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ASSESSMENT OF ATLANTIC SALMON IN THE MARGAREE RIVER, NOVA SCOTIA, 1991

by

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ABSTRACT

The recreational catches of Atlantic salmon (*Salmo salar*) from the Margaree River between June 1 and Oct. 15, 1991, were estimated by creel survey at 391 1SW salmon (<63 cm fork length) and 596 MSW salmon released. The recreational fishery exploitation rate estimates, based on recaptures of salmon tagged and released at the estuary, were 0.19 for 1SW salmon and 0.17 for MSW salmon. The estimated returns of Atlantic salmon to the Margaree River in 1991 were 1909 (90% C.I. 794 to 3891) 1SW salmon and 3484 (90% C.I. 1853 to 5785) MSW salmon, resulting in potential egg depositions by MSW salmon of 326% (90% C.I. 170% to 547%) of target requirements (334% of target by 1SW and MSW salmon). Potential egg depositions have exceeded target requirements since 1985 (137% in 1985 to 1067% in 1990). The high densities of juvenile salmon (20.8 to 73.0 parr/m^2) in the Margaree River in 1991 are a reflection of the high spawning escapements achieved in recent years.

RESUME

Les captures de Saumon atlantique (*Salmo salar*) de la pêche récréative de la rivière Margaree, pour la période du 1^{ier} juin au 15 octobre, 1991, ont été estimés par enquête à 391 saumons unibermarins récoltés (longueur à la fourche inférieur à 63 cm) et 596 saumons pluribermarins relâchés. Les taux d'exploitation de la pêche récréative, estimés par la méthode de recaptures de saumons étiquettés dans l'estuaire de la rivière, s'élevaient à 0,19 pour les saumons unibermarins et 0,17 pour les saumons pluribermarins. Les retours de Saumon atlantique à la rivière Margaree en 1991 ont été estimés à 1909 (I.C. 90% 794 à 3891) saumons unibermarins et 3484 (I.C. 90% 1853 à 5785) saumons pluribermarins. Les survivants de ces retours de saumons pluribermarins auraient contribués plus de 326% (I.C. 170% à 547%) du niveau cible d'oeufs pour la rivière Margaree (334% du niveau cible par les saumons unibermarins et pluribermarins). Les dépots potentiels d'oeufs ont excédé au niveau cible depuis 1985 (137% en 1985 à 1067% en 1990). Les hautes densités des juvéniles dans la rivière Margaree en 1991 (20,8 à 73,0 tacons/m^2) sont dues aux niveaux élevés de géniteurs atteints récemment.

INTRODUCTION

This is the 8th assessment of the Margaree River Atlantic salmon (*Salmo salar*) resource. Previous assessments have been presented for 1983, and 1985 to 1990 (Chaput and Jones 1991a; Claytor and Chadwick 1985; Claytor et al. 1987; Claytor and Chaput 1988; Claytor and Jones 1990; Claytor and Leger 1986; Gray and Chadwick 1984).

The Margaree River is situated in Cape Breton Island, Inverness County, Nova Scotia (Statistical District 2, Salmon Fishing Area 18) (Fig. 1). The two principal branches, the Southwest Margaree and the Northeast Margaree, meet at Margaree Forks to form the Margaree River which flows into the Gulf of St. Lawrence. Most of the recreational fishery takes place in the Northeast Margaree and the Margaree River proper, although the Southwest Margaree is fished in the fall. The Margaree River salmon has traditionally been considered as having two run components, the summer run which for statistical purposes ends on August 31, and the fall run occurring from Sept. 1 onwards.

Since 1979, numerous regulatory restrictions have been imposed to increase the summer component of the salmon run (Chaput and Claytor 1988). Mandatory release of multi-sea-winter (MSW) salmon ($\geq$ 63 cm fork length) angled before Sept. 1 has been in place since 1979. Since 1985, all MSW salmon have been released regardless of date of capture. There was a change in the angling season in 1991 relative to previous years; the angling season was extended from June 1 to Oct. 31, rather than closing on Oct. 15, except for waters upstream of Cranton Bridge which were closed to angling after Oct. 15. The season limit of 10 1SW salmon (<63 cm fork length) kept per license, the requirement that all 1SW salmon kept be tagged, and mandatory MSW salmon hook and release regulations were maintained. Restrictions on the commercial fishery were introduced in 1984 through a season reduction from 8 weeks to 3 weeks followed by closure of the fishery in 1985. The commercial fishery of Salmon Fishing Area 18 has remained closed since. Commercial landings prior to 1985 are summarized in Claytor and Jones (1990).

Some of the changes in this assessment relative to the 1990 assessment include:
- the method of estimating river catch using the creel catch estimate,
- the estimation of an integrated exploitation rate applied to angling catches in summer and fall,
- the use of "bootstrap" techniques for obtaining non-parametric estimates of variance for several parameters, and
- the use of simulations to generate estimates of catch, returns and escapements with associated confidence intervals for the estimators.

The results of electrofishing surveys are presented and used as indicators of past spawning escapements and to evaluate past and present habitat saturation by the juveniles in the Margaree River.

The angling catches from other Gulf Nova Scotia rivers, based on license stub returns are presented.

MATERIALS AND METHODS

Estimates of harvests and catches

Recreational catch estimates were obtained from three sources.

1. Fisheries officers from the Dept. of Fisheries and Oceans (DFO) at Margaree Forks, Nova Scotia,

have provided estimates of angling catch for the period 1947 to 1991. MSW salmon hook and release estimates were not provided in 1991.

2. Recreational catches, since 1984, have been estimated from license stub returns (LIC) (O'Neil et al. 1985, 1986, 1987, 1989, 1991). Catch estimates for 1989 and 1990, and preliminary estimates for 1991 were obtained from S. O'Neil, DFO Halifax, Nova Scotia. The estimation procedures for the LIC data are outlined in O'Neil et al. (1991). Anglers are only required to report the number of MSW hooked and released from a given river for the entire season, therefore, seasonal breakdowns are not possible.

3. Angling catch was estimated by creel surveys, designed by DFO Science Branch, for 1987 to 1991. The creel survey method used in 1991 was identical to the 1990 "bus route" access point survey (Robson and Jones 1989) combined with lattice sampling (Chaput and Jones 1991a). The 10 index pools surveyed in 1990 were also surveyed in 1991 for the period June 1 to Oct. 15. Between Oct. 16 and Oct. 31, 8 index pools were surveyed including two pools on the southwest branch of the Margaree River (Fig. 1). The sampling day was divided into AM and PM periods. Each sampling period lasted 7.5 hours with the AM period commencing at 600 or sunrise depending on season and the PM period finishing at 2100 or sunset depending on season. Weekly strata were used for the time period between June 1 and Aug. 30, 1991. A total of three strata were constructed for the fall period: Aug. 31 to Sept. 22, Sept. 23 to Oct. 15, and Oct. 16 to Oct. 31. Both the AM and PM periods were sampled on the same day at least once in each stratum. The sampling effort was 5 of 7 days with one of the sample days designated for obtaining angler counts at the 32 angling pools. The Horvitz-Thompson unweighted matrices were used to estimate total catch and effort by stratum (Robson 1990). Variance estimates of effort (hours) and angling catch by size group (1SW and MSW salmon) for the summer (June 1 to Aug. 30) and fall (Aug. 31 to Oct. 15) were obtained using the Yates-Grundy variance estimator (Robson 1990). The variance estimates of the catch for the Oct. 16 to 31 sampling period were obtained by bootstrap methods (Chaput 1992) because no within day replicates were obtained. The 95% confidence intervals for the estimates were calculated using $\pm$ 2 standard deviations as in the previous assessment. The creel survey field methods for Margaree River are described in Appendix A.

The estimates of total river catch were obtained using logbook reports. Creel catch at index pools was expanded to total river catch using the proportion of the logbook catch originating at index pools. The distributions of the river catch estimates for 1SW and MSW salmon by season were generated using 6000 replications and bootstrap estimates of individual parameter uncertainty (Chaput 1992).

Volunteeer angler logbook reports which detailed the daily catch by size, release method, effort (hours) and pools fished were received and processed as in previous assessments (Claytor and Jones 1990). Logbook data were used to expand creel catch estimates to total river catch and to provide estimates of reporting rates of recaptured fish in the recreational fishery.

Salmon Check-In Program (SCIP)

A pilot volunteer catch declaration program was initiated in 1991 for the Margaree River. Anglers were asked to report the 1SW salmon catches to one of 5 stations where the angled fish could be sampled for biological characteristics, date of capture, location captured, etc. The declaration stations included four local business establishments and the Margaree Fish Culture Station (DFO). The program was a cooperative initiative between DFO and the Margaree Salmon Association.

Estimation of Exploitation Rate (ER)

The exploitation rate was estimated using mark/recapture methods, similar to those used since 1988, and the following formula:

$$ER = \text{Tags Recaptured} / \text{Tags Available.}$$

Two trapnets, identical in construction and installation to those of the previous assessments (Claytor and Chaput 1988), were fished within tidal waters between June 11 and Aug. 30, 1991. All salmon captured in the trapnets were marked using blue, individually numbered Carlin tags secured with a double stainless steel wire attachment directly under the dorsal fin. Tag recaptures in the angling fishery were reported in logbooks, at SCIP stations and by mail.

Estimation of Tags Available

Losses of tagged fish due to emigration and mortality were considered minimal and were not considered further. Losses due to tag shedding by marked fish were estimated by marking all 73 MSW salmon collected for broodstock on Aug. 27 with Carlin tags prior to confinement in the holding tanks at the Margaree Fish Culture Station. The tagging method was similar to that used at the estuarine trapnets. Fish were examined for tags when spawned in late October, early November. The tag shedding rate (tags lost per day) was calculated as the ratio of the number of tags lost to the number of tags initially placed divided by the number of days since tagging (taken as 65 days in 1991). The number of tags available to anglers was estimated from the number of marked fish released multiplied by the proportion of tags retained where the proportion retained equalled (1 - tag shedding rate times median days to recapture) (Table 1).

Estimation of Tags Recaptured

The tags returned voluntarily were adjusted to account for the reporting rate. The reporting rate of tag recaptures from the angling fishery was estimated for 1SW and MSW separately. The proportion of logbook tag recaptures to logbook catch reported was assumed to represent 100% reporting. The proportion of tags recaptured at index pools to estimated catch at index pools represented the partial reports. The ratio of creel catch proportions to logbook catch proportions equalled the reporting rate.

Estimation of Returns

The estimate of returns in 1991 was obtained using the formula:

Returns = Angling Catch / ER (see Table 1).

The confidence around the returns estimate was quantified using simulation techniques. The returns equation was solved a total of 6000 times with the angling catch and exploitation rate allowed to vary for each replication. Variation in angling catch and exploitation rate was simulated using bootstrap techniques as described in Table 1.

Estimation of Spawning Requirements and Spawning Escapements

The spawning requirements for the Margaree River were calculated using the formula and biological characteristics summarized in Table 2. The spawning escapement to the Margaree River was calculated using the following formula (Claytor and Jones 1990):

$$\text{Spawners} = \frac{\text{Sport Catch X (1 - ER)}}{\text{ER}}$$

For the years 1947 to 1986, DFO estimates of catch were used. For 1987 to 1991, creel survey estimates of sport catch were used. Prior to 1987, the exploitation rate for both 1SW and MSW salmon was assumed to be uniformly distributed between 0.206 and 0.379 for both summer and fall angled fish(Claytor and Chaput 1987). The returns for 1987 to 1989 were estimated using an assumed exploitation rate for the summer (uniform distribution between 0.206 and 0.379) and derived exploitation rates for the fall varying from 0.11 to 0.35 for 1SW salmon and 0.09 to 0.26 for MSW salmon (Chaput and Jones 1991b). The returns and escapements in 1990 were reassessed using the simulation and bootstrapping techniques. Since 1979, summer MSW sport catch and since 1985, all MSW sport catch regardless of date of capture was added back to the spawners formula above, less 5% for hook and release mortality. The estimate of the percent of egg target met by MSW spawners exlcudes eggs collected by the DFO hatchery.

Hatchery Releases and Returns

Releases of hatchery reared fish, by life stage, to the Margaree River were updated for 1991. The proportions of hatchery and wild salmon returning to the Margaree River were determined from angler logbooks, creel survey, SCIP reports, broodstock collections, trapnet catches, and counting fence data at Lake O'Law Brook.

Electrofishing Surveys

A total of five electrofishing stations were sampled in July 1991. The methods were similar to those described by Chaput and Claytor (1989). Estimates of wild Altantic salmon juvenile population numbers, densities, and mean size by size group were obtained for each station. Population estimates were calculated using the Zippin method (Zippin 1956). The percent habitat saturation index (PHS) was calculated according to the method proposed by Grant and Kramer (1990):

$$PHS = 100 \times \Sigma D_i \times T_i \times 1.19$$

where D_i is the density (per m^2) of size class $_i$

T_i is the territory size (m^2) for size class $_i$ predicted from the territory size-body size regression (Grant and Kramer 1990).

The index was calculated for the 1991 stations and for previous years as an indication of present juvenile abundance relative to previous levels and potential levels.

RESULTS

Recreational Catches and Catch Rates

The DFO estimated catch of 1SW salmon from the Margaree River between June 1 and Oct. 31, 1991 was 246 (Table 3). MSW salmon catch estimates were not obtained by field personnel in 1991.

Preliminary license stub estimates of catch from the Margaree River for 1991 were 743 1SW salmon and 1786 MSW salmon (Table 4). The previous 5 year mean license stub catch from the Margaree River was 770 1SW salmon and 1900 MSW salmon. The angling catch and effort for the Margaree River represented 60% of the 1SW salmon catch, 50% of the MSW salmon catch and 72% of declared effort (rod-days) for SFA 18 in 1991. (Table 4).

Creel catch estimates of MSW salmon from the index pools in 1991 were down substantially from 1990 catches for both the summer and fall periods. The MSW salmon catch in 1991, up to Oct. 15, was 46% of the 1990 catch. The 1991 1SW salmon catch estimate up to Oct. 15 was 95% of the 1990 catch estimate (Table 5). The effort estimate was 94% of the 1990 value. Forks Pool was favored over all other index pools during June to October in 1990 but only for August and September in 1991 (Fig. 2). Effort was reduced substantially at the lower index pools (LTHOM, SEAL, and FORKS) in late fall in 1991 relative to previous time periods and 1990 (Fig. 2) because high water conditions rendered the pools unfishable during most of the late fall. Effort increased with the progression of the seasons in both AM and PM periods during 1990 and 1991 (Fig. 3).

The 1SW and MSW salmon catch proportions from the index pools, estimated using logbook catches versus tag recapture distributions, were similar for MSW salmon but differed for 1SW salmon catch from the fall (Table 6). The estimated proportion of MSW salmon from index pools in 1990 was also similar between the two data sources (Table 7). The effort proportions based on angler counts were most different from either tags or logbook data. In the 1990 assessment, the tag recapture proportions were used for expanding the 1990 fall catch of 1SW and MSW salmon but proportion of effort had to be used for the summer (Chaput and Jones 1991a). A reanalysis of the 1990 data using logbooks versus tag recaptures for the fall resulted in only minor changes in estimated catch and returns for 1990 (Table 7; Chaput 1992). As a result, logbook proportions were used for expanding the index pool catches to total river catch in 1990 and 1991.

The 1991 estimated catch of 1SW salmon, up to Oct. 15, from the Margaree River was 391, 153% of the 1990 estimated catch (Table 8). The MSW salmon catch up to Oct. 15, 1991 was 595, about 35% of the 1990 catch (Table 8). The catch of MSW salmon was down in both the summer and fall periods in 1991 relative to 1990.

The logbook reports for 1991 (Table 9), when compared to previous years, illustrate some consistent patterns in the catch rates of 1SW salmon and MSW salmon.

			YEAR		
	1991	1990	1989	1988	1987
Summer					
Effort (Rod days)	341	359	490	412	163
1SW (#/rod day)	0.073	0.092	0.078	0.117	0.166
MSW (#/rod day)	0.129	0.114	0.106	0.403	0.147
Fall (Sept.1 - Oct. 15)					
Effort (Rod days)	391	306	194	261	64
1SW (#/rod day)	0.082	0.092	0.041	0.111	0.063
MSW (#/rod day)	0.355	0.127	0.325	0.682	0.250
Fall (Oct. 16 - 31)					
Effort (Rod days)	39				
1SW (#/rod day)	0.103				
MSW (#/rod day)	0.487				

The logbook anglers were almost three times more successful at hooking a MSW salmon in the fall of 1991 than in 1990. Summer success in 1991 was similar to 1990 and has been relatively constant since 1987. Catch rates increased in the fall relative to the summer, and the catch rates during the season extension in 1991 were higher yet than early fall catch rates.

Logbook catch rate and creel catch rate trends do not always agree. Catch per unit effort from creel data gave a dramatically different impression of abundance for 1991 relative to 1990 than did the logbook data: the creel MSW catch per hour in 1990 was about three times greater than the 1991 catch rates for both summer and fall. Logbook and creel catch rate trends were similar for summer and fall 1991 (Table 9): the logbook angler success rate in the fall of 1991 was three times higher than for the summer, similar to the creel data trend.

Distribution of Tagging Effort and Recaptures

A total of 164 1SW salmon and 203 MSW salmon were marked and released from the estuarine trapnets between June 11 and Aug. 30, 1991 (Table 10). The largest portion of the catch occurred in August representing 77% of total salmon marked and released (Fig. 4). The modal length of 1SW salmon was 52 cm whereas MSW salmon had a modal length of 75 cm (Fig. 4).

About 15% of the 1SW salmon tags and 12% of the MSW salmon tags were returned by anglers (Table 10). Of the 31 1SW salmon marked and released during the broodstock seining on Aug. 27, 1991, 29% were recaptured by anglers whereas 10% of the 21 MSW salmon marked and released were subsequently recaptured (Table 10).

All the recaptures of 1SW salmon marked and released from the trapnets before July 30 (pre week 31), were reportedly caught before Aug. 19 (Table 11). The 1SW salmon marked and released in August were recaptured throughout Aug., Sept., and Oct. (Table 11). The median days to recapture for estuarine trapnet marked 1SW salmon was 19 days (Table 1).

MSW salmon marked and released before July 30 (pre week 31) were recaptured in both the summer and fall seasons, as were some of the MSW salmon marked in August (Table 11). The median days to recapture for MSW salmon marked at the trapnets was 35 days (Table 1).

Estimation of Returns Equation Parameters

The angling catch data used in the estimation of returns for 1947 to 1991 are summarized in Table 12. The parameters which made up the returns equation in 1991 are presented in Table 1. The 1990 data were reanalysed using a similar technique although not all the parameters were analysed in the same way (Appendix B; Chaput 1992). The main differences were:

- Reporting Rate: in 1990, RR was calculated for 1SW and MSW combined because of the small number of tag returns (3) from the logbook anglers. In 1991, RR was calculated seperately for 1SW and MSW salmon. Adjusted reporting rate means that RR values greater than 1 were set equal to 1 in the simulations.

- Tags available were calculated using tags placed, the tag loss rate and the median days to recapture for 1SW and MSW. In the 1990 assessment, Chaput and Jones (1991) had used mean days to recapture rather than median.

- ER's in 1991 were considered to be integrated values over the entire angling season for the following reasons:
  1 - no marks were placed after Aug. 30, 1991,
  2 - marked fish were recaptured throughout the summer and fall.

In 1990, summer ER was assumed to be between 0.206 and 0.379. New estimates of fall ER for 1SW and MSW salmon for 1990, generated using the simulation technique, were 0.19 for 1SW and 0.13 for MSW salmon (Table 8).

The returns in 1991, based on angling catches up to Oct. 15, were 1909 1SW salmon (90% C.I. 794 to 3891) and 3484 MSW salmon (90% C.I. 1853 to 5785) (Table 8, 13). The 1991 returns were 191% and 31% of 1990 returns of 1SW and MSW salmon respectively but were as high as the highest returns noted since 1984 (Table 13).

The escapements in 1991 were estimated at 1507 1SW salmon (90% C.I. 644 to 3116) and 3453 MSW salmon (90% C.I. 1836 to 5740) (Table 13). These escapements resulted in an estimated egg deposition by MSW salmon equal to 326% of target (90% C.I. 170% to 547%) or 334% by both 1SW and MSW salmon (Table 13). Potential egg depositions by MSW salmon have exceeded target egg depositions since 1985, even at the lower confidence limit (Table 13).

Electrofishing Surveys

The densities of fry at the five sites were high in 1991, ranging from 36.2 to 230.2 fry per 100m^2 (Table 14). Parr densities were also high, ranging from 20.8 parr per 100m^2 at the Trout Brook site (Lake Ainslie tributary) to 73.0 parr per 100m^2 at one of the Forest Glen Brook sites (Table 14). Higher densities of fry (383 per 100 m^2) and parr (88 per 100 m^2) were recorded at Forest Glen Brook sites in 1987 (Chaput and Claytor 1989). Fry densities at the MacFarlane's Brook site were 2 to 4 times those observed between 1975 and 1978 whereas parr densities were 2 to 10 times higher (see Chaput and Claytor 1989). The fry densities at the Big Brook site are the highest ever recorded since 1964. The parr densities at the Big Brook site were similar to those of the late 1980's, about half those of the 1960's but 4 times those of the 1970's. The PHS index values for the Margaree River ranged from 13.8% to 59.7% (Fig. 5). With the exception of Trout Brook, the PHS index values suggested that density-dependent responses, such as emigration, mortality or reduced growth rates, were likely occurring in the Margaree River.

Lake O'Law Fence

A counting fence on Lake O'Law Brook was operated from May 2 to Nov. 18 1991. Movements of Atlantic salmon by life stage are summarized below.

			Upstream	Downstream
Parr			4	28
Smolt	Wild			3999
	Hatchery			2300
1SW Salmon	Wild	Male	27	
		Female	1	
	Hatchery	Male	6	
		Female	0	
	Total		34	
MSW Salmon	Wild	Male	25	
		Female	47	
	Hatchery	Male	2	
		Female	2	
	Total		76	

The estimated rearing area for Lake O'Law Brook is 97,200 m^2. The egg requirements are 233,280 which would be acheived by 36 MSW salmon. The fence was located about 1.5 km upstream of the confluence with the Margaree River. Counts through the fence were 2.1 times the required number.

Hatchery Contributions

Releases of hatchery progeny to the Margaree River by life stage are summarized in Table 15. The proportions of hatchery and wild 1SW and MSW salmon by collection method are summarized in Table 16. The trapnets provide the best indication of the proportion of wild salmon in the runs because of the larger sample size and the estuarine location from which samples were obtained. Prior to Aug. 31, the 1SW salmon run was 81% wild origin and the MSW salmon run was 91% wild origin (Table 16). The high proportion of hatchery origin fish in the broodstock samples and the SCIP/Creel samples relates to the larger number of samples which were collected from Hatchery Pool, the pool situated next to the Margaree Fish Culture Station.

Marine Exploitation of the Margaree River Atlantic Salmon

The Margaree River Atlantic salmon kelts, as well as returning previous spawners, are regularly intercepted in the Newfoundland and Quebec north shore commercial fisheries (Table 17). One salmon, from the 1989 spawning migration, was recaptured in the Greenland commercial fishery in 1990 (Table 17).

DISCUSSION

The angling catch, returns, and escapement estimates, obtained using simulation techniques, permitted the inclusion of uncertainty in several of the estimation parameters. The results were simpler to interpret and provided a clearer picture of the overall confidence around the returns and escapements estimates.

The return of MSW Atlantic salmon to the Margaree River in 1991 was down substantially from the record return of 1990. The spawning escapement in 1991 was three times the target spawning requirement. The similarly high escapement to the Lake O'Law fence, two times the requirement for that size of tributary, provided supporting evidence for the estimated escapement to the entire river. The return of 1SW salmon in 1991 was strong and may provide some positive forecast of MSW salmon returns in 1992.

The use of angling catch and exploitation rate to estimate returns is, unfortunately, far from perfect. The exploitation rate should be calculated every year because river conditions have a very large impact on exploitation rate. The integrated ER calculated in 1991 oversimplifies the pattern of exploitation. The estimated ER is correct for fish entering the river prior to September but it is likely too high for those fish which entered after. In that case, the returns are underestimated.

In previous assessments, the angling catches from the summer and fall were treated as two distinct components representing the respective sizes of the runs. The mark/recapture data from 1991 indicate that this was not the case. Some of the fall recreational catch consisted of fish which had been marked and released in the summer. The exploitation rates derived in 1988 to 1990 for fall angled fish actually correspond to exploitation rates for fish entering and angled in the fall. This overestimated the fall returns while underestimating the summer returns. The overestimation was probably not excessive since the large portion of the fall catch was expected to be fall fish. A marking study which covers the entire season would provide some indication of the relative proportions of summer and fall run fish in the catches. An estimate of population size, independent of angling recaptures, would provide the best indicator of stock status.

The densities of Atlantic salmon juveniles in the Margaree River were high. The PHS index values were in the range that predicted the occurence of density-dependent effects in the tributaries. The PHS index is a measure of spatial saturation only and ignores other factors such as quality of habitat, productivity, and predation (Grant and Kramer 1990). These authors suggested that the PHS index could be used as a rough guide for setting maximum stocking densities. Stocking fish into a stream where the PHS is greater than 27 would likely cause a density-dependent response in either the resident or stocked population (Grant and Kramer 1990). On that basis, hatchery-reared juveniles should not be stocked in the tributaries of the Margaree River which were surveyed in 1991.

The abundance of juveniles has increased dramatically from the low levels noted in the 1970's and have either equalled or surpassed the juvenile densities noted in the late 50's and early 60's. It is interesting to note that the PHS index for the Forest Glen Brook sites has not varied over time and has not shown the dramatic increase in 1991 relative to previous years as was seen at the Big Brook site. The Forest Glen Brook appears to have received adequate spawning throughout the time period studied whereas lesser tributaries such as Big Brook have responded to the increased adult escapement between 1986 and 1991.

The Atlantic salmon resource of the Margaree River has increased in abundance since 1985 to the point where surpluses of fish to presently designated spawning requirements are occurring every year. A forecast for 1992 and beyond is not available but given the escapements that have been estimated since 1985, returns of MSW salmon will likely exceed spawning requirements in 1992 and beyond if factors such as habitat degradation are minimized.

REFERENCES

Chaput, G. 1992. Estimating and incorporating parameter uncertainty when returns of Atlantic salmon are derived from angling catches. CAFSAC Res. Doc. 92/1.

Chaput, G.J. and R.R. Claytor. 1988. Sport catch of Atlantic salmon from Margaree River, Nova Scotia, 1947 to 1987. Can. Data Rep. Fish. Aquat. Sci. No. 678. iv+50p.

Chaput, G.J. and R.R. Claytor. 1989. Electrofishing surveys for Atlantic salmon from Margaree River, Nova Scotia, 1957 to 1987. Can. Data Rep. Fish. Aquat. Sci. No. 736. iv+76p.

Chaput, G. and R. Jones. 1991a. Assessment of Atlantic salmon (Salmo salar) in the Margaree River, Nova Scotia 1990. CAFSAC Res. Doc. 91/3. 31p.

Chaput, G. and R. Jones. 1991b. Evaluating spawning requirements, returns, escapements and surpluses to conservation levels of Atlantic salmon for selected Gulf Nova Scotia rivers. CAFSAC Res. Doc. 91/73. 23p.

Claytor, R.R. and E.M.P. Chadwick, 1985. Assessment of Atlantic salmon (Salmo salar), in the Margaree River, Nova Scotia, 1985. CAFSAC Res. Doc. 85/103. 25p.

Claytor, R.R. and G.J. Chaput. 1988. Assessment of Atlantic salmon (Salmo salar), in the Margaree River, 1988. CAFSAC Res. Doc. 88/75. 43p.

Claytor, R.R., G.J. Chaput, and T.G. Lutzac. 1987. Assessment of Atlantic salmon (Salmo salar), in the Margaree River, 1987. CAFSAC Res. Doc. 87/105. 36p.

Claytor, R.R. and R. Jones. 1990. Assessment of Atlantic salmon (Salmo salar), in the Margaree River, 1989. CAFSAC Res. Doc. 90/27. 22p.

Claytor, R.R. and C. Léger. 1986. Assessment of Atlantic salmon, Salmo salar, in the Margaree River, Nova Scotia, 1986. CAFSAC Res. Doc. 86/93. 21p.

Elson, P.F. 1975. Atlantic salmon rivers. Smolt production and optimal spawning - an overview of natural production. Int. Atlantic Sal. Found. Spec. Public. Ser. 6:96-119.

Grant, J.W.A. and D.L. Kramer. 1990. Territory size as a predictor of the upper limit to population density of juvenile salmonids in streams. Can. J. Fish. Aquat. Sci. 47:1724-1737.

Gray, R.W. and E.M.P. Chadwick. 1984. Assessment of Margaree River salmon stocks in 1983. CAFSAC Res. Doc. 84/36. 11p.

Marshall, T.L. 1982. Background and management alternatives for salmon of the Margaree River: a working document for the selection of stock enhancement strategies. Fisheries and Oceans, Halifax, NS. Mimeo. 117pp.

O'Neil, S.F., M. Bernard, P. Gallop, and R. Pickard. 1987. 1986 Atlantic salmon sport catch statistics, Maritime provinces. Can. Data Rep. Fish. Aquat. Sci. No. 663. v+69p.

O'Neil, S.F., M. Bernard, and J. Singer. 1985. 1984 Atlantic salmon sport catch statistics, Maritime provinces (Redbook). Can. Data Rep. Fish. Aquat. Sci. No. 530. v+71p.

O'Neil, S.F., M. Bernard, and J. Singer. 1986. 1985 Atlantic salmon sport catch statistics, Maritime provinces (Redbook). Can. Data Rep. Fish. Aquat. Sci. No. 600. v+71p.

O'Neil, S.F., K. Newbould, and R. Pickard. 1989. 1987 Atlantic salmon sport catch statistics, Maritime Provinces. Can. Data Rep. Fish. Aquat. Sci. No. 770. 73p.

O'Neil, S.F., D.A. Stewart, K.A. Newbould, and R. Pickard. 1991. 1988 Atlantic salmon sport catch statistics, Maritime provinces. Can. Data Rep. Fish. Aquat. Sci. No. 852. 79p.

Robson, D. 1990. Handout on multi-dimensional lattice sampling in creel surveys. Manuscript 8p. (Available from D. Robson 150 McLaren, Ph 6, Ottawa, Ontario K2P 0L2, Canada).

Robson, D. and C.M. Jones. 1989. The theoretical basis of an access site angler survey design. Biomerics 45:83-98.

Zippin, C. 1956. An evaluation of the removal method of estimating animal populations. Biometrics 12:163-189.

Table 1. Formulation for the estimation of the returns of Atlantic salmon to the Margaree River, 1991. Boldtype indicates parameters which changed value for every repetition.

$$\textbf{RETURNS (1SW; MSW)} = \frac{\textbf{CATCH (1SW; MSW)}}{\textbf{EXPLOITATION RATE (1SW; MSW)}}$$

CATCH (1SW; MSW) = Catch Summer + Catch Fall

$$\textbf{Catch (summer; fall)} = \frac{\textbf{Est. Creel Catch from Index Pools (CCI)}}{\textbf{Proportion of Catch from Index Pools (PCI)}}$$

CCI ---> 1SW summer assumed distribution N(108, 2779)
1SW fall assumed distribution N(52, 1006)
MSW summer assumed distribution N(53, 916)
MSW fall assumed distribution N(193, 2997)

PCI ---> variability simulated using bootstrapping.
Using logbooks:

summer	N = 25	1SW prop.	13/27 =	0.48
		MSW prop.	29/44 =	0.66
fall	N = 38	1SW prop.	12/35 =	0.34
		MSW prop.	54/145 =	0.37
fall2	N = 10	1SW prop.	1/5 =	0.20
(Oct. 16-31)		MSW prop.	5/19 =	0.26

Using tag returns from angling fishery:

summer	1SW prop.	9/14 =	0.64
	MSW prop.	5/9 =	0.56
fall	1SW prop.	7/11 =	0.64
	MSW prop.	5/14 =	0.36

EXPLOITATION RATE (1SW; MSW) = Tags Recaptured / Tags Available

Estimated for both seasons combined.

$$\textbf{Tags Recaptured} = \frac{\text{Tags Returned Voluntarily (1SW; MSW)}}{\textbf{Reporting Rate (RR) (1SW; MSW)}}$$

Bootstrap estimates of RR for 1991 estimated from:

$$\textbf{RR} = \frac{\dfrac{\textbf{Tag Recaptures from Index Pools (1SW; MSW)}}{\textbf{Creel Catch Estimate at Index Pools (1SW; MSW)}}}{\dfrac{\text{Tag Recaptures by Logbook Anglers (1SW; MSW)}}{\text{Logbook Catch (1SW; MSW)}}}$$

Nonbootstrap value: 1SW = (15/160)/(6/67) 1.05
MSW = (10/246)/(5/189) 1.54

Note: If RR > 1 then RR = 1.

Table 1 (cont'd).

Tags Available (1SW; MSW) = Tags Placed X **Proportion Retained(PR)**

Tags Placed in 1991:	1SW	=	164
	MSW	=	203

PR = 1 - **(Tag Loss Rate)** X **Median Days to Recapture**

Tag Loss Rate is Bootstrapped.
Of 73 MSW salmon marked and retained for 65 days in 1991, 37 had shed their tags. Tag loss rate = 0.008 tags/day.

Recapture data is bootstrapped to obtain median days to recapture.
1SW Recaptures: N = 25, Range 6 to 69 days, Median = 19 days
MSW Recaptures: N = 24, Range 0 to 84 days, Median = 35 days

SUMMARY EQUATION

$$\textbf{RETURNS (1SW; MSW)} = \left| \frac{\textbf{CCI (Summer)}}{\textbf{PCI (Summer)}} + \frac{\textbf{CCI (Fall)}}{\textbf{PCI (Fall)}} \right| \times \frac{\text{Tags Placed X } \textbf{PR} \text{ X } \textbf{RR}}{\text{Tags Returned Voluntarily}}$$

Solve **RETURNS** a large number of times to generate the distribution from which the Confidence Limits can be determined.

Table 2. Estimation of spawner requirements for the Margaree River.

MARGAREE RIVER

Rearing Units		27,976 (100 sq. m)	(Elson 1975)
Optimal Egg Deposition		240 per rearing unit	(Marshall 1982)
Total Egg Requirements =		6,714,240	
Biological characteristics			
Fecundity		1764 eggs/kg	(Elson 1975)
1SW	% female	11	(Marshall 1982)
	mean wt	1.7	(Marshall 1982)
MSW	% female	75	(Marshall 1982)
	mean wt	4.9 kg	(Marshall 1982)

Eggs per spawner 1SW = eggs/kg * mean wt(kg) * %female
= 1764 * 1.7 * 11%
= 330

MSW = eggs/kg * mean wt(kg) * %female
= 1764 * 4.9 * 75%
= 6483

Required number of MSW = egg requirements / eggs per MSW
= 6,714,240 / 6483

= 1036 --->> 777 females
259 males

Deficit males = 777 - 259 = 518

1SW spawners to obtain 518 males = 518 / 89%
= 582

MSW spawners to obtain 518 males = 518 / 25%
= 2072

Spawning Requirements	Minimum	MSW =	1036
		1SW =	582
	Maximum	MSW =	3108
	All 1SW surplus		

Table 3. Salmon angling catch on Margaree River (1947-1991) as compiled by Department of Fisheries and Oceans fisheries officers (DFO statistics).

Year	1SW	MSW Retained	MSW Released	MSW Total	Unsized	Total
1947	36	363			1	400
1948	106	704			.	810
1949	41	332			9	382
1950	111	320			8	439
1951	21	424			25	470
1952	83	204			4	291
1953	49	291			8	348
1954	68	298			10	376
1955	53	258			.	311
1956	28	90			1	119
1957	36	136			.	172
1958 *	N/A	N/A			.	334
1959 *	N/A	N/A			.	235
1960 *	N/A	N/A			.	140
1961	29	49			11	89
1962	46	410			.	456
1963	87	212			.	299
1964	120	289			.	409
1965	86	254			.	340
1966	92	165			.	257
1967	98	265			8	371
1968	64	198			6	268
1969	214	139			6	359
1970	85	215			3	303
1971	21	94			.	115
1972	42	105			.	147
1973	166	117			.	283
1974	60	107			.	167
1975	36	64			.	100
1976	96	82			.	178
1977	69	140			1	210
1978	25	158			.	183
1979	597	62	19	81	8	686
1980	167	138	2	140	11	318
1981	899	105	34	139	11	1049
1982	691	103	76	179	1	871
1983	68	107	42	149	4	221
1984	148	12	109	121	.	269
1985	223	0	312	312	1	536
1986	295	0	754	754	.	1049
1987	353	0	408	408	.	761
1988	435	0	580	580	.	1015
1989	179	0	244	244	.	423
1990 @	208	0	314	314	.	522
1991 @	246	0	-	-	.	246

* Information regarding 1SW and MSW salmon for 1958-1960 are not available.
@ Note: Season was extended from October 15 to October 31.

Table 4. Annual summaries of catch and effort for Gulf N.S. rivers from 1984-91 using license stub returns. +/-Mean = (1991-Mean)/Mean.

Year River	No. Angler	1SW Obs.	1SW Est.	MSW Obs.	MSW Est.	Unk. Obs.	Total Obs.	Total Est.	Rod-days Obs.	Rod-days Est.	CPUE	% MSW
Cheticamp												
1984	35	2	2	36	37	0	38	39	132	148	0.288	94.7
1985	24	15	15	52	53	0	67	68	170	182	0.394	77.6
1986	34	4	4	50	50	0	54	54	108	114	0.500	92.6
1987	37	7	7	59	60	0	66	67	124	131	0.532	89.4
1988	28	1	1	37	43	0	38	45	105	127	0.362	97.4
1989	33	6	7	116	140	0	122	148	237	296	0.515	95.1
1990	23	0	0	44	56	0	44	56	107	140	0.411	100.0
1991	12	0	0	13	30	0	13	30	36	87	0.361	100.0
Mean(86-90)	31	4	4	61	70	0	65	74	136	162	0.464	94.9
+/- Mean	-61%	-100%	-100%	-79%	-57%	0%	-80%	-59%	-74%	-46%	-24%	6%
East: Pictou Co.												
1984	70	14	14	39	40	0	53	54	423	474	0.125	73.6
1985	63	38	40	153	162	1	192	203	373	398	0.515	80.1
1986	152	84	89	582	620	0	666	709	1094	1151	0.609	87.4
1987	202	80	83	377	389	0	457	472	1214	1286	0.376	82.5
1988	200	110	129	360	422	0	470	551	1072	1300	0.438	76.6
1989	240	72	87	554	670	0	626	757	1365	1705	0.459	88.5
1990	223	86	109	237	299	0	323	408	1069	1394	0.302	73.4
1991	121	49	111	186	423	0	235	534	602	1463	0.390	79.1
Mean(86-90)	203	86	99	422	480	0	508	579	1163	1367	0.437	81.7
+/- Mean	-41%	-43%	12%	-56%	-12%	0%	-54%	-8%	-48%	7%	-11%	-5%
Margaree												
1984	678	233	242	293	305	4	530	551	5952	6665	0.089	55.7
1985	793	473	509	1130	1215	3	1606	1724	7324	7824	0.219	70.5
1986	1131	748	782	2522	2636	2	3272	3420	9724	10232	0.336	77.1
1987	1441	925	977	1757	1857	0	2682	2834	12165	12887	0.220	65.5
1988	1455	749	879	1647	1932	0	2396	2810	11582	14042	0.207	68.7
1989	1486	464	561	1298	1570	0	1762	2132	10594	13234	0.166	73.7
1990	1382	514	649	1193	1507	0	1707	2156	10789	14072	0.158	69.9
1991	634	327	743	786	1786	0	1113	2528	5872	14266	0.190	70.6
Mean(86-90)	1379	680	770	1683	1900	0	2364	2670	10971	12893	0.218	71.0
+/- Mean	-54%	-52%	-3%	-53%	-6%	0%	-53%	-5%	-46%	11%	-12%	-1%
River John												
1984	5	1	1	0	0	0	1	1	20	22	0.050	0.0
1985	6	2	2	55	58	0	57	60	55	59	1.036	96.5
1986	21	29	30	146	154	0	175	184	179	188	0.978	83.4
1987	47	24	25	69	70	0	93	95	224	237	0.415	74.2
1988	47	44	52	101	118	0	145	170	211	256	0.687	69.7
1989	59	15	18	82	99	0	97	117	214	267	0.453	84.5
1990	47	49	62	33	42	0	82	104	232	303	0.353	40.2
1991	21	16	36	59	134	0	75	170	112	272	0.670	78.7
Mean(86-90)	44	32	37	86	97	0	118	134	212	250	0.577	70.4
+/- Mean	-52%	-50%	-4%	-32%	39%	0%	-37%	27%	-47%	9%	20%	8%

Table 4. Continued ...

Year	River	No. Angler	1SW Obs.	1SW Est.	MSW Obs.	MSW Est.	Unk. Obs.	Total Obs.	Total Est.	Rod-days Obs.	Rod-days Est.	CPUE	% MSW
	River Philip												
1984		53	24	25	57	60	0	81	85	275	308	0.295	70.4
1985		60	11	12	65	69	0	76	81	291	311	0.261	85.5
1986		103	107	111	325	338	0	432	449	608	640	0.711	75.2
1987		160	71	76	317	337	0	388	413	1055	1118	0.368	81.7
1988		167	144	169	280	328	0	424	497	1012	1227	0.419	66.0
1989		144	94	114	336	407	0	430	520	999	1248	0.430	78.1
1990		147	123	155	151	191	0	274	346	873	1139	0.314	55.1
1991		86	77	175	212	482	0	289	657	619	1504	0.467	73.4
Mean(86-90)		144	108	125	282	320	0	390	445	909	1074	0.448	71.2
+/- Mean		-40%	-29%	40%	-25%	51%	0%	-26%	48%	-32%	40%	9%	1%
	Wallace												
1984		25	1	1	4	4	0	5	5	48	54	0.104	80.0
1985		28	5	5	16	17	0	21	22	80	85	0.263	76.2
1986		71	16	16	113	115	0	129	131	222	234	0.581	87.6
1987		79	11	11	48	50	0	59	61	269	285	0.219	81.4
1988		81	14	16	28	33	0	42	49	243	295	0.173	66.7
1989		67	10	12	27	33	0	37	45	191	239	0.194	73.0
1990		54	11	14	23	29	0	34	43	198	258	0.172	67.6
1991		50	12	27	43	98	0	55	125	145	352	0.379	78.2
Mean(86-90)		70	12	14	48	52	0	60	66	225	262	0.268	75.3
+/- Mean		-29%	-3%	96%	-10%	88%	0%	-9%	90%	-35%	34%	41%	-2%
	Waugh												
1984		3	0	0	0	0	0	0	0	7	8	0.000	0.0
1985		4	0	0	1	1	0	1	1	5	5	0.200	100.0
1986		15	9	10	27	29	0	36	39	32	34	1.125	75.0
1987		23	0	0	7	7	0	7	7	45	48	0.156	100.0
1988		21	8	9	19	22	0	27	32	65	79	0.415	70.4
1989		24	4	5	4	5	0	8	10	74	92	0.108	50.0
1990		17	14	18	14	18	0	28	35	75	98	0.373	50.0
1991		24	12	27	53	120	0	65	148	125	304	0.520	81.5
Mean(86-90)		20	7	8	14	16	0	21	25	58	70	0.435	69.1
+/- Mean		20%	71%	221%	273%	641%	0%	207%	502%	115%	333%	43%	22%
	West: Antigonish Co.												
1984		20	17	17	2	2	0	19	19	96	107	0.198	10.5
1985		33	32	34	115	122	0	147	156	211	225	0.697	78.2
1986		72	116	126	438	476	0	554	602	498	524	1.112	79.1
1987		117	80	84	188	198	0	268	282	699	741	0.383	70.1
1988		89	57	67	107	126	0	164	192	377	457	0.435	65.2
1989		99	74	90	180	218	0	254	307	420	525	0.605	70.9
1990		126	120	152	158	200	0	278	351	536	699	0.519	56.8
1991		60	26	59	144	327	0	170	386	284	690	0.599	84.7
Mean(86-90)		101	89	104	214	244	0	304	347	506	589	0.611	68.4
+/- Mean		-40%	-71%	-43%	-33%	34%	0%	-44%	11%	-44%	17%	-0%	20%

Table 4. Continued ...

Year	River	No. Angler	1SW Obs.	1SW Est.	MSW Obs.	MSW Est.	Unk. Obs.	Total Obs.	Total Est.	Rod-days Obs.	Rod-days Est.	CPUE	% MSW
	West: Pictou Co.												
1984		1	0	0	0	0	0	0	0	1	1	0.000	0.0
1985		8	2	2	4	4	0	6	6	29	31	0.207	66.7
1986		12	4	4	4	4	0	8	8	36	38	0.222	50.0
1987		45	14	15	25	26	0	39	41	233	247	0.167	64.1
1988		49	21	25	37	43	0	58	68	257	312	0.226	63.8
1989		60	12	15	50	60	0	62	75	340	425	0.182	80.6
1990		51	27	34	30	38	0	57	72	193	252	0.295	52.6
1991		58	22	50	79	179	0	101	229	298	724	0.339	78.2
Mean(86-90)		43	16	19	29	34	0	45	53	212	255	0.218	62.2
+/- Mean		34%	41%	169%	171%	423%	0%	125%	334%	41%	184%	60%	20%
	Other Rivers												
1984		3	0	0	0	0	0	0	0	6	6	0.000	0.0
1985		9	0	0	4	4	0	4	4	14	14	0.286	100.0
1986		17	9	9	25	26	0	34	35	42	44	0.810	73.5
1987		23	12	12	16	17	0	28	29	70	73	0.400	57.1
1988		13	2	2	8	9	0	10	11	40	48	0.250	80.0
1989		12	16	19	3	3	0	19	22	43	53	0.442	15.8
1990		20	11	14	10	12	0	21	27	62	80	0.339	47.6
1991		9	1	2	9	20	0	10	22	24	59	0.417	90.0
Mean(86-90)		17	10	11	12	13	0	22	25	51	60	0.448	54.8
+/- Mean		-47%	-90%	-82%	-27%	49%	0%	-55%	-11%	-53%	-1%	-4%	63%
	SFA 18 Totals:												
1984		893	292	302	431	448	4	727	754	6960	7793	0.104	59.6
1985		1028	578	619	1595	1705	4	2177	2325	8552	9134	0.255	73.4
1986		1628	1126	1181	4232	4448	2	5360	5631	12543	13199	0.427	79.0
1987		2174	1224	1290	2863	3011	0	4087	4301	16098	17053	0.254	70.1
1988		2150	1150	1349	2624	3076	0	3774	4425	14964	18143	0.252	69.5
1989		2224	767	928	2650	3205	0	3417	4133	14477	18084	0.236	77.6
1990		2090	955	1207	1893	2392	0	2848	3598	14134	18435	0.201	66.5
1991		1075	542	1230	1584	3599	0	2126	4829	8117	19721	0.262	74.5
Mean(86-90)		2053	1044	1191	2852	3226	0	3897	4418	14443	16983	0.274	72.5
+/- Mean		-48%	-48%	3%	-44%	12%	0%	-45%	9%	-44%	16%	-3%	2%

* - "Other Rivers" includes Barney's, French, Mabou, Middle: Pictou Co., Pomquet, Pugwash, Shinimikas, South, Sutherland Tidnish, Tracadie, and Wright.

Table 5. Estimation of angling catch and effort (hours) from the index pools on the Margaree River, June 1 to Oct. 31, 1991.

		Estimate of Total	Std. Dev.	C.I. 95% Lower	C.I. 95% Upper	Accuracy +/- %
Summer	1SW	108	52.7	3	213	97.6%
(June 1 to Aug. 28)	MSW	53	30.3	-8	114	114.2%
	EFFORT	10568	904.9	8758	12378	17.1%
Fall	1SW	52	31.7	-11	115	122.0%
(Aug. 29 to Oct. 15)	MSW	193	54.7	84	302	56.7%
	EFFORT	10622	754.3	9113	12131	14.2%
Subtotal	1SW	160	61.5	37	283	76.9%
	MSW	246	62.6	121	371	50.9%
	EFFORT	21190	1178.1	18834	23546	11.1%
FALL	1SW	0	-	-	-	
(Oct. 16 to Oct. 31)	MSW	81	22.5	36	126	55.6%
	EFFORT	930	not estimated			
TOTAL	1SW	160	61.5	37	283	76.9%
	MSW	327	66.5	202	452	38.3%

Table 6. Proportion of catch and effort at index pools based on logbook data, tag recapture data and angler counts, 1991.

	Catch	Logbooks Median	Logbooks Percentiles 5%	Logbooks Percentiles 95%	Tag Recaptures Median	Tag Recaptures Percentiles 5%	Tag Recaptures Percentiles 95%
Summer	1SW	0.50	0.21	0.74	0.64	0.43	0.86
(June 1 to Aug. 28)	MSW	0.67	0.52	0.86	0.56	0.33	0.78
Fall	1SW	0.35	0.18	0.55	0.64	0.36	0.82
(Aug. 29 to Oct. 15)	MSW	0.37	0.29	0.47	0.36	0.14	0.57
FALL	1SW	-	-	-	-	-	-
(Oct. 16 to Oct. 31)	MSW	0.27	0.07	0.83	0.00	"1 Tag Recapture"	

River Counts (# of anglers)

	Total at Pools Index	Total at Pools 32 Pools	Proportion of Anglers at Index Pools
June 1 to Aug. 31 (N=9)	82	116	0.707
Sept. 1 to Oct. 15 (N=4)	108	211	0.512
Oct. 16 to Oct. 31 (N=2)	1	16	0.063

Table 7. Effects of using logbook data versus tag recapture data on the estimates of catchand returns of 1SW and MSW Atlantic salmon to the Margaree River, 1990.

			Using Logbooks	Using Tag Recap
Proportion of catch at index pools				
1SW	summer	median	0.677	
		5%	0.442	
		95%	0.858	
	fall	median	0.647	0.538
		5%	0.455	0.308
		95%	0.815	0.769
MSW	summer	median	0.532	
		5%	0.313	
		95%	0.770	
	fall	median	0.404	0.375
		5%	0.264	0.188
		95%	0.563	0.563
Estimates of River Catch				
1SW	summer	median	203	
		5%	78	
		95%	383	
	fall	median	51	60
		5%	0	0
		95%	114	150
MSW	summer	median	359	
		5%	156	
		95%	705	
	fall	median	1,307	1,410
		5%	630	635
		95%	2,369	3,184
Estimates of Returns				
1SW	summer	median	693	
		5%	259	
		95%	1,443	
	fall	median	274	330
		5%	0	0
		95%	739	929
MSW	summer	median	1,239	
		5%	519	
		95%	2,614	
	fall	median	9,752	10,560
		5%	6,901	6,517
		95%	15,069	21,430

Table 8. Summary statistics of various parameters used in the assessment of the recreational catch and returns of Atlantic salmon to the Margaree River in 1990 and 1991. The 1991 formulation is described in Table 1. The 1990 formulation is described in Appendix 2.

			1990			1991		
				Percentiles			Percentiles	
			Median	5%	95%	Median	5%	95%
Adjusted Reporting Rate								
	1SW		0.63	0.43	1	1	0.61	1
	MSW		0.63	0.43	1	1	0.84	1
Adjusted Tags Recaptured								
	1SW		21	13	30	25	25	40
	MSW		27	17	40	23	23	27
Tags Available								
	1SW		114	98	114	139	123	146
	MSW		200	197	206	139	107	174
Exploitation Rate								
	1SW	Summer	0.29	0.21	0.37	0.19	0.17	0.30
		Fall	0.19	0.10	0.28	0.19	0.17	0.30
	MSW	Summer	0.29	0.21	0.37	0.17	0.13	0.23
		Fall	0.13	0.07	0.20	0.17	0.13	0.23
Estimated Angling Catch								
	1SW	Summer	203	78	383	221	44	611
		Fall (Sept. 1 to Oct. 15)	51	0	114	148	0	407
		Subtotal	256	120	449	391	146	842
		Fall (Oct. 16 to 31)		not estimated		0	0	0
		Total				391	146	842
	MSW	Summer	359	156	705	78	6	161
		Fall (Sept. 1 to Oct. 15)	1,307	630	2,369	514	262	830
		Subtotal	1,699	959	2,821	596	331	917
		Fall (Oct. 16 to 31)		not estimated		292	91	1,089
		Total				924	546	1,778
Estimated Returns								
	1SW	Summer	693	259	1,443	1,085	236	2,781
		Fall (Sept. 1 to Oct. 15)	274	0	739	728	0	1,962
		Subtotal	997	443	1,880	1,909	794	3,891
		Fall (Oct. 16 to 31)				-	-	-
		Total	997	443	1,880	1,909	794	3,891
	MSW	Summer	1,239	519	2,614	454	39	986
		Fall (Sept. 1 to Oct. 15)	9,752	6,901	15,069	3,013	1,476	5,228
		Subtotal	11,144	8,073	16,606	3,484	1,853	5,785
		Fall (Oct. 16 to 31)				1,753	524	6,859
		Total	11,144	8,073	16,606	5,512	3,001	11,106

Table 9. Summary of monthly effort,catch and CPUE from logbook anglers on Margaree River in 1991.

Season	Month	No.	Effort Rods	Effort Hours	Grilse Kept	Grilse Rel'd	Grilse Total	Salmon Rel'd	Total Fish	Catch/Unit Effort Rods	Catch/Unit Effort Hours
Summer	June	10	60	187	0	0	0	3	3	0.050	0.016
	July	14	101	349	8	1	9	10	19	0.188	0.055
	Aug.	22	180	841	16	0	16	31	47	0.261	0.056
Sub-Total			341	1376	24	1	25	44	69	0.202	0.050
Fall	Sept.	33	217	1210	19	6	25	76	101	0.465	0.083
	Oct. 1-15	30	174	1071	6	1	7	63	70	0.402	0.065
	Oct. 16-31	9	39	217	2	2	4	19	23	0.590	0.106
	Oct. 1-31	31	213	1288	8	3	11	82	93	0.437	0.072
Sub-Total			430	2498	27	9	36	158	194	0.451	0.078
Total Season		43	771	3874	51	10	61	202	263	0.341	0.068

Table 10. Distribution of recaptures in the angling fishery by standardized week of tagging for 1SW and MSW salmon for 1991.

Gear	Start	End	Week	No. Tagged	Recaptures Index Pools	Recaptures Other Pools	Recaptures Total	Prop. Return
1SW Salmon								
Trap	06/25	07/01	26	1	0	1	1	1.00
Trap	07/02	07/08	27	7	1	0	1	0.14
Trap	07/09	07/15	28	2	0	0	0	0.00
Trap	07/16	07/22	29	12	2	1	3	0.25
Trap	07/23	07/29	30	15	1	1	2	0.13
Trap	07/30	08/05	31	31	3	3	6	0.19
Trap	08/06	08/12	32	43	6	2	8	0.19
Trap	08/13	08/19	33	29	2	1	3	0.10
Trap	08/20	08/26	34	24	1	0	1	0.04
Sub Total				164	16	9	25	0.15
Seine	08/27	09/02	35	31	6	3	9	0.29
Sub Total				31	6	3	9	0.29
Total				195	22	12	34	0.17
MSW Salmon								
Trap	06/11	06/17	24	4	0	0	0	0.00
Trap	06/18	06/24	25	1	0	0	0	0.00
Trap	06/25	07/01	26	3	1	0	1	0.33
Trap	07/02	07/08	27	2	0	0	0	0.00
Trap	07/09	07/15	28	8	1	0	1	0.13
Trap	07/16	07/22	29	15	1	3	4	0.27
Trap	07/23	07/29	30	5	0	1	1	0.20
Trap	07/30	08/05	31	52	3	2	5	0.10
Trap	08/06	08/12	32	54	3	2	5	0.09
Trap	08/13	08/19	33	27	2	0	2	0.07
Trap	08/20	08/26	34	32	3	2	5	0.16
Sub Total				203	14	10	24	0.12
Seine	08/27	09/02	35	21	1	1	2	0.10
Sub Total				21	1	1	2	0.10
Total				224	15	11	26	0.12

Table 11. Distribution of recaptures in the angling fishery by standardized week tagging group for 1SW and MSW salmon for 1991.

Gear	Week	Tagged	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	?	Total	Prop
1SW Salmon																				
Trap	26	1	1																1	1.00
Trap	27	7					1												1	0.14
Trap	28	2																	0	0.00
Trap	29	12		1	2														3	0.25
Trap	30	15	.			2													2	0.13
Trap	31	31	.	.		2		2			1				1				6	0.19
Trap	32	43	.	.	.			1	1	2	1	1		2					8	0.19
Trap	33	29	.	.	.	.		1		1	1								3	0.10
Trap	34	24	.	.	.	.	.		1										1	0.04
Sub Total		164	1	1	2	4	1	4	2	3	3	1	0	2	1	0	0	0	25	0.15
Seine	35	31	.	.	.	.	.	.	5	1				3					9	0.29
Sub Total		31	0	0	0	0	0	0	5	1	0	0	0	3	0	0	0	0	9	0.29
Total		195	1	1	2	4	1	4	7	4	3	1	0	5	1	0	0	0	34	0.17
MSW Salmon																				
Trap	24	4																	0	0.00
Trap	25	1																	0	0.00
Trap	26	3									1								1	0.33
Trap	27	2																	0	0.00
Trap	28	8												1					1	0.13
Trap	29	15	2		2														4	0.27
Trap	30	5	.										1						1	0.20
Trap	31	52	.	.	1		2				1				1				5	0.10
Trap	32	54	.	.	.				1		1		1		2				5	0.09
Trap	33	27	.	.	.	.							1		1				2	0.07
Trap	34	32	.	.	.	.	.			1		1			1		1	1	5	0.16
Sub Total		203	2	0	3	0	2	0	1	1	3	1	3	1	5	0	1	1	24	0.12
Seine	35	21	.	.	.	.	.	.						1	1				2	0.10
Sub Total		21	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	0.10
Total		224	2	0	3	0	2	0	1	1	3	1	3	2	5	0	1	1	25	0.11

Table 12. Angling catches used for estimating returns and escapements to the Margaree River, 1947-1991. Catches by season for 1SW and MSW salmon are adjusted for the unsized catches in Table 3.

Year	1SW Salmon June 1 to Aug. 31	1SW Salmon Sept. 1 to Oct. 15	1SW Salmon Oct. 16 to Oct. 31	1SW Salmon Total*	MSW Salmon June 1 to Aug. 31	MSW Salmon Sept. 1 to Oct. 15	MSW Salmon Oct. 16 to Oct. 31	MSW Salmon Total*
1947	16	20		36	156	208		364
1948	64	42		106	276	428		704
1949	26	16		42	77	263		340
1950	49	64		113	79	247		326
1951	14	8		22	187	261		448
1952	37	47		84	86	121		207
1953	28	22		50	124	174		298
1954	38	32		70	170	137		306
1955	30	23		53	100	158		258
1956	16	12		28	67	24		91
1957	15	21		36	38	98		136
1958								0
1959								0
1960								0
1961	20	13		33	35	21		56
1962	25	21		46	273	137		410
1963	23	64		87	49	163		212
1964	77	43		120	135	154		289
1965	43	43		86	89	165		254
1966	48	44		92	22	143		165
1967	48	52		100	117	154		271
1968	30	35		65	54	148		203
1969	108	110		218	77	64		141
1970	48	38		86	55	163		217
1971	13	8		21	40	54		94
1972	22	20		42	53	52		105
1973	97	69		166	69	48		117
1974	34	26		60	30	77		107
1975	14	22		36	4	60		64
1976	43	53		96	9	73		82
1977	37	32		69	53	87		141
1978	9	16		25	20	138		158
1979	538	66		604	21	62		83
1980	104	69		173	2	143		145
1981	737	172		909	29	11		140
1982	603	89		692	65	114		179
1983	38	31		69	46	106		152
1984	81	67		148	27	94		121
1985	116	107		223	144	168		313
1986	196	99		295	297	457		754
1987	306	97		403	242	561		803
1988	367	222		589	190	178		368
1989	151	57		208	152	311		463
1990 Median	203	51		256	359	1307		1699
Perc. 5	78	0		120	156	630		959
Perc. 95	383	114		449	705	2369		2821
1991 Median	221	148	0	391	78	514	292	596
Perc. 5	44	0	-	146	6	262	91	331
Perc. 95	611	407	-	842	161	830	1089	917

* Totals up to and including October 15.

Table 13. Estimates of returns, escapements, and percent of egg target met for Atlantic salmon from the Margaree River, 1947 to 1991. Eggs collected for the hatchery are removed from escapement estimates before the calculation of the percent target met.

	1SW Returns			1SW Escapement			MSW Returns			MSW Escapement			Egg Target Met by MSW			Collected
		Percentiles			Percentiles			Percentiles			Percentiles			Percentiles		for Hatchery
Year	Median	5%	95%	Median	5%	95%	Median	5%	95%	Median	5%	95%	Median	5%	95%	(eggs)*
1947	123	97	167	87	61	131	1236	981	1688	873	618	1325	9.8%	-14.8%	53.5%	5.00
1948	361	286	493	255	180	387	2397	1902	3274	1693	1198	2570	96.4%	48.6%	181.2%	4.50
1949	140	111	191	99	70	150	1130	897	1544	798	565	1212	35.4%	12.8%	75.3%	2.80
1950	378	300	516	267	189	405	1090	864	1488	770	544	1168	74.3%	52.6%	112.8%	0.00
1951	72	57	98	51	36	77	1444	1145	1972	1020	721	1548	98.5%	69.6%	149.5%	0.00
1952	283	224	386	200	141	303	695	551	949	491	347	745	47.4%	33.5%	71.9%	0.00
1953	167	132	228	118	83	179	991	786	1353	700	495	1062	67.6%	47.8%	102.6%	0.00
1954	232	184	316	164	116	248	1015	805	1386	717	507	1088	69.2%	49.0%	105.1%	0.00
1955	180	143	247	127	90	194	878	697	1200	620	439	942	52.5%	34.9%	83.5%	0.50
1956	95	76	130	67	48	102	306	243	419	216	153	329	-31.2%	-37.3%	-20.4%	3.50
1957	123	97	167	87	61	131	463	367	633	327	231	497	18.2%	8.9%	34.5%	0.90
1958																1.00
1959																0.50
1960																1.50
1961	99	78	135	70	49	106	167	132	228	118	83	179	-18.4%	-21.7%	-12.5%	2.00
1962	157	124	214	111	78	168	1396	1108	1907	986	698	1497	90.7%	62.9%	140.1%	0.30
1963	296	235	405	209	148	318	722	573	986	510	361	774	32.8%	18.4%	58.4%	1.10
1964	409	324	558	289	204	438	984	781	1344	695	492	1055	61.1%	41.5%	95.9%	0.40
1965	293	232	400	207	146	314	865	686	1181	611	432	927	50.0%	32.8%	80.6%	0.60
1966	313	249	428	221	157	336	562	446	767	397	281	602	32.4%	21.1%	52.2%	0.40
1967	334	265	456	236	167	358	902	716	1233	637	451	968	58.6%	40.6%	90.4%	0.20
1968	218	173	298	154	109	234	674	535	921	476	337	723	40.0%	26.6%	63.8%	0.40
1969	729	578	995	515	364	781	473	375	647	334	236	508	27.1%	17.6%	43.8%	0.35
1970	289	230	395	204	145	310	732	581	1000	517	366	785	46.9%	32.3%	72.8%	0.20
1971	72	57	98	51	36	77	320	254	437	226	160	343	21.1%	14.7%	32.4%	0.05
1972	143	113	195	101	71	153	358	284	488	253	179	383	22.9%	15.8%	35.5%	0.10
1973	565	448	772	399	282	606	398	316	544	281	199	427	25.7%	17.7%	39.8%	0.10
1974	204	162	279	144	102	219	364	289	498	257	182	391	24.8%	17.6%	37.7%	0.00
1975	123	97	167	87	61	131	218	173	298	154	109	234	14.1%	9.8%	21.8%	0.05
1976	327	259	447	231	163	351	279	222	381	197	140	299	19.0%	13.5%	28.9%	0.00
1977	235	186	321	166	117	252	477	378	651	337	238	511	32.5%	23.0%	49.4%	0.00
1978	85	68	116	60	43	91	538	427	735	380	269	577	35.2%	24.5%	54.2%	0.10
1979	2033	1613	2777	1436	1016	2180	276	219	377	195	138	296	18.8%	13.3%	28.6%	0.00
1980	569	451	777	402	284	610	477	378	651	337	238	511	31.0%	21.5%	47.9%	0.10
1981	3061	2428	4181	2162	1529	3282	473	375	647	334	236	508	31.5%	22.1%	48.3%	0.05
1982	2353	1867	3214	1662	1176	2523	609	484	833	430	305	654	38.6%	26.4%	60.1%	0.20
1983	232	184	316	164	116	248	507	402	693	358	253	544	33.1%	23.0%	51.0%	0.10
1984	504	400	688	356	252	540	412	327	563	291	206	442	26.6%	18.4%	41.2%	0.10
1985	838	634	1167	615	411	944	1462	1109	2217	1446	1093	2201	137.4%	103.3%	210.3%	0.15
1986	1096	838	1420	801	543	1125	3616	2738	5680	3578	2700	5642	343.3%	258.5%	542.6%	0.15
1987	1478	1143	1865	1075	740	1462	4015	2976	6540	3975	2936	6500	381.6%	281.2%	625.4%	0.15
1988	2209	1674	2911	1620	1085	2322	1688	1286	2494	1670	1268	2476	156.7%	117.9%	234.6%	0.30
1989	768	591	977	560	383	769	2289	1708	3693	2266	1685	3670	214.3%	158.2%	349.9%	0.30
1990	997	443	1880	730	315	1457	11144	8073	16606	11067	8022	16497	1062.9%	768.9%	1587.2%	0.38
1991	1909	794	3891	1507	644	3116	3484	1853	5785	3453	1836	5740	326.4%	170.2%	547.2%	0.47

* Eggs are in millions.

Table 14. Results of electrofishing surveys of Atlantic salmon juveniles at five sites on the Margaree River, July, 1991. Site locations, site #'s and analysis procedures are described in Chaput and Claytor (1989).

Tributary	Site #	Area sq. m.	# of Sweeps	Life Stage	Lgth (cm) Boundaries	Catch	Est. Population N	Est. Population Var.	90% Conf. Lower	90% Conf. Upper	Prob. Capture	Density	Mean Lgth (cm)
Big Brook	15	221.5	4	Fry	< 6.0	510	510	0.6	509	512	0.831	230.2	5.0
				Parr	>= 6.0	60	62	6.4	57	67	0.568	28.0	10.3
Forest Glen Brook	45-1	234.3	4	Fry	< 6.0	303	308	9.2	302	314	0.637	131.5	4.1
				Sm. Parr	6.0 to 9.2	132	135	6.3	130	140	0.614	57.6	7.7
				Lg. Parr	> 9.2	35	36	2.5			0.628	15.4	10.3
	45-2	387.3	4	Fry	< 6.0	186	216	144.0	192	240	0.609	55.8	4.1
				Sm. Parr	6.0 to 9.2	149	153	7.9	147	158	0.603	39.5	7.5
				Lg. Parr	> 9.2	37	38	1.9			0.645	9.8	10.3
MacFarlane's Brook	96	240.1	4	Fry	< 6.0	85	87	4.5	83	91	0.619	36.2	4.7
				Sm. Parr	6.0 to 11.2	133	134	1.4	131	136	0.737	55.8	9.7
				Lg. Parr	> 11.2	36	39	17.2			0.458	16.2	12.1
Trout Brook	98	250.8	4	Fry	< 5.5	95	106	46.6	93	120	0.431	42.3	3.9
				Sm. Parr	5.5 to 9.0	23	27	49.7			0.369	10.8	7.5
				Lg. Parr	> 9.0	20	25	76.6			0.343	10.0	10.2

Table 15. Numbers of salmon smolt and parr released to Margaree River since 1976 by parent stock origin (MAR = Margaree River, RB = Rocky Brook or Miramichi River). MAR, Rearing locations are: MAR, Margaree; COB, Cobequid; MER, Mersey.

		Smolt				Parr			
	Rearing	2+		1+		1+		0+	
Year	Location	MAR	RB	MAR	RB	MAR	RB	MAR	RB
1976	MAR	8,971							
1977	MAR					5,022			
1978	COB		15,250						
1979	COB		15,927 *						
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 @				
	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		5,400		40,000	
	COB	18,337						12,429	
1988	MAR	4,136		22,313		2,201		40,000	
	COB	12,785						6,300	
1989	MAR	2,600		13,000		10,000		150,000	
	COB	18,500						6,000	
1990	MAR	4,119		14,200		21,425		60,500	
	COB	15,976							
1991	MAR	12,100		20,000		22,000		110,000	
	COB	10,200				4,000			

* Millbank broodstock

@ MSW hatchery return broodstock collected from Margaree River and crossed with wild Margaree River salmon. The hatchery return broodstock would have been 2SW fish originating from Rocky Brook 2+ smolts released in 1981.

Table 16. Numbers of wild and hatchery salmon from summer and fall sampling on Margaree River in 1991.

Season	1SW Salmon Wild	1SW Salmon Hatchery	1SW Salmon % Wild	MSW Salmon Wild	MSW Salmon Hatchery	MSW Salmon % Wild	Percent Salmon
Summer							
June 1 - Aug. 31							
Logbook	12	12	50.0%	26	11	70.3%	60.2%
Broodstock	10	21	32.3%	59	35	62.8%	75.0%
Trapnets	137	32	81.1%	184	19	90.6%	54.5%
SCIP/Creel	35	36	49.3%	5	1	83.3%	7.7%
Sub-Total	194	101	65.8%	274	66	80.6%	53.5%
Fall							
Sept. 1 - Oct. 31							
Logbook	25	3	89.3%	99	3	97.1%	77.9%
SCIP/Creel	43	9	82.7%	16	2	88.9%	25.4%
Lake O'Law	28	6	82.4%	72	4	94.7%	68.6%
Sub-Total	96	18	84.2%	187	9	95.4%	63.1%
Total Season	290	119	70.9%	461	75	86.0%	56.7%

Table 17. Summary of tag recaptures from smolt and adult releases in the Margaree River 1986 to 1991.

Release Year	Stock	Stage	No. Tag Applied	Tag Type	Series	Greenland 1A	1B	1C	1D	1E	1F	Newfoundland 1	2	3	4	8	13	14	Quebec Q9	Total Returns
1986	Rocky Brook	2+ smolt	7311	CWT	55 0/0		2		2	3	1	1			2					11
1986	Rocky Brook	2+ smolt	3376	CWT	62 2/23															0
1986	Rocky Brook	2+ smolt	1992	CWT	62 2/25		1		1											2
1987	Lake O'Law	1+ smolt	995	CWT	55 16/7															0
1987	Lake O'Law	1+ smolt	1107	CWT	55 16/8															0
1987	Margaree River	2+ smolt	10000	CWT	55 16/16	a									1					1
1987	Margaree River	1+ smolt	8599	CWT	55 16/16	a														0
1987	Lake O'Law	1+ smolt	3080	CWT	55 16/17	a									2					2
1987	Margaree River	2+ smolt	933	Carlin	P22200-P22299															
					P22500-P23199	1	1	1												3
					P23300-P23499															0
1987	Margaree River	1SW/MSW	138	Carlin	zz23000-zz23137								1					1	2	4
1988	Margaree River	2+ smolt	4116	CWT	55 16/12															
		1SW/MSW	340	Carlin	zz23138-zz23299								2		2				1	5
					zz23401-zz23581															
1989	Margaree River	1SW/MSW	425	Carlin	zz23583-zz23999	b				1			1	3		1				6
					zz23300-zz23309															
1990	Margaree River	1SW/MSW	576	Carlin	zz23310-zz23399	c								1			1	1	2	5
					zz24000-zz24489															
1991	Margaree River	1SW/MSW	494	Carlin	zz24490-zz24799	d														
					zz24900-zz24999															
					zz35000-zz35087															

a - May also be Neisiguit River origin as same series used for those released.
b - Excluding tags zz23950 and zz23951.
c - Excluding tags zz24287, zz24443, and zz24482.
d - Excluding tags zz24510, zz24713, zz24719, and zz24763.

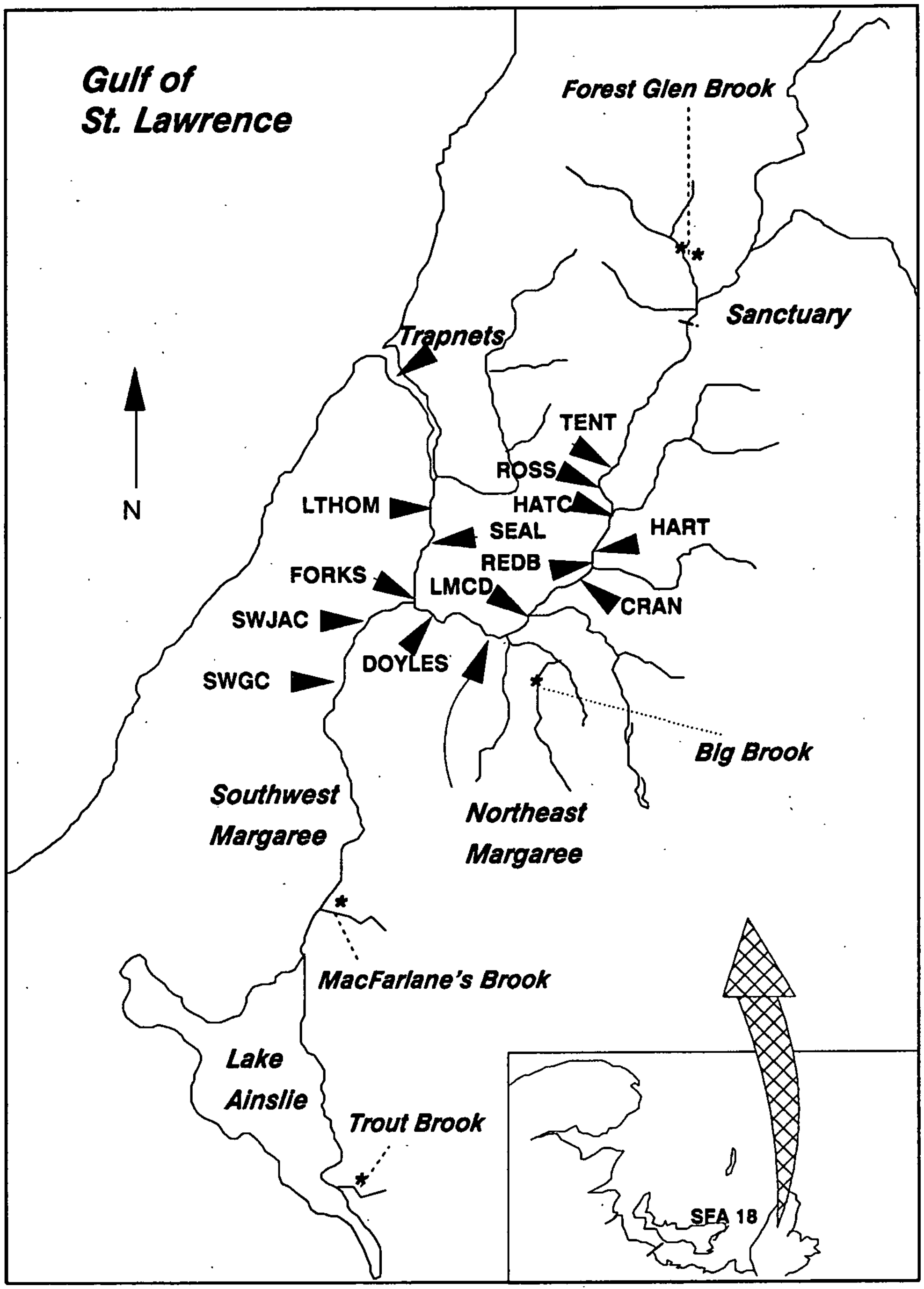

Figure 1. Margaree River, NS, showing index pool locations for 1991 creel survey, trapnet location, and electrofishing stations (*---).

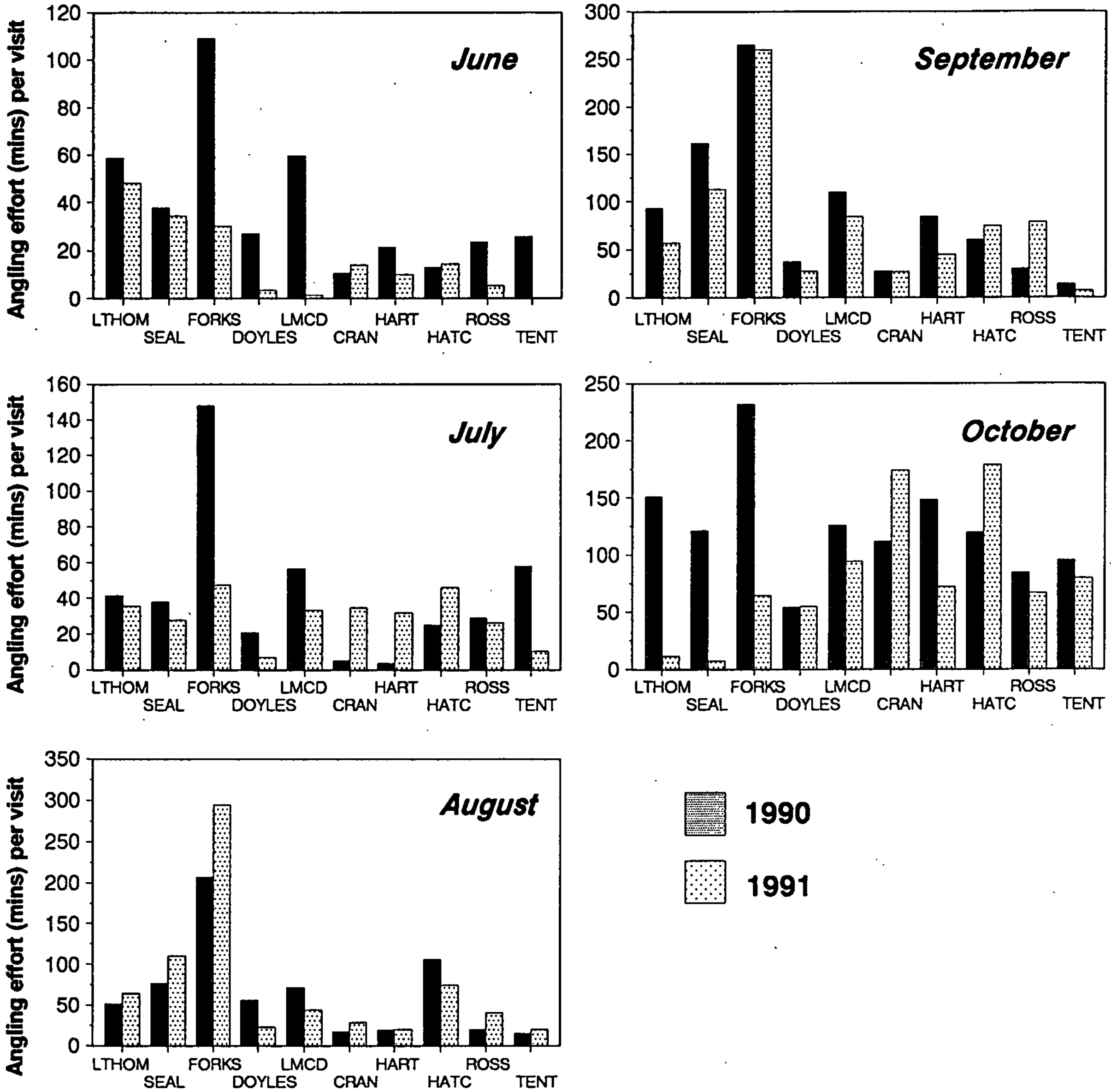

Figure 2. Angling effort (mins) per visit at the index pools by month for 1990 and 1991. One visit is equivalent to 60 mins of observation time.

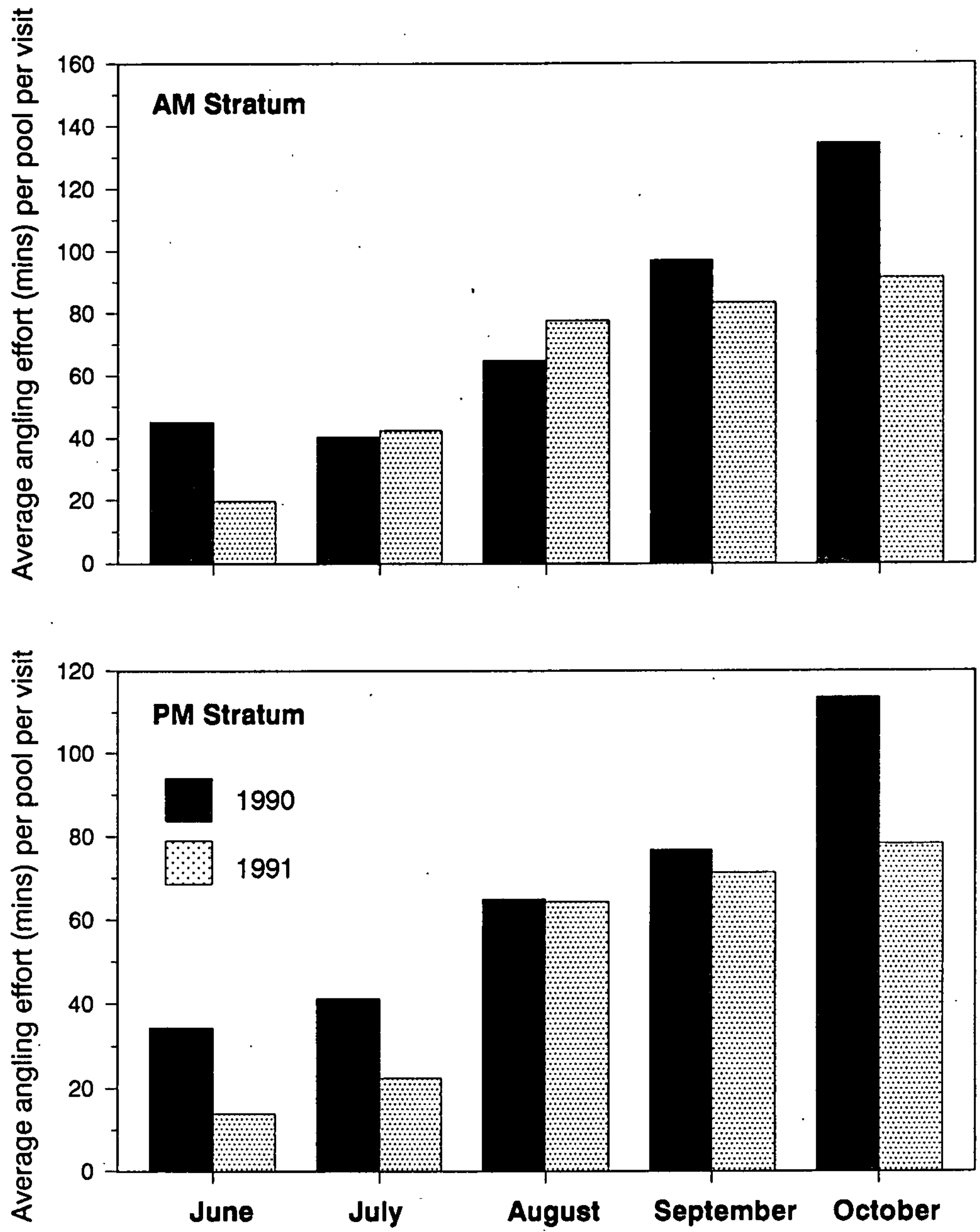

Figure 3. Comparison of AM and PM stratum angling effort by month for Margaree River, 1990 and 1991.

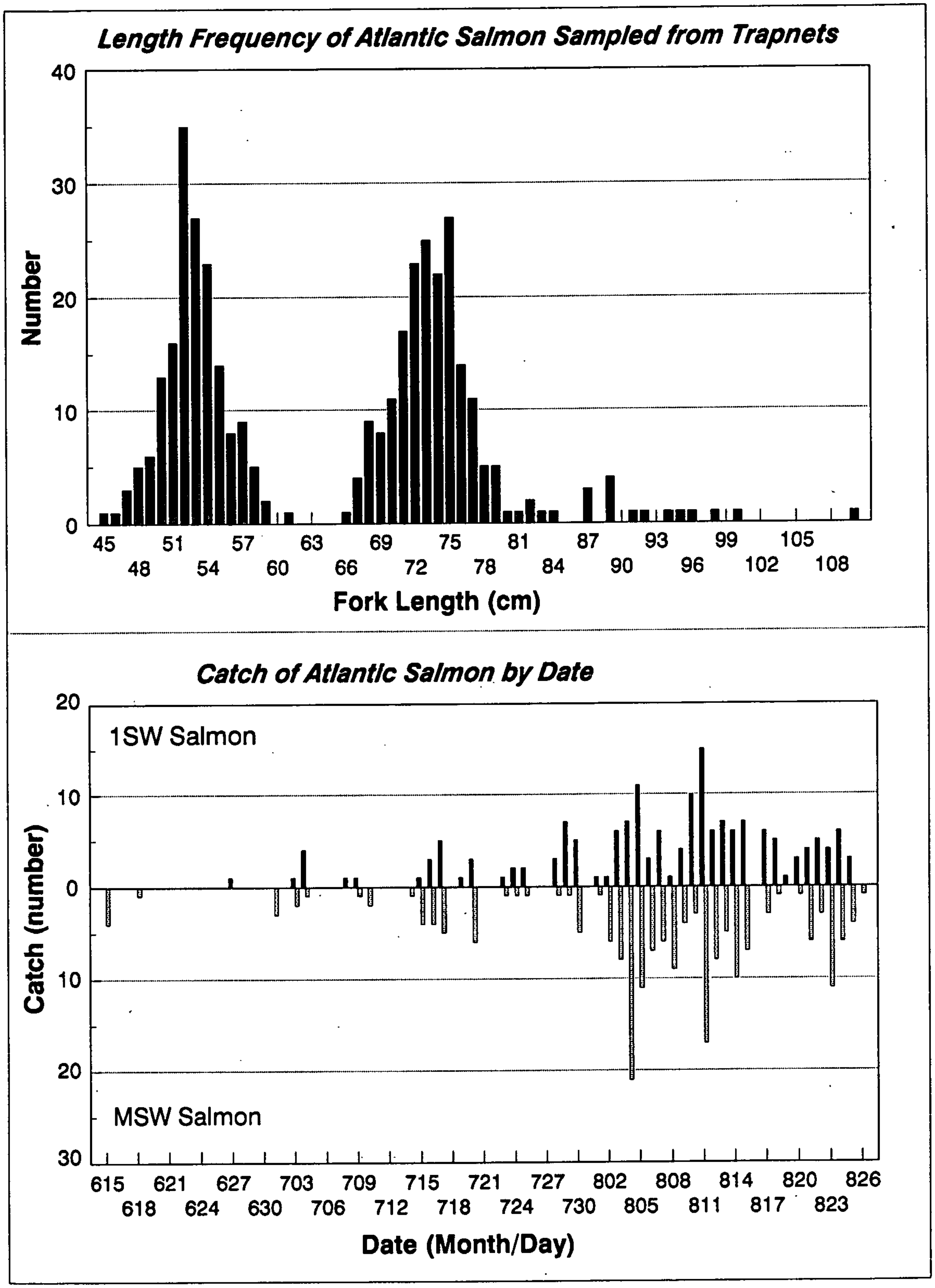

Figure 4. Length frequency distribution and timing of catches of Atlantic salmon at the trapnets on the Margaree River, 1991.

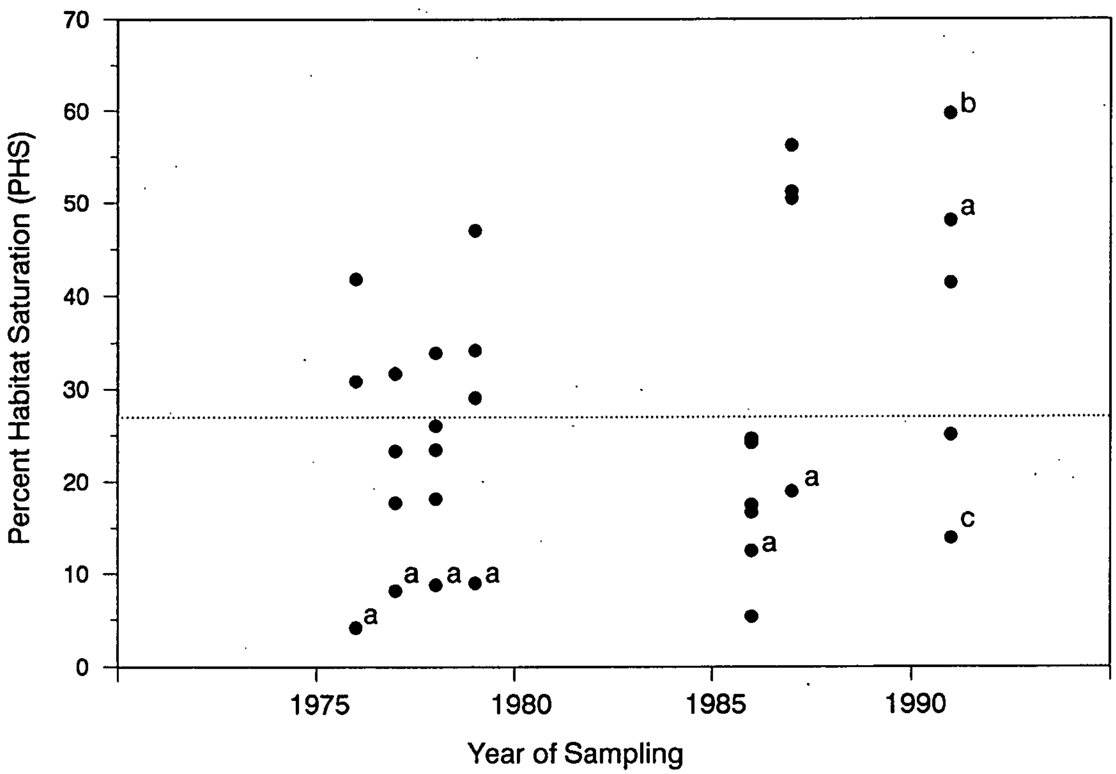

Figure 5. Grant and Kramer (1990) Percent Habitat Saturation index for Atlantic salmon juveniles from the Margaree River, 1976 to 1991. Symbols are as follows: a = Big Brook sites, b = MacFarlane's Brook site, c = Trout Brook site, and all other symbols are Forest Glen Brook sites. Dotted line denotes the 27% PHS value delimiting the inflection point in the logistic regression of density dependent effects on PHS (Grant and Kramer 1990).

APPENDIX A. Instructions for conducting the creel survey of the Margaree River Atlantic salmon recreational fishery, 1991.

The creel survey is designed as a bus route where the clerk travels along a predetermined route with prescribed stops of fixed duration at several points on the route. The direction of travel for Margaree River is in an upstream direction. There are ten (10) designated stops of fixed duration along the route:

Lower Thompkins Pool (LTHOM)	- 60 minutes
Seal Pool (SEAL)	- 60
Forks Pool (FORKS)	- 120
Doyles Bridge Pool (DOYLES)	- 60
Little McDaniel Pool (LMCD)	- 60
Cranton Bridge Pool (CRAN)	- 60
Hart Pool (HART)	- 60
Hatchery Pool (HATC)	- 60
Ross Bridge Pool (ROSS)	- 60
Tent Pool (TENT)	- 60

After Tent Pool, Lower Thompkins Pool should be sampled, etc.

The day is divided into two sampling periods (AM and PM) starting at 600 and 1330 hours and lasting 7.5 hours each. The actual start time may vary somewhat on the schedule and these start times should be respected. The clerk starts at the pool selected for that day, and stays at that pool for the indicated period of time. The actual observation of angling activity should begin at the pool exactly at the time indicated, not get out of vehicle at that time. After the required observation time for the first pool is completed, the clerk walks back to the vehicle and moves to the next pool in the sequence, in an upstream direction. The actual creel period begins when the clerk arrives at the pool where angling can be directly observed. The creel period for that pool corresponds to the creel durations indicated above.

The clerk moves through the sequence of pools until the sampling period is completed (up to 1330 for AM creels and 2100 for PM creels). The last pool sampled may only be for 15 minutes but even this period of observation should be completed.

Data to be collected at each pool:

On arrival, the clerk counts the number of anglers actually fishing and records this number with the start time on the form. As changes occur in the number of anglers, the clerk records with the corresponding change (for example, +1 or -2 designating one more angler or 2 less anglers fishing) and the time the change occurred. At the same time, fish which are hooked, lost, kept, released, etc. are recorded. The following designations should be used:

LOST - fish is hooked but unsuccessfully landed. This category includes fish which are on for 5 seconds and fish which are on for 15 minutes if the intent of the angler was to land the fish but fish broke away. This type may have a size category, grilse or MSW but more often does not.

GRILSE - KEPT - grilse which is landed and kept by the angler. Attempts should be made to look at the fish to determine if it is a wild or adipose clipped fish, if it has an external tag or if a tagging mark is present, to get length and a scale sample if possible.

GRILSE - REMOVED HOOK - grilse which is released from the hand by the angler. Should note if it is wild or adipose clipped, if external tag is present or if tagging mark is present.

APPENDIX A (Cont'd).

GRILSE - CUT LINE - grilse which is released by snapping the line, not handled on shore. Wild or probably be unknown. Tag or untagged may also be unknown.

MSW - REMOVED HOOK - Large salmon which is released by hand. Attempts should be made to determine if the fish is wild or hatchery origin, if it has an external tag or if tagging mark is present. **No scales should be collected.**

MSW - CUT LINE - Large salmon which is intentionally released by cutting or snapping the line. Wild or hatchery origin may not be evident. Presence of tag may also be unknown.

All the above activities should be noted if they occur.

APPENDIX A (cont'd).

At the end of the creel period for the pool, the number of active anglers and the time the observation period ends are recorded.

Anglers which leave the pool while the clerk is on site should be interviewed if possible. The following data should be obtained for each angler:

- time started fishing at given pool
- time finished fishing at given pool
- numbers of fish by size category lost, hooked and released, kept.
- fish which are kept should be sampled for length, scales and sex if fish is or was cleaned. Look for external tags, adipose fin clips, tagging scars below the dorsal fin, etc.
- for sampled fish, obtain angler name and address if the individual would like information of the kept fish and angling success in general on the river, to be sent at the end of the year.

For the Oct.16 to Oct. 31 creel, the following pools will be monitored:

Lower Thompkins Pool (LTHOM)	- 60 minutes
Seal Pool (SEAL)	- 60
John Archie (SWARCH)	- 30
Forks Pool (FORKS)	- 90
Gerard Chiasson (SWGCH)	- 30
Doyles Bridge Pool (DOYLES)	- 60
Little McDaniel Pool (LMCD)	- 60
Cranton Bridge Pool (CRAN)	- 60

RIVER COUNTS

Since only 10 pools are surveyed during the present creel and the Margaree River has in excess of 60 pools (historically), the effort on the entire river must be determined in order to estimate catch from the entire river. Counts of anglers are obtained at 32 pools on the river on specific days. The clerk starts at the designated pool and working in an upstream direction, counts the number of anglers at each pool and the time of observation. River counts will be obtained in AM and PM periods. No interviews are conducted but opportunistic samples of fish length, scales, tag marks, adipose clipped, etc. may be obtained if the opportunity presents itself. The counts are recorded on the special forms.

APPENDIX B. **Formulation for the estimation of the returns of Atlantic salmon to the Margaree River, 1990. Boldtype indicates parameters which changed value for every repetition.**

$$\textbf{RETURNS (1SW; MSW)} = \frac{\textbf{CATCH (1SW; MSW)}}{\textbf{EXPLOITATION RATE (1SW; MSW)}}$$

CATCH (1SW; MSW) = Catch Summer + Catch Fall

$$\text{Catch (summer; fall)} = \frac{\textbf{Est. Creel Catch from Index Pools (CCI)}}{\textbf{Proportion of Catch from Index Pools (PCI)}}$$

CCI ---> 1SW summer assumed distribution N(135, 2601)
1SW fall assumed distribution N(33, 441)
MSW summer assumed distribution N(192, 3844)
MSW fall assumed distribution N(533, 24180)

PCI ---> variability simulated using bootstrapping.
Using logbooks:

summer	N = 20	1SW prop.	27/40 =	0.68
		MSW prop.	29/55 =	0.53
fall	N = 22	1SW prop.	20/32 =	0.63
		MSW prop.	20/50 =	0.40

Using tag returns from angling fishery:

fall	1SW prop.	7/13 =	0.54
	MSW prop.	6/16 =	0.38

EXPLOITATION RATE (1SW; MSW) = **Tags Recaptured** / **Tags Available**

Estimated for fall only.
Assumed for summer, uniform distribution between 0.206 and 0.379 for both 1SW and MSW.

$$\textbf{Tags Recaptured} = \frac{\text{Tags Returned Voluntarily (1SW; MSW)}}{\textbf{Reporting Rate (RR)}}$$

Bootstrap estimates of RR for 1990 estimated from:

$$\textbf{RR} = \frac{\dfrac{\text{Tag Recaptures from Index Pools (1SW + MSW)}}{\textbf{Creel Catch Estimate at Index Pools (1SW + MSW)}}}{\dfrac{\text{Tag Recaptures by Logbook Anglers (1SW + MSW)}}{\text{Logbook Catch (1SW + MSW)}}}$$

Nonbootstrap value = (13/566) / (3/82) = 0.62

Note: Logbook catch of 82 is updated value from that reported by Chaput and Jones (1991).

Tags Available (1SW; MSW) = Tags Placed X **Proportion Retained(PR)**

PR = 1 - (Tag Loss Rate) X **Median Days to Recapture**

In 1990, tag retention experiment was performed. Of 18 fish marked and held for 21 days, 5 tags had been shed. Tag loss rate (per day) = 0.013.

Recapture data is bootstrapped to obtain median days to recapture.
1SW Recaptures: N = 13, Range 1 to 25 days, Median = 4 days
MSW Recaptures: N = 17, Range 0 to 20 days, Median = 6 days

APPENDIX B (cont'd).

Note: In the 1990 assessment, mean days to recapture were used (Chaput and Jones 1991)
1SW: Mean = 10.9 days
MSW: Mean = 7.7 days

SUMMARY EQUATION

$$\text{RETURNS (1SW; MSW)} = \frac{\text{CCI (Summer)}}{\text{ER (Summer)} \times \text{PCI (Summer)}} + \frac{\text{CCI (Fall)} \times \text{Tags Placed} \times \text{PR} \times \text{RR}}{\text{PCI (Fall)} \times \text{Tags Returned Voluntarily}}$$

Solve RETURNS a large number of times to generate the distribution from which the Confidence Limits can be determined.