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The rate of growth and food of whitefish,
Coregonus clupeaformis, in Heming Lake,
Manitoba

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THE RATE OF GROWTH AND FOOD OF WHITEFISH

Coregonus clupeaformis

in HEMING LAKE, MANITOBA

INTRODUCTION

An investigation of the whitefish in Heming Lake was carried on from March 2 to September 10, 1945 in conjunction with the experiment conducted by **Dr. K. H. Doan** to reduce the number of jackfish, Esox lucius, in the lake and determine the resulting effect on the infestation of the tapeworm, Triaenophorus crassus, in the whitefish population.

There has been no commercial fishing in this lake so that the results embodied in this report represent the conditions of rate of growth and food of an unexploited whitefish population. These data will be used for comparison with similar data obtained at intervals throughout the period, of the jackfish control experiment to determine if any change occurs that can be correlated with the scheduled netting programme in the lake.

HEMING LAKE

Heming Lake is situated 18 miles south of the town of Serridon in northern Manitoba at 54° 53' north latitude and 101° 07' west longitude, The lake is three miles long, from one-quarter to one-half mile wide and has an area of 588 acres, The maximum depth found was 16 feet but most of the lake was

less than 10 feet deep. The bottom consists of fine inorganic silt covered with decaying organic debris with the exception of certain shore regions where hard sand bottoms prevail. The shallow bays support a copious growth of aquatic vegetation throughout the short summer season. The shoreline is characterized by alternate areas of flat muskeg and exposed rock slopes of the Precambrian shield.

There are two main streams flowing into the lake, one at the southern tip and the other at the north-west corner. Both these streams drain small lakes and contribute a considerable volume of water throughout the summer. Several smaller streams enter the lake from the surrounding muskeg areas but these flow only during the spring period of high water. A single outlet stream situated in the north-east corner of the lake drains into Home Lake, 2 miles distant, and thence into the Grass River which is a tributary of the Nelson River.

RATE OF GROWTH

The data used to determine the rate of growth were obtained from 439 fish taken at scattered localities throughout the lake. Most of the fish were caught in $4\frac{1}{4}$ -inch gill nets although a few were taken in $3\frac{3}{4}$ - and $5\frac{1}{4}$ -inch nets. There were three fishing periods, the first from March 2 to 10 when the lake was ice-covered, the second from May 23 to June 23 and the third

from August 28 to September 10.

The length measurements recorded in this report are total lengths, from the tip of the snout to the fork of the tail, and the age represents the number of completed annuli found on the scales.

The specimens ranged in age from 3 to 12 years with the age-frequency distribution showing a bimodality at the 5 and the 9 year classes with an average length of 13.81 and 15.30 inches and an average weight of 24.06 and 32.21 ounces, respectively. The smallest fish collected was 3 years old, $10\frac{1}{2}$ " long and weighed 11 ounces; the largest fish was 11 years old, $7\frac{1}{2}$ inches long and weighed 49 ounces.

The length increases rapidly up to the end of the fifth year and thence proceeds slowly. The weight follows the same general trend with a tendency to accelerate again in older fish. There were no appreciable differences between the average lengths of males and females in each year-class but the males exceeded the females in weight in all but the 4 year class. Further, the older and larger fish in the sample were predominantly males. Of the fish 10 years old and over, 60 were males and 26 were females. Also there were 31 males and 19 females 35 ounces and over. A similar condition was found in the whitefish population of Shakespeare Island Lake, Ontario, by Hart (1932). The rate of growth data are summarized in tables 1 and 2.

SEX RATIO

• A total of 429 mature fish were obtained during the investigation of which 235 were males and 194 females. This gives a sex ratio of 1.21 to 1.00

AGE AT MATURITY

There are not sufficient data at hand to state definitely the age at which Heming Lake whitefish mature since only 10 immature fish were collected. The only 3 year old fish caught was immature, 9 of the 18 fish 4 years old were immature while all the 5 year class were mature. From these data it seems probably that some mature during their fifth year at an average length of 2.44 inches and the remainder during their sixth year at an average length of 13.81 inches.

Seven of the 9 immature four-year-olds were females and 7 of the 10 mature four-year-olds were males. From these data it may be assumed that in general males mature earlier than females.

BOTTOM FAUNA

An estimate of the amount of bottom fauna present in the lake was obtained from two series of dredgings made on June 6 and September 6 (Table 4). The depths from which samples were obtained varied from 3 to 16 feet and the bottom consisted of fine inorganic silt mixed with decaying organic matter in all but the three-foot sample where the bottom consisted of fine sand. The small number of samples taken is inadequate to show any

seasonal trend in the amount of bottom fauna present and the results have been summed and averaged. It was found that there was an average of 126 organisms per square foot with a volume of 0.51 c.c.

The immature stages of insects made up 61.9 per cent. of the total number of organisms with the chironomids contributing 40.7 per cent. and ephemerid nymphs 13.8 per cent. of the total. Molluscs made up 19.6 per cent. and amphipods 18.5 per cent. of the total.

FOOD

Analyses were made of the stomach contents of 194 whitefish which averaged 14.6 inches in length and ranged from $11\frac{1}{4}$ to $17\frac{1}{2}$ inches. Eighty-one stomachs were examined between March 2 and 6 with 5 or 6.2 per cent. void, 50 between May 23 and June 23 of which 4 or 8.0 per cent. were void and 63 from August 28 to September 6 of which 13 or 20.6 per cent were void. It is possible that this increase in the percentage of empty stomachs found in the fall is related to a decrease in feeding activity prior to spawning.

The food utilized by the whitefish consisted almost exclusively of aquatic invertebrates although 8 stomachs were found containing terrestrial insects and 3 contained fish remains. Insects formed the most important group of food organisms and made up 96.1, 76.4 and 90.0 per cent. of the total volume of food in the March, May-June and August-September analyses respectively, (Table 4). Molluscs formed the next most important

group from the standpoint of percentage volume making up respectively 3.9, 8.8 and 10.0 per cent. of the total volume for the three collecting periods. Water mites, crustaceans, fish and leeches were of minor importance and were only found in appreciable volumes in the specimens taken in the May-June collections.

Mayfly nymphs, mainly Hexagenia sp., were found in 145 of the 172 stomachs that contained food and constituted the most important single food item from the standpoint of frequency of occurrence in the stomachs and percentage volume.

No consistent differences were found between the food of whitefish of different size groups or sex. The component elements of the food taken varied considerably with the seasons, with the most diversified diet found in the stomachs from the May-June sample, followed respectively by the August-September and March samples. Several food items including fish, fish eggs, crayfish, water beetles, chironomid pupae, ceratopogonid larvae and plant seeds were found only in the stomachs of fish taken during late May and June.

DISCUSSION

The rate of growth of whitefish in Heming Lake is slower than that in other lakes of the prairie provinces for which data are available, including Wabamun, Pigeon, Newell, Jackfish, Winnipeg, and Winnipegosis. Lake Huron and Lake Ontario also have a more rapid growth rate than Heming Lake. On the other hand the rate of growth in Heming Lake is faster than that in Hudson Bay, Shakespeare Island Lake and Lake Nipigon, (table 5).

The comparatively slow rate of growth of Heming Lake whitefish is probably related to the meagre bottom fauna present, 0.5 0.0. per square foot, possible overcrowding since the lake has not been exploited, and a relatively short growing season, as the lake is ice-covered for approximately 7 months each year,

The food analyses show that the whitefish in this lake are primarily bottom feeders although the presence of terrestrial insects in the stomachs of samples taken during the period of open water show that surface feeding is resorted to occasionally, There was no evidence of selective feeding in the lake; the abundance and availability of food organisms in the area where the fish were feeding seem to be the factors determining the food utilized,

TABLE 1. The age-length relationships of 439 whitefish taken from scattered localities in Heming Lake from March 2 to September 10, 1945.

Age	No. of specimens				Length range			Average Length			Total
	Imm.	male	female	total	Imm.	Male	Female	Imm.	Male	Female	Av. Length
1											
2											
3	1	-	-	1	10½			10½			10.50
4	9	6	3	18	11¼-13¼	13 - 14	13½-14	12.4	13.5	13.8	12.44
5	-	61	55	116		12½-15¼	12½-15		13.8	13.9	13.81
6	-	27	26	53		13¼-15¾	12¾-15¾		14.4	14.3	14.33
7	-	21	21	42		13½-15½	14 - 15¾		14.6	14.6	14.58
8	-	26	24	50		13¾-16¼	13¾-16		15.1	14.9	15.00
9	-	34	39	73		14½-16¾	14¼-16¾		15.4	15.2	15.30
10	-	40	16	56		14¼-17	14¼-16½		15.7	15.5	15.64
11	-	18	10	28		15½-17	15t-17t		16.0	16.1	16.04
12	-	2	-	2		16¼-17¼	-		16.7	-	16.75
TOTALS	10	235	194	439							

TABLE 2. The age-weight relationships of 439 whitefish taken from scattered localities in Heming Lake from March 2 to September 10, 1945.

Age	Number of specimens				Weight range			Average Weight			Total
	Imm.	Male	Female	Total	Imm	Male	Female	Imm.	MalG	Female	Average weight.
1	1	-	-								
2											
3	1	-	-	1	11	-	-	11	-	-	11.00
4	9	6	3	18	-12-22	23-24	24-26	17.9	23.3	24.7	20.83
5	-	61	55	116		16-31	17-31		24.2	23.9	24.06
6	-	27	26	53		19-38	17-40		27.2	26.2	26.70
7	-	21	21	42		21-33	21-33		28.1	26.4	27.24
8	-	26	24	50		24-40	21-40		31.2	28.5	29.90
9	-	34	39	73		28-47	22-47		33.7	30.9	32.21
10	-	40	16	56		27-47	23-40		34.1	30.3	33.02
11	-	18	10	28		30-44	27-49		36.0	35.7	35.82
12	-	2	-	2		35-43	-		39.0	-	39.00
TOTALS	10	235	194	439							

TABLE 3. The composition of a series of 6 dredgings taken from Heming Lake on June 6 and Sept. 6, 1945.

Date	Depth	Type of bottom	Number of organisms								Total number (36 sq. in.)	Total vol. (36 sq. in.)	No. per sq. ft.	Vol. per sq. ft.
			Chironomidae	Ceratopogonidae	Chaoborus spp.	Ephemeroptera	Trichoptera	Zygoptera	MeIlusca	Amphipoda				
June 6	3 ft.	Sand	13	-	-	1	-	-	.7	-	21	0.05	84	0.20
June 6	6 ft.	Muck	11	1	-	20	1	-	6	-	39	0.10	156	0.40
June 6	11 ft.	Muck	7	-	-	2	-	-	1	-	10	0.02	40	0.08
Sept 6	5 ft.	Muck	26	-	-	-	1	1	12	26	66	0.12	2640	4.48
Sept 6	7 ft.	Muck	16	-	-	-	-	-	11	9	36	0.08	144	0.32
Sept 6	16 ft.	Muck	4	1	9	3	-	-	-	-	17	0.40	68	1.60
TOTALS			77	2	9	26	2	1	37	35	189	0.77	756	3.08
Percentage composition			40.7	1.1	4.8	13.8	1.1	0.5	19.6	18.5				
Averages											31.5	0.13	126	0.51

TABLE 4. Percentage analyses of the stomach contents of the 194 whitefish taken from scattered localities in Heming Lake from March 2 to September 6, 1945.

Food Item	Percentage frequency			Percentage oomposition			Percentage volume		
	March 2 to March 6	May 23 to June 23	Aug. 28 to Sept. 6	March 2 to March 6	May 23 to June 23	Aug. 28 to Sept. 6	March 2 to March 6	May 23 to June 23	Aug. 28 to Sept. 6
Hirudinea	-	6.5	-	-	0.2		-	1.0	
Crustacea	-	60.9	8.0	-	11.7	0.6		3.5	T
Arachnida	5.3	28.3	2.0	1.0	14.9	0.3	T	6.3	T
Insecta	100.0	97.8	98.0	70.9	54.6	52.2	96.1	76.4	90.0
Mollusca	71.1	43.5	30.0	28.1	17.0	46.9	3.9	8.8	10.0
Pisces	-	6.5	-	-	0.3			3.9	-
Eggs (fish)	-	8.7	-	-	1.4			?	-
Plant remains	1.3	30.4	4.0				T	?	T

TABLE 5. Comparison of the standard lengths in millimeters of Heming Lake whitefish of different ages with whitefish populations of other lakes.

<u>AGE</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Nipigon (Ontario)		227	238	251	282	322	358	384	393	400	404	435
Shakespeare Island (Ont.)		231	241	259	286	302	316	348	364	370	371	396
Hudson Bay		241	260	273	318	358	367					
Heming (Manitoba)	250	296	329	341	347	357	364	372	382	399		
Jackfish (Saskatchewan)		317	357	386	402	440	457					
Pigeon (Alberta)	326	343	369	388	405							
Wabamun (Alberta)	343	350	369	397	407							
Newell (Alberta)		388	405	431	466							
Ontario		336	346	409	459							
Winnipeg		380	420	450	480	500	520	540	560	575	585	590
Winnipegosis		390	420	450	480	500	520	540	560	575	585	592
Huron	409	450	470	490	513	542	559	569	585	555		

Lakes Winnipeg and Winnipegosis (Bajkov, 1930); Shakespeare Island Lake, Lake Nipigon and Lake Ontario, (Hart, 1931); Hudson Bay (Dymond, 1933); Lake Huron (Van Oosten, 1939). The data for Lakes Pigeon, Wabamun and Newell were supplied by Dr. R. B. Miller from unpublished manuscripts.