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Status of Atlantic salmon in the Restigouche River, 1985

by

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ABSTRACT

Returns of MSW salmon to the Restigouche River in 1985 were estimated to be 14,600 fish. Significantly reduced harvests of MSW salmon (no commercial fisheries and release of MSW salmon by anglers in New Brunswick) increased the proportion of returns that potentially survived to spawning. The ratio of spawners to returns in 1985 was 0.70, compared to 0.52 and 0.11 in 1984 and 1983, respectively. Spawning escapement was estimated to be 84% of spawning requirements and this was the most optimistic estimate of spawning success in recent years. Angling catches of 1SW salmon in 1985 suggested returns were greater than in 1984. MSW returns in 1986 are forecasted to be about 14,800 fish; thus spawning requirements should be met if controls on homewater harvests are continued in 1986. Returns of 1SW salmon in 1986, assuming average returns, could be about 8,800 fish; thus there could be a potential surplus of 6,200 1SW salmon.

RESUME

Les retours de saumons de plusieurs hivers en mer (PHM) à la rivière Restigouche ont été estimés à 14 600 poissons en 1985. La réduction importante des prises de saumons PHM (aucune pêche commerciale et remise à l'eau de saumons PHM par les pêcheurs à la ligne au Nouveau-Brunswick) a fait augmenter la proportion de retours qui auraient survécu au frai. Le rapport reproducteurs/retours en 1985 a été de 0,70 comparativement à 0,52 et 0,11 en 1984 et 1983 respectivement. L'échappement pour la reproduction a été estimé à 84 % du niveau requis, ce qui est l'estimation la plus optimiste du succès de la reproduction ces dernières années. Les prises à la ligne de saumon d'un hiver en mer (1HM) en 1985 indiquent que les retours ont été plus nombreux qu'en 1984. Les retours prévus de PHM en 1986 seraient de 14 800 poissons; le niveau requis pour la reproduction devrait donc être atteint si l'on continue à contrôler les prises dans les eaux natales en 1986. Les retours moyens de saumon 1HM en 1986, devraient être d'environ 8 800 poissons; il pourrait donc y avoir un surplus de 6 200 saumons 1HM.

INTRODUCTION

Restrictions on the harvest of Atlantic salmon in homewaters of the Restigouche River in 1985 were the most severe in history. Commercial trap net fishermen on the New Brunswick shore of Baie des Chaleurs, who were allowed a shortened fishing season in 1984 (9-20 July), were not allowed to fish in 1985. As in 1984, commercial fishermen in Québec did not fish in 1985. Angling regulations in 1985 were similar in both provinces to 1984 regulations. New Brunswick anglers were allowed to land 1SW salmon only, with a daily limit of 2 fish and a season limit of 10 fish. However, the angling season was opened two weeks earlier in 1985 (1 June-31 August) and catch and release of salmon was not counted against daily bag limits in 1985. Québec anglers were allowed to land both 1SW and MSW salmon, with a daily and seasonal limit of one and seven fish, respectively.

Native fishermen at Cross Point, Québec, were restricted by a 6,995 kg quota as in 1984. Native fishermen at Eel River Bar, NB, were not controlled by quota.

The objective of this report was to summarize landings of Restigouche salmon in 1985 and to evaluate the impact of the 1985 management plan on the salmon stock of the Restigouche River.

METHODS

1. Landings and 'catch and release'

Angling catches from the Matapédia River and the Québec portions of the Patapédia and Kedgwick rivers were reported by the Ministère du Loisir, de la Chasse et de la Pêche (MLCP). New Brunswick angling catches were summarized monthly by DFO fishery officers. Crown reserve angling data were provided by the Department of Forests, Mines and Energy (DFME). Catches were identified as being either 1-sea-winter (1SW) or multi-sea-winter (MSW; ≥ 63 cm) salmon. Effort was given in rod-days, where one rod-day was one fisherman fishing a river for any portion of one day.

Catch and release of MSW salmon in New Brunswick was estimated three ways: (i) correlation between catch and release of salmon at four angling camps and total Restigouche catches, 1970 to 1983 (Chadwick et al. 1984; Chadwick et al. 1985; Table 1); (ii) correlation between Québec angling and NB angling catches, 1970 to 1983 (Randall et al. 1985; Table 2); and (iii) reported catch and release data from NB fishery officers.

Native fishery landings from Cross Point, Québec, were provided by MLCP. Landings from Eel River Bar, NB, were reported weekly to DFO by the Band Council Office.

Counts of salmon at a fish barrier on the Northwest Upsalquitch River were provided by DFME.

Biological characteristics of spawning salmon were determined from about 200 salmon sampled from the Native and angling fisheries. Sampling included: recording gear, date and area; removing scales for aging; and recording fork length (cm) and weight (0.1 kg).

2. Recruitment

During 1985, densities of salmon fry (age 0+) and parr (age 1+) were estimated at 45 sites by electrofishing. Historic parr densities (1972 to 1984) and estimates in 1985 were calculated using the removal method (Zippin 1956). Details of the electrofishing procedure and statistical analysis of the data are described by Randall and Chadwick (1986). Average age 1+ parr densities have been used as an index of recruitment in the Restigouche River (Randall et al. 1985).

3. Spawning escapement in 1985

As in previous assessments (Randall et al. 1985), two methods were used to calculate spawning escapement in 1985:

Method 1: An angling exploitation rate of 0.20 was used. This rate was calculated by Chadwick and Randall (1983) using tagging information for Restigouche salmon from 1972 and 1973. Escapement was estimated as angling catch / 0.20, minus angling and poaching removals. Total returns were calculated as the sum of escapement, harvest and poaching removals.

Method 2: A ratio of spawner to angled fish of 0.86 was used (Table 3). This ratio was updated from the 1984 assessment (Randall et al. 1985) by including 1985 parr densities. Total egg deposition (1970 to 1983) was back-calculated from small parr densities assuming 10% survival (Elson 1957, 1974; Chadwick 1982), and a rearing area of 29,768,000 m². Spawners were calculated from egg deposition by dividing by eggs per salmon (Randall 1984) and were proportioned into MSW and 1SW spawners using proportions from angling catches (Table 2). Escapement in 1985 was estimated as the product of the spawner to angled fish ratio and angling catch in 1985.

For estimating spawning escapement, mortalities of salmon due to poaching and disease were assumed to be 2,000 MSW and 1,000 1SW salmon. Reported mortalities from furunculosis were 45 MSW and 15 1SW salmon (A. Madden, DFME, personal communication); however, poaching or unaccounted losses in freshwater were probably higher (Randall et al. 1985). Mortalities due to angling catch and release were estimated from observations at five angling camps.

The number of MSW and 1SW salmon required for spawning in the Restigouche River was estimated to be 12,200 and 2,600 salmon, respectively (Randall 1984). Total egg deposition requirements were 71,443,200 eggs.

4. Forecast

Returns of MSW salmon to the Restigouche River in 1986 were predicted from a significant correlation between 1SW salmon at Kedgwick Lodge (year i) and total MSW returns (year i+1) (Chadwick et al. 1984; Randall et al. 1985). Returns of 1SW salmon were predicted from long-term averages.

RESULTS

1. Landings and 'catch and release'

Angling catches of MSW salmon in Québec increased to 752 fish in 1985 from 570 fish in 1984 (increase of 32%; Table 4). Because angling effort was similar in both years, increased landings suggest MSW returns were greater in 1985 than in 1984 in the Québec tributaries.

Estimates of catch and release of MSW salmon in New Brunswick in 1985 are given below:

Method	R ²	NB catch	Total catch minus camps	Total catch
1. Camps versus total angling (Table 1; Fig. 1)	0.87	5,310	5,203 (3,679-6,728)	6,062
2. PQ versus NB angling (Table 2)	0.52	2,276 (0-4,699)		3,028
3. Reported catch and release		3,379		4,131

Method 1, although it probably overestimates total catch because of possible recaptures in 1985, is probably the best estimate of angling catches; this method was used in the 1984 assessment (Randall et al. 1985). The estimate of catch and release from DFO officers was an underestimate because some sections of river were not covered. New Brunswick catch and release data from the four index camps indicate an increase (75%) in MSW salmon catches from 1984, suggesting large salmon were more abundant in 1985. However, angling effort also increased in New Brunswick in 1985 (Table 4) and increased effort may account for some of the increase in catches.

Landings of 1SW salmon in Quebec decreased by 26% from 348 fish in 1984 to 259 fish in 1985 (Table 4). In contrast, catches of 1SW salmon in New Brunswick tributaries increased in 1985 from 1984 by 101% (Table 4), suggesting increased returns. The increase in angling effort in New Brunswick in 1985 unlikely affected catches of 1SW salmon. Most of the increased effort probably resulted from the earlier starting date of the angling season (first two weeks of June) and 1SW salmon are not available to anglers at this time. These angling statistics suggests 1SW salmon returns increased in New Brunswick, but not in Québec tributaries of the Restigouche River from 1984 to 1985.

Native landings of MSW salmon at Eel River Bar and Cross Point were similar in 1985 to 1984 (Table 4). The reported catch at Cross Point was 5,920 kg, or 85% of the allocated quota of 6,995 kg.

Landings in the Restigouche River in 1985 are compared to historic landings in Table 5 and Fig. 2.

Counts of 1SW salmon at the Upsalquitch barrier increased to 748 fish in 1985 from 518 fish in 1984 (Table 6; Fig. 3) which agrees with the increase in 1SW returns suggested by the angling data. Counts of MSW salmon at the barrier were down by 20% from 1984, however, indicating returns to the upper Upsalquitch River decreased in 1985.

Preliminary samples of salmon examined from the Native and angling fisheries in 1985 indicated 1SW and MSW salmon were predominantly from the 1981 and 1980 year-classes. Biological characteristics are given below:

Sea age (yr)	n	Fork length (cm)	Weight (kg)	Condition
1SW	47	52.0	1.86	1.29
2SW	112	76.5	4.66	1.03
3SW	47	91.9	9.21	1.18
Previous spawner	6	96.5	12.33	1.22

2. Recruitment

Densities of age 0+ and age 1+ salmon in 1985 were above long-term averages (Table 7; Fig. 4). This suggests spawning levels in 1983 and 1984 were above average.

3. Spawning escapement

For estimating spawning escapement, a total angling catch (PQ landings and NB catch and release) of 6,100 MSW salmon was used (calculated from Method 1 on Page 5). Mortalities attributed to angling stress were calculated as 8% of the estimated caught and released MSW salmon in New Brunswick:

	Catch and release	Mortalities	Proportion
Camp 1	223	12	0.05
Camp 2	150	10	0.07
Camp 3	219	50	0.23
Camp 4	257	20	0.08
Camp 5	277	3	0.01
TOTAL	1,126	95	0.08

As in previous years, there was a large discrepancy in estimates of spawning escapement using the two methods:

	Method 1		Method 2	
	MSW	1SW	MSW	1SW
1. Total returns	31,717	16,155	14,600	7,032
2. Harvest	1,969	3,259	1,969	3,259
3. Poaching and disease	2,000	1,000	2,000	1,000
4. Broodstock	37	0	37	0
5. Catch and release mortality	425	-	425	-
6. Spawning escapement	27,286	11,896	10,169	2,773
7. Target spawners	12,200	2,600	12,200	2,600
% of target achieved	224%	458%	83%	107%

Method 2 is probably the most reliable (Randall et al. 1985), and it indicated 83% of required MSW salmon spawned in 1985. In terms of egg deposition, Method 2 indicated a spawning deposition of 60.3×10^6 eggs (84% of requirements).

4. Forecast

MSW salmon returns to the Restigouche River in 1985 were predicted from the following equation (Table 8; Fig. 5):

$$y = 8889.3 + 60.4x \quad (r = 0.72, P < 0.01)$$

where y = MSW salmon returns (year $i+1$)

x = 1SW salmon catch at Kedgwick Lodge (year i)

Total returns of MSW salmon are expected to be 14,811 (8,862-20,759). Total 1SW salmon returns in 1986 could be about 8,840 fish, assuming average returns, 1981 to 1985 (Table 10).

DISCUSSION

As in previous assessments, there was a large discrepancy between Methods 1 and 2 in estimates of salmon spawning levels in the Restigouche River in 1985. Because Method 2 estimates actual spawners (from observed parr densities) while Method 1 estimates potential spawners (from an assumed angling exploitation rate), Method 2 is considered to be relatively more reliable (Randall et al. 1985). Total returns of MSW salmon to the Restigouche River, as estimated using Method 2, was about 14,600 fish; these returns are within the 95% confidence interval of predicted returns in the 1984 assessment ($12,219 \pm 6,024$). Substantially reduced homewater harvests of MSW salmon in 1985 increased the proportion of returns that potentially survived to spawning (Table 11). Spawning escapement in 1985 was estimated to be 84% of requirements and this is the most optimistic estimate of spawning success in the Restigouche River in recent years.

Both Methods 1 and 2 for estimating salmon returns assume that angling catches are an accurate index of stock abundance. However, with changing regulations affecting angling effort, particularly in the past two years when anglers released all MSW salmon, angling data are becoming less reliable. Estimates of spawner abundance based on angling catch and release data in 1984 and 1985 are approximations at best. In order to improve estimates of stock abundance in 1986, the following research projects are planned:

- (1) a mark-recapture experiment will be used to estimate the number of 1SW and MSW salmon entering the Restigouche River in 1986;
- (2) information on salmon tagging at the Dalhousie trap (Peppar 1983) will be re-examined to estimate angling exploitation rates and escapement between 1972 and 1977;
- (3) the influence of water discharge on angling catches and estimates of parr densities will be examined.

With this additional research, estimates of both past and future spawning levels in the Restigouche River will be more accurate.

Angling catches and counts of 1SW salmon at the Upsalquitch barrier indicated that returns were greater in 1985 than 1984, at least in New Brunswick tributaries. Returns of MSW salmon in 1986, based on 1SW catches in 1985 (Table 8), are expected to be about 14,800 fish, and thus spawning escapement should be achieved. Returns of 1SW salmon in 1986 are expected to be average (8,800 fish).

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Table 1. Catches of MSW salmon at four index angling camps (Chadwick et al. 1984) and total catch in the Restigouche River.

MSW salmon angling catch		
Year	Angling camps	Total catch minus camps
1970	277	1,765
1971	194	822
1972	601	4,440
1973	571	4,321
1974	959	4,989
1975	494	2,407
1976		
1977	909	5,798
1978	615	4,410
1979	353	1,470
1980	905	5,252
1981	602	3,638
1982	453	2,129
1983	409	1,659
1984	490	(2,836) ¹
1985	859	(5,203) ¹

¹ Total catch in 1984 and 1985 estimated from the correlation between catch at the angling camps (x) and total catch (y) 1970 to 1983; $y = -308.7 + 6.4(x)$; $R^2 = 0.87$, $P < 0.01$.

Table 2. Angling catches in the Restigouche River, 1970 to 1985.

Year	MSW			1SW			Proportion MSW
	PQ	NB	Total	PQ	NB	Total	
1970	326	1,716	2,042	166	1,340	1,506	0.58
1971	259	757	1,016	173	999	1,172	0.46
1972	1,171	3,870	5,041	111	978	1,089	0.82
1973	1,146	3,746	4,892	147	1,423	1,570	0.76
1974	1,163	4,785	5,948	129	1,038	1,167	0.84
1975	741	2,160	2,901	149	1,130	1,279	0.69
1976	1,029	4,481	5,510	377	2,345	2,722	0.67
1977	1,579	5,128	6,707	459	2,333	2,792	0.71
1978	1,652	3,373	5,025	282	1,322	1,604	0.76
1979	826	997	1,823	556	1,990	2,546	0.42
1980	2,059	4,098	6,157	409	2,833	3,242	0.66
1981	1,408	2,832	4,240	635	3,010	3,645	0.54
1982	962	1,620	2,582	402	2,449	2,851	0.48
1983	587	1,481	2,068	181	715	896	0.70
1984	570	0	570	348	1,474	1,822	0.24
1985	752	0	752	259	2,965	3,224	0.19

Table 3. Ratios of spawner per angled fish in the Restigouche River, 1970 to 1983.

Year (i)	Parr (i+2)	Eggs/MSW salmon	Proportion MSW	Spawners		Ratio of spawner per angled fish
				MSW	1SW	
1970	0.021	5,933	0.58	1,054	763	0.52
1971	0.025	5,933	0.46	1,254	1,472	1.23
1972	0.068	5,661	0.82	3,576	785	0.71
1973	0.099	6,282	0.76	4,691	1,481	0.96
1974	0.085	6,056	0.84	4,178	796	0.70
1975	0.043	6,565	0.69	1,950	876	0.67
1976	0.081	6,441	0.67	3,744	1,844	0.68
1977	0.071	5,445	0.71	3,882	1,585	0.58
1978	0.039	6,094	0.76	1,905	602	0.38
1979	0.035	6,155	0.42	1,693	2,338	0.93
1980	0.041	4,700	0.66	2,597	1,338	0.42
1981	0.068	5,933	0.54	3,412	2,906	0.80
1982	0.050	5,933	0.48	2,509	2,718	0.97
1983	0.100	5,933	0.70	5,017	2,150	2.43
Mean						0.86
S.D.						0.51

Table 4. Preliminary 1985 nominal landings and effort in Restigouche River from Native and angling fisheries. Landings for 1984 (updated from Randall et al. 1985) given for comparison.

Fishery	1985			1984		
	MSW	1SW	Effort	MSW	1SW	Effort
Commercial Traps						
New Brunswick	-	-	0	1,958	6,716	220
Quebec	-	-	0	-	-	0
Native						
Cross Point	976	35		1,070	177	
Eel River Bar	241	0		213	1	
Angling						
New Brunswick	-	2,965	10,320	-	1,474	7,298
Quebec	752	259	5,759	570	348	5,639
TOTAL	1,969	3,259		3,811	8,716	

Table 5. Commercial, angling and Native salmon landings from Baie des Chaleurs and Restigouche River, 1951 to 1985. Data are numbers x 10³. Data sources given in Appendix 1.

Year	Commercial			Angling			Native			Grand Total
	1SW	MSW	Total	1SW	MSW	Total	1SW	MSW	Total	
1951		42.4	42.4			3.7				46.1
1952		39.6	39.6			6.2				45.8
1953		31.9	31.9			3.2				35.1
1954		31.3	31.3			3.4				34.7
1955		18.3	18.3			2.3				20.6
1956		15.2	15.2			2.6				17.8
1957		19.9	19.9			3.8				23.7
1958		26.8	26.8			9.7				36.5
1959		32.1	32.1			3.5				35.6
1960		30.6	30.6			3.0				33.6
1961		22.0	22.0			3.2				25.2
1962		27.4	27.4			3.4				30.8
1963		24.1	24.1			7.4				31.5
1964		28.8	28.8			6.9				35.7
1965		39.6	39.6			7.6				47.2
1966		33.3	33.3			4.1				37.4
1967		34.7	34.7			4.3				39.0
1968		26.7	26.7			1.2				27.9
1969		18.4	18.4			3.0				21.4
1970		18.2	18.2	1.6	2.0	3.6				21.8
1971		8.9	8.9	1.2	1.0	2.2				11.1
1972	0.1	0.0	0.1	1.1	5.0	6.1				6.2
1973	1.3	0.3	1.6	1.6	4.9	6.5				8.1
1974	0.1	0.1	0.2	1.1	6.0	7.1				7.3
1975	0.2	1.0	1.2	1.3	2.9	4.2	0.0	0.1	0.1	5.5
1976	5.1	0.2	5.3	2.7	5.5	8.2	0.0	1.6	1.6	15.1
1977	1.1	0.2	1.3	2.8	6.7	9.5	0.0	2.9	2.9	13.7
1978	1.5	0.2	1.7	1.6	5.0	6.6	0.0	0.2	0.2	8.5
1979	0.1	0.7	0.8	2.6	1.8	4.4	0.2	0.8	1.0	6.2
1980	2.0	0.0	2.0	3.2	6.2	9.4	0.0	1.9	1.9	13.3
1981	3.1	3.5	6.6	3.6	4.2	7.8				14.4
1982	2.2	4.5	6.7	2.9	2.6	5.5	0.2	1.5	1.7	13.9
1983	1.6	4.5	6.1	0.9	2.1	3.0	0.0	1.5	1.5	10.6
1984	7.2	2.0	9.2	1.8	0.6	2.4	0.2	1.2	1.4	13.0
1985	0.0	0.0	0.0	3.3	0.8	4.1	0.0	1.2	1.2	5.3

Table 6. Counts of MSW and 1SW salmon at the fish barrier on the N.W. Upsalquitch River, 1980 to 1985.

Year	1SW	MSW	Total
1980	843	887	1,730
1981	789	481	1,270
1982	819	622	1,441
1983	430	301	731
1984	518	642	1,160
1985	748	516	1,264

Table 7. Juvenile Atlantic salmon densities (number /100 m²) in the Restigouche River, 1972 to 1985. (n = number of sites; 95% confidence interval in parenthesis).

Year	n	Mean density/100 m ²	
		age 0+	age 1+
1972	21	4.8 (3.1- 7.7)	2.1 (1.5- 2.9)
1973	25	18.0 (11.3-28.6)	2.5 (1.9- 3.3)
1974	26	12.9 (7.5-22.0)	6.8 (5.0- 9.3)
1975	31	32.6 (20.1-53.0)	9.9 (6.6-14.8)
1976	29	14.7 (9.5-22.8)	8.5 (5.7-12.6)
1977	34	17.2 (11.2-26.3)	4.3 (3.2- 5.6)
1978	38	23.8 (16.9-33.3)	8.1 (6.1-10.9)
1979	40	10.4 (7.5-14.6)	7.1 (5.6- 9.0)
1980	42	10.5 (7.6-14.5)	3.9 (3.0- 5.1)
1981	45	16.3 (12.5-21.3)	3.5 (2.8- 4.4)
1982	47	8.4 (6.0-11.8)	4.1 (3.1- 5.6)
1983	51	23.9 (15.1-37.6)	6.8 (5.1- 9.0)
1984	51	25.1 (15.7-40.1)	5.0 (3.8- 6.5)
1972-84 mean		16.8	5.6
1985	45	23.0 (13.3-40.0)	10.0 (7.1-14.1)

Table 8. Total returns of MSW salmon to Restigouche River and catch of 1SW salmon at Kedgwick Lodge in the previous year (1969-85). Total returns are calculated in Table 9. Returns of MSW salmon predicted for 1986 are given in parenthesis.

Year (i)	Kedgwick Lodge 1SW salmon catch (year i)	Total returns of MSW salmon to Restigouche (year i+1)
1969	174	23,200
1970	124	13,100
1971	72	10,600
1972	36	11,900
1973	30	12,300
1974	27	7,900
1975	33	13,000
1976	71	15,700
1977	37	9,300
1978	25	7,000
1979	128	12,700
1980	26	13,100
1981	45	13,100
1982	69	15,200
1983	44	11,400
1984	83	14,600
1985	98	(14,800)

Table 9. Returns of MSW salmon (numbers $\times 10^3$) to the Restigouche River, 1970 to 1985. Escapement (1970 to 1983) was estimated as total angling \times spawner/angled salmon ratio (Table 3). Escapement in 1984 and 1985 was calculated from a catch (PQ) and catch and release (NB) angling harvest of 3,300 and 6,100 MSW salmon, respectively.

Year	Angling		Commercial		Native	Poaching and disease	Escapement	Total
	NB	PQ	NB	PQ				
1970	1.7	0.3	9.1	9.1	-	2.0	1.0	23.2
1971	0.8	0.2	3.9	5.0	-	2.0	1.2	13.1
1972	3.8	1.2	0.0	0.0	-	2.0	3.6	10.6
1973	3.8	1.1	0.2	0.1	-	2.0	4.7	11.9
1974	4.8	1.2	0.0	0.1	-	2.0	4.2	12.3
1975	2.2	0.7	0.9	0.1	0.1	2.0	1.9	7.9
1976	4.5	1.0	0.1	0.1	1.6	2.0	3.7	13.0
1977	5.1	1.6	0.2	0.0	2.9	2.0	3.9	15.7
1978	3.4	1.6	0.2	0.0	0.2	2.0	1.9	9.3
1979	1.0	0.8	0.7	0.0	0.8	2.0	1.7	7.0
1980	4.1	2.1	0.0	0.0	1.9	2.0	2.6	12.7
1981	2.8	1.4	3.5	0.0	-	2.0	3.4	13.1
1982	1.6	1.0	2.6	1.9	1.5	2.0	2.5	13.1
1983	1.5	0.6	2.2	2.3	1.5	2.0	5.1	15.2
1984	0.0	0.6	2.0	0.0	1.2	2.0	5.6	11.4
1985	0.4	0.8	0.0	0.0	1.2	2.0	10.2	14.6

Table 10. Returns of 1SW salmon (numbers $\times 10^3$) to the Restigouche River, 1970 to 1985. Escapement (1970 to 1985) was estimated as total angling \times spawner/angled salmon ratio (Table 3).

Year	Angling		Commercial		Native	Poaching and disease	Escapement	Total
	NB	PQ	NB	PQ				
1970	1.4	0.2	-	-	-	1.0	0.8	3.4
1971	1.0	0.2	-	-	-	1.0	1.5	3.7
1972	1.0	0.1	0.1	0.0	-	1.0	0.8	3.0
1973	1.4	0.2	0.7	0.6	-	1.0	1.5	5.4
1974	1.0	0.1	0.0	0.1	-	1.0	0.8	3.0
1975	1.1	0.2	0.2	0.0	0.0	1.0	0.9	3.4
1976	2.3	0.4	3.7	1.4	0.0	1.0	1.8	10.6
1977	2.4	0.4	1.1	0.0	0.0	1.0	1.6	6.5
1978	1.3	0.3	1.5	0.0	0.0	1.0	0.6	4.7
1979	2.0	0.6	0.1	0.0	0.2	1.0	2.4	6.3
1980	2.8	0.4	2.0	0.0	0.0	1.0	1.3	7.5
1981	3.0	0.6	3.1	0.0	-	1.0	2.9	10.6
1982	2.5	0.4	2.1	0.1	0.2	1.0	2.8	9.1
1983	0.7	0.2	1.5	0.1	0.0	1.0	2.2	5.7
1984	1.5	0.3	7.2	0.0	0.2	1.0	1.5	11.7
1985	3.0	0.3	0.0	0.0	0.0	1.0	2.8	7.1

Table 11. Comparison of predicted and actual returns of 1SW and MSW salmon as estimated in annual assessments of the Restigouche salmon stock, 1982 to 1986. Estimates of actual returns and the ratio of spawners to returns are based on Method 2 (see text).

Year	1SW returns		Spawner/ returns ratio	MSW returns		Spawner/ returns ratio
	Predicted	Actual		Predicted	Actual	
1982		6,700	0.15		13,500	0.14
1983	6,200	4,200	0.12	13,500	11,000	0.11
1984	5,000	10,400	0.13	11,300	9,900	0.52
1985	9,000	7,000	0.40	12,200	14,600	0.70
1986	8,800			14,800		

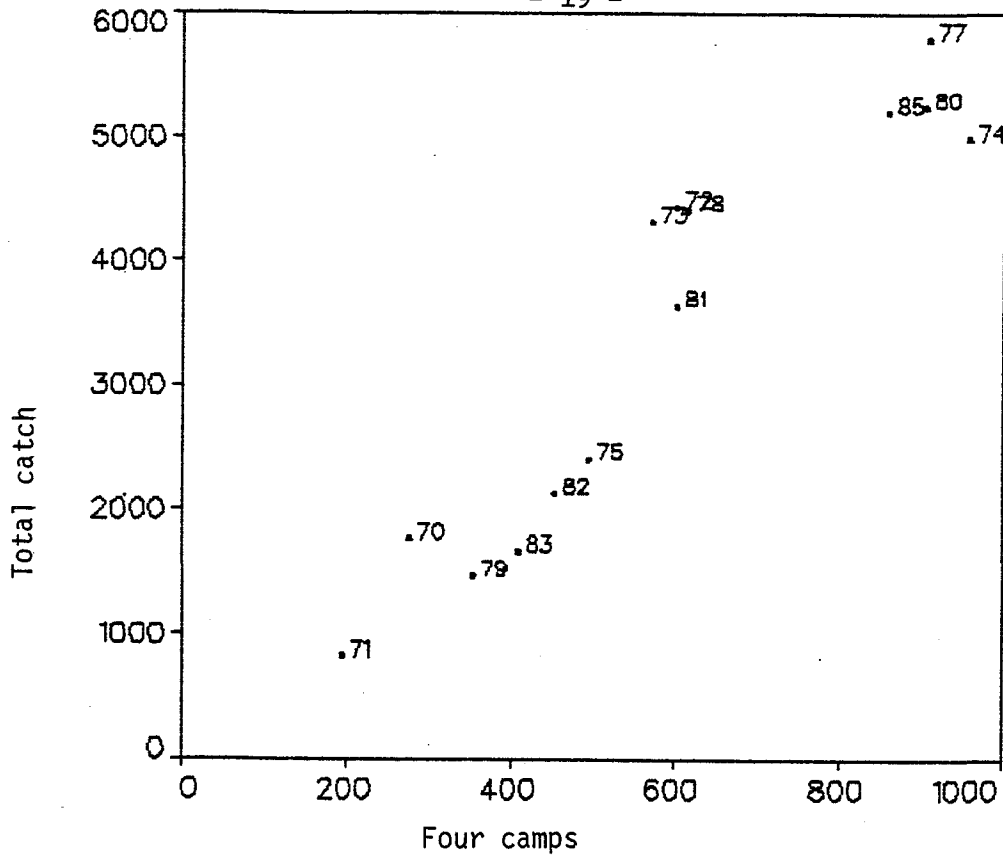


Figure 1. Correlation between numbers of MSW salmon caught at four angling camps and total New Brunswick catch. Data in Table 1.

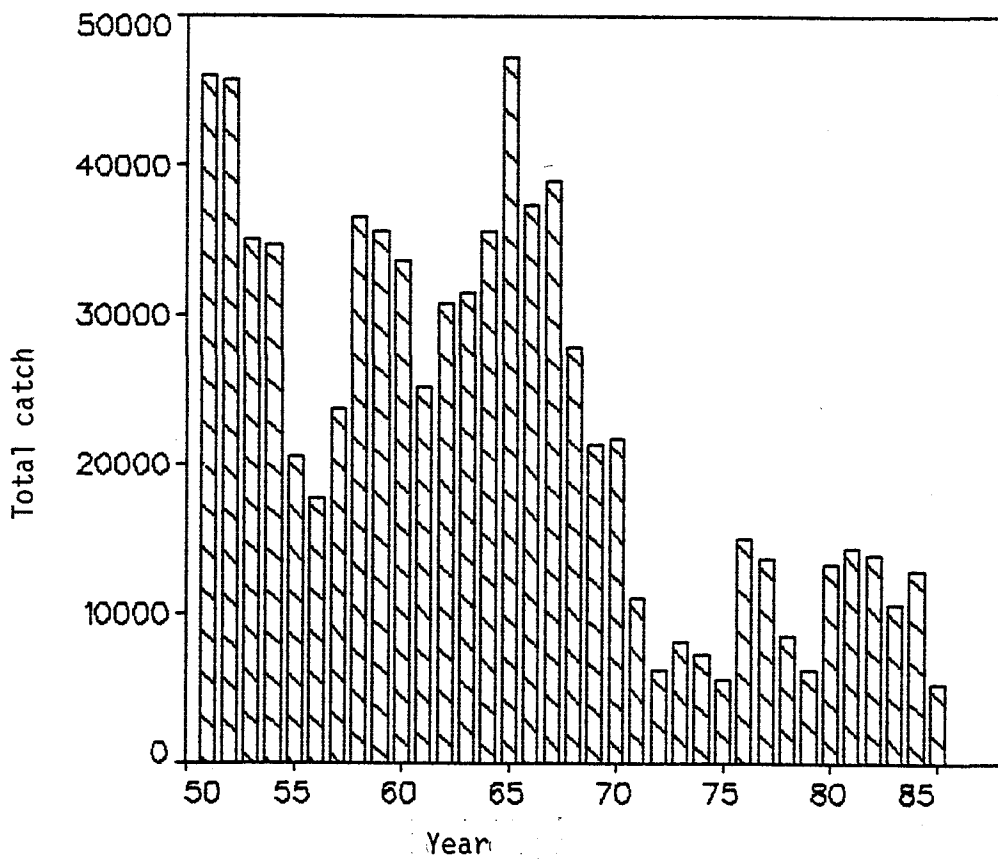


Figure 2. Total salmon landings in the Restigouche River and upper Baie des Chaleurs, 1951 to 1985.

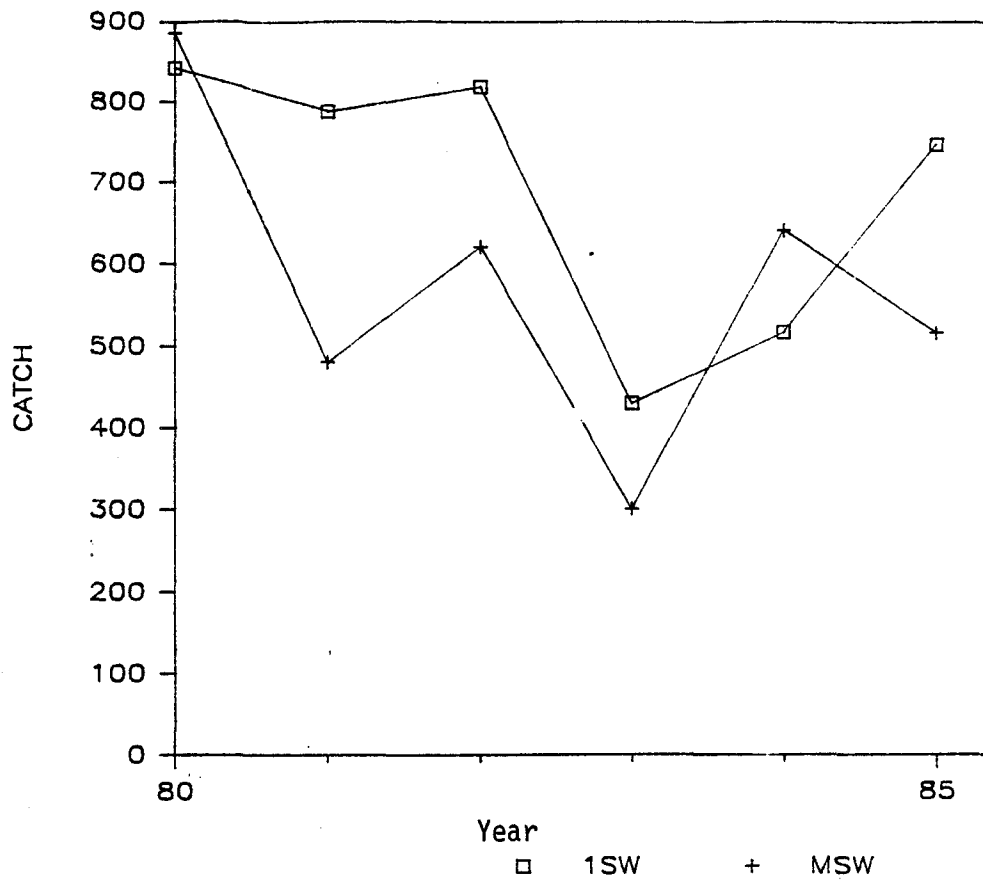


Figure 3. Counts of 1SW and MSW salmon at the Upsalquitch barrier, 1980-1985.

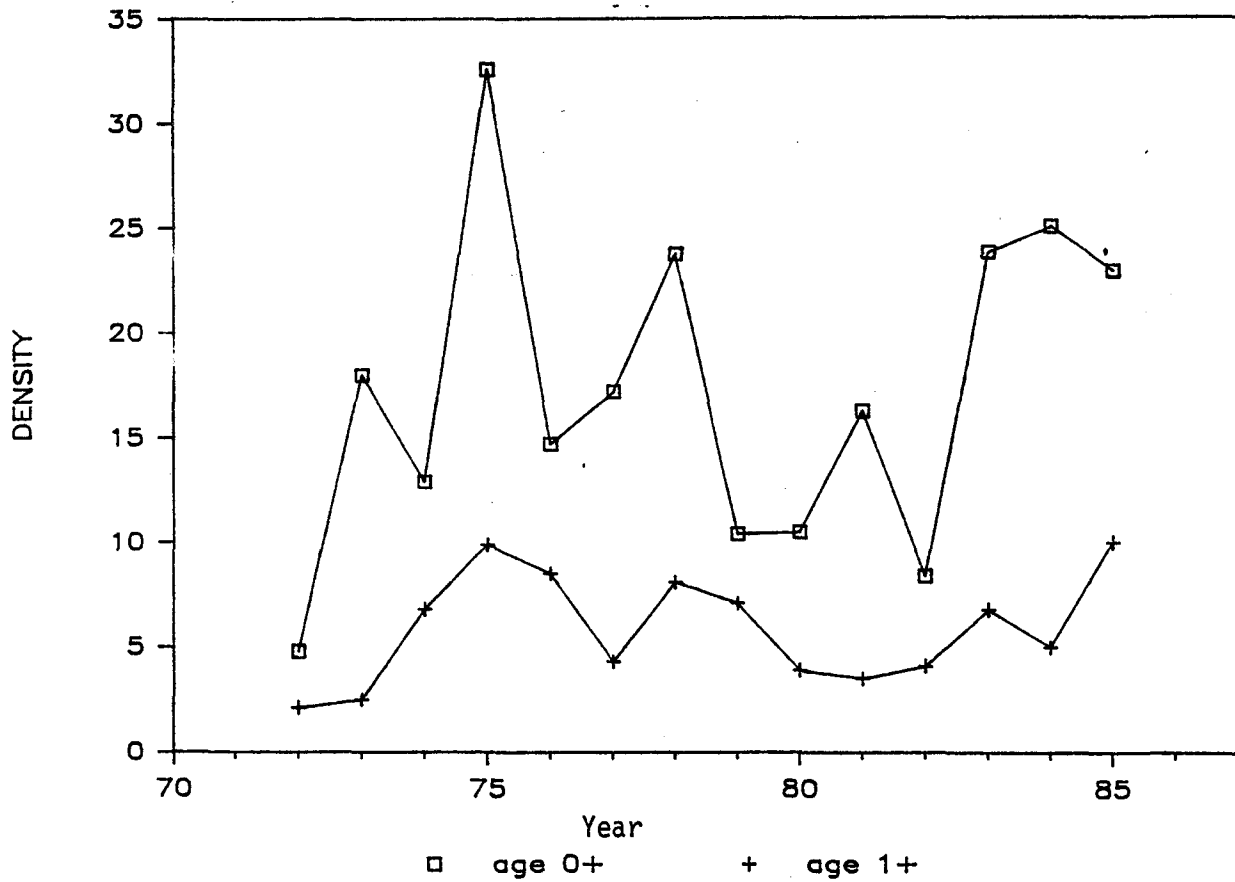


Figure 4. Mean densities of age 0+ and age 1+ salmon in the Restigouche River, 1972 to 1985.

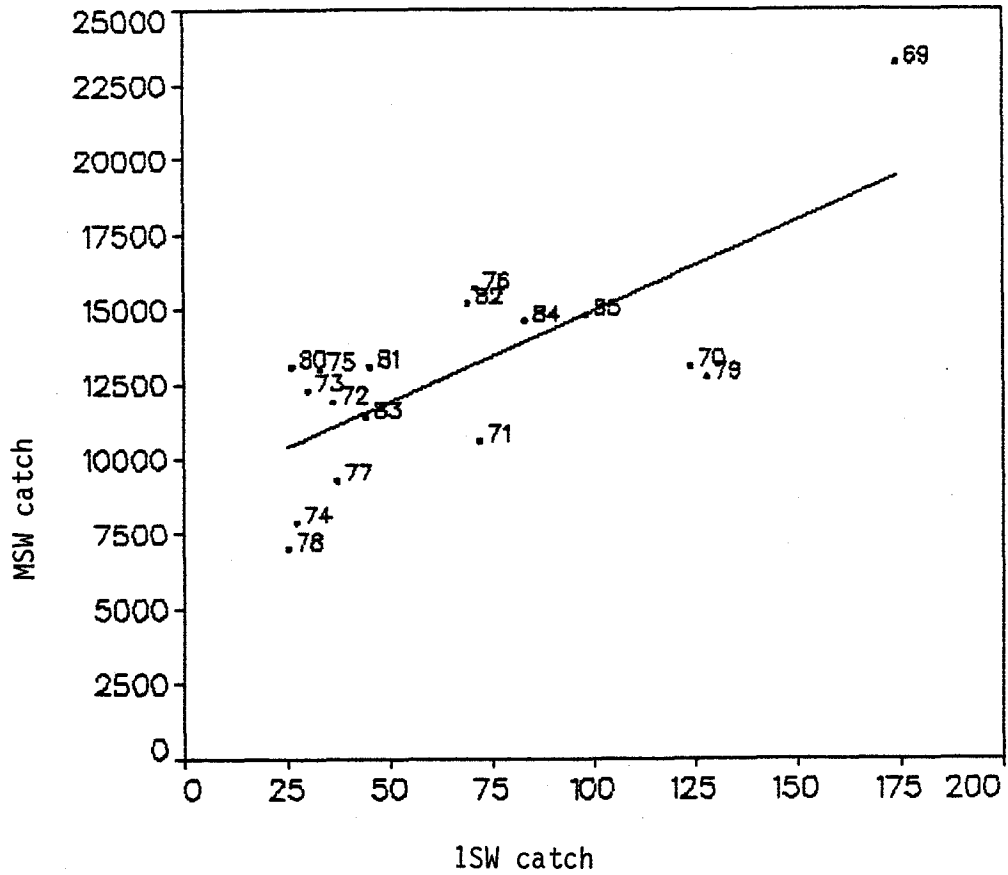


Figure 5. Correlation between catch of 1SW salmon at Kedgwick Lodge (year i) and total returns of MSW salmon to Restigouche River (year i+1).

APPENDIX 1

Salmon landings for Baie des Chaleurs and Restigouche River given in Table 4 are from the following sources:

1. Commercial data

New Brunswick: Districts 63, 64 and 65

Québec: Districts 12, 13, 14 and 15

New Brunswick and Québec commercial data for 1951 to 1969 from May and Lear (1971) and assume salmon average 6.4 kg.

New Brunswick commercial for 1970 to 1984 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. Ouellet and J.P. Lebel, pers. comm.), and assume average weight and MSW/1SW ratio same as calculated from Redbooks.

Québec commercial for 1982 to 1984 from Ministère du Loisir, de la Chasse et de la Pêche, Québec (G. Ouellet and G. Landry, pers. comm.).

2. Angling data

New Brunswick angling data for 1951 to 1959 from Smith (1981); 1960 to 1969 from Swetnam and O'Neil (1985); 1970 to 1979 from O'Neil and Swetnam (1984); 1980 to 1983 from Swetnam and O'Neil (1984); and 1984 from O'Neil et al. (1985).

Québec angling from 1951 to 1969 from New Brunswick Department of Natural Resources files (A. Madden, pers. comm.). Angling data for 1970 to 1984 from Ministère du Loisir, de la Chasse et de la Pêche, Québec (G. Ouellet and J.P. Lebel, pers. comm.).

3. Native data

New Brunswick Native data for 1975 to 1982 from Department of Fisheries and Oceans, Protection and Regulations Branch, files (R. Roy and M. Sullivan, pers. comm.); 1983 to 1984 from Department of Fisheries and Oceans, Resource Allocations and Development Branch, (K. Atwin, pers. comm.).

Québec Native data for 1976 to 1984 from Gaudreault (1984).

4. All 1985 data are preliminary as described in text.