

BOTTOM TRAWL EXPLORATIONS IN NORTHERN LAKE MICHIGAN, 1963 - 65



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BUREAU OF COMMERCIAL FISHERIES

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in Northern Lake Michigan,
1963-65**

By

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ABSTRACT

Over a period of 3 years the Bureau of Commercial Fisheries Exploratory Fishing Base at Ann Arbor, Mich., surveyed the relative abundance, depth distribution, and seasonal availability of various fish stocks that were fished with bottom trawls.

The alewife, Alosa pseudoharengus, and chubs, Leucichthys spp., were taken readily with the bottom trawl. Alewives composed 48 percent and chubs 42 percent of the total trawl catch. Three other fish--smelt, Osmerus mordax, suckers, Catostomus commersoni and C. catostomus, and common whitefish, Coregonus clupeaformis--were taken occasionally in commercial amounts.

Alewives have very pronounced seasonal movements, and at certain times of the year bottom trawls catch them only at specific depths. Bottom trawls did not take alewives in commercial amounts during all periods fished; there is evidence that alewives would be available commercially only in certain seasons. Chubs were caught readily throughout the study, although they too appeared to be taken in greater quantities at certain times. Bottom trawling indicated some horizontal dispersal of both alewife and chubs shoreward in summer and back to deeper water in fall. Chubs are caught over a wide depth range throughout the year.

INTRODUCTION

The fish population of Lake Michigan is currently in a state of flux, caused in recent years by the destructive invasion of the sea lamprey, Petromyzon marinus, the explosion of the alewife population, and the restocking or introduction of predator fish, i.e. lake trout, Salvelinus namaycush; coho salmon, Oncorhynchus kisutch; and chinook salmon, O. tshawytscha. With such an unstable fish population the commercial fishermen have been changing their methods. Many Lake Michigan fishermen are now using different types of gear such as trawls and are concentrating on the efficient, high-volume production of low-value species.

In 1962, the Bureau of Commercial Fisheries Exploratory Fishing Base at Ann Arbor, Mich., began a comprehensive 4-year bottom trawling survey of Lake Michigan. The primary purpose of this study was to determine the abundance, seasonal availability, and depth

distribution of various fish stocks. In 1962, explorations were made only in the southern half of the lake. The 1963-65 operations were extended to include the northern half of the lake and Green Bay. The results of these explorations are being presented in three reports: 1) Bottom trawl explorations in southern Lake Michigan 1962-65, 2) Bottom trawl explorations in northern Lake Michigan 1963-65, and 3) Bottom trawl explorations in Green Bay 1963-65.

Northern Lake Michigan (fig. 1) is here defined as that portion of Lake Michigan north of a line from a point 5 miles north of Rawley Point, Wis., on the west shore to a point 5 miles south of Manistee, Mich., on the east shore.

VESSELS, GEAR, AND METHODS

All fishing explorations during this study were made with research vessels of the

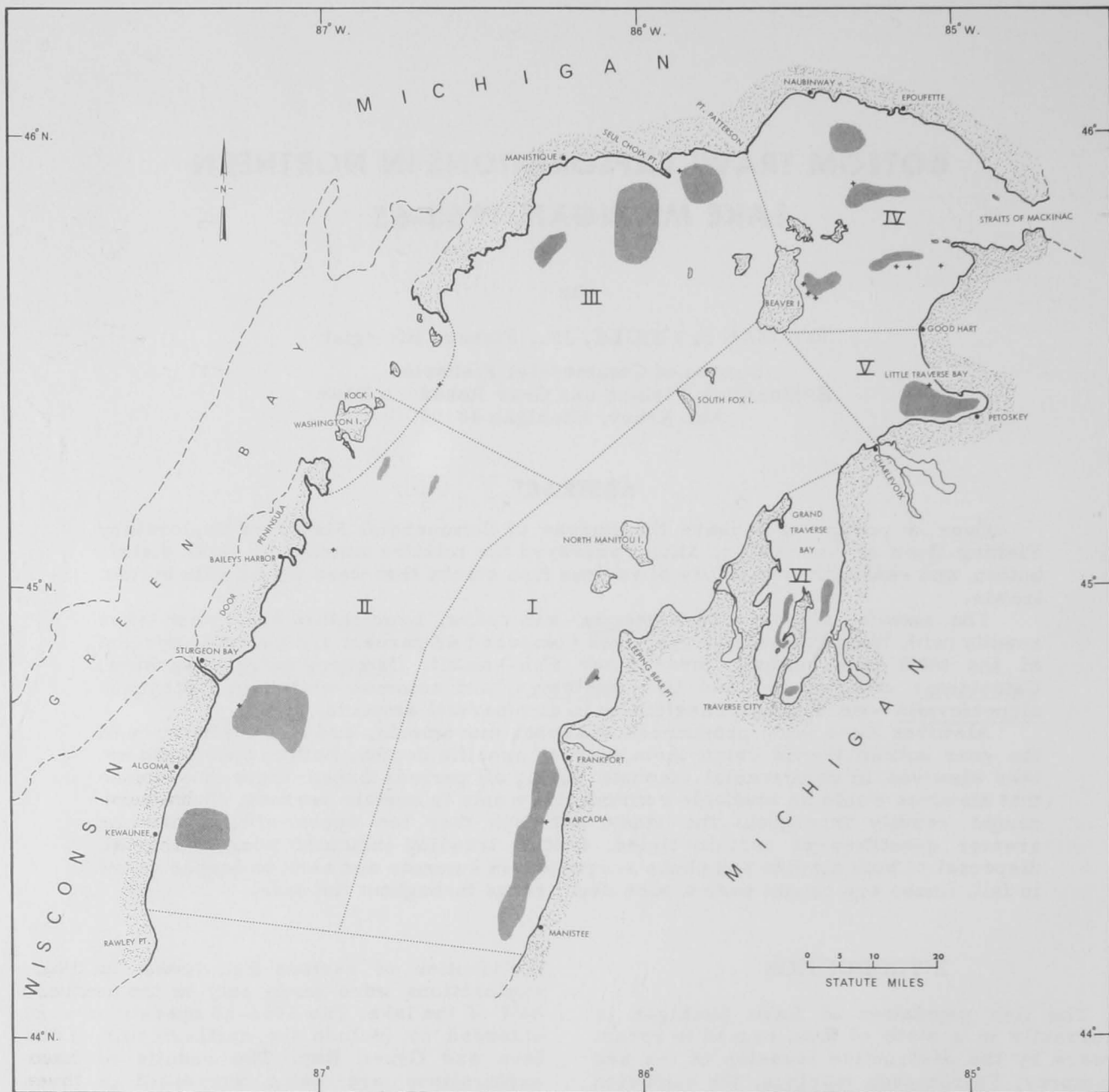


Figure 1.--Map of northern Lake Michigan. Discussion districts are separated by dotted lines. Shaded areas indicate trawlable grounds where drags were made during this study. Crosses (+) indicate locations where trawling attempts resulted in snagging.

Bureau of Commercial Fisheries. The research vessel Cisco was used for 1 cruise; the research vessel Kaho, for the remaining 10 cruises.

All trawling was done with a 52-foot (head-rope) Gulf-of-Mexico type fish trawl (Gordon and Brouillard, 1960). The net was rigged with a 1-inch mesh (stretch measure) cotton liner in the cod end to sample young fish and small species. All drags were monitored with a "white line" echo sounder.

Most trawl drags were one-half hour, although two drags were extended to 35 and 40 minutes, respectively, and 29 drags were less than one-half hour for one of the following reasons: encountering snags, rough bottom conditions, or set fishing gear in the area, i.e. gill nets or pound nets. Gear was damaged severely on 9 occasions and damaged slightly on 11 occasions.

Drags were made along bottom contours at depths of 5 to 111 fathoms. In waters with

available depths and suitable bottom, drags were generally made in a series at 5-fathom intervals from 5 to 50 fathoms and at 10-fathom intervals from 60 to 70 or 80 fathoms. At shallower stations, drags were made at 5-fathom intervals to the deepest depth available. An effort was made to secure as complete a depth coverage as possible at each station. Bottom irregularities and water currents sometimes caused actual fishing depths to vary by several fathoms. To provide a uniform analysis, I have rounded off the fishing depths to the nearest 5- or 10-fathom point as follows:

Depth range Fathoms	Designated depth Fathoms	Depth range Fathoms	Designated depth Fathoms
3-7	= 5	38-42	= 40
8-12	= 10	43-47	= 45
13-17	= 15	48-55	= 50
18-22	= 20	56-65	= 60
23-27	= 25	66-75	= 70
28-32	= 30	76-85	= 80
33-37	= 35		

The one drag over 80 fathoms (111 fathoms) was disregarded in depth analyses.

In the early part of the study, drags were made in random directions or in reverse directions on alternate drags; however, later in the study, biologists noted that current apparently affected the size of catches. Thereafter at the first station of a series visited, two drags were made in opposite directions at the same depth. If one direction had a substantially greater catch, all remaining drags in that series were made in the direction producing the larger catch.

Evaluation of fishing results is based on two methods of calculation: 1) Catch rate - which is pounds produced per unit effort for all drags in a particular evaluation, and 2) average catch for effective effort - which is pounds per unit effort for only those drags that contained the particular species being evaluated. Effective fishing effort has been discussed by Hile (1962). All analyses of catch rates and average catch for effective effort is based on 1/2-hour dragging time unless specified otherwise.

Commercially significant catches are defined as those worth a gross value of \$15 per hour (\$7.50 per one-half hour). At current prices this value is equal to 500 pounds of alewives per one-half hour. Chub catches usually contain some individuals large enough for human consumption and therefore worth more to the fishermen, so a smaller poundage is necessary to reach a value of \$15. A catch of 250 pounds per one-half hour was considered a commercially significant catch of chubs.

Other commercially significant 1/2-hour catch rates are: smelt - 150 pounds, suckers - 200 pounds, and whitefish - 15 pounds.

For the purpose of catch discussions and analysis northern Lake Michigan was divided into six districts as follows:

- District I - East shore from 5 miles south of Manistee to Charlevoix exclusive of Grand Traverse Bay.
- District II - Wisconsin waters of northern Lake Michigan.
- District III - Northwest shore from Rock Island to Point Patterson.
- District IV - Island - straits area east of Point Patterson and north of Good Hart.
- District V - East shore from Good Hart to Charlevoix and Little Traverse Bay.
- District VI - Grand Traverse Bay.

These districts are outlined in figure 1.

FISHING EFFORT

From 1963 through 1965, parts of 11 Lake Michigan cruises were devoted to fishing explorations in the northern portion. Total operating time in northern Lake Michigan during these 11 cruises was 60 days--an average of 5 1/2 days per cruise. During the study, 289 trawl drags were completed totaling over 138 hours fishing time (table 1).

Cruises were scheduled for all but December to March. Thus on a monthly basis surveys were made as follows: April 1963 and 1965; May 1964; June 1964 and 1965; July 1964; August 1963, 1964, and 1965 (also early September 1964); October 1963 and 1964; and November 1963.

Fishing effort on an annual basis was as follows: In 1963, 91 drags were made during four cruises; in 1964, 134 drags were made during four cruises; and in 1965, 64 drags were made during three cruises.

Investigations were fairly well distributed by district in proportion to the size of the district. Effort (number of drags) by district was as follows:

District	Number of drags
I	88
II	90
III	50
IV	30
V	19
VI	12

Depths from 10 to 70 fathoms were well covered; however, only two drags were made at the 5-fathom interval, and only four drags

Table 1.--Exploratory fishing effort in northern Lake Michigan
by cruise and year, 1963-65

Cruise No.	Dates	Days	Drags	Gear damage		Time fished
				Minor	Major	
<u>1963</u>		<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Minutes</u>
9	April 14-17 and 23-24.....	6	12	1	1	314
12	July 10-14.....	5	28	0	1	835
13	August 18-24.....	7	21	0	2	591
14	October 29-31 and November 23-24.....	5	30	0	1	905
Total.....		23	91	1	5	2,645
<u>1964</u>						
17	May 12-13, 16, and 18-22.....	8	46	3	1	1,275
19	June 24-25, 27-29, and July 1.....	6	34	3	1	1,010
21	August 25-26, 31, and September 1-2..	5	27	0	1	795
22	October 20, 25, and 27-28.....	4	27	3	0	746
Total.....		23	134	9	3	3,826
<u>1965</u>						
24	April 27.....	1	7	0	0	158
26	June 23-25 and 28-29.....	5	24	0	1	680
28	August 18-19 and 22-27.....	8	33	1	0	990
Total.....		14	64	1	1	1,828
Grand total.....		60	289	11	9	8,299

were made deeper than 76 fathoms. The distribution of drags by depth intervals was as follows:

Depth interval Fathoms	Drags Number
5	2
10	31
15	37
20	38
25	30
30	31
35	30
40	20
45	20
50	18
60	17
70	14
80	3
over 86	1

TRAWLING GROUNDS

Figure 1 shows ground trawled during this survey. Locations where trawling was attempted unsuccessfully (snags encountered) are also shown in figure 1. Much of the

bottom in northern Lake Michigan is unsuitable for bottom trawling, and suitable grounds are scattered.

In District I the trawling is good between 20 and 80 fathoms from Frankfort to Manistee. In less than 20 fathoms, the bottom is too rough for trawling. The steep sloping bottom contour in this area makes it difficult to fish at certain depths for a prolonged period. A small isolated patch of trawlable bottom was located south of Sleeping Bear Point.

In District II, the bottom is trawlable from 15 to 70 fathoms off Sturgeon Bay and Kewaunee. One drag was made successfully in less than 15 fathoms, but in another drag the gear was damaged. Along the Door Peninsula, the bottom is rough except for two small areas off Washington Island.

District III has three large areas in which drags were made, and further explorations may demonstrate continuously suitable bottom. In this district, trawlable grounds were found in 10 to 50 fathoms. One drag at 5 fathoms snagged.

The trawling grounds in District IV are scattered, and gear was damaged frequently; however, four good areas were located in depths of 7 to 27 fathoms.

In District V, only Little Traverse Bay was trawlable. In the bay, the bottom is good and drags were made from 15 to 50 fathoms.

The bottom in District VI (Grand Traverse Bay) is generally rough with jagged slopes reaching depths of 100 fathoms or more in a short distance. It is impossible to trawl in the northern half of the bay; however, some trawlable bottom was located in both the east and west arms in 10 to 45 fathoms.

SPECIES COMPOSITION OF THE TRAWL CATCH

The total species composition (table 2) was dominated by alewife and chubs. Alewives were 48.0 percent and chubs 42.0 percent of the catches. Three additional fish--sculpins (3.8 percent), smelt (3.4 percent), and suckers (1.5 percent)--were 8.7 percent of the catch, and 12 miscellaneous species made the remaining 1.3 percent.

Table 2.--Species composition of 289 exploratory trawl catches in northern Lake Michigan
1963-65

Species	Total catch		Occurrences in total drags		Catch rate per 1/2-hr. effort	Average catch for effective 1/2-hr. effort
	Pounds	Percent 1/	Number	Percent 1/	Pounds 1/	Pounds
Alewife (<u>Alosa pseudoharengus</u>)	36,533	48.0	207	72	132.1	184
Chubs (<u>Leucichthys</u> spp.)	32,022	42.0	219	76	115.8	149
Sculpins (<u>Cottidae</u>)	2,908	3.8	114	39	10.5	26
Smelt (<u>Osmerus mordax</u>)	2,623	3.4	125	43	9.5	21
White sucker (<u>Catostomus commersoni</u>)	1,007	1.3	17	6	3.6	62
Whitefish (<u>Coregonus clupeaformis</u>)	441	0.6	44	15	1.6	10
Ninespine stickleback (<u>Pungitius pungitius</u>)	170	0.2	27	9	0.6	6
Longnose sucker (<u>Catostomus catostomus</u>)	121	0.2	4	1	0.4	30
Lake herring (<u>Leucichthys artedi</u>)	119	0.2	34	12	0.4	3
Yellow perch (<u>Perca flavescens</u>)	72	0.1	11	4	0.3	7
Trout-perch (<u>Percopsis omiscomaycus</u>)	71	0.1	13	4	0.3	6
Spottail shiner (<u>Notropis hudsonius</u>)	29	T	6	2	0.1	5
Lake sturgeon (<u>Acipenser fulvescens</u>)	16	T	1	T	0.1	16
Menominee whitefish (<u>Prosopium cylindraceum</u>)	14	T	6	2	0.1	2
Lake trout (<u>Salvelinus namaycush</u>)	10	T	8	3	T	1
Burbot (<u>Lota lota</u>)	5	T	1	T	T	5
Brown trout (<u>Salmo trutta</u>)	1	T	1	T	T	1
Northern pike (<u>Esox lucius</u>)	1	T	1	T	T	1
TOTAL	76,163	99.9			275.4	275

1/ T = Trace, less than 0.5 or 0.05.

The catch composition varied from year to year (table 3 and fig. 2). The change in yearly species composition reflected the rise in abundance of alewives. The changing species composition was also evident on a cruise by cruise basis (fig. 3). Chubs dominated the catch of the first four cruises; alewives, the last four cruises.

The species composition varied among districts (table 4). Chubs dominated the District I catch; alewife dominated the catches in the other five districts. Few chubs were caught in District IV. Suckers were almost entirely lack-

ing in the catch in Districts I, II, and III but made up 16.1 percent of the catch in District V. Percentage of sculpins was highest in District I, and percentage of smelts was highest in District III.

Depth had an effect on the species composition (fig. 4). In shallow water (5-15 fathoms), alewives composed 84.4 percent of the catch; in medium depths (20-50 fathoms), chubs composed 58.7 percent of the catch, and alewives made up 35.4 percent; and in deep water (over 60 fathoms), sculpins made up 53.0 percent, chubs 34.4 percent, and alewives 12.6 percent.

Table 3.--Species composition of exploratory trawl catches in northern Lake Michigan by year, 1963-65

Species	1963		1964		1965	
	Pounds	Percent	Pounds	Percent	Pounds	Percent
Alewife.....	4,566	21.8	23,413	57.0	8,554	60.4
Chubs.....	14,429	68.8	14,195	34.6	3,398	24.0
Sculpins.....	1,109	5.3	1,160	2.8	639	4.5
Smelt.....	769	3.7	1,224	3.0	630	4.5
Suckers.....	1	-	575	1.4	552	3.9
Whitefish.....	32	.1	233	.6	176	1.2
Others.....	55	.3	246	.6	207	1.5
Total.....	20,961	100.0	41,046	100.0	14,156	100.0

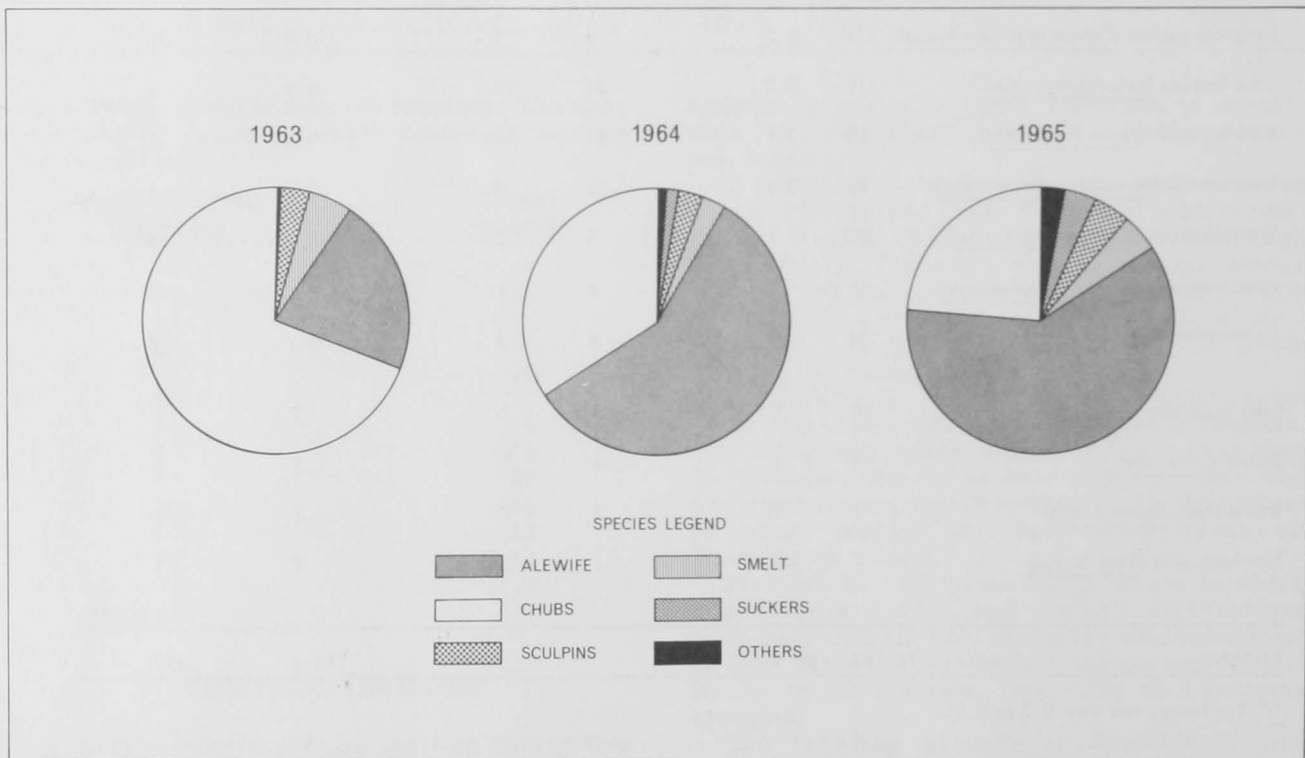


Figure 2.--Species composition of exploratory trawl catches in northern Lake Michigan by year.

DISCUSSION BY DISTRICT

The following discussion describes fishing results in each of the six fishing districts outlined in figure 1.

District I - East shore from 5 miles south of Manistee to Charlevoix exclusive of Grand Traverse Bay

Chubs were the dominant species in the trawl in District I and occurred in 82 of the 90 drags and composed 77.8 percent of the catch. Commercially significant catches of chubs were made 29 times in the district and on 9 of the 10 cruises. The largest chub catch during the study was made off Arcadia during cruise 14, and the largest landing of chubs during 8 of the 11 cruises was made in this district.

Alewives were sparse in the district. They were taken in only 55 drags and composed only 13.7 percent of the catch. Only one commercially significant alewife catch--600 pounds--was made in District I, at 20 fathoms on cruise 22.

Sculpins occurred in 65 drags and composed 8.0 percent of the landings, and the remaining 0.5 percent of the catch was composed of smelt, lake herring, sticklebacks, and one white sucker.

District II - Wisconsin waters of northern Lake Michigan

In District II, alewives were the dominant species, composing 59.3 percent of the catch. The alewife catch rate (173 pounds) was nearly five times greater than the alewife catch rate in District I (37 pounds). Commercially significant alewife catches were made on 5 of the 10 cruises in District II. The largest landing of alewives of the study (1,800 pounds) was made in this district.

The chub catch rate was only half as great in District II (99 pounds) as in District I (207 pounds); however, commercially significant chub catches were made on half the cruises in the district, and chubs composed 34.0 percent of the catch. The largest landing of chubs in the district was 1,024 pounds taken on cruise 9.

Catches of species other than alewife and chubs were light. Sculpins composed 3.6 percent of the catch; smelt, 2.9 percent of the catch. The largest catch of smelt was 105 pounds on cruise 17. The remaining 0.2 percent was composed of common whitefish, lake herring, four lake trout, and one yellow perch.

District III - Northwest shore from Rock Island to Point Patterson

Alewives and chubs were taken in nearly equal amounts by the trawls in District III. Alewives were in 40 of the 50 drags, composed

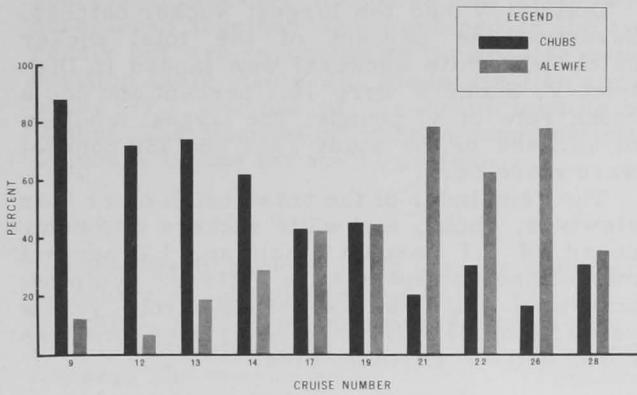


Figure 3.--Percentage of chubs and alewife in exploratory trawl catches in northern Lake Michigan by cruise. Cruise 24 is not shown since only 3 pounds of fish (all alewives) were taken in northern Lake Michigan on that cruise.

Table 4.--Species composition of trawl drags in northern Lake Michigan by district, 1963-65

Species	District					
	I	II	III	IV	V	VI
Percent.....					
Alewife..	13.7	59.3	44.3	89.4	56.3	81.2
Chubs....	77.8	34.0	39.9	0.2	20.1	8.7
Sculpins..	8.0	3.6	0.6	0.2	0.8	0.3
Smelt....	0.2	2.9	12.9	2.9	5.7	2.2
Suckers..	0	0	0	0.5	16.1	2.8
Others...	0.3	0.2	2.3	6.8	1.0	4.8

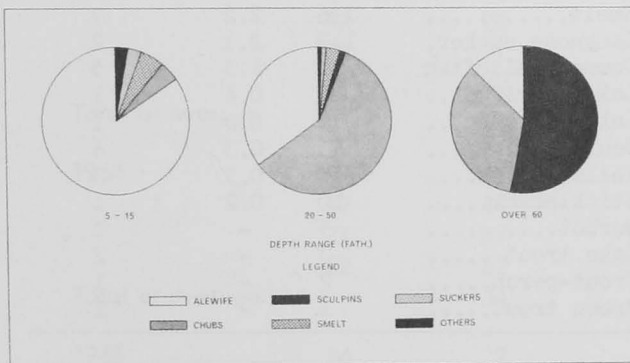


Figure 4.--Species composition of exploratory trawl catches in northern Lake Michigan by depth zones.

44.3 percent of the catch, and had a catch rate of 90 pounds; chubs were in 43 drags, composed 39.9 percent of the catch, and had a catch rate of 80 pounds. No commercially significant alewife catches were made in this district, and the largest landing was 450 pounds. Only three commercially significant chub catches were made--the largest catch was 610 pounds on cruise 28.

Smelt catches were good with 47 percent of the total smelt catch being landed in this district. Smelt were in 37 drags, composed 12.9 percent of the catch, and had a catch rate of 26 pounds. Average catch for effective effort was 35 pounds. The largest catches of smelt--from 125 to 150 pounds--were taken from District III.

The remaining 2.9 percent of the district catch was composed of common whitefish, sculpins, ninespine sticklebacks, lake herring, trout-perch, menominee whitefish, and eight lake trout.

District IV - Island - straits area east of Point Patterson and north of Good Hart

Alewives dominated the trawl catch in this district, occurred in all but 2 of the 30 drags, composed 89.4 percent of the catch, and had a catch rate of 267 pounds. Five of the landings were commercially significant, and the largest landing was 770 pounds.

District IV was the best area for taking common whitefish and had 59 percent of the total catch of common whitefish. In the district catch, whitefish were 3.3 percent and had a catch rate of 10 pounds.

Eleven species other than alewives and common whitefish occurred in the catch and composed the remaining 7.3 percent. Smelt was the third most abundant species--2.9 percent of the catch. The remaining species were longnose and white suckers, sculpins, ninespine sticklebacks, chubs, trout-perch, yellow perch, spottail shiner, lake herring, and lake trout.

Chubs were almost nonexistent in the district catch, and only 14 pounds were landed. All the drags in this district were in 27 fathoms or less, and this shallow-water fishing may account in part for the absence of chubs.

District V - East shore from Good Hart to Charlevoix and Little Traverse Bay

In District V, alewives were the dominant species and chubs were the second most abundant species. Alewives composed 56.3 percent of the total landings, and had a catch rate of 186 pounds. Two alewife catches of 600 and 700 pounds (both taken on cruise 22) were commercially significant. Chubs were 20.1 percent of the catch; however, no commercially significant landings were made.

District V had the largest sucker catches. Seventy-three percent of the total sucker catch (all white suckers) was landed in District V. Suckers were 16.1 percent and had a catch rate of 47 pounds. The largest landings of suckers of the study (325 and 350 pounds) were made here.

The remainder of the trawl catch other than alewives, chubs, and white suckers was composed of 5.7 percent smelt and 1.8 percent miscellaneous species as follows: sculpins, ninespine sticklebacks, trout-perch, yellow perch, spottail shiners, lake herring, one lake trout, and one northern pike.

District VI - Grand Traverse Bay

The fish catch of Grand Traverse Bay was the most diverse of any of the districts. Fifteen of the 18 species taken during the study were caught in this district (table 5). Alewife was the most abundant species in the catch in Grand Traverse Bay, occurred in 10 of the 12 drags, and composed 81.2 percent of the landings. Four of the alewife catches were commercially significant, and the largest landing was 1,100 pounds. Chubs, suckers, and whitefish were also taken in commercially significant quantities in Grand Traverse Bay. The largest landing of each of these three was: chubs 220 pounds, suckers 140 pounds, and whitefish 30 pounds.

Table 5.--Species composition of the 12 exploratory trawl drags in Grand Traverse Bay, 1964-65

Species	Total catch		Occurrences
	Pounds	Percent	Number
Alewife.....	4,314	81.2	10
Chubs.....	462	8.7	5
White sucker....	150	2.8	6
Smelt.....	116	2.2	7
Longnose sucker.	113	2.1	2
Common whitefish	70	1.3	5
Lake herring....	23	0.4	1
Lake sturgeon...	16	0.3	1
Sculpins.....	15	0.3	4
Yellow perch....	14	0.3	3
Stickleback.....	10	0.2	1
Burbot.....	5	-	1
Lake trout.....	3	-	2
Trout-perch.....	2	-	1
Brown trout.....	1	-	1

DISCUSSION BY SPECIES

The following discussion describes the fishing results, by species, for the six most abundant fish taken in the trawl catch. Two

species of suckers (longnose and white) are considered together and combined in the appendix but are separated on the species composition table (table 2). These six fish composed 99.3 percent of the trawl landing by weight. The discussion order is based on total poundage landed for the 11 cruises.

Alewife

Alewives occurred in 72 percent of the exploratory drags and composed 48 percent of the catch. At certain times and places, alewives would constitute the major portion of the trawl fishery. The overall catch rate was 132 pounds; average catch for effective effort was 184 pounds. Twenty-two commercially significant catches were made during the study and on 7 of 11 cruises (table 6). Commercially significant catches were made on all but cruises 9, 12, 13, and 24. The largest catch rate for a cruise (332 pounds) and largest average catch for effective effort (375 pounds) were obtained on cruise 21. Two drags (both off Sturgeon Bay on cruise 21) netted 1,800 pounds each of alewife, and these were the largest landings of the study. Table 7 lists the largest landing for each cruise.

The availability of alewives to bottom trawls by month and depth in northern Lake Michigan is shown in figure 5. Catch rates were low in April, and alewives do not appear to be available commercially to the bottom trawls in

northern Lake Michigan at that time. In May the alewives, which spend the winter in deep water, were migrating shoreward and became more abundant on the bottom. In June, many fish were still migrating shoreward, and a commercially significant catch rate was obtained at the 10-fathom interval. Catch rates in the open lake were very low in July because spawning fish were in harbors and shoal water, which is not generally suited to bottom trawling. In August and early September, good catch rates were made between 10 and 20 fathoms--the highest rate was at the 15-fathom interval. The largest concentrations of alewife in October were at the 15-to-20-fathom intervals. In November, the fish were still moving deeper, and the highest catch rates were at the 20- and 25-fathom intervals.

Chubs

Chubs were caught in more drags (76 percent) than any other species and were 42 percent of the catch. The overall catch rate of chubs was 116 pounds, and the average catch for effective effort was 149 pounds. Chubs dominated the catch (78 percent) in District I and composed significant portions of the catches in Districts II and III. In these districts chubs would be a major component of the commercial trawl landings. Chubs were not caught in commercially significant amounts in Districts IV, V, and VI and would likely contribute

Table 6. --Summary of catch records of alewife in northern Lake Michigan by cruise and year, 1963-65

Year	Cruise No.	Total drags	Significant catches	Total catch	Catch rate per 1/2-hour effort	Average 1/2-hour catch for effective effort
		Number	Number	Pounds	Pounds	Pounds
1963	9	12	0	404	39	46
	12	28	0	146	5	9
	13	21	0	750	38	47
	14	30	2	3,266	108	154
Total or average		91	2	4,566	52	76
1964	17	46	3	4,524	106	116
	19	34	3	4,400	131	249
	21	27	5	8,807	332	375
	22	27	4	5,682	228	248
Total or average		134	15	23,413	184	227
1965	24	7	0	3	1	4
	26	24	4	5,181	229	317
	28	33	1	3,370	102	225
Total or average		64	5	8,554	140	267

Table 7. --Largest catch of alewife for each cruise in northern Lake Michigan, 1963-65

Cruise No.	Dates	Nearest port	Depth	Time fished	Alewife catch
			Fathoms	Minutes	Pounds
9	4/24/63	Manistee	39	30	180
12	7/11/63	Manistique	10	30	90
13	8/20/63	Epoufette	12	30	380
14	10/29/63	Sturgeon Bay	15	30	700
17	5/16/64	Sturgeon Bay	20	30	650
19	6/24/64	Sturgeon Bay	15	30	850
21	8/31/64	Sturgeon Bay	15	30	1,800
21	8/31/64	Sturgeon Bay	20	30	1,800
22	10/25/64	Sturgeon Bay	20	30	300
24	4/27/65	Sturgeon Bay	40	22	3
26	6/23/65	Grand Traverse Bay	12	30	950
28	8/24/65	Grand Traverse Bay	14	30	1,100

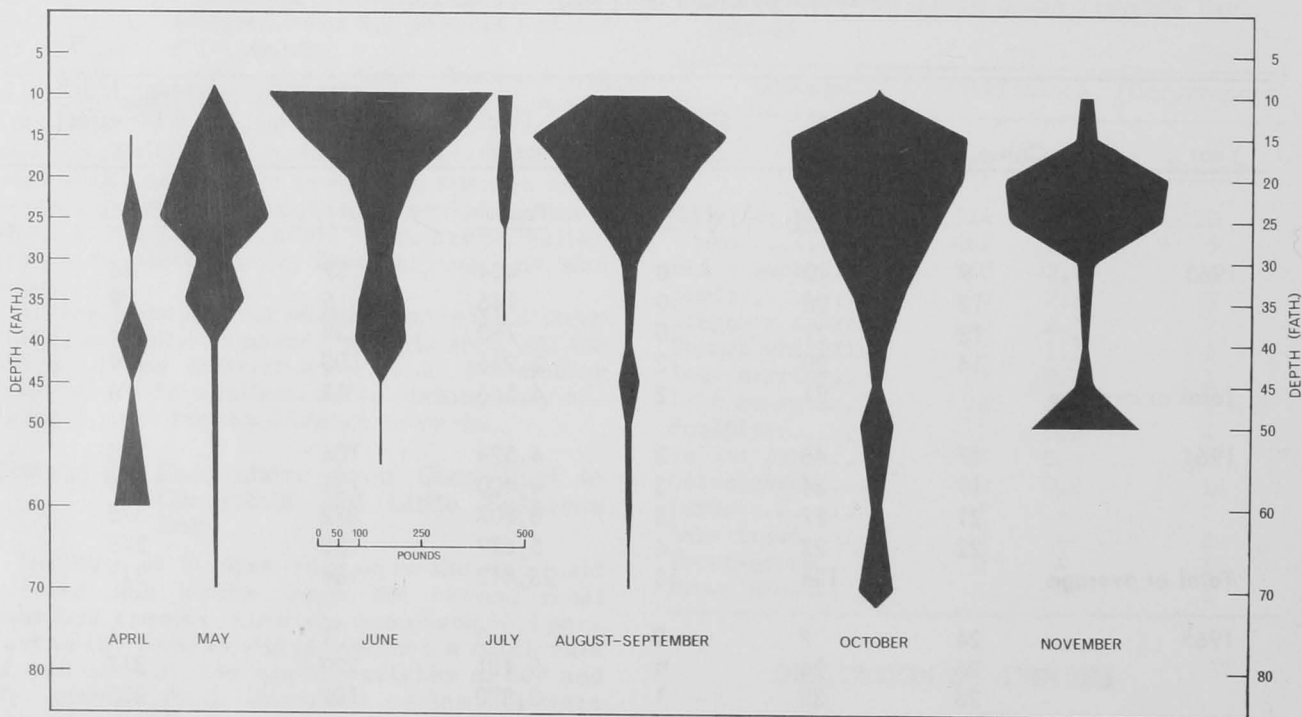


Figure 5.--Availability of alewives to bottom trawls in northern Lake Michigan by depth and month. The illustration figures represent catch rates of alewives by 5-fathom intervals.

only as an incidental supplement to the catch. Forty-two drags or 14.5 percent of all drags had commercially significant amounts of chubs (catch rate of 250 pounds per one-half hour). Commercially significant catches were taken on every cruise except cruise 24. The largest landing of the study was 1,118 pounds in a 1/2 hour drag off Arcadia on cruise 14. A list of the largest landings by cruise is given in table 8. The highest catch rate for a cruise (296 pounds) and average catch for effective effort (371 pounds) were obtained on cruise 9. Table 9 summarizes the chub catch by cruise and year.

Chubs were available to bottom trawling at all times during the study (fig. 6). During April very few chubs were taken in less than 25 fathoms, and catch rates were highest at 30 to 35 fathoms. In May some chubs had migrated to shallower water, but catch rates were highest between 30 and 45 fathoms. From June through September, chubs were caught over a wide depth range and were found at all depths fished. The catch rates did not vary substantially between 20 and 50 fathoms; inside 20 fathoms catch rates were higher than during the rest of the year. In most series of stations, catch rates were sometimes slightly

higher at two distinct depths, usually at 20 to 25 fathoms and again at 35 to 45 fathoms. This stratification is best seen in the fishing logs. In October and November few chubs were taken shallower than 20 fathoms, and catch rates were highest between 30 and 35 fathoms.

Sculpins

Sculpins have no present commercial value; however, they were the third most abundant species in the trawl catch and composed 3.8 percent of the catch. The sculpin catch rate was 10.5 pounds, and the average catch for effective effort was 26 pounds. Eight catches were over 100 pounds including two catches of 200 pounds. Sculpins were taken at depths of 10 to 80 fathoms but were only abundant deeper than 50 fathoms. Eighty-five percent of the sculpin catch was caught at 50 fathoms or deeper.

Smelt

Smelt were the fourth most abundant species in the northern Lake Michigan trawl catch and showed promise of being an important species for trawlers in certain areas and at certain

Table 8. --Largest catch of chubs for each cruise in northern Lake Michigan, 1963-65

Cruise No.	Date	Nearest port	Depth	Time fished	Chub catch
			Fathoms	Minutes	Pounds
9	4/14/63	Kewaunee	34	30	1,024
12	7/14/63	Arcadia	30	30	345
13	8/24/63	Arcadia	20	30	470
14	10/31/63	Arcadia	30	30	1,118
17	5/2/64	Arcadia	40	30	610
19	7/1/64	Arcadia	35	30	590
21	9/2/64	Arcadia	25	30	475
22	10/25/64	Sturgeon Bay	30	30	660
24 ^{1/}	-	-	-	-	-
26	6/29/65	Frankfort	25	30	270
28	8/22/65	Manistique	20	30	610

^{1/} No chubs were taken in the seven drags during cruise 24.

Table 9.--Summary of catch records of chubs in northern Lake Michigan by cruise and year, 1963-65

Year	Cruise No.	Total drags	Significant catches	Total catch	Catch rate per 1/2-hour effort	Average 1/2-hour catch for effective effort
		Number	Number	Pounds	Pounds	Pounds
1963	9	12	5	3,093	296	371
	12	28	1	1,600	57	69
	13	21	6	2,900	147	249
	14	30	9	6,836	227	243
Total or average		91	21	14,429	164	202
1964	17	46	5	4,588	108	139
	19	34	7	4,441	132	148
	21	27	3	2,298	87	104
	22	27	4	2,868	115	146
Total or average		134	19	14,195	111	136
1965	24	7	0	0	0	0
	26	24	1	1,102	49	73
	28	33	1	2,296	69	96
Total or average		64	2	3,398	56	87

times. Smelt composed 3.4 percent of the total catch at a catch rate of 9.5 pounds and had an average catch for effective effort of 21 pounds. Smelt were at depths of 9 to 50 fathoms, but were most abundant at 15 to 20 fathoms where catch rates of 22 and 23 pounds, respectively, were taken.

The smelt catch rates by district were as follows:

District	Smelt catch rate (1/2-hour effort) Pounds
I	0.4
II	8.5
III	26.5
IV	8.8
V	16.6
VI	9.7

Seven catches netted 100 pounds or more, four of these were in District III, two in District II, and one in District V. Only one commercially significant catch was landed during the study (150 pounds taken in 20 fathoms off Seul Choix Point on cruise 28).

Suckers

Both longnose suckers and white suckers were taken in the trawl catches, and together they were 1.5 percent of the total catch. Longnose suckers occurred in four drags--two in Grand Traverse Bay and two near Naubinway. The largest landing of longnose suckers was 110 pounds at 14 fathoms in Grand Traverse Bay. White suckers were taken in greatest abundance in Little Traverse Bay where 81 percent of the total poundage and the two commercially significant catches of 325 and 350 pounds were landed. Grand Traverse Bay was another area where suckers were abundant. Suckers would most likely be of commercial importance only in Little and Grand Traverse Bays.

Common Whitefish

The common whitefish was not taken frequently enough to be a major species for trawlers; however, it could be an important supplement to fishing for alewives or chubs in certain areas. The best locations for taking whitefish were off Beaver Island, Manistique, and Seul Choix Point. Seventy-seven percent

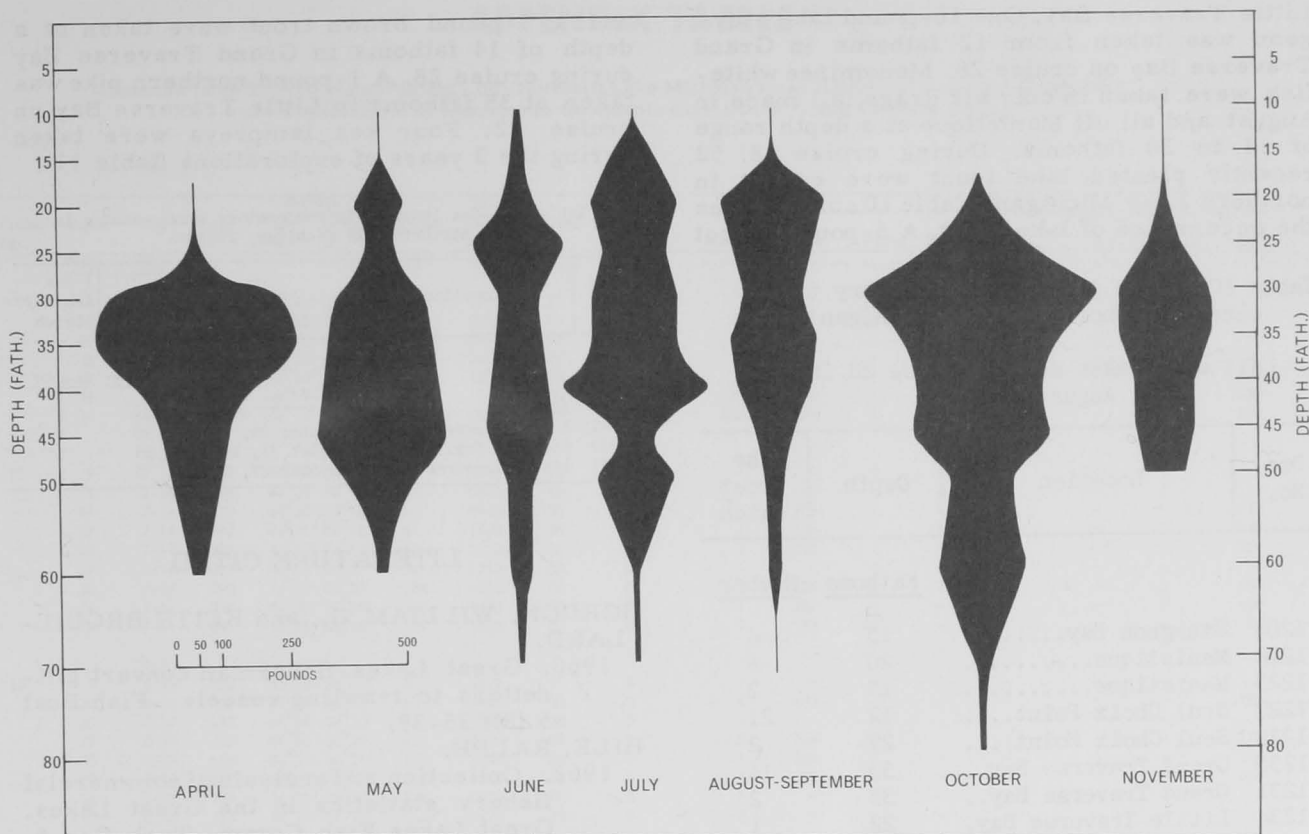


Figure 6.--Availability of chubs to bottom trawls in northern Lake Michigan by depth and month. The illustration figures represent catch rates of chubs at 5-fathom intervals.

of the whitefish were landed in the above three areas. Whitefish were most frequently caught at the 15-fathom interval--77 percent of the catch being landed in 17 fathoms or less. Ten commercially significant catches were made, and the largest catch was 75 pounds taken from 15 fathoms east of Beaver Island during cruise 19.

Miscellaneous Species

The following miscellaneous species, in order of poundage abundance, were taken in the trawl catch in northern Lake Michigan: ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, menominee whitefish, lake trout, burbot, brown trout, and northern pike. Table 2 summarizes the occurrences, total pounds landed, catch rate and average catch for effective effort for these fish.

Ninespine sticklebacks occurred in 27 drags in amounts from one individual up to 100 pounds taken at 12 fathoms off Beaver Island. Ninespine sticklebacks were at depths from 10 to 49 fathoms but were most frequently caught at the 10- and 15-fathom intervals.

Lake herring occurred in 34 trawl drags but usually in amounts of only one or a few individuals. The largest catch was 23 pounds in Grand Traverse Bay. Lake herring were most frequently caught off the ports of Sturgeon Bay and Frankfort at depths of 25 fathoms or less.

Very few yellow perch were taken in northern Lake Michigan when compared with results in southern Lake Michigan and Green Bay. Yellow perch occurred in only 11 drags and had an average catch for effective effort of only 7 pounds. One good catch of 50 pounds off Beaver Island in 15 fathoms accounted for 69 percent of the total perch catch. With the exception of one fish, all yellow perch taken in this study were caught off Beaver Island or in Grand and Little Traverse Bays.

The other miscellaneous species were of minor importance. Trout-perch occurred in 13 trawl catches; the maximum landing was 30 pounds. Trout-perch were taken at depths from 10 to 40 fathoms but only in Districts III, IV, V, and VI. Spottail shiners were caught in six drags and only off Beaver Island and in Little Traverse Bay. The largest landing of 20 pounds of spottail shiners was taken at 25 fathoms in

Little Traverse Bay. One 16-pound lake sturgeon was taken from 12 fathoms in Grand Traverse Bay on cruise 26. Menominee whitefish were taken in only six drags, all made in August and all off Manistique at a depth range of 11 to 20 fathoms. During cruise 28, 52 recently planted lake trout were caught in northern Lake Michigan. Table 10 summarizes the occurrence of lake trout. A 5-pound burbot

Table 10.--Lake trout in exploratory trawl catches in northern Lake Michigan

[All were taken during cruise 28 in August 1965]

Drag No.	Location	Depth	Lake trout catch	
			Fathoms	Number
1204	Sturgeon Bay.....	15		4
1224	Manistique.....	20		6
1225	Manistique.....	15		2
1227	Seul Choix Point....	12	21	
1228	Seul Choix Point....	27		2
1230	Grand Traverse Bay..	33	14	
1231	Grand Traverse Bay..	35		2
1234	Little Traverse Bay.	22		1

and a 1-pound brown trout were taken at a depth of 14 fathoms in Grand Traverse Bay during cruise 28. A 1-pound northern pike was taken at 35 fathoms in Little Traverse Bay on cruise 22. Four sea lampreys were taken during the 3 years of explorations (table 11).

Table 11.--Sea lampreys in exploratory trawl catches in northern Lake Michigan, 1963-65

Drag No.	Location	Date	Depth	Sea lamprey catch	
				Fathoms	Number
312	Arcadis.....	April 17, 1963	35		1
541	East of Beaver Island	October 31, 1963	30		1
947	Sturgeon Bay.....	August 31, 1964	35		1
1071	Little Traverse Bay..	October 27, 1964	35		1

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APPENDIX TABLES

Appendix table 1.—R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District 1 (East shore from 5 miles south of Manistee to Charlevoix exclusive of Grand Traverse Bay)

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch							
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total
9	16	4-23	332	44°48'	86°09'	N.	0910	30	7	1	-	1	1	-	-	-	3
	20	4-23	333	44°50'	86°10'	S.	0950	20	3	1	1	-	1	-	-	-	3
	29	4-17	313	44°30'	86°18'	N.	0800	30	7	1	738	1	3	-	-	7	750
	35	4-17	314	44°30'	86°19'	N.	0930	20	2	-	137	-	1	-	-	2	140
	35	4-23	334	44°20'	86°25'	S.	1350	30	0	-	427	1	1	-	-	1	430
	39	4-23	335	44°18'	86°26'	S.	1510	30	2	30	298	1	-	1	-	-	330
	39	4-24	336	44°18'	86°26'	S.	0800	30	0	180	399	1	-	-	-	-	580
12	1963																
	9	7-14	387	44°32'	86°16'	S.	0740	15	4	-	-	-	-	-	-	-	-
	14	7-14	388	44°30'	86°16'	SE.	0840	40	0	2	65	-	3	-	-	-	70
	17	7-14	389	44°30'	86°18'	N.	0940	30	0	1	225	-	4	-	-	-	230
	22	7-14	390	44°31'	86°18'	S.	1030	30	0	1	135	-	1	-	-	3	140
	30	7-14	391	44°30'	86°19'	NE.	1120	30	0	2	345	1	1	-	-	1	350
	34	7-14	392	44°31'	86°19'	SW.	1210	30	0	-	-	-	-	-	-	-	-
	35	7-14	393	44°29'	86°20'	NW.	1310	30	0	1	225	1	1	-	-	2	230
	44	7-14	394	44°30'	86°20'	SW.	1400	30	0	1	107	1	-	-	-	1	110
	70	7-14	395	44°29'	86°22'	SW.	1510	30	0	1	33	31	-	-	-	-	65
13	1963																
	9	8-23	422	44°50'	86°09'	S.	1220	15	4	1	-	-	1	-	-	-	2
	20	8-24	429	44°26'	86°19'	S.	1400	30	0	9	470	-	1	-	-	-	480
	25	8-24	428	44°24'	86°20'	S.	1320	30	0	-	-	-	-	-	-	-	-
	29	8-24	427	44°26'	86°20'	S.	1230	30	0	5	264	1	-	-	-	-	270
	35	8-24	426	44°24'	86°21'	N.	1140	30	0	1	338	1	-	-	-	-	340
	39	8-24	425	44°26'	86°21'	S.	1050	30	0	1	298	1	-	-	-	-	300
	68	8-24	424	44°26'	86°23'	SW.	0930	30	0	1	-	-	-	-	-	-	1
	111	8-23	423	44°39'	86°23'	S.	1420	30	0	1	-	-	-	-	-	-	1
14	1963																
	20	10-31	539	44°32'	86°18'	S.	0820	30	0	1	197	1	1	-	-	-	200
	25	10-31	540	44°30'	86°18'	N.	0900	30	0	3	385	1	1	-	-	-	390
	30	10-31	541	44°32'	86°19'	S.	0950	30	0	1	1,118	-	1	-	-	-	1,120
	35	10-31	542	44°30'	86°19'	N.	1040	30	0	1	658	1	-	-	-	-	660
	40	10-31	543	44°32'	86°20'	S.	1130	30	0	-	625	35	-	-	-	-	660
	45	10-31	544	44°30'	86°20'	N.	1220	30	0	-	565	45	-	-	-	-	610
	50	10-31	545	44°32'	86°20'	S.	1320	30	0	-	265	5	-	-	-	-	270
	60	10-31	546	44°30'	86°21'	N.	1420	30	0	-	520	80	-	-	-	-	600
	70	10-31	547	44°32'	86°21'	S.	1520	30	0	-	100	170	-	-	-	-	270
80	10-31	548	44°30'	86°22'	N.	1630	30	0	-	10	200	-	-	-	-	210	
17	1964																
	20	5-12	734	44°30'	86°17'	N.	1120	30	0	90	305	4	6	-	-	5	410
	20	5-12	735	44°32'	86°18'	S.	1200	30	3	30	230	8	-	-	-	2	270
	25	5-12	736	44°30'	86°18'	N.	1320	30	0	50	180	10	-	-	-	-	240
	30	5-12	737	44°30'	86°19'	N.	1410	30	0	20	475	5	-	-	-	-	500
	35	5-12	738	44°30'	86°19'	N.	1520	30	0	20	480	10	-	-	-	-	510
	40	5-12	739	44°30'	86°20'	N.	1630	30	0	10	610	10	-	-	-	-	630
	45	5-12	740	44°30'	86°20'	N.	1730	30	0	5	365	20	-	-	-	-	390
	50	5-13	741	44°32'	86°20'	S.	0720	30	5	6	104	80	-	-	-	-	190
	60	5-13	742	44°32'	86°21'	S.	0830	30	5	10	40	80	-	-	-	-	130
70	5-13	743	44°32'	86°22'	S.	0950	30	5	20	20	100	-	-	-	-	140	
19	1964																
	20	7- 1	834	44°30'	86°15'	N.	0640	30	4	140	540	-	-	-	-	-	680
	25	7- 1	835	44°31'	86°17'	N.	0750	30	3	20	210	-	-	-	-	20	250
	25	7- 1	836	44°32'	86°17'	S.	0840	30	0	15	260	-	5	-	-	-	280
	30	7- 1	837	44°32'	86°18'	S.	1000	30	0	-	350	-	-	-	-	-	350
	35	7- 1	838	44°32'	86°19'	S.	1130	30	0	-	590	-	-	-	-	-	590
	40	7- 1	839	44°29'	86°20'	S.	1300	30	0	-	310	-	-	-	-	-	310
	45	7- 1	840	44°29'	86°21'	S.	1400	30	0	-	140	10	-	-	-	-	150
	50	7- 1	841	44°29'	86°21'	S.	1500	30	0	-	210	160	-	-	-	-	370
	60	7- 1	842	44°29'	86°21'	S.	1610	30	0	-	30	170	-	-	-	-	200
70	7- 1	843	44°29'	86°22'	S.	1720	30	0	-	10	80	-	-	-	-	90	
21	1964																
	20	9- 2	959	44°32'	86°17'	S.	0740	30	8	5	175	-	-	-	-	-	180
	25	9- 2	958	44°32'	86°18'	S.	0650	30	8	5	475	-	-	-	-	-	480
	30	9- 1	957	44°32'	86°18'	S.	1630	30	0	2	75	3	-	-	-	-	80
	35	9- 1	956	44°32'	86°19'	S.	1530	30	0	-	38	2	-	-	-	-	40
	40	9- 1	955	44°32'	86°19'	S.	1430	30	0	2	35	3	-	-	-	-	40
	45	9- 1	954	44°32'	86°20'	S.	1330	30	0	-	55	5	-	-	-	-	60
	50	9- 1	953	44°32'	86°20'	S.	1230	30	8	-	35	10	-	-	-	-	45
50	9- 1	952	44°32'	86°20'	S.	1130	30	8	1	29	10	-	-	-	-	40	

See footnotes at end of table.

Appendix table 1.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District 1 (East shore from 5 miles south of Manistee to Charlevoix exclusive of Grand Traverse Bay)--Continued

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch							
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total
	Fath.	1964					Min.										
22	20	10-20	1033	44°30'	86°16'	N.	0940	30	0	600	55	-	5	-	-	-	660
	25	10-20	1031	44°32'	86°17'	S.	0750	30	0	150	200	-	-	-	-	-	350
	25	10-20	1032	44°30'	86°17'	N.	0830	30	0	240	310	-	-	-	-	-	550
	30	10-20	1034	44°30'	86°18'	N.	1030	30	0	450	69	-	-	-	-	1	520
	35	10-20	1035	44°30'	86°18'	N.	1120	30	0	150	60	-	-	-	-	-	210
	40	10-20	1036	44°30'	86°19'	N.	1220	30	7	50	60	-	-	-	-	-	110
	45	10-20	1037	44°30'	86°19'	N.	1300	30	3	20	90	-	-	-	-	-	110
	50	10-20	1038	44°30'	86°20'	N.	1350	30	7	15	145	10	-	-	-	-	170
	60	10-20	1039	44°30'	86°21'	N.	1440	30	3	-	100	30	-	-	-	-	130
	26	20	6-29	1163	44°38'	86°18'	S.	0810	20	8	100	10	-	-	-	-	-
25		6-29	1162	44°36'	86°18'	N.	0720	30	0	110	270	-	-	-	-	-	380
30		6-29	1161	44°38'	86°19'	S.	0630	30	0	150	100	-	-	-	-	-	250
35		6-28	1160	44°27'	86°19'	N.	1640	30	0	260	20	-	-	-	-	-	280
40		6-28	1159	44°29'	86°20'	S.	1540	30	0	240	110	-	-	-	-	-	350
45		6-28	1158	44°27'	86°20'	N.	1460	30	0	10	140	-	-	-	-	-	150
50		6-28	1157	44°29'	86°21'	S.	1360	30	0	-	70	10	-	-	-	-	80
60		6-28	1156	44°29'	86°21'	N.	1310	30	8	-	110	30	-	-	-	-	140
70		6-28	1155	44°29'	86°22'	S.	1210	30	0	-	12	48	-	-	-	-	60
28		25	8-27	1246	44°32'	86°17'	S.	0900	30	0	-	220	10	-	-	-	-
	30	8-27	1245	44°32'	86°18'	S.	0800	30	0	-	120	20	-	-	-	-	140
	35	8-26	1237	44°32'	86°18'	S.	0800	30	0	-	190	20	-	-	-	-	210
	35	8-26	1238	44°30'	86°18'	N.	0900	30	0	-	101	30	-	-	-	-	131
	40	8-26	1239	44°32'	86°19'	S.	0950	30	0	-	210	20	-	-	-	-	230
	45	8-26	1240	44°32'	86°19'	S.	1040	30	0	-	90	50	-	-	-	-	140
	50	8-26	1241	44°32'	86°20'	S.	1150	30	0	-	85	25	-	-	-	-	110
	60	8-26	1242	44°32'	86°20'	S.	1300	30	0	-	20	80	-	-	-	-	100
	70	8-26	1243	44°32'	86°21'	S.	1400	30	0	-	5	80	-	-	-	-	85
	80	8-26	1244	44°32'	86°25'	S.	1510	30	0	-	-	70	-	-	-	-	70

^{1/} 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

^{2/} Include longnose and white suckers.

^{3/} Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.

Appendix table 2.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District II
(Wisconsin waters of northern Lake Michigan)

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch								
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total	
										Pounds								
	Fath.	1963					Min.											
9	25	4-14	308	44°30'	87°24'	N.	0710	30	0	5	-	-	-	-	-	-	-	5
	27	4-15	311	45°16'	86°47'	E.	0900	30	0	100	49	-	1	-	-	-	-	150
	34	4-14	309	44°32'	87°22'	N.	0810	30	0	5	1,024	-	1	-	-	-	-	1,030
	38	4-14	310	45°06'	86°55'	S.	1410	4	4	1	-	-	-	-	-	-	-	1
	60	4-15	312	45°14'	86°40'	S.	1020	30	8	80	20	40	-	-	-	-	-	140
12	1963																	
	10	7-12	377	44°45'	87°16'	S.	0940	30	0	1	-	-	-	-	-	-	-	1
	14	7-12	378	44°43'	87°16'	SW.	1020	30	0	2	29	-	7	-	-	-	-	38
	19	7-12	379	44°42'	87°16'	N.	1110	30	0	-	31	-	1	-	-	-	-	32
	24	7-12	380	44°43'	87°14'	SW.	1210	30	0	-	55	-	-	-	-	-	-	55
	30	7-12	381	44°41'	87°14'	N.	1250	30	5	-	16	-	-	-	-	-	-	16
	33	7-12	382	44°43'	87°13'	S.	1350	30	5	1	89	-	-	-	-	-	-	90
	44	7-13	383	44°44'	87°12'	S.	0800	30	0	1	7	-	-	-	-	-	-	8
	58	7-13	384	44°41'	87°09'	S.	0910	30	0	-	15	65	-	-	-	-	-	80
	69	7-13	385	44°40'	87°07'	N.	1030	30	0	4	-	8	-	-	-	-	-	12
	80	7-13	386	44°41'	87°05'	S.	1140	30	0	-	-	200	-	-	-	-	-	200
14	1963																	
	9	10-29	528	44°43'	87°17'	NE.	1350	30	4	-	-	-	-	-	-	-	-	-
	15	10-29	529	44°45'	87°16'	SW.	0820	30	0	700	1	-	15	-	-	10	4	730
	20	10-29	530	44°45'	87°16'	NE.	0910	30	0	400	60	-	16	-	-	3	1	480
	25	10-29	531	44°45'	87°14'	SW.	1000	30	0	600	278	-	100	-	-	1	1	980
	30	10-29	532	44°43'	87°15'	NE.	1050	30	0	200	155	5	50	-	-	-	-	410
	35	10-29	533	44°43'	87°15'	S.	1150	30	0	150	412	-	38	-	-	-	-	600
	40	10-29	534	44°43'	87°14'	NE.	1250	35	0	20	258	-	30	-	-	-	2	310
	45	10-30	535	44°46'	87°11'	S.	0820	30	5	5	225	3	-	-	-	-	-	233
	50	10-30	536	44°44'	87°09'	N.	0930	30	5	1	102	6	1	-	-	-	-	110
	60	10-30	537	44°46'	87°07'	S.	1040	30	5	-	80	140	-	-	-	-	-	220
70	10-30	538	44°42'	87°05'	NE.	1140	30	5	-	15	30	-	-	-	-	-	45	
17	1964																	
	15	5-16	759	44°45'	87°16'	S.	0730	30	2	450	2	-	105	-	-	-	3	560
	20	5-16	760	44°45'	87°14'	S.	0840	30	0	650	37	-	50	-	-	13	-	750
	25	5-16	761	44°45'	87°14'	S.	0940	30	0	600	78	-	50	-	-	1	1	730
	30	5-16	762	44°45'	87°13'	S.	1030	30	0	250	79	-	-	-	-	-	1	330
	35	5-16	763	44°45'	87°13'	S.	1130	30	0	3	215	-	-	-	-	-	2	220
	40	5-16	764	44°45'	87°12'	S.	1230	30	0	10	159	-	-	-	-	-	1	170
	45	5-16	765	44°45'	87°11'	S.	1330	30	0	5	185	-	-	-	-	-	-	190
	50	5-16	766	44°45'	87°09'	S.	1440	30	0	5	175	-	-	-	-	-	-	180
	60	5-16	767	44°45'	87°08'	S.	1550	30	0	2	53	30	-	-	-	-	-	85
	70	5-16	768	44°45'	87°05'	S.	1650	30	0	-	15	45	-	-	-	-	-	60
19	1964																	
	15	6-24	802	44°45'	87°15'	SW.	0930	30	0	75	35	-	10	-	-	-	-	120
	15	6-24	803	44°43'	87°16'	NE.	1020	30	0	850	26	-	4	-	-	-	-	880
	20	6-24	804	44°43'	87°15'	N.	1110	30	3	15	290	-	5	-	-	-	-	310
	25	6-24	805	44°43'	87°14'	N.	1210	30	0	5	295	-	-	-	-	-	-	300
	30	6-24	806	44°43'	87°14'	N.	1300	30	0	3	126	-	1	-	-	-	-	130
	35	6-24	807	44°43'	87°13'	N.	1400	30	0	-	190	-	-	-	-	-	-	190
	40	6-24	808	44°45'	87°12'	N.	1500	30	0	-	130	-	-	-	-	-	-	130
	45	6-24	809	44°44'	87°11'	N.	1600	30	0	-	80	-	-	-	-	-	-	80
	50	6-25	812	44°43'	87°08'	N.	1100	30	0	-	22	-	-	-	-	-	-	22
	60	6-25	811	44°43'	87°07'	N.	1000	30	0	-	17	15	-	-	-	-	-	32
70	6-25	810	44°43'	87°06'	N.	0850	30	0	-	5	50	-	-	-	-	-	55	
21	1964																	
	15	8-31	942	44°45'	87°16'	S.	0700	30	0	1,200	16	-	50	-	-	-	4	1,270
	15	8-31	943	44°44'	87°17'	N.	0750	30	0	1,800	15	-	20	-	-	-	5	1,840
	20	8-31	944	44°42'	87°16'	N.	0900	30	0	1,800	120	-	-	-	-	-	10	1,930
	25	8-31	945	44°42'	87°16'	N.	1000	30	0	1,100	95	-	-	-	-	-	5	1,200
	30	8-31	946	44°42'	87°15'	N.	1100	30	0	380	120	-	-	-	-	-	-	500
	35	8-31	947	44°42'	87°14'	N.	1150	30	0	160	427	-	-	-	-	2	1	590
	40	8-31	948	44°42'	87°14'	N.	1250	30	0	50	265	-	5	-	-	-	-	320
	45	8-31	949	44°42'	87°14'	N.	1350	30	0	180	135	-	5	-	-	-	-	320
	50	8-31	950	44°42'	87°09'	N.	1500	30	0	55	45	-	-	-	-	-	-	100
	60	8-31	951	44°42'	87°08'	N.	1630	30	0	45	35	10	-	-	-	-	-	90

See footnotes at end of table.

Appendix table 2.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District II
(Wisconsin waters of northern Lake Michigan)--Continued

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor 1/	Catch							
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers 2/	White-fish	Others 3/	Total
		Fath.	1964					Min.	Pounds								
22	15	10-25	1058	44°41'	87°17'	SW.	0740	25	1	270	-	-	-	-	-	-	270
	15	10-25	1059	44°42'	87°17'	NE.	0830	25	0	280	-	-	-	-	-	-	280
	20	10-25	1060	44°41'	87°16'	SW.	0910	30	0	800	1	-	7	-	-	2	810
	25	10-25	1061	44°41'	87°15'	SW.	1010	30	0	110	5	-	15	-	-	-	130
	30	10-25	1062	44°41'	87°14'	SW.	1100	30	0	170	660	-	90	-	-	-	920
	35	10-25	1063	44°41'	87°13'	SW.	1200	30	0	140	590	-	10	-	-	-	740
	40	10-25	1064	44°41'	87°12'	SW.	1300	18	1	100	90	-	-	-	-	-	190
	45	10-25	1065	44°41'	87°12'	SW.	1340	30	0	40	280	-	-	-	-	-	320
	50	10-25	1066	44°41'	87°11'	S.	1440	30	0	300	45	5	-	-	-	-	350
	60	10-25	1067	44°41'	87°08'	S.	1540	30	0	90	40	40	-	-	-	-	170
	70	10-25	1068	44°41'	87°05'	S.	1640	30	0	250	20	100	-	-	-	-	370
1965																	
24	15	4-27	1121	44°03'	87°16'	S.	0650	30	0	-	-	-	-	-	-	-	-
	20	4-27	1122	44°01'	87°16'	N.	0740	30	0	-	-	-	-	-	-	-	-
	25	4-27	1123	44°03'	87°15'	S.	0820	12	2	-	-	-	-	-	-	-	-
	30	4-27	1124	44°03'	87°14'	S.	1150	30	0	-	-	-	-	-	-	-	-
	35	4-27	1125	44°01'	87°14'	N.	1240	30	0	-	-	-	-	-	-	-	-
	40	4-27	1126	44°03'	87°12'	S.	1350	22	9	3	-	-	-	-	-	-	3
45	4-27	1127	44°01'	87°12'	S.	1410	4	9	-	-	-	-	-	-	-	-	
1965																	
26	50	6-29	1166	44°45'	87°08'	S.	1410	30	0	1	8	10	-	-	-	-	19
	60	6-29	1165	44°43'	87°07'	N.	1310	30	0	-	10	20	-	-	-	-	30
	70	6-29	1164	44°45'	87°04'	SW.	1210	30	0	-	10	60	-	-	-	-	70
1965																	
28	15	8-18	1204	44°45'	87°16'	S.	1150	30	0	180	40	-	30	-	-	1	251
	20	8-18	1205	44°43'	87°15'	NE.	1250	30	0	5	40	-	-	-	-	-	45
	25	8-19	1206	44°45'	87°14'	S.	0740	30	0	-	1	-	-	-	-	-	1
	30	8-19	1207	44°43'	87°14'	N.	0830	30	0	1	74	-	-	-	-	-	75
	35	8-19	1208	44°45'	87°13'	S.	0930	30	0	-	100	-	-	-	-	-	100
	40	8-19	1209	44°43'	87°12'	N.	1020	30	0	-	-	-	-	-	-	-	5
	45	8-19	1210	44°45'	87°10'	S.	1140	30	0	-	5	-	-	-	-	-	5
	50	8-19	1211	44°43'	87°07'	N.	1210	30	0	-	2	2	-	-	-	-	4
	60	8-19	1212	44°45'	87°07'	N.	1300	30	2	-	-	1	-	-	-	-	1
70	8-19	1213	44°43'	87°05'	NE.	1400	30	0	-	-	2	-	-	-	-	2	

1/ 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

2/ Include longnose and white suckers.

3/ Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.

Appendix table 3.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District III
(Northwest shore from Rock Island to Point Patterson)

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch								
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total	
Fath.		1963											Pounds					
								Min.										
12	10	7-11	371	45°55'	86°05'	E.	0830	30	0	90	10	1	17	-	1	1	120	
	15	7-11	372	45°53'	86°03'	SW.	0940	30	0	35	25	-	90	-	-	-	150	
	19	7-11	373	45°50'	86°05'	SW.	1050	30	0	2	26	1	14	-	-	-	43	
	24	7-11	374	45°49'	86°06'	NE.	1140	30	0	-	3	-	4	-	-	-	7	
	30	7-11	375	45°49'	86°05'	W.	1240	30	0	-	7	-	5	-	-	-	12	
	34	7-11	376	45°47'	86°06'	SW.	1330	30	0	1	5	-	-	-	-	-	6	
	45	7-10	370	45°45'	86°08'	NE.	1530	30	0	-	34	1	1	-	-	-	36	
	49	7-10	369	45°44'	86°06'	W.	1410	30	0	-	108	12	-	-	-	-	120	
	59	7-10	368	45°40'	86°09'	E.	1240	30	2	-	5	7	-	-	-	-	12	
1963																		
13	11	8-18	409	45°52'	86°14'	SW.	1550	30	0	200	1	1	7	-	-	1	210	
	15	8-19	410	45°54'	85°57'	W.	0830	30	5	10	75	-	90	-	3	2	180	
	16	8-19	414	45°42'	85°57'	SW.	1710	16	4	1	-	-	-	-	-	1	2	
	22	8-19	411	45°50'	85°59'	NE.	0930	30	5	1	450	-	39	-	-	-	490	
	25	8-19	412	45°51'	85°59'	N.	1050	30	5	1	360	1	8	-	-	-	370	
	32	8-19	413	45°51'	85°55'	S.	1200	30	5	-	238	1	1	-	-	-	240	
1963																		
14	10	11-23	561	45°54'	86°02'	E.	1130	30	5	25	1	-	3	-	6	-	35	
	14	11-23	562	45°52'	86°00'	W.	1220	30	5	42	5	-	26	-	2	-	75	
	18	11-24	563	45°50'	86°02'	NE.	0830	30	5	390	14	-	95	-	1	-	500	
	25	11-24	564	45°49'	86°00'	W.	0930	30	7	360	66	-	4	-	-	-	430	
	30	11-24	565	45°48'	86°02'	E.	1030	30	7	36	192	1	1	-	-	-	230	
	33	11-24	566	45°48'	86°00'	W.	1120	30	5	28	191	-	1	-	-	-	220	
	39	11-24	567	45°47'	86°02'	E.	1210	30	0	13	127	-	-	-	-	-	140	
	44	11-24	568	45°47'	86°00'	W.	1310	30	0	40	126	1	-	-	-	3	170	
	49	11-24	569	45°45'	86°02'	E.	1400	30	0	250	85	3	-	-	-	2	340	
1964																		
17	5	5-20	785	45°57'	85°53'	S.	0600	18	1	-	-	-	-	-	-	-	-	
	10	5-18	777	45°51'	86°15'	NE.	1500	30	0	3	-	-	1	-	-	-	4	
	10	5-19	779	45°54'	86°02'	W.	0640	24	1	4	-	-	1	-	-	-	5	
	15	5-19	780	45°53'	86°02'	E.	0730	30	0	10	-	-	2	-	-	-	12	
	20	5-18	778	45°50'	86°12'	SE.	1610	25	8	200	-	-	130	-	-	-	330	
	20	5-19	781	45°51'	86°02'	E.	0830	30	0	20	8	1	65	-	-	6	100	
	25	5-19	782	45°49'	86°02'	E.	0910	30	0	160	75	-	10	-	-	5	250	
	30	5-18	776	45°29'	86°35'	NE.	1200	16	3	5	100	-	3	-	-	-	108	
	30	5-19	783	45°49'	86°02'	E.	1000	15	9	5	53	-	-	-	2	-	60	
	35	5-19	784	45°48'	86°02'	E.	1040	12	9	20	65	-	5	-	-	-	90	
1964																		
19	10	6-27	823	45°56'	85°48'	W.	1340	30	0	320	38	-	60	-	2	-	420	
	10	6-27	824	45°56'	85°50'	E.	1420	30	0	190	50	-	130	-	-	-	370	
	15	6-27	825	45°55'	85°48'	W.	1520	30	0	24	130	-	65	-	1	-	220	
	20	6-27	825	45°54'	85°47'	W.	1630	30	0	3	30	-	15	-	-	-	48	
	45	6-27	822	45°47'	86°02'	E.	1120	30	0	-	130	-	-	-	-	-	130	
	50	6-27	821	45°45'	86°05'	E.	1010	30	0	-	145	15	-	-	-	-	160	
1964																		
21	10	8-26	915	45°56'	85°48'	W.	1650	30	0	120	1	-	3	-	2	4	130	
	15	8-26	916	45°55'	85°50'	E.	1740	30	0	150	4	1	10	-	15	-	180	
	20	8-27	917	45°54'	85°49'	E.	0720	30	5	450	90	-	11	-	8	1	560	
1965																		
26	10	6-25	1136	45°56'	85°50'	E.	0660	30	0	450	-	-	5	-	25	-	480	
	15	6-25	1137	45°55'	85°48'	W.	0740	30	0	230	7	-	3	-	-	-	240	
	20	6-25	1138	45°54'	85°48'	E.	0840	30	0	40	5	-	-	-	-	-	45	
	35	6-25	1139	45°46'	86°08'	NE.	1120	10	9	-	20	-	-	-	-	-	20	
1965																		
28	10	8-22	1226	45°56'	85°50'	E.	1520	30	0	250	20	-	30	-	5	5	310	
	15	8-22	1225	45°55'	85°48'	W.	1440	30	0	75	60	-	125	-	8	2	270	
	20	8-22	1224	45°54'	85°49'	E.	1330	30	0	50	610	7	150	-	-	3	820	

^{1/} 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

^{2/} Include longnose and white suckers.

^{3/} Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.

Appendix table 4.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District IV
(Island-Straits area east of Point Patterson and north of Good Hart)

Cruise No.	Depth Fath.	Date	Drag No.	Position		Course	Time of day	Fished Min.	Limiting factor ^{1/}	Catch							Total	
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}		
		1963																
13	10	8-20	418	45°41'	85°01'	NW	1530	30	0	40	-	-	22	-	-	13	75	
	12	8-20	417	46°00'	85°20'	S.	1220	30	0	380	-	-	5	-	5	-	390	
	14	8-20	416	45°58'	85°19'	E.	1050	30	2	95	-	-	-	-	-	5	100	
	16	8-20	415	45°44'	85°12'	NW	0830	30	0	1	-	-	-	-	-	1	2	
		1964																
17	7	5-20	790	45°42'	85°00'	W.	1520	2	3	-	-	-	-	-	-	3	3	
	11	5-20	788	45°58'	85°19'	NW	1120	30	0	4	-	-	12	-	4	8	28	
	15	5-20	786	45°53'	85°20'	SE.	0900	30	4	-	-	-	5	-	-	2	7	
	15	5-20	789	45°43'	85°12'	NW	1400	30	0	30	1	-	10	-	6	53	100	
	25	5-20	787	45°53'	85°10'	W.	1000	30	0	2	-	-	5	-	30	13	50	
		1964																
19	10	6-29	831	45°43'	85°28'	SE.	0840	30	0	550	-	-	-	20	20	-	590	
	10	6-29	832	45°52'	85°28'	NW	1050	20	9	350	-	-	-	12	8	-	370	
	15	6-28	828	45°43'	85°12'	W.	1110	30	0	490	5	-	30	-	5	-	530	
	15	6-28	829	45°41'	85°27'	NW	1420	30	0	770	-	-	8	-	20	2	800	
	15	6-28	830	45°43'	85°28'	SE.	1750	30	0	450	-	-	3	-	75	2	530	
	25	6-28	827	44°53'	85°13'	E.	0920	30	0	130	7	-	40	-	-	3	180	
		1964																
21	10	8-25	909	45°43'	85°28'	S.	0750	30	7	350	-	-	-	-	4	6	360	
	10	8-25	910	45°42'	85°26'	N.	0840	15	4	20	-	-	-	-	1	15	36	
	13	8-26	914	46°01'	85°19'	SE.	1350	30	0	350	-	-	5	2	1	2	360	
	15	8-25	911	45°43'	85°14'	E.	1020	30	7	550	-	-	2	-	8	-	560	
	20	8-26	913	45°54'	85°13'	E.	1110	30	0	30	-	1	10	1	5	3	50	
		1964																
22	8	10-27	1069	45°43'	85°28'	SE.	0800	10	1	11	-	-	-	-	-	-	11	
	12	10-27	1070	45°44'	85°14'	E.	0910	8	3	6	-	-	-	-	-	-	6	
		1965																
26	12	6-24	1131	45°43'	85°28'	SE.	0850	30	0	200	-	6	10	-	4	10	230	
	12	6-24	1135	46°00'	85°19'	SW.	1440	30	0	550	-	-	-	-	20	-	570	
	14	6-24	1132	45°40'	85°25'	NW	0940	30	0	400	-	-	10	-	35	5	450	
	15	6-24	1133	45°44'	85°14'	E.	1130	20	4	40	-	-	-	-	-	-	40	
	22	6-24	1134	45°53'	85°10'	W.	1310	30	0	600	-	-	10	-	-	-	610	
		1965																
28	12	8-23	1227	45°59'	85°21'	NE.	0840	30	0	250	-	-	5	3	8	4	270	
	12	8-23	1229	45°41'	85°27'	SE.	1320	30	8	400	-	1	5	-	1	123	530	
	27	8-23	1228	45°53'	85°12'	E.	1020	30	0	35	1	11	35	5	-	3	90	

^{1/} 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

^{2/} Include longnose and white suckers.

^{3/} Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.

Appendix table 5.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District V
(East shore from Good Hart to Charlevoix and Little Traverse Bay)

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch							
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total
	Fath.	1963					Min.			Pounds							
13	30	8-21	419	45°25'	85°01'	W.	0820	20	9	-	56	1	7	-	-	1	65
	30	8-21	421	45°24'	85°01'	W.	1040	30	0	-	180	-	20	-	-	-	200
	31	8-21	420	45°24'	85°03'	W.	0900	30	0	2	170	1	27	-	-	-	200
1964																	
17	20	5-21	794	45°23'	85°05'	W.	1040	5	9	30	-	-	-	-	-	-	30
	20	5-21	796	45°26'	85°04'	NW.	1200	30	0	140	-	-	10	-	-	-	150
	25	5-21	792	45°26'	84°59'	E.	0840	30	0	360	25	-	20	325	-	-	730
	25	5-21	793	45°23'	84°58'	W.	0930	30	0	120	60	-	5	-	-	-	185
	30	5-21	791	45°24'	84°57'	W.	0740	30	0	40	150	-	9	-	-	1	200
	30	5-21	795	45°25'	85°06'	E.	1110	30	0	95	.55	-	-	-	-	-	150
	40	5-21	797	45°28'	85°08'	N.	1250	20	8	15	32	15	2	4	-	2	70
	50	5-21	798	45°25'	85°14'	N.	1420	30	0	15	130	10	-	-	-	-	155
1964																	
19	30	6-29	833	45°24'	84°58'	W.	1510	30	3	-	40	-	-	-	-	-	40
1964																	
21	30	8-25	912	45°24'	84°56'	W.	1330	30	7	2	13	-	1	-	-	-	16
1964																	
22	20	10-27	1073	45°23'	85°07'	NE.	1440	30	0	600	-	-	6	2	-	12	620
	25	10-27	1072	45°23'	84°58'	W.	1330	30	0	700	2	1	20	10	-	27	760
	35	10-27	1071	45°24'	84°59'	W.	1220	30	0	90	46	1	27	130	-	6	300
1965																	
28	15	8-25	1236	45°28'	85°06'	SW.	0950	30	0	450	-	-	6	350	-	4	810
	22	8-25	1234	45°23'	84°58'	W.	0740	30	0	220	7	1	100	-	-	2	330
	30	8-25	1235	45°24'	85°01'	W.	0930	30	0	-	60	10	30	-	-	-	100

^{1/} 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

^{2/} Include longnose and white suckers.

^{3/} Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.

Appendix table 6.--R/V Kaho Fishing Log - northern Lake Michigan trawl stations in District VI
(Grand Traverse Bay)

Cruise No.	Depth	Date	Drag No.	Position		Course	Time of day	Fished	Limiting factor ^{1/}	Catch							
				Lat. N.	Long. W.					Alewife	Chubs	Sculpins	Smelt	Suckers ^{2/}	White-fish	Others ^{3/}	Total
	Fath.	1964					Min.			Pounds							
17	10	5-22	799	44°57'	85°24'	NE.	0950	30	0	35	17	-	5	11	-	27	95
	25	5-22	801	44°56'	85°32'	SW.	1330	30	0	525	-	-	25	-	-	-	550
	35	5-22	800	44°53'	85°33'	SW.	1200	30	0	450	10	-	-	-	-	-	460
1964																	
22	10	10-28	1075	44°57'	85°24'	N.	1240	30	8	-	-	-	-	58	-	2	60
	18	10-28	1074	44°46'	85°33'	E.	1100	30	8	50	-	-	10	-	-	-	60
1965																	
26	12	6-23	1129	44°59'	85°24'	S.	1040	30	8	950	-	-	-	2	-	8	960
	12	6-23	1130	44°46'	85°33'	E.	1240	30	8	850	-	-	-	47	7	16	920
	45	6-23	1128	45°00'	85°25'	N.	0910	30	8	-	200	10	-	-	-	-	210
28	14	8-24	1232	44°49'	85°24'	N.	1220	30	8	1,100	-	2	40	140	12	18	1,312
	17	8-24	1233	44°46'	85°33'	SE.	1410	30	8	350	-	-	4	-	16	-	370
	33	8-24	1230	44°53'	85°33'	S.	0900	30	3	3	15	2	20	5	30	2	77
	35	8-24	1231	45°01'	85°25'	S.	1120	30	8	1	220	1	12	-	5	1	240

^{1/} 0 - clear drag, 1 - snag encountered (no gear damage), 2 - gear malfunction, 3 - minor gear damage, 4 - major gear damage (including loss of net), 5 - wind over 20 m.p.h., 6 - strong current, 7 - adverse weather conditions (including high seas, fog, and ice), 8 - rough bottom, 9 - set fishing gear in area.

^{2/} Include longnose and white suckers.

^{3/} Include ninespine stickleback, lake herring, yellow perch, trout-perch, spottail shiner, lake sturgeon, round whitefish, lake trout, burbot, brown trout, and northern pike.