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CANADIAN WILDLIFE SERVICE

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MEMORANDUM

FILE.........

Ottawa, 24 April, 1953.

Very nicely prepared & written up.

MEMORANDUM TO THE CHIEF LIMNOLOGIST

Attached hereto please find a report concerning the bottom fauna investigation carried out at Lake Minnewanka, Banff National Park, during the summer of 1952.

F.H. Schultz,
Limnologist.

A very good report

Schultz,
+ J. Shapiro 19

BOTTOM FAUNA STUDIES - LAKE MINNEWANKA
1952

In order to determine if and to what extent the productive capacity in Lake Minnewanka has changed, since previous studies as far as bottom dwelling organisms are concerned, a survey was conducted and a careful analysis of the material was carried out. The results of this study appear below.

On July 21 and 22, 1952, 24 dredgings of the bottom of Lake Minnewanka were obtained from which the organisms were removed. Samples were taken at this time, between depths of one-half and 68 metres, inclusive. On August 18 and 19, 1952, 16 more dredgings were taken from the same location, between depths of 1 and 58 metres. Each of the 40 dredgings was taken with a 9-inch Eckman dredge in front of the warden's patrol cabin on the north shore of the lake about 8 miles from the dam site. The organisms taken, were counted, dried, weighed, ashed and reweighed from which the dry weight of available animal organic matter was determined. The numbers of organisms, the dry and ash weights, and the number of pounds of dry organic matter per acre of bottom are presented in the attached table 3 and table 4.

The bottom samples analysed, contained chironomid larvae, chironomid pupae, amphipods, oligochaets, sphaeriids, gastropods and nematodes.

A brief summary of the data recorded in the above mentioned tables is presented below:

Total number of samples	40
Total number of organisms recovered	4940
Average number of organisms recovered per sample	123
Average number of chironomid larvae per sample	118
Average dry weight of animal organic matter per sample	0.0417 grs
Average dry weight of animal organic matter per acre	5.1 lbs.

The bottom fauna of the lake had been sampled four times previously. Rawson (1936, 1941, 1943) and Solman (1947) determined the production of bottom fauna during the summers of the years mentioned. A comparison of the results of the present study with those of the previous studies is provided in the following table:

TABLE 1 - Comparative results of the present bottom fauna study with four previous studies carried out in 1936, 1941, 1943 and 1947.

Year	No. of Samples	Aver. No. of Animals per sq. metre	Aver. No. of Chironomids per sq. metre	Aver. % of Total No. of animals represented by Chironomid Larvae	Aver. Dry Weight of animal organic matter per acre
1936	42	1,149	661	57	6.5 lbs.
1941	21	846	502	59.5	3.5 "
1943	64	424	393	92.7	2.9 "
1947	29	2,720	2,520	92.6	4.0 "
1952	40	2,363	2,210	93.5	5.1 "

It is noted from the above table that the total average weight of animal organic matter recorded was lowest in 1943 having decreased from 6.5 lbs. per acre in 1936 to 3.5 lbs. per acre in 1941 and to 2.9 lbs. per acre in 1943. After 1943, the weight apparently increased and reached 4.0 lbs. per acre in 1947. The weight of the bottom fauna has again increased since 1947, having reached a value of 5.1 lbs. per acre in 1952.

It is further noted that the numerical composition of the bottom fauna has continued to maintain the high percentage of chironomid larvae that was discovered in 1943 and 1947, and that the percentage has slightly increased in 1952 (about 1% from 1947). This indicates a production or a sampling of larger larvae in 1952, because the average number of larvae per square metre has decreased. It is, however, 5 to 6 times greater than that determined in 1943. If Solman's work (1947) is referred to, it is seen that two extremely large samples (containing 609 and 490 larvae) probably account for the higher average numbers determined in 1947.

From these data, it is postulated that a severe change in the environmental conditions occurred shortly after the construction of the present power dam, which resulted in a serious depletion of the bottom fauna. Considering the large proportion of chironomid larvae to the total number of organisms now present, it appears that a satisfactory recovery has been made by these larvae, which probably adapted more quickly to the changed environment and have increased ever since. It is probable that the bottom fauna of Lake Minnewanka will continue to increase in numbers and weight during the coming years. It was noted that there is a small increase (2%) in the numbers of sphaeriidae. It is believed that the mollusc population may be again increasing toward its population level prior to the construction of the dam. For both the July and August samplings, the lake level was well above the minimum level (4,805 feet) to which the power company can draw down. At the time of the July sampling, the water level was 4,835 feet and during the August sampling, the water level had reached its maximum height of 4,840 feet. If we examine the results of the bottom samples taken by depth ranges we see a relationship for the flooded and non-flooded areas.

The following table summarizes the average animal organic matter in pounds per acre for each of the two sampling dates and for the total of both samples and the average number of organisms per sample for 0 to 5 metres, 6 to 12 metres, 13 to 20 metres, and 21 metres or greater ranges in depth. Examining these depths we see that samples from the 0 to 5 metre range were taken in areas that were flooded about one month or so prior to sampling.

The samples from the 6 to 12 metre range were taken from areas which were exposed for a much shorter period of time but includes the area over which the water fluctuates in depth depending on the amount of water drawn down by the power company. The 13 to 20 metre range represents the area of lake bottom that was not flooded prior to the construction of the dam but which was permanently flooded after 1941. At depths of 21 metres or greater, the bottom was flooded prior to 1941; in other words this depth range represents the old lake bottom.

TABLE 2 - Average weight of Animal Organic Matter and Average number of organisms per sample for four depth ranges for samples taken on July 21 and 22, 1952, and on August 18 and 19, 1952.

Depth Range (Metres)	Average Animal Organic Matter in pounds per acre			Average number of organisms per sample		
	July	August	Total	July	August	Total
0 - 5	0.07	0.71	0.29	6	17	10
6 - 12	5.96	7.78	5.42	84	254	97
13 - 20	5.10	9.77	8.92	105	162	201
21 & up	5.39	4.57	4.68	150	130	142
TOTAL	4.71	5.94	5.14	112	148	123

It is seen that only samples from the 0 to 5 metre range were noticeably low in weight and numbers of organisms having an average value of 0.29 pounds per acre and an average of 10 organisms per sample. This is expected for an area that is only occasionally flooded as is the area in this depth-range. This area of the lake is practically non-productive as far as bottom fauna is concerned.

The 6 to 12 metre range which represents an area of the lake bottom which is flooded only part of the time, produces a relatively high weight and number of fauna. In July this depth range produced 5.96 pounds per acre, which increased to 7.78 pounds per acre in August with a total average for all samples of 5.42 pounds per acre.

The 13 to 20 metre range which represents the area of the lake bottom which was flooded as the result of the dam construction but which does not become exposed due to the lake level fluctuation, produced the greatest number of organisms and the heaviest available animal organic matter. This area of the lake bottom produced 5.10 pounds per acre in July and 9.77 pounds per acre in August with a total average weight of 8.92 pounds per acre. This is higher than any other area of the lake. This area also produced the greatest number of organisms with a total average of 201 organisms per sample. The reason for the high productive capacity for this area of the lake is probably related to its relative shallowness compared with the rest of the lake; and the fact that it is flooded all year and hence does not receive annual interuptions in the faunal cycles. It further is an area which is undoubtedly high in nutritive components as it has only been flooded since 1941 and will not yet be dependent on a chemical-nutrition cycle. It is also an area of the lake that receives a considerable settling of detritus as the result of inflow and wave action along the shore line as the lake level is raised each summer.

The data for July and August further indicate that a large increase in the numbers and weight of organisms occurred between July and August, 1952, between the depths of 13 and 20 metres, while a lesser change is noted for the samples taken between the depths of 6 and 12 metres and no change is apparent within experimental error at depths greater than 20 metres. This may also indicate that there are several peaks of abundance and consequently several hatches of chironomid larvae which comprise the major portion of the bottom organisms.

From the data presented, it appears that the bottom fauna suffered a reduction in numbers, possibly resulting from a change in the environment brought about by the dam construction in 1941. Conditions have obviously improved and the fauna has recovered since that time. The chironomid population appears to have made the most rapid recovery, however, there is evidence that the molluscs are now beginning to increase in numbers.

Other samples from Lake Minnewanka were taken at different times throughout the summer at other locations in the lake. These samples were not analysed at this time but will be reported on at a later date.

Conclusions

From the above study, the analysed results have indicated conclusions which can be briefly immerated as follows:

(1) The bottom fauna is recovering from the large decrease in numbers that occurred as a consequence of the construction of the dam.

(2) The bottom fauna has increased numerically since the last investigation in 1947.

(3) The chironomid larvae seem to have made the most rapid recovery since 1941.

(4) The most productive area of the lake bottom is apparently between 13 and 20 metres below the lake surface, measured at high water.

(5) There seems to be an ample supply of bottom organisms to support the present bottom feeding fish population and even a larger number of individuals since the productive capacity of the bottom is not fully utilized.

TABLE 3 - Bottom Fauna from Lake Minnewanka - Cabin Station, taken on July 21, 1952.

Dredging Number	Depth (Metres)	Chironomid Larvae Small	Chironomid Larvae Large	Chironomid Pupae	Amphipoda	Oligochaeta	Spaheridae	Others	Total No. of Organisms	Wet Weight - gms.	Dry Weight - gms.	Ash Weight - gms.	Pounds per Acre Organic Matter
[illegible]	6	72	25	2	--	1	2	--	102	--	0.0640	0.0158	8.22
14	19	144	17	2	--	--	6	--	169	0.165	0.0347	0.0093	4.33
15	52	142	11	2	--	1	2	--	158	0.185	0.0325	0.0097	3.89
16	55	78	15	1	--	1	17	--	112	0.191	0.0372	0.0126	4.20
21	17	63	14	2	--	--	41	--	120	0.222	0.0801	0.0269	9.08
22	3½	--	--	--	--	--	--	--	--	--	--	--	--
23	4	9	--	2	--	--	--	--	11	0.012	0.0005	0.0002	0.051
24) and) 25)	8	58	--	3	19	1	--	1*	82	0.2413	0.0505	0.0091	7.07
28	59	96	14	--	1	-	5	-	116	0.2040	0.0397	0.0106	4.97
29	68	76	3	1	-	1	17	--	98	0.1470	0.0362	0.0114	4.23
30	56	127	5	--	--	--	10	--	142	0.2144	0.0494	0.0145	5.95
31	51	168	5	--	--	1	16	-	190	0.2772	0.0570	0.0195	6.40
32	39	119	11	--	1	--	--	-	131	0.2235	0.0561	0.0139	7.21
33	52	195	15	--	--	-	4	-	214	0.3544	0.0628	0.0178	7.68
34	38	194	10	--	--	1	--	--	205	0.2676	0.0506	0.0180	5.57
35	32	91	7	--	--	--	5	--	103	0.0511	0.0293	0.0071	3.79
36	16	39	20	--	1	--	--	--	60	0.1452	0.0309	0.0080	3.90
37	29	144	6	--	--	--	1	--	151	0.1990	0.0423	0.0126	5.07
38	24	157	7	--	--	--	6	--	170	0.2118	0.0477	0.0138	5.78
39	17	54	13	--	--	--	5	--	72	0.0868	0.0215	0.0062	2.61
40	11	48	9	2	9	--	--	--	68	0.1145	0.0219	0.0068	2.58
41	14	74	29	--	--	--	3	--	106	0.2372	0.0473	0.0146	5.58
42	0.5	--	--	--	--	6**	--	--	6	0.0003	0.0001	0.0000	0.171
Total Number		2148	236	17	31	13	140	1	2586	3.8503	0.8923		108.33
Average Number													4.51

Small - less than 10 mm. in length
Large - greater than 10 mm. in length

* - Gastropod
** - very small

TABLE 4 - Bottom Fauna from Lake Minnewanka - Cabin Station, taken on August 18, 1952.

Dredging Number	Depth (Metres)	Chironomid Larvae: Large	Chironomid Larvae: Small	Chironomid Larvae: Very Small	Chironomid Pupae	Amphipoda	Oligochaeta	Sphaeriidae	Others	Total No. of Organisms	Wet Weight - grams	Dry Weight - grams	Ash Weight - grams	Pounds per Acre Organic Matter
1	37	2	123	--	--	--	1	6	-	132	0.2080	0.0481	0.0132	5.96
2	56	8	129	-	--	--	-	1	-	138	0.1929	0.0344	0.0123	3.77
3	25	6	91	20	--	--	1	8	4	130	0.2168	0.0521	0.0163	6.11
4	14	12	86	88	2	-	1	29	-	218	0.3755	0.1455	0.0572	15.08
5	11	-	30	24	1	--	--	7	-	62	0.1002[illegible]	0.0452	0.0070	6.52
6	9	-	5	398	4	--	1	--	1	409	0.2109	0.0444	0.0154	4.96
7	18	65	27	10	--	--	--	1	--	103	0.3507	0.0588	0.0135	7.7
8	45	10	136	4	--	--	-	1	-	151	0.2582	0.0406	0.0106	5.12
9	15	9	72	136	1	-	-	14	-	232	0.2358	0.0692	0.0137	9.4
10	12	25	73	181	1	1	1	8	1	291	0.3819	0.0903	0.0208	11.8
11	58	7	122	4	--	-	--	11	-	144	0.2073	0.0397	0.0122	4.7
12	50	8	101	--	-	--	3	1	1	114	0.1740	0.0258	0.0092	2.8
13	30	2	81	19	--	-	--	--	-	102	0.1422	0.0246	0.0043	3.4
14	18	17	32	42	--	1	--	2	-	94	0.1857	0.0480	0.0081	6.8
15	5	--	2	27	-	1	-	--	-	30	0.0086	0.0072	0.0005	1.1
16	1	--	3	-	--	1	-	--	-	4	0.0072	0.0019	0.0003	0.2
Total Number		171	1173	953	9	4	8	89	7	2354		0.7758		95.8
Average Number		10.7	69.6	59.6						147				5.9

 Schultz, F. H.
Bottom fauna studies
- Lake Minnewanka.

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