MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

NO. 401

Fish (Salmon) Management

Volume 41

1949

FISHERIES RESEARCH BOARD OF CANADA

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No.

401

Title

FISH (SALMON) MANAGEMENT, 1949

Author

Davidson, V. M.

FISH (SALMON) MANAGEMENT

VOLUME XLI

CONTENTS

FISH (SALMON) MANAGEMENT

1949

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

1. Methods used to secure reports on angling in Grand lake in 1949.

In compiling data during August and September of the 1949 angling in Grand lake, it was necessary to interview anglers who were willing to recall their experiences of the early spring and summer and to estimate the number of fish taken by them individually or by their fishing companions. The courtesy, kindness and interest displayed by approximately 100 anglers who were approached was very encouraging and made the task both agreeable and interesting.

The first gentlemen interviewed were Mr. W. H. Cameron of Wellington Station, Mr. A. Morash of Grand Lake Station, Mr. Andrew King of King Station and Mr. Gerald Horne of Enfield. Each gave an estimate of the number of grayling or bass or both which had been caught in his respective region by anglers who had reported to him and was very helpful in supplying the names and addresses of other anglers who should be approached regarding their catches. Subsequent work led me to believe that these gentlemen were conservative in their estimates and as far as possible I have tried to avoid duplication of the numbers reported by them in making up the total catch.

The next step was an attempt to interview all the campers around the lake. This was done during the weekend when the

men were in camp and was a slow procedure, often requiring return trips. On the whole it was highly successful. Each camper was asked the number of grayling, bass and trout taken during the year. Anglers were interrogated on the condition of the fish, the sizes, the bait used, the depth at which they fished, and the general and often the particular part of the lake fished. Comments on their observations concerning the food and the movements of the grayling in particular were elicited. Emphasis was laid on the importance of keeping careful record of the 1950 catch and reporting the same. Special note was made of the names of the anglers who had long experience on the lake, were keen observers and seemed accurate in their accounts. These comments were recorded and filed for reference.

Then came the task of getting in touch with anglers who came occasionally to Grand lake from Halifax, Dartmouth, Rockingham Enfield and Wellington and were reported to have fished there in 1949. Some had brought their own boats and put them into the lake at the south end at the rearing ponds, or at King's or at Tingley's or had angled from the shore; others had rented boats from either Ivan Cameron, Noel Bradley, Andrew King, Michael King or Mrs. C. M. King. The names of many of the anglers were unknown to those who owned the boats and I have asked them to obtain the names and addresses of all anglers as far as possible next season. To the list of anglers whose

names had been supplied I added those who had turned in tags from the grayling catch of 1949 and went to Halifax determined to reach as many as possible either by calling at their homes or over the telephone. Through the kindness of Dr. S. A. Beatty, Director of the Fisheries Experimental Station, I was given the use of his office telephone on four different occasions for two or three hours and was able to reach many of the anglers themselves or leave messages as to the data required for a subsequent call. I also called at the homes of people who could not be reached by telephone and submitted questionnaires to be returned by mail if the angler were away. Much additional data was thus secured and I feel that the anglers approached are familiar with the fact that we are anxious for a complete report on the angling in 1950.

The data in detail is submitted under the heading of the individual kinds of fish caught, and the list of anglers with their addresses is on file.

2. Angling for grayling in Grand Lake in 1949

Tagged kelts

Between November 16 and November 24, 1948 inclusive, 280 kelts were released in the Waverley system of four lakes, Grand, Fletcher, Thomas and William, by the superintendents of the Grand Lake and Sackville River rearing ponds. All were stripped, weighed, measured and tagged before being released. They were obtained from three sources: 200 were 5-yr.olds, pond stock, 37 were Sebago salmon which had been trapped in the large Rawdon and the Fletcher rivers and the rest were Atlantic salmon from the Sackville river. Grand Lake received 220 kelts, of which 200 were pond stock and 10 were Sebago and 10 Atlantic salmon. The remainder of the Sebago and Atlantic kelts were divided equally between the three smaller lakes. (See table 1).

Thirty-eight kelts from the November planting have been recaptured and reported for reward. Most of them were taken within a month after the season opened in April 1949. Twenty-seven were caught by anglers in the same lake in which they had been planted, ten were found farther down in the chain of lakes or in Shubenacadie river and one was captured in L. Charles, which is above L. William. From Grand Lake which is the largest and most extensively fished only 10.9 percent of the fish were retaken. None of the fish released in L. Thomas were recaptured in that lake which is the most shallow in the chain and is reported to have few anglers. (See table 1).

Marked grayling

Smolts marked by clipping one of the ventral fins have been released from the rearing ponds into Grand lake for several years but since the reward for evidence of the recapture of them has been withdrawn no marked fins were received during 1949. Anglers interviewed while the report of the total catch made in Grand lake was being compiled reported the capture of 33 grayling with marked fins in 1949. (See table 6).

Table 1. The numbers of tagged kelts planted in each of four lakes in the Waverley system in November 1948 and the numbers recaptured in 1949.

Lake	Pond stock 5-yr.-olds (Grand lake)		"Sebago" (Grand lake)		"Atlantic" (Sackville river)		
	Planted	Recap.	Planted	Recap.	Planted	Recap	Percent. Recap.
Grand	200	20	10	3	10	1	10.4
Fletcher	0	0	9	2	11	4	30
Thomas	0	0	9	1	11	1	10
William	0	0	9	2	11	4	30
Percent recap.		10		22		23	

Note: With the following exceptions all recaptures were made in the lakes in which the fish were planted.

1 "Sebago") from Grand lake in the Shubenacadie river
1 "Atlantic")
1 Pond " " " " " " "
(just below lake)
1 "Sebago") from lake Fletcher in Grand lake
1 "Atlantic")
1 "Atlantic" " " " in Shubenacadie river
1 "Sebago" from lake Thomas in Grand lake
1 "Atlantic" " " " in Shubenacadie river

1 "Atlantic" from lake William in Grand lake
1 "Atlantic" " " " " lake Charles
1 " " " " " Shubenacadie river.

Untagged and unmarked grayling

After the planting of kelts had been completed the following numbers of untagged and unmarked grayling of their respective ages were released into Grand lake: 500 two-year-olds, 1075 three-year-olds, 30 four-year-olds, and 71 five-year-olds.

At the beginning of August Dr. Huntsman asked me to obtain a report on the number of grayling that had been captured by anglers during the spring and summer of 1949 in addition to those that had been reported for reward. He also wished me to get information about the methods used in securing fish, to find out when and where the angling had been done and to learn as much as possible about the habits of the grayling in preparation for a more comprehensive survey to be made in 1950. The methods used in securing the data gathered during the next six weeks are dealt with in a special section of this report. The results are tabulated under four headings referring to the particular parts of the shore-line of Grand lake from which the anglers operated and may be explained as follows: (a) the head of the lake at Wellington receiving the main inflow from the two lake systems, Waverley and Rawdon, (b) the main part of the lake at Grand Lake Station midway between the head and the mouth, (c) the mouth at King where the outflow enters the Shubenacadie river and (d) the "Little" lake at Horne settlement, a shallow northward extension of Grand lake proper.

Table 2. Report received from anglers of grayling who operated from Wellington at the head of Grand lake in 1949.

Angler	No. of fish	Max. Weight (lbs.)	Min. Weight (lbs.)	Additional information
Bradley, N.	10	3½	1	Caught two tagged fish; smaller than the untagged fish. Off Adams island.
Brimicombe, W. and family	15	3		Three had marked fins; caught below the dam.
Bryden, C. G.	12	2	½	May and June; all caught near shore in central region of lake.
Clahane, T.	1	2½		May 24; off Adam's island. Minnows for bait.
Cleveland, B.	8	3½	1½	June 1; along the west shore from south end to Sandy cove and Cook's camp; all in good condition; minnows, fly with silver body; caught near the surface.
Cook, L.	20	3½	1½	April and May; 6 with marked fins; trolling inshore near surface, minnows. Food in summer-insects, spring-smelts.
Crowell, A. M.	1	length 21 in.		Aug. 22; mechanical bait; at mouth of large Rawdon after rain and freshet.
Dahr, B.	3			Small; caught near the dam.
Dibbon, G.	3	2	1	June and July; minnows and mechanical bait. All in good condition.
Ellis, W. E.	14	7		Reported by D. Turner
Fineberg, L.	15	4½	2	April and May; trolling with minnows.

Table 2 continued.

Angler	No. of fish	Max. Weight (lbs.)	Min. Weight lbs.	Additional information
Fogarty, R. E.	5	2-3		Good condition.
Fry, A.	3	4½	2	June and July; Sandy Cove, Tingley's and Five Islands. Trolled deep with wobbling spoons and minnows.
Gerrard, E. G.	5	2	¾	Minnows for bait.
Kenny, K.	10	2½		Reported by L. Cook; none large.
McDonald, B.	5	1¾		All small; caught near the dam.
Mitchell, M.	1	5½		Length 21 in; in large Rawdon between dam and railway on May 10; fat and gamey; bait artificial gnat fly.
Mullins C. and T. Chisholm	3	1½	1	June; trolling from Mullin's camp to Rocky Br. inshore with minnows; 5-6 ft.
Potts, Maj. G.	3	2	½	May; fished 500 yds, from the south end with minnows.
Russell, H. B.	2	2	1	Early May with minnows.
Sievert, L. W.	10	3	1¼	Reports 50% lean fish; bait - minnows.
Smith, C. and D. Carnell	50-60	3	¾	May; trolling from south end to Five islands 12-15 ft. deep inshore; live minnows.
Steeves, R. K.	1	3½		May 1 near Five Islands; 50-100 ft. from shore. Has seen smelts in grayling but no gaspereaux.
Swim, C.	3			Good condition; conservative estimate/1 lb. weight
Swim, A. and ? Briggs	7	2¼	14 oz.	Caught between April 16 and May 2; lengths 18"-13"; one with marked fin.

Table 2 continued

Angler	No. of fish	Max. Weight (lbs.)	Min. Weight (lbs.)	Additional information
Wadlin, E. M.	25			All small; bait-fly and worm; early June.
Wolfe, A. J.	20	2	¼	April 16 to May 15
Total	255			

Table 3. Report from anglers of grayling who operated from Grand Lake Station in 1949.

Angler	No. of fish	Max. Weight (lbs.)	Min. Weight (lbs.)	Additional information
Morash, A.	25-50			Anglers arrived late and left early in the morning and were loath to divulge details of fishing.
Morash, W.	10	7¾	1¼	Large one was tagged; all good condition.
Palmer, H. R. and family	100	5 (av.2-3)	2	Excellent condition; early fishing best; poor when gaspereau began to run. Best catch for years. Has observed smelt in grayling; got a tagged fish 4½ lbs.; tag lost. Claimed that the estimate was conservative.
Total	160			

Table 4. Report received from anglers who operated from King Station and Sandy Cove in 1949.

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Barrett, W. and L.	75			Talked over long distance phone - not clear. Fished all summer.
Bauld, W.	25	3½	2	Best fishing for 5 years; good condition.
Branch, W.	7	5	1½	One with marked fin.
Bottomley, J.	1	½		Fish in better condition than formerly.
Bottomley, G.	4	2½		Considered catch very poor.
Coolen, K.	(20)	3½	½	May; minnows for bait; 2 with marked fins.
Connors, F.	(23)	3-10 oz.	14 oz.	Bait - fly dark, Montreal for 2 grayling.
Connors, B.	(25)	3½	1½	Early May; minnows; 3 with marked fins.
Dyment, B. C.	2	3½	3½	Early May; trolling off Rocky Br. minnows for bait; good condition.
Flinn, F.	12	?	?	May and July; inshore near surface.
Flinn, H.	22	2½	1	Caught off shoal in Sandy cove; minnows for bait; in addition 2 with tags.
King, A.	200	4½	1½	Estimate for anglers from King Landing. Catch larger than '48 but more anglers.
King, Mrs. C. M.	12	2½		Rents boats to 10-12 anglers
King, M.	1	1		Caught near mouth of lake; rents boats.

Table 4 continued.

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Meagher, T.J.M. and E. Merchant	1	3½		May 5; minnow bait; also caught a small smelt.
Ottman, S.	8	4-5	2½	Good condition; Apr. and May; Sleepy cove northward; minnows for bait.
Stone, W.	4	4	2	May; shallow water in Sandy cove. Minnows and mechanical bait.
Tolson, Dr. H.	27	3½	2	Bait live minnows; catch poor; 3 with marked fins.
Wentzell, ?	1	1		Aug. 21; reported by Mr. A. King.
( ) Reported in estimate of A. King				
Total	408			

Table 5. Report received from anglers who operated from Horne Settlement on "Little Lake" in 1949.

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Barrett, A. and E.	6	4	2½	Fish in good condition.
Crane, L.	5	3	1½	Also caught 70 perch.
Cornfoot, F.	1	½		Fishes with H. Dorey
Dorey, H.	3	2	1	May 9; inshore fishing from camp at Rocky brook north to Nolan's bank.
Feetham, N.	6	3	1	May; chiefly in Sandy cove; used mechanical bait. Report made by brother for absent angler.
Peake, Wm.	10	2½	½	Fly fishing inshore in the "Little lake".
Total	31			

Table 6. Report of anglers who caught grayling with marked fins.

Name of angler	No. of fish
Branch, Wm.	1
Brimicombe, Wm.	2
Connors, B. and F.	3
Cook, L.	6
Coolen, K.	2
King, A.	15
Swim, A.	1
Tolson, Dr. H.	3
Total	33

Summary

The names of sixty-one persons reporting catches of grayling in Grand lake in 1949 appear in the tables. This total falls short of the actual number of successful anglers since reporters such as Mr. Andrew King who rented boats were unable to furnish the names of all anglers in their regions and , no doubt, many angled unobserved from other parts of the shore-line not included in the tables and either were unaware of the value of reporting their catches or were unwilling to make the effort.

According to the information compiled in the tables approximately 850 grayling were captured in Grand lake in 1949 of which nearly 50% were taken by anglers who entered the lake near its mouth and 30% by anglers from the head of the lake. The small catch of 31 grayling made by anglers from Horne Settle-

ment on "Little" lake may be contrasted with the large catch of 400 striped bass reported from the same part of the lake. The anglers who were explicit in reporting the part of the lake in which they fished seemed to be most successful along the west shore from Adams' island to Rocky brook.

A great variety of bait was used in Grand lake, live minnows being much more popular than other types. Some anglers used both minnows and mechanical bait on the same line; others, such as Wm. Peake of Horne settlement, did fly-fishing exclusively. Trolling from row-boat or motor-boat was the common method of angling.

Although most of the angling was done in the early spring, several captures were made even in late summer for the most part by campers who were on the lake during weekends and vacation. A grayling weighing 3 lbs. and reported to be in fine condition was caught near Rocky brook on August 7. Mr. A. M. Crowell who had only two or three small bass to report when he was interviewed at his camp on August 20 caught a grayling 21 inches long on August 22 at the mouth of the large Rawdon river after a freshet.

Boats for hire by anglers are few at Grand lake. Nine or ten are available near the mouth of the lake and two at Wellington. The owners reported a great rush for boats when the season opened and insufficient demand for the rest of the year to make a paying investment. Mr. Andrew King declared that he believed that the summer catches would compare favourably with

those of early spring if the anglers would exert as great effort then as they do at the opening of the season when the weather is often unfavourable.

Ardent anglers of long experience in Grand lake reported having found smelt from 4 to 5 inches long in the mouths and stomachs of grayling. Mr. L. Cook of Halifax found water bugs and insects in his summer catches. Mr. Wm. King, a life-long resident near Grand lake and an experienced guide and angler, recalled having found a small field mouse in a grayling caught near a precipitous shore and concluded that the mouse had fallen from a ledge into the water.

A few anglers who have camped for many years on the shores of Grand lake deplored the scarcity of grayling compared with former years. In proportion to the number of anglers interviewed they formed less than 10% and some admitted having done less intense angling than formerly. Most of the successful anglers commented upon the fine condition of the grayling. For example, Mr. H. R. Palmer who reported the largest catch from the Grand Lake Station region said that the fish were more abundant and in better condition than he had experienced in many years.

3. Angling for striped bass in Grand lake in 1949.

Collection of information regarding the size of the catch of striped bass from Grand lake in 1949 began with interviewing Mr. Gerald Horne of Enfield whom anglers at Wellington Station assured me was well acquainted with conditions at the north end of the lake. "Little Lake", at the north end is well known to be especially good for bass and poor for grayling. Mr. Horne reported the following:

---Fishing began about April 16 when the trout season opened and for three weeks small bass were easily caught with live minnows or mechanical bait. The weight of the bass varied from 2 lbs. to 3 lbs. and a fair estimate of the number caught by anglers in his vicinity would be 200. ---

For the region near the mouth of the lake, the first information came from Mr. Andrew King of King Station who rents boats to anglers. He observed a large school of bass moving along the shore in front of his landing toward the Shubenacadie river about the last week of April and another school moving in the same direction late in May. Angling for bass in that part of the lake commenced in early June. He estimated that approximately 40 bass varying in weight from 7 lbs. to 1½ lbs. had been brought in at his landing by anglers during the season.

From Mr. W. H. Cameron, Superintendent of the rearing ponds at Grand lake came an estimate of 60 striped bass having

been caught by his family and visiting anglers from Halifax at the south end of the lake.

Enquiries made of grayling-anglers at Grand Lake Station did not disclose any captures of striped bass. They claimed to be uninterested in catching bass.

The detailed report of the interviews I had with anglers of Grand lake is presented in tabular form. The names of the anglers are listed under three headings, each of which refers to the part of the lake from which their angling began.

Table 1. Report of angling for striped bass from the head of Grand lake in 1949.

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Brimicombe, W.	35	?	?	Combined catch of the family.
Burbridge, A.	23	3	1	Length 18"-10"; caught below the dam with live minnows.
Bryden, C. G.	30	4	1½	
Cameron, W. H.	60	?	?	Estimated catch
Carnell, Don.	12	4	½	South end to Five islands; bait live minnows.
Cleveland, B.	25	?	?	June; trolling with live minnows as far as Indian point.
Cook, L.	12	3½	1	July; west shore.
Crowell, A. M.	4	8-9	1	Aug. 26 caught 27 in. bass mechanical bait; west shore near Cook's camp
Dahr, B.	40	?	?	

Table 1 continued

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.),	Additional information
Dibbon, G.	8	3	1½	Live minnows for bait; early June catch.
Embree,	3	3		Summer fishing
Fineberg, L.	2			Trolling with minnows - May
Fogarty,	5-6	3	?	Large one disgorged 4 in. smelt.
Hagell, A. F.	21	3½	3	Trolling north to Five islands.
Hayter, F.	50	6		Caught below dam in the evening.
Hoblin, V.	1	2½		In July at the dam.
Kenny, K.	8-9		small	Reported by L. Cook
King, Lillian	3		"	Early spring; near the dam.
Myers, C.	8	?	?	Reported by Mrs. W. King.
O'Brien, Insp.	6	1		June fishing.
Potts, Maj. G.	14	3½	½	Live minnows for bait.
Russell, H.	30	3	½	Early May; minnows; trolling.
Shrum,	5	1½	1	May 15.
Swim, A.	40	4	1	
Turner, D.	8	"	small	
Wolfe, A. J.	20	4½	1	
Total	475			

Table 2. Report of angling for striped bass from King's landing on Sandy cove, Grand lake in 1949.

Anglers	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Barrett, Wm.	4	?	?	Caught south of Sandy cove.
Bauld, Wm.	4	"	"	
Branch, Wm.	1	3½		
Bottomley, G.	1	3		Considered fishing very poor.
Carnell, C. W.	12	6	1	
Coolen, K.	2	1½		May fishing with minnows.
Dyment, B. C.	2	3	1¾	Trolling with minnows.
Flinn, F.	4			
Flinn, H.	3			
King, A.	40	7	1½	Estimated report for district.
King, M.	5	1		Caught by children near mouth of the lake at their camp.
Meagher, T. J. N.	4			
Merchant, E.	20	2½	¾	May angling with minnows,
Stone, W.	12	3	1	June
Tolson, Dr. H.	2	2½		Bait - live minnows.
Wentzell, ?	3	1½		About August 21.
Total	119			

Table 3. Report of angling for striped bass from Horne settlement/"Little Lake", 1949.
on

Angler	No. of fish	Max. weight (lbs.)	Min. weight (lbs.)	Additional information
Barrett, A.	12	5-6	3	
Cornfoot, F.	3	4½	3	West shore off Mt. Rascal.
Feetham, N.	1	3		June; reported by brother.
Francis,	2	2		
Gray, R. A.	5	3		Not interested in bass.
Horne, G.	200	spring catch	2-3	Estimate for district.
Norris, J.	60	8	½	
Peake, C.				Fishes with Mr. Francis.
Peake, Wm.	125	8	½	Threw back a lot.
Total	408			

Summary and discussion

Anglers secured approximately 1,000 striped bass from Shubenacadie (Grand) lake in 1949.

It was extremely difficult to obtain reports of the particular regions of the lake from which bass were taken. Anglers entering the lake from the three directions indicated in the tables doubtless overlapped in the areas in which they fished. The largest number of anglers operated from the head of the lake and secured 475 bass; the smallest number from the opposite end at Horne settlement on "Little" lake and got 408 fish. Both regions are more shallow than the main part of the

lake opposite Grand Lake Station from which no bass were reported or the region around the mouth of the lake from which 119 bass were reported. The last two regions mentioned yielded the largest catches of grayling.

4. Smelt fishing in Grand lake, in 1949.

Smelts from Grand lake are highly prized by anglers for their fine flavour and large size. They are much larger and darker in colour than the sea-run smelts of the Shubenacadie river and are believed to remain in the lake throughout the year. They may reach ¾ lb. in weight and grow to 11 inches in length. Small smelts about four inches long have been reported by several anglers in the stomachs of grayling caught in April and May. About the end of March smelts run into the rivers and brooks to spawn. According to reports spawning fish go only a short distance into the brooks at night and return to the lake in the morning. Spawn can be seen on the stones of the brooks and on the stones below the dam on the Fletcher run. Netting is illegal at spawning time in the tributaries of Grand lake but legal in the next county on the Shubenacadie river. Some illegal fishing is done in the Rawdon river by the local residents for their own use during the first night or two but is soon stopped by the fishery officer. No estimate of the 1949 catch/is available. taken in this way, of course,

Angling through the ice is a cold business but is indulged in by local anglers for their own use as soon as the ice

is strong enough to be safe. It is legal until the end of March. The total catch of smelts procured in this way during 1949 has been reported as approximately 1,000 fish.

Grand Lake Station		Wellington Station	
Angler	Number	Angler	Number
Morash, Wm.	50	Bradley, Noel	18
Palmer, H. R.	300-400	Brimicombe, W.	300-400
		Dahr, B.	150 x
		King, Lillian	few doz. x

x May have been dipped

5. Trout angling in Grand lake in 1949

During the collection of data on the angling in Grand lake in 1949, I found that those fortunate enough to have taken a large speckled trout offered information concerning the capture before being asked. Many anglers wanted to know why brook trout were so scarce in Grand lake. Twelve anglers reported catches of trout. Of these only four secured specimens weighing two or more pounds. These were taken in the lake or at the mouths of rivers emptying into it. Most of the small trout were caught by campers who reside along the shores of what is known as "Little Lake" at the north end, and were reported as coming from the brooks emptying into the lake. The detailed report is

given in the following table.

Angler	No.	Size (lbs.)	Additional information
Enfield and Horne settlement			
Peake, C. and Francis ?	20	small	Caught in brooks at the north end; worms for bait.
Norris, Jack	2	1-¾	
Barrett, Arch.	2	1¾ to 1	
Gray, R. A.	2	¾	
Peake, Wm.	1	2	Caught on Good Friday in lake
	30-40	small	Caught in brooks at north end of the lake.
King settlement			
Bauld, Wm.	1	2	
King, M.	1	2	Caught in Shubenacadie river close to the lake.
Wellington station			
Dahr, B.	1	2½	Caught below the dam.
Fineberg, L.	1	1	Caught in Sleepy cove.
Smith, Clarence and Don Carnell	12-16	¾	Caught in Rocky brook.

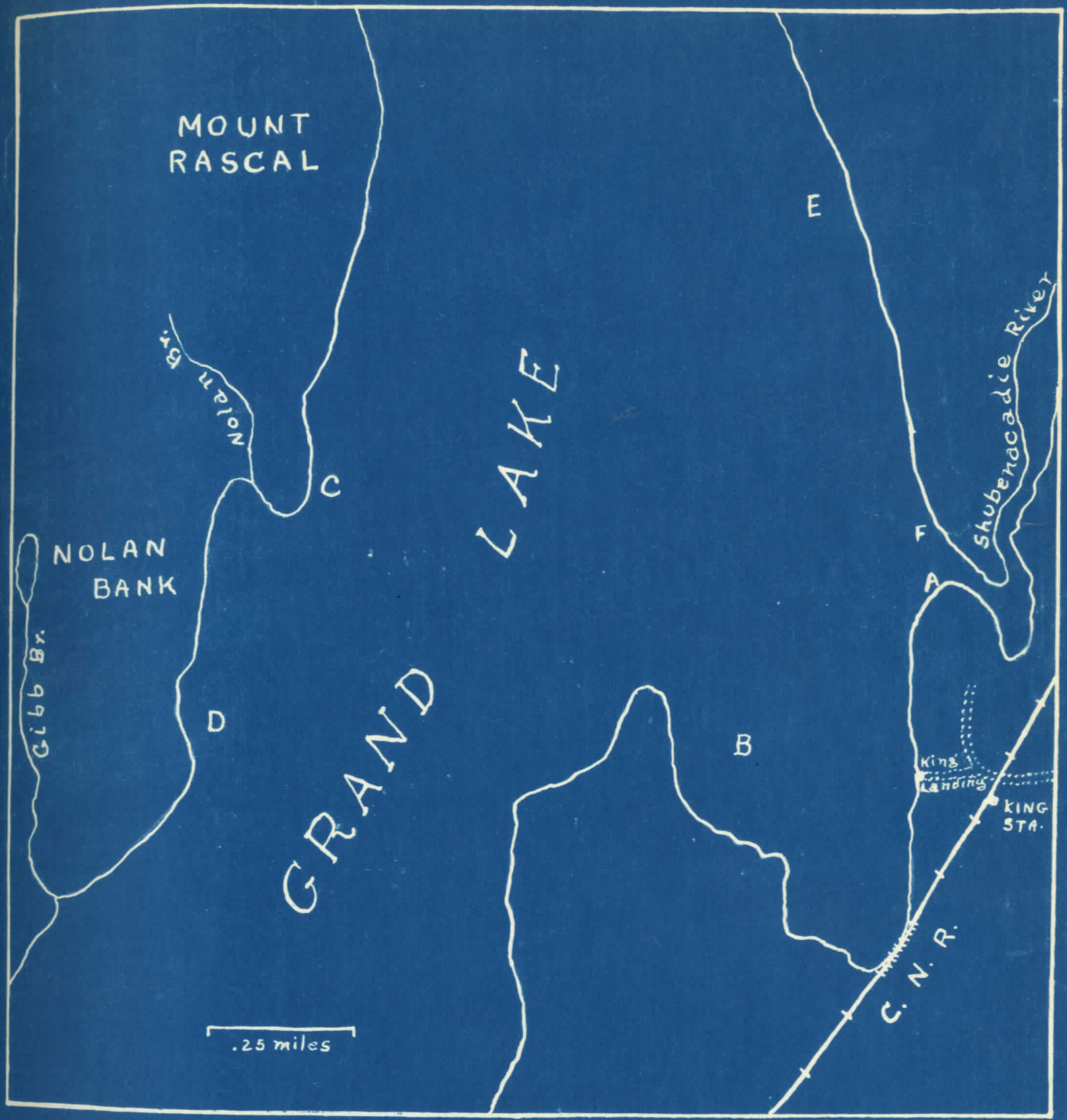
6. Experiment in netting large striped bass

With the permission of the Department of Fisheries represented by Mr. W. A. Fulleton, Inspector of Fisheries, and the co-operation of the Fisheries Research Board an experiment in gill-net fishing for large striped bass in Grand lake was begun by Mr. Andrew King on July 25, 1949. Since he suggested that

the removal of large bass believed to be predacious on the grey-ling might be worth the expense involved and offered to set and tend the nets, Mr. King was given the responsibility of choosing the locations and the times of operation. I was instructed by Dr. Huntsman to be present when the nets were examined, to make measurements, get scale samples and examine the stomach contents and gonads of the captured fish.

The first net used was 72 ft. long, 8 ft. wide and 6 inches in mesh. During the evening of July 25, it was placed to extend outward from the shore at the south side of the mouth of Grand lake. (See map, location A). Next morning the net was empty but on July 27 a striped bass was found entangled by the gills. It was a rather thin, immature male fish weighing 16 lbs. The stomach was empty and from the appearance of the scales the bass was ten or probably fifteen years old. On the following morning the net was found to be slack as though it had been interfered with by swimmers in the neighbourhood in spite of an attached warning and Mr. King moved it to a shoal about 500 yards in front of his own landing. (Map, location B). There it remained for two days without taking any fish and was then taken up at the suggestion of Mr. Fullerton lest it interfere with Sunday boat traffic.

On Sunday night, July 31, anglers landing at King's brought in two small bass and reported several strikes of larger fish along the west shore near Rocky brook. When the net which had been reset early Sunday evening on the shoal (map, location B)



Grand lake showing location of nets to catch large striped bass.

was found empty on Monday morning, Mr. King decided to move it to the west shore of the lake north of Nolan's brook. (Map, location C). No fish were caught there nor when it was anchored for the next two days farther south towards Rocky brook (See map location D).

Meanwhile a second net 50 ft. long, 9 ft. wide and having 6-inch mesh had been secured and on August 4 was anchored near shore on the east side of the lake about a mile north of Mr. King's landing and opposite Mt. Rascal. The net reached bottom along a channel unfrequented by boats but where bass had been observed to move. No fish were netted in this position. (See map, location E).

On Sunday evening, August 7, the first net (72 ft.) was set on the northeast side of the mouth of Grand lake with the outer end of the net in water 12 ft. deep. (See map, location F). On Monday the net was empty. Next morning a dead striped bass weighing 6 lbs. was found caught by the gills in the upper part of the net. It was an immature female, seven years old and its stomach was empty except for some mucus. No capture was made the following morning and Mr. King decided to stop fishing.

Gill-netting for bass was resumed on August 24. The second net was set at the northeast side of the mouth of the lake where a fish had been captured on August 9. (See map, No. 2 location F). In the interval between August 10 and August 24, an additional net 114 ft. long, 11 ft. wide and 6 inches in

mesh had been found and was used as an extension of the first net. The combined 186 feet of net was set in location A (see map) and is indicated in the accompanying table as net No. 3. It was long enough to stretch approximately two-thirds of the distance across the mouth of the lake. Next morning both nets were empty. On the morning of August 26 a bass still very active was found caught by the mouth in that part of the net about 5 feet below the surface and about 40 feet from shore. It was 31 in. long, weighed 11 lbs. and was fatter than either of the fish previously captured. The stomach was empty and the eggs were just large enough to be visible with the naked eye. Reading of the scales indicated the age to be 10-12 years. After a fruitless visit to the nets on August 27, Mr. King decided that the catch was no longer worth the effort and the expense involved.

Table showing the days on which each of three nets set for catching large striped bass were visited, the position of each net on an accompanying map and the results of the fishing.

Date of visit	Net No.	Length	Location on map	Catch
July 26	1	72 ft.	A	Nil
27	1	"	A	Living bass, 90 cm. long, weight - 16 lbs. lean, immature male, 15 years, stomach empty.
28	1	"	A	

Date of visit	Net No.	Length	Location on map	Catch
July 29	1	72 ft.	B	Nil
30	1	"	B	"
Aug. 1	1	"	B	"
2	1	"	C	"
3	1	"	C	"
4	1	"	D	"
5	1	"	D	"
	2	50 ft.	E	"
6	1	72 ft.	D	"
	2	50 ft.	E	"
8	1	72 ft.	F	"
	2	50 ft.	E	"
9	1	72 ft.	F	Dead bass, 60 cm. long, weight 6 lbs. immature female, 7 yrs. stomach empty.
	2	50 ft.	E	Nil
10	1	72 ft.	F	"
	2	50 ft.	E	"
25	2	50 ft.	F	"
	3	186 ft.	A	"
26	2	50 ft.	F	"
	3	186 ft.	A	Living bass, 77 cm. long, weight 11 lbs. immature female, 12 yrs., stomach empty.
27	2	50 ft.	F	Nil
	3	186 ft.	A	"

7. Gaspereau migration and fishing in Shubenacadie lake in 1949

Ascent for spawning

The time of the ascent of gaspereaux from Shubenacadie lake into the tributary streams was indicated by captures in the traps operated by Mr. W. M. Chisholm on the Fletcher run and on the large and small Rawdon rivers. Three gaspereaux were found in the trap for ascending fish in the large Rawdon river on May 7 but the first large run began there on May 16. On the following day gaspereaux commenced ascending the fishway into the Fletcher run. On May 18 they were running up the small Rawdon in large numbers. The migrations had practically ceased in both of these rivers by May 21 but whether the same were true for the Fletcher run could not be determined as the trap was left open during the run to comply with a local request. A second ascent began into the large Rawdon river on June 1 and into the small Rawdon on June 3 and continued until June 6. Occasional captures were made in both traps during the rest of June and up to July 2. The fact that the gaspereaux were trapped later in the small Rawdon than in the large would coincide with the report made by local fishermen that the migrating fish followed the east shore of the lake in the ascent. The obstacle of the fishway was overcome a day earlier than the greater distance to the mouth of the small Rawdon river.

How many gaspereaux ascended the fishway into the Waverley system of lakes of how far they went before spawning is unknown.

Enquiries made of the owner of the dam at the head of lake Fletcher revealed that no gaspereaux were seen to pass from lake Fletcher into lake Thomas. This would lead to the conclusion that the spawning must have taken place in the slow moving parts of the Fletcher run or the lake itself. Mr. Chisholm estimated that two thousand gaspereaux were allowed to ascend the large Rawdon.

Local fishermen correlate their preparations for dipping gaspereaux with the weather, expecting their best catches on sunny days when the water is warming up rapidly and the wind is blowing from the southwest. Temperatures from a continuous thermograph record for the water entering the rearing ponds from the Fletcher run have been plotted for May and early June and correlated with the time of the gaspereaux migrations in 1949. (Fig. 1). Each run lasted approximately five days and took place when the water was warming up rapidly in the afternoon and cooling rapidly at night, the usual consequence of clear skies. During the first run the daily minima were approximately 54°F. and the maxima 60°F., a difference of 6 degrees and during the second run the difference was 4-5 degrees but both minima and maxima were rising from day to day. The runs were separated by a period of ten days during which falling temperatures and cloudy skies on the whole prevailed, except on May 22 and May 23 which immediately followed the cloudy day when the run stopped. The general rise in temperature at the beginning of May brought the minimum almost as high as it was during the first run but the

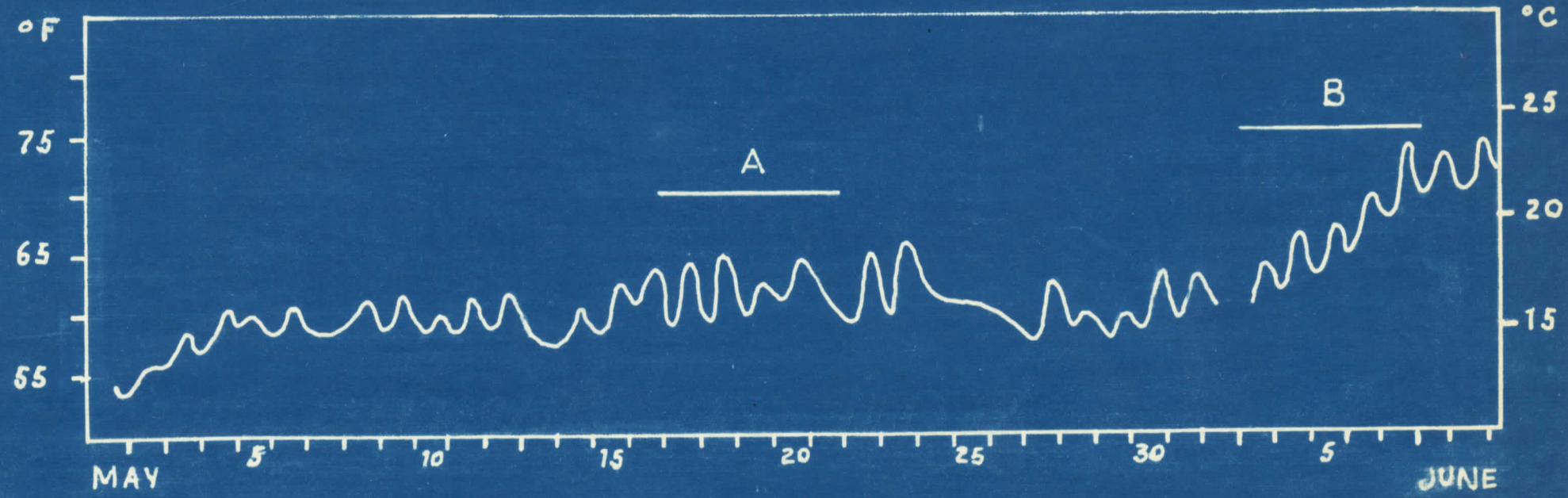


Figure 1. Temperatures from a continuous thermograph record for the water in the rearing ponds fed by the Fletcher run from May 1 to June 9, 1949. Lines A and B indicate the days on which the gaspereaux were ascending from Shubenacadie (Grand) lake into the Fletcher and Rawdon rivers.

1949 Rawdon 7

daily difference did not exceed 3 degrees indicating cloudy weather. The fact that three ascending fish were taken in the trap on May 7 indicated that the migration was probably under way earlier at the mouth of the lake.

The catch

The principal commercial fishing for gaspereaux in the Shubenacadie lake region occurs below the dam across the Fletcher run and in the lower part of the large Rawdon river. In the spring of 1949 Mr. Bert Dahr of Windsor Junction netted 176 barrels and Miss Lillian King of Wellington 107 barrels each weighing 200 lbs. and making a combined catch of approximately 28 tons. Other fishermen and local residents secured at least 10 to 12 tons according to the estimate of Mr. Dahr and Mr. Cameron, Superintendent of the rearing ponds. In his estimate Mr. Cameron included the one and one-half tons frozen for feeding the fish in the ponds. The 1949 catch of gaspereaux may be estimated, therefore, as approximately 40 tons. According to Mr. D. R. Neish who inspected fish for export to the West Indies, gaspereaux were selling in Halifax at $9 to $11 per barrel of 300 lbs. The monetary value of the catch would be about $2,500 at that price.

Descent of spent gaspereaux

The descent of spent gaspereaux into Shubenacadie (Grand) lake as indicated by captures in the trap on the large Rawdon river occurred from June 25 until the trap was removed at the end of August, the following numbers being recorded for each

month: June - 122, July - 149 and August - 204. During the latter half of July and during most of August the water in the large Rawdon river became so low that no fish entered the trap and when a freshet was created by opening the dam above the trap on July 28 spent gaspereaux came down into the trap. On August 19 very heavy rainfall produced a natural freshet which lasted for five days and led to the capture of 204 adults and many underyearling gaspereaux. The examination of the alimentary canal of a spent gaspereau brought down in the freshet revealed that the stomach contained only mucus and traces of almost completely digested plankton. The caecum was full of a brownish plankton-coloured mass so far digested that the forms could not be determined.

No descending gaspereaux passed through the fishway-trap from the Fletcher run into Grand lake although some may have passed over the dam. No trap for descending fish was installed on the small Rawdon river but Mr. Chisholm reported that no descending fish were observed along the fence beside the trap for ascending fish. Since this stream is an off-shoot of the large Rawdon the fish probably followed the main current in their descent.

Descent of underyearling gaspereaux

On July 19 underyearling gaspereaux began descending the Fletcher run into the trap at the top of the fishway. The first specimen was 2.5 cm. long. From July 25 to July 29 inclusive thousands were taken daily in the trap. The largest fish appeared earliest in the run. The descent in large num-

bers stopped as suddenly as it began. On August 2 another run occurred and lasted until August 8. During these migrations many gaspereaux passed through the screens into the salmon-rearing ponds and their behaviour could be observed there. In the circular ponds with a constant current they moved down stream in a direction opposite to that in which the salmon were moving; in the long ponds with relatively still water all, except the very small gaspereaux, moved in ribbon-like formation up one side and down the other close to the margins of the ponds and did not appear to be feeding. The small fish showed less tendency to migrate and appeared to be feeding.

Reports were received of similar runs taking place about the same time along the west shore of Grand lake near Mullin's camp and along the east shore at Oakfield. On the morning of August 10 I had an opportunity of watching schools of gaspereaux moving along the shore of Sandy cove toward the mouth of the lake. They were moving in long parallel lines in bright sunlight close to shore in water no more than ten inches deep and the ribbons were broken by the necessity of passing around vegetation and moored boats. Each school was led by the largest fish and the smallest were in the rear. Only occasionally did a fish rise to the surface as in feeding.

Not until August 19 when heavy rainfall produced a freshet did the first underyearling gaspereaux descend the large Rawdon river. Mr. Chisholm reported the capture of

1069 fish and added the following comment - "and it is thought many went through the fence because more fry were seen than were trapped". During this freshet Dr. Huntsman dipped from the trap on the Rawdon river a sample containing 174 gaspereaux which varied in length from a minimum of 7.5 cm. to a maximum of 11 cm. the greatest number (62) being 9 cm. long. On the same day he dipped 181 gaspereaux from one of the circular salmon-rearing ponds and found them to vary from 3 cm. to 7 cm. in length, the greatest number (35) being 5 cm. long. It was evident that the smallest gaspereau taken from the Rawdon river exceeded in length the largest taken from the pond. As far as could be observed the gaspereaux that entered the rearing-ponds during August were no larger than those which entered during the first run in July. That the gaspereaux from the Rawdon river had been feeding up to the time of migration was evident from the fine condition of the fish and from the examination of the alimentary canals of three individuals, 10 cm., 10 cm. and 9 cm. long. The caecum in each was crammed full of food and the stomach of one also contained a similar brownish plankton-coloured mass which on examination consisted of partly digested adults, nauplii and eggs of copepods, water mites, cladocera, and an occasional diatom. How long the gaspereaux had been in the pond before removal could not be determined nor were any stomachs examined at the time. A week later, August 29, a gaspereau of medium size removed

from one of the round ponds had its stomach full of a brown mass similar in colour to the liver fed to the fish and some chains of fresh green algae. This observation agreed with one made by Mr. W. Brimicombe who fed the fish and cared for the ponds, namely, that the gaspereau which were left in the ponds fed with the salmon.

The question arises as to the probable explanation of the earlier descent of the underyearlings from the Waverley system of lakes than from the Rawdon system. Two possible explanations were suggested to me by Dr. Huntsman: (1) that the ascending gaspereaux spawned a relatively short distance above the dam either in the Fletcher run or in lake Fletcher and (2) a scarcity of plankton for food. In the first case the fish would have to migrate a short distance only before reaching the trap and the inlet to the ponds. In the second case data concerning the abundance of plankton in the Waverley system of lakes before and during the period of migration would be necessary. In the summer of 1948 an exploratory survey of the plankton in the four lakes of the Waverley chain was made (Rep. 1948) and showed that the quantity was small in July and decreased rapidly in August especially in the shallower lakes Thomas and Fletcher. For example, an oblique tow taken with No. 5 plankton net in lake Fletcher on July 7, 1948, yielded 65 cc. of settled plankton which was chiefly cladocera and a corresponding tow taken on August

8, 1948, yielded only 15 cc. and was largely composed of copepods. On August 31, 1949, two oblique hauls were made from very nearly the same part of the lake and the combined hauls scarcely filled 1 cc. An inadequate supply of plankton may have been responsible, therefore, for (1) the small gaspereaux which entered the trap and the ponds both in the July and the August runs and continued to feed there and (2) the earliest descent of the schools into Shubenacadie lake.

On the other hand the underyearling gaspereaux descended nearly two weeks later in the Rawdon river in 1949 than in 1947 or in 1948. This may have been due to the exceedingly low water in 1949 since the first fish did not appear until after the heavy rainfall of August 19 had produced a freshet. The records show that the descent began on August 6 in 1947 and on August 7 in 1948. A single large specimen 4 cm. to 5 cm. long was mentioned as descending on July 24, 1947 and excited special comment by Mr. Purves who operated the trap, the lengths of the underyearlings in the subsequent run being only 2 cm. to 2.5 cm. In view of the size of the specimens (7.5 cm. to 11 cm.) captured a month later in 1949, the size would not be phenomenal. The fact that the gaspereaux were in such good condition in 1949 and had grown so large would incidate that sufficient plankton had been available in spite of the later time of migration.

Another factor entered the picture in 1949 which should be mentioned here, namely, a measure of control upon the number of gaspereaux which ascended for spawning in 1949 which was not

in operation previously. Approximately 2,000 gaspereaux were dipped from the trap and allowed to ascend and how this number compared with the number ascending during the two previous years is not known. Competition for the plankton would be greater if more than that number successfully spawned.

Annual gaspereau migrations at the head of Shubenacadie lake

Year	First ascent	Max. Water Temp.	Second ascent	Temp.	Descent adults	Temp.	Descent Young	Temp.	
1946	May 28		June 4		June 15				
1947	May 27	15.5°C. (sunny)	June 9 (sunny)	17°C.	June 23	19°C.	July 24 Aug. 6	23.5°C. 25°	(one) (many)
1948	May 26						Aug. 7		
1949	May 18	15.5°C. (sunny)	June 1	16.5°	June 25 (approx.)	21°	July 25 (Fletcher) Aug. 19 (Rawdon)	23°C. 20°C	(Freshet) July 30-29.5°C.

8. The ascent of a smolt

On three successive days July 6, July 7 and July 8, Mr. W. M. Chisholm, who operated the fishway trap in the Fletcher run reported the capture of single smolts 22 cm., 22 cm., and 20 cm. in length in the uppermost compartment of the trap open to fish from above but screened from ascending fish. None of the smolts had marked fins but the one taken on July 8 had a scar indicating that scales had been taken some time previously from the left side above the anal fin. The usual procedure of measuring the fish, taking a sample of scales and placing it in the pool below the dam was followed. Three days later, July 11, a smolt 20 cm. long with two marks of scale removal was captured in the same part of the trap. One half of the left ventral fin was then removed, another sample of scales taken and the smolt was released as before in deep water below the fishway. On July 19, the same smolt recognized by its markings again appeared in the trap for descending fish and was returned to the pool.

The scales taken from the smolt on July 8 showed that it was 2+ years old. There were 21 to 22 circuli from the centre to the end of the winter of the first year, 18 to 25 circuli in the second year with the winter check at approximately the 10th circulus and 8 to 11 in the third year, the 8 circuli being wide and the last three narrow and incomplete along the anterior edge of the scale. The sample removed on July 11 was composed mainly of scales which showed regeneration and when normal scale growth was resumed the numbers of circuli for the second and third years

were similar to those found in the sample removed on July 8. One good scale was found having 21 circuli in the first year, 21 in the second and 8-10 in the third. The two samples of scales were similar enough to indicate that they had been removed from the same smolt.

Clear evidence had been obtained that the trap designed to capture smolts descending the Fletcher run was functioning instead as a trap for fish ascending the fishway. Mr. Chisholm offered the following explanation: (See plan of trap). Before the trap was examined all the gates were open except that between compartment A, already referred to, and B, the next one down, which was covered by a screen. Thus descending fish were free to enter or leave A and ascending fish might enter C first and then B through the funnel from C to B. When the trap was being examined the gate between C and the fishway below was closed and that from A upstream was also closed. Compartment A was checked. A board was dropped to close the mouth of the funnel and first B, and then C was examined, care being taken to disturb any fish which might be hidden in the funnel. All the gates were then opened except that upstream from A and the screen was removed and cleaned. It would appear that the cleaning of the screen would offer the only opportunity for an undiscovered fish in compartments B or C to enter compartment A and the dam beside the fishway-trap prevented ascent otherwise.

The short time elapsing between the recaptures of the smolt would point to a tendency of the fish to linger in the deep water below the falls. Similar behaviour was observed

Fig. 1

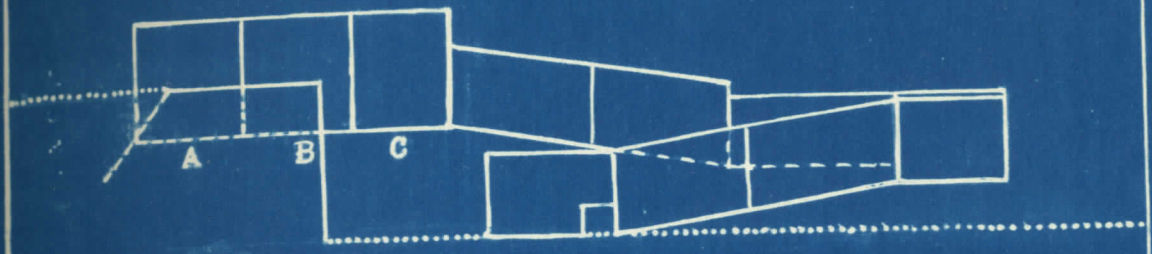


Fig. 2

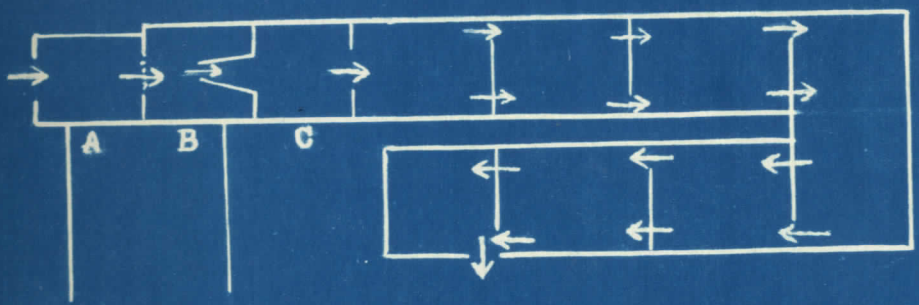
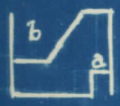


Fig. 3



Fishway and fishway-trap in Fletcher run. Fig. 1 shows the elevation, fig. 2 the plan along the floor and fig. 3 elevation of one partition or baffle. The dotted lines indicate upper and lower levels of Fletcher run.

1919 (8)

for fish of the same size and even larger in the long rearing ponds when they tended to crowd where the water fell from the inlet pipe. The rush of water from the fishway into a pool 3 feet deep and from the dam nearby into a pool 5½ ft. deep provided similar conditions. To reach the trap 7 feet above the surface of the pool, the smolt had to ascend through a series of rapids and pools in a fishway shown diagramatically in elevation in fig. 1 and in plan along the floor in fig. 2. The elevation of one partition or baffle between the compartments is shown in fig. 3. During early July the water was low throughout the whole system. On July 21 when conditions were believed to be essentially similar to those at the time of the ascents the water in the rapids on the fishway was approximately 8 inches deep at the openings along the floor. (Fig. 3, a.). No water was passing over the upper openings (fig. 3, b) except in the two compartments closest to the trap. The depth of the water in these two compartments was 2 feet but in the compartments at the bottom only 1 foot.

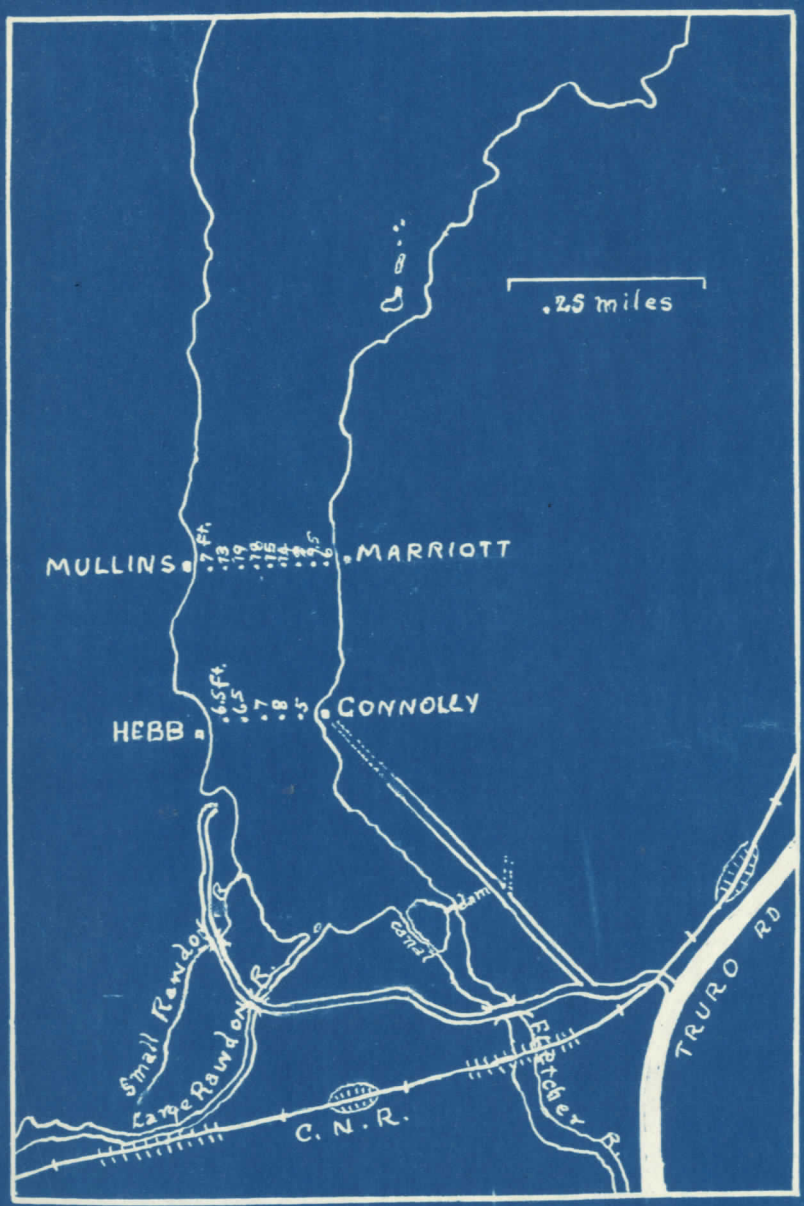
The question arises as to the probable source of the smolts which ascended the fishway in July. The old scar of scale removal on the 20 cm. smolt first observed on July 8 points to the probability that it was one from which scales had been removed by Mr. Chisholm when it descended through the trap on the large Rawdon river. One or more smolts of the same length and age by scale reading were recorded in descent there everyday from May 8 to June 1, and also on June 3, June 4, June 6 and June 15. To reach the fishway a smolt would have to make

its way through the bay at the head of the lake. (See map 1).

On June 1, June 2 and June 7, Mr. W. H. Cameron, Superintendent of the Rearing Ponds at Wellington planted 13,171 marked smolts varying in length from 15 cm. to 25 cm. near the head of Shubenacadie lake in a region which was surveyed on August 27 to determine the depth of the water. (See map). The Atlantic smolts had the right ventral fin clipped and the "Sebago" the left ventral. That some of these smolts moved upstream soon after planting was indicated by the capture on June 8 of a smolt with the Atlantic mark in an abandoned canal lock open to the lake and having some water from the Fletcher run discharging into it. A second Atlantic smolt, 18 cm. long, was captured in Compartment A of the fishway-trap on July 18. Its scales were examined and compared with scales removed from a fish of the same length from the Rearing Ponds and known to be 2+ years old. It was found to be of the same age group and similar in the number of circuli per year.

9. A comparison of the size and rate of growth of three male Salmo salar of the same length at spawning time.

On November 16, 1949, two dead male Salmo salar were found jammed on the upper side of the trap operated by Mr. W. H. Cameron for ascending kelts on the large Rawdon river. One was an Atlantic salmon which had been captured earlier in the season in the Sackville river, tagged and released in Shubenacadie lake on November 10, and the other was an untagged lake salmon. Since both were the same length (22 in.) and captured under similar conditions they were preserved for comparative



Head of Shubenacadie lake with its tributaries showing region in which smolts were planted in June, 1949. The depths of the water are indicated along two boundary lines joining camps on opposite shores of the lake.

1949 (8)

study. Later it was found that scales removed by Mr. Cameron from a male lake salmon kelt of the same length trapped in the fall of 1945 were available and a comparison of the data secured from the study of these three fishes is submitted in this brief report.

Method

(a) Measurements

The overall length of each fish was measured, the depth in front of the dorsal fin and the diameter of the eye along the horizontal margin of the iris were found for the two fish captured on November 16, 1949. The overall length of the scales was measured through the origin and the width at the widest part irrespective of erosion irregularities, the scales being moist and flattened on a glass slide. (See table 1).

(b) Determination of age

The age of each fish was determined by microscopic examination of the scales and the periods of spawning by the erosion at the edges of the scales. (Table 2).

(c) Determination of rate of growth

To compare the rate of growth of the fishes it is assumed that the increase in length of the scale is proportional to the increase in the length of the body. This may or may not be true. As far as is known the discrepancy between these two rates which has been worked out for other fishes,(1) has not been done for Salmo salar. Typical scales for each fish were placed on a ruled slide and measured to find (a) the length from the centre of origin to the anterior edge and (b) the width

of each annual ring. These two measurements were expressed as a fraction of the total length of the body to arrive at the rate of growth in each year. The results are recorded in table 2 together with the time that the fish left the river and the years in which spawning took place.

Condition of the fish

The condition of each fish was determined by calculating the commonly used condition factor, which is $\frac{100 \times W}{L^3}$, where W is weight in ounces and L is the total length of the fish in inches. (Table 1).

Discussion

The most striking difference in the rate of growth is that between that of the Atlantic grilse which went to sea after spending three years in the river and the two salmon which remained in the lake after the smolt stage. Two-thirds of the length of the former was acquired in one year at sea. The scales were larger, tougher and thicker than those of either of the lake salmon. Although the Atlantic kelt had stretched out in length in its rapid growth its condition or fatness was less than that of the lake kelt caught in 1949 and only slightly greater than that of the lake salmon caught in 1945. The rate of growth during the pre-smolt stage was similar in all three fish. This is interesting since both of the lake salmon probably were parr in the large Rawdon or the Waverley run and the origin of the Atlantic smolt is unknown.

For further comparison scales from seven pond-reared salmon which were killed by the high temperature of Aug. 1949

were studied. Since they varied in length the calculations of the growth made in each year were averaged and included in table 2. The details of the sizes, rates of growth and the periods of spawning are shown in table 3. The scales of pond reared fish were much more difficult to read and the decimal value has less significance than for the native fish. The pond fish grew more rapidly during the first two years than the native fish but less rapidly as they grew older. (Fig. 1). It is interesting to note that the rate of growth in both the lake kelts and for the most part in the pond kelts decreased after spawning.

Mr. H. C. White (2) found that comparison of eye diameter was a useful factor in age determination of salmon parr, the older parr having the larger eyes. He suggested that xxx eye diameter could be used as a check on age determination from scale reading when the annual rings were difficult to see. The eye diameters of the two kelts captured in Nov. 1949 are plotted against scale age in fig. 2.

It was observed that the scales of the pond fishes and those of the lake salmon captured in 1949 were on the whole thinner than those of the lake salmon captured in 1945 or the Atlantic salmon.

References

1. Huntsman, A. G. The growth of the scales in fishes. Trans. Roy. Can. Inst. Vol. XII, Pt. 1, No. 27.

2. White, H. C. Age determination of salmon parr by the effect of the rate of growth on body proportions. Journ. Biol. Bd. Can., Vol. II, No. 4, 1936.

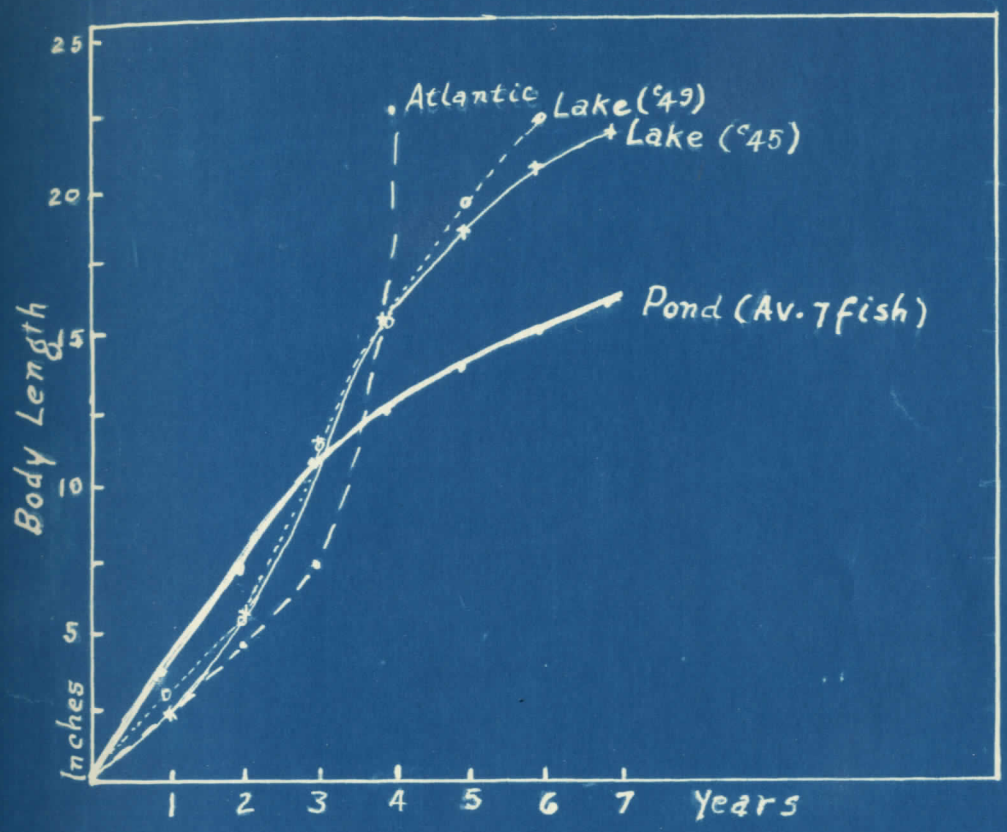


Fig. 1. Comparison of the length of the body and the age, as determined by the scales, of Atlantic, Shubenacadie lake, and pond-reared Salmo salar.

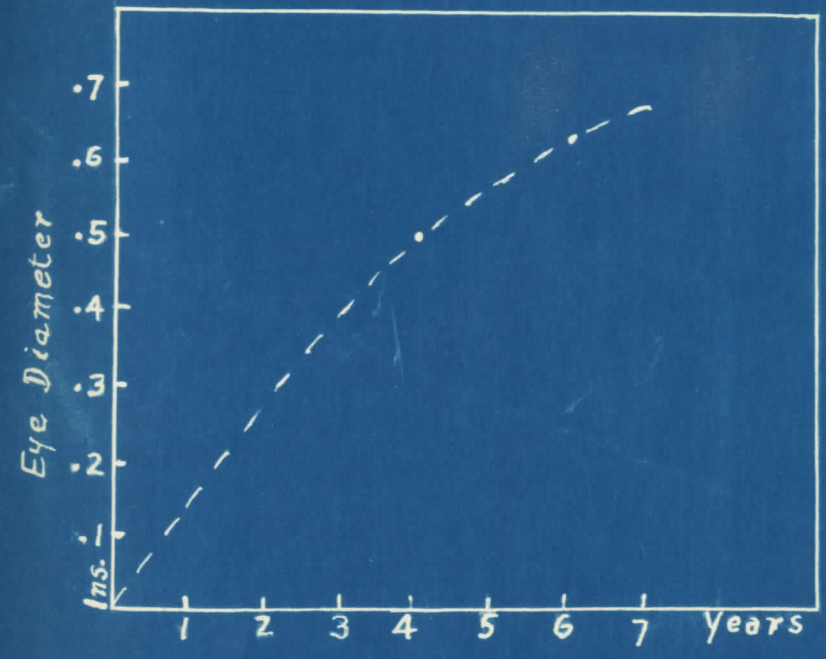


Fig. 2. Comparison of the age, as determined by the scales, and the diameter of the eye of Salmo salar.

Table 1

Date of capture	Kind of salmon	Length of body (in.)	Depth of body (in.)	Weight (oz.)	Eye diam. (in.)	Aver. scale length (mm.)	Aver. scale width in mm.	Condition
16/11/49	Atlantic	22	3.5	40.5	.5	6.2	4.0	.38
16/11/49	Lake	22	4.75	58.5	.625	5.1	3.7	.54
23/11/45	Lake	22	-	36	-	5.6	4.0	.33

Table 2

Date of capture	Kind	Length (in.)	Age yrs.	Increase in length in each year in inches 1	2	3	4	5	6	7	River age
16/11/49	Atlantic	22	4	2.2	2.2	2.2	15.4 sp				3 yrs.
16/11/49	Lake	22	6	2.8	2.8	5.5 sp	4.1 sp	4.1 sp	2.7		2 yrs.
23/11/45	Lake	22	7	2.2	3.2	5.5	4.4	3.3 sp	2.2 sp	1 sp?	2+ yrs.
3/8/49	Pond	12.2 to 16.8	4 to 5	3.4	3.3	3.1	2.5	1.5	1	1	

Table 3

No.	Length (in.)	Age (yrs.)	Increase in length in each year in inches 1	2	3	4	5	6	7
1	16.8	7	3	3	3	3 sp	2 sp	1 sp	1
2	16.6	5	4.1	4.1	4.1 sp	2.8 sp	1.4	(scales poor; sp.not clear)	
3	15.2	5	2.5	3.8	3.8	2.5 sp	2.5		
4	14.8	5	3	3	4	3	2		
5	12.8	4	3	3	3 sp	2 sp	1		
6	12.4	4	4	3	2 sp	2 sp	1		
7	12.2	4	4	3	2 sp	2	1		
Average rate of growth			3.4	3.3	3.1	2.5	1.5	1	1

Note: The last mentioned year is the current one and too early for spawning.

10. The study of salmon scales

Aim

To acquire skill in determining readily the age, rate of growth and time of spawning of Salmo salar.

This skill was considered important for studying data obtained from recaptured marked and tagged salmon which have been planted from time to time and from those which are to be released during the experiment in fish management.

Collection of material

1. With the permission of the Superintendent, Mr. W. H. Cameron, samples of scales from living yearlings being raised in the ponds were collected. The extremes in size in each haul of the net were used.

2. Scales were obtained from fish in the older age groups which died in the ponds during the hot weather in August.

3. Scales from tagged and marked fish turned in by anglers since 1945 have been available for study.

4. Removal of scale samples from smolts taken in the traps on the Rawdon river and the Fletcher run has been a regular procedure and the scales were stored for study.

Method

The scales were examined dry if flat and clean. Dirty and bent scales were softened in soapy water, scraped gently and read when moist on a glass slide. A rough estimate of the rate of growth was based on the assumption that the scales increase in length at the same rate as the body. This may or may not be true but as far as is known any variation from this relationship has not been worked out for Salmo salar. The increase in the length of the scale per year was measured on a slide ruled at intervals of 0.2 mm. Periods of spawning were determined by the erosion at the edges of the scale.

Preliminary study

Little time was available for the study of salmon scales

during the summer. A beginning, however, was made at Wellington with scales removed from pond fish and those of the tagged fish turned in during the current year. The scales of the smolts which ascended the Rawdon river and the Fletcher run were given special attention during the summer and were reviewed in the autumn in Toronto and are reported in "The ascent of a smolt". For valuable suggestions and help in this preliminary work I am deeply grateful to Dr. Huntsman. Since it was observed that a large proportion of the scales in some samples showed regeneration, it seemed important to find out the region of the body where the scales would be most suitable for age determination. Accordingly a salmon parr 12.5 cm. long was selected from a preserved lot of fish from the Kennebecasis river and scales from the various parts of its body that are indicated by numbers on the accompanying diagram (fig. 1) were studied. Scales were taken from corresponding areas from both sides of the fish. The results may be summarized as follows:

1. Scales from corresponding areas on opposite sides of the salmon were similar in appearance.

2. Scales found anteriorly along the lateral line (1) tended to be small.

3. The best scales for reading came from the middle of the side between the dorsal and ventral fins (2, 5 and 8).

4. The region showing the largest proportion of regenerated scales was near the tail (4 and 3).

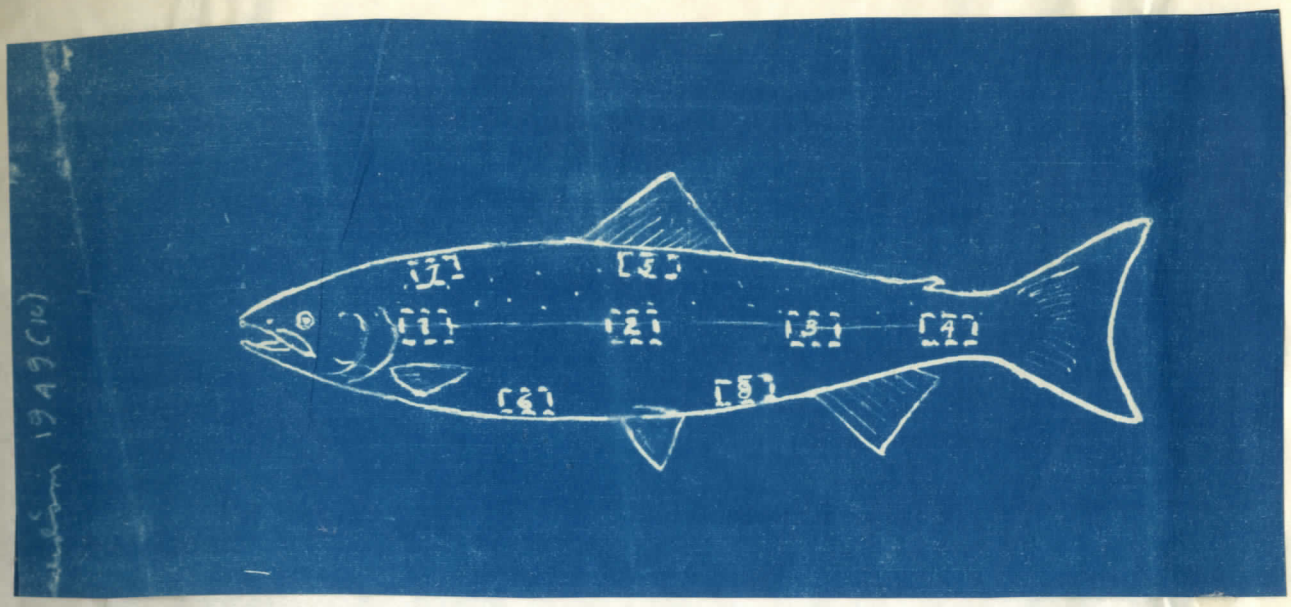


Fig. 1. A young salmon showing regions from which scales were removed for comparative study.

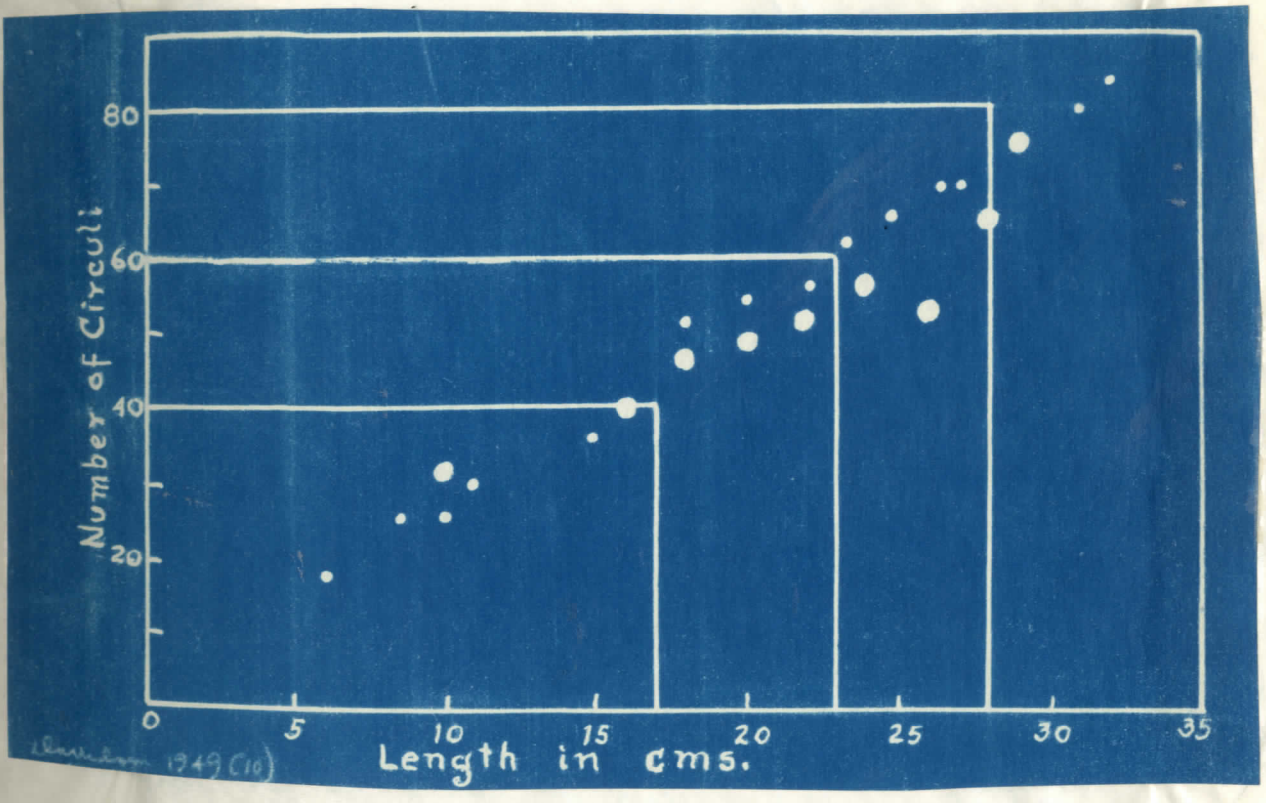


Fig. 2. Relationship between length of a salmon and total number of circuli on the scales. The small dots refer to fish reared in ponds and the large dots to "native" fish trapped in the Rawdon river. The rectangles divide the ages of the pond fish into years.

Scales of pond fish

Scales of salmon raised in the ponds at Wellington presented more difficulty in age determination than those of native or "trapped" lake salmon or sea salmon. There was less differentiation in the seasonal growth and on the whole the scales were thinner and more apt to be perforated when cleaned. This was particularly true of the older fish which had been retained in the ponds beyond the smolt stage and of the tagged pond kelts which were recaptured. Familiarity with these scales proved to be of value in determining the age at planting of similarly marked fish of the same age-year class group only when a change in the rate of growth after the fish entered the lake was apparent.

There was considerable variation in the length of the pond fish of the same age and it was found that the total number of circuli on the scales increased with the length of the fish. The relationship between the overall length of the body and the number of circuli for each length are shown in table 1 and graphically in fig. 2. The lengths in each year class are separated by vertical lines. It is apparent that the number of circuli on the scales of the longest fish in each year class was less than that of the shortest in the next year class. In the case of the scales in which the winter check is difficult to identify it would be useful to know that a scale with not more than 40 circuli probably came from a pond yearling, one with 40 to 60 circuli from a 2 year-old and one with 60 to 80 circuli from a 3 year-old salmon. Insufficient material and erosion due to spawning interfered with determining the upper limit of the number of circuli in the 4-year-olds.

Table 1. Relation between the age, the length of the body and the number of circuli on the scales of (a) salmon reared in ponds and (b) salmon trapped in the Rawdon river in 1949.

Age	Length of body (cm.)	Total number of circuli (pond fish)	Total number of circuli ("native fish") (averages)
1 yr.	6.5	17	
	8.5	25	
	10	25.1 (av.)	31
	11	30	
	15	36	
	16	40	
2 yrs.	16		39
	18	52	46
	20	55	48
	22	57	51
	24		56
3 yrs.	23.5	62	
	25	66.5 (av.)	
	26		53
	26.5	70	
	27	70	
	28		65
	29		75
4 yrs.	31	80	
	32	84	

Scales of Recaptured kelts

The ages at recapture of the tagged kelts taken by anglers in the spring of 1949 were determined and the periods of spawning as indicated by erosion at the edge of the scale recorded. Scales were received from only 13 kelts of the total number recaptured. The results are shown in table 2. All of the fish were captured early in the spring between April 28 and

May 11 except one caught on June 5. New growth in the current year was discernible only in the few cases indicated by the plus sign.

Table 2. Determination of age and periods of spawning of recaptured salmon kelts caught by anglers in 1949 in the Shubenacadie lake region. The age is separated into periods before and after the smolt stage.

No. of tag	Kind of kelt	Sex	Length (in.)	Weight (lbs.)	Age (yrs.)	Years of spawning
K 4889	sea	F	23	-	2:2	3rd and 4th
K 4901	"	M	30	5	2:3	4th and 5th
K4882	"	F	31	-	2:3	3rd, 4th and 5th
K4872	"	F	31.5	5-14 oz.	2:3	3rd, 4th and 5th
K4873	"	F	32	8	2:3	3rd, 4th and 5th
B2918	trapped lake	M	14	1	2:1+	3rd
B2923	"	M	14	1	2:1	3rd
A 597	"	F	18	1-12 oz.	2:3+	3rd, 4th and 5th
A 197	"	F	18	2	2:2	3rd and 4th?
B 2910	pond	M	16	1	2:3	3rd?, 4th and 5th?
B 2976	"	F	16	1	2:4+	4th? xxx 5th?
K 4933	"	F	16	1	2:4	?
B 2934	"	M	17	1-3 oz.	2:4?	?

Scales of marked fish

Scales from marked fish taken in Shubenacadie lake by anglers in 1945, 1947 and 1948 were available for study and as much time as possible was given to this work in November and December.

Efforts were made to determine the year class for each fish and it was then a matter of referring to the records of the plantings of that year class to find out how long the fish had been growing in the lake. In the case of the Atlantic salmon there was no difficulty as all were planted as yearlings in the Beaver or Rawdon rivers. The lake salmon raised in the ponds, however, were planted at different ages and the length of time that a fish spent in the lake was not always clear.

It is recognized in calculating the annual increase in the length of a fish from scale reading by the method described above that the measurements of the overall length of the marked fish as reported by the anglers are open to question since there was wide variation in the weights ascribed to a fish of the same length. For example, fourteen-inch fish were reported to weigh from 12 oz. to 36 oz. In all probability there was a lack of facilities for accurately weighing or measuring the fish before disposal.

In marking Atlantic salmon during this period the adipose and left pelvic or ventral fins were removed. The anglers were asked to measure and weigh the fish and along with a sample of scales from the side of the fish turn in clear evidence of the marking. Removal of the adipose fin was seldom mentioned by the anglers and it is assumed that it was missing when evidence of the missing left ventral was accepted as adequate. Scales from 17 fish with the above marking were received. 10 are believed to be of the 1943 year class and 7 of the 1944 year class and the calculated rate of growth and the periods of spawning for

each fish are shown in table 3.

In 1944, 4,769 Atlantic salmon yearlings from the Grand Lake Rearing Ponds were released, 1,074 in the Beaver river and the rest in the Rawdon river. In the following year, 4,820 Atlantic yearlings were distributed, 1,200 in the Beaver river and 3,620 in the Rawdon river. All the recaptured fish were taken in Shubenacadie lake, five at the upper end, five near the mouth, one at the extreme north end where the shallow part is known as "Little lake" and for the rest the part of the lake from which they came is unknown. Although seventeen recaptures is small recovery from a large planting, it is valuable evidence that offspring of Atlantic salmon could be captured in Shubenacadie lake four or five years after planting although perfectly free to move out to sea through the Shubenacadie river.

From a study of table 3 it would appear that the yearlings planted in 1945 were slightly larger than those planted in 1944. All grew rapidly during the first year in the lake, spawned and then the rate of growth declined with successive spawnings.

The average length of the ten fish which were five years old when caught was 14.1 inches; that of the four year olds 12.7 inches. The smallest fish 11 inches long and five years old was found in "Little lake" which is considered poor for salmon and the largest near the dam at the upper end of the lake in June during a week following a flood so great that it interfered with the operation of the trap on the nearby Rawdon river. (Report - Mr. W. M. Chisholm, 1948).

Lake salmon from the rearing ponds were marked by the re-

moval of adipose and right ventral fins. Twenty-three specimens of scales from fish bearing this mark were examined. The age at capture, rate of growth and years in which spawning took place are shown in table 4. Fifteen captures were made in Shubenacadie lake, more near the mouth than at either end. Four were found in Beaverbank lake, one in Kinsac or Long lake and three in the Shubenacadie river. The fish most distant from the planting area was taken in the Shubenacadie river at Milford in fresh water below the upper limit of tide. The other two caught in the Shubenacadie river were found a mile below the mouth of the lake.

Determining with certainty the age at which the lake salmon were planted was impossible since the same year class were released at various ages with the same marking. Fish caught in Beaverbank lake were in all probability those released as yearlings in the Beaver river and the fish caught in Kinsac lake on May 12, 1947, was probably set free as a yearling in the Rawdon river in 1945. In table 5 are shown the numbers, ages and bodies of water in which the lake salmon were planted from 1941 to 1945 inclusive and this information indicates the wide range of possibility in the choice of age at which the fish caught in Shubenacadie lake were planted. The smallest and youngest fish caught on May 8, 1945, must have been one of the underyearlings planted in 1942 since the three-year-olds would be planted later in 1945. It was probably a large fish when planted (4.1 inches) and grew less rapidly when it was released. In most cases the lake salmon made their most

rapid growth in the third year and then spawned. Subsequent spawnings were accompanied by a decrease in the rate of growth. Rates of growth in tables 3 and 4 are so similar that one is led to believe that most of the lake salmon were planted as very young fish and had been living in the lake from three to five years before being caught by anglers. It is suggested xxxxx in table 4 that three fish of the 1941 year-class may have been planted at three years of age because of the relatively rapid rate of growth in the first two years usually characteristic of life in the rearing ponds.

Table 3. Marked Atlantic salmon planted as yearlings in the Beaver and Rawdon rivers and captured in Shubenacadie lake showing age and rate of growth as determined by scale examination. The age is separated into two periods before and after smolt stage.

Year class	Date of capture	Length (in.)	Weight (oz.)	Age (yrs.)	Rate of growth per year in inches and marks of spawning (sp) 1	2	3	4	5	6
1943	23/5/48	11	8	2:3+	1.7	1.7	sp 3.3	sp 2.5	sp 1.7	
"	11/6/48	12	12	2:3+	2	2.8	sp. 3.2	sp 2.1	sp 1.6	
"	4/6/48	13	16	2:3+	2.3	2.4	sp 3.6	sp 2.8	sp 1.8	
"	15/5/48	13	12	2:3	2	2	sp? 4	sp? 3	sp? 2	
"	5/5/48	14	20	2:3+	2	2	sp 6	sp 3	sp 1	
"	10/5/48	14.5	17	2.3	2	2	sp 4.5	sp 3.5	sp? 2.5	
"	22/4/48	14.5	36	2.3	2	2	sp 5	sp 3	sp 2	
"	17/6/48	15	16	2.3+	2.5	2.5	sp 2.5	sp 3.7	sp 2.5	1.2
"	22/5/48	16	24	2.3+	2.7	2.6	sp 5.3	sp 2.7	sp 2	.7
"	13/6/48	18	32	2.3+	2.5	2.5	sp 5.1	3.9	sp 3.2	.7

Table 3 (continued)

Year class	Date of capture	Length (in.)	Weight (oz.)	Age (yrs.)	Rate of growth per year in inches and marks of spawning (sp) 1	2	3	4	5	6
1944	3/6/48	12	12	2:2+	2.4	2.4	2.4 sp	3.6 sp	1.2	
"	7/6/48	12	12	2:2+	2	3	4 sp	2 sp	1	
"	1/6/48	12	12	2:2+	2.6	4	3.3 sp?	2		
"	20/5/48	13	16	2:2+	2	2	5 sp	3 sp?	1	
"	20/6/48	13	12	2:2+	3.2	3.3	4.5 sp	1.9 sp		
"	2/5/48	13	16	2:2	2	3	5 sp	3 sp?		
"	30/5/48	14	24	2:2+	3	3	4	3	1	

Table 4. Marked lake salmon from the rearing ponds at Wellington planted as yearlings in the Beaver and Rawdon rivers and at various ages in Shubenacadie lake, showing age at capture amd rate of growth as determined by scale examination. The age is separated into two periods before and after smolt stage.

Year class	Date of capture	Length (in.)	Weight (oz.)	Age (yrs.)	Rate of growth per year in in. and periods of spawning (sp) 1	2	3	4	5	6	Probable age at planting
1940	1/4/45	14	12	2:3	2.3	3.5	4.6 sp	2.3 sp	1.2 sp		1 year
"	12/5/46	16.5	24	2:4	2.5	2.5	3.8 sp	2.5	2.5	2.5	1 "
1941	25/4/45	10	7	2:2	2.3	2.7	3.2 sp.	1.8 sp?			1 "
"	22/4/45	10	8	2:2+	2	2.5	3 ?	2.5			1 "
"	25/4/45	12	12	2:2	1.7	3.4	5.1 sp	1.7 sp?			1 "
"	3/6/45	13	10	2:2+	3.9	3.9	2.6 sp?	2	.6		3 "
"	3/6/45	13	8	2:2+	3	3	4 sp?	2	1		3 "
"	25/4/45	14	10	2:2	4.2	4.2	3.5 sp	2.1 sp			3 "
"	23/6/47	19	32	2:4+	2.2	2.2	6.7 sp	2.2 sp	3.3 sp	2.2	1 "
1942	8/5/45	9.5	4	2:1	4.1	3.6	1.8				under-yearling

Table 4 (continued)

Year class	Date of capture	Length (in.)	Weight (oz.)	Age (yrs.)	Rate of growth per year in in. and periods of spawning (sp) 1	2	3	4	5	6	Probable age at planting
1942	9/5/47	14	12	2:3	2.1	2.1	3.2 sp	3.2 sp	3.2 sp		under-yearling
"	11/5/47	14	20	2:3+	1.7	2.3	2.9 sp	3.5 sp	3.5 sp?		"
"	9/5/47	16	24	2:3	1.8	1.8	4.3 sp	4.3 sp	3.7 sp		"
1943	20/6/48	11	?	2:3+	2.2	2.2	2.7 sp	2.2	1.6		yearling (Beaver river)
"	28/4/48	12	16	2:3	2.4	1.8	1.8 sp	3.6 sp	2.4 sp		"
"	9/5/48	12	16	2:3	2	2	3.5	3.5 sp	1 sp?		yearling
"	1/6/48	14	?	2:2+	2	2	3	2	1		"
"	23/5/48	15.5	?	2:3	2.4	2.4	4.8 sp	3.6 sp	2.4 sp		1 yr.
"	20/5/47	15	16	2:2+	3.4	3.4	4.8 sp	3.4 sp			1 yr. (Beaver river)
1944	8/5/47	10	8	2:1	2.5	3.7	3.8 sp				1 yr.
"	20/5/47	11	8	2:1+	2.8	3.2	5.0 sp				1 or 2 yrs. (Beaver river)
"	12/5/47	15	16	2:1+	2.3	5.4	6.9 sp	1.3			1 or 2 yrs. (Rawdon river)
1945	30/5/48	14	24	2:1	2.5	3.9	7.6 sp				?
1947	3/6/49	7.2	?	2+	3.0	3.0	1.2				1 yr.
"	14/6/49	7.2	?	2+	3.0	3.0	1.2				"

Table 5. Ages and numbers of lake salmon planted from 1941 to 1947 inclusive in the Shubenacadie lake region to which the fish listed in table 4 might belong.

Year class	Age at planting (years)	Number planted	Region of planting
1940	1-1941	31,250	Shubenacadie L.
	2- 42	5,377	" "
	3- 43	82	" "
	4- 44	12	" "
	5- 45	10	" "
1941	1- 42	14,555	" "
	3- 44	482	" "
	4- 45	75	" "
	5- 46	100	" "
1942	1- 42	4,000	" "
	3- 45	1,595	" "
	4- 46	90	" "
1943	1- 44	1,074	Beaver river
	1- 44	3,695	Rawdon "
	3- 46	565	Shubenacadie L.
	4- 47	20	" "
1944	1- 45	1,200	Beaverbank L.
	1- 45	3,620	Rawdon river
	2- 46	471	" "
1945	1- 45	7,000	Shubenacadie L.
	1- 46	28,450	" "
	1- 46	235	Rawdon river
	2- 47	400	" "
1947	1-1948	9,948	Shubenacadie L.

Scales of smolts

During May and June of 1948 and 1949 a smolt trap was operated in the large Rawdon river a short distance above the mouth by Mr. W. M. Chisholm and samples of the scales of the smolts were stored for study. Sixty-seven samples were taken in 1948 and over three hundred in 1949. A selection of represent-

ative samples covering the whole period of the run in each year was made and the scales were examined carefully to determine the age of each fish at the time of capture, the rate of growth according to the increase in the length of the scale and the number of circuli added in each year. The results are shown in table 6, fish of the same size being listed together irrespective of the year of capture.

In May, 1948, two smolts were taken in a trap near the mouth of the Fletcher run and are included in table 6. Six salmon trapped in 1949 and indicated by Mr. Chisholm as still being in the parr stage are also indicated in the same table for comparison.

Examination of the smolt scales and study of the summary in table 6 led to the following conclusions:

1. With very few exceptions the winter checks were plainly visible on the scales of the smolts and the scales showed less regeneration than those of salmon reared in the ponds at Wellington.

2. All the smolts less than 26 cm. long which descended the Rawdon river were two-year-olds and growing rapidly in the third year as shown by the wide circuli in the current year.

3. The "smolts" 28 cm. and 29 cm. long, three of which bore spawning marks had scales resembling those of pond fish and they may have belonged to a group of 1,075 unmarked three-year-olds released by Mr. Cameron in the fall of 1948 after the stripping of the kelts was completed.

4. It is curious that both of the fish which descended

the Fletcher run in May, 1948 showed no growth in the current year although smolts taken about the same time in the Rawdon had 3 or 4 circuli of new growth. It is suggested that conditions for feeding may be less favourable in that stream or in the lakes above.

5. For the sake of comparing the rate of growth during the smolt runs, the time of each run was divided into three periods (a) early May (1st to 15th), (b) late May and (c) early June. The average number of circuli of new growth up to the time of capture was found for each period and the averages were as follows:

1948--- late May-- 4.1 circuli
1949--early May--3.1 "
" late May-- 5.5 "
" early June- 7.3 "

It would appear from these calculations that growth began earlier in the spring of 1949 than in 1948 and may be associated with the higher temperature of 5.5°C recorded for the water entering the rearing ponds in the latter part of May, 1949 than for the same time in 1948.

6. That pond fish and "native" fish resemble each other in rate of growth is indicated by the relationship between the total number of circuli on the scales and the length of the body. (Table 1; Fig. 2).

Table 6. Smolts of various lengths taken in the trap for descending fish in the large Rawdon river showing age and rate of growth as determined by scale examination.

Date of capture	Length (cm.)	Age (yr.)	Rate of growth in cm. per yr. 1	2	3	No. of circuli per yr. 1	2	3	Total
22/5/49	16	2+	5.3	6.6	4.0	16	20	5	41
1/6/49	16	2+	5.7	6.5	3.8	18	15	7	40
3/6/49	16	2+	4.8	8.0	3.2	15	15	7	37
3/6/49	16	2+	5.3	8.0	2.7	21	14	7	42
17/5/48	17	2+	6.8	6.8	3.4	20	15	4	39
20/5/48	18	2+	7.5	9.0	1.5	24	24	3	51
23/5/48	18	2+	10.0	7.0	1.0	25	19	3	47
7/5/49	18	2+	6.0	10.5	1.5	18	27	3	48
7/5/49	18	2+	6.0	10.5	1.5	15	28	3	46
12/5/49	18	2+	2.6	11.5	3.9	12	29	5	46
17/5/49	18	2+	3.9	11.6	2.5	11	30	6	47
17/5/49	18	2+	8.3	6.9	2.8	21	20	3	44
22/5/49	18	2+	5.1	9.0	3.9	19	20	6	45
27/5/49	18	2+	7.7	7.7	2.6	23	22	5	50
27/5/49	18	2+	3.6	7.2	7.2	12	14	7	35
27/5/49,	18	2+	7.7	8.7	1.7	21	18	6	45
27/5/49	18	2+	9.0	6.0	3.0	26	19	5	50
27/5/49	18	2+	6.0	9.0	3.0	22	19	5	46
1/6/49	18	2+	6.4	7.7	3.9	20	18	7	45
10/6/49	18	2+	3.3	9.9	5.0	12	21	8	41
27/5/48	18.5	2+	6.1	9.4	3.0	19	23	4	46
17/5/48	19	2+	8.8	7.3	3.0	24	25	4	53
26/5/48	19	2+	6.8	9.5	2.7	17	26	4	47

Table 6 (continued)

Date of capture	Length (cm.)	Age (yr.)	Rate of growth in cm. per yr. 1	2	3	4	No. of circuli per yr. 1	2	3	4	Total
29/5/48	19	2+	6.3	8.0	4.7		19	18	6	43	43
25/5/48	20	2+	8.3	8.3	3.3		22	14	4		40
22/5/49	20	2+	7.1	10.0	3.0		20	24	5		49
27/5/49	20	2+	6.6	10.5	2.9		23	18	7		48
27/5/49	20	2+	7.5	10.0	2.5		22	29	7		58
1/6/49	20	2+	6.6	10.0	3.3		17	18	8		43
24/5/48	21	2+	8.0	11.3	1.7		21	23	5		47
24/5/48	22	2+	9.5	9.5	3.0		21	20	4		45
12/5/49	22	2+	11.0	10.5	.5		23	22	2		47
10/6/49	22	2+	9.4	9.4	3.1		28	19	8		55
5/6/49	22	2+	9.5	9.5	3.0		24	21	7		52
5/6/49	22	2+	8.0	11.0	3.0		24	25	6		55
22/5/49	24	2+	9.0	12.0	3.0		20	26	6		52
10/6/49	24	2+	8.0	10.7	5.3		26	26	8		60
5/5/49	26	2+	10.4	13.0	2.6		21	26	4		51
22/5/49	26	2+	8.6	13.0	4.4		22	26	6		54
23/5/48	28	3+	8.7	10.5	7.0	1.7	24	21	13	4	62
3/5/49	28	3+	11.2	11.2	4.2 sp	1.8	25	28	11	3	67
3/5/49	29	3+	10.9	10.9	6.2 sp	1.0	34	30	12	3	79
Taken in the trap for descending fish in the Fletcher river											
19/5/48	23	2	9.9	13.1	0		22	23	0		46
19/5/48	34	3	6.8	17.0	10.2		21	31	27		79
Salmon parr taken in the smolt trap in the Rawdon river											
3/6/49	8	2	4.0	4.0			20	20			40

Table 6 (Continued)

Date of capture	Length (cm.)	Age (yr.)	Rate of growth in cm. per yr. 1	2	3	4	No. of circuli per yr. 1	2	3	4	Total
5/6/49	10	1+	6.2	3.8			22	9			31
5/6/49	10	1+	6.2	3.8			22	10			32
10/6/49	10	1+	6.2	3.8			22	8			30
27/5/49	16	2	9.6	6.4			20	14			34
9/5/49	29	3+	13.3	10.9	4.8 sp		36	18	17	1	72