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

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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 $\geq=63 \mathrm{~cm}$ 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 4958 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 1989. Les prises sportives de 1036 poissons ( 180 en aval du barrage de dénombrement) et l'effort estimé (jours de pêche) sont respectivement inférieurs de 33 q 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 78588 poissons ( $72600-84000$ ), 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 7360 ( $6824-7896$ ) petits saumons reviennent dans la rivière Conne et dans son estuaire en 1990; les captures possibles seraient de 2824 à 3896 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 $<63 \mathrm{~cm}$ 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 $\geq 63 \mathrm{~cm}$, 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 below 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 ( $\mathrm{G}^{2}$ - 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 $\geq 63 \mathrm{~cm}$ and then totaled.

Egg deposition $=$ spawners $\mathrm{x} \%$ female x fecundity at mean length.
An estimate of fecundity was obtained from the following relationship derived in 1987 (0ctober 27-30) from ripe salmon (Dempson et al. 1987):

$$
\text { Fecundity }=0.1988(\text { fork length }, \mathrm{cm})^{2.3942}\left(\mathrm{r}^{2}=0.48, \mathrm{P}<0.001\right)
$$

where length is the mean length of female salmon $<63 \mathrm{~cm}$ in size sampled in 1989.

An estimate of the egg deposition from salmon $\geq 63 \mathrm{~cm}$ in size was obtained using the same length-fecundity relationship for salmon $<63 \mathrm{~cm}$ in size, with the mean size of virgin multi-sea-winter (MSW) and repeat spawning fish ( $\geq 63 \mathrm{~cm}$ ) 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 $\geq 63 \mathrm{~cm}$ 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 ( $1.5 \mathrm{~m} \times 1.0 \mathrm{~m} \times 0.5 \mathrm{~m}$ ) 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 $\mathrm{G}^{2}$-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 $=9.3 \mathrm{t}$, 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 $1989\left(\mathrm{G}^{2}=24.3, \mathrm{P}=0.00\right)$. This was also observed in comparisons of 1987 smolt with 1988 grilse ( $G^{2}=15.5, \mathrm{P}=0.00$ ). 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 2 SW salmon ( 680 mm ) while the remaining 11 were repeat spawning fish ( $660-710 \mathrm{~mm}$ ). One 2 SW salmon ( 650 mm ) and 8 repeat spawning fish ( $550-700 \mathrm{~mm}$ ) were also sampled in the recreational fishery. Repeat spawning salmon were both consecutive ( $\mathrm{N}=6$ ) and alternate spawners $(\mathrm{N}=13)$.

## 3. Estimated returns and spawning escapement

There were 4469 salmon $<63 \mathrm{~cm}$ and 319 salmon $\geq 63 \mathrm{~cm}$ 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 without an adjustment for smolts produced in the estuary were $10.5 \%$ for 1988 (7627/72752) and 8.2\% for 1989 (4958/60360). A test for homogeneity of survival indicated a significant difference between the two years ( $\mathrm{G}^{2}=166.0, \mathrm{P}=0.000$ ). 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 spawning escapement in 1989 was estimated to be 3386 salmon <63 cm and 303 salmon $\geq 63 \mathrm{~cm}$ (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 $79 \%$ ( $\mathrm{N}=135$, N -females $=107$ ). The estimated total number of eggs deposited were:
salmon < $63 \mathrm{~cm}=6.52 \times 10$

6
salmon $\geq 63 \mathrm{~cm}=1.04 \times 10$
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 ( $\mathrm{G}^{2}=2.80, \mathrm{P}=0.094$ ). Similarly, homogeneity of mortality between tagged and untagged smolts with data pooled for the past three years (1987-89) was also not significant ( $\mathrm{G}^{2}=0.256$, $\mathrm{P}=0.613$ ). 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 ( $95 \% \mathrm{CL}=72,585-83,991$ ) (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. $0^{\prime}$ 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 ( $\mathrm{G}^{2}=16.4, \mathrm{P}=0.00$ ); 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 ( $\mathrm{G}^{2}=1.21, \mathrm{P}=0.27$ ), 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. $0^{\prime}$ Connell and Ash (1989) have reported production estimates of 3 smolt per unit ( $100 \mathrm{~m}^{2}$ ) 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:

$$
\begin{aligned}
& \text { Fluvial habitat }=13,180 \text { units @ } 3 \text { smolt/unit }=39,540 \text { smolt } \\
& \text { Lacustrine habitat }=46,20 \text { ha @ } 10 \text { smolt/hectare }=46,200 \text { smolt }
\end{aligned}
$$

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

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

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

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

| Year | Smolt mark-recapture$\qquad$ |  | Adult counting fence |  |
| :---: | :---: | :---: | :---: | :---: |
|  | 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 3. Commercial landings (t) of Atlantic salmon in Statistical Section 36, SFA, 1974-89.

|  |  |  |  | Targe |
| :--- | ---: | ---: | ---: | ---: |
| Year | Small | Latal | Proportion <br> small |  |
| 1974 | 14.2 | 37.5 | 51.7 | 0.28 |
| 1975 | 22.5 | 24.3 | 46.8 | 0.48 |
| 1976 | 20.1 | 51.8 | 71.9 | 0.28 |
| 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 | 41.2 | 0.40 |
| 19891 | 5.5 | 6.1 | 11.6 | 0.47 |
|  |  |  |  |  |
| Mean |  |  |  |  |
| $1979-88$ | 8.1 | 9.8 | 17.9 | 0.43 |
| $1984-88$ | 9.3 | 10.6 | 19.9 | 0.46 |
|  |  |  |  |  |

[^0]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.

| Year | Sport fishery |  |  |  | Native food fishery |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \hline \text { Effort } \\ & \text { rod days } \end{aligned}$ | Salmon |  |  | Quota | Salmon |  |  |
|  |  | $<63 \mathrm{~cm}$ | $\geq 63 \mathrm{~cm}$ | Total |  | <63 cm | $\geq 63 \mathrm{~cm}$ | Total |
| 1953 | 445 | 138 | 26 | 164 |  |  |  |  |
| 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: | Conne Rive | icmac | Indian |
| 1969 | 2909 | 1751 | 38 | 1789 |  | Band Counc | report | $s$ taking |
| 1970 | 2909 | 1673 | 66 | 1739 |  | 2,000-3,00 | almon | for food |
| 1971 | 3483 | 1707 | 33 | 1740 |  | each year | or to | 1986. |
| 1972 | 3194 | 2509 | 42 | 2551 |  |  |  |  |
| 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 | 2343 |  |  |  |  |
| 1985 | 5202 | 2729 | 0 | 2729 |  |  |  |  |
| 1986 | 6038 | 2060 | 0 | 2060 | 1200 | 519 | $3^{\text {a }}$ | 522 |
| 1987 | 4979 | 1598 | 0 | 1598 | 1200 | 18 | 0 | 18 |
| 1988 | 5504 | 1544 | 0 | 1544 | 1200 | 607 | 2 | 609 |
| 1989 | 4414 | 1036 | 0 | 1036 | 1200 | 369 | 0 | 369 |
| Mean |  |  |  |  |  |  |  |  |
| 1984-88 | 5686 | 2055 |  |  |  |  |  |  |
| 1979-88 | 5136 | 2171 |  |  |  |  |  |  |

[^1]Table 5. Estimates of angling exploitation rates on small salmon in Conne River, Newfoundland, 1986-89.

| Year | Small salmon <br> released upstream | Angling catch | Exploitation <br> rate |
| :--- | :---: | :---: | :---: |
| 1986 | 7488 | 2060 | 0.275 |
| $1987^{2}$ | 9666 | 1598 | 0.165 |
| 1988 | 7111 | 1544 | 0.217 |
| 1989 | $4645^{3}$ | 1036 | 0.223 |
| Mean |  |  |  |

${ }^{1}$ Mortalities above fence have been subtracted from numbers released at the fence.
${ }^{2}$ Exploitation rate $=0.181$ if upstream releases only during the period opened to recreational fishing (river closed July 13) in 1987 ( $\mathrm{N}=8853$ ) are used.
${ }^{3}$ Includes 180 fish angled below fence (i.e. fence count (4469) + angled below (180) - mortalities above (4).

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

| Year | River age | N | Length (mm) |  |  | Weight (g) |  |  | River Age (y) |  |  | Sex ratio |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | SD | Range | Mean | SD | Range | Mean | SD | Range | N | female |
| 1986 | 2 | 2 | 130 | 7.1 | 125-135 |  |  |  |  |  |  |  |  |
|  | 3 | 106 | 152 | 10.6 | 125-180 |  |  |  |  |  |  |  |  |
|  | 4 | 36 | 156 | 10.7 | 125-185 |  |  |  |  |  |  |  |  |
|  | 5 | 1 | 210 |  |  |  |  |  |  |  |  |  |  |
| Total |  | 145 | 153 | 12.0 | 125-210 |  |  |  | 3.25 | 0.48 | 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 |  |  |  | 83 | 76 |
|  | 5 | 5 | 162 | 16.4 | 145-184 | 37.0 | 14.0 | 24.6-59.6 |  |  |  | 5 | 60 |
|  |  | 283 | 151 | 16.9 | 108-209 |  |  |  |  |  |  |  |  |
| Total |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (Aged samples) |  | 271 | 144 | 16.5 | 106-198 | 29.1 | 9.8 | 11.5-73.8 | 3.32 | 0.54 | 2-5 | 270 | 77 |
| Total |  | 554 | 148 | 17.1 | 106-209 |  |  |  |  |  |  |  |  |
| 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 |
| Total |  | 328 | 147 | 15.7 | 102-201 | 32.2 | 10.4 | 12.4-78.8 | 3.38 | 0.51 | 3-5 | 327 | 73 |
| 1989 | 2 | 9 | 138 | 18.8 | 98-157 | 26.5 |  | 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 |
| Total |  | 288 | 152 | 21.3 | 98-265 | 35.0 | 14.0 | 9.8-123.2 | 3.24 | 0.53 | 2-5 | 288 | 79 |

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

| Year R | River age | N | Length (mm) |  |  | Weight (g) |  |  | River Age (y) |  |  | Sex ratio |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | SD | Range | Mean | SD | Range | Mean | SD R | 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 | 490-560 | 1457 | 139.7 | 1300-1600 |  |  |  | 7 | 43 |
| Total |  | 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 |
| Total |  | 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 |
| Total |  | 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 | 490-540 | 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 |
| Total |  | 140 | 512 | 23.3 | 460-580 | 1411 | 201.7 | 1000-2000 | 3.18 | 0.50 | 2-5 | 135 | 79 |

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

| Year | River age | N | Length (mm) |  |  | Weight (g) |  |  | River Age (y) |  |  | Sex ratio |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | SD | Range | Mean | SD | Range | Mean | SD | Range | N | female |
| 1986 | 3 | 1 | 630 |  |  | 2600 |  |  | 3.0 |  |  | 1 | 100 |
| 1989 | $\begin{aligned} & 3 \\ & 4 \end{aligned}$ | 1 | $\begin{aligned} & 650 \\ & 680 \end{aligned}$ |  |  | 2700 |  |  |  |  |  | 1 |  |
|  |  | 2 | 665 | 21.2 | 650-680 | 2700 |  |  | 3.5 | 0.71 | 3-4 | 1 | 100 |

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

| Year R | River age | N | Length (mm) |  |  | Weight (g) |  |  | River Age (y) |  |  | Sex ratio |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | SD | Range | Mean | SD | Range | Mean | SD R | Range | N | female |
| 1986 | 3 | 2 | 580 | 28.2 | 560-600 | 2100 | 424.3 | 1800-2400 | 3.0 |  |  | 2 | 100 |
| 1987 | 2 | 1 | 520 |  |  | 1800 |  |  |  |  |  | 1 | 100 |
|  | 3 | 3 | 547 | 25.2 | 530-576 | 1700 | 360.6 | 1400-2100 |  |  |  | 3 | 100 |
|  | 4 | 1 | 520 |  |  | 1500 |  |  |  |  |  |  |  |
| Total |  | 5 | 536 | 23.2 | 520-576 | 1680 | 277.5 | 1400-2100 | 3.0 | 0.71 | 2-4 | 4 | 100 |
| 1988 | 2 | 2 | 560 | 14.1 | 550-570 | 1550 | 70.7 | 1500-1600 |  |  |  | 2 | 0 |
|  | 3 | 2 | 565 | 35.4 | 540-590 | 1800 | 424.3 | 1500-2100 |  |  |  | 2 | 50 |
|  | 4 | 1 | 530 |  |  | 1500 |  |  |  |  |  | 1 | 100 |
| Total |  | 5 | 556 | 24.1 | 530-590 | 1640 | 260.8 | 1500-2100 | 2.8 | 0.84 | 2-4 | 5 | 40 |
| 1989* | $\begin{aligned} & 3 \\ & 4 \end{aligned}$ | $\begin{array}{r} 18 \\ 1 \end{array}$ | $\begin{aligned} & 647 \\ & 680 \end{aligned}$ | 56.5 | 550-710 | 2163 | 763.3 | 1500-3500 |  |  |  | 8 | 63 |
| Total |  | 19 | 649 | 55.4 | 550-710 | 2163 | 763.3 | 1500-3500 | 3.1 | 0.23 | 3-4 | 8 | 63 |

*0nly 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).

Table 10. Weekly summary of numbers of Atlantic salmon enumerated at the counting fence on Conne River, Newfoundland, with mean weekly water temperatures ( ${ }^{\circ} \mathrm{C}$ ) and water levels (cm).

|  |  | Number of Fish |  |  |  |  |  |  |  | Mean water Temperature |  |  |  | Mean water level |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Small |  |  |  | Large |  |  |  |  |  |  |  |  |  |  |  |
| Date | Week | 1986 | 1987 | 1988 | 1989 | 1986 | 1987 | 1988 | 1989 | 1986 | 1987 | 1988 | 1989 | 1986 | 1987 | 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 | 44.6 | - | 27.5 |
| May 21-27 | 21 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 11.1 | 11.4 | 15.6 | 14.3 | 36.5 | 28.2 | 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 | 15.5 | 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 | 13.0 | 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 | 32.5 | 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 | 22.3 | 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 | 17.1 | 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 | 11.3 | 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 | -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 | -3.0 | 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 | -8.9 | 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 | -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 | -0.5 | 14.0 | 15.0 |
| Sep 3-9 | 36 | 0 | $417{ }^{1}$ | - | - | 0 | 0 | - | - | 14.8 | 14.8 | - | - | 10.3 | -4.3 | - | - |
| Total/average |  | 7515 | 9687 | 7118 | 4469 | 397 | 498 | 418 | 319 | 16.0 | 17.8 | 17.1 | 17.0 | 26.0 | 8.5 | 30.2 | 22.7 |

[^2]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.

|  | Salmon | $<63 \mathrm{~cm}$ |  |  | Salmon | $\geq 63$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1986 | 1987 | 1988 | 1989 | $\overline{1986}$ | 1987 | 1988 | 1989 |

Returns to Conne R.

| *Food fishery (estuary) | 766 | 451 | 506 | 307 | 14 | 18 | 2 | 0 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Angling below fence |  |  |  | 180 |  |  |  |  |
| Mortalities below fence | 21 | 17 | 3 | 2 | 1 | 0 | 0 | 0 |
| Fence count | 7515 | 9287 | 7118 | 4469 | 397 | 498 | 418 | 319 |
| Estimated count |  | 400 |  |  |  |  |  |  |
| $\quad$ 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 | 27 | 21 | 7 | 4 | 1 | 0 | 0 | 0 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Unrecorded mortalities-5\% of (1) | 376 | 484 | 356 | 223 | 20 | 25 | 21 | 16 |
| Angling above fence | 2060 | 1598 | 1594 | 856 | 0 | 0 | 0 | 0 |
| Brood stock | 0 | 245 | 0 | 0 | 0 | 10 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |
| (2) Total | 2463 | 2348 | 1907 | 1083 | 21 | 35 | 21 | 16 |

Spawning escapement

(1) - (2) $\quad$| 5052 | 7339 | 5211 | 3386 | 376 | 463 | 397 | 303 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

## Egg deposition

| in millions | 9.20 | 13.75 | 9.97 | 6.52 | 1.41 | 1.96 | 1.68 | 1.04 |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | :--- |
| \% of 7.8 million target met | 118 | 176 | 128 | 84 |  |  |  |  |

*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 ( $\mathrm{N}=967$ ) and 0.914 ( $\mathrm{N}=493$ ) 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.

| Year | $\begin{gathered} \mathrm{N} \\ \text { tagged } \end{gathered}$ | Population estimate | 95\% confidence interval | $\begin{aligned} & \text { Mean river } \\ & \text { age (y) } \end{aligned}$ | Percent in each age group |  |  |  | N |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | 2 | 3 | 4 | 5 |  |
| $1987{ }^{1}$ | 4863 | 72752 | 68464-77040 | 3.3 | 2 | 66 | 30 | 2 | 271 |
| $1988{ }^{1}$ | 3161 | 60360 | 57219-63500 | 3.4 | 0 | 63 | 36 | 1 | 328 |
| 1989 | 2699 | 78588 | 72585-83991 | 3.3 | 3 | 71 | 24 | 2 | 288 |

[^3]Table 13. Estimated total number of smolts in each age group, for Conne River, Newfoundland, 1987-89.

|  | River age (y) |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | :--- |
| Year | 2 | $\frac{4}{4}$ |  | 5 | Total |
| 1987 | 1455 | 48016 | 21826 | 1455 | 72752 |
| 1988 | 0 | 38027 | 21730 | 603 | 60360 |
| 1989 | 2358 | 55797 | 18861 | 1572 | 78588 |

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.

| Recapture location | Tag Type |  |
| :---: | :---: | :---: |
|  | Streamer | Carlin |
|  | Return year | Return year |
|  | 19881989 | 1989 |
| Commercial | $0 \quad 0$ | 1 (Hermitage B.) |
| Native food fishery | 10 | 3 |
| Angled below counting fence | 00 | 2 |
| At counting fence | 406 | 1 |
| Angled above counting fence | $0 \quad 0$ | 3 |
| Total | 416 | 10 |
| Number tagged in year i-1 | 49753234 | 3084 |

Test of homogeneity of recovery between:

|  | $\mathrm{G}^{2}$ | P |
| :--- | :---: | :---: |
| Streamer tags 1988 vs 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.


[^0]:    ${ }^{1}$ Preliminary information only for 1989.

[^1]:    ${ }^{\mathrm{a}}$ Dead in trap.

[^2]:    ${ }^{1}$ Includes estimate of 400 fish in lower part of the river at the time the counting fence was removed.

[^3]:    ${ }^{1}$ Number tagged and released has been adjusted for $2.26 \%$ mortality.
    Test of homogeneity of mortality between tagged and untagged smolts was not significant: $\mathrm{G}^{2}=0.26, \mathrm{P}=0.613$, with data for all three years pooled.

