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Biological Assessment of Atlantic Salmon in the  
Miramichi River, N.B., 1983

by

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#### ABSTRACT

Approximately 20,000 salmon and 12,400 grilse were landed in the commercial, recreational and Native Miramichi fisheries in 1983. Although commercial driftnet fishermen reported a good season, all other fisheries were down and spawning escapement to the river was poor (only 10 to 70% of spawning requirements). Low grilse catches in 1983, the poorest on record, suggest that salmon returns in 1984 will be low. Spawning requirements will probably not be met without any homewater fisheries.

#### RESUME

En 1983 on a pris environ 20 000 saumons et 12 400 castillons dans les pêches de la Miramichi, soit commerciales, sportives et des autochtones. La pêche commerciale au filet dérivant a été bonne mais les autres pêches étaient à la baisse et le nombre de géniteurs ayant échappé à la pêche fut faible (entre 10 et 70% des besoins en progéniture). Les prises de castillons en 1983, les plus faibles jamais enregistrées, laissent présager de piètres prises de saumons en 1984. Même si aucune pêche ne devait se faire du saumon arrivant dans ces eaux d'origine, il est improbable que le nombre requis de géniteurs sera atteint.

## INTRODUCTION

This paper presents a biological assessment of the Miramichi River salmon population for 1983. Estimated spawning escapement in 1983 is compared to required spawning levels, and a preliminary forecast of salmon available for harvest in 1984 is presented. All 1983 salmon landings presented in this report are preliminary.

There were several restrictions on the Miramichi salmon fisheries in 1983. As in 1982, the commercial fishery was restricted to a quota of 10,000 salmon and 4,000 grilse. The season for trap nets was shortened by two weeks to 15 June to 31 July, which coincided with the drift net season. The season for the angling fishery was also shortened by two weeks, opening on 15 June rather than 1 June as in 1982. (Closing dates for the angling fishery differs for different tributaries in the Miramichi, but all waters were closed by 30 October). The seasonal bag limit for anglers was the same as in 1982: 5 salmon and 5 grilse. There were no quota or seasonal restrictions on the Native fisheries.

## METHODS

### a) Landings

Commercial salmon landings from Miramichi Bay and estuary drift net and trap net fisheries were summarized from log books submitted weekly by the fishermen. Catches were reported as grilse (1 SW salmon, < 63 cm) and salmon (2 SW and older salmon,  $\geq$  63 cm). As in 1982, serious under-reporting was suspected in the driftnet fishery (M. Leveque, DFO, Tracadie). Reported landings were adjusted by assuming that changes in the proportion of large salmon from 1982 to 1983 occurred consistently in all fisheries (Table 1).

Native fishery landings from Eel Ground, Red Bank and Burnt Church Indian Reserves were reported from the Band Council offices.

Angling statistics for the Miramichi River are normally available from two independent sources, the Department of Fisheries and Oceans (DFO) and the New Brunswick Department of Natural Resources (DNR).

Both sets of data show similar trends, but in terms of absolute numbers, DNR statistics are considered to be more accurate (Randall and Chadwick 1983). DNR data for 1983 were not available and therefore estimates were made from significant correlations between DNR and DFO (or Millbank) salmon and grilse counts, 1969-1982 (see results).

Landings in the fisheries were compared to counts of salmon and grilse at the Millbank fish trap and at fish barriers operated on the Dungarvon and S.W. Miramichi tributaries. The Millbank trap has been operated since 1954 and provides a reliable and independent estimate of stock abundance. Fish barriers have been operated by the Department of Natural Resources since 1981.

Ages and sizes of salmon were determined from samples taken in the three fisheries and at the Millbank trap. Over 700 salmon were aged to identify the spawning year-classes that contributed to the 1983 salmon run.

b) Spawning requirements

Egg deposition requirements for the Miramichi River were estimated by Randall and Chadwick (1983); details of the methodology used can be found in that report.

c) Spawning escapement in 1983

Spawning escapement in 1983 was estimated using 3 methods:

Method 1 - an angling exploitation rate of 0.246 and 0.257 was used for salmon and grilse, respectively. These were based on a tagging experiment carried out on the Miramichi River from 1971 to 1975 (Randall and Chadwick 1983).

Method 2 - Millbank trap efficiencies of 0.034 and 0.044 were used for salmon and grilse, respectively. These were calculated from a Peterson mark-recapture experiment for fish tagged at Millbank (Turner, 1983) in 1973.

Method 3 - Ratios of spawners per fish counted at Millbank and per fish angled in the recreational fishery were used. Spawners were back-calculated from 1+ parr densities, assuming a 10% survival rate, for the period 1971 to 1980. These ratios are:

	<u>Millbank count</u>	<u>Angling</u>
Salmon	5.2863	0.8518
Grilse	5.2865	0.9064

In all three methods, losses due to poaching and disease were assumed to be 1,000 salmon and 4,000 grilse (Randall and Chadwick 1983).

d) Predicting 1984 returns

Total numbers of salmon returning to the Miramichi River in 1984 were predicted from a significant multiple correlation between the numbers of grilse and percent female grilse at Millbank in year (i) and total salmon returns in year (i+1). The use of both of these variables to predict salmon returns is discussed by Marshall et al. (1982).

RESULTS

a) 1983 landings

Forty-seven trap net fishermen and 75 drift net fishermen were licensed in 1983, and of these 98% and 92% submitted log records for the trap and drift net fisheries, respectively. Unadjusted commercial landings indicated a total catch of 1,483 grilse and 7,470 salmon (Table 2). As previously mentioned, however, serious under-reporting of salmon was suspected in the drift net fishery. Reported landings were therefore adjusted upwards by a factor of 2.48. The two assumptions in this adjustment were, first, that the reporting of grilse was accurate in the drift net fishery and, second, that consistent annual changes in the salmon to grilse ratio would be seen in all fisheries (Table 1). Adjusted landings indicate that the quota for salmon (10,000) was exceeded by 60%, while the quota for grilse (4,000) was not achieved (Table 2).

Native fisheries at Red Bank, Eel Ground and Burnt Church reported a total harvest of 171 salmon and 357 grilse (Table 3).

Angling catches of bright and black salmon in 1983 were 1,646 and 1,442 fish respectively (Table 4). Grilse catches were 3,897 and 1,306 for bright and black grilse, respectively.

Total 1983 landings were 20,033 salmon and 12,358 grilse (Table 5). Salmon catches were down slightly for all fisheries except commercial drift nets from 1982. Grilse landings were down by about 50% from 1982. Total landings in 1983 were lower than in 1971, the year before the ban in the commercial fishery (Table 6; Fig. 1).

Counts of salmon and grilse at Millbank in 1983 were lower than historic levels (Table 7). Catches of grilse were only 30% of the 1969 to 1982 average. Counts of grilse were also down at fish barriers on the Dungarvon and S.W. Miramichi tributaries (Table 8), monitored by the New Brunswick Department of Natural Resources. Counts of salmon at the two barriers were similar to 1982 (Table 8).

Adult salmon sampled at Millbank (Fig. 2), Escuminac (Fig. 3), and from the recreational fisheries (Fig. 4) indicated that large salmon were composed of approximately equal proportions of two year-classes, 1978 and 1979. Grilse were also from 2 year-classes, 1979 and 1980.

b) Spawning requirements

Egg deposition requirements for the Miramichi River were 13,400 salmon and 38,500 grilse (Randall and Chadwick 1983). Total egg requirements were 115,828,800 eggs. Recent unpublished data indicates that this estimate of egg requirements is an underestimate, perhaps by as much as 30%. New target spawning requirements based on recent fecundity information, will be used in the 1984 stock assessment.

c) Spawning escapement in 1983

All three methods indicated that spawning requirements were not met in 1983. Methods 2 and 3 indicated that 1983 spawning escapement was only 20% of requirements:

	<u>Method 1</u>	<u>Method 2</u>	<u>Method 3</u>	
			Millbank	Angling
<u>Salmon</u>				
1. Returns (add 2. to 5. inclusive)	30,770	23,563	22,478	24,167
2. Harvest*	20,033	20,033	20,033	20,033
3. Poaching and disease	1,000	1,000	1,000	1,000
4. Broodstock	150	150	150	150
5. Spawning escapement	9,587	2,380	1,295	2,984
6. Target escapement	13,400	13,400	13,400	13,400
% of target escapement achieved	72%	18%	10%	22%
<u>Grilse</u>				
1. Returns (add 2. to 5. inclusive)	42,552	19,966	20,640	25,824
2. Harvest*	12,358	12,358	12,358	12,358
3. Poaching and disease	4,000	4,000	4,000	4,000
4. Broodstock	-	-	-	-
5. Spawning escapement	26,194	3,608	4,282	9,466
6. Target escapement	38,500	38,500	38,500	38,500
% of target escapement achieved	68%	9%	11%	25%

\* includes recreational, commercial, Native and by-catch.

d) Forecast of salmon returns in 1984

Total numbers of salmon returning to the Miramichi River in 1984 were predicted from a significant multiple regression (Table 9):

$$\log_e y = 4.9428 + 0.8504 \log_e x_1 - 0.0437 \arcsine \sqrt{x_2}$$

$$R^2 = 0.57 \quad (P < 0.025)$$

where: y = 1984 returns of salmon  
 x<sub>1</sub> = Millbank grilse catch in year i  
 x<sub>2</sub> = % female grilse in year i

Because of low grilse returns in 1983, salmon returns in 1984 are predicted to be only 9,967 fish (95% confidence limits: 3,143 - 31,603). Thus, spawning requirements in the Miramichi River will not be met without any fisheries. This prediction should be used with caution, however, since the 1983 grilse count (810) is out of the range used in the regression (Table 9).

Based on estimated average returns of grilse from 1979 to 1983 (Table 10), returns of grilse in 1984 could be about 50,000 fish. This is supported by parr densities in 1981-82 which were average (Table 11).

#### DISCUSSION

Salmon returns to the Miramichi River in 1983 were critically low. Although commercial drift net fishermen in Miramichi Bay reported a good season, spawning escapement to the river was poor. Catches of salmon at Millbank, in the Native Fisheries and in the recreational fisheries in 1983 were all lower than in 1982 (particularly grilse) and more importantly they were substantially lower than historic averages (1969 to 1982). Total salmon spawning escapement in 1983 was estimated to be from 10 to 70% of spawning requirements. Total salmon landings in 1983 were lower than in 1971, the year before the commercial salmon ban (Fig. 1). Reported salmon landings at present are clearly at an historic low.

Both salmon and grilse returns in 1983 were less than what was predicted in the 1982 assessment (Randall and Chadwick 1983). Low grilse returns may have been caused by: (i) the majority of the 1979 year-class smoltifying at age 2 and therefore returning at age 3 grilse in 1982 (Randall, unpublished data) and/or (ii) a weak 1979 year-class (indicating poor spawning escapement in 1978). Low salmon returns may have resulted from significantly higher than reported drift net salmon catches and a weak 1979 year-class. Low water levels in 1983 also may have affected salmon and grilse angling catches, and possibly delayed salmon migration into the river and thereby increased their susceptibility to the drift net fishery.

Critically low grilse levels in 1983, as evidenced by the Millbank trap counts and landings by anglers, suggest that salmon returns in 1984 are going to be poor. Spawning requirements will probably not be achieved in 1984, even without a homewater fishery. Grilse returns are expected to be greater in 1984 than in 1983.

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Table 1. Proportion of large salmon in the recreational, Millbank trap net and drift net catches, 1982 and 1983

Year	% large salmon			
	Recreational	Millbank	Trap	Drift
1982	18	13	53	97
1983	25	23	59	95
change	+7	+10	+6	- 2

Grilse were scarce in 1983 and this is reflected in the fact that the proportion of large salmon increased between 1982 and 1983 in the recreational and trap net fisheries and also at the Millbank trap. The apparent decrease in the proportion of salmon in the drift net landings (from 97 to 95%) was caused by under-reporting of large salmon by the drift net fishermen. To estimate the extent of the under-reporting, we assumed that the proportion of large salmon in the drift net landings increased from 97% in 1982 to 98% in 1983. This is a change of +1% from 1982, a conservative change compared to the other fisheries. Then total landed salmon would be equal to : reported grilse catches/0.02 - 291 where 291 is the reported grilse catch. The estimate is 14,260 salmon, an increase of 2.48 x the reported landings of 5,745 salmon.

Table 2. Reported and adjusted\* commercial trapnet and driftnet landings (numbers of fish) in 1983.

Fishery	Salmon	Grilse
a) Reported catch		
Trap nets	1725	1192
Drift nets	<u>5745</u>	<u>291</u>
Total	7470	1483
b. Adjusted catch*		
Trap nets	1725	1192
Drift nets	<u>14260</u>	<u>291</u>
Total	15985	1483

\* adjustment described in Table 1.

Table 3. Native Fishery landings in 1983.

Fishery	Salmon	Grilse
Red Bank	97	201
Eel Ground	72	155
Burnt Church	2	1
Total	171	357

Table 4. Recreational angling landings in the Miramichi River, 1983. Data from Department of Fisheries and Oceans.

	BLACK SALMON						BRIGHT SALMON						GRAND TOTAL		ROD DAYS
	Salmon		Grilse		Total		Salmon		Grilse		Total		No.	Kg.	
	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	No.	Kg.	
April	1077	3657	979	1333	2056	4990							2056	4990	3375
May	365	1262	327	405	692	1667							692	1667	2593
June							350	1433	256	386	606	1819	606	1819	4456
July							649	2640	1752	2857	2401	5497	2401	5497	10432
Aug.							315	1301	1166	1570	1481	2871	1481	2871	6508
Sept.							301	1247	704	1153	1005	2400	1005	2400	3087
Oct.							31	143	19	36	50	179	50	179	196
Total	1442	4919	1306	1738	2748	6657	1646	6764	3897	6002	5543	12766	8291	19423	30647

Table 5. Preliminary 1983 salmon landings in the Miramichi River by commercial, recreational and Native fisheries. Landings for 1982 (updated from Randall and Chadwick [1983]) given for comparison.

Fishery	1983		1982		
	Salmon	Grilse	Salmon	Grilse	
Commercial	Trap	1,725	1,192	2,012	1,762
	Drift	14,260 <sup>a</sup>	291	9,936	186
	By-catch	374 <sup>b</sup>	74 <sup>b</sup>	565	363
Native	171	357	381	666	
Recreational	3,503 <sup>c</sup>	10,444 <sup>c</sup>	4,608	21,402	
Total	20,033	12,358	17,502	24,379	

a 1983 driftnet landing adjusted for underreporting as indicated in Table 1; 1982 reported landings (6624) x 1.5.

b by-catch was estimated as 5% of reported commercial landings.

c recreational landings adjusted from DFO and Millbank data as indicated in Table 7.

Table 6. Recorded catches of salmon in all fisheries, Miramichi River, 1951-83 (includes commercial, by-catch, recreational and Indian). Kelts angled in year n are added to landings in year n-1. Commercial data for 1951 to 1969 are from May & Lear (1971) and assume salmon average 4.46 kg. Commercial 1970 to 1982 are from Redbooks\*. Angling data are from Smith (1981) from 1951 to 1979; 1980 to 1982 are from Redbooks. 1983 data are preliminary. All data are numbers X 10<sup>3</sup>.

Year	COMMERCIAL			RECREATIONAL						INDIAN FISHERY			GRAND TOTAL	
	Gr.	Sal.	Total	Kelts (yr n+1)			Bright (yr n)			Total	Grilse	Salmon		Total
				Gr.	Sal.	Total	Gr.	Sal.	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	4.2	1.9	6.1	26.7	2.8	29.5	35.6				76.9
1970		39.7	39.7	2.7	1.7	4.4	19.7	2.1	21.8	26.2				65.9
1971		18.3	18.3	1.5	0.8	2.3	8.5	1.2	9.7	12.0				30.3
1972		2.5	2.5	1.8	5.3	7.1	15.5	5.5	21.0	28.1				30.6
1973		0.9	0.9	2.4	5.7	8.1	9.0	4.9	13.9	22.0				22.9
1974		1.0	1.0	1.3	4.5	5.8	18.0	5.9	23.9	29.7				30.7
1975	0.4	0.7	1.1	3.7	5.1	8.8	9.7	3.8	13.5	22.3	0.4	0.2	0.6	24.0
1976	1.8	0.9	2.7	10.1	11.5	21.6	14.7	5.3	20.0	41.6	0.2	0.2	0.4	44.7
1977	0.4	6.9	7.3	1.9	5.7	7.6	8.2	14.3	22.5	30.1	0.5	0.4	0.9	38.3
1978	1.2	8.4	9.6	1.2	7.4	8.6	5.4	4.2	9.6	18.2	0.4	0.4	0.8	28.6
1979	5.5	1.7	7.2	1.6	4.4	6.0	7.7	2.4	10.1	16.0	0.1	0.2	0.3	23.5
1980	2.7	10.9	13.6	2.3	6.6	8.9	7.5	5.4	12.9	21.8	-	-	-	35.4
1981	1.6	7.8	9.4	0.9	0.6	1.5	7.0	1.6	8.6	10.1	1.0	0.5	1.5	21.0
1982	2.3	12.5	14.8	1.3	1.4	2.7	9.2	2.6	11.8	14.5	0.7	0.4	1.1	30.4
1983	1.6	16.4	18.0				3.9	1.6	5.5	5.5	0.4	0.2	0.6	24.3

\* Atlantic salmon commercial and angling statistics compiled by Freshwater and Anadromous Division Fisheries Research Branch, Halifax, Nova Scotia.

Table 7. New Brunswick Department of Natural Resources (DNR) and Department of Fisheries and Oceans (DFO) angling statistics, 1969 to 1983. Catches of salmon and grilse at the Millbank trap site during the same period are also shown. Values in parentheses are estimated, as indicated in the footnotes.

Year	DNR		DFO		Millbank	
	Grilse	Salmon	Grilse	Salmon	Grilse	Salmon
1969	24284	3804	26715	2827	4350	667
1970	19610	3268	19662	2057	2484	245
1971	13727	1792	8464	1247	1962	399
1972	19101	8933	15472	5456	2543	1151
1973	13857	5977	9033	4881	2450	1132
1974	18232	7184	17957	5895	4038	1791
1975	15598	6288	9730	3756	3548	1208
1976	27128	7374	14749	5319	4939	943
1977	13590	11617	8244	14344	1505	1934
1978	8265	4893	5353	4196	1268	693
1979	14508	2656	7625	2422	2500	318
1980	11997	6546	7355	5422	2139	1093
1981	22716	3238	7031	1602	2174	199
1982	21402	4608	9217	2642	2665	408
1983	(10444) <sup>a</sup>	(3503) <sup>b</sup>	3897	1646	810	245

a 1983 DNR grilse catch estimated from correlation between Millbank grilse (x) and DNR grilse (y) from 1969 to 1982;  $y = 7533.7 + 3.59(x)$   $r = 0.76$   $n = 14$   $y(1983) = 10444$ .

b Estimated from regression of DFO salmon (x) with DNR salmon (y), 1969-82;  $y = 2274.3 + 0.75(x)$   $r = 0.91$ ,  $n = 14$   $y(1983) = 3503$ .

Table 8. Numbers of salmon and grilse counted at barriers in two tributaries of the Miramichi River, 1981 to 1983

Tributary	Year	Salmon	Grilse	Total
North Branch of S.W. Miramichi	1981	54	645	699
	1982	288	615	903
	1983	223	284	507
Dungarvon River	1981	112	570	682
	1982	113	450	563
	1983	126	325	451

Table 9. Total returns of large salmon to the Miramichi River and counts and sex ratio of grilse at Millbank in the previous year. Total returns are calculated in Table 10.

Year (i)	Grilse (X1)	% females (X2)	salmon returns(y) (year i + 1)
1971	1962	11.0	36,298
1972	2543	22.0	34,160
1973	2450	16.9	53,639
1974	4038	30.2	36,272
1975	3548	27.4	28,613
1976	4939	24.1	63,747
1977	1505	22.8	28,759
1978	1268	37.4	11,012
1979	2500	27.4	43,046
1980	2139	19.3	13,689
1981	2174	25.1	24,511
1982	2665	29.5	23,565
1983	810	29.2	[9,967]

Table 10. Estimated escapement, commercial landings and total salmon and grilse returns to the Miramichi River, 1971 to 1983.

Year 1	Escapement		Commercial		Returns	
	Grilse 2	Salmon 3	Grilse 4	Salmon 5	Grilse 6	Salmon 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	1,557	16,359	19,966	23,565

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 as in Table 4.  
 6 : 2 + 4  
 7 : 3 + 5

Redbook data series from Freshwater and Anadromous Division, Halifax.

Table 11. Juvenile salmon densities (mean number per 100 m<sup>2</sup>) in the Miramichi River, 1969-1983. n = number of sites.

Year	n	Fry	Small parr	Large parr
1969	14	6.2	13.9	2.9
1970	50	12.6	3.2	4.8
1971	73	15.0	5.5	2.0
1972	72	5.3	4.8	2.3
1973	80	16.8	1.9	1.8
1974	98	22.6	10.0	2.3
1975	89	31.7	14.6	3.8
1976	80	22.3	11.8	3.4
1977	86	34.4	10.0	4.1
1978	87	23.5	9.4	3.4
1979	48	13.2	7.3	2.7
1980	46	20.0	6.3	3.0
1981	47	40.9	9.2	3.0
1982	85	9.3	9.5	2.7
1983	85	30.5	10.5	3.5

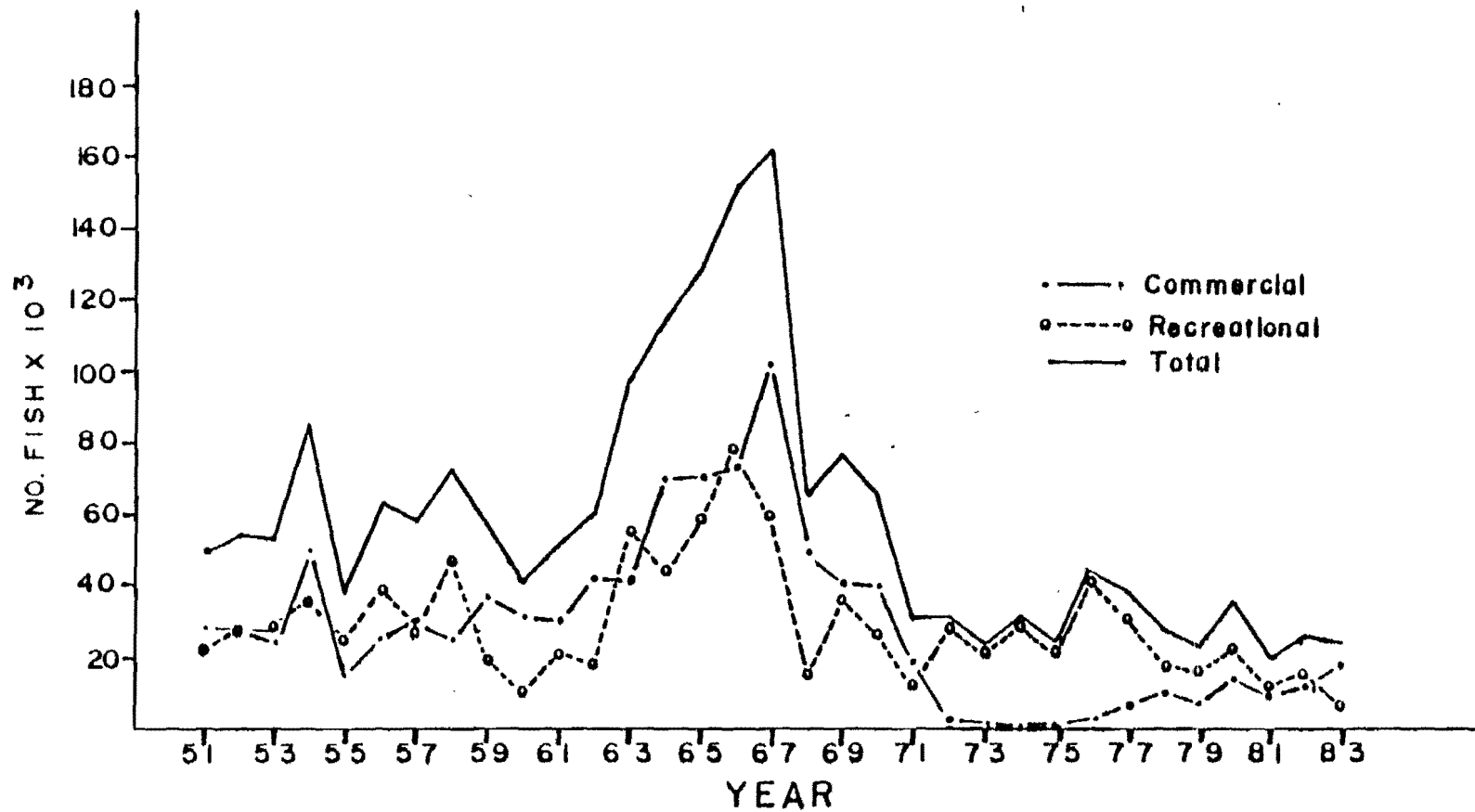


Figure 1. Commercial and recreational salmon landings in the Miramichi River, 1951 to 1983.



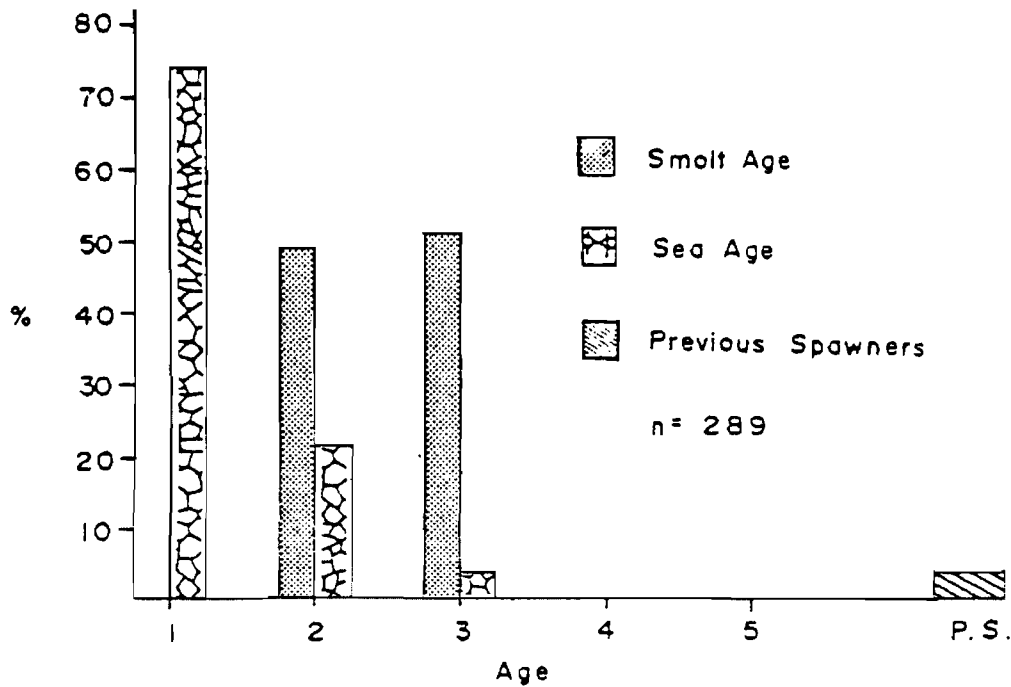
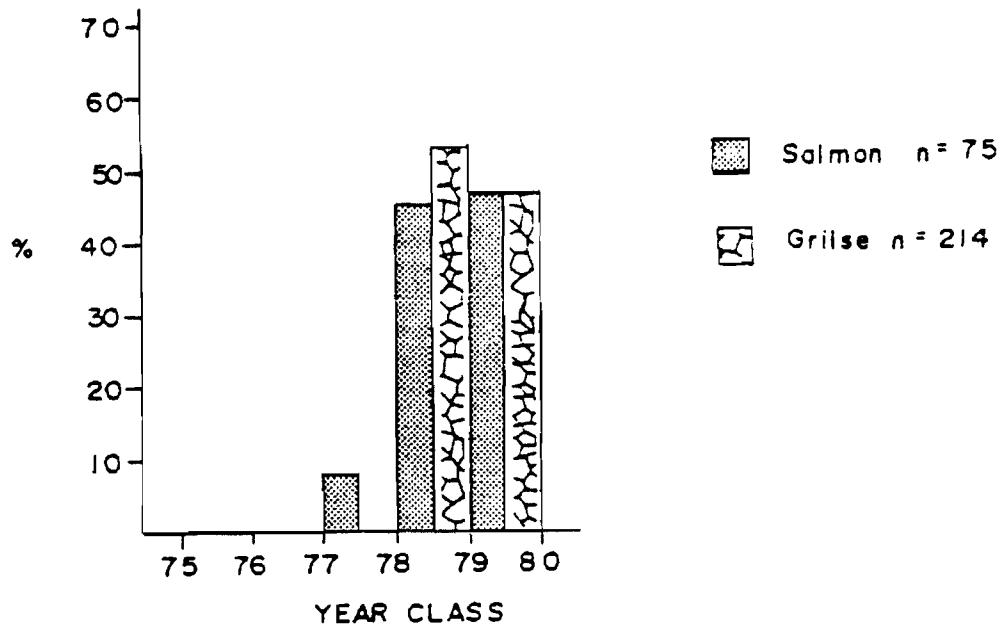


Figure 2. Upper. Year-class composition of salmon and grilse sampled at the Millbank trap. Lower: Smolt and sea-age composition of Millbank salmon.

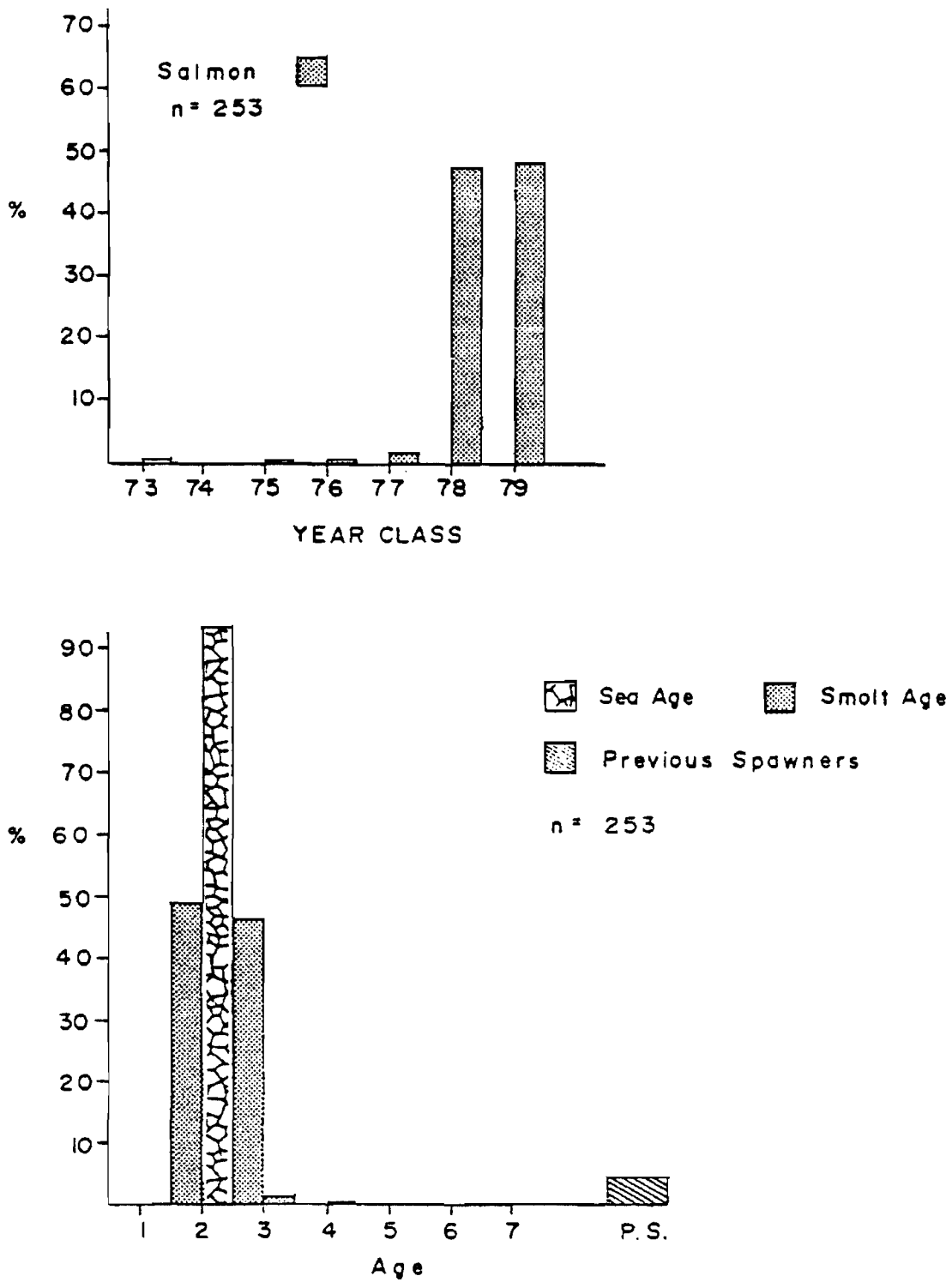


Figure 3. Upper: Year-class composition of salmon sampled in the commercial drift net fishery at Escuminac. Lower: Smolt and sea-age composition of drift net salmon.

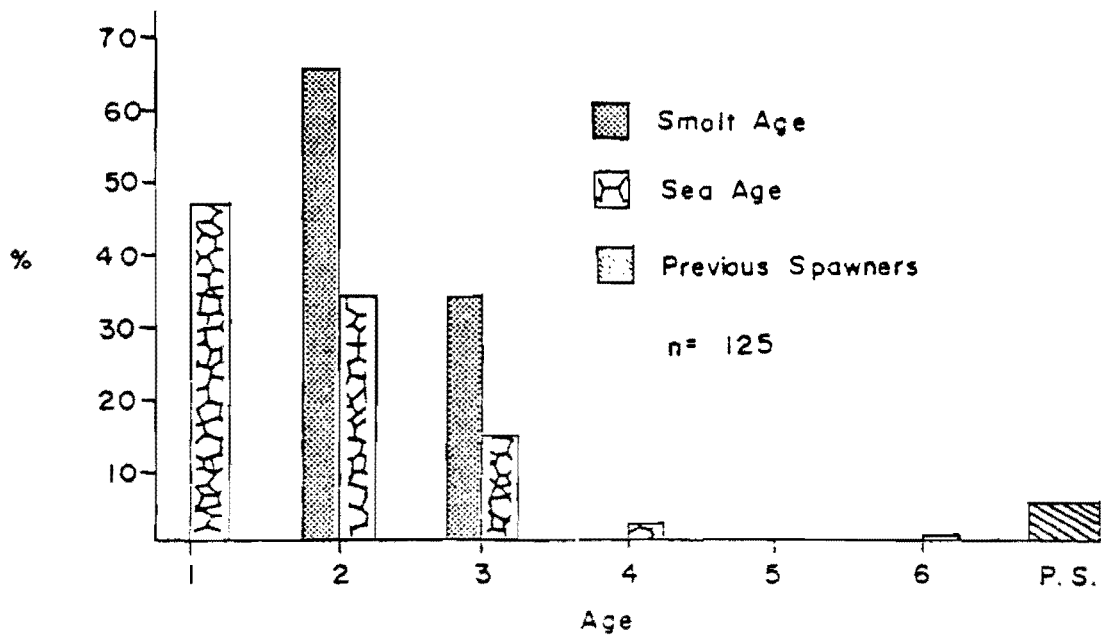
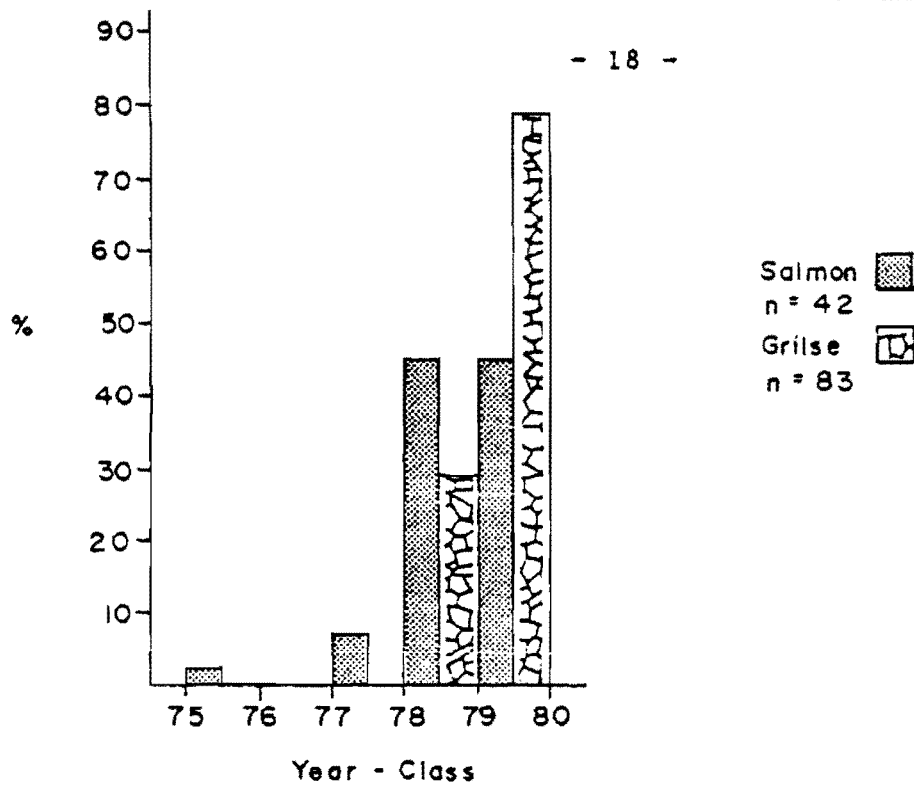


Figure 4. Upper: Year-class composition of salmon and grilse sampled from the recreational fishery. Lower: Smolt and sea-age composition of salmon and grilse sampled in the recreational fishery.