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AN INTENSIVE CREEL CENSUS ON WHITMORE LAKE, SUMMER, 1945

by

H. E. Predmore, Jr.

During the summer of 1945 the author was assigned to conduct an intensive creel census on Whitmore Lake (Washtenaw and Livingston counties). To a certain degree the information obtained is expected to serve as a basis for comparison with data to be collected in subsequent years. It is hoped that the status of the fish population, as measured by the anglers' results, will reflect the effects of modifying fishing regulations for the lake. At the time of the census, in 1945, fishing regulations were the same as those for all other non-trout lakes in southern Michigan.

Any conclusions based on comparisons with subsequent creel census data must take into account a cyclic fluctuation in the fish population, which has been noted for Whitmore Lake (Trautman, 1941). The abundance or scarcity of any or all species most certainly will affect the fishermen's success. This in turn will probably be reflected in the creel census data. The question then arises as to whether any change in a season's catch per hour or species composition of the catch as measured by the creel census will be due to a natural fluctuation in the fish population or to the effect of the new regulations.

The material presented in this report was amassed during the period June 25 to October 14, inclusive, except that data are not available for July 12-17, because the census clerk was ill. Except for the days which the clerk spent visiting cottages to pick up records, the census day began when the first angler started fishing in the morning and ended when darkness made sampling impractical.

Whitmore Lake is a fairly large body of water covering an area of 677 acres. The lake was mapped in January, 1940 by an Institute for Fisheries Research party, and has been described in detail by Brown (I.F.R. Report No. 681) and by Trautman (1941).

Because Whitmore Lake is so large, and fishing intensity was so great during most of the census period, it was impossible to obtain complete records of all fishing. Consequently, a system of taking data on part of the total fishing was established. A technique for obtaining an estimate of the total fishing was also a part of the creel census program. After the data were subjected to analysis, certain weaknesses in the methods were observed. For example, it apparently was a poor policy to omit, in the census, the same week day (Thursday--this being the clerk's day off) throughout the season, and especially to select Thursday as the day off. It would have been better to have rotated the clerk's day off among the different days of the week. Other discrepancies in the sampling technique are discussed elsewhere in the report, with a view to insuring that future creel census project plans may benefit from experiences recorded here.

Methods

Duties of the creel census clerk were originally outlined as follows:[1]

1. Contact all the boat liveries operating on Whitmore Lake as soon as possible after the opening date of the fishing season (June 25). Request the liverymen to keep a daily record of boat rentals made to fishermen.

2. Visit all cottage residents and ask them to keep a record of the number of fishing trips made each day by members of the family or their guests.

3. Using the intensive lake creel census blank (Figure 1), fill out the following: (a) number and sex of anglers (one card for each party), (b) time of day spent fishing, (c) city and state of angler's residence, (d) number and kind of fish caught, (e) kind of fishing done, (f) kind of bait used, and (g) date fishing was done. This information to be collected by a random sample based on reports made by anglers at the end of their fishing trip.

4. Make a count every two daylight hours of boats engaged in fishing to determine fishing intensity as related to time of day. The days for making the boat count to be selected at random, and separate records to be kept of private boats and livery boats.

5. In addition to the aforementioned creel census duties, the following observations were to be made, as time permitted, when the clerk was not engaged in censusing: (a) take a series of vertical temperature

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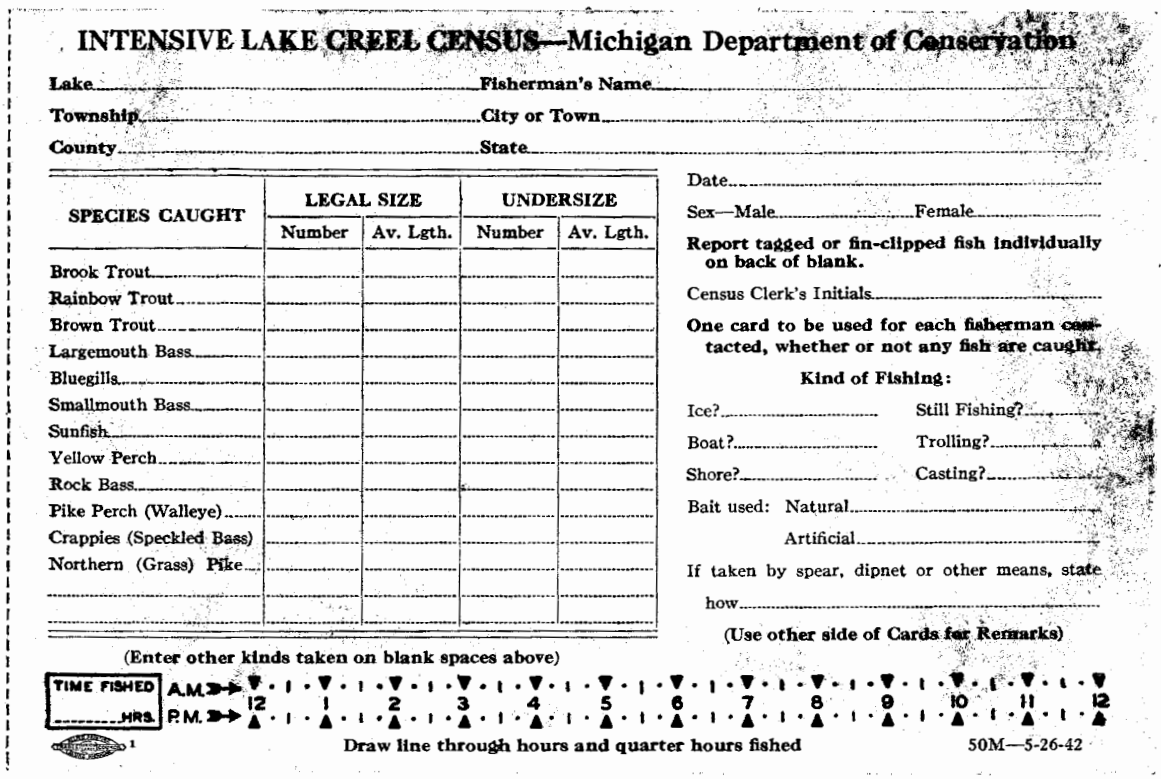
[1] The study was made under the supervision of L. A. Krumholz



INTENSIVE LAKE CREEL CENSUS—Michigan Department of Conservation

Lake_____ **Fisherman's Name**_____

Township_____ **City or Town**_____

County_____ **State**_____

SPECIES CAUGHT	LEGAL SIZE		UNDERSIZE	
	Number	Av. Lgth.	Number	Av. Lgth.
Brook Trout				
Rainbow Trout				
Brown Trout				
Largemouth Bass				
Bluegills				
Smallmouth Bass				
Sunfish				
Yellow Perch				
Rock Bass				
Pike Perch (Walleye)				
Crappies (Speckled Bass)				
Northern (Grass) Pike				

(Enter other kinds taken on blank spaces above)

Date_____

Sex—Male_____ Female_____

Report tagged or fin-clipped fish individually on back of blank.

Census Clerk's Initials_____

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

Kind of Fishing:

Ice?_____ Still Fishing?_____

Boat?_____ Trolling?_____

Shore?_____ Casting?_____

Bait used: Natural_____

Artificial_____

If taken by spear, dipnet or other means, state how_____

(Use other side of Cards for Remarks)

TIME FISHED _____ HRS.

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 quarter hours fished

50M—5-26-42

Figure 1.--The intensive lake creel census blank used at Whitmore Lake, 1945.

measurements at the stations established by the lake survey party of August, 1940. (b) Make field examinations and record stomach contents of principal game fishes. Make visual estimates, by percent, of volumes of principal types of food. These examinations to be made weekly. (c) Seine and observe continuously for young game and forage fishes along shore. (d) Record maximum and minimum water and air (in shade) temperatures, the water temperatures to be taken southeast of the public fishing site in about three feet of water with the thermometer on a pole one foot below the surface.

Five boat liveries were operated on Whitmore Lake during 1945. Four of these were open all season and the fifth began renting boats the latter part of July. Each of the livery owners was contacted shortly after the fishing season opened and the creel census explained to them. They were requested to keep a daily record of the number of boats rented to fishermen. All of them agreed to cooperate as long as their individual records were kept secret from the other liverymen. It was noted that none of them had a very satisfactory method of bookkeeping, and we discussed a suitable form for doing so. After conferring with the operators, a satisfactory system was devised which would give the liverymen sufficient information for their files and creel census data for ours. The Institute for Fisheries Research then furnished free of charge as many record cards (Figure 2) as the boat liveries could use. The cards were picked up each week. This system was installed sometime after the fishing season opened. In spite of their agreement to cooperate fully with us, many of the liverymen kept poor records throughout the season. Only one of the rental places furnished reasonably accurate information. Three of the five failed to use any of the record cards.

Name_____

Street_____

City_____

Date_____

Time: out_____ in_____

Boat No._____ Amt. pd._____

Number of persons in party: Men_____ Women_____

List on other side number and kind of fish caught.

Figure 2.--The form given Whitmore Lake boat liverymen for recording creel census data.

One of the liveries made a great number of rentals to vacationers who did no fishing, and it was impossible to separate the fishermen renters from the total rentals.

It developed that one to two days' time was required to contact only one third of the cottage owners on the lake. Shortly after this program began it became apparent that the records kept by cottagers were not accurate. Therefore the time required to contact fishermen at their cottages was not justified by the results obtained, and the procedure was discontinued.

Most of the fishing on the lake was done from boats; there was practically no bank fishing. At the start of the census period, the clerk cruised around the lake in a rowboat equipped with an outboard motor, and as the fishermen finished fishing, motored over to their boat or followed them in to shore to obtain their catch record.[2] Although

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[2] Of all the various duties performed by the author in conducting this creel census, the most difficult from the standpoint of public relations was the actual contact with the fishing party. An angler engaged in fishing usually reacted to any invasion of his privacy with a "none-of-your-business" attitude. In addition, many fishermen resented any interruption in their angling by someone motoring close to them and pulling alongside to inspect their catch. In doing this a great many remarks were heard to the effect that, "You chased the fish away," or, "The fish stopped biting when you came along." In an effort to eliminate this undesirable practice I obtained the creel census in a number of cases by stopping the boat a considerable distance from the fishing parties and requesting that the anglers count and identify the various fish in their creel without any interference by me. In each of these instances I then suggested some excuse for handling the fish myself. It was a rare occasion when the anglers had given a correct estimate of the number and/or species in their catch. For this reason the word of very few anglers was taken when recording catch data. I do not believe this error on the part of fishermen was deliberate--it was just that they believed a guess was sufficient information.

there had been considerable advance publicity (in local newspapers and by posters placed at all principal boat landings) to make the anglers aware that a creel census was in progress, the majority were ignorant of the whole project. This handicapped the collecting of data because the fishermen failed to cooperate. A great deal of time was spent in chasing the anglers and explaining the "what" and "why" of the census. By the time the fishermen were run down, their creels checked, and the census explained, twenty to thirty minutes had been spent censusing each boat. This difficulty, coupled with the fact that most of the fishing was done during the evening hours and ended abruptly as darkness fell, made the sampling very inefficient. In order to avoid this loss of time while gathering "completed records" (due to the necessity of explaining the census to each fisherman), the practice was begun on July 25 of contacting fishermen while they were fishing, explaining the nature of the census, and obtaining records on their fishing up to that time. By this method the clerk obtained records on fishing trips which had not yet been completed ("partial census") as well as records of finished fishing trips ("completed census"). This practice of obtaining both "completed" and "partial" records was continued throughout the summer.

In a preliminary analysis of the "partial" and "completed census" records a significant difference was found in the catch per hour for the two types of censuses. Furthermore it is concluded that the difference was a matter of error in the "partial census" method, for reasons discussed later. Therefore the present report is based primarily on the "completed census" records. There is a section devoted to a comparison of the two census methods.

Counts of boats containing fishermen were made by anchoring in a position from which the entire area of the lake could be seen. The use of field glasses made it possible to determine whether or not occupants of distant boats were fishing. It was not practical to attempt to distinguish between the private and the livery boats, a practice which would have involved motoring around the lake and which would have left too little time for other phases of the study.

Boat counts were made one day per week, and on successive days of the week progressively throughout the season (most Thursdays omitted). The first count was made on Monday, June 25, during the week of June 20-26, the second count on Tuesday, July 2, et seq., ending October 14. On each of these days, counts were made at two-hour intervals--at 7:00 a.m., 9:00 a.m., 11:00 a.m., etc., to 9:00 p.m.; or at 8, 10, 12, 2, etc. to 10:00 p.m. The first count in the morning was made the hour following the first appearance of fishermen, the final count for the day was the last hour when fishermen were present or before darkness made counting impossible. Length of fishing day was recorded as the time interval during which fishermen were on the lake. In addition to the boat counts made every two hours, many other counts were taken at different times of the day throughout the season. Since the only boats counted were those engaged in fishing (trolling, casting, or still-fishing), the boat counts are used to estimate the total fishing intensity and fish yield for the season.

Vertical temperatures were not taken as requested in the work program because no equipment was available until too late in the season. A few observations were made on the food habits of some fishes, but they

were not extensive enough to include in this report. So much time was required to conduct the census that few examinations of stomach contents were made. Observations on the presence of young game and forage fishes in the lake are given elsewhere in this report.

Air and water temperatures were recorded throughout the season except for a two-week period following theft of the water thermometer. A discussion of temperature records is given later in the report.

Number and Residence of Anglers Censused (Table 1)

In all, 1,633 fishermen were censused after they had finished a fishing trip. Of these, 1,094 (67.01 percent) gave their residence as Washtenaw County. The next largest group of anglers, (430, or 26 percent), came from Wayne County. Only 53 (3.24 percent) out-of-state anglers were recorded; 44 of these came from Ohio. Residents of 16 Michigan counties and six different states fished Whitmore Lake at some time during the season.

Fishermen who gave the village of Whitmore Lake as their residence were included in the Washtenaw County tally. Since the lake lies partly in Livingston County, a number of the anglers giving Whitmore Lake as their residence were incorrectly classified as residents of Washtenaw County when in reality they were residents of Livingston County. When collecting data, the clerk asked anglers their city and state of residence. Consequently, it was impossible to separate the angling records of people who lived in the Livingston County part of the lake from those inhabiting the Washtenaw side.

It will be interesting to note in subsequent censuses what proportion of the anglers come from Wayne County. During most of the time this census was conducted, gas rationing was in effect, a factor

Table 1.--Residence of Anglers Based on Percentage of Total.

State or Michigan county of residence	Complete census	Partial census
Calhoun	0.1	0.0
Genesee	0.1	0.3
Huron	0.0	0.04
Ingham	0.4	0.1
Jackson	0.3	0.2
Kalamazoo	0.1	0.04
Kent	0.1	0.3
Lenawee	0.1	0.0
Livingston	0.0	0.1
Mackinac	0.1	0.0
Monroe	0.6	0.8
Muskegon	0.0	0.04
Oakland	1.0	1.23
Ogemaw	0.3	0.1
Saginaw	0.0	0.1
St. Clair	0.2	0.2
St. Joseph	0.2	0.1
Shiawassee	0.1	0.0
Washtenaw	67.0	65.3
Wayne	26.3	28.5
Illinois	0.1	0.1
Indiana	0.2	0.4
Kentucky	0.1	0.04
Louisiana	0.0	0.1
New Jersey	0.1	0.04
New York	0.0	0.04
Ohio	2.0	1.9
Pennsylvania	0.1	0.04
Unknown	...	0.1

which may have forced a greater than usual number of Wayne County anglers to fish Whitmore Lake because their driving range was limited to a few miles from home.

Sex of Anglers

Of the 1,633 anglers contacted throughout the season, 78.5 percent (1,281) were men and 21.5 percent (352) were women.

Fishing Methods and Baits Used by the Anglers

Data are available for 1,390 anglers on their fishing methods. This figure represents 85.1 percent of all anglers contacted in the completed census. The following table presents the data in detail:

	Still-fishing	Trolling	Casting	Still-fishing, casting and trolling	Trolling and casting
Number of anglers	1,165	77	83	59	6
Percent of total	83.8	5.5	6.0	4.2	0.4

Data on bait preference are available for 1,393 anglers, or 85.3 percent of the total number of anglers contacted by the completed type census. The following table presents the data in detail:

	Natural Baits*	Artificial Baits**
Number of anglers preferring	1,245	148
Percent of total	89.4	10.6

*Worms, grubs, crickets, grasshoppers, crayfish tails, minnows, and frogs.

**Plugs, spoons, spinners, and flies.

Those anglers who used a spinner with natural bait were tabulated as using artificial bait.

Number, Average Size, and Species Composition of the Catch

In the completed type of census, 6,892 fish were enumerated. Table 2 gives the percent of total for each species recorded for the entire season.

Bluegills (5,306) made up approximately three-fourths of the catch. The average length of 114 of these bluegills, selected at random, was 6.9 inches. Because the number of fish measured was so small in proportion to the total, it is doubtful whether this figure is valid.

The yellow perch was the second most abundant panfish in the anglers' catches. It constituted 11.2 percent (772) of the total. Sixty-seven fish of this species were measured. Their average length was 6.8 inches. The number of yellow perch measured may have been too small to give a very accurate average. However the low, measured, average size was consistent with fishermen's reports of small average size for this species in Whitmore Lake.

The principal game species of large size encountered during the census were the largemouth bass and the northern pike. During the entire census 161 largemouth bass (2.3 percent of the total) and 45 northern pike (0.7 percent of the total) were recorded. Measurements were made of 66 largemouth bass and 39 northern pike, to provide average total length figures of 12.7 and 19.8 inches, respectively.

Other species represented in the completed census together with the percent of the total number are as follows: Bullheads, 2.5 percent;

Table 2.--Species composition of the catch for the completed type of census.

	Large-mouth bass	Small-mouth bass	Blue-gill	Yellow perch	Pumpkin-seed	Black crappie	Rock bass	Northern pike	Bull-heads	War-mouth bass
Number	161	17	5,306	772	202	77	133	45	173	6
Percent of total	2.3	0.3	77.0	11.2	2.9	1.1	1.9	0.7	2.5	0.1

pumpkinseeds, 2.9 percent; rock bass, 1.9 percent; black crappie, 1.1 percent; smallmouth bass, 0.3 percent; and warmouth bass, 0.1 percent.

Total Weight of the Fish Recorded in the Completed Type of Census

Only a few of the fish seen in the completed census were weighed, and these figures were not used in the estimated total weight calculations. A rough estimate of the total weight is derived by using the size distribution of the Whitmore Lake fish which were measured, together with average length-weight data for these species as given by Beckman.[1] Lengths of Whitmore Lake fish were grouped in frequency classes as follows: 20 mm. classes, northern pike; 10 mm. classes, largemouth bass, smallmouth bass, and crappie, 5 mm. classes, bluegills, pumpkinseeds, yellow perch, and rock bass. The total weight of all fish measured was computed by using a weight value corresponding to the mean of each length class. The total weight of all fish recorded in this type census was calculated by direct proportion, assuming that the measured sample was representative. From general observations on the size of all fish seen during the census, it is believed that the measured samples were fairly representative. In the case of the bullheads, and warmouth data on length-weight relationship have not been summarized by Beckman. The weight of these fish was estimated, by reference to records in the I.F.R. files.

The estimated total weight of the 6,892 fish recorded in the completed type of census is 1,974 pounds. The total estimated weight for each species is as follows: Largemouth bass, 226 pounds; smallmouth bass, 27 pounds; bluegills, 1,273 pounds; yellow perch, 111 pounds;

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[1] W. C. Beckman, I.F.R. Report No. 1065

pumpkinseeds, 62 pounds; black crappie, 40 pounds; rock bass, 38 pounds; northern pike, 82 pounds; bullheads, 113 pounds; and warmouth, 1 pound.

The above method of calculating total weight of fish from Whitmore Lake has several sources of error, as follows: The number of length measurements was relatively small. The Whitmore Lake fish might have a somewhat different length-weight relationship from the state-wide average. Table 3 gives the total number of fish recorded, number measured, number measured as percent of total number recorded, average total length by species, estimated total weight of all fish censused, and the mean calculated weight for each species in the completed census.

Length of the Fisherman Day and Total Hours of Angling Censused

There were 4,548.5 hours of angling recorded in the completed census. The average fisherman spent 2.79 hours per fishing trip.

Fishing Intensity and Fishing Success at Different Times of Day

For hourly variation in fishing intensity the completed census records were analyzed on a basis of 3-hour periods: 9:00 a.m. - 12:00 p.m., 12:00 p.m. - 3:00 p.m., etc. There were so few anglers fishing from 12:00 a.m. to 9:00 a.m. that this interval was considered as one time period. The 3-hour period was selected as closely approximating the average length of the fisherman day (2.79 hours). By this method the fishing intensity at different times of day (expressed as percent of total anglers) is as follows: 12:00 a.m. - 9:00 a.m., 6.0 percent; 9:00 a.m. - 12:00 p.m., 16.2 percent, 12:00 p.m. - 3:00 p.m., 14.5 percent; 3:00 p.m. - 6:00 p.m., 12.0 percent;

Table 3.--Total number of fish censused, number measured, percent of total measured, average total length, estimated total weight of fish measured, total estimated weight of all fish censused, and mean calculated average weight of Whitmore Lake fish, 1945.

Species	Total number of fish recorded	Number measured	Percent of total measured	Average total length[1]	Estimated total weight of fish measured (pounds)	Total estimated weight of all fish censused (pounds)	Mean calculated average weight (ounces)
Largemouth bass	161	58	36.02	13.5	77.9	226.0	21.8
Smallmouth bass	17	6	35.3	13.2	8.5	27.1	22.4
Bluegill	5,306	113	2.1	6.9	27.1	1,273.2	3.8
Yellow perch	772	67	8.7	7.0	9.6	111.5	2.3
Pumpkinseed	202	13	6.4	7.1	3.0	62.1	4.9
Crappie	77	7	9.1	9.4	3.7	40.4	8.4
Rock bass	133	6	4.5	7.2	1.7	38.3	4.6
Northern pike	45	39	86.7	19.8	73.2	82.2	30.0
Bullheads	173	15	8.7	10.7	...	113.5[2]	...
Warmouth	6	...	...	...	...	1.0[2]	...

[1] Computed from empirical data.

[2] Complete data on length-weight relationship lacking.

6:00 p.m. - 9:00 p.m., 39.3 percent, 9:00 p.m. - 12:00 a.m., 12.0 percent. Since the data were analyzed by sorting the census cards into boxes labelled with the time period, there was some overlapping because all the anglers did not begin and stop fishing within a selected period. In this case the anglers were assigned to the period in which they had done most of their angling. Data on those fishermen who fished through several periods were discarded.

Because there were considerable overlapping and some discarded data, the validity of the three-hour method was tested by using a more sensitive one-hour method which classified all the time spent fishing by every angler. In the one-hour method the sum of the number of anglers fishing in any one hour was obtained. In order to compare the two methods the one-hour data were lumped into corresponding three-hour totals. The greatest error in the three-hour method occurred for the 6:00 p.m. - 9:00 p.m. period where the three-hour method gave a higher percentage of anglers fishing (Table 4). The amount of difference is probably not significant.

The data on distribution of anglers throughout the day are summarized from the completed creel census cards, and their accuracy is dependent upon a constant proportion of the anglers being censused throughout the day. The best check on this question is derived from the boat-count data, which are a direct measurement of all fishing. The boat-count data, obtained on an hourly basis, were lumped into three-hour time intervals for a comparison with the census data on distribution of anglers (Table 4). Inspection of Table 4 shows that there was little difference between the three techniques used in determining the distribution of fishing intensity during the average day.

Table 4.--Fishing intensity at different times of day (expressed as percent of total anglers).

	12:00 a.m.-9:00 a.m.	9:00 a.m.-12:00 p.m.	12:00 p.m.-3:00 p.m.	3:00 p.m.-6:00 p.m.	6:00 p.m.-9:00 p.m.	9:00 p.m.-12:00 a.m.
Three-hour period	6.0	16.2	14.5	12.0	39.3	12.0
One-hour period	9.2	14.7	16.4	12.8	31.9	15.0
Boat-count data	4.5	14.3	11.9	16.6	36.1	16.6

Figure 3 illustrates the fishing success in terms of catch per hour for the different time groups. The trend of the average catch per hour agrees somewhat with the fishing intensity. The conclusion might be drawn from this agreement that the fishing success on an average day grew better as the fishing pressure increased. On the other hand, if the anglers were aware of a better fishing time, the majority of them would fish then. At any rate the greatest amount of fishing was done when the average catch per hour was highest.

The Number of Unsuccessful Anglers, Fish Per Fisherman, and Catch Per Hour

Approximately 23 out of every hundred anglers caught no fish at all. The unsuccessful anglers fished, on the average, 2.4 hours while the fishermen who caught one or more fish spent 2.8 hours on the lake. Apparently the fishermen catching some fish were induced to stay longer in hopes of adding to their creel.

In creel census work there is always the criticism that fluctuations in the average catch per hour from week to week throughout the season do not reflect the quality of the fishing, but are due to changes in the skill of the angling population. If the same anglers fish a lake throughout the season, the proportion of unskilled anglers remains constant, and other things being equal, any change in the average catch per hour summarized weekly, bi-monthly, or monthly will be directly due to changes in the fish population which contribute to successful or unsuccessful angling. However, in Whitmore Lake the angling population was in a continual state of flux due to mid-summar immigration of resorters. It might be logical to assume that those anglers who are more familiar with the lake, its fishing grounds, and other factors which make for a successful fishing trip, have a definite influence

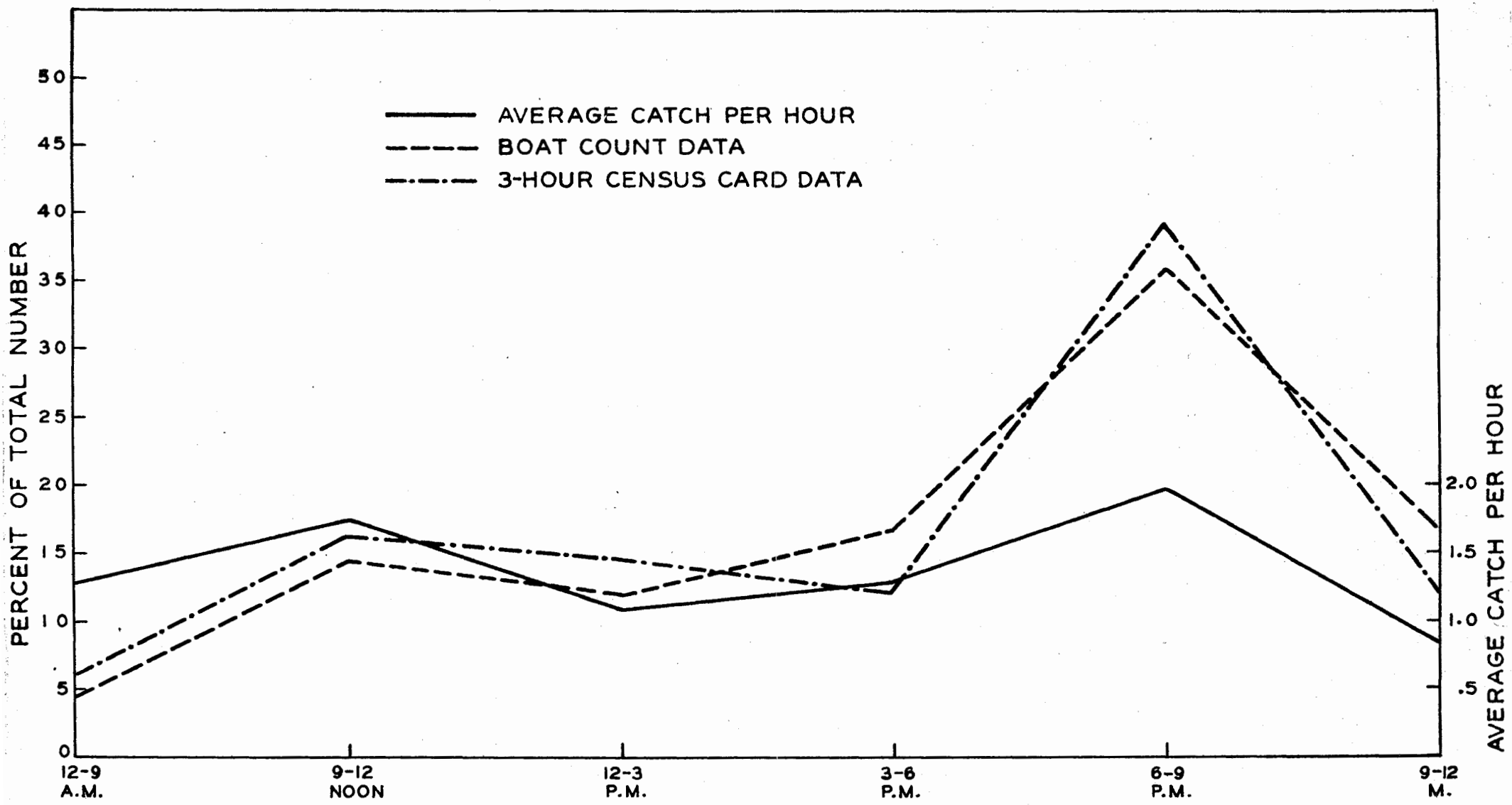

Figure 3.--Graph showing fishing intensity (calculated from the boat-count data and completed type census cards) and the average catch per hour at different times of the day.

toward increasing the catch per hour. The opposite effect on the catch per hour is expected from resort people who are handicapped by lack of knowledge of the factors which contribute to successful fishing. Consequently, the author presents the following evidence that the immigrating resorters had little effect in bringing about the observed fluctuations in the average weekly catch per hour.

That the resort people were the cause of the weekly oscillations of the catch per hour was suspected when a test of correlation was made between the average weekly catch per hour and a corresponding weekly percent of unsuccessful fishermen. The fact that as the percent of unsuccessful anglers in any one week increases or decreases, the catch per hour will decrease or increase, respectively, goes without saying. However, it does not answer the question as to whether or not the change in the catch per hour is due to a difference in the fishing quality or to an increase or decrease in the number of unskilled anglers fishing the lake. At any rate the correlation between the average weekly catch per hour and the percent of unsuccessful fishermen for 16 corresponding weeks was -0.754, a value which is much greater than the lowest (0.623) required for significance at a 1 percent level according to Fisher (1944). It is to be noted that the correlation coefficient obtained was negative. In other words, as the percent of unsuccessful fishermen became greater, the catch per hour for a corresponding period grew smaller. As mentioned earlier, these computations merely confirmed an obvious condition. In order to arrive at some conclusion as to which factor--an increase in the number of unskilled fishermen or a change in the quality of the fishing--caused the ups and downs in the average weekly catch per hour, the following deductions

were made. It was assumed that members of the local resident angling population were more accurately testing the fishing quality of the lake because they had advantageous knowledge of the most successful baits, location of fishing grounds, and other features of the lake which put them in a favorable position to catch fish if the fish were at all inclined to take a hook. The average non-local resident, on the other hand, lacked this helpful information and accordingly might be expected to be more likely to return home with an empty creel. Therefore, if the average catch per hour changed from week to week in accordance with the relative abundance of local resident fishermen, a significant positive correlation between the catch per hour and percent of local fishermen would indicate that the less-competent, non-local fishermen were causing the average weekly catch per hour to vacillate throughout the season.

The anglers who were considered to have the prerequisites necessary to qualify as local resident fishermen were arbitrarily designated as those who resided in Washtenaw County. It was not considered necessary to sort out and tabulate the number of anglers who gave their residence as Whitmore Lake alone, because most of the people who came from Washtenaw County fish the lake regularly and are acquainted with fishing conditions there. The correlation coefficient derived by comparing the average weekly catch per hour with the corresponding weekly number of fishermen residing in Washtenaw County expressed as a percent of the total anglers censused each week was a positive 0.259. According to Fisher (1944) a figure of at least 0.497 for a 5 percent level must be obtained to indicate a significant correlation. In other words, the correlation between catch per hour and percent of local anglers was not significant. The conclusions are that the proportion of non-local, unskilled fishermen to local, skilled anglers remained relatively

constant throughout the season, and that changes in fishing quality from week to week were not due to weekly changes in the relative proportion of skilled anglers, but to some other factor or factors.

Although the effect of a varying number of unskilled anglers using Whitmore Lake during the summer of 1945 was not potent enough to exercise a significant influence on the validity of the average weekly catch per hour as a test of seasonal changes in fishing quality, such a condition conceivably might occur in subsequent years and on other lakes. For this reason some improvements in the evaluation of skill in angling, either by direct or indirect methods, are desirable, in addition to the present method of recording residence. Knowledge of the particular water, amount of experience in fishing, and skill in the use of tackle, etc., should be considered.

The catch per hour statistic is one of the most important features derived from creel census data. Theoretically it is the index to angling success and therefore a measure of the factors controlling the yield of fish from the lake to the fishermen's creel. From it are drawn conclusions on the success or failure of stocking policies, management programs, and estimates of the game fish production, to mention some of its more important uses.

The mathematical validity of the catch per hour figure depends upon the condition that either an entire sample or an adequate random sample of all the fishing on a body of water be taken. In the author's opinion, the Whitmore Lake creel census was conducted in a manner which qualifies the data as being a random sample (see introductory section describing methods). Whether the data provided an adequate sample of the entire or parent angling population is not known. An "adequate sample" means simply that a sufficient numerical proportion of the

parent angling population has been censused to insure that the summarized data accurately depict the whole. The "sufficient numerical proportion" in turn depends upon the size of, and the amount of variation within, the parent population. For example, a larger proportion of the fishermen need be censused on a lake which in a season was visited by ten thousand anglers whose catch per hour exhibited a large deviation from the mean, than from a lake fished by twenty thousand anglers whose catch per hour had little variation from the mean.

While it is not possible to predict the characteristics of the angling population on any particular lake before starting a census, it seems possible that a table giving the percent of the total fishing population necessary to sample for various combinations of fishing intensity and deviations could be prepared. Complete creel census data already in the Institute files probably could be used to prepare the table.

Then the first step in conducting a creel census for a new lake or for a new season would be to place several trained census clerks on the lake for one or two weeks to begin the work. A crew large enough to take sufficient records for the most extreme conditions would make the earliest records valid. Some system of analyzing the first one or two weeks' census records quickly would accompany this program. These records and the use of a method for estimating the entire fishing intensity during the period would place the lake at a certain level in the table mentioned above. The table would indicate what proportion of the angling must be sampled to give valid statistics. The number of census clerks could then be reduced to the number able to take the required number of records.

The following example illustrates the use of the above technique: A given lake, to be censused, lies within easy access to a city of 75,000 people. Consequently, the fishing intensity is expected to be high. A routine investigation of the number of cottages and boat liveries prior to the start of the census reveals that facilities are available for a potential 200 fishing trips per day. This estimate is based on the observations and is set very high. Part of our estimate is based on information obtained by talking with a local sportsmen's group, the boat livery owners, and interested residents on the lake. We then discover that our table, listing the percent of total fishing which must be sampled, indicates that a 50 percent sample will give valid results regardless of the deviation of the catch per hour where the fishing intensity is at least 200 fishing trips a day.

It is assumed that each census clerk can obtain records for 50 fishing trips a day, and five clerks are assigned to the lake. Thus we have set the estimated number of fishing trips high and assigned an extra man to take care of any unforseen increase in the fishing intensity.

The creel census records are summarized at the end of a week's time. The mean catch per hour per angler is calculated and the standard deviation computed. At the same time the census clerks have measured the fishing intensity by some approved method.

The week's summary indicates that the standard deviation of the average catch per hour per angler is low. The fishing intensity is less than the original estimate by 100 boats per day. Referring again to our tables we may find that for a lake having a fishing intensity of 100 boats per day and a low standard deviation in the catch per hour

per angler, only 20 percent of all fishing need be sampled. Since any one of the clerks is capable of censusing more than 20 boats a day, the other four men can be transferred to some other lake.

The author realizes that the method outlined above is a mere skeleton procedure for such a program. There are errors which are not accounted for, particularly in regard to adjusting the amount of censusing to fit seasonal changes in the intensity and quality of fishing. It will also be difficult to obtain data from different lakes having different deviations in the catch per hour on which to base our tables. However, some of these difficulties can be overcome by using a statistical approach to the problem. The foregoing suggestions apply only to the intensive type census and are intended to place the value of this method out of the "assumption" stage and onto more solid ground. At the present writing a great deal is "assumed" about the quality and quantity of sampling required for an intensive census where it is possible to obtain only part of the records of all fishing.

The Catch Per Hour

The catch per hour, based on all the hours of fishing and the total fish caught for the season as recorded in the completed census, was 1.52 fish per hour. The number of hours fished, total number of fish caught, the catch per hour, and the length of the fishermen day for all the anglers censused are summarized by weeks in Table 5.

Some completed creel census data are available for the fishermen using Manning's boat livery. These fishermen were mostly non-local, i.e., from outside of Washtenaw and Livingston counties. The following

Table 5.--Total hours of angling, number of fish and anglers censused, weekly average catch per hour, and weekly average length of the angler-day for the completed and partial type of censuses.

Period	Number anglers censused		Hours of angling census		Total fish recorded		Catch per hour		Length of angler-day (hours)	
	Complete	Partial	Complete	Partial	Complete	Partial	Complete	Partial	Complete	Partial
June 25-June 30	189	...	617.75	...	965	...	1.56	...	2.75	...
July 1-July 7	194	...	629.50	...	774	...	1.23	...	3.25	...
July 8-July 14	137	...	410.50	...	591	...	1.44	...	3.00	...
July 15-July 21	62	...	174.75	...	280	...	1.60	...	2.81	...
July 22-July 28	121	74	303.25	143.50	428	187	1.41	1.30	2.51	1.94
July 29-August 4	121	359	310.75	585.25	455	744	1.46	1.27	2.57	1.63
August 5-August 11	52	210	139.00	407.00	172	433	1.24	1.06	2.67	1.94
August 12-August 18	101	496	279.75	966.00	489	1,272	1.75	1.32	2.43	1.95
August 19-August 25	119	313	288.00	525.75	441	596	1.53	1.13	2.38	1.68
August 26-September 1	117	313	330.75	502.00	455	528	1.38	1.05	2.83	1.60
September 2-September 8	169	438	462.50	768.50	922	1,165	1.99	1.52	2.74	1.75
September 9-September 15	89	191	231.50	335.25	477	519	2.06	1.55	2.60	1.76
September 16-September 22	80	140	175.50	236.00	303	419	1.73	1.77	2.19	1.69
September 23-September 29	34	76	68.50	128.50	113	91	1.65	0.71	2.01	1.69
September 30-October 6	24	15	69.25	20.00	17	4	0.25	0.20	2.89	1.33
October 7-October 13	22	51	55.25	85.25	10	19	0.18	0.22	2.51	1.67
October 14	2	10	2.00	10.75	...	3	0.00	0.28	1.00	1.07
Total	1,633	2,686	4,548.50	4,713.75	6,892	5,980	1.52	1.27	2.79	1.75

data are considered insufficient to be anything but suggestive in nature. The table below lists the average catch per hour by weeks for Manning's data and for the completed census records.

Date	Manning's Boat Livery catch per hour	Completed census catch per hour
August 12 - 18	0.53	1.75
August 19 - 25	0.47	1.53
August 26 - September 1	0.37	1.38

A test of correlation between the above weekly average catch per hour figures resulted in a correlation coefficient of 0.968. The coefficient is significant at the 5 percent level but falls short of attaining importance at the 2 percent level, indicating that such a correlation is due to a significant relationship nineteen in twenty times. While the data are few, the relationship is suggested that all the anglers, no matter how unskilled, reflected the fishing quality in the average weekly catch per hour. In Manning's data, 945 hours of fishing were recorded; the number of hours in the completed census for this three-week period was 898.5. The number of anglers censused was: Manning's data - 214; completed census - 337.

Six resident anglers cooperated sincerely and kept detailed records of a large share of fishing from their cottages. In the author's opinion, some of the unsuccessful fishing trips were not recorded. Consequently the information presented may be criticized because of this error. The amount of omitted fishing is not considered very great. Their creel data are as follows:

Angler	Fisherman trips	Fisherman hours	Fish	Fish per hour
A	35	87.00	351	4.03
B	25	97.75	257	2.81
C	23	52.00	143	2.75
D	25	68.25	179	2.62
E	31	149.00	480	3.22
F	8	30.00	10	0.33

Angler "F" fished with fly and bait casting only. The others spent the majority of their time still fishing. Not enough information is available to make a correlation between the average weekly catch per hour achieved by these anglers and that for all anglers in the completed census. The catch per hour attained by these anglers was very high in comparison to all the anglers. In contrast, fishing from Manning's Boat Livery was very poor. The latter, however, did reflect a slight correlation with changes in the fishing quality for all the lake during a three-week period.

The Average Catch Per Hour Per Angler

In most creel census studies, average catch per hour over a given period has been calculated by lumping all fish caught and dividing by the total hours fished. By this method no record of the distribution (and degree of variation) of individual fishing quality is obtained, without which it is impossible to make statistical comparisons between averages. Furthermore, it is impossible to judge the significance of the difference between means unless this difference is very great. the logical procedure is to analyze the variability of the creel census data either on (1) the basis of the average catch per hour per angler,

(2) the average catch per hour of angling, or (3) fish per angler per trip. There is an important question of deciding which of the three methods should be used in analyzing data from future creel census programs of the Institute.

Figure 4 illustrates the frequency distribution of the catch per hour per angler in the completed census for the entire season. The range was from 0 to 19 fish per hour per angler, and the mean was 1.68 fish per hour per angler. Of all the anglers, 61.3 percent had poorer than average luck; 34.9 percent did better than average; and 3.8 percent fell within the range of average fishing.

It will be noted that the average catch per hour for all angling hours was calculated as 1.52, whereas the average catch per hour per angler for all anglers was 1.68. The difference between the two is due to the fact that the second figure is an average which is unweighted on the basis of angling time.

Some additional characteristics of the angling population became apparent when the catch per hour per angler was computed. Figure 5 depicts the distribution of the length of the fishermen's day and the catch per hour per angler for the corresponding fishing time. The majority of anglers who had better than average luck fished between 0 - 2.99 hours per trip. The anglers who fished longer than this had poorer than average luck, with the exception of 15 anglers who fished eight to nine hours apiece and did better than average.

The fact that a longer fishing trip was less successful than a shorter one may be due to either one or both of two factors. It was previously pointed out that fishing success varied throughout the day. An angler fishing several hours probably had varying success (in terms

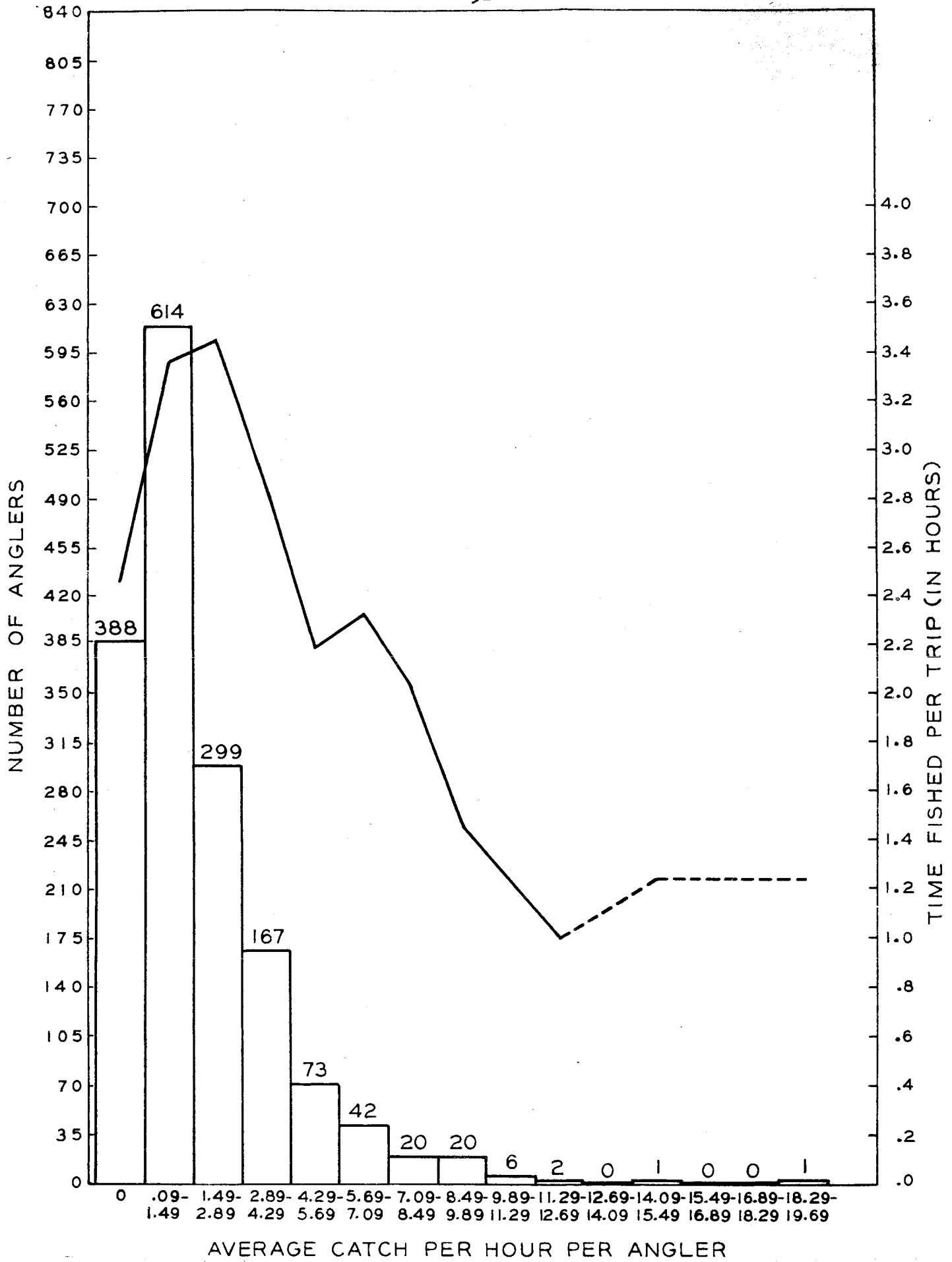

Figure 4.--A frequency distribution curve showing the number of anglers classified according to average catch per hour per angler groups, and a line graph illustrating the average length of time fished by each group.

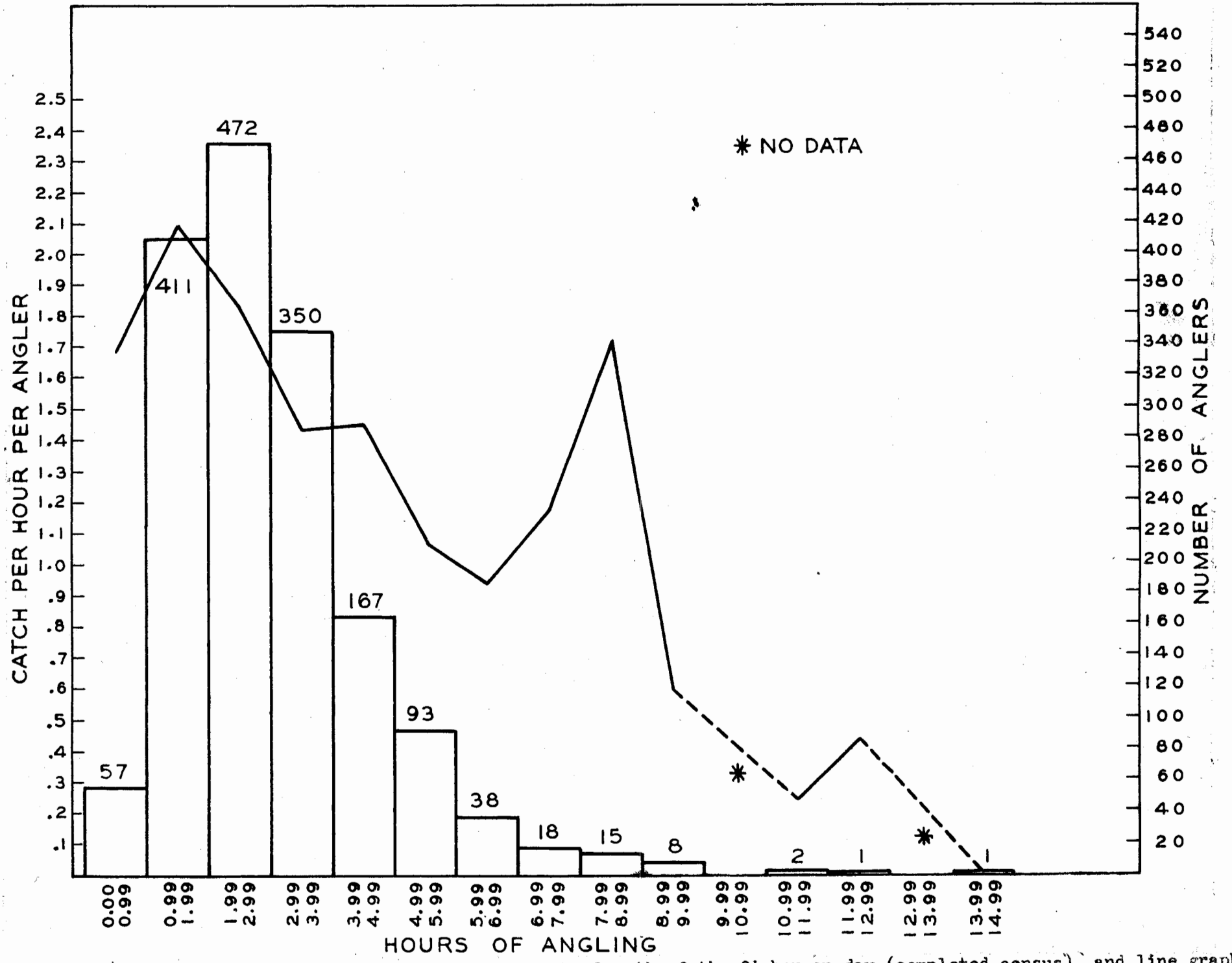

Figure 5.--Histogram showing the distribution of the length of the fisherman day (completed census), and line graph showing average catch per hour per angler attained by anglers fishing certain lengths of time.

of catch per hour) throughout his fishing trip. Since there were only two periods in the day when fishing was above average (9:00 a.m. - 12:00 noon, 1.74 fish per hour; and 6:00 p.m. - 9:00 p.m., 1.97 fish per hour), and these periods 6 hours apart, the chance that an angler fishing longer than 3 hours would hit two periods of better than average fishing is unlikely. This factor explains why the 15 anglers who fished 8 to 9 hours had above average luck. They fished through the two periods of good fishing mentioned above. The intervening periods of poor fishing (or no fishing) failed to drag their catch per hour below average. Those anglers fishing less than eight hours and more than nine, probably fished through more periods of poor fishing than good. Consequently, their catch per hour was lowered below average.

The Quality of Still Fishing with Certain Types of Lures

The still fishermen who used worms, grubs, crickets, and other natural baits (exclusive of minnows) caught 78.2 percent of all the fish observed by the completed census while fishing only 63.5 percent of the total time recorded.

The catch per hour figure for this class of angler was 1.87 for the season. The fishermen engaged in all other types of angling caught 0.90 fish per hour. Figure 6 illustrates the catch per hour by weekly periods for the still fishermen in comparison to the catch per hour for all fishing.

The Relationship of Air and Water Temperatures to Fishing Success

Beginning June 30, observations on the maximum and minimum water temperatures were made daily until October 14, except for a 2-week period when the water thermometer was stolen (September 1 - 15) and

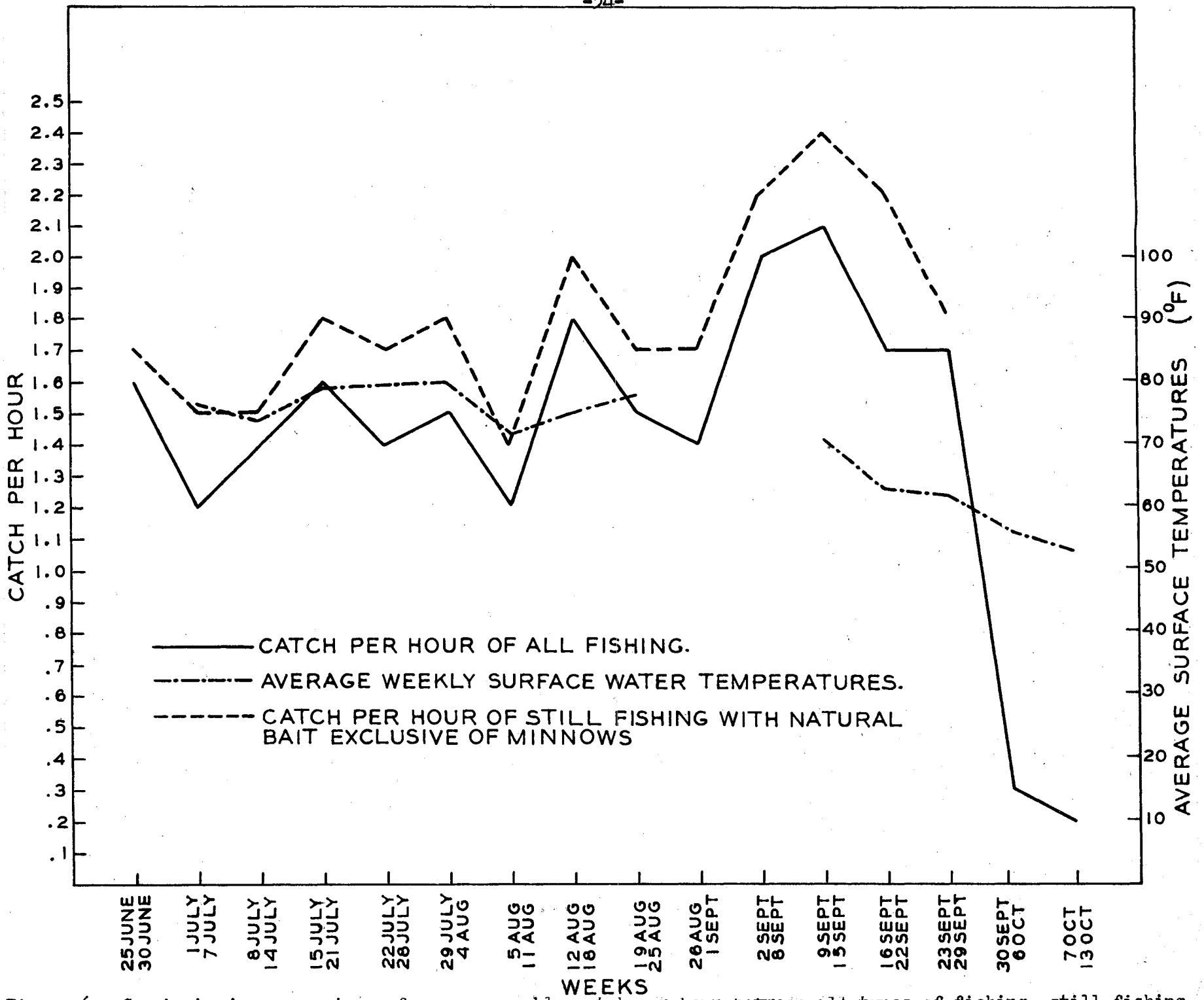

Figure 6.--Graph showing comparison of average weekly catch per hour between all types of fishing, still fishing with natural bait exclusive of minnows, and average weekly surface water temperatures.

5 days when the clerk was ill. Altogether there are records for 13 weeks. All temperatures were recorded as degrees Fahrenheit.

No data are available for maximum or minimum air temperatures after August 25. The air thermometer was used to take water temperatures when the water thermometer was stolen.

A test of correlation between the average weekly catch per hour and the average weekly maximum water temperature resulted in a positive correlation coefficient of 0.612. The correlation coefficient between the average weekly minimum water temperature and average weekly catch per hour was a plus 0.568. Both of these figures are significant at the 5 percent level. Apparently fishing success at Whitmore Lake was connected with surface temperature. As the water temperature increased, the fish bit better. When the water temperature dropped, the rate of catch decreased; average weekly surface temperatures and catch per hour are shown in Figure 6.

The correlations between average weekly maximum or minimum air temperatures and average weekly catch per hour were not significant. The correlation coefficient was greater for average weekly minimum air temperatures than for the average weekly maximum air readings. No relationship between air temperatures and catch per hour is indicated.

Estimated Total Fishing and Catch for the Season

One of the more important functions of the creel census is to arrive at an estimation of the total catch from a body of water. Where it is possible to obtain records from all the fishermen using a lake, the total number of fish recorded in the census is the total yield. However, for a census which samples only a part of the total fishing,

some method of estimating all the angling is necessary. The method used in this census was based on a number of boat counts made every 2 hours 1 day each week up to September 22 (after which it was possible to contact directly most of the fishermen). In addition, a good many other boat counts were made at other times throughout the day on specified boat-count days and on other days (See table 6 for boat-count schedule). All boat-count data were then tabulated on an hourly basis. An average value of all counts was then computed for each of these hour periods. The average fishing intensity in boat-hours per day was then figured as the total of the hourly averages.

No boat counts were made on days of adverse weather conditions. On such days the fishing intensity, on the average, was approximately 2 or 3 boats per day or less. Since only a few boat-count days (2-hour schedule) were involved during the season, the inclusion of such bad-weather days would have distorted the picture of the actual fishing intensity. For the period following September 21 it was estimated that 90 percent of all angling was included in the completed census. The total of normal fishing days was then computed by subtracting the total number of days (13.5) of adverse weather conditions and the number of days (22) remaining in the census after September 21 from the total number of days (110) in the census period. This left a total of 74.5 days when the fishing intensity was more or less normal.

Total fishing for the period from June 25 to September 21 was calculated as follows: The average daily boat hours of fishing totalled 346.0. This figure multiplied by the average number of anglers per boat (2.0, determined from records of all boats contacted) yields an estimated 692 angler-hours of fishing each day. The total angler-hours

Table 6.--Calendar showing dates on which boat-counts were made.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
June	(25)+	AP 26	A 27	28	29	30	...	...
July	...	...	...	...	...	...	1	...
	2	P (3)	P 4 +	° 5	P 6	P 7	P 8	...
	P 9	° 10	(11)	° 12	° 13	° 14	15	...
	16	17	18	(19)++	P 20	P 21	P 22	...
	P 23 °	P 24	P° 25	26	(27)	28	P 29	...
	P 30	31	...	...	...	...	...	...
August	...	...	A 1	P 2	P 3	(4)	PA 5	...
	AP 6	P 7	P 8	9	P° 10	P 11	(12)	...
	(13)	° 14	15	16	17	P 18	P 19	...
	A 20	(21)	P° 22	P 23	P 24	PA 25	P 26	...
	27	28	° (29)++	30	31	...	...	...
September	...	...	...	...	...	1	2	...
	3	4	5	(6)	7	8	9	...
	A 10	11	P 12	P 13	(14)	° 15	16	...
	17	18	19	20	21	...	...	...
Total	13	13	13	13	13	12	12	89
Total days of no fishing	2	2.5	4	2	2	2.5	0.5	15.5
Total number days when only a few boat counts were made	4	4	5	3	5	5	6	32
Total number days complete boat counts made	2	2	1	1	2	1	1	10

+ = Holidays
° = Days of little or no fishing
A = 1/2 day of little or no fishing
++ = No boat count made
P = Days when only a few boat counts were made
( ) = Boat counts scheduled

of fishing is then calculated: 692 x 74.5 = 51,554 hours of fishing. The estimated yield of fish equals the total estimated hours of fishing x the average catch per hour: 51,554 hours x 1.52 fish per hour = 79,909 fish. For the final period of the census, September 22 to October 14, a total of 140 fish was recorded, estimated to represent 90 percent of all fish (calculated as 156) caught during this period. The total for the period from June 25 to October 14, inclusive, was 79,909 plus 156, or 80,065 fish. The number of fish taken during the 13.5 bad-weather days during the summer undoubtedly was an insignificant addition to this total.

The production in pounds of fish is derived by calculating the weight of the fish caught up to September 22. This figure is estimated as 1,786.9 pounds, and since it is the estimated weight of the fish censused up to September 22, the weight of the total estimated number of fish removed from the lake is obtained by dividing 1,786.9 pounds by 8.44 percent, (the estimated percent of all angling hours contacted). The calculated weight of fish removed from the lake was 21,171 pounds. The weight of the fish removed after September 22 is estimated (by the method described above) to have been 37 pounds. The total calculated weight of fish caught during the season is 21,208 pounds. Since the lake is 677 acres in area, the total season's estimated production of fish is 31 pounds per acre.

There are two considerable sources of error in the above estimations. First of all the number of boat counts made seems hardly sufficient to show an adequate picture of the fishing intensity on which the whole estimation depends. It is felt that the average number of boat-hours of angling per day was more nearly 200 to 300 hours. Estimates of the production based on the latter figures would be 18.1 pounds to 27.2 pounds per acre.

It is indeed unfortunate that the values for the total estimated production cannot be given with more certainty. The method of estimating the total fishing intensity has had no prior test to determine the frequency with which the boat counts should be made in order to give valid results. This information is readily available from creel census data in the Institute files and can be tested as follows: the creel census data from a lake which has had a reasonably complete sampling should be used. It is assumed that a man is on the lake counting boats every hour. Each creel census blank represents one or more anglers fishing on the lake. The blank also indicates what time the angler or anglers were on the lake. Then for each hour on the hour we tally his fishing time on a data sheet. This is done for all the census records available that day. The next days' data are treated the same. For example, the records are sorted out by days. The first creel census card picked up indicates that one angler fished from 7 a.m. till 1 p.m. We put ourselves in place of the man counting boats on the lake. Our boat count will be made beginning 15 minutes before the hour and stopped before the hour or until all boats are counted. This angler will then be tallied as seen fishing at 8 a.m., 9 a.m., 10 a.m., 11 a.m., 12 noon, and 1 p.m. A total of 6 hours fishing is recorded in the boat count. In this hypothetical case the amount of fishing tallied in the boat count agrees perfectly with the amount of fishing the angler actually did. Of course, if the angler had stopped fishing at 1:30 p.m. our estimated fishing time of 6 hours would have been one-half hour less than the actual time fished. If there are a large number of anglers fishing each day, the amount of time underestimated will probably be balanced with a reasonably equal amount of overestimated time. We can only discover this by conducting such a test. It is possible that a boat count

every 2 hours or even once each 3 hours will give adequate results. The average length of the fishing day will no doubt govern this procedure. If the average length of the fishing day is 1.5 hours on a particular lake, the amount of error in making a boat count once in 3 hours may be beyond the limits of producing good estimates.

Seasonal Variation of Angling Intensity and Number of Fish Caught

The number of anglers censused each week of the season does not reflect the true variation of angling intensity for different weeks of the census. During the first half of the census period the clerk spent considerable amount of time away from the lake while contacting cottage owners. As mentioned previously, although only one-third of the cottages were visited, the time required for picking up data from the residents usually amounted to two or two and one-half days per week. These days were not consistently the same days of the week because it was necessary to adjust the collecting when the cottagers would be at home. Therefore, the census records may not be equally representative of the angling intensity for different weeks. By the same token the figures for the number of fish caught in any week are not representative values. The same question might be raised for the catch per hour figures, but it is believed that no one day or even two days were so radically different in the rate at which fish were caught to have made the average weekly catch per hour figure invalid. These data are presented in Figure 7.

A Comparison of the Completed and Partial Type Censuses

In the beginning of this report it was mentioned that two types of census records were obtained from Whitmore Lake anglers. The "partial"

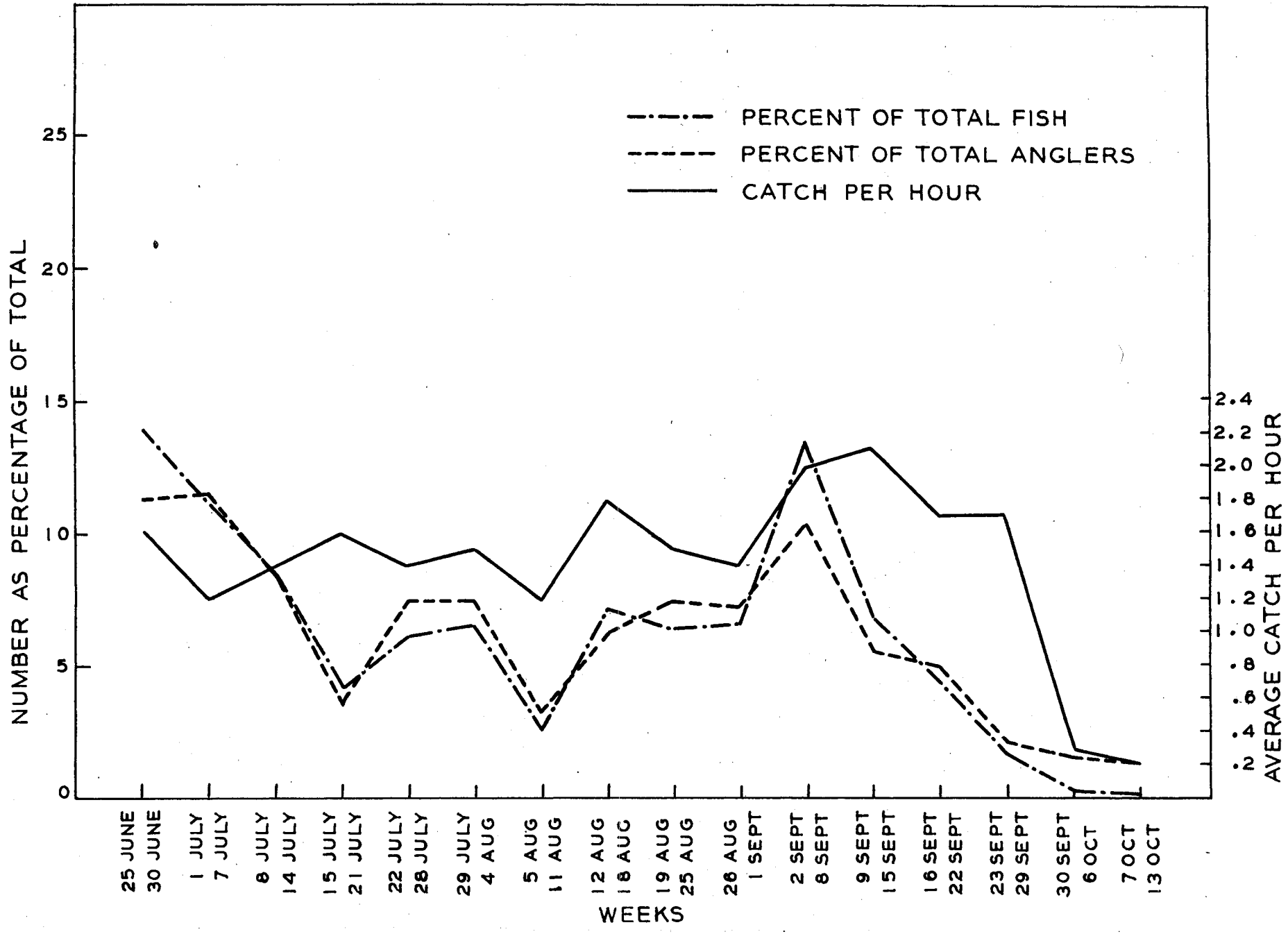

Figure 7.--Graph showing number of anglers, number of fish caught, and average catch per hour as measured in the completed census by weeks.

census data represent only a part of the fishing done by a party. The "completed" census records contain all the time fished and fish caught for each fishing trip. This is the first time a "completed" and "partial" census have been conducted simultaneously on the same lake. The partial type census was not begun until the middle of July. A weekly summary of both types of census data is given in Table 5. In sampling the angling population no effort was made to census a fishing party a single time only. Fishing time and catch by some of the fishermen appear in both types of census.

The differences between the results of the two types of census were examined critically by statistical procedures in order to determine their significance. This was done because the partial type of census was conducted, for the most part, in a manner similar to the state-wide "General Creel Census."

A total of 980 anglers and 2,423.00 hours fishing time are recorded in the completed census from July 25 to October 14, inclusive. At the same time 2,686 anglers and 4,713.75 hours of fishing were censused by the partial method.

In the completed census 80.9 percent of all the anglers were males. This set comprised 77.1 percent of the partial census. The percent difference is considered insignificant.

Of the 4,053 fish counted in the completed census, 84.1 percent were bluegills. In the partial census, 5,980 fish were observed, of which 79.8 percent were bluegills. A comparison of the species composition of the catch for other fishes is as follows: Yellow perch, completed census - 7.4 percent, partial census - 11.3 percent; largemouth bass, completed census - 1.9 percent, partial census - 2.0 percent. None of these differences appears to be anything but a normal variation.

The average length of the fisherman day was 2.57 hours in the completed census. The average angler had fished 1.75 hours prior to being contacted for the partial census. This difference is due to the fact that the partial census does not represent all the time a fishing party spent per angling trip.

The average catch per hour was higher (1.61 fish per hour) in the completed census than in the partial census (1.27 fish per hour). In order to test the significance of this difference between the two mean values, each angler's average catch per hour for the two types of census was computed. The daily or weekly average catch per hour figures were not used since they would give a less sensitive test. The average catch per hour per angler was 1.93 fish for the completed census and 1.45 in the partial census. The statistic t computed for these data is 2.032. This figure is significant at the 1 percent level (t = 2.607). The statistical conclusion interprets this to signify that the difference between the above mean values would be due to chance at least once, but no more than 5 times, out of 100 such censuses. The odds for significance are great enough to suggest the conclusion that, for Whitmore Lake, a partial creel census such as the general creel census would have given a false value for the quality of fishing in terms of catch per hour.

Since the partial census catch per hour figure was significantly low, it is assumed that the unsampled part of the anglers' fishing trips was the more successful in rate of catch. This may have been due to the fact that the earlier part of any angler's fishing trip consists of loading gear, rowing to a fishing spot, etc., which most anglers include as part of their fishing time. On the other hand the partial census

data may have been collected during the time of day when fishing was poor. A check on the percent of total anglers contacted by each type of census for different times of the day is given in Table 7. The relative percentages of sampling done in any of the time-periods by either method does not differ significantly. Therefore, the latter unsampled portion of the anglers' fishing trips not measured by the partial census was more successful.

Fishing Calendar

Among the many devices placed before the angling public to assure them of successful fishing is the well-known "fishing calendar." This item consists of a simple calendar which has the outline of a fish printed under each day of the month. Under the various dates the fish may be entirely black, partly black, or entirely blank. Above the calendar is a simple statement, "Blacker the fish, better the fishing...". On the days inscribed with a blackened fish silhouette fishing is supposed to be very successful. Of course the above statement is only relative. The fishing calendar which was examined is the product of Grady W. Coble of Greensboro, North Carolina.

The average weekly degree of blackness was calculated by translating the amount of darkened area into a mathematical figure. An entirely black fish was given a value of 1.0. A totally blank fish was considered as 0.0. The intermediate forms were estimated visually. There is probably some error in the estimates because the fish symbols are only 3/32-inch long.

The average weekly degree of blackness was then correlated with the average weekly catch per hour for corresponding weeks of the census. This correlation was so low (0.0585) that no relationship is indicated (Figure 8).

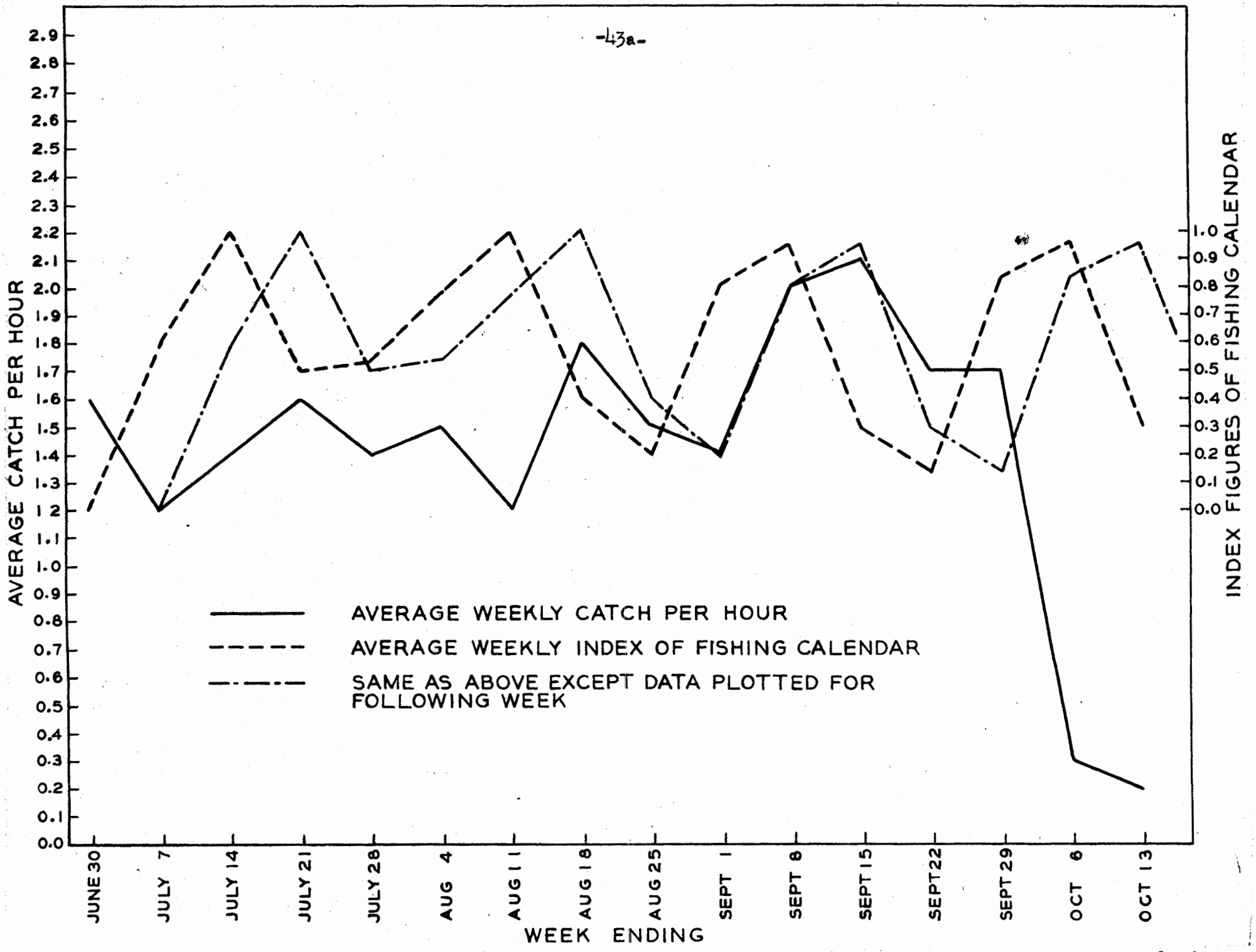

Figure 8.--Graph showing comparison between the average weekly catch per hour and index figures of the fishing calendar.

Table 7.--Fishing success and angling pressure for different periods in the average fishing day. (Angling pressure expressed as percent).

	12:00-9:00 a.m.	9:00-12:00 noon	12:00-3:00 p.m.	3:00-6:00 p.m.	6:00 9:00 p.m.	9:00-12:00 midnight	Total
Partial census	8.2	14.7	13.5	14.3	48.2	1.1	100.0
Completed census	7.7	14.4	9.9	12.7	52.6	2.7	100.0
	Average catch per hour per angler						
Partial census	1.34	1.28	0.91	1.20	1.76	0.66	1.45
Completed census	0.83	1.98	1.64	1.34	2.30	0.73	1.93

In graphing these data it was noted that the trend of the calendar's prediction for good and bad fishing had been made a week too soon. When these data for a particular average week's blackness were plotted with the following week's average catch per hour, the relationship was quite good. A similar comparison was made mathematically except that the last 2 weeks of the census were omitted. The correlation coefficient between these data was 0.4014. According to Fisher (1944) this figure is not sufficiently great to indicate a significant correlation for the 10 percent level. Although the correlation of these data is not significant, the trend of better or worse fishing is predicted by the fishing calendar (Figure 8). The fishing calendar successfully predicted the trend of fishing quality in 9 out of 13 weeks, but only when the forecast for any one week was applied to the following week's fishing. The mere fact that there is some sort of agreement between the fishing calendar and weekly changes in fishing quality places the device in the position of demanding further investigation in subsequent years.

Miscellaneous Observations

On June 30 a tremendous hatch of caddisflies appeared. This emergence continued to be abundant until July 9 when the population practically disappeared over night. A few bluegill stomachs examined during this period were bulging with caddis pupae or larvae. Coincident with the caddis hatch the average weekly catch per hour for the week of July 1 to July 8 dropped from 1.56 to 1.23 fish per hour from the previous week.

On July 30 swarms of 1-inch skipjacks appeared everywhere just below the surface of the lake. These juveniles generally swam about 3 inches below the surface but when frightened went to 24 inches.

They may have dove even deeper, but none were visible below this depth. At the same time this phenomenon was observed, large schools of bluegills were seen lying almost motionless just below the surface or with their backs out of water. A few bluegills were caught (with difficulty) from these schools and their stomachs examined. No microscope was available to absolutely identify the ingested food, but it is believed that the bluegills had been feeding on the young skipjacks. The average weekly catch per hour dropped from 1.46 to 1.24 fish per hour in the week following this observation.

On September 25 no more young-of-the-year gamefish were seen in shoal water. At this time experimental gill nets set in 15-30 feet of water caught a number of 1-1/2 - 2-1/2-inch bluegills in the small-mesh portion of the nets.

No seining was done to measure the abundance of young game fishes. General observations made while conducting the census seem to indicate that all young-of-the-year game fish were fairly abundant.

A number of anglers stated that they had never taken any black crappies prior to 1945. A few of the regular residents of the lake mentioned that they had taken black crappies in former years but not as many as during this summer. Most of the resident anglers I talked to believed that this species entered the lake through the Horseshoe Lake drain after this inlet was constructed.

Violations of Fishing Regulations

In the course of the creel census activities, 4,319 anglers (angler-days) were asked to show their fish for counting. The angler-days checked represented about one-fifth of the total for the season. Twenty violations in fishing regulations were observed. One of these anglers admitted

on his own volition that he had no license. The other 19 lawbreakers had either shorter fish or more fish than are allowed by law. Only one instance of repeated violation by an individual was noted.

In interpreting the above figures it must be kept in mind that the creel census clerk had no official interest in or authority to investigate violations. These 20 cases were recorded merely as a matter of interest. Law infractions would tend to make any total estimate on the low side, for the clerk had no way of knowing if an angler had too many fish or sub-legal fish concealed.

In each instance where a violation was observed, the census clerk requested the angler's cooperation in keeping within the law in the future. It was pointed out that the regulations were imposed in order that good fishing would be assured every angler and not the individual. Three of the miscreants stated that their violations were in no way inimical to the best interest of good fishing as based on reports they had read pertaining to fisheries management in other regions. It was explained to them that what may be good management for some lakes or regions may not be applicable everywhere, and that the creel census and other research conducted by the Institute for Fisheries Research was testing these things.

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