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FURTHER INVESTIGATIONS OF CHAMCOOK LAKES, N.B., CANADA.

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During the open season of 1935 the author was engaged on further investigations of two Chamcook lakes, namely First and Second, in order to obtain more detailed information with regard to the feeding habits of Chamcook fishes and at the same time to make further observations on temperatures, plankton and seasonal distribution of bottom fauna. In connection with the last problem temperature readings, bottom and plankton samples were taken periodically during the summer and fall at certain definite spots. In First Chamcook in deepest spot below the thermocline, above the thermocline and in shallow spots near shore; in Second lake, in the deepest hole and in many other places all over the lake. The conditions in the Second are not so variable as in First lake.

It has been found more convenient to concentrate first on the feeding habits of Chamcook fishes and to get a definite idea on distribution and occurrence of food organisms this way. And, indeed, after a detailed study of the stomach contents of certain fishes quite a number of previously un-recorded important food organisms have been discovered in Chamcook chain. Though some of these organisms play primary roles in the biology of these lakes and occur by thousands in the stomachs of certain fishes, they have not been taken in our bottom or plankton samples. These facts well illustrate how incomplete our data can be, if they are based on dredge and plankton net only, without regards to stomach analyses of fishes.

In every lake exists, undoubtedly, special strata, in the form of a very thin layer (probably colloidal) of fine mud which covers the bottom. It is practically impossible to detect this strata with plankton net or any kind of heavy bottom sampler without mixing it with the lower strata of mud. However, fishes, especially such forms as suckers, are well adapted to feed on this pasture, and, therefore, we often find in their stomachs such animals which we cannot catch in other ways. For instance the following example will illustrate this. Only one broken post abdomen of Eurycercus lamellatus has been found in Second Chamcook in 1934 but this crustacean was very common in stomachs of the sucker and as many as six thousand of them were observed in an intestine of a single specimen of this fish. Another phyllopod Acantholeberis curvirostris, which was not observed at all from any bottom or plankton samples, has been found in the majority of sucker stomachs in great number, far exceeding the previous form. The same thing can be said about Eatona setifera and Rhynchotalona falcata, as well as some other forms. Rhynchotalona falcata plays probably the most important role in the diet of sucker fry in First Chamcook lake.

The detailed examinations of feeding habits of Catostomus commersonnii, Notropis cornutus, Couesius plumbeus, Fundulus diaphanus, Cristivomer namaycush and land-locked salmon and smelt in Chamcook lakes, based on about 500 stomachs, are subjects of special reports already submitted. It is planned to use these findings for the completion of a final and more extensive report on the biological conditions of Chamcook lakes together with other hydrological and biological data obtained during 1935.

Temperature conditions. Temperature conditions in First and Second lakes were followed during the summer and fall of 1935. The deepest spots were selected in these lakes for this purpose, namely, station 48 in First lake with a depth of about 45 metres (variable with changing of the level of this lake) and station 50 in the Second lake with a depth between $5\frac{1}{2}$ and 7 metres, also depending on the fluctuation in water level.

In general the summer temperatures during 1935 in both lakes agree quite well with those of 1934, although, due to extreme hot weather, slightly higher temperatures were observed in both lakes.

In First lake August 12, 1935, the lowest temperature below the thermocline was 7°C . instead of 6.5°C at the same station in 1934 on August 15th. In Second Chamcook the lowest temperature recorded during August, 1935, was 24.3°C . also somewhat higher than the year before. For the Second Chamcook, due to its shallowness and comparatively flat bottom, this phenomena is not very characteristic because on certain occasions, during or following a heavy wind, the temperatures may be found uniform in all depths.

The following tables show the temperature reading obtained during 1935 from First and Second Chamcook lakes.

Chamcook First. 1935. Station 48

Date	12/VI	26/VI	12/VIII	29/VIII	19/IX	11/X	7/XI
Weather	noon, fair	noon, fair	4p.m. calm	3 p.m. calm	2 p.m.	noon	noon
Air T°C	20.4	22.	24.6	19.9	23.9	13.4	12.5
Surface	16.9	18.5	23.	21.3	17.5	12.8	10.4
1 m.	16.9	17.4	22.3	22.2	16.9	12.6	10.3
2 m.	16.7	17.1	22.1	20.0	16.2	12.6	10.2
3 m.	16.	17.	22.	19.9	16.2	12.6	10.2
4 m.	15.4	16.4		19.7	16.1	12.6	10.1
5 m.	15.2	16.1	20.	19.5	16.	12.6	10.1
7 m.	9.5	11.5	16.2	15.0	15.2	12.6	10.1
10 m.	7.8	8.4	10.4	8.9	8.2	12.0	10.05
15 m.	7.5	7.8	7.7	8.0	7.5	8.0	9.0
20 m.	7.1	7.5	7.4	7.4	7.2	7.4	8.9
25 m.	7.0	7.0	7.2	7.3	7.1	7.2	
30 m.	7.0	7.0	7.0	7.0	7.0	7.1	7.0
40 m.	6.9	6.9	7.0	7.0	7.0	7.0	7.0
45 m.	6.9	6.9	7.0	7.0	7.0	7.0	7.0

The homothermous condition in the upper ten metres on October II, is result of the mixing of these strata caused by a heavy S.W. wind shortly before the temperatures were taken. The thermocline during the 1935 was approximately at the same level as in 1934 and this condition is persistent during the summer.

Only in late fall when the water is completely circulated from the surface to the bottom do all strata become uniform in temperature. In such cases (and probably occasionally) the bottom temperatures in First Chamcook lake may drop below 4°C. Such phenomena were observed in winter 1934-35.

Chamcook Second. 1935. Station 50

Date.	3/VI	10/VII	24/VII	2/VIII	4/IX	14/IX	10/X	6/XI
Weather	6pm. fair	4 p.m. fair	6p.m. SW	4p.m. NW	4p.m. f.	11a.m. f.	4p.m. f	4p.m. f
Air T°C	25.4	29.8	30.		21.	17.2	15.4	10.
Surface	22.	24.5	26.8	24.3	20.8	17.8	12.4	10.
1 m.	22.	23.4	24.1	24.3	20.6	17.8	12.4	10.
2 m.	20.	21.8	23.9	24.3	20.4	17.6	12.3	10.
3 m.	19.8	21.2	23.4	24.3	19.6	17.6	12.1	10.
4 m.	19.6					17.5	12.1	9.9
5 m.	19.5	16.	15.2	24.3	19.	17.4	12.	9.9
6 m.	19.2					17.4	12.	

In Second Chamcook the difference between the surface and bottom temperatures during the summer is not great and on certain occasions as, for example, August 2, 1935, during and following a heavy wind, the water of this lake may be found homothermous.

Fishing operations. In July two gill nets 2½" and 3" mesh, about thirty fathoms each, were put into operation in both lower lakes.

The catches of salmon and togue in First lake were rather poor so from these catches and also from many trials of sporting fishing we conclude that population of game fishes in this lake is not very large.

It has been estimated that in average only one landlocked salmon can be caught during ten hours of trolling (by means of artificial spoon with gang hooks baited by minnow). Such fishing can hardly be called a high sport method but it seems probably impossible to catch the salmon in these lakes with a plain spoon only. It is still more difficult to catch salmon there by means of artificial fly.

Suckers are very abundant in First Chamcook and can be easily obtained by gill nets in certain depth. Only in one case was a good catch of landlocked salmon made under specially favourable conditions in Second lake.

The following are the results of gill net catches from First and Second Chamcook lakes in 1935.

Chamcook First

12/VIII	(Deep water near island. Two nets)	1 salmon
13/VIII	(5 to 10 m. N.E.shore. Two nets)	60 suckers and 2 togue
15/VIII	(2 to 10 M. West shore. Two nets)	9 suckers
20/VIII	(5 to 10 m. N.E.shore. Two nets)	53 suckers 1 togue
24/VIII	(10 to 25 m. N.E. shore. Two nets)	1 sucker 1 togue
30/VIII		
31/VIII	(10 to 25 m. N.E.shore. Two nets)	12 suckers 2 togue
4/IX	(5 to 10 m. North end. Two nets)	nothing
14/IX	(ditto)	"
26/IX	(")	3 suckers 2 salmon

Total: 2 salmon, 6 togue, 138 suckers

It must be mentioned, however, that it is very difficult to catch salmon in First Chamcook by gill nets. The lake is too deep and the vertical and horizontal migration of salmon there is subject to considerable variation throughout the year. Salmon in First Chamcook is a pelagic fish and follows the vertical migration of smelt.

Chamcook Second

11/VIII	(middle of the lake. 4 m. One net)	nothing
24/VII	(the deepest part. 6 m. One net)	15 salmon
2/VIII	(" Two nets)	nothing
17/IX	(")	"
18/IX	(")	"
19/IX	(middle of the lake. 4 m. Two nets)	"
20/IX	(")	"
29/IX	(")	2 salmon
10/X	(")	nothing

Total: 17 salmon

Investigation of bottom fauna. This is the most difficult problem in lake investigations, especially in such deep lakes as First Chamcook. The work can be more easily done with someone assisting in keeping the boat against the wind, holding washing screen when the dredge is taken from the water, etc. However, more than 100 bottom samples were taken during the summer and fall of 1935 (comparing with several hundred in 1934). All the results of these dredgings are listed below and as far as we can judge from this limited number of samples the following tentative conclusions can be made:

1. No considerable variations were observed in the population of small mollusks (pelecipods and gastropods) during the different seasons.

2. The number of red chironomid larvae (Chironomus plumosus ?) probably is the subject to some variations during the seasons but this problem can be solved only after special and extensive work in one lake based on many samples. In Second Chamcook, as our samples show, the number of Chironomidae larvae is somewhat increased in the fall.

3. The number of Corethra larvae decreases (at least near the bottom) in late fall.

The seasonal variations of other aquatic insect larvae cannot be determined on the basis of such limited numbers of samples.

The following are the results of dredgings in First and Second Chamcook during the open season of 1935. The very minute animals which easily washed through the 1/15 inch mesh of iron sieve are not included herewith. However, as the microscopical analyses of bottom samples show, the total amount of this minute fauna is not so important as those listed below.

Chamcook First

12/VI	5	dredges. Station 48. Below the thermocline		nothing
	5	" 6 m.	Chironomidae (1)	3
	5	" 4-5 m.	Hexagenia sp. (n) Valvata tricarinata	2 5
26/VI	5	" 5 m. stone bottom		nothing
	5	" 8 m. mud	Hexagenia Chironomidae Anodonta Trichoptera (1)	4 30 11 3
	5	" 35 m. mud	Chironomidae	2
10/VII	5	" 10 m. mud	Chironomidae Valvata sp.	21 2
	5	" 4 m. stone bottom	dead Pisidium shells only	
	5	" Station 48.	Chironomidae	1
29/VIII	4	" 10 m. mud NE. shore.	Chironomidae in tubs (including empty tubs)	60 (about)
	5	" Station 48.		nothing
	5	" $\frac{1}{2}$ mile north of 48.	Chironomidae	3
4-7/IX	5	" 10 m. mud. NE. shore.	Chironomidae in tubs (including empty tubs)	100 (about)
	5	" Station 48.		nothing

Chamcook Second

4/VII	10	dredges (across the lake. S--N. 3-4 m.)		
			Chironomidae (1)	11
			Valvata tricarinata	49
			Valvata sp. & other small spp.	55
			Pisidium sp.	7
			Corethra sp.	8
			Trichoptera (1)	2
			Spherical blue-green algae	many

24/VII 4 dredges (4½ m. mud)

Chironomidae	14
Zygoptera (n)	1
Trichoptera (1)	2
Corethra (1)	1
Planorbis companulatus (dead shells)	2
Hirudinea (small)	2
Ephemerae (n)	1
Valvata tricarinata	27
Valvata sp.	17
Planorbis sp. (small)	1
Pisidium sp.	3
Anodonta	1

10/VIII 3 dredges (middle of the lake, 5 m.)

Chironomidae	7
Valvata tricarinata	20
Planorbis companulatus	2
Valvata sp.	25
Pisidium sp.	4
Planorbis sp. (small)	2
Trichoptera (1)	4

4/IX 12 dredges (between island and north shore, 3-5 m.)

Chironomidae	21
Valvata tricarinata	70
Valvata sp.	78
Trichoptera (1)	3
Pisidium sp.	10
Hirudinea (small)	4
Planorbis companulatus	5 (4 of them dead)
Ephemerae (n) small	3

The Plankton. The vertical and horizontal hauls were made in both lakes periodically throughout the summer and fall with a No. 18 plankton net. As in previous year samples the amount of phytoplankton in First lake was very much smaller than in Second.

The seasonal distribution of most common planktonic organisms in First lake may be described as follows:

Early in June Epischura lacustris seems to be more common than during the other times of the year. Diaptomus and Cyclops, on

the other hand, are not very abundant at that time though the young stages of these copepods were noticed. They become very abundant in July, August and September, especially Diaptomus minutus, which is always the more dominant form. Leptodora appears early in July and become fairly common during summer and fall. We have no indication of the occurrence^{of}/this form during the winter but it is very likely that it can be obtained from Chamcook all year round. Holopedium is common during late June, July and August, but it never reaches such an abundance in First lake as in the other lakes of this chain. The genus Daphnia (represented by two species) is fairly common throughout the year but reaches probably two maxima of abundance in June and late in August.

Bosmina is not a rare form during all seasons but is more common in First lake during the period of highest temperatures - July and August. Well marked maximum of certain rotifers can be noticed in First Chamcook. Thus, for example, Asplanchna priodonta has its maximum in October; Anuraea cochlearis in second part of August and in September; Notholca longispina in June and Conochilus unicornis in July.

Diatoms, mostly Asterionella and Tabellatia, are more common in spring than in other seasons and the same statement might be applicable for other diatoms.

Green algae, especially desmids, reach their maximum abundance during July and August though they are never so common in First lake as in three other lakes of Chamcook chain.

Synura appears suddenly in July and August in great quantity and is the dominant form of all plankton during this time but disappears again before the lake is frozen over.

Representatives of the genus Dinobryon can be found in the plankton samples almost during all seasons but reach their maximum abundance in summer.

The seasonal distribution of planktonic organisms in Second lake is quite different from that in First lake. First of all the relative abundance of desmids and Myxophyceae is much greater in Second Chamcook. The maximum abundance of these algae is in the second part of the summer. Microcystis aeruginosa, Anabaena and several species of Chroococcus are very common during this time of year. Many species of Staurastrum and other desmids are very common in August and September.

Other green algae as well as Dinophyceae are not common in this lake. Diatoms, especially Tabellaria, are common in all seasons but reach their maximum abundance in the fall (September) when Melosira, Fragilaria, etc., become also more common.

Synura also appears quite suddenly but later than in First lake. In the first part of August this species can hardly be detected at all but at the beginning of September it becomes the most abundant form in plankton of Second lake. Dinobryon was ^{never} found so common as in First Chamcook and only in September is it common in plankton samples.

Rotifers are common during spring, summer and fall but Notholca reaches its maximum abundance in July and August, Conochilus in August and September, Rattulus in September, Anuraea is probably equally distributed throughout the year.

Ceriodaphnia, Daphnia and Diaphanosoma are more common in second part of the summer. Holopedium reaches its maximum of

abundance in July and August and probably disappears in winter. Cyclops are common throughout the year, becoming more or less common sporadically when new generations hatched out. The same is true also for Diaptomus minutus, the single representative of this genus in Chamcook chain, which is probably more abundant in August when many females are bearing egg sacks.

Epischura lacustris appears to be more common in the spring and first part of the summer, same as in First lake.