March 14, 1950

Report No. 1246

MUSKEGON LAKE CREEL CENSUS FOR THE SPRING AND SUMMER OF 1948

By

K. G. Fukano

ABSTRACT

A creel census was conducted on Muskegon Lake during the spring and summer of 1948. The purpose of the creel census was to determine fishing quality and to estimate the total amount of fishing and number of fish caught during the major part of the fishing season. A total of 15 different species of fish was caught by anglers during the census period. Yellow perch, bluegill, and rock bass were caught in largest numbers. Pan fish made up the bulk of total catch. Still fishing was the method employed by the majority of anglers. It is estimated that about 40,000 anglers (angler-days, not separate individuals) fished 136,000 hours and caught 133,000 fish. The catch per hour for Muskegon Lake was not so high as for other non-trout lakes in Muskegon County as determined by the 1948 general creel census. A summary of the general creel census reveals that the annual catch per hour has fluctuated greatly and it appears that the number of yellow perch caught is the factor influencing yearly catch per hour in recent years.

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By

K. G. Fukano

A creel census was conducted on Muskegon Lake from May 2 to September 27, 1948 by Floyd E. Simonis of the Institute for Fisheries Research. Records of two types of fishing were obtained: (1) boat fishermen and (2) shore fishermen. The purpose of this census was to evaluate fishing intensity and quality in Muskegon Lake. Obtaining a random sample of catch records, together with counts of shore fishermen and boat counts, permits an estimation of the total amount of fishing and total catch of fish. The creel census was made in connection with the overall study of the walleye in the Muskegon River System under the supervision of Dr. Paul H. Eschmeyer, then of the Institute for Fisheries Research.

A voluntary creel census was also taken by boat-livery operators who were interested enough to obtain catch records.

Method of the random census

The census method was patterned after the method developed by the late Henry E. Predmore, Jr. on the experimental lakes with liberalized fishing regulations. Anglers were interviewed, and shore fishermen and boats were counted, on certain days only, and these census days were chosen on a definite sampling pattern. The clerk made the counts from about six vantage points on the lake shore. Traveling between counting stations was done by car, since the large size of the lake made the use of a boat impractical.

The days on which the random census was conducted on Muskegon Lake and the hours when counts were made are given in Table 1. Catch records were obtained on 38 days, and a total of 114 counts were made on boats and shore anglers. For catch records, the clerk contacted only fishermen who had completed their fishing trips, and recorded number of anglers per party, time spent fishing, fish caught, and type of fishing. Bear Lake channel between Muskegon Lake and highway M 20, the north and south channels of Muskegon River, and Cedar Creek downstream from the west lane of highway US 31, were included in the creel census and counts. The Lake Michigan channel was not included.

Records for the two groups of anglers (shore and boat) were divided according to two seasons defined as follows: spring--the period from May 2 to June 24, inclusive; and summer--the period from June 25 to September 27, inclusive. The purpose of splitting the data into four parts was to determine if the fishing quality was significantly different for the four groups. The catch per hour for each angler was calculated, and the means were calculated and compared by the t-test based on the formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma x_1^2}{N_1} + \frac{\sigma x_2^2}{N_2}}}$$

The "catch-per-hour-per-angler" is different from the "catch per hour." In the latter the total number of fish taken is divided by the total number of hours spent fishing for all anglers combined. To compute the former, the number of fish caught by each angler is divided by the number of hours which that angler fished, thus determining his individual catch per hour. An average "catch-per-hour-per-angler" may then be computed as the mean of the values for individual anglers. The advantage of computing the catch-per-hour-per-angler is that the distribution and degree of variation of

Table 1. Dates on which clerk obtained creel census records by personal inter-
view with fishermen and the hours at which counts were made of
fishermen boats and shore anglers, spring and summer of 1948.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
May 2 (7-11-4)	May 3 (9-2-6)	May 11 (9-2-6)	May 12 (8-12-5)	May 20 (10-1-7)	May 21 (9-3-6)	May 29 (7-1-4)
May 30 (10-2-7)	June 7 (8-11-5)	June 8 (7-2-4)	June 16 (9-12-6)	June 17 (10-3-7)	June 25 (7-12-4)	June 26 (8-2-5)
		July 6 (7-11-4)	July 7 (9-2-6)	July 15 (9-12-5)	July 16 (10-1-7)	July 24 (9-3-6)
July 25 (7-1-4)	Aug. 2 (10-2-7)	Aug. 3 (8-11-5)	Aug. 11 (7-2-4)	Aug. 12 (9-12-6)	Aug. 20 (10-3-7)	Aug. 21 (7-12-4)
		Aug. 24 (8-2-5)	Aug. 25 (9-11-6)			
Aug. 29 (7-1-4)	Aug. 30 (10-2-7)	Sept. 7 (9-2-6)	Sept. 8 (8-12-5)	Sept. 16 (10-1-7)	Sept. 17 (9-3-6)	
Sept. 26 (9-2-6)	Sept. 27 (8-1-5)					

fishing quality is obtained; and it is then possible to make statistical comparisons
between the means or averages. The statistics on the Muskegon Lake census, sum-
marized by type of census and season, are partially summarized in Table 2. A
statistical comparison of the difference between means is given in Table 3.

Analysis of the creel census

In the present study the catch-per-hour-per-angler was used as the measure
of the fishing quality. In the several comparisons of angling quality, according
to type of census and season, there were only two instances, out of a total of 12
combinations of the records, where the "t" value was sufficiently large to be
significant at a 95 percent probability (i.e., unless a one-in-twenty chance has
occurred in the sampling). In one instance, livery data (voluntary creel census
data collected by interested boat livery operators) for the spring and summer were
significantly different, the spring fishing being better than the summer. The other

significant difference was found when comparing the summer shore fishing with the summer livery fishing (see Table 3). The summer shore fishing was better than the summer livery fishing, according to these data.

Probably not too much importance should be attached to the fact that the two instances of difference, cited above, were observed; for, in the same analysis of the records (Table 3), there were ten instances of comparisons which showed no difference at a probability level of 95 percent. In other words the data as a whole show a relatively high degree of uniformity in fishing quality, for the two seasons and three types of census data, so that the principal conclusion to be drawn from this analysis of the data is that the records, logically, can be lumped into seasonal totals.

A total of 15 species of fish was caught by anglers during the census period. Game fish taken were: largemouth black bass, smallmouth black bass, walleyes, and pike. Yellow perch, rock bass, bluegills, pumpkinseed sunfish, and black crappie were the species of pan fish caught. Suckers, white bass, dogfish, catfish, bullheads, and saugers were the species of non-game fish taken (see Table 4). The yellow perch, bluegill, and rock bass were the species taken in largest numbers in all the types of census.

For the spring shore fishing pan fish made up 99.1 percent and non-game fish the remaining 0.9 percent of the catch. For the summer shore fishing pan fish comprised 97.3 percent; game fish, 2.3 percent; and non-game fish 0.4 percent of the catch. The total shore fishing catch was made up of 98.3 percent pan fish, 1.1 percent game fish, and 0.6 percent non-game fish.

Pan fish constituted 91.8 percent; game fish, 4.5 percent; and non-game fish, 3.7 percent of the catch for spring boat fishing. For the summer boat fishing pan fish made up 90.5 percent; game fish, 7.0 percent; and non-game fish, 2.5 percent of the catch. The total boat fishing catch was made up of 90.7 percent pan fish, 6.6 percent game fish, and 2.7 percent non-game fish.

Table 2. Average catch by angling, Muskegon Lake, 1948,
analyzed according to type of census and season.

Type of census	Season	Number of anglers	Mean catch-per-hour-per-angler	Standard deviation	Standard error of the mean
Boat	Spring	60	0.73	1.4166	0.1828
Boat	Summer	253	0.91	1.2964	0.0812
Boat	Total	313	0.87	1.3197	0.0748
Shore	Spring	61	1.42	3.4125	0.4369
Shore	Summer	55	1.20	1.5176	0.2047
Shore	Total	116	1.31	2.6774	0.2486
Livery	Spring	61	1.24	1.6565	0.2121
Livery	Summer	111	0.75	0.7538	0.0714
Livery	Total	172	0.92	1.1762	0.0894

During the spring the livery fishermen caught 94.5 percent pan fish, 2.9 percent game fish, and 2.6 percent non-game fish. The summer livery fishing catch was made up of 81.6 percent pan fish, 17.9 percent game fish, and 0.6 percent non-game fish. For the total livery fishing pan fish, game fish, and non-game fish constituted 87.7 percent, 10.8 percent, 15 percent, respectively.

Still fishing was the method employed by the majority of anglers in all the types of census. In the boat census 70.0 percent were still fishing, 13.7 percent were casting, 3.2 percent were trolling, 10.5 percent used a combination of more than one method, and the method of fishing used by the remaining 2.6 percent was not given. In the shore census 94.0 percent were still fishing, 1.7 percent were casting and 4.3 percent did some casting and still fishing during a fishing trip. In the livery census 65.1 percent were still fishing, 9.3

Table 3. Analysis of differences between means of catch-per-hour-per-angler for different types of census and seasons.

Season	Type of census	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_1 - \bar{X}_2$	σ_D	"t"	P (%)
Summer-Spring	Boat	0.91	0.73	0.18	0.2000	0.9000	62
Spring-Summer	Shore	1.42	1.20	0.22	0.4825	0.4560	less than 50
Spring-Summer	Livery	1.24	0.75	0.49	0.2238	2.1895	96
Spring	Shore-Boat	1.42	0.73	0.69	0.4736	1.4569	85
Spring	Livery-Boat	1.24	0.73	0.51	0.2800	1.8214	92
Spring	Shore-Livery	1.42	1.24	0.18	0.4857	0.3706	less than 50
Summer	Shore-Boat	1.20	0.91	0.29	0.2202	1.3170	82
Summer	Boat-Livery	0.91	0.75	0.16	0.1082	1.4787	86
Summer	Shore-Livery	1.20	0.75	0.45	0.2168	2.0756	96
Total	Shore-Boat	1.31	0.87	0.44	0.2596	1.6949	90
Total	Livery-Boat	0.92	0.87	0.05	0.1166	0.4288	less than 50
Total	Shore-Livery	1.31	0.92	0.39	0.2642	1.4762	86

$\bar{X}_1$, $\bar{X}_2$ = means

σ = standard deviation

σ_D = standard error of difference of two means = $\sqrt{\dfrac{\sigma X_1^2}{N_1} + \dfrac{\sigma X_2^2}{N_2}} = \sqrt{\sigma_{\bar{X}_1}^2 + \sigma_{\bar{X}_2}^2}$

σ_X = standard deviation of population

$\sigma_{\bar{X}}$ = standard error of mean

$t = \dfrac{\bar{X}_1 - \bar{X}_2}{\sigma \text{Diff.}}$

P = probability of significance of mean difference. Above values approximations only.

Table 4. Monthly and seasonal summary of Muskegon Lake Creel census

	Male anglers	Female anglers	Unsuccessful anglers	Hours fished	Fish caught	Catch per hour	Perch	Rock bass	Bluegill	P'seed	L.M. bass	S.M. bass	Walleye	Sucker	Dogfish	Pike	Crappie	White bass	Catfish	Bull-head	Sauger
Shore fishermen																					
May	45	8	35	115.5	168	1.45	136	30	...	...	...	...	...	...	2	...	...	...	...	...	...
June (1 to 24)	7	1	3	22.0	59	2.68	55	4	...	...	...	...	...	...	...	...	...	...	...	...	...
Spring total	52	9	38	137.5	227	1.65	191	34	...	...	...	...	...	...	2	...	...	...	...	...	...
June (25-30)	5	1	3	14.0	36	2.57	1	...	35	...	...	...	...	...	...	...	...	...	...	...	...
July	28	9	13	132.5	166	1.25	6	10	140	7	1	1	...	1	...	...	...	...	...	...	...
August	10	...	6	21.5	18	0.84	...	12	5	...	...	...	1	...	...	...	...	...	...	...	...
September	2	...	1	10.0	2	0.20	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...
Summer total	45	10	23	178.0	222	1.25	7	22	180	7	1	3	1	1	...	...	...	...	...	...	...
Grand total	97	19	61	315.5	449	1.42	198	56	180	7	1	3	1	1	2	...	...	...	...	...	...
Boat fishermen																					
May	28	5	19	102.0	70	0.69	45	22	...	...	...	...	...	...	1	...	1	...	...	1	...
June (1-24)	25	2	12	85.0	64	0.75	31	21	...	...	...	...	...	...	2	6	3	...	...	1	...
Spring total	53	7	31	187.0	134	0.72	76	43	...	...	...	...	...	...	3	6	4	...	...	2	...
June (25-30)	65	9	15	294.5	356	1.21	70	49	136	67	19	...	...	...	3	8	2	...	2	...	...
July	40	3	19	173.5	82	0.47	18	29	15	10	2	2	3	...	1	1	...	1	...	...	...
August	74	6	27	266.0	185	0.70	71	21	45	15	11	4	...	...	1	1	3	11	2	...	...
September	48	8	13	196.5	297	1.51	159	25	60	38	3	5	1	...	1	4	...	1	...	...	...
Summer total	227	26	74	930.5	920	0.99	318	124	256	130	35	11	4	...	6	14	5	13	4	...	...
Grand total	280	33	105	1,117.5	1,054	0.94	394	167	256	130	35	11	4	...	9	20	9	13	4	2	...
Livery fishermen																					
May	38	4	12	179.0	271	1.51	41	185	...	...	...	...	5	...	1	3	29	...	...	4	3
June (1 to 24)	16	3	12	60.0	39	0.65	...	...	...	...	...	...	1	...	...	...	38	...	...	...	...
Spring total	54	7	24	239.0	310	1.30	41	185	...	...	...	...	6	...	1	3	67	...	...	4	3
July	96	15	37	448.5	347	0.77	54	39	174	16	23	2	32	...	...	5	...	2	...	...	...
Summer total	96	15	37	448.5	347	0.77	54	39	174	16	23	2	32	...	...	5	...	2	...	...	...
Grand total	150	22	61	687.5	657	0.96	95	224	174	16	23	2	38	...	1	8	67	2	...	4	3

percent were casting, 13.9 percent were trolling, 10.5 percent used a combination of more than one method, and the method of fishing for 1.2 percent was not recorded.

Estimated total fishing and total catch

An important objective of the creel census was to make an estimation of the total fishing and total catch from Muskegon Lake during the census period. Estimated hours, estimated anglers, and estimated catch were calculated separately for boat and shore fishermen for each season. Adding the four estimates gave the totals for the census period.

The seasonal estimates of the number of hours fished by boat anglers were obtained by multiplying the average number of anglers in a boat, average number of boats counted, the length of fishing day, and number of fishing days in that season. The seasonal estimate of anglers was calculated by dividing the estimated hours by the average number of hours the angler spends fishing. The estimated hours multiplied by the average catch-per-hour-per-angler gave the number of fish taken. For estimating totals on shore fishermen, the above procedure was used, except that individual fishermen were counted, rather than fisherman boats: average number of anglers (from counts), times length of day, times number of days to give total angling hours. The estimated totals of the fishing are given in Table 8.

The basis of the estimates of total fishing is the series of counts of number of boats (hence anglers in boats) and number of shore fishermen on the lake at periodic intervals of time (see Table 1 for counting schedule). Averaging these counts gives the average fishing intensity. Because the counting schedule did not involve exactly the same number of counts (for the season) for the different hours of the day, there are two possible approaches in averaging the results: (1) Obtain averages according to hour, giving 13 values to represent fishing density over a 13-hour day, and finally average these

Table 5. Analysis of residence of the 429 boat and shore
fishermen contacted on Muskegon Lake, 1948.

County or state of residence	Boat anglers			Shore anglers		
	spring	summer	total	spring	summer	total
Muskegon	57	203	260	61	43	104
Kent	...	16	16	...	3	3
Berrien	...	4	4	...	...	...
Ottawa	...	4	4	...	6	6
Eaton	...	2	2	...	...	...
Ionia	...	2	2	...	...	...
Wayne	2	...	2	...	...	...
Calhoun	...	1	1	...	...	...
Jackson	...	1	1	...	...	...
Mason	...	1	1	...	...	...
Newaygo	...	1	1	...	...	...
Oakland	...	...	...	...	2	2
Ingham	...	...	...	...	1	1
Illinois	...	3	3	...	...	...
Indiana	...	4	4	...	...	...
Ohio	...	2	2	...	...	...
Unknown	...	10	10	...	...	...
Total	59	254	313	61	55	116

Table 6. Frequency distribution of the numbers of
counts made on boats and shore fishermen,
according to hour of the day.

Hour	Spring	Summer	Total
7 A.M.	3	6	9
8	2	5	7
9	4	9	13
10	3	6	9
11	2	4	6
12 Noon	2	5	7
1 P.M.	2	5	7
2	4	8	12
3	2	4	6
4	3	6	9
5	2	6	8
6	4	8	12
7	3	6	9
Total	36	78	114

Table 7. Frequency distribution of numbers of fisherman-boats and numbers of shore fishermen, Muskegon Lake, 1948, from census schedule given in Table 1.

Number of boats counted	Spring	Summer
0	2	...
1	3	2
2	6	...
3	4	2
4	3	3
5	1	2
6	1	...
7	2	2
8	3	4
9	...	3
10	2	1
11	...	2
12	...	1
13	2	2
14	1	...
15	1	1
16	...	2
17	...	1
18	...	2
20	...	1
21	...	2
22	1	2
23	...	2
25	...	1
26	...	1
27	...	2
28	...	1
29	...	2
30	...	1
32	1	...
33	...	4
34	...	1
37	1	2
38	...	1
41	...	1
42	1	...
46	1	...
48	...	1
49	...	1
51	...	1
54	...	2
55	...	2
57	...	1
60	...	1
62	...	1
66	...	1
68	...	1
71	...	1
72	...	1
74	...	2
83	...	1
84	...	1
100	...	1
103	...	1
105	...	2
134	...	1
152	...	1
Total counts	36	78

Number of shore anglers counted	Spring	Summer
0	1	2
1	1	4
2	2	4
3	4	3
4	1	2
5	5	6
6	...	7
7	1	3
8	2	5
9	4	2
10	...	3
11	2	1
12	...	3
13	...	2
14	2	3
15	...	1
16	1	5
17	3	1
18	...	1
20	1	3
21	1	...
22	1	3
25	1	...
28	1	...
29	...	1
30	...	1
32	1	3
35	1	...
36	...	1
41	...	1
42	...	1
47	...	1
50	...	1
51	...	1
52	...	1
55	...	1
62	...	1
Total counts	36	78

Table 8. Calculated total angling and fish catch,
Muskegon Lake, May 2 - September 27,1948.

(For methods, see text)

Season and type	Anglers	Hours	Fish
Spring - Boat	4,062	13,338	9,783
Spring - Shore	3,504	7,898	11,181
Spring totals	7,566	21,236	20,964
Summer - Boat	26,496	97,447	88,677
Summer - Shore	6,175	19,984	24,003
Summer totals	32,671	117,431	112,680
Grand totals	40,237	138,667	133,644

Table 9. Summary of general creel census data for Muskegon Lake

Year	Number anglers	Hours fished	Fish caught	Catch per hour	Small-mouth bass	Large-mouth bass	Bluegill	P'seed	Rock bass	Black crappie	Yellow perch	Walleye	Pike	Musky	Sucker	Sauger	Catfish	Redhorse	White bass	Bullhead	Carp	Garpike	Sheeps-head	Dogfish	Brown trout
1933	175	722.5	785	1.09	7	19	184	66	50	...	22	427	10	...	...	...	...	...	...	...	...	...	...	...	...
1934	306	1368.5	2674	1.95	57	49	415	131	335	114	624	891	13	2	...	...	2	...	1	36	3	1	...	...	...
1935	705	2785.5	6393	2.30	70	118	1568	107	1779	796	1615	134	17	...	3	...	...	1	...	184	...	...	1	...	...
1936	580	2331.5	2698	1.16	95	93	255	198	561	280	988	170	29	...	8	3	...	...	2	15	...	...	...	1	...
1937	38	132.0	93	0.70	...	22	10	...	...	...	50	4	7	...	...	...	...	...	...	...	...	...	...	...	...
1942	91	242.5	190	0.78	11	1	121	...	17	...	1	30	9	...	...	...	...	...	...	...	...	...	...	...	...
1944	37	118.0	111	0.94	...	3	58	...	...	14	20	15	1	...	...	...	...	...	...	...	...	...	...	...	...
1945	112	464.0	1123	2.42	...	6	25	...	5	10	1072	5	...	...	...	...	...	...	...	...	...	...	...	...	...
1946	308	835.5	1048	1.25	13	3	197	90	54	13	657	12	7	...	...	...	...	...	...	...	...	..	...	2	...
1947	400	942.0	3084	3.27	...	8	75	...	148	130	2674	21	16	...	...	...	...	...	3	3	...	3	1	1	1
1948	375	960.0	2547	2.65	7	9	497	81	205	71	1412	8	6	...	4	...	...	...	245	...	...	...	...	...	...
1949	292	708.0	978	1.38	3	1	242	64	100	6	518	8	15	...	3	...	...	...	9	8	...	...	1	...	...
Total	3425	11610.0	21724	1.87	263	332	3647	737	3254	1434	9653	1725	138	2	18	3	2	1	260	245	3	4	3	4	1

13 values to give one value for the season. (2) To average all counts, irrespective of hour. Both methods were applied to the data on boat counts and shore-fishermen counts, seasons separately. The observed t values showed no significant difference in fishing intensity in these two approaches (data not included in this report), which means that there was good distribution within the boat-count schedule according to hours of the day.

General creel census data for Muskegon Lake

(Fishing records taken by Conservation Officers in the course of their regular patrols.)

The summary of the general creel census for Muskegon Lake (see Table 9) indicated that walleyes were caught in numbers from 1933 to 1936. Since that time only a few walleyes have been reported in the census each year. The catch per hour has fluctuated greatly and it appears that the number of yellow perch caught is the influencing factor in the yearly catch per hour in recent years. From 1933 to 1935 the catch per hour rose then dropped in the following two years. No records were received from 1938 to 1941 inclusive. From 1942 to 1945 the catch per hour rose again and then slipped in 1946 only to rise to a new high in 1947 since then the trend has been downward.

INSTITUTE FOR FISHERIES RESEARCH

K. G. Fukano

Approved by A. S. Hazzard

Typed by B. J. Bair

April 3, 1950

Mr. O. Hilding Carlson, President
Muskegon Conservation Club
881 Terrace
Muskegon, Michigan

Dear Mr. Carlson:

Enclosed herewith please find a copy of our Institute for Fisheries
Research Report No. 1246 entitled "Muskegon Lake Creel Census for the
Spring and Summer of 1948". This report includes a number of statisti-
cal tables including table No. 9 which reflects a summary of general
creel census data for Muskegon Lake including also 1949. As mentioned
in the abstract, the number of perch caught to a considerable degree
influences the catch per hour since they are taken in greater numbers
than any other fish. There is no way of knowing what percentage of the
total amount of fishing done in Muskegon Lake is reflected in this
general creel census. It does, however, bear out the contention of
you people that the walleyed pike production in recent years has been
relatively lower in Muskegon Lake than it was 12 to 15 years ago. The
important thing is to try to find why this has happened and what can
be done to restore better walleye fishing.

I trust that the additional work planned will shed some light on this.

Very truly yours,

F. A. WESTERMAN
Chief, Fish Division

FAW:vb
cc: J. T. Wilkinson
Education-Game
Dr. Hazzard