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Status of Atlantic Salmon (*Salmo salar* L.) in eight rivers in the Newfoundland Region, 1994

by

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Abstract

The status of Atlantic salmon in 1994 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 third year in 1994. Target spawning requirement was exceeded in Campbellton River, Middle Brook, Northeast River, Biscay Bay River, Lomond River, Torrent River, and Western Arm Brook in 1994 but was not met in Terra Nova River. Compared to the late 1970s and early 1980s, since 1989, estimated total polulation sizes of small salmon for Middle Brook and Biscay Bay River have been quite low. Total river returns to Middle Brook and Biscay Bay River in 1995 are anticipated to exceed target. An estimated 6.2% of Atlantic salmon entering Campbellton River in 1994 possessed net marks; this was a minimum estimate.

Résumé

On a évalué l'état des stocks de saumon de l'Atlantique dans la rivière Campbellton, située dans la zone de pêche du saumon (ZPS) 4, dans le ruisseau Middle et la rivière Terra Nova (ZPS 5), dans la rivière Biscay Bay (ZPS 9), dans la rivière Northeast (ZPS 10), ainsi que dans les rivières Lomond, Torrent et dans le ruisseau Western Arm (ZPS 14A) en 1994. Ces évaluations faisaient suite à l'adoption du moratoire quinquennal sur la pêche commerciale du saumon de l'Atlantique, qui en arrivait à sa troisième année d'existence en 1994. Les besoins-cibles de reproducteurs ont été dépassés dans les rivières Campbellton, Northeast, Biscay Bay, Lomond, Torrent ainsi que dans les ruisseaux Middle et Western Arm en 1994, mais non dans la Terra Nova. Comparativement à la fin des années 1970 et au début des années 1980, l'effectif total de petits saumons dans le ruisseau Middle et la rivière Biscay Bay est assez faible. On s'attend, cependant, à ce que les montaisons totales soient supérieures à la cible dans ces deux cours d'eau en 1995. On estimait à 6,2 % la proportion de saumons porteurs de marques de filet ayant pénétré dans la rivière Campbellton en 1994. Il s'agit là d'une estimation minimale.

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 1994, the third year of the commercial fishing moratorium. The location of the SFA in which each river is found 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 spawning escapements. 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, 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. As in previous years, retention of large salmon was not permitted in insular Newfoundland.

Special management regimes were in place for Lomond River, Torrent River, and Western Arm Brook, three of fourteen scheduled rivers in SFA 14A. The recreational harvest for Lomond River was controlled by a quota of 350 small salmon downstream from the fishway with no angling permitted above; the angling season below the fishway in Torrent River, the only area where angling is allowed, opened after 1,000 fish passed through the fishway; the recreational fishery in Western Arm Brook has been closed since 1989.

Methods

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).

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 mortalities (Ricker 1976). Non-catch fishing mortalities 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, 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 enumeration facilities is by observation of net marks on fish surviving these activities. In 1994, 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 technique does not quantify unrecorded removals but does provide an indication that this activity did take place.

BIOLOGICAL CHARACTERISTIC DATA

Biological characteristic 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. For Terra Nova River, in 1994, the following information was used: female mean weight = 1.94 kg (SD = 0.60), N = 22; proportion female = 0.71, N = 22. In 1992-94, for Middle Brook, the following values for female mean weight and proportion female were used:

Year	Weight (kg)			Proportion Female (N)
	Mean	SD	N	
1992	1.70	0.37	46	0.82 (46)
1993	1.62	0.39	61	0.72 (79)
1994	1.70	0.41	34	0.74 (34)

In 1993 and 1994, 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	1.50	0.21	60	0.74 (88)
1994	1.55	0.27	28	0.73 (40)

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.

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 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 Campbellton River, a default value of 1775 eggs per kg was used in the absence of values for that river (O'Connell and Dempson MS 1991a; Reddin and Downton MS 1994).

For Lomond River, Torrent River and Western Arm Brook, a mean fecundity of 1783 eggs per 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:

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

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 (Biscay Bay River only)

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 (1991a and 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 for rivers other than those in SFA 14A was 368 eggs/ha, while for SFA 14A rivers, the requirement was 105 eggs/ha (O'Connell *et al.* MS 1991). 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, 1974-94, AND ANTICIPATED RETURNS IN 1995

It is possible to retrospectively estimate total population size of small salmon (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 and Biscay Bay River 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 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

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

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

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

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, respectively for Middle Brook and 0.74 and 0.26, respectively, 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

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. For small salmon with a smolt age of 3+ years, the average R/S for 1992-94 was used while for 4+ the average was for 1991-93. 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

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 1992-94

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, 1993, and 1994.

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 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, when there was no mandatory release of small salmon. Total catch for 1994 (retained plus released fish), effort, and catch per unit of effort (CPUE) are compared to years prior to 1992, 1992, and 1993. In 1992, there was no estimate of released fish during the period of retention of catch and hence comparisons with 1994 are open to question. The total number of fish retained in 1994 is also shown. Comparison of 1994 retained catch and effort with 1992 and 1993 provides an indication of the effectiveness of the elimination of quotas in 1994 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 Nove River, retained catch nearly doubled over 1992 and 1993. It is not possible to evaluate Biscay Bay River (Appendix 4) and Northeast River (Appendix 5) in this regard since these rivers were closed to angling for most of July as a result of low water levels and high water temperatures. The magnitude of the partial season catch in 1994 for Biscay Bay River suggests

that the catch for the entire season would have been substantially higher than 1992 and 1993 levels. It should be noted that the quota for retained fish for SFA 9, which includes Biscay Bay River, was not caught in 1993.

The recreational quota of 350 small salmon for the Lomond River was not reached in 1994. The quota was not reached in 1993 but because the SFA 14A quota was reached, the river was closed for hook and release only from July 20-31 and from August 8-September 6. In 1989-92, the quota was reached after seven weeks of angling. The opening of the recreational fishery in Torrent River was similar to previous years.

UNRECORDED MORTALITIES

At the Campbellton River fence, visible netmarks were recorded on a daily basis. Overall, 6.20% or 189 of the 3,048 upstream migrating Atlantic salmon had 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. It is concluded that there is some mortality at sea; although the overall magnitude is unkown.

COUNTS AT COUNTING FACILITIES

Counts of small and large salmon at the Campbellton River counting facility for 1993-94 are shown in Table 8. The 1994 count of small salmon decreased from that of 1993 by 29%. The 1994 count of large salmon increased over 1993 by 32%.

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 1994 count of small salmon in Middle Brook decreased from 1993 (23%) and increased over the 1984-89 (65%) and 1986-91 (100%) means. For Terra Nova River, the count of small salmon in 1994 also decreased from 1993 (42%) and increased over each mean (22% and 36%, respectively). The count of large salmon in Middle Brook increased by 3% over 1993 and by 258% and 474% over the 1984-89 and 1986-91 means, respectively. For Terra Nova River, the large salmon count decreased by 49% from1993, but increased over the 1984-89 (90%) and 1986-91 (81%) means. Counts of small and large salmon for Terra Nova River in 1993 were partial. This resulted from a combination of the loss of the flow control dam above the fishway and exceptionally high water levels in 1993 which allowed some fish to bypass the fishway.

Counts of small and large salmon for the Northeast River fishway and the Biscay Bay River counting fence are presented in Table 9 and Fig. 3. In Biscay Bay River, the count of small salmon increased over 1993 (52%) and the 1986-91 mean (13%), but decreased from the 1984-89 mean (9%). The count of small salmon in Northeast River in 1994 decreased from 1993 (20%) but remained above the 1984-89 (31%) and 1986-91 (26%) means. The count of large salmon in Biscay Bay River in 1994 decreased from 1993 and the means (41, 16, and 15%, respectively); in Northeast River, there was an increase over 1993 and the means (8, 236, and 268%, respectively).

The count of small salmon at the Lomond River fishway in 1994 increased over 1993 (33%) and the 1984-89 (97%) and 1986-91 (84%) means (Table 10 and Fig. 4). At the Torrent River fishway the count of small salmon in decreased from 1993 (10%) but increased over the 1984-89 (78%) and 1986-91 (73%) means. At the Western Arm Brook counting fence, the count of small salmon in 1994 was similar to that of 1993 but was well above the means (167 and 165%, respectively). The count of large salmon at Lomond River in 1994 increased over 1993 and the means (47, 100 and 134%, respectively) (Table 10 and Fig. 4). A similar pattern was noted for Torrent River (49, 241, and 374%) and Western Arm Brook (288, 4550, and 6100%) but the magnitude of change was greater for these rivers.

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 11. For Campbellton River (208%) and Middle Brook (171%), the percentage of target egg deposition achieved in 1994 was in excess of requirement. Terra Nova River on the other hand received only 31% of target. Percentage of target achieved for Biscay Bay River (Table 12) was 133%. Target egg requirement was exceeded in Biscay Bay River (133%) and Northeast River (343%) in 1994 (Table 12).

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 13. Target egg deposition requirements were exceeded for the areas above the counting facilities in all three rivers (143, 530, and 292% respectively).

The outcome of calculations of estimated total numbers of small salmon recruits, numbers of spawners, and ratios of recruits to spawners for Middle Brook and Biscay Bay rivers are shown in Tables 14 and 15 and Figs. 6 and 7, respectively. Since 1974, the patterns for stock and recruit have been highly variable but typically both spawning stocks and recruitment from them were higher in earlier years than at present (Fig.6A and 7A). Since 1974, there was a significant decline in the total number of small salmon recruits produced for each spawner for Biscay Bay River (r^2=0.76; df=15; P<0.01) but not for Middle Brook (r^2=0.15; df=15; P>0.05) (Fig. 6B and 7B). There was no identifiable trend in numbers of small salmon spawners (Fig. 6C and 7C). Expressing target spawning requirement in terms of small salmon adults (horizontal line in Figs. 6C and 7C), it is evident that for Biscay Bay River the target was achieved in 1979-88, 1992, and 1994 and for Middle Brook in 1977-84 and 1992-94. For both rivers, numbers of spawners in 1992-94 represent a substantial improvement over the lows observed for 1985-91 but remain below the highs in the late 70s and early 80s. The lowest recruitment for the entire time series for Middle Brook was in 1992 (Fig. 6D) while 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 1995, based on the average R/S for each smolt-age grouping and assuming natural survival rates remain the same, is approximately 1,700; corresponding low and high values are approximately 1,100 and 2,100, respectively (Table 14 and Fig. 6D). Assuming no recreational fishery, spawning escapement in 1995 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 1992-94 was -7%). The variability described in Fig. 6A must be kept in mind with respect to estimates of anticipated returns. Similarly, the anticipated number of recruits for Biscay Bay River in 1995 is 1,500 with corresponding low and high values of 1,000 and 2,200 (Table 15 and Fig. 7D). Assuming no recreational fishery, the anticipated spawning escapement of small salmon in 1995 is above target 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 -11% (Table 15).

Average smolt age for Lomond and Torrent rivers is 3+ while for Western Arm Brook it is 4+. Hence, the majority of small salmon returns to Lomond and Torrent rivers in 1994 (year i) were the progeny of spawners in 1989 (year i-5), and the majority of those returning to Western Arm Brook were from spawners in 1988 (year i-6) (Figs. 8-10). Therefore, the returns and spawning escapements in 1992-94 which were among the highest recorded in all three rivers, indicate good potential for increased returns in 1997-99 for Lomond River and Torrent River and in 1998-2000 for Western Arm Brook (Figs. 8-10) assuming that natural survival rates remains the same.

RECRUIT OVERFISHING

During the commercial fishery moratorium years 1992-94, estimated numbers of spawners in Middle Brook were above the replacement (diagonal) line (Fig. 11). 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 (Fig. 12). The three years immediately preceeding the moratorium, 1989-91, were below the replacement line.

Discussion

The 1984-89 mean used for comparisons corresponds to years during major management changes in the commercial fishery in the 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 1994. A moratorium on cod fishing was introduced in SFAs 10-14A in 1993 and remained in effect in 1994. For Campbellton River, in spite of these moratoria, net-marked Atlantic salmon were encountered at the counting fence.

Counts of small and large salmon during the moratorium years 1992-94 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. Target spawning requirement was met in all rivers except Terra Nova River. For Middle Brook and Biscay Bay River, returns of small salmon in some pre-moratorium years were as high or higher than observed collectively for the period 1992-94; this also applied to large salmon, with the exception of Terra Nova River. Compared to the late 1970s and early 1980s, since 1989, total polulation sizes of small salmon for Middle Brook and Biscay Bay River have been quite low. Total river returns to Middle Brook and Biscay Bay River in 1995 are anticipated to exceed target. This prediction was based on fixed parameter values (smolt-age composition and commercial and recreational fishery exploitation rates) and assumes 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 variable in Northeast Brook, Trepassey (SFA 9) and Conne River (SFA 11) (O'Connell *et al.* MS 1995).

Cautions associated with the parameter values used to calculate target spawning requirements have been discussed previously by O'Connell *et al.* (MS 1991) and O'Connell and Dempson (MS 1991a and b) and will not be dealt with here in detail. Recent research findings pertaining to the egg-to-smolt survival parameter however warrant mention. This parameter is very sensitive to change in terms of impact on calculations of egg deposition requirements using the model presented in O'Connell and Dempson (MS 1991a and b). There is evidence that egg-to-smolt survival could be substantially lower than used in the model (O'Connell *et al.* MS 1992c). However, further substantiation is required. The use of a lower value would increase target spawning requirements accordingly.

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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, 1983-1994.

	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												
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	33	3.15	14	87.5
1986	15	52.5	3.44	45.0 - 58.0	9	1.71	0.30	1.25 - 2.20	58	2.95	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	52	2.94	14	27.5
1993	46	54.0	2.62	49.5 - 61.2	36	1.77	0.48	0.70 - 3.00	74	2.92	47	62.7
1994	13	52.5	4.25	40.6 - 57.1	12	1.50	0.46	0.50 - 2.40	19	3.37	13	68.4
Total	141	52.8	3.36	40.6 - 61.2	105	1.58	0.38	0.50 - 3.00	314	2.95	147	54.4
Large salmon												
1984	2	68.3	3.18	66.0 - 70.5	2	3.70	0.71	3.20 - 4.20	4	2.50	2	100.0
1986	0	.	.	.	0	.	.	.	7	2.43	0	.
1992	1	70.0	.	70.0 - 70.0	0	.	.	.	25	2.80	1	3.8
1993	6	69.2	2.86	66.0 - 74.0	5	3.45	0.65	2.75 - 4.25	7	2.43	6	85.7
1994	1	76.8	.	76.8 - 76.8	1	5.20	.	5.20 - 5.20	1	3.00	1	100.0
Total	10	69.8	3.46	66.0 - 76.8	8	3.73	0.82	2.75 - 5.20	44	2.66	10	27.8

Table 4. Biological characteristics for female small and large salmon for Torrent River (SFA 14A), Newfoundland, 1983-1994.

	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												
1983	10	53.4	2.21	49.5 - 56.0	10	1.45	0.24	1.00 - 1.60	16	3.31	10	62.5
1985	81	52.0	2.80	46.0 - 59.8	3	1.50	0.00	1.50 - 1.50	154	3.36	81	55.5
1986	172	52.1	3.12	41.0 - 59.0	172	1.70	0.41	1.00 - 2.70	305	3.21	172	56.4
1987	181	51.9	2.82	43.8 - 60.5	181	1.55	0.40	0.70 - 2.80	299	3.15	181	61.1
1988	74	53.6	3.30	48.6 - 62.1	74	1.43	0.39	1.00 - 2.50	221	3.16	74	67.3
1989	84	54.1	3.27	45.9 - 62.0	80	1.66	0.32	0.20 - 2.60	108	3.28	84	77.8
1990	16	52.9	2.34	49.0 - 57.0	0	.	.	.	33	3.15	16	45.7
1991	27	52.1	3.39	47.0 - 59.0	4	2.00	0.00	2.00 - 2.00	45	3.11	27	57.4
1992	12	53.2	3.20	46.7 - 59.0	0	.	.	.	18	3.11	12	66.7
1993	188	52.9	4.44	30.0 - 62.0	4	2.10	0.23	1.90 - 2.30	250	3.19	188	74.0
1994	16	53.7	3.42	48.0 - 60.5	12	1.47	0.62	0.90 - 3.00	20	3.50	16	66.7
Total	861	52.6	3.45	30.0 - 62.1	540	1.60	0.41	0.20 - 3.00	1469	3.21	861	63.4
Large salmon												
1985	2	73.5	2.12	72.0 - 75.0	1	4.30	.	4.30 - 4.30	5	3.40	2	40.0
1986	5	70.4	3.89	64.0 - 74.5	5	3.86	1.00	2.20 - 4.70	9	3.44	5	55.6
1987	4	79.1	5.88	73.8 - 87.0	4	4.45	0.64	3.80 - 5.00	7	3.14	4	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	6	75.0	6.59	66.9 - 82.4	4	4.40	1.01	3.10 - 5.30	14	3.36	6	40.0
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	103	70.0	4.79	63.0 - 81.5	0	.	.	.	141	3.06	103	69.6
1994	1	71.0	.	71.0 - 71.0	1	3.80	.	3.80 - 3.80	3	3.00	1	33.3
Total	127	70.7	5.17	63.0 - 87.0	19	4.24	0.79	2.20 - 5.30	191	3.11	127	63.2

Table 5. Biological characteristics for female small and large salmon for Western Arm Brook (SFA 14A), Newfoundland, 1983-1994.

	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												
1983	6	51.1	1.9	48.0 - 53.5	6	1.43	0.27	1.00 - 1.80	9	4.0	6	66.7
1984	0	.	.	.	0	.	.	.	3	3.0	0	.
1985	19	50.8	4.1	37.5 - 56.0	19	1.43	0.26	1.10 - 2.20	27	3.9	19	70.4
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	69	1.66	0.33	1.10 - 2.70	81	3.7	70	82.4
1988	24	52.5	4.7	36.5 - 59.5	24	1.69	0.49	0.50 - 2.40	28	3.6	24	80.0
1989	125	53.5	3.0	43.0 - 60.0	45	1.82	0.32	1.00 - 2.50	139	3.6	125	87.4
1990	45	55.4	3.1	50.8 - 62.2	32	1.88	0.37	1.20 - 2.40	46	3.5	45	93.7
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	198	53.9	2.7	46.6 - 62.0	182	1.95	0.42	1.20 - 4.10	251	3.7	198	78.0
1994	86	53.4	3.3	36.5 - 60.9	85	1.80	0.32	1.00 - 2.80	101	3.8	86	82.7
Total	1123	53.4	3.0	34.0 - 62.2	564	1.80	0.38	0.50 - 4.10	1354	3.5	1124	81.4
Large salmon												
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
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	1	70.5	.	70.5 - 70.5	0	.	.	.	3	3.3	1	33.3
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	75.0	4.3	72.0 - 78.1	2	4.65	0.49	4.30 - 5.00	6	3.7	2	33.3
Total	9	70.7	4.7	64.0 - 78.1	8	3.82	0.80	2.40 - 5.00	16	3.6	9	56.2

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

River	Year	Relative fecundity (No. eggs/kg)	N
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			
Northeast River, Plac.		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, Plac.	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) 1993-94, Middle Brook fishway 1974-94, and lower Terra Nova River fishway 1978-94, Bonavista Bay (SFA 5). Partial counts are in parentheses 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	1512	90	1570	242
1984-89						
Mean			916.8	25.2	1281.7	127.2
95% LCL			610.4	8.1	965.4	75.1
UCL			1223.2	42.2	1597.9	179.2
N			6	6	6	6
1986-91						
Mean			754.2	15.7	1153.7	133.7
95% LCL			539.6	12.9	834.6	82.5
UCL			968.7	18.5	1472.8	184.8
N			6	6	6	6

Table 9. Counts of Atlantic salmon at the Biscay Bay River counting fence, St. Mary's Bay (SFA 9), 1983-94, and the Northeast River fishway, Placentia Bay SFA (10), 1974-94. 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	Large	Small	Large
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	675	70
1984-89				
Mean	1753.3	80.5	517.0	20.8
95% LCL	1095.8	46.5	339.0	2.9
UCL	2410.9	114.5	695.0	38.7
N	6	6	6	6
1986-91				
Mean	1412.7	80.2	533.8	19.0
95% LCL	647.5	49.3	356.4	7.1
UCL	2177.9	111.0	711.3	30.9
N	6	6	6	6

Table 10. Counts of Atlantic salmon at Lomond River and Torrent River fishways and Western Arm Brook counting fence (SFA 14A), 1974-94. 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
1984-89						
Mean	355.2	25.0	2020.3	97.0	357.5	0.7
95% LCL	229.2	6.7	1434.4	-3.7	202.4	-0.2
UCL	481.2	43.3	2606.3	197.7	512.6	1.5
N	5	5	6	6	6	6
1986-91						
Mean	382.0	21.3	2079.2	69.8	360.7	0.5
95% LCL	263.7	-4.8	1464.4	52.2	240.1	-0.1
UCL	500.3	47.4	2693.9	87.5	481.3	1.1
N	3	3	6	6	6	6

Table 11. Total river returns, spawning escapement, and percentage of target spawning requirement achieved on Campbellton River (SFA 4), 1993-94 and on Middle Brook and Terra Nova River (SFA 5), 1984-1994.

Year	Total returns		Spawning escapement		Egg deposition (No. x 10^6)		% of target
	Small	Large	Small	Large	Small	Large	
Campbellton River							
1993	4001	145	3685	145	7.23	0.772	274
1994	2857	191	2517	191	5.06	1.020	208
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	3.085	0.251	142
1993	2226	87	1927	87	4.606	0.508	218
1994	1832	90	1423	90	3.475	0.524	171
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	2.764	1.388	29
1993[1]	3017	470	2533	470	5.107	2.416	53
1994	2019	242	1368	242	3.227	1.244	31

[1]Based on incomplete count.

Table 12. 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), 1984-94.

Year	Total returns		Spawning escapement		Egg deposition ($No. \times 10^6$)		% of target (eggs)
	Small	Large	Small	Large	Small	Large	
			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	3.626	0.229	131
1993[1]	1117	120	818	120	2.129	0.539	90
1994	1600	68	1386	68	3.608	0.306	133
			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	2.957	0.227	443
1993	976	65	843	65	2.713	0.321	422
1994	707	70	668	70	2.150	0.345	347

[1]Based on adjusted count.

Table 13. Total river returns, spawning escapement, and percentage of target spawning requirement achieved in Lomond River, Torrent River, and Western Arm Brook (SFA 14A), 1984-1994.

	Total returns		Spawning escapement		Egg deposition (No. x 10^6)		% of target
Year	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
			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
			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

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 14. Data used to estimate total stock size and anticipated returns in 1994 for Middle Brook.
The smolt age distribution is 50% 3+ and 50% 4+. Target spawning escapement =1012.

Spawning Year i	Recruit years i+5	i+6	Total river escapement i	Total recruits i	Spawning escapement i	Recruits 3+ i+5	Recruits 4+ i+6	Total 3+4	No. of recruits/spawner 3+ i+5	4+ i+6	Total	R/S ratio rec yr	Smolt dist 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	1383	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			1.9870				0.5	0.5
90	95	96	1070	2675	721									
91			763	1908	485									
92	97	98	1563	1563	1140									
93			2226	2226	1927									
94	99	00	1832	1832	1423									
95														
96	01	02												
97														
98	03	04												

Anticipated returns in 95

	R/S ratios 3+	4+	No. of small 3+	4+	Total	Total (avg92-94)
Mora. yrs						1.05
Mean	1.5530	1.2575	1120	580	1699	1779
Hi	1.9870	1.4563	1433	671	2104	2202
Low	0.9024	1.0310	651	475	1126	1179

Comparison of observed & expected in 92-94

Year	R/S ratios 3+	4+	Est. no. of small 3+	4+	Total	Differenc (Obs-exp	% Difference
92	1.5530	1.2575	1345	953	2298	-735	-47
93	1.5530	1.2575	977	1089	2066	160	7
94	1.5530	1.2575	716	791	1507	325	18
						Mean	-7

NB - uses 3 yrs of moratorium

Table 15. Data used to estimate total stock size and anticipated returns in 1994 for Biscay Bay River.
Target spawning requirement =1134.

Spawning Year i	Recruit Years i+5	i+	River escapement i	Total recruits i	Spawning escapement i	Recruits 3+ i+5	Recruits 4+ i+6	Total 3+4	No. of recruits/spawner 3+ i+5	No. of recruits/spawner 4+ i+6	Total	R/S Recruit yr	Smolt dist 3+	Smolt dist 4+
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			1.4300				0.74	0.26
90	95	96	1670	4175	1328									
			394	985	384									
92	97	98	1467	1467	1393									
			1117	1117	818									
94	99	00	1600	1600	1386									
96	01	02												
98	03	04												

Anticipated returns in 95 (based on moratorium years)

	R/S ratios 3+	R/S ratios 4+	No. of small 3+	No. of small 4+	Total	Total (avg92-94)	1.08
Mora.							
Mean	0.9924	0.2449	1318	203	1521	1638	
Hi	1.4300	0.3121	1899	258	2157	2324	
Low	0.6201	0.1746	823	145	968	1043	

Comparison of observed & expected in 92-94

Year	R/S ratios 3+	R/S ratios 4+	Est. no. of small 3+	Est. no. of small 4+	Total	Difference (Obs-exp)	% Difference
92	0.9924	0.2449	1162	535	1697	-230	-16
93	0.9924	0.2449	1323	287	1610	-493	-44
94	0.9924	0.2449	822	326	1148	452	28
						Mean	-11

NB - the average used for anticipated returns is for 3 years.

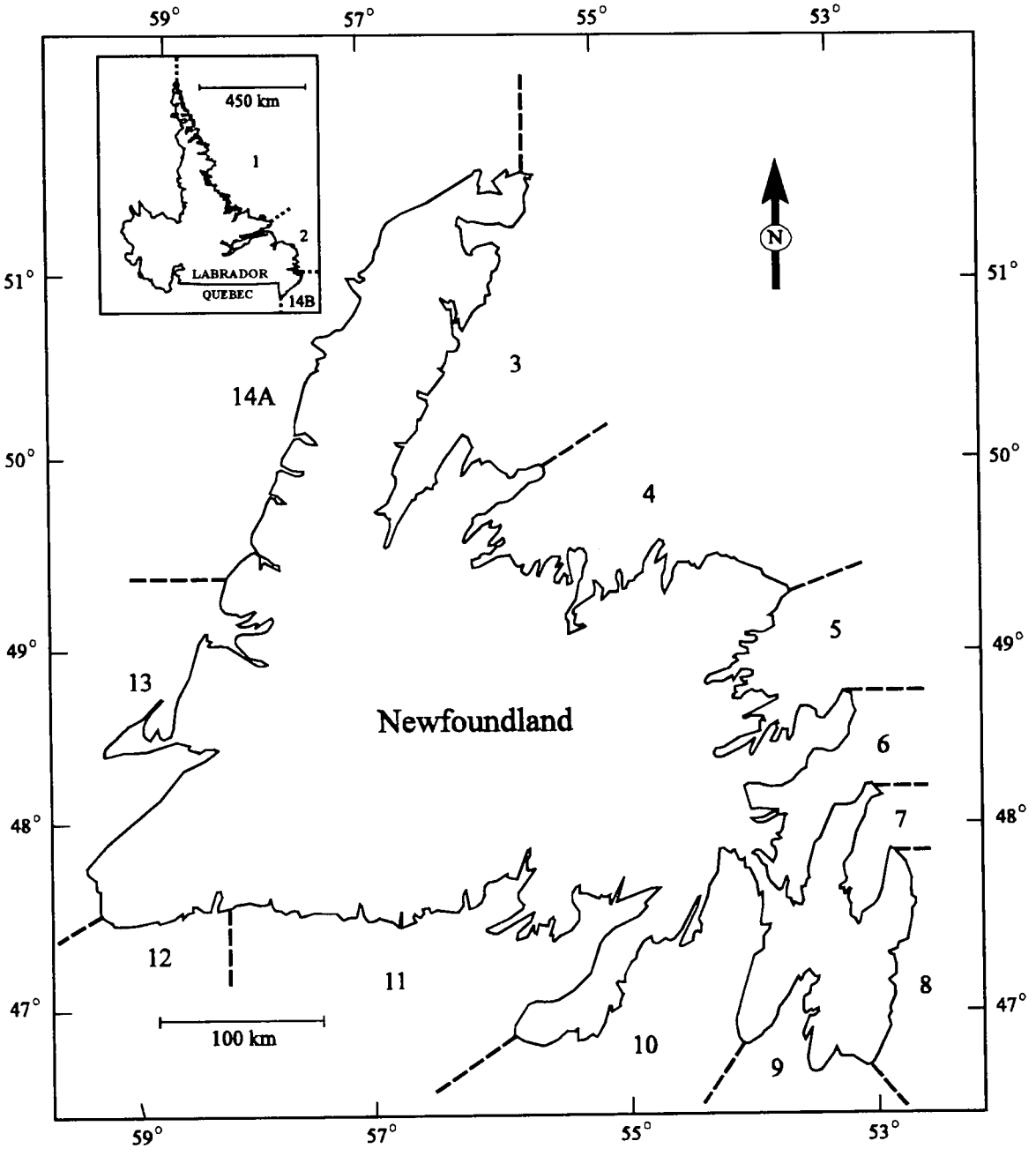

Fig. 1. Map showing the 14 Salmon Fishing Areas of the Newfoundland Region.

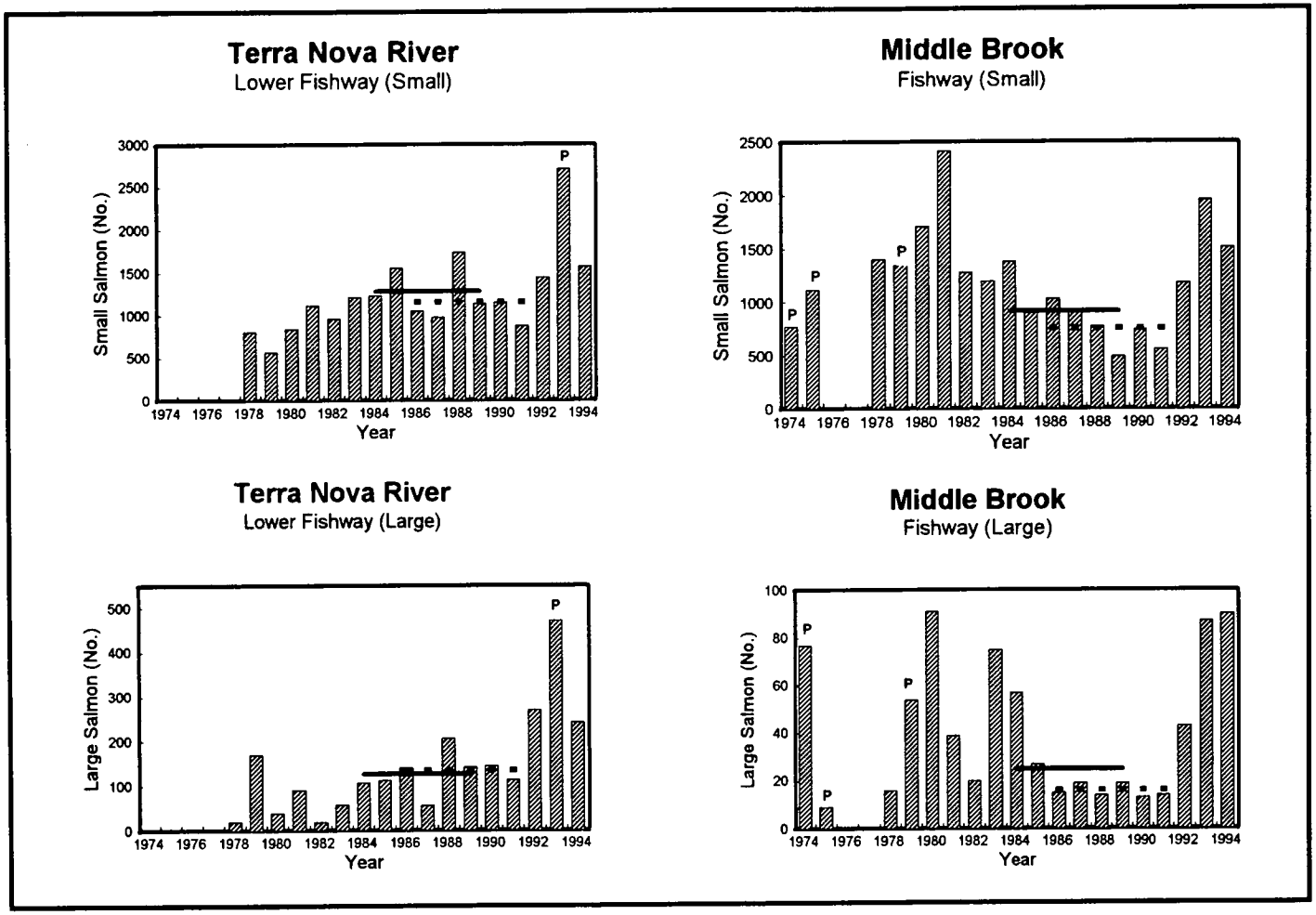

Fig. 2. Counts of small and large salmon at the lower Terra Nova River fishway and Middle Brook fishway, 1974-94. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count not included in means.

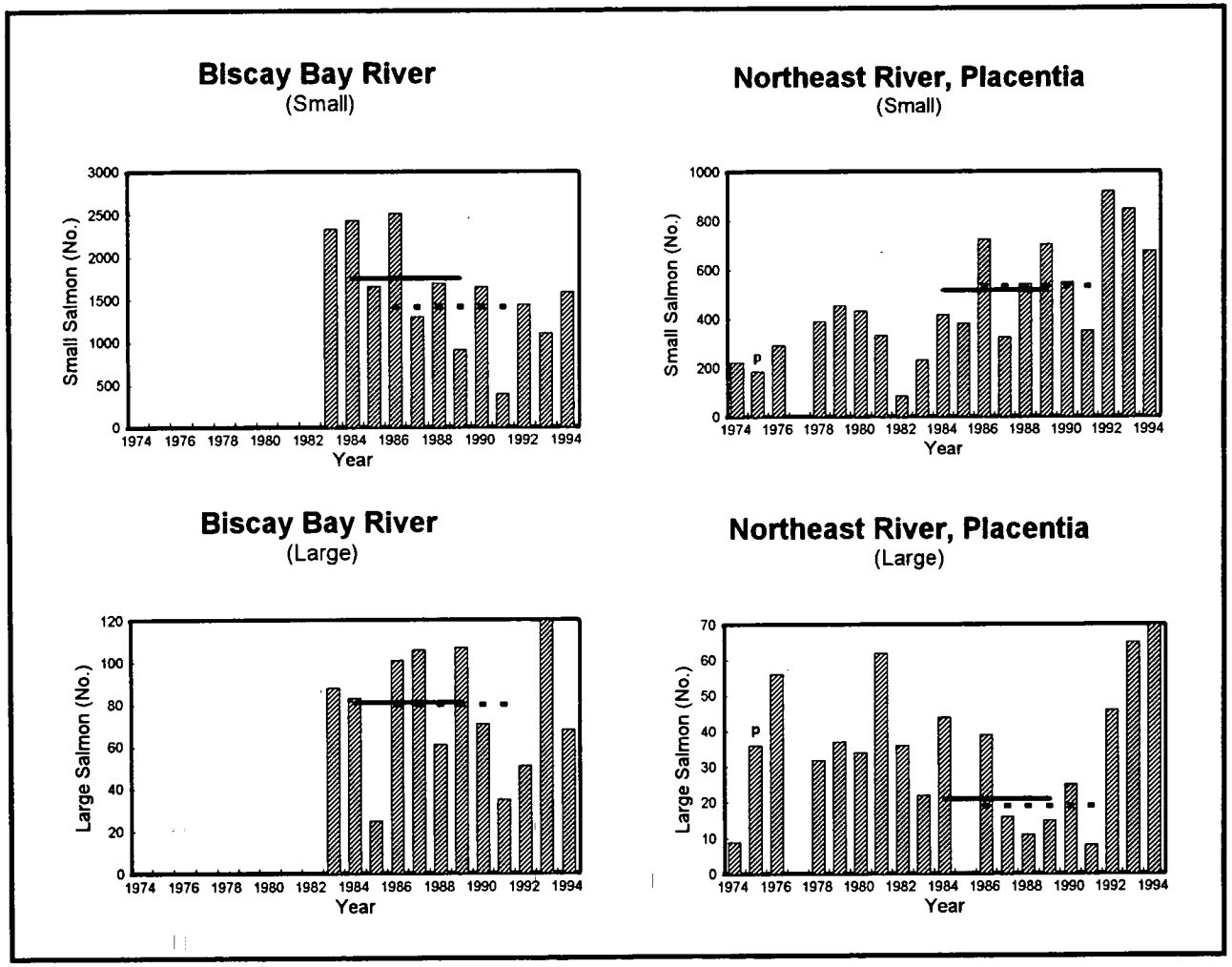

Fig. 3. Counts of small and large salmon at the Biscay Bay River counting fence, and the Northeast River fishway, 1974-94. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count, not included in means.

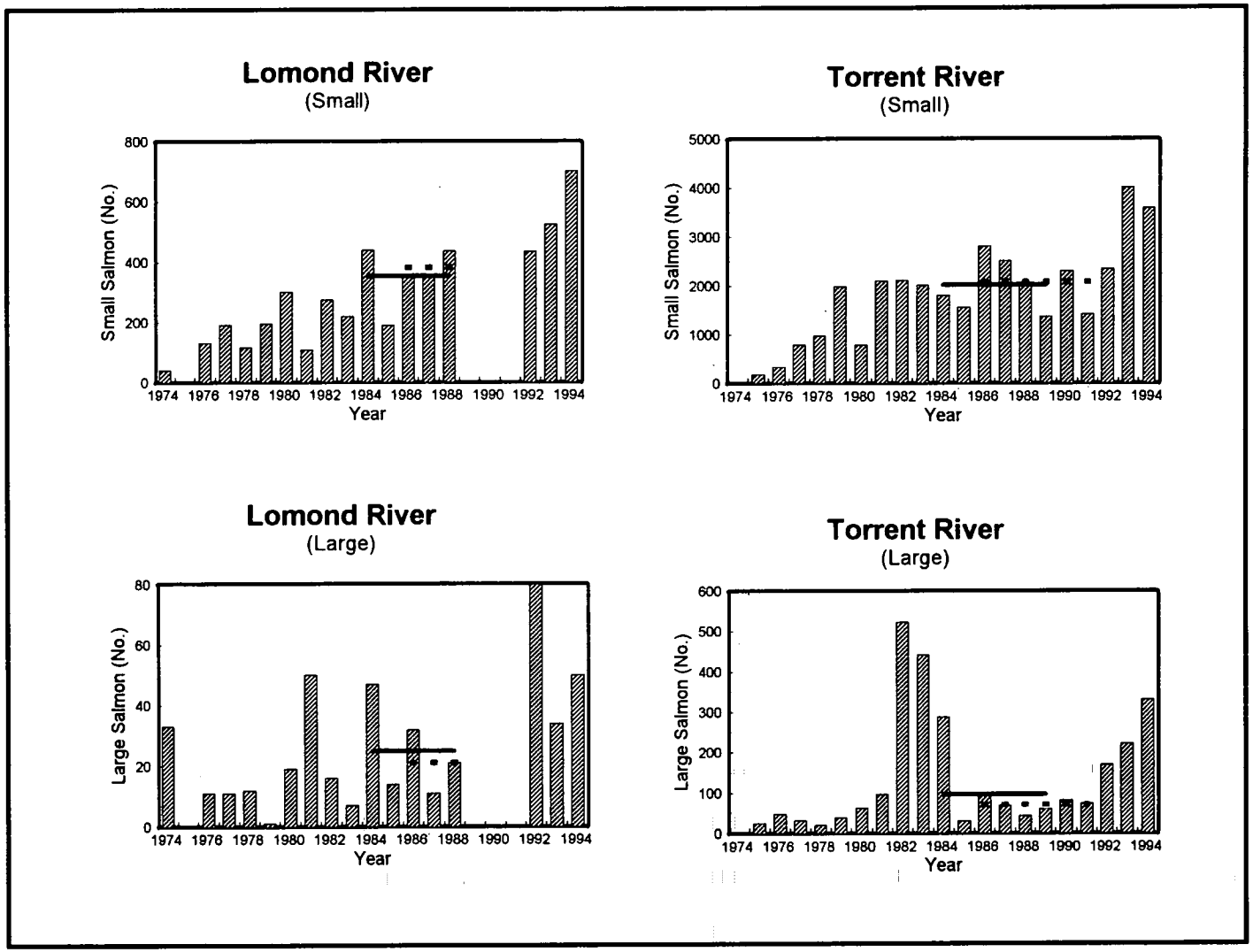

Fig. 4. Counts of small and large salmon at the Lomond River fishway and the Torrent River fishway, 1974 - 94. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91mean.

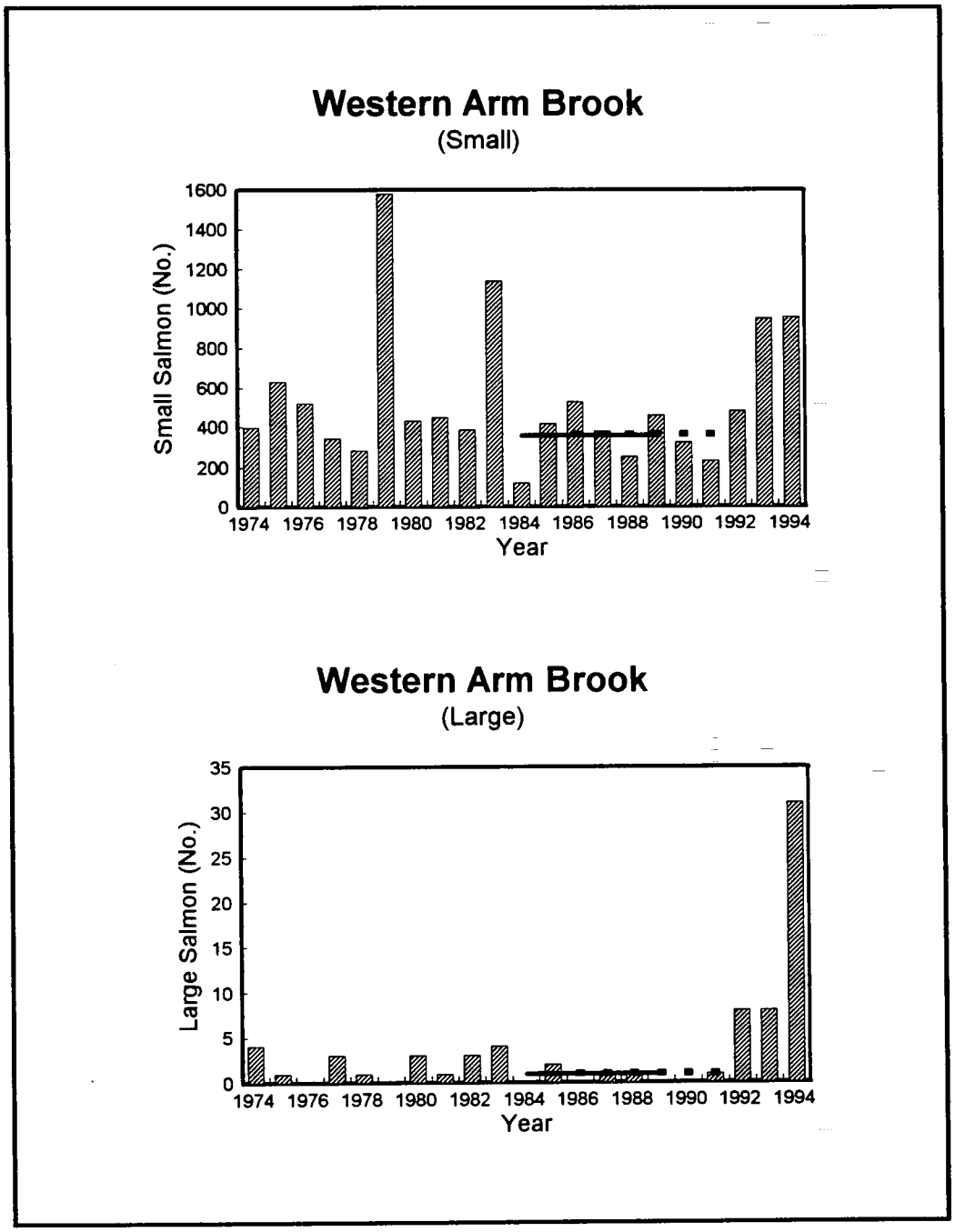

Fig. 5. Counts of small and large salmon at the Western Arm Brook counting fence, 1974 - 94. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean.

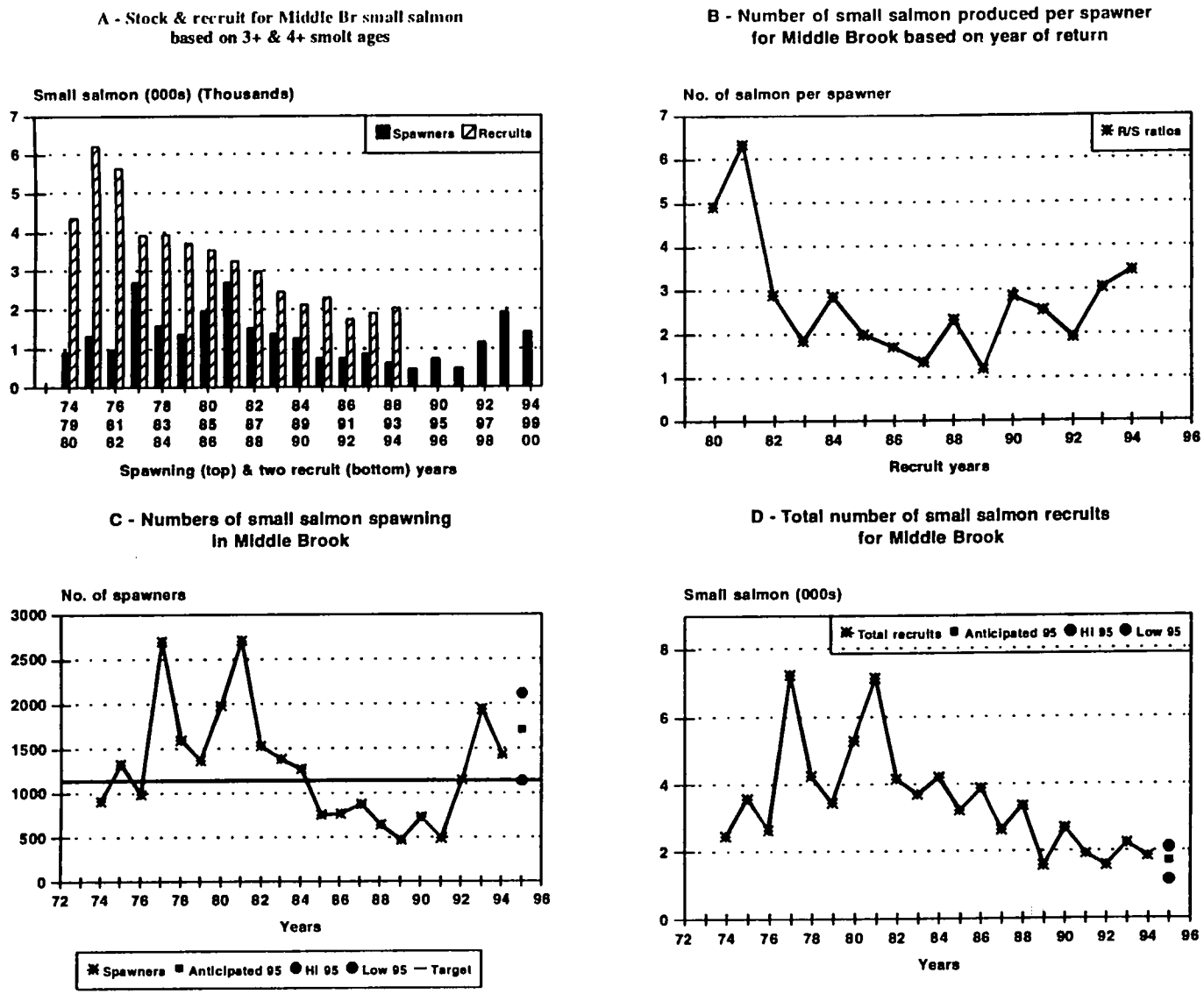

Fig. 6. Number of small salmon spawners and recruits, lagged and totalled according to smolt age (A), number of small salmon produced (years i+5,6) per spawner (year i) for spawner years 1974-88 (B), number of small salmon spawners, 1974-94, and anticipated spawners in 1995 in relation to the target number of spawners (C), and the total number of small salmon produced (recruits),1974-94, and anticipated total returns for 1995 (D) for Middle Brook.

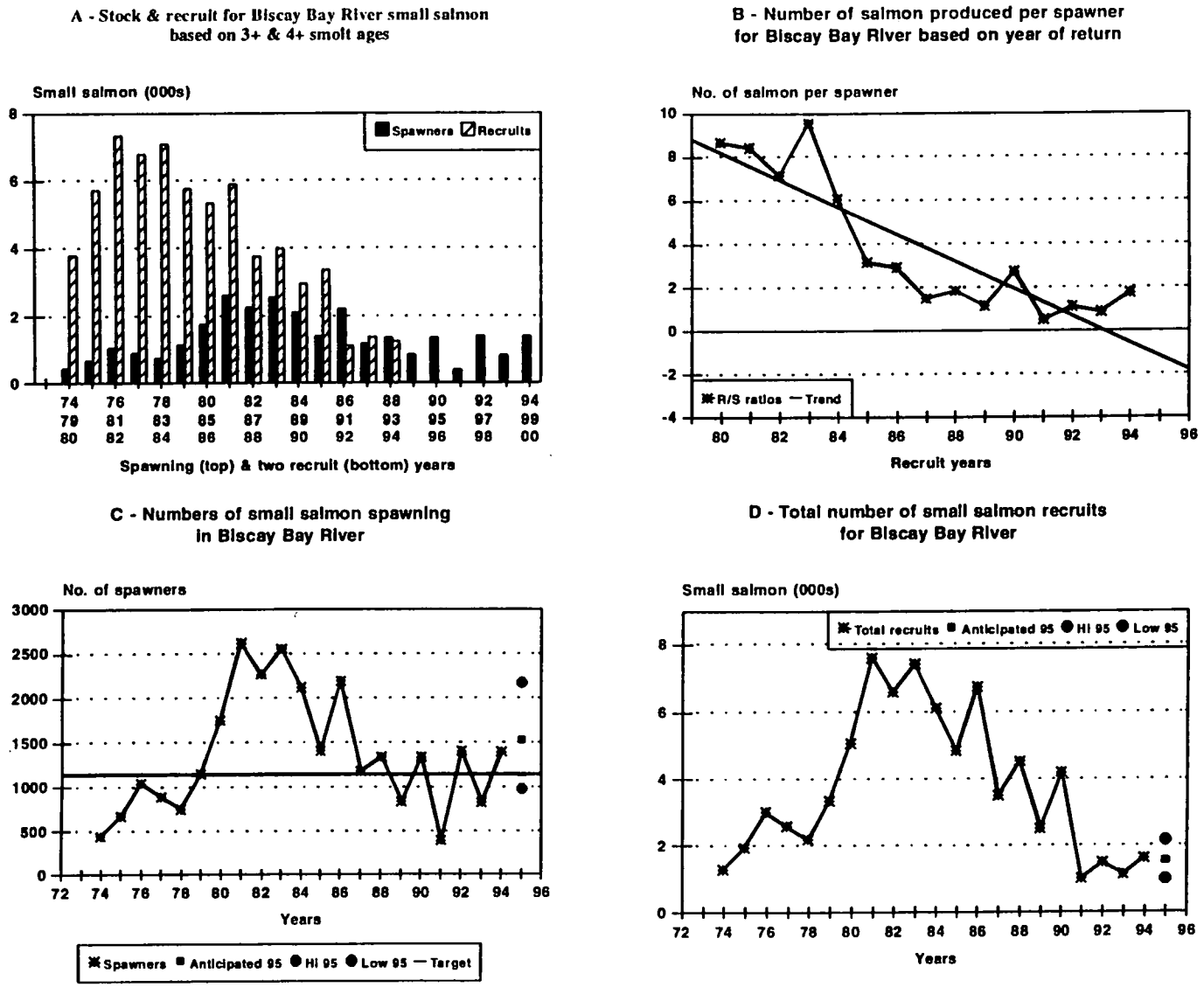

Fig. 7. Number of small salmon spawners and recruits, lagged and totalled according to smolt age (A), number of small salmon produced (years i+5,6) per spawner (year i) for spawner years 1974-88 (B), number of small salmon spawners, 1974-94, and anticipated spawners in 1995 in relation to the target number of spawners (C), and the total number of small salmon produced (recruits),1974-94, and anticipated total returns for 1995 (D) for Biscay Bay River.

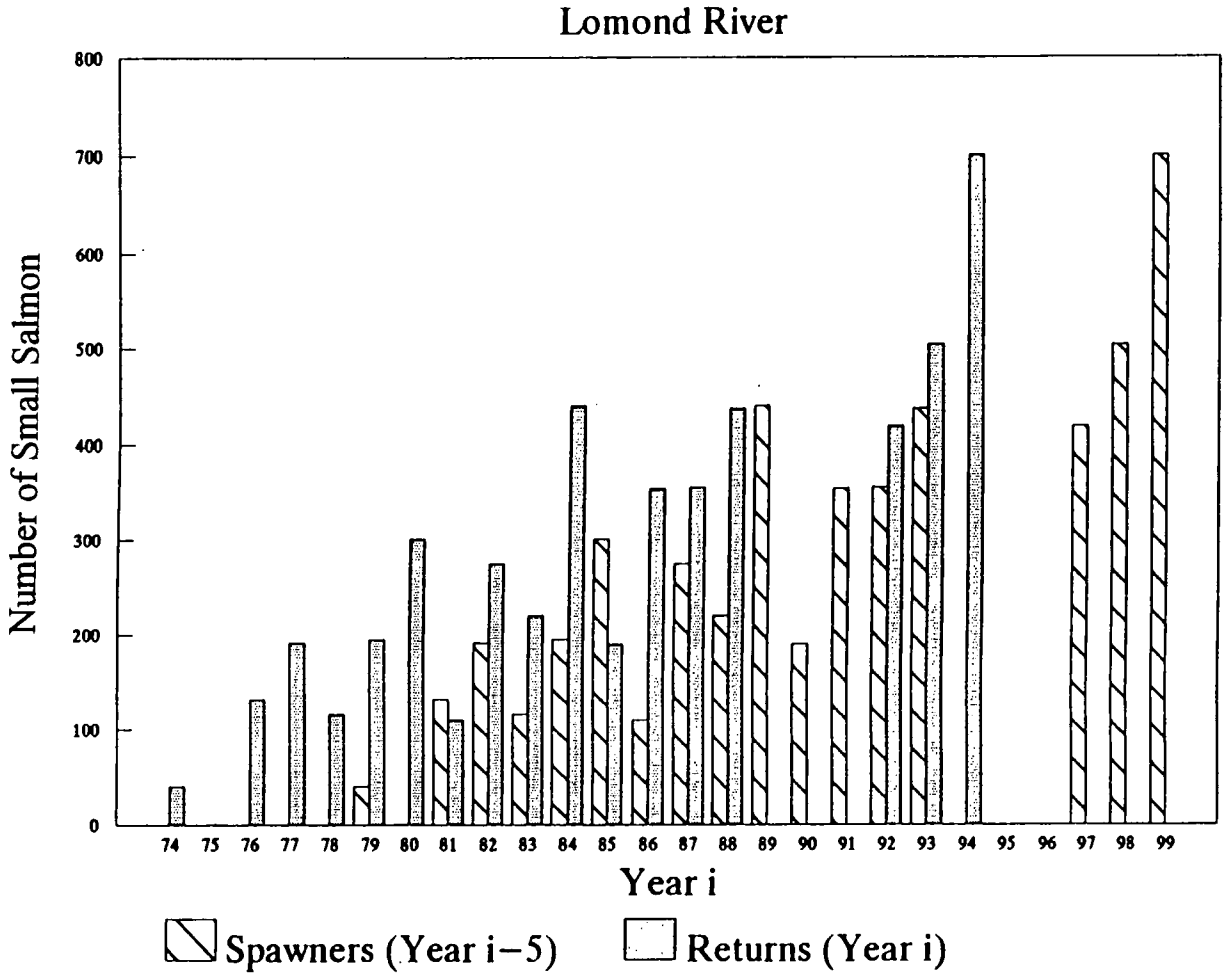

Fig. 8. Spawners above the Lomond River fishway and approximate total returns, 1974 - 1994.

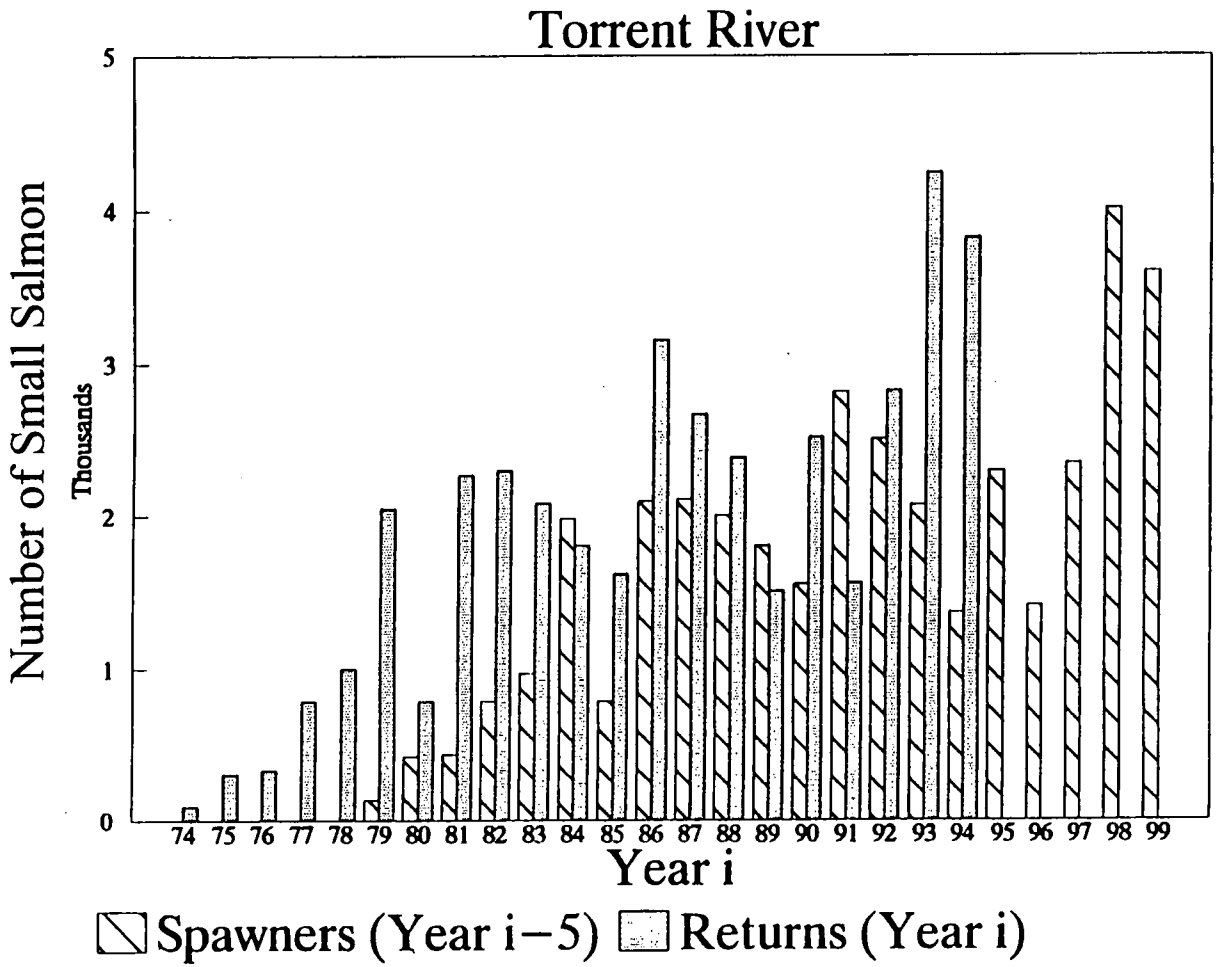

Fig. 9. Spawners above the Torrent River fishway and approximate total returns, 1974 - 1994.

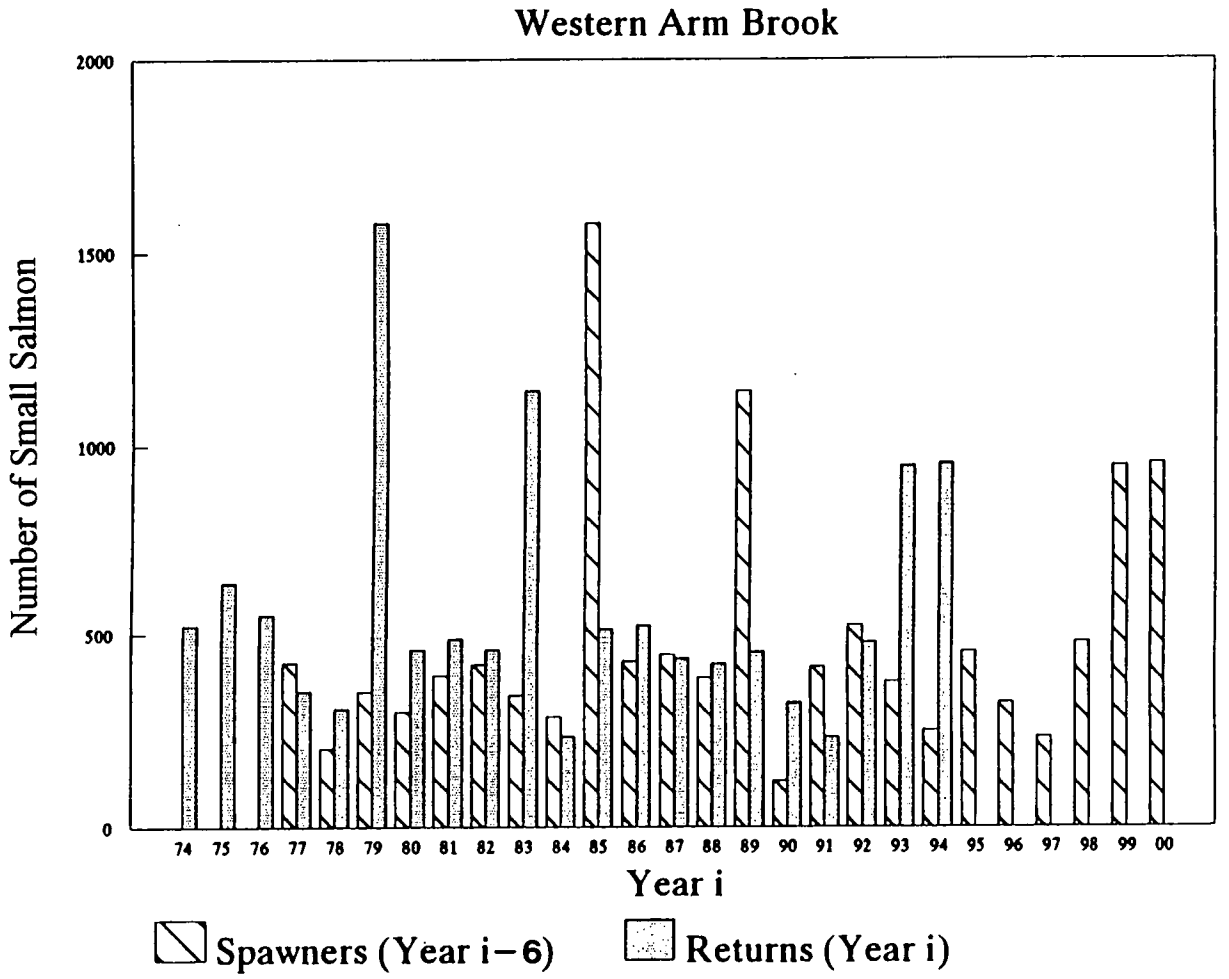

Fig. 10. Spawners above the counting fence on Western Arm Brook and total returns, 1974 - 1994.

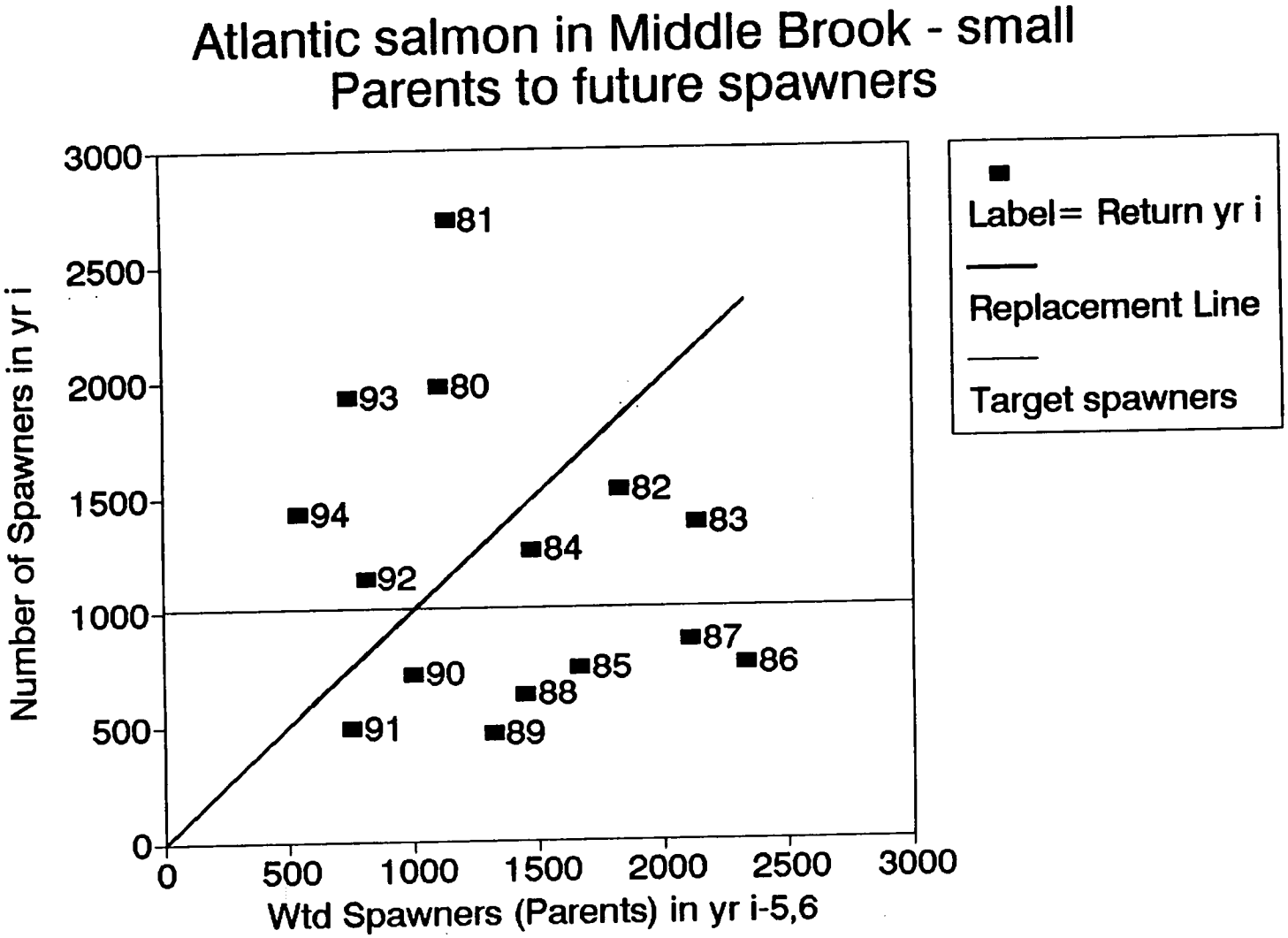

Fig. 11. The relationship between parents and spawners (after exploitation), the replacement line (diagonal), and target spawning requirement for small salmon for Middle Brook, 1980-94.

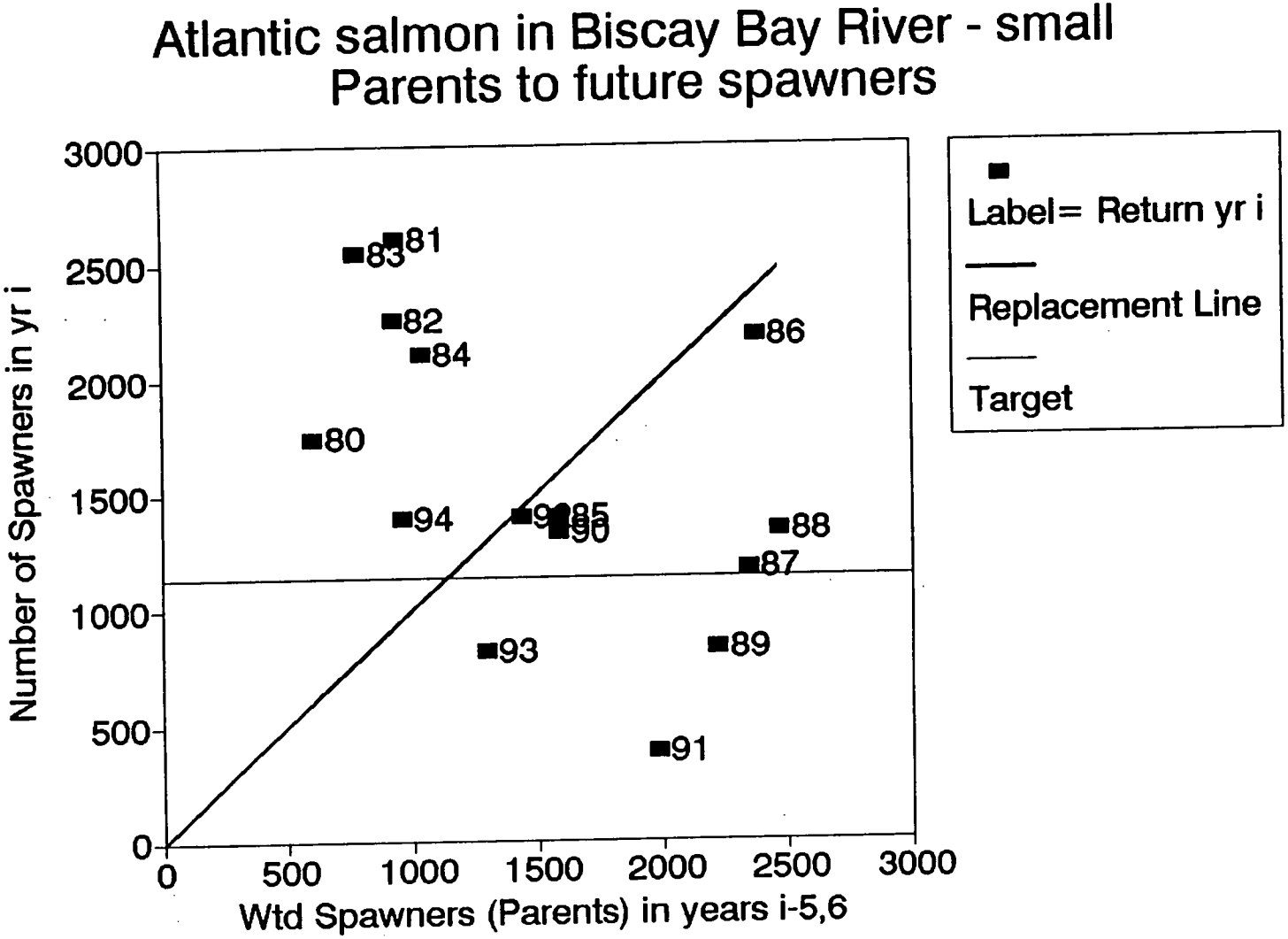

Fig. 12. The relationship between parents and spawners (after exploitation), the replacement line (diagonal), and target spawning requirement for small salmon for Biscay Bay River, 1980-94.

Appendix 1. Atlantic salmon recreational fishery catch and effort data for Campbellton River, Notre Dame Bay (SFA 4), 1974-1994. 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	*	.	.	782	.	782	0.24
1986	1791	422	.	422	*	.	.	422	.	422	0.24
1987	803	169	.	169	*	.	.	169	.	169	0.21
1988	1837	636	.	636	*	.	.	636	.	636	0.35
1989	854	148	.	148	*	.	.	148	.	148	0.17
1990	693	106	.	106	*	.	.	106	.	106	0.15
1991	693	126	.	126	*	.	.	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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	2072	596	.	596	.	.	.	596	.	596	0.29
95% CL	1123	404	.	404	.	.	.	404	.	404	0.10
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1174	288	.	288	.	.	.	288	.	288	0.25
95% CL	731	290	.	290	.	.	.	290	.	290	0.11
N	5	5	0	5	0	0	0	5	0	5	5

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 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 2. Atlantic salmon recreational fishery catch and effort data for Middle Brook, Bonavista Bay (SFA 5), 1974-1994. 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	*	.	.	538	.	538	0.23
1986	2307	789	.	789	*	.	.	789	.	789	0.34
1987	840	187	.	187	*	.	.	187	.	187	0.22
1988	1545	708	.	708	*	.	.	708	.	708	0.46
1989	712	165	.	165	*	.	.	165	.	165	0.23
1990	949	349	.	349	*	.	.	349	.	349	0.37
1991	903	278	.	278	*	.	.	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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	1919	522	.	522	.	.	.	522	.	522	0.27
95% CL	989	308	.	308	.	.	.	308	.	308	0.15
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1283	458	.	458	.	.	.	458	.	458	0.36
95% CL	809	341	.	341	.	.	.	341	.	341	0.09
N	5	5	0	5	0	0	0	5	0	5	5

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 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 3. Atlantic salmon recreational fishery catch and effort data for Terra Nova River, Bonavista Bay (SFA 5), 1974-1994. 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	*	.	.	751	.	751	0.41
1986	1485	620	.	620	*	.	.	620	.	620	0.42
1987	1764	546	.	546	*	.	.	546	.	546	0.31
1988	1613	682	.	682	*	.	.	682	.	682	0.42
1989	1946	357	.	357	*	.	.	357	.	357	0.18
1990	2165	624	.	624	*	.	.	624	.	624	0.29
1991	1701	448	.	448	*	.	.	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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	1779	609	.	609	.	.	.	609	.	609	0.34
95% CL	286	186	.	186	.	.	.	186	.	186	0.13
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1782	546	.	546	.	.	.	546	.	546	0.31
95% CL	338	170	.	170	.	.	.	170	.	170	0.12
N	5	5	0	5	0	0	0	5	0	5	5

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 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 4. Atlantic salmon recreational fishery catch and effort data for Biscay Bay River, St. Mary's Bay (SFA 9), 1974-1994. 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	*	.	.	290	.	290	0.26
1986	1124	393	.	393	*	.	.	393	.	393	0.35
1987	1062	101	.	101	*	.	.	101	.	101	0.10
1988	1221	349	.	349	*	.	.	349	.	349	0.29
1989	965	102	.	102	*	.	.	102	.	102	0.11
1990	1165	232	.	232	*	.	.	232	.	232	0.20
1991	1134	10	.	10	*	.	.	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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	1069	291	.	291	.	.	.	291	.	291	0.27
95% CL	156	139	.	139	.	.	.	139	.	139	0.11
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	1122	217	.	217	.	.	.	217	.	217	0.19
95% CL	119	201	.	201	.	.	.	201	.	201	0.17
N	5	5	0	5	0	0	0	5	0	5	5

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 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 5. Atlantic salmon recreational fishery catch and effort data for Northeast River, Placentia Bay (SFA 10), 1974-1994. 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	*	.	.	173	.	173	0.14
1986	862	234	.	234	*	.	.	234	.	234	0.27
1987	349	36	.	36	*	.	.	36	.	36	0.10
1988	772	186	.	186	*	.	.	186	.	186	0.24
1989	852	210	.	210	*	.	.	210	.	210	0.25
1990	786	173	.	173	*	.	.	173	.	173	0.22
1991	153	19	.	19	*	.	.	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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	950	175	.	175	.	.	.	175	.	175	0.18
95% CL	246	78	.	78	.	.	.	78	.	78	0.11
N	5	5	0	5	0	0	0	5	0	5	5
86-91 $\bar{X}$	685	164	.	164	.	.	.	164	.	164	0.24
95% CL	372	105	.	105	.	.	.	105	.	105	0.03
N	5	5	0	5	0	0	0	5	0	5	5

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 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.

* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 6. Atlantic salmon recreational fishery catch and effort data for Lomond River (SFA 14A), 1974-1994. 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
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	1365	349	.	349	.	18	20	353	18	368	0.27
95% CL	270	126	.	126	.	22	17	136	22	139	0.10
N	6	6	0	6	0	5	6	6	5	6	6
86-91 $\bar{X}$	1523	343	.	343	.	19	19	343	19	362	0.24
95% CL	317	56	.	56	.	15	15	56	15	66	0.07
N	6	6	0	6	0	6	6	6	6	6	6

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.

Appendix 7. Atlantic salmon recreational fishery catch and effort data for Torrent River (SFA 14A), 1974-1994.
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	.	.	.	.	.	.	.	.	.	.	.
1977	.	.	.	.	.	.	.	.	.	.	.
1978	183	31	.	31	4	.	4	35	.	35	0.19
1979	238	65	.	65	3	.	3	68	.	68	0.29
1980	.	.	.	.	.	.	.	.	.	.	.
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	.	.	.	.	.	.	.	.	.	.	.
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	727	477	75	552	*	6	6	477	81	558	0.77
1993	619	179	266	445	*	15	15	179	281	460	0.74
1994	992	227	82	309	*	9	9	227	91	318	0.32
Means, 95% Confidence Limits, N's:											
84-89 $\bar{X}$	591	206	.	206	.	1	1	206	1	207	0.35
95% CL	273	144	.	144	.	3	3	144	3	145	0.10
N	5	5	0	5	0	5	5	5	5	5	5
86-91 $\bar{X}$	629	222	.	222	.	2	2	222	2	224	0.36
95% CL	144	90	.	90	.	2	2	90	2	91	0.08
N	6	6	0	6	0	6	6	6	6	6	6

IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
CPUE IS BASED ON RETAINED + RELEASED FISH FOR 1992 AND 1993 AND ON RETAINED FISH ONLY PRIOR TO 1992.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.