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Status of Atlantic Salmon (Salmo salar L.) in Selected Rivers With Counting Facilities in the Newfoundland Region, 1992

by

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Abstract

The status of Atlantic salmon was determined for the period 1984-92 in selected rivers with counting facilities in the Newfoundland Region. The rivers were 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 major management changes which were introduced in 1992. Specifically, there was a moratorium on the commercial Atlantic salmon fishery and a quota was placed on the recreational catch in each SFA. Target spawning requirement was exceeded in all rivers except Terra Nova River.

Résumé

On a déterminé l'état des stocks de saumon de l'Atlantique pour la période 1984-1992 dans certaines rivières de la région de Terre-Neuve dotées d'installations de dénombrement, en l'occurrence le ruisseau Middle et la rivière Terra Nova (ZPS 5), la rivière Biscay (ZPS 9) et la rivière Northeast (ZPS 10). Ces évaluations faisaient suite à d'importantes modifications apportées au régime de gestion en 1992, plus précisément à l'adoption d'un moratoire sur la pêche commerciale du saumon de l'Atlantique dans l'île de Terre-Neuve et à l'établissement d'un quota de prises sportives dans chaque zone de pêche du saumon. Les échappées de reproducteurs se sont révélées partout supérieures aux besoins-cibles, sauf dans la rivière Terra Nova.

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 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 recreational fishery in each SFA closed to the retention of grilse when the quota was caught and from that point until the closure of the angling season, hook and release fishing only was permitted.

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 relation to the 1992 management measures. The location of the SFA in which each river is found is shown in Fig. 1. Counts of grilse 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 adult Atlantic salmon < 63 cm in length (grilse) are presented in Tables 1 (Middle Brook and Terra Nova River) and 2 (Biscay Bay River and Northeast River). In 1992, for Middle Brook, new female mean weight (1.70 kg, SD = 0.37, N = 46) and proportion of female (0.82, N = 46) values were used instead of the values presented in Table 1. 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 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. Relative fecundity values used to calculate egg depositions for both grilse and large salmon for each river 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 grilse 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:

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

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.

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 (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^2) (Elson 1975); the requirement for lacustrine habitat was 368 eggs/ha (O'Connell et al. 1991). Spawning requirements were calculated in terms of grilse 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. These figures represent retained fish for the entire angling season for all years prior to 1992. As stated earlier, the recreational fishery for the retention of grisle in 1992 closed when the quota for each SFA was caught. The closure dates were as follows: Middle Brook and Terra Nova River - July 19; Biscay Bay River - July 13; Northeast River - July 4. Quotas (number of grilse) for the SFAs involved were: SFA 5 - 2000; SFA 9 - 600; SFA 10 - 200. The values in Appendices 1-4 labelled "After Quota" are estimates of the number of fish hooked and released **after** the quota for each SFA was caught.

Counts at Counting Facilities

Counts of grilse and large salmon at the Middle Brook and lower Terra Nova River fishways for the period 1974-92 are shown in Table 5 and Fig. 2. The 1992 grilse count in Middle Brook increased over 1991 (110%) and the 1984-89 (29%) and 1986-91 (57%)

means. For Terra Nova River, the count of grilse in 1992 also increased over 1991 (65%) and each mean (12% and 25%, respectively). The count of large salmon in Middle Brook increased by 207% over 1991 and by 71% and 174% over the 1984-89 and 1986-91 means, respectively. For Terra Nova River, large the salmon count increased by 137% over 1991, 112% over the 1984-89 mean, and 102% over the 1986-91 mean.

Counts of grilse and large salmon for the Biscay Bay River counting fence and the Northeast River fishway are presented in Table 6 and Fig. 3. The count of grilse in Northeast River in 1992 increased over 1991 (161%), and the 1984-89 (66%) and 1986-91 (60%) means. In Biscay Bay River, the count of grilse increased over 1991 (229%) but decreased from the means (41% and 17%, respectively). The count of large salmon in Northeast River in 1992 increased over 1991 and the means (475%, 111%, and 135%, respectively); in Biscay Bay River, there was an increase over 1991 (40%) but a decrease from the means (40% and 27%, respectively). It should be noted that the counts of grilse and large salmon for Biscay Bay River are partial due to a counting fence washout in early July.

Total River Returns, Spawning Escapement, and Percentage of Target Achieved

Total river returns and spawning escapements of grilse 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 1992 was in excess of requirement (239%) while for Terra Nova River it was 29%. Target requirement was exceeded in Biscay Bay River (118%) and Northeast River (440%) (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 evaaluations 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.

While escapements of grilse in 1992 improved over 1991 (among the lowest in recent years) in all rivers, with the exception of

Northeast River, they were not the highest recorded (Tables 7 and 8, Figs. 2 and 3). Smolt-to-adult survival back to the river in 1992 for Northeast Brook, Trepassey (SFA 9) and Conne River (SFA 11) was lower than for pre-salmon moratorium years (O'Connell et al. 1993), suggesting heavy natural mortality occurred at sea. Environmental conditions at sea in the spring and early summer of 1991 were the worst on record (Narayanan et al. 1993) which suggests that severe mortality could have occurred at the smolt/post-smolt stage.

Except for Terra Nova River, escapements of large salmon were also higher in the past than in 1992 (Tables 7 and 8, Figs. 2 and 3). Most fish classified as large salmon in the above rivers are are repeat (successive) spawning grilse. The low escapements of virgin grilse in 1991 could have contributed to the low returns of large salmon in 1992, offsetting potential gains resulting from the fishery closures.

The average proportion of total recreational catch represented by the number of retained fish taken up to the time the quota was reached in each river, for the period 1984-91, was as follows: Middle Brook = 0.50; Terra Nova River = 0.42; Biscay Bay River = 0.60; Northeast River = 0.38. Had angling occurred over the entire season in 1992, spawning escapements could have been diminished accordingly.

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 (1991) 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 (1991). 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.

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Table 1. Biological characteristic data for Atlantic salmon < 63 cm in length for Middle Brook and Terra Nova River, Bonavista Bay (SFA 5) and for salmon ≥ 63 cm in length for Gander River (SFA 4) and Terra Nova River, Newfoundland.

	Fork length of Females (cm)				Weight of Females (kg)				River Age (y)				Sex Ratio	
River	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	$\bar{X}$	SD	Range	N	% Female
Grilse														
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	3-4	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	3-6	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	2-5	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	3-5	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	3-4	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	2-6	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	3-5	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	3-5	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	3-6	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	3-6	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	2-5	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	2-6	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 Atlantic salmon < 63 cm in length for Biscay Bay River, St. Mary's Bay (SFA 9) and Northeast River, Placentia Bay (SFA 10), Newfoundland.

	Fork length of Females (cm)				Weight of Females (kg)				River Age (y)				Sex Ratio	
River	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	3.10	0.59	2-5	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	2-4	63	94
1979	-	-	-	-	12	1.43	0.24	0.91-1.82	12	2.58	0.51	2-3	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	2-3	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	2-4	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	2-4	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	2-3	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	2-4	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	2-4	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	2-4	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	2-4	424	91

Table 3. Relative fecundity values used to calculate egg depositions for each river.

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, Placentia		2267	106

Table 4. Atlantic salmon target spawning requirements for each river in terms of eggs and grilse.

River	Target spawning requirement	
	Eggs (No. x 10^6)	Grilse (No.)
SFA 5		
Middle Brook	2.342	1012
Terra Nova River[1]	14.303	7094
SFA 9		
Biscay Bay River	2.951	1134
SFA 10		
Northeast River, Placentia	0.719	224

[1]Calculations are for the area above the lower fishway, including the area above Mollyguajeck Falls.

Table 5. Counts of Atlantic salmon at Middle Brook (1974-92) and lower Terra Nova River (1978-92) fishways, Bonavista Bay (SFA 5).

Year	Middle Brook		Terra Nova River	
	Grilse	Large salmon	Grilse	Large salmon
1974	770[1]	77[1]		
1975	1119[1]	9[1]		
1976				
1977				
1978	1403	16	810	20
1979	1350[1]	54[1]	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	1168	43	1443	270
1984-89				
Mean	916.8	25.2	1281.7	127.2
95% LCL	610.4	8.1	965.5	75.1
UCL	1223.2	42.3	1597.9	179.3
N	6	6	6	6
1986-91				
Mean	754.2	15.7	1153.7	133.7
95% LCL	539.7	13.0	833.8	114.1
UCL	968.7	18.4	1473.6	153.3
N	6	6	6	6

[1]Partial count: not included in mean.

Table 6. Counts of Atlantic salmon at the Biscay Bay River counting fence, St. Mary's Bay (SFA 9), 1983-92, and the Northeast River fishway, Placentia Bay (SFA 10), 1974-92.

Year	Biscay Bay River		Northeast River	
	Grilse	Large salmon	Grilse	Large salmon
1974			223	9
1975			186[1]	36[1]
1976			294	56
1977				
1978			390	32
1979			454	37
1980			433	34
1981			334[1]	62[1]
1982			86[1]	36[1]
1983	2330	88	233	22
1984	2430	83	419	44
1985	1377[1]	21[1]	384	0
1986	2516	101	725	39
1987	1302[1]	106[1]	325[1]	16[1]
1988	1695	58	543	11
1989	889[1]	104[1]	706	15
1990	1657	73	551	25
1991	394	35	353	8
1992	1298[1]	49[1]	921	46

[1]Partial count: not included in mean.

1984-89				
Mean	2213.7	81.7	555.4	21.8
95% LCL	1092.8	32.0	359.5	-1.7
UCL	3334.6	131.4	751.3	45.3
N	3	3	5	5
1986-91				
Mean	1565.5	67.0	575.6	19.6
95% LCL	172.1	23.6	388.9	4.0
UCL	2958.9	110.4	762.3	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), 1984-1992.

Year	Total returns G	Total returns LS	Spawning escapement G	Spawning escapement LS	(No. x 10^6) G	(No. x 10^6) LS	% Target achieved
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	2.505	239
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

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), 1984-1992.

Year	Total returns G	Total returns LS	Spawning escapement G	Spawning escapement LS	Egg deposition (No. x 10^6) G	Egg deposition (No. x 10^6) LS	% Target achieved
SFA 9							
Biscay Bay River							
1984	2430	83	2108	83	5.487	0.373	199
1985[1]	1638	21	1109	21	2.887	0.094	101
1986	2688	101	2184	101	5.685	0.454	208
1987[1]	1393	106	1171	106	3.048	0.476	119
1988	1802	61	1333	61	3.470	0.274	127
1989[1]	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[1]	1323	49	1249	49	3.251	0.220	118
SFA 10							
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[1]	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

[1]Based on incomplete count.

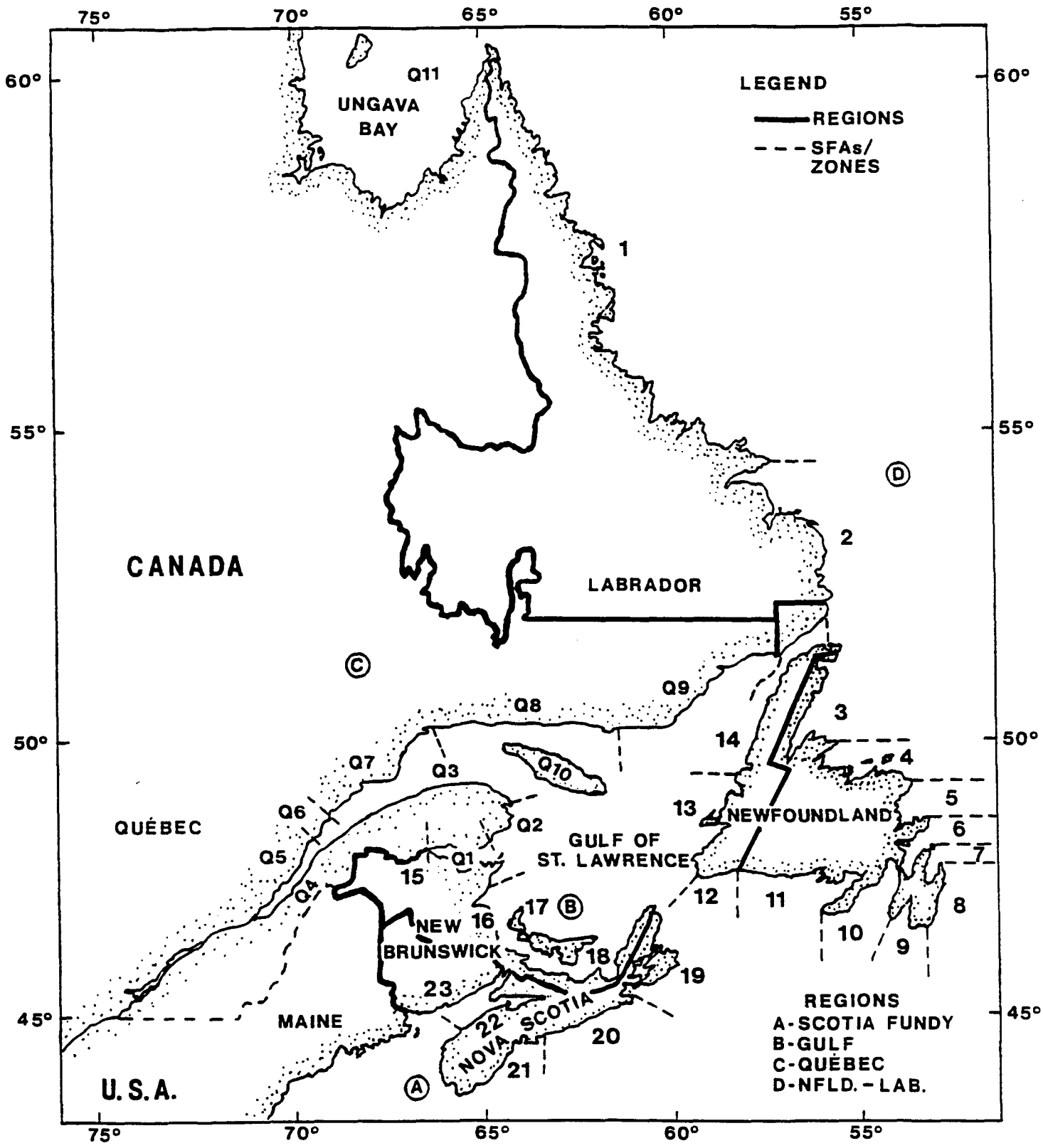

Fig. 1. Map of Atlantic Provinces of Canada showing Salmon Fishing Areas (SFAs) 1-23, Salmon Management Zones of Quebec (Qs) 1-11, and regional boundaries. The Newfoundland Region is comprised of SFAs 1-11.

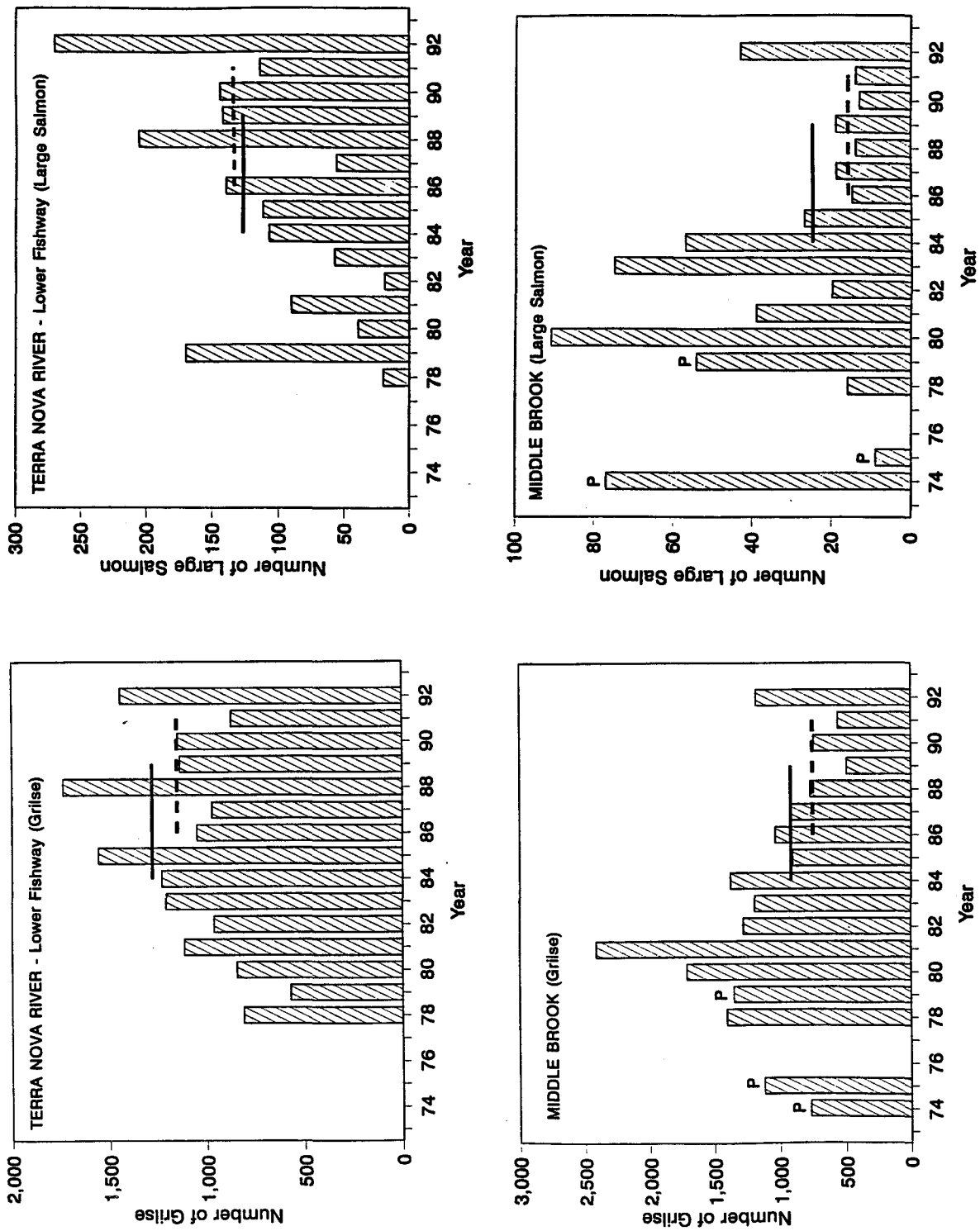

Fig. 2. Counts of grilse and large salmon at the Lower Terra Nova River fishway and Middle Brook fishway, 1974-92. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count.

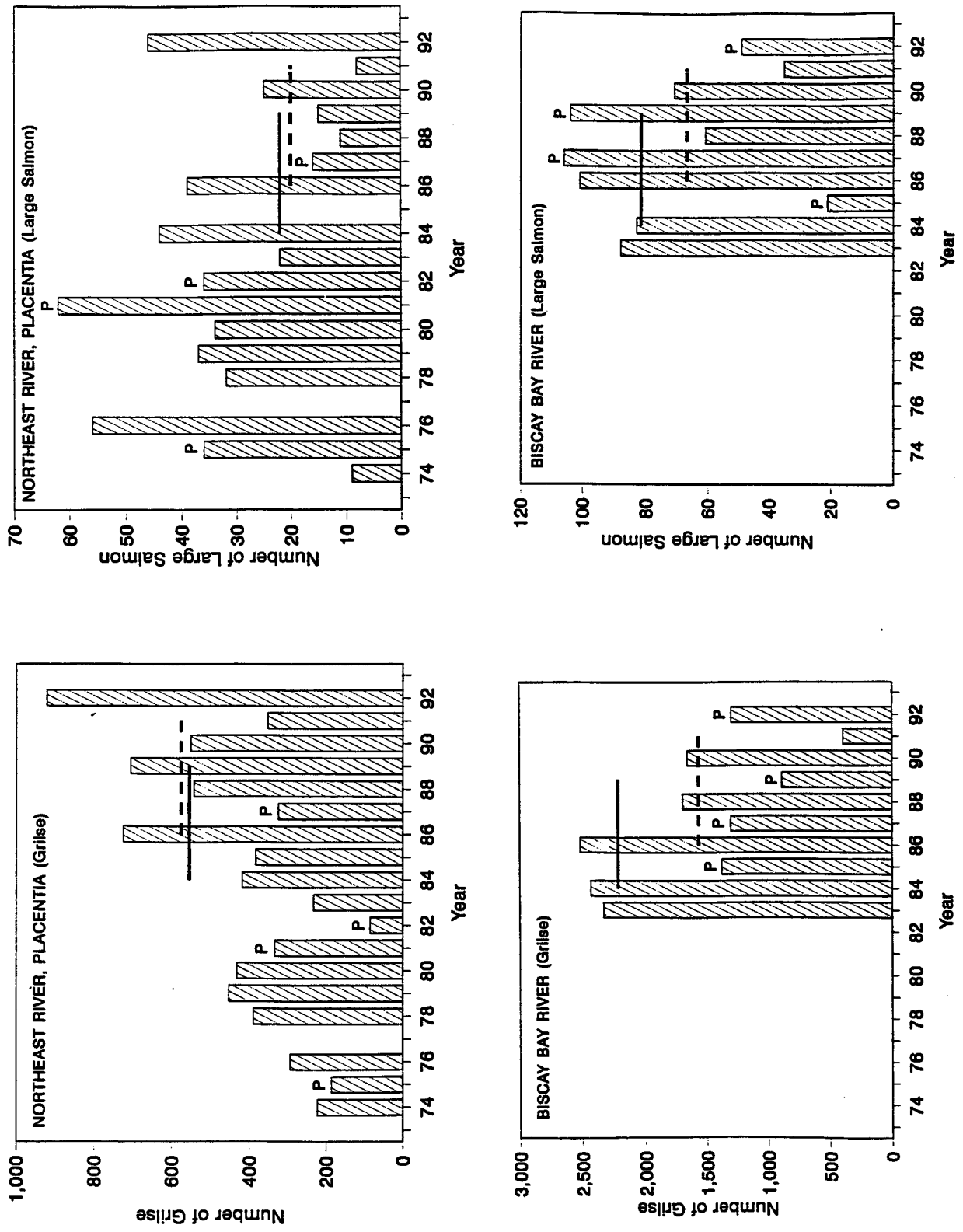

Fig. 3. Counts of grilse and large salmon at the Northeast River fishway and the Biscay Bay River counting fence, 1974-92. The solid horizontal line represents the 1984-89 mean and the broken line the 1986-91 mean. P = partial count.

Appendix 1. Atlantic salmon recreational fishery catch and effort data for Middle Brook, Bonavista Bay (SFA 5), Newfoundland, 1953-1992.

RIVER: MIDDLE BROOK (GAMBO) CODE: 11097600

YEAR	EFFORT ROD DAYS	GRILSE <63 CM	SALMON ≥63 CM	TOTAL CATCH	CPUE	PERCENT GRILSE
1953	710	116	0	116	0.16	.
1954	360	57	0	57	0.16	100
1955	134	29	1	30	0.22	98
1956	923	95	7	102	0.11	81
1957	289	144	0	144	0.50	100
1958	459	172	2	174	0.38	99
1959	427	160	4	164	0.38	98
1960	334	58	0	58	0.17	100
1961	208	30	2	32	0.15	97
1962	459	174	0	174	0.38	100
1963	638	350	0	350	0.55	100
1964	1266	570	0	570	0.45	100
1965	1568	454	2	456	0.29	100
1966	1627	272	0	272	0.17	100
1967	965	217	0	217	0.22	100
1968	2014	374	0	374	0.19	100
1969	1704	389	2	391	0.23	99
1970	1111	323	2	325	0.29	99
1971	662	185	0	185	0.28	100
1972	287	224	0	224	0.78	100
1973	213	283	0	283	1.33	100
1974	1823	277	11	288	0.16	96
1975	1635	415	8	423	0.26	97
1976	1339	280	2	282	0.21	100
1977	1511	767	3	770	0.51	99
1978	1322	391	1	392	0.30	100
1979	211	28	0	28	0.13	100
1980	1358	542	2	544	0.40	93
1981	1574	587	0	587	0.37	100
1982	2481	504	8	512	0.21	99
1983	1505	372	20	392	0.26	96
1984	2712	410	0	410	0.15	100
1985	2319	538	*	538	0.23	100
1986	2307	789	*	789	0.34	100
1987	840	187	*	187	0.22	100
1988	1545	708	*	708	0.46	100
1989	712	165	*	165	0.23	100
1990	949	349	*	349	0.37	100
1991	903	278	*	278	0.31	100
1992	1121	423	*	423	0.38	100
(AFTER QUOTA)		17	*	17		
MEANS, 95% CONFIDENCE LIMITS, N'S:						
84-89	1919.0	522.0	0.0	522.0	0.27	100
$\bar{X}\pm$95%CL	±988.7	±308.0	.	±308.0	±0.15	±0.00
N	5	5	1	5	5	5
86-91	1283.2	457.8	.	457.8	0.36	100
$\bar{X}\pm$95%CL	±809.3	±341.3	.	±341.3	±0.09	±0.00
N	5	5	.	5	5	5

1987 DATA NOT INCLUDED IN MEAN.
PERCENT GRILSE IS CALCULATED BY SMOLT CLASS.
IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
* 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), Newfoundland, 1953-1992.

RIVER: TERRA NOVA RIVER CODE: 11102200

YEAR	EFFORT ROD DAYS	GRILSE <63 CM	SALMON ≥63 CM	TOTAL CATCH	CPUE	PERCENT GRILSE
1953	1706	151	13	164	0.10	.
1954	1003	72	13	85	0.08	92
1955	335	178	16	194	0.58	82
1956	2685	198	18	216	0.08	91
1957	569	73	3	76	0.13	99
1958	590	123	12	135	0.23	86
1959	959	120	20	140	0.15	86
1960	463	157	8	165	0.36	94
1961	623	117	14	131	0.21	92
1962	777	254	25	279	0.36	82
1963	1160	274	29	303	0.26	90
1964	699	334	5	339	0.48	98
1965	787	327	10	337	0.43	97
1966	117	224	2	226	1.93	99
1967	557	337	2	339	0.61	99
1968	143	319	12	331	2.31	97
1969	1477	523	0	523	0.35	100
1970	285	443	18	461	1.62	97
1971	1458	402	11	413	0.28	98
1972	456	467	11	478	1.05	97
1973	1044	334	1	335	0.32	100
1974	2098	243	5	248	0.12	99
1975	1723	506	2	508	0.29	99
1976	1236	424	7	431	0.35	99
1977	1956	850	13	863	0.44	97
1978	1608	628	6	634	0.39	99
1979	910	537	15	552	0.61	98
1980	872	512	22	534	0.61	96
1981	1303	739	33	772	0.59	94
1982	1174	465	24	489	0.42	97
1983	2157	486	43	529	0.25	92
1984	2042	636	0	636	0.31	100
1985	1810	751	*	751	0.41	100
1986	1485	620	*	620	0.42	100
1987	1764	546	*	546	0.31	100
1988	1613	682	*	682	0.42	100
1989	1946	357	*	357	0.18	100
1990	2165	624	*	624	0.29	100
1991	1701	448	*	448	0.26	100
1992	1360	409	*	409	0.30	100
(AFTER QUOTA)		141	*	141		
MEANS, 95% CONFIDENCE LIMITS, N'S:						
84-89	1779.2	609.2	0.0	609.2	0.34	100
$\bar{X}\pm$95%CL	±285.9	±186.1	.	±186.1	±0.13	±0.00
N	5	5	1	5	5	5
86-91	1782.0	546.2	.	546.2	0.31	100
$\bar{X}\pm$95%CL	±338.3	±170.5	.	±170.5	±0.12	±0.00
N	5	5	.	5	5	5

1987 DATA NOT INCLUDED IN MEAN.
PERCENT GRILSE IS CALCULATED BY SMOLT CLASS.
IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
* 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), Newfoundland, 1953-1992.

RIVER: BISCAY BAY RIVER CODE: 27002300

YEAR	EFFORT ROD DAYS	GRILSE <63 CM	SALMON ≥63 CM	TOTAL CATCH	CPUE	PERCENT GRILSE
1953	124	82	3	85	0.69	.
1954	47	19	0	19	0.40	100
1955	113	36	2	38	0.34	90
1956	338	105	1	106	0.31	97
1957	219	165	0	165	0.75	100
1958	486	195	6	201	0.41	96
1959	551	415	6	421	0.76	97
1960	959	295	9	304	0.32	98
1961	585	174	0	174	0.30	100
1962	659	193	0	193	0.29	100
1963	663	320	20	340	0.51	91
1964	1522	151	1	152	0.10	100
1965	1272	346	25	371	0.29	86
1966	715	123	0	123	0.17	100
1967	3239	206	7	213	0.07	95
1968	798	141	0	141	0.18	100
1969	1326	148	0	148	0.11	100
1970	960	149	0	149	0.16	100
1971	743	217	4	221	0.30	97
1972	564	66	0	66	0.12	100
1973	880	190	0	190	0.22	100
1974	1043	71	1	72	0.07	99
1975	1553	108	0	108	0.07	100
1976	1074	168	0	168	0.16	100
1977	1607	144	0	144	0.09	100
1978	1790	121	5	126	0.07	97
1979	612	186	5	191	0.31	96
1980	392	283	32	315	0.80	85
1981	1181	424	31	455	0.39	90
1982	1044	367	9	376	0.36	98
1983	1064	414	10	424	0.40	97
1984	915	322	0	322	0.35	100
1985	1121	290	*	290	0.26	100
1986	1124	393	*	393	0.35	100
1987	1062	101	*	101	0.10	100
1988	1221	349	*	349	0.29	100
1989	965	102	*	102	0.11	100
1990	1165	232	*	232	0.20	100
1991	1134	10	*	10	0.01	100
1992	769	75	*	75	0.10	100
(AFTER QUOTA)		63	*	63		
MEANS, 95% CONFIDENCE LIMITS, N'S:						
84-89	1069.2	291.2	0.0	291.2	0.27	100
$\bar{X}\pm$95%CL	±156.3	±139.4	.	±139.4	±0.11	±0.00
N	5	5	1	5	5	5
86-91	1121.8	217.2	.	217.2	0.19	100
$\bar{X}\pm$95%CL	±118.5	±200.9	.	±200.9	±0.17	±0.00
N	5	5	.	5	5	5

1987 DATA NOT INCLUDED IN MEAN.
PERCENT GRILSE IS CALCULATED BY SMOLT CLASS.
IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
* 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 10), Newfoundland, 1953-1992.

RIVER: NORTH EAST RIVER (PLACENTIA) CODE: 29030700

YEAR	EFFORT ROD DAYS	GRILSE <63 CM	SALMON ≥63 CM	TOTAL CATCH	CPUE	PERCENT GRILSE
1953	219	24	3	27	0.12	.
1954	137	28	8	36	0.26	75
1955	153	61	5	66	0.43	85
1956	392	83	0	83	0.21	100
1957	649	196	2	198	0.31	98
1958	175	79	14	93	0.53	93
1959	292	118	0	118	0.40	100
1960	399	80	0	80	0.20	100
1961	310	54	0	54	0.17	100
1962	1135	46	0	46	0.04	100
1963	340	61	0	61	0.18	100
1964	345	66	5	71	0.21	92
1965	296	38	0	38	0.13	100
1966	282	163	0	163	0.58	100
1967	504	62	3	65	0.13	98
1968	1467	125	0	125	0.09	100
1969	130	66	2	68	0.52	98
1970	111	77	3	80	0.72	96
1971	740	148	4	152	0.21	95
1972	588	49	0	49	0.08	100
1973	1720	238	0	238	0.14	100
1974	1721	142	0	142	0.08	100
1975	877	121	4	125	0.14	97
1976	1164	147	1	148	0.13	99
1977	1465	180	1	181	0.12	99
1978	1237	161	0	161	0.13	100
1979	969	138	0	138	0.14	100
1980	1612	246	6	252	0.16	96
1981	2339	349	0	349	0.15	100
1982	1303	150	0	150	0.12	100
1983	2037	165	0	165	0.08	100
1984	988	70	0	70	0.07	100
1985	1276	173	*	173	0.14	100
1986	862	234	*	234	0.27	100
1987	349	36	*	36	0.10	100
1988	772	186	*	186	0.24	100
1989	852	210	*	210	0.25	100
1990	786	173	*	173	0.22	100
1991	153	19	*	19	0.12	100
1992	186	37	*	37	0.20	100
(AFTER QUOTA)		189	*	189		
MEANS, 95% CONFIDENCE LIMITS, N'S:						
84-89	950.0	174.6	0.0	174.6	0.18	100
$\bar{X}\pm$95%CL	±245.8	±78.2	.	±78.2	±0.11	±0.00
N	5	5	1	5	5	5
86-91	685.0	164.4	.	164.4	0.24	100
$\bar{X}\pm$95%CL	±372.5	±105.0	.	±105.0	±0.03	±0.00
N	5	5	.	5	5	5

1987 DATA NOT INCLUDED IN MEAN.
PERCENT GRILSE IS CALCULATED BY SMOLT CLASS.
IN THE ABOVE TABLE A PERIOD INDICATES NO DATA FOR THAT YEAR.
* NOT ALLOWED TO RETAIN LARGE SALMON IN INSULAR NEWFOUNDLAND.