DFO Atlantic Fisheries
Research Document 96/106

MPO Pêches de l'Atlantique
Document de recherche 96/106

Status of Atlantic Salmon (*Salmo salar* L.) in Eight Rivers in the Newfoundland Region, 1995

by

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Abstract

The status of Atlantic salmon in 1995 was determined for Campbellton River located in Salmon Fishing Area (SFA) 4, Middle Brook and Terra Nova River in SFA 5, Biscay Bay River in SFA 9, Northeast River in SFA 10, and Lomond River, Torrent River, and Western Arm Brook in SFA 14A. Assessments were conducted in relation to the five-year moratorium on the commercial Atlantic salmon fishery, which entered its fourth year in 1995. Target spawning requirement was not met in Terra Nova River and Biscay Bay River; target was exceeded in all the remaining rivers. Compared to the late 1970s and early 1980s, since 1989, estimated total population sizes of small salmon for Middle Brook, Biscay Bay River, and Western Arm Brook have been quite low. Estimated total river returns of small salmon for Middle Brook and Western Arm Brook in 1996 are expected to exceed target requirement; returns to Biscay Bay River are expected to be below target. An estimated 5.0% of Atlantic salmon entering Campbellton River in 1995 possessed net marks, compared to 6.2% in 1994; these are minimum estimates.

Résumé

L'état des stocks de saumon de l'Atlantique a été déterminé en 1995 dans la rivière Campbelton, située dans la zone de pêche du saumon (ZPS) 4, les rivières Middle Brook et Terra Nova, dans la ZPS 5, la rivière Biscay Bay, dans la ZPS 9, la rivière Northeast, dans la ZPS 10, et dans les rivières Lomond, Torrent et Western Arm Brook, dans la ZPS 14A. Ces évaluations ont été réalisées dans le contexte du moratoire de cinq ans imposé à la pêche commerciale du saumon de l'Atlantique et dont la quatrième année débutait en 1995. Les cibles de géniteurs n'ont pas été atteintes dans les rivières Terra Nova et Biscay Bay, mais ont été dépassées dans toutes les autres rivières. Comparativement à la fin des années 1970 et au début des années 1980, l'effectif total estimé de petits saumons a été passablement faible depuis 1989 dans les rivières Middle Brook, Biscay Bay et Western Arm Brook. En 1996, les remontées totales de petits saumons dans les rivières Middle Brook et Western Arm Brook devraient être supérieures aux besoins de géniteurs, mais celles de la rivière Biscay Bay devraient être inférieures. Il est estimé que 5,0 % des saumons de l'Atlantique qui sont remontés dans la rivière Campbelton en 1995 présentaient des marques de filet, comparativement à 6,2 % en 1994. Ces valeurs sont des estimations minimum.

Introduction

In this paper, we examine the status of Atlantic salmon in Campbellton River, Notre Dame Bay (SFA 4), Middle Brook and Terra Nova River, Bonavista Bay (SFA 5), Biscay Bay River, St. Mary's Bay (SFA 9), Northeast River, Placentia Bay (SFA 10), and Torrent River, Lomond River, and Western Arm Brook (SFA 14A) in 1995, the fourth year of the commercial salmon fishing moratorium. The location of each river is shown in Fig. 1. Counts of small and large salmon are used in conjunction with recreational fishery data and biological characteristics data to calculate total river returns and egg depositions. Stock status is evaluated relative to target spawning requirements developed for all rivers.

Management Measures

In 1992, a major change was introduced in the management of Atlantic salmon. A five-year moratorium was placed on the commercial fishery in insular Newfoundland while in Labrador, fishing continued under quota. In addition, a commercial license retirement program went into effect in both insular Newfoundland and Labrador. In the recreational fishery, in 1992 and 1993, a quota on the number of fish that could be retained was introduced in each Salmon Fishing Area (SFA). The quota was assigned for an entire SFA and was not administered on an individual river basis. Only hook-and-release fishing was permitted after the quota was caught.

In 1994, SFA recreational fishery quotas were eliminated. In place of quotas, for insular Newfoundland, the season bag limit for retained small salmon was lowered from eight to six fish, three to be caught prior to July 31 and three after that date. After the bag limit of three was reached in each time period, hook-and-release fishing only was permitted. These measures remained in effect in 1995. As in previous years, retention of large salmon was not permitted in insular Newfoundland.

Special management measures were in place for Lomond River, Torrent River, and Western Arm Brook, three of fourteen scheduled rivers in SFA 14A. For Lomond River, the quota for retained small salmon downstream from the fishway increased to 375 in 1995 from 350 in 1994; as in previous years, no angling permitted above the fishway. The season for retention of small salmon below the fishway in Torrent River (the only area where angling is permitted) opened on July 18, after 750 fish (1,000 in 1994) had passed through the fishway. The recreational fishery in Western Arm Brook has been closed since 1989.

Methods

Catch and effort information and counts in 1995 were compared to two pre-salmon moratorium means (1984-89 and 1986-91) and to the 1992-94 mean during the moratorium. The 1984-89 mean used for comparisons corresponds to years during major management changes in the commercial fishery in Newfoundland and Labrador (see O'Connell *et al.* MS 1992a). In 1990 and

1991, the commercial fishery in all SFAs of Newfoundland and Labrador was controlled by quota (O'Connell *et al.* MS 1992b). The mix of management measures in effect during 1984-89 on the one hand and the imposition of commercial quotas in 1990 and 1991 on the other, should be kept in mind when making evaluations based on the 1986-91 mean. The complete closure of the commercial fishery in insular Newfoundland was the most significant management change to date. All of these management measures were aimed at increasing river escapements. Also, a moratorium on the Northern Cod Fishery was implemented in early July of 1992 which should have resulted in the elimination of by-catch in cod fishing gear in SFAs 1-9. The cod fishery moratorium was continued in 1995. A moratorium on cod fishing was introduced in SFAs 10-14A in 1993 and remained in effect in 1995.

RECREATIONAL FISHERY DATA

Catch and effort data for each river were collected by Department of Fisheries and Oceans (DFO) Officers and processed by DFO Science Branch staff. For Terra Nova River, data for Maccles Brook are included in the totals. Rivers with counting facilities have angling catches separated above and below the counting facilities where appropriate. Procedures for the collection and compilation of recreational fishery data are described by Ash and O'Connell (1987), Mullins *et al.* (1989), Mullins and Jones (MS 1993a), and Mullins and Jones (1993b). For Middle Brook, Terra Nova River, Biscay Bay River, and Northeast River, 1987 was not included in the means because in that year these rivers were closed to angling for nearly the entire season due to drought conditions.

UNRECORDED MORTALITIES

Complete understanding of all life history factors including mortalities is an important part of any stock assessment (Ricker 1975). Mortalities due to fishing but not recorded as part of the catch statistics have been defined as non-catch fishing mortality (Ricker 1976). Non-catch fishing mortality should include those fish killed due to both illegal and legal fishing activities. Legal fishing mortalities of salmon in Newfoundland and Labrador include catches in food (First Peoples), recreational, sentinel, and commercial fisheries. Illegal mortalities include poaching in both the freshwater and marine environments. Illegal mortalities by their very nature are extremely difficult to quantify. An indirect method of quantifying illegal removals prior to entering enumeration facilities is by observation of net marks. In 1995, occurrences of fish with visible net marks were observed at Campbellton River using the closed circuit video fish-counting system. These observations provide a minimum estimate of the incidence of net-marked fish, since light conditions or minor scarring could render some marks invisible to either the video camera or the naked eye. The incidence of net marks does not quantify unrecorded removals but does provide an indication that this activity did take place.

SALMON POSTSMOLTS RETURNING TO FRESHWATER

Stocks of Atlantic salmon exhibit various life history patterns including several alternate strategies. The entire life cycle can take place in freshwater; they can start life in the river, then migrate between river and estuary; they can migrate between river and estuary and then go to sea;

or they can have the more typical anadromous life cycle of going to sea for one or more years before returning to freshwater (Power *et al.* 1987). In Newfoundland and Labrador, the most common life history type is starting life in the river, migrating to sea at two to seven years of age, and then returning to freshwater after spending at least one or more years in the sea. Salmon that have spawned one or more times after one or more years in the sea are also quite common. As evidenced by reading the scales of a few salmon that were caught by anglers or sampled at enumeration facilities, a small minority of salmon exists that spend only a couple of months in the estuary before returning to freshwater. Because they do not spend a full year at sea, these salmon are typically very small, being less than 40 cm in fork length. Also, since they are uncommon, the salmon nomenclature does not have a separate name for this life stage; they are currently labelled as postsmolts, but differ from the postsmolts described by Allan and Ritter (1977) which refers to an intermediate stage occurring entirely in the sea. Life-history was examined from scale samples taken from a number of these fish captured as kelts at the Campbellton River counting fence in the spring of 1994. In 1995, a 30 cm line was installed in the tunnel of the video counting chamber in the adult counting fence in Campbellton River to better enable enumeration of these fish.

BIOLOGICAL CHARACTERISTICS

Biological characteristics information (obtained by sampling recreational catches) used to calculate egg depositions for adults < 63 cm in length (small salmon) for years prior to 1992 for Middle Brook and Terra Nova River is presented in Table 1 and for Biscay Bay River and Northeast River in Table 2. In 1992-95, for Terra Nova River, Biscay Bay River, and Northeast River, small sample sizes each year necessitated combining data for each river; the following information was used:

River	Weight (kg)			Proportion Female (N)
	Mean	SD	N	
Terra Nova River 1992-95	1.69	0.51	49	0.76 (49)
Biscay Bay River 1992-95	1.96	0.36	53	0.65 (53)
Northeast River 1992-95	1.69	0.35	40	0.95 (40)

For Middle Brook, the following values for female mean weight and proportion female for each year during the period 1992-95 were used:

Year	Weight (kg)			Proportion Female (N)
	Mean	SD	N	
1992	1.74	0.40	37	0.82 (37)
1993	1.65	0.42	71	0.76 (71)
1994	1.75	0.33	33	0.74 (33)
1995	1.47	0.34	33	0.62 (33)

In 1993-95, for Campbellton River, the following values for female mean weight and proportion female were used:

Year	Weight (kg)			Proportion Female (N)
	Mean	SD	N	
1993	1.47	0.21	60	0.74 (88)
1994	1.55	0.27	28	0.72 (40)
1995	1.55	0.32	38	0.83 (38)

For fish ≥ 63 cm in length (large salmon), mean values of all available data for Gander River (SFA 4) and Terra Nova River (SFA 5) combined were used for Campbellton River, Middle Brook, and Terra Nova River (Table 1). For Biscay Bay River and Northeast River, data for Biscay Bay River, Colinet River, and Little Salmonier River combined (the latter two rivers are located in SFA 9) were used (female mean weight = 2.94 kg, SD = 0.61, N = 17; proportion female = 0.74, N = 17).

The biological characteristics of salmon for Lomond River, Torrent River, and Western Arm Brook from 1983-94 (Tables 3-5) were obtained from sampling conducted at the counting facilities and in the recreational fishery. Sex composition was determined by external examination at the counting facilities and internal examination in the recreational fishery. Potential egg depositions for Lomond River in 1984-88 were based on 1983-93 mean biological characteristics and 1992-93 were based on 1993 values. For Torrent River, egg depositions in 1990-93 were based on 1985-89 mean biological characteristics for small and large salmon. Western Arm Brook egg deposoitions in 1984 were based on 1974-93 mean biological characteristics. Biological characteristics were combined for small and large salmon for Western Arm Brook. Smolt-adult survival values for Western Arm Brook

have been adjusted from previous reports to represent the proportion of virgin 1-sea-winter salmon in the adult returns (i.e., repeat spawners were not included in the calculation).

Fecundity was determined from ovaries collected in the recreational fishery. Ovaries were stored in Gilson's fluid until ovarian tissue had broken down, after which time eggs were transferred to 10% formalin. Eggs, which for the most part were in early stages of development, were counted directly. The same relative fecundity values were used to calculate egg depositions for both small and large salmon for Campbellton River, Middle Brook, Terra Nova River, Biscay Bay River, and Northeast River and these are shown in Table 6. For Terra Nova River, the average for that river was used in 1985 and 1986.

For Lomond River, Torrent River, and Western Arm Brook, a mean fecundity of 1783 eggs/kg was used to calculate egg depositions. This value was estimated from an average of 3388 (N=264) eggs per female for Western Arm Brook in 1979-80 (Chadwick *et al.* 1986) and a mean weight of 1.90 kg.

TOTAL RIVER RETURNS, SPAWNING ESCAPEMENT, AND EGG DEPOSITION

Calculations were performed for small and large salmon separately. Total egg deposition was obtained by summing depositions for grilse and large salmon.

Total River Returns

Total river returns (TRR) were calculated as follows:

$$TRR = RC_b + C \qquad (1)$$

where,

RC_b = recreational catch below fishway
C = count of fish at counting facility

For Terra Nova River, recreational catch below the fishway did not include that of Maccles Brook. Partial counts of small and large salmon for Biscay Bay River were adjusted to total counts. For each each year in question, fish by-passed the counting fence for an approximate 24 hour period. The average count for 3-5 days immediately prior to flood conditions each year was used to fill in missing data. For details on the method used to adjust counts of small and large salmon for Western Arm Brook, see Claytor and Mullins (MS 1988).

Spawning Escapement

Spawning escapement (SE) was calculated according to the formula:

$$SE = FR - RC_a - BR \quad (2)$$

where,

FR = fish released at counting facility
RC_a = recreational catch above counting facility
BR = broodstock removal (Terra Nova River, Biscay Bay River, and Western Arm Brook)

Egg Deposition

Egg deposition (ED) was calculated as follows:

$$ED = SE \times PF \times RF \times MW \quad (3)$$

where,

SE = number of spawners
PF = proportion of females
RF = relative fecundity (no. of eggs/kg)
MW = mean weight of females

For Terra Nova River, spawning escapement and egg deposition were calculated for the area above the lower fishway, including the area above Mollyguajeck Falls.

The phenomenon of atresia has been reported to occur in Atlantic salmon in the Soviet Union (Melnikova 1964) and in France (Prouzet et al. 1984). Recently there is evidence to show that it can occur to varying degrees in insular Newfoundland (O'Connell and Dempson, unpublished data). Since egg deposition calculations above were based on eggs in early stages of development, they should be regarded as potential egg depositions.

TARGET SPAWNING REQUIREMENTS

The target spawning requirement for each river (exclusive of those of SFA 14A) was developed by O'Connell and Dempson (MS 1991a,b) (Table 7). The basic methodology used to derive targets for SFA 14A rivers was the same as for the others. The egg deposition requirement for fluvial parr rearing habitat (Elson 1957) for all rivers was 240 eggs/unit (a unit = 100 m^2) (Elson 1975). The requirement for lacustrine habitat was 368 eggs/ha, except for Western Arm Brook and Torrent River where the requirement was 105 eggs/ha (O'Connell and Dempson 1995). Target

spawning requirements were calculated in terms of small salmon only. Egg deposition from large salmon was considered as a buffer to the estimate of spawning requirement.

NUMBER OF RECRUITS AND SPAWNERS, 1974-95, AND ANTICIPATED RETURNS IN 1996

It is possible to estimate total population size of small salmon retrospectively (or total number of small salmon recruits), prior to any exploitation, for several year classes in some rivers with counting facilities, and to use the ratio of recruits to spawners to estimate anticipated returns one year in advance. A calculation of anticipated total returns (small plus large salmon) is also possible. Details of the calculations are presented below and were used for the Middle Brook, Biscay Bay River, and Western Arm Brook salmon stocks.

Since the implementation of the commercial fishery moratorium in 1992, the total number of small salmon recruits (TNR) for Middle Brook and Biscay Bay River, and for Western Arm Brook from 1993 on (see below), were equivalent to TRR (equation 1). Prior to 1992, TNR was calculated using a commercial fishery exploitation rate (μ_c) of 0.60 (Anon. MS 1990) according to the equation:

$$TNR = TRR/(1 - \mu_c) \qquad (4)$$

For the period 1974-83, TRR for Biscay Bay River was calculated as the ratio of total recreational catch (RC_t) and the average recreational fishery exploitation rate (μ_r) for the years 1989-91 (prior to recreational quotas) of 0.14, or

$$TRR = RC_t/\mu_r \qquad (5)$$

For the years 1974-83, TRR for Middle Brook was determined by applying the average proportion of total recreational catch below the fishway ($P\_RC_b = 0.74$) for 1984-91 to total recreational catch and counts of small salmon according to the equation

$$TRR = (RC_t \times P\_RC_b) + C \qquad (6)$$

Spawning escapement for Middle Brook for 1974-83 was calculated using the average proportion of total recreational catch above the fishway ($P\_RC_a = 0.26$) for 1984-91 in the relationship

$$SE = C - (RC_t \times P\_RC_a) \text{ or } TRR - RC_t \qquad (7)$$

Age composition of Middle Brook and Biscay Bay River smolts was adjusted to reflect only the 3+ and 4+ age groups, i.e., the minimal numbers of 2+ and 5+ year old smolts present were not considered; the resultant proportions of 3+ and 4+ smolts were 0.5 and 0.5 Middle Brook, and 0.74 and 0.26 for Biscay Bay River. The ratio of recruits to spawners (R/S) was calculated incorporating smolt age composition of small salmon according to the equation

$$R/S = [(TNR_{i+5} \times P\_3+) + (TNR_{i+6} \times P\_4+)]/SE_i \quad (8)$$

where,

TNR_{i+5} and TNR_{i+6} = small salmon recruits in years i+5 and i+6
SE_i = spawning escapement (small salmon) in year i
P_3+ and P_4+ = proportion of 3+ and 4+ smolts, respectively

Smolt-age composition of Western Arm Brook small salmon rectuits was adjusted to reflect only the 3+, 4+, and 5+ age groups. The percentage of returns at age 2+ was added to 3+ and age 6+ was added to 5+. The percentage of 2+ and 6+ smolts was zero or minimal in most years. Equation 8 can be modified accordingly to accomodate these smolt-age structures.

Anticipated returns of small salmon (AR_s) in 1995 was calculated as the product of the average R/S and SE for each smolt-age grouping separately and then summed. The average R/S for 1992-95 was used for both the 3+ and 4+ smolt-age groups for Middle Brook and Biscay Bay River. The equation was as follows:

$$AR_s = (R/S\_3+_i \times SE_{i-5}) + (R/S\_4+_i \times SE_{1-6}) \quad (9)$$

where,

R/S_3+_i and R/S_4+_i = small salmon recruits with smolt ages 3+ and 4+ in 1995 (year i)
SE_{i-5} and SE_{i-6} = spawning escapement (small salmon) in years i-5 and i-6

For Western Arm Brook (age groups 3+, 4+, and 5+), the average R/S for 1993-95 was used instead of 1992-95. This was because the value for 1992 was substantially lower than for the succeeding moratorium years, which could have been due to the interception of adult salmon in cod fishing gear. The cod fishery has been closed from 1993 to the present time. Equation 9 can be modified to accomodate these smolt-age structures.

A similar calculation was performed with the minimum and maximum R/S corresponding to the mean for each smolt-age grouping to obtain an estimate of the range of anticipated returns.

Total anticipated returns (AR_t), or the sum of small and large salmon, was determined as follows:

$$AR_t = AR_s/P\_AR_s \quad (10)$$

where,

P_AR_s = mean proportion of small salmon in escapements for 1992-95

A measure of the precision of estimates of anticipated returns of small salmon was obtained by applying the average R/S for each smolt age group (from equation 9) to the appropriate spawning year, summing, and comparing the results to actual returns for 1992-95.

ANALYSIS TO DETECT RECRUITMENT OVERFISHING

Anon. (MS 1994) defined recruitment overfishing as a level of fishing mortality that reduces the ability of a population to persist, more specifically, the failure of a cohort of spawners to replace itself as a result of fishing. One way to evaluate Atlantic salmon stocks in terms of recruitment overfishing is through the examination of spawner-to-spawner relationships. Estimated numbers of spawners obtained from parental spawning cohorts of small salmon were traced backward, beginning with the estimate of the number of spawners for the current year. Data sets (Middle Brook and Biscay Bay River) were examined to see if numbers of spawners, which were made up of a range of chronological ages, were sufficient to replace the weighted sum of spawning parents of the same sea age. The appropriate weighting for historical spawners was determined from the average smolt-age distribution. This technique, demonstrating the use of the necessary lags and river-age distributions, is found in Anon. (MS 1994).

Results

RECREATIONAL FISHERY

Catch and effort data for each river are presented in Appendices 1-7. Catches for all years prior to 1992 represent retained catch for the entire angling season. Total catch for 1995 (retained plus released fish), effort, and catch per unit of effort (CPUE) are compared to years prior to 1992 and 1992-94. In 1992, there was no estimate of released fish during the period of retention of catch which could impact on comparisons. The total number of fish retained in 1995 is also shown. Comparison of 1994 and 1995 retained catch and effort with 1992 and 1993 provides an indication of the effectiveness of the elimination of quotas in 1994 and 1995 on maintaining catch and effort at 1992 and 1993 levels. Calculation of CPUE in terms of retained fish only was not possible since effort figures apply to both retained and released fish collectively. An objective of the split in seasonal quota of 3 fish prior to and after July 31 in 1994 was to constrain the catch of retained fish to levels similar to the quota years of 1992 and 1993. This objective was met more or less for Campbellton River (Appendix 1) and Middle Brook (Appendix 2) but for Terra Nova River, retained catch in 1994 nearly doubled over 1992 and 1993 and was substantially higher than these years in 1995. In both 1994 and 1995, Biscay Bay River (Appendix 4) was closed to angling during peak periods in July, as a result of high water temperatures and low water levels. In spite of this, the catch for 1995 was substantially higher than in 1992 and 1993 and was the fourth highest on record. It should be noted that the quota for retained fish for SFA 9, which includes Biscay Bay River, was not caught in 1993. Northeast River (Appendix 5) was also closed to angling during peak periods in July in both 1994 and 1995 due to low water levels and high water temperatures.

Recreational catches in Lomond River have been controlled by an individual river quota since 1989. However, excluding 1995, over the years other catch and effort controls such as split seasons and reduced bag limits may have been responsible for preventing the quota from being reached earlier in the season. The 1995 retention quota of 375 small salmon was reached on July 23 and the river was opened to hook-and-release fishing only. In 1993 and 1994, quotas of 350 small salmon were not reached but in 1993, because the SFA quota was reached, the river was closed to retention angling on July 20-31 and August 8-September 6. The quota of 350 was reached in 1989-92 after seven weeks of angling. The total retained and released catches of small and large salmon in Lomond River have increased since 1992 (Appendix 6). The total catch in 1995 was the highest on record and CPUE was the highest in nine years. The retained and released catch of small salmon in Torrent River in 1995 was the highest recorded and the released catch of large salmon was the highest since 1965 (Appendix 7). The total catch (retained plus released fish) for Torrent River in 1995 was the highest ever recorded and CPUE among the fourth highest recorded.

UNRECORDED MORTALITIES

At the Campbellton River fence, visible net marks were recorded on a daily basis. Overall in 1995, there were 5.0% or 162 of the 3,253 upstream migrating Atlantic salmon with visible netmarks. Because the Campbellton counting fence is only 0.25 km from the sea, these marks had to have occurred sometime before the salmon entered freshwater. In 1994, 6.2% of the upstream migrating salmon had net marks. It is concluded that there is some mortality at sea, although the overall magnitude is unknown. Net scarring was also noted at the Lomond River fishway.

SALMON POSTSMOLTS RETURNING TO FRESHWATER

In 1993 and 1994, a few very small (<40 cm) salmon were noted at the counting fence ascending Campbellton River. In 1995, 13 salmon of approximately 28-35 cm in length were observed ascending through the Campbellton River counting fence. The total upstream run was 13 postsmolts, 3035 small and 218 large salmon; thus, the upstream run consisted of 0.4% postsmolts. Therefore, it is concluded that for 1995 the presence of salmon postsmolts in the upstream run at Campbellton River is not unusual in that it also occurred in 1993 and 1994.

In the spring of 1994, out of a total of 907 kelts sampled there were 4 or 0.4% that had not completed a full year in the sea. Another 12 or 1.4% of the kelts had no complete sea year but showed 2 or more spawning marks.

COUNTS AT COUNTING FACILITIES

SFA 4

Counts of small and large salmon at the Campbellton River counting fence for 1993-95 are shown in Table 8. The 1995 count of small salmon increased over that of 1994 by 5% but remained

24% below the count for 1993. The 1995 count of large salmon increased over both 1993 (14%) and 1994 (50%).

SFA 5

Counts of small and large salmon at the Middle Brook and lower Terra Nova River fishways for the period 1974-94 are shown in Table 8 and Fig. 2. The count of small salmon at the Middle Brook fishway in 1995 decreased from 1994 (25%) and the 1992-94 mean (27%) but remained above the 1984-89 (24%) and 1986-91 (51%) means. For Terra Nova River, the count of small salmon in 1995 was the second highest on record, exceeding 1994 (44%) and the 1984-89 (76%), 1986-91 (96%), and 1992-94 (18%) means. The count of large salmon at Middle Brook in 1995 was the highest recorded, increasing over 1994 (87%) and the means (568, 972, and 129%, respectively). At Terra Nova River, the count of large salmon in 1995 was also the highest on record (162, 399, 374, and 74% over 1994 and the means, respectively). In 1993, as a result of a combination of the loss of the flow control dam above the fishway in Terra Nova River and exceptionally high water levels, some fish bypassed the fishway and hence counts of small and large salmon are partial. However, even the partial counts were the highest on record (highest up to that point for large salmon), and for this reason they were included in the mean for 1992-94.

SFAS 9 and 10

Counts of small and large salmon for the Biscay Bay River counting fence (SFA 9) and the Northeast River fishway (SFA10) are presented in Table 9 and Fig. 3. The count of small salmon in Biscay Bay River in 1995 decreased from 1994 and the means (33, 39, 24, and 22%, respectively). At Northeast River, the 1995 count of small salmon was similar to 1994 (-2%), was below the 1992-94 mean (19%), but remained above the 1984-89 (28%) and 1986-91(24%) means. The count of large salmon for Biscay Bay River in 1995 also declined from 1994 and the means (18, 30, 30, and 30%, respectively). For Northeast River, the count of large salmon in 1995 increased over 1994 and the means (6, 255, 289, and 23%, respectively) with the increases being most pronounced over the 1984-89 and 1986-91 means.

SFA 14A

The count of small salmon at the Lomond River fishway in 1995 (Table 10 and Fig. 4) was the highest on record, exceeding 1994 and the means (43, 182, 162, and 81%, respectively). A record number of small salmon was also counted at Torrent River fishway in 1995 (61, 187, 179, and 75% above 1994 and the means, respectively). Record counts of large salmon were also observed at Lomond (90, 280, 345, and 74% above 1994 and the means respectively) and Torrent (85, 530, 775, and 154%) rivers.

On the basis of a 31% lower smolt count in 1994 compared to 1993, the number of small salmon expected to return to the Western Arm Brook counting fence in 1995 was expected to decline from 1994. It was expected that if smolt-adult survival remained similar to the previous year, then

returns of small salmon in 1995 would be 31% less than in 1994. As expected, returns were less but the decline at 14% was lower in magnitude than predicted. This was the result of a 31% increase in survival rate compared to the previous year (Table 11). The count of small salmon in 1995 increased over the 1984-89 (130%) and 1986-91 (128%) means and was similar to the 1992-94 mean (6%) (Table 10 and Fig. 4). The count of large salmon in 1995 was the highest on record and increased over 1994 (6%) and the means (4850, 6500, and 111%, respectively).

The smolt count of 15144 for Western Arm Brook in 1995 was 63% above the count for 1994 (Table 11). Therefore, assuming that the smolt-adult survival rate in 1996 is similar to that in 1995 (8.9%), returns of small salmon in 1996 are expected to be above those in 1995. Smolt-adult survival has increased each year since 1992 (Table 11).

TOTAL RIVER RETURNS, SPAWNING ESCAPEMENT, AND PERCENTAGE OF TARGET ACHIEVED

Total river returns and spawning escapements of small and large salmon, potential egg depositions, and percentages of target spawning requirement (eggs) achieved for Campbellton River, Middle Brook, and Terra Nova River are shown in Table 12. For Campbellton River (295%) and Middle Brook (120%), the percentage of target egg deposition achieved in 1995 was in excess of requirement. Terra Nova River on the other hand received 49% of target, the second highest on record. Target egg requirement was not met in Biscay Bay River (77%), the second time since the moratorium; in Northeast River, target was exceeded (378%) in 1995 (Table 13). For Terra Nova River, broodstock removals in 1994 (54 small and 6 large) and 1995 (214 small and 52 large) were not included in the calculations of egg deposition.

Total river returns and spawning escapements of small and large salmon, potential egg depositions, and percentages of target spawning requirement (eggs) achieved for Lomond River, Torrent River, and Western Arm Brook are shown in Table 14. Target egg deposition requirements in 1995 were exceeded for the areas above the counting facilities in all three rivers (187, 1033, and 285% respectively).

TRENDS IN TOTAL NUMBERS OF RECRUITS AND SPAWNERS

The estimated number of small salmon recruits and corresponding number of spawners for each year class for Middle Brook, Biscay Bay River, and Western Arm Brook are shown in Tables 15-17 and Figs 6A, 7A, and 8A, respectively. There was a lot of variability in recruitment from a given spawning for all rivers. The ratio of total number of small salmon recruits to spawners (R/S) in 1995 decreased from 1994 in all three rivers (Figs. 6B, 7B, and 8B, respectively). The decline for Biscay Bay River continued a significant trend since 1980 ($r^2 = 0.75$; $df = 14$; $P < 0.01$). Trends for Middle Brook and Western Arm Brook were not significant ($P > 0.05$). Expressing target spawning requirement in terms of small salmon adults (horizontal line in Figs. 6C, 7C, and 8C), it is evident that for Middle Brook the target was achieved in 1977-84 and 1992-94, but not in 1995. For Biscay Bay River the target was achieved in 1979-88, 1992 and 1994 but not in 1993 and 1995. Target was

reached in Western Brook in most pre-salmon moratorium years and every year since the moratorium. For Middle Brook and Western Arm Brook, numbers of spawners in 1992-95 represent a substantial improvement over the lows observed from around the mid-1980s to 1991 but remain below the highs in the late 1970s and early 1980s (all rivers). Since 1981 for Middle Brook ($r^2 = 0.85$; df = 12; $P < 0.01$) and 1980 for Biscay Bay River ($r^2 = 0.86$; df = 13; $P < 0.01$), there has been a significant decline in numbers of small salmon recruits (Figs. 6D and 7D, respectively); there was a significant declining trend for Western Arm Brook since 1983 ($r^2 = 0.31$; df = 11; $P < 0.05$) (Fig 8D). The lowest recruitment for the entire time series for Middle Brook and Western Arm Brook was in 1992 (Fig. 6D and 8D, respectively) and for Biscay Bay River it was in 1991 (Fig. 7D).

ANTICIPATED RETURNS IN 1995

For Middle Brook, the estimated number of small salmon recruits anticipated for 1996, based on the average R/S for each smolt-age grouping and assuming natural survival rates remain the same, is approximately 1650; corresponding low and high values are approximately 1200 and 2100, respectively (Table 15 and Fig. 6D). Assuming no recreational fishery, anticipated spawning escapement in 1996 is equivalent to the number of recruits, and as shown in Fig. 6C, the average anticipated returns of small salmon are above the target requirement. An idea of the precision of these estimates for small salmon recruits is shown in Table 14 (mean difference between estimated and observed for 1992-95 was -10%). The estimated return of small salmon in 1995 was 18% less than the actual return. The variability described in Fig. 6A must be kept in mind with respect to estimates of anticipated returns. The anticipated number of recruits for Biscay Bay River in 1996 is around 700 with corresponding low and high values of approximately 470 and 1000 (Table 16 and Fig. 7D). Anticipated returns of small salmon in 1996 are below target spawning requirement (Fig. 7C), bearing in mind the variability shown in Fig. 7A.. The mean difference between estimated and observed small salmon returns for 1992-94 was -13% (Table 16); the estimated return of small salmon in 1995 was 25% less than the actual return. The anticipated number of small salmon recruits for Western Arm Brook in 1996 is approximately 800 with corresponding high and low values of 550-100 (Table 17 and Fig. 8D). Returns in 1996 are anticipated to be above target spawning requirement (Fig. 8C), again keeping in mind the variability shown in Fig. 8A. The mean difference between estimated and observed small salmon returns for 1992-94 was -7% (Table 17); the estimated return of small salmon in 1995 was 12% less than the actual return.

RECRUIT OVERFISHING

During the commercial fishery moratorium years 1992-95, estimated numbers of spawners in Middle Brook were above the replacement (diagonal) line (Fig. 9). The three years immediately preceeding the moratorium, 1989-91, were below the replacement line.

For Biscay Bay River, spawners for 1992 and 1994 were above the replacement line but not 1993 and 1995 (Fig. 10). The three years immediately preceeding the moratorium, 1989-91, were below the replacement line.

Discussion

Counts of small and large salmon during the moratorium years 1992-95 improved overall over the 1984-89 and 1986-91 means for all rivers except Biscay Bay River. This is consistent with results expected from the moratorium. Since 1992, target spawning requirement was met in all rivers except Terra Nova River (all years) and certain years in Biscay Bay River. For Middle Brook, Northeast River, Biscay Bay River, and Western Arm Brook, returns of small salmon in some pre-moratorium years were as high or higher than observed collectively for the period 1992-95; this also applied to large salmon, with the exception of Terra Nova River and Western Arm Brook and to a lesser extent, Northeast River and Lomond River.

Compared to the late 1970s and early 1980s, since 1989, total polulation sizes of small salmon for Middle Brook, Biscay Bay River, and Western Arm Brook have been quite low. Total river returns of small salmon to Middle Brook and Western Arm Brook in 1996 are anticipated to exceed target while returns for Biscay Bay River are not expected to meet target. These predictions were based on fixed parameter values (smolt-age composition and commercial and recreational fishery exploitation rates) and assume constant natural survival rates in both the freshwater and marine environments. The use of constants in the prediction of adult returns entails risk since parameters are most likely subject to annual variablilty. For instance, smolt-adult survival has been shown to be highly variable in Northeast Brook, Trepassey (SFA 9) and Conne River (SFA 11) (O'Connell *et al.* MS 1996). Each of these rivers showed a marked increase in smolt-adult survival in 1995, while increases for Rocky River (SFA 9) and Western Arm Brook (SFA 14A) were much less, and Campbellton River (SFA 4) showed a decline

Reports of very small salmon migrating upstream in 1995 have come from rivers in St.George's Bay, e.g., Southwest River. Small fish for Campbellton River were those that moved into the estuary in spring and returned to freshwater in the summer of the same year. A number of fish with this life-history pattern have been encountered over the years at counting facilities throughout insular Newfoundland. The average size of small salmon entering Middle Brook in 1995 was the lowest during the moratorium. These fish however had returned to freshwater after one winter in the sea (typical grilse pattern).

Cautions associated with the parameter values used to calculate target spawning requirements have been discussed previously by O'Connell and Dempson (MS 1991a,b, 1995) and will not be dealt with here.

Acknowledgements

Funding for the operation of the Lomond River and Torrent River fishways was provided to the Bonne Bay Development Association and the St. Barbe Development Association through grants from the Canada/Newfoundland Agreement on Salmonid Enhancement and Conservation (CASEC), the Canada Employment Commission (CEC), Corner Brook, NF, and the Department of Fisheries

and Oceans, Science Branch, Corner Brook, NF. Funding for the operation of the Campbellton River counting fence was provided to the Lewisporte Area Development Association through a CASEC grant; CEC Gander NF, and the Department of Fisheries and Oceans, St. John's, NF. The Biscay Bay River counting fence was operated by the Southern Avalon Development Association through a CASEC grant and funding from the Department of Fisheries and Oceans, St. John's, NF.

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Table 1. Biological characteristic data for female small salmon for Middle Brook and Terra Nova River, Bonavista Bay (SFA 5) and for female large salmon for Gander River (SFA 4) and Terra Nova River, Newfoundland.

	Fork length of females (cm)				Weight of females (Kg)				River age (yr)				Sex ratio	
River	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	% Female
Small salmon														
Middle Brook														
1983	19	50.8	4.5	35.0-56.0	17	1.66	0.32	1.00-2.27	19	3.58	0.51	3.00-4.00	24	79
1984	121	49.8	4.4	38.5-62.0	121	1.48	0.40	0.60-2.80	121	3.51	0.59	3.00-6.00	154	79
1985	88	50.1	4.2	33.9-57.1	88	1.51	0.34	0.70-2.30	88	3.43	0.56	2.00-5.00	107	82
1986	42	52.0	4.8	45.0-61.4	41	1.58	0.47	0.90-2.70	42	3.74	0.59	3.00-5.00	49	86
1987	7	49.5	3.4	44.0-55.0	7	1.30	0.33	1.00-2.00	7	3.71	0.49	3.00-4.00	17	41
Total	277	50.3	4.4	33.9-62.0	274	1.51	0.39	0.60-2.80	277	3.53	0.58	2.00-6.00	351	79
Terra Nova River														
1983	81	51.8	3.8	38.5-61.5	83	1.66	0.35	0.91-2.70	83	3.64	0.67	3.00-5.00	105	79
1984	73	50.2	3.7	43.0-61.0	73	1.57	0.36	0.96-2.70	73	3.55	0.62	3.00-5.00	99	74
1985	29	51.8	4.4	44.0-60.5	18	1.45	0.49	0.80-2.60	29	3.62	0.72	3.00-6.00	41	71
1986	35	52.6	3.7	46.0-59.0	35	1.61	0.36	0.90-2.40	35	3.45	0.66	3.00-6.00	53	66
1987	35	51.5	3.5	42.0-61.0	36	1.52	0.32	0.80-2.40	36	3.50	0.70	2.00-5.00	50	72
Total	253	51.4	3.9	38.5-61.5	245	1.59	0.36	0.80-2.70	256	3.57	0.66	2.00-6.00	348	74
Large salmon														
Gander River	8	69.2	80.6	63.0-82.6	8	3.66	1.81	2.38-7.71	8	3.50	0.53	3.00-4.00	10	80
Terra Nova River	6	68.3	38.4	63.0-73.5	6	3.08	0.60	2.27-3.70	6	4.00	0.63	3.00-5.00	6	100
Gander and Terra Nova rivers combined	14	68.8	63.9	63.0-82.6	14	3.41	1.41	2.27-7.71	14	3.71	0.61	3.00-5.00	16	88

Table 2. Biological characteristic data for female small salmon for Biscay Bay River, St. Mary's Bay (SFA 9) and Northeast River, Placentia Bay (SFA 10), Newfoundland.

River	Fork length of females (cm)				Weight of females (Kg)				River age (yr)				Sex ratio	
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	% Female
SFA 9														
Biscay Bay River	505	52.6	3.5	41.5-62.4	326	1.68	0.36	0.81-3.50	519	3.1	0.59	2.00-5.00	698	75
SFA 10														
Northeast River														
1974	1	55.9	-	-	1	1.81	-	-	1	3.00	-	-	1	100
1975	-	-	-	-	1	1.59	-	-	1	3.00	-	-	1	100
1978	59	53.7	2.7	45.7-59.0	59	1.52	0.19	1.10-2.00	59	2.93	0.36	2.00-4.00	63	94
1979	-	-	-	-	12	1.43	0.24	0.91-1.82	12	2.58	0.51	2.00-3.00	14	86
1980	38	53.4	2.2	46.0-57.2	38	1.58	0.23	1.10-2.10	38	2.68	0.47	2.00-3.00	42	90
1981	91	52.6	2.6	43.0-58.0	86	1.54	0.24	0.91-2.04	93	2.91	0.43	2.00-4.00	103	90
1982	16	54.3	2.5	51.0-58.5	22	1.55	0.28	1.00-2.00	22	2.77	0.53	2.00-4.00	24	92
1983	19	51.9	1.9	49.0-56.0	26	1.50	0.20	1.15-1.90	26	2.46	0.51	2.00-3.00	29	90
1984	24	52.2	2.3	46.0-58.0	22	1.51	0.19	1.10-1.90	24	2.92	0.50	2.00-4.00	27	89
1985	47	51.8	3.2	41.7-57.8	47	1.56	0.24	1.00-2.16	47	2.91	0.35	2.00-4.00	51	92
1986	63	53.2	2.3	46.8-60.0	63	1.69	0.25	0.90-2.40	63	3.14	0.43	2.00-4.00	68	93
1987	1	49.0	-	-	1	1.40	-	-	1	3.00	-	-	1	100
Total	359	52.9	2.7	41.7-60.0	378	1.56	0.24	0.90-2.40	387	2.88	0.47	2.00-4.00	424	91

Table 3. Biological characteristics for female small and large salmon for Lomond River (SFA 14A), Newfoundland, 1975-1995.

	Fork length of females (cm)				Weight of females (Kg)				River age (yr)		Sex ratio	
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	N	% Female
Small salmon												
1975	0	.	.	.	0	.	.	.	1	3.00	0	.
1978	11	52.3	3.50	47.3 - 60.0	11	1.53	0.32	1.20 - 2.30	22	3.00	12	54.5
1979	16	51.8	3.50	41.9 - 57.2	20	1.43	0.23	1.00 - 1.81	39	2.80	20	52.6
1980	8	51.4	3.20	46.0 - 56.0	6	1.44	0.29	1.06 - 1.81	15	2.50	8	53.3
1981	18	51.9	3.50	47.7 - 62.4	18	1.76	0.40	1.30 - 2.80	39	3.00	18	46.2
1982	5	48.8	2.80	45.0 - 52.0	25	1.53	0.22	1.02 - 2.04	36	3.00	27	77.1
1983	9	52.9	3.76	44.0 - 56.0	8	1.46	0.09	1.30 - 1.60	15	2.80	9	75.0
1984	30	50.8	2.82	46.0 - 58.0	31	1.43	0.16	1.10 - 1.80	55	2.80	32	61.5
1985	14	51.5	3.90	45.0 - 57.0	3	1.57	0.32	1.20 - 1.80	32	3.20	14	87.5
1986	15	52.5	3.44	45.0 - 58.0	9	1.71	0.30	1.25 - 2.20	57	2.90	15	40.5
1988	1	52.0	.	52.0 - 52.0	1	1.36	.	1.36 - 1.36	6	2.83	1	16.7
1990	1	50.8	.	50.8 - 50.8	1	1.10	.	1.10 - 1.10	1	3.00	1	100.0
1991	1	54.6	.	54.6 - 54.6	1	1.30	.	1.30 - 1.30	1	3.00	1	100.0
1992	11	55.5	2.44	52.5 - 60.0	3	1.60	0.20	1.40 - 1.80	51	2.90	14	28.0
1993	44	53.7	2.40	49.5 - 60.0	34	1.78	0.48	0.70 - 3.00	71	2.90	45	63.4
1994	13	52.5	4.25	40.6 - 57.2	12	1.50	0.46	0.50 - 2.40	22	3.30	13	59.1
1995	4	55.5	1.90	53.0 - 57.0	5	1.89	0.20	1.54 - 2.09	43	2.90	5	55.6
Total	201	52.4	3.40	40.6 - 62.4	188	1.58	0.35	0.50 - 3.00	506	2.90	235	55.0
Large salmon												
1978	2	69.8	0.40	69.5 - 70.0	2	3.40	0.28	3.20 - 3.60	3	3.00	2	66.7
1979	1	69.9	.	69.9 - 69.9	1	3.50		3.50 - 3.50	1	3.00	1	100.0
1980	3	67.9	3.60	64.0 - 71.1	3	3.74	0.69	2.95 - 4.20	3	3.00	3	100.0
1981	0	.	.	.	0				1	2.00	0	
1982	2	70.0	0.00	70.0 - 70.0	3	3.78	0.26	3.63 - 4.08	3	3.00	3	100.0
1984	2	68.3	3.20	66.0 - 70.5	2	3.70	0.71	3.20 - 4.20	4	2.50	2	100.0
1986	0	.	.	.	0	.	.	.	5	2.60	0	.
1992	1	70.0	.	70.0 - 70.0	0	.	.	.	23	2.80	1	4.2
1993	5	69.4	3.10	66.0 - 74.0	4	3.56	0.69	2.75 - 4.25	6	2.30	5	85.7
1994	1	76.8	.	76.8 - 76.8	1	5.20	.	5.20 - 5.20	1	3.00	1	100.0
Total	17	69.6	3.00	64.0 - 76.8	16	3.73	0.61	2.75 - 5.20	50	2.70	18	27.8

Table 4. Biological characteristics for female small and large salmon for Torrent River (SFA 14A), Newfoundland, 1975-1995.

	Fork length of females (cm)				Weight of females (Kg)				River age (yr)		Sex ratio	
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	N	% Female
Small salmon												
1975	0				11	1.50	0.15	1.36 - 1.82	15	3.30	11	73.3
1979	2	52.0	7.1	47.0 - 57.0	1	1.15		1.15 - 1.15	4	3.30	2	50.0
1980	14	51.8	2.5	47.2 - 54.9	0				58	3.00	14	58.3
1981	0				10	1.53	0.34	1.02 - 2.04	10	3.10	10	100.0
1983	11	53.3	2.10	49.5 - 56.0	11	1.45	0.23	1.00 - 1.60	16	3.30	11	68.8
1985	83	52.2	2.90	46.0 - 60.0	3	1.50	0.00	1.50 - 1.50	154	3.40	83	56.5
1986	172	52.1	3.10	41.0 - 59.0	172	1.70	0.41	1.00 - 2.70	305	3.20	172	56.4
1987	182	51.9	2.80	43.8 - 60.5	180	1.55	0.40	0.70 - 2.75	297	3.10	180	61.0
1988	150	53.1	3.30	47.0 - 62.1	151	1.46	0.34	1.00 - 2.50	215	3.20	151	68.6
1989	84	54.0	3.30	45.9 - 62.0	79	1.66	0.32	0.20 - 2.60	108	3.30	85	78.7
1990	16	53.4	3.30	49.0 - 62.5	0	.	.	.	33	3.20	17	48.6
1991	25	52.5	3.40	47.0 - 59.0	2	1.90	0.42	1.60 - 2.20	41	3.10	27	62.8
1992	11	53.2	3.30	46.7 - 59.0	0	.	.	.	17	3.10	11	64.7
1993	188	52.9	4.40	30.0 - 62.0	2	2.10	0.28	1.90 - 2.30	249	3.20	190	75.4
1994	14	53.8	3.50	48.0 - 60.5	10	1.46	0.60	0.90 - 3.00	22	3.50	14	63.6
1995	11	54.9	2.30	51.0 - 58.4	10	1.68	0.21	1.40 - 2.00	22	3.10	12	70.6
Total	946	52.7	3.40	30.0 - 62.5	642	1.58	0.38	0.20 - 3.00	1566	3.20	990	64.7
Large salmon												
1975	0				1	4.09		4.09 - 4.09	1	4.00	1	100.0
1980	0				0				1	4.00	0	
1985	2	73.5	2.12	72.0 - 75.0	1	4.20	.	4.20 - 4.20	5	3.40	2	40.0
1986	1	64.0	3.89	64.0 - 64.0	1	2.20	1.00	2.20 - 2.20	1	4.00	1	100.0
1987	0	79.1	5.88	73.8 - 87.0	0	4.45	0.64	3.80 - 5.00	2	3.00	0	50.0
1988	4	74.8	2.59	71.5 - 77.8	4	4.44	0.72	3.50 - 5.00	10	3.00	4	40.0
1989	9	74.8	6.00	66.9 - 82.4	4	4.40	1.01	3.10 - 5.30	14	3.36	9	60.0
1990	1	64.0	.	64.0 - 64.0	0	.	.	.	1	4.00	1	50.0
1992	1	78.0	.	78.0 - 78.0	0	.	.	.	1	3.00	1	100.0
1993	101	69.9	4.79	63.0 - 81.5	0	.	.	.	140	3.06	101	68.7
1994	1	71.0	.	71.0 - 71.0	1	3.80	.	3.80 - 3.80	3	3.00	1	33.3
Total	118	70.4	5.10	63.0 - 82.4	11	4.13	0.96	2.20 - 5.30	174	3.11	119	65.0

Table 5. Biological characteristics for female small and large salmon for Western Arm Brook (SFA 14A), Newfoundland, 1971-1995.

	Fork length of females (cm)				Weight of females (Kg)				River age (yr)		Sex ratio	
	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	N	% Female
Small salmon												
1971	47	52.6	2.8	47.5 - 61.2	11	1.48	0.20	1.02 - 1.82	77	4.0	47	62.7
1972	47	52.3	4.1	37.2 - 62.5	56	1.71	0.33	0.62 - 2.56	71	3.8	57	81.4
1973	88	53.0	3.1	43.8 - 62.1	87	1.57	0.28	0.84 - 2.62	137	3.9	88	80.0
1974	56	53.0	2.3	48.9 - 58.3	55	1.62	0.22	1.10 - 2.20	81	4.1	56	82.4
1975	10	53.4	4.3	42.8 - 58.5	10	1.72	0.33	1.10 - 2.26	18	3.7	10	55.6
1976	8	52.0	4.5	43.2 - 58.5	8	1.69	0.54	1.35 - 3.00	11	4.0	8	72.7
1977	33	52.1	3.4	45.0 - 60.3	33	1.47	0.33	1.00 - 2.60	53	3.7	33	62.3
1978	50	52.2	2.8	45.0 - 58.0	18	1.57	0.23	1.10 - 2.00	61	3.6	50	78.1
1979	131	51.1	3.2	27.5 - 62.0	131	1.47	0.31	0.50 - 2.90	206	3.9	131	59.3
1980	59	53.5	2.8	46.6 - 58.0	59	1.71	0.30	1.10 - 2.40	58	3.8	59	88.1
1981	51	51.7	3.2	43.0 - 59.5	51	1.55	0.34	0.90 - 2.50	65	3.6	51	82.3
1982	54	53.0	2.0	48.0 - 56.5	54	1.81	0.29	1.40 - 3.00	73	4.0	54	74.0
1983	153	50.9	2.9	35.9 - 58.5	152	1.51	0.29	0.80 - 2.50	187	3.9	153	78.1
1984	17	50.6	2.8	45.0 - 55.0	16	1.54	0.26	1.10 - 2.00	19	3.7	17	81.0
1985	64	51.8	2.9	37.5 - 56.5	64	1.53	0.29	1.10 - 2.20	80	3.8	64	81.0
1986	34	52.9	3.1	46.0 - 58.5	34	1.65	0.29	1.10 - 2.20	37	3.7	34	91.9
1987	69	53.8	2.6	47.2 - 59.0	68	1.66	0.34	1.10 - 2.70	80	3.7	69	82.1
1988	26	52.6	4.6	36.5 - 59.5	26	1.62	0.53	0.50 - 2.40	34	3.6	26	72.2
1989	119	53.6	3.0	43.0 - 60.0	39	1.81	0.33	1.00 - 2.50	133	3.6	119	86.9
1990	43	55.5	3.2	50.8 - 62.2	30	1.92	0.36	1.20 - 2.40	45	3.5	43	93.5
1991	192	53.0	2.4	47.0 - 60.0	65	1.71	0.17	1.40 - 2.10	224	3.5	192	84.2
1992	325	53.3	2.9	34.0 - 61.6	3	2.00	0.00	2.00 - 2.00	408	3.1	325	78.9
1993	222	53.8	2.7	46.6 - 62.0	206	1.83	0.52	0.60 - 4.10	281	3.7	222	76.8
1994	78	53.4	3.4	36.5 - 60.9	77	1.77	0.35	0.90 - 2.80	94	3.8	78	80.4
1995	60	53.9	2.4	45.8 - 58.7	60	2.06	0.33	1.25 - 2.75	76	3.8	60	80.0
Total	2036	52.9	3.1	27.5 - 62.5	1413	1.67	0.38	0.50 - 4.10	2609	3.7	2046	77.8
Large salmon												
1973	0				0				1	4.0	0	
1977	1	75.0		75.0 - 75.0	1	3.88		3.88 - 3.88	2	3.0	1	50.0
1980	2	75.0	2.8	73.0 - 77.0	2	4.55	0.49	4.20 - 4.90	2	3.5	2	100.0
1981	1	68.5		68.5 - 68.5	1	3.60		3.60 - 3.60	1	4.0	1	100.0
1985	0	.	.	.	0	.	.	.	1	3.0	0	
1987	1	64.0	.	64.0 - 64.0	1	2.40	.	2.40 - 2.40	1	4.0	1	100.0
1988	1	72.0		72.0 - 72.0	1	4.00		4.00 - 4.00	1	3.0	1	100.0
1989	0				0				1	4.0	0	
1990	1	64.8	.	64.8 - 64.8	1	3.00	.	3.00 - 3.00	1	3.0	1	100.0
1991	1	76.2	.	76.2 - 76.2	1	4.00	.	4.00 - 4.00	1	4.0	1	100.0
1992	5	73.4	4.5	69.0 - 79.0	1	4.50	.	4.50 - 4.50	7	3.6	5	62.5
1993	3	70.2	1.9	68.0 - 71.5	3	3.97	0.21	3.80 - 4.20	3	3.7	3	100.0
1994	2	75.1	4.3	72.0 - 78.1	2	4.65	0.49	4.30 - 5.00	4	3.8	2	50.0
1995	27	73.2	3.3	64.8 - 79.4	27	4.69	0.80	3.00 - 6.00	31	3.6	27	84.4
Total	45	72.8	3.8	64.0 - 79.4	41	4.44	0.83	2.40 - 6.00	51	3.6	45	76.3

Table 6. Relative fecundity values used to calculate egg depositions for each river in SFAs 4, 5, 9, and 10.

River	Year	Relative fecundity (No. eggs/Kg)	N
SFA 4			
Campbellton River	92-93	2114	45
SFA 5			
Middle Brook	1984	1896	102
	1985	1988	83
	1986	1955	36
	Total	1941	211
Terra Nova River	1984	1709	46
	1985	2372	6
	1986	1364	14
	Total	1713	66
SFA 9			
Biscay Bay River		2066	290
SFA 10			
Northeasr River, Placentia		2267	106

Table 7. Atlantic salmon target spawning requirement for each river in terms of eggs and small salmon.

River	Target spawning requirement	
	Eggs (No. x 10^6)	Small salmon (No.)
SFA 4		
Campbellton River	2.916	1480
SFA 5		
Middle Brook	2.342	1012
Terra Nova River	14.303	7094
SFA 9		
Biscay Bay River	2.951	1134
SFA 10		
Northeast River, Placentia	0.719	224
SFA 14A		
Lomond River	1.0952	653
Torrent River	1.4832	867
Western Arm Brook	0.9078	344

Table 8. Counts of Atlantic salmon at Campbellton River counting fence (SFA 4) 1993-95, Middle Brook fishway 1974-95, and lower Terra Nova River fishway 1978-95, Bonavista Bay (SFA 5). Partial counts are in partntheses and are not included in means.

	Campbellton River		Middle Brook		Terra Nova River	
Year	Small	Large	Small	Large	Small	Large
1974			(770)	(77)		
1975			(1119)	(9)		
1976						
1977						
1978			1403	16	810	20
1979			(1350)	(54)	569	170
1980			1712	91	843	39
1981			2414	39	1115	90
1982			1281	20	963	19
1983			1195	75	1210	57
1984			1379	57	1233	107
1985			904	27	1557	112
1986			1036	15	1051	140
1987			914	19	974	56
1988			772	14	1737	206
1989			496	19	1138	142
1990			745	13	1149	144
1991			562	14	873	114
1992			1182	43	1443	270
1993	4001	145	1959	87	(2713)	(470)
1994	2857	191	1513	90	1571	242
1995	3035	218	1139	168	2258	634
$\bar{X}$ 84-89			917	25	1282	127
95% LCL			610	8	965	75
95% UCL			1223	42	1598	179
N			6	6	6	6
$\bar{X}$ 86-91			754	16	1154	134
95% LCL			540	13	835	83
95% UCL			969	18	1473	185
N			6	6	6	6
$\bar{X}$ 92-94			1551	73	1909	327
95% LCL			583	8	172	18
95% UCL			2520	139	3646	636
N			3	3	3	3

Table 9. Counts of Atlantic salmon at the Biscay Bay River counting fence, St. Mary's Bay (SFA 9), 1983-95, and the Northeast River fishway, Placentia Bay SFA (10), 1974-95. Partial counts are in parentheses and are not included in means. Adjusted counts are bold and in italics.

	Biscay Bay River		Northeast River	
Year	Small salmon	Large salmon	Small salmon	Large salmon
1974			223	9
1975			(186)	(36)
1976			294	56
1977				
1978			390	32
1979			454	37
1980			433	34
1981			334	62
1982			86	36
1983	2330	88	233	22
1984	2430	83	419	44
1985	***1665***	***25***	384	0
1986	2516	101	725	39
1987	1302	106	325	16
1988	1695	61	543	11
1989	***912***	***107***	706	15
1990	1657	71	551	25
1991	394	35	353	8
1992	***1442***	***51***	921	46
1993	***1107***	***120***	847	65
1994	1592	68	677	70
1995	1071	56	663	74
$\bar{X}$ 84-89	1753	81	517	21
95% LCL	1096	47	339	3
95% UCL	2411	114	695	39
N	6	6	6	6
$\bar{X}$ 86-91	1413	80	534	19
95% LCL	647	49	356	7
95% UCL	2178	111	711	31
N	6	6	6	6
$\bar{X}$ 92-94	1380	80	815	60
95% LCL	763	-10	504	29
95% UCL	1997	169	1126	92
N	3	3	3	3

Table 10. Counts of Atlantic salmon at Lomond River and Torrent River fishways and Western Arm Brook counting fence (SFA 14A), 1974-95. Adjusted counts are bold and in italics.

	Lomond River		Torrent River		Western Arm Brook	
Year	Small	Large	Small	Large	Small	Large
1974	41	33	38	3	399	4
1975	1	0	191	25	631	1
1976	132	11	341	47	520	0
1977	192	11	789	33	341	3
1978	117	12	971	21	285	1
1979	195	1	1984	39	1578	0
1980	301	19	792	63	430	3
1981	110	50	2101	97	447	1
1982	275	16	2112	523	387	3
1983	220	7	2007	442	1141	4
1984	440	47	1805	288	120	0
1985	190	14	1553	30	***416***	2
1986	354	32	2815	92	***525***	0
1987	355	11	2505	68	378	1
1988	437	21	2075	44	***251***	1
1989			1369	60	***455***	0
1990			2296	82	***322***	0
1991			1415	73	233	1
1992	435	80	2347	169	480	8
1993	526	34	4009	222	947	8
1994	701	50	3592	331	954	31
1995	1002	95	5799	611	823	33
$\bar{X}$ 84-89	355	25	2020	97	358	1
95% LCL	229	7	1434	-4	202	-0
95% UCL	481	43	2606	198	513	2
N	5	5	6	6	6	6
$\bar{X}$ 86-91	382	21	2079	70	361	1
95% LCL	264	-5	1464	52	240	-0
95% UCL	500	47	2694	88	481	1
N	3	3	6	6	6	6
$\bar{X}$ 92-94	554	55	3316	241	794	16
95% LCL	218	-3	1168	35	119	-17
95% UCL	890	113	5464	446	1469	49
N	3	3	3	3	3	3

Table 11. Sea-survival of Atlantic salmon smolts from Western Arm Brook, 1971-1995.

Year i	Smolts Year i	Small Returns Year i+1	% V. 1SW Year i+1	1SW Returns Year i+1	% Sea-Survival
71	5735	406		406	7.1
72	11905	798		798	6.7
73	8484	523		523	6.2
74	11854	639		639	5.4
75	9600	552	100	552	5.8
76	6232	352	100	352	5.6
77	9899	307	98	301	3.0
78	13071	1578	100	1578	12.1
79	8349	460	100	460	5.5
80	15665	488	97	473	3.0
81	13981	460	100	460	3.3
82	12477	1141	99	1130	9.1
83	10552	235	100	235	2.2
84	20653	514	99	509	2.5
85	13417	525	100	525	3.9
86	17719	437	100	437	2.5
87	17029	422	83	350	2.1
88	15321	455	100	455	3.0
89	11407	322	100	322	2.8
90	10563	233	100	233	2.2
91	13453	480	100	480	3.6
92	15405	947	86	814	5.3
93	13435	954	96	916	6.8
94	9284	823	100	823	8.9
95	15144				
Mean (84-89)	15924	446	97	433	2.8
Max	20653	525	100	525	3.9
Min	11407	322	83	322	2.1
C.V.	20.61	16.48	7.08	19.01	22.97
N	6	6	6	6	6
Mean (92-94)	12708	908	94	851	7.0
Max	15405	954	100	916	8.9
Min	9284	823	86	814	5.3
C.V.	24.59	8.12	7.67	6.61	25.68
N	3	3	3	3	3

Table 12. Total river returns, spawning escapement, and percentage of target spawning requirement achieved on Campbellton River (SFA 4), 1993-95 and on Middle Brook and Terra Nova River (SFA 5), 1984-1995.

	Total returns		Spawning escapement		Egg deposition (No. x 10^6)		% of
Year	Small	Large	Small	Large	Small	Large	target
			Campbellton River				
1993	4001	145	3685	145	8.424	0.920	320
1994	2857	191	2517	191	5.946	1.212	245
1995	3035	218	2642	218	7.232	1.383	295
			Middle Brook				
1984	1675	57	1265	57	2.804	0.332	134
1985	1283	27	745	27	1.834	0.157	85
1986	1547	15	758	15	2.014	0.087	90
1987	1053	19	866	19	2.005	1.107	90
1988	1337	14	629	14	1.456	0.081	66
1989	626	19	461	19	1.067	1.107	50
1990	1070	13	721	13	1.669	0.076	75
1991	763	14	485	14	1.123	0.081	51
1992	1563	43	1140	43	3.157	0.250	145
1993	2226	87	1927	87	4.690	0.507	222
1994	1833	90	1424	90	3.579	0.524	175
1995	1441	168	1039	168	1.838	0.979	120
			Terra Nova River				
1984	1534	107	1100	107	2.185	0.550	19
1985	2012	112	1431	112	2.885	0.576	24
1986	1459	140	974	140	1.964	0.720	19
1987	1404	56	940	56	1.895	0.288	15
1988	2114	206	1617	206	3.260	1.059	30
1989	1377	142	1085	142	2.187	0.730	20
1990	1518	144	1052	144	2.121	0.740	20
1991	1127	114	815	114	1.643	0.586	16
1992	1780	270	1371	270	3.016	1.388	31
1993[1]	3017	470	2533	470	5.573	2.416	56
1994	2020	242	1315	236	2.893	1.213	29
1995	2627	634	1845	582	4.059	2.992	49

[1]Based on incomplete count.

Table 13. Total river returns, spawning escapement, and percentage of target spawning requirement achieved in Biscay Bay River, St. Mary's Bay (SFA 9), and Northeast River, Placentia Bay (SFA 10), 1984-95.

	Total returns		Spawning escapement		Egg deposition (No. x 10^6)		% of target
Year	Small	Large	Small	Large	Small	Large	(eggs)
			Biscay Bay River				
1984	2430	83	2108	83	5.487	0.373	199
1985[1]	1926	25	1397	25	3.636	0.112	127
1986	2688	101	2184	101	5.685	0.454	208
1987	1393	106	1171	106	3.048	0.476	119
1988	1802	61	1333	61	3.470	0.274	127
1989[1]	1004	107	828	107	2.156	0.481	89
1990	1670	73	1328	73	3.457	0.328	128
1991	394	35	384	35	0.999	0.157	39
1992[1]	1467	51	1393	51	3.666	0.229	132
1993[1]	1117	120	818	120	2.153	0.539	91
1994	1600	68	1386	68	3.648	0.306	134
1995	1151	56	765	56	2.014	0.252	77
			Northeast River, Placentia				
1984	459	44	389	44	1.219	0.217	200
1985	519	0	346	0	1.095	0.000	152
1986	879	39	645	39	2.314	0.192	349
1987	350	16	317	16	1.020	0.079	153
1988	637	11	451	11	1.451	0.054	209
1989	809	15	599	15	1.928	0.074	278
1990	699	25	526	25	1.693	0.123	253
1991	368	8	349	8	1.123	0.039	162
1992	956	46	919	46	3.345	0.227	497
1993	976	65	843	65	3.068	0.321	471
1994	709	70	670	70	2.439	0.345	387
1995	773	74	646	74	2.351	0.365	378

[1]Based on adjusted count.

Table 14. Total river returns, spawning escapement, and percentage of target spawning requirement achieved in Lomond River, Torrent River, and Western Arm Brook (SFA 14A), 1984-1995.

Year	Total returns		Spawning escapement		Egg deposition (No. x 10^6)		% of target
	Small	Large	Small	Large	Small	Large	(eggs)
			Lomond River				
1984	986	75	440	47	0.7368	0.0758	74
1985	393	14	190	14	0.3182	0.0226	31
1986	725	32	354	32	0.5928	0.0516	59
1987	652	11	355	11	0.5945	0.0177	56
1988	841	21	437	21	0.7318	0.0339	70
1992	792	80	419	80	0.9495	0.3728	121
1993	801	34	504	33	1.1421	0.1538	118
1994	1026	50	701	50	1.2824	0.2850	143
1995	1345	95	982	95	1.5100	0.5415	187
			Torrent River				
1984	1805	288	1805	288	3.0902	0.9118	270
1985	1623	30	1553	30	2.3052	0.0909	161
1986	3155	92	2815	92	4.9539	0.3922	360
1987	2670	68	2505	68	2.7278	0.2486	201
1988	2388	44	2075	44	3.8292	0.1130	266
1989	1512	60	1369	60	3.1524	0.1874	225
1990	2518	82	2296	82	3.0851	0.1993	221
1991	1565	73	1415	73	2.3776	0.2317	176
1992	2824	169	2347	169	4.1177	0.5364	314
1993	4188	222	4009	222	7.2739	0.7046	538
1994	3656	331	3592	331	6.2796	1.5815	530
1995	6130	611	5799	611	12.4096	2.9193	1033
			Western Arm Brook				
1984	120	0	120	0	0.2817	0.0000	31
1985	416	2	416	2	0.7202	0.0035	80
1986	525	0	525	0	1.4194	0.0000	156
1987	378	1	378	1	0.9297	0.0025	103
1988	251	1	251	1	0.6051	0.0024	67
1989	455	0	455	0	1.2905	0.0000	142
1990	322	0	322	0	1.0351	0.0000	114
1991	233	1	233	1	0.6129	0.0026	68
1992	480	8	480	8	1.3454	0.0224	151
1993	947	8	947	8	2.5943	0.0219	288
1994	954	31	954	31	2.5321	0.1187	292
1995	823	33	789	31	2.3634	0.2193	285

Notes:

1. Lomond egg depositions in 1984 - 1988 is based on 1983 - 1993 mean biological characteristics and 1992 - 1993 based on 1993 values.
2. Torrent egg depositions in 1990 - 1993 is based on 1985 - 1989 mean biological characteristics for small and large salmon.
3. Western Arm Brook egg depositions in 1984 is based on 1974 - 1993 mean biological characteristics for small and large salmon combined.

Table 15. Data used to estimate total stock size and anticipated returns in 1996 for Middle Brook.
The smolt age distribution is 50% 3+ and 50% 4+. Target spawning escapement =1012.

Spawning	Recruit years		Total river escapement	Total recruits	Spawning escapement	Recruits at smolt age			No. of recruits/spawner (R/S ratio)				Smolt age distribution	
	3+	4+												
Year (i)	(i+5)	(i+6)	Year i	Year i	Year i	(i+5)	(i+6)	Total	(i+5)	(i+6)	Total	Recruit Year	3+	4+
74	79	80	975	2438	903	1714	2641	4355	1.8978	2.9250	4.8228	4.9290	0.5	0.5
75			1426	3565	1318	2641	3560	6201	2.0040	2.7011	4.7050	6.3337	0.5	0.5
76	81	82	1053	2633	980	3560	2068	5628	3.6327	2.1097	5.7423	2.8800	0.5	0.5
77			2883	7208	2684	2068	1838	3905	0.7703	0.6846	1.4549	1.8395	0.5	0.5
78	83	84	1692	4230	1591	1838	2094	3931	1.1549	1.3160	2.4709	2.8521	0.5	0.5
79			1371	3428	1363	2094	1604	3698	1.5361	1.1766	2.7128	1.9899	0.5	0.5
80	85	86	2113	5283	1972	1604	1934	3538	0.8133	0.9806	1.7939	1.6979	0.5	0.5
81			2848	7120	2696	1934	1316	3250	0.7173	0.4882	1.2055	1.3525	0.5	0.5
82	87	88	1654	4135	1523	1316	1671	2988	0.8642	1.0973	1.9616	2.3137	0.5	0.5
83			1470	3675	1374	1671	783	2454	1.2163	0.5695	1.7858	1.1881	0.5	0.5
84	89	90	1675	4188	1265	783	1338	2120	0.6186	1.0573	1.6759	2.8526	0.5	0.5
85			1283	3208	745	1338	954	2291	1.7953	1.2802	3.0755	2.5384	0.5	0.5
86	91	92	1547	3868	758	954	782	1735	1.2582	1.0310	2.2892	1.9334	0.5	0.5
87			1053	2633	866	782	1113	1895	0.9024	1.2852	2.1876	3.0547	0.5	0.5
88	93	94	1337	3343	629	1113	916	2029	1.7695	1.4563	3.2258	3.4433	0.5	0.5
89			626	1565	461	916	721	1637	1.9870	**1.5629**	**3.5499**	**2.5622**	0.5	0.5
90	95	96	1070	2675	721	721			**0.9993**					
91			763	1908	485									
92	97	98	1563	1563	1140									
93			2226	2226	1927									
94	99	00	1832	1832	1423									
95			1441	1441	1039									
96	01	02												
97														
98	03	04												

Anticipated returns in 1996 (based on the mean R/S in 1992-95)

Source	R/S ratios 3+	R/S ratios 4+	No. of small 3+	No. of small 4+	No. of small Total	Total 1.06
Mean	1.4145	1.3339	686	962	1648	1754
Hi	1.9870	1.5629	964	1127	2091	2225
Low	0.9024	1.0310	438	743	1181	1257

Estimate of precision

Comparison of observed & expected in 1992-95

Recruit Year	R/S ratios 3+	R/S ratios 4+	Est. no. of small 3+	Est. no. of small 4+	Total	Difference (Obs-exp)	%
92	1.5853	1.4348	1373	1088	2460	-897	-57
93	1.2962	1.3501	815	1169	1984	242	11
94	1.2237	1.2930	564	813	1377	455	25
95	1.5530	1.2575	1120	580	1699	-258	-18
						Mean	-10

Table 16. Data used to estimate total stock size and anticipated returns in 1996 for Biscay Bay River.
Target spawning requirement =1134.

Spawning	Recruit years		Total river escapement	Total recruits	Spawning escapement	Recruits at smolt age 3+	4+	Total	No. of recruits/spawner (R/S ratio) 3+	4+	Total	Recruit	Smolt age distribution 3+	4+
Year (i)	(i+5)	(i+6)	Year i	Year i	Year i	(i+5)	(i+6)		(i+5)	(i+6)		Year		
74	79	80	507	1268	436	2459	1314	3772	5.6388	3.0128	8.6517	8.6516	0.74	0.26
			771	1928	663	3739	1969	5708	5.6388	2.9693	8.6081	8.3992	0.74	0.26
76	81	82	1200	3000	1032	5604	1704	7307	5.4299	1.6508	7.0807	7.1301	0.74	0.26
			1029	2573	885	4849	1922	6771	5.4793	2.1720	7.6513	9.5342	0.74	0.26
78	83	84	864	2160	743	5470	1580	7050	7.3623	2.1257	9.4880	6.0590	0.74	0.26
			1329	3323	1143	4496	1252	5747	3.9333	1.0953	5.0286	3.1454	0.74	0.26
80	85	86	2021	5053	1738	3563	1747	5310	2.0500	1.0053	3.0553	2.9142	0.74	0.26
			3029	7573	2605	4973	905	5878	1.9090	0.3476	2.2566	1.4909	0.74	0.26
82	87	88	2621	6553	2254	2577	1171	3748	1.1433	0.5196	1.6629	1.8306	0.74	0.26
			2957	7393	2543	3334	653	3986	1.3109	0.2566	1.5675	1.1377	0.74	0.26
84	89	90	2430	6075	2108	1857	1086	2943	0.8811	0.5149	1.3961	2.7265	0.74	0.26
			1926	4815	1397	3090	256	3346	2.2115	0.1833	2.3948	0.5171	0.74	0.26
86	91	92	2688	6720	2184	729	381	1110	0.3337	0.1746	0.5084	1.1017	0.74	0.26
			1393	3483	1171	1086	290	1376	0.9271	0.2480	1.1751	0.8681	0.74	0.26
88	93	94	1802	4505	1333	827	416	1243	0.6201	0.3121	0.9322	1.7420	0.74	0.26
			1004	2510	828	1184	299	1483	1.4300	0.3614	1.7914	1.0028	0.74	0.26
90	95	96	1670	4175	1328	852			0.6414					
			394	985	384									
92	97	98	1467	1467	1393									
			1117	1117	818									
94	99	00	1600	1600	1386									
			1151	1151	765									
96	01	02												
98	03	04												

Anticipated returns in 1996 (based on the mean R/S in 1992-95)

Source	R/S ratios 3+	4+	No. of small 3+	4+	Total	Total 1.07
Mean	0.9046	0.2740	347	364	711	761
Hi	1.4300	0.3614	549	480	1029	1101
Low	0.6201	0.1746	238	232	470	503

Estimate of precision

Comparison of observed & expected in 1992-95

Recruit Year	R/S ratios 3+	4+	Est. no. of small 3+	4+	Total	Difference (Obs-exp)	%
92	0.8971	0.3072	1051	671	1721	-254	-17
93	0.9995	0.2827	1332	331	1663	-546	-49
94	0.7295	0.2614	604	348	952	648	40
95	0.9924	0.2740	1318	227	1545	-394	-25
						Mean	-13

NB - the average used for anticipated returns is for 4 years.

Table 17. Data used to estimate total stock size and anticipated returns in 1996 for Western Arm Brook.
Target spawning requirement = 344.

Spawning Year (i)	Recruit Years (i+5)	Recruit Years (i+6)	Recruit Years (i+7)	River Escapement Year i	Total Recruits Year i	Spawning Escapement Small	Recruits at Smolt Age 3+ (i+5)	Recruits at Smolt Age 4+ (i+6)	Recruits at Smolt Age 5+ (i+7)	Recruits at Smolt Age Total	Recruits/spawners (R/S ratio) 3+	Recruits/spawners (R/S ratio) 4+	Recruits/spawners (R/S ratio) 5+	Recruits/spawners (R/S ratio) Total	R/S ratio Rec. Yr.
71	76	77	78	632	1580	427	552	484	38	1074	1.2927	1.1335	0.0899	2.5161	2.3623
72	77	78	79	406	1015	302	352	422	197	971	1.1656	1.3978	0.6531	3.2165	12.1124
73	78	79	80	798	1995	351	307	2170	58	2534	0.8746	6.1816	0.1638	7.2201	3.4497
74	79	80	81	523	1308	299	1578	633	61	2272	5.2776	2.1154	0.2040	7.5970	3.0733
75	80	81	82	639	1598	393	460	671	58	1189	1.1705	1.7074	0.1463	3.0242	3.0012
76	81	82	83	552	1380	420	488	633	143	1263	1.1619	1.5060	0.3396	3.0074	8.9439
77	82	83	84	352	880	341	460	1569	29	2058	1.3490	4.6008	0.0861	6.0359	1.3688
78	83	84	85	307	768	285	1141	323	64	1528	4.0035	1.1338	0.2254	5.3627	1.8687
79	84	85	86	1578	3945	1578	235	707	66	1007	0.1489	0.4479	0.0416	0.6384	2.8949
80	85	86	87	460	1150	430	514	722	55	1291	1.1953	1.6788	0.1270	3.0012	2.6005
81	86	87	88	488	1220	447	525	601	53	1179	1.1745	1.3442	0.1180	2.6367	1.9872
82	87	88	89	460	1150	387	437	580	57	1074	1.1292	1.4994	0.1470	2.7755	4.4869
83	88	89	90	1141	2853	1141	422	626	40	1088	0.3699	0.5483	0.0353	0.9534	4.4989
84	89	90	91	235	588	120	455	443	29	927	3.7917	3.6896	0.2427	7.7240	1.4567
85	90	91	92	514	1285	416	322	320	24	666	0.7740	0.7701	0.0577	1.6019	1.0685
86	91	92	93	525	1313	525	233	264	47	544	0.4438	0.5029	0.0902	1.0369	2.9773
87	92	93	94	437	1093	378	192	521	48	761	0.5079	1.3779	0.1262	2.0120	3.0553
88	93	94	95	422	1055	251	379	525	41	945	1.5092	2.0904	0.1639	3.7635	2.1811
89	94	95	96	455	1138	455	382	453			0.8387	0.9948			
90	95	96		322	805	322	329				1.0224				
91	96			233	583	233									
92				480	480	480									
93				947	947	947									
94				954	954	954									
95				823	823	789									
96															

% Smolt-Age Distribution

Spawning Year (i)	3+	4+	5+
71	40.0	55.0	5.0
72	40.0	55.0	5.0
73	40.0	55.0	5.0
74	40.0	55.0	5.0
75	40.0	55.0	5.0
76	40.0	55.0	5.0
77	40.0	55.0	5.0
78	40.0	55.0	5.0
79	40.0	55.0	5.0
80	40.0	55.0	5.0
81	40.0	55.0	5.0
82	40.0	55.0	5.0
83	40.0	55.0	5.0
84	40.0	55.0	5.0
85	40.0	55.0	5.0
86	40.0	55.0	5.0
87	40.0	55.0	5.0
88	40.0	55.0	5.0
89	40.0	55.0	5.0
90	40.0	55.0	5.0
91	40.0	55.0	5.0
92	40.0	55.0	5.0
93	40.0	55.0	5.0
94	40.0	55.0	5.0
95	40.0	55.0	5.0

Anticipated Returns in 1996 (based on the average R/S in 1993-1995)

	R/S Ratio 3+	R/S Ratio 4+	R/S Ratio 5+	No. of Small 3+	No. of Small 4+	No. of Small 5+	No. of Small Total	
Mean	1.1234	1.4877	0.1268	262	479	58	798	1.0253
Hi	1.5092	2.0904	0.1639	352	673	75	1099	
Low	0.8387	0.9948	0.0902	195	320	41	557	

Estimate of Precision

Observed - expected returns in 1992-1995.
Comparison in 92-95 based on R/S ratio in 1992-1994.

Recruit Year	Expected No. Small Total	Diff (Obs-exp) Mean	% Difference
92	1093	-613	-56
93	787	160	20
94	800	154	19
95	932	-109	-12
96	798		
		Mean	-7.0

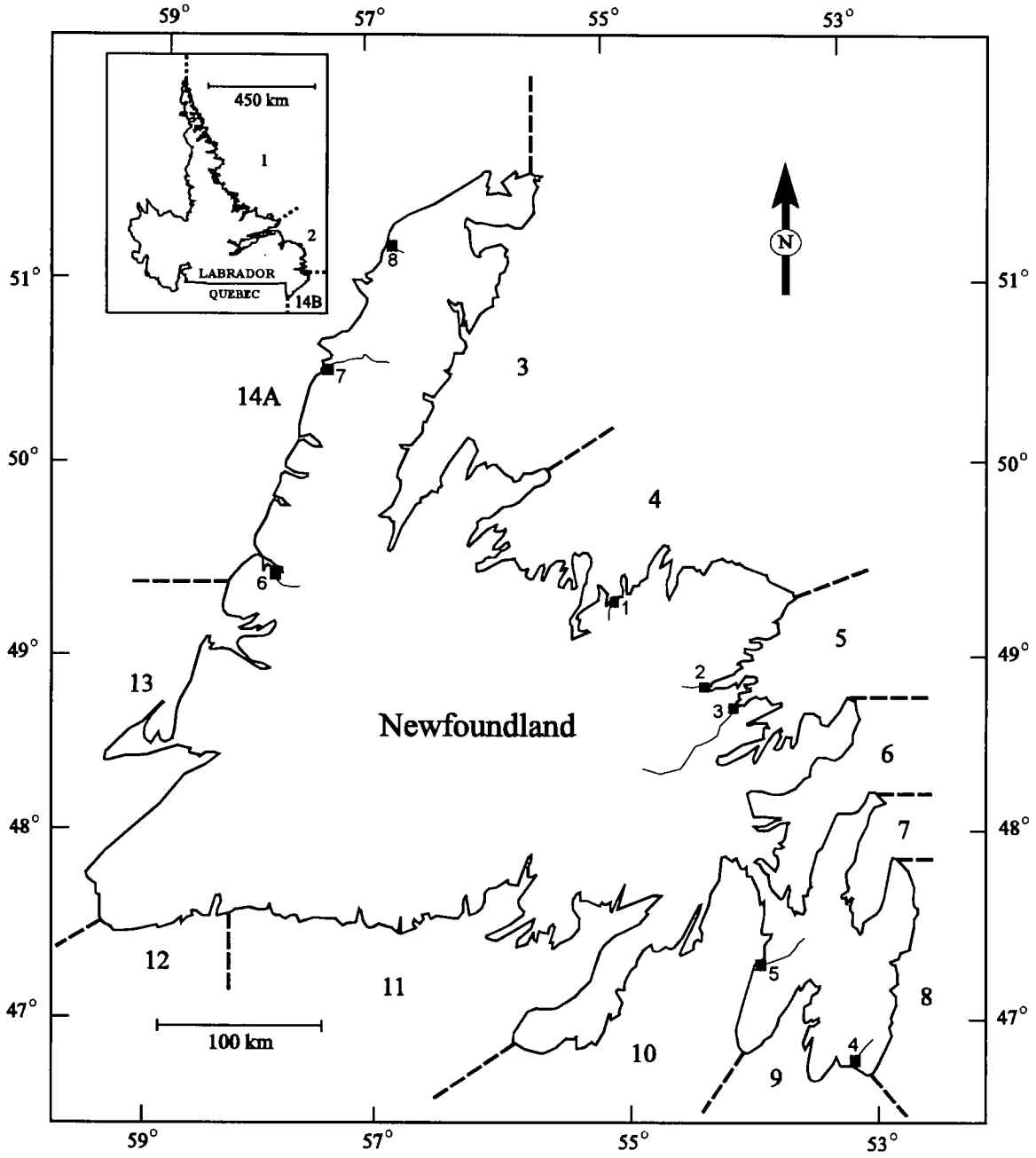

Fig. 1. Map showing Salmon Fishing Areas of Newfoundland and Labrador and the locations of the eight rivers mentioned in the text (1) Campbellton River; (2) Middle Brook; (3) Terra Nova River; (4) Biscay Bay River; (5) Northeast River, Placentia; (6) Lomond River; (7) Torrent River; (8) Western Arm Brook.

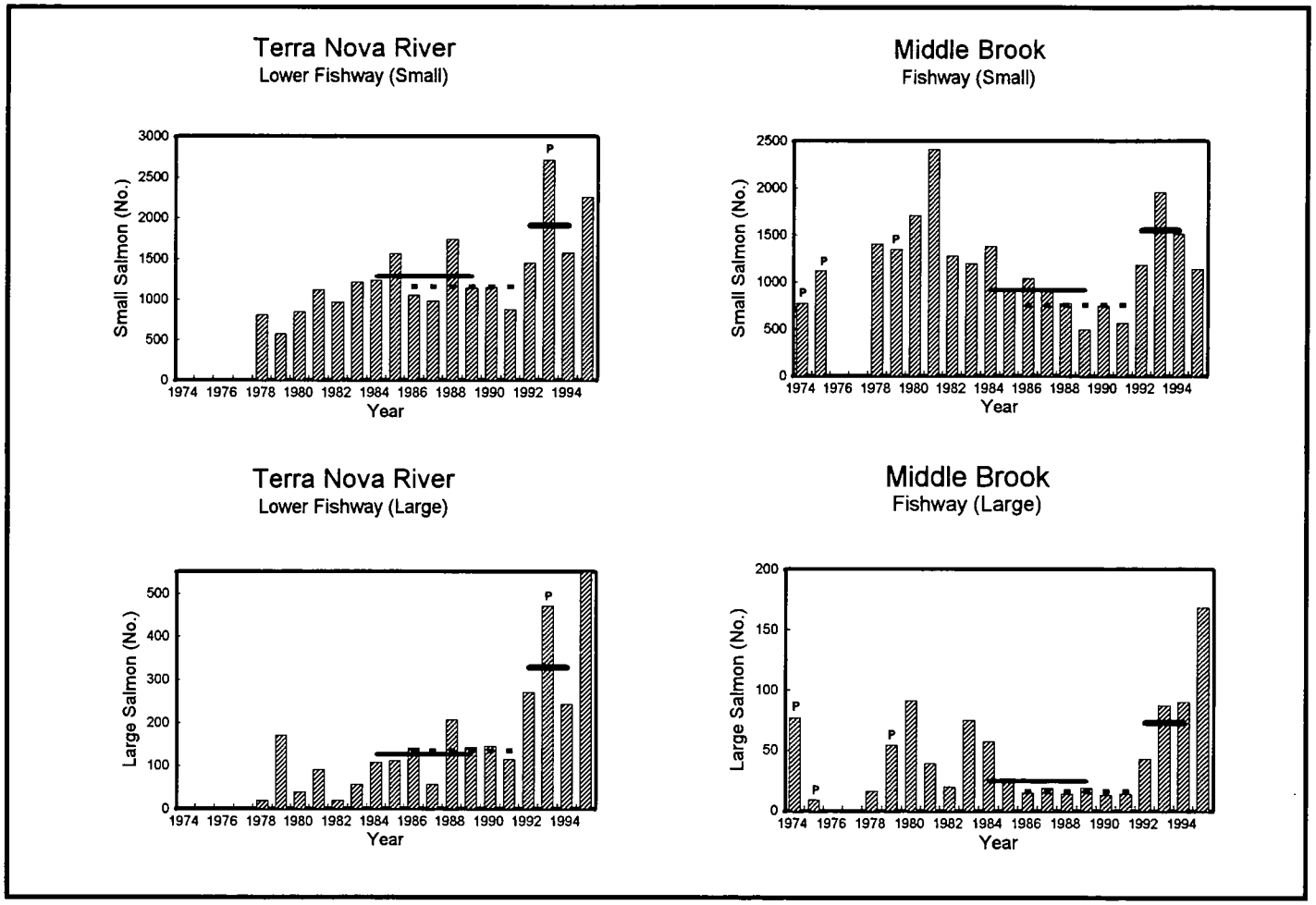

Fig. 2. Counts of small and large salmon at the lower Terra Nova River fishway and Middle Brook fishway, 1974-95. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-94 mean. P = partial count not included in means.

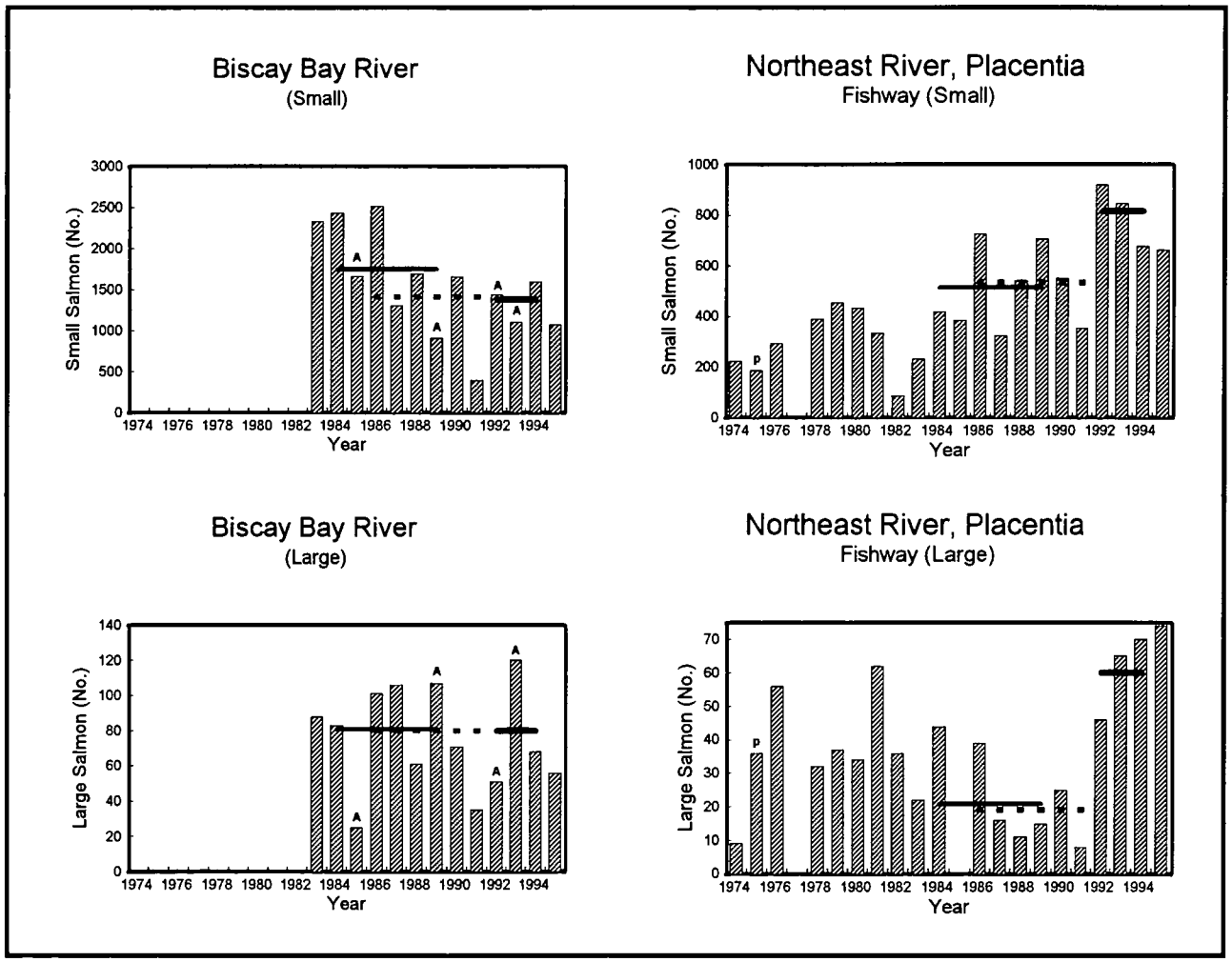

Fig. 3. Counts of small and large salmon at the Biscay Bay River counting fence, and the Northeast River fishway, 1974-95. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-94 mean. A = adjusted count and P = partial count not included in means.

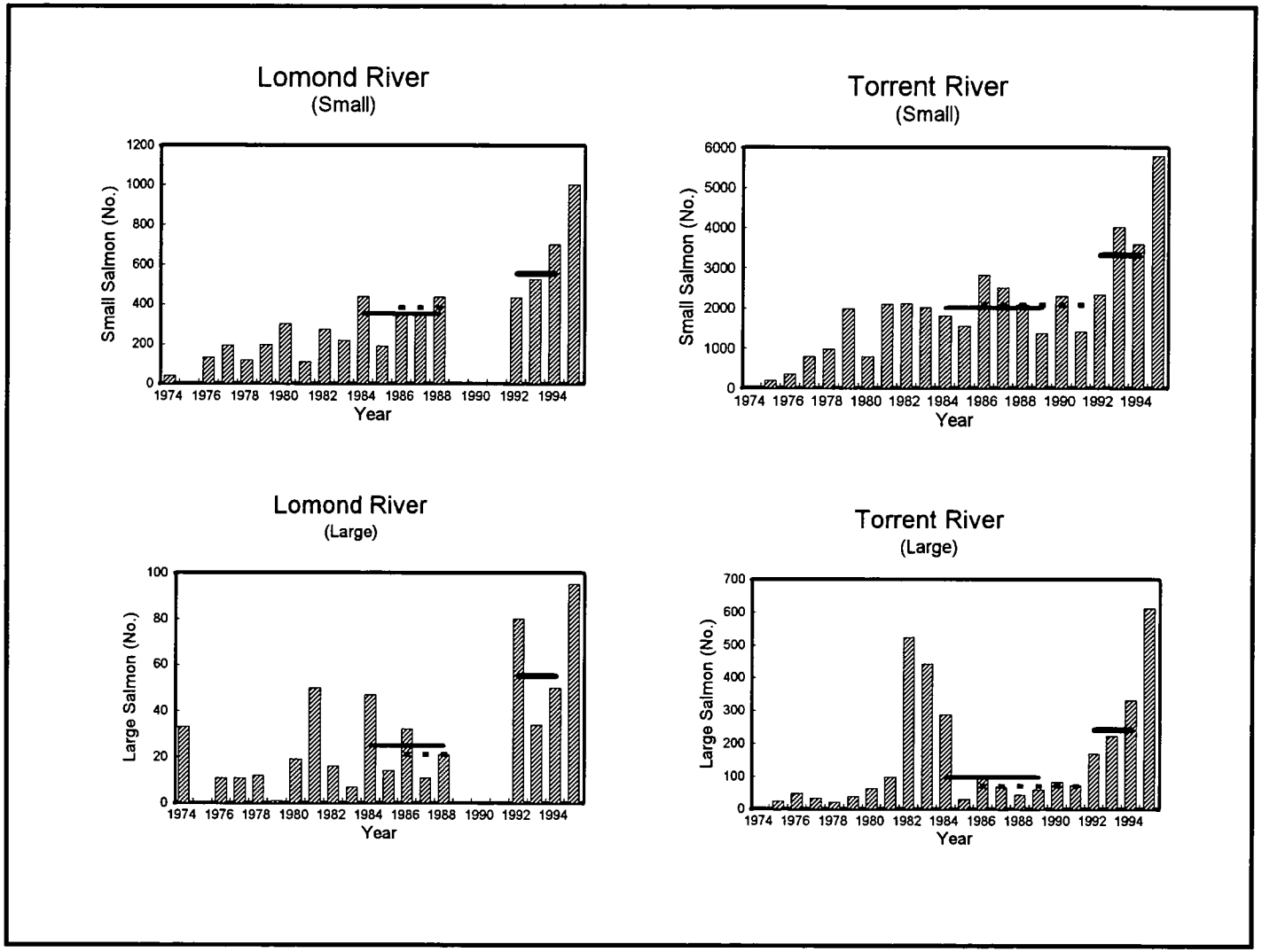

Fig. 4. Counts of small and large salmon at the Lomond River fishway and the Torrent River fishway, 1974 - 95. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91mean and the thick solid line the 1992-94 mean.

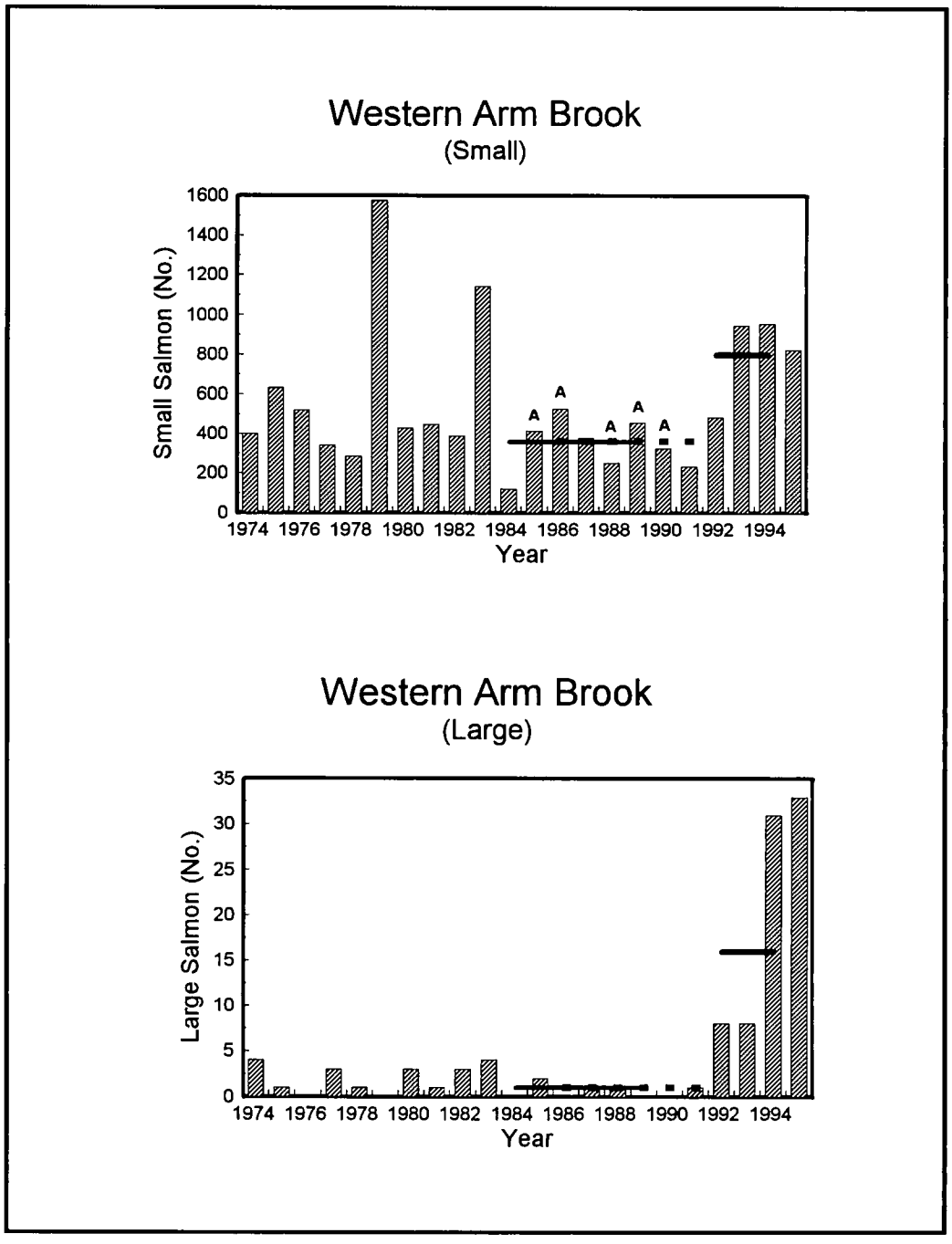

Fig. 5. Counts of small and large salmon at the Western Arm Brook counting fence, 1974 - 95. The thin solid horizontal line represents the 1984-89 mean, the broken line the 1986-91 mean and the thick solid line the 1992-94 mean.

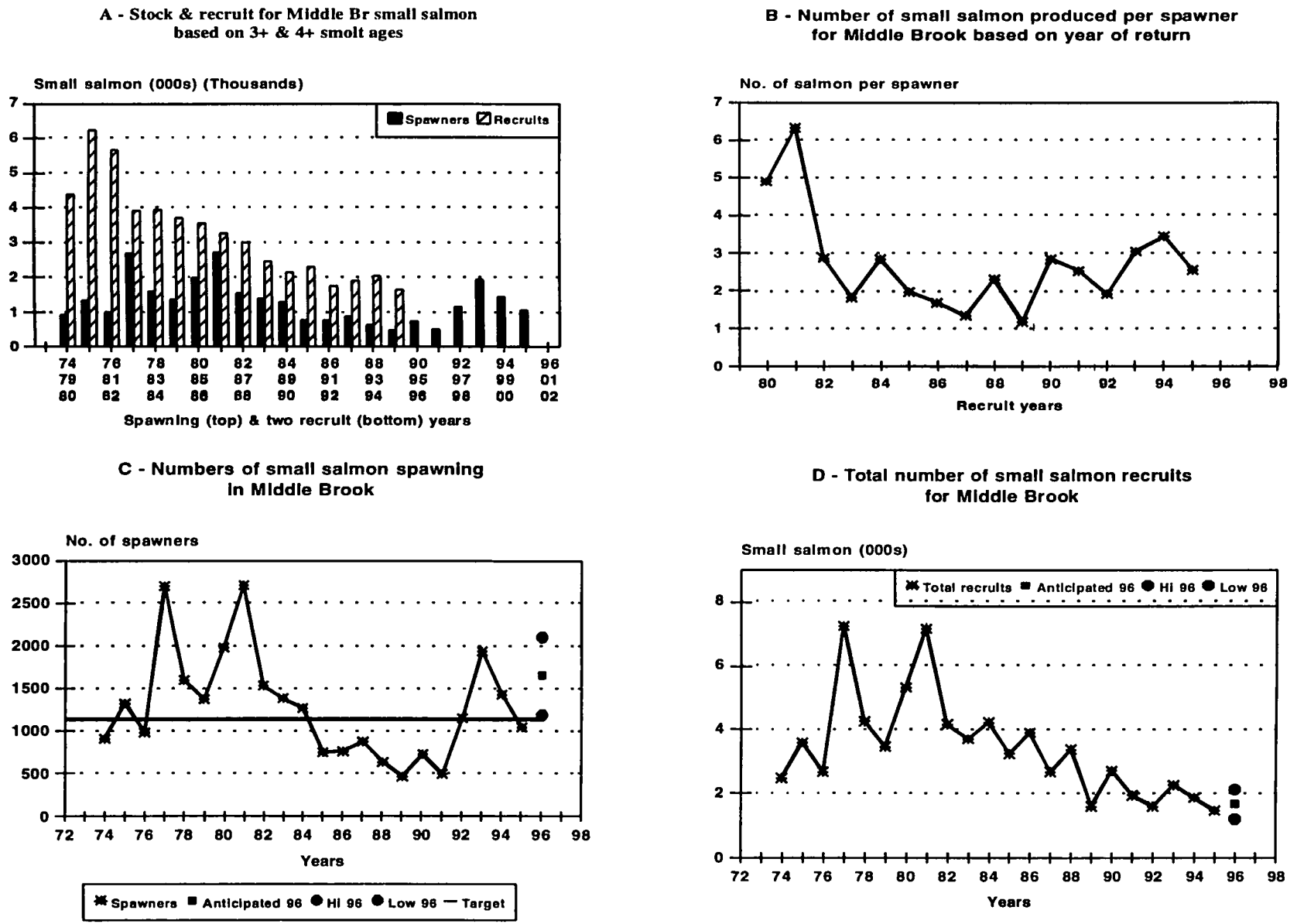

Fig. 6. Number of small salmon spawners and recruits, lagged and totalled according to smolt age (A), number of small salmon produced (years i+5,6) per spawner (year i) (B), number of small salmon spawners, 1974-95, and anticipated spawners in 1996 in relation to target number of spawners (C), and the total number of small salmon produced (recruits), 1974-95, and anticipated total returns for 1996 (D) for Middle Brook.

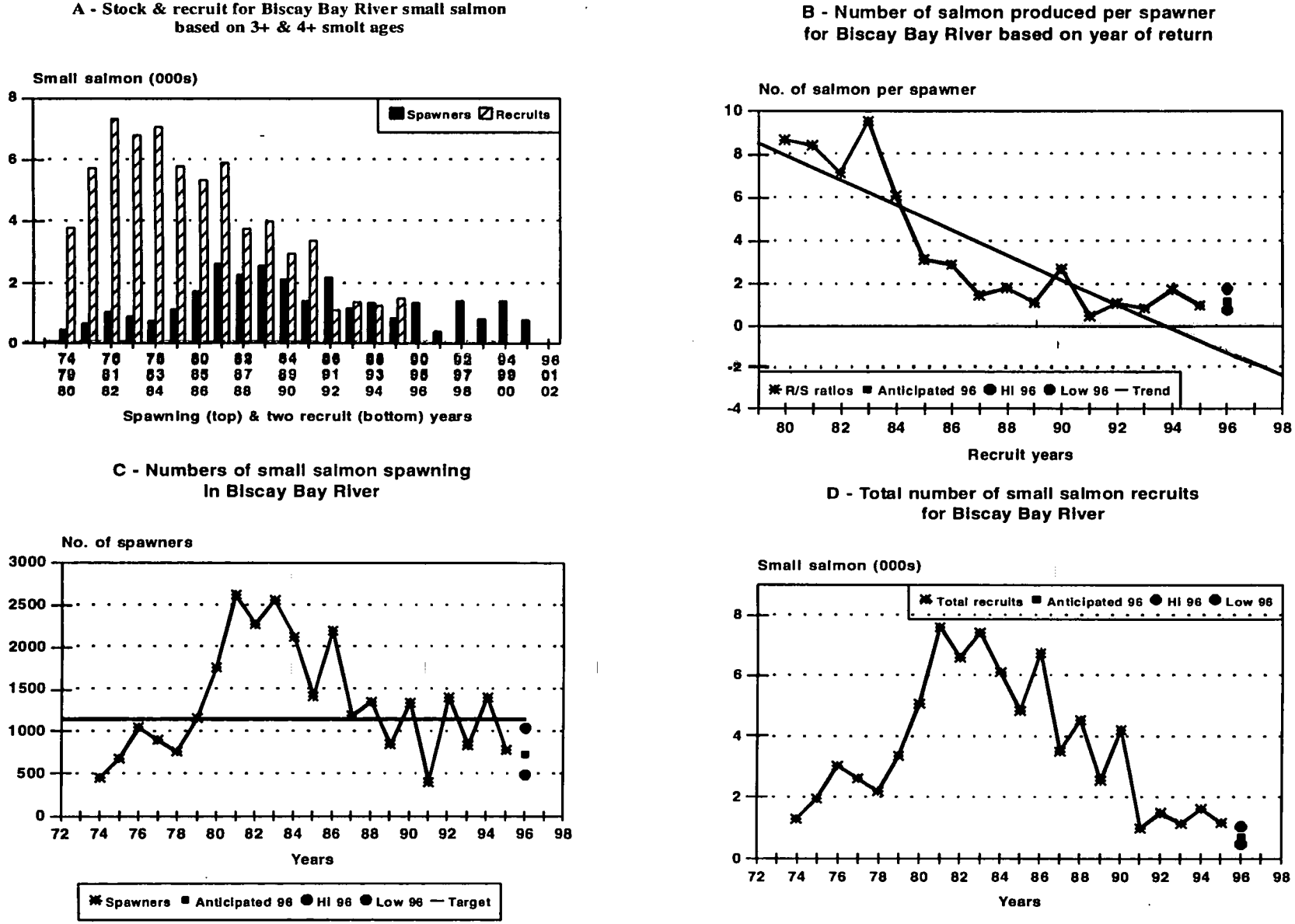

Fig. 7. Number of small salmon spawners and recruits, lagged and totalled according to smolt age (A), number of small salmon produced (years i+5,6) per spawner (year i) (B), number of small salmon spawners, 1974-95, and anticipated spawners in 1996 in relation to target number of spawners (C), and the total number of small salmon produced (recruits), 1974-95, and anticipated total returns for 1996 (D) for Biscay Bay River.

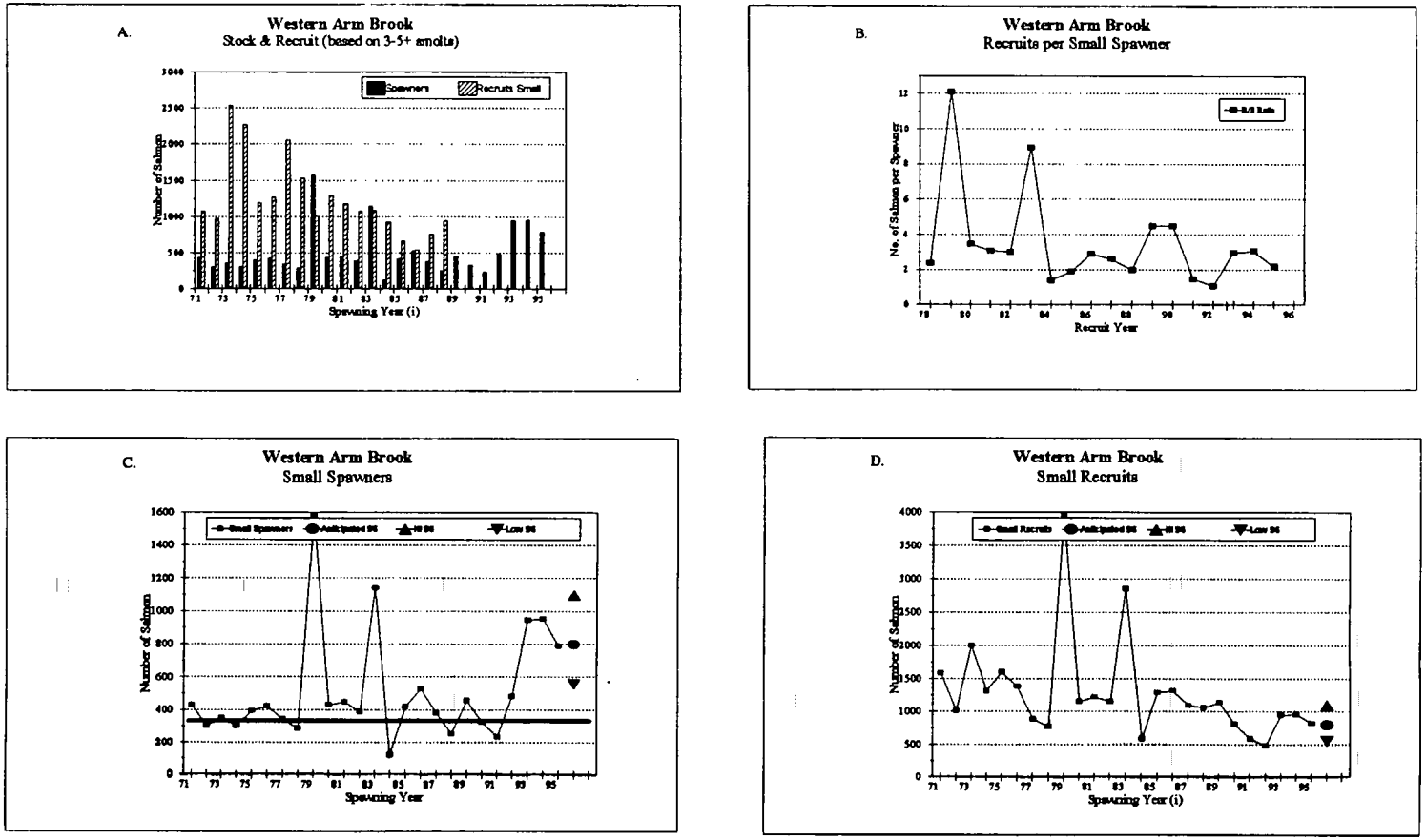

Fig. 8. Number of small salmon spawners and recruits, lagged and totalled according to smolt age (A), number of small salmon produced (years i+5,6,7) per spawner (year i) (B), number of small salmon spawners, 1974-95, and anticipated spawners in 1996 in relation to target number of spawners (C), and the total number of small salmon produced (recruits), 1974-95, and anticipated total returns for 1996 (D) for Western Arm Brook.

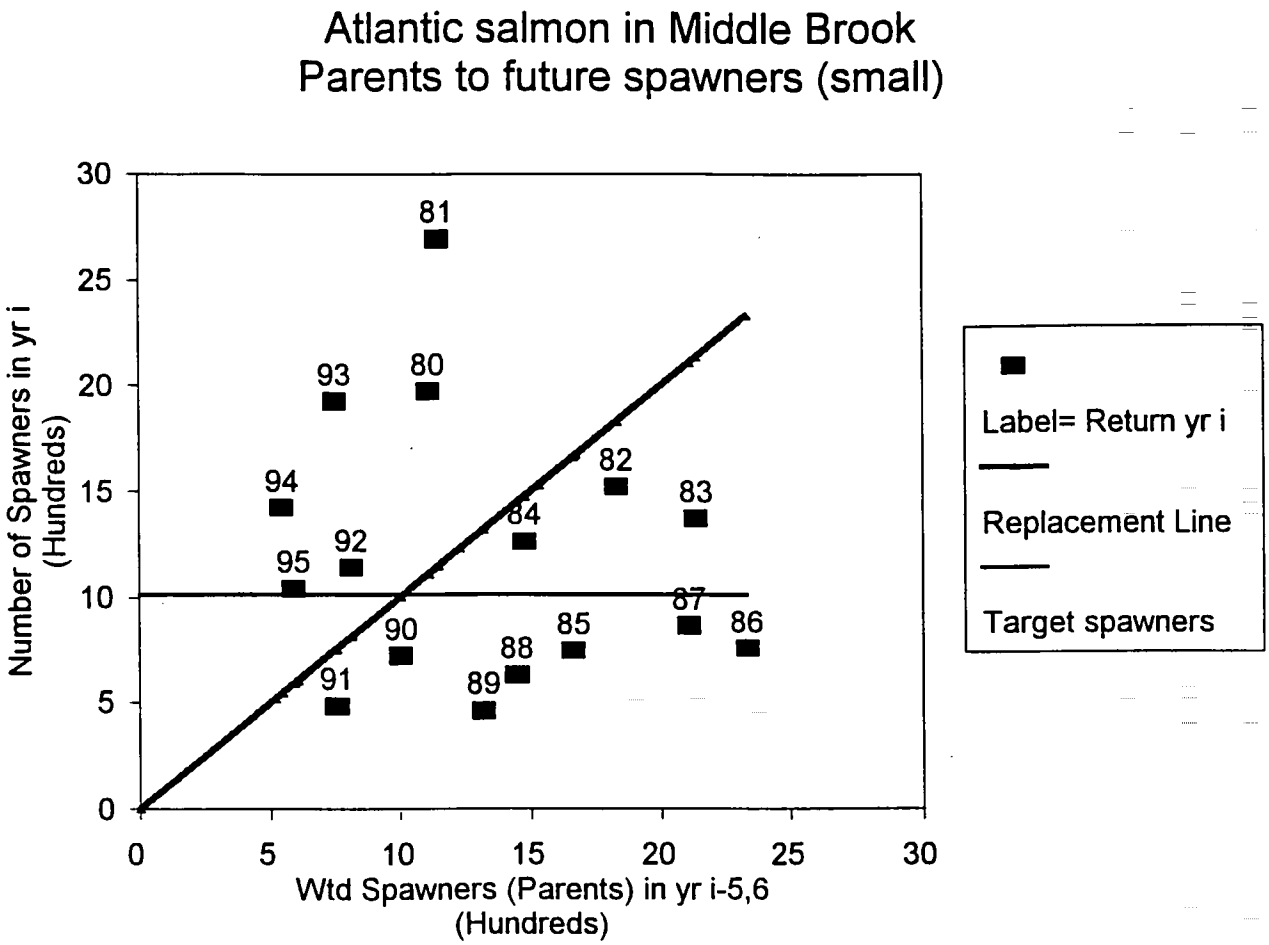

Fig. 9. The relationship between parents and spawners (after exploitation), the replacement (diagonal) line, and target spawning requirement (horizontal line) for small salmon for Middle Brook, 1980-95.

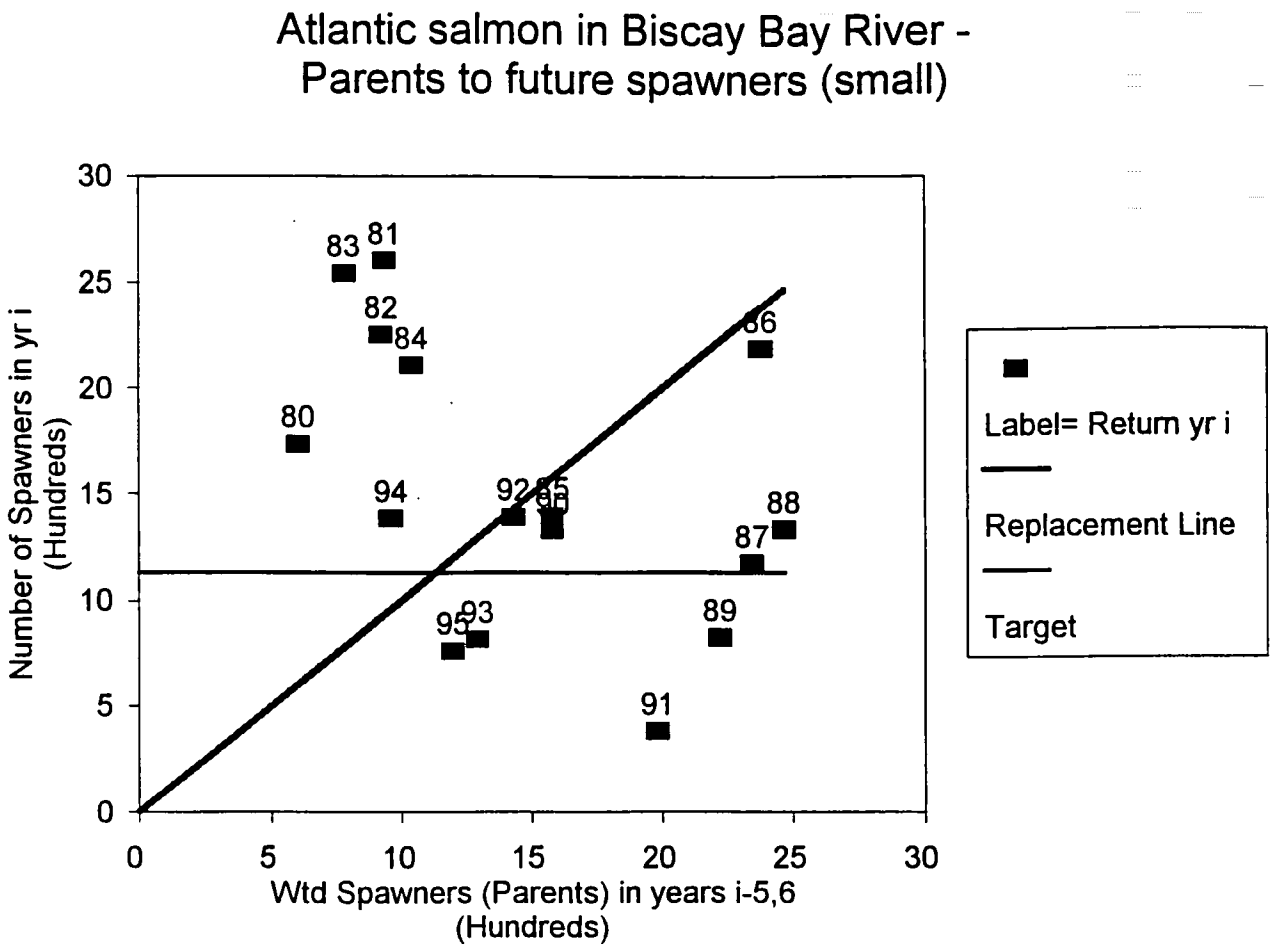

Fig. 10. The relationship between parents and spawners (after exploitation), the replacement (diagonal) line, and target spawning requirement (horizontal line) for small salmon for Biscay Bay River, 1980-95.

Appendix 1. Atlantic salmon recreational fishery catch and effort data for Campbellton River, Notre Dame Bay (SFA 4), 1974-1995. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1956	505	.	505	0	.	0	505	.	505	0.26
1975	1768	424	.	424	63	.	63	487	.	487	0.28
1976	2042	834	.	834	0	.	0	834	.	834	0.41
1977	2134	895	.	895	17	.	17	912	.	912	0.43
1978	1314	426	.	426	3	.	3	429	.	429	0.33
1979	53	23	.	23	0	.	0	23	.	23	0.43
1980	2298	1112	.	1112	0	.	0	1112	.	1112	0.48
1981	2950	1547	.	1547	2	.	2	1549	.	1549	0.53
1982	1674	471	.	471	2	.	2	473	.	473	0.28
1983	1619	597	.	597	0	.	0	597	.	597	0.37
1984	2657	991	.	991	1	.	1	992	.	992	0.37
1985	3219	782	.	782	*	.	0	782	.	782	0.24
1986	1791	422	.	422	*	.	0	422	.	422	0.24
1987	803	169	.	169	*	.	0	169	.	169	0.21
1988	1837	636	.	636	*	.	0	636	.	636	0.35
1989	854	148	.	148	*	.	0	148	.	148	0.17
1990	693	106	.	106	*	.	0	106	.	106	0.15
1991	693	126	.	126	*	.	0	126	.	126	0.18
1992	916	311	30	341	*	0	0	311	30	341	0.37
1993	1355	316	103	419	*	0	0	316	103	419	0.31
1994	1484	340	4	344	*	1	1	340	5	345	0.23
1995	1775	393	47	440	*	1	1	393	48	441	0.25
84-89 $\bar{X}$	2071.6	595.8	.	595.8	.	.	.	596.0	.	596.0	0.29
95% CL	1123.4	403.8	.	403.8	.	.	.	404.2	.	404.2	0.10
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1173.6	287.6	.	287.6	.	.	.	287.6	.	287.6	0.25
95% CL	730.6	289.8	.	289.8	.	.	.	289.8	.	289.8	0.11
N	5	5	0	5	0	0	0	5	0	5	5
92-94 $\bar{X}$	1251.7	322.3	45.7	368.0	.	0.3	0.3	322.3	46.0	368.3	0.29
95% CL	739.8	38.5	127.5	109.8	.	1.4	1.4	38.5	126.5	109.1	0.17
N	3	3	3	3	0	3	3	3	3	3	3

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1992.

Appendix 2. Atlantic salmon recreational fishery catch and effort data for Middle Brook, Bonavista Bay (SFA 5), 1974-1995. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1823	277	.	277	11	.	11	288	.	288	0.16
1975	1635	415	.	415	8	.	8	423	.	423	0.26
1976	1339	280	.	280	2	.	2	282	.	282	0.21
1977	1511	767	.	767	3	.	3	770	.	770	0.51
1978	1322	391	.	391	1	.	1	392	.	392	0.30
1979	211	28	.	28	0	.	0	28	.	28	0.13
1980	1358	542	.	542	2	.	2	544	.	544	0.40
1981	1574	587	.	587	0	.	0	587	.	587	0.37
1982	2481	504	.	504	8	.	8	512	.	512	0.21
1983	1505	372	.	372	20	.	20	392	.	392	0.26
1984	2712	410	.	410	0	.	0	410	.	410	0.15
1985	2319	538	.	538	*	.	0	538	.	538	0.23
1986	2307	789	.	789	*	.	0	789	.	789	0.34
1987	840	187	.	187	*	.	0	187	.	187	0.22
1988	1545	708	.	708	*	.	0	708	.	708	0.46
1989	712	165	.	165	*	.	0	165	.	165	0.23
1990	949	349	.	349	*	.	0	349	.	349	0.37
1991	903	278	.	278	*	.	0	278	.	278	0.31
1992	1584	423	17	440	*	0	0	423	17	440	0.28
1993	1327	299	387	686	*	37	37	299	424	723	0.54
1994	2049	409	122	531	*	0	0	409	122	531	0.26
1995	2657	402	82	484	*	0	0	402	82	484	0.18
84-89 $\bar{X}$	1919.0	522.0	.	522.0	.	.	.	522.0	.	522.0	0.27
95% CL	988.5	308.0	.	308.0	.	.	.	308.0	.	308.0	0.15
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1283.2	457.8	.	457.8	.	.	.	457.8	.	457.8	0.36
95% CL	809.1	341.2	.	341.2	.	.	.	341.2	.	341.2	0.09
N	5	5	0	5	0	0	0	5	0	5	5
92-94 $\bar{X}$	1653.3	377.0	175.3	552.3	.	12.3	12.3	377.0	187.7	564.7	0.34
95% CL	909.2	168.7	473.7	309.0	.	53.1	53.1	168.7	524.9	358.9	0.35
N	3	3	3	3	0	3	3	3	3	3	3

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1992.

Appendix 3. Atlantic salmon recreational fishery catch and effort data for Terra Nova River, Bonavista Bay (SFA 5), 1974-1995. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	2098	243	.	243	5	.	5	248	.	248	0.12
1975	1723	506	.	506	2	.	2	508	.	508	0.29
1976	1236	424	.	424	7	.	7	431	.	431	0.35
1977	1956	850	.	850	13	.	13	863	.	863	0.44
1978	1608	628	.	628	6	.	6	634	.	634	0.39
1979	910	537	.	537	15	.	15	552	.	552	0.61
1980	872	512	.	512	22	.	22	534	.	534	0.61
1981	1303	739	.	739	33	.	33	772	.	772	0.59
1982	1174	465	.	465	24	.	24	489	.	489	0.42
1983	2157	486	.	486	43	.	43	529	.	529	0.25
1984	2042	636	.	636	0	.	0	636	.	636	0.31
1985	1810	751	.	751	*	.	0	751	.	751	0.41
1986	1485	620	.	620	*	.	0	620	.	620	0.42
1987	1764	546	.	546	*	.	0	546	.	546	0.31
1988	1613	682	.	682	*	.	0	682	.	682	0.42
1989	1946	357	.	357	*	.	0	357	.	357	0.18
1990	2165	624	.	624	*	.	0	624	.	624	0.29
1991	1701	448	.	448	*	.	0	448	.	448	0.26
1992	2488	409	141	550	*	0	0	409	141	550	0.22
1993	3925	484	569	1053	*	62	62	484	631	1115	0.28
1994	5853	822	178	1000	*	44	44	822	222	1044	0.18
1995	6042	696	132	828	*	72	72	696	204	900	0.15
84-89 $\bar{X}$	1779.2	609.2	.	609.2	.	.	.	609.2	.	609.2	0.34
95% CL	285.8	186.1	.	186.1	.	.	.	186.1	.	186.1	0.13
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1782.0	546.2	.	546.2	.	.	.	546.2	.	546.2	0.31
95% CL	338.2	170.4	.	170.4	.	.	.	170.4	.	170.4	0.12
N	5	5	0	5	0	0	0	5	0	5	5
92-94 $\bar{X}$	4088.7	571.7	296.0	867.7	.	35.3	35.3	571.7	331.3	903.0	0.22
95% CL	4194.7	546.6	589.2	686.6	.	79.2	79.2	546.6	652.5	764.6	0.15
N	3	3	3	3	0	3	3	3	3	3	3

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1992.

Appendix 4. Atlantic salmon recreational fishery catch and effort data for Biscay Bay River, St. Mary's Bay (SFA 9), 1974-1995. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1043	71	.	71	1	.	1	72	.	72	0.07
1975	1553	108	.	108	0	.	0	108	.	108	0.07
1976	1074	168	.	168	0	.	0	168	.	168	0.16
1977	1607	144	.	144	0	.	0	144	.	144	0.09
1978	1790	121	.	121	5	.	5	126	.	126	0.07
1979	612	186	.	186	5	.	5	191	.	191	0.31
1980	392	283	.	283	32	.	32	315	.	315	0.80
1981	1181	424	.	424	31	.	31	455	.	455	0.39
1982	1044	367	.	367	9	.	9	376	.	376	0.36
1983	1064	414	.	414	10	.	10	424	.	424	0.40
1984	915	322	.	322	0	.	0	322	.	322	0.35
1985	1121	290	.	290	*	.	0	290	.	290	0.26
1986	1124	393	.	393	*	.	0	393	.	393	0.35
1987	1062	101	.	101	*	.	0	101	.	101	0.10
1988	1221	349	.	349	*	.	0	349	.	349	0.29
1989	965	102	.	102	*	.	0	102	.	102	0.11
1990	1165	232	.	232	*	.	0	232	.	232	0.20
1991	1134	10	.	10	*	.	0	10	.	10	0.01
1992	954	75	63	138	*	0	0	75	63	138	0.14
1993	1593	299	38	337	*	0	0	299	38	337	0.21
1994	1406	214	43	257	*	0	0	214	43	257	0.18
1995	1715	386	112	498	*	0	0	386	112	498	0.29
84-89 $\bar{X}$	1069.2	291.2	.	291.2	.	.	.	291.2	.	291.2	0.27
95% CL	156.3	139.4	.	139.4	.	.	.	139.4	.	139.4	0.11
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1121.8	217.2	.	217.2	.	.	.	217.2	.	217.2	0.19
95% CL	118.5	200.9	.	200.9	.	.	.	200.9	.	200.9	0.17
N	5	5	0	5	0	0	0	5	0	5	5
92-94 $\bar{X}$	1317.7	196.0	48.0	244.0	.	0.0	0.0	196.0	48.0	244.0	0.19
95% CL	816.2	280.9	32.9	248.8	.	0.0	0.0	280.9	32.9	248.8	0.08
N	3	3	3	3	0	3	3	3	3	3	3

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1992.

Appendix 5. Atlantic salmon recreational fishery catch and effort data for Northeast River, Placentia Bay (SFA 10), 1974-1995. Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1721	142	.	142	0	.	0	142	.	142	0.08
1975	877	121	.	121	4	.	4	125	.	125	0.14
1976	1164	147	.	147	1	.	1	148	.	148	0.13
1977	1465	180	.	180	1	.	1	181	.	181	0.12
1978	1237	161	.	161	0	.	0	161	.	161	0.13
1979	969	138	.	138	0	.	0	138	.	138	0.14
1980	1612	246	.	246	6	.	6	252	.	252	0.16
1981	2339	349	.	349	0	.	0	349	.	349	0.15
1982	1303	150	.	150	0	.	0	150	.	150	0.12
1983	2037	165	.	165	0	.	0	165	.	165	0.08
1984	988	70	.	70	0	.	0	70	.	70	0.07
1985	1276	173	.	173	*	.	0	173	.	173	0.14
1986	862	234	.	234	*	.	0	234	.	234	0.27
1987	349	36	.	36	*	.	0	36	.	36	0.10
1988	772	186	.	186	*	.	0	186	.	186	0.24
1989	852	210	.	210	*	.	0	210	.	210	0.25
1990	786	173	.	173	*	.	0	173	.	173	0.22
1991	153	19	.	19	*	.	0	19	.	19	0.12
1992	485	37	189	226	*	0	0	37	189	226	0.47
1993	592	132	61	193	*	0	0	132	61	193	0.33
1994	313	39	5	44	*	0	0	39	5	44	0.14
1995	544	127	8	135	*	0	0	127	8	135	0.25
84-89 $\bar{X}$	950.0	174.6	.	174.6	.	.	.	174.6	.	174.6	0.18
95% CL	245.8	78.2	.	78.2	.	.	.	78.2	.	78.2	0.11
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	685.0	164.4	.	164.4	.	.	.	164.4	.	164.4	0.24
95% CL	372.4	105.0	.	105.0	.	.	.	105.0	.	105.0	0.03
N	5	5	0	5	0	0	0	5	0	5	5
92-94 $\bar{X}$	463.3	69.3	85.0	154.3	.	0.0	0.0	69.3	85.0	154.3	0.33
95% CL	349.7	134.9	234.3	240.9	.	0.0	0.0	134.9	234.3	240.9	0.33
N	3	3	3	3	0	3	3	3	3	3	3

1987 DATA NOT INCLUDED IN MEAN.

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.

CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1992.

Appendix 6. Atlantic salmon recreational fishery catch and effort data for Lomond River (SFA 14A), 1974-1995.
Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	1331	324	.	324	19	.	19	343	.	343	0.26
1975	773	258	.	258	20	.	20	278	.	278	0.36
1976	2045	650	.	650	25	.	25	675	.	675	0.33
1977	1461	495	.	495	34	.	34	529	.	529	0.36
1978	1267	345	.	345	29	.	29	374	.	374	0.30
1979	900	235	.	235	2	.	2	237	.	237	0.26
1980	1218	293	.	293	13	.	13	306	.	306	0.25
1981	1446	507	.	507	3	.	3	510	.	510	0.35
1982	1435	308	.	308	7	.	7	315	.	315	0.22
1983	1112	251	.	251	3	.	3	254	.	254	0.23
1984	1505	546	.	546	28	.	28	574	.	574	0.38
1985	1075	203	.	203	*	2	2	203	2	205	0.19
1986	1164	371	.	371	*	46	46	371	46	417	0.36
1987	1186	297	.	297	*	13	13	297	13	310	0.26
1988	1545	404	.	404	*	25	25	404	25	429	0.28
1989	1714	270	.	270	*	5	5	270	5	275	0.16
1990	1938	386	.	386	*	17	17	386	17	403	0.21
1991	1591	328	.	328	*	10	10	328	10	338	0.21
1992	1612	357	24	381	*	56	56	357	80	437	0.27
1993	2190	281	85	366	*	40	40	281	125	406	0.19
1994	2017	325	116	441	*	58	58	325	174	499	0.25
1995	2043	343	190	533	*	62	62	343	252	595	0.29
84-89 $\bar{X}$	1364.8	348.5	.	348.5	.	18.2	19.8	353.2	18.2	368.3	0.27
95% CL	269.8	126.5	.	126.5	.	22.2	17.3	136.3	22.2	138.6	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	1523.0	342.7	.	342.7	.	19.3	19.3	342.7	19.3	362.0	0.24
95% CL	317.1	55.6	.	55.6	.	15.4	15.4	55.6	15.4	66.5	0.07
N	6	6	0	6	0	6	6	6	6	6	6
92-94 $\bar{X}$	1939.7	321.0	75.0	396.0	.	51.3	51.3	321.0	126.3	447.3	0.23
95% CL	737.0	94.8	116.3	98.6	.	24.5	24.5	94.8	116.8	117.6	0.11
N	3	3	3	3	0	3	3	3	3	3	3

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 7. Atlantic salmon recreational fishery catch and effort data for Torrent River (SFA 14A), 1974-1995.
Ret. = retained fish; Rel. = released fish.

	Effort	Small (<63 cm)			Large (>=63 cm)			Total (Small + Large)			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CPUE
1974	400	58	.	58	4	.	4	62	.	62	0.16
1975	364	123	.	123	6	.	6	129	.	129	0.35
1976	.	.	.	.	.	.	.	.	.	0	ERR
1977	.	.	.	.	.	.	.	.	.	0	ERR
1978	183	31	.	31	4	.	4	35	.	35	0.19
1979	238	65	.	65	3	.	3	68	.	68	0.29
1980	.	.	.	.	.	.	.	.	.	0	ERR
1981	656	167	.	167	18	.	18	185	.	185	0.28
1982	535	187	.	187	2	.	2	189	.	189	0.35
1983	354	82	.	82	1	.	1	83	.	83	0.23
1984	.	.	.	.	.	.	.	.	.	0	ERR
1985	251	70	.	70	*	0	0	70	0	70	0.28
1986	767	340	.	340	*	5	5	340	5	345	0.45
1987	576	165	.	165	*	0	0	165	0	165	0.29
1988	803	313	.	313	*	0	0	313	0	313	0.39
1989	559	143	.	143	*	0	0	143	0	143	0.26
1990	629	222	.	222	*	4	4	222	4	226	0.36
1991	438	150	.	150	*	1	1	150	1	151	0.34
1992	833	477	75	552	*	6	6	477	81	558	0.67
1993	619	179	266	445	*	15	15	179	281	460	0.74
1994	992	227	82	309	*	9	9	227	91	318	0.32
1995	1816	331	369	700	*	36	36	331	405	736	0.41
84-89 $\bar{X}$	591.2	206.2	.	206.2	.	1.0	1.0	206.2	1.0	207.2	0.35
95% CL	272.5	143.6	.	143.6	.	2.8	2.8	143.6	2.8	145.5	0.11
N	5	5	0	5	0	5	5	5	5	5	5
86-91 $\bar{X}$	628.7	222.2	.	222.2	.	1.7	1.7	222.2	1.7	223.8	0.36
95% CL	143.5	90.1	.	90.1	.	2.4	2.4	90.1	2.4	91.4	0.08
N	6	6	0	6	0	6	6	6	6	6	6
92-94 $\bar{X}$	814.7	294.3	141.0	435.3	.	10.0	10.0	294.3	151.0	445.3	0.55
95% CL	465.0	397.5	269.1	302.6	.	11.4	11.4	397.5	280.0	299.8	0.59
N	3	3	3	3	0	3	3	3	3	3	3

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1985 - 1995 AND ON RETAINED FISH ONLY PRIOR TO 1985.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.