Original: Fish Division
cc: Inst. for Fish. Research
Education-Game
K. E. Christensen
C. T. Yoder
W. C. Latta

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

GERALD P. COOPER PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

May 28, 1957

Report No. 1515

CENSUS OF ANGLING, HOUGHTON LAKE, ROSCOMMON COUNTY, WINTER OF 1956-57

By

K. E. Christensen

Introduction

Houghton Lake was the site of an experiment in perch population control during the winter of 1956-57. Several conferences were held between Conservation Department personnel, bait dealers, sporting goods dealers, and resort operators during the fall of 1956. These local people expressed concern over the tremendous numbers of small yellow perch to be found in Houghton Lake. They felt that the perch population was detrimental to northern pike reproduction due to perch preying on the eggs and fry of the northern pike. Partial chemical treatment was considered as a management tool which could be employed. The local committee suggested that legalizing the taking of unlimited numbers of perch during the ice-fishing season might be a more immediate approach to the control of the perch. The Fish Division believed this procedure might be justified as an experiment.

A memorandum to the Director of the Department of Conservation, dated November 28, 1956, summarized the problem as outlined above, and recommended that the Conservation Commission under authority of Act 230, P.A. 1925, as amended "permit the taking of an unlimited number of perch with hook and line through the ice from Houghton Lake, Roscommon County, during the

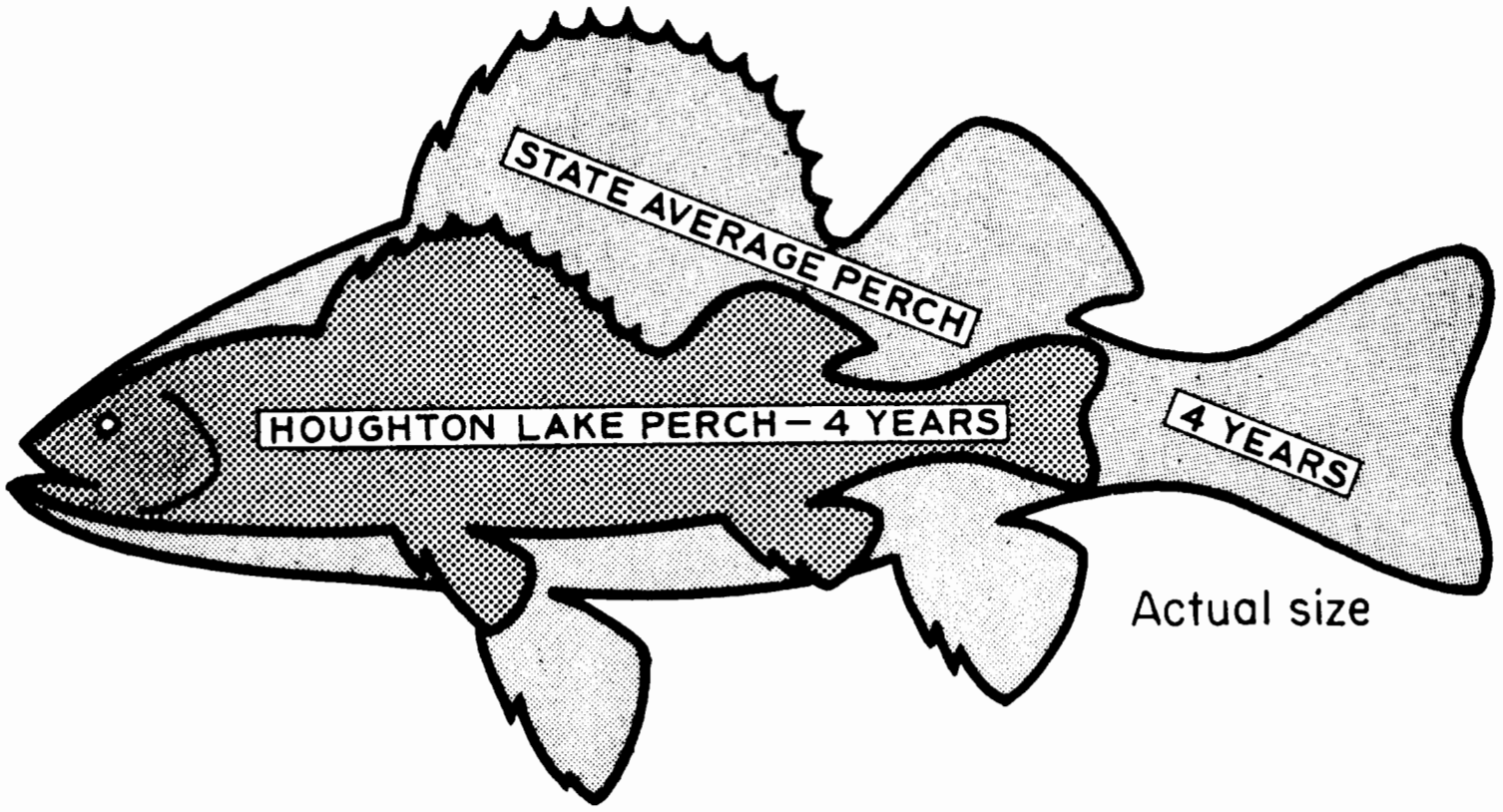
winter of 1956-57, the regulation to be effective immediately." The Conservation Commission concurred in the above recommendation at its meeting on December 14, 1956, and the regulation went into effect on that date.

The Fish Division gave the regulation wide-spread publicity. Handbills (Fig. 1), explaining the reasons for the special regulation on Houghton Lake, were printed and distributed through various business establishments in the area. On the handbill, the stunted condition of the perch was graphically illustrated by outline drawings of two four-year-old perch, one representing an average four-year-old from Houghton Lake (5.4 inches long), and the other a fish of average size for the state as a whole (7.5 inches long). The regulation was posted at many points around the lake and trash cans were provided for the disposal of unwanted perch.

The creel limit on perch in Houghton Lake was dropped during the winter of 1956-57 to see if anglers would remove a large number of small perch. If the abundant population of small perch could be greatly reduced, the supposition was that growth rate of perch would improve and more large perch would be caught by anglers in future years. To test this idea, we needed to know how many perch were removed by anglers in 1956-57, and the growth rate of perch. Growth rate in future years should also be ascertained. To obtain this information a census of angling on Houghton Lake was conducted during the winter of 1956-57, and studies are being made on the growth of perch and other game species in the lake.

Census methods

Mr. F. E. Simonis of the Institute staff secured the creel census records at Houghton Lake. Mr. C. T. Yoder, Regional Fisheries Supervisor, made an important contribution by counting fishermen's cars on the lake on several occasions during the winter; his counts were made from a department plane flown by Peter Van Valin.



PERCH ARE VERY NUMEROUS IN HOUGHTON LAKE and they grow slowly. Presumably the slow growth is a direct result of numbers--there are too many perch for the amount of food present. The above illustration shows the average size of Houghton Lake perch in comparison with the average perch from lakes in Michigan.

IF THE NUMBER OF PERCH COULD BE REDUCED, the remaining perch might make better growth. Consequently, the Conservation Department has set up regulations which permit fishermen to remove unlimited numbers of small perch during the winter season of 1956-1957. An employee of the Conservation Department will be at the lake during the ice-fishing season. He will be checking anglers' catches as a part of this experiment.

IF FISHERMEN WILL REMOVE A SUFFICIENT NUMBER, it may have some effect on growth of perch in Houghton Lake. The number and poundage of perch removed will be estimated from the creel census.

COOPERATION FROM FISHERMEN IS ESSENTIAL to the success of the experiment. Anglers should remove all small perch captured. Don't put them back in the lake. Trash cans have been provided for the disposal of unwanted perch.

This regulation was established by action of the Conservation Commission under authority of Act 230, P. A. 1925, as amended, at its meeting on December 14, 1956.

MICHIGAN DEPARTMENT OF CONSERVATION

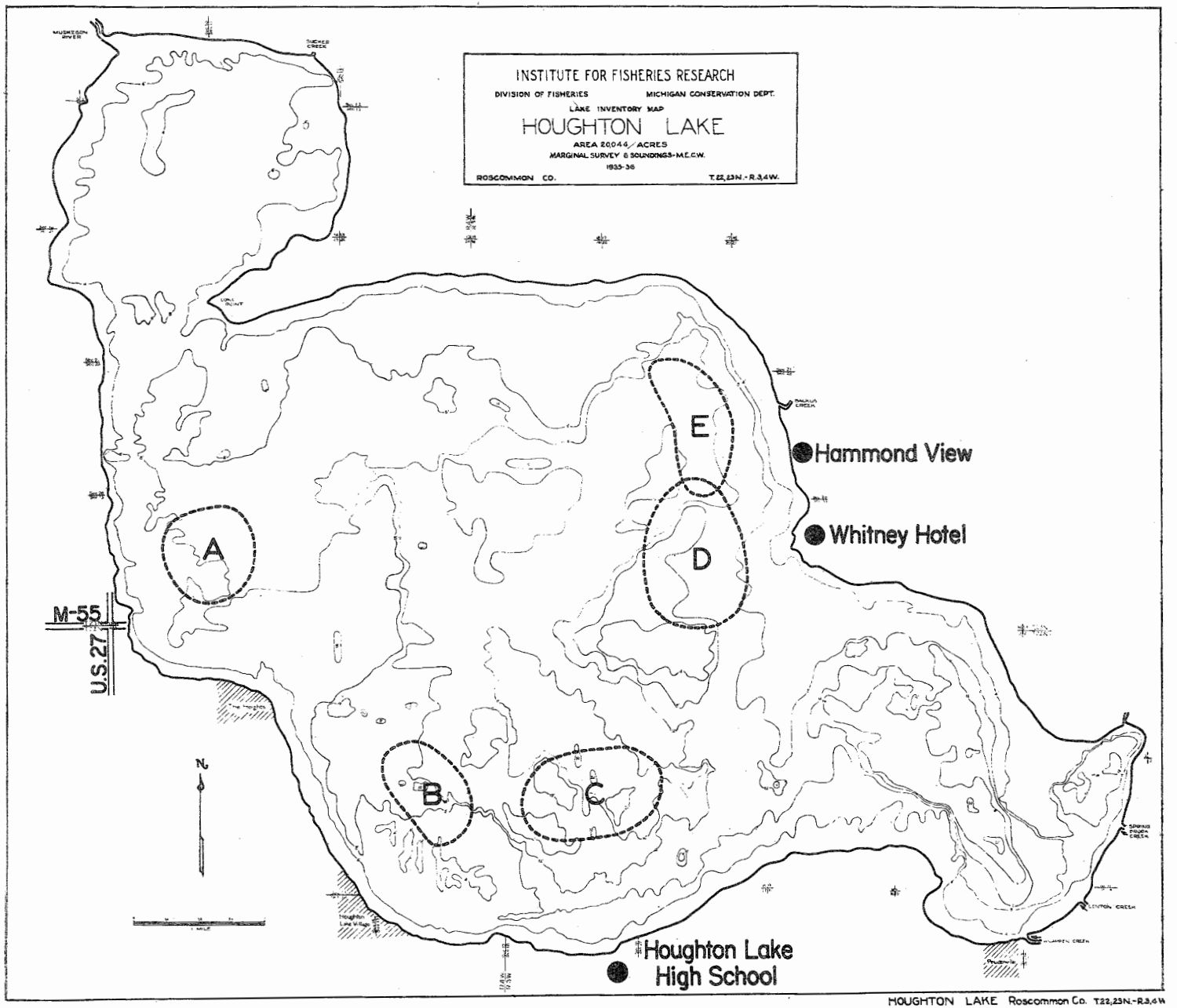
Fig. 1

It would be impossible for one man to interview, or even count all fishermen on Houghton Lake, because of the large size of the lake, the large number of fishermen, and the 40-hour work week of the census clerk. Thus a sampling type of census was conducted. The census was stratified to give equal coverage for the different fishing grounds on the lake and equal coverage for different portions of the winter fishing season. From the census, data on fishing effort and catch for a certain percentage of all fishing were obtained. The percentage of census coverage was determined from the census schedule itself. Total fishing effort and total catch were computed from the sample and from the percentage of all angling which the sample covered. Furthermore, the airplane counts of anglers' cars, made concurrently with counts of cars by the census clerk on the lake itself, showed that car counts made from the surface of the lake were too low; thus the estimates of total fishing pressure and catch were adjusted upward to compensate for the greater number of cars counted from the plane.

For the stratified sample census, Houghton Lake was divided into five geographic areas, corresponding to fishing grounds where winter anglers were known to concentrate; these were designated as Areas A, B, C, D, and E (see Figure 2). The winter fishing season (Dec. 18, 1956 to Mar. 16, 1957--the period when the ice was safe) was divided into three census periods: Dec. 18 to Jan. 14, Jan. 15 to Feb. 16, and Feb. 17 to March 16.

The census clerk worked in a particular area on a given day, and the clerk's schedule was planned to give equal coverage of different areas and equal coverage for week days and week-end days throughout the census period. The schedule for census on Areas A to E was as follows:

Fig. 2. Inventory map of Houghton Lake, Roscommon County, showing major fishing grounds (A-E), winter, 1956-57.



HOUGHTON LAKE Roscommon Co. T22,23N.-R3,4W

Creel census schedule
Winter 1956-57
Houghton Lake, Roscommon County

Week of:	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Dec. 15				D	E	A	B
22	..	D	..	..	..	C	D
29	..	E	E	A	B	C	..
Jan. 5	..	A	D	E	A	B	..
12	B	C	C	D	..	..	..
19	D	E	E	..	..	A	B
26	A	B	..	..	C	D	E
Feb. 2	C	D	..	A	B	C	D
9	..	..	A	B	C	D	..
16	E	A	E	A	B	..	..
23	B	C	C	..	..	..	E
Mar. 2	D	E	A	..	..	B	C
9	A	B	..	..	D	E	A
16	C						

Area A. = Southwest portion near junction of M55 and U.S. 27.
Area B. = Houghton Lake Village.
Area C. = Houghton Lake High School.
Area D. = Harvey's Resort (Whitney's Hotel on map).
Area E. = Hammond's View, Morlands Resort.

Each of the five areas was censused 12 times during the winter season. The census data were gathered as anglers completed their fishing trips. A few of the interviews were made before anglers finished fishing. Most of these records of incomplete trips were obtained early in the season when we felt that an adequate sample could be obtained only by use of data on both complete and incomplete trips. A comparison of the two types of data (complete and incomplete fishing trips) made in early January proved that there was no significant difference in the catch-per-hour figures. Data from incomplete trips comprise only 17 percent of the total data. Records of residence of anglers, baits used, and species of fish sought were also kept.

During December, Mr. Simonis counted the anglers on the ice, in his designated area, at two-hour intervals starting at 11:00 A.M. and ending

at dark. After January 2, most anglers were driving onto the ice, so he counted cars instead of anglers. To convert car counts to angler estimates, a figure for anglers-per-car was obtained from the census data. The counting hours were changed on February 1 to even-hour counts starting at 10:00 A.M., when it became possible to make 6:00 P.M. counts. Counts were made at 9:00 A.M., one day on each area, and at 8:00 A.M., one day on each area, to give some indication of the early morning fishing activity. The average length of fisherman-day was five hours. The census data therefore included a representative sample of anglers who fished in the early morning hours, even though the census work day started at 10:00 A.M.

Results of the Sample Census

Results of 1,439 angling trips were recorded (Table 1). The anglers caught eight species of fish. In descending order of abundance, these were: bluegill, perch, northern pike, rock bass, black crappie, pumpkinseed, yellow walleye and largemouth bass (one bass, recorded in December). The 1,279 perch recorded were caught by 294 anglers. Catches in excess of the regular 25-perch limit were recorded from only four anglers. Perch made up the largest share of the catch in areas D and E. Areas D and E, particularly E, also produced a major portion of the recorded catch of walleyes and northern pike.

The catch per hour per angler varied from one period to the next on most of the areas, and also varied from one area to another. It was high in Areas A and B due to the greater emphasis on fishing for pan fish. Very few pike were recorded from these two areas during the second period; the high catch of bluegills accounted for the high catch-per-hour figure. Area D also had a high catch of bluegills and perch during the second period.

Table 1.--Summary of creel census data for anglers interviewed by creel census clerk, Houghton Lake, winter of 1956-57

Area	Period	Number of anglers interviewed	Average hours per angler	Anglers per car	Catch per hour per angler	Number anglers fishing for:			Recorded catch						
						Pan fish	Pike	"Fish"	Bluegill	Perch	Pumpkin-seed	Crappie	Rock bass	Walleye	Pike
A	1	63	4.49	2.70	0.2498	8	46	9	5	37	...	...	2	...	27
	2	112	4.79	2.43	1.3418	56	4	52	479	116	15	57	9	1	4
	3	70	4.69	2.14	0.7869	4	37	29	65	106	2	2	...	...	71
Total		245	4.68	2.41	0.9024	68	87	90	549	259	17	59	11	1	102
B	1	100	4.00	2.71	0.8677	52	12	36	247	55	5	5	18	2	30
	2	117	4.55	2.30	0.9603	57	8	52	317	52	20	18	11	...	8
	3	107	4.33	2.67	0.6166	40	5	62	125	96	1	12	16	1	32
Total		324	4.34	2.53	0.8182	149	25	150	689	203	26	35	45	3	70
C	*1	92	4.37	2.78	0.8705	30	32	30	256	51	7	2	5	1	42
	2	103	4.55	2.44	0.7129	25	24	54	189	41	3	7	14	2	77
	3	133	3.46	2.49	0.6431	63	30	40	210	28	24	8	15	...	27
Total		328	4.00	2.56	0.7288	118	86	124	655	120	34	17	34	3	146
		* One Largemouth bass recorded in Period 1.													
D	1	61	6.39	3.19	0.3525	5	31	25	24	29	4	...	...	12	63
	2	151	5.78	3.22	0.8949	7	28	116	274	255	23	22	48	9	46
	3	71	6.04	2.78	0.4628	...	59	12	18	135	...	...	4	7	52
Total		283	5.93	3.09	0.6696	12	118	153	316	419	27	22	52	28	161
E	1	69	5.33	3.09	0.5935	7	27	35	46	86	...	...	16	10	50
	2	100	6.44	2.85	0.4930	...	47	53	77	130	3	4	14	18	68
	3	90	6.40	2.69	0.2970	5	66	19	9	62	6	1	...	22	75
Total		259	6.09	2.85	0.4511	12	140	107	132	278	9	5	30	50	193
*/	1	385	4.77	2.86	0.6373	102	148	135	578	258	16	7	41	25	212
	2	583	5.23	2.63	0.8928	145	111	327	1,336	594	64	108	96	30	203
	3	471	4.72	2.56	0.5651	112	197	162	417	427	33	23	35	30	257
Total		1,439	4.94	2.67	0.7172	359	456	624	2,231	1,279	113	138	172	85	672

*/ Period totals, all areas.

Daily census data from Area B are given in Tables 2 and 3. The data for Area B are included to show the extent of the census procedure; similar data for the other areas are on file.

Estimates of Total Fishing

For estimates of total fishing pressure and total catch, the census-clerk data were first expanded to the total number of fishing days in the season (Table 4). Total angling hours for an area for each day censused was computed from counts of anglers present and length of fishing day. Estimates for each period for each area were made by expanding the average total angling hours per day (based on four days each period) to cover the entire 28 or 33 days in the period. The census data for each period were the source of an hours-per-angler figure which, when divided into the estimate of total angling hours, gave an estimate of number of angling trips for each period in each area. The estimated hours multiplied by the catch per hour per angler gave an estimate of the total fish caught, for each period in each area.

As has been mentioned, a comparison of plane counts and counts made from the ice showed that the plane counts consistently recorded more cars than could be seen by the census clerk. The plane counts were 38 percent higher than the census counts; therefore, the estimates based on the clerks counts were adjusted upward by 38 percent (Table 5).

Some angling took place during the winter at locations outside of the five major areas (A to E). The plane counts indicated that the total fishing in the five census areas had to be adjusted upward by 33 percent in order to represent fishing over the entire lake (Table 5).

Area B had the greatest number of angling trips, produced the most fish, and was high in estimated catch of bluegills, pumpkinseeds, and rock bass.

Table 2.--Counts of anglers or cars by creel census clerk,
Area B, Houghton Lake,
Winter 1956-57

Time (E.S.T.)

Date	A.M.					P.M.					
	8	9	10	11	12	1	2	3	4	5	6
Angler counts											
Dec. 22	...	...	...	73	...	68	...	84	...	67	...
Car counts											
Jan. 2	...	...	...	11	...	12	...	17	...	16	...
Jan. 10	...	...	...	10	...	10	...	12	...	8	...
Jan. 12	...	...	...	45	...	36	...	49	...	32	...
Jan. 25	...	11	...	19	...	18	...	18	...	11	...
Jan. 27	...	...	...	51	...	39	...	45	...	25	...
Feb. 6	...	...	14	...	16	...	18	...	21	...	9
Feb. 12	...	...	8	...	10	...	15	...	13	...	6
Feb. 20	...	...	13	...	12	...	20	...	18	...	11
Feb. 23	...	...	35	...	38	...	39	...	49	...	23
Mar. 7	1	...	3	...	8	...	7	...	5	...	4
Mar. 10	...	...	15	...	24	...	25	...	23	...	8

Table 3.--Summary of creel census data for anglers interviewed by creel census clerk in Area B, Houghton Lake, winter of 1956-57

Period Date	Anglers interviewed after completed trips			Anglers/Cars[1]	Anglers interviewed (both complete and incomplete trips)	Number anglers fishing for:			Recorded catch						
	Number	Total hours fished	Hours per angler			Panfish	Pike	"Fish"	Bluegill	Perch	Pumpkin-seed	Crappie	Rock bass	Walleye	Pike
Period 1.															
Dec. 22	31	115.5	3.73	36/12	36	14	9	13	85	3	...	2	7	1	13
Jan. 2	7	22.0	3.14	20/10	20	10	3	7	35	16	2	...	4	1	12
Jan. 10	5	22.0	4.40	8/3	9	6	...	3	8	...	1	...	2	...	1
Jan. 12	12	60.5	5.04	39/13	35	22	...	13	119	36	3	3	5	...	4
Total	55	220.0	4.00	103/38	100	52	12	36	247	55	6	5	18	2	30
Period 2.															
Jan. 25	20	89.0	4.45	22/13	22	5	4	13	46	37	1	4	...	...	5
Jan. 27	55	246.0	4.47	63/22	58	28	3	27	155	5	11	6	4	...	1
Feb. 6	21	107.0	5.10	24/12	23	15	1	7	76	2	2	4	2	...	2
Feb. 12	4	12.5	3.12	15/7	14	9	...	5	40	8	6	4	5	...	...
Total	100	454.5	4.55	124/54	117	57	8	52	317	52	20	18	11	...	8
Period 3.															
Feb. 20	18	75.5	4.19	20/10	19	12	...	7	15	26	...	3	3	...	1
Feb. 23	41	200.5	4.89	44/14	43	18	2	23	74	28	1	5	10	...	4
Mar. 7	9	31.0	3.44	11/4	11	4	...	7	5	22	...	2	1	1	1
Mar. 10	27	104.0	3.85	37/14	34	6	3	25	31	20	...	2	2	...	26
Total	95	411.0	4.33	112/42	107	40	5	62	125	96	1	12	16	1	32

[1] Average number of anglers per car: Dec. 22-Jan. 12, 103/38 = 2.71; Jan. 25-Feb. 12, 2.30; and Feb. 20-March 10, 2.67.

Table 4.--Estimates of fishing and catch on Houghton Lake, winter of 1956-57, based on census clerk data
(For adjusted estimates, see Table 5)

Area	Period	Hours	Anglers	Fish	Bluegill	Perch	Pumpkinseed	Crappie	Rock bass	Largemouth bass	Walleye	Pike
A	1	4,900	1,091	1,224	86	638	...	...	35	...	...	465
	2	15,939	3,328	21,387	15,044	3,642	471	1,790	282	...	32	126
	3	6,020	1,284	4,737	1,252	2,041	39	38	...	...	...	1,367
Total		26,859	5,703	27,348	16,382	6,321	510	1,828	317	...	32	1,958
B	1	17,360	4,340	15,063	10,279	2,288	208	208	748	...	83	1,249
	2	15,444	3,394	14,831	11,036	1,811	695	627	383	...	...	279
	3	14,168	3,272	8,736	3,859	2,963	31	370	494	...	31	988
Total		46,972	11,006	38,630	25,174	7,062	934	1,205	1,625	...	114	2,516
C	1	13,300	3,043	11,578	8,121	1,617	222	64	159	31	31	1,333
	2	11,880	2,611	8,469	4,807	1,042	76	178	357	...	51	1,958
	3	9,744	2,816	6,266	4,218	563	482	160	301	...	...	542
Total		34,924	8,470	26,313	17,146	3,222	780	402	817	31	82	3,833
D	1	3,276	513	1,155	210	254	35	...	...	...	105	551
	2	14,157	2,449	12,669	5,127	4,772	431	412	898	...	169	860
	3	5,404	895	2,501	209	1,563	...	...	46	...	81	602
Total		22,837	3,857	16,325	5,546	6,589	466	412	944	...	355	2,013
E	1	23,212	4,355	13,776	3,046	5,696	...	...	1,059	...	633	3,312
	2	21,120	3,280	10,412	2,553	4,311	100	132	464	...	597	2,255
	3	11,648	1,820	3,459	178	1,225	119	...	20	...	435	1,482
Total		55,980	9,455	27,647	5,777	11,232	219	132	1,543	...	1,695	7,049
*	1	62,048	13,342	42,796	21,742	10,493	465	272	2,001	31	882	6,910
	2	78,540	15,062	67,768	38,567	15,578	1,773	3,139	2,384	...	849	5,478
	3	46,984	10,087	25,699	9,716	8,355	671	568	861	...	547	4,981
Total		187,572	38,491	136,263	70,025	34,426	2,909	3,979	5,246	31	2,278	17,369

* Period totals, all areas.

Area E received the greatest pressure in total hours of angling and produced the highest number of perch, walleyes, and northern pike. Anglers in Area E fished longer, on the average, than did anglers in Area B. In all five areas, two bluegills were caught for every perch taken. These two species comprised over 76 percent of the fish estimated to have been removed from the five areas (Table 4).

The adjusted estimates for total winter fishing in Houghton Lake (Table 5) are as follows: 70,647 angler trips were made; 344,269 hours were spent in catching 250,097 fish. The estimated catches, by species, were: 128,524 bluegills, 63,186 perch, 5,339 pumpkinseeds, 7,303 black crappie, 9,628 rock bass, 4,181 walleye, 31,879 pike, and 57 largemouth bass. Thus Houghton Lake, which has an area of 20,000 acres, was subjected to a fishing pressure of 17.2 hours per acre, or 3.5 trips per acre, during which 12.5 fish per acre were removed (weight of catch estimated at 4 lbs. per acre). The three dominant species--bluegill, perch, and pike--were removed at rates of 6.4, 3.2, and 1.6 fish per acre, respectively. The estimates for the five areas represented 54 percent of the estimates for the entire lake which were obtained by use of the two correction factors (Table 5).

On January 27, scale samples were collected from 241 angler-caught perch. Perch in the sample had an average length of 4.9 inches, and ranged from 3.4 to 8.4 inches long. In this random sample of angler-caught fish, only two were over 7 inches long. These fish were 3.8, 4.6, and 5.4 inches in length at the age of 1, 2, and 3 years, respectively. State averages for these ages are 5.8, 6.4, and 7.5 inches.

Perch Removal

The removal of 63,000 perch (3.2 perch per acre) from Houghton Lake is, without a doubt, far short of the objective of extensive population reduction.

Table 5.--Estimates of fishing and catch from census clerk data on Houghton Lake, winter of 1956-57, corrected to higher plane counts of anglers and to total lake area

Records	Estimates from census clerk data (Areas A to E)	Estimates corrected to plane counts (Areas A to E)	Estimates corrected for entire lake area
Total angling hours	187,572	258,849	344,269
Total angling trips	38,491	53,118	70,647
Total catch	136,263	188,043	250,097
Bluegills	70,025	96,635	128,524
Perch	34,426	47,508	63,186
Pumpkinseeds	2,909	4,014	5,339
Black crappie	3,979	5,491	7,303
Rock bass	5,246	7,239	9,628
Largemouth bass	31	43	57
Walleye	2,278	3,144	4,181
Pike	17,369	23,969	31,879

We have no estimate of the total population of perch in Houghton Lake, and thus we have no real knowledge of the degree of reduction of the perch population.

Dr. W. C. Beckman (1950) cited two examples of perch population reduction and subsequent growth. Duck Lake, Montcalm County, and Green Lake, Washtenaw County, had extensive mortalities in the winter of 1944-45 due to oxygen depletion under the ice. An estimated 13,500 perch (44 per acre) were destroyed by the winterkill on Duck Lake. The improvement in growth of the remaining perch in 1945 amounted to 61.3 percent over the average growth for the four years prior to the winterkill. In 1946 the growth was 2.3 percent below this same average. On Green Lake, 6,698 perch (85 per acre) were destroyed by the winterkill. The growth of perch increased, in 1945, by 35.0 percent over the average growth for the six years prior to the winterkill. The growth declined slightly in 1946 to 32.7 percent over the above mentioned average growth and in 1947 was only 9.8 percent above the growth for the six years prior to the winterkill. These data seem to indicate that the 3.2 perch per acre removed from Houghton Lake accomplished little in the way of improving the growth of this species.

Winter Fishing, 1935-36 and 1936-37

Winter fishing on Houghton Lake was intensively censused during the winters of 1935-36 and 1936-37. The data for these two winters were summarized by Dr. R. W. Eschmeyer (1936, 1937). The census data for 1935-36 represented about 85 percent of the total fishing on Houghton Lake for that winter. The season extended from December 18 to March 24. The data for 1936-37 represented about 90 percent of the fishing for that winter, and the season was from December 21 to February 28. Houghton Lake was open to pike spearing during both of these winter seasons. The census data were gathered by a crew of 15 to 20 men from Camp Houghton Lake (Civilian Conservation Corps).

The work crews obtained records of 5,520 angling trips during the winter of 1935-36. The estimates of total fishing (Table 6) were derived from the reported census data (expanded to represent 100 percent). The 1936-37 census records were obtained from 4,153 angling-trip interviews and these data were increased to represent 100 percent of the winter fishing.

Over the twenty-year span from 1935-36 to 1956-57, winter fishing on Houghton Lake has increased twelvefold. The fish harvest has increased twentyfold, due largely to the greater catch of bluegills in recent years.

The greatest difference in the harvest between the two earlier winters, 1935-36 and 1936-37, was the greater catch of perch in 1936-37. Pike fishing was about the same but the catch of walleyes declined. The most abundant fish in the catch of these two winters was the yellow perch. Pike were second.

Over 50 percent of the winter catch in 1956-57 was of bluegills. Perch made up over 25 percent of the catch. Twenty years ago anglers took seven to eight pike per 100 hours of angling, whereas in the winter of 1956-57, pike were caught at a rate of better than nine pike per 100 angling hours. There is evidence in this study which indicates that pike fishing in 1956-57 was as good as, or better than, it was in 1935-36 and 1936-37.

Table 6.--Comparative estimates of fishing, Houghton Lake, winters of 1935-36, 1936-37, and 1956-57

Item	Number of anglers	Hours	Fish caught	Perch	Pike	Walleye	Rock bass	Bluegill	Pumpkinseed	Crappie	Other
1935-36	6,881	39,427	7,019	3,244	2,764	896	26	60	...	...	29
Fish/100 angling											
Hours	...	...	17.8	8.2	7.0	2.3	0.1	0.2	...	...	tr.
Fish/acre	...	...	0.35	0.16	0.14	0.04	tr.	tr.	...	...	tr.
1936-37	4,614	24,054	17,089	14,711	1,963	341	...	19	...	...	55
Fish/100 angling											
Hours	...	...	70.9	61.0	8.1	1.4	...	0.1	...	...	0.3
Fish/acre	...	...	0.85	0.74	0.10	0.02	...	tr.	...	...	tr.
1956-57	70,647	344,269	250,097	63,186	31,879	4,181	9,628	128,524	5,339	7,303	57
Fish/100 angling											
Hours	...	...	72.6	18.4	9.3	1.2	2.8	37.3	1.6	2.1	tr.
Fish/acre	...	...	12.5	3.16	1.59	0.21	0.48	6.43	0.27	0.37	tr.

Literature Cited

Beckman, William C

1950. Changes in growth rates of fishes following reduction in population densities by winterkill. Trans. Am. Fish. Soc., Vol. 78 (1948), pp. 82-90.

Eschmeyer, R. W.

1936. Houghton Lake creel census winter of 1935-36. Institute for Fisheries Research, Report No. 368 (typewritten).

1937. Houghton Lake creel census, winter of 1936-37. Institute for Fisheries Research, Report No. 417 (typewritten).

INSTITUTE FOR FISHERIES RESEARCH

K. E. Christensen

Approved by: G. P. Cooper

Typed by: J. M. Lederer

Appendix A

Growth of fishes in Houghton Lake

By William C. Latta

In past years (1922-1957) many scale collections have been made from the fishes of Houghton Lake. Fish were captured with gill net, trap net, seine and hook and line, at many different times of year. For each collection the average empirical total length in inches, for each age group, was computed (Tables 7 and 8). For the species included, Table 7 lists the state average growth figures, as prepared by Beckman (1949). Because Beckman's material does not include all species, other average growth rates (Eschmeyer, 1950; and tentative state average compiled by John E. Williams) were needed for comparison with the growth of northern pike and walleyes from Houghton Lake (Table 8).

Differences in the selectivity of the collecting gear used and the differences each year in the date of collection complicate comparison of empirical averages. For example, the average length of angler-caught fish might be larger than a sample of fish of the same age captured in trap nets; and, with regard to the date of collection, some account should be taken of the amount of growth made each month by the fish. Most of the yearly growth of fishes is made during the early summer months (Beckman, 1943; Hile, 1941). Number of fish in the sample should also be considered. Obviously, the length of one or two fish does not provide a reliable average for an age group.

All of the common centrarchids (bluegill, pumpkinseed, rock bass, black crappie, smallmouth bass and largemouth bass) in the various collections through the years, unquestionably have been growing much better than average (Table 7). However, growth rates of the yellow perch have been consistently slower than average.

Table 7.--Average empirical total lengths in inches, by age groups, of several species of fish from Houghton Lake, Roscommon County, 1922-1957

[Number of specimens in parentheses]

Species	Date of collection Month	Year	Age group I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Bluegill	7	1922	2.7 (15)	...	...	...	...	...	...	...	...	...	...
	8	1922	3.1 (2)	5.6 (1)	7.1 (6)	9.7 (1)	...	...	...	...	...	...	...
	1	1939	...	...	...	...	8.0 (3)	8.7 (2)	10.5 (1)	...	...	...	...
	2	1939	...	...	7.3 (1)	7.4 (4)	8.3 (3)	8.7 (5)	10.0 (2)	...	...	...	...
	2	1943	...	...	...	...	8.3 (16)	9.2 (4)	9.4 (5)	10.0 (4)	9.8 (2)	...	...
	1	1947	...	...	6.9 (2)	...	...	...	...	...	...	...	...
	2	1947	...	...	...	...	...	9.4 (13)	9.8 (1)	10.0 (3)	10.5 (4)	10.7 (2)	10.9 (2)
	7	1948	...	...	5.8 (20)	7.4 (16)	8.9 (3)	9.2 (6)	9.4 (13)	10.2 (1)	9.9 (1)	...	...
	5, 6	1955	...	4.5 (1)	5.3 (12)	6.4 (8)	7.2 (1)	7.7 (53)	9.1 (4)	9.2 (5)	...	...	...
State average[2]			1.7	3.1	4.3	5.4	6.6	7.3	7.7	8.2	8.4	8.7	8.9
Pumpkinseed	7	1922	2.5 (57)	3.9 (11)	5.3 (11)	...	...	...	...	...	...	...	...
	2	1939	...	...	...	6.7 (1)	6.0 (1)	7.5 (4)	8.3 (3)	...	...	...	...
	1	1947	...	...	...	7.6 (3)	...	...	...	...	...	...	...
	7	1948	...	...	6.2 (19)	7.0 (23)	7.7 (16)	8.3 (13)	...	...	...	...	...
	5, 6	1955	...	...	6.3 (5)	6.3 (7)	7.7 (1)	7.5 (54)	8.4 (14)	...	...	...	...
State average[2]			2.0	2.9	4.1	4.9	5.7	6.2	6.8	...	...	...	...

(Table 7 continued)

Species	Date of collection Month	Year	Age group I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Rock bass	7	1922	2.5 (36)	3.8 (18)	6.6 (29)	8.2 (3)	8.7 (1)	9.9 (1)	...	...	...	...	...
	8	1922	2.7 (15)	3.9 (7)	7.1 (30)	7.8 (6)	8.1 (1)	9.9 (2)	10.1 (4)	...	...	...	...
	8	1931	...	...	5.3 (1)	...	...	...	...	...	...	...	...
	7	1948	...	...	5.6 (1)	7.3 (11)	8.2 (17)	8.9 (1)	...	10.8 (1)	11.0 (1)	...	...
	5, 6	1955	...	...	5.9 (12)	6.8 (7)	7.4 (5)	8.8 (30)	10.2 (6)	10.7 (12)	...	...	...
State average[2]			1.5	3.2	4.3	5.2	6.2	7.3	7.9	8.8	9.0	...	...
Black crappie	7	1922	...	5.7 (1)	...	...	...	...	...	...	...	...	...
	7	1948	...	7.6 (3)	8.3 (8)	9.8 (1)	...	...	...	...	...	...	...
	5, 6	1955	5.9 (2)	8.4 (9)	9.6 (12)	10.6 (7)	11.4 (12)	11.8 (3)	...	...	...	...	...
State average[2]			...	5.9	8.0	9.0	9.9	10.7	...	...	...	...	...
Smallmouth bass	7	1922	...	...	...	...	13.6 (1)	...	...	...	...	...	...
	8	1922	6.6 (1)	...	...	...	...	...	...	...	...	...	...
	7	1948	5.9 (1)	9.4 (5)	13.1 (3)	15.4 (3)	16.5 (1)	17.4 (1)	...	...	...	...	...
	5, 6	1955	...	9.1 (2)	11.4 (13)	14.1 (4)	14.7 (4)	15.9 (9)	17.1 (5)	16.7 (1)	18.1 (1)	19.3 (2)	...
State average[2]			3.3	5.9	9.0	11.2	13.3	15.0	15.3	16.4	16.8	...	...

(Table 7 continued)

Species	Date of collection Month	Year	Age group I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Largemouth bass	7	1948	...	9.9 (4)	12.8 (8)	15.5 (3)	...	...	...	...	...	...	...
	5, 6	1955	...	8.6 (3)	10.3 (6)	12.6 (4)	14.5 (6)	14.9 (17)	16.1 (8)	16.9 (2)	18.4 (2)	...	...
State average [2]			...	8.7	10.0	12.1	13.7	15.1	16.1	17.7	17.9	...	...
Yellow perch	8	1922	...	...	...	7.5 (1)	...	10.2 (1)	...	...	...	...	...
	2	1937	...	...	...	7.3 (4)	7.2 (1)	...	...	...	...	...	...
	2	1938	...	...	...	7.2 (2)	8.0 (3)	...	...	...	...	...	...
	2	1939	...	3.9 (28)	4.9 (23)	6.0 (6)	7.5 (2)	...	...	...	...	...	...
	7	1948	...	5.2 (5)	...	...	...	...	...	...	...	...	...
	1	1954	...	3.7 (4)	4.1 (1)	5.4 (2)	...	...	...	...	...	...	...
	5, 6	1955	...	...	...	...	8.2 (3)	9.4 (2)	10.5 (3)	9.6 (2)	10.5 (1)	...	...
	10	1956	3.9 (32)	5.0 (12)	5.6 (4)	6.5 (1)	...	...	...	...	...	...	...
	1	1957	...	3.8 (8)	4.6 (136)	5.4 (79)	6.6 (9)	5.9 (1)	...	...	...	...	...
State average [2]			4.1	5.8	6.4	7.5	8.5	9.5	10.4	10.8	11.3	...	...

[1] Months are numbered consecutively from January (1) to October (10).

[2] Beckman, 1949.

Table 8.--Average empirical total lengths in inches, by age groups, of the walleye and northern pike from Houghton Lake, Roscommon County, spring, 1955, compared with average growth in other waters

[Number of specimens in parentheses]

Species	Date of collection	Age group							
		II	III	IV	V	VI	VII	VIII	IX
Walleye	5, 6 1955	10.4 (3)	12.4 (26)	14.3 (9)	15.0 (6)	15.9 (11)	16.6 (4)	19.7 (5)	19.8 (2)
Average [1]		10.0	13.0	15.1	16.9	18.4	19.5	21.4	22.2
Northern pike	5, 6 1955	16.4 (3)	19.8 (23)	21.9 (2)					
Average [2]		19.7	22.0	24.1					

[1] Eschmeyer, 1950.

[2] Tentative average growth rates for the northern pike from Michigan waters, compiled by John E. Williams.

The growth of the walleye is compared with the average growth rate of walleyes from many waters of North America, because no average growth rate has been computed for walleyes of Michigan. The growth rate of this species was below average in 1955 (Table 8). The comparison is satisfactory because the collection was made at the start of the growing season and, likewise, the average is for length of fish at time of annulus formation or beginning of the growing season.

The northern pike was growing at an average rate, comparing the limited number of fish collected in 1955 with the tentative state average compiled by John E. Williams for northern pike from Michigan waters (Table 8). In this comparison some consideration should be given to time of collection. The 1955 collection was made at the beginning of the growing season, whereas the average growth figures are for fish in mid-season, after most of the growth is completed; thus the better comparison would be the 1955 three-year-olds that have just completed the third year of growth with the average two-year-olds that have probably finished most of the third year of growth.

There seems to be no indication that there has been an important change through the years in the growth rate of any species represented.

In summary all species, in past years, were growing at a better than average or average rate, except the yellow perch and walleye. A possible explanation is a lack of suitable habitat for these percids. Lewis (1950) and Adams and Hankinson (1928) have commented on the larger perch favoring the deeper waters of lakes, and the smaller ones, the shallower waters. Lewis (1950) concluded that "a lake may provide an excellent environment for smaller perch but a very poor or completely unsuitable environment for the larger ones." Likewise, the adult walleye prefers the deeper waters. Perhaps Houghton Lake does not provide the right combination of environmental factors to encourage rapid growth of these two percids.

Literature cited

Adams, Charles C. and T. L. Hankinson

1928. The ecology and economics of Oneida Lake fish. Bull. N.Y. State Coll. Forestry, Syracuse Univ., Roosevelt Wild Life Annals, Vol. 1, Nos. 3 and 4, pp. 235-548.

Beckman, William C.

1943. Annulus formation on the scales of certain Michigan game fishes. Pap. Mich. Acad. Sci., Arts and Letter, Vol. 28 (1942), pp. 281-312.

1949. The rate of growth and sex ratio for seven Michigan fishes. Trans. Am. Fish. Soc., Vol. 76 (1946), pp. 63-81.

Eschmeyer, Paul H.

1950. The life history of the walleye, Stizostedion vitreum vitreum (Mitchill), in Michigan. Inst. Fish. Research Bull. No. 3, pp. 1-99.

Hile, Ralph

1941. Age and growth of the rock bass, Ambloplites rupestris (Rafinesque) in Nebish Lake, Wisconsin. Trans. Wisc. Acad. Sci., Arts and Letters, Vol. 33, pp. 189-337.

Lewis, William M.

1950. Fisheries investigations on two artificial lakes in southern Iowa. II. Fish populations. Iowa State Coll. Jour. Sci., Vol. 24, No. 3, pp. 287-324.