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Canadian Atlantic Fisheries Scientific Advisory Committee

Comité scientifique consultatif des pêches canadiennes dans l'Atlantique

CAFSAC Research Document 90/6 (Revised)

CSCPCA Document de recherche 90/6 (Révisé)

Status of Atlantic salmon of the Stewiacke River, 1989

by

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ABSTRACT

Densities of juvenile Atlantic salmon in the Stewiacke River ,1984-1989, indicate that production remains relatively stable despite declines in grilse catches since 1987. Precipitation the year previous to smoltification continues to explain a significant but limited amount of the variance in survival from indexed egg contribution to indexed grilse recruits to the river. Management strategies aimed at maintaining minimum grilse recruits are no more likely to succeed in maintaining stable production than those aimed at protection of repeat spawners unless two consecutive extreme low years of grilse recruits occur. Forecasts to the sport fishery have become questionable because of changes in reporting systems and while the trend in grilse catches was correctly indicated the magnitude of the trends were underestimated.

RESUME

D'après les densités de juvéniles relevées dans la rivière Stewiacke, de 1984 à 1989, la production de saumons de l'Atlantique demeure relativement stable, malgré une baisse des prises de madeleineaux depuis 1987. Les précipitations dans l'année qui précède le passage à l'état de saumonneau (smoltification) restent une cause, quoique partielle, de l'écart entre le nombre d'oeufs recensés et le nombre de madeleineaux recrutés dans la rivière. Il apparaît que les stratégies de gestion ayant pour but de maintenir un recrutement minimal de madeleineaux ne parviendront pas davantage à assurer une production stable que celles qui visaient à protéger les saumons à pontes antérieures, à moins que le recrutement des madeleinaux ne soit extrêmement bas durant deux années consécutives. Les prévisions portant sur la pêche sportive sont devenues douteuses pour deux raisons : d'une part on a modifié le système de déclaration; d'autre part, bien que l'on ait correctement prévu la tendance des prises de madeleineaux, on en a sous-estimée l'importance.

INTRODUCTION

This document provides data and analyses for assessment of the status of Atlantic salmon (Salmo salar) stock of the Stewiacke River, and reviews the methodology of forecasting grilse recruits to the sport fishery begun in 1986 by Amiro and McNeill (1986) and continued in 1987 by Amiro (1987).

BACKGROUND

The Stewiacke River (Fig.1) Atlantic salmon stock, like that of nearly all inner Bay of Fundy salmon stocks, is comprised almost entirely of virgin (recruit) and repeat spawning grilse. These fish have not been intercepted in distant or homewater commercial fisheries other than in the Bay of Fundy (closed since 1985), during any tagging or marking program conducted by the Department of Fisheries and Oceans.

The capacity of the Stewiacke River to produce salmonids is less encumbered by known environmental constraints, such as low pH, mineral, (G. Farmer pers. comm)[1], or excessively high water temperatures, than many other drainages within the Scotia-Fundy Region. These factors combined with the presence of a full range of habitats available to juvenile salmonids have contributed to the Stewiacke being selected for the study of alternative assessment methodologies. Data collected to assess methodology provide means to assess the status of the juvenile populations in an era when stocks throughout the inner Bay of Fundy are experiencing extremes in abundance.

Forecast methodology developed for the Stewiacke and other inner Bay of Fundy rivers utilizes index variables for stock and recruits and accounts for variation in survival with an environmental variable in the freshwater stage. However while the 1986 grilse catches and the low 1987 catches were close to forecast catches, the 1988 recovery was only half of that forecast by the models. Further use of the original models is hampered by changes that have occurred in both commercial and sport fisheries and changes in the reporting systems in the sport fisheries.

METHODS

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Sport fishery statistics were those of the "Redbook"[2] reports of the Department of Fisheries and Oceans 1970-1983. Sport catch statistics 1984-1988 are those reported by O'Neil et al. (1985-1987).

Biological characteristics of the adult population were derived from 238 fish sampled from the angling fishery (S.F.O'Neil, pers. comm.)[3] and 28 fish sampled while conducting broodstock collections by electroboat in 1983. Samples taken from the commercial fishery were not included in the derivation of biological characteristics because of the uncertainty of river-of-origin and possible sampling bias.

Length-fecundity, determined by water displacement following annual egg stripping (Amiro and McNeill, 1986) was;

$$Y_{Fecundity}=431.3*e^{0.037*X_{Length}}$$

Required spawning escapement was calculated from the number and size-at-age distribution determined from the 1983 biological sampling, the length-fecundity relationship and a target egg deposition of $3.0*10^6$ eggs. Contribution to egg deposition by age-class was weighted by the proportion-at-age and the percent female-at-age.

Habitat area and juvenile densities are those of Amiro et al. (1989) the detailed collection of which are explained therein. In summary the areas for electrofishing sites are derived from proximately measured ecological unit type surveys, the total habitat area is derived from remote surveying using 1:10,000 orthophotographic maps with 5.0 m contour intervals and 1:10,000 colour aerial photographs, and the juvenile densities are derived by mark-recapture electrofishing of continuous ecological sections, called sites, at 34 locations in the main Stewiacke River and tributaries (Fig.1).

Estimates of index stock eggs and index recruit eggs were calculated per Amiro (1987) but with the years 1970-1983 adjusted to equate to the angler stub return estimates of catches. Adjustment to license stub equivalents for data prior to 1984 was made by using the correction factor of 1.3 determined in 1983, the final year of fishery officer reports and the first year of license stub returns (S. F. O'Neil pers comm.)

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[2] Atlantic Salmon Sport Catch Statistics, Maritime Provinces, annual series beginning 1970. DFO, Halifax,N.S.

[3] S.F.O'Neil, Fisheries and Oceans, Freshwater and Anadromous Div.,P.O. Box 550, Halifax, N.S.

In summary the stock side of the relationship is derived from an estimate of the numbers of eggs contributing (year i-4 and year i-5) to a recruit year (i=1, maiden grilse), proportioned by smolt age contribution determined from scale reading, indexed from the record of angling catches and calculated at mean size and fecundity. The recruit eggs are indexed from the reported grilse catch in the recruit year.

Stock and recruitment egg indexes were regressed with July precipitation at Upper Stewiacke in year i-2 of grilse catches rather than the average of July to September precipitation as in the 1986 assessment (Amiro, 1987).

Estimated index egg deposition for each year was calculated as the product of the number of grilse and salmon angled in a year and the fecundity at the same mean lengths as used in the calculation of index stock eggs.

RESULTS

Habitat area

The amount of area available to juvenile production (Table 1) was estimated at $26,762*10^2$ m^2 above the head of tidal influence (Amiro et al., 1989). Area with ortho-gradient less than 0.12% was $13,928*10^2$ m^2 which included $12,153*10^2$ m^2 on the main Stewiacke with less than 0.03% ortho-gradient.

Sport fishery

The sport fishery season traditionally opened June 15 and closed October 15 with extensions to October 31 in 1975-1977 and 1980. Beginning in 1981 the season has opened on August 31 and closed October 31. Entry to the river and exploitation by the sport fishery is concentrated in the months of September and October (Fig.2). Beginning in 1984 only fish less than 63 cm were permitted to be retained.

Annual catches (Table 2, Fig. 3) were highly variable for both salmon and grilse. In addition to the change in reporting systems from that of DFO officers to licence stub returns the definition of grilse has changed from less than 2.3 kg to less than 63 cm.

As in all rivers of the inner Bay of Fundy, catch of grilse has declined since 1985 but not to record low catches. Effort has increased since the 1970's (Fig.3). Catch $unit^{-1}$ effort (Fig.3) is as variable as the catch and lowest in recent years of low catches and increased effort.

Biological characteristics

The length-fecundity relationship and the 1983 adult sampling data were used to calculate contribution to egg deposition by age-class (Table 3). These data show recruits (mostly grilse) contribute in the order of 55% (Fig.4) and first-repeating grilse contribute 16% of the egg deposition. The remainder of the contribution comes from multiple repeat spawning grilse (17%) and two-sea-winter (2SW) salmon (5%). These data, rather than those of the complete data set of the Big Salmon River, as in the last assessment, are used to estimate spawning requirements. These data were used because of the dependence of stock stability on achieving minimum grilse recruits to the spawning stock (Amiro and McNeill, 1986) and the greater proportion of grilse recruits in the 1983 Stewiacke data set.

Egg requirements

The number of eggs required to seed the entire Stewiacke River and tributaries at 240 eggs 10^{-2} m^2 (Elson,1975) is $6.38*10^6$ eggs. However, considering that 52% of the area has an ortho-gradient less than 0.12% and electrofishing has revealed that few juvenile salmon occupy these areas while more preferred areas have extreamly high densities, a more reasonable estimate of required egg deposition would be $3.0*10^6$ eggs obtained by discounting the low gradient waters.

Required spawning escapement

The 1983 adult sampling data and the length-fecundity relationship indicated that for a required egg deposition of $3.0*10^6$ eggs an escapement of 1061 fish (Table 3) comprised of 73% recruit grilse or 772 grilse would adequately seed the habitat and provide for a stable population.

Stock status

Mean densities of age-1+ parr, 1984 to 1989, (Table 4) indicate higher densities of 29 and 34 parr $unit^{-1}$, 1985 and 1987, and densities of 16 and 18 parr $unit^{-1}$ (10^2 m^2) for other years. Densities of age-2+ parr are lower, ranging from 5.5 to 8.1 age-2+ parr $unit^{-1}$. Total age-1+ and 2+ parr densities ranged from 23.8 to 39.2 fish $unit^{-1}$.

Standard deviations of annual mean parr densities were large.

Some annual means had coefficients of variation approaching or greater than 100%, particularly in years of high densities. Annual group variance was not homogeneous between years and precluded post hypothesis contrast comparisons of years. Annual variation in the number and mixture of locations (Table 5) reduced the set of locations for a two-way ANOVA to three locations. The risks associated with drawing conclusions from small samples suggest the use of non-parametric methods.

Annual mean parr densities were compared by examination of box plots (Fig. 5). Box plots use ranked data to calculate the median, hinges (quartiles), outlying data and 95% confidence limits of the groups. Visual inspection of these figures indicate that no one year median is outside the inner quartile of another year therefore the probability of a significantly different annual age 1+, 2+ or total parr density is extreamly low. Data collected in 1985 and 1987 had 3 to 4 values outside the range of the inner and outer hinges.

Stock and Recruitment

Three approaches were used to examine stock and recruitment: **1)** the relationship between annual index egg deposition from angling (Table 2) and resulting (year i+2) age-1+ parr densities (Table 4), **2)** the relationship between the estimated egg depositions (year i-4 and year i-5) contributing to the estimated grilse recruit eggs angled in year-i (Table 2), and **3)** the relationship between grilse in year i and salmon in year i+1 (Table 2).

1) The egg-to-age-1+ parr relationship (Fig. 6) was not significant at the 95% level (p=0.061), but did account for 53% of the annual variance in age-1+ parr densities.

2) The stock egg to grilse recruit egg relationship (1975-1988) which includes the variable, precipitation in year i-2 of recruits, was significant (p=0.012) when calculated as in the 1986 assessment ie., Ln Recruit eggs Spawner^{-1} eggs on Ln July precipitation at Upper Stewiacke in year i-2. The equation ;

$$Y_{\text{Ln (Rec eggs/Spawner eggs)}} = -6.544 + 1.241 * X_{\text{LnJuly precip.}}$$

accounted for 38% of the variance and had a standard error of the estimate =0.87 which converts to a ratio of 2.4 (Recruit eggs/Spawner eggs). A ratio of 1 would indicate replacement in one generation and an error of $\pm$ 2.4 is considerable in comparison. This is without the increased error component arising from geometric to arithmetic conversion.

The relationship was more simply calculated by regression of Grilse Recruit eggs (year i) (Z) on Contributing Stock eggs(X)*July precipitation(Y) (year i-2) and the slope was significant (p=0.055) without log transformation of the data (Fig. 7). The equation;

$$Z_{Recruit\ eggs}=215.5 + 0.005*(X_{Stock\ eggs} * Y_{July\ precip.})$$

accounted for only 24% of the variance, had a standard error of the estimate = 947 recruit eggs and a non-significant (p=0.742) constant.

3) The grilse to salmon relationship was not significant (p<<0.05) and accounted for only 9% of the variance.

Index egg stock and recruitment models (approach **2**) forecast at average length and proportion female, a catch of 233 or 234 grilse in the 1989 season. Forecasts for the 1990 season area 1,176 or 1,224 grilse.

Hatchery returns

A total of 70,366 hatchery cultured and marked Stewiacke origin juveniles, including 10,574 tagged smolts, have been released into the Stewiacke River and tributaries from 1985 to 1987. No tags have been recovered and only a few adipose clipped adults have been reported.

No juvenile salmon were released into the Stewiacke in 1989.

DISCUSSION

Low grilse catches and index egg depositions in 1987 has not resulted in significantly lower mean densities of juvenile salmon in the Stewiacke River and tributaries in 1989. Juvenile densities may have been maintained by higher than accounted-for escapements or higher than average egg-to-parr survival. Higher age-1+ parr densities were associated with higher index egg depositions eg. 1985 parr from 1983 eggs and 1987 parr from 1985 eggs. Regression of parr densities on index egg depositions, while not highly significant, is suggestive of an underlying stock-recruitment relationship. It is interesting to note that the point that least fits the relationship, 1988 parr from 1986 eggs is unique in the 1984 to 1989 time series of parr densities because it is derived from a high egg index, follows a previous high index egg year and is 45% lower than the 1987 density.

The juvenile stock-and-recruitment relationship together with the modifying affect low summer water conditions has on the subsequent return of grilse suggests a reason why returns are highly variable ie.

low egg deposition together with low water result in low returns. Short-term stability in these stocks can be provided by multiple-spawners maintaining minimum required egg depositions in grilse paucity years. However, no statistical relationship could be demonstrated between grilse returns and subsequent salmon returns. Such a relationship would be difficult to demonstrate without adequate sampling and ageing of multiple-spawners over a long time series. Long-term stability in production is dependant on maintaining a minimum number of recruit grilse in the escapement which in later years maintain egg depositions above replacement of the population.

The weak relationship between index egg deposition and age-1+ parr densities and the recent low catches indicate declines in parr populations are to be expected in 1990. However, water levels in 1990 cannot be predicted and therefore the rationale for attempting to have managed the spawning escapement of grilse in 1988, based on the predicted return, in order to stabilize returns in 1992 is a chance laden strategy. Such a strategy is unlikely to lead to improved stability in returns while incurring the costs associated with a further restricted fishery. Hence, present management strategies that restrict harvest to fish less than 63 cm (a length which includes some repeat-spawners) may be credited with maintaining minimum egg depositions in years of low grilse returns. Attempting to decrease the exploitation of grilse may only be warranted when the forecast is very low ie. less than 50% of the mean and follows two consecutive years of low grilse returns.

Restricted harvest of grilse in years following two consecutive years of low grilse recruitment is founded on the basis that first and second repeat-spawning grilse can contribute 33% (Table 3) of the required egg deposition. Therefore in a year following two consecutive years of low grilse returns repeat spawning grilse cannot be expected to contribute their requirement. However this situation has not occurred in the 1970 to 1988 data series.

Forecasts provided herein differ from the 1986 assessment and are the result of changes in the angling catch reporting system and the use of July precipitation rather than the June-to-October average precipitation. The predicted catch for 1989 by the 1986 equation was for 844 grilse while the two equations presented herein predict 233 or 234 grilse. This difference is the result of the September and October precipitation cancelling out the low July and August precipitations of 1987. The 1989 catch may provide additional insight into inclusion or exclusion of September and October values in the models.

Sea surface temperatures, a significant additional variable in the recruitment models (Amiro, 1987), were not available at the time of writing and because of changes in collection regime require analysis before inclusion in these models. The effect that sea temperatures had on the catch of grilse was correlated with summer precipitation (or discharges) and therefore enhanced the magnitude of the predictions. The inclusion of the temperature data may have been beneficial in accounting for the predictors to correctly indicate the trend of the catches but not the magnitude of the changes.

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Table 1. Area (m^2*100) by percent orthogradient and distance above the 10-m contour for the Stewiacke River.

	Orthogradient interval												
Dist. interval (km)	0-0.12	0.121-0.249	0.25-0.49	0.5-.99	1-1.49	1.5-1.99	2-2.49	2.5-2.9	3-3.49	3.5-5.0	>5.0	Row totals	Row percents of total area
00-09.999	3,000	116	142	0	0	0	0	0	0	0	0	3,258	12.2
10-19.999	3,238	668	63	29	6	0	0	1	0	0	0	4,007	15.0
20-29.999	2,824	86	244	419	21	16	2	3	0	0	0	3,616	13.5
30-39.999	2,865	0	264	732	157	29	0	0	0	0	0	4,047	15.1
40-49.999	1,972	1,557	411	175	33	8	6	0	5	2	0	4,170	15.6
50-59.999	28	1,480	1,390	702	288	55	33	7	4	6	0	3,994	14.9
60-69.999	0	0	1,046	1,092	523	166	88	21	20	7	5	2,968	11.1
70-79.999	0	0	80	267	265	91	0	0	0	0	0	703	2.6
Column totals	13,928	3,907	3,640	3,416	1,293	366	130	32	29	16	5	26,762	100.0
Column percents of total area	52.0	14.6	13.6	12.8	4.8	1.9	0.5	0.1	0.1	0.1	<0.1		

Table 2. Recreational catch including releases of Atlantic salmon from the Stewiacke River 1970 to 1988 with estimated number of spawner eggs (from yr i-4 and i-5 of sport catch) contributing to recruit eggs returned in year i, precipitation at Upper Stewiacke in July and August of year i-2 and estimated index egg deposited in year i.

Year	Sport catch a.		Spawnner eggs*1000			Recruit eggs*1000	Precipitation (mm) in recruit_yri-2		Egg deposit *1000
i	Grilse	Salmon	Grilse	Salmon	Total	Grilse	July	August	yr=i
70	462	212							
71	438	60							
72	446	345							
73	676	291							
74	1,413	462							
75	575	234	1,052	456	1,508	1,360	151.4	110.2	2,435
76	1,222	257	1,051	1,242	2,292	2,893	106.9	54.6	4,075
77	135	481	1,459	1,400	2,859	320	28.4	14.7	2,528
78	709	98	2,892	1,915	4,807	1,677	46.2	51.0	2,125
79	885	311	1,876	1,346	3,222	2,096	129.7	82.5	3,522
80	53	264	2,494	1,154	3,648	126	54.7	28.9	1,338
81	690	116	989	1,941	2,930	1,634	164.1	177.9	2,165
82	399	126	1,324	905	2,230	945	116.0	45.4	1,524
83	1,619	317	1,987	1,172	3,159	3,833	138.2	67.2	5,288
84	425	140	638	1,267	1,906	1,006	110.8	100.4	1,649
85	1,037	361	1,242	708	1,950	2,455	177.9	193.4	4,112
86	495	579	1,124	566	1,691	1,172	55.6	160.4	3,830
87	148	216	3,082	1,227	4,309	350	53.0	130.0	1,342
88	247	119	1,741	854	2,595	585	151.6	89.4	1,131
89	1,323	223	2,078	1,393	3,472	3,132	44.4	70.2	4,156
90			1,505	2,398	3,903		148.6	120.4	
91			564	1,425	1,989				
92			524	662	1,186				

a. Data prior to 1983 increased by 30%

Grilse avg.length = 55.2 cm.==>3,288 eggs/female @ 72% of the grilse population.
Salmon avg length = 71.3 cm.==>5,962 eggs/female @ 77% of the salmon population.

Proportion of eggs destined to 2yr smolt==> 0.74 of yri-4 of recruits(grilse).
Proportion of eggs destined to 3yr smolt==> 0.26 of yri-5 of recruits(grilse).

Table 3. Age distribution by age-at-first maturity, post smolt age, spawning history mean length, fecundity, percent female, percent-at-age, percent contribution to egg deposition and required spawning escapement of Atlantic salmon for the Stewiacke River as determined from samples collected from the commercial and the angling fisheries, 1983.

Post smolt age	Spawing history				FW age	Number @ age	Mean length (cm)	Mean fecundity (eggs)	Percent female @ age	Percent of pop. @ age	Percent cont. to egg dep.	Required spawners		
	1st	2nd	3rd	4th								Females	Males	Total
1SW														
1	0				2	204	52.7	2,999	73	68.5	53.2	532	197	729
1	0				3	12	54.9	3,252	50	4.0	2.3	21	21	43
2	1				2	38	64.4	4,613	66	12.8	13.8	90	46	136
2	1				3	8	61.8	4,192	62	2.7	2.5	18	11	29
3	1	2			2	9	73.0	6,331	89	3.0	6.0	29	4	32
3	1	2			3	2	71.6	6,013	100	0.7	1.4	7	0	7
3	1				2	7	78.0	7,610	100	2.3	6.3	25	0	25
5	1	2	3	4	2	1	96.3	14,923	100	0.3	1.8	4	0	4
2SW														
2	0				2	7	72.1	6,125	100	2.3	5.1	25	0	25
2	0				3	2	75.0	6,814	100	0.7	1.6	7	0	7
3	2				2	3	79.4	8,012	66	1.0	1.9	7	4	11
3	2				3	1	--	--	--	--		--	--	0
4	2	3			2	4	80.8	8,436	100	1.3	4.0	14	0	14
	Totals					298						779	282	
											Total req'd escapement=			1061

Required egg deposition = 3.00E6 eggs

Table 4. Annual means and standard deviation of age-1+ and age-2+ densities as determined by mark-recapture electrofishing at sites in the Stewiacke River 1984-1989.

	Year and number of sites					
Age	1984 44	1985 27	1986 38	1987 36	1988 29	1989 31
1+						
Mean	17.0	28.9	16.0	33.6	18.5	16.1
SD.	13.2	26.7	13.0	44.7	9.0	13.7
2+						
Mean	6.8	6.8	8.1	5.5	7.0	6.7
SD.	7.9	8.3	8.9	4.8	5.1	5.7
Total						
Mean	23.8	35.7	24.2	39.2	25.5	22.4
SD.	19.0	34.2	18.4	47.8	10.7	16.1

Table 5. Annual distribution and frequency and total numbers of sites electrofished at 34 locations in the Stewiacke River, 1984-1989.

Location number	Year 1984	1985	1986	1987	1988	1989	Repeat site frequency
1	2	2	2	2	0	0	8
2	2	0	0	0	0	0	2
4	3	0	3	3	3	3	15
6	3	0	0	0	0	0	3
8	2	2	2	2	2	2	12
9	3	3	3	0	0	0	9
12	3	0	0	2	0	0	5
14	3	0	0	0	0	0	3
15	3	3	3	3	3	3	18
16	1	0	1	1	0	0	3
17	3	0	0	0	0	0	3
18	2	2	2	2	2	2	12
19	2	0	2	2	2	2	10
20	3	0	3	0	0	0	6
21	4	0	0	0	0	0	4
22	2	0	0	0	0	0	2
23	1	1	1	1	0	0	4
25	0	1	0	0	0	0	1
26	2	0	0	0	0	0	2
27	0	1	2	2	2	2	9
28	0	2	2	2	2	2	10
29	0	3	3	3	3	3	15
30	0	2	3	3	3	3	14
31	0	0	0	2	2	2	6
32	0	1	1	1	0	0	3
33	0	1	2	2	2	2	9
34	0	3	3	3	3	3	15
Total sites	44	27	38	36	29	29	203

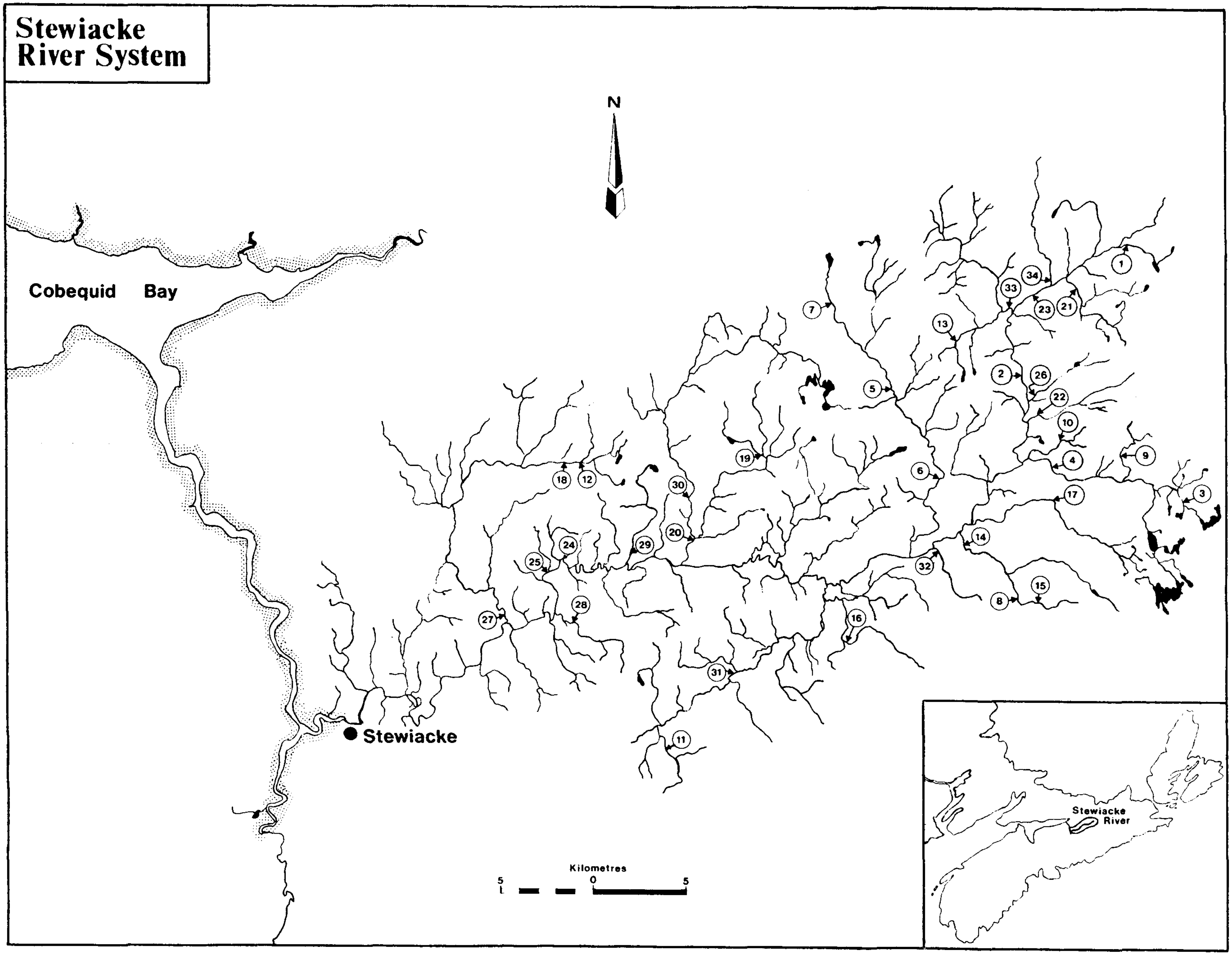

Fig. 1. Stewiacke River with electofishing site locations.

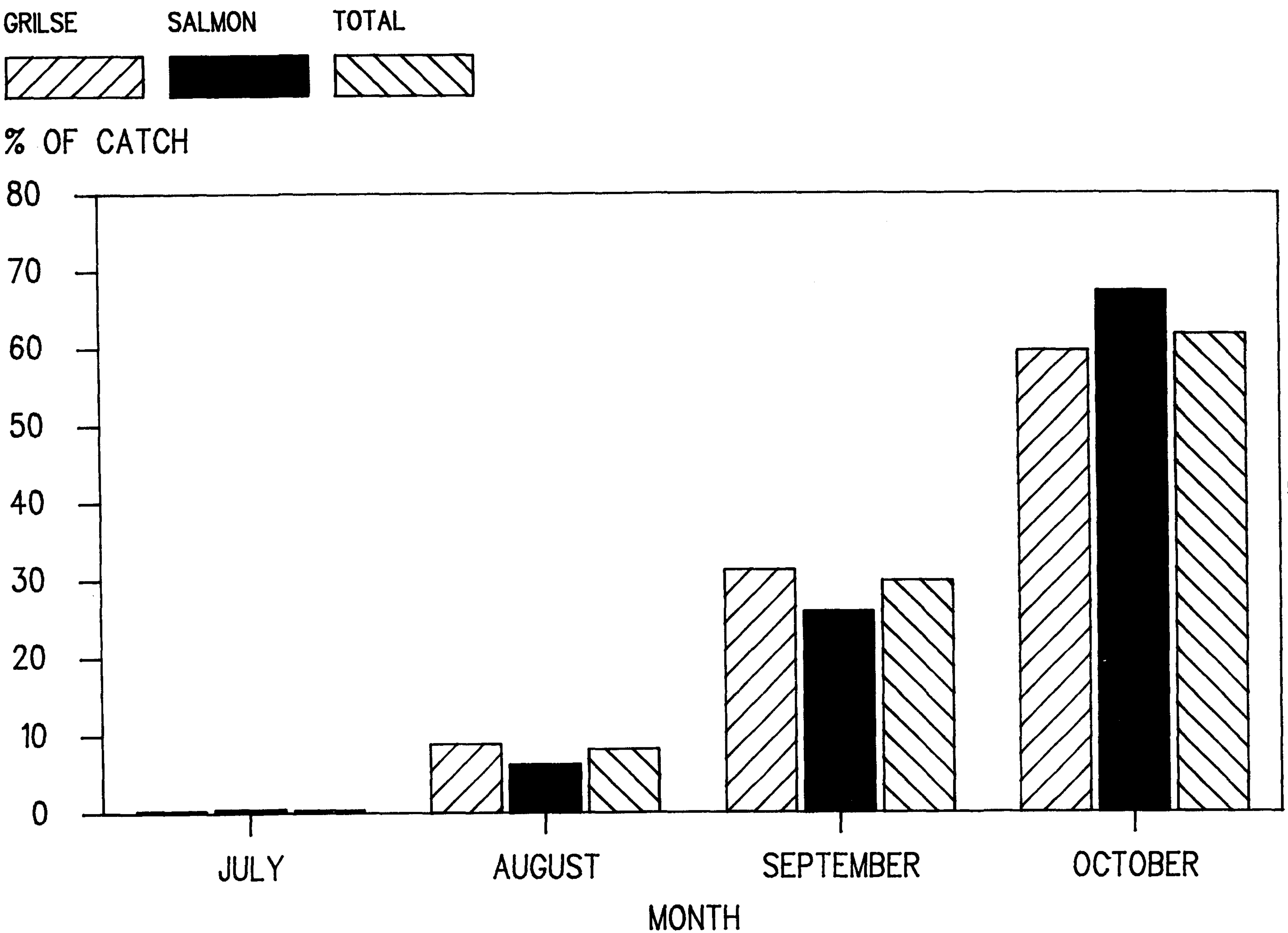

Fig. 2. Percent of the Stewiacke Rver Atlantic salmon sport catch of grilse and salmon reported for the months July to October 1970-1983.

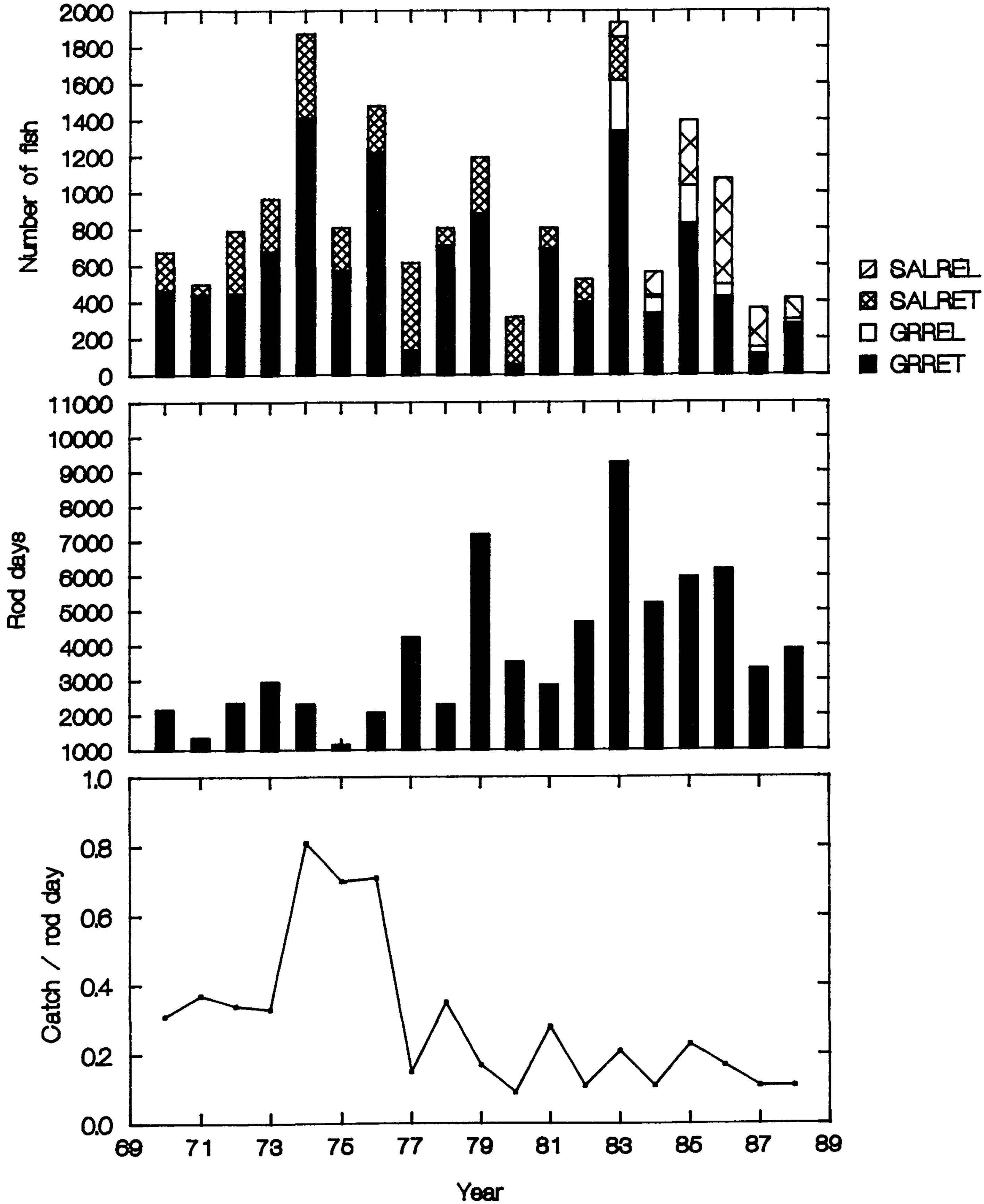

Fig. 3. Annual reported retained and released catchs (top) of Atlantic salmon by weight class prior to 1983 and length class thereafter, effort in rods*days (middle) and catch rod^{-1} day (bottom) for the Stewiacke River 1970-1988.

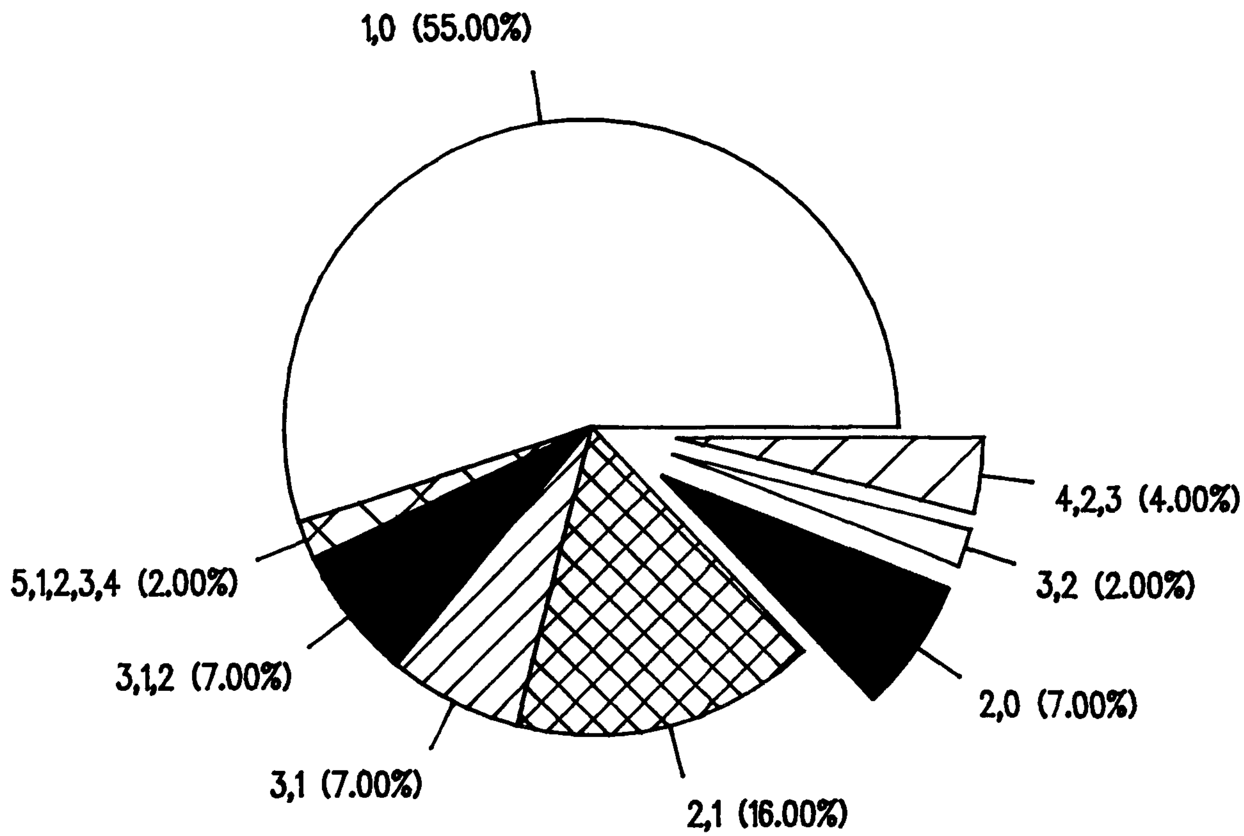

Fig. 4. Contribution to required egg deposition by age classes of Atlantic salmon to the Stewiacke River as determined from a sample of the sport and commercial fisheries 1983. Numbers refer to total age after smoltification and ages at which spawning occurs.

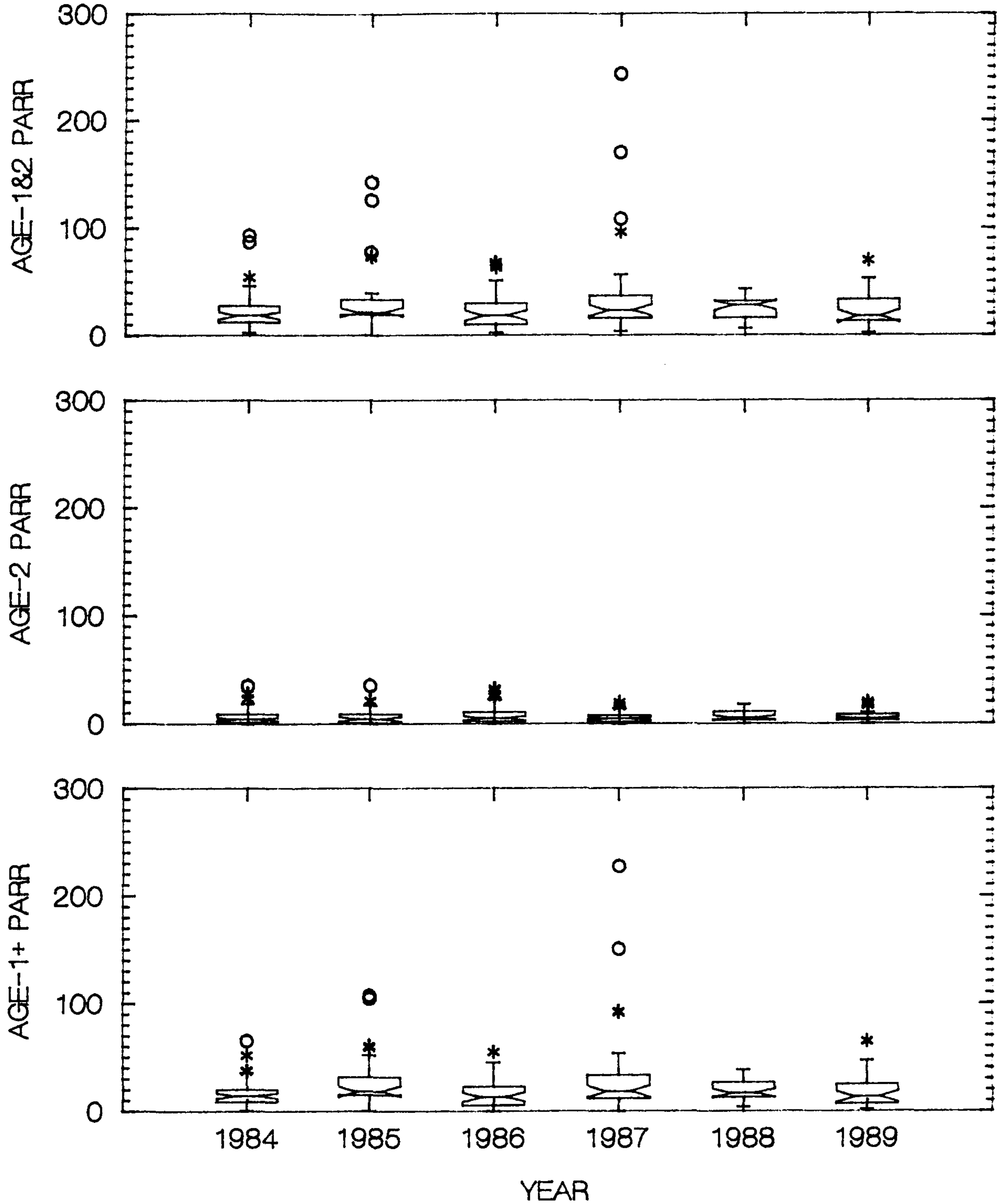

Fig. 5. Box plots of median ranks (notches), quartiles (wide and narrow lines), 95% confidence interval outliers of inner quartiles (*) and outer quartiles (o) of age-1+ parr (lower), age 2+ parr (middle) and age-1 and 2+ parr (upper) densities (10^{-2} m^2) of Atlantic salmon electrofished in the Stewiacke River 1984 to 1989.

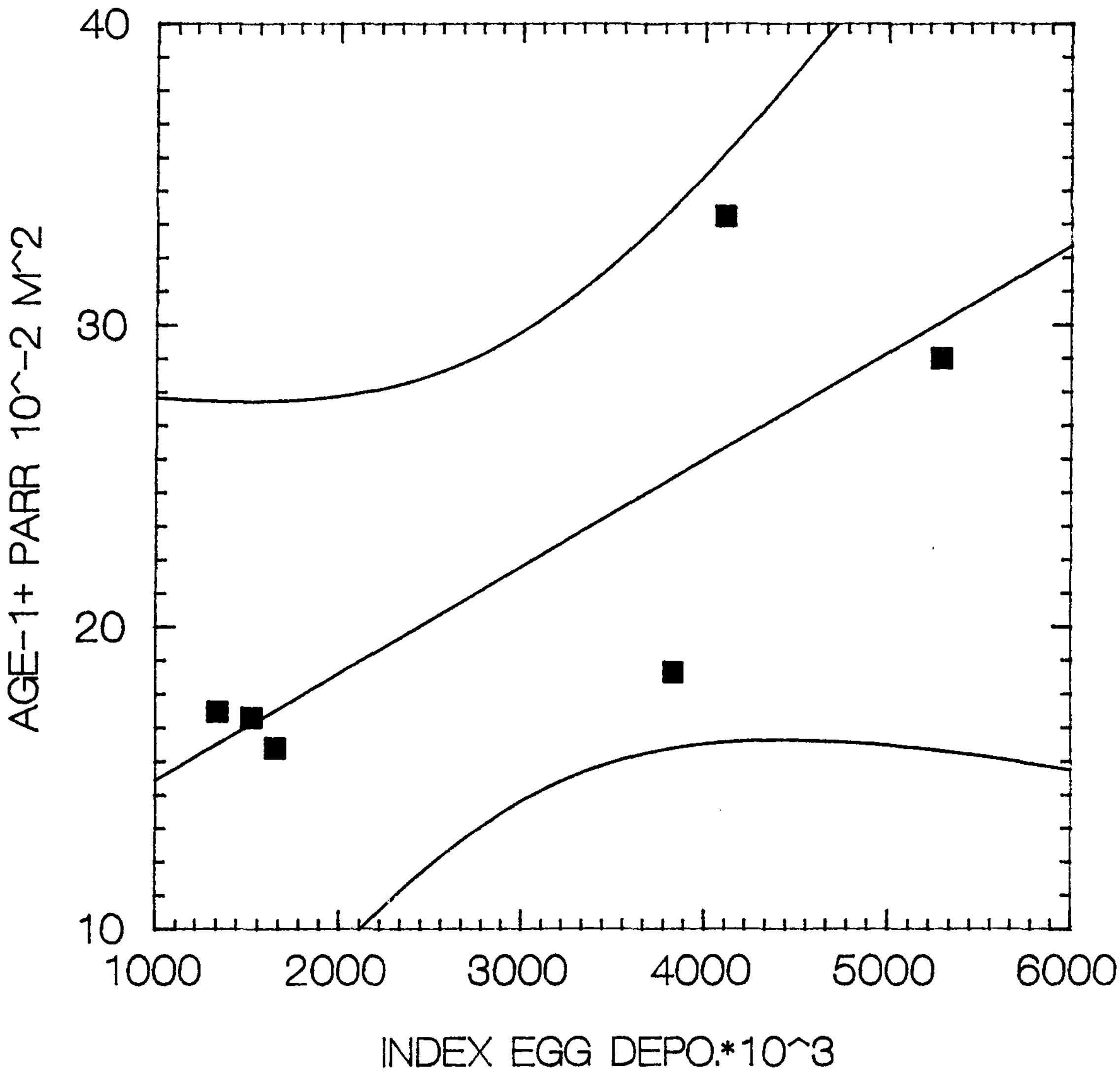

Fig. 6. Relationship between densities (10^{-2} m^2) of age-1+ Atlantic salmon parr electrofished in the Stewiacke River (1984 to 1989) and index egg deposition (1982 to 1987) as determined from sport catches and releases. The regression line and 95% confidence interval shown is significant at p=0.061 and accounts for 53% of the variance.

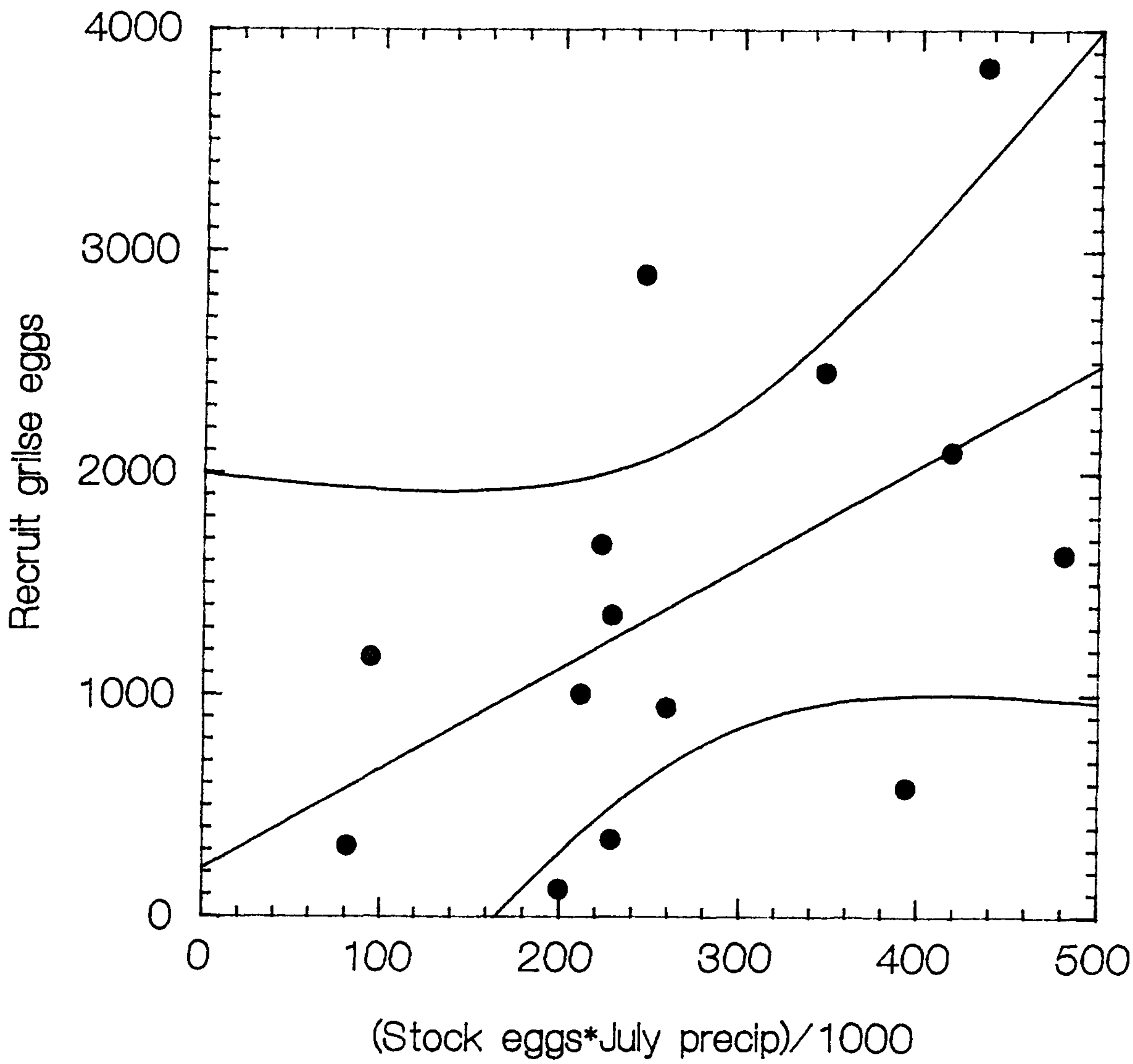

Fig. 7. Relationship between recruit grilse eggs (1975-1988) indexed from sport catch and contributing spawner egg index (1970-1983) times July precipitation for Stewiacke River Atlantic salmon. The slope is significant at $p=0.055$ but acounts for only 24% of the variance.