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Title

FISH (SALMON) MANAGEMENT

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## FISH (SALMON) MANAGEMENT

1950

REPORT NO. II. Report by V. M. Davidson

### 1. Salmon angling in Shubenacadie lake in 1950

#### Collection of results

Shortly before the fishing season opened on April 15, I arrived in Wellington and at once visited the chief persons who had aided in supplying data for the angling report of 1949. The individual anglers of previous years had already been supplied with a circular letter explaining the tagging done in November and asking for their co-operation in getting accurate information and telling them where to report. Daily efforts were made to find out when and where salmon were caught, the equipment used and to examine the fish. Information about other fish related to the salmon was sought at every opportunity. The names and addresses of 124 new and prospective anglers were obtained, many of whom were interested enough to visit the laboratory and all were acquainted with the importance of keeping accurate records of their catches. I believe that most of the anglers who visit this lake make an effort to keep the data and report it. Scales have been received from 63 untagged and unmarked fish for which no reward is paid, some of which were sent in by mail accompanied by full data. Several anglers caught tagged fish, and thinking them too small or thin to be of use, noted the number on the tag and returned the fish to the water.

Early in the season the upper end of the lake and Sandy cove near the mouth of the lake were the busiest landings for boats, and required constant attention on weekends, Wednesday afternoons and holidays. Later, more and more reports were received from campers who were visited regularly for collection of data and payment of rewards.

I am grateful for the co-operation of the anglers, the fishery officers and especially that of Mr. Andrew King, who rents boats at Sandy Cove, Mr. A. Morash of Grand Lake Station and Mr. W. H. Cameron, Superintendent of the rearing ponds at Wellington and his staff who so ably assisted again this year.

#### Conditions for angling

##### Boats

At the beginning of the season there were too few boats for hire or places free of charge where privately-owned boats might be launched. Private roads to landings were in such poor condition after the heavy snowfall in April that anglers were deterred from bringing boats on the top of motor cars or in trucks. Since angling seems to be confined almost entirely to weekends and holidays, it is doubtful whether an extension of the business of renting boats would be lucrative. Most of the campers possess row boats and outboard motors, but did not use them extensively for angling as they were busy about their camps and few were in residence before the latter part of June, when salmon were more difficult to catch.

Height of the water and the weather

The following quotations from the summaries of the weather at Halifax issued by the Meteorological Division of the Department of Transport aptly describe the weather at Wellington: "April was an extremely dull and snowy month...it was the dullest April for which records are available.... For the third consecutive month temperatures were subnormal and, despite the heavy snowfall, for the fifth consecutive month the precipitation was subnormal".

"May was a dry and exceedingly sunny month. The period of sub-normal precipitation has now extended through six consecutive months, with May having experienced less than half the usual rainfall. Despite five sunless days, the month was the second sunniest on record...May 22nd marked a significant change in the temperature pattern. For the first 21 days temperatures were generally below normal (thereafter until the last day of the month they were consistently very much above normal), resulting in a slightly above-normal mean temperature for the entire month".

"June followed the pattern of most of 1950, to date, by being cool and dry...temperatures were below normal for the fourth month...the sun shone brightly for 46% of the possible time, slightly above normal".

Due to the subnormal precipitation, the level of Shubenacadie lake subsided a distance of 3 feet between April 25, the occasion of the spring high, and May 21 and maintained the low level except for slight variations which did not exceed five inches until the end of August. Before May 21, 67% of the sal-

mon reported had been caught. Whether the abrupt change in the light or the rising temperature of the water had the greater effect on the decrease is not known. It is doubtful whether the anglers would try fishing at a deeper level in sunny weather. One outstanding feature of June was the very strong winds on three successive weekends which interfered with operations on the broad part of the lake.

#### Temperature of the water

The temperature of the water entering the rearing ponds at Wellington as recorded by a thermograph was compared for the months of April, May and June in 1948, 1949 and 1950. The two latter were warm years and the former cool and wet. Two main differences were apparent: (a) <sup>in</sup> April, 1950, the water warmed up more rapidly than in either of the previous years, reaching a maximum of 50°F. as compared with 46°F. in 1949 and 41°F. in 1948, and (b) the maximum temperatures in May were slightly below those of the same month in 1949 until May 23 when an increase of 10°F. in the maximum in a matter of nine days raised it to 72° F., a temperature reached 10 days later in 1949 and not before July 9 in 1948.

It is evident that the warmer water in April and the rapid change in May could be an important factor in affecting the salmon catch.

#### Angling results

The salmon caught by anglers may be separated into three groups: (a) tagged fish of pond, lake and sea (Sackville river)

origin, (b) pond fish that had been marked by removal of one or more fins before being released and (c) naturally produced or "wild" salmon having no indication of loss of tag or scar from fin-removal. Samples of scales accompanied the reports of 90% of the tagged fish for which rewards are paid as compared with 22% for the untagged fish for which no reward is offered. The marked fish required very careful examination and some may have been overlooked and reported as naturally produced fish if they had been marked as yearling parr.

#### Tagged fish

In November, 1949, a total of 826 fish were tagged and released in Shubenacadie lake. They were composed of 745 fish from the rearing ponds at Wellington, 42 trapped lake fish and 39 sea fish from the Sackville river. During 1950, 90 of them have been captured, 87 by angling in Shubenacadie lake, its head waters and near its outlet and 3 in the Shubenacadie river and the estuary of the Stewiacke river at some distance below the mouth of the lake by net fishermen.

Two trapped lake fish tagged in 1948 were caught in Shubenacadie lake in 1950, one of which had been liberated in Lake Thomas and the other in Shubenacadie lake.

That the lake fish migrate out of the lake to some extent is shown by the fact that two trapped lake fish tagged and liberated near Grand Lake Station in 1949 were caught by anglers in Kinsac lake in 1950. A summary of the recaptures made in 1950 from previous tagging is shown in table No. 1, and the re-

sults of tagging experiments from 1946 to 1950 in table No. 2. In comparison with 1949, a smaller percentage of pond fish was recaptured by angling in 1950, which may be due to there being more small fish tagged. A larger percentage of trapped lake fish was taken in 1950 than in any previous first year of tagging except that in 1946 and the percentage of sea fish by angling greater than in any previous year.

The greater tendency for the sea fish than for the other groups to travel toward the sea is shown by the recapture of one or more of them by nets at considerable distance from the lake each year as compared with none of the pond fish and a single trapped lake fish taken near Moore's Falls on the Shubenacadie river in 1949.

#### Marked fish

Only 10 marked fish have been reported in 1950 by anglers. Of these 3 were examined by me at Wellington and 3 more accepted as reliably described. To arrive at a fair estimate of the number which might have been overlooked it was calculated that on a basis of 14% of the whole catch of 307 untagged fish carefully examined for marking, 42 might be presumed to have been marked. Data regarding these six fish is summarized in table No. 3. Study of their scales revealed that the two fish taken in April were 4 years old and presumably belonged to 36,173 yearling parr of lake salmon origin (1946 year-class) which had been released in the lake; the next three in the list were 3 years old and presumably from 3,982 smolts of sea salmon

origin released in 1949 and the sixth was a 2-year-old smolt recently marked and too badly injured to be released.

Table No. 1. Summary of tagging results in 1950

Pond fish tagged in 1949

<u>Number of fish tagged</u>	<u>Age at tagging</u>	<u>Number of fish recaptured by</u>		
		<u>angling</u>	<u>nets</u>	<u>traps</u>
661	3 yr.	54	0	6 (Rawdon river)
39	4 yr.	5	0	0
44	5 yr.	5	0	0
<u>1</u>	?	<u>1</u>	<u>0</u>	<u>0</u>
745		65		6

Trapped lake fish tagged in 1949

42		10	0	0
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Sea fish trapped in 1949

39		12	3	9 (in Nov. 1949 (Rawdon) 1 in Nov. 1950 (Bedford Hatchery)
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Trapped lake fish tagged in 1948

Number of tag

A 1032	1
B 2633	1

Table No. 2. Summary of the results of tagging experiments from 1946 to 1950.

<u>Number of tagging</u>	<u>Year of recapture</u>	<u>Number tagged</u>	<u>Number recaptured by</u>	
			<u>Angling</u>	<u>Nets</u>
<u>Pond fish</u>				
1948	1949	200	20 (10%)	0
1949	1950	745	65 (8.7%)	0
<u>Trapped lake fish</u>				
1946	1947	33	14 (42%)	0
1947	1948	15	3 (20%)	0
1948	1949	37	7 (19%)	1
	1950		2	
1949	1950	42	10 (24%)	0
<u>Sea fish (Sackville river)</u>				
1946	1947	254	68 (23%)	8
	1948			1
1947	1948	65	8 (12%)	3
	1949			1
1948	1949	43	8 (19%)	2
1949	1950	39	12 (31%)	3

Table No. 3. Marked salmon recaptured in 1950 by angling.

Date of capture	Marking	Sex	Place of capture	Length inches	Weight ounces
Apr. 23	R. ventral and adipose	F.	W. shore Shuben. L. above Five Is.	20	28
" 26	"	M.	Fletcher lock	18.5	28
May 28	R. ventral adipose present	?	near Big Is. of Five Is.	12.5	9.25
June 3	R. ventral	F	Near Cook's camp	12	12?
" 4	"	F.	"	13	16?
July 2	L. ventral	?	Big Hd. near Grand Lake Sta.	10.5	7?

During the trapping in November 1950, in preparation for breeding and tagging, 11 marked fish were recaptured: 8 with the left ventral fin removed were 3 years old and might belong to 9,948 lake salmon (1947 yr.-class) planted as yearling parr or 9,189 lake salmon smolts released in the lake in 1949. The right ventral and adipose fins were missing from the other 3 fish and since they were 4 years old, it is presumed that they belong to the 36,173 lake salmon of the 1946 year-class released as yearling parr.

In 1949, the anglers who were interviewed reported 33 marked fish. None of the reports could be verified or the kind of marking ascertained as no scars of the missing fins were received.

#### Untagged and unmarked salmon

Anglers reported 297 "wild" salmon from Shubenacadie lake and its tributaries in 1950, submitting date and place of capture. Approximately 25% of the reports included the length and weight of the fish, 63 samples of scales were received and 56 stomachs were examined, most of them at Wellington. This is a much more detailed and, I believe, more reliable report than was secured last year by interviewing the anglers after the fishing had been completed. The number taken in 1950 is 42% of the estimate of approximately 700 "wild" fish made in 1949. Some of the difference may be due to duplication and over-estimate in 1949, but verbal reports received from fishery officers, guides and anglers indicate that the catch by angling was much reduced in other parts of

Nova Scotia as well as in Shubenacadie lake. Expert local opinion was strong that the catch in 1950 was definitely quite low.

#### Location of the fishing grounds

##### Regions

Shubenacadie lake may be described as having four main regions for salmon angling: (a) Head of the lake at the south end which is comparatively shallow (less than 40 feet) and received drainage from the Rawdon and the Fletcher rivers, (b) Grand lake which is wide and deep and is fished along both the east and west shores, (c) region about the mouth and the immediate upper part of the Shubenacadie river into which it empties and (d) Little lake, a comparatively shallow region (20 feet) at the north end and entered through a narrows.

##### Distribution of the catch

The earliest fishing was done at the head of the lake and near the mouth, where the ice first moved out. When the total catch was analyzed it was found that the head of the lake produced approximately 8%, Grand Lake along the east shore 17% and along the west shore 31%, the region about the mouth 42% and Little lake 1%. The distribution was similar to that reported in 1949 except that the region about the mouth accounted for 50% and Little lake about 4% in 1949. From conversation with anglers, the decrease in the number taken in Little lake may be attributed partly to lack of fishing effort as compared with last year, but in the region about the mouth of the lake it seemed to be due to the fish being harder to

catch than in 1949. The approximate monthly distribution of the catch is shown in table 4, and the geographical distribution is roughly indicated in figure 1. There was considerable lack of exactness in many reports and on days of poor catches the anglers covered a great part of the lake in their operations.

Considering that the season opened on April 15, the rate of fishing was about the same in April as in May and approximately 70% of the catch<sup>was made</sup> in the first six weeks. More than half of the June catch came from the west shore of Grand Lake between Cook's camp below Wellington and the mouth of Rocky brook. At that time many of the campers were in residence on weekends and were the chief anglers. The late catch near the mouth of the lake was particularly poor and it is there that boats may be rented.

#### Sizes of the salmon in the catch

In table No. 5, the tagged fish have been classified according to length at the time of tagging and the numbers and percentages of the various sizes recaptured are shown. It is apparent that there was more intensive fishing for the larger fish. To show that the same was true for the "wild" fish, the lengths of 88 or approximately 30% of the catch of 297 naturally produced salmon believed to be carefully measured have been similarly classified in table No. 6.

63°35'W

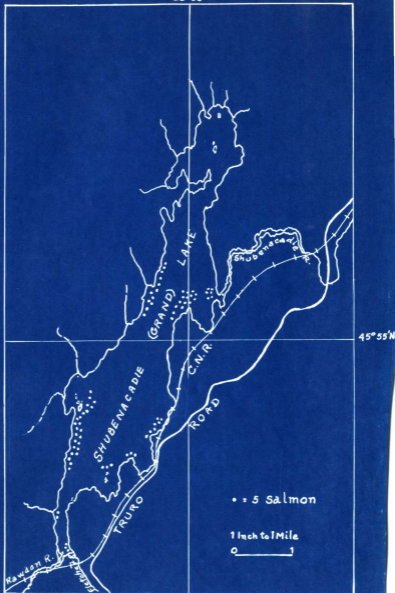


Table No. 4. The numbers of salmon caught by angling in the four main regions of Shubenacadie lake from April to August, 1950.

Region	Month of angling					Total number of salmon caught
	April	May	June	July	August	
Head of the lake	11	16	4	2	0	33
Grand lake East shore	20	24	19	5	0	68
West shore	15	28	67	10	1	121
Mouth of the lake	44	112	12	2	0	170
Little lake	<u>0</u>	<u>4</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>4</u>
	90	184	102	19	1	396

Table No. 5. The numbers of tagged salmon of various lengths in the catch made by angling in Shubenacadie lake in 1950.

Length inches	Pond fish			Lake fish			Sea fish		
	Number tagged	Number caught	% caught	Number tagged	Number caught	% caught	Number tagged	Number caught	% caught
7-10	496	25	5						
11-14	163	29	11	10	2	20			
15-19	85	11	13	24	4	16			
20-25		8	4	58	4	50	24	8	33
29-35							15	4	27
?	<u>1</u>								
	745	65		42	10		39	12	

Table No. 6. The numbers of salmon of various lengths in a group of 88 "wild" salmon considered to be reliably measured and taken by angling from Shubenacadie lake in 1950.

Length inches	Number caught	Percentage caught
7-10	2	2
11-14	9	10
15-19	64	73
20-25	<u>13</u>	15
	88	

Condition of the salmon

The condition of a fish may be indicated by applying the well-known formula  $\frac{100 \text{ times } W}{L^3}$  where W is the weight of the fish in ounces and L the length of the body in inches. The values have been worked out for the tagged fish based upon the length at the time of tagging and the weight reported when they were caught. In the case of the small fish, many of the weights could not be used as they were obviously too high. Verified and carefully checked data only are used for the "wild" fish. A summary of the monthly averages for each group is given in table No. 7. The details upon which these averages are based are shown for convenience in tables No. 8 to No. 12, in which the time of capture, age and size are also given.

Table No. 7. Average monthly condition of salmon in the catch from Shubenacadie lake in 1950.

<u>Month</u>	<u>Pond fish</u>	<u>Trapped lake fish</u>	<u>Sea fish</u>	<u>"Wild" lake fish</u>
April	.24	.42	.33	.43
May	.36	.44	.29	.55
June	?	?	?	.53
Sept.	.61 (from retaining pond)			

On the whole the fish in the spring catch were lean as compared with fish held in the rearing ponds all summer and with those released from the ponds after tagging. The pond fish were thinner than any of the others in April, but fattened up when they began to feed in the lake. The trapped lake fish and the "wild" fish were in similar condition in April but the latter showed greater improvement in May and maintained good condition in June. The sea fish alone lost ground in May.

The fatter fish were brighter in external colouring than the thin fish, more difficult to land and deeper pink when opened. The trapped lake and sea fish, although thin, were big fish and there was considerable sport in catching them. A single angler reported returning a tagged sea fish 20.5 inches long to the lake as being too thin to keep.

#### Food and bait

During the season 56 stomachs of salmon taken by anglers were examined of which 13 were empty and the rest contained the remains of partly digested fish and insects. Smelts were the

most frequent remains. One salmon caught on April-22 contained 10 partly digested smelts 8-10 cm. long. Sticklebacks and a doubtful perch were the only other fish remains identified. During the last week of May many fish contained black flying ants. In fact some of the stomachs were crammed with them. Small eels were found in the stomachs of two salmon in early June when elvers were migrating.

With few exceptions, anglers used live minnows for bait both for still fishing and trolling. Artificial lures were employed and some fly-fishing was done.

Age and current growth as shown by the scales

The age of a salmon is determined from the scales by counting the numbers of checks upon growth associated with winter. This seems to be a simple basis upon which to reckon age. Other factors, however, come into the picture. Circuli of pond fish tend to become narrower in the summer months and on some scales there seems to be a harrowing of the circuli associated with spawning which may be followed later by the winter check. These irregularities make the task of the scale-reader difficult.

Fish reared in the ponds at Wellington have scales which present little difficulty to the smolt stage after the second winter check but samples of scales taken from older fish that have been tagged and recaptured may yield few that are fit to read. For example, out of 1,642 scales making up the samples received from five recaptured pond fish 4 years old it was found that 4% showed no regeneration, 17% were regenerated in the first

year, 12% in the second year, 36% in the third year and 31% in the fourth year.

Scales from lake fish were thicker than those of the pond fish and showed little regeneration, but were less thick and tough than the scales of the sea fish. Scales of pond fish and lake fish lengthened at a more uniform rate than those of sea fish, the latter showing most rapid growth after the smolt stage.

Scales have been studied from all the samples received from the anglers in 1950 and the age, indications of spawning and the number of circuli of growth in the current year have been recorded.

A series of tables follows in which age and condition of the captured fish are indicated. A representative group, only, of the 65 pond fish of which the ages were known at tagging is given for the sake of indicating the change in their condition as the season advanced. Data for all the other fish for which scales were available are tabulated (Tables 8-12).

#### Ages of the salmon

Four-year-olds formed the greater part of the catch. They represented 83% of the pond fish (see table No. 1), 63% of the trapped lake fish, 91% of the sea fish and 85% of the "wild" fish.

#### Growth in the current year

#### Tagged fish

The first indications of growth in the current year ap-

peared on the scale of a 4-year-old pond fish taken on May 20 and on one from a trapped lake fish captured the same day. In June, 80% of the 4-year-old pond fish scales showed new circuli but there was no other sign of new circuli being formed on the scales of the trapped lake fish and none at all in any month on the scales of the sea fish.

#### "Wild" fish

As early as April 23, the scales of naturally produced fish were showing circuli of growth in the current year. By the end of May 62% had growing scales, the number of circuli varying from 1 to 3. In June 80% were adding circuli, the maximum number by that time being 4. Single fish taken in July and August each had 6 new circuli on the margin of the scales, and a 2-year-old fish had 8 new circuli.

#### Smolts

The scales of the smolts which descended through the trap on the Rawdon river in May and June were examined and it was found that the "wild" smolt had produced a greater number of circuli in 1950 than the marked smolt of similar length which had been planted in the autumn of 1949 as yearling parr.

#### Spawning marks on the scales of the captured salmon

Erosion on the margins of the scales associated with spawning in salmon was indistinct and difficult to identify on the scales of recaptured pond fish of all ages. The lake fish and sea fish with few exceptions showed erosion along the margin at the end of the third and each succeeding year.

Table No. 8. Condition and age of representative pond fish recaptured in 1950.

Number of tag	Date of capture 1950		Length inches	Weight ounces	Condition	Age years
					$\frac{100 \times W}{L^3}$	
9204	Apr.	14	11 $\frac{1}{2}$	3 $\frac{1}{2}$	.24	4
F424	"	22	17	16	.31	5
9661	"	29	10 $\frac{1}{2}$	3	.27	4
9681	"	30	"	2 $\frac{1}{2}$	.21	4
F345	"	30	17	12	.23	6
9423	"	30	9 $\frac{3}{4}$	2	<u>.22</u>	4
					Av. .24	
9255	May	1	10	2 $\frac{1}{2}$	.25	4
9066	"	4	10	4	.40	4
9245	"	4	11 $\frac{3}{4}$	8	.50	4
F365	"	5	16	16	.38	6
9512	"	7	11 $\frac{1}{2}$	4	.26	4
F453	"	12	15	14	.41	5
F488	"	24	15	10	.36	4
F415	"	24	16	15 $\frac{1}{2}$	<u>.37</u>	5
					Av. .36	

Table No. 10. Condition and age of the sea fish recaptured in 1950.

Number of tag	Date of recapture	Length inches	Weight ounces	Condition	Age years
				$\frac{100xW}{L^3}$	
9006	Apr. 16	24	?	?	4
9004	" 22	22	36	.34	4
9005	" 23	23 $\frac{1}{2}$	?	?	4
9039	" 23	20	28	.35	4
9011	" 25	31 $\frac{1}{2}$	96	.30	4
9024	" 26	22	38	.36	4
9035	" 30	20	23	<u>.28</u>	4
				Av. .34	
9006	May 3	23 $\frac{1}{2}$	37	.29	4
9035	" 3	31 $\frac{1}{2}$	111	.35	5
9019	" 12	23 $\frac{1}{2}$	?	?	?
9029	" 17	22 $\frac{1}{2}$	28	.26	4
9025	" 26	30 $\frac{1}{2}$	80	<u>.28</u>	4
				Av. .29	
9026	June 2	33 $\frac{1}{2}$	72?	?	4

Table No. 11. Condition and age of the marked salmon recaptured in 1950.

Mark	Date of capture	Length inches	Weight ounces	Condition	Age years
				$\frac{100xW}{L^3}$	
R. ventral and adipose	Apr. 23	20	28	.35	4
"	" 26	18 $\frac{1}{2}$	28	.44	4
				Av. .39	
L. ventral	May 17	14	20?	?	?
R. ventral	" 28	12 $\frac{1}{2}$	9 $\frac{1}{2}$	.47	3
R. "	June 3	12	12?	?	3
R. "	" 4	13	16?	?	3
L. "	July 2	10 $\frac{1}{2}$	?		2

Table No. 12. Condition and age of naturally produced salmon caught in Shubenacadie lake in 1950.

Date of capture	Length inches	Weight ounces	Condition	Age years	Circuli in 1950
			$\frac{100xW}{L^3}$		
Apr. 22	16.5	20	.44	4	0
" 23	14.5	12	.39	4	0
" 23	18	28	.46	4	1
" 23	15.5	12	.31	4	1

Table No. 12 continued

Date of capture	Length inches	Weight ounces	Condition $\frac{100 \times W}{L^3}$	Age years	Circuli in 1950
Apr. 23	17	16	.33	4	0
" 23	20	36	.45	4	3
" 26	22	58	.54 (fat)	5	4
" 27	20	40?		4	0
" 28	24	56	.40	5	0
" 28	19.5	34	.45	4	0
" 29	17	28	.57	4	1
" 30	21	39	<u>.42</u>	5	0
			Av. .43		
May 2	20.5	48?		4	1
" 4	19.5	40	.53	4	0
" 4	19	28	.40	4	0
" 4	16.5	28	.62	4	1
" 4	17	32	.65	4	2
" 6	15.5	24	.64	4	2
" 6	17.5	?		4	1
" 6	18	?		4	1
" 6	13	?		3	2
" 6	18	?		4	4
" 6	15	?		4	3
" 6	15.5	?		4	0
" 7	19	?		4	0

Table No. 12 continued

Date of capture	Length inches	Weight ounces	Condition $\frac{100 \times W}{L^3}$	Age years	Circuli in 1950
May 7	17	?		4	0
" 7	16.5	?		4	1
" 7	15.5	19	.51	4	1
" 7	17	24?		4	0
" 7	17.5	31	.57	4	1
" 8	15.5	32?		4	1
" 11	19	48?		4	0
" 11	20?	60?		5	0
" 20	16.5	36?		4	1
" 20	18	36	.61	4	0
" 20	15	22	.65	4	1
" 21	19	36	.52	4	3
" 21	15	19	.56	4	3
" 21	16.5	28	.62	4	3
" 22	20?	48?		5	0
" 24	17	21	.52	4	1
" 24	18	26	.44	?	
" 24	21.5	58	.58	5	0
" 24	15?	24?		4	0
" 26	16	24?		4	0
" 28	17.5	24	.44	4	3
" 28	?	?		4	2

Table No. 12 continued

Date of capture	Length inches	Weight ounces	Condition $\frac{100 \times W}{L^3}$	Age years	Circuli in 1950
May 28	?	?		4	2
" 30	17	?	—	4	0
			Av. .55		
June 1	?	24		4	3
" 1	?	?		5	0
" 3	16	20	.48	4	2
" 13	17	28	.56	4	0
" 3	17	24	.48	4	3
" 4	13?	16?		4	4
" 4	15	16?		4	3
" 4	18	28?		4	2
" 4	17.5	24		4	1
" 4	15	12?		4	4
" 11	15	21	<u>.62</u>	4	3
			Av. .53		
July 1	15	?		4	3
" 2	8	4-6?		2	8
" 7	19	36	.52	4	6
Aug. 13	16	?		4	6

Summary

Age years	April	May	June	July	Aug.	Percentage of catch
2				1		7
3		1				7
4	9	32	10	2	1	85
5	3	3	1			11
no scales		1				
	12	37	11	3	1	

2. Smelt fishing in Shubenacadie lake in 1950

Winter catch

Angling for smelts takes place through the ice of Shubenacadie lake as soon as it is safe for the anglers in the autumn. It is at its height usually in January and February. A piece of smelt or pork rind is the best bait. The angling is concentrated near the mouths of the brooks and rivers. Mr. N. Fogarty estimated that 2,000 smelts were caught by a group of anglers who reside near Wellington in their operations near the mouth of Rocky brook. An average fish was 8 in. to 9 in. long and an occasional one 13 in. or even 15 in. The group residing at Grand Lake Station according to Mr. H. L. Palmer and Mr. J. Morash, fish at the mouth of Macdonald and Oakfield brooks and got 350. Mr. Stewart of Col. Laurie's staff caught about 3 dozen

smelts at the mouth of Oakfield brook. Anglers were reported to have come from as far as Lantz and Dartmouth to fish near Grand Lake Station but the extent of their catch is not known. Mr. Wm. Peake reported taking 50 in the Little Lake region. He said that the fish were in spawning condition and estimated the smallest-to-long be approximately 7 inches/and reported three fish 12 $\frac{1}{2}$  inches in length.

In 1949, 1,000 smelt were reported from the winter fishing in the lake, as compared with 2,400 in 1950.

#### Spring catch

Dipping smelts during the spawning season takes place annually in the large Rawdon river near its mouth as soon as the ice goes out and often with snow still on the ground. Entrance to the banks of the river is over private property along a gravel road in poor condition in the spring. Although dipping smelts is legal for residents of the neighbourhood for their own use, outsiders are known to come from Halifax and Dartmouth and are not welcome. Since operations are carried out by flashlight when the "run" takes place, data of the size of the catch is difficult to get.

In 1950, some dipping was done in the Fletcher river below the dam at Wellington. According to Mr. Brimicombe of the staff at the rearing ponds, no dipping of smelts had been done in the Fletcher river for many years previously.

The consensus of opinion was that the catch was very poor, the duration of the run short and conditions for netting

difficult because of the high water produced by the melting of an unusually large quantity of snow which fell during the first week of April. The following details of the fishing were gleaned from reports made by local residents:

- (a) March 30 - First catch made in Fletcher river,
- (b) April 1 - First catch dipped in the Rawdon river,
- (c) April 14 - Last catch reported from Rawdon by Miss Lillian King, who got 10 smelts and donated 4 of them for preservation in the laboratory. They were ready to spawn and varied in length from 8 in. to 10.5 in. The donor apologized for the small fish, declaring that some taken in the early part of the "run" were 14 inches long.
- (d) April 30 - A single smelt with spawn was taken in the newly-operating smolt trap on the Rawdon river,
- (e) May 5 - Two dead adult smelts seen by the son of J. Morash floating at the mouth of Macdonald's brook.

#### Water temperature

From the records for water entering the rearing ponds at Wellington, it was found that the temperature of the Fletcher river had risen to 35°F. before the first catch took place and registered 36° the following day. The temperature then hovered near the freezing point both day and night for a week during the snowstorm and subsequent melting of the snow and did

not rise again to the late March level until the "run" was waning.

3. Eel fishing in Shubenacadie lake  
and in the Rawdon and Fletcher  
rivers

On April 26, 1950, Mr. R. Feener launched near the rearing ponds at Wellington a rowboat containing 3 or 4 wooden traps similar in construction to lobster traps, in which he hoped to catch eels. He placed them in the lower part of the Fletcher river and visited them daily. He moved them about from the river mouth to various places in the lake within easy rowing distance of the landing and also varied the type of trap and bait trying to find the best method to adopt for lucrative fishing.

On June 20, he took up all the traps, declaring that approximately fifty eels formed the whole catch while the traps were in operation. His findings were:

1. Gaspereau bait was better than sea fish or offal,
2. wire-mesh traps were better than wooden slats,
3. eels were more abundant where the run-off from the long ponds occurred than elsewhere,
4. Halifax market for eels was weak as soon as mackerel were available,
5. price - wholesale - when skinned 22 cents per lb.  
Retail 35 cents.

When eels began to appear in number in the Rawdon or near the Rawdon smolt trap Miss Lillian King began experiment-

ing with a wire-mesh barrel-shaped eel trap. She was very successful and since the market was weak, kept them in a submerged trap until the autumn when prices would be better.

A beginning has been made in investigating the possibilities of catching and marketing eels which are abundant predators on other fish in the lake.

Speckled trout captured in Shubenacadie lake  
and its tributary streams in 1950

Date of capture	Number of fish	Length inches	Weight ounces	Location	Angler
April 25	4	?	?	Tannery Br.	M. Blandford
" 28	✓ 1	15	24	Fletcher R.	S. Roberts
May 4	- 1 (fat)	8	4	" "	R. Burbridge
" 4	3	?	?	Col. Laurie's brook	Brimicombe
" 7	2	?	2.5 3	Large Rawdon below Island	Campbell and Matthews
" 14	1	14.5	48	Narrows bet. Little and Grand lakes	Wm. Peake
" 14	1	11	12	Little lake	G. Horne
July 3	1 1	6 6.5	?	Rocky br.	D. Carnell

✓ minnow for bait

- minnow for bait and stomach was empty - fat fish

4. Angling for striped bass in Shubenacadie lake in 1950

Collection of data

Information about angling for striped bass is collected along with that for salmon angling. The data in this account were collected chiefly from the region about the head of the lake where the laboratory is situated and since bass were being caught there from May 12 until September 15 when the laboratory was closed, it was possible to make measurements, collect samples of scales and examine the stomachs of many fish. As much information as possible was collected also from the bass netted by Mr. Andrew King at the mouth of the lake.

The catch

Table No. 1 shows the number of striped bass reported caught each month from the three main regions of angling. The total number of bass reported from each of the same regions in 1949 is inserted below. It is apparent that less than half as many bass were caught in 1950 as in 1949, the chief decrease being in the catch from Little lake, at the north end. I believe that this was due partly to lack of effort on the part of the campers there. I first visited them on Sunday afternoon, May 14, and found that bass fishing was already in progress and saw five fine large fish that had been caught that day. On my second visit, June 18, no boats were out as the lake was very rough and few fish were reported for the interval between my visits. During the summer no more fish were re-

ported and when I made my last visit on September 4, before the camps were closed, the answer was still in the negative.

Table No. 1. The number of striped bass captured by angling in Shubenacadie lake in 1950.

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Month	Head of lake (Wellington)	Grand lake and region about the mouth	Little lake (north end)
May	60		
June	116	47	119
July	29	1	0
August	17	3	0
September 1 to September 15	26	0	0
Total	248	51	119
1949	475	119	408

---

Condition of the bass

Two bass netted by Mr. Andrew King on May 31 were fat fish and their condition factors calculated according to the formula  $\frac{100 \times W}{L^3}$  were .57 and .59 respectively. An angler reported a fat bass on May 20 and another was so described by an angler on September 4. In table No. 2, the condition factors are shown for fish which are considered to have been reliably reported and the average condition for 15 bass was .54, a factor similar to that found for the naturally produced salmon

caught in the lake in May (.55) and in June (.53). The fattest fish for which verified measurements were available was caught off Indian Point on August 22 and had a condition factor of .61 equal to that of a 4-year-old salmon from the Wellington rearing ponds.

#### Sizes and movement

The smallest bassm 9.5 inches long and weighing 4 ounces, caught by angling, was one of a group taken from the Fletcher river below the dam when the upstream migration of gaspereaux was taking place; the largest, reported weighing 16 pounds was caught along the east shore of the lake below Adam's island on July 22, about the time that the underyearling gaspereaux were beginning to move downstream. Eighty percent of the 53 bass of all sizes listed in table No. 2 were caught near the mouths of the Fletcher and the Rawdon rivers when heavy rainfall had raised the water level or when the gaspereaux were migrating. These facts would lead to the conclusion that the fish were moving along the shore toward the shallow upper end of the lake and relatively near the surface. Anglers with camps near the shore reported observing schools of bass moving inshore near the surface.

#### Bait and food

Few anglers in the neighbourhood of Shubenacadie lake seem to prize the striped bass highly as a food fish. It is usually caught when angling for salmon with live bait or artificial minnows. However, young migrating gaspereaux are good bait when available. One angler used pieces of trout and occasionally a worm is used.

Thirty-two stomachs were examined of which thirteen were empty. Three contained partly digested elvers and the rest small fishes in various stages of digestion. After the underyearling gasperesaux began to migrate they were the chief food. Anglers reported three bass in June to contain partly digested small smelts, but this was not verified. On September 15, two bass weighing four pounds and five pounds respectively each contained a small sucker (4 in. to 5 in.) identified by the ventral mouth. The striped bass is believed by many anglers to prey upon the salmon. No evidence to substantiate this theory has been advanced to date.

#### The ages of the bass

Table No. 2 shows the ages of 53 striped bass from which scales were received from the anglers. The fish have been listed in order of body length for the same age rather than in order of capture to emphasize the variation in length with age. It is apparent that a variation of approximately 4 inches in length was common to all age groups. In weight the older fish (6-9 years) averaged nearly one pound per year. The two age groups, 4-year-olds and 6-year-olds comprised 62% of the whole catch.

#### Sexual maturity

In table No. 3, the information obtained from the examination of the gonads of 17 females and 7 males is given. None of the bass was sexually mature. No relationship could be found between the time of capture and the development of the eggs, those measured in May being as large as some measured in September. The largest pair of gonads weighed 2 lb.

Table No. 2. Relation between the length, weight and age as determined by study of the scales in striped bass (Roccus lineatus).

Date of capture 1950	Length (inches)	Weight (lbs. - oz.)		Condition $\frac{100 \times W}{L^3}$	Age (years)
June 2	9.5	4			2
Aug. 15	13	1?			2
June 3	14	1	0	.58	3
" 5	14	1	0	.58	3
" 11	14	1	8?		3
Aug. 26	14	?			3
Sept. 2	14?	2?	2?		3
" 5	15	1	2	.53	3
May 29	?	1			3
" 12	16	1	8	.58	3
June 2	16	?			3
May 12	17	1	12	.57	3
May 29	?	1	8		4
June 1	?	1	4		4
Aug. 15	15?	3?			4
Sept. 2	14?	2?			4
" 3	15 $\frac{1}{2}$	1	4	.54	4
" 3	?	1	8		4
" 3	?	2?			4
" 4	16	1	8	.57	4

Table No. 2 continued

Date of capture 1950	Length (inches)	Weight (lbs. ozs.)		Condition $\frac{100xW}{L^3}$	Age (years)
Sept. 5	16 $\frac{1}{2}$	1	8	.49	4
June 2	17	?			4
Sept. 6	17	2?			4
" 15	17	?			4
June 2	18	?			4
" 2	18	?			4
Sept. 2	18	3?			4
May 30	?	?			5
Sept. 3	?	3?			5
" 3	?	3	8		5
" 3	17	1	12	.57	5
" 3	19	2	4	.52	5
" 4	19	2	4	.52	5
July 28	21	?			6
May 27	22?	4	8		6
" 29	?	3	10		6
Aug. 15	22	5?			6
June 2	23	?			6
Aug. 16	23	4	8	.59	6
Sept. 3	23	3	6	.44	6
Sept. 15	23	4	?		6
Aug. 8	24	7	12		6

Table No. 2 continued

Date of capture 1950	Length (inches)	Weight (lb. oz.)	Condition $\frac{100xW}{L^3}$	Age (years)
Sept. 1	24	6 8		6
" 2	24	5?		6
" 3	24	5?		6
" 3	24	6?		6
" 3	24	5?		6
" 15	24	5		6
" 15	24	5 ?		7
Aug. 22	25	6	.61	7
Sept. 3	26	7?		7
" 2	28	8?		7
Aug. 16	29	8 6	.55	9

Av. .54

Table No. 3. The length, age, sex and size of the gonads and eggs of striped bass caught in Shubenacadie lake in 1950.

Date of capture 1950	Body length (inches)	Age (years)	Sex	Length of gonad in centimetres	Diameter of egg in millimetres
June 11	14	3	F.	4	-
Sept. 4	16	4	F.	small	.2
" 3	17	4	M.	8	-
" 4	18.5	5	M.	6	-
" 3	19	5	F.	7	.4
May 14	19.5	?	M.	12	-
June 7	22	6	F.	11	.2
May 14	23	?-	F.	7	.8
June 2	23	6	M	7	-
" 14	23	6	M.	5	-
Aug. 16	23	6	F.	12	.4
Sept. 4	23	6	F.	7	-
" 4	23	6	F.	9	-
Aug. 7	24	6	M.	-	-
Sept. 2	24	5	F.	10	.4
" 3	24	6	F.	9	.6
" 4	24	6	F.	9	-
" 4	24	6	F.	10	-
May 31	25	6	F.	10	.6
" 31	25	6	M.	9	-

Table No. 3 continued

Date of capture 1950	Body length (inches)	Age (years)	Sex	Length of gonad in centimetres	Diameter of egg in millimetres
Aug. 22	25	7	F.	9	.4
Sept. 2	28	8	F.	14	.3-.8
June 8	29	9	F.	22.5	1.6
" 8	34	10-12	F.	12.5	.2

Netting

Netting of large striped bass by Mr. Andrew King with permission of the responsible authorities was begun on May 31, 1950. Two nets were set each having 6-inch mesh. One 125 feet long was placed on the north side of the mouth of Shubenacadie lake and the other 80 feet long on the south side of the mouth, both being easily accessible from Mr. King's landing and so well marked that they did not interfere with the traffic between the lake and the river. Both nets were in operation from May 31 to June 15 and from June 18 to June 29 and visited daily. During July and August Mr. King did not think the experiment worth the effort in view of the fact that only three fish were taken during those months in 1949. He set the nets again on September 3 and 4 and made no catch.

In all 15 striped bass were captured, nine in the longer nets on the north side and six on the south side of the mouth of the lake, as compared with one on the north and two on the south side in 1949. The bass varied in length from 23 inches to 34

inches, 11 being less than 30 inches long. The largest weighed 17 lbs. and the smallest 5 lbs. 10 oz. All except three had empty stomachs and those had recently eaten adult gaspereaux, which at that time were on their spawning migration. Five were males, 5 females and 5 immature.

The combined experiments have now covered the three summer months and show that more bass are moving near the mouth of the lake early in the summer than in the late summer and that few large fish are feeding in that region. It remains to be seen whether there is a greater number there when the water begins to warm up, since the anglers in Little lake made catches as early as May 14 and whether there is an autumn migration.

#### 5. Gaspereau migration and fishing in 1950

##### Ascent for spawning

It was reported at Wellington that gaspereaux were ascending the Shubenacadie river at Enfield during the week-end of April 23 and the local fishermen began to repair their dip nets and secure a supply of barrels and salt. The fishery officer for Hants Co., Mr. W. A. Fullerton, reported that the first catch large enough to signify a "run" was made on April 25.

From the beginning of May until the middle of June local residents visited the east bank of the Fletcher river below the dam almost daily in search of gaspereaux. Although a few fish could be obtained on most days after the first of May, many

went away empty handed. I made enquiries and some calculations of the quantity that seemed to be in the bags and baskets, but could not make a fair estimate of the size of the catch. There were three periods of greatest abundance, May 2 to May 5, May 19 to May 27 and June 9 to June 12. A few underspawed fish were <sup>ascending</sup> observed/through the trap at the top of the fishway as late as July 3.

A single gaspereau appearing in the trap on the large Rawdon river on April 29 heralded the first "run" in that river. Miss Lillian King began dipping from the large Rawdon on May 3 and in the next two days filled two barrels. Fish were too few for the effort involved until the big "run", which commenced on the evening of May 24 and lasted for three days. The following evening (May 25) the fish entered the small Rawdon in great numbers and were plentiful for about 24 hours.

#### The catch

The half-dozen fishermen who salted the fish they got from the Fletcher river sold approximately 4 tons to the local merchant in Enfield. Miss King sold a little over 23 tons (154 bbls. of 300 lb.) and the staff at the rearing ponds put 2 tons in the freezer as food. The gross catch, therefore, exclusive of what was used fresh, was just under 30 tons. In 1949, the local catch from the two rivers was estimated as 40 tons and the returns in 1950 are in accord with the local report that the "run" was a poor one.

## Physical Conditions

### a. Height of water in the rivers

The spawning migration in the Shubenacadie river as far as Enfield began with a rapid rise in the water level resulting from the run-off after the heavy snowfall of late April. At Wellington where a record is kept of the level of the water in the lock between the Fletcher river and Shubenacadie lake, the maximum for the season, 5.8 ft., was reached on April 24 and April 25. In 10 days the level had fallen to 5 ft. and continued decreasing gradually to 2.8 ft. by the end of June. In fact, the water was so shallow over the rocky beds of both rivers that there were few channels deep enough for the fish between the remaining pools. This low condition of the water was believed to be the chief cause for the poor catch of gaspereaux in 1950.

### b. Water temperature

Periods of abundance of gaspereaux occurred when there was a rapid rise in water temperature associated with a series of sunny days. During the first "run" the minimum temperature remained between 48°F. and 50°F. for the first time during the spring. Between May 21 and May 27 when the greatest number of gaspereaux were in both rivers and maximum and minimum temperatures both increased 10 degrees, and again during the final run, approximately 6 degrees in a period of four days.

### c. Hours of sunshine

Since fishermen interviewed regarding the gaspereau

catch of 1949 seemed to stress a correlation between sunshine and abundance of fish it seemed advisable to investigate this factor. A sunshine recorder was borrowed from the Meteorological Service and put in operation at Wellington between April 19 and September 14, daily records being kept. A comparison between the level of the water in the lake at the entrance to the Fletcher lock, the temperature of the water and the daily sunshine is shown graphically in Figure No. 1.

It is evident that both sunny and cloudy days occurred during the opening "run". The period of maximum abundance in late May took place after a sunny spell of 11 days (May 21 to May 31) had begun, but was over before the next cloudy day (June 1). No definite correlation between the numbers of fish dipped daily from the river and the hours of sunshine could be found. Early in the season there was evidence of heavy evening fishing after a sunny day but less after cloudy weather. Observations of the size of the catches made by the fishermen along the east bank of the Fletcher and conversation with Miss King based on her experience on the Rawdon river led to the conclusion that sunshine causing a rapid rise in the water temperature, rather than the number of hours of sunshine per day might be the limiting factor in causing the fish to ascend. When the water had warmed up to a minimum of 60.F. neither sunny or cloudy days affected the abundance. For example, the best catch of the last run in June was made from the Fletcher river early on the morning of June 12. June 10 was a bright day with a moderate catch; June 11 a rainy day

when few fish were dipped and those in the river had a chance to gather in the pools from which the big catch was made the following morning.

d. The obstacle of the fishway

Since there was local criticism of the effectiveness of the fishway, at the suggestion of Mr. W. M. Chisholm, some counts were made to determine the numbers of gaspereaux able to ascend to the river above the dam. On May 26, when the "run" was at its height, and a great many "dippers" operating below the fishway, the rate of ascent between 11 a. m. and 11.30 a. m. was approximately 100 per hour. By 2.30 p. m. the rate had decreased to 80 per hour and by 6 p. m. to 72 per hour. On the following day when few fishermen were dipping and disturbing the pools below the dam, the fish were ascending at a rate of 500 per hour. Thereafter the number of fish in the river rapidly decreased and no further counting was done.

The fishway was also used by the spent gaspereaux in their descent.

Descent after spawning

The first gaspereaux observed descending the Fletcher river collected in front of the screens at the intake to the rearing ponds on June 5. Four days later they were abundant above the dam and at the mouth of the fishway. On June 11, the intake was described as "plugged" with descending fish and those examined were thin and spent. At the same time, fish already having spawned were appearing daily in the trap

for descending fish on the large Rawdon river. The first marked descent occurred during heavy rain. Gaspereaux continued descending both rivers throughout the summer, but no further correlation with freshets was observed.

Size, sex and condition of the gonads

Migrating gaspereaux found/<sup>dead</sup>in the smolt trap operated by Mr. Chisholm on the Rawdon river were collected, measured and examined for sexual development. The results, including the date of capture are shown in table No. 1. Sixty-four females and 35 males were examined and the numbers of each sex arranged in order of body length exhibited the usual curve of growth for the fish of the same age. The females were longer than the males, varying from 27 cm. to 37 cm., while the males ranged from 26 cm. to 30 cm. The greatest number of females measured 30 cm. and the greatest number of males 29 cm. During the first two weeks of the migration, the sexes were approximately equal in number; between May 16 and June 1, the females slightly outnumbered the males (21:18), and during June there were more than 3 times as many females (32:9). Whether this relationship was maintained for the fish allowed through the open trap or for those that passed through the fishway is not known.

It is apparent from a study of the table that the gaspereaux which ascended the Rawdon during the first small "run" early in May should be able to reach the lakes and streams above the Rawdon before being fully mature. Those that com-

prised the main or middle run were quite mature and some were already spawning in the river near the trap. The four females examined on June 10 and June 12 during the third period of abundance were in fine condition, quite comperable to many appearing a month earlier. As late as July 3, two females which had not yet spawned were taken in the trap at the top of the fishway on the Fletcher river. Spent gasperesaux were examined as early as June 5, and were descending both rivers throughout the summer.

Table No. 1. Numbers and sizes of gasperesaux trapped in the Rawdon river with a report on their sexual development.

Date	Number	Size (cm.)	Sex	Condition of gonads
1950				
April 29	1	2	F.	Nearly full
May 9	1	29	F.	" "
	1	28	M.	" "
	1	29	M.	" "
	1	30	M.	" "
May 10	1	30	F.	" "
	2	31	F.	" "
	2	29	M.	" "
May 12	1	30	F.	" "
	2	31	F.	Full
May 13	2	29	M.	Nearly full

Table No. 1 continued

Date	Number	Size (cm.)	Sex	Condition of gonad
May 16	1	28	M.	Nearly full
" 17	1	28	M.	" "
	1	29	M.	" "
" 20	1	28	F.	Full
	2	29	M.	"
	1	30	M.	"
" 23	1	29	M.	"
" 25	1	26	M.	Height of run
	3	27	M.	
	2	28	M.	Males full to ripe (except 26 cm.)
	2	29	M.	
	2	29	F.	
	3	30	M.	Females up to 32 cm. full to ripe; 34 cm. and 35 cm. partly spent
	4	30	F.	
	1	31	F.	
	2	32	F.	
	2	34	F.	
	2	35	F.	
X " 26	1	33	F.	All ripe to partly spent
	2	34	F.	
	3	36	F.	
	1	37	F.	
" 30	1	32	F.	Partly spent
June 5	1	29	M.	" "

Table No. 1 continued

Date	Number	Size (cm.)	Sex	Condition of gonad
June 9	4	27	F.	Partly spent
	6	28	F.	" "
	5	29	F.	" "
	2	30	F.	" "
	1	32	F.	" "
	1	28	M.	Spent
	1	29	M.	"
" 10	1	29	F.	"
	2	30	F.	"
	1	31	F.	Full
	1	32	F.	"
" 12	1	27	M.	Spent
	1	28	M.	"
	1	29	F.	Full
	1	31	F.	"
" 30	2	28	M.	Far spent (gonad almost empty)
" 30	1	29	F.	" "
" 30	2	30	F.	" "
" 30	2	28	M.	Nearly full. All were taken in the "up" trap
" 30	3	30	F.	Nearly full and a few fish were seen in the river below the trap. They were gaspereaux with the saw belly. They had the same appearance as fish taken early in May

Table No. 1 continued

Date	Number	Size (cm.)	Sex	Condition of gonad
Aug. 11	4	27	?	Preserved unopened; very thin and spent in appearance
	3	29	?	
" 22	1	28	M.	Gonads empty
	1	29	F.	" "

Table No. 2. Numbers of gaspereaux of various lengths occurring in samples dipped from the Fletcher river and the Rawdon river during downstream migration in 1950.

Length (cm.)	Fletcher river					Rawdon river		
	Date	2/8	22/8	31/8		14/9	2/8	22/8
3.0	--	5						
3.5		26						
4.0		47						
4.5		50						
5.0		<u>53</u>					1	
5.5		50						
6.0		19				5		
6.5			6			12		2
7.0			31	2		<u>15</u>	1	4
7.5			63	14	1	3	3	27
8.0			<u>69</u>	<u>70</u>	11	5	2	94
8.5			13	35	13		3	<u>130</u>
9.0			20	21	<u>57</u>		3	60
9.5			3	0	14		3	9
10.0			1	3	8		<u>10</u>	8
10.5							2	18
11.0								21
11.5	—	—	—	—	—	—	—	<u>2</u>
Total	250	206	145	104		40	28	375

- Half-inch screen may have stopped the largest

Descent of underyearling gaspereaux

It was observed in 1949, that the time of the descent of young gaspereaux seemed to be associated with sunshine following a day or night of heavy rain, and that the late descent in the Rawdon river occurred with the first summer freshet. In the summer of 1950, rain of sufficient volume to cause an appreciable rise in the level of the lake occurred on July 25, Aug. 1, Aug. 21, Sept. 1 and Sept. 12 and 13, that of Aug. 21 being the heaviest and accompanied by winds of hurricane proportions. On the sunny day following each of these rains, young gaspereaux were observed to be descending. In contrast to this, cool cloudy weather following similar rainfall on Aug. 5 and Aug. 29 was not the time of noticeable migration.

Samples of the migrants from the Fletcher river were dipped from the salmon rearing ponds when they were small enough to get through the half-inch mesh and later from the well at the intake. The fish were measured and a few of the stomachs were examined. Samples from the Rawdon river, if the fish were entering the trap, were obtained on the same day and similarly examined. Table No. 2 shows the dates of the runs, the numbers of fish measured and the range of sizes. It is apparent that the fish descending the Rawdon river were a little larger than those from the Fletcher and that the greatest number of fish in each of the large samples varied by only 1 cm. (8-9) between Aug. 22 and September 14, which was probably due to the variation in the sexual maturity of the spawners shown in table No. 1. The

difference in size between the fish migrating in the two rivers was less than in 1949 when a limitation was placed upon the number of spawners (Fletcher 1949, 3-6 cm.; Rawdon 1949, 7.5-11 cm.).

With the exception of a few fish that had been in the rearing ponds for several days, the stomachs were empty and the caeca varied from being empty to being crammed with a brownish-coloured residue resembling the hard parts of plankton. Study of plankton samples collected regularly from <sup>the</sup> Fletcher river after May 14 and from the Rawdon on July 28 (see accompanying paper) showed the supply of food to be at a minimum when the descent began.

6. Surveys of the depth and plankton  
in Shubenacadie lake in 1950

Surveys of the depth and the plankton of Shubenacadie lake in the region between its mouth and Mt. Rascal on the opposite shore were made on May 12, July 24 and September 6, 1950. In addition, on May 12, a survey was made of the temperature, depth and plankton of the middle parts of Sandy cove and of Little lake, two rather shallow regions about 2 1/2 miles apart, one on each side of the mouth of the lake. In table No. 1, the time of day at which the work was done, the numbers assigned to the stations, their location with reference to points along the shore and the temperatures of the water are shown in figure No. 1, the approximate positions of the stations in the first and last surveys are indicated on a map.

The plankton was collected with a No. 5 net by hauling

vertically from the bottom or towing at different depths. No. 20 net was towed near the surface during the May survey of Sandy cove and Little lake. Vertical hauls were made several times if necessary in shallow water in order that similar depths of water would be strained at each station. The plankton was preserved and studied during the summer, the chief groups of animals and the common genera being identified. Since the volume of the settled material was small, counting and averaging the number of animals in several small samples (1 cc.) drawn from the well-mixed total collection was used as a basis of comparison. Animals other than Copepoda and Cladocera were so few that they seldom appeared in the small samples and have been omitted in the computation of the numbers in the various hauls which have been listed in table No. 2.

#### Survey of depth

Sandy cove and Little lake were found to be approximately the same depth near the middle. Although only 2 1/2 miles apart, one on each side of the mouth of the lake, they provide quite different conditions for fish. Sandy cove had water 4°C. colder at the surface and 2.4°C. colder at the bottom in May than Little lake and this great difference in temperature may well be the chief factor in making Little lake poor for salmon angling and better for sttiped bass.

The presence of a submerged ridge between Indian Point and the mouth of the lake was somewhat of a surprise and a series of stations from the ridge toward the mouth or along the

63° 35' W.

Fig. I

45° 55' N



ridge itself revealed a range in depth from 9-75 ft. That the ridge was relatively narrow was shown by the third survey along a line parallel to that made in the second survey in which four out of seven stations had water 115-120 ft. deep. More information is needed about this interesting and important route of migration between the lake and its outlet.

Table No. 1. Surveys of the depths of Shubenacadie lake made on May 12, July 24 and September 6, 1950.

Date and time of day	Number of Station	Location (see map line A)	Depth in feet	Temp. water °C.	Distance between stations
May 12					
9.20 a.m.	shore	King's ldg.	20	7.3	
9.32 "	1	Sandy cove	21	6.2	40 strokes (rowing)
9.55 "	1 a	Between mouth of lake and Indian head	21 0	6.8	"
10.00 "	2	Line from Sandy cove to Mt. Rascal	38 0	6.1 5.9	"
	3	Toward Mt. R.	50		"
	4	"	57		"
	5	"	80		"
	6	"	97		"
			0	6.6	
12.10 p.m.	7	Centre of Little lake	0 20	10.2 9.2	

Table No. 1 continued

Date and time of day	Number of station	Location (see map line A)	Depth in feet	Temp. water °C.	Distance between stations
<u>July 24</u> Series No. 1					
9.35 a.m.	1	Off Indian Hd. to a submerged ridge	100		
9.50 "	2	"	75		
10.05 "	3		35		
Series No. 11					
10.25 "	1	Line from Mt. Rascal just west of mouth of lake	70		
10.50 "	2	"	54		
11.00 "	3	"	48		
11.10 "	4	"	30		
11.25 "	5	"	21		
11.40 "	6	"	09		
12 noon	Series No. 111	Sandy cove	18		
<hr/>					
<u>Sept. 6</u>		(see map line B)			
2.45 p.m.		Sandy cove	0	20.6	
3.00 "	1	Line from just west of the mouth of lake to Mt. Rascal	10		
3.15 "	2		50		
3.30 "	3		115		
3.40 "	4		115		
3.50 "	5	(Tingley's in view)	120		
4.00 "	6	(Big Is. just out of view)	115		

Table No. 1 continued

Date and time of day	Number of station	Location (see map line B)	Depth in feet	Temp. water °C.	Distances between stations
4.10 p.m.	7	(nearer Mt. R. Approx. 100 ft. from shore)	35		

Table No. 2. The numbers of Copepoda and Cladocera estimated to have been collected by No. 5 plankton net during surveys of Shubenacadie lake on May 12, July 24 and September 6, 1950.

Station	Max. depth (feet)	No. of hauls	Calculated number of Copepoda and Cladocera per 100 ft. of water	
			Total	Copepoda
<u>May 12, 1950</u>				
1	21	3	2,400	2,000
2	38	3	11,300	10,500
6	97	1	4,800	4,400
Little lake surface tow (5 min.)			28,750	18,750
Sandy cove	" "	"	135,000	124,000
<u>July 24, 1950</u>				
Series I	100	1	14,400	9,600
	75	2	20,700	16,700
	35	3	3,500	300
Series II	70	2	14,000	10,500
	54	2	9,400	7,000
	48	2	6,000	4,400

Table No. 2 continued

Station	Max. depth (feet)	No. of hauls	Calculated number of Copepoda and Cladocera per 100 ft. of water	
			Total	Copepoda
	30	3	5,200	300
	21	6	1,000	250
	12	10	800	0
Series 111	18	8	900	50
<u>September 6, 1950</u>				
1	10	8	400	200
2	50	2	550	200
3	115	1	12,000	9,000
4	115	1	13,000	7,000
5	120	1	5,800	4,400
6	115	1	5,800	4,400
7	35	3	250	0
6	Tow for 5 min. (125 ft. line)		13,000	10,000
6	" " (100 ft. line)		66,000	60,000
6	" " (50 ft. line)		40,000	10,000

### Plankton survey

In the collections from all the surveys the animals were chiefly Copepoda of the genera Diaptomus, Cyclops and Epischura and Cladocera of the genera Daphnia, Bosmina and Holopedium, the same genera which were present in the collections made in the summer of 1948. Some additional Cladocera, chiefly Ceriodaphnia, Polyphemus and Leptodora were found in small numbers. No. 5 net secured adult stages chiefly and No. 20 the early stages and some flagellates and phytoplankton. There was evidence of a succession of peaks of abundance of different animals as the season advanced and the last collections contained many empty skeletons, broken colonies and colourless phytoplanktons. The following brief summary will indicate the major changes in the animal content of the collections.

#### May

In all the collections, the Copepoda and Cladocera were reproducing. Diaptomus of Copepoda was the chief animal in the region about the mouth of the lake. There were relatively more Cyclops than Diaptomus in the deep tow from Little lake and fewer were carrying eggs than in the region near the mouth of the lake.

#### July

The large Epischura of the Copepoda was abundant in July. Diaptomus and Cyclops were still reproducing and nauplii as well as adults were present. In the collection from shallow water many colonies of Conochilus unicornis of the Rotatoria

were obtained.

### September

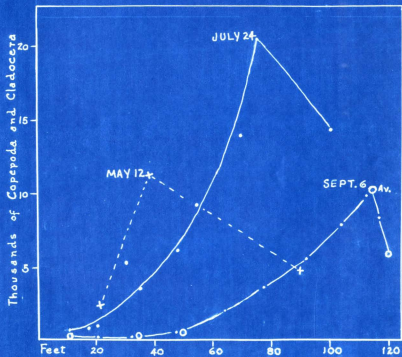
In all the collections from deep water (115-120 ft.) the animals seemed to be very large. Copepoda in a variety of stages were collected and the inshore waters produced plankton in very poor condition.

### Quantitative results

Study of table No. 2 and figure No. 2 shows that the richest zooplankton was found at increasing depth as the season advanced. There were approximately as many animals at 38 feet in May as at 115 feet in September in Shubenacadie lake. Little lake was less rich than Sandy cove in May and had a smaller proportion of Copepoda. Apparently the difference in the temperature of the water affected both the amount and character of the plankton. Whether the rising temperature or the increased light intensity drove the zooplankton to 75 feet in July is not clear, but since both the survey in May and that of July were carried out in morning light, it might be concluded that temperature was a greater factor than light. In September there was little zooplankton in water less than 50 feet deep.

### 7. Survey of Kinsac (Long) Lake

On July 28, 1950, a row-boat/<sup>was</sup>secured from Mr. Hamilton Lee and Dr. Huntsman, the local fishery officer, Mr. Vaughan and I left Mr. Lee's landing near Fall River Station to survey the upper or south end of Kinsac (Long) lake. The purpose of the survey was to get information about the depths and if poss-



ible the deepest part and also to get samples of the plankton for comparison with that of Shubenacadie lake, hoping to find an explanation of the fact that smelts from Kinsac lake were much smaller than those found in Shubenacadie lake.

Four series of Stations were used for the survey of depth. Two places were selected for collection of plankton, the first in the region of the deepest water located and the second opposite Mr. Lee's farm. The details of the survey of depth are shown in table No. 1, and of the plankton in table No. 2. The approximate positions of the stations are shown on the accompanying map.

#### Discussion of results

##### Depth

The south end of the lake was found to be shallow (15 feet) and the region off the high bluff less deep than reported by the local residents. The deepest water was located half-way between the narrows and the bluff. In comparison with Shubenacadie (120 feet), it is not a deep lake, but is deeper than its neighbours, Lake Thomas (36 feet) and Lake Fletcher (42 feet) and less deep than Lake William (68 feet), which were surveyed in 1948.

##### Plankton

The surface of the lake especially between Lee's farm and the Narrows had a thick coating of fine black dust which, apparently, had been swept over it by the winds from the railway passing the entire length of the lake close to the shore-



Survey of Kinsac (Long) Lake 1950

line. As soon as the plankton was concentrated in the jars a deep colouration was readily seen. After preservation in formalin, the colour varied from a rich reddish-brown to black and was deeper in the collections made by towing at intermediate levels than near the surface or near the bottom.

Examination of the collections revealed that the zooplankton of Kinsac lake was very similar in character as that of Shubenacadie lake in July. Copepoda and Cladocera of the same genera far outnumbered all other kinds of animals, and in the quantitative study only they were counted. The effect of the dust was most interesting. At first the colouring seemed to be in the liquid, but when the plankton settled the liquid was only slightly stained. The colour was found to be distributed within the bodies of the animals, especially the Copepoda, and could not be removed by crushing them. Some were stained in the thorax, others in the posterior part or in the legs. Many Cladocera showed only slight colour; others like the genus *Holopedium* were highly stained, with the gelatinous sac a deep brown. The alimentary tract and the brood sac were also affected. It would be interesting to find out whether the stained animals are to be found in the fishes.

The variations in the quantity of the collections are shown in table No. 3 by the volume of the settled material and by the estimated numbers of Copepoda and Cladocera based upon counting and averaging the numbers in small samples ( 1 cc.) as was done for the survey of Shubenacadie lake and the Fletcher

river. The greatest concentration of plankton occurred at levels intermediate between surface and bottom.

A comparison of the food available in Kinsac and Shubenscadie lakes might be made by referring to two vertical hauls from similar depths, the one made on July 28 at 11.35 a. m. from Kinsac lake and the other at 11 a. m. on July 24 from Shubenscadie lake. The zooplankton was more than 6 times as abundant in Kinsac<sup>lake</sup> as in Shubenscadie lake and in the former the Copepoda formed a higher percentage (80%-74%).

Table No. 1. Survey of depths of the water in Kinsac (Long) lake by row-boat from the landing at Lee's farm on July 28, 1950.

Time of day	Number of station	Location (see map)	Depth (feet)	Distance between stations by rowing
	<u>Series I</u>			
9.55 a.m.	1	Half-way between Lee's landing and	15	
	2	camp opposite 3/4 distance to camp	15	
	<u>Series II</u> <u>Line from upper end of lake to the Narrows</u>			
10.03 a.m.	1	Opposite No end Lee's clearing	18	
	2		18	35 strokes
	3		18	"
	4		21	"
	5	Nearly opposite culvert from br.	28	"
	6	Beyond culvert (soot on surface)	35	"

Table No. 1 continued

Time of day	Number of station	Location (see map)	Depth (feet)	Distance between stations by rowing
10.13 a.m.	7		42	35 strokes
	8		38	"
	9		28	"
10.20 a.m.	10		33	"
	11	Almost to Point	36	"
	12	" opposite "	46	"
	13	" lower end "	54	"
<u>New line from Narrows to upper end second hill on Ry.</u>				
10.30 a.m.	14		54	35 strokes
	15		57	"
10.37 a.m.	16		57	"
	17		54	"
10.43 a.m.	18		46	"
	19		35	"
	20	Highest pt. of Bluff	25	"
	21		27	"
10.50 a.m.	22		31	"
	23		27	"
<u>Series 111. From pt. of Bluff to centre of first hill on Ry.</u>				
	1	From shore	11	20 strokes
11.00 a.m.	2		35	"
	3		42	"
11.02 "	4		33	

Table No. 1 continued

Time of day	Number of station	Location (see map)	Depth (feet)	Distance between stations by rowing
11.02 a.m.	5	At 15 str. lily pads and shallow	5	20 strokes
	6	At 10 str. edge of shoal	17	"
	7	To fill	11	"
				4 "
Series Iv. <u>From shallow point above first fill slightly diagonally across lake midway between Bluff and Pt. at Narrows</u>				
11.15 a.m.	1		18	20 strokes
	2		21	"
	3		35	"
	4		54	
	5		57	
	6		33	"
	7	To shore		10 "

Table No. 2. Location of the plankton station and the type of work done in Kinsac lake on July 28, 1950.

Time	Location	Gear	Kind	Depth (feet)	Temperature of water
11.35 a.m.	60 strokes from shore at Sta.No.7 Series IV toward the shallow point. (see map)	No. 5 net	Vert. haul (2)	54 48	At surface 22°C.
11.45 a.m.	"	"	Tow with 50 feet line for 5 min.		
11.55 a.m.	"	"	" "	30 "	" " " "
12.05 a.m.	"	"	" "	15 "	" " " "
12.15 a.m.	"	"	"	surface	

Table No. 3. The amount and relative proportion of Copepoda and Cladocera in plankton collected from two stations in Kinsac (Long) lake on July 28, 1950.

Gear	Kind	Location	Vol. of settled plankton	Calculated no. of Copepoda and Cladocera	Percentage of Copepoda
No. 5	Vert. haul net	Sta. No. 7 (Series IV)		40,000	80
"	Tows 50 ft. line	"	20 c.c.	35,800	78
"	30 ft. line	"	60 c.c.	266,500	80
"	15 ft. line	"	140 c.c.	459,000	75
"	surface	"	35 c.c.	81,000	80
"	surface	Off Lee's farm	40 c.c.	180,300	60

8. The plankton of the Fletcher and the  
Rawdon Rivers in 1950

Fletcher River

Method of Collection and Counting

No. 5 plankton net was suspended weekly from the first bridge over the Fletcher river above the dam at Wellington. All the collections except one were made in the morning and if possible before the sunshine was bright. One afternoon, collection was made for comparison with one on the morning of the same day which was cloudy in the morning and bright in the afternoon. The time allowed for the water to flow through the net depended upon the rate of flow. When the experiment was begun, the water was passing under the bridge, approximately 15 feet wide, in 10 seconds and the net was suspended for 10 minutes. This rate was made the standard and as the rate changed the time was altered so that approximately the same volume of water would be strained. Rapid examination of the fresh material was made and a list of the chief organisms recorded and then the collection was preserved for further study.

Since the volume of the settled material was small and of diverse character, an estimate of the total number of animals in the plankton as well as the number of Copepoda and Cladocera, the chief elements of fish food, was reached by counting and averaging the numbers found in several small samples ( 1 c.c.) drawn from the well-mixed total collection and multiplying by the volume in the container. The date of collection, the calculated total number of organisms and the numbers of Copepoda and Cladocera are given in table No. 1

Quantitative and qualitative study

At no time during the season were there as many Cladocera as Copepoda found in the collections, the latter forming 80% of the whole. Throughout the season, some phytoplankton, especially the filamentous types and occasionally desmids and diatoms and infusoria were caught, but were not included in the count. The Copepoda belonged chiefly to the genera, Diaptomus and Cyclops with an occasional Epischura. The Cladocera included Holopedium, Bosmina, Daphnia, Chydorus and an occasional Polyphemus and Leptodora. The fact that the latter form known to be nocturnal in coming to the surface, the occasional presence of hydra and that there was little difference in the numbers of organisms in the morning and afternoon samples taken on May 27, one may conclude that the part of the river chosen for collecting the plankton was subject to vertical as well as horizontal movement. In the brief monthly summary which follows, the chief variations from the above list of forms are shown.

May

The first collection contained many Glochidia which disappeared from subsequent collections. Many Diaptomus and Cyclops were bearing eggs and an occasional Holopedium occurred with eggs. Larvae, nymphs and pupa cases of Insecta were present, but not identified. Hydra both stalked and medusae occurred.

June

There was evidence that the peak of spring abundance of Copepoda and Cladocera had passed, as many dead were found.

Round colonies of flagellates, probably Volvox, were abundant on June 3, but had almost disappeared by the end of the month. Both limnetic forms of Cladocera were present. Insect larvae and pupa cases were prevalent on June 3 and June 10.

#### July

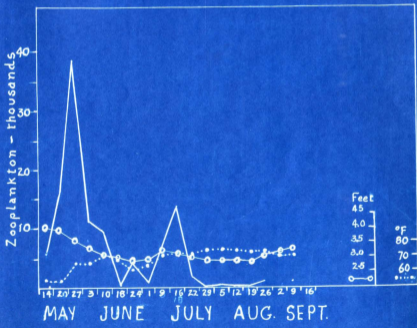
A summer peak of abundance of Copepoda showed up in the collection of July 16. There were larval forms, nauplii and adults bearing eggs, and the whole collection was richer in colour than for several weeks formerly. The large form, Epischura, was present, and a wider variety of Cladocera than in June. Holopedium carrying hatched young in the brood sac was found in the collection of July 9.

#### Aug. and Sept.

There was very little plankton in the collections made between August 1 and September 9, the last for the season. There was much debris washed down by rain, a few mites, empty pupa cases and small numbers of the same species of Copepoda and Cladocera appearing earlier.

#### Plankton abundance in relation to physical conditions

A comparison between the numbers of organisms calculated to be present in the collections of plankton, the height of the water in the lock at Wellington and the maximum temperature of the water on the day that the collection was made, is shown geographically in figure 1. The maxima in abundance of the plankton occurring on May 27 and July 16 both occurred with rising temperature of the water associated with sunshine and



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original book**

Table No. 1 continued

Date of collection 1950	Calculated total number organisms	Copepoda	Cladocera
July 29	250	165	85
Aug. 5	250	250	0
12	250	125	125
19	0		
26	1,000	1,000	0
Sept. 9	1,000	500	500
Total	111,000	87,250	18,485
Percentage		80	15

The Plankton of the Rawdon River

On July 28, 1950, Dr. Huntsman made two collections of plankton from the upper Rawdon river by suspending No. 5 plankton net in the current for 10 minutes, first a short distance above the railway bridge and second just below Beaverbank lake. The collections were preserved for study. On the following day the same net was suspended in the current below the bridge over the Lower Rawdon at Wellington for 10 minutes. All the collections were exceedingly poor in plankton, consisting chiefly of insect larvae and casts. A few Copepoda and Cladocera of the same species occurring in the Fletcher river were found. The quantity was so small that no animals appeared in the samples drawn for counting from the collection made in the Upper Raw-

don near the railway bridge or from that made in the lower Rawdon. A single copepod appeared in each of two samples from the collection made just below Beaverbank lake. Considering that the work was done after both peaks in abundance of the Fletcher were over, little can be learned from this survey except that the young gaspereaux were leaving the rivers when food was scarce.