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**Status of Atlantic Salmon (Salmo salar L.) in Middle Brook and  
Terra Nova River (SFA 5), Biscay Bay River (SFA 9),  
and Northeast River, Placentia (SFA 10) in 1993**

by

M. F. O'Connell  
Science Branch  
Department of Fisheries and Oceans  
P. O. Box 5667  
St. John's, Newfoundland A1C 5X1

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### **Abstract**

The status of Atlantic salmon in 1993 was determined for Middle Brook and Terra Nova River located in Salmon Fishing Area (SFA) 5, Biscay Bay River in SFA 9, and Northeast River in SFA 10. Assessments were conducted in relation to the five-year moratorium on the commercial Atlantic salmon fishery, which entered its second year in 1993. Target spawning requirement was exceeded in Middle Brook and Northeast River in 1993 but was not met in Terra Nova River and Biscay Bay River.

### **Résumé**

On a établi l'état des stocks de saumon de l'Atlantique dans le ruisseau Middle et la rivière Terra Nova, qui font partie de la zone de pêche du saumon (ZPS) 5, dans la rivière Biscay (ZPS 9) et dans la rivière Northeast (ZPS 10) en 1993. Ces évaluations faisaient suite à l'adoption du moratoire quinquennal sur la pêche commerciale du saumon de l'Atlantique, en vigueur depuis 1992. Les besoins-cibles de reproducteurs ont été comblés, largement, dans le ruisseau Middle et dans la rivière Northeast, mais non dans la Terra Nova et la Biscay.

## Introduction

In 1992, a major change was introduced in the management of Atlantic salmon in the Newfoundland Region. 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, a quota on the number of fish that could be retained was introduced in each Salmon Fishing Area (SFA) for the first time. The quota was assigned for each SFA as a whole and not administered on an individual river basis. The quota was in effect in each SFA from the beginning of the season until it was caught, following which, only hook-and-release fishing was permitted. In 1993, the quota was split to cover two time periods during the angling season in insular Newfoundland. The first time period, which accounted for most of the quota, was from the opening of the season until July 31; the remainder of the quota was taken between August 1 and the end of the season. Only hook-and-release fishing was permitted after each portion of the quota was caught. As in past years, the retention of large salmon was not permitted in insular Newfoundland.

In this paper, we examine the status of Atlantic salmon in Middle Brook and Terra Nova River, Bonavista Bay (SFA 5); Biscay Bay River, St. Mary's Bay (SFA 9); and Northeast River, Placentia Bay (SFA 10) in 1993, the second year of the 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 characteristic data to calculate total river returns and spawning escapements. Stock status is evaluated relative to target spawning requirements developed for all rivers by O'Connell and Dempson (1991a,b).

## 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. Procedures for the collection and compilation of recreational fishery data are described by Ash and O'Connell (1987).

### 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 is presented in Tables 1 (Middle Brook and Terra Nova River) and 2

(Biscay Bay River and Northeast River). In 1992 and 1993, for Middle Brook, the following values for female mean weight and proportion of 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	0.76 (79)

For fish  $\geq 63$  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 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).

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 each river and are shown in Table 3. For Terra Nova River, the average for that river was used in 1985 and 1986.

#### *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) was calculated as follows:

$$(1) \quad \text{TRR} = \text{RC}_b + C$$

where,

$\text{RC}_b$  = 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.

### Spawning Escapement

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

$$(2) \quad SE = FR - RC_1 - BR$$

where,

FR = fish released at counting facility  
 RC<sub>1</sub> = recreational catch above counting facility  
 BR = broodstock removal (Biscay Bay River only)

### Egg Deposition

Egg deposition (ED) was calculated as follows:

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

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 Mollyguajack 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 (Table 4) was developed by O'Connell and Dempson (1991a,b). The egg deposition requirement for classical fluvial parr rearing habitat (Elson 1957) was 240 eggs/unit (a unit = 100 m<sup>2</sup>) (Elson 1975); the requirement for lacustrine habitat was 368 eggs/ha (O'Connell et al. 1991). 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.

## Results

### Recreational Fishery

Catch and effort data for each river are presented in Appendices 1-4. 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 1993 (retained plus released fish), associated effort, and catch per unit of effort (CPUE) are compared to years prior to 1992. In 1992, there was no estimate of released fish during the period of retention of catch and hence comparisons with 1993 are not appropriate. The total number of fish retained (both quota periods combined) in 1993 for each river is also shown; direct comparison with 1992 is not valid since the closure date for retention of fish in that year was different from 1993. Calculation of CPUE in terms of retained fish only was not possible since effort figures apply to both retained and released fish collectively.

Total catch of small salmon (retained plus released fish) and effort expenditure for Terra Nova River in 1993 was the highest on record while CPUE (which included some large salmon) remained below the 1984-89 and 1986-91 means; total catch for Middle Brook was the highest since 1986 and CPUE the highest during the period since 1974. For Biscay Bay River, the catch of small salmon and effort expenditure in 1993 were above the means while CPUE was below the 1984-89 mean and increased slightly over the 1986-91 mean. The 1993 catch for Northeast River decreased from 1992 but was higher than both means, effort was below the means, while CPUE was the second highest since 1974 (that of 1992 being the highest).

The quota for retained catch of small salmon during the first quota period was reached on July 8 for SFA 5 and on July 9 for SFA 10; closure dates for retention of fish during the second quota period for these SFAs were August 8 and August 2, respectively. In SFA 9, the period of retention lasted the entire angling season (closed on September 6) without the quota being caught. Quotas in both 1992 and 1993 constrained retained catches at levels below or near the means for Middle Brook, Terra Nova River, and Northeast River. The number of fish retained in Biscay Bay River in 1992 was well below the means, the result of the SFA quota being taken early in the angling season; in 1993 however, with the SFA retention period spanning the entire angling season, the number of fish retained was similar to the 1984-89 mean and above the 1986-91 mean.

The percentage of SFA retained catch of small salmon and effort expenditure up to the time of closure of the first quota period attained by various rivers in SFAs 5, 9, and 10 are shown in

Figs. 2-4, respectively. Terra Nova River accounted for the second highest proportion of catch and the highest proportion of effort expenditure in SFA 5 while Middle Brook had the fourth highest proportion of catch and effort. Biscay Bay River attained the second highest proportion of retained catch in SFA 9 and the third highest proportion of expenditure of effort. Northeast River achieved the third highest proportion of catch and effort in SFA 10.

#### Counts at Counting Facilities

Counts of small and large salmon at the Middle Brook and lower Terra Nova River fishways for the period 1974-93 are shown in Table 5 and Fig. 5. The 1993 count of small salmon in Middle Brook increased over 1992 (66%) and the 1984-89 (114%) and 1986-91 (160%) means. For Terra Nova River, the count of small salmon in 1993 also increased over 1992 (88%) and each mean (112% and 135%, respectively). The count of large salmon in Middle Brook increased by 102% over 1992 and by 245% and 454% over the 1984-89 and 1986-91 means, respectively. For Terra Nova River, the large salmon count increased by 74% over 1992, 269% over the 1984-89 mean, and 252% over the 1986-91 mean. Small and large salmon counts for Terra Nova River 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 6 and Fig. 6. In Biscay Bay River, the count of small salmon decreased from 1992 (19%) and the means (53% and 33%, respectively). The count of small salmon in Northeast River in 1993 decreased slightly from 1992 (8%) but remained above the 1984-89 (53%) and 1986-91 (47%) means. The count of large salmon in Biscay Bay River in 1993 increased over 1992 and the means (137, 42, and 73%, respectively); in Northeast River, there was also an increase over 1992 and the means (41, 198, and 232%, respectively). It should be noted that counts of small and large salmon for Biscay Bay River in both 1992 and 1993 were partial due to water flowing over the counting fence in early July for a period of approximately 24 hours each year. It is estimated that 100-200 fish could have escaped upstream undetected during these high-water periods in both years.

#### 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 achieved for Middle Brook and Terra Nova River for 1984-91 are shown in Table 7. For Middle Brook, the percentage of target achieved in 1993 was in excess of requirement (218%)

while for Terra Nova River it was 53% of target (based on a partial counts of small and large salmon). Percentage of target achieved for Biscay Bay River (Table 8) based on the partial count was 84%. Even if the number of fish estimated to have escaped detection were added to spawning escapement, the target for Biscay Bay River would not have been met in 1993. Target requirement for Northeast River was exceeded (418%) in 1993 (Table 8).

### Discussion

The 1984-89 mean used above for comparisons corresponds to years under major management changes in the commercial fishery in the Newfoundland Region (see O'Connell et al. 1992a). In 1990 and 1991, the commercial fishery in all SFAs of the Newfoundland Region was controlled by quota (O'Connell et al. 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 more recent 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. The cod fishery moratorium was continued in 1993.

Judging from counts at the fishway and calculations of total river returns, escapements of small salmon to Northeast River, Placentia in both 1992 and 1993 were the highest on record, which is consistent with expectations resulting from the closure of the commercial fishery. At Terra Nova River, returns of small salmon in 1993 were the highest on record while returns for 1992 were lower than in certain years prior to the moratorium (based on counts at the fishway). For both Middle Brook and Biscay Bay River, returns of small salmon in some pre-moratorium years were higher than observed collectively for 1992 and 1993. Returns of large salmon were the highest recorded for Terra Nova River, Biscay Bay River, and Northeast River, although with the exception of Terra Nova River, the improvement was not that pronounced compared to some pre-moratorium years. For Middle Brook, returns of large salmon of a magnitude similar to or greater than observed collectively for 1992 and 1993 occurred in pre-moratorium years.

Cautions associated with the parameter values used to calculate target spawning requirements have been discussed previously by O'Connell et al. (1991) and O'Connell and Dempson (1991a,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 (1991a,b). There is evidence that egg-to-smolt survival could be



substantially lower than used in the model (O'Connell et al. 1992c). However, further substantiation is required. The use of a lower value would increase target spawning requirements accordingly.

### References

- Ash, E.G.M., and M. F. O'Connell. 1987. Atlantic salmon fishery in Newfoundland and Labrador, commercial and recreational, 1985. Can. Data Rep. Fish. Aquat. Sci. 672: v + 284 p.
- Elson, P. F. 1957. Using hatchery reared Atlantic salmon to best advantage. Can. Fish. Cult. 21: 7-17.
- Elson, P. F. 1975. Atlantic salmon rivers smolt production and optimal spawning. An overview of natural production. Int. Atl. Salmon Found. Spec. Publ. Ser. 6: 96-119.
- Melnikova, M. N. 1964. The fecundity of Atlantic salmon (Salmo salar L.) from the Varguza River. Vopr. Ikhtiol. 4: 469-476.
- O'Connell, M. F., and J. B. Dempson. 1991a. Atlantic salmon (Salmo salar L.) target spawning requirements for selected rivers in salmon fishing area 5 (Bonavista Bay), Newfoundland. CAFSAC Res. Doc. 91/17. 10 p.
- O'Connell, M. F., and J. B. Dempson. 1991b. Atlantic salmon (Salmo salar L.) target spawning requirements for rivers in Notre Dame Bay (SFA 4), St. Mary's Bay (SFA 9), and Placentia Bay (SFA 10), Newfoundland. CAFSAC Res. Doc. 91/18. 14 p.
- O'Connell, M. F., J. B. Dempson, and R. J. Gibson. 1991. Atlantic salmon (Salmo salar L.) smolt production parameter values for fluvial and lacustrine habitats in insular Newfoundland. CAFSAC Res. Doc. 91/19. 11 p.
- O'Connell, M. F., J. B. Dempson, and R. J. Gibson. 1992c. Atlantic salmon (Salmo salar L.) egg-to-smolt survival in Newfoundland rivers. CAFSAC Res. Doc. 92/122. 8 p.
- O'Connell, M. F., J. B. Dempson, and D. G. Reddin. 1992a. Evaluation of the impacts of major management changes in the Atlantic salmon (Salmo salar L.) fisheries of Newfoundland and Labrador, Canada, 1984-1988. ICES J. mar. Sci.: 49-69.

- O'Connell, M. F., J. B. Dempson, T. R. Porter, D. G. Reddin, E.G.M. Ash, and N. M. Cochrane. 1992b. Status of Atlantic salmon (Salmo salar L.) stocks of the Newfoundland Region, 1991. CAFSAC Res. Doc. 92/22. 56 p.
- Prouzet, P., P. Y. LeBail, and M. Heydorff. 1984. Sex ratio and potential fecundity of Atlantic salmon (Salmo salar L.) caught by anglers on the Elorn River (Northern Brittany, France) during 1979 and 1980. Fish. Mgmt. 15: 123-130.

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.

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
<b>Small salmon</b>														
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
<b>Large salmon</b>														
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
<b>SFA 9</b>														
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
<b>SFA 10</b>														
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. Relative fecundity values used to calculate egg depositions for each river.

River	Year	Relative fecundity (No. eggs/kg)	N
<b>SFA 5</b>			
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
<b>SFA 9</b>			
Biscay Bay River		2066	290
<b>SFA 10</b>			
Northeast River, Plac.		2267	106

Table 4. Atlantic salmon target spawning requirement for each river in terms of eggs and small salmon.

River	Target spawning requirement	
	Eggs (No. x 10 <sup>6</sup> )	Small salmon (No.)
<b>SFA 5</b>		
Middle Brook	2.342	1012
Terra Nova River	14.303	7094
<b>SFA 9</b>		
Biscay Bay River	2.951	1134
<b>SFA 10</b>		
Northeast River, Plac.	0.719	224

Table 5. Counts of Atlantic salmon at Middle Brook (1974-93) and lower Terra Nova River (1978-93) fishways, Bonavista Bay (SFA 5). Partial counts are in parentheses and are not included in means.

	Middle Brook		Terra Nova River	
Year	Small salmon	Large salmon	Small salmon	Large salmon
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	1959	87	(2713)	(470)
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 6. Counts of Atlantic salmon at the Biscay Bay River counting fence, St. Mary's Bay (SFA 9), 1983-93, and the Northeast River fishway, Placentia Bay SFA (10), 1974-93. Partial counts are in parentheses and are not included in means.

	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	(1377)	(21)	384	0
1986	2516	101	725	39
1987	(1302)	(106)	(325)	(16)
1988	1695	61	543	11
1989	(889)	(104)	706	15
1990	1657	71	551	25
1991	394	35	353	8
1992	(1298)	(49)	921	46
1993	(1045)	(116)	847	65
1984-89				
Mean	2213.7	81.7	555.4	21.8
95% LCL	1092.7	31.9	359.5	-1.6
UCL	3334.7	131.4	751.3	45.2
N	3	3	5	5
1986-91				
Mean	1565.5	67.0	575.6	19.6
95% LCL	172.1	23.6	388.8	4.0
UCL	2958.9	110.4	762.4	35.2
N	4	4	5	5



Table 7. Total river returns, spawning escapement, and percentage of target spawning requirement achieved in Middle Brook and Terra Nova River, Bonavista Bay (SFA 5), 1984-93.

Year	Total returns		Spawning escapement		Egg deposition (No. x 10 <sup>6</sup> )		% of target
	Small	Large	Small	Large	Small	Large	
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
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 <sup>1</sup>	3017	470	2533	470	5.107	2.416	53

<sup>1</sup>Based on incomplete count.

Table 8. 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), 1984-93.

Year	Total returns		Spawning escapement		Egg deposition (No. x 10 <sup>6</sup> )		% of target
	Small	Large	Small	Large	Small	Large	
Biscay Bay River							
1984	2430	83	2108	83	5.487	0.373	199
1985 <sup>1</sup>	1638	21	1109	21	2.887	0.094	101
1986	2688	101	2184	101	5.685	0.454	208
1987 <sup>1</sup>	1393	106	1171	106	3.048	0.476	119
1988	1802	61	1333	61	3.470	0.274	127
1989 <sup>1</sup>	981	104	805	104	2.095	0.467	87
1990	1670	73	1328	73	3.457	0.328	128
1991	394	35	384	35	0.999	0.157	39
1992 <sup>1</sup>	1323	49	1249	49	3.251	0.220	118
1993 <sup>1</sup>	1055	116	756	116	1.968	0.521	84
Northeast River, Placentia							
1984	459	44	389	44	1.219	0.198	197
1985	519	0	346	0	1.095	0.000	152
1986	879	39	645	39	2.314	0.175	346
1987 <sup>1</sup>	350	16	317	16	1.020	0.072	152
1988	637	11	451	11	1.451	0.049	209
1989	809	15	599	15	1.928	0.067	277
1990	699	25	526	25	1.693	0.112	251
1991	368	8	349	8	1.123	0.036	161
1992	956	46	919	46	2.957	0.207	440
1993	976	65	843	65	2.713	0.292	418

<sup>1</sup>Based on incomplete count.

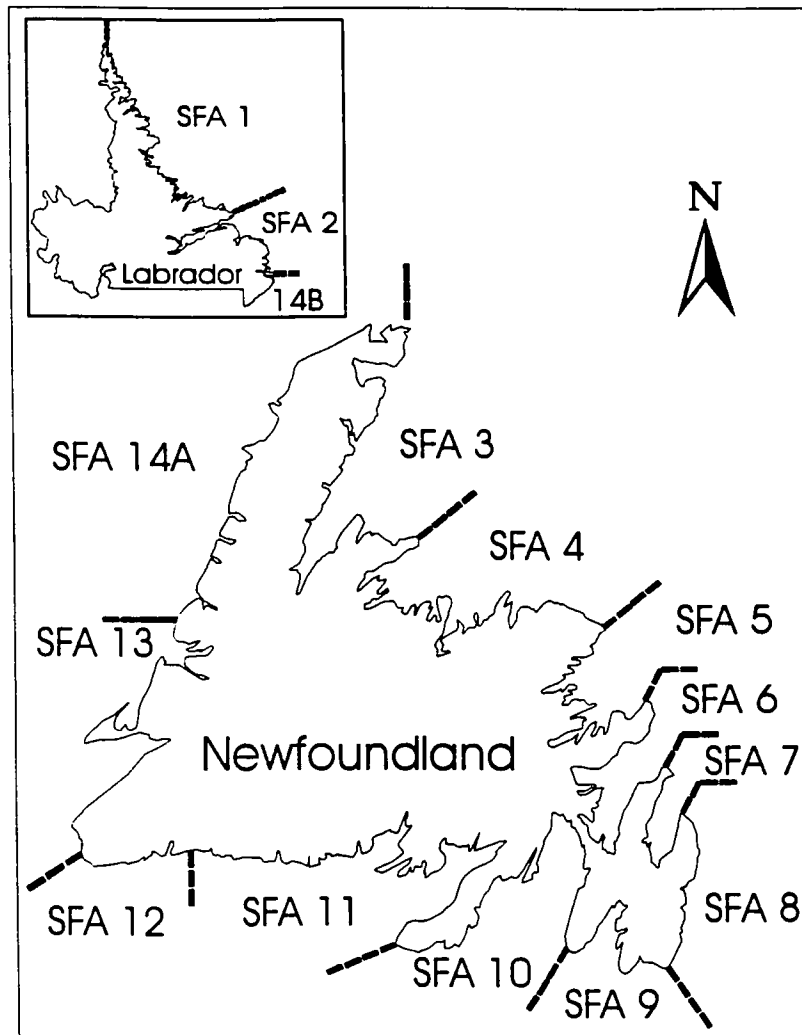


Fig. 1. Map showing the 14 Salmon Fishing Areas of the Newfoundland Region.

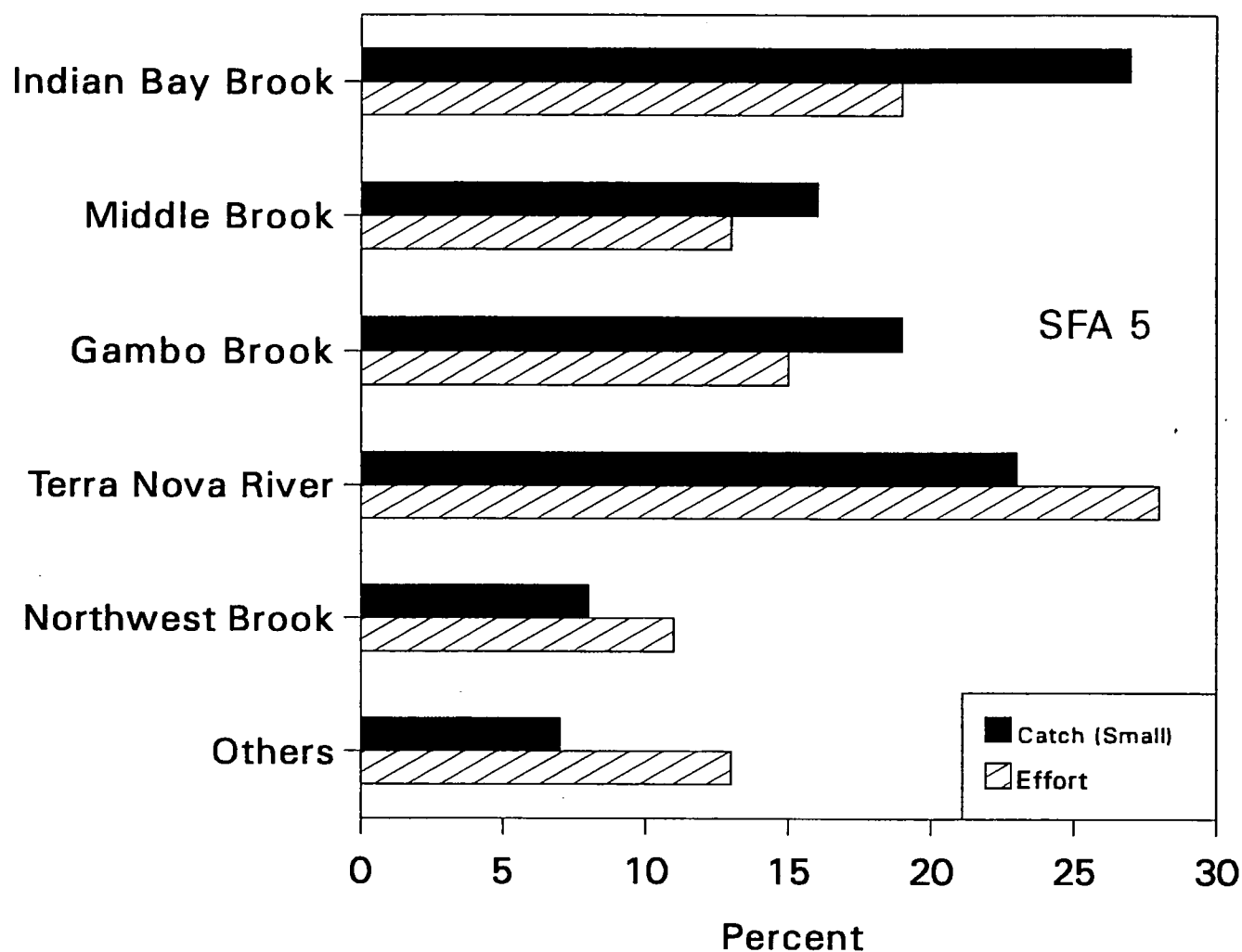


Fig. 2. Percentage of retained SFA catch of small salmon and effort expenditure up to the time of closure of the first quota period attained by various rivers in SFA 5 in 1993.

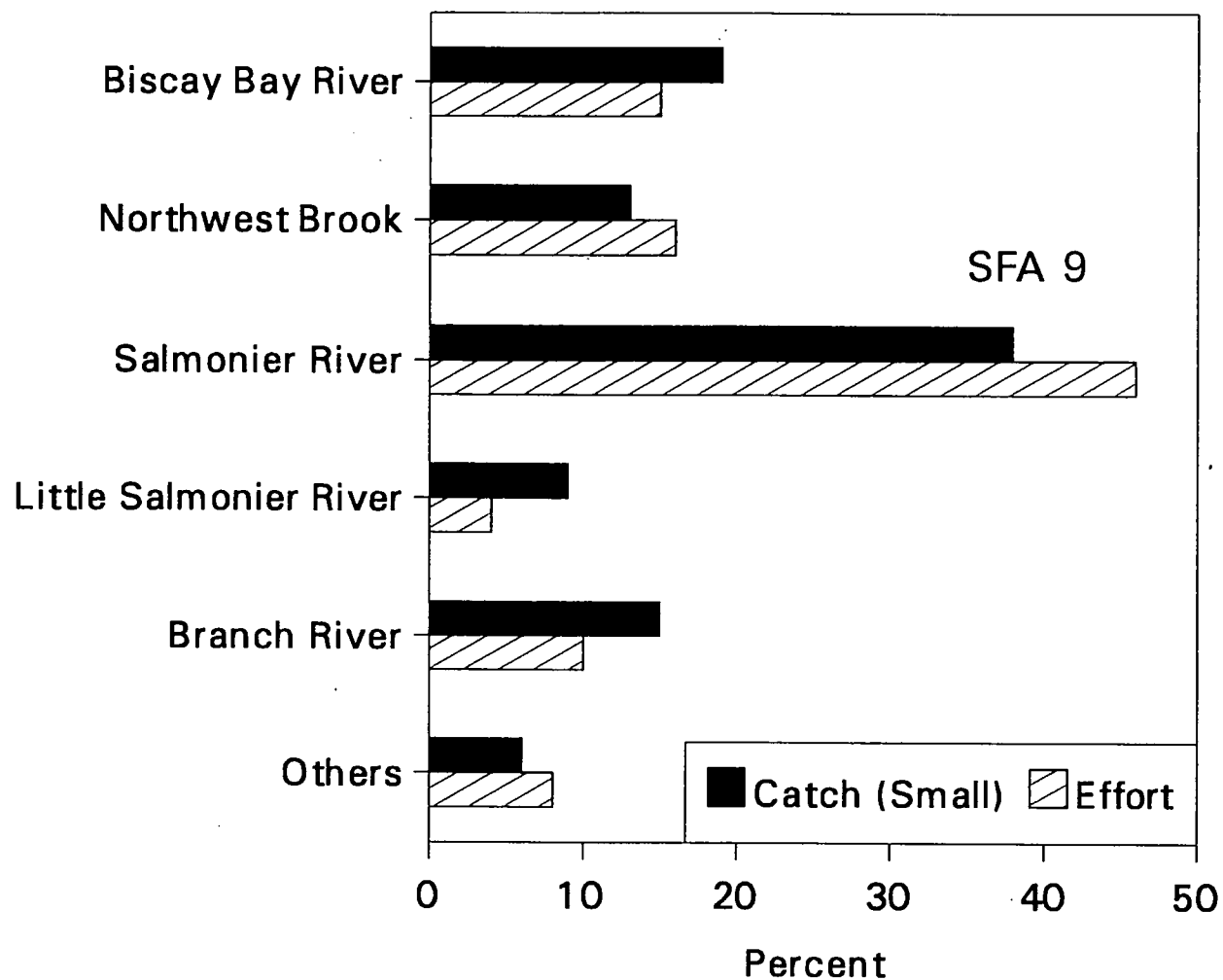


Fig. 3. Percentage of retained SFA catch of small salmon and effort expenditure up to the time of closure of the first quota period attained by various rivers in SFA 9 in 1993.

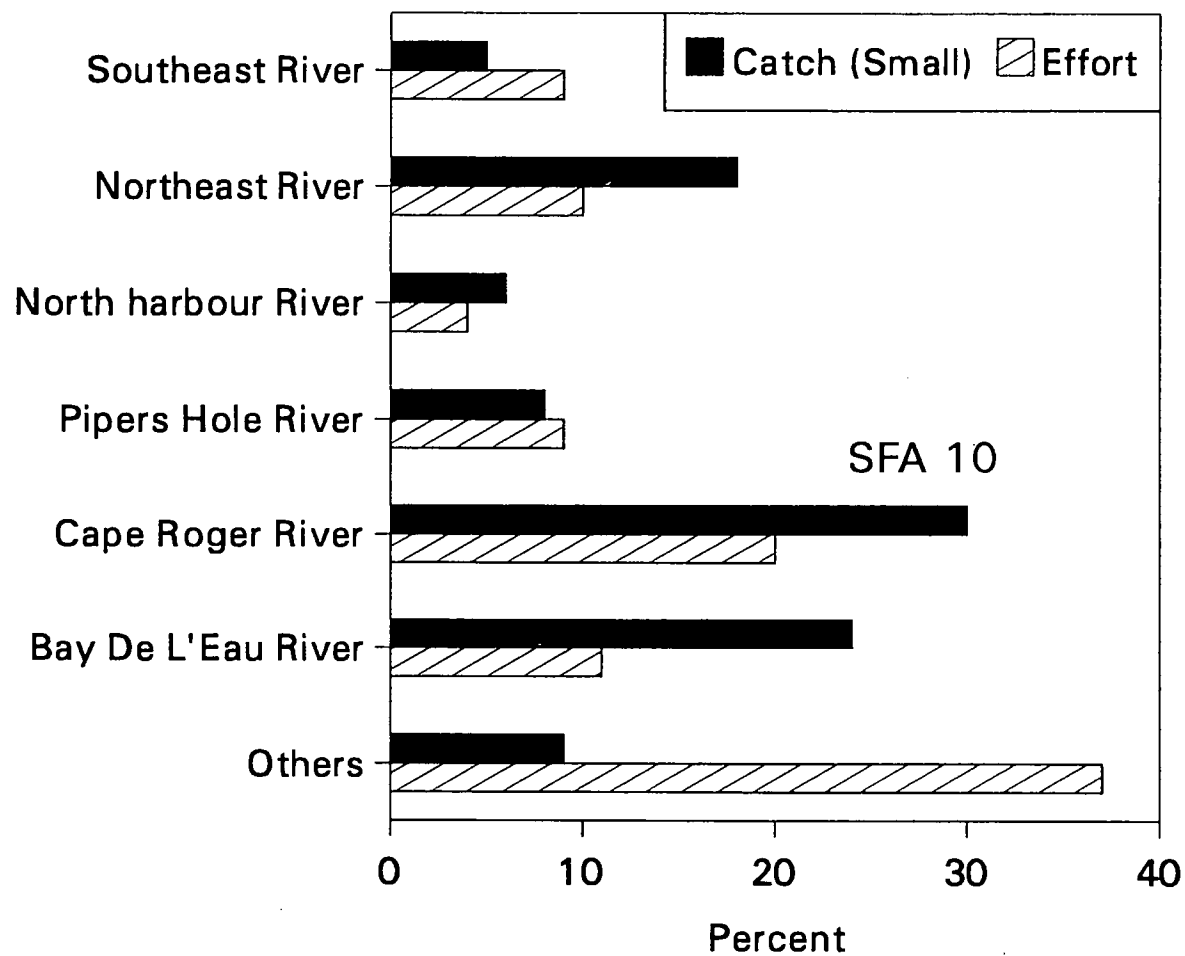


Fig. 4. Percentage of retained SFA catch of small salmon and effort expenditure up to the time of closure of the first quota period attained by various rivers in SFA 10 in 1993.

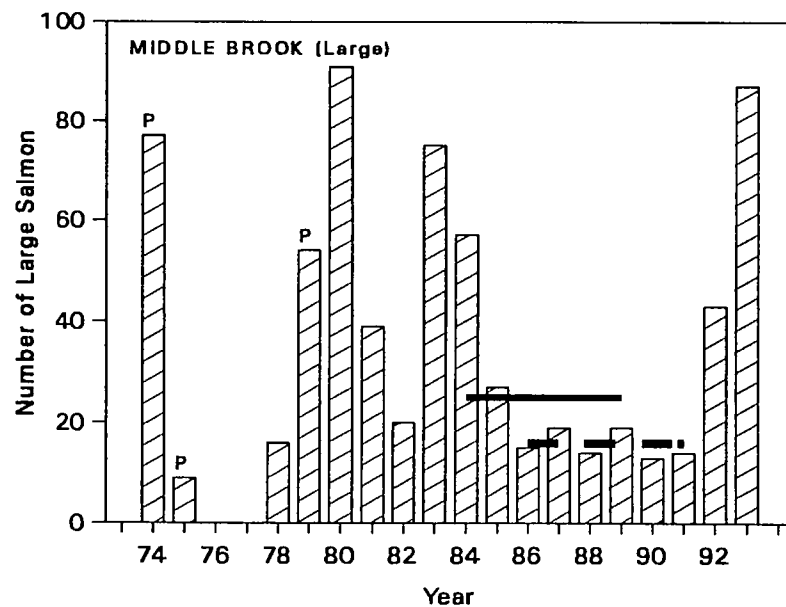
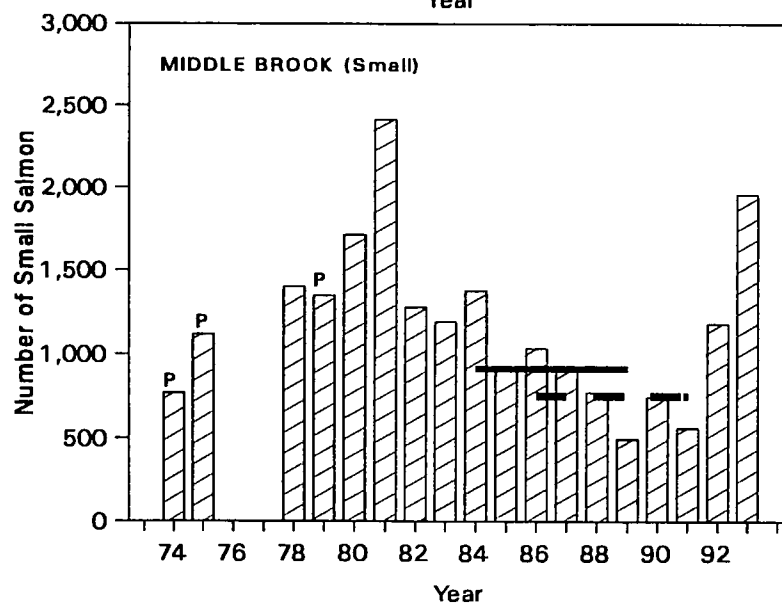
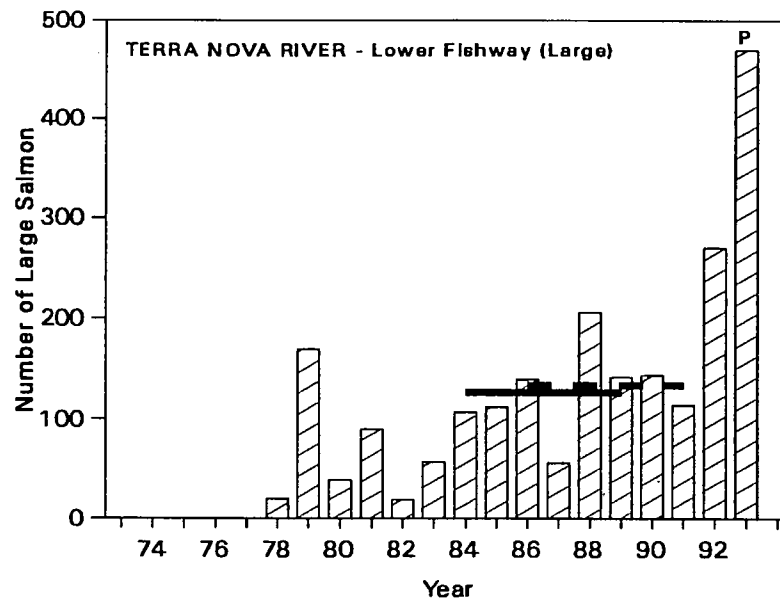
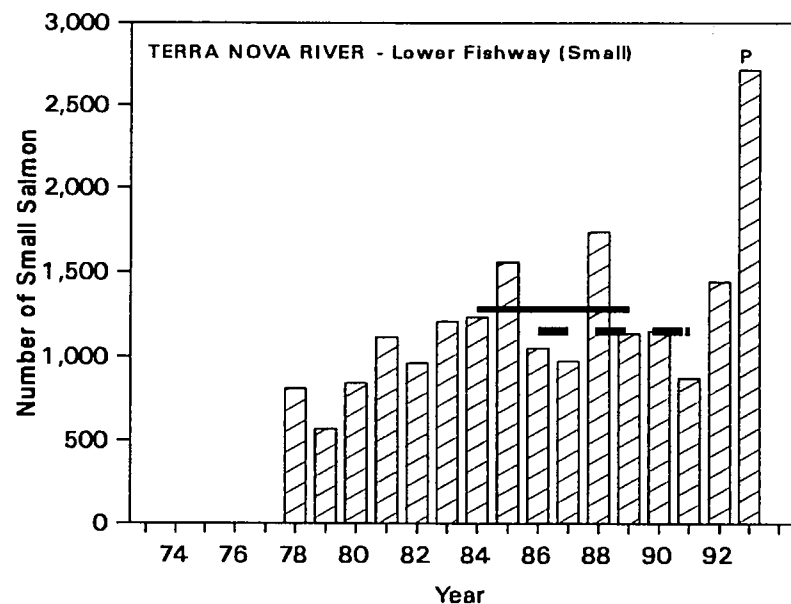


Fig. 5. Counts of small and large salmon at the lower Terra Nova River fishway and Middle Brook fishway, 1974-93. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count, not included in means.

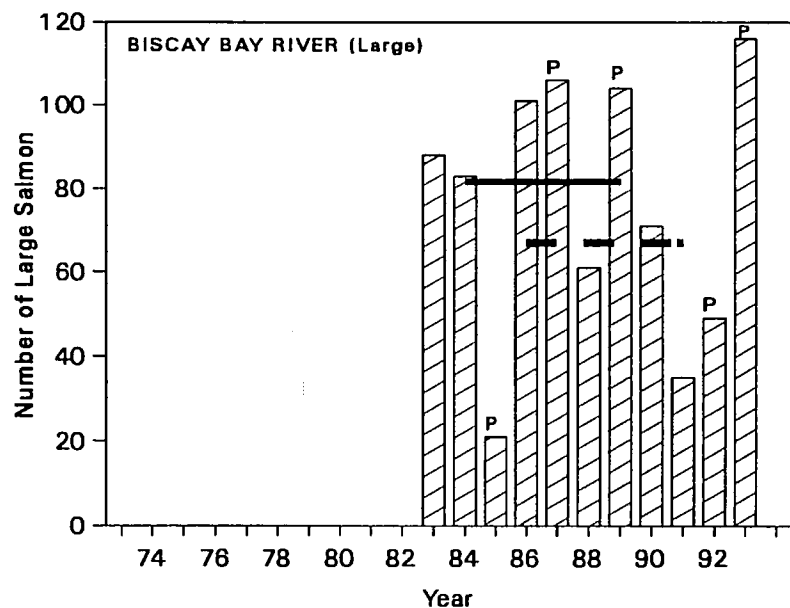
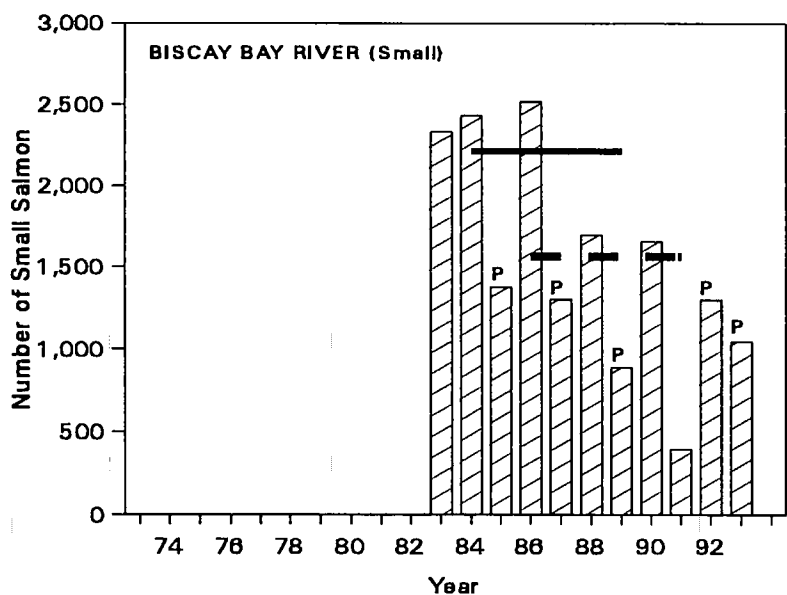
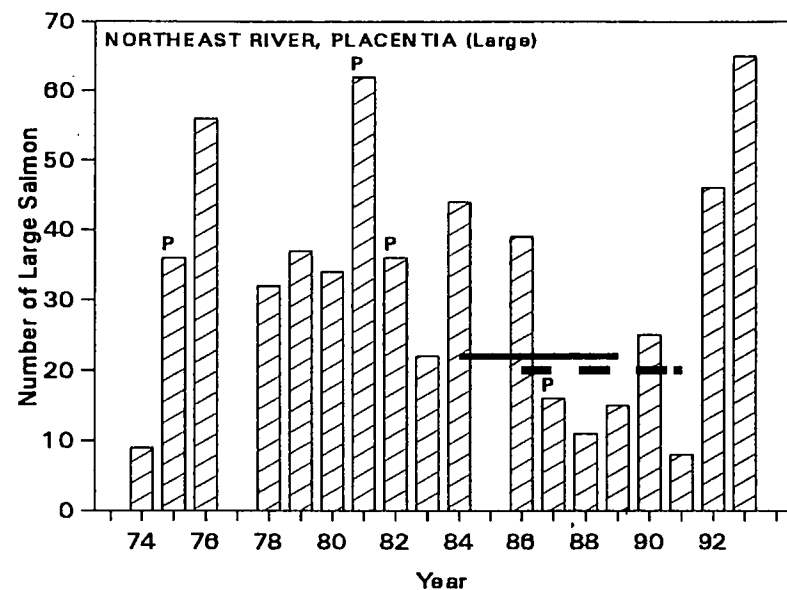
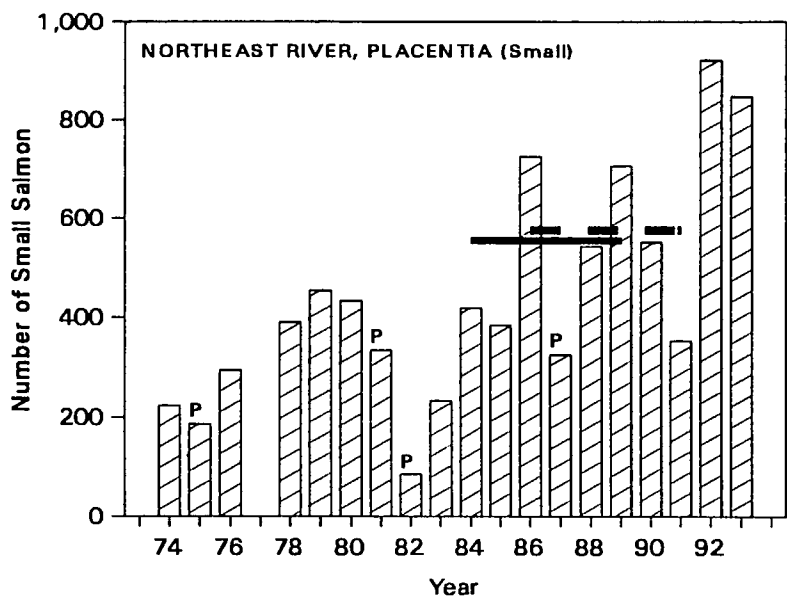


Fig. 6. Counts of small and large salmon at the Northeast River fishway and the Biscay Bay River counting fence, 1974-93. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count, not included in means.



Appendix 1. Atlantic salmon recreational fishery catch and effort data for Middle Brook, Bonavista Bay (SFA 5), 1974-93. Ret. = retained fish; Rel. = released fish.

YEAR	EFFORT ROD DAYS	SMALL (<63CM)			LARGE (>63CM)			TOTAL (SMALL+LARGE)			CPUE
		RET.	REL.	TOT.	RET.	REL.	TOT.	RET.	REL.	TOT.	
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	0	423	17	440	0.28
1993	1327	299	387	686	0	37	37	299	424	723	0.54
MEANS, 95% CONFIDENCE LIMITS, N'S:											
84-89	1919.0	522.0	.	522.0	0.0	.	0.0	522.0	.	522.0	0.27
95%CL	988.7	308.0	.	308.0	.	.	.	308.0	.	308.0	0.15
N	5	5	0	5	1	0	1	5	0	5	5
86-91	1283.2	457.8	.	457.8	.	.	.	457.8	.	457.8	0.36
95%CL	809.3	341.3	.	341.3	.	.	.	341.3	.	341.3	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 2. Atlantic salmon recreational fishery catch and effort data for Terra Nova River (Maccles Brook included), Bonavista Bay (SFA 5), 1974-93. Ret. = retained fish; Rel. = released fish.

YEAR	EFFORT ROD DAYS	SMALL (<63CM)			LARGE (>63CM)			TOTAL (SMALL+LARGE)			CPUE
		RET.	REL.	TOT.	RET.	REL.	TOT.	RET.	REL.	TOT.	
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	0	409	141	550	0.22
1993	3925	484	569	1053	0	62	62	484	631	1115	0.28
MEANS, 95% CONFIDENCE LIMITS, N'S:											
84-89	1779.2	609.2	.	609.2	0.0	.	0.0	609.2	.	609.2	0.34
95%CL	285.9	186.1	.	186.1	.	.	.	186.1	.	186.1	0.13
N	5	5	0	5	1	0	1	5	0	5	5
86-91	1782.0	546.2	.	546.2	.	.	.	546.2	.	546.2	0.31
95%CL	338.3	170.5	.	170.5	.	.	.	170.5	.	170.5	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 3. Atlantic salmon recreational fishery catch and effort data for Biscay Bay River, St. Mary's Bay (SFA 9), 1974-93. Ret. = retained fish; Rel. = released fish.

YEAR	EFFORT ROD DAYS	SMALL (<63CM)			LARGE (>63CM)			TOTAL (SMALL+LARGE)			CPUE
		RET.	REL.	TOT.	RET.	REL.	TOT.	RET.	REL.	TOT.	
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	0	75	63	138	0.14
1993	1593	299	38	337	0	0	0	299	38	337	0.21
MEANS, 95% CONFIDENCE LIMITS, N'S:											
84-89	1069.2	291.2	.	291.2	0.0	.	0.0	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	1	0	1	5	0	5	5
86-91	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

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 Northeast River, Placentia Bay (SFA 9), 1974-93. Ret. = retained fish; Rel. = released fish.

YEAR	EFFORT ROD DAYS	SMALL (<63CM)			LARGE (>63CM)			TOTAL (SMALL+LARGE)			CPUE
		RET.	REL.	TOT.	RET.	REL.	TOT.	RET.	REL.	TOT.	
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	0	37	189	226	0.47
1993	592	132	61	193	0	0	0	132	61	193	0.33
MEANS, 95% CONFIDENCE LIMITS, N'S:											
84-89	950.0	174.6	.	174.6	0.0	.	0.0	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	1	0	1	5	0	5	5
86-91	685.0	164.4	.	164.4	.	.	.	164.4	.	164.4	0.24
95%CL	372.5	105.0	.	105.0	.	.	.	105.0	.	105.0	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.