Food of Lake Trout in Lake Superior

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ABSTRACT

Stomachs were examined from 1,492 lake trout and 83 siscowets collected from Lake Superior. Data are given on the food of lake trout of legal size (17 inches or longer) by year, season, and depth of water, and on the relation between food and size among smaller lake trout.

Fish contributed 96.7 to 99.9 per cent of the total volume of food in the annual samples. Ciscoes (*Coregonus* spp.) were most common (52.2 to 87.5 per cent of the volume) in 1950 to 1953 and American smelt ranked first (65.6 per cent of the volume) in 1963. Cottids were in 8.9 to 12.3 per cent of the stomachs in 1950 to 1953 but in only 4.3 per cent in 1963. Insects ranked second to fish in occurrence (9.6 per cent for the combined samples) and crustaceans followed at 3.9 per cent.

The greatest seasonal changes in the food of lake trout were among fish caught at 35 fathoms and shallower. The occurrence of *Coregonus* increased from 34.6 per cent in February–March to 71.1 per cent in October–December. Smelt were in 76.9 per cent of the stomachs in February–March but in only 2.2 per cent in October–December. Cottids, *Mysis relicta*, and insects were most common in the July–September collections.

Lake trout taken at depths greater than 35 fathoms had eaten a higher percentage of Cottidae and *Coregonus* than had those captured in shallower water. Smelt, ninespine sticklebacks, *Mysis*, and insects were more frequent in stomachs of lake trout from less than 35 fathoms.

Crustaceans comprised more than 70 per cent of the total volume of food for 4.0- to 7.9-inch lake trout but their importance decreased as the lake trout grew larger. *Pontoporeia affinis* was the most common in the stomachs of 4.0- to 6.9-inch lake trout and *Mysis* held first rank at 7.0 to 12.9 inches. Ostracods were important only to 4.0- to 4.9-inch lake trout. As the lake trout became larger, the importance of fish grew from 4.4-per cent occurrence at 5.0 to 5.9 inches to 93.9 per cent at 16.0 to 16.9 inches. Smelt were most commonly eaten by undersize (less than 17 inches) lake trout.

INTRODUCTION

The lake trout (*Salvelinus namaycush*) has been of extreme interest to investigators of the Great Lakes since the sea lamprey (*Petromyzon marinus*) spread to the upper lakes in the mid-1930's. After the collapse of the fisheries for lake trout in Lake Huron and Lake Michigan, special attention was given to Lake Superior, the last of the upper Great Lakes in which populations of native lake trout still exist.

The earlier work on the life history of the lake trout in Lake Superior included the collection of data and materials on the food of the species. Collections in 1950 to 1953 were made from commercial landings by the staff of the U. S. Fish and Wildlife Service (Bureau of Commercial Fisheries) Biological Station at Marquette, Michigan. Later materials were collected in 1963 from commercial landings and in 1958 to 1963 by the research vessel *Siscowet* at Ashland, Wisconsin. These materials form the basis for this report.

A number of papers have been published on the food of lake trout (reviewed by Van Oosten and Deason, 1938), but the only ones on the Great Lakes stocks are for Lake Ontario (Dymond, 1928), Lake Michigan (Van Oosten and Deason, 1938), and Lake Superior (Eschmeyer, 1956). Eschmeyer's study was confined to the food of lake trout during their first 3 years of life. The present paper expands the knowledge to larger lake trout of Lake Superior.

MATERIALS AND METHODS

Details on collections of 1,492 lake trout (*Salvelinus namaycush namaycush*) and 83 siscowets (*S. namaycush siscowet*) sampled from commercial landings at various locations and seasons in 1950 to 1953 and 1963 appear

TABLE 1.—*Number of stomachs examined from Lake Superior lake trout and siscowets taken by commercial gear, 1950 to 1953 and 1963*

Date	Port	Depth (fathoms)	Number examined	Number containing food		Total length[1] (inches)	
				Lake trout	Siscowet	Average	Range
1950							
July	Marquette	60–80	36	14	12	21.2	15.1–29.9
August	Marquette	10–90	208	124	27	18.3	10.0–30.9
September	Marquette	10–22	231	147	—	22.8	12.0–33.9
September	Munising	12–24	62	30	—	29.3	16.0–37.9
September	Grand Marais	16–30	36	20	—	18.1	12.0–34.9
September	Ontonagon	10–20	80	34	—	24.6	11.0–37.9
September	Copper Harbor	18–35	32	22	—	16.1	10.0–28.9
October	Bete Grise	10	34	15	—	27.7	20.0–32.9
October	Marquette	11–19	64	28	—	27.6	15.0–36.9
November	Marquette	11–70	113	41	5	24.7	18.0–40.9
December	Marquette	30–80	[2] —	64	20	21.2	14.0–33.9
1951							
April	Marquette	28–33	47	41	—	20.4	9.0–29.9
May	Marquette	28–35	[2] —	21	—	24.5	15.0–42.9
June	Marquette	18–35	43	27	—	21.2	11.0–33.9
July	Cornucopia	10	49	42	—	19.2	16.0–28.9
August	Marquette	12–25	43	29	—	25.3	16.0–35.9
August	Bete Grise	10	41	6	—	24.8	17.0–31.9
October	Marquette	12–18	20	4	—	25.3	16.0–31.9
1952							
June	Cornucopia	10	[2] —	52	—	19.6	16.0–28.9
June	Marquette	30	[2] —	17	—	20.2	16.0–28.9
August	Marquette	10–15	57	30	—	21.4	15.0–31.9
1953							
February	Marquette	34–70	118	67	13	20.0	7.0–28.9
March	Marquette	26–48	44	32	—	20.0	12.0–29.9
April	Marquette	17–72	64	36	6	21.2	12.0–28.9
May	Marquette	22–25	27	20	—	23.2	19.0–37.9
June	Marquette	20–23	96	32	—	17.4	12.0–28.9
July	Marquette	[3] —	14	8	—	25.5	22.0–29.9
1963							
August	Bayfield	25	38	38	—	21.6	8.0–26.0
September	Marquette	12–18	17	15	—	21.0	8.4–29.4
Total or average		—	[2] —	1,056	83	21.4	7.0–42.9

[1] Lake trout and siscowets combined.
[2] Unknown.
[3] Floating 2 fathoms below the surface in water 50 fathoms deep.

in Table 1; records of catches of the Bureau's research vessel *Siscowet* in 1958 to 1963 are in Table 2. All sampling points can be located in Figure 1. The lengths of the fish from commercial gear ranged from 7.0 to 42.9 inches (average, 21.4). Most were captured in 4½- to 6-inch-mesh (extension measure) gill nets; a few were taken in 2½-inch-mesh gill nets, pound nets (50 to 70 feet deep, 4½- to 4¾-inch-mesh pot), and from set hooks (No. 6 hooks spaced 30 feet apart, usually baited with small lake herring, and suspended from a line floated about 2 fathoms below the surface). The other 436 stomachs came from lake trout captured in experimental gill nets (1- to 5-inch mesh) and bottom trawls (31-foot semiballoon, 2½-inch-mesh body, and ½-inch-mesh cod end) fished by the *Siscowet* in the Apostle Islands, in Keweenaw Bay, and at Isle Royale (Table 2). These fish were 4.0 to 16.7 inches long (average, 8.1).

Each stomach from commercially landed lake trout was wrapped in muslin, labeled (total length of the fish, location, gear, depth, and date of collection), and preserved in 10-per cent formalin. The empty stomachs (stomachs that seemed to be empty were opened to make certain of their condition) were not preserved but full data on the fish were recorded. Stomach contents were analyzed at the Bureau's Biological Laboratory in Ann Arbor, Michigan, or at Biological Stations at Marquette and Ashland.

Lake trout captured by the *Siscowet* were preserved whole and the collections were labeled according to date, location, gear, and depth of water. The stomachs were later removed from the preserved fish for examination. No adjustments were made for shrinkage in length of the fish due to preservation.

Quantitative determinations for food of the commercially landed lake trout in 1950 to

TABLE 2.—*Number of stomachs examined from Lake Superior lake trout collected by the M/V* Siscowet, *1958 to 1963*

Date	Location	Depth (fathoms)	Number examined	Number containing food	Total length (inches)	
					Average	Range
1958						
July	Apostle Islands	10–12	2	2	9.2	8.7– 9.7
August	Apostle Islands	13	3	1	14.0	—
1959						
July	Apostle Islands	15–27	3	1	5.2	—
August	Apostle Islands	19–26	13	13	6.4	4.9– 8.1
1960						
August	Isle Royale	20–72	54	46	12.7	10.2–16.7
1961						
July	Apostle Islands	15–19	10	9	5.5	4.3– 7.8
August	Keweenaw Bay	18–30	72	65	6.0	4.0– 8.7
1962						
May	Apostle Islands	30	42	36	8.4	6.6–13.3
June	Apostle Islands	25	90	86	8.5	5.8–12.2
September	Apostle Islands	22	50	48	6.7	4.8– 9.0
November	Apostle Islands	20	36	31	7.5	5.1–12.4
December	Apostle Islands	19	27	25	7.5	5.7–10.8
1963						
February	Apostle Islands	18–29	48	38	6.8	5.6–10.8
March	Apostle Islands	2–24	38	35	9.6	6.0–15.5
Total or average			488	436	8.1	4.0–16.7

1953 were made by wet weight to the nearest 0.1 gram with a triple-beam balance; all others were made by liquid displacement in a sedimentation tube graduated to 0.01 milliliter. Volume and weight were considered to be equivalent; i.e., 1 gram corresponds to 1 milliliter.

Some explanations are required to permit an instructive description of the food of Lake Superior lake trout from the records of Tables 3 to 5. Comparison of the food of lake trout and siscowets (not given here) revealed only minor differences, which probably represented sample variations rather than real differences in food. The data for lake trout and siscowets from commercial gear were accordingly combined for this study; the term "lake trout" includes siscowets. The *Siscowet* took only lake trout.

The extent to which the food had been digested affected the accuracy of identification. Many of the sculpins and ciscoes (*Coregonus* spp.) were originally identified to species in 1950 to 1953. *Cottus bairdi* and *C. cognatus* were troublesome to separate, however, and even fresh specimens of the ciscoes often are difficult to identify. Consequently, we believe that the pooling of all Cottidae (except the fourhorn sculpin, *Myoxocephalus quadricornis*, which was relatively easy to identify) and all the ciscoes offers the best measure of their importance as food of lake trout.[1] Obviously, the amount of unidentified food in the stomachs affected the percentages of volume and occurrence for individual items.

ANNUAL DIFFERENCES IN FOOD OF LEGAL-SIZE LAKE TROUT, 1950 TO 1953 AND 1963

The food of legal-size[2] lake trout varied somewhat according to year, season of capture, and depth of water, but little with length of fish. The data were not adequate to show differences according to geographical location in the lake but they did not appear to be great. The data on the food of lake trout in each of the 5 years and for the combined samples (Table 3) provide both a record of annual

[1] Species tentatively identified in the genus *Cottus* were *bairdi cognatus*, and *ricei*. The identified species of *Coregonus* were *artedi, hoyi, zenithicus*, and *reighardi*. Lake whitefish (*Coregonus clupeaformis*), round whitefish (*Prosopium cylindraceum*), and pygmy whitefish (*P. coulteri*) were not found in any stomach.

[2] The minimum legal size for lake trout is 17 inches, total length, in Wisconsin and 1½ pounds, round, or 1¼ pounds, dressed (approximately 17 inches), in Michigan. In this paper, 17 inches is considered the minimum legal size.

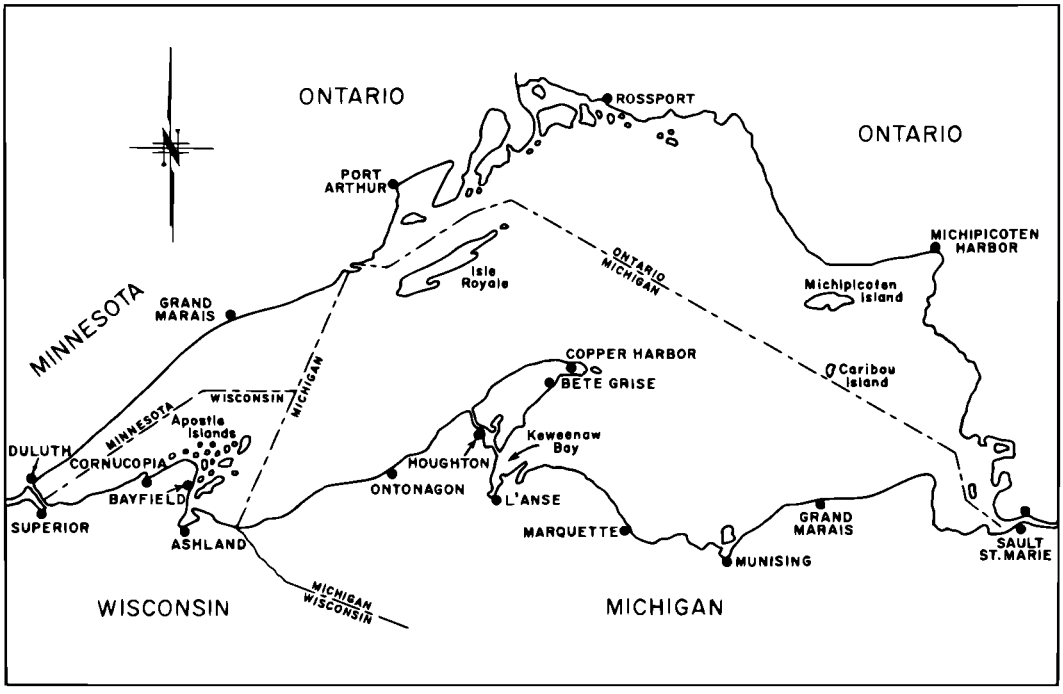

FIG. 1.—Lake Superior.

differences and a general summary of the feeding habits of Lake Superior lake trout.

Fish were by far the most important food of legal-size lake trout. They were in 87.0 to 100.0 per cent of the stomachs in the annual samples and contributed 96.7 to 99.9 per cent of the total volume. The values for the combined samples in the 5 years of collections were 92.3-per cent occurrence and 98.1 per cent of the volume. Ciscoes were the most common in 1950 to 1953 when they contributed 52.2 to 87.5 per cent of the volume. In 1963, however, the American smelt (*Osmerus mordax*) ranked first and the representation of *Coregonus* was only 8.1 per cent of the volume and 6.4-per cent occurrence. The contribution of smelt climbed from 1.7 per cent of the volume of food in 1950 to 42.1 per cent in 1952. The value decreased to 27.3 per cent in 1953 but reached 65.6 per cent in 1963. Bailey (1964) reported that the first significant landings of smelt in Lake Superior were made in 1952. The annual commercial take increased to nearly 1 million pounds in 1960.

Cottids were in 8.9 to 12.3 per cent of the stomachs in 1950 to 1953 but in only 4.3 per cent in 1963; the fourhorn sculpin was the most common.

The importance of other species of fish as food of legal-size lake trout was small. Ninespine sticklebacks (*Pungitius pungitius*) were in each year's samples but their average occurrence was only 3.8 per cent. Trout-perch (*Percopsis omiscomaycus*) and burbot (*Lota lota*) were found only in the 1951 samples, and occasional small lake trout were in the stomachs collected in 1950 and 1953.

Crustaceans were in only 3.9 per cent of the stomachs and composed 0.4 per cent of the total volume. *Mysis* was most frequent in 1950 to 1953 but was absent in 1963. *Pontoporeia* was in 6.4 per cent of the lake trout stomachs in 1963.

Insects ranked second to fish in occurrence (9.6 per cent for the combined samples) but made up only 1.3 per cent of the volume. Formicidae, Lepidoptera, and Coleoptera were the most common.

Dymond (1928) reported that lake trout from commercial gill nets in Lake Ontario ate

TABLE 3.—*Percentage of occurrence and (in parentheses) percentage of total volume of food in stomachs of legal-size lake trout, 1950 to 1953 and 1963*

[0.0 indicates less than 0.05]

Item	1950	1951	1952	1953	1963	Combined samples
Number of stomachs	486	156	95	187	47	971
Food						
Fish (total)	87.0 (98.2)	90.4 (96.8)	87.4 (96.7)	96.8 (99.5)	100.0 (99.9)	92.3 (98.1)
Coregonus[1]	59.3 (87.5)	52.6 (61.1)	49.5 (52.2)	56.1 (67.7)	6.4 (8.1)	44.8 (55.3)
American smelt	3.1 (1.7)	30.8 (21.0)	36.8 (42.1)	32.6 (27.3)	68.1 (65.6)	34.3 (31.5)
Cottidae[1]	10.7 (2.0)	8.9 (0.8)	— —	12.3 (1.7)	4.3 (1.0)	7.2 (1.1)
Cottus spp.[2]	2.9 (0.6)	3.8 (0.4)	— —	0.5 (0.0)	— —	1.4 (0.2)
Fourhorn sculpin	3.1 (0.8)	1.9 (0.1)	— —	7.5 (0.6)	— —	2.5 (0.3)
Ninespine stickleback	5.3 (0.8)	6.4 (1.3)	4.3 (0.3)	1.1 (0.0)	2.1 (0.1)	3.8 (0.5)
Trout-perch	— —	3.2 (0.3)	— —	— —	— —	0.6 (0.1)
Burbot	— —	2.6 (11.2)	— —	— —	— —	0.5 (2.2)
Lake trout	0.2 (0.3)	— —	— —	0.5 (0.3)	— —	0.1 (0.1)
Unidentified fish	30.7 (5.9)	10.3 (1.1)	14.7 (2.1)	18.2 (2.5)	66.0 (25.1)	28.0 (7.3)
Crustaceans (total)	6.6 (1.2)	3.8 (0.5)	1.1 (0.3)	1.6 (0.1)	6.4 (0.1)	3.9 (0.4)
Mysis relicta	6.6 (1.2)	3.2 (0.5)	1.1 (0.3)	1.6 (0.1)	— —	2.5 (0.4)
Pontoporeia affinis	— —	0.6 (0.0)	— —	— —	6.4 (0.1)	1.4 (0.0)
Insects (total)	7.0 (0.3)	16.0 (2.7)	18.9 (3.0)	5.9 (0.4)	— —	9.6 (1.3)
Orthoptera	— —	1.9 (0.0)	— —	0.5 (0.0)	— —	0.5 (0.0)
Odonata	0.8 (0.0)	6.4 (0.8)	3.2 (0.0)	0.5 (0.0)	— —	2.2 (0.2)
Hemiptera	0.2 (0.0)	— —	2.1 (0.0)	0.5 (0.0)	— —	0.6 (0.0)
Coleoptera	0.6 (0.0)	3.8 (0.0)	9.5 (0.2)	0.5 (0.0)	— —	2.9 (0.0)
Lepidoptera	1.2 (0.0)	9.0 (1.6)	9.5 (1.6)	0.5 (0.1)	— —	4.0 (0.7)
Diptera	1.6 (0.2)	1.9 (0.0)	7.4 (0.0)	— —	— —	2.2 (0.0)
Formicidae	2.1 (0.0)	6.4 (0.3)	13.7 (1.2)	2.7 (0.3)	— —	5.0 (0.4)
Unidentified insects	1.0 (0.1)	— —	— —	— —	— —	0.0 (0.1)

[1] Includes all individuals of this group.
[2] Includes individuals tentatively identified as mottled, slimy, and spoonhead sculpin.

mostly alewives. *Coregonus* ranked second, followed by Cottidae.

FOOD OF LEGAL-SIZE LAKE TROUT BY SEASONS AND DEPTH OF WATER

The 1950 to 1953 Marquette samples were chosen for the study of changes in the food of lake trout with season and depth because they represented a greater span of both seasons and depths than did samples from other locations. Although the food of lake trout, as earlier described, did vary somewhat from year to year (Table 3), the records for the individual samples revealed that changes by season and depth were consistent regardless of the year in which the samples were collected. Consequently, the annual samples could be combined for the study of seasonal and depth differences. Because the data were not adequate to show changes by small depth intervals, an arbitrary division was made between samples collected down to and below 35 fathoms. This separation seemed to fit best the general differences. Only major foods were considered in this study; the frequency of occurrence of less important foods was extremely small.

Seasonal differences in the food of lake trout were greatest in samples from depths of 35 fathoms or less (Table 4). The occurrence of *Coregonus* increased from 34.6 per cent in the February–March collections to 71.1 per cent in October–December; the percentage of the total volume increased from 48.3 to 98.1 over the same period. The importance of

TABLE 4.—*Percentage of occurrence and (in parentheses) percentage of volume of major foods in stomachs of legal-size lake trout according to season and depth, Marquette, 1950 to 1953*

[0.0 indicates less than 0.05]

Food and depth	Season			
	Feb.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.
Coregonus				
Shallow[1]	34.6 (48.3)	37.6 (55.2)	45.9 (76.3)	71.1 (98.1)
Deep[2]	73.5 (94.8)	86.7 (96.9)	54.8 (94.2)	77.6 (98.8)
American smelt				
Shallow	76.9 (51.5)	46.5 (41.5)	9.4 (15.7)	2.2 (0.7)
Deep	1.2 (1.1)	3.3 (2.3)	— —	— —
Cottidae				
Shallow	3.8 (0.0)	8.2 (0.6)	10.6 (2.1)	4.4 (0.1)
Deep	31.3 (4.1)	13.3 (0.8)	25.8 (5.3)	12.1 (1.2)
Ninespine stickleback				
Shallow	— —	4.7 (1.1)	7.6 (1.7)	8.9 (0.6)
Deep	— —	— —	1.6 (0.2)	0.9 (0.0)
Mysis relicta				
Shallow	3.8 (0.2)	8.2 (0.6)	22.2 (3.5)	6.7 (0.2)
Deep	3.6 (0.0)	— —	— —	1.9 (0.0)
Insects				
Shallow	— —	5.9 (1.0)	11.9 (0.7)	6.7 (0.3)
Deep	— —	— —	3.2 (0.3)	— —
Number of stomachs				
Shallow	26	170	329	45
Deep	83	30	62	107

[1] 35 fathoms or less.
[2] More than 35 fathoms.

American smelt, on the other hand, was greatest in the February–March samples (76.9-per cent occurrence, 51.5 per cent of the volume) and decreased progressively to October–December (2.2-per cent occurrence and 0.7 per cent of the volume). The percentage of stomachs containing Cottidae increased from 3.8 per cent in February–March to 10.6 per cent in July–September, but dropped to 4.4 per cent in October–December. Ninespine sticklebacks were lacking in the February–March samples but were in 8.9 per cent of the stomachs collected in October–December. The importance of *Mysis* followed closely that of Cottidae; mysids were most frequent in the July–September collections and were less common in the February–March and October–December samples. Stomachs of lake trout collected in February–March contained no insects but the occurrence was 11.9 per cent in the fish of the July–September collections.

Seasonal differences were smaller in the samples from depths below 35 fathoms. Cottidae were most abundant in February–March and July–September, and *Coregonus* was most important (98.8 per cent of the volume) in the October–December samples. The records for other foods were too scanty to show seasonal changes.

The percentage of lake trout stomachs void of food (data not given in table) did not vary greatly from one season to the next. The average percentage of stomachs without food was 39.4 per cent (range, 46.2 per cent in October–December to 30.9 per cent in February–March).

Van Oosten and Deason (1938) reported that small lake trout (mostly under 16 inches long) from Lake Michigan appeared to feed less on Cottidae and more on *Coregonus* during the early summer, but no consistent seasonal variations were observed for other foods.

The principal difference in the food of lake trout caught at different depths was the higher percentage of stomachs which contained Cottidae and ciscoes among lake trout from the deeper water. Smelt, conversely, were by a wide margin more abundant in stomachs of fish from less than 35 fathoms. Ninespine sticklebacks, *Mysis*, and insects were less frequent in stomachs of lake trout from deep water than in those from shallow water.

Small lake trout captured in the deeper waters of Lake Michigan contained a high percentage of Cottidae but ciscoes appeared most frequently in the stomachs of lake trout caught in shallow water (Van Oosten and Deason, 1938). Ninespine sticklebacks were an important food only for lake trout captured in less than 50 fathoms in northern Lake Michigan.

RELATION BETWEEN FOOD AND SIZE OF LAKE TROUT UNDER 17 INCHES LONG

The 1958 to 1963 *Siscowet* collections and the undersize lake trout collected from the commercial fishery in 1950 to 1953 and 1963 have been combined by 1-inch intervals for the study of food according to size of fish (Table 5). Although the food of small lake trout varied slightly with season (fish eggs,

TABLE 5.—*Percentage occurrence and (in parentheses) percentage volume of food in stomachs of undersize lake trout taken by commercial gear in 1950 to 1953 and 1963, and by the* Siscowet *in 1958 to 1963*

[0.0 indicates less than 0.05]

Item	Total length (inches)													
	4.0–4.9	5.0–5.9	6.0–6.9	7.0–7.9	8.0–8.9	9.0–9.9	10.0–10.9	11.0–11.9	12.0–12.9	13.0–13.9	14.0–14.9	15.0–15.9	16.0–16.9	Total
Number of stomachs	9	68	102	82	63	36	33	23	41	44	34	36	33	604
Food														
Fish (total)	22.2	4.4	11.8	15.9	28.6	25.0	51.5	43.5	51.2	61.4	67.6	80.6	93.9	42.9
	(20.8)	(1.8)	(23.4)	(26.0)	(57.6)	(67.4)	(68.4)	(40.3)	(55.5)	(77.2)	(89.5)	(90.1)	(96.6)	(54.9)
Coregonus[1]	—	—	—	—	—	—	—	4.3	—	4.5	20.6	5.6	18.2	4.1
	—	—	—	—	—	—	—	(5.1)	—	(10.2)	(13.8)	(6.5)	(20.6)	(4.3)
American smelt	—	—	1.9	3.7	6.4	5.6	3.0	—	4.9	9.1	5.9	19.4	33.3	7.2
	—	—	(5.3)	(10.4)	(20.8)	(10.4)	(16.6)	—	(7.8)	(18.3)	(18.2)	(37.8)	(49.5)	(15.0)
Cottidae[1]	—	—	—	—	4.8	13.9	3.0	8.7	4.9	22.7	20.6	19.4	24.2	9.4
	—	—	—	—	(5.2)	(24.0)	(6.0)	(5.1)	(9.0)	(11.2)	(25.4)	(18.0)	(5.1)	(8.4)
Ninespine stickleback	—	—	—	—	—	—	—	4.3	—	2.3	11.8	16.7	12.1	3.6
	—	—	—	—	—	—	—	(3.2)	—	(3.5)	(8.8)	(12.1)	(5.4)	(2.5)
Trout-perch	—	—	—	—	3.2	—	—	—	—	—	—	—	—	0.2
	—	—	—	—	(6.5)	—	—	—	—	—	—	—	—	(0.5)
Cyprinidae	—	—	—	—	—	—	—	—	—	—	—	—	3.0	0.2
	—	—	—	—	—	—	—	—	—	—	—	—	(0.5)	(0.0)
Northern pike[2]	—	—	—	—	—	—	—	—	—	—	—	—	3.0	0.2
	—	—	—	—	—	—	—	—	—	—	—	—	(0.8)	(0.1)
Fish eggs	—	1.5	5.9	9.8	6.4	2.8	9.1	—	—	—	—	—	—	2.7
	—	(0.1)	(10.5)	(8.5)	(14.4)	(14.6)	(20.4)	—	—	—	—	—	—	(5.3)
Unidentified fish	22.2	2.9	3.9	11.0	11.1	16.7	36.4	26.1	43.9	22.6	29.4	19.4	12.1	19.8
	(20.8)	(1.7)	(7.6)	(7.1)	(9.8)	(18.4)	(25.4)	(26.9)	(38.7)	(34.1)	(23.3)	(16.1)	(14.7)	(18.8)
Crustaceans (total)	77.8	98.5	88.2	89.0	74.6	80.6	78.6	78.3	53.7	43.2	44.1	27.8	15.2	65.4
	(79.2)	(91.6)	(73.0)	(76.5)	(42.9)	(28.7)	(31.7)	(59.7)	(44.2)	(22.7)	(10.5)	(9.4)	(3.4)	(44.1)
Conchostraca	—	2.9	2.9	—	—	—	—	—	—	—	—	—	—	0.4
	—	(0.2)	(0.0)	—	—	—	—	—	—	—	—	—	—	(0.0)
Ostracoda	22.2	8.8	2.9	2.4	—	—	—	—	—	—	—	—	—	2.8
	(12.5)	(0.2)	(0.0)	(0.0)	—	—	—	—	—	—	—	—	—	(0.0)
Mysis relicta	22.2	50.1	58.9	76.8	68.3	61.1	75.8	73.9	56.1	43.2	44.1	27.8	15.2	51.8
	(12.5)	(27.3)	(33.6)	(44.6)	(29.5)	(25.4)	(25.6)	(59.1)	(44.2)	(22.7)	(10.5)	(9.4)	(3.4)	(26.7)
Pontoporeia affinis	55.6	66.2	61.8	62.3	52.4	41.7	24.2	8.7	4.9	—	—	—	—	29.1
	(54.2)	(63.9)	(39.4)	(31.9)	(13.4)	(3.3)	(6.1)	(0.6)	(0.0)	—	—	—	—	(16.4)
Insects (total)	22.2	23.5	21.6	18.3	14.3	33.3	6.1	21.7	4.9	11.4	8.8	8.3	—	15.0
	(0.0)	(6.4)	(1.7)	(0.2)	(0.2)	(3.9)	(0.0)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	—	(1.0)
Coleoptera	—	—	1.0	1.2	—	2.8	3.0	—	—	2.3	—	—	—	0.8
	—	—	(0.1)	(0.1)	—	(0.1)	(0.0)	—	—	(0.0)	—	—	—	(0.0)
Diptera	1.1	14.7	11.8	9.8	12.7	16.7	—	—	—	—	—	—	—	5.1
	(0.0)	(5.4)	(0.4)	(0.0)	(0.2)	(0.3)	—	—	—	—	—	—	—	(0.5)
Formicidae	—	1.5	1.0	—	—	—	—	—	—	6.8	8.8	—	—	1.4
	—	(1.0)	(0.0)	—	—	—	—	—	—	(0.0)	(0.0)	—	—	(0.0)
Unidentified insects	1.1	7.4	7.9	7.3	3.2	13.9	3.0	21.7	4.9	6.8	—	8.3	—	6.6
	(0.0)	(0.0)	(1.2)	(0.1)	(0.0)	(3.5)	(0.0)	(0.0)	(0.1)	(0.1)	—	(0.0)	—	(0.5)
Pelecypoda	—	2.9	4.9	14.6	6.4	5.6	—	—	2.4	—	—	—	—	2.8
	—	(0.2)	(0.2)	(0.1)	(0.2)	(0.0)	—	—	(0.2)	—	—	—	—	(0.0)

[1] Includes all individuals in this group.
[2] *Esox lucius*.

for example, were found only in the late fall and early spring; insects were most common in midsummer and fall), the foods eaten were sufficiently similar to justify the combination of the data for all seasons. Combination of samples for different years and localities was also justifiable. Division of samples by depths of capture was unnecessary; nearly all of the fish were caught at depths less than 35 fathoms.

Crustaceans were present in more than 50 per cent of the stomachs of lake trout 4.0 to 12.9 inches long. They comprised more than 70 per cent of the total volume of food for 4.0- to 7.9-inch lake trout. As the lake trout grew larger, the importance of crustaceans declined—they accounted for only 3.4 per cent of the volume at 16.0 to 16.9 inches.

The amphipod *Pontoporeia* occurred in 66.2 per cent of the stomachs (63.9 per cent of the total volume) of 5.0- to 5.9-inch lake trout but its importance declined to nil when the lake trout reached 13 inches. *Mysis*, although less important than *Pontoporeia* to the smallest lake trout, gained first rank in percentage occurrence at 7.0 to 7.9 inches and held this position until the fish reached 13 inches. *Mysis* ranked first in volume of food for only the 7.0- to 7.9-inch and 11.0- to 11.9-inch groups. Ostracods were important only to the 4.0- to 4.9-inch lake trout. They were not eaten by fish longer than 7.9 inches.

Although Crustacea were the principal food of the smaller lake trout, fish contributed significantly to all the size groups. Among the 1-inch groupings represented by 10 or more lake trout, the percentage of stomachs containing fish climbed from 4.4 per cent at 5.0 to 5.9 inches to 93.9 per cent at 16.0 to 16.9 inches. Fish made up more than 50 per cent of the total volume of food for all lake trout longer than 8 inches (exception at 11.0 to 11.9 inches). The smallest lake trout that had eaten American smelt were at 6.0 to 6.9 inches. Cottidae entered the diet when the lake trout were 8.0 to 8.9 inches long, and *Coregonus* and ninespine sticklebacks appeared first at 11.0 to 11.9 inches. By the time the lake trout reached 16 inches, *Coregonus* and smelt contributed most to the volume of food and the importance of Cottidae and ninespine sticklebacks had decreased.

Fish eggs contributed significantly to the food of lake trout 5.0 to 10.9 inches long. The eggs were tentatively identified as those of *Coregonus*.

Insects appeared regularly in the stomachs of small lake trout (maximum occurrence, 33.3 per cent for the 9.0- to 9.9-inch group) but their contribution to the total volume never exceeded 6.4 per cent (at 5.0 to 5.9 inches). The smallest lake trout (4.0 to 9.9 inches) appeared to feed more extensively on insects than did the lake trout longer than 10 inches. The insects, in rank of importance, were Diptera, Formicidae, and Coleoptera.

Pelecypoda were present in some stomachs of the smaller lake trout but were unimportant in the total volume of food (never more than 0.2 per cent).

Eschmeyer (1956) determined that crustaceans were the most important food of 0- to II-group lake trout (1.1 to 8.9 inches long), but *Mysis* far outranked *Pontoporeia*. Fish were in 9 per cent of the stomachs and comprised about 13 per cent of the total volume of food. Van Oosten and Deason (1938) reported that no Lake Michigan lake trout longer than 18 inches had eaten invertebrates. Lake trout less than 15 inches long had consumed largely Cottidae and invertebrates; those larger than 15 inches had eaten Cottidae and *Coregonus*. Smelt were not firmly established in Lake Michigan when their samples were collected in 1930 to 1932; few were found in the stomachs of lake trout.

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