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Assessment of Atlantic salmon, *Salmo salar*, in the Margaree River, Nova Scotia, 1985

by

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ABSTRACT

The 1985 1SW and MSW salmon angling catch surpassed 1984 values and the MSW salmon angling catch was the greatest recorded since 1962. The proportion of MSW salmon caught in the summer portion of the angling season exceeded 1979-1984 values but was still below long term trends (1947-1978).

Spawning requirements with all egg deposition coming from MSW salmon was estimated to be 1036 MSW salmon and 579 1SW salmon. Angling catch remains the best index of spawning escapement available for the Margaree River. Significant correlations between the MSW salmon angling catch and 1+ parr densities support the above conclusion. 1SW salmon appear to make a negligible contribution to recruitment which is supported by the lack of a significant correlation between 1SW salmon angling catch and 1+ parr densities. The exploitation rate derived from the relationship between 1+ parr and MSW salmon angling catch is 12.9%. 12.9% is lower than has been used in past assessments and further research is required to evaluate this rate, as exploitation rate is crucial in estimating egg deposition on the Margaree River.

MSW salmon returns were predicted from the regression between MSW salmon angling catch (year i) with MSW salmon (year i+5). A return similar to 1985 can be expected in 1986. The above prediction is based on a poor relationship, low R^2 and wide confidence limits and will require further evaluation.

RESUME

Le nombre de saumons d'une et de plusieurs hivers en mer 1HM et PHM) pêchés à la ligne en 1985, a dépassé celui de 1984 et a été le plus élevé depuis 1962. La proportion de saumons PHM pêchés pendant la partie estivale de la saison de pêche à la ligne dépassait celle de 1979-1984 mais restait néanmoins inférieure aux tendances à long terme (1947-1978).

Pour les besoins du frai, en supposant que tous les oeufs proviennent du saumon PHM, on a estimé qu'il fallait 1036 saumons PHM et 579 saumons 1HM. Les prises à la ligne restent le meilleur indice d'échappement du frai pour la rivière Margaree. Des corrélations significatives entre les densités de saumons PHM puis à la ligne et celle des tacons 1+ le confirment. Le saumon 1HM semble contribuer peu au recrutement, comme le confirme l'absence d'une corrélation significative entre les densités de saumons 1HM pris à la ligne et celle des tacons 1+. Le taux d'exploitation dérivé de la relation entre les tacons 1+ et les saumons PHM pris à la ligne est de 12,9%. Ce pourcentage est inférieur à celui utilisé dans les évaluations passées et il faudra faire d'autres recherches pour évaluer ce paramètre qui est crucial pour estimer la quantité d'oeufs pondus dans la rivière Margaree.

Les retours de saumons PHM ont été prévus par régression entre le nombre de saumons PHM pêchés à la ligne (année i) et le nombre de saumons PHM (année i+5). On peut s'attendre en 1986 à un retour semblable à celui de 1985. Cette prévision est basée sur une relation ténue, un R^2 faible et un grand intervalle de confiance et nécessitera une évaluation plus poussée.

INTRODUCTION

The purpose of this paper is to provide an assessment of the Margaree River Atlantic salmon stock in 1985. As such, this assessment determines the number of spawners required to meet egg deposition requirements of the Margaree River with all egg deposition coming from MSW (two-sea-winter and older) salmon. Spawning escapement is estimated using sport catch as an index of abundance. The appropriateness of using sport catch to estimate spawning escapement is examined. Forecasts concerning 1986 returns are reported. The relationship between commercial landings and sport catch is evaluated. An assessment of the hatchery contribution to river returns is attempted.

The Margaree River is located on Cape Breton Island, Inverness County, Nova Scotia. Two principal branches; the Northeast Margaree and Southwest Margaree meet at Margaree Forks to form the Main Margaree which flows into the Gulf of St. Lawrence. Most of the Atlantic salmon angling occurs in the Main Margaree and Northeast Margaree rivers. Margaree River salmon stocks are composed of two runs: the summer run enters the river up to the end of August; and the fall run, after September 1.

Since 1979, efforts to increase the summer run component of the Atlantic salmon stock has consisted of regulatory restrictions and hatchery-reared introduction of progeny from early-run fish. Anglers have been required to release MSW salmon during early portions of the run (before September 1) since 1979. 1985 was the first year in which all MSW salmon were to be released regardless of date caught. In 1984 there was a reduction in the commercial fishery from eight to three weeks. There was no commercial fishery in 1985.

METHODS

Landings

1984 Commercial salmon landings from Statistical Districts 11, 12, 13, 2, and 3 were obtained from departmental records (O'Neil et al. 1985). These 1984 landings have been added to the 1967-83 records summarized by Gray and Chadwick (1984).

Angling records from 1947-1984 were provided by Ralph Watts, Fishery Officer, Margaree Forks, Nova Scotia.

The relationship between commercial catch in Zone 6 and 1SW, MSW and 1SW + MSW salmon sport catch was also examined using correlation coefficients. The correlation procedure of SPSS/PC was used to derive the correlation coefficients of the above comparisons.

Spawing requirements

The required number of spawners was calculated using the method (Method 2) recommended by Randall (1985) for the Miramichi River. The number of spawners required to meet egg deposition requirements was calculated presuming that all egg deposition came from MSW salmon. The numbers of 1SW salmon required were calculated assuming that at least one male spawner was needed for each female MSW salmon.

The characteristics used to determine the spawning requirements were essentially those given by Gray and Chadwick (1984) and are repeated below:

Egg deposition rate	=	2.4 eggs/m^2 (Elson 1975)
Rearing area	=	2,797,600 m^2 (Marshall 1982)
Fecundity MSW	=	1,764 eggs/kg (Elson 1975)
1SW	=	1,764 eggs/kg (Elson 1975)
Mean weight MSW	=	4.9 kg (Marshall 1982)
1SW	=	1.7 kg (Marshall 1982)
Eggs per MSW	=	6,482 eggs = 1,764 x 4.9 x .75
1SW	=	330 eggs = 1,764 x 1.7 x .11
Eggs per fish	=	(6,482 x .75) + (330 x .25) = 4,945
Sex ratio male/female MSW	=	25:75 (Marshall 1982)
1SW	=	89:11 (Marshall 1982)

1SW/MSW salmon ratio = 25:75 (described below)

The 1SW:MSW ratio in the sport catch from 1947-1978 was derived using 6.0 pounds as the division between 1SW and MSW salmon (Fig. 1). All fish in the angling catch less than or equal to 6.0 pounds were considered 1SW salmon; those over 6.0 pounds, MSW salmon.

From 1979-85, the 1SW salmon component of the sport catch has increased dramatically (1SW:MSW = 71:29). This increase has probably been as a result of an increasing influence of hatchery stocking (Gray and Chadwick 1984). It is felt that the sport catch composition from 1947-78 is a better representation of the wild stock.

Spawning escapements

The suitability of using sport catch as an index of spawning escapement was tested by examining the correlation coefficients between sport catch, discharge, temperature and juvenile densities. Sport catch data, from 1947-84, recorded by date, pool and weight were provided by Ralph Watts, Fishery Officer, Margaree Forks. Larry Marshall provided juvenile densities collected during his investigations of the Margaree River from 1975-79 and those originating from Paul Elson's studies from 1957-69.

Three sets of correlation coefficients were examined: (1) 1SW, MSW, 1SW + MSW sport catch, mean daily temperature and total discharge (cfs) (Water Resources Branch*) for each two-week period of the angling season; (2) the combined values of 1SW, MSW, 1SW + MSW sport catch, mean daily temperature and total discharge (dam^3) for June, July and August; (3) 1SW, MSW, 1SW + MSW sport catch (year i), fry (year i+1) and 1+ parr (year i+2).

An exploitation rate based on the relationship between 1+ parr (year i+2) and MSW salmon (year i) was calculated as follows:

total number of parr = mean 1+ parr densities X rearing area;

total number of eggs = total number of parr ÷ 10% survival rate from egg to 1+ parr;

total number of spawners = total number of eggs ÷ eggs per fish;

total number of MSW spawners = total number of spawners X proportion MSW salmon in population;

*Environment Canada, Inland Waters Directorate.

exploitation rate = sport catch ÷ (sport catch + MSW salmon spawners).

Egg deposition

Total egg deposition from 1SW and MSW salmon was calculated as described below:

$$\frac{\text{Sport Catch (SC)}}{\text{Sport Catch (SC) + Spawners}} = \text{Exploitation Rate (ER)}$$

$$\frac{\text{SC (1 - ER)}}{\text{ER}} = \text{Spawners}$$

For years in which there were hook and release regulations 1979-1985 the MSW salmon caught and released were added to the number of spawners calculated as above.

Three exploitation rates were used; the one calculated above (12.9%) and two used in past assessments (20.6% and 37.9%) (Hayes 1949; Marshall 1982; Gray and Chadwick 1984).

For all years egg deposition was calculated as the number of 1SW or MSW spawners times the eggs per 1SW or MSW fish (see above). The eggs obtained from broodstock collections were subtracted from the above egg deposition values.

Forecast

Three correlations were examined to predict return: 1SW salmon (year i) to predict MSW salmon (year i+1) sport catch, hatchery released smolts (year i) to predict 1SW salmon (year i+1) sport catch and 1SW salmon (year i+1) commercial catch, and, MSW salmon (year i) to predict MSW salmon (year i+5). The SPSS/PC correlation procedure as described above was used.

RESULTS

Landings

Historical, recreational, and commercial landings are presented in Table 1 and the long term trend in total (1SW + MSW) angling catch is illustrated in Figure 2. Angling catch declined from 1947 to 1961 and again from 1976 to 1979 (Fig. 2). The increase in catch since 1979 has largely been the result of high 1SW salmon catches recorded in 1979, 1981 and 1982.

The 1985 MSW salmon angling catch was the greatest recorded since 1962 (Table 1).

There has been a gradual decline in the proportion of MSW salmon in the angling catch since 1947. This trend was most pronounced in 1979, 1981, and 1982 when large 1SW salmon catches were recorded in summer and fall portions of the angling season. Even if these years are excluded; the proportion of MSW salmon comprising the summer angling catch during 1980, 1983 and 1984 was still well below historical values (1947-1978). In 1985 the proportion of MSW salmon taken in the summer season exceeded 1979-1984 values but was still below long term trends (1947-1978) (Table 2).

Angling catch of MSW salmon and commercial catch were significantly positively correlated. Correlations between sport catch of 1SW salmon and commercial catch were significantly negatively correlated for Districts 2, 3 and the total catch of zone 6 (Table 3).

Spawning requirements

The spawning requirements of the Margaree River were found to be 1,036 MSW and 579 1SW salmon. These figures were derived as given below:

(1) egg requirements = 2.4 eggs m^{-2} x 2,797,600 m^2
= 6,714,600 eggs

(2) eggs/MSW salmon = 8,643 eggs/MSW X .75 (females)
= 6,482

(3) required number of MSW = 6,714,600 ÷ 6,482
= 1,036

number of female MSW = 1,036 X .75
= 776

number of male MSW = 260 = 1,036 - 776

number of male 1SW = 516 = 776 - 260

number of 1SW = 579 = 516 ÷ .89

Using the above requirements, MSW salmon account for 100% of the egg deposition requirements and 97% of the total egg deposition.

Spawning escapements

The MSW salmon sport catch appears to be an adequate index of spawning escapement for the Margaree River. Correlations between sport catch, discharge and temperature were generally not significant (Table 4).

Significant correlations between MSW salmon (year i) with 1+ parr (year i+2) were found for overall average juvenile densities, as well as those at individual sites at Lake O'Law, McLeod's, and Below Cranton Bridge (Table 5; Fig. 3). Correlations between 1+ parr densities and 1SW salmon sport catch were not significant (Table 5). The average exploitation rate derived from the MSW and 1+ parr densities was 12.9% (Table 6).

Egg deposition

1SW salmon have made a relatively small contribution to egg deposition in the Margaree River (Table 7). Using an exploitation rate of 12.9% to estimate potential MSW salmon spawners; egg deposition requirements have been met in most years (1947-1985). If the exploitation rate used to estimate potential MSW salmon spawners is only 8% higher, 20.6%, egg deposition requirements have rarely been met from 1947-1985. At an exploitation rate of 37.9%, egg deposition requirements have not been met from 1947-1985 (Table 7; Fig. 4).

Forecast

MSW salmon returns were predicted from the regression between MSW salmon angling catch (year i) with MSW salmon angling catch (year i+5) (Fig. 5). The 1985 angling catch (314) was outside the confidence limits of the value predicted from 1980 angling catch (145 ± 82). Based on the level of sport catch in 1981 (139), a return similar to 1985 can be expected in 1986. Correlations between hatchery smolts (year i) and 1SW angling catch (year i+1) were not significant (Table 8). The high 1SW salmon angling catches in 1979, 1981, and 1982 (Table 1) are coincident with the release of smolts of Rocky Brook parentage in 1978, 1980, and 1981 (Table 9).

DISCUSSION

Landings

The significant negative correlation between commercial catch in Zone 6 and 1SW salmon sport catch (Table 3) suggests that declines in 1SW salmon returns to the Margaree River are directly attributable to commercial fishery interception. The significant positive correlation between MSW salmon and commercial catch in Zone 6 suggests that relative abundance of MSW salmon has a greater influence on sport catchability than interception.

Spawning requirements, escapement and egg deposition

Sport catch remains the best index of spawning escapement available for Margaree River MSW salmon. The insignificant correlations between MSW salmon sport catch, discharge and temperature indicates that abundance of fish, not environmental conditions, has the greatest influence on catchability (Table 4). That MSW salmon sport catch is indicative of spawning escapement is further supported by significant correlations between MSW salmon sport catch and 1+ parr densities (Table 5). 1SW salmon appear to make a negligible contribution to recruitment on the Margaree River (Table 7). The lack of a significant correlation between the angling catch of 1SW salmon and 1+ parr densities also suggests that the 1SW salmon contribution to egg deposition is negligible.

More research is required to evaluate the 12.9% exploitation rate used in this assessment to estimate potential MSW salmon spawners. 12.9% is a low exploitation rate compared to past assessments (Marshall 1982; Gray and Chadwick 1984). A small shift in exploitation rate may have a relatively large effect on the spawning escapement and egg deposition estimates (Table 7, Fig. 4). Annual changes in egg to 1+ parr survival and exploitation rates during the season are two factors which have to be evaluated. A means of determining the number of salmon entering the river after the close of the angling season is also required.

Forecast

The increase in 1SW salmon sport catches of the 1979, 1981 and 1982 seasons (Table 1) may be attributable to the release of smolts of Rocky Brook parentage in the year previous to each of these seasons (Table 9). The failure of 1SW salmon abundance to be maintained in several years since 1979 (Table 1) and the lack of a significant correlation between 1SW sport catch (year i+1) and hatchery smolt releases (year i) (Table 8) emphasizes the need for an

objective means of assessing the hatchery contribution to the sport catch and spawning escapement of Margaree River salmon.

A return of MSW salmon similar to 1985 is forecast for 1986. In the absence of a commercial fishery this would represent an egg deposition above requirements (Table 7; Fig. 4). The above forecast is based on a poor relationship, low R^2 and wide confidence limits (Fig. 5), and will require further evaluation.

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Table 1. Commercial landings for Zone 6 (1967-1984) and angling catch on the Margaree River (1947-1985)*.

Year	Recreational catch			Commercial catch (kg)		
	1SW	MSW	Total	District 11, 12, 13	District 2 ,3	Zone 6
1947	37	363	400			
1948	106	704	810			
1949	50	332	382			
1950	119	320	439			
1951	46	424	470			
1952	87	204	291			
1953	57	291	348			
1954	78	298	376			
1955	53	258	311			
1956	29	90	119			
1957	36	136	172			
1958	N/A	N/A	334			
1959	N/A	N/A	235			
1960	N/A	N/A	140			
1961	40	49	89			
1962	46	410	456			
1963	87	212	299			
1964	120	289	409			
1965	86	254	340			
1966	92	165	257			
1967	92	210	302	40,388	12,852	53,240
1968	63	197	260	25,619	12,537	38,156
1969	206	136	342	21,018	9,429	30,447
1970	85	214	299	17,620	12,874	30,494
1971	21	92	113	7,286	4,740	12,026
1972	41	106	147	23,869	8,022	31,891
1973	165	116	281	18,350	9,340	27,690
1974	59	107	166	23,179	14,258	37,437
1975	36	64	100	11,904	11,727	23,631
1976	95	82	177	7,451	10,910	18,361
1977	68	140	208	13,308	12,913	26,221
1978	25	158	183	18,847	11,369	30,216
1979	605	81 (19)	686	4,718	3,199	7,917
1980	169	140 (2)	309	14,466	9,946	24,412
1981	899	139 (34)	1,038	10,105	5,457	15,562
1982	692	179 (76)	871	16,485	10,179	26,664
1983	72	149 (43)	221	11,556	10,226	21,782
1984	148	121 (109)	269	8,947	6,192	15,139
1985	222	314 (314)	536	N/F	N/F	N/F

* The statistics for commercial fisheries from 1947-1966 are not available. Information regarding 1SW and MSW salmon for 1958-1960 are not available. Numbers in parentheses for recreational catch from 1979-1985 indicate fish released.

Table 2. The number and percentage of 1SW and MSW salmon taken in the summer (June - August), fall (September - October), and complete portions of the sport fishery season on the Margaree River from 1947-1985. The 1947-1961 seasons were from June 1 - September 30, the 1962-1978 seasons were from June 14 - October 15, and the 1979-1985 seasons were from June 1 - October 15. 1979, 1981 and 1982 were the years in which there was a large increase in the 1SW salmon contribution to the summer catch. Numbers in parentheses indicate percentage of MSW or 1SW salmon taken in the various portions of the angling season. (i.e. For 1947-1961; 78.9% of the salmon caught in the summer were MSW, but 39.4% of the MSW salmon caught during the 1947-1961 seasons were taken in the summer portion of the season.

RUN TIMING	1947-1961		1962-1978		1979-1984		1979,81,82		1980,83,84		1985	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
MSW SALMON												
SUMMER	1367	78.9(39.4)	1132	61.4(38.4)	189	8.3(23.4)	115	5.8(28.8)	74	24.9(18.1)	146	52.6(46.5)
FALL	2102	84.9(60.6)	1815	72.9(61.1)	620	55.7(76.6)	284	46.5(71.1)	336	66.9(82.0)	168	60.9(53.5)
COMPLETE	3469	82.5	2947	68.0	809	23.8	399	15.5	410	51.3	314	58.6
1SW SALMON												
SUMMER	365	21.1(49.5)	711	38.6(51.3)	2091	91.7(80.9)	1868	94.2(85.1)	223	75.1(57.3)	114	43.9(51.4)
FALL	373	15.1(10.5)	676	27.1(48.7)	493	44.3(19.1)	327	53.5(14.9)	166	33.1(42.7)	108	39.1(48.7)
COMPLETE	738	17.5	1387	32.0	2584	76.2	2195	84.6	389	48.7	222	41.4

Table 3. Correlations between sport catch and commercial catch of the districts comprising Zone 6 from 1967-1984. * indicates significant correlations.

	COMMERCIAL CATCH								
	Districts 11, 12, 13			Districts 2, 3			Zone 6		
Sport catch	No.	R	P	No.	R	P	No.	R	P
1SW	18	-.30	.11	18	-.51*	.02	18	-.39*	.05
MSW	18	.77*	.00	18	.47*	.03	18	.75*	.00
1SW + MSW	18	-.14	.30	18	-.42	.04	18	-.23	.18

Table 4. Correlations between sport catch, discharge and temperature. A) Sum of 1SW, MSW, 1SW + MSW sport catch, discharge (cfs) and daily mean temperature by two-week period during angling season from 1947-84. B) Total 1SW, MSW, 1SW + MSW sport catch, discharge (dam^3) and daily mean catch for July, August and September.

	Discharge			Temperature		
	No.	R	P	No.	R	P
A) By two-week period						
1SW	284	-.04	.26	90	-.01	.47
MSW	284	.11	.03	90	-.14	.09
1SW + MSW	284	.05	.20	90	-.07	.26
B) Totals for July, August and September						
1SW	35	.04	.41	11	-.18	.29
MSW	35	-.07	.36	11	.29	.19
1SW + MSW	35	-.03	.44	11	-.01	.49

Table 5. Correlations between 1+ parr (year i+2) densities and sport catch (year i). Tributary densities are based on the means of the site numbers indicated. * indicates significant correlations.

Site	1SW			MSW			1SW + MSW		
	No.	R	P	No.	R	P	No.	R	P
TRIBUTARY									
Forest Glen 1, 2, 3, 4	3	.24	.42	3	.22	.43	4	.54	.23
Forest Glen 1, 2, 4	5	.27	.33	5	-.38	.26	6	.48	.27
Forest Glen 1, 2	8	.09	.41	8	-.53	.09	9	.25	.26
Lake O'Law 1, 2	5	.68	.10	5	.91*	.02	5	.92*	.01
Northeast Margaree									
McLeod's	7	-.33	.23	7	.85*	.01	8	.73*	.02
Below Old Bridge	8	.13	.38	8	.42	.15	9	.56	.06
Below Cranton Bridge	8	-.12	.38	8	.86*	.00	9	.67*	.03
OVERALL AVERAGE	8	-.14	.37	8	.66*	.04	9	.70*	.02

Table 6. The exploitation rate based on the relationship between MSW salmon sport catch (year i) and average 1+ parr (year i+2) density on the Margaree River.

Year (i+2)	Density 1+ parr No./100 m^2	Total parr $X10^4$	Eggs $X10^4$	Spawners	MSW Spawners	MSW sport catch	Exploitation rate
1957	29.1	81.4	814	1,646	1,234	258	17.3
1958	20.2	56.5	565	1,143	857	90	9.5
1959	26.1	73.0	730	1,476	1,107	136	10.9
1975	18.5	51.8	518	1,047	785	116	15.1
1976	18.3	51.2	512	1,035	776	107	12.1
1977	14.2	39.7	397	802	602	64	9.6
1978	21.4	59.9	599	1,211	908	82	8.3
1979	13.1	36.6	366	740	555	140	20.1
AVERAGE	20.1	56.3	563	1,138	853	124	12.9

Table 7. Estimated Atlantic salmon egg deposition in the Margaree River from 1947-1985. Angling catch, 12.9% exploitation rate and the exploitation rates used in past assessments have been used to estimate potential MSW and 1SW salmon spawners. Fecundity rates used to calculate egg deposition were 6482 eggs/MSW and 330 eggs/1SW. Egg deposition requirements are 6,710,000 eggs. A * indicates years in which spawning requirements have been met. For 1957, 58, 59, 75-79 egg depositions calculated from 1+ parr densities have been used.
N/C; no collection made.
N/A; data not available.

MILLIONS OF EGGS

YEAR	EGGS COLLECTED FOR HATCHERY	MSW (12.9)	1SW (20.6)	TOTAL	MSW (20.6)	1SW (20.6)	TOTAL	MSW (37.9)	1SW (32.9)	TOTAL
1947	5.00	15.88	0.05	10.93*	9.07	0.05	4.12	3.86	0.02	-
1948	4.50	30.81	0.13	26.44*	17.58	0.13	13.21*	7.48	0.06	3.04
1949	2.80	14.53	0.64	12.37*	8.30	0.64	6.14	3.58	0.03	0.76
1950	N/C	14.01	0.15	14.16*	7.99	0.15	8.14*	3.40	0.06	3.46
1951	N/C	18.56	0.58	19.14*	10.59	0.58	11.17*	4.50	0.02	4.52
1952	N/C	8.93	0.11	9.04*	5.09	0.11	5.20	2.16	0.05	2.21
1953	N/C	12.74	0.73	13.47*	7.27	0.73	8.00*	3.09	0.03	3.12
1954	N/C	13.04	0.99	14.03*	7.45	0.99	8.44*	3.16	0.04	3.20
1955	0.50	11.29	0.67	11.46*	6.44	0.67	6.61	2.74	0.03	2.27
1956	3.50	3.94	0.76	1.20	2.25	0.76	-	0.95	0.02	-
1957	0.90	-	-	8.14*	3.40	0.46	2.96	1.45	0.02	0.5
1958	1.00	-	-	5.65	N/A	N/A	N/A	N/A	N/A	N/A
1959	0.50	-	-	7.30*	N/A	N/A	N/A	N/A	N/A	N/A
1960	1.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1961	2.00	2.15	0.51	0.66	1.23	0.51	-	0.52	0.02	-
1962	0.30	17.94	0.51	18.15*	10.24	0.51	10.45*	4.36	0.02	4.08
1963	1.10	9.28	0.11	8.29*	5.30	0.11	4.31	2.25	0.05	1.20
1964	0.40	12.65	0.15	12.40*	7.22	0.15	6.97*	3.07	0.07	2.74
1965	0.60	11.12	0.11	10.63*	6.35	0.11	5.86	2.70	0.05	2.15
1966	0.40	7.22	0.12	6.95*	4.12	0.12	3.84	1.75	0.05	1.40
1967	0.20	9.19	0.12	9.11*	5.24	0.12	5.16	2.23	0.05	2.08
1968	0.40	8.62	0.08	8.30*	4.92	0.08	4.60	2.09	0.03	1.72
1969	0.35	5.95	0.26	5.86	3.40	0.26	3.31	1.45	0.11	1.21
1970	0.20	9.37	0.11	9.28*	5.35	0.11	5.26	2.28	0.05	2.13
1971	0.05	4.03	0.03	4.01	2.30	0.03	2.28	0.98	0.01	0.94
1972	0.10	4.64	0.05	4.59	2.65	0.05	2.60	1.13	0.02	1.05
1973	0.10	5.08	0.21	5.29	2.90	0.21	3.01	1.23	0.09	1.22
1974	N/C	4.68	0.07	4.75	2.67	0.07	2.74	1.13	0.03	1.16
1975	0.05	-	-	5.18	1.60	0.05	1.60	0.68	0.02	0.65
1976	N/C	-	-	5.12	2.05	0.12	2.17	0.87	0.05	0.92
1977	N/C	-	-	3.97	3.50	0.09	3.59	1.48	0.04	1.52
1978	0.10	-	-	5.99	3.95	0.03	3.88	1.68	0.01	1.59
1979	N/C	-	-	3.66	2.15	0.77	2.92	0.99	0.33	1.32
1980	0.10	6.14	0.12	6.25	3.51	0.21	3.62	1.50	0.09	1.49
1981	0.05	6.31	1.14	7.40*	3.69	1.14	4.78	1.70	0.50	2.15
1982	0.20	8.33	0.88	9.01*	4.97	0.88	5.65	2.39	0.37	2.56
1983	0.10	6.80	0.09	6.79*	4.00	0.09	3.99	1.86	0.04	1.80
1984	0.10	6.00	0.19	6.09	3.73	0.19	3.82	1.99	0.08	1.97
1985	0.15	15.78	0.28	15.91*	9.88	0.28	10.01*	5.37	0.12	5.34

Table 8. Correlations between 1) 1SW salmon sport catch (year i) with MSW salmon sport catch (year i+1) from 1947-1985; 2) Hatchery released smolts (year i) with 1SW salmon sport catch (year i+1) from 1976 to 1985.

	R	P
1SW (year i) with MSW (year i+1)	0.10	0.52
Hatchery smolts (year i) with 1SW (year i+1)	0.44	0.33

Table 9. Smolts released to Margaree River since 1976.

Year	Smolts	Genetic stock
1976	8,971	Margaree
1978	16,053	5% Margaree 95% Rocky Brook
1979	15,927	Millbank
1980	14,960	Rocky Brook
1981	15,950	Rocky Brook
1982	8,481	Margaree
1983	18,396	Margaree
1984	35,888	Margaree
1985	19,900	95% Margaree 5% Rocky Brook

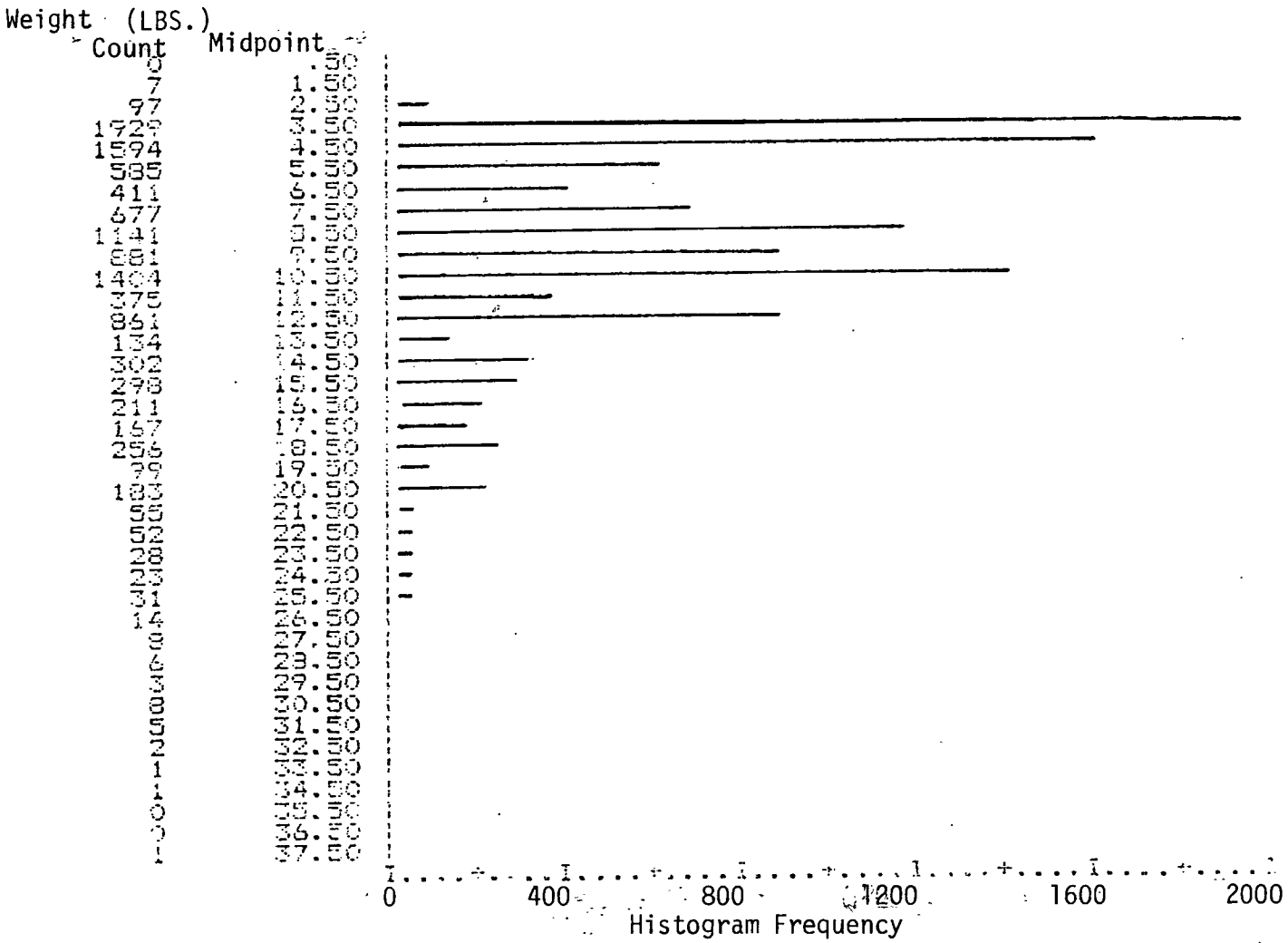

Fig. 1 Weight distribution of Margaree River angling catch 1947-1984. All fish in the sport catch less than or equal to 6.0 pounds were considered 1SW salmon, those over 6.0 pounds, MSW salmon.

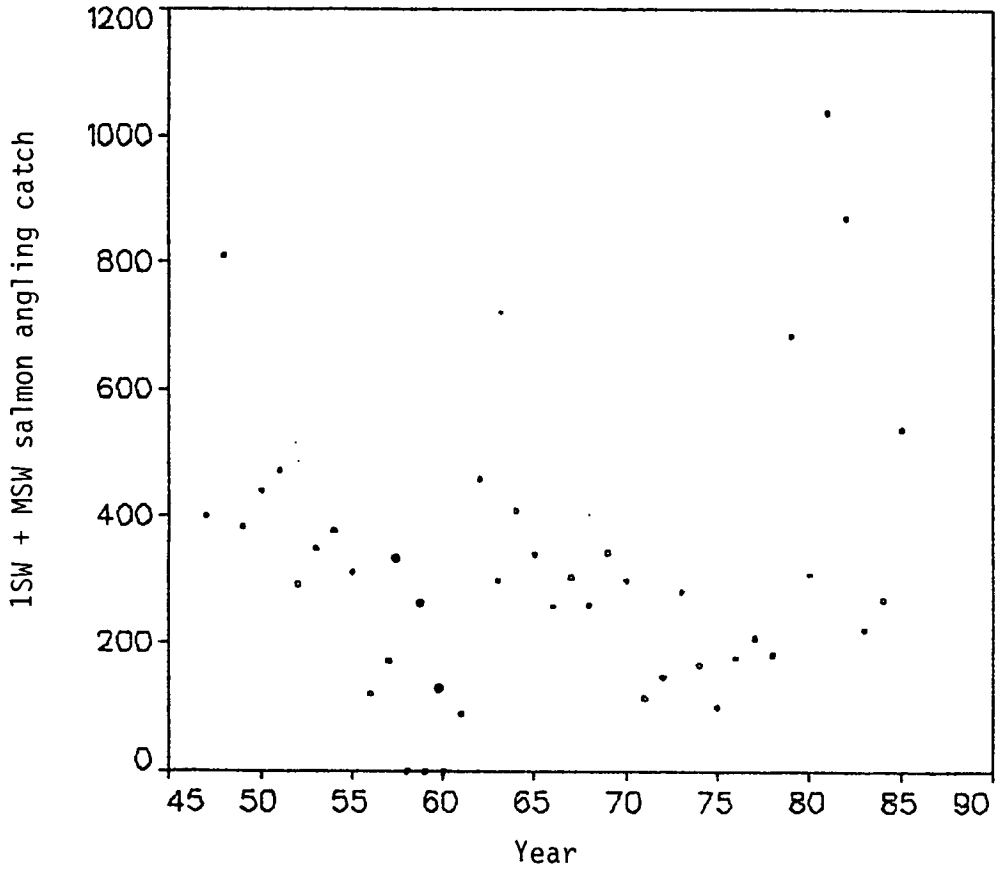

Fig. 2 Scatter plot of total angling catch (1SW + MSW salmon) against year (1947-1985)

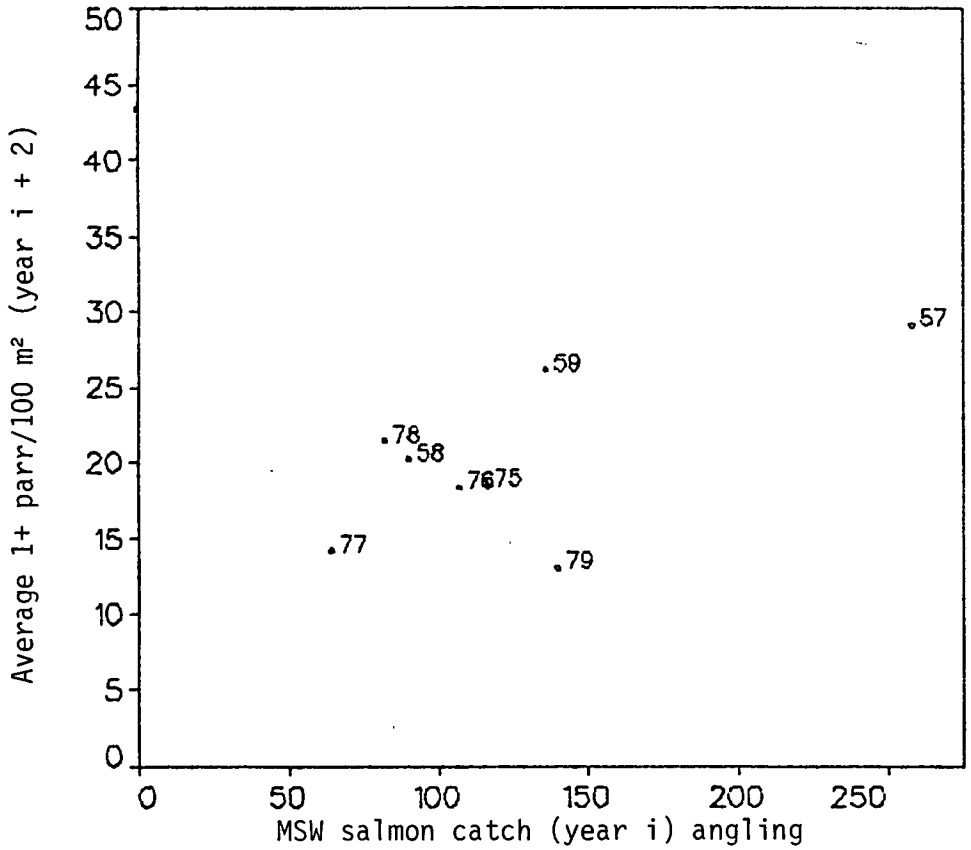

Fig. 3 Scatter plot of MSW salmon angling catch (year i) and average 1+ parr densities (year i + 2) for eight years of electrofishing sampling (1957-1959, 1975-1979). Year in figure corresponds to parr sampling year.

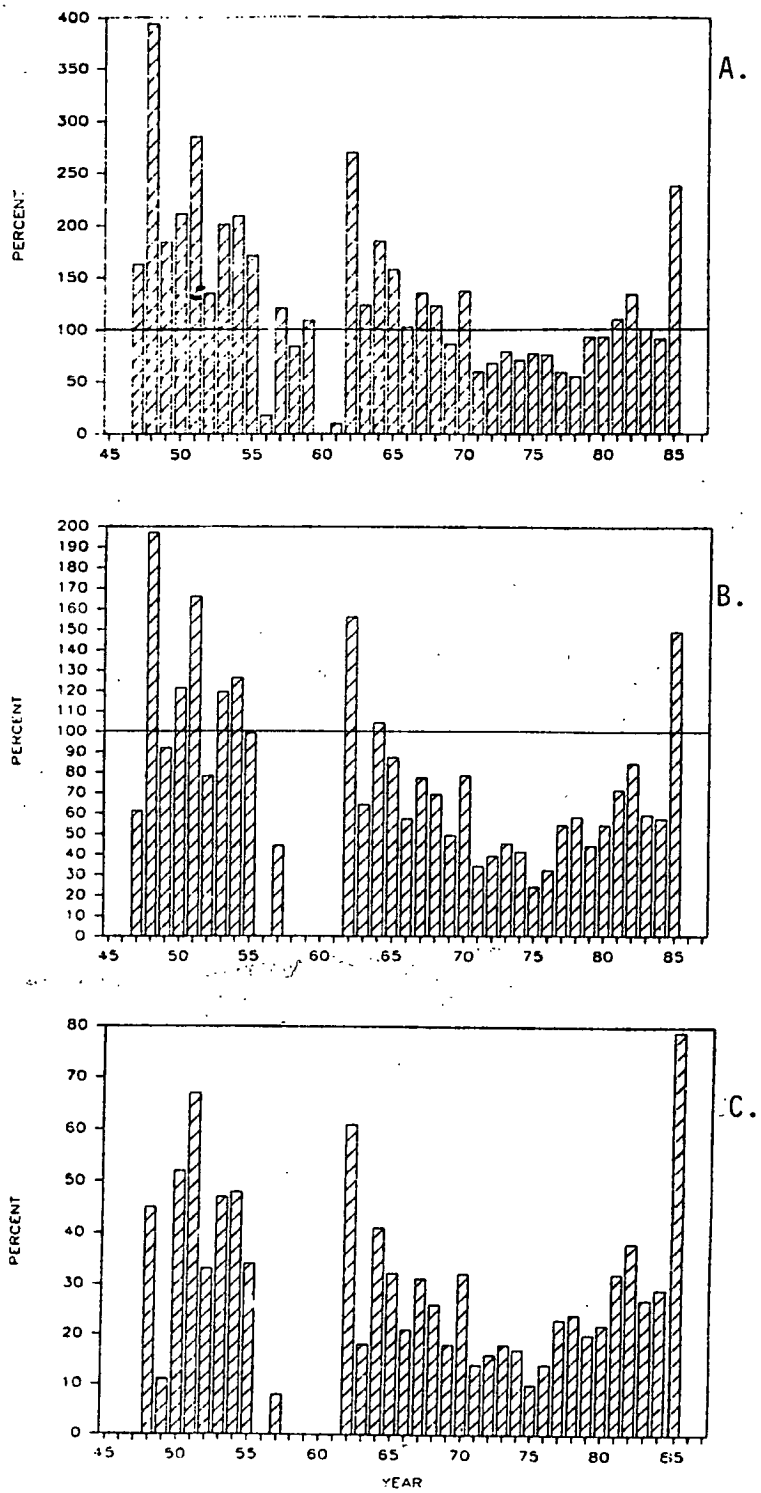

Fig. 4. The percentage of required Atlantic salmon egg deposition achieved on the Margaree River 1947-1985. A) Using a 12.9% exploitation rate for MSW salmon and 20.6% exploitation rate for 1SW salmon. 1957-59 and 1975-79 egg depositions are based on back calculations of 1+ parr densities. No data is available for 1960. B) Using a 20.6% exploitation rate for both MSW and 1SW salmon. No data is available for 1958-1960. C) Using a 37.9% exploitation rate for both MSW and 1SW salmon. No data is available for 1958-1960. Horizontal line in A and B denotes when 100% of required egg deposition has been achieved.

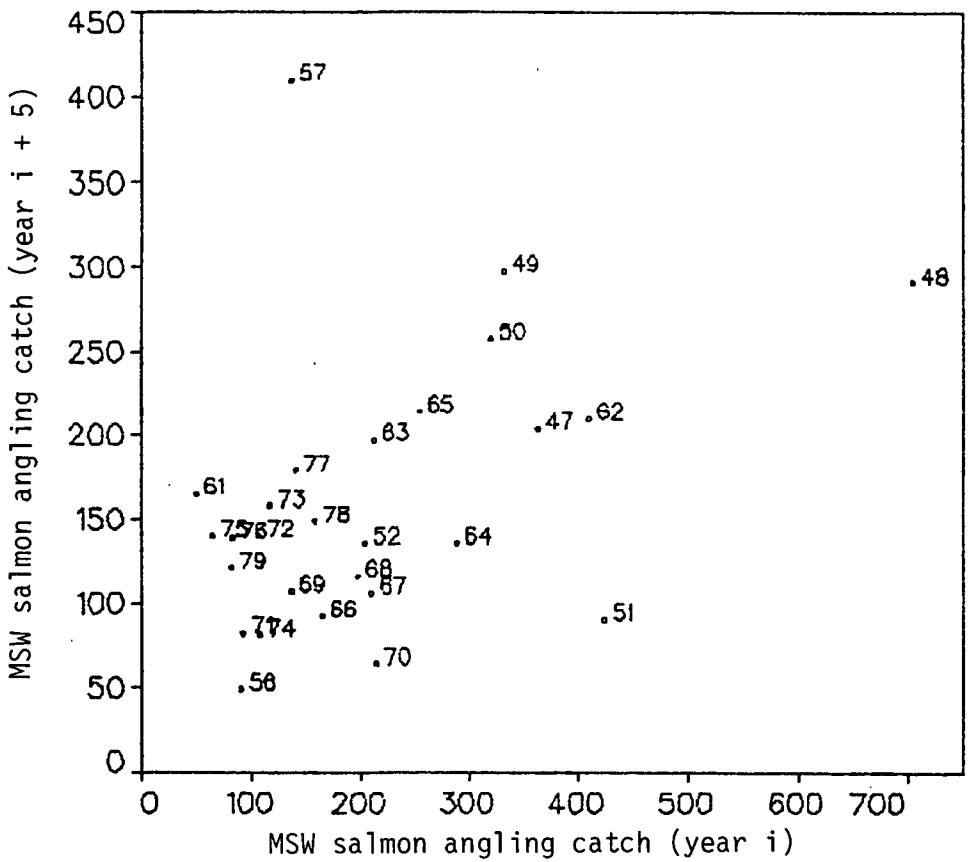

Fig. 5 Scatter plot of MSW salmon angling catch (year i) and MSW salmon angling catch (year i + 5). Regression equation used to predict 1986 angling catch was (year i + 5) angling catch = 112.49 + 0.23×(year i angling catch). Standard error slope = 0.10; standard error intercept = 25.95; R^2 = 0.17; P value = 0.03.