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**Assessment of Atlantic Salmon,
(Salmo salar), in the
Margaree River, 1987**

by

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ABSTRACT

Sport catch of 1SW salmon in 1987 as estimated by DFO fisheries officers and Nova Scotia license stub returns exceeded 1986. The DFO estimate of 1SW salmon sport catch was the greatest since 1947, with the exceptions of 1979, 1981, and 1982. MSW salmon sport catch in 1987 as estimated by DFO and stub returns was 50% of 1986, but otherwise the DFO estimate was the highest since 1962. A creel survey at Forks Pool suggested that DFO underestimated 1SW salmon fall catch by a factor of 1.2 and MSW salmon fall catch by a factor of 2.0. Voluntary angling logbooks suggested that Nova Scotia license stubs overestimated MSW salmon fall catch by a factor of 2.0. Using exploitation rates of 20.6% and 37.9%, both non-adjusted and adjusted estimates of DFO sport catch suggest that spawning requirements were met in 1987. Recovery of tags applied at an estuarine trapnet suggest an angling exploitation rate of 15.5% for 1SW and MSW salmon combined. Considering all of the above factors, we conclude that spawning requirements were met in 1987.

The contribution of 1SW salmon hatchery returns to the summer portion of the run exceeded 60% but was 30% for the fall. MSW salmon hatchery returns were 40% of the summer and 4% of the fall runs. Assessment of hatchery smolts released to the Margaree River indicate that the Rocky Brook stock has a return rate 2.5 times higher than Margaree origin smolts. Sampling from sport fishery, trapnet, and brookstock collections indicate that 13% of the MSW returns are either repeat spawning 2SW or virgin 3SW salmon and that these are primarily female.

MSW salmon returns similar to 1987 are forecast for 1988.

RESUME

Selon les estimations des agents des pêches du MPO et les talons de permis de pêche de la Nouvelle-Écosse qui ont été retournés, les prises sportives de saumons unibermarins de 1987 ont dépassé celles de l'année antérieure. En fait, les évaluations du MPO sont les plus élevées depuis 1947, si l'on fait exception de 1979, 1981 et 1982. Par ailleurs, d'après les estimations du MPO et les talons de permis de pêche de la Nouvelle-Écosse retournés, les prises sportives de saumons redibermarins se sont établies à la moitié des prises de 1986; l'estimation du MPO était la plus élevée depuis 1962. Selon les résultats d'un sondage des pêcheurs, effectué au fosse Forks, il apparaît que le MPO a sous-estimé les prises automnales de saumons unibermarins par un facteur de 1,2 et les prises automnales de redibermarins par un facteur de 2,0. Les relevés volontaires des pêcheurs à la ligne semblent indiquer que les chiffres fondés sur les talons des permis de pêche de la Nouvelle-Écosse surestimaient les prises automnales de redibermarins par un facteur de 2,0. Si l'on se fonde sur des taux respectifs d'exploitation de 20,6 % et 37,9 %, les estimations, révisées et non révisées, de prises sportives établies par le MPO indiquent que les besoins de reproducteurs ont été satisfaits en 1987. Compte tenu

des récupérations d'étiquettes posées à un parc en filet estuarien, on peut chiffrer à 15,5 % le taux d'exploitation combiné de la pêche à la ligne des unibermarins et des redibermarins. Tous ces facteurs permettent de conclure que les besoins de reproducteurs ont été satisfaits en 1987.

La proportion des retours d'unibermarins d'élevage dans la migration d'été a dépassé les 60 %. Elle s'établissait à 30 % pour l'automne. Les retours de redibermarins d'élevage ont été de 40 % et de 4 % respectivement dans les migrations d'été et d'hiver. Les évaluations de saumoneaux d'élevage lâchés dans la rivière Margaree indiquent que le stock du ruisseau Rocky a un taux de retour 2,5 fois supérieur à celui des saumoneaux originaires de la rivière. Des échantillons de prises sportives, de saumons captés dans le parc en filet et de spécimens du stock reproducteur permettent d'établir que 13 % des redibermarins qui retournent à la frayère sont soit des dibermarins à pontes antérieures, soit des tribermarins vierges et qu'il s'agit essentiellement de femelles.

On s'attend à ce que les retours de saumon de 1988 soient sensiblement les mêmes qu'en 1987.

INTRODUCTION

OBJECTIVES

The purpose of this paper is to provide an assessment of the Margaree River Atlantic salmon stock in 1987. Past assessments have relied exclusively on DFO angling statistics and fixed exploitation rates to determine spawning escapement and forecast returns (Claytor and Chadwick 1985; Claytor and Léger 1986). As a result, these assessments have raised several issues requiring additional information to resolve. These issues include, resolving the difference between angling catch statistics collected by DFO fisheries officers and those from Nova Scotia license stub returns, ensuring that hook-and-release estimates of MSW salmon can be interpreted relative to historical catch-kill records, evaluating the relative contribution of hatchery released salmon to river returns, and finding a reliable method of forecasting returns. In addition, recent information on size-at-age and previous spawners has been deficient for the Margaree River.

In 1987, three programs were initiated to address the above concerns. Firstly, a creel survey at Forks Pool, the major angling pool, and secondly, voluntary angling logbooks provided a means of resolving the discrepancy between DFO fisheries officers and Nova Scotia license stub returns.

Thirdly, the feasibility of a mark-recapture program to estimate population size, exploitation rate and determine biological characteristics was examined using an estuarine trapnet to capture salmon. The development of these programs and their use in resolving the above issues are described in the following sections.

BACKGROUND

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 component of the Atlantic salmon stock have consisted of regulatory restrictions and introduction of hatchery-reared progeny from early-run fish. Anglers have been required to release MSW salmon during the early-run (before September 1) since 1979. From 1985-1987, all MSW salmon were released regardless of date caught. In 1984, there was a reduction in the zone 6 commercial fishery from eight to three weeks. There was no zone 6 commercial fishery from 1985-1987.

METHODS

LANDINGS

Angling records from 1947-1987 were provided by fishery officers, Department of Fisheries and Oceans, Margaree Forks, Nova Scotia. These records are subsequently referred to as DFO statistics. Sport catches for 1984-1986 were also obtained from Nova Scotia license stub returns (O'Neil et al. 1985, 1986, 1987). Preliminary 1987, as of November 12, Nova Scotia license stub returns were obtained from S. O'Neil, DFO Halifax, Nova Scotia. Commercial landings for zone 6 (1967-1984) are also reported (Clayton and Chadwick 1985).

FORKS POOL CREEL SURVEY

A creel survey was conducted at Forks Pool (Fig. 1) from September 1 - October 15 to estimate catch and effort for this portion of the sports fishery. Creel periods were stratified into AM (0600-1330) and PM (1330-2100) and weekday and weekend (including holidays) periods. It was decided to cover 23/30 (75%) of the available weekdays and 7/14 (50%) of the weekend days. Each day within a weekday-weekend stratum was assigned a consecutive number and was selected for the creel using a random number table. Once these days were selected, a random number table was used to determine whether a day would be an AM or PM creel. An odd number selected AM and even PM. Days and time periods are given in Table 1.

During the creel period numbers of 1SW salmon kept, and 1SW and MSW salmon hooked and released , as well as method of release were noted. (Fig. 2). The release methods were defined as:

- 1) remove hook (RH), fish was handled by angler and hook removed by hand;
- 2) cut line (CL), fish was not handled but leader was intentionally cut or broken by angler;
- 3) lost (LO), fish took fly, but dislodged hook before it could be intentionally released.

As anglers left the pool they were interviewed to obtain the time they started and completed fishing, numbers and types of fish kept or released, and method of release. Forms used for interview are provided in Fig. 3. Sampling from all 1SW kept and as many 1SW and MSW salmon released as possible included fork length (nearest cm), scales, sex, and presence or absence of adipose clips and wire nose tags. Sex was determined internally from kept and externally from released fish.

The observed catch and effort data from each stratum was used to estimate total catch and effort at Forks Pool from September 1 - October 15 in the following manner. Total effort at Forks Pool was estimated by calculating mean effort in hours/day and rod-days/day (rod-day is one angler fishing for any portion of one day) and multiplying by the number of available days in each stratum. These estimates of effort were then multiplied by observed catch/effort to determine estimated catch in each stratum. Estimated catches were divided into 1SW and MSW salmon on a proportional basis within each stratum. The estimated catches and efforts were then summed to determine the overall estimated catch/effort. Estimates of fall 1SW and MSW salmon catches for the entire Margaree River were calculated using the percentage of total fall 1SW and MSW salmon catch taken at Forks Pool as an adjustment factor.

The Forks Pool creel provides three comparisons to DFO sport catch statistics, 1) estimates from creel days to DFO counts for the same days, 2) estimates of total Forks Pool catch by creel and DFO, and 3) estimates of total river catch based on Forks Pool creel and DFO. It has been assumed (Claytor and Léger 1986) that DFO underestimates sport catch. Comparing these estimates provides a test of this assumption.

VOLUNTEER LOGBOOKS

Nineteen members of the Margaree Salmon Association were asked to keep a logbook of each fishing trip on the Margaree River. As of Nov. 3, 1987, eleven of these anglers had returned their logbooks. Anglers were requested to note the start and finish times for each fishing trip, pools fished, numbers kept, hooked and released, and method of release (Fig. 4). In addition, they collected scale samples, determined sex, and collected noses or heads from all hatchery fish kept for wire nose tag detection.

It has been suggested that Nova Scotia license stub returns may be overestimating sport catch (Clayton and Léger 1986). MSW salmon catch, in particular, may be overestimated by the inclusion of lost fish in hook and release reports. Anglers returning voluntary logbooks report method of release and numbers of lost fish. Thus fish which would have been landed (RH, CL) may be separated from those lost. The proportion of 1SW: MSW salmon in logbook catches may be assumed to be identical to all anglers on the Margaree River. By considering only RH or CL releases, these proportions may be used to adjust license stub MSW salmon hook and releases relative to catch/kill reports for 1SW salmon. Comparing the stub adjustments by this method to creel estimates provides a test of whether or not Nova Scotia license stub returns are overestimating sport catch.

TRAPNET

A trapnet was used to monitor 1SW and MSW salmon returns to the Margaree River for seven, one week periods from June 23 - October 17 (Table 2). The trapnet was located approximately 1 km above the Margaree Harbour Bridge (Fig. 1) and was the same design as the recapture traps on the Northwest and Southwest Miramichi, a commercial Miramichi box trapnet (Dunfield 1974). The trap was made from 5.72 cm (2¼") knotless nylon mesh, was 4.3 m (14') deep, 3.7 m (12') wide, and 18.9 m (62') long. The trap portions at each end were 7.9 m (26') long. The leader extended 90 m (300') to shore and consisted of 14 and 15.25 cm (5½" and 6") mesh. In the fall a 45 m (150') section of 5 cm (2") mesh was substituted at the shore end of the leader to prevent meshing of salmon. A larger mesh was used in the summer because of the debris in the river that would otherwise be caught in the leader. Even with the larger mesh this debris tended to block the leader and prevent salmon from meshing in the leader. In the fall this debris was not present in large quantities. Hence, it was felt that salmon may have meshed in the leader unless a smaller mesh size were used.

A numbered carlin tag was attached to all fish captured in the trap. Fork length (nearest cm) was measured and a scale sample removed from all fish captured. Sex was determined externally. All hatchery released fish have the adipose fin removed. Wild were distinguished from hatchery returns by the presence of the adipose fin.

An exploitation rate was calculated using tag returns from the sports fishery. As for the LaHave River, tag loss, non-reporting and mortality were assumed to be 30% overall (Cutting and Jefferson 1986). Twelve tags have been returned to date. We expect an additional return of 17% during the winter, as is the case for the Miramichi (R. Randall, DFO, Moncton, N.B.) for a total tag return of 14. This number of tags was used to provide a preliminary estimate of exploitation rate and population size using trapnet data.

HATCHERY RETURNS

In 1986 smolts of Rocky Brook, Miramichi, parentage released into the Margaree were wire nose tagged, while those of Margaree parentage were not.

All hatchery released smolts were adipose fin clipped. Heads or noses collected from adipose fin clipped 1SW salmon caught by volunteer logbook anglers, Forks Pool creel, and spot checks at various pools were checked for wire nose tags using a Northwest Marine Technology, Inc. field sampling detector.

Proportions of hatchery and wild fish returning to the Margaree River were determined from angler logbooks, Forks Pool creel, angler spot checks, broodstock collections (Hatchery and McKenzie pools, Fig. 1), and trapnet captures.

SPAWNING 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)
Sex ratio male/female MSW	=	25:75 (Marshall 1982)
1SW	=	89:11 (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

EGG DEPOSITION

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

$$\frac{\text{Sport catch (SC)}}{\text{Sport catch (SC) + Spawners}} = \text{Exploitation rate (ER)}$$
$$\frac{\text{SC (1 - ER)}}{\text{ER}} = \text{Spawners}$$

Exploitation rates for 1SW and MSW salmon 20.6 and 37.9%, were those determined by Hayes (1949).

For years in which there were hook-and-release regulations, 1979-1987, the MSW salmon caught and released were added to the number of spawners calculated as above. This factor assumes there is no mortality as a result of hook and release.

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

The number of 1SW and MSW salmon, both hatchery and wild, caught in the summer and fall segments of the season since 1983 were used in an attempt to forecast returns in 1988. A regression of 1SW year (i) against MSW year (i+1) for each part of the run was attempted for this purpose. Considering years since 1983 has the advantage of using only data collected after the implementation of hook and release requirements to calculate forecasts.

RESULTS AND DISCUSSION

LANDINGS

Commercial landings for zone 6 (1967-1984) are presented in Table 3, DFO Sport catch statistics from (1947-1987) in Table 4, and Nova Scotia license stubs (1984-1987) in Table 5. 1SW salmon sport catch based on license stub estimates was 1.5-2.5 times DFO statistics from 1984-1987. MSW salmon sport catch based on license stub estimates was 2.5-3.5 times DFO statistics from 1984-1987 (Tables 4, 5). 1SW salmon sport catch in 1987 (DFO) was the greatest since 1947, with the exceptions of 1979, 1981, and 1982. MSW salmon sport catch in 1987 (DFO) was 50% of 1986, but otherwise was the highest since 1962 (Table 4).

Most (70%) of the MSW salmon in 1987 were caught in the fall. Since 1947 the percentage of MSW salmon caught in the fall has ranged between 54-78%, with the exception of 1980 (99%) (Table 6). In contrast, the percentage of 1SW salmon caught in the summer (76%) was the highest ever except for 1979, 1981, and 1982. Previous percentages for 1SW caught in the summer have ranged from 51-66% (Table 6).

The fishing effort and catch observed during the September 1-October 15 Forks Pool creel are presented in Table 7. Estimates of effort and catch for this period are presented in Table 8.

From 1947-1983 Forks Pool accounted on average for 18.7% of the 1SW and 14.3% of the MSW salmon catches (DFO) on the Margaree River from September 1

- October 15. Since 1984, Forks Pool has accounted on average for 5.3% of the 1SW and 6.6% of the MSW catches (Table 9). Because of a possible change in catch pattern, only the value for 1987 was used to provide a total estimate of fall 1SW and MSW salmon catches for the Margaree River.

Estimates of 1SW salmon retained at Forks Pool by the creel method are similar to those counted by DFO for days corresponding to creel and total time period. DFO accounted for six 1SW salmon on the days corresponding to the creel. Three 1SW salmon were observed by the clerk during AM and PM creel periods (Table 1). Using the observed catch and effort from the creel, six 1SW salmon were estimated to have been caught for all time periods during the 30 creel days. For the entire fall period, DFO accounted for seven 1SW salmon, while eight 1SW salmon were estimated to have been caught for the 45 day fall period using creel data (Table 10). This difference suggests that DFO may underestimate 1SW salmon catch by a factor of 8/7 or 1.1 if only catch at Forks Pool is considered. Using the 1987 proportion of Forks Pool catch (Table 9) to estimate total river catch suggests the actual 1SW salmon catch is 1.2 times (98/85) the DFO estimate (Table 10).

Estimates of MSW salmon, considering only those released by removing the hook by hand, using the creel method are twice those counted by DFO for days corresponding to creel and total time period. DFO accounted for 24 MSW salmon hooked and released on the days corresponding to the creel. Twenty MSW salmon were observed by the clerk during AM and PM creel periods (Table 1). Using the observed catch and effort from the creel, 42 MSW salmon were estimated to have been caught for all time periods during the 30 creel days. For the entire fall period at Forks Pool, DFO accounted for 32 MSW salmon hooked and released, while 63 MSW salmon were estimated to have been caught for the 45 day fall period using creel data. This difference suggests that DFO may underestimate MSW salmon catch by 63/32 or 2.0 (Table 10). Using the Forks Pool proportion method of estimating total river catch suggests that MSW salmon catch may be 2.0 times (563/285) the DFO estimate (Table 10).

Preliminary Nova Scotia license stub returns provides an estimate of 693 1SW kept and 1,540 MSW salmon hooked and released on the Margaree River this year (Table 5). Using the summer:fall (76:24) ratio for 1SW salmon caught in 1987 (Table 6) an estimate of 166 fish caught in the fall and 527 in the summer is obtained (Table 10). Using the summer:fall (30:70) ratio for MSW salmon catch in 1987 (Table 6) an estimate of 1,078 fish caught in the fall and 462 in the summer is obtained (Table 10).

The proportion of 1SW:MSW salmon in the fall logbook angler catch was 1:4 (Table 7). Assuming the stub estimate of 1SW salmon is accurate this logbook ratio suggests that catch of MSW salmon should have been 664. This is much closer to DFO statistics. However, stub returns are similar to creel estimates which include lost fish (Table 10).

The general agreement for 1SW salmon retained between creel and DFO methods suggests that DFO statistics more closely reflect numbers retained than hook and release figures. This discrepancy could result from the

difficulty of recording or interpreting releases from angler interviews during patrols. Hence, regarding the relationship between hook and release and catch/kill records, it is suggested that with the above correction, removing the hook by hand and cutting the line are appropriate criteria for equivalence between release and catch/kill records for the Margaree River.

These comparisons suggest that DFO statistics underestimate 1SW and MSW salmon catch, while stub returns overestimate MSW salmon catch because lost fish are included in hook and release reports. When DFO catch statistics are adjusted by creel correction factors, 1.2 for 1SW and 2.0 for MSW salmon, and lost fish are removed from stub return MSW salmon reports, reasonable agreement occurs between these two statistics.

A summer creel comparable to the fall was not conducted. Hence, determining a correction factor for resolving differences between DFO and stub return statistics unique to this period was not possible. Therefore, the creel correction factors determined in the fall were used to adjust DFO angling catch over the whole season for purposes of determining spawning escapement. Including a summer creel and expansion of the voluntary logbook system will assist in a further resolution of the discrepancy between these two reporting systems.

SPAWNING REQUIREMENTS

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

- (1) egg requirements = $2.4 \text{ eggs m}^{-2} \times 2,797,600 \text{ m}^2$
= 6,714,600 eggs

- (2) eggs/MSW salmon = $8,643 \text{ eggs/MSW} \times .75 \text{ (females)}$
= 6,482

- (3) required number of MSW = $6,714,600 + 6,482$
= 1,036

- number of female MSW = $1,036 \times .75$
= 776

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

- number of male 1SW = $516 = 776 - 260$

- number of 1SW = $579 = 516 + .89$

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

SPAWNING ESCAPEMENT, EGG DEPOSITION, AND EXPLOITATION RATE

Exploitation rates of 20.6 and 37.9% applied to non-adjusted DFO counts as in previous assessments (Claytor and Léger 1986) provide estimates of spawning escapement indicating that spawning requirements were met in 1987 (Table 11). Assessments using non-adjusted DFO sport catch suggest that spawning requirements were rarely achieved on the Margaree River since 1947 (Table 12). However, when the DFO sport catch statistics are adjusted as suggested above (by creel survey results), spawning requirements have been met each year since 1985, provided exploitation rate has not exceeded 37.9% (Table 11). Recapture of tags indicates an exploitation rate of 15.5%. This rate would indicate a population size of 5,265 for MSW and 2,311 for 1SW salmon based on adjusted DFO statistics. These fish would provide 561% of egg requirements. Considering all of the above factors, we conclude that spawning requirements have been met in 1987.

An exploitation rate of 15.5% is lower than estimates used in previous assessments. This lower rate could reflect changes in catch patterns resulting from the implementation of hook and release of MSW salmon and/or the prohibition on angling in the sanctuary area above McKenzie Pool (Fig.1). In addition, low water levels during the summer of 1987 may have reduced catchability. As a result, at least another year of tag return data is required to determine which exploitation rates reflect current catch patterns.

HATCHERY CONTRIBUTION

The proportion of hatchery versus wild 1SW and MSW salmon in the Margaree River are indicated in Table 13. Applying these proportions to the sport catch (DFO) since 1983 produces the numbers of hatchery and wild salmon caught on the Margaree River in this period (Table 14).

Detector results of 41 angled hatchery return 1SW salmon indicated that 27 or 66% had wire nose tags and were from the 2⁺ smolts of Rocky Brook parentage released in 1986. These nose tagged smolts made up 41% of the hatchery released parr and smolts available to return to the Margaree River as 1SW salmon in 1987 (Table 15).

Of the 268 1SW salmon caught in the summer of 1987, 169 were of hatchery origin (Table 14). Therefore, 112 of these were from Rocky Brook 2⁺ smolt releases. From the 26 hatchery returns caught in the fall, 17 would be from this group for a total of 129 1SW salmon of Rocky Brook parentage in the angling catch. Applying the 20.6 and 37.9% exploitation rates to the hatchery released fish caught in 1987 provides the following return rates for Rocky Brook 2⁺ smolts and all others available for return as 1SW salmon (Table 15).

Origin	Angled	Exploitation rate			
		20.6%		37.9%	
		Total returns	Return Rate	Total returns	Return Rate
Rocky Brook 2 ⁺	129	626	6.46	340	3.51
Others	66	320	2.25	174	1.23

Hence, Rocky Brook fish are more than twice as likely to return as 1SW salmon than those of Margaree origin.

The years 1979, 1981, and 1982 are the only other years corresponding to those following releases of Rocky Brook smolts (Table 15). These years provided very high returns of 1SW salmon (Table 4). Earlier conclusions (Gray and Chadwick 1984) regarding the importance of this stock for increasing the summer 1SW salmon run to the Margaree River appear to be validated by the results of this tagging experiment.

BIOLOGICAL CHARACTERISTICS

The length-frequency histogram of all sampled fish clearly separates 1SW from MSW salmon and suggests two components to the MSW salmon population. The first component consists of MSW salmon from 62.5 - 87.5 cm (87%), and likely includes repeat spawning 1SW and virgin 2SW salmon, while those > 87.5 cm (13%) likely include repeat spawning 2SW or virgin 3SW salmon (Fig. 5).

Mean fork lengths of 1SW salmon sampled in the fall exceeded those in the summer by 1.5 cm (Table 16), while fall exceeded summer MSW salmon by 1.7 cm (Table 17). These differences were significant for 1SW but not for MSW salmon, $p < 0.05$.

There was no difference in fork length between male and female 1SW salmon over the entire season (Table 16). Fork length of female MSW salmon sampled in the fall exceeded male MSW salmon by 2.7 cm (Table 17). These differences were significant, $p < 0.05$, but only because all salmon over 84 cm were females, suggesting that repeat 2SW spawners and virgin 3SW salmon are primarily females.

The sex ratios male/female were 84:16 for 1SW and 37:63 for MSW salmon. The proportions of males are slightly lower than previous assessment values for 1SW but higher for MSW salmon. However, they are not sufficiently different to warrant a change in calculation of spawning requirements.

FORECAST

The fall MSW salmon angling catch (DFO) was predicted using fall 1SW salmon angling catch (DFO) from the previous year since 1983 (Table 14,

Fig. 6). This relationship predicts a fall MSW salmon catch (DFO) of 273 for 1988. This catch would be similar to 1987 (Table 14) and suggests that spawning requirements will be met in 1988 if the fall again accounts for 54 - 78% for the MSW salmon catch as it has done since 1947 (Table 6). If 273 represents 78% of the MSW salmon catch, the total number of hook and releases would be 350, this number would provide 89% of egg deposition requirements if exploitation rate is 37.9% and 164% if it is 20.6%. These figures would be doubled if the adjustment to DFO figures suggested above is made. This forecast should be interpreted with caution as it is based on only four points.

The unpredictable nature of summer returns appears to be the reason previous attempts to forecast returns were not reliable. There is no apparent relationship between 1SW salmon (year i) and MSW salmon (year i+1) even for wild fish during the summer period (Table 14).

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Table 1. Days and time periods of Forks Pool creel survey. Salmon catch observed during creel periods is compared to DFO catch estimates at Forks Pool for corresponding days. * indicates a weekend.

Date m/d	1SW			MSW		
	AM	PM	DFO	AM	PM	DFO
901	0		0	0		0
902		0	0		0	0
903	0		0	0		0
904		0	0		0	0
906*	0		0	0		0
908	1		0	1		0
909	0		0	0		0
910	0		0	0		0
914	0		0	0		0
915	0		0	0		0
917		0	1		3	9
918	0		0	0		0
920*		0	0		2	3
921	0		0	0		0
923	1		1	3		3
925		1	1		2	2
926*		0	0		0	0
928		0	0		1	0
929		0	1		1	1
930		0	0		1	1
1001		0	0		0	0
1002	0		0	0		0
1003*	0		0	0		0
1004*		0	0		0	0
1005	0		0	1		0
1010*	0		0	2		2
1011*	0		2	1		3
1013		0	0		1	0
1014		0	0		1	0
1015	0		0	0		0
Total	2	1	6	8	12	24

Table 2. Weeks of Margaree River trapnet operation, numbers of salmon tagged, and number of tags returned or reported from the sport fishery for each tagging period.

Date	1SW			MSW		
	Wild	Hatchery	Tags Returned	Wild	Hatchery	Tags Returned/or reported
June 23-27	2	4	1	1	0	0
July 8-11	0	0	0	0	0	0
Aug. 10-15	2	3	0	3	0	0
Aug. 25-30	2	0	1	13	0	1
Sept. 9-13	2	3	0	14	3	1
Sept. 28- Oct. 3	9	0	1	67	1	8 ¹
Oct. 14-17 ²	1	0		13	1	
Total	18	10	3	111	5	9

1 One MSW salmon was caught and released twice in sports fishery.

2 Fish tagged during this period were not considered available to sports fishery.

Table 3. Commercial salmon landings for Zone 6 (1967-1984) in kg.

Year	Northumberland Strait-NS Fisheries Statistical District				Gulf Cape Breton-NS Fisheries Statistical District			Gulf NS Zone 6 total (kg)
	11	12	13	Subtotal	2	3	Subtotal	
1967		10,503	29,885	40,388	10,728	2,124	12,852	53,240
1968	1,175	9,495	14,949	25,619	10,480	2,057	12,537	38,156
1969		9,968	11,050	21,018	7,831	1,598	9,429	30,447
1970		4,605	13,015	17,620	12,760	114	12,874	30,494
1971		1,689	5,597	7,286	4,485	255	4,740	12,026
1972		5,155	18,714	23,869	7,026	996	8,022	31,891
1973		2,562	15,788	18,350	8,043	1,297	9,340	27,690
1974		5,742	17,437	23,179	11,213	3,045	14,258	37,437
1975		2,080	9,824	11,904	10,670	1,057	11,727	23,631
1976		1,606	5,845	7,451	9,954	956	10,910	18,361
1977		4,137	9,171	13,308	11,490	1,423	12,913	26,221
1978		2,940	15,907	18,847	10,691	678	11,369	30,216
1979		169	4,549	4,718	3,117	82	3,199	7,917
1980		2,534	11,932	14,466	9,088	858	9,946	24,412
1981		1,822	8,283	10,105	4,978	479	5,457	15,562
1982		2,805	13,680	16,485	8,704	1,475	10,179	26,664
1983		1,863	9,770	11,633	11,621	1,026	12,647	24,280
1984		1,097	7,850	8,947	5,291	902	6,193	15,140

Table 4. Salmon angling catch on Margaree River (1947-1987) as compiled by Department of Fisheries and Oceans fisheries officers (DFO statistics).

Year	1SW	MSW			Total	Rod-days ¹	CUE
		Retained	Released	Total			
1947	37	363			400		
1948	106	704			810		
1949	50	332			382		
1950	119	320			439		
1951	46	424			470	2,610	0.212
1952	87	204			291	2,265	0.143
1953	57	291			348	2,145	0.179
1954	78	298			376	1,965	0.224
1955	53	258			311	1,650	0.209
1956	29	90			119	1,380	0.110
1957	36	136			172	1,215	0.152
1958 ²	N/A	N/A			334	1,275	0.762
1959 ²	N/A	N/A			235	1,110	0.212
1960 ²	N/A	N/A			140	1,050	0.133
1961	40	49			89	1,035	0.142
1962	46	410			456	1,240	0.407
1963	87	212			299	1,190	0.281
1964	120	289			409	2,243	0.185
1965	86	254			340	2,769	0.128
1966	92	165			257	2,482	0.113
1967	92	210			302	2,801	0.133
1968	63	197			260	3,274	0.082
1969	206	136			342	2,762	0.129
1970	85	214			299	2,612	0.116
1971	21	92			113	2,332	0.050
1972	41	106			147	1,985	0.074
1973	165	116			281	2,402	0.117
1974	59	107			166	2,203	0.076
1975	36	64			100	1,529	0.065
1976	95	82			177	2,108	0.084
1977	68	140			208	2,055	0.101
1978	25	158			183	2,543	0.072
1979	605	62	19	81	686	3,733	0.183
1980	169	138	2	140	309	2,978	0.110
1981	899	105	34	139	1,038	4,936	0.213
1982	692	103	76	179	871	5,160	0.156
1983	72	106	43	149	221	3,100	0.056
1984	148	12	109	121	269	N/A	N/A
1985	223	0	312	312	535	N/A	N/A
1986	295	0	754	754	1,049	N/A	N/A
1987	353	0	408	408	761	N/A	N/A

¹ Rod-days is defined as one angler fishing for any portion of one day.

² Information regarding 1SW and MSW salmon for 1958-1960 are not available.

Table 5. Salmon angling catch on Margaree River, 1984-1987, based on Nova Scotia license stubs.

	No. of Anglers	1SW			MSW			Unknown	Effort		Percentage	
		Retain	Release	Total	Retain	Release	Total		Rod-days ¹	CUE	1SW	MSW
1984 Obs	678	184	48	232	9	285	294	4	5,956	0.089		
Est		191	50	241	9	294	303	4	6,669	0.082	44%	56%
1985 Obs	793	371	102	473	0	1,130	1,130	3	7,324	0.219		
Est		399	110	509	0	1,215	1,215	3	7,824	0.221	30%	70%
1986 Obs	1,131	622	126	748	0	2,522	2,522	2	9,724	0.336		
Est		650	132	782	0	2,636	2,636	2	10,232	0.334	23%	77%
² 1987 Est	418	693	343	1,036	0	1,540	1,540	0	12,414	0.208	40%	60%

¹ Rod-days are defined as one angler fishing for any portion of one day.

² Preliminary

Table 6. Number of 1SW and MSW salmon caught in summer and fall components of the Margaree River sports fishery (DFO statistics).

Year		Summer	Fall	Total	% Summer
1947-1978					
	Mean MSW	87	137	223	39
	1SW	37	35	71	51
	%MSW	70	80	76	
1979, 1981, 1982					
	Mean MSW	38	95	133	29
	1SW	621	108	729	85
	%MSW	6	46	15	
1980					
	MSW	2	138	140	1
	1SW	100	67	167	60
	%MSW	2	67	46	
1983					
	MSW	45	104	149	30
	1SW	37	31	68	54
	%MSW	52	77	69	
1984					
	MSW	27	94	121	22
	1SW	81	67	148	55
	%MSW	25	58	45	
1985					
	MSW	144	168	312	46
	1SW	116	107	223	52
	%MSW	55	61	58	
1986					
	MSW	297	457	754	39
	1SW	196	99	295	66
	%MSW	58	81	72	
1987					
	MSW	123	285	408	30
	1SW	268	85	353	76
	%MSW	32	77	54	

Table 7. Observed salmon catch, effort, and catch per unit effort for Forks Pool creel survey and anglers returning logbooks. RH, removed hook by hand; CL, cut line release; LO, fish was lost. K/RH, catch is sum of kept 1SW and MSW released by removing hook by hand. K/ALL, catch is sum of kept 1SW and MSW released by all methods including lost.

=====														
Forks Pool Creel														
Date	Available days	No. creel days	No. anglers interviewed	Effort		1SW Kept	Catch				CUE Fish/Rod-day		CUE Fish/Hour	
				Rod-days	Hours		RH	CL	LO	K/RH	K/ALL	K/RH	K/ALL	
Sept.1-Oct.15														
Weekday	AM	31	13	84	84	196.50	2	5	0	1	0.083	0.095	0.036	0.041
	PM	31	10	129	129	326.50	1	10	0	5	0.085	0.124	0.034	0.049
Weekend	AM	14	4	38	38	91.75	0	3	0	6	0.079	0.237	0.033	0.098
	PM	14	3	33	33	60.75	0	2	0	1	0.061	0.091	0.033	0.049
Total		45	30	284	284	675.50	3	20	0	13	0.081	0.127	0.034	0.053
Logbook														
Anglers														
July 1-Aug.	30		11	163	895.25	27	13	11	3	0.245	0.331	0.045	0.060	
Sept 1-Oct.	15		5	64	246.75	4	11	5	1	0.234	0.328	0.061	0.085	
Total				227	1142.00	31	24	16	4	0.242	0.330	0.048	0.066	

Table 8. Estimated effort and salmon catch at Forks Pool, September 1-October 15, 1987 using creel data (Table 8).

Period		Effort		Catch		
		Rod-days	Hours	1SW Kept	MSW	
					RH	LO
Weekday	AM	200	469	5	12	2
	PM	400	1,012	3	31	16
Weekend	AM	133	321	0	11	21
	PM	154	284	0	9	5
TOTAL		887	2,086	8	63	44

Table 9. Contribution of Forks Pool to total fall river catch from 1947-1987. Based on DFO statistics. * indicates mean.

	YEAR	Percentage	Range
1SW	1947-1983	18.7*	4.3 - 50.0
	1984	3.0	
	1985	2.8	
	1986	7.1	
	1987	8.2	
	Mean (1984-1987)	5.3*	
MSW	1947-1983	14.3*	3.8 - 31.6
	1984	0.0	
	1985	3.6	
	1986	11.6	
	1987	11.2	
	Mean (1984-1987)	6.6*	

Table 10. Estimated salmon catch at Forks Pool and total river (using creel data) compared to DFO statistics corresponding to days of Forks Pool creel, total fall period at Forks Pool, and total river catch. K, 1SW salmon kept; RH, released by removing hook by hand; K/RH, catch for 1SW kept MSW released by hand; K/ALL, applies to 1SW kept and MSW released by all methods including lost. See Table 8 for figures used to derive this table.

Sea Age	Forks Pool only					Season	Sea-age	Total river				
	Corresponding days		Fall season					DFO	Stubs	Creel		Stub Adjustment
	DFO	Creel	DFO	Creel						K/RH	K/ALL	
				K/RH	K/ALL							
1SW	6	6	7	8	N/A	Fall	1SW	85	166	98	N/A	166
								MSW	285	1,078	563	955
MSW	24	42	32	63	107	Summer	1SW	268	527	N/A	N/A	527
								MSW	123	462	N/A	N/A

Table 11. Estimated Atlantic salmon egg deposition in the Margaree River from 1984-1987 using non-adjusted and adjusted DFO catch statistics. Exploitation rates (20.6 and 37.9%) used in past assessments have been used to estimate potential 1SW and MSW salmon spawners. Fecundity rates used to calculate egg deposition were 6,482 eggs/MSW and 330 eggs/1SW. Egg deposition requirements are 6,714,600 eggs. * indicates years in which spawning requirements have been met.

=====							
Eggs X 10 ⁶							
Year	Collected for hatchery	MSW (20.6)	1SW (20.6)	Total	MSW (37.9)	1SW (37.9)	Total
Non-adjusted							
1984	0.10	3.73	0.19	3.82	1.99	0.08	1.97
1985	0.15	9.82	0.28	9.95*	5.34	0.12	5.31
1986	0.15	23.73	0.38	23.96*	12.89	0.15	12.89*
1987	0.15	12.84	0.45	13.14*	6.98	0.19	7.02*
Adjusted							
1984	0.10	7.16	0.23	7.29*	4.14	0.10	4.14
1985	0.15	19.63	0.34	19.82*	10.67	0.14	10.66*
1986	0.15	47.45	0.45	47.75*	25.79	0.16	25.80*
1987	0.15	25.68	0.53	26.06*	13.96	0.23	14.04*

Table 12. Estimated Atlantic salmon egg deposition in the Margaree River from 1947-1983 using non-adjusted DFO statistics. Exploitation rates (20.6 and 37.9%) used in past assessments have been used to estimate potential MSW and 1SW salmon spawners. Fecundity rates used to calculate egg deposition were 6,482 eggs/MSW and 330 eggs/1SW. Egg deposition requirements are 6,714,600 eggs. * indicates years in which spawning requirements have been met. N/C, no collection made; N/A, data not available.

=====

Eggs X 10⁶

Year	Collected for hatchery	MSW (20.6)	1SW (20.6)	Total	MSW (37.9)	1SW (37.9)	Total
1947	5.00	9.07	0.05	4.12	3.86	0.02	-
1948	4.50	17.58	0.13	13.21*	7.48	0.06	3.04
1949	2.80	8.30	0.64	6.14	3.58	0.03	0.76
1950	N/C	7.99	0.15	8.14*	3.40	0.06	3.46
1951	N/C	10.59	0.58	11.17*	4.50	0.02	4.52
1952	N/C	5.09	0.11	5.20	2.16	0.05	2.21
1953	N/C	7.27	0.73	8.00*	3.09	0.03	3.12
1954	N/C	7.45	0.99	8.44*	3.16	0.04	3.20
1955	0.50	6.44	0.67	6.61	2.74	0.03	2.27
1956	3.50	2.25	0.76	-	0.95	0.02	-
1957	0.90	3.40	0.46	2.96	1.45	0.02	0.50
1958	1.00	N/A	N/A	N/A	N/A	N/A	N/A
1959	0.50	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
1961	2.00	1.23	0.51	-	0.52	0.02	-
1962	0.30	10.24	0.51	10.45*	4.36	0.02	4.08
1963	1.10	5.30	0.11	4.31	2.25	0.05	1.20
1964	0.40	7.22	0.15	6.97*	3.07	0.07	2.74
1965	0.60	6.35	0.11	5.86	2.70	0.05	2.15
1966	0.40	4.12	0.12	3.84	1.75	0.05	1.40
1967	0.20	5.24	0.12	5.16	2.23	0.05	2.08
1968	0.40	4.92	0.08	4.60	2.09	0.03	1.72
1969	0.35	3.40	0.26	3.31	1.45	0.11	1.21
1970	0.20	5.35	0.11	5.26	2.28	0.05	2.13
1971	0.05	2.30	0.03	2.28	0.98	0.01	0.94
1972	0.10	2.65	0.05	2.60	1.13	0.02	1.05
1973	0.10	2.90	0.21	3.01	1.23	0.09	1.22
1974	N/C	2.67	0.07	2.74	1.13	0.03	1.16
1975	0.05	1.60	0.05	1.60	0.68	0.02	0.65
1976	N/C	2.05	0.12	2.17	0.87	0.05	0.92
1977	N/C	3.50	0.09	3.59	1.48	0.04	1.52
1978	0.10	3.95	0.03	3.88	1.68	0.01	1.59
1979	N/C	2.15	0.77	2.92	0.99	0.33	1.32
1980	0.10	3.51	0.21	3.62	1.50	0.09	1.49
1981	0.05	3.69	1.14	4.78	1.70	0.50	2.15
1982	0.20	4.97	0.88	5.65	2.39	0.37	2.56
1983	0.10	4.00	0.09	3.99	1.86	0.04	1.80

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Table 131. Numbers of wild and hatchery salmon from summer and fall sampling on the Margaree River, 1987. Numbers in parentheses indicate percentages of wild and hatchery fish for each category.

Sampling method	1SW		MSW	
	Wild	Hatchery	Wild	Hatchery
June 1-August 31				
Angling	25	40	14	15
Broodstock	11	25	17	19
Trapnet	6	7	17	0
Total summer	42 (37)	72 (63)	50 (60)	34 (40)
September 1-October 17				
Angling	6	5	41	1
Trapnet	12	3	94	5
Total fall	18 (69)	8 (31)	135 (96)	6 (4)
Total season	60	80	185	40

¹ Table 13 should be interpreted with the following cautionary notes. Broodstock collections occur at sites of hatchery releases and may be biased towards them. Trapnet counts would have missed 1SW and MSW salmon which were observed in the sanctuary in early June and may be biased toward wild fish during the summer if most hatchery fish returned during that period.

Table 14. Estimated numbers of summer and fall, wild and hatchery, salmon caught on the Margaree River from 1983-1987 using DFO Statistics from Table 6 and proportions from Table 13.

Year	Summer						Fall					
	Wild		Hatchery		Total		Wild		Hatchery		Total	
	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW	1SW	MSW
1983	14	27	23	18	37	45	21	100	10	4	31	104
1984	30	16	51	11	81	27	46	90	21	4	67	94
1985	43	86	73	58	116	144	74	161	33	7	107	168
1986	73	178	123	119	196	297	68	439	31	18	99	457
1987	99	74	169	49	268	123	59	274	26	11	85	285

Table 15. Numbers of salmon smolt and parr released to Margaree River since 1976. MAR, Margaree; RB, Rocky Brook; COB, Cobequid; MER, Mersey.

Year	Rearing location	Smolt				Parr			
		2+		1+		1+		0+	
		MAR	RB	MAR	RB	MAR	RB	MAR	RB
1976	MAR	8,971							
1977	MAR					5,022			
1978	COB		15,250						
1979	COB		15,927 ¹						
1980	COB		14,960						
1981	COB		15,950						
1982	MER			8,481		1,098			
1983	COB	13,486						9,853	
	MAR	3,783							
1984	MAR				10,195 ²				
	MER			14,483					
	COB	11,210							
1985	MAR			2,669	1,303	5,882	834		
	COB	13,660				7,820	5,860		
1986	MAR			2,105		8,754		25,000	
	COB	8,820	9,684					6,750	
1987	MAR	6,369		8,599				40,000	
	COB	18,337						12,429	

¹ Millbank broodstock

² Rocky Brook x Margaree broodstock

Table 16. Mean fork lengths of 1SW salmon sampled by angling, broodstock collection, and trapnet during summer and fall periods on the Margaree River, 1987. Standard deviations are indicated in parentheses.

Sex	Wild		Hatchery		Total Fork length
	N	Fork length	N	Fork length	
June 1-August 31					
Male	16	54.9 (1.86)	42	53.8 (2.41)	54.1 (2.30)
Female	3	56.0 (4.36)	5	55.0 (4.18)	55.4 (3.96)
Unkown	7	52.4 (3.15)	8	52.5 (3.51)	52.4 (3.23)
Total summer	26	54.4 (2.74)	55	53.8 (2.77)	53.9 (2.76)
September 1-October 17					
Male	10	56.7 (2.21)	2	58.0 (4.24)	56.9 (2.43)
Female	2	51.5 (2.12)	-	-	51.5 (2.12)
Unkown	6	53.7 (2.89)	3	55.0 (2.00)	54.1 (2.26)
Total fall	18	55.1 (2.89)	5	56.2 (3.03)	55.4 (2.89)
June 1-October 17					
Male	26	55.6 (2.16)	44	54.0 (2.59)	54.6 (2.54)
Female	5	54.2 (4.09)	5	55.0 (4.18)	54.6 (3.92)
Unkown	13	53.0 (2.80)	11	53.2 (3.28)	53.1 (2.96)
Total season	44	54.7 (2.79)	60	54.0 (2.85)	54.3 (2.83)

Table 17. Mean fork lengths of MSW salmon sampled by angling and trapnet during summer and fall periods on the Margaree River, 1987. Standard deviations are indicated in parentheses.

Sex	Wild		Hatchery		Total Fork length
	N	Fork length	N	Fork length	
June 1-August 31					
Male	3	71.0 (1.73)	-	-	71.0 (1.73)
Female	2	76.0 (0.00)	-	-	76.0 (0.00)
Unkown	12	76.7 (5.26)	3	84.0 (20.22)	78.1 (2.00)
Total summer	17	75.6 (4.93)	3	84.0 (20.22)	76.9 (8.54)
September 1-October 17					
Male	31	76.9 (3.34)	1	80.0 (0.00)	77.0 (3.34)
Female	57	79.8 (7.68)	1	76.0 (0.00)	79.7 (7.63)
Unkown	15	77.8 (8.24)	3	80.3 (8.50)	78.2 (8.08)
Total fall	103	78.6 (6.83)	5	79.4 (6.31)	78.6 (6.79)
June 1-October 17					
Male	34	76.4 (3.63)	1	80.0 (0.00)	76.5 (3.63)
Female	59	79.6 (7.57)	1	76.0 (0.00)	79.6 (7.52)
Unkown	27	77.3 (6.97)	6	82.2 (14.02)	78.2 (8.60)
Total season	120	78.2 (6.66)	8	81.1 (12.05)	78.4 (7.08)

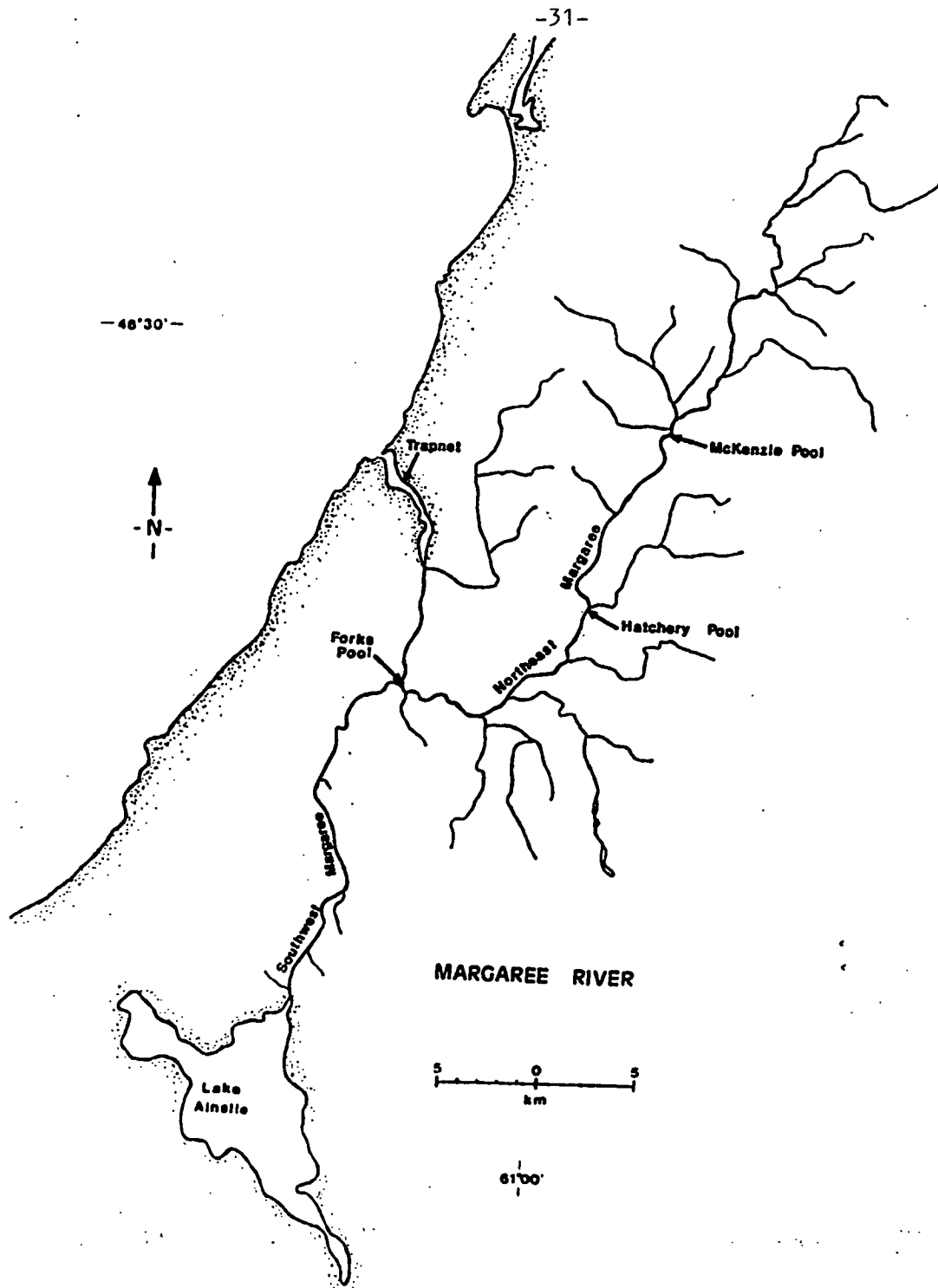


Fig. 1. Location of trapnet, Forks Pool creel, and broodstock collection sites (Hatchery and McKenzie Pools), Margaree River, 1987

1987 VOLUNTEER ANGLING LOGBOOK - MARGAREE RIVER

TRIP INFORMATION

Name _____

Day _____ Month _____

Time Started Fishing _____ a.m. ___ p.m.

Time Finished Fishing _____ a.m. ___ p.m.

Pool(s) Fished: _____

Please check if no catch

CATCH INFORMATION

Grilse Retained

	Adipose clip (Yes/No)	Tag number	Fork length	Weight	Sex	Scale sample	Name of pool
1.							
2.							

Salmon and Grilse Released

	Catch grilse or salmon	Adipose clip (Yes/No)	Tag number	Release method				Name of pool
				RH	CL	OT	LO	
1.								
2.								
3.								
4.								

Number of grilse released by other methods _____

Number of salmon released by other methods _____

Fig. 4. Volunteer angler logbook record sheets, Margaree River, 1987.

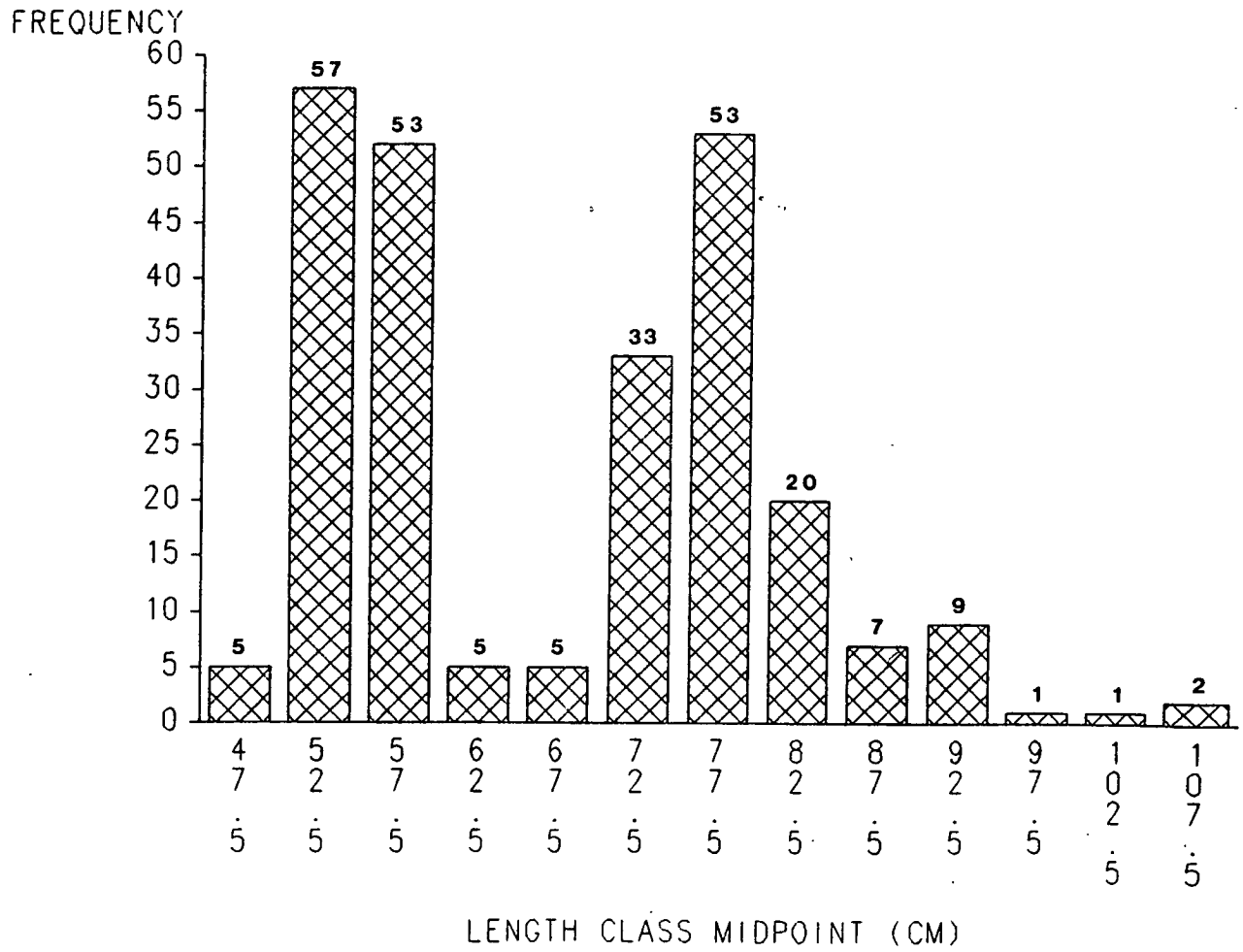


Fig. 5. Length-frequency histogram derived from angling, broodstock, and trapnet sampling, Margaree River, 1987. Numbers above each bar are counts for each length-class.

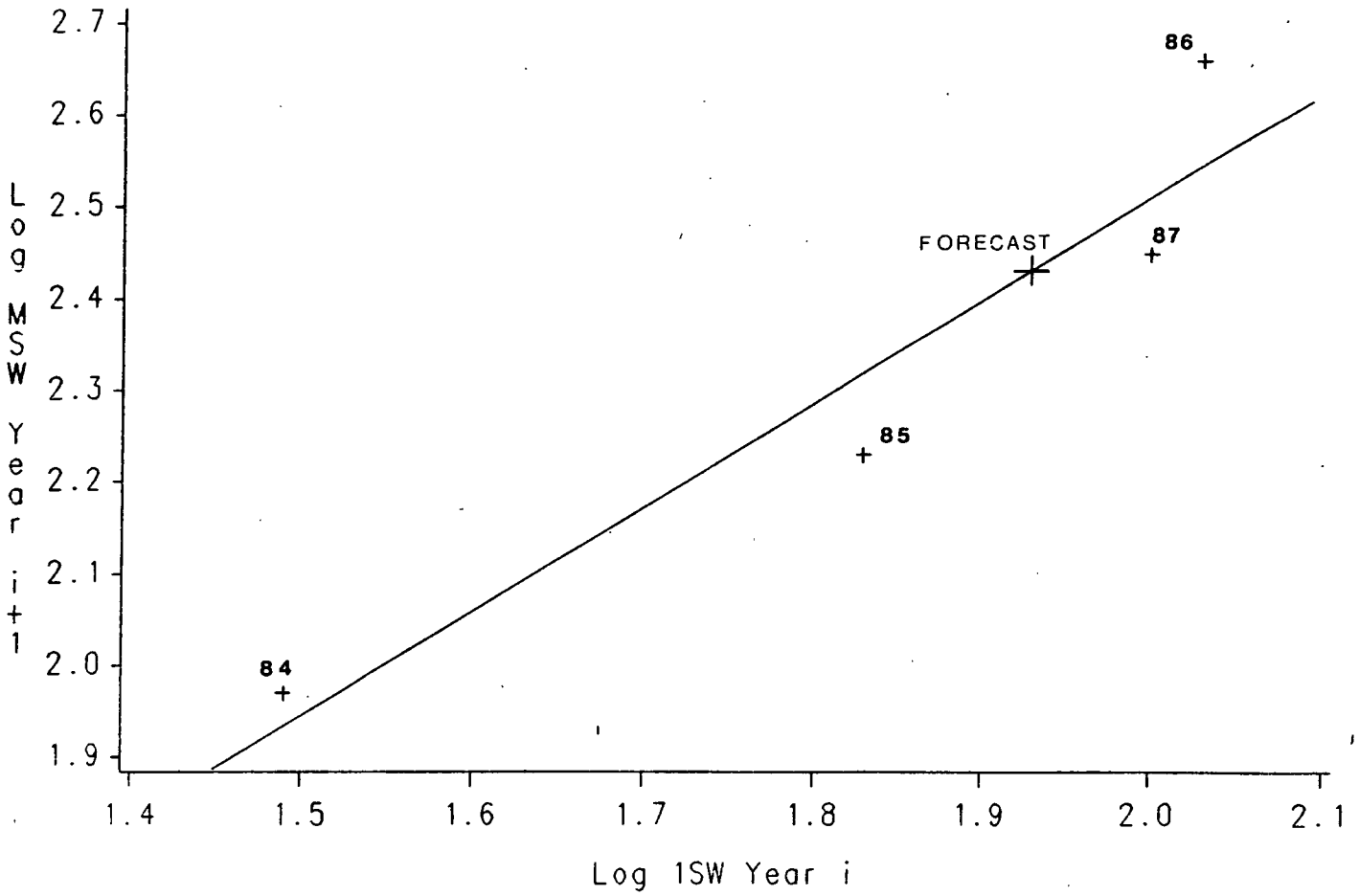


Fig. 6. Relationship used to predict fall MSW salmon returns to Margaree River in 1988. $\text{Log MSW (year } i + 1) = \text{log 1SW (year } i) \times 1.14 + 0.23$, $R^2 = 0.90$, $p \leq 0.05$. Year represents MSW sport catch.