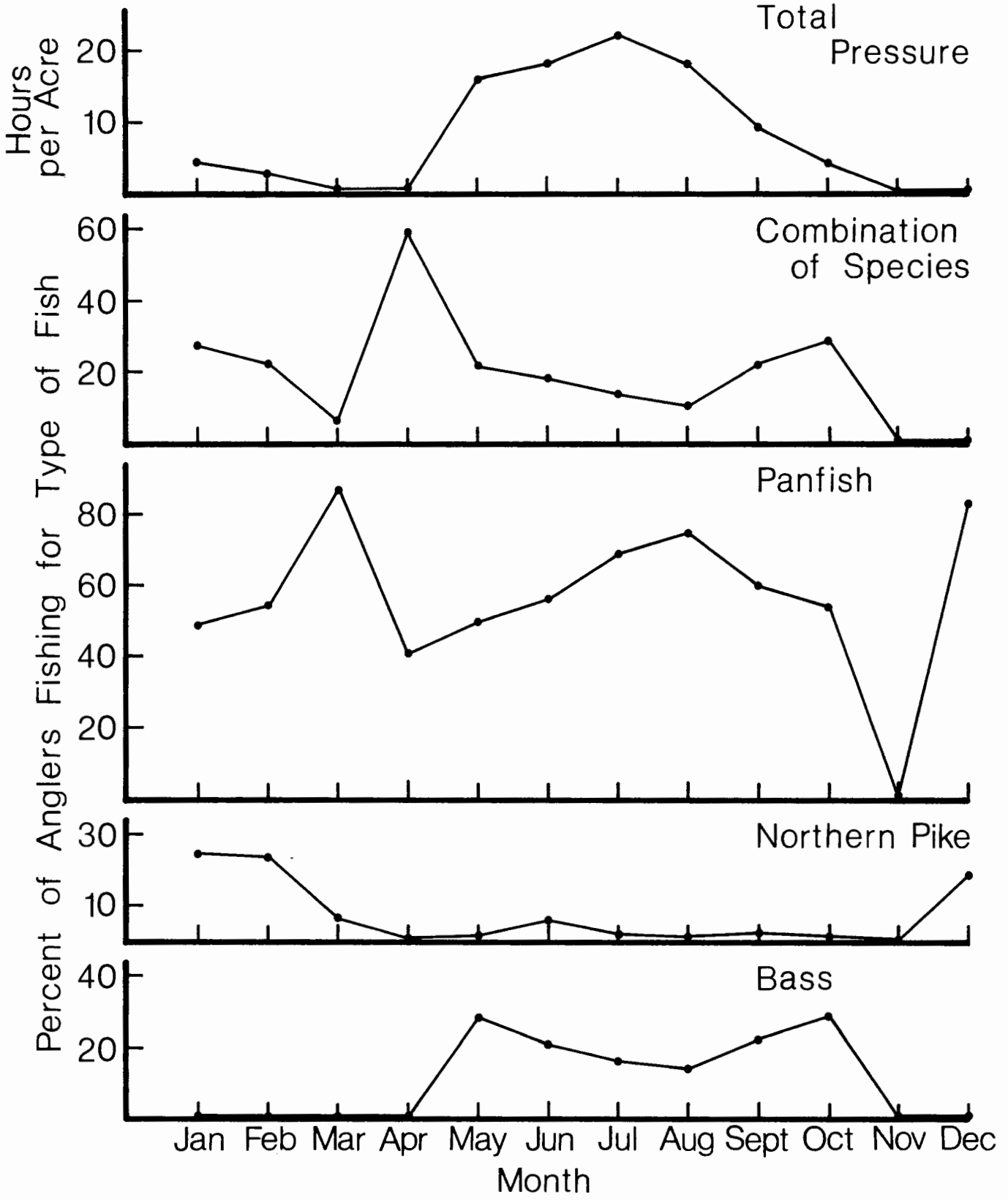

Figure 21.--Monthly averages for fishing pressure and percentage of anglers fishing for bass, pike, panfish, or a combination of species during years (1954-58) of no-closed seasons at Whitmore Lake.

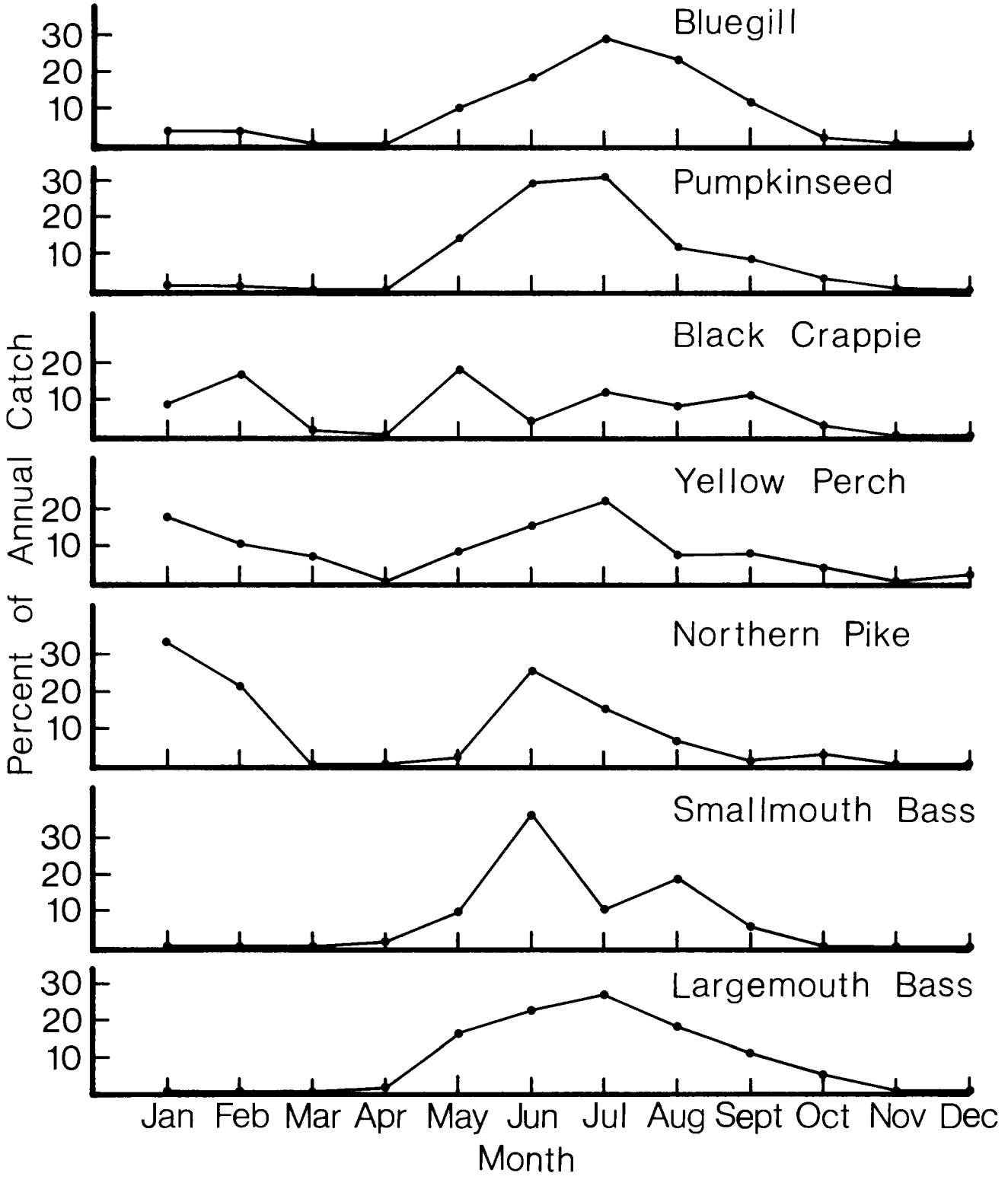

Figure 22.--Average monthly catch (in percent of annual) for seven species at Whitmore Lake during years (1954-58) of no closed season.

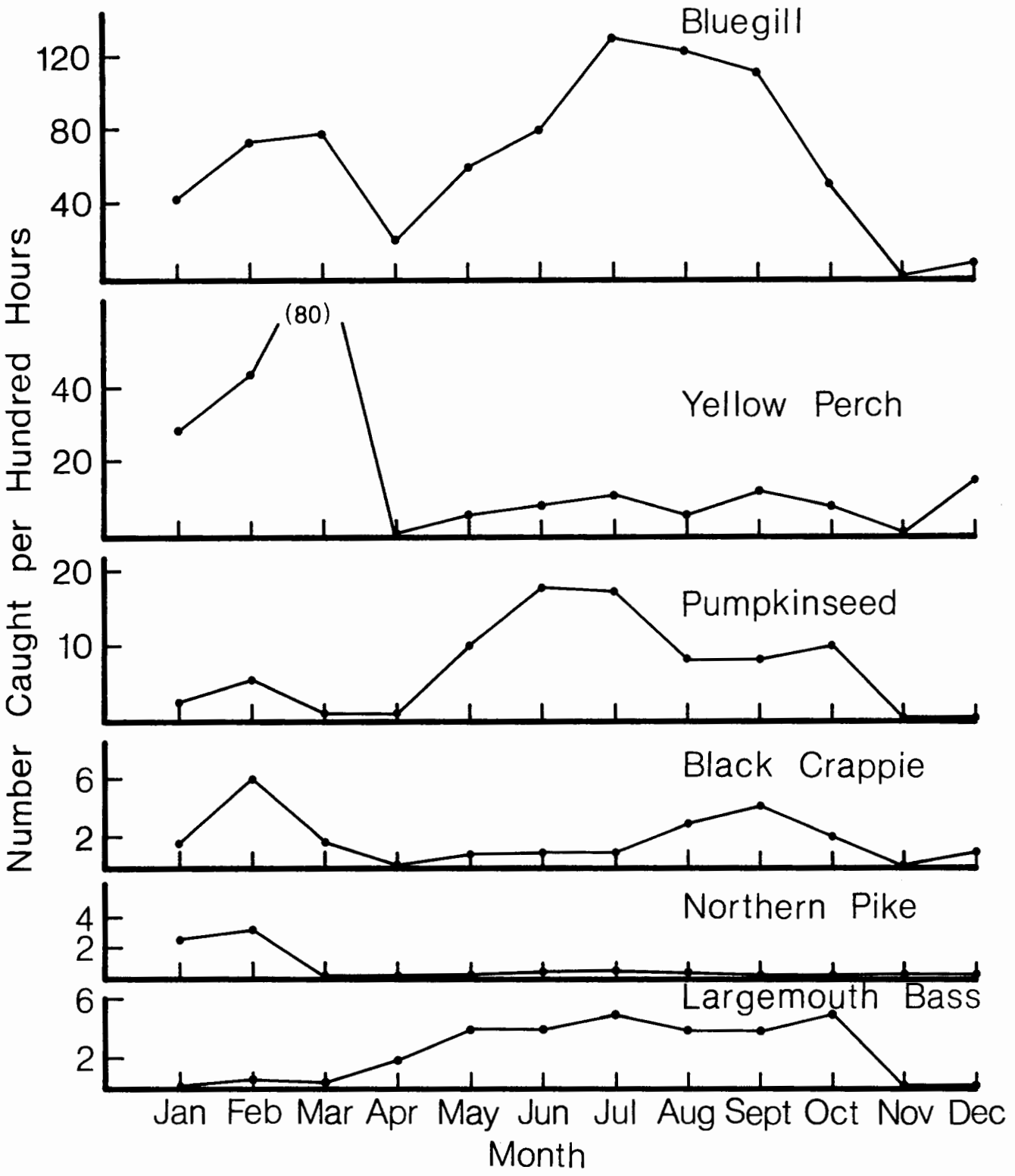

Figure 23.--Average monthly catch rate (number of fish per 100 hours of fishing) for six species of fish at Whitmore Lake during years (1954-58) of no closed season.

Literature cited

Beckman, William C. 1941. The age and growth of the bluegill from six Michigan lakes. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 649, 14 pp.

Beckman, William C. 1948a. The Craig Lake population investigation for the summer of 1947. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1160, 10 pp.

Beckman, William C. 1948b. The length-weight relationship, factors for conversions between standard and total lengths, and coefficients of condition for seven Michigan fishes. Trans. Am. Fish. Soc. 75: 237-256.

Brown, C. J. D. 1941. Fisheries survey of Whitmore Lake, Washtenaw and Livingston counties. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 681, 13 pp.

Carbine, W. F. 1941. Observations on the life history of the northern pike (Esox lucius) at Houghton Lake, Michigan. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 687, 24 pp.

Carbine, W. F. 1942. Northern pike investigations conducted at Houghton Lake, 1942. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 811, 4 pp.

Christensen, Kenneth E. 1953. Fishing in twelve Michigan lakes under experimental regulations. Mich. Dep. Conserv., Inst. Fish. Res. Misc. Publ. 7, 46 pp.

Christensen, Kenneth E. 1954. An improved method of censusing winter shanty fishermen on experimental regulation lakes. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1424, 5 pp.

Christensen, Kenneth E. 1957. Census of angling, Houghton Lake, Roscommon County, winter of 1956-57. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1515, 26 pp.

Christensen, Kenneth E. 1958. A summary of fishing on Houghton Lake, Roscommon County, June 8-September 24, 1957. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1540, 6 pp.

Christensen, Kenneth E. 1960. Estimates of the populations of six species of fish in Fife Lake, Grand Traverse and Kalkaska counties. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1609, 11 pp.

Christensen, K. E., and G. P. Cooper. 1955. Returns on some recent plantings of warm-water game fish in Michigan lakes. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1445, 10 pp.

Christensen, Kenneth E., and James R. Ryckman. 1960. Anglers' catch of rainbow trout in lakes during special winter season, January-February 1960. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1600, 13 pp.

Christensen, Kenneth E., Floyd E. Simonis, and J. E. Williams. 1955. A summary of creel census data (1952-1954) and a review of spawning ground research and management suggestions for Otsego Lake, Otsego County. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1458, 10 pp.

Christensen, K. E., and J. E. Williams. 1959. Status of the northern pike population in Fletcher Floodwater, Alpena and Montmorency counties, 1948 and 1955-1956. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1576, 13 pp.

Clady, Michael D. 1966. A study of the population fluctuations of the cisco, Coregonus artedi (Le Sueur) in Birch Lake, Cass County, Michigan, with special reference to the gill-net sport fishery. M.S. thesis, Univ. Mich., 126 pp.

Clark, O. H. 1939. Analysis of winter fishing on three lakes of the Waterloo Area 1938-39 and comparisons with 1935-36 and 1936-37 records. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 535, 16 pp.

Clark, O. H. 1940. An analysis of the annual fish catch on several Michigan lakes winter of 1938-1939 and summer of 1939. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 588, 17 pp.

Clark, O. H. 1941. Progress report of the investigation of the winter fishing problem on several southern Michigan "bluegill lakes." Mich. Dep. Conserv., Inst. Fish. Res. Rep. 661, 94 pp.

Cooper, Gerald P. 1951. Estimation of fish populations in Michigan lakes. Trans. Am. Fish. Soc. 81: 4-16.

Cooper, Gerald P. 1953. Population estimates of fish in Sugarloaf Lake, Washtenaw County, Michigan, and their exploitation by anglers. Pap. Mich. Acad. Sci. 38: 163-186.

Cooper, Gerald P., and William C. Latta. 1954. Further studies on the fish population and exploitation by angling in Sugarloaf Lake, Washtenaw County, Michigan. Pap. Mich. Acad. Sci. 39: 209-223.

Cooper, Gerald P., William C. Latta, and Robert N. Schafer. 1957. Populations of game fish and their exploitation by angling in several Michigan lakes. Unpublished manuscript given at American Fisheries Society, Las Vegas, September 13, 1957.

Cooper, Gerald P., and Robert N. Schafer. 1954. Studies of the population of legal-size fish in Whitmore Lake, Washtenaw and Livingston counties, Michigan. Trans. 19th Conf. N. Am. Wildl. Soc.: 241-259.

Eschmeyer, R. W. 1935. Analysis of the game-fish catch in a Michigan lake. Trans. Am. Fish. Soc. 65: 207-223.

Eschmeyer, R. W. 1937. A second season of creel census on Fife Lake. Trans. Am. Fish. Soc. 66: 324-334.

Eschmeyer, R. William. 1939. Summary of a four-year creel census on Fife Lake, Michigan. Trans. Am. Fish. Soc. 68: 354-358.

Funk, John. 1942a. Fisheries survey of Lobdell Lake, Genesee and Livingston counties. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 726, 14 pp.

Funk, John. 1942b. Fisheries survey of Prairie, Minnewaukon, Eberhard, and Little Fish lakes, St. Joseph County. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 777, 22 pp.

Hazzard, Albert S., and Kenneth E. Christensen. 1953. The use of experimental streams and lakes in Michigan. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1362, 18 pp.

Hazzard, Albert S., and R. William Eschmeyer. 1938. Analysis of the fish catch for one year in the Waterloo Project area. Pap. Mich. Acad. Sci. 23: 633-643.

Hooper, Frank F., John E. Williams, Mercer H. Patriarche, Fred Kent, and James C. Schneider. 1964. Status of lake and stream rehabilitation in the United States and Canada with recommendations for Michigan waters. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1688, 56 pp.

Hubbs, Carl L. 1934. The problem of winter versus summer fishing in Otsego Lake, Otsego County. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 245, 5 pp.

Hubbs, Carl, and R. W. Eschmeyer. 1932. Report on Bear Lake, Manistee County, with recommendations for the improvement of fishing. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 174, 5 pp.

Laarman, Percy W. 1976. The sport fisheries of the twenty largest inland lakes in Michigan. Mich. Dep. Nat. Resour., Fish. Res. Rep. 1843, 198 pp.

Laarman, Percy W., and James C. Schneider. 1979. The fish population and harvest in Sugarloaf Lake, Washtenaw County, in 1962 compared to 1948-55. Mich. Dep. Nat. Resour., Fish. Res. Rep. 1870, 15 pp.

Latta, William C. 1959. Significance of trap net selectivity in estimating fish population statistics. Pap. Mich. Acad. Sci. 44: 123-137.

Latta, W. C. 1972. The northern pike in Michigan: a simulation of regulations for fishing. Mich. Acad. 5(2): 153-170.

Latta, W. C. 1974. Fishing regulations for largemouth bass in Michigan. Mich. Dep. Nat. Resour., Fish. Res. Rep. 1818, 38 pp.

Latta, W. C. 1975. Fishing regulations for smallmouth bass in Michigan. Mich. Dep. Nat. Resour., Fish. Res. Rep. 1834, 30 pp.

Loeb, Howard A. 1949. A study of the trend of fishing in Houghton Lake, 1928-1946. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1220, 37 pp.

Merna, James W. 1963. The effect of raising the water level on the productivity of a marl lake. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1657, 20 pp.

Pettengill, Thomas D. 1975. Evaluation of a walleye, Stizostedion vitreum vitreum (Mitchill), stocking program, Fife Lake, Michigan. M.S. thesis, Central Mich. Univ., 36 pp.

Predmore, H. E., Jr. 1947. An intensive creel census on Whitmore Lake, summer, 1945. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1140, 48 pp.

Predmore, H. E., Jr. 1948. Two years of fishing in lakes with liberalized regulations. Mich. Conserv. 17(6): 3, 12.

Schneider, James C. 1969. Results of experimental stocking of walleye fingerlings, 1951-1963. Mich. Dep. Nat. Resour., Res. Develop. Rep. 161, 31 pp.

Taube, Clarence M. 1950. A fisheries survey of Otsego Lake, Otsego County, Michigan. Mich. Dep. Conserv., Inst. Fish. Res. Rep. 1255, 24 pp.

Taube, Clarence M. 1965. Tests of the effects of several management practices on a group of lakes. Mich. Dep. Nat. Resour., Dingell-Johnson final report, Project F-27-R-2 (Michigan), Work Plan 2, Job 5.

Trautman, Milton B. 1941. Fluctuations in lengths and numbers of certain species of fishes over a five-year period in Whitmore Lake, Michigan. Trans. Am. Fish. Soc. 70: 193-208.

Report approved by W. C. Latta

Typed by M. S. McClure

Appendix

Forms and computation methods used for intensive creel census since 1954

INTENSIVE LAKE CREEL CENSUS — Michigan Department of Conservation

Lake.....Date.....19.....

County.....Fisherman's Name.....

County.....

State.....

Sex—Male.....Female.....

Report tagged or fin-clipped fish individually on blank space to left.

Census Clerk's Initials.....

One card to be used for each fisherman contacted, whether or not any fish are caught.

SPECIES CAUGHT	LEGAL SIZE Number	UNDER-SIZE Number
Bluegills		
Yellow Perch		
Sunfish		
Crappies (Speckled Bass)		
Rock Bass		
Largemouth Bass		
Smallmouth Bass		
Walleye		
Northern (Grass) Pike		
Bullheads		

(Enter other kinds taken on blank spaces above)

Kind of Fishing?

Boat?.....Still Fishing?.....Casting?.....

Shore?.....Trolling?.....Ice?.....

Bait used:

Worms?.....Minnows?.....Insect?.....

Plug?.....Spinner?.....Fly?.....

If taken by spear, dipnet or other means, state how.....

(Use other side of Card for Remarks)

TIME FISHED A.M. ▶▶ 12 1 2 3 4 5 6 7 8 9 10 11 12

P.M. ▶▶ 12 1 2 3 4 5 6 7 8 9 10 11 12

Draw line through hours and half hours fished

60M 5-59

MICHIGAN DEPARTMENT OF CONSERVATION

FISHING CENSUS

Lake WHITMORE LAKE WASHTENAW COUNTY Date _____

Residence _____ No. in Shanty _____

Fishing by spear _____ hook and line _____

Fished from _____ to _____

Time _____

FISH KEPT	NUMBER KEPT	
	WHEN CONTACTED	TOTAL AT QUITTING TIME
Bluegill.....		
Perch.....		
Northern Pike.....		

Your cooperation is appreciated. Thank you.

CONS. 8145
1/57

BOAT COUNT DATA

Lake____________________ Census Clerk____________________

County____________________ Month____________________ 19____

Date	Location	7 AM	8 AM	9 AM	10 AM	11 AM	12 N	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	*

Methods of estimating total angling effort and harvest
(spring, summer, and fall)

Determine mean and variance for each of the following categories:

Fish per boat-hour (total fish, and each species)
Anglers per boat
Hours per angler
Boats per count

$$\bar{X} \cdot \frac{\sum X}{n} \cdot s^2_{\bar{X}} \cdot \frac{n\sum X^2 - (\sum X)^2}{n^2 (n-1)}$$

Estimated boat hours = boats per count × hours per season.*

Variance of estimate = (hours per season^2 × var. boats per count)

Estimated angling hours = est. boat hours × anglers per boat.

$$\text{var.}_{\text{est.}} = (\text{anglers per boat}^2 \times \text{var. est. boat hours}) + (\text{est. boat hours}^2 \times \text{var. anglers per boat})$$

Estimated angling trips = est. angling hours ÷ hours per angler.

$$\text{var.}_{\text{est.}} = \text{est. angling trips}^2 \left(\frac{\text{var. hours per angler}}{\text{hours per angler}^2} + \frac{\text{var. est. angling hours}}{\text{est. angling hours}^2} \right)$$

Estimated catch = est. boat hours × fish per boat hour.

$$\text{var.}_{\text{est.}} = (\text{fish per boat hour}^2 \times \text{var. est. boat hours}) + (\text{est. boat hours}^2 \times \text{var. fish per boat hour})$$

Boat Count method:

Determine $\bar{X}$ and $s^2_{\bar{X}}$ for several counts made each day.

Total means and divide by number of days counts were made.
Total variances and divide by square of number of days counts were made.

* Hours per season defined as: spring--784; summer--1,240; fall--1,148.

Methods of estimating total angling effort and harvest
(winter, open ice)

Determine mean and variance for each of the following categories:

Fish per party-hour (total fish, and each species)
Anglers per party
Hours per angler
Anglers per count

$$\bar{X} = \frac{\sum X}{n} \quad . \quad s^2_{\bar{X}} = \frac{n \sum X^2 - (\sum X)^2}{n^2 (n-1)}$$

Estimated angling hours = $\bar{X}$ anglers per count $\times$ hours per season (770).

Variance of estimate = hours per season^2 $\times$ variance of $\bar{X}$ anglers per count

Estimated angling trips = est. ang. hrs. $\div$ $\bar{X}$ hours per angler.

$$\text{var.}_{\text{est.}} = \text{est.ang.trips}^2 \left(\frac{\text{var. of hours per angler}}{\bar{X} \text{ hours per angler}^2} + \frac{\text{var.est.ang.hrs.}}{\text{est.angling hrs.}^2} \right)$$

Est. party hours = est. ang. hrs $\div$ $\bar{X}$ anglers per party.

$$\text{var.}_{\text{est.}} = \text{est.party hrs.}^2 \left(\frac{\text{var. of anglers per party}}{\bar{X} \text{ anglers per party}^2} + \frac{\text{var.est.ang.hrs.}}{\text{est.angling hrs.}^2} \right)$$

Est. catch = est. party hours $\times$ $\bar{X}$ fish per party hour.

$$\text{var.}_{\text{est.}} = (\text{est.party hrs.}^2 \times \text{var.fish per party hr.}) + (\bar{X} \text{ fish per party hr.}^2 \times \text{var.est.party hrs.})$$

Methods of estimating total angling effort and harvest
(winter, shanty)

Determine mean and variance for each of the following categories:

Fish per shanty hour
Hours per shanty
Anglers per shanty
Shanties used per day

$$\bar{X} = \frac{\sum X}{n} \qquad s^2_{\bar{X}} = \frac{n\sum X^2 - (\sum X)^2}{n^2 (n-1)}$$

Estimated shanty days = $\bar{X}$ shanties per day $\times$ days in season (first day to last day--total).

Variance of estimate = days in season^2 $\times$ var. shanties per day

Est. shanty hours = est. shanty days $\times$ $\bar{X}$ hours per shanty.

$\text{var.}_{\text{est.}}$ = (est. shanty days^2 $\times$ var. hrs. per shanty) +
($\bar{X}$ hrs. per shanty^2 $\times$ var. est. shanty days)

Est. angler trips = est. shanty days $\times$ $\bar{X}$ anglers per shanty.

$\text{var.}_{\text{est.}}$ = (est. shanty days^2 $\times$ var. ang. per shanty) +
($\bar{X}$ ang. per shanty^2 $\times$ var. est. shanty days)

Est. angling hours = est. shanty hours $\times$ $\bar{X}$ anglers per shanty.

$\text{var.}_{\text{est.}}$ = (est. shanty hrs.^{2} $\times$ var. ang. per shanty) +
($\bar{X}$ ang. per shanty^2 $\times$ var. est. shanty hrs.)

Est. catch = est. shanty hours $\times$ $\bar{X}$ fish per shanty hour.

$\text{var.}_{\text{est.}}$ = (est. shanty hrs.^{2} $\times$ var. fish per shanty hour) +
($\bar{X}$ fish per shanty hr^2 $\times$ var. est. shanty hrs.)