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Whitefish-Triaenophorus crassus investigations  
on Negslin Lake, Saskatchewan, 1950

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## INTRODUCTION

This report is to be a continuation and summary of the 1949 report. There are a few amendments to that report, as well as much added data.

The Nesslin Lake program was continued during the summer of 1950 under the joint auspices of the Central Fisheries Station of the Dominion Department of Fisheries, and the Fisheries Branch of the Department of Natural Resources and Industrial Development of the Province of Saskatchewan. The field work was carried on by R. R. Wheaton and G. E. M. Hazen, with Field Officer E. C. Over and Patrolmen L. Johnson and C. Colby providing valuable assistance in keeping the party supplied with food, mail, etc. Laboratory analysis was carried out at the University of Saskatchewan during the winter 1950-51 by G. E. M. Hazen.

The lake and its situation in the surrounding country was described in the 1949 report, although it might be recalled that it has a length of 2.9 miles and a maximum width of 1.5 miles with a total area of 2.3 square miles. (See Map in Plankton Report.) The area was incorrectly stated in the 1949 report to be 4.8 square miles. An adjustment has been made in the figures for the area and percentage area of each depth zone in the lake, and for the resulting mean depth. The amended data are recorded in Table I.

Regarding the flow of water into the lake, three streams, in addition to those found in 1949, were discovered, all of them dry the year round. The two flowing streams had some passage of water all summer, although the other two were again dry. There was

discovered, in 1950 as in 1949, no visible outlet to the lake.

#### PHYSICAL AND CHEMICAL DATA

The water temperatures were recorded periodically with a standard type of reversing thermometer. The surface temperatures varied from  $2.7^{\circ}$  to  $21.0^{\circ}$  C., while those at the bottom ranged  $4.2^{\circ}$  up to  $7.0^{\circ}$ . Marked stratification was again noted, the thermocline being at a depth of 7 - 10 meters, slightly shallower than that of 1949. The vernal circulation occurred sometime after 24 June, with stratification persisting until sometime after 26 August, when the field work terminated.

The content of dissolved oxygen was determined for surface and bottom waters at the same time as the temperatures. The variation in surface oxygen was from 5.8 to 8.1 cc./l., that of the bottom oxygen from 1.2 to 6.5 cc./l. There was no bottom stagnation during the period of observation.

The lake is moderately alkaline, ranging in pH from 8.3 to 8.5 at the surface and from 7.3 to 8.5 at the bottom. The pH was computed by means of a Hellige pocket comparator using methylene blue as an indicator.

Transparency, measured with a modified Secchi disc, ranged from  $2\frac{1}{2}$  to  $5\frac{1}{2}$  meters, which is fairly clear for a lake of this type. This data is enumerated in Table II.

## PLANKTON

The full report on the plankton of Nessler Lake is given in a term paper by G. E. M. Hazen. This was done in conjunction with University studies in fresh water biology.

## BOTTOM FAUNA

A total of 27 dredgings were taken in 1950 using a 6-inch Ekman dredge. They were taken from varying depths and followed the series done in 1949. The sampling was not efficient for a lake of this size, and the 1949 figures should stand as being the more accurate. A total of 77 dredgings were taken in 1949. The organisms were counted in the field and weighed in the laboratory. The results are tabulated in Table III. It can be seen that chironomid larvae made up the bulk of the numbers as compared with chironomids and amphipods in the 1949 series. The average wet weight of a dredging was 0.411 grams and the average number, 97 organisms per dredging. The only organisms found at a depth greater than 25 meters were chironomids and oligochaetes. A depth distribution diagram of all organisms encountered will be found in Table IV. The average bottom population was 4168 per square meter and its wet weight averaged 177 kilograms per hectare or 199 pounds per acre which is roughly equivalent to 35.4 kilograms per hectare dry weight. Table V shows a summary of 1949 and 1950 data arranged in parallel.

## FISH POPULATION

There are eleven species found in Nesslin Lake, all of them mentioned in the 1949 report. Only whitefish and pike will be discussed here.

(a) Whitefish

The lake whitefish, Coregonus clupeaformis, is the most interesting species in regard to Triaenophorus infestation, for it is through this fish that the parasite has gained such widespread importance.

The whitefish made up 40% of the total catch by number, and 36% by weight, the average weight being 19 ounces or 1.19 pounds. The growth rate has been computed from a sample of 245 fish, the scales being imprinted on plastic slides for age determination. The growth curve is shown in Graph II.

The stomach contents have been analysed and show that chironomid larvae and mayfly nymphs make up the bulk of their diet, with plankton playing a smaller, but none the less important, role. Again, as in 1949, it is interesting to note that plankton, mostly entomostraca, was eaten by several large fish taken in deep water.

During the middle of July and on through August, there appeared large numbers of small round cysts on the stomachs and pyloric ceca of the whitefish. These cysts were thought to be late procercoids of T. crassus in their migration to the back muscles of the host. In order to positively identify the cysts, sections

have been prepared for histological examination. No identifying structure has been noted, but the material is being referred to Dr. Ella Ekbaum of the University of Toronto for further study. As well as the stomach cysts, certain cysts of similar appearance found in the livers of several whitefish were taken for sectioning. It is not known if these bear any relation to the parasite being studied.

(b) Pike

The pike, Esox lucius, serving as definitive host for both T. crassus and T. nodulosus, provides another interesting and important study. This fish made up 7% of the catch by number, and 5% by weight. The average weight was  $4\frac{1}{2}$  pounds. Stomach contents were analysed in the field, and it was noted that whitefish made up a very small percentage of their food. Almost half of the stomachs examined were empty, and of those that contained food, the yellow perch was found in the greatest number of cases. Whitefish were found in only 4.2% of stomachs examined as compared with 9.3% in 1949. A sample of 95 pike were analysed, and 75 scale samples were taken for age determination. The growth curve for pike will be found in Graph III.

Catch data are recorded in Table VI, stomach analyses for both whitefish and pike in Tables VII and VIII.

TRIAENOPHORUS CRASSUS INFESTATION

As the definitive host for T. crassus, all pike taken were examined for the presence of this parasite. Those taken during the latter part of May had a high incidence of ripe adults, the number diminishing until, by the end of June, no fish were taken that harbored the parasite. The new crop made their appearance sometime between 20 and 26 July, the young tapes consisting of hardly more than a scolex. The number and size of these increased as the season progressed.

The incidence of cysts in the flesh of the whitefish has been recorded by months and by year classes in Tables IX and X. A total of 209 fish were cut in order to count cysts. It will be noticed that the incidence of cysts has declined markedly from the 1949 rate.

It was suggested that perhaps other intermediate hosts of the parasite might be found in the lake, and in order to find out if this was true, 10 fish of each species were cut. The examination revealed no plerocercoids of T. crassus, but did reveal two other types of cysts, both of them thought to be a fluke.

In order to complete the life history of T. crassus, 17 special surface plankton tows were taken. From each of these, 50 Cyclops bicuspidatus were identified and examined for the presence of proceroids. No case was found where a Cyclops contained the parasite.

Table 1. -- Area and percentage area of the depth zones in Nesslin Lake, with the mean depth.

<u>Depth Zones Meters</u>	<u>Area in Square Miles</u>	<u>Area Percent</u>
0 - 5	0.61	26.8
5 - 10	0.38	16.5
10 - 15	0.27	11.6
15 - 20	0.48	20.8
20 - 25	0.26	11.5
25 - 30	0.25	10.8
30 - 35	0.04	1.9
35 -	neg.	0.1
Total	2.29	100.0

Mean depth = 13.21 meters.

Table II -- Limnological observations at Nesslin Lake from May to August, 1950.

	May 22	May 29	June 10	June 16	June 24	July 6	July 11	July 17	July 25	Aug. 10	Aug. 17	Aug. 26
	Temp. °C											
Air	10.1	10.3	20.0	-	15.0	-	14.5	15.0	27.5	20.5	14.0	21.8
Surface	2.7	7.0	11.0	15.4	14.8	20.1	18.0	18.9	21.0	19.5	17.3	17.7
5	-	-	9.7	13.4	14.8	18.2	18.0	17.9	18.4	19.4	17.6	15.5
7½	-	-	-	10.4	14.8	14.0	15.5	16.5	16.8	19.1	17.5	15.4
10	-	-	-	7.9	11.0	8.8	11.9	11.4	15.0	15.1	13.6	15.2
12	-	-	-	-	-	-	9.5	8.7	10.8	10.4	10.4	12.0
15	-	-	-	7.1	8.4	7.2	7.8	7.6	8.0	8.0	8.0	7.9
20	-	-	-	-	7.1	7.1	-	7.1	7.1	7.3	7.2	7.1
25	3.5	-	-	6.9	-	-	-	-	-	-	-	-
Bottom (34 in.)	-	4.2	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0	7.0	7.0
	<u>Dissolved Oxygen cc./l.</u>											
Surface	7.7	8.1	7.8	6.8	7.1	6.4	7.0	6.3	6.1	5.8	6.1	6.4
Bottom	3.4	6.1	6.5	6.3	5.7	5.3	4.4	3.7	2.9	1.7	1.3	1.2
	<u>pH</u>											
Surface	8.4	8.3	8.4+	8.4+	8.4+	8.4+	8.4+	8.4+	8.4+	8.4+	8.4	8.4
Bottom	7.6	1.7	8.1	8.4+	8.0	7.9	7.9	7.7	7.5	7.5	7.5	7.3
	<u>Transparency Meters</u>											
	4½	5½	4½	4	4½	5½	5	5½	4½	3	2½	3½

Table III -- Numerical and gravimetric analysis of bottom fauna from Nesslin Lake.

<u>Organism</u>	<u>Total Number</u>	<u>Percentage of Total</u>	<u>Av. No. per Dredging</u>
Chironomids	2070	78.5	76.1
Oligochaetes	222	8.3	8.1
Sphaeriids	148	5.7	5.5
Amphipods	119	4.5	4.4
Mayfly nymphs	26	1.0	1.0
Ostracods	15	0.6	0.6
Tabanid larvae	11	0.4	0.4
Gastropods	9	0.3	0.3
Caddisfly larvae	5	0.2	0.2
Hydrachnids	3	0.1	0.1
Leeches	2	0.1	0.1
Ceratopogonids	2	0.1	0.1
Nematodes	1	0.04	0.04
	<hr/>	<hr/>	<hr/>
	2633	99.84%	96.94

Table IV -- Depth distribution by numbers of the bottom fauna of Nesslin Lake.

DEPTH ZONE	0-2	2-5	5-10	10-15	15-20	20-25	25-30	30-35	Totals
NO. OF DREDGINGS	4	4	1	2	7	8	1	0	
Chironomids	451	1273	14	18	154	130	30	-	2070
Oligochaetes	35	2	2	6	93	76	8	-	222
Sphaeriids	88	43	5	2	3	7	-	-	148
Amphipods	90	29	-	-	-	-	-	-	119
Mayfly nymphs	21	5	-	-	-	-	-	-	26
Ostracods	-	-	-	1	7	7	-	-	15
Tabanid larvae	11	-	-	-	-	-	-	-	11
Gastropods	9	-	-	-	-	-	-	-	9
Caddisfly larvae	5	-	-	-	-	-	-	-	5
Hydrachnids	1	1	-	1	-	-	-	-	3
Leeches	2	-	-	-	-	-	-	-	2
Ceratopogonids	1	1	-	-	-	-	-	-	2
Nematodes	-	-	1	-	-	-	-	-	1
Totals	714	1354	22	28	257	220	38	0	2633

Table V -- A comparison of bottom fauna data for 1949 and 1950 from Nesslin Lake.

	<u>1949</u>	<u>1950</u>
Total number of organisms	4386	2633
Average number per dredging	569	97
Total wt. of dredgings, gms.	19.978	11.069
Average wt. of dredgings, gms.	0.259	0.411
Wet wt., Kg/ha	88.7	177
Wet wt., lbs/acre	99.5	199
Dry wt., Kg/ha	17.5	35.4
Average bottom population per square meter	2560	4168

Table VI -- Numerical and weight analysis of the fish catch from Nesslin Lake.

	Whitefish	Pike
Total number	593	106
% composition by number	40	7
Total weight, lbs.	703	425
% composition by weight	36	5
Average weight	1.19	4.125

Table VII -- Stomach content analysis for whitefish and pike, comparing data for 1949 and 1950 from Nesslin Lake.

<u>Whitefish</u>			<u>Pike</u>		
<u>Food Item</u>	<u>% of stomachs containing item</u>		<u>Food Item</u>	<u>% of stomachs containing item</u>	
	<u>1949</u>	<u>1950</u>		<u>1949</u>	<u>1950</u>
Chironomid larvae	43.7	73.1	Stomach empty	----	49.5
Sphaeriids	15.2	71.2	Unidentified fish remains	24.0	17.9
Mayfly nymphs	15.9	56.5	Perch	25.2	29.5
Amphipods	8.2	37.4	Sucker	10.7	7.4
Plankton	10.6	32.4	Whitefish	9.3	4.2
Gastropods	2.0	32.1	Stickleback	----	4.2
Chironomid pupae	----	20.8	Spot-tail	----	2.1
Chaoborus larvae	----	13.9	Darter	----	1.1
Tapeworm fragments	----	8.8	Minnows	10.7	1.1
Ostracods	----	7.5	Pike-perch	6.7	----
Nematodes	----	5.5	Miscellaneous	13.4	----
Caddisfly larvae	----	3.9			
Fish remains	----	1.3			
Hydrachnids	----	1.0			
Leeches	1.2	1.0			
Notonectid nymphs	----	0.9			
Oligochaetes	----	0.3			
Dytiscids	----	0.3			
Fish eggs	----	0.3			
Tabanid larvae	----	0.3			
Ceratopogonids	----	0.3			
Algae	6.1	---			
Miscellaneous	3.1	---			

Table VIII -- Stomach content analysis for whitefish with each item as a percentage of the total.

<u>Food item</u>		<u>% of total food</u>
Chironomid larvae		38.8
Mayfly nymphs		37.5
Plankton		12.0
Sphaeriids		3.6
Chironomid pupae		1.7
Amphipods		1.7
Caddisfly larvae		1.7
Chaoborus larvae		1.4
Gastropods		0.8
Hydrachnids		0.5
Fish eggs		0.3
Leeches		0.2
Ostracods		0.2
Tapeworm fragments		0.1
Miscellaneous		0.2
Fish remains	0.06 %	
Oligochaetes	0.03 %	100.7 %
Notonectids	0.02 %	
Nematodes	0.02 %	
Tabanids	0.02 %	
Dytiscids	0.01 %	
Ceratopogonids	0.003 %	
		<u>0.163 %</u>

Table IX -- Periodic whitefish infestation with Triacnophorus crassus, Nesslin Lake.

<u>Date</u>	<u>Cut by</u>	<u>No. of fish</u>	<u>No. of cysts</u>	<u>Av. wt.</u>	<u>Infestation per 100 lbs.</u>	<u>Infestation per 100 fish</u>
May 1946	Over	10	263	1.86	1367	2630
May 1949	Gorst, Wheaton	234	4600	1.44	1298	1962
June-July 1949	Gorst, Wheaton	195	3635	1.67	1156	1865
June 1950	Wheaton, Hazen	49	874	2.1	844	1782
July 1950 1st. week	Wheaton, Hazen	30	180	0.8	729	600
2nd "	Wheaton, Hazen	40	390	1.0	965	975
3rd "	Wheaton, Hazen	20	151	1.1	689	755
4th "	Wheaton, Hazen	25	256	1.3	800	1024
Aug. 1950	Wheaton, Hazen	45	539	1.06	1228	1198

Table X -- Whitefish infestation with Triaenophorus crassus by year classes, Nesslin Lake.

Year Class	Average Wt.,	<u>Infest./100 fish</u>	<u>Infest./100 lbs.</u>
1	1.6	420	4200
2	4.7	220	758
3	10.2	310	482
4	15.2	710	800
5	26.4	1570	952
6	33.7	2260	1070
7	37.3	2110	904
8	33.7	1780	844
9	39.9	1970	793
10	46.4	2080	719
11	50.0	1500	1600
13	53.0	2900	878