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Status of Atlantic salmon in the Miramichi River, 1985

by

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ABSTRACT

Returns of adult salmon to the Miramichi River in 1985, as estimated by a mark-recapture experiment, were 24,300 MSW and 46,400 1SW salmon. Homewater harvests of MSW salmon were significantly reduced as in 1984 because of the absence of a commercial fishery and the mandatory release of MSW salmon by anglers. Reduced harvests increased the proportion of MSW salmon that survived to spawning; the ratio of spawners to total returns in 1985 was 0.93, compared to 0.10 in 1983, the last year when homewater harvests of salmon were significant. Two methods for estimating spawning escapement in 1985 indicated between 68% and 114% of target egg depositions were met. MSW salmon returns in 1986 were forecasted to be about 28,400 fish and thus spawning requirements should be met. Returns of 1SW salmon could be about 40,700 fish, with a potential surplus for harvest of 18,100 fish.

Mark-recapture data in 1985 indicate that the catch efficiency of the Millbank trap has decreased significantly since it was last estimated in 1973. This may have resulted from dredging activities around Millbank which began in 1981. Because of the importance of Millbank data for estimating spawning escapement into the Miramichi River, a mark-recapture experiment will be conducted again in 1986. Several years of mark-recapture information are needed to determine the annual variation in the catch efficiency of the Millbank trap.

RESUME

D'après une expérience de marquage-recapture, on a estimé que 24 300 saumons ayant passé plusieurs hivers en mer et 46 400 saumons ayant passé un hiver en mer sont retournés à la rivière Miramichi en 1985. Comme en 1984, la récolte de saumons ayant passé plusieurs hivers en mer capturés dans leurs eaux natales a beaucoup diminué pour deux raisons : absence de pêche commerciale et libération obligatoire des saumons de ce type capturés dans le cadre de la pêche récréative. La diminution des récoltes a augmenté la proportion de saumons ayant passé plusieurs hivers en mer qui ont survécu au frai. Le rapport du nombre de reproducteurs au nombre total de retours a été de 0,93 en 1985, contre 0,10 en 1983, dernière année où la récolte de saumons dans leurs eaux natales a été importante. D'après les deux méthodes utilisées pour estimer l'échappement requis pour la reproduction, le niveau de ponte souhaité a été atteint en 1985 dans une proportion comprise entre 68 % et 114 %. On a prévu que les retours de saumons ayant passé plusieurs hivers en mer s'élèveraient à 28 400 en 1986 et que le nombre de reproducteurs serait par conséquent suffisant. Les retours de saumons ayant passé un hiver en mer pourraient s'élever à environ 40 700, ce qui donnerait un surplus exploitable de 18 100 poissons.

Les données obtenues en 1985 par marquage-recapture indiquent que l'efficacité de capture de la barrière Millbank a beaucoup diminué depuis qu'elle a été calculée pour la dernière fois en 1973. Il est possible que cette baisse soit attribuable à des activités de dragage qui ont commencé à cet endroit en 1981. Comme ces données sont très importantes pour l'estimation de l'échappement pour la reproduction dans la rivière Miramichi, on effectuera de nouveau une expérience de marquage-recapture en 1986. Il faudra recueillir des données pendant plusieurs années avant de pouvoir déterminer la variation annuelle de l'efficacité de capture de la barrière Millbank.

INTRODUCTION

Severe restrictions on the harvest of Atlantic salmon in the Miramichi River introduced in 1983 and 1984 were continued in 1985. Commercial fishermen in Miramichi Bay and estuary again accepted government compensation and did not fish. Anglers on all tributaries were allowed to land 1SW but not MSW salmon, and for the first in 1985, this regulation included the spring kelt fishery. Some tributaries were opened one to two weeks earlier in 1985 than in 1984 (Appendix I), but daily and seasonal limits remained at 2 and 10 fish, respectively. Catch and release of salmon was not counted against daily bag limits in 1985.

Native fishermen at Burnt Church, Eel Ground and Red Bank were not restricted by quota, as in previous years. However, restrictions on the fishing season (15 May - 18 October) were imposed in 1985.

The objective of this report was to summarize salmon landings in 1985, and to examine the status of salmon in the Miramichi River in view of the 1985 management plan.

METHODS

1. Landings and trap counts

Angling catches in the Miramichi River were estimated by both DFO and the Department of Forests, Mines and Energy (DFME). DFO officers submitted angling summaries once monthly. Because angling summaries were not available from Carleton and York counties (upper Southwest Miramichi River), 1SW landings from the rest of the Miramichi were adjusted upwards based on the proportion of catches from these counties in 1983 (Randall et al. 1985). DFO angling landings have been collected since 1951, and they are used to indicate long-term trends. For recent years, however, catches estimated by DFME are considered more accurate (Randall and Chadwick 1983) because they are based on an unbiased stub report system. Unfortunately, 1985 DFME catches were not available in time for this assessment; therefore, DFO catches were adjusted upwards using a significant correlation ($P < 0.01$) between DFO and DFME catches, 1969 to 1984 (Table 1). Angling effort was recorded in rod days, where one rod day was one angler fishing for any portion of one day.

Native landings of MSW and 1SW salmon from Burnt Church, Red Bank and Eel Ground were reported from Band Council Offices periodically during the season.

Independent counts of MSW salmon and 1SW salmon entering the Miramichi River were available from the Millbank trap (monitored since 1954) and from fish barriers on the Dungarvon and SW Miramichi tributaries (monitored by

DFME since 1981). Biological characteristics of adult salmon were determined from samples collected at Millbank and at two recapture traps at the confluence of the Northwest and Southwest tributaries (described below).

2. Recruitment

During 1985, 40 sites were electrofished to estimate juvenile salmon densities. Densities of age 0+ and 1+ salmon were estimated by the removal method (Zippin 1956); methodology for the field surveys and statistical analysis of the data was described by Randall and Chadwick (1986). Age 1+ parr densities have been used as an index of recruitment in previous assessments (Randall et al. 1985).

3. Escapement in 1985

Spawning escapement in 1985 was estimated using two methods:

Method 1: MSW and 1SW salmon returns to Millbank were estimated by a mark-recapture experiment in 1985. About 71% of MSW and 66% of 1SW salmon captured at Millbank were tagged. Two recapture traps, located at the confluence of the Northwest and Southwest Miramichi tributaries, were monitored throughout the salmon run and all tagged fish were recorded. Total returns to Millbank were estimated by the adjusted Petersen method (Ricker 1975), where

$$N = \frac{(M + 1)\ (C + 1)}{(R + 1)}$$

where M = number of salmon tagged
C = catch at the recapture traps
R = recaptures
N = population estimate at time of marking

Confidence intervals (95%) were calculated assuming R approximated a binomial distribution (Ricker 1975, Appendix II). For estimating N, tagging mortality was assumed to be 0.20. Spawning escapement was calculated as returns to Millbank minus know removals in the river.

Method 2: Ratios of spawners per MSW and 1SW salmon counted at Millbank were calculated for the period 1971 to 1983. These ratios were updated from Randall et al. (1985) using current data on parr densities, rearing area and eggs per spawner. Spawners were back-calculated from age 1+ parr densities, assuming 10% survival from eggs to parr (Elson 1957, 1974; Chadwick 1982) and a total rearing area of 55 X 106 m^2 (Amiro 1983). Eggs per fish were calculated by Randall (1985). The new ratio of spawners per salmon counted at Millbank was 9.52 (Table 2). Spawning escapement in 1985 was calculated as the product of this ratio and counts of MSW and 1SW salmon at Millbank.

For both methods, losses to disease and poaching were assumed to be 1,000 MSW and 4,000 1SW salmon, as in previous assessments. Mortality caused by catch and release of MSW salmon was estimated from data presented by Currie (1985).

Required spawners to maintain salmon at optimum levels in the Miramichi River were estimated by Randall (1985). Total egg deposition requirements were 132 X 10^6 eggs; numbers of MSW and 1SW salmon required to produce these eggs were 23,600 and 22,600, respectively.

4. Predicting salmon returns in 1986

Returns of MSW salmon to the Miramichi River in 1986 were predicted from a multiple regression between the number and proportion female 1SW salmon returns (year i) and total MSW salmon returns (year i+1). This regression was a modification of the regression used in the 1984 assessment, where counts of 1SW salmon at Millbank were used rather than total 1SW returns (Randall et. al 1985). Returns of 1SW salmon were predicted from historic averages.

RESULTS

1. Landings in 1985

Catches of 1SW kelts by anglers increased to 3,531 fish in 1985 from 644 in 1984 (Table 3). Increased catches resulted at least in part from increased effort; rod days during the kelt fishery were 6,863 in 1985 compared to 3,817 in 1984. Catches of bright 1SW salmon in 1985 were 11,926 fish (Table 3), up by 21% from 1984. As with the kelts, these increased catches probably resulted at least in part from increased effort. Total rod days during the bright salmon angling season increased in 1985 (33,159) from 1984 (28,589). Angling seasons in the Miramichi River depend on tributary; earliest and latest dates were 1 June and 15 October, respectively (Appendix I).

Reported landings of 1SW salmon were adjusted upwards by correlation between DFO and DFME (1969 to 1984; Table 1). This indicated an adjusted catch of 17,330 fish, which is compared to historic catches in Table 1.

Native fishermen at Eel Ground, Burnt Church and Red Bank reported landing 327 MSW salmon and 546 1SW salmon in 1985 (Table 4). MSW salmon landings were similar to 1984, but 1SW landings were up by 43% in 1985. Effort in all three fisheries was approximately the same as in 1984.

Total landings in 1985 were compared to 1984 and 1983 landings in Table 5. Landings of both 1SW and MSW salmon in 1985 were very similar to 1984. Historic landings for the Miramichi River are given in Table 6 and Fig. 1.

Counts of MSW and 1SW salmon at the Millbank trap in 1985 were similar to 1984 (Table 1) and remained below long-term averages. MSW and 1SW salmon catches in 1985 were only 39% and 36% of 1969 to 1984 averages, respectively (Fig. 2). However, recent counts at the Millbank trap should be interpreted with caution because the catch efficiency has apparently changed in recent years (see Section 3). Counts of both 1SW and MSW salmon at the Dungarvon and SW Miramichi barriers increased in 1985 from 1984 (Table 7; Fig. 3). Counts of MSW salmon at the SW Miramichi barrier were the highest recorded since the barrier has been monitored (Fig. 3); this indicates spawning escapement to the headwaters of this tributary was greater than in the previous four years.

2. Recruitment

Mean densities of age 0+ and 1+ parr densities in the Miramichi River in 1985 were above average (Table 8; Fig. 4). This indicated spawning levels were high in 1983 and 1984.

3. Spawning escapement in 1985

Mark-recapture information for salmon tagged at Millbank and recaptured in the two upstream traps was summarized in Table 9. Using the Petersen method and assuming a tagging mortality of 0.20, these data indicate the following returns of salmon to Millbank in 1985:

	Returns	Millbank trap efficiency
MSW	24,323 (10,859-60,808)	0.013 (0.005-0.029)
1SW	46,417 (28,785-79,007)	0.020 (0.012-0.032)

These results indicate that the Millbank trap efficiency has decreased significantly since it was last estimated in 1973. Turner (1983) estimated the Millbank trap efficiency was 0.034 and 0.044 for MSW and 1SW salmon, respectively. These 1973 efficiencies were 2.615 times greater for MSW salmon and 2.200 times greater for 1SW salmon. This change may have resulted from dredging activities around Millbank, which began in 1981.

Mortality rate of MSW salmon released by anglers was estimated to be 0.03:

River		Released	Mortality	Proportion
North Pole, Miramichi	1982	44	2	0.05
	1983	19	0	0.00
	TOTAL	63	2	0.03

Numbers of MSW salmon released by anglers were estimated using a significant correlation between counts of salmon at Millbank and angling catches, 1969 to 1983 (Table 1). Counts of salmon at Millbank in 1985 (311) were adjusted upwards by 2.615 (to 813) because of the apparent change in catch efficiency. Numbers of released MSW salmon were estimated to be 5,291; thus, assuming a mortality rate of 0.03, total angling mortalities were 159 fish.

Two adjustments were made before the ratio of spawners to salmon counts at Millbank (Method 2) was used to estimate escapement. First, adjusted Millbank counts of MSW salmon (813) and 1SW salmon (2,006) were used. Second, estimated angling catches (minus catch and release mortalities) of MSW salmon were added to the estimated spawners; this was necessary because these fish were not removed in 1985 as they were in other years when the spawner/Millbank count ratio was calculated (Table 2).

Spawning escapement in 1985, as estimated by Methods 1 and 2, are given below:

	Method 1	Method 2
MSW salmon		
1. Total returns	24,323	
2. Harvest	327	
3. Poaching and disease	1,000	
4. Broodstock	101	
5. Trap mortalities	81	
6. Catch and release mortality	159	
7. Spawners	22,655	12,872
8. Required spawners	23,600	23,600
% of target achieved	96%	55%

1SW salmon

1. Total returns	46,417	
2. Harvest	17,876	
3. Poaching and disease	4,000	
4. Spawning escapement	24,541	19,097
5. Target spawners	22,600	22,600
% of target achieved	109%	85%

In terms of eggs, Method 1 indicated an egg deposition of 150.6 X 10^6 eggs (114% of requirements), while Method 2 indicated an egg deposition of 89.3 X 10^6 eggs (68% of requirements).

4. Forecast of 1986 returns

Numbers of MSW salmon expected to return to the Miramichi River in 1986 were predicted two ways. First, an unadjusted multiple correlation between 1SW returns (year i), proportion female 1SW salmon (year i), and MSW returns (year i+1) was used (Table 11). Returns to Millbank were estimated assuming a constant catch efficiency at the Millbank trap, 1971 to 1984. Because of the potential change in the Millbank catch efficiency since 1981, a second correlation was used where returns from 1981 to 1984 were recalculated using the 1985 estimates of catch efficiency for 1SW and MSW salmon. Results of these regressions are given below:

	R^2	F	P < F	Prediction
Unadjusted (Table 11)	0.65	9.99	0.0034	28,359
Adjusted	0.52	5.96	0.0176	30,297

Because the unadjusted data gave the best regression, these data were used to predict 1986 returns. The equation was:

$$y = 48{,}937.13 + 0.42\ X_1 - 1{,}403.66 \arcsin \sqrt{X_2}$$

where y = returns of MSW salmon (year i+1)
X_1 = Millbank 1SW returns (year i)
X_2 = proportion female 1SW salmon (year i)

Salmon returns were predicted to be 28,359 (5,485-51,233).

Average 1SW returns for the past 5 years suggest 1986 returns could be about 40,700 fish. 1SW salmon in 1986 will be predominantly from the 1982 year-class; densities of age 1+ parr of this year-class were slightly above average (Table 8).

DISCUSSION

Results of the mark-recapture experiment indicated that about 24,300 MSW and 46,400 1SW salmon returned to the Miramichi River in 1985. Both sea-age groups of salmon returned in slightly greater numbers than predicted in the 1984 assessment; predictions were 18,400 MSW salmon and 42,000 1SW salmon (Randall et al. 1985). As in 1984, the ban on homewater harvests of MSW salmon increased the proportion of returns that potentially survived to spawning in 1985. The ratio of spawners to total returns was 0.93 in 1985, compared to 0.10 in 1983 (Table 12), when homewater harvests of MSW salmon were substantially higher (Table 5). Method 1 indicated that spawning requirements were met in 1985. However, Method 1 may underestimate losses in freshwater due to poaching and other unaccounted mortalities (Randall et al. 1985) and therefore spawning escapement would be overestimated. Method 2 indicated 68% of the required egg deposition was met. In either case, these results indicate the most optimistic estimate of spawning success in the Miramichi River in recent years. Juvenile salmon densities (age 0+) in 1985 were the highest ever recorded (Table 8), suggesting spawning escapement was good in 1984 as well.

The estimate of MSW salmon returns should be considered with some caution because the number of recaptures at the upstream traps was only four fish. This is the minimum number of recaptures required for statistically valid results (Ricker 1975, pg. 79). However, estimates of both MSW and 1SW salmon returns were consistent in showing that the catch efficiency of the Millbank trap in 1985 was significantly less than in 1973, the last year when the catch efficiency was tested (Turner 1983). Dredging in the lower Miramichi River above and below Millbank may have caused this change in the trap catch efficiency (Randall et al. 1985). Because dredging began in 1981, it is possible that Millbank catches have underestimated salmon returns since that year. The mark-recapture experiment will be repeated in 1986 to retest the catch efficiency, and to estimate total salmon returns in that year.

Correlation between total returns of 1SW salmon (year i) and returns of MSW salmon to Millbank (year i+1) (Table 11) predicted MSW salmon returns in 1986 of about 28,400 fish. Thus, spawning requirements should be met, with a potential surplus of 4,800 salmon. However, because of the uncertainty of Millbank catches as an index of stock abundance, it would be safer to assume no surplus of MSW salmon available for harvest until the Millbank catch efficiency can be retested in 1986. Returns of 1SW salmon in 1986 could be about 40,700 fish, indicating a potential surplus of 18,100 fish.

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Table 1. Angling statistics for MSW and 1SW salmon in the Miramichi River as estimated by DFME and DFO, and salmon catches at Millbank 1969 to 1985.

Year	MSW salmon			1SW salmon		
	DFO	DFME	Millbank	DFO	DFME	Millbank
1969	2,827	3,804	667	26,715	24,284	4,350
1970	2,057	3,268	245	19,662	19,610	2,484
1971	1,247	1,792	399	8,464	13,727	1,962
1972	5,456	8,933	1,151	15,472	19,101	2,543
1973	4,881	5,977	1,132	9,033	13,857	2,450
1974	5,895	7,184	1,791	17,957	18,232	4,038
1975	3,756	6,288	1,208	9,730	15,598	3,548
1976	5,319	7,374	943	14,749	27,182	4,939
1977	14,344	11,617	1,934	8,244	13,590	1,505
1978	4,196	4,893	693	5,353	8,265	1,268
1979	2,422	2,656	318	7,625	14,508	2,500
1980	5,422	6,546	1,093	7,533	11,997	2,139
1981	1,602	3,238	199	7,031	22,716	2,174
1982	2,642	4,608	408	9,217	21,402	2,665
1983	1,646	2,240	245	3,897	8,390	810
1984	0	0	333	9,892	18,794	1,010
1985	0	(5,291)a	311	11,926	(17,330)b	912

a Angling catch and release of MSW salmon in 1985 was estimated from a correlation between Millbank salmon (x) and DFME salmon (y) from 1969 to 1983; y = 1,746.56 + 4.36 (x), r = 0.89, y (1985) = 5,291. The catch of MSW salmon in 1985 was adjusted upwards (from 311 to 813) because of the change in catch efficiency of the Millbank Trap (see text).

b 1985 DFME angling catch of 1SW salmon estimated from correlation between DFO salmon (x) and DFME salmon (y) from 1969 to 1984; y = 10,312.0 + 0.59 (x), r = 0.66, y (1985) = 17,330.

Table 2. Ratios of spawner to fish (1SW and MSW) counted at Millbank Trap, 1971 to 1983 (see text).

Year (i)	Parr (i+2)	Eggs/ fish	Spawners MSW	Spawners 1SW	Ratio of spawner to Millbank count
1971	0.016	1,206	1,233	6,064	3.09
1972	0.097	1,911	8,710	19,207	7.57
1973	0.112	2,125	9,160	19,828	8.09
1974	0.099	2,444	6,840	15,439	3.82
1975	0.096	2,149	6,241	18,329	5.17
1976	0.100	1,541	5,711	29,980	6.06
1977	0.074	3,761	6,082	4,740	3.14
1978	0.063	2,846	4,298	7,877	6.20
1979	0.091	1,370	4,128	32,405	12.98
1980	0.094	2,492	7,012	13,734	6.42
1981	0.104	956	5,026	54,807	25.26
1982	0.068	1,450	3,430	22,363	8.41
1983	0.097	1,832	6,756	22,365	27.58
				Mean	9.52
				SD	7.95

Table 3. Angling landings in the Miramichi River, 1985. Data from Department of Fisheries and Oceans.

	Black 1SW No.	Black 1SW Kg	Bright 1SW No.	Bright 1SW Kg	Rod days
April	2,161	3,071			3,959
May	1,370	1,801			2,904
June			597	914	4,398
July			4,691	6,842	10,428
August			3,458	5,571	7,317
September			3,053	5,262	10,208
October			127	230	808
TOTAL	3,531	4,872	11,926	18,819	40,022

Table 4. Native fishery landings and effort in the Miramichi River and Bay, 1985. Landings and effort for 1984 given for comparison.

Fishery	Landings		Effort		
	MSW	1SW	Nets	Maximum length (M)	Season
1985					
Red Bank	127	216	12	12.2	May 20 - Oct. 15
Eel Ground	195	330	18	33.6	June 3 - Oct. 18
Burnt Church	5	0	15	45.8	May 15 - Oct. 15
Total	327	546			
1984					
Red Bank	108	147	12	12.2	June 7 -
Eel Ground	200	233	18	33.6	June 4 -
Burnt Church	1	1	15	45.8	May 7 -
Total	309	381			

Table 5. Preliminary 1985 salmon landings in the Miramichi River by Native fishermen and anglers. Landings for 1983 and 1984 given for comparison.

Fishery	1985		1984		1983	
	MSW	1SW	MSW	1SW	MSW	1SW
Commercial traps	-	-	-	-	2,133	1,217
drift	-	-	-	-	14,455	295
by-catch	-	-	-	-	467	76
Native	327	546	309	381	171	357
Angling[1]	-	17,330	-	18,794	2,240	8,390
Total	327	17,876	309	19,175	19,466	10,335

1 Angling landings for 1983 and 1984 are from DFME; landings in 1985 were adjusted DFO catches (Table 1).

Table 6. Recorded catches of salmon in all fisheries, Miramichi River, 1951-85 (includes commercial, by-catch, recreational and Native). Kelts angled in year i are added to landings in year i-1. Data sources are given in Appendix II. 1985 data are preliminary. All data are numbers x 10^3.

	COMMERCIAL			ANGLING CATCH							NATIVE			GRAND
				Kelts (yr i+1)			Bright (yr i)							
Year	1SW	MSW	Total	1SW	MSW	Total	1SW	MSW	Total	Total	1SW	MSW	Total	TOTAL
1951		27.6	27.6			12.0			9.6	21.6				49.2
1952		27.3	27.3			11.3			15.9	27.2				54.5
1953		24.4	24.4			10.1			18.2	28.3				52.7
1954		50.6	50.6			11.2			23.5	34.7				85.3
1955		15.3	15.3			8.9			14.7	23.6				38.9
1956		24.7	24.7			9.3			28.9	38.2				62.9
1957		29.9	29.9			8.4			19.5	27.9				57.8
1958		25.2	25.2			10.2			36.7	46.9				72.1
1959		37.3	37.3			9.5			10.3	19.8				57.1
1960		30.8	30.8			5.6			4.5	10.1				40.9
1961		30.0	30.0			9.5			11.0	20.5				50.5
1962		41.6	41.6			7.3			10.3	17.6				59.2
1963		40.7	40.7			5.2			50.9	56.1				96.8
1964		69.8	69.8			9.0			35.1	44.1				113.9
1965		69.5	69.5			16.0	38.7	3.9	42.6	58.6				128.1
1966		72.9	72.9			20.0	51.7	5.9	57.6	77.6				150.5
1967		102.2	102.2			14.1	41.8	4.1	45.9	60.0				162.2
1968		48.5	48.5			6.9	7.0	1.5	8.5	15.4				63.9
1969		41.3	41.3	3.7	1.6	5.3	24.3	3.8	28.1	33.4				74.7
1970		39.7	39.7	2.4	1.4	3.8	19.6	3.3	22.9	26.7				66.4
1971		18.3	18.3	1.5	0.5	2.0	13.7	1.8	15.5	17.5				35.8
1972		2.5	2.5	1.5	3.0	4.5	19.1	8.9	28.0	32.5				35.0
1973		0.9	0.9	1.5	3.0	4.5	13.9	6.0	19.9	24.4				25.3
1974		1.0	1.0	1.8	3.1	4.9	18.2	7.2	25.4	30.3				31.3
1975	0.4	0.7	1.1	2.3	1.4	3.7	15.6	6.3	21.9	25.6	0.4	0.2	0.6	27.3
1976	1.8	0.9	2.7	2.4	2.2	4.6	27.2	7.4	34.6	39.2	0.2	0.2	0.4	42.3
1977	0.4	6.9	7.3	1.4	2.1	3.5	13.6	11.6	25.2	28.7	0.5	0.4	0.9	36.9
1978	1.2	8.4	9.6	2.2	1.7	3.9	8.2	4.9	13.1	17.0	0.4	0.4	0.8	27.4
1979	5.5	1.7	7.2	2.2	1.5	3.7	14.5	2.7	17.2	20.9	0.1	0.2	0.3	28.4
1980	2.7	10.9	13.6	1.7	2.1	3.8	12.0	6.5	18.5	22.3	-	-	-	35.9
1981	1.6	7.8	9.4	2.7	1.4	4.1	22.7	3.2	25.9	30.0	1.0	0.5	1.5	40.9
1982	2.3	12.5	14.8	1.1	0.4	1.5	21.4	4.6	26.0	27.5	0.7	0.4	1.1	43.4
1983	1.6	17.1	18.7	1.6	0.7	2.3	8.4	2.2	10.6	12.9	0.4	0.2	0.6	32.2
1984	0.0	0.0	0.0	3.5	0.0	3.5	18.8	0.0	18.8	22.3	0.4	0.3	0.7	23.0
1985	0.0	0.0	0.0	-	-	-	17.3	0.0	17.3	17.3	0.5	0.3	0.8	18.1

Table 7. Numbers of MSW and 1SW salmon counted at barriers in two tributaries of the Miramichi River, 1981 to 1985.

Tributary	Year	MSW	1SW	Total
North Branch of S.W. Miramichi	1981	54	645	699
	1982	288	615	903
	1983	223	284	507
	1984	297	228	525
	1985	604	492	1,096
Dungarvon River	1981	112	570	682
	1982	113	450	563
	1983	126	325	451
	1984	93	315	408
	1985	162	536	698

Table 8. Juvenile Atlantic salmon densities (number .100 m-2) in the Miramichi River, 1970 to 1985. (n = number of sites; 95% confidence limits in parenthesis.)

Year	n	Age 0+	Age 1+
1970	44	14.6 (9.4-22.5)	3.0 (2.4- 3.9)
1971	66	14.5 (10.8-19.4)	5.1 (3.9- 6.7)
1972	66	5.5 (4.2- 7.3)	5.1 (4.0- 6.4)
1973	73	17.5 (13.1-23.5)	1.6 (1.4- 1.9)
1974	90	24.4 (17.7-33.7)	9.7 (7.4-12.5)
1975	89	25.7 (18.7-35.4)	11.2 (8.6-14.5)
1976	80	18.8 (13.7-25.7)	9.9 (7.6-12.9)
1977	86	34.8 (25.4-47.7)	9.6 (7.5-12.4)
1978	87	22.7 (17.4-29.5)	10.0 (7.6-13.1)
1979	48	13.4 (9.6-18.7)	7.4 (5.4-10.3)
1980	45	21.5 (14.7-31.6)	6.3 (4.5- 8.9)
1981	47	41.3 (28.4-60.0)	9.1 (6.3-13.1)
1982	85	11.1 (8.5-14.4)	9.4 (7.3-12.1)
1983	85	27.9 (20.6-37.8)	10.4 (7.9-13.8)
1984	85	16.6 (12.2-22.5)	6.7 (5.3- 8.3)
1970-84 mean		20.7	7.6
1985	40	49.5 (27.4-89.3)	9.7 (6.7-14.2)

Table 9. Summary of mark-recapture data in the Miramichi River, 1985.

	Millbank	Recapture traps		
		Southwest	Northwest	Total
MSW				
Catch	311	486	204	690
Meshed	27	41	13	54
Broodstock	40	61	0	61
Tagged	222[1]	-	-	
Recaptures	3	4	0	4
1SW				
Catch	912	848	695	1,543
Tagged	600	-	-	-
Recaptured	1	10	5	15

[1] 3 MSW salmon were tagged in late October and were not considered accessible to the recapture traps.

Table 10. Estimated escapement, commercial landings and total salmon and grilse returns to the Miramichi River, 1971 to 1985.

	Escapement		Commercial		Returns	
Year	1SW	MSW	1SW	MSW	1SW	MSW
1	2	3	4	5	6	7
1971	44,591	11,735	0	18,268	44,591	30,003
1972	57,795	33,853	39	2,445	57,834	36,298
1973	55,682	33,294	0	866	55,682	34,160
1974	91,773	52,676	0	963	91,773	53,639
1975	80,636	35,529	393	743	81,029	36,272
1976	112,250	27,735	1,819	878	114,069	28,613
1977	34,205	56,882	407	6,865	34,612	63,747
1978	28,818	20,382	1,234	8,377	30,052	28,759
1979	56,818	9,353	5,512	1,659	62,330	11,012
1980	48,614	32,147	2,697	10,899	51,311	43,046
1981	49,409	5,853	1,628	7,836	51,037	13,689
1982	60,568	12,000	2,311	12,511	62,879	24,511
1983	18,409	7,206	1,588	17,055	19,997	24,261
1984	22,955	9,794	-	-	22,955	9,794
1985	46,417	24,323	-	-	46,417	24,323

Data sources: Column 2: Millbank trap catch/0.044
3: Millbank trap catch/0.034
4 and 5: from Redbooks; 1982 and 1983 drift landings adjusted for underreporting (Randall and Schofield 1983)
6: 2 + 4
7: 3 + 5

Table 11. Total returns of MSW and 1SW salmon (calculations in Table 10) to the Miramichi River, 1971 to 1985. Proportion of 1SW salmon which were female is also given. Returns of MSW salmon forecasted for 1986 is given in parenthesis (regression equation in text).

Year	1SW returns (year i)	% females (year i)	MSW returns (year i+1)
1971	44,591	11.0	36,298
1972	57,834	22.0	34,160
1973	55,682	16.9	53,639
1974	91,773	30.2	36,272
1975	81,029	27.4	28,613
1976	114,069	24.1	63,747
1977	34,612	22.8	28,759
1978	30,052	37.4	11,012
1979	62,330	27.4	43,046
1980	51,311	19.3	13,689
1981	51,037	25.1	24,511
1982	62,879	29.5	24,261
1983	19,997	29.2	9,794
1984	22,955	21.7	24,323
1985	46,417	22.8	(28,359)

Table 12. Comparison of predicted and actual returns of salmon as estimated in annual assessments of the Miramichi salmon stock, 1982 to 1986. Estimates of actual returns and ratio of spawners to returns are based on Method 2 (see text).

	1SW returns			MSW returns		
Year	Predicted	Actual	Spawners/ returns ratio	Predicted	Actual	Spawner/ returns ratio
1982		62,500	0.63		20,000	0.31
1983	80,700	20,000	0.18	43,000	23,600	0.10
1984	50,000	23,000	0.34	10,000	9,800	0.85
1985	42,000	46,400	0.53	18,400	24,300	0.93
1986	40,700			28,400		

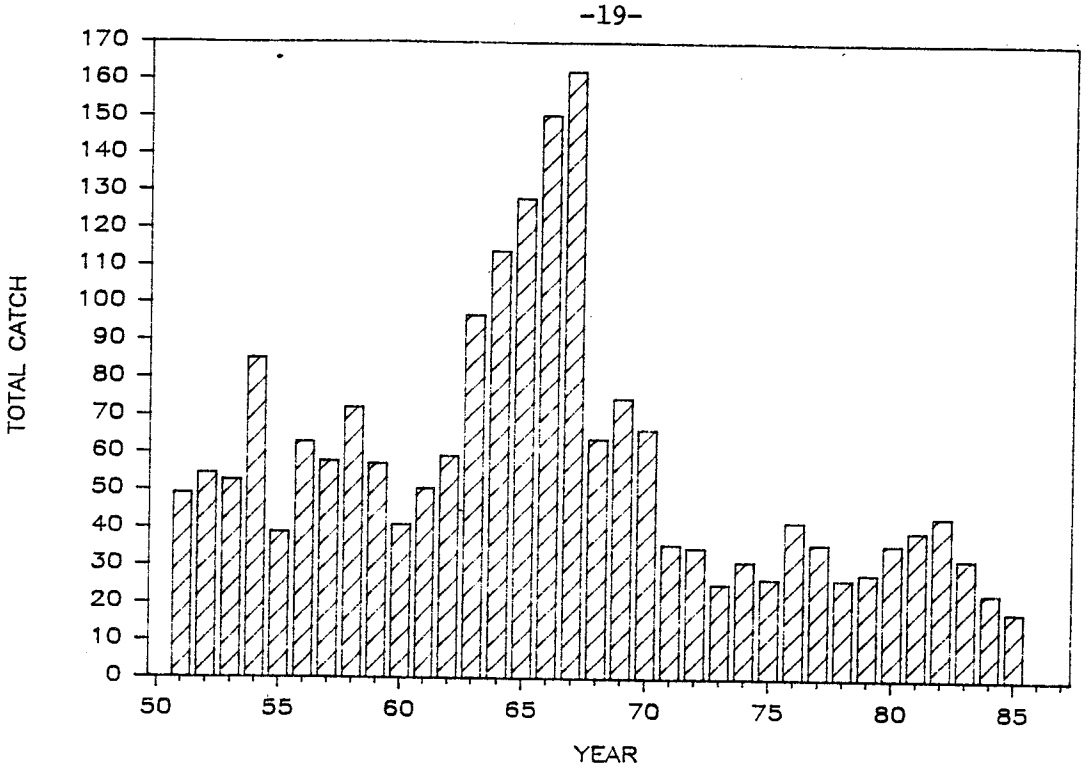


Figure 1. Total landings of salmon (numbers x 10^3) in the Miramichi River, 1951 to 1985.

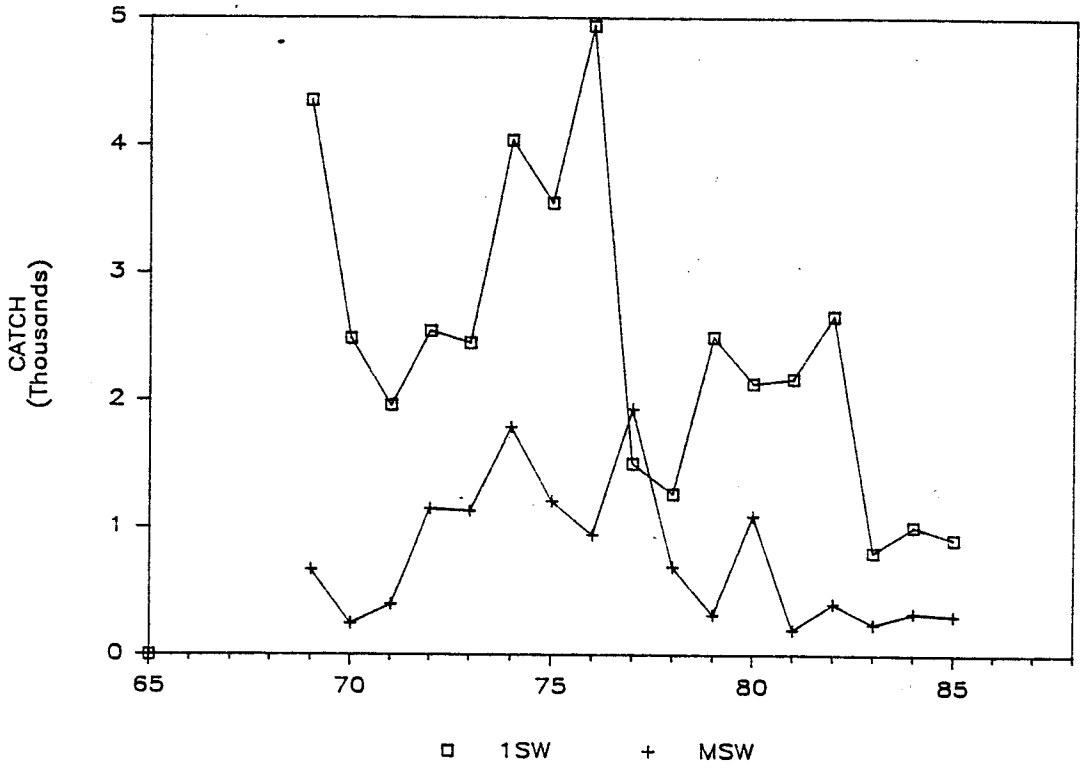
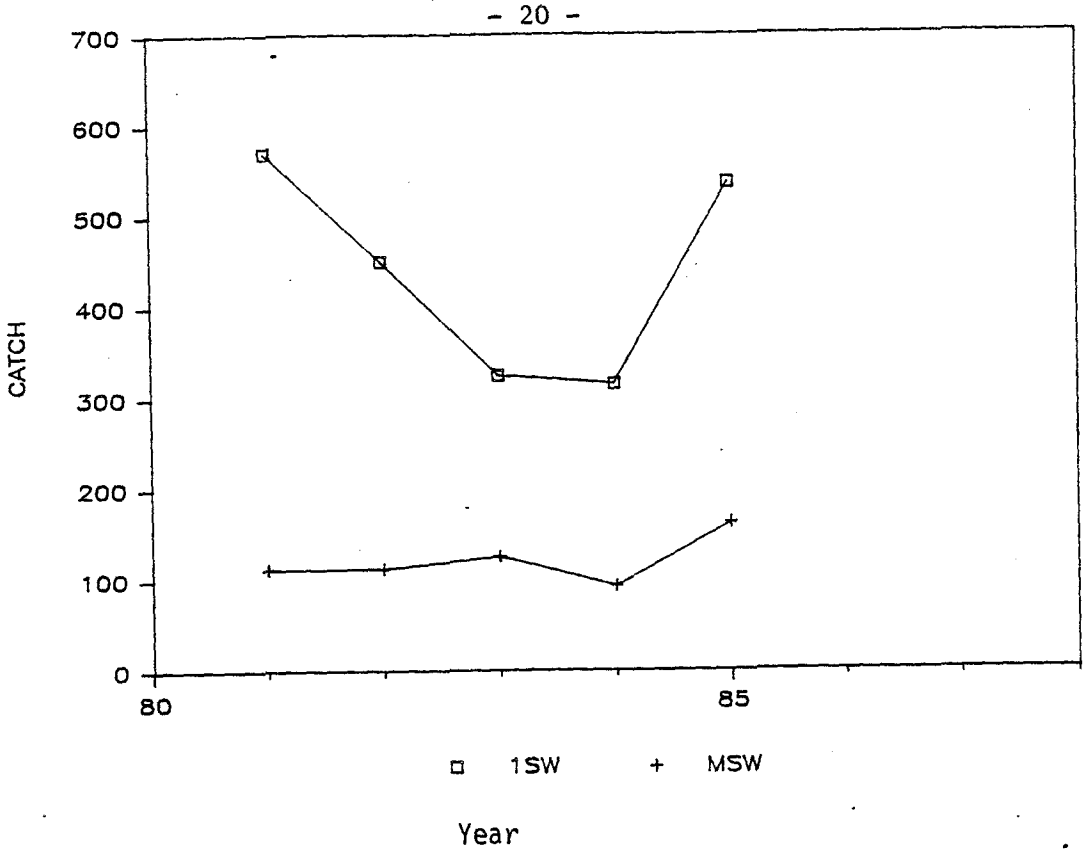


Figure 2. Catches of 1SW and MSW salmon at the Millbank trap, 1969 to 1985.



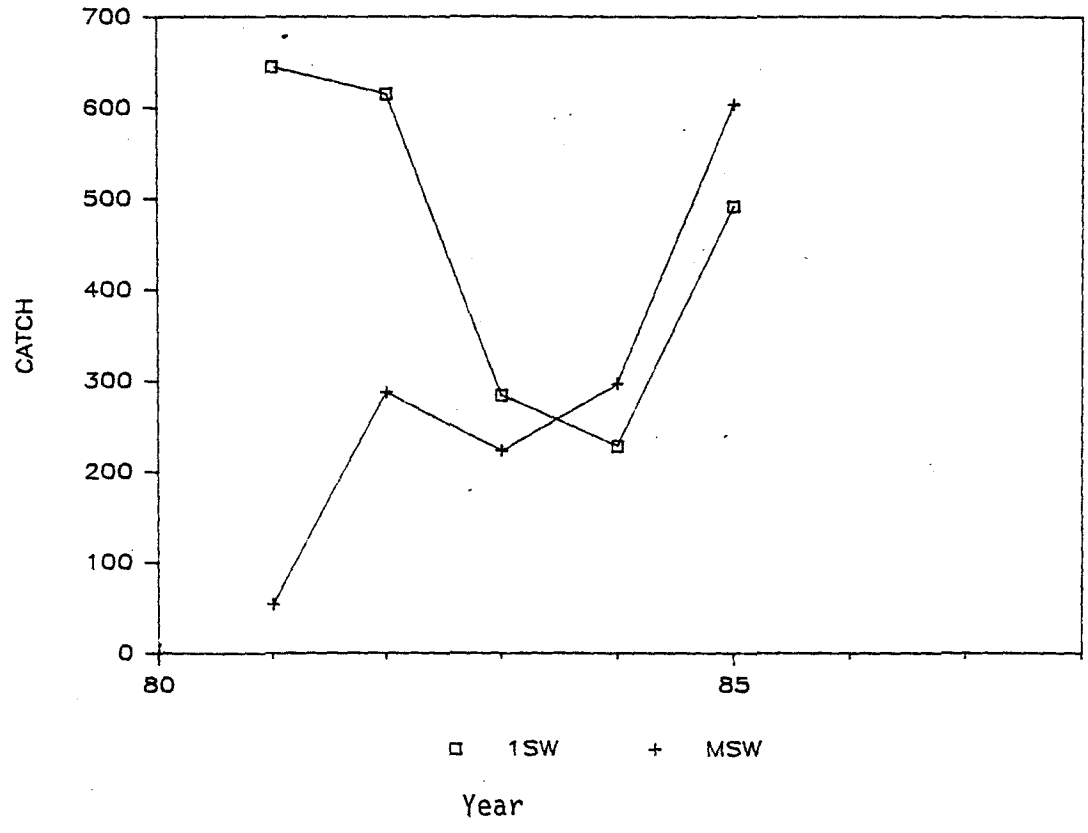


Figure 3. Catches of MSW and 1SW salmon at the Dungarvon (upper figure) and SW Miramichi barriers, 1981 to 1985.

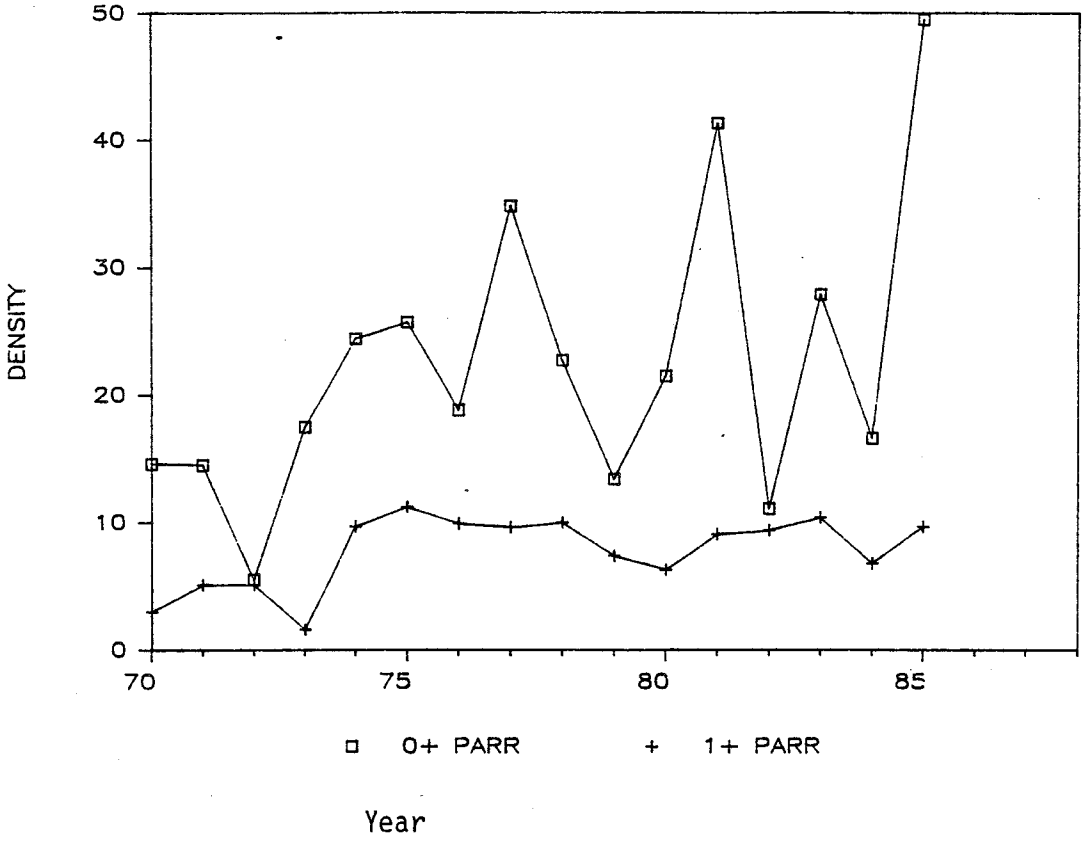


Figure 4. Mean densities (no. 100 m^{-2}) of age 0+ and 1+ salmon parr in the Miramichi River, 1970 to 1985.

APPENDIX I. Angling seasons on Miramichi tributaries, 1985 and 1984.

Tributary	Season 1985	Season 1984
General (Bright salmon)	8 June - 30 September	15 June - 30 September
Exceptions		
Bartholomew	Closed	Closed
Bartibog	1 July - 15 October	1 July - 15 October
Cains	1 July - 15 October	1 July - 15 October
Dungarvon (above Underwood Brook)	8 June - 15 September	15 June - 15 September
Little Southwest (above Catamaran)	8 June - 15 September	15 June - 15 September
Southwest (above MacKeil Brook)	8 June - 15 September	15 June - 15 September
Northwest (above Little River)	1 June - 31 August	15 June - 31 August
Renous (above North Renous)	8 June - 15 September	15 June - 15 September
Rocky Brook	1 June - 31 August	15 June - 31 August
Sevogle (above Square Forks)	8 June - 15 September	15 June - 15 September
Southwest (above Cains, except as above)	8 June - 15 September	15 June - 15 September

APPENDIX II

Salmon landings for Miramichi Bay and River given in Table 6 are from the following sources:

1. Commercial data

Commercial data for 1951 to 1969 are from May and Lear (1971) and assume salmon weigh 4.46 kg on average.

Commercial data 1970 to 1983 are from Redbooks (compiled by Freshwater and Anadromous Division, Research Branch, Halifax). Redbook drift net landings are adjusted upwards by 1.5 (1982) and 2.48 (1983) as discussed by Randall and Schofield (1983).

2. Angling data

Angling data for 1951 to 1959 from Smith (1981); 1960 to 1968 from Swetnam and O'Neil (1985); 1969 to 1984 from DFME.

3. Native data

Native fisheries landings are from DFO unpublished files.

4. All 1985 data are preliminary.