Assessment of the Restigouche River Salmon Stock in 1982

by

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Abstract

Preliminary 1982 landings in Restigouche River were 4,600 grilse and 9,700 salmon. Spawning requirements were estimated to be 16,300 fish. Two estimates of spawning escapements indicated that, at best, egg depositions were met in 1982, or at worst, they were only 18% of recommended values. Two estimates were made for returns in 1983: at best, returns would allow a harvest equal to 1982; at worst, there would be insufficient spawners without any harvest. Comparison of present landings to historical values suggested that the lower estimate was most accurate.

Résumé

Les débarquements provisoires de 1982 dans la rivière Restigouche ont été de 4 600 castillons et de 9 700 saumons. On avait estimé à 16 300 poissons les nombres requis pour la reproduction. Deux estimations dessujets qui se sont échappés pour la ponte indiquent qu'au maximum, la déposition d'oeufs a été adéquate en 1982 et qu'au minimum, elle n'a atteint que 18 % des valeurs recommandées. Nous avons calculé deux estimations des retours de 1983: au maximum, les retours permettraient une récolte égale à celle de 1982; au minimum, même sans récolte, il n'y aurait pas suffisamment de reproducteurs. Une comparaison entre les débarquements actuels et les valeurs historiques donnent à penser que la basse estimation est la plus précise des deux.

INTRODUCTION

During 1982, Atlantic salmon in the Restigouche River and the adjacent waters of the Baie des Chaleurs were exploited by three fisheries: commercial trap net fishermen, Indian food fishery, at Cross Point, Quebec, and recreational anglers. This was the second year for a commercial fishery in N. B. after a closure from 1972 to 1980, and the first year in Quebec after a closure from 1972 to 1981. Preliminary 1982 landings indicate a total catch of 4,623 grilse (1SW) and 9,654 salmon (2SW and older). The 1982 landings (68t) are only about 35% of the average 1950-1969 annual landings before the commercial ban.

This report presents a biological assessment of the Restigouche River salmon stock for 1982. Specifically, the following are discussed: (i) an estimate of the required egg deposition to sustain Restigouche salmon at optimal harvest levels, (ii) estimated spawning escapement in 1982 and, (iii) a preliminary forecast of available salmon for harvest in 1983.

METHODS

Commercial salmon landings were summarized from logbooks submitted by the fishermen on a weekly basis. Quebec catch data were collected by the provincial government and N. B. catch data were collected by Department of Fisheries and Oceans. All landings were recorded as being grilse ($<$ 63 cm; 1SW) or salmon ($>$ 63 cm; 2SW and older; Table 1)

Harvests in the recreational fishery are recorded by three agencies, Department of Natural Resources of New Brunswick (DNR), DFO in New Brunswick and Department of Tourism in Quebec. DNR statistics for 1982 were not available and therefore, DFO and Quebec data are used in this report (Table 2). Both DFO and DNR statistics show the same trends, as correlations between them are highly significant for both salmon, $r = 0.85$, $p < 0.001$, and grilse, $r = 0.92$, $p < 0.001$.

Indian Food Fishery landings were reported by the Restigouche Band Council office at Cross Point.

Egg Deposition Requirement

Egg deposition requirements for Restigouche River were estimated from the following data:

Required egg deposition rate	= 2.4 eggs m^{-2}	(Elson 1975)
Accessible rearing area	= 29,768,000 m^2	(Anon 1978)
Female salmon-fecundity	= 1764 eggs . kg^{-1}	(Elson 1974)
-mean weight	= 6.4 kg	(Peppar 1983)
Female grilse-fecundity	= 1764 eggs . kg^{-1}	(Elson 1974)
-mean weight	= 1.5 kg	(Peppar 1983)
Salmon % female	= 62%	(Peppar 1983)
Grilse % female	= 3%	(Peppar 1983)
% salmon	= 62%	(Peppar 1983)

1982 Escapement Estimates

The 1982 spawning escapement was estimated two ways. The first method (Method I) used an angler exploitation rate and an estimate of losses to poaching and disease (furunculosis). The exploitation rate was obtained from two years of adult tagging at the Dalhousie trap. (A description of the Dalhousie trap is given by Peppar, 1983). In 1972, 16.1% of available tags were recovered in the recreational fishery; in 1973 it was 15.3%. These values were adjusted upwards by 30% to account for non-reporting of tags. The rate was 20.4%. Losses due to poaching and disease were estimated to be 2,000 salmon and 1,000 grilse. Losses due to disease were based on canoe surveys of the watershed. In 1979, 1000 adults and in 1980, 2000 adults were lost to disease (A. Madden, Regional Biologist, DNR, Campbellton, N.B.). There was no reliable estimate of losses to poaching.

The second method (Method II) for estimating 1982 spawning escapement was calculated from a ratio of spawner per angled fish. Number of spawners was estimated from density of 1^+ parr, for the years 1972 - 1980 (Table 3). A significant relationship ($p < 0.01$) between salmon angled in the Restigouche and 1^+ parr two years later ($r = 0.78$, 9 df, Fig. 1) suggested the latter was an index of egg deposition. The survival rate from egg to 1^+ parr was assumed to be a constant 10% (Elson 1957, 1974; Chadwick 1982). Biological characteristics of spawning adults were taken from Peppar (1983). The mean rate of spawner per angled fish was 0.5059, SD = 0.1605 (Table 3).

Predicting 1983 Returns

A prediction was made for harvest of large salmon in the 1983 recreational fishery. The prediction was based on a significant ($p<0.05$) multiple linear relationship between number of large salmon and two independent variables: number of grilse at Millbank and sex ratio (percent females) of these grilse in year i-1. The equation was

$$\text{Log } Y = 2.7773 + 0.4628 \text{ Log } X_1 - 0.0219 \text{ arc sin } \sqrt{X_2} \quad r = 0.726, 8df, \text{ (Table 4)}.$$

The predicted harvest of large salmon in the 1983 recreational fishery is 4397 fish.

The grilse harvested in the 1983 recreational fishery is projected to be the same as the 13 year mean (1970-1982); (Table 2) which is 2227 fish, S.D. = 839.7.

Total spawning escapement in 1983 was estimated using the projected 1983 angler harvest with the two methods described above. Method I is based on the calculated angler exploitation rate (20.4%) and the assumption that losses to disease and poaching would be 2,000 and 1,000 fish, respectively. Method II is based on the average ratio of spawner per angled fish (0.5059; Table 3); losses to disease and poaching were assumed as in Method I.

RESULTS

1982 Landings

Preliminary data on commercial landings from the trap net fishery in both New Brunswick and Quebec indicate a total landing of 1812 grilse and 4293 salmon (Table 1). The commercial season was from 14 June to 31 July, and there were 25 and 19 fishermen registered in N. B. and P. Q. respectively. The total Restigouche commercial quota was 4,000 salmon and 4,000 grilse. Preliminary angling data for 1982 indicate a total catch of 3,737 salmon and 2,040 grilse. These landings were down from the previous two years (Table 2).

1982 marks the first accurate record of harvest in the Indian Food Fishery at Cross Point. The total catch (11,567 kg) was less than the designated quota (16,557 kg). Landings are reported in Table 5.

Age composition of salmon sampled in the commercial and recreational fisheries are given in Figures 2 and 3.

Egg Deposition Requirements

Egg deposition per fish was calculated as follows:

	Eggs . kg^{-1}	% F	Mean Weight Kg	% Salmon or grilse	Egg deposition per fish
Salmon	1764	0.62	6.4	0.62	4340
Grilse	1764	0.03	1.5	0.38	30
				Total egg deposition per fish	4370

Therefore, the total number of fish required for egg deposition can be estimated by: required deposition rate x rearing area/egg deposition per fish

= 2.4 x 29,768,000/4370

= 16,349 fish.

From the grilse/salmon ratio, the numbers of salmon and grilse required for egg deposition are 10,136 ($\approx$10,100) and 6,213 ($\approx$6,200), respectively.

1982 Escapement

Spawning escapement in 1982 as estimated by Method I (angler exploitation rate of 0.204) is given below:

		Salmon	Grilse
1.	Escapement to river (Recreational fish / 0.204)	18,319	10,000
2.	Removals by commercial and food fisheries	5,917	2,583
3.	Total returns, 1982	24,236	12,583
4.	Removals by (i) fisheries	9,654	4,623
	(ii) poaching, disease	2,000	1,000
5.	Spawning escapement	12,582	6,960
6.	Spawning requirement	10,100	6,200

Use of these values suggest that spawning requirements were met.

Method II for estimating 1982 escapement utilizes the ratio of spawners per angled fish:

		Salmon	Grilse
1.	All removals (i) by fisheries	9,654	4,623
	(ii) poaching, disease	2,000	1,000
2.	Spawning escapement (Recreational fish X 0.5059)	1,890 ±452	1,032 ±247
3.	Total Return	13,544	6,655
4.	Spawning requirement	10,100	6,200
5.	Spawning deficit (2. -4.)	-8,210	-5,168

These values suggest that egg deposition was only 18% of the recommended value.

1983 Escapement

Using Method I, i.e. recreational fishery exploitation = 0.204, 1983 spawning escapement was estimated to be:

		Salmon	Grilse
1.	River escapement (4,397 and 2,227 / 0.204)	21,554	10,917
2.	Fish which would be removed by commercial and food fish given 1982 catch proportions	6,877	2,834
3.	Total return	28,431	13,751
4.	Spawning requirement	10,100	6,200
5.	Losses - disease, poaching	2,000	1,000
6.	Balance for all harvest	16,331	6,551

Using Method II, i.e. ratio of spawner per angled fish, 1983 escapement is estimated as follows:

		Salmon	Grilse
1.	Spawning escapement (4,397 and 2,227 x 0.5059)	2,224	1,127
2.	Removals by all fisheries using 1982 catch proportions	11,274	5,061
3.	Total returns 1983	13,498	6,188
4.	Spawning requirement	10,100	6,200
5.	Losses to disease and poaching	2,000	1,000
6.	Balance for all harvest	1,398	-1,012

Method I and II give quite different results. If angling and Indian fishery catches in 1983 are similar to 1982, Method I indicates a potential harvest of approximately 10,000 large salmon and 3,500 grilse available for harvest in the commercial fishery; in contrast to this, Method II indicates there would be a spawning deficit in the order of 4,000 salmon and 4,000 grilse.

DISCUSSION

Three facts suggest that the 1982 spawning run into the Restigouche was not as large as the previous year: (i) Angling catches of salmon were down substantially from 1981, and the 1982 catch (3,737 salmon) was less than the 1970 to 1981 annual mean (5,030 salmon; Table 2); (ii) The quota allocated to the Indian Fishery was not reached (Table 5); (iii) Although commercial trap net fishermen reached their quota for salmon, most fishermen had to keep fishing right to the end of the season, even though their quota was quite small. The total 1982 commercial catch (31 t) was only a fraction (20%) of the 1950-1971 average catch in the pre-ban years (Table 6). Total 1982 landings are summarized in Table 7.

The results of two methods used for estimating 1982 escapement levels differed substantially. Angler exploitation rate projections suggested that required spawning levels were met, while spawner per angled fish ratios indicated escapement was only 18% of required levels. Using method 1 to predict 1983 results suggested spawning escapement would be met if catch levels were similar to 1982, while Method II indicated there would be a substantial deficit in spawning escapement.

Both methods are based on parameters that need verification, and it is difficult to judge which is more reliable. Given historical landings from this river, however, and the comparatively poor landings in recent years, it seems likely that Method II gives a more realistic evaluation than Method I. If this is the case, then recommended spawning levels were not met in 1982, and they will not be met in 1983 if removals are similar to 1982.

It is also possible that both methods are valid. The difference in estimates of what should have spawned in 1982 (Method I), and what actually did spawn, as indicated by parr density in Method II, could be explained by substantially higher mortalities in the river due to poaching and disease. If this is the case, then these substantial losses in the river after the fisheries would not be greatly affected by reduction in the angling or commercial fisheries.

Estimates of fry and parr densities in the Restigouche River since 1972 corroborate the suggestion that spawning levels have not been met in recent years. Juvenile salmon levels increased from 1972 to 1975 after the commercial ban, but subsequently they generally declined; 1982 levels are similar to the pre-ban years (Table 8).

This assessment has indicated need for research in the following areas:

(1) Verification of the angler exploitation rates; investigate annual variations in this rate.

(2) Confirmation of egg to parr survival rates.

(3) Evaluation of the use of the parr density information as an absolute indication of recruitment, rather than an index.

(4) Investigate the possibility of higher losses in the river than what has been accounted for in the past.

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TABLE 1

Commercial Salmon Trap Net Landings, Restigouche River, 1982

N. B.	Quebec
Stat. Districts 63, 64 & 65	Stat. Dist. 14, 15
Season: 14 June - 31 July	Season: 14 June - 9 July
25 Fishermen (100% reporting)	19 Fishermen (100% reporting)

Landings		N. B. No.	N. B. Kg.	Quebec No.	Quebec Kg.
Salmon	< 63 cm	1,713	2,934	99	169
	63-85 cm	1,289	5,868	2,236	15,177
	> 85 cm	768	7,110		
		3,770	15,912	2,335	15,346

Total (N.B. & P.Q.)

Landings	No.	Kg.	Quota (no.)
GRILSE	1,812	3,103	4,000
SALMON	4,293	28,155	4,000
TOTAL	6,105	31,258	8,000

TABLE 2

Sport fishery statistics compiled by DFO and Quebec provincial authorities for the Restigouche River, 1970-1982.

Year	Large Salmon	Grilse	Total	% Salmon
1970	2,310	1,667	3,977	58.1
1971	1,152	1,251	2,403	47.9
1972	5,637	1,235	6,872	82.0
1973	5,246	1,962	7,208	72.8
1974	6,871	1,581	8,452	81.3
1975	3,372	1,487	4,859	69.4
1976	5,908	3,031	8,939	66.1
1977	8,161	3,103	11,264	72.5
1978	5,940	1,862	7,802	76.1
1979	1,949	2,680	4,629	42.1
1980	7,896	3,503	11,399	69.3
1981 *	5,918	3,554	9,472	62.5
1982 *	3,737	2,040	5,777	64.7

* Preliminary

TABLE 3

Calculation of spawners per angled fish in Restigouche River; based on 10% egg to 1+ parr survival, 1,764 eggs kg^{-1} and 29,768,000 m^2 rearing area.

Year (i)	Density of 1^+ parr per $100m^2$ in year (i+2)	Dalhousie samples Salmon Kg	Salmon %F	Grilse Kg	Grilse %F	DFO angling % Salmon	Spawners Salmon	Spawners Grilse	Spawner/angled Salmon	Spawner/angled Grilse
1972	7.1	7.0	44	1.5*	3*	82.0	3,878	851	0.6880	0.6891
1973	9.7	6.0	71	1.5	5	72.8	3,815	1,426	0.7272	0.7268
1974	8.4	6.1	66	1.6	4	81.3	3,510	807	0.5108	0.5104
1975	4.4	6.5	73	1.5	4	69.4	1,555	686	0.4612	0.4613
1976	8.3	6.2	66	1.4	1	66.1	3,414	1,751	0.5779	0.5777
1977	7.1	4.9	71	1.5	1	72.5	3,439	1,304	0.4214	0.4202
1978	4.1	6.2	61	1.4	1	76.1	1,828	574	0.3077	0.3083
1979	3.6	7.9	65	1.4	3	42.1	1,171	1,611	0.6008	0.6011
1980	4.4	7.1	51	1.5	3	69.3	2,041	904	0.2585	0.2581
1981						62.5				
1982						64.7				
$\bar{X}$									0.5059**	0.5059
SD									0.1605	0.1605

* Mean 1973-80 values

** Salmon df = 8 SE = 0.0535
Grilse df = 7 SE = 0.0535

TABLE 4

Correlation between number of grilse and their sex ratio at Millbank (Miramichi) and number of large salmon angled at Restigouche River in the following year.

Year	Millbank trap		Restigouche
	No. grilse year i 1.	% Female 2.	No. large salmon Year i + 1 3.
1971	1,962	11.0	5,637
1972	2,543	22.0	5,246
1973	2,450	16.9	6,871
1974	4,038	30.2	3,372
1975	3,548	27.4	5,908
1976	4,939	24.1	8,161
1977	1,505	22.8	5,940
1978	1,268	37.4	1,949
1979	2,500	27.4	7,896
1980	2,139	19.3	5,918
1981	2,174	25.1	3,737
1982	2,665	29.5	

Correlation	R^2	r	p
3.on 1. and 2	0.53	0.73	0.05

$\text{Log } Y = 2.7773 + 0.4628 \text{ Log } X_1 - 0.0219 \text{ arc sin } \sqrt{X_2}$

Y (1983) = 4,397

TABLE 5

Landings of Atlantic salmon in the Indian food fishery at Cross Point, P. Q., 1982

Fishing effort = Unknown
Quota = 36,500 lbs (16,295 kg)
Catch = 25,500 lbs (11,567 kg)

Percentage grilse in Indian fishery = Unknown
Percentage grilse (by weight) in commercial fishery = 10%

Therefore, estimated Grilse catch = 1,157 kg = 771 fish
Salmon catch = 10,410 kg = 1,627 fish

TABLE 6

Commercial salmon landings (kg x 10^3) for the Restigouche River and surrounding areas, 1950 - 1982 (1950-67 data from May and Lear (1971); 1968 - 1981 data from Redbooks; 1982 data are preliminary)

	N. B. Stat. Dist.				Quebec Stat. Dist					GRAND
YEAR	63	64	65	Total	12	13	14	15	Total	TOTAL
1950	115	28	24	167	9	5	40	29	83	250
1951	76	18	19	113	15	5	88	52	160	273
1952	90	19	14	123	16	3	78	33	130	253
1953	69	19	20	108	11	9	48	29	97	205
1954	67	19	24	110	10	3	54	24	91	201
1955	40	3	10	53	5	2	37	20	64	117
1956	30	7	10	47	5	2	29	14	50	97
1957	44	6	11	61	22	1	29	14	66	127
1958	80	11	8	99	5	1	46	22	74	173
1959	70	22	11	103	8	5	62	28	103	206
1960	56	24	7	87	7	4	65	34	110	197
1961	51	17	9	77	5	3	37	18	63	140
1962	49	34	22	105	6	5	41	19	71	176
1963	53	22	14	89	7	6	35	18	66	155
1964	54	38	10	102	11	7	39	25	82	184
1965	86	35	24	145	14	9	53	33	109	254
1966	54	34	25	113	12	4	51	33	100	213
1967	66	49	22	137	14	5	42	25	86	223
1968	56	27	19	102	14	7	34	16	71	173
1969	33	20	12	65	9	9	25	10	53	118
1970	25	18	6	49		(12-14)	42	7	49	98
1971	11	5	7	23		(12-14)	26	4	30	53
1981	18	4	7	29	-	-	-	-	-	29
1982	10	3	3	16					15	31

TABLE 7

Preliminary data for 1982 landings in the Restigouche River from the commercial, Indian and recreational fisheries. 1981 landings are given for comparison.

	1982		1981	
	Salmon	Grilse	Salmon	Grilse
Commercial trap net				
N. B.	2,057	1,713	3,307	2,850
P. Q.	2,236	99	-	-
Indian *	1,627	771	5,000	1,000
Recreational	3,737	2,040	5,918	3,554
TOTAL:	9,657	4,623	14,225	7,404

* 1981 Indian landings were estimated.

TABLE 8

Juvenile Atlantic salmon densities in the Restigouche River, 1972 to 1982

YEAR	n	Mean Number Fry	Small parr	Large parr
1972	22	5.5	2.2	1.2
1973	25	17.4	2.5	1.0
1974	26	12.6	7.1	1.0
1975	31	31.3	9.7	2.8
1976	30	15.1	8.4	1.6
1977	34	19.1	4.4	1.7
1978	38	23.5	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

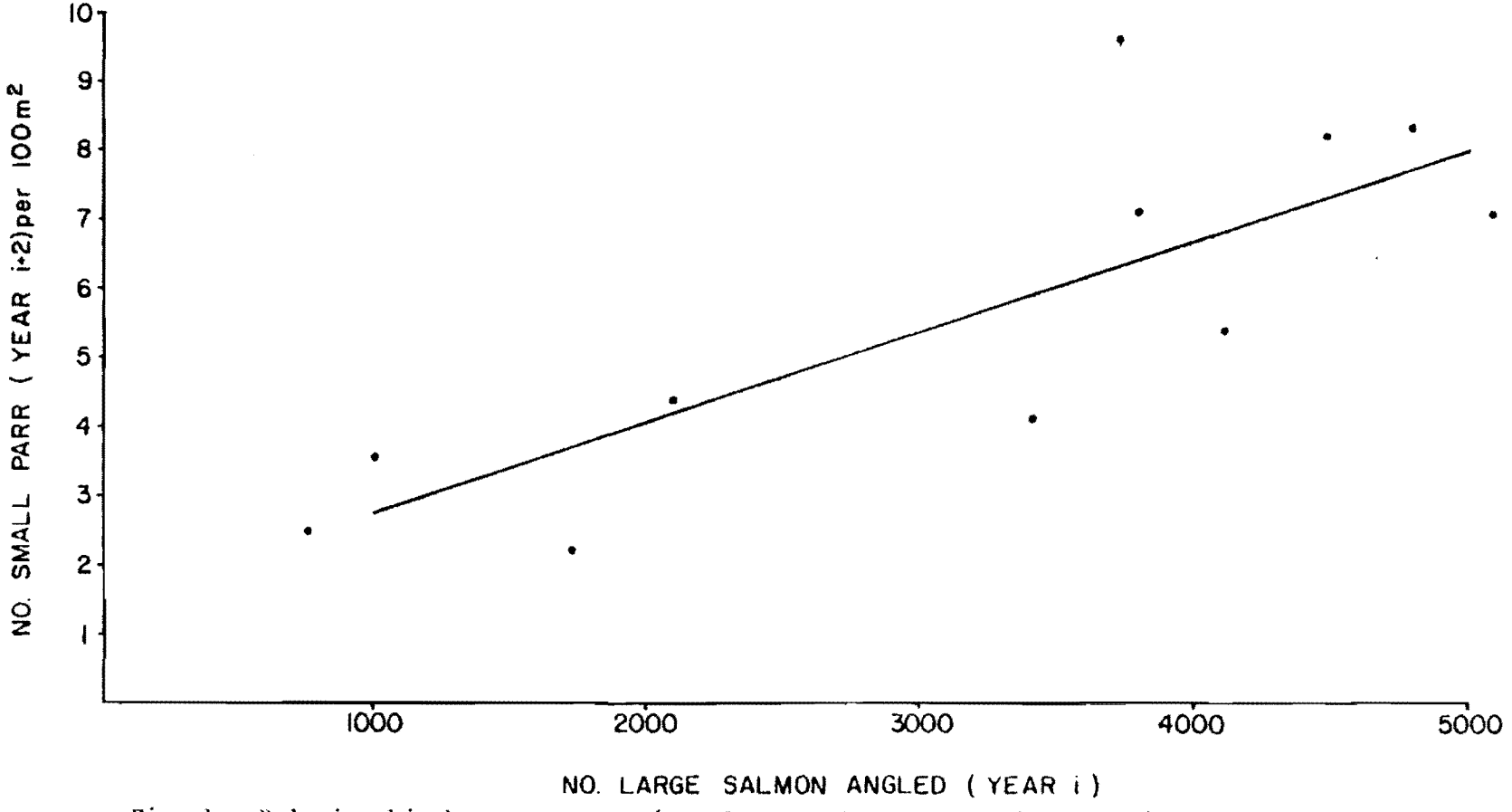

Fig. 1 Relationship between stock (no. large salmon angled in year i) and recruitment (no. of parr in year i + 2) on the Restigouche River, 1972-1982.

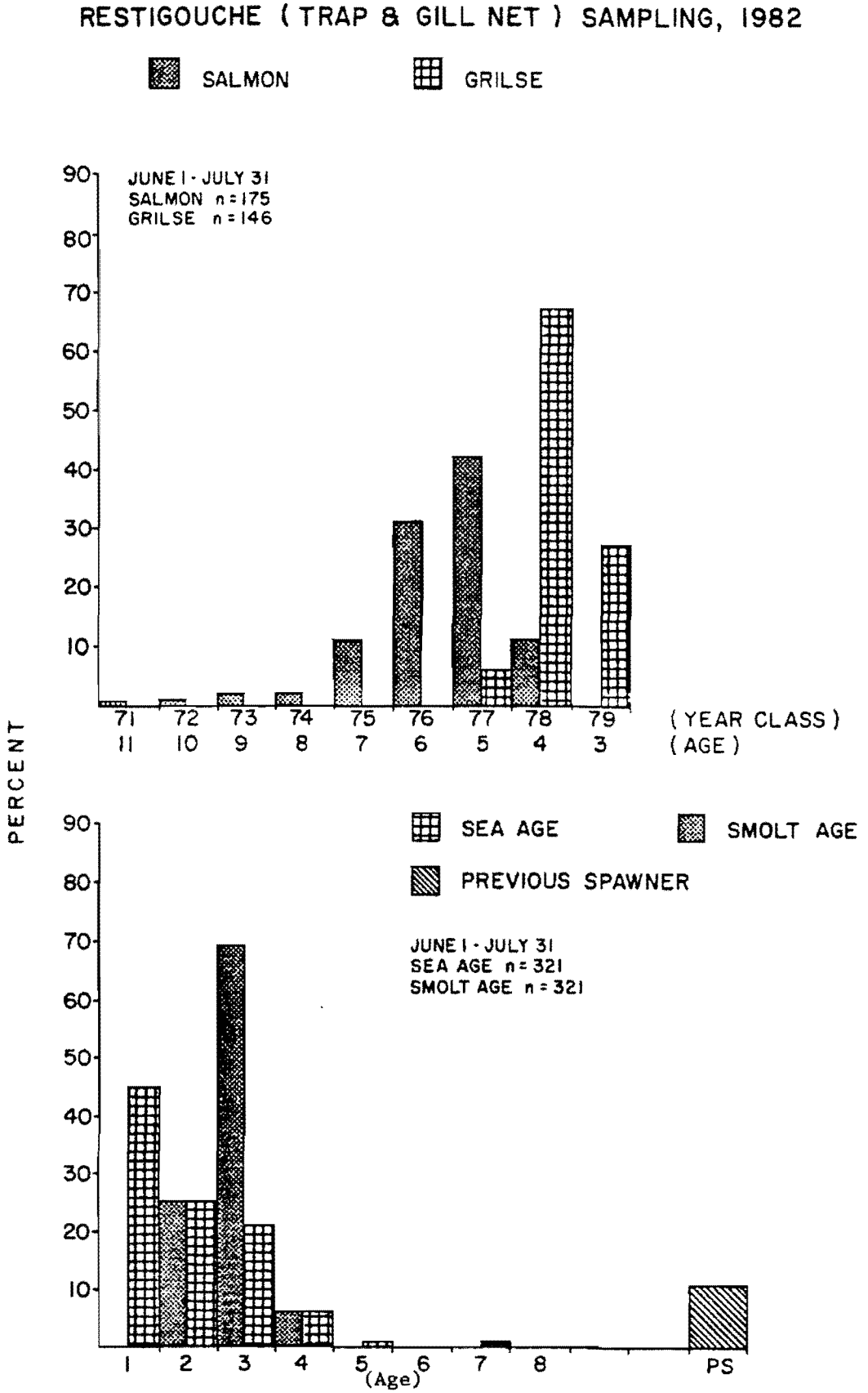

Fig. 2 Sea-age and smolt-age composition of salmon landed in the commercial trap net fishery, Baie des Chaleurs, 1982.

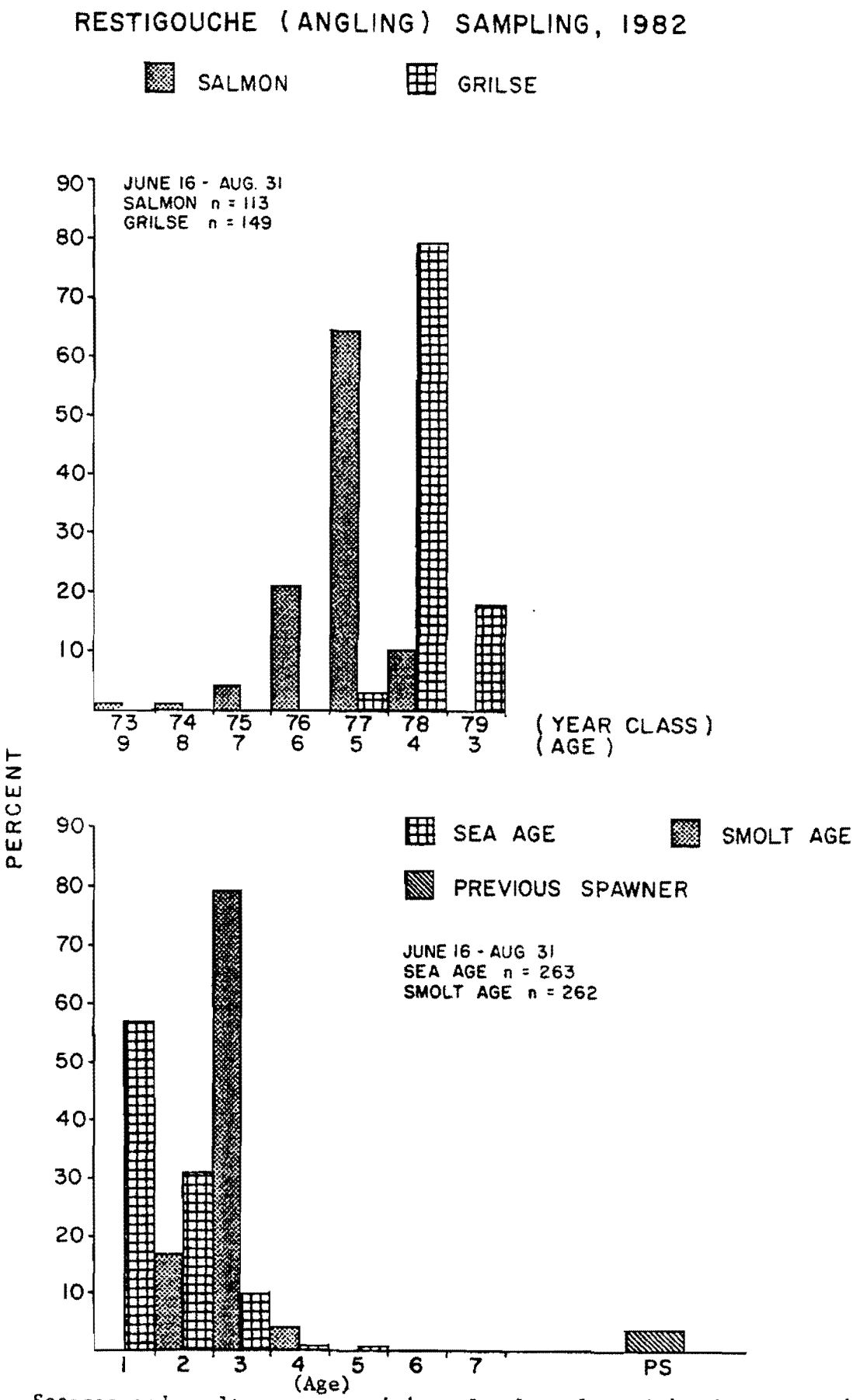

Fig. 3 Sea-age and smolt-age composition of salmon landed in the recreational fishery, Restigouche River, 1982.