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Assessment of the Atlantic salmon population of Conne River, Newfoundland, in 1989

by

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### Abstract

Results obtained from a fish counting fence provided the basis for the assessment of the Atlantic salmon population of Conne River, Newfoundland, SFA 11, in 1989. Returns to the river (and estuary) were 4958 salmon < 63 cm in size and 319 salmon  $\geq$ = 63 cm in size. This was 35% below the 1988 returns of small salmon and 24% below the predicted return which had been forcasted to be lower than the three previous years. Returns of large salmon were 24% below 1988 returns. Total egg deposition from small salmon in 1989 was estimated to be 6.52 million eggs; 84% of the target requirement of 7.8 million eggs. The additional contribution from large salmon of 1.04 million eggs ensures that about 97% of the target was obtained in 1989. The recreational catch of 1036 (180 below the fish counting fence) small salmon was 33% lower than in 1988 with estimated effort (rod-days) down 20% from the previous year. The native food fishery reported a catch of 369 small salmon. Total returns, and returns of tagged fish suggested a lower sea survival last year. A mark-recapture study indicated a smolt run in 1989 of 78,588 fish (72,600-84,000); 30% higher than the 1988 smolt estimate. With survival back to the river estimated at 9.4%, 7,360 (6,824-7,896) small salmon are expected to return to the Conne River and estuary in 1990 with an available harvest of 2824-3896 salmon. Should survival be lower than 9.4%, then predicted returns would also decline reducing the available harvest.

#### Résumé

L'évaluation de la population de saumon de l'Atlantique de la rivière Conne (Terre-Neuve), ZPS 11, de 1989 est fondée sur les résultats obtenus à un barrage de dénombrement. Les remontées dans la rivière et dans l'estuaire se sont chiffrées à 4 958 saumons de moins de 63 cm et 319 saumons de longueur égale ou supérieure à 63 cm. Cela représentait une diminution de 35 % par rapport aux remontées de petits saumons de 1988 et de 24 % par rapport aux nombres prévus, pourtant inférieurs à ceux des trois années antérieures. Les remontées de gros saumons accusaient également une diminution de 24 % par rapport à celles de 1988. La ponte totale des petits saumons en 1989 a été évaluée à 6,52 millions d'oeufs, soit 84 % des besoins, ciblés à 7,8 millions. Grâce à l'apport des gros saumons, qui a été de 1,04 million d'oeufs, on a atteint 97 % de la cible de Les prises sportives de 1 036 poissons (180 en aval du barrage de 1989. dénombrement) et l'effort estimé (jours de pêche) sont respectivement inférieurs de 33 % et de 20 % à ceux de 1988. La pêche de subsistance des autochtones s'est soldée par des prises de 369 petits saumons. Les remontées totales et les remontées de saumons étiquetés semblent refléter une survie en mer moindre l'an dernier. Selon une expérience d'étiquetage et de recapture, la remonte de tacons en 1989 s'établissait à 78 588 poissons (72 600-84 000), soit 30 % de plus que les estimations de 1988. Compte tenu d'un taux estimé de survie en rivière de 9,4 %, on s'attend à ce que 7 360 (6 824- 7 896) petits saumons reviennent dans la rivière Conne et dans son estuaire en 1990; les captures possibles seraient de 2 824 à 3 896 poissons. Si le taux de survie en rivière s'avérait inférieur à 9,4 %, les remontées prévues et, partant, les captures possibles diminueraient en conséquence.

### Introduction

A fish counting fence was operated on the Conne River, Newfoundland (Fig. 1), SFA 11, during 1989 to enumerate the upstream migrating population of Atlantic salmon, and thus provide information to assess the status of this stock. This marked the fourth year of operation of this facility. Similar to the situation in past years, Atlantic salmon stocks of the Conne River potentially could contribute to commercial, recreational, and native food fisheries during 1989. The opening and closing dates for these fisheries are summarized in Table 1. The restrictions for the native food fishery were essentially the same as in past years and were as follows: 1) a total quota of 1200 salmon < 63 cm in fork length; 2) fishing was restricted to the Conne River estuary and the use of two trap nets or a combination of one trap net and two gillnets; 3) mesh size of gillnets was restricted to 127 mm or larger; 4) maximum weekly harvest levels, which applied to the total quota, were 200 fish from June 5-11, 400 fish from June 12-18, 400 fish from June 19-25, with the remainder of the quota during the subsequent weeks of the fishery. Both recreational and food fisheries were prohibited from retaining salmon  $\geq 63$  cm, although salmon of this size found dead in the food fishery gear could be retained and counted against the quota.

The objective of this paper is to present an assessment of the Atlantic salmon population of the Conne River for 1989. Catch data from various fisheries are reviewed, biological characteristic data of the population are updated, salmon returns and spawning escapements are estimated and compared to previous years and forecasts, and a forecast of adult returns in 1990 is provided.

#### Methods

### 1. Landings in 1989

Data on landings in the recreational fisheries were collected by Department of Fisheries and Oceans (DFO) Fisheries Officers and processed by DFO Science Branch personnel. Estimates of the recreational catch <u>below</u> the fish counting fence (allowed for the first time in 1989) were obtained from Science Branch personnel operating the counting facility. Landings in the native food fishery were obtained from the Conne River Native Band Council. Commercial landings for Statistical Section 36 of SFA 11 were obtained from Fisheries Statistics and Systems Branch of DFO. Only preliminary commercial catch information for 1989 was available at the present time.

## 2. Biological characteristics

Biological characteristic information on adult salmon, including fork length, whole weight, age, and sex, was obtained from sampling salmon caught in the recreational fishery. Age and length data were also obtained from a limited number of fish sampled at the fish counting trap. Biological data from salmon smolts were obtained from specimens sampled at the downstream counting fence trap. Comparisons of the river age distribution of smolts in year i with grilse in year i+1 were carried out using likelihood ratio statistics (G<sup>2</sup> - test).

# 3. Estimated returns and spawning escapement

Adult Atlantic salmon migrants were enumerated at a fish counting fence, located about 1 km upstream from the mouth of the Conne River (Fig. 1), which operated from May 20 to August 28, 1989 (Table 2). Total returns were estimated from:

Total returns = count of fish at the fence + known mortalities below the counting fence + recreational catch below the counting fence + an estimate of the number of Conne River origin salmon caught in the native food fishery.

Similar to last year (Dempson 1988), the estimated proportion of Conne River origin salmon in the food fishery was an average value calculated during 1986 and 1987 and was 0.833.

Number of spawners were estimated from:

Spawners = salmon released at fence - known mortalities above the counting fence - unrecorded mortalities - angling catch above counting fence.

Unrecorded mortalities, which include natural mortality in the river prior to spawning and illegal removals, were assumed to be 5% of the number released upstream at the counting fence, similar to previous years (Porter et al. 1986; Dempson et al. 1987; Dempson 1988).

Egg deposition was calculated separately for salmon < 63 cm and salmon  $\geq$  63 cm and then totaled.

Egg deposition = spawners x % female x fecundity at mean length.

An estimate of fecundity was obtained from the following relationship derived in 1987 (October 27-30) from ripe salmon (Dempson et al. 1987):

where length is the mean length of female salmon < 63 cm in size sampled in 1989.

An estimate of the egg deposition from salmon  $\geq 63$  cm in size was obtained using the same length-fecundity relationship for salmon < 63 cm in size, with the mean size of virgin multi-sea-winter (MSW) and repeat spawning fish ( $\geq 63$  cm) derived from pooling data from all years (N = 16). The estimate of percent females for large salmon was derived using data for all years for both MSW and repeat spawning fish (all sizes) (N = 21, N-females = 15 or 71%). The target spawning requirements were the same as in previous years at 7.8 million eggs or approximately 4000 salmon < 63 cm. Generally in past assessments, egg deposition from salmon  $\geq 63 \text{ cm}$  was considered as a buffer to estimates of spawning requirements.

### 4. Forecast of 1990 returns

A mark-recapture study was carried out to estimate the smolt production in 1989. The study was similar to those carried out in 1987 and 1988 which used two partial fish counting fences, located about 10 km apart (Fig. 1), to catch migrating smolt. Smolts were tagged and released at the upstream site using numbered Floy streamer tags. As in past years, smolts were not anesthetized.

Following tagging, smolts were held in a cage in the river for approximately one hour before being released. In order to examine tag loss, tagging or handling mortality, 75 tagged and 25 untagged smolts were kept in a holding box (1.5 m x 1.0 m x 0.5 m) in the river for a 7-day period. Comparisons of the homogeneity of mortality between tagged and untagged smolts for 1989, as well as the combined 1987-89 data, were carried out by  $G^2$ -tests.

A maximum likelihood estimate derived by Darroch (1961) for a two-sample stratified population was applied to estimate the smolt population in 1989. No adjustment was made to the smolt estimate for parr migrating downstream and smoltifying in the estuary as was done in past years. Although some smolts are undoubtedly produced in the estuary, the actual number is unknown and is probably small (< 10%) compared with the estimated smolt run from the river. Thus it was felt that it was better to stay with the known facts and avoid extrapolation.

A prediction of adult returns in 1990 was derived by applying a survival rate from smolts to returning adults of 9.4%; the mean of the two values obtained to date from the Conne River system (1987-88 = 10.5%, 1988-89 = 8.2%)

#### Results

### 1. Landings in 1989

Table 3 summarizes the commercial landings of small and large salmon from Statistical Section 36, SFA 11, from 1974-89. Preliminary landings in 1989 of 5.5 t of small salmon and 6.1 t of large salmon were higher than in 1988, but below (> 40%) the previous 5-year means (1984-88, small = 9.3 t, large = 10.6 t).

Landings in the recreational fishery and native food fishery are summarized in Table 4. The recreational catch of 1036 was 33% lower than in 1988 and 50% below the previous 5-year mean of 2055 fish. A total of only 180 fish (17.4% of total sport catch) was angled in the lower section of the Conne River, below the fish counting fence in 1989. The reported number of rod-days fished also decreased by 20% to the lowest level since 1980. The recreational fishery was closed due to low water conditions from July 8-14 inclusive. The native food fishery reported a catch of 369 small salmon; 39% below the 1988 total of 607 small salmon. Estimates of angling exploitation rate for the years 1986-89 are provided in Table 5. Rates vary form 16.5 to 27.5% (mean of 22%). In 1989, angling exploitation was estimated to be 22.3% despite the low recreational catch.

### 2. Biological characteristics

Biological characteristic information from Atlantic salmon smolts and returning adults was obtained from a sample of 288 smolts and 140 grilse during 1989. These data are appended to previous information collected in 1986-88 (Tables 6 and 7). Smolts averaged 152 mm in fork length with an average river age of 3.24 years. Seventy-nine percent of the out going smolts were female. Grilse averaged 512 mm in length with a mean river age of 3.18 years. Similarly, seventy-nine percent of the grilse were female. The river age distribution of smolts in 1988 was significantly different than that of the returning grilse in 1989 ( $G^2 = 24.3$ , P = 0.00). This was also observed in comparisons of 1987 smolt with 1988 grilse ( $G^2 = 15.5$ , P = 0.00). In both cases, there was a greater proportion of river age 4 fish in the smolt population compared with the same smolt class of returning adults in the following year.

Biological characteristic data was also obtained from virgin two-sea-winter (2SW) salmon and repeat spawning fish in 1989. These data, and data obtained from earlier years, are summarized in Tables 8 and 9 for large salmon and repeat spawners, respectively. Twelve 'large' salmon were sampled from the counting fence trap for age and fork length information. Of these, one was a 2SW salmon (680 mm) while the remaining 11 were repeat spawning fish (660-710 mm). One 2SW salmon (650 mm) and 8 repeat spawning fish (550-700 mm) were also sampled in the recreational fishery. Repeat spawning salmon were both consecutive (N = 6) and alternate spawners (N = 13).

### 3. Estimated returns and spawning escapement

There were 4469 salmon  $\leq 63$  cm and 319 salmon  $\geq 63$  cm counted at the fence on Conne River in 1989 (Table 10). This represents a decrease of 37% in the number of small salmon returns and 24% in the large salmon returns compared with the previous year. Mean water temperatures and water levels are also summarized in Table 10. Figure 2 illustrates the cumulative percent frequencies of small salmon counted at the fence for 1986-1989.

Total returns of adult salmon to Conne River (and estuary) in 1989 are summarized in Table 11. The estimate of 4958 small salmon returning in 1989 was 35% below the 1988 value. Predicted returns estimated for 1989 were expected to be lower than in other years at 6180-6798 small salmon: actual returns were 24% below this. The prediction was based on an estimate of smolt to adult returns from 1987 to 1988 of 10.3%. Results for 1989 suggest survival was 7.9% (4958/63084). If tagged fish experience a higher mortality than untagged fish, then the survival back to the river would be somewhat higher given that 3161 smolts were tagged and released in 1988. Smolt to adult survival estimates (7627/72752) and 8.2% for 1989 (4958/60360). A test for homogeneity of survival indicated a significant difference between the two years ( $G^2 = 166.0$ , P = 0.000). By applying the river age distribution data to both smolts and returning adults over the two years of information available (1987 smolts to 1988 adults and 1988 smolts to 1989 adults) it appears that there may be a differential survival between age 3+ and 4+ smolts. Survival of 3+ smolts has been 9.7 and 12.7%, while survival of 4+ smolts was 4.7 and 5.9%.

Estimated <u>spawning escapement</u> in 1989 was estimated to be 3386 salmon <63 cm and 303 salmon  $\geq 63$  cm (Table 11).

Mean length of female salmon < 63 cm in size in 1989 was 51.0 cm, which gives a mean fecundity of 2436 eggs per female. The percentage of females in the run was 79% (N = 135, N-females = 107). The estimated total number of eggs deposited were:

salmon < 63 cm = 
$$6.52 \times 10^{6}$$
  
salmon  $\geq 63$  cm =  $1.04 \times 10^{6}$ 

for a total egg deposition of 7.56 million eggs; 97% of the target requirement of 7.8 million eggs. It should be noted that only 84% of the target was met from eggs deposited by small salmon with the 'buffer' provided by large salmon ensuring that the target was essentially met.

## 4. Forecast of 1990 returns

A total of 2699 smolts was tagged and released in 1989 at the upstream partial fence site (Fig. 1). At the downstream recapture site 17,515 smolts were caught, including 601 tagged smolts. Figure 3 illustrates the number of migrating smolt caught by day at the downstream recapture site in relation to mean daily water temperature and discharge. There was no significant difference in mortality between tagged and untagged fish held in the river in 1989 to examine tag loss, handling, and tagging mortality ( $G^2 = 2.80$ , P = 0.094). Similarly, homogeneity of mortality between tagged and untagged smolts with data pooled for the past three years (1987-89) was also not significant ( $G^2 = 0.256$ , P = 0.613). As a result, no adjustment was made to the number of smolts tagged and released as in past years.

The estimated number of smolts in 1988 was 78,588 (95% CL = 72,585-83,991) (Table 12). As pointed out in the methods section, no adjustment was made for the production of smolts in the estuary. Smolt estimates for 1987 and 1988, also summarized in Table 12, have been readjusted accordingly for comparison. The 1989 estimate is about 30% higher than the 1988 estimate (unadjusted smolts; or 25% greater than the adjusted 1988 smolt estimate) with no impact of low water levels and warm temperatures in 1987 apparent in the 1989 smolt run. The percentage of smolts at each river age and the estimated total number of smolts in each age group, as determined from biological characteristic information, are summarized in Tables 12 and 13, respectively.

A forecast of the number of adults expected to return in 1990 was made assuming that the mean estimate of sea survival of 9.4%, based on 1988 and 1989 results, is consistent for 1990. With an estimate of approximately 72,600-84,000 smolts, 6,824-7,896 (midpoint of 7,360) salmon are expected to return to the Conne River and estuary in 1990, or 48% more than was estimated to have returned in 1989. Available harvest in Conne River would be 2,824-3,896. By weighting the 1989 smolt estimate to the average of the differential survival estimates suggested in section 3 above, it results in an adult return in 1990 about 3% higher (7619) than that predicted based on using the mean value of 9.4%.

#### Discussion

Adult returns to Conne River were forecasted to be about 25% lower in 1989 in comparison with the three previous years (Dempson 1988). This forecast was based on a single estimate of smolt to adult survival. Actual returns were, as predicted, lower than earlier years, but were 24% below the prediction. Results obtained from the Conne River, as well as salmon returns to Biscay Bay River, SFA 9, (M. O'Connell, personal communication) and Exploits River, SFA 4, (C. Bourgeois, personal communication) suggest that, for some populations survival at sea was lower in 1989. Returns to Biscay Bay River in 1989 were about 50% lower than the previous six year mean (1983-88 mean = 2016, but includes one partial count in 1985). Returns to Gander River were also below expected values.

Adult returns of smolts tagged in Conne River in 1987 and 1988 are summarized in Table 14. A test of the homogeneity of recovery between streamer tagged smolts from 1987 to 1988 (adult returns in 1988 and 1989) was statistically significant ( $G^2 = 16.4$ , P = 0.00); again suggestive of lower survival of fish returning in 1989. A similar result was found in returns of Carlin tagged fish to the Exploits River for the same two years. Conne River smolts tagged with Carlin tags in 1988 also had a poor return in 1989 (Table 14). Only one tag was returned from the commercial fishery in 1989 (Carlin tag) and no streamer tags have been returned from commercial fisheries during the past two years suggesting a relatively low commercial exploitation. This was in spite of a directed effort to solicit tag recoveries from commercial fishermen in the Hermitage area during the summer followed up by telephone requests during the fall. The homogeneity of recovery between Carlin tags and streamer tags was not statistically significant ( $G^2 = 1.21$ , P = 0.27), however, returns were low for both types of tags. It should be noted that streamer tags are not marked with 'reward' and this may affect the potential return of these tags. If commercial exploitation of the Conne River stock is low because of the early return of fish to the river, then variation in adult returns from year to year, relative to smolt output, could be indicative of marine survival conditions moreso than a combined effect of both this and exploitation.

No additional information has been obtained on the relative production of lacustrine habitat in the Conne River system. O'Connell and Ash (1989) have reported production estimates of 3 smolt per unit (100 m<sup>2</sup>) for fluvial habitat and 10 smolt per hectare for lacustrine habitat for Newfoundland systems. Applying these values to the Conne River would yield the following smolt production:

Fluvial habitat = 13,180 units @ 3 smolt/unit = 39,540 smolt Lacustrine habitat = 46,20 ha @ 10 smolt/hectare = 46,200 smolt

for a total smolt production of 85,740. In order to relate this back to a target number of eggs and spawners, an estimate of egg to smolt survival is

required. As an example, say egg to smolt survival was estimated to be 1.25% (3 smolt per unit / 240 eggs per unit) although different survival rates for different environments would probably be more appropriate. At the 1989 estimate of fecundity (eggs per fish) (2436 eggs per female x 79% female) the required number of spawners would be 3564; our current target is 4,000. It is not known what adult escapement was responsible for the production of the current smolt runs. However, 1990 would be the first year that 3+ smolts originating from known egg deposition in 1986 could be enumerated. At that time we may be in a better position to evaluate the production of the system in relation to the current target of 4000 fish.

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Fishery	Season
Recreational*	June 17 - September 4
Commercial	June 5 - July 10
Native Food	June 5 - July 31

Table 1. Opening and closing dates for 1989 Atlantic salmon recreational, commercial, and native food fisheries potentially harvesting salmon of Conne River origin.

\*River closed due to low water from July 8-14, inclusive.

	Smolt mark-r studie	ecapture s	Adult counti	ng fence
Year	Start	Finish	Start	Finish
				· · · · · · · · · · · · · · · · · · ·
1986			May 12	Sept 10
1987	April 26	June 16	May 18	Sept 8
1988	May 9	June 14	May 21	Aug 29
1989	May 9	June 15	May 20	Aug 28

Table 2. Summary of dates of operation for downstream smolt mark-recapture studies, and upstream adult fence counts at Conne River, Newfoundland.

Year	Small	Large	Total	Proportion small
1974	14 2	37 5	51 7	0.28
1975	22.5	24.3	46.8	0.20
1976	20.1	51.8	71 9	0.40
1977	3.3	13.0	16.3	0.20
1978	1.3	3.9	5.2	0.25
1979	3.6	8.7	12.4	0.29
1980	13.2	8.0	21.3	0.62
1981	2.9	8.7	11.7	0.25
1982	9.1	12.4	21.5	0.42
1983	5.5	7.2	12.7	0.43
1984	4.8	6.7	11.5	0.42
1985	14.8	23.9	38.7	0.38
1986	17.6	11.4	29.0	0.61
1987	7.7	8.5	16.3	0.47
1988	1.7	2.5	4.2	0.40
1989 <sup>1</sup>	5.5	6.1	11.6	0.47
Maan				
<b>nean</b>	0 1	0.0	17 0	0.40
19/9-88	8.1	9.8	1/.9	0.43
1904-08	9.3	10.0	19.9	0.46

Table 3. Commercial landings (t) of Atlantic salmon in Statistical Section 36, SFA, 1974-89.

<sup>1</sup>Preliminary information only for 1989.

		Sport fis	shery		Native food fishery						
	Effort		Salmon				Salmon				
Year	rod days	<63 cm	<u>≥</u> 63 cm	Total	Quota	<63 cm	<u>≻</u> 63 cm	Total			
1953	445	138	26	164	AMO <u>17 - 1</u> - 1 - 1						
1954	134	120	23	143							
1955	99	303	37	340							
1956	308	476	36	512							
1957	413	369	23	392							
1958	610	480	55	535							
1959	555	393	18	411							
1960	89	387	0	387							
1961	644	491	0	491							
1962	769	873	11	884							
1963	855	1007	10	1017							
1964	1073	1296	25	1321							
1965	1242	983	39	1022							
1966	1436	879	43	922							
1967	1629	570	3	573							
1968	2379	1724	49	1773	NOTE: (	onne River	Micmac	Indian			
1969	2909	1751	38	1789		and Counci	l renort	s takino			
1970	2909	1673	66	1739	- 2	-000-3.000	salmon	for food			
1971	3483	1707	33	1740	-	ach vear n	rior to	1986.			
1972	3194	2509	42	2551		uch jeur p	1101 10	1700.			
1973	3427	2139	10	2149							
1974	4033	1988	17	2005							
1975	3800	1903	17	1920							
1976	3894	1931	27	1958							
1977	3375	1665	5	1670							
1978	3122	1735	7	1742							
1979	2147	1010	, 0	1010							
1980	3512	2238	14	2252							
1981	5029	2691	2	2693							
1982	5268	3302	24	3326							
1983	6972	2192	21	2213							
1984	6709	2343	0	2213							
1985	5202	2729	Õ	2729							
1986	6038	2060	õ	2060	1200	510	зa	500			
1987	4979	1598	ň	1598	1200	10	0	10			
1988	5504	1544	õ	1544	1200	607	2	600 10			
1989	4414	1036	õ	1036	1200	369	0	369			
Mean											
1984-8	8 5686	2055									

Table 4. Atlantic salmon landings (in numbers of fish) in the sport fishery 1953-89, and in the native food fishery, 1986-89, for the Conne River.

<sup>a</sup>Dead in trap.

Year	Small salmon released upstream <sup>1</sup>	Angling catch	Exploitation rate
1986	7488	2060	0.275
1987²	9666	1598	0.165
1988	7111	1544	0.217
1989	4645³	1036	0.223
Mean			0.220

Table 5. Estimates of angling exploitation rates on small salmon in Conne River, Newfoundland, 1986-89.

<sup>1</sup>Mortalities above fence have been subtracted from numbers released at the fence.

<sup>2</sup>Exploitation rate = 0.181 if upstream releases only during the period opened to recreational fishing (river closed July 13) in 1987 (N=8853) are used.

<sup>3</sup>Includes 180 fish angled below fence (i.e. fence count (4469) + angled below (180) - mortalities above (4).

Year	River age	N	Le	ength SD	(mm) Range	Mean	Weigh SD	t (g) Range	River Mean	r Age SD	e (y) Range	Sex	ratio % female
					Ū.			0					
1086		ŋ	120	71	195 195								
1900	2	106	150	10 6	12J - 13J 125 190								
	5	200	154	10.0	123 - 100								
	4	20	110	10.7	125-185								
	2	T	210										
Tot	al	145	153	12.0	125–210				3.25 (	).48	2–5		-
1987	2	5	129	24.5	109-163	23.1	12.3	13.8-42.2				4	100
	3	178	144	15.9	106-188	28.3	9.1	11.5-61.8				178	78
	4	83	145	16.9	108 - 198	30.7	10.6	13.0-73.8				270	76
	5	5	162	16.4	145_184	37.0	14 0	24 6-59 6				5	60
	-	283	151	16.9	108-209	3/10	14.0	24.0 37.0				2	00
Tot	al	200		2007	100 207								
(Aged	samples)	271	144	16.5	106-198	29.1	9.8	11.5-73.8	3.32 (	).54	2-5	270	77
Tot	al	554	148	17.1	106-209				5155 (			270	
1988	2	0											
	3	206	145	14.7	102-191	30.8	9.0	12.4-65.4				205	72
	4	118	151	16.9	113-201	34.5	12.0	15.9-78.8				118	75
	5	4	157	14.9	143–178	40.7	14.0	27.2-60.2				4	50
Tot	al	328	147	15.7	102-201	32.2	10.4	12.4-78.8	3.38 (	).51	3–5	327	73
1989	2	9	138	18.8	98–157	26.5	8.1	9.8-34.6				9	100
	3	204	153	21.1	101–265	35.6	12.9	9.8-99.1				204	78
	4	70	149	19.1	110-216	33.9	13.3	13.8-89.7				70	79
	5	5	154	47.8	121-238	42.4	45.3	18.5-123.2				5	100
_	_												
Tot	al	288	152	21.3	98–265	35.0	14.0	9.8-123.2	3.24 (	).53	2–5	288	79

Table 6. Summary of biological characteristic information for Atlantic salmon smolt samples from Conne River, Newfoundland, 1986-89.

												_	_
			L	ongth	(mm)		Woigh	+ (a)	Divo		()	Sex	<u>ratio</u>
Year	River age	N	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	N	∽ female
									······				
1986	2	9	491	30.2	440–540	1367	250.0	900–1700				9	89
	3	212	505	22.3	450-560	1442	199.7	1000-2100				211	76
	4	129	507	23.2	460–570	1471	251.9	1100-2900				129	77
	5	7	517	22.8	490560	1457	139.7	1300-1600				7	43
Tot	al	357	506	23.0	440–570	1451	220.4	900-2900	3.38	0.57	2–5	356	76
1987	2	10	495	22.8	470-530	1320	322.5	699–1700				10	60
	3	284	510	22.8	430–580	1511	239.9	1000-2600				250	81
	4	77	509	25.2	450–570	1448	245.3	1000-2000				65	66
	5	1	530			1800						1	100
Tot	al	372	509	23.4	430–580	1493	245.9	600-2600	3.19	0.46	2-5	326	78
1988	2	8	509	23.0	470–540	1375	249.3	1100-1900				8	88
	3	214	505	26.1	440-600	1344	217.0	1000-2200				210	79
	4	45	510	26.3	470–560	1389	265.6	1000-2000				43	86
Tota	al	267	506	26.1	440-600	1352	226.5	1000-2200	3.14	0.42	2-4	261	80
1989	2	6	517	19.7	490540	1400	178.9	1200-1700				6	83
	3	104	511	23.6	460-580	1395	198.7	1000-2000				99	77
	4	29	513	23.4	465-560	1459	211.3	1000-1900				29	86
	5	1	535			1700	-					1	100
Tota	al	140	512	23.3	460–580	1411	201.7	1000-2000	3.18	0.50	2–5	135	79

Table 7. Summary of biological characteristic information for Atlantic salmon virgin one-sea-year grilse samples from Conne River, Newfoundland, 1986-89.

			Length (mm)			1	Weight	(g)	River Age (v)			Sex ratio		
Year	River age	N	Mean	SD	Range	Mean	SD	Range	Mean	SD R	ange	N	female	
1986	3	1	630			2600			3.0			1	100	
1989	3 4	1 1	650 680			2700						1		
Tota	al	2	665	21.2	650–680	2700			3.5	0.71	3-4	1	100	

Table 8. Summary of biological characteristic information for Atlantic salmon virgin two-sea-year salmon from Conne River, Newfoundland, 1986 and 1989.

Voor	River are	N	Length (mm) Mean SD Range		Weight (g) Mean SD Range			<u>River Age (y)</u> Mean SD Range			Sex	ratio %	
lear	KIVEL age	N	nean	50	Kange	Hean	ענ	Nalige	nean	י ענ	ange	IN	remare
1986	3	2	580	28.2	560-600	2100	424.3	1800-2400	3.0			2	100
1987	2 3 4	1 3 1	520 547 520	25.2	530–576	1800 1700 1500	360.6	1400-2100				1 3	100 100
Tota	ıl	5	536	23.2	520–576	1680	277.5	1400-2100	3.0	0.71	2-4	4	100
1988	2 3 4	2 2 1	560 565 530	14.1 35.4	550–570 540–590	1550 1800 1500	70.7 424.3	1500-1600 1500-2100				2 2 1	0 50 100
Tota	1	5	556	24.1	530-590	1640	260.8	1500-2100	2.8	0.84	2-4	5	40
1989*	3 4	18 1	647 680	56.5	550-710	2163	763.3	1500-3500				8	63
Tota	ıl	19	649	55.4	550-710	2163	763.3	1500-3500	3.1	0.23	3–4	8	63

Table 9. Summary of biological characteristic information for Atlantic salmon repeat spawners from Conne River, Newfoundland, 1986-1989.

\*Only 8 fish measured for weight. These were obtained from recreational samples, mean length 601 mm (550-700). The 11 samples from the counting fence had a mean length of 684 mm (660-710).

						Nu	mber o	of Fish				Mean water	M	ean	wate	r
					Sma	11			Lar	ge		Temperature		lev	vel	
]	Date		Week	1986	1987	1988	1989	1986	1987	1988	1989	1986 1987 1988 1989	1986 1	987	1988	1989
May	7-13		19									7.5	32.0	_	_	
May	14-20		20	0	0	0	0	2	0	0	0	12.3 8.3 - 11.2	26.0 4	4.6	-	27.5
May	21–27		21	0	0	0	0	4	0	0	0	11.1 11.4 15.6 14.3	36.5 28	8.2	18.6	22.0
May	28–Jun	3	22	6	2	0	3	14	0	0	12	11.3 13.1 12.0 13.9	39.9 1	5.5	25.2	46.8
Jun	4-10		23	108	17	11	38	42	15	7	25	12.2 14.1 10.3 16.2	61.1 1	3.0	68.1	34.4
Jun	11–17		24	870	1905	652	946	87	294	123	85	13.4 14.5 15.1 14.6	35.2 3	2.5	49.8	16.7
Jun	18-24		25	2690	3713	1939	2119	160	116	119	154	15.8 16.1 15.9 17.9	24.0 2	2.3	42.3	14.0
Jun	25-Jul	1	26	1899	1514	2256	856	67	38	114	31	15.3 16.7 15.1 18.8	22.7 1	7.1	51.9	12.9
Jul	2-8		27	612	515	730	216	7	7	16	3	15.3 18.8 16.7 17.1	33.3 1	1.3	67.0	5.6
Jul	9–15		28	848	1374	769	248	13	17	5	9	16.0 22.1 17.8 18.2	33.4	3.1	30.4	15.8
Jul	16-22		29	263	32	344	3	4	0	17	0	17.7 20.8 18.8 18.3	30.5 -3	1.0	16.7	34.1
Jul	23-29		30	114	126	91	15	0	4	3	0	19.3 20.5 19.3 18.6	20.4 -	1.6	9.4	20.7
Jul	30-Aug	5	31	54	3	268	4	2	0	11	0	16.8 20.4 20.2 19.8	20.0 -3	3.0	16.6	20.1
Aug	6-12		32	7	25	1	21	0	1	2	0	20.1 20.1 20.8 20.6	13.4 -	7.4	9.3	31.6
Aug	13–19		33	2	0	0	0	0	0	0	0	19.4 17.2 17.8 19.8	9.2 -8	8.9	3.8	30.4
Aug	20–26		34	11	6	57	0	0	0	1	0	18.9 18.3 15.6 18.1	3.0 -2	1.6	18.7	15.9
Aug	27-Sep	2	35	31	38	0	0	1	0	0	0	15.5 16.8 17.6 13.9	9.6 -0	0.5	14.0	15.0
Sep	3-9		36	0	417 <sup>-</sup>	1 <b>–</b>	-	0	0	-	-	14.8 14.8	10.3 -4	4.3	-	-
Tota	al/avera	age	2	7515	9687	7118	4469	397	498	418	319	16.0 17.8 17.1 17.0	26.0 8	8.5	30.2	22.7

Table 10. Weekly summary of numbers of Atlantic salmon enumerated at the counting fence on Conne River, Newfoundland, with mean weekly water temperatures (°C) and water levels (cm).

<sup>1</sup>Includes estimate of 400 fish in lower part of the river at the time the counting fence was removed.

		Salmon	<63 cm			Salmon	≻63 c	m
	1986	1987	1988	1989	1986	1987	1988	1989
Returns to Conne R.								
*Food fishery (estuary) Angling below fence	766	451	506	307 180	14	18	2	0
Mortalities below fence	21	17	3	2	1	0	0	0
Fence count Estimated count	7515	9287 400	7118	4469	397	498	418	319
Total	8302	10155	7627	4958	412	516	420	319
(1) Released at fence	7515	9687	7118	4469	397	498	418	319
Removals and mortalities								
Mortalities above fence Unrecorded mortalities-5% of (1) Angling above fence Brood stock	27 376 2060 0	21 484 1598 245	7 356 1594 0	4 223 856 0	1 20 0 0	0 25 0 10	0 21 0 0	0 16 0 0
(2) Total	2463	2348	1907	1083	21	35	21	16
Spawning escapement								
(1) - (2)	5052	7339	5211	3386	376	463	397	303
Egg deposition								
in millions % of 7.8 million target met	9.20 118	13.75 176	9.97 128	6.52 84	1.41	1.96	1.68	1.04

Table 11. Total estimated returns of Atlantic salmon to Conne River, Newfoundland, with a summary of mortalities and removals, and estimated spawning escapement, 1986-1989.

\*Food fishery includes fish caught in estuary for tagging studies in 1986 and 1987. Proportions of Conne River origin fish in 1986 and 1987 were 0.792 (N=967) and 0.914 (N=493) respectively. For remaining years, weighted mean (0.833) was used.

Table 12. Estimated size of the Conne River, Newfoundland, Atlantic salmon smolt population, 1987-89, as determined from mark-recapture studies. Mean river age, percentage of smolts at each river age and sample size are also presented.

	N	Population	95% confidence	Mean river	Per				
Year	tagged	estimate	interval	age (y)	2	3	4	5	N
1987 <sup>1</sup>	4863	72752	68464-77040	3.3	2	66	30	2	271
1988 <sup>1</sup>	3161	60360	57219-63500	3.4	0	63	36	1	328
1989	2699	78588	72585-83991	3.3	3	71	24	2	288

<sup>1</sup>Number tagged and released has been adjusted for 2.26% mortality.

Test of homogeneity of mortality between tagged and untagged smolts was not significant:  $G^2=0.26$ , P=0.613, with data for all three years pooled.

Year	2	River 3	age (y) 4	5	Total
1987	1455	48016	21826	1455	72752
1988	0	38027	21730	603	60360
1989	2358	55797	18861	1572	78588

Table 13. Estimated total number of smolts in each age group, for Conne River, Newfoundland, 1987-89.

	Streamer		Carl	in
Recapture location	<u>Retur</u> 1988	n year 1989	Return 1989	year 9
Commercial	0	0	1	(Hermitage B.)
Native food fishery	1	0	3	· - ·
Angled below counting fence	0	0	2	
At counting fence	40	6	1	
Angled above counting fence	0	0	3	
			<del></del>	
Total	41	6	10	
Number tagged in year i-1	4975	3234	3084	

Table 14. Summary of known tag recoveries from smolts tagged and released in Conne River, Newfoundland, in 1987 and 1988, and recovered in 1988 and 1989.

Streamer tags 1988 vs 1989 vs Carling tags 1989 16.4 0.00 Streamer tags 1989 vs Carling tags 1989 1.21 0.27



Fig. 1. Conne River, Newfoundland, illustrating the location of the fish counting fences used for tag release and recapture sites in the mark and recapture experiment.



Fig. 2. Cumulative percent frequencies of small salmon enumerated at the Conne River fish counting fence, 1986-1989.



Fig. 3. Number of migrating Atlantic salmon smolt caught by day at the downstream recapture site in relation to mean daily water temperature and discharge, 1989.