Canadian Atlantic Fisheries
Scientific Advisory Committee

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CAFSAC Research Document 83/88

CSCPSA Document de recherche 83/88

Biological Assessment of Atlantic Salmon in the Restigouche River, 1983

by

R.G. Randall and P.R. Pickard

Department of Fisheries and Oceans
Gulf Region
Fisheries Research Branch
P.O. Box 5030
Moncton, N.B.
E1C 9B6

ABSTRACT

Approximately 7,800 salmon and 2,600 grilse were landed in the commercial, recreational and Native fisheries of the Restigouche River in 1983. Salmon landings in 1983 were similar to 1982 but grilse catches were only 50% of the 1982 landings. Spawning escapement was estimated to be only 10 to 50% of the spawning levels required for adequate recruitment. Low grilse returns in 1983 indicate salmon returns in 1984 will be critically low. Spawning requirements will probably not be met, even without homewater fishing mortality.

RESUME

Près de 7 800 saumons et 2 600 castillons ont été capturés par les pêcheurs commerciaux, sportifs et autochtones dans la rivière Restigouche en 1983. Les déberquements de saumons en 1983 sont sensiblement les mêmes qu'en 1982, mais les prises de castillons n'ont atteint que 50 % des prises de 1982. Le nombre estimé de géniteurs ayant échappé aux pêcheurs ne représente que de 10 à 50 % du nombre requis pour un frai convenable. Les faibles retours de castillons en 1983 signifient que les retours de saumons en 1984 seront extrêmement bas. Le nombre de géniteurs ne sera probablement pas suffisant, même si on ne tient pas compte de la mortalité due à la pêche dans les eaux d'origine.

INTRODUCTION

Poor salmon catches throughout Maritime Canada, including on the Restigouche River, prompted the Department of Fisheries and Oceans to form an Atlantic Salmon Task Group in fall of 1983. Randall (unpublished) prepared a preliminary assessment of Restigouche salmon at the request of this Task Group. This report is an update of that assessment, and it includes more recent and more complete catch data. Spawning escapement is estimated for 1983 and compared to required spawning levels. A forecast of potential salmon returns in 1984 is also given.

Restigouche salmon are exploited by three fisheries: commercial trap nets, anglers, and a Native fishery at Cross Point, Québec. As in 1982, there were restrictions on all three fisheries in 1983. Commercial fishermen were restricted by quota (4000 salmon and 4000 grilse) and by season (15 June to 31 July in New Brunswick and 15 June to 8 July in Québec). Anglers were restricted to a 10 week season (15 June to 31 August) and a seasonal bag limit of 5 salmon and 5 grilse. The Native fishery was regulated by a 16,300 kg quota. Preliminary landings from all fisheries in 1983 are summarized and compared to historic catches.

METHODS

a) Salmon landings

Commercial salmon landings were summarized from logbooks submitted weekly by the fishermen. Québec commercial data were collected by the Ministère du Loiser, de la Chasse et de la Pêche and New Brunswick data were collected by the Department of Fisheries and Oceans. Angling catches from the Québec and New Brunswick portions of the Restigouche were collected by the same two agencies. Crown reserve angling data from New Brunswick were provided by the New Brunswick Department of Natural Resources.

Native Fishery landings were reported by the Restigouche Band Council Office at Cross Point, Québec. Total reported landings (in kilograms) were divided into salmon and grilse portions based on the 1982 salmon to grilse ratio at Cross Point.

Landings of salmon in the three fisheries were compared to counts of salmon and grilse at a fish barrier on the Upsalquitch River. This barrier has been operated by the Department of Natural Resources since 1980.

Ages and sizes of salmon were determined from samples taken in the commercial and recreational fisheries. About 450 salmon were aged to identify the year-classes contributing to the 1983 salmon run.

b) Egg Depostion Requirements

Spawning requirements for the Restigouche River were calculated using fecundity data collected in 1983. The methodology used for estimating spawning requirements is described in detail by Randall (in preparation).

c) Spawning escapement in 1983

Two methods were used to estimate Restigouche spawning escapement in 1983 (both methods are described in detail by Chadwick and Randall 1983):

Method 1. An angler exploitation rate of 0.204 was used. This was based on two years of tagging data at the Dalhousie trap (1972 and 1973). The operation of the Dalhousie trap is described by Peppar (1983).

Method 2. A ratio of spawner per angled fish of 0.6050 was used. This ratio was recalculated from the 1982 value (Chadwick and Randall 1983; Table 3) using a new fecundity of 1475 eggs kg^{-1} (Randall in preparation). Spawners were back-calculated from 1+ parr densities (assuming a 10% survival rate) for the period 1972 to 1980.

For both methods, losses due to poaching and disease were assumed to be 2000 salmon and 1000 grilse.

d) Predicting 1984 Returns

Angling catches of salmon in 1984 were predicted from a multiple regression between numbers and percent female grilse at the Millbank salmon trap on the Miramichi River and salmon catches in the Restigouche one year later (Chadwick and Randall 1983). The use of these two variables to predict salmon returns is discussed by Marshall et al. 1982. Justification for using Miramichi grilse to predict salmon returns to the Restigouche comes from observations that both juvenile salmon densities and angling catches of salmon are significatly correlated between the two rivers, indicating that the two populations are fluctuating in phase (Appendix 1).

Total salmon returns in 1984 were estimated using the projected 1984 angler catch and the two methods described above. Method 1 uses the angling exploitation rate of 0.204 and Method 2 uses a spawner/angled salmon ratio of 0.6050. Losses to disease and poaching were assumed to be 2000 salmon, and removals by fisheries were assumed to be the same proportion of river escapement as in 1983.

RESULTS

a) 1983 landings

Total commercial landings in 1983 were 4,070 salmon and 1,551 grilse (Table 1). The quota of 4,000 salmon was therefore reached, but the quota for grilse (4,000) was not. Twenty-five and twenty-one fishermen were licensed to fish in New Brunswick and Québec, respectively.

Total angling catches from New Brunswick and Québec sections of the Restigouche were 2,022 salmon and 877 grilse (Table 2).

Preliminary reports from the Native fishery at Cross Point indicated a landing of about 11,300 kg. Based on the salmon to grilse ratio and average weights in the 1982 catch, this indicated a landing of 1,724 salmon and 191 grilse.

Total landings for the Restigouche River in 1983 are 7,816 salmon and 2,619 grilse (Table 3). Salmon landings are comparable to 1982, but grilse catches are down substantially (about 50%), primarily because of poor recreational catches. Total landings in 1983 are less than total landings in 1971 (Table 4; Fig. 1), the year before a commercial ban was placed on the commercial fisheries because of critically low stock levels.

Counts of salmon and grilse at the Upsalquitch fish barrier corrorborate the low returns of salmon and particularly grilse in 1983 compared to previous years (Table 5).

Salmon sampled from the commercial (Fig. 2) and recreational (Fig. 3) fisheries indicate salmon were predominately from the 1977 and 1978 year-classes. Grilse were predominately from the 1979 year-class, but 1980 year-class fish were also important (Fig.2).

b) Spawning requirements

Total salmon required for spawning was calculated to be 12,800 fish (Randall in preparation). An additional 2500 grilse are required to ensure a 1:1 sex ratio for spawning. Total egg deposition requirements are approximately 71,450,000 eggs.

c) Spawning escapement in 1983

Both methods indicate serious spawning deficits of salmon (54 to 90%) in 1983. Method 2 suggests that only 10% of required egg depositions were achieved:

	Method 1		Method 2	
	Salmon	Grilse	Salmon	Grilse
1. Total returns (add 2. to 4. inclusive)	15706	6041	11039	4150
2. Harvest	7816	2619	7816	2619
3. Poaching and disease	2000	1000	2000	1000
4. Spawners	5890	2422	1223	531
5. Target spawners	12800	2500	12800	2500
6. % of target egg deposition achieved	46%	97%	10%	21%

d) Forecast of salmon returns in 1984

Angling catches of salmon in the Restigouche River in 1984 were predicted using the multiple regression (Table 6):

$$\log_e y = 6.5932 + 0.4347 \log_e X_1 - 0.0572 \text{ arcsine } \sqrt{X_2}$$

where: y = predicted salmon catch:
X_1 = catches of grilse at Millbank in year i
X_2 = % female grilse at Millbank in year i
$R^2 = 0.49$ ($p < 0.05$)

Estimated salmon catch in 1984 is 2065 (95% C.L.: 679 - 6286). Total returns are calculated to be:

	Method 1	Method 2
1. River escapement	10,123[a]	3,314[b]
2. Removals by fisheries assuming 1983 catch proportions	5,917	7,982
3. Total returns	16,040	11,296
4. Spawning requirement	12,800	12,800
5. Looses due to poaching and disease	2,000	2,000
6. Balance	+ 1,240	- 3,504

[a] river escapement = (2065/0.204) = 10,123
[b] river escapement = (2065 X 0.6050) + 2065 = 3,314

Both methods predict low salmon returns in 1984, and Method 2 suggests spawning requirements will not be met, even without homewater fisheries.

The above equation for predicting angling catches in the Restigouche should be used with caution because the number of grilse at Millbank in 1983 (810) is outside the range of values used in the regression (Table 6). At present, however, we have no other means of predicting salmon returns in the Restigouche River. Given recent low landings of salmon in the Restigouche compared to historic landings, Method 2 probably gives a more realistic forecast of salmon returns than Method 1 (Chadwick and Randall 1983).

Grilse returns in 1984 are not expected to be greater than in 1983 (about 5,000 fish). Evidence for this is the low densities of small parr in 1981 (Table 7). Grilse available for harvest are not expected to exceed 1500 fish.

DISCUSSION

Total salmon landings from all fisheries in 1983 indicate that Restigouche stocks have remained depressed despite the nine year ban that was placed on the commercial fishery from 1972 to 1980. The success of the 1983 commercial fishery was similar to 1982: although trap net fishermen were able to catch their quota for salmon, they had to fish for the entire season to do so. This suggests Restigouche stocks are low since present quotas for the commercial fishermen are only a fraction of historic commercial landings (Fig. 1). Native fishermen at Cross Point did not obtain their quota again this year. Although recreational angling landings improved somewhat during the commercial ban years (Fig. 1), they declined again in 1982 and 1983; present landings are similar to the pre-ban year. Catches of grilse by anglers were particularly poor in 1983. Spawning escapement in 1983, as estimated by two different methods in this report, was only 10 to 50% of spawning levels required for adequate recruitment.

Extremely low water levels in 1983 might partially explain the poor angling landings, since angling catches in the Restigouche are positively correlated with water levels (Randall, unpublished data). Another factor that may have contributed to low grilse returns in 1983 is age-at-maturity. In the Miramichi River, the majority of the 1979 year-class smoltified at age 2 and therefore returned as age 3 grilse in 1982 (Randall, unpublished data). Because of this, the 1982 grilse run was somewhat inflated while the 1983 run was depressed. The same phenomenon may have affected Restigouche grilse returns. Future stock assessments of both the Restigouche and the Miramichi salmon populations may be improved if the effects of both water levels and age-at-maturity are included in our predictive equations.

Low grilse returns in 1983 suggest that large salmon will be scarce in 1984. Data given in this report indicate spawning requirements will probably not be met in 1984, even if there is no homewater fishing mortality. These results emphasize the critically depressed condition of Restigouche salmon stocks at present.

ACKNOWLEDGEMENTS

We would like to acknowledge M. Redmond and A. Madden, New Brunswick Department of Natural Resources, and G. Ouellet and J.P. LeBel, Ministère du Loisir, de la Chasse et de la Pêche, Québec for providing angling and commercial landings used in this report. A. Madden also provided salmon counts from the Upsalguitch fish barrier. E.M.P. Chadwick and R. Alexander reviewed the manuscript.

REFERENCES

Chadwick, E.M.P. and R.G. Randall. 1983. Assessment of the Restigouche River salmon stock in 1982. CAFSAC Res. Doc. 83/30.

May, A.W. and W.H. Lear. 1971. Digest of Canadian Atlantic salmon catch statistics. Fish. Res. Board Can. Tech. Rept. 270, 106p.

Marshall, T.L., J.L. Peppar and E.J. Schofield. 1982. Prediction of 2-SW and older Atlantic salmon returning to the Millbank trap, Miramichi River, N.B. CAFSAC Res. Doc. 82/51.

Peppar, J.L. 1983. Adult Atlantic salmon (Salmo salar) investigations, Restigouche River system, N.B., 1972-80. Can. MS Rep. Fish. Aquat. Sci. No. 1695, 33p.

Smith, S.J. 1981. Atlantic salmon sport catch and effort data, Maritimes Region, 1951- 1979. Can. Data. Rept. Fish. Aquat. Sci. No. 258, 267p.

Table 1. Commercial salmon trap landings, Restigouche River,1983.

	New Brunswick	Quebec	Total
Landings			
Salmon	2237	1833	4070
Grilse	1474	77	1551
Quota			
Salmon	2400	1600	4000
Grilse	2400	1600	4000
Fishermen			
Numbers	25	21	46
% reporting	100%	Unknown	-
Statistical			
Districts	63,64,65	13,14,15	-

Table 2. Angling statistics for the Restigouche River, 1983.

	Salmon	Grilse	Total	Rod Days
New Brunswick				
Angling camps	1282	461	1743	6711
Crown Reserve	194	251	445	2285
Quebec	546	165	711	6664
Total	2022	877	2899	15660

Data sources: N.B. angling camps from DFO fishery officers; N.B. Crown reserve from Department of Natural Resources; Quebec angling from Ministère du loisir, de la Chasse et de la Pêche. All data are preliminary.

Table 3. Preliminary 1983 landings in the Restigouche River from the commercial, Native and recreational fisheries. 1982 landings are given for comparison.

Fishery	1983		1982	
	Salmon	Grilse	Salmon	Grilse
Commercial traps				
N.B.	2237	1474	2544	2119
P.Q.	1833	77	1892	84
Native (Cross Pt.)	1724	191	1722	168
Recreational	2022	877	2582	2851
Total	7816	2619	8740	5222

Table 4. Commercial and recreational salmon landings from the Restigouche River, 1951 to 1983. Data sources given in Appendix 2.

	COMMERCIAL							RECREATIONAL							
	New Brunswick			Quebec			TOTAL	New Brunswick			Quebec			TOTAL	GRAND
Year	Gr.	Sal.	Total	Gr.	Sal.	Total		Gr.	Sal.	Total	Gr.	Sal.	Total		TOTAL
1951		17.7	17.7		24.7	24.7	42.4			3.5	0.0	0.2	0.2	3.7	46.1
1952		19.2	19.2		20.4	20.4	39.6			5.7	0.1	0.4	0.5	6.2	45.8
1953		16.9	16.9		15.0	15.0	31.9			3.0	0.1	0.1	0.2	3.2	35.1
1954		17.1	17.1		14.2	14.2	31.3			2.9	0.1	0.4	0.5	3.4	34.7
1955		8.2	8.2		10.1	10.1	18.3			2.0	0.1	0.2	0.3	2.3	20.6
1956		7.5	7.5		7.7	7.7	15.2			2.3	0.1	0.2	0.3	2.6	17.8
1957		9.6	9.6		10.3	10.3	19.9			3.4	0.1	0.3	0.4	3.8	23.7
1958		15.4	15.4		11.4	11.4	26.8			9.1	0.2	0.4	0.6	9.7	36.5
1959		16.2	16.2		15.9	15.9	32.1			3.2	0.1	0.2	0.3	3.5	35.6
1960		13.5	13.5		17.1	17.1	30.6			3.0	0.0	0.0	0.0	3.0	33.6
1961		12.1	12.1		9.9	9.9	22.0			3.2	0.0	0.0	0.0	3.2	25.2
1962		16.4	16.4		11.0	11.0	27.4			3.4	0.0	0.0	0.0	3.4	30.8
1963		13.8	13.8		10.3	10.3	24.1			7.4	0.0	0.0	0.0	7.4	31.5
1964		15.9	15.9		12.9	12.9	28.8			6.5			0.4	6.9	35.7
1965		22.8	22.8		16.8	16.8	39.6	3.9	3.0	6.9			0.7	7.6	47.2
1966		17.8	17.8		15.5	15.5	33.3	1.7	1.7	3.4			0.7	4.1	37.4
1967		21.4	21.4		13.3	13.3	34.7	1.1	2.4	3.5			0.8	4.3	39.0
1968		15.7	15.7		11.0	11.0	26.7	0.4	0.6	1.0			0.2	1.2	27.9
1969		10.2	10.2		8.2	8.2	18.4	1.4	1.2	2.6			0.4	3.0	21.4
1970		9.1	9.1		9.1	9.1	18.2	1.4	1.7	3.1	0.2	0.3	0.5	3.6	21.8
1971		3.9	3.9		5.0	5.0	8.9	1.0	0.8	1.8	0.2	0.2	0.4	2.2	11.1
1972	0.1	0.0	0.1	0.0	0.0	0.0	0.1	1.0	3.8	4.8	0.1	1.2	1.3	6.1	6.2
1973	0.7	0.2	0.9	0.6	0.1	0.7	1.6	1.4	3.8	5.2	0.2	1.1	1.3	6.5	8.1
1974	0.0	0.0	0.0	0.1	0.1	0.2	0.2	1.0	4.8	5.8	0.1	1.2	1.3	7.1	7.3
1975	0.2	0.9	1.1	0.0	0.1	0.1	1.2	1.1	2.2	3.3	0.2	0.7	0.9	4.2	5.4
1976	3.7	0.1	3.8	1.4	0.1	1.5	5.3	2.3	4.5	6.8	0.4	1.0	1.4	8.2	13.5
1977	1.1	0.2	1.3	0.0	0.0	0.0	1.3	2.4	5.1	7.5	0.4	1.6	2.0	9.5	10.8
1978	1.5	0.2	1.7	0.0	0.0	0.0	1.7	1.3	3.4	4.7	0.3	1.6	1.9	6.6	8.3
1979	0.1	0.7	0.8	0.0	0.0	0.0	0.8	2.0	1.0	3.0	0.6	0.8	1.4	4.4	5.2
1980	2.0	0.0	2.0	0.0	0.0	0.0	2.0	2.8	4.1	6.9	0.4	2.1	2.5	9.4	11.4
1981	3.1	3.5	6.6	0.0	0.0	0.0	6.6	3.0	2.8	5.8	0.6	1.4	2.0	7.8	14.4
1982	2.1	2.6	4.7	0.1	1.9	2.0	6.7	2.5	1.6	4.1	0.4	1.0	1.4	5.5	12.2
1983	1.5	2.2	3.7	0.1	1.8	1.9	5.6	0.7	1.5	2.2	0.2	0.5	0.7	2.9	8.5

Table 5. Counts of salmon and grilse at the fish barrier on the N.W. Upsalquitch River, 1980 to 1983.

Year	Grilse	Salmon	Total
1980	855	903	1758
1981	794	484	1278
1982	805	611	1416
1983	430	301	731

Table 6. Numbers and percent female grilse at Millbank (Miramichi) and the number of large salmon angled in the Restigouche the following year.

Year	Millbank		Restigouche
	No. Grilse (year i)	Percent female	Angled Salmon year i + 1
1971	1962	11.0	5041
1972	2543	22.0	4886
1973	2450	16.9	5948
1974	4038	30.2	2901
1975	3548	27.4	5510
1976	4939	24.1	6707
1977	1505	22.8	5025
1978	1268	37.4	1823
1979	2500	27.4	6157
1980	2139	19.3	4240
1981	2174	25.1	2582
1982	2665	29.5	2022
1983	810	29.2	(2065)

Table 7. Juvenile Atlantic salmon densities in the Restigouche River 1972 to 1983. n = number of sites.

Year	n	Mean Number/100m^2		
		Fry	Small parr	Large parr
1972	22	5.0	2.0	1.1
1973	25	17.3	2.5	1.0
1974	26	12.6	7.1	1.0
1975	31	31.3	9.7	2.7
1976	30	15.1	8.4	1.6
1977	34	19.0	4.4	1.6
1978	38	23.4	8.3	1.4
1979	40	10.7	7.1	2.1
1980	41	10.9	4.1	1.7
1981	44	17.3	3.6	1.0
1982	46	8.8	4.4	1.0
1983	50	33.5	6.9	3.5

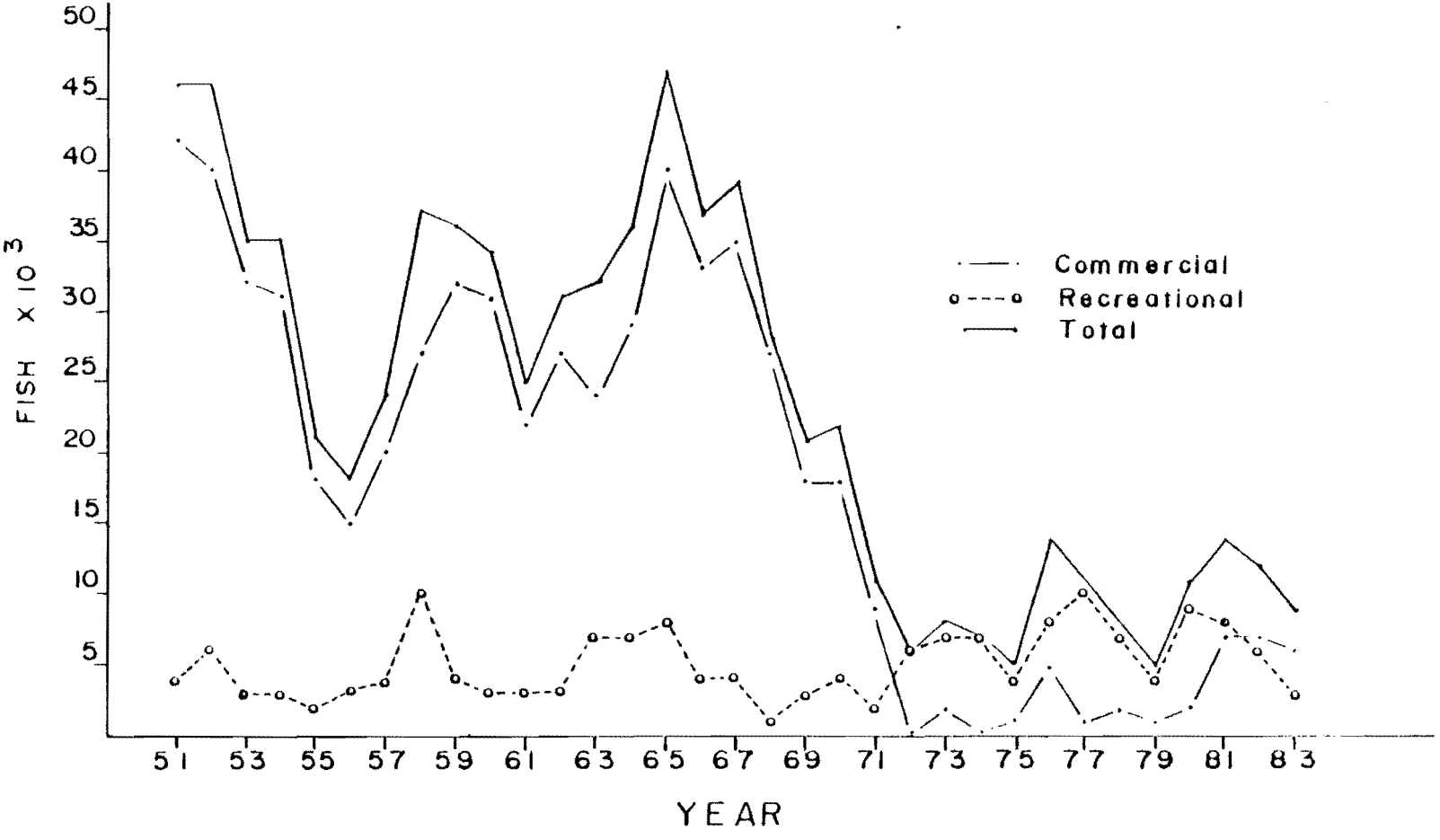
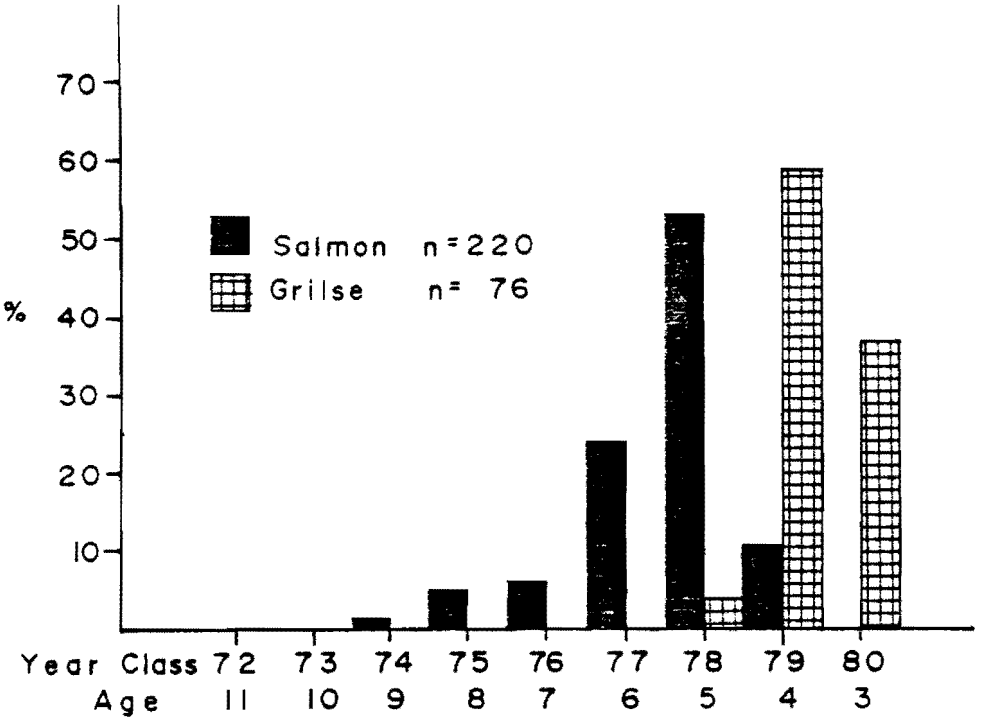


Figure 1. Commercial and recreational salmon landings in the Restigouche River, 1951 to 1983.



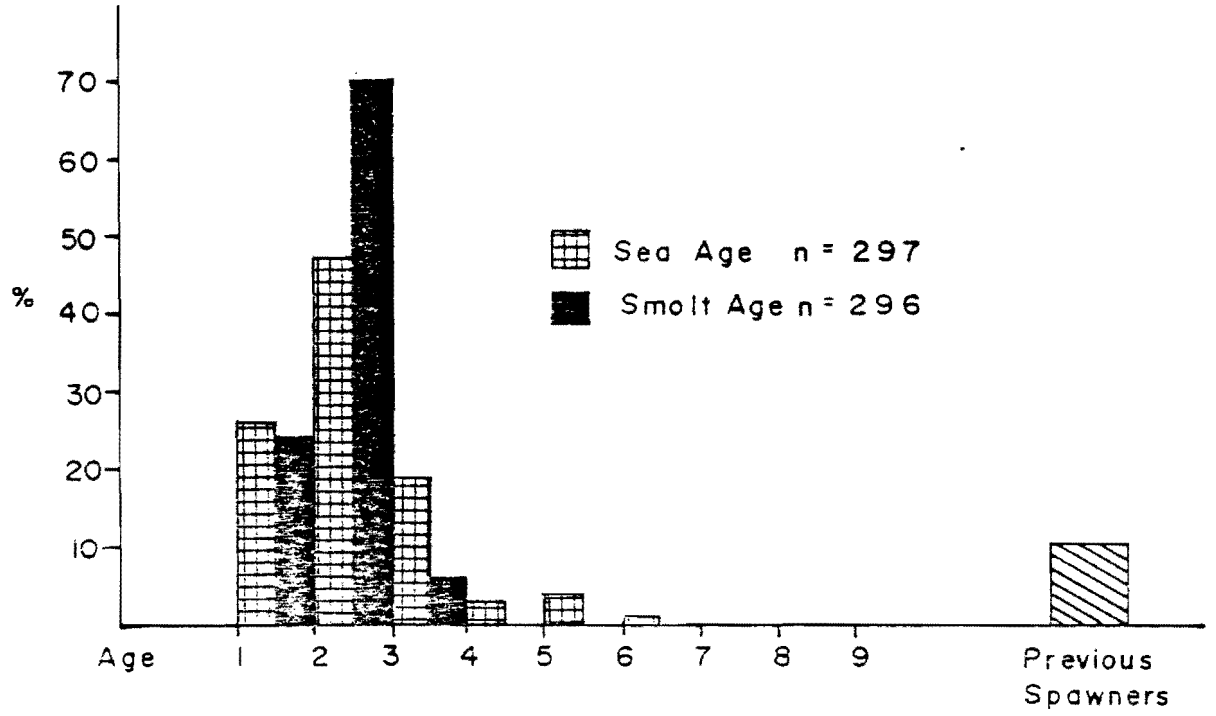
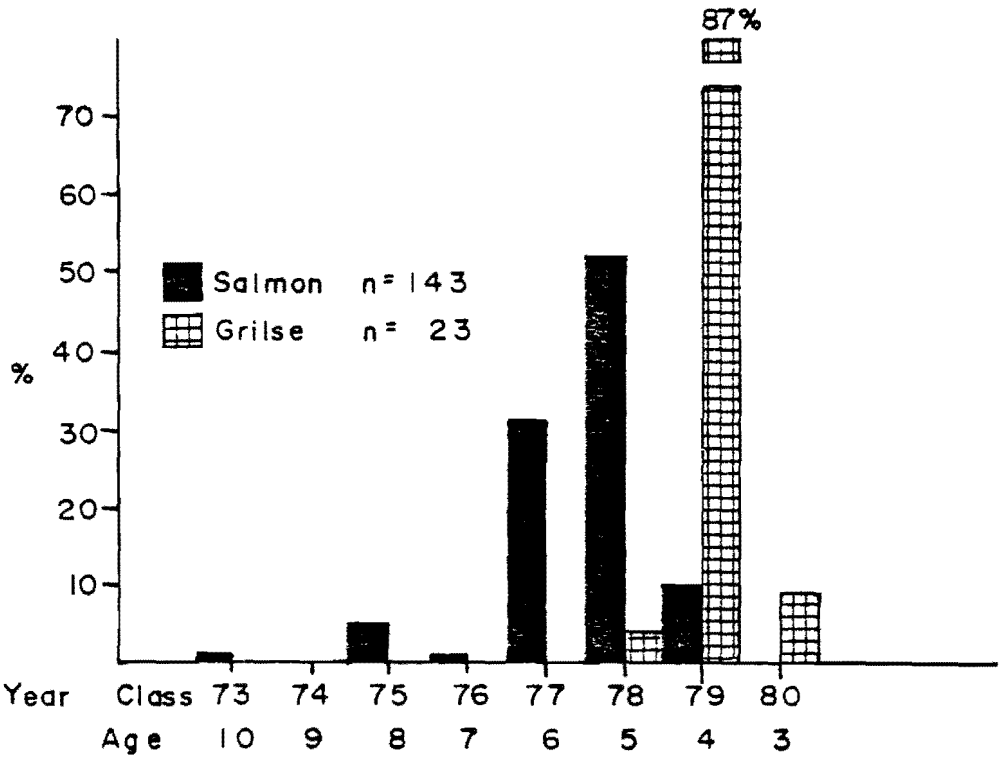


Figure 2. Upper. Year-class and age composition of salmon and grilse landed in the 1983 commercial trap fishery, Restigouche River.
Lower. Smolt and sea age of salmon and grilse from the commercial traps.



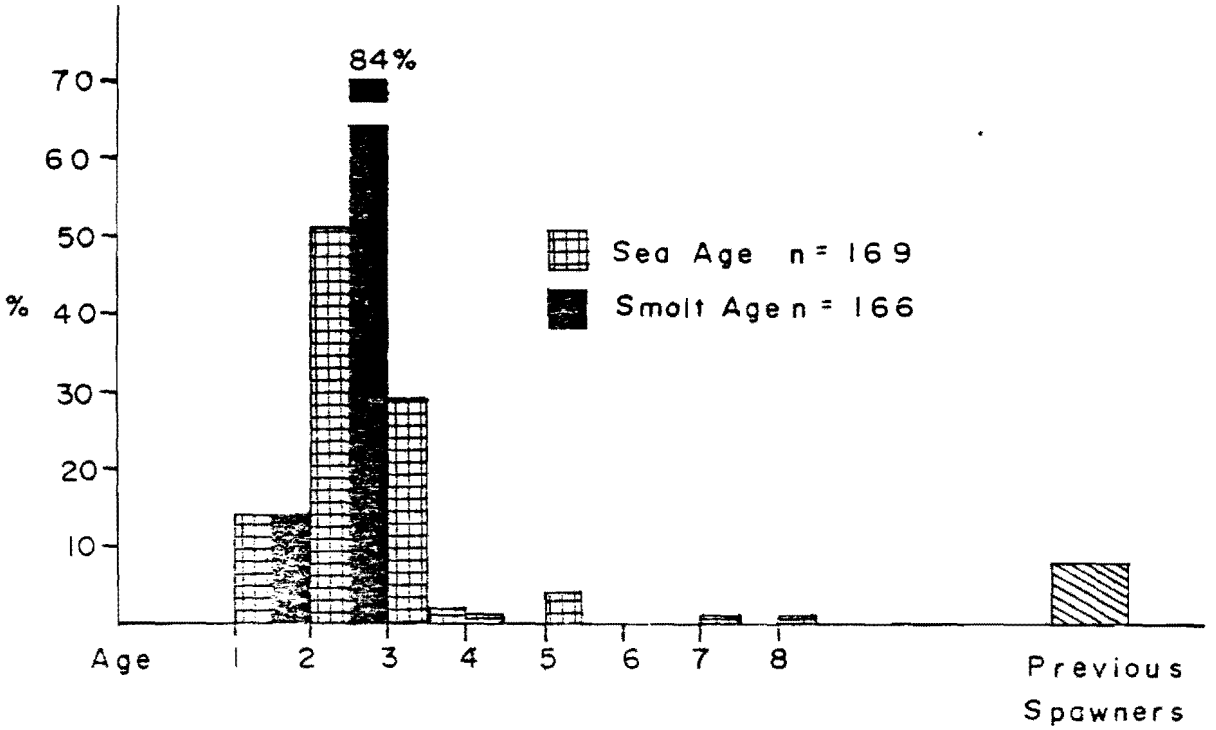


Figure 3. Upper: Year-class and age composition of salmon and grilse landed in the 1983 recreational fishery in the Restigouche River.
Lower: Smolt and sea age composition of salmon and grilse from the Restigouche angling fishery.

Appendix 1

Correlations between Restigouche and Miramichi salmon catches and juvenile salmon densities.

1	2	3	4	5	6	7	8
	RESTIGOUCHE			MIRAMICHI			
Year	Angled Salmon	Fry	Parr	Millbank salmon	Angled Salmon	Fry	Parr
1970	2042	-	-	245	3268	12.6	3.2
1971	1016	-	-	399	1792	15.0	5.5
1972	5041	5.0	2.0	1151	8933	5.3	4.8
1973	4886	17.3	2.5	1132	5597	16.8	1.9
1974	5948	12.6	7.1	1791	7184	22.6	10.0
1975	2901	31.3	9.7	1208	6288	31.7	14.6
1976	5510	15.1	8.4	943	7374	22.3	11.8
1977	6707	19.0	4.4	1934	11617	34.4	10.0
1978	5025	23.4	8.3	693	4893	23.5	9.4
1979	1823	10.7	7.1	318	2656	13.2	7.3
1980	6157	10.9	4.1	1093	6546	20.0	6.3
1981	4240	17.3	3.6	199	3238	40.9	9.2
1982	2582	8.8	4.4	408	4608	9.3	9.5
1983	2022	33.5	6.9	245	3503	30.5	10.5

Correlations:

Variables	R^2	probability
2 on 5	0.60	< 0.01
2 on 6	0.67	< 0.001
5 on 6	0.78	< 0.001
3 on 7	0.46	< 0.02
4 on 8	0.61	< 0.01

Appendix 2

Salmon landings for the Restigouche River given in Table 4 are from the following sources:

1. Commercial data

New Brunswick and Québec commercial data for 1951 to 1969 from May and Lear (1971) and assume salmon average 6.7 kg.

New Brunswick commercial for 1970 to 1982 from Redbooks (compiled by Department of Fisheries and Oceans, Fisheries Research Branch, Halifax).

Québec commercial for 1970 to 1981 from Bureau de la Statistique du Québec (G. Ouellett and J.P. LeBel, pers. comm.), and assume average weight and salmon/grilse ratio same as in Redbooks.

Québec commercial for 1982 from Ministère du Loisir de la Chasse et de la Pêche, Québec (G. Ouellett and J.P. LeBel, pers. comm.).

2. Angling data

New Brunswick angling data for 1951 to 1979 from Smith (1981): 1980 and 1982 data from Redbooks.

Québec angling data for 1951 to 1969 from New Brunswick Dept. of Natural Resources files (A. Madden, pers. comm.). Angling data for 1970 to 1982 from Ministère du Loisir de la chasse et de la Pêche, Québec (G. Ouellet and J.P. LeBel, pers. comm.).

3. All 1983 data are preliminary as described in text.