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# Assessment of the Atlantic salmon (*Salmo salar*) stock of the Margaree River, Nova Scotia, 1993

by

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[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte Atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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## ABSTRACT

Mark/recapture methods were used to estimate the returns of small and large Atlantic salmon (*Salmo salar*) to the Margaree River. The returns of large salmon in 1993 were estimated at 3,300 fish, about half the 1992 return of 6,375 fish. Small salmon returns in 1993 were estimated at 2,079 fish, up from the 1992 return of 1,645. The differences in the estimated returns in 1992 and 1993 correspond to the trend in the angling catches and the abundance indices based on angling catch per unit effort from license stub returns and from angler logbooks. The exploitation rate on small salmon in the angling fishery was at least 27% and was higher on hatchery origin fish, 40%, as compared to wild origin small salmon (21%). Exploitation rates on large salmon were lower, 10% for the year, but hatchery large salmon were exploited at twice the rate of wild origin large salmon (17% versus 9% respectively). Egg depositions by large salmon in 1993 equalled 294% of the conservation target of 6.7 million eggs. The target egg deposition has been exceeded every year since 1985 and juveniles continued to be very abundant at the annually sampled sites. Returns of large salmon in 1993 were 25% below the forecasted return derived from a stock and recruitment relationship. The forecasted return of large salmon in 1994 is 4,293 fish, with a 95% probability that the returns will be at least 3,324 fish, more than three times the target spawner requirement for the river.



## RESUME

Des méthodes de marquages-captures ont servi à l'estimation des retours de petit et grand Saumon atlantique (*Salmo salar*) à la rivière Margaree. Les retours de grand saumon en 1993 étaient 3 300 poissons, seulement la moitié de la remontée de 6 375 poissons en 1992. Les retours de petit saumon en 1993 ont été estimés à 2 079 poissons, une légère augmentation de la remontée de 1 645 poissons en 1992. Ces différences dans les retours de poissons en 1992 et 1993 correspondent aux tendances observées dans les prises sportives, et dans les indices d'abondances des captures par unité de l'effort de pêche provenant des rapports de pêche et des carnets de pêche. Le taux d'exploitation de petit saumon dans la pêche sportive était au moins 27%. Les poissons élevés en pisciculture ont subit un taux d'exploitation élevé, 40%, par rapport à ceux d'origine sauvage, 21%. Le taux d'exploitation de grand saumon était inférieur à celui de petit saumon, se situant à 10% sur toute l'année. Mais comme chez le petit saumon, le taux d'exploitation des poissons élevés en pisciculture était près de deux fois supérieur à celui des poissons sauvages (17% comparativement à 9%). Les survivants de la remontée de grand saumon ont déposé 294% du niveau cible d'oeufs de 6,7 million. Le niveau cible a été surpassé chaque année depuis 1985. Les juvéniles, échantillonnés à quelques sites chaque année, sont toujours très abondants. La remontée de grand saumon en 1993 était inférieure de 25% à la prévision obtenue avec une relation stock et recrutement. La prévision pour 1994 se situe à 4 293 grand saumon avec une probabilité à 95% d'observer une remontée d'au moins 3 324 poissons. Cette remontée est plus de trois fois le niveau cible de géniteurs pour la rivière Margaree.

## INTRODUCTION

Annual assessments of the Atlantic salmon (*Salmo salar*) stock of the Margaree River, Nova Scotia have been prepared since 1985. All the assessments prior to 1992 are published in the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) research document series (Gray and Chadwick 1984; Claytor and Chadwick 1985; Claytor and Léger 1986; Claytor et al. 1987; Claytor and Chaput 1988; Claytor and Jones 1990; Chaput and Jones 1991, Chaput et al. 1992). The assessment of the 1992 returns was published in the Dept. of Fisheries and Oceans Atlantic Fisheries Research Document series (Chaput et al. 1993).

The Margaree River is situated in Cape Breton Island, Inverness County, Nova Scotia (Statistical District 2, Salmon Fishing Area 18) (Fig. 13). 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. The Margaree River salmon has traditionally been considered as having two run components, an early or summer run and a fall or late run.

The following terms are used in the document:

Small Salmon: adult salmon of fork length less than 63 cm. Generally referred to as grilse. Usually salmon which have spent only one winter at sea. May contain some previous spawning salmon.

Large Salmon: adult salmon of fork length greater than or equal to 63 cm. Generally referred to as multi-sea-winter salmon. Contains varying proportions of one-sea-winter, two-sea-winter and three-sea-winter maiden (first time) spawners as well as previous spawners.

Hatchery Salmon: salmon which are known to have been artificially incubated in the hatchery, stocked back to the river at various life stages and identified as such by the clipped adipose fin. In recent years,all hatchery fish have been marked with an adipose fin clip.

Wild Salmon: salmon which originated from eggs spawned in the river itself and are identified by the presence of the adipose fin.

Early versus Late

Early: refers to the time period from the spring up to and including Aug. 31.
Late: after Aug. 31.

This stock status report consists of the following sections:

1 - an accounting of the harvests and total removals by size group, by origin (hatchery or wild progeny), by user group and by time of year,
2 - a description of the environmental conditions in 1993 which would have affected the run-timing and the intensity of the migrations into the river,
3 - an estimate of the total returns of small and large salmon to the river by origin,
4 - an estimate of the escapement and egg depositions in 1993,
5 - escapement and egg depositions relative to the target spawning requirement, and
6 - a forecast of potential returns of salmon for 1994.

Indices of abundance based on harvest rates are compared to the estimates of returns. Trends over time in the estimated spawning escapement are compared to indices of escapement at a counting fence and to relative abundance indices of juvenile salmon. The assessment of absolute returns, composition of the returns, and the relative exploitation rates in the recreational fisheries are based on the capture and marking of salmon in the estuarine trapnets.

Input from industry, user groups and other government agencies was obtained during a stock assessment workshop, the minutes are provided in Appendix A. Minutes from the peer review held on Feb. 11 are provided in Appendix B. A summary sheet of the status of the Atlantic salmon stock of the Margaree River is also provided (Appendix C).

## 1 - Harvests, Total Removals

### Management Regulations

Atlantic salmon were harvested by two user groups in 1993; First Nations food fisheries and recreational fisheries. Other removals of Atlantic salmon included broodstock collections and incidental mortalities at the tagging trapnets.

For the first time, an Aboriginal Food Fishery agreement was signed with the Wagmatcook First Nation for the harvesting of Atlantic salmon in the Margaree River. Harvests were to be taken with trapnet(s) with the following allocation by size group:

| | Small Salmon | Large Salmon |
|---|---|---|
| Allocation | 70 | 130 |

Other agreements were initiated late in the year with other First Nations on Cape Breton Island.

There were no significant changes in recreational fishery regulations in 1993 relative to 1992. Daily limits of 2 small salmon kept (<63cm fork length) and a maximum of 8 kept

for the year remained in place. The angling season was as in the previous three years, June 1 to Oct. 31.

**Aboriginal Food Fisheries**

Aboriginal Food Fishery harvests by the Wagmatcook First Nation at the food fishery trapnet in 1993 were 8 small salmon and 58 large salmon (Table 1). All the harvests were taken between Oct. 2 and 19, except for 2 small salmon which were removed in Aug. 16 & 17 from the index trapnet. There were releases of salmon from the food fishery trapnet, mostly previously Carlin-tagged salmon, totalling 8 large and 5 small salmon.

**Recreational Fisheries**

Recreational fishery catches are available from two sources: DFO Conservation and Protection Officers (DFO C&P), and from Nova Scotia licence stub returns (STUBS). Each source has its strengths. The DFO C&P data are considered incomplete because of other duties which the officers must fulfil, mostly night patrols and other fisheries enforcement activities. The data set does provide an indication of the timing of the catches, the location of the catches and has been collected annually since 1947 (Chaput and Claytor 1988). Since 1991, hook and release estimates for large salmon have not been collected. License stub returns are collated by DFO Scotia-Fundy (O'Neil et al. 1991). These statistics have been collected since 1984 and cover the entire fishery. It is possible to get a seasonal breakdown of the small salmon catches but not of the large salmon hook and release. There is some concern about the validity of the stub return data especially for large salmon hook and release estimates (Claytor and O'Neil 1990).

Between 1987 and 1992, DFO Science Branch conducted creel surveys of the Atlantic salmon fishery of the Margaree River to obtain independent estimates of catches. For those years, angling catches were used to estimate returns. No creel survey was conducted in 1993.

Since 1991, a volunteer salmon check-in program (SCIP) has been conducted for the registration of harvested small salmon at one of five stations on the Margaree River. The objective of the program was primarily to introduce the concept of catch registration in the Margaree River Atlantic salmon fishery. The number of small salmon registered and the number of participants over the three year period are as follows:

| | Salmon Registered | Anglers Registering |
|---|---|---|
| 1991 | 103 | 59 with addresses |
| 1992 | 102 | 41 with addresses |
| 1993 | 128 | 48 with addresses |

Harvests and trends over time

The preliminary estimated catch of small salmon in 1993 is:

272 DFO C&P (Table 2)
735 NS License Stub (Table 3).

The catches as reported from both sources are similar to the previous 5-year average estimated catches (Tables 2, 3) and have been consistent over the last five years with a coefficient of variation of 34.6% for DFO and 15.2% for license stubs data.

The preliminary large salmon hook and release estimate for the Margaree River in 1993 is 1,051 fish, down 46% from 1992 and down 40% from the previous 5-year average (Table 3). Previous catches of large salmon have been fairly consistent with a coefficient of variation of 10.3%.

The estimated effort for the Margaree River in 1993 is about 15,700 rod-days, up slightly from 1992 and up 13% from the previous 5-year average effort (Table 3).

Catch-per-unit-effort

The relative abundance of salmon over time can be inferred from the catch-per-unit of effort (CPUE) in the recreational fishery. There are two sources of data available: the catch and effort from the license stub database (Table 3) and the catch and effort data from the volunteer angler logbooks for the Margaree River (Table 4). These are summarized below and in Figure 1.

| | | Effort (Rod-days) | | Small Salmon Catch | | Small Salmon CPUE | | Large Salmon Catch | | Large Salmon CPUE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Season | Year | Logs | Stub | Logs | Stub | Logs | Stub | Logs | Stub | Logs | Stub |
| Summer | 1988 | 308 | | 32 | | 0.104 | | 60 | | 0.195 | |
| | 1989 | 433 | | 31 | | 0.072 | | 34 | | 0.079 | |
| | 1990 | 428 | | 42 | | 0.098 | | 55 | | 0.129 | |
| | 1991 | 347 | | 26 | | 0.075 | | 45 | | 0.130 | |
| | 1992 | 464 | | 44 | | 0.095 | | 63 | | 0.136 | |
| | 1993 | 491 | | 47 | | 0.096 | | 29 | | 0.059 | |

| | | Effort (Rod-days) | | Small Salmon Catch | | Small Salmon CPUE | | Large Salmon Catch | | Large Salmon CPUE | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Season | Year | Logs | Stub | Logs | Stub | Logs | Stub | Logs | Stub | Logs | Stub |
| | | | | | | | | | | | |
| Fall | 1988 | 205 | | 23 | | 0.112 | | 47 | | 0.229 | |
| | 1989 | 171 | | 5 | | 0.029 | | 42 | | 0.246 | |
| | 1990 | 387 | | 32 | | 0.083 | | 50 | | 0.129 | |
| | 1991 | 441 | | 35 | | 0.079 | | 158 | | 0.358 | |
| | 1992 | 461 | | 35 | | 0.076 | | 141 | | 0.306 | |
| | 1993 | 376 | | 16 | | 0.043 | | 46 | | 0.122 | |
| | | | | | | | | | | | |
| Season | 1988 | 513 | 14042 | 55 | 879 | 0.107 | 0.063 | 107 | 1932 | 0.209 | 0.138 |
| | 1989 | 604 | 13234 | 36 | 561 | 0.060 | 0.042 | 76 | 1570 | 0.126 | 0.119 |
| | 1990 | 815 | 14072 | 74 | 649 | 0.091 | 0.046 | 105 | 1507 | 0.129 | 0.107 |
| | 1991 | 788 | 13432 | 61 | 752 | 0.077 | 0.056 | 203 | 1757 | 0.258 | 0.131 |
| | 1992 | 925 | 14909 | 79 | 678 | 0.085 | 0.045 | 204 | 1938 | 0.221 | 0.130 |
| | 1993 | 867 | 15682 | 63 | 735 | 0.073 | 0.047 | 75 | 1051 | 0.087 | 0.067 |

The total season CPUE for small salmon whether logbooks or license stubs has not changed between 1988 and 1993. On the other hand the large salmon CPUE from logbooks in 1991 and 1992 is twice the value of three other years, including 1993.

There are some consistent trends, regardless of the year:

1 - CPUE of small salmon over the entire season has not varied between years,

2 - CPUE of small salmon in summer and fall are generally similar, except for 1993,

3 - CPUE for large salmon has varied more between years than that of small salmon, 1993 has been less than the previous two years, and

4 - CPUE for large salmon in the fall is higher than in the summer, consistently for all years, except for 1990.

The CPUE from license stubs has tended to vary less than that for logbooks. This may be the result of changes in logbook participants from year to year. Consistent participation (in the last 3 years) was obtained from 15 angler volunteers and their catch and effort data are summarized below:

| Using Consistent Logbook Volunteers (N=15) | | | | | | Catch-per-Unit-Effort | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Effort | | Catches | | Small | | Large | |
| Season | Year | Rods | Hours | Small | Large | Rods | Hours | Rods | Hours |
| | | | | | | | | | |
| Summer | 1991 | 176 | 634 | 13 | 22 | 0.074 | 0.021 | 0.125 | 0.035 |
| | 1992 | 201 | 874 | 17 | 18 | 0.085 | 0.019 | 0.090 | 0.021 |
| | 1993 | 199 | 863 | 22 | 12 | 0.111 | 0.025 | 0.060 | 0.014 |
| | | | | | | | | | |
| Fall | 1991 | 242 | 1331 | 18 | 93 | 0.074 | 0.014 | 0.384 | 0.070 |
| | 1992 | 192 | 1135 | 15 | 42 | 0.078 | 0.013 | 0.219 | 0.037 |
| | 1993 | 169 | 864 | 7 | 26 | 0.041 | 0.008 | 0.154 | 0.030 |
| | | | | | | | | | |
| Season | 1991 | 418 | 1965 | 31 | 115 | 0.074 | 0.016 | 0.275 | 0.059 |
| | 1992 | 393 | 2009 | 32 | 60 | 0.081 | 0.016 | 0.153 | 0.030 |
| | 1993 | 368 | 1727 | 29 | 38 | 0.079 | 0.017 | 0.103 | 0.022 |

The "dedicated" logbook angler data differ from that of all the logbook reports analysis in that the CPUE for large salmon is much higher in 1991 than in the two recent years, the analysis with all the logbooks indicated that 1991 and 1992 were similar (see previous text table). The second point is that the difference between 1992 and 1993 is not as dramatic, 1993 is less than 1992 for summer, fall and all season by about 1/3 rather than 1/2 as noted with the all-logbooks analysis. Both groups of logbooks however indicate that abundance was down in 1993 relative to 1991 and 1992.

Composition of the angling Catch - wild and hatchery components

Hatchery and wild proportions in samples collected throughout the river in 1993 are summarized in Table 5. The angling catches of both small and large salmon in 1993 were composed of both wild and hatchery origin salmon. The relative proportion of each group in the catches is determined from the logbook reports (Table 5). In 1993, the small salmon catch in the summer was composed of 56% wild salmon, fall catch was 87% wild fish. Large salmon catches were 85% wild in the summer, 93% wild in the fall. Over the whole season, the small salmon catch was considered to have been 64% wild small salmon and 90% wild large salmon. These proportions are similar to the previous five-years (Table 6).

The proportion of wild small salmon reported at the SCIP stations was lower than from logbooks, 39% wild in the summer reports, 79% wild for the fall reports. The pools where fish are angled are expected to affect the proportion of wild and hatchery salmon available for angling. The catches from the SCIP reports were angled in 28 pools, of which the following were dominant; Seal Pool at 14.0% of reports, Forks at 13.8%, Hatchery Pool at 11.6% and Swimming Hole/Little McDaniel at 11.0%. Catches of small salmon from the logbooks were reported from 21 pools of which Forks Pool was dominant at 19.4% of the catch followed by Seal Pool at 9.7%. Since the largest proportion of stocking of hatchery progeny occurs in the Northeast Branch, hatchery returning fish would be expected to accumulate in the Northeast Branch pools while the wild salmon would distribute themselves into the Northeast and the Southwest. Forks and Seal pools are two major pools below the confluence of the Northeast and Southwest branches of the Margaree while Hatchery Pool is the pool immediately adjacent to the hatchery and Swimming Hole/Little McDaniel are pools directly below the outlet of Lake O'Law Brook. Atlantic salmon are cage-reared in Lake O'Law and smolts have been released from the cages into Lake O'Law Brook. These two pools would be good candidates for the retention of hatchery returning adults.

Exploitation rates and timing of harvests

Recreational fisheries harvested from both the early and late portions of the run. In previous years, the greatest proportion of the small salmon catch was taken before Sept. 1 while the large salmon hook and release catches were greater after Sept. 1 (Chaput et al. 1993). The return rate of tags by anglers is used as an index of the relative exploitation rate in the recreational fishery. The return rates in this case refer to the proportion of the tags available for angling which are recaptured and returned to DFO by all sources; mail, at SCIP stations or logbooks.

The relative exploitation rate on small salmon remains higher than on large salmon. In 1993, 27% of the small salmon tags were returned as compared to 10% of the large salmon tags (Table 7). In 1992, similar rates of returns were noted, 21% for small salmon, 10% for large salmon (Chaput et al. 1993).

Exploitation was high on the early-run tag groups, especially for small salmon where 48% of tags placed on the June fish were returned and 35% of the August tags were returned (Table 7). For large salmon, 14% of both June and July tags were returned, the rate dropping to 10% or less for the other months. This pattern of heavier exploitation on the early-run fish was also noted in 1991 and 1992 (Chaput et al. 1992, 1993). Salmon from the summer tagging groups were angled almost equally in both summer and fall angling periods, as in 1991 and 1992 (text table below).

The exploitation rate on hatchery small salmon was always higher and generally twice as high as on wild small salmon, especially for those from the summer-run. The exploitation on hatchery large salmon was higher in 1993 than on wild salmon but this was not the case in 1992 (text table below).

| Small Salmon | | Tagged in summer | | Tagged in fall | Total for the Year |
|---|---|---|---|---|---|
| Recovered in -->> | | Summer | Fall | Fall | |
| Origin | Year | | | | |
| *Wild* | 1991 | 7% | 15% | - | - |
| | 1992 | 6% | 23% | 18% | 19% |
| | 1993 | 12% | 22% | 19% | 21% |
| *Hatchery* | 1991 | 16% | 23% | - | - |
| | 1992 | 29% | 48% | 23% | 34% |
| | 1993 | 38% | 41% | 0% | 40% |

| Large Salmon | | Tagged in summer | | Tagged in fall | Total for the Year |
|---|---|---|---|---|---|
| Recovered in -->> | | Summer | Fall | Fall | |
| Origin | Year | | | | |
| *Wild* | 1991 | 2% | 7% | - | - |
| | 1992 | 4% | 10% | 10% | 10% |
| | 1993 | 5% | 12% | 5% | 9% |
| *Hatchery* | 1991 | 21% | 58% | - | - |
| | 1992 | 0% | 6% | 8% | 7% |
| | 1993 | 0% | 17% | 17% | 17% |

This higher exploitation rate on hatchery salmon is important when considering the hatchery and wild proportions in the angling catches as compared to the returns to the river. It is also important in terms of the absolute contributions of hatchery return salmon to the river escapement. Similarly, the heavier exploitation on summer-run wild fish as compared to fall-run fish results in proportionally lower escapements of summer salmon and this may be limiting the recruitment of summer run fish more than ecological factors such as competition on spawning grounds and competition among juveniles.

**Other Removals**

Broodstock Collection

Broodstock from the Margaree River were collected on August 11, 1993 from Hatchery Pool and McKenzie Pool in the sanctuary area. The removals were as follows:

| | Large Salmon | Small Salmon |
|---|---|---|
| Male - Wild | 6 | 3 |
| Male - Adipose clipped | 2 | 1 |
| Female - Wild | 12 | 1 |
| Female - Adipose clipped | 8 | 0 |
| Total | 28 | 5 |

These salmon represent a total removal of 90,000 eggs. Removals in the last 5 years have averaged about 310,000 eggs.

Incidental Mortalities and Other Removals

There were 2 incidental mortalities of small salmon at the tagging trapnets in 1993 but no large salmon mortalities occurred.

Other known losses include apprehensions and confiscations of salmon by Conservation and Protection officers (Wes Barrington, pers. comm.) including:

| | Number | Weight (est.) |
|---|---|---|
| Large Salmon | 3 | 15 kg |

**2 - Environmental Conditions in 1993**

Daily discharge values of the Northeast Margaree River are obtained at a gauging station, maintained by Environment Canada, situated about 10 km upstream of the confluence of the Northeast and Southwest branches. The monthly discharge levels in the Margaree in 1993 were generally lower relative to the long-term median values (1918-1991). Water levels were above normal in August but remained lower than normal in the fall, especially in September (Fig. 2). During 1992, the monthly water discharges were quite different; about 50% lower in August and September (Fig. 2).

The analysis of the catches of salmon at the trapnets relative to season, discharge levels, water temperature and other environmental factors are in the preliminary stage but the relationship between discharge levels and catches at the trapnets appears well-defined in both the early and late portions of the run.

Timing of Trapnet Catches

The timing of the catches at the tagging trapnets was different again in 1993. Almost 50% of the large salmon catch for the year occurred before Sept. 1 (Fig. 3, 4). This contrasts with the returns in 1992 when 80% of the salmon were sampled after Sept. 1 (Fig. 4). The highest daily catch of large salmon at the index trapnet occurred on July 19 in 1993 (32 fish), the second largest catch was on Oct. 10 (26 fish). In 1992, the highest daily catch of large

salmon at the index trapnet was recorded on Oct. 4 (57 fish) with catches greater than 30 fish on 5 other days in the fall of 1992. Small salmon migration in 1993 and 1992 was similar to that of the large salmon (Fig. 3).

Return-timing of hatchery salmon

There were few (N=15) adipose-clipped (hatchery) large salmon sampled at the index trapnet in 1993 and 75% of these had been sampled before the end of July (Fig. 5). This differs from the migration of adipose-clipped large salmon in 1992 which was more evenly distributed over the entire season, less than half of the total sampled catch (N=37) had entered before Sept. 1 (Fig. 5). The returns of adipose-clipped small salmon was also much earlier in 1993 as compared to 1992; 80% of the total 1993 return had been sampled by the end of July in contrast to only 50% by Sept. 1 in 1992 (Figure 5). The largest daily catch of both size groups in 1993 occurred on July 19.

## 3 - Estimation of Returns

### Methods

Total returns of small and large salmon are estimated using mark/recapture methods. Tagging and sampling of salmon occurred at trapnets located in tidal waters. The upriver trapnet (referred to as Levis trapnet) was situated about 0.5 km above the East Margaree Bridge, and the lower trapnet about 1.5 km below the bridge. The Levis trapnet is treated as the index trap and tagging at the lower trapnet with subsequent recaptures at the Levis trapnet is used for calibration. Other recapture gears which are used to calibrate the trapnet and to estimate the returns to the river include catch and recapture data from the volunteer angler logbooks and data from the Lake O'Law counting fence.

The large salmon returns are estimated directly from tagging and recapture data. Small salmon returns are also estimated with tag and recapture data as well as from the large salmon return estimate factored by the ratio of large to small salmon at the index trapnet.

Tagging Trapnets

The trapnet fishing dates were as follows:

Index trapnet (Levis): June 14 to October 18 (washout between Aug. 6 and 16)
Lower trapnet: June 22 to October 18 (washout between Aug. 6 and 9).

Small and large salmon were sampled, marked and released at both trapnets:

| | Small Salmon | | Large Salmon | |
|---|---|---|---|---|
| | Catch | Tagged | Catch | Tagged |
| Index trapnet: | 165 | 159 | 262 | 242 |
| Lower trapnet: | 88 | 80 | 122 | 120 |

Recoveries of Tagged Salmon

Tagged salmon were recovered in the recreational fisheries (Table 7), during broodstock seining, and at the Lake O'Law counting fence. The recaptures from the logbook anglers, at the index trapnet and at the counting fence were used to calibrate the index trapnet and to provide estimates of returns. The following data were used:

| | Small Salmon | | Large Salmon | |
|---|---|---|---|---|
| | Catch | Recaptures | Catch | Recaptures |
| Recoveries at Index trapnet of Lower trapnet tags | 165 | 3 | 262 | 10 |
| Broodstock seining (Aug. 11) | 19 | 1 | 48 | 6 |
| Lake O'Law counting fence | 30 | 3 | 58 | 6 |
| Logbook Anglers | 63 | 11 | 71 | 11 |

Logbook catch includes only handled fish (kept or removed hook releases), releases designated as cut line fish were excluded.

Estimation of Returns

The estimation of returns using mark/recapture methods is based on calculating the efficiency of the recapture gear (Ricker 1975):

$$u = R / M$$

where $u$ = rate of exploitation or efficiency of the gear
R = number of marks recaptured
M = number of marks available for recapture.

A consistent estimator of the population size (N) is:

$$N = C/u$$

where N = population size
C = sampled catch
$u$ = exploitation rate (from above).

When R and M are substituted for $u$, we obtain the following relationship known as the Petersen population estimate (Ricker 1975):

$$N = C * M / R.$$

. Estimates of the confidence intervals of N can be obtained by resampling from the observed data especially when there is uncertainty in some of the parameters, either sampled catch (C), marks available (M) or recaptures recorded (R) (Chaput 1992). Two of the more important uncertainties are tag loss (affects marks available) and misreporting of marks (affects recaptures). When all the parameters are known without error, such as at the index trapnet where every fish is sampled (C is known) and examined for tags and tagging scars (M is known, assuming no tagging mortality), then the confidence intervals for N can be obtained directly using the Bayes algorithm (Gazey and Staley 1986) which assumes that the probability of recaptures follows a binomial distribution.

$$P(N_i \mid R) = \frac{P(R \mid N_i)}{\sum_{i=1}^{K} P(R \mid N_i)}$$

We have assumed that there is no tagging mortality and that all tag loss can be monitored at the index trapnet and the counting fence. Tag loss for recoveries in the logbook fishery is estimated using the tag loss rate from the 1992 (Chaput et al. 1993) and 1993 tag retention experiments and the median days to recapture of tagged large salmon in the angling fishery. The following table summarizes the calculation of the tags lost and the tags available for each trapnet in 1992 and 1993.

| Year | Trapnet | Marks | Tag Lose Rate | Median Days | Tags Lost | Tags Available |
|---|---|---|---|---|---|---|
| 1993 | Lower | 120 | 0.011 | 46.5 | 61 | 59 |
| | Index | 242 | 0.011 | 11 | 29 | 213 |
| | Both | 362 | 0.011 | 29 | 115 | 247 |
| 1992 | Lower | 265 | 0.009 | 10.5 | 25 | 240 |
| | Index | 577 | 0.009 | 10 | 52 | 525 |
| | Both | 842 | 0.009 | 10 | 76 | 766 |

Median days to recapture were very different in 1993 for tags placed at the lower net relative to tags placed at the index net. The effect of a long time-at-large before recapture is to substantially reduce the tags available, by half for lower net tags in 1993.

**Returns of Large Salmon to the Margaree in 1993**

The raw data inputs are summarized in the text table below. The estimated returns to the estuary, up to and including Oct. 18, 1993 are 3,150 salmon (95% C.I. of 2,200 to 6,650) (Fig. 6). There is a greater than 97% probability that the returns were at least 2,100 large salmon and a 50% chance that the returns were greater than 3,550 fish (Fig. 6). The returns to the end of the year, based on logbook reports and the counting fence data, are estimated at 3,300 salmon with a 95% probability that the returns were greater than 2,350 salmon and a 50% chance that the returns were greater than 3,650 fish (Fig. 6). The efficiency of the index trapnet is estimated at 8.3% when calibrated with the lower trapnet tag recoveries and 7.9% based on the logbook and counting fence calibration. The combined fence and logbook estimate is obtained using the Bayes algorithm and gives equal weight to both samples. The results are summarized in the following table.

| | Marking Data | | Recapture Data | | | Population | | |
|---|---|---|---|---|---|---|---|---|
| Year | Gear | Marks Placed | Gear | Marks | Total Catch | Number of Fish | Up to | Index Trap Efficiency |
| 1993 | Lower Trap | 120 | Index Trap | 10 | 262 | **3,150** | Oct. 18 | 8.3% |
| | Index | 242 | O'Law Fence | 4 | 58 | 3,500 | Nov. 15 | 7.5% |
| | Index | 213 | Logbooks | 5 | 71 | 2,965 | Oct. 31 | 8.8% |
| | Index | 242 | Fence + Logs | 9 | 129 | **3,300** | | 7.9% |
| 1992 | Lower Trap | 171 | Index Trap | 29 | 590 | **3,472** | Oct. 12 | 17.0% |
| | Index | 577 | O'Law Fence | 5 | 58 | 6,758 | Nov. 15 | 8.7% |
| | Index | 525 | Logbooks | 16 | 189 | 6,230 | Oct. 31 | 9.5% |
| | Index | 577 | Fence + Logs | 21 | 247 | **6,375** | | 9.3% |

A revisit of the 1992 data and analyses similar to those conducted above for 1993 provide different estimates of the total returns to the Margaree in 1992 from those previously reported (Chaput et al. 1993). The returns of large salmon to tidal waters of the Margaree River in 1992 (up to and including Oct. 12, the last day before the washout) were estimated at 3,479 salmon (the 1992 assessment had returns of 3,941 salmon) (Fig. 6). The estimate of the total returns for the year, based on the counting fence and logbook data is 6,375 fish, over 83% greater than the trapnet estimate (Fig. 6).

The large discrepancy between the two estimates is attributable to the early washout of the index trapnet in 1992. The lower trapnet fished for an additional 6 days before also being washed out but over that six day period (Oct. 13 to Oct. 18), the lower trapnet sampled almost 40% of its large salmon catch for the Sept. 1 to Oct. 18 fishing interval (Fig. 7). This

indicates that there was a large pulse of salmon which entered the river after Oct. 12 and which was not accounted for by the index trapnet. Further evidence is available from the angler logbook data. Logbook anglers in 1992 angled over 33% of their large salmon catches for the year after Oct. 12 and 38% (6 of 16) of the index trapnet tags were recovered after Oct. 12. The estimated efficiency of the index trapnet in 1992 during the fishing period up to and including Oct. 12 was 17%.

There was no evidence of a large pulse of fish entering in 1993 after the index trapnet was washed out on Oct. 18 because the estimates from the two methods are similar. In 1993, logbook anglers caught less than 6% of their annual catch and one of the five index trapnet tags was recovered after Oct. 18.

A large salmon return in 1992 of 6,400 fish as compared to about 3,300 in 1993 is more comparable to the trend between the two years of the license stub catches, logbook catches and catch per unit effort in the recreational fishery. Previously estimated returns in 1992 of about 3,500 fish would not be compatible with the contrasts noted in the angling fishery.

We chose to use only the tagging data from the index trapnet to estimate the returns using the fence and logbook recaptures for the following reasons:

1 - in 1992, the lower trapnet was only fishing after Sept. 1 therefore we would have marked a different proportion of the summer run relative to the fall run if the tags from both trapnets had been included. Disproportionate marking of the run results in a biased exploitation rate for both counting fence and logbooks (Randall et al. 1991).

2 - very long time-at-large intervals for salmon tagged from the lower trapnet relative to those tagged at the index trapnet results in a high proportion (50%) of marks theoretically being unavailable for recapture. Fished tagged at the lower trapnet in 1993 seemingly undertook a different movement into the river than those tagged at the index trapnet.

Estimated Returns of Wild and Hatchery Salmon by Season

The number of wild and adipose-clipped salmon returning to the Margaree River in 1993 are determined using the total returns of large salmon and the proportion of the wild component from the index trapnet sampling (Table 5). Only the index trapnet samples are considered because this trapnet was the most consistent sampler of the salmon population. In 1992, the lower trapnet was only fished in the fall. The native harvests (58 wild fall salmon) are also added to the estimate of returns to the index trapnet because those harvests occurred below the point of the population estimate.

The returns of of large salmon for each group by season are summarized below:

| | Total | Summer | Fall |
|---|---|---|---|
| *1993* | | | |
| Total | 3,358 | 1,523 | 1,835 |
| Wild | 3,170 | 1,385 | 1,785 |
| Adipose-clipped | 188 | 138 | 50 |
| *1992* | | | |
| Total | 6,375 | 958 | 5,417 |
| Wild | 6,075 | 844 | 5,231 |
| Adipose-clipped | 300 | 114 | 186 |

**Returns of Small Salmon to the Margaree in 1993**

The estimates of the small salmon returns are summarized in the table below. The efficiency of the index trapnet for small salmon was estimated at 3.7% as compared to 8.3% for large salmon. The best direct mark/recapture estimate for 1993 is 1,500 small salmon based on the fence+logbook recapture data. There is a greater than 95% probability that the returns in 1993 were at least 1,075 and a 50% probability that the returns were greater than 1,650 (Fig. 8). The estimate based on the ratio of small to large salmon at the index trapnet (2,079 fish) is higher than the combined logbook and fence recapture estimate.

| | Marking Data | | Recapture Data | | | Population | | |
|---|---|---|---|---|---|---|---|---|
| Year | Gear | Marks Placed | Gear | Marks | Total Catch | Number of Fish | Up to | Index Trap Efficiency |
| 1993 | Lower Trap | 80 | Index Trap | 3 | 165 | **4,380** | Oct. 18 | 3.8% |
| | Index | 159 | O'Law Fence | 2 | 30 | 2,400 | Nov. 15 | 6.9% |
| | Index | 159 | Logbooks | 9 | 63 | 1,112 | Oct. 31 | 14.7% |
| | Index | 159 | Fence+Logs | 11 | 93 | **1,500** | | 11.0% |
| | Based on returns of large salmon of 3,300 and ratio of 0.630 | | | | | **2,079** | | 7.9% |

| | Marking Data | | Recapture Data | | | Population | | |
|---|---|---|---|---|---|---|---|---|
| Year | Gear | Marks Placed | Gear | Marks | Total Catch | Number of Fish | Up to | Index Trap Efficiency |
| 1992 | Lower Trap | 50 | Index Trap | 5 | 165 | 1,660 | Oct. 12 | 9.9% |
| | Index | 158 | O'Law Fence | 1 | 15 | 2,400 | Nov. 15 | 6.9% |
| | Index | 158 | Logbooks | 3 | 79 | 4,150 | Oct. 31 | 4.0% |
| | Index | 158 | Fence+Logs | 4 | 94 | 3,450 | | 4.8% |
| | Based on returns of large salmon of 6,375 and ratio of 0.258 | | | | | 1,645 | | 10.0% |

In 1992, the estimates based on the index trapnet efficiency and the combined logbook and fence recaptures also differed. The mark/recapture estimate based on the trapnet was close to those from the counting fence and by using the ratio of small to large salmon at the trapnets. The logbook estimate is almost twice as high. The best mark/recapture estimate of returns of small salmon in 1992 is 1,660 (95% C.I. of 1,100 to 5,980), which is very similar to the estimate of small salmon based on the ratio of small to large salmon (1,645 fish). There is a greater than 97% probability that the returns in 1992 were at least 1,020 salmon and a 50% probability that the returns were greater than 2,140 (Fig. 8).

As with the large salmon, a large proportion (30%) of the small salmon caught at the lower trapnet in the fall were sampled after Oct. 12 (Fig. 7). In contrast to the large salmon catches, logbook anglers reported less than 13% of the total year catch of small salmon after Oct. 12, but three of the five tags were caught after that date.

In 1993, the logbook catch distributions were similar to those for large salmon; logbook anglers reportedly angled 6% of their total small salmon catches after Oct. 18 and only one of the 11 tags was recovered after Oct. 18.

The estimate of small salmon returns based on the ratio of small to large salmon at the index trapnet is the "best" estimate of small salmon returns to the Margaree on the assumption that the trap efficiency for small and large salmon is similar. Mark/recapture estimates for small salmon are inconsistent and are dependent upon the recapture method. The inconsistency probably results from several factors including: the smaller number of marks placed, the large number of marks lost from the population (due to the high angler exploitation rate which removes tags) and the subsequent smaller number of marks recaptured. A small salmon return in 1992 of about 1,645 fish as compared to 2,079 fish in 1993 corresponds to the trend in the license stub catches, logbook catches and catch per unit efforts in the recreational fishery.

Estimated Returns of Wild and Hatchery Salmon by Season

The number of wild and adipose-clipped small salmon returning to the Margaree River in 1993 are determined using the total returns of small salmon and the proportions of the wild and adipose-clipped components from the index trapnet sampling (Table 5). The returns of each group in each season are summarized below (which includes the 1993 native harvests of 2 wild summer and 6 wild fall small salmon):

| | Total | Summer | Fall |
|---|---|---|---|
| 1993 | | | |
| Total | 2,087 | 1,362 | 725 |
| Wild | 1,394 | 681 | 713 |
| Adipose-clipped | 693 | 681 | 12 |
| *1992* | | | |
| Total | 1,645 | 389 | 1,256 |
| Wild | 1,291 | 223 | 1,068 |
| Adipose-clipped | 354 | 166 | 188 |

**4 - Estimation of Egg Depositions in 1993**

The total egg depositions are obtained from estimates of the escapement of small and large salmon and the biological characteristics of the salmon in 1993. The escapement of salmon refers to fish which were not harvested in fisheries or otherwise removed from the river. No adjustments are made for illegal removals or losses due to disease and predation.

Estimation of Escapement

We assume that there is a 5% mortality on large salmon from hook and release (Chaput et al. 1992).

The estimate of large salmon hook and release in 1993 is 1,051 fish therefore the losses from hook and release are 52 fish. Other removals of large salmon include 21 of the 28 fish from broodstock collections, native harvests of 58 fish and 3 fish seized. Small salmon losses in 1993 are estimated at 735 fish from angling, 5 from broodstock, 8 from native harvests, and 2 from trapnet mortalities.

The escapements of small and large salmon, by origin (wild or hatchery) in 1993 are as follows:

| **Large Salmon** | | Percentiles | |
|---|---|---|---|
| | Estimate | 5% | 95% |
| **All Fish** | | | |
| Returns | 3,358 | 2,408 | 6,158 |
| Removals | 134 | 134 | 134 |
| Escapement | 3,224 | 2,274 | 6,024 |
| **Wild** | | | |
| Returns | 3,170 | 2,274 | 5,809 |
| Removals | 120 | 120 | 120 |
| Escapement | 3,050 | 2,154 | 5,689 |
| **Adipose-clipped** | | | |
| Returns | 188 | 134 | 349 |
| Removals | 14 | 14 | 14 |
| Escapement | 174 | 120 | 335 |

| **Small Salmon** | | Percentiles | |
|---|---|---|---|
| | Estimate | 5% | 95% |
| **All Fish** | | | |
| Returns | 2,087 | 1,489 | 3,851 |
| Removals | 750 | 750 | 750 |
| Escapement | 1,337 | 739 | 3,101 |
| **Wild** | | | |
| Returns | 1,394 | 995 | 2,570 |
| Removals | 471 | 471 | 471 |
| Escapement | 923 | 524 | 2,099 |

| Small Salmon | | Percentiles | |
|---|---|---|---|
| | Estimate | 5% | 95% |
| **Adipose-clipped** | | | |
| Returns | 693 | 494 | 1,281 |
| Removals | 279 | 279 | 279 |
| Escapement | 414 | 215 | 1,002 |

Biological Characteristics of Salmon in 1993

A length/weight relationship was derived using the samples collected from the Native food fishery catches. The average weight of large salmon was calculated from the lengths of salmon sampled at the index trapnet (Fig. 9) and was estimated at 4.46 kg (Table 8). The sex ratio of large salmon was derived from fall trapnet catches (Sept. 1 to Oct. 18) and in 1993, it was estimated at 74% female (Table 8). In 1992, the sex ratio from the trapnet samples was estimated at 74% female and the average weight was nearly identical to 1993, 4.24 kg (Table 8). The average eggs per large salmon spawner is 5,822 for 1993 and 5,535 for 1992 (Table 8). There were so few small salmon samples obtained at the trapnets in 1993 that a sex ratio was not calculated. It is expected that the small salmon were composed mostly of males, 89%, as in previous years (Chaput et al. 1993).

Egg depositions in 1993

The egg depositions by large salmon in 1993 were estimated to be:

| | Eggs | Percent of Total |
|---|---|---|
| Wild | 17.9 million | 95% |
| Adipose-clipped | 0.9 million | 5% |

Spawning escapements for 1992 and previous years are summarized in Table 9. The 1992 escapement is estimated on the basis of the revised return estimate (Table 8). Since 1989, the egg depositions to the Margaree River have exceeded 14 million eggs.

## 5 - Alternate Indicators of Escapements to the Margaree River

There are two other indicators of the trend in escapement to the Margaree River: Lake O'Law counting fence and electrofishing surveys of juveniles.

Lake O'Law Counting Fence

Details of the number of salmon by life stage, origin (wild, adipose-clipped) and sex for 1992 and 1993 are summarized in Table 10. Fence counts for 1991 to 1993 are summarized in the text table below. The wild large salmon escapement above the fence was highest in 1991 while the 1992 and 1993 escapements were similar. The escapement of wild small salmon was lowest in 1992 and of equal strength in 1991 and 1993. Wild smolt counts have progressively declined since 1991 and the smolts leaving in 1994 are likely to be from the 1991 escapement (smolts are expected to be predominantly 2-years old in Lake O'Law Brook).

| | | Counts by Origin | | | |
|---|---|---|---|---|---|
| | | Hatchery | | Wild | |
| Life Stage | Year | Upstream | Downstream | Upstream | Downstream |
| Smolts | 1991 | | 1,845 | | 2,541 |
| | 1992 | | 1,900 | | 2,416 |
| | 1993 | | 3,522 | | 1,513 |
| Small | 1991 | 5 | | 29 | |
| | 1992 | 1 | | 14 | |
| | 1993 | 5 | | 25 | |
| Large | 1991 | 4 | | 71 | |
| | 1992 | 10 | | 48 | |
| | 1993 | 4 | | 54 | |

The salmon ascending through the fence are composed of both early and late-run fish but the composition of the run varies depending on the year.

| Year | Total Tags Recovered | Summer Tags | Fall Tags |
|---|---|---|---|
| 1991 | 3 | 3 | N/A |
| 1992 | 10 | 0 | 10 |
| 1993 | 8 | 3 | 5 |

We are uncertain whether the escapement of salmon through the Lake O'Law fence is representative of the relative escapement to the river as a whole.

Juvenile Salmon Abundance

A total of 4 electrofishing sites were sampled with barrier nets in July 1993. Barrier nets were not used at the Trout Brook site. Electrofishing methods were similar to those described by Chaput and Claytor (1989). Estimates of wild Atlantic salmon juvenile population numbers, densities and mean length 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):

$$PHS = 100 * \sum D_i * T_i * 1.19$$

where $D_i$ = density (#/$m^2$) of size class i
$T_i$ = territory size ($m^2$) for size class i predicted from the territory size/body size regression (Grant and Kramer 1990).

The densities of fry at the 4 sites in 1993 ranged from 50 to 207 fish/100$m^2$ (Table 11). Densities at the same sites in 1992 ranged between 37 and 381 fry/100$m^2$, while in 1991, the densities ranged from 36 to 230 fry/100$m^2$ (Chaput et al. 1992). Parr densities have also on average remained high over the three years. The PHS values have averaged over 35% which suggests that at those sites, the habitat is well utilized.

| | Mean of four sites | | |
|---|---|---|---|
| Year | Fry Density (#/100$m^2$) | Parr Density (#/100$m^2$) | PHS Value |
| 1991 | 113 | 56 | 37 |
| 1992 | 135 | 52 | 36 |
| 1993 | 132 | 79 | 39 |

The densities of juveniles have remained high since 1987 (Chaput and Jones 1991) and at the Big Brook site have increased almost four times from the levels noted in the 1970's (Table 11). The MacFarlane Brook site is a tributary of the Southwest Margaree and if the densities at that site reflect the escapement of salmon into the Southwest, then it would appear that the escapement is as good, if not better, in that branch as it is in the Northeast branch of the river. The electrofishing results in 1994 may show a decrease in the fry densities relative to 1993 if the index sites which have been sampled are representative of the total river escapement. There is always the chance that the sites which are sampled are prime sites which are utilized first by spawners, even at low escapement levels.

**Summary of abundance and escapement trends**

Returns of Large Salmon

| | |
|---|---|
| License stub abundance index: | 93 < 89 = 90 < 91 = 92 |
| Logbooks: | 93 < 89 = 90 < 91 = 92 |
| Estimated returns: | 93 = 91 < 92 |

Total Escapements

| | |
|---|---|
| Lake O'Law fence (wild large): | 92 < 93 < 91 |
| Electrofishing (fry): | 90 < 92 < 91 |

The abundance indices and the returns suggest that 1992 and 1991 were similar years and both were higher return years than 1993. The juvenile data and the fence data also suggest that 1991 was at least as good if not better than 1992. This would indicate that the returns of salmon for 1991, which were based on angling catches and estimated exploitation rates, may be underestimated. In fact, relative to 1992 and 1993, the returns are underestimates because they are based on angling catches up to and including Oct. 15 and not to the end of October. This was done to be consistent with the pre-1991 time series which is based entirely on angling catches and for which the season closed on Oct. 15 (Chaput et al 1992). We would say then that the total returns and escapement of Atlantic salmon to the Margaree River for 1947 to 1991 are minimum estimates, with the discrepancy dependent upon the size and timing of the fall run.

**6. Target Spawning Requirements for the Margaree River**

The conservation spawning requirement based on 2.4 eggs/$m^2$ of spawning and rearing area for the Margaree River translates to an egg deposition requirement of 6.716 million eggs (Table 12). Using average biological characteristics of large and small salmon, the target egg deposition would be met by 1,036 large salmon and 582 small salmon, the small salmon are required to provide an equal male to female ratio.

Refinements to the target egg depositions specific to the Margaree can be considered. A preliminary stock-recruit relationship has been developed for large salmon for the Margaree River by reconstructing the returns and escapements since 1947 (Chaput and Jones 1992). The relationship considers only large salmon for the following reasons:

1 - target egg depositions are based on eggs from large salmon since small salmon contribute minimally to the egg depositions (small salmon are less than 10% female),
2 - Margaree River stock is principally a large salmon stock with the proportion of large salmon in the total returns generally exceeding 75%.

When the analysis was conducted, the 1992 return data point had been estimated at 3,372 large salmon, very similar to the returns of 1991 (3,484 large salmon). This data value

is closest to the returns which were attained up to Oct. 15, the cutoff date for the estimates from all the previous years (Chaput and Jones 1992). The relationship has not been reanalyzed to account for the full year returns because the adjustment would have to be made back through the time series. There are insufficient data presently that would provide us with an indication of the adjustment factor which would have to be applied. The effect of an underestimate of both the returns and escapements on the reference points derived from the curve has not been considered to date.

Reference Levels from the Stock-Recruitment Curve

There are three reference levels (or targets) which can be objectively defined on the stock-recruit curve:

1 - spawners for maximum gain: point on the curve where the difference between the recruitment back to the river and the spawners which generated that recruitment is maximum,
2 - spawners for maximum recruitment: spawners which generate the maximum recruitment,
3 - replacement level: level of spawners where one spawner produces one recruit.

For the large salmon stock-recruitment curve, the spawners for each reference level are as follows (Chaput and Jones 1992) (Fig. 10):

| Reference Level | Estimate | 90% Confidence Interval |
|---|---|---|
| Spawners for Maximum Gain | 1,352 | 1,091 to 1,693 |
| Maximum Gain | 2,937 | 2,437 to 3,561 |
| Spawners for Maximum Recruitment | 1,974 | 1,524 to 2,602 |
| Recruitment | 4,584 | 3,859 to 5,514 |
| Spawners for Replacement | 3,637 | 2,982 to 4,464 |

Associated with each of these reference levels for large salmon spawners is a requirement of small salmon to ensure an equal sex ratio on the spawning grounds. Small salmon requirements are 760 fish for the maximum gain reference level and 1,110 fish for the maximum recruitment reference level (Table 12).

The reference level to use is a resource management decision but there are different reference levels or targets for escapement which can be determined based on biological considerations of the Margaree River Atlantic salmon stock. The reference level for maximum recruitment is higher than that for maximum gain and its use over the latter level would be considered a risk averse strategy. It would provide for protection against uncertainty in the relationship itself and in environmental conditions which cannot be controlled.

Egg Depositions Relative to Reference Levels

The escapements of large salmon to the Margaree River since 1985, relative to the different reference levels, are summarized in Figure 11 and Table 9. The conservation target and the maximum gain reference level have been exceeded since 1985. The target for maximum recruitment was exceeded in seven of the nine years, including 1993, and the replacement level was met or exceeded in about five of the nine years (Fig. 11). Small salmon spawning requirements have been met for the conservation and maximum gain reference level for 4 of the last 6 years and fell short in 3 of the last 6 years for the maximum recruitment reference level (Table 9). The high escapements which have been noted in recent years will add substantially to the understanding and the refinements of the spawner-recruit relationship for Margaree large salmon.

**7 - Forecast of Returns**

A forecast of the returns of large salmon in 1994 can be obtained from the spawner recruitment relationship and the estimated escapement of large salmon in 1989 (five year generation time). The estimated escapement of large salmon in 1989 is 2,164 spawners. When this value is substituted into the spawner-recruitment model, the expected recruitment is 4,323 large salmon, with 95% probability that the recruitment will be at least 3,394 fish (Fig. 12). The forecast of the 1993 large salmon returns was about 4,500 large salmon, with a 95% probability that the returns would have been at least 3,833 fish. The estimated returns in 1993 were about 3,358 salmon, 25% below the predicted return, and 12% below the lower probable return prediction.

**8 - Auxiliary Information**

Enhancement Initiatives

The releases of hatchery progeny to the Margaree River by life stage are summarized in Table 13. Since 1988, the number of 1+ smolts released into the Margaree River has approximated 20,000 while the releases of 2+ smolts have amounted to over 30,000 in 1992 and 1993. Parr, both 0+ and 1+, have also been stocked.

At Sea Survival Rates

Although not exact, optimistic survival rates of hatchery smolts can be estimated based on the estimated releases of smolts and returns of adipose-clipped small and large salmon. Parr are also adipose-clipped but the proportion of these which survive to the smolt stage is

unknown. Releases, returns of small and large salmon by year of release are summarized below.

| | | Returns from Smolt Releases | | Sea Survival | |
|---|---|---|---|---|---|
| Year of Release | Smolts Released | Small Adipose-Clipped | Large Adipose-Clipped | Small Adipose-Clipped | Large Adipose-Clipped |
| All River | | | | | |
| 1991 | 42,300 | 354 | 189 | 0.84% | 0.45% |
| 1992 | 58,700 | 693 | | 1.18% | |
| From Lake O'Law | | Returns to fence (after exploitation) | | Survival (after exploitation) | |
| 1991 | 1,845 | 1 | 4 | 0.05% | 0.22% |
| 1992 | 1,900 | 5 | | 0.26% | |
| From Lake O'Law | | Wild adult returns | | Wild smolt survival | |
| | Wild smolts | Small wild | Large wild | Small wild | Large wild |
| 1991 | 2,541 | 14 | 54 | 0.55% | 2.13% |
| 1992 | 2,416 | 25 | | 1.03% | |

The optimistic sea-survival of hatchery smolts has been about 1% in the last two years. Survival rates of smolts back to the fence are even lower, in part because of harvests in the recreational fishery. Wild smolt survival, as inferred from the releases through Lake O'Law fence are much better, especially for the large salmon. Sea-survival of the 1992 smolt class appears to have been much better than that of the 1991 smolt class, for both hatchery and wild smolts from Lake O'Law. The low hatchery smolt survival in 1991 may also have resulted from the manipulation of these fish prior to stocking (hot-branding of groups of smolts prior to release). These survival rates of hatchery smolts are much lower than those recorded for the Morell River, where survival rates in 1991 were 5% while for 1992, the preliminary survival rate estimate is 2% (Davidson and Angus 1994).

Ocean Migrations of Margaree Atlantic Salmon

The Margaree River Atlantic salmon kelts, as well as returning previous spawners, have been regularly intercepted in the Newfoundland and Quebec north shore commercial fisheries (Table 14). There were only 2 recaptures reported from the 1992 kelts, in part as a result of the elimination of the commercial salmon fishery in Newfoundland and reductions in the fisheries of Greenland and Quebec north shore.

## CONCLUSIONS AND RECOMMENDATIONS

The assessment of the Atlantic salmon stock of the Margaree River has evolved from using angling catches and assumed exploitation rates, to annual estimates of the angling exploitation rates and finally to the assessment of returns independent of angling catches. The three different methods for estimating the returns to the river provided similar results; direct estimation of the index trapnet efficiency from marking and release at a lower trapnet, recaptures of marked/released fish from the index trapnet at a counting fence, and recaptures in the angling fishery (logbooks). When the estimates differed, the differences could be readily explained by differences in sampling duration. The estimated returns of large salmon and small salmon in 1992 and 1993 correspond to the differences in the abundance indices from angling and the angling catches, abundance in 1993 was about half of 1992, as were the returns.

Estimates of small salmon returns based on mark/recapture were highly variable between methods. This is in part the result of a smaller number of marks available for recapture because the small salmon are less abundant than the large salmon. Many marked and unmarked small salmon are also removed in the angling fishery which results in a reduced available recapture population for the counting fence and the logbook anglers. Consideration could be given to including both small and large salmon marks and recaptures from the lower net to the index trapnet and then proportioning the population size of each based on the ratio of small and large salmon. This would increase the size of the marked population and both the recaptured and sampled catch at the index trapnet. There is no reason to suspect that the efficiency of the trapnets is different for small and large salmon. The mesh sizes of the trapnet, 4 to 6 cm stretched mesh, and the leaders, 7.6 cm stretched mesh, are small enough to preclude any escape of small salmon through the mesh. The estimation of the small salmon returns in 1992 and 1993 based on the small to large salmon ratio implicitly assumes that the catchability of both sizes is identical at the index trapnet. The ratio of small to large salmon at the index trapnet should serve as the best indication of the relative proportion of small salmon in the run. .

A proper accounting of the removals of small and large salmon is important in evaluating the status of the stock. The escapement of small and large salmon is calculated from the estimated returns minus the removals. In this case, most of the removals occur in the angling fishery. The angling catch is difficult to estimate and there are discrepancies between angling catches collected by DFO and those reported on license stubs. Even catches reported in logbooks by volunteer anglers do not always correspond to the catches reported on the license stubs (Claytor and O'Neil 1990). Creel surveys conducted in the previous three years did not resolve the discrepancy between license stub reported catches and actual hook and release catches on the river (Chaput et al. 1993). License stub hook and release values tended to be about twice those estimated from creel surveys for large salmon and small salmon but, were on occasion, similar. For large salmon, overestimation of the angling catches is not a major problem since we assume that there is 5% hook and release mortality. In 1993, hook and release mortality represented about 52 large salmon, out of a return of 3300 fish (1.6%).

It is more important for small salmon because not only can these fish be retained but the initial population size is smaller and the exploitation rate can be over 25%.

The estimated egg depositions have exceeded the conservation target level since 1985. Alternate target escapement levels derived from a stock and recruitment curve for the Margaree River large salmon have also been exceeded in most years. These high escapements have resulted in high densities of juveniles in the last 7 years relative to the much lower densities noted in the 1970's (Chaput et al. 1992). Generally more than 95% of the egg depositions were obtained from wild origin large salmon.

Hatchery origin small salmon are readily captured in the angling fishery and constituted 44% of the summer angled small salmon in 1993. The exploitation rate on these hatchery progeny is about twice that of wild small salmon. In 1993, hatchery origin small salmon were more available in the summer than in the fall, making up 50% of the small salmon summer return in 1993 but only 2% of the fall small salmon return. Large salmon tended to be predominantly wild origin, 91% for the summer component and 97% for the fall. This is similar to the relative contributions observed in previous years (Chaput et al. 1992, 1993).

Preseason forecasts of large salmon returns in 1994 are based on a stock and recruitment relationship of the returns between 1947 and 1992. The returns and escapement values which were used to describe the stock and recruitment relationship are lower than the total returns and escapements for the year because they consider only the returns up to Oct. 15. As was noted for 1992, a substantial number of salmon can return to the river in the latter half of October. In spite of enumerating the returns to the end of the year in 1993, the actual returns were still 25% below the predicted returns from the stock-recruitment curve suggesting that the preseason forecast is a starting point that should be subject to inseason adjustments.

Inseason adjustments to the preseason forecast should be possible even with only two years of complete returns data from the index trapnet. It is critical that the efficiency of the trapnet be as constant from year to year as possible. Mark/recapture methods were used to calculate the catch efficiency of the index trapnet. The two years of data would indicate that constant trap efficiency is not a valid assumption. The estimated efficiency in 1992 was 17% while in 1993, the trapnet at the same location had an efficiency of only 8.3%. The discrepancy between the two years is likely the result of the different mesh size used in the 1993 trapnet relative to 1992. The mesh size of the trapnet in 1993 was reduced to 3.8 cm stretched mesh from 5.7 cm in 1992. The change was required to eliminate the large bycatch mortalities of gaspereau resulting from meshing during the months of June through August. For 1994, a catch efficiency of 8.3% would be appropriate if the small mesh trapnet is used, similar to 1993. The 1992 data are important in describing the relative run-timing to the river.

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**Appendix A.** Minutes of the Margaree River stock workshop.

Margaree, N.S. (Visitor's Centre, Margaree SEC)
0900-1630 Hours, Wednesday, 2 February 1994

**Chairperson:**

| | |
|---|---|
| Mike Chadwick | DFO, Science, Moncton |

**Recording Secretary:**

| | |
|---|---|
| John Peppar | DFO, Science, Moncton |

**Attendees:**

| | |
|---|---|
| Eugene Denny | Aboriginal Fisheries Strategy, Eskasoni |
| Lynda Calvert | Cape Breton Sports Fishing Advisory Committee |
| Harry Vickers | Cape Breton Anglers Association |
| Joe Anthony | Cape Breton Anglers Association |
| John Hart | Margaree Salmon Association |
| Rick MacDonald | Margaree Salmon Association |
| Lewis Hinks | Atlantic Salmon Federation |
| Mike McAdam | Atlantic Salmon Federation |
| Don MacLean | NS DofF, Aquaculture & Inland Fisheries, Pictou |
| Leroy MacEachern | DFO, Development, Antigonish |
| Wes Barrington | DFO, C&P, Margaree |
| Leonard Forsyth | DFO, Science, Margaree SEC |
| John Ritter | DFO, Science, Halifax |
| Ross Claytor | DFO, Science, Moncton |
| Gerald Chaput | DFO, Science, Moncton |
| Kevin Davidson | DFO, Science, Moncton |
| Ross Jones | DFO, Science, Moncton |

**1. Introduction - Purpose of Meeting and Framework of Workshops.**

Mike Chadwick provided a general overview of the purpose of this meeting and an explanation of the "workshop" approach and its framework.

An overview was provided of the four major features associated with the **"Stock Workshop"** framework or approach:

1. **Roles of government and the public:** the public wants to participate, money is scarce, agencies must remove redundancy, horizontal links in resource management, combine enhancement and assessment, DFO focus on analysis and structure.

**Appendix A (continued).**

2. **Scientific basis for resource management:** what are the problems?, assemble knowledge, make a model, where is model sensitive?, ask an answerable question, develop test, document repeatable methods, improve model, ask another important question.
3. **Watershed management:** fine-scale information, in-season management, all stocks, knowledge accessible to everyone, identify problems in order of priority, best projects distinguish between alternative views of the resource, share tasks.

There is a different dynamic now, with more stakeholders involved in the stock assessment process. CAFSAC is gone. There will still be peer review of assessments, but these assessments will be developed and assembled through the stock workshop process first. Research documents will be prepared, with summary sheets provided for wider distribution.

**2. Salmon Stock Status - Salmon Assessments.**

Ross Claytor provided a general overview of how the salmon assessments are developed.

He outlined the **"Assessment Process"** as incorporating a framework of four basic components:

1. **Landings** (catches): from the First Nations, angling, and commercial fisheries.
2. **Targets** (spawning requirements): using the value of 2.4 eggs/square metre.
3. **Where we are now** (spawning escapements): total returns minus removals.
4. **Forecasts**: pre-season and in-season updates.

**Margaree Salmon**

Gerald Chaput presented information on the status of the Margaree salmon stock; a handout, detailing all material presented, was provided to attendees.

**Points of Discussion**

**Landings**

- C&P to provide table showing summary of violations for the past years (numbers of apprehensions, nets seized, etc.), in an attempt to quantify enforcement activities.

**Appendix A (continued).**

- Can an approach be developed to document an estimate of the unreported catches (by 3 categories: false licence stub returns, poaching, and catches in excess of daily bag limits)? DFO (C&P & Science), with the assistance of the Margaree Salmon Association, to consider this question.
- The angling creel survey should be expanded to include the fall run and to verify license stub returns (to assess unreporting of fish, etc.).
- The relationship between fishing catch and discharge needs to be examined.

**Target**

- Spawning targets for the three scenarios should be calculated for males and females.
- Rearing area measurements should be re-examined.
- Conservation requirements need to be re-examined by FHMB, in addition, the possibility of a fall harvest of large salmon and catch-and-release of small salmon.
- Importance of stock/recruitment (smolts out/adults back) relationship to explain "where we should be" and "where we are".
- In the long-term, spawning requirements should be separated into early and late components if these two groups are shown to spawn in different locations.

**Returns**

- We need more recaptures of tags, to improve precision of estimates of returns; combination of angler logbooks and fish counting fence (on Ingram and MacFarlane's Brooks) would seem to be the best approach to take (accounts for longer period of time, more recaptures, therefore better estimate). Camera surveillance could be an additional approach, that may work well in the Sanctuary and provide valuable data.
- Tagging to be conducted at First Nation food fishery trap in 1994 (tag recap site of previous years).
- Run timing of salmon and grilse should be examined separately for early and late runs.
- Results of snorkel count surveys conducted 1990-93 should be tabled; these counts should be examined for their utility in estimating abundance.

**Forecast**

- The ability to conduct in-season forecasts of returns needs to be examined.
- We were 20-30% below forecast in 1993.
- Forecast for 1994 = approx. 4,300 large salmon.

**Appendix A (continued).**

**Margaree River Trout**

**Points of Discussion**

**Landings**

- Trout stocking information from NS DofF in Lake Ainslie and other areas should be included in the report; MSA to table historical stocking data.
- Trout catches from the licence stub returns and anglers surveys need to be summarized by NS DofF.
- A framework for trout, similar to what has been done for salmon, must be developed.
- Increased cooperative studies between NS DofF and DFO (Gulf) would be beneficial.

**Target**

- A target for trout needs to be developed.
- The impact of the closure on Trout Brook should be examined with regard to establishing a target.

**Returns**

- Electrofishing surveys should summarize the catches of all salmonids, by species.
- Trap counts should be summarized by species and year.
- Future meetings of stock status workshops should be linked to the RFAC meetings.

**Other**

- Possible changes in water temperature in the Southwest Margaree should be examined by Habitat Science.
- Possible impacts of clearcutting on Margaree watershed should be summarized by Habitat Science.

**Appendix B**

**Minutes of Peer Review**
**Anadromous Stocks Gulf Region**
**February 21, 1994**

**Review Committee:**

M. Chadwick (Chair)
J. Allard
S. Bates
A. Chiasson
R. Cunjak
J.-G. Godin

**General Comments**

1. The error associated with extrapolating information from one watershed to another should be estimated using the prorating techniques in hydrological studies. This type of error could be estimated from smaller watershed within rivers where the populations are well estimated.
2. In order to account for possible longterm trends, comparisons should be made with means over long time periods in addition to 5-year means.
3. A logbook program similar to the program in Nova Scotia should be considered for New Brunswick and PEI.
4. The mark-recapture experiments should be encouraged, but other independent estimates of stock abundance such as sport catch data and electrofishing should also be continued.
5. An introductory document summarizing terminology, the basics of mark-recapture experiments, and methods used in electrofishing, creel surveys, and fish fences should accompany next year's assessments. The stock assessment documents should have the same format.
6. Summary sheets should be pictoral, perhaps maps with pie graphs by watershed of catches, spawning requirements, and spawning escapements.
7. A description of multi-species factors such as the abundance and dynamics of other stocks should be included in the assessments.
8. With some minor changes all the assessments were suitable to be published as research documents; however future assessments should be put into a standardized format.
9. Estimate tag-loss function using brood-stock experiments at hatcheries for Miramichi, Restigouche, and Nepisiguit rivers. The tag loss rate contributes significantly to the error in population estimates.
10. More time is required for reviews in the future and reviewers should focus on 1 or 2 assessments for critical evaluation.

**Appendix B (continued).**

11. Techniques to summarize results from several estimators should be explored.
12. The decision of whether or not a value is a constant or a variable needs to be standardized. Variables are re-evaluated every year, where as constants can be aggregated over years to reduce the confidence interval.

**Specific Comments**

Margaree River

1. The tag loss rate should be described as a function over time.

**Participants:**

R. Claytor
G. Chaput
F. Mowbray
G. Atkinson
K. Davidson
M. Biron
D. Moore
R. Pickard
R. Jones
D. Caissie

**Appendix C.** Summary sheet of the Margaree River Atlantic salmon stock.

**STOCK:** Margaree River (SFA 18)
**TARGET:** 6.7 million eggs (1,036 large, 582 small salmon)

| Year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | MIN[2] | MAX[2] | MEAN[2] |
|---|---|---|---|---|---|---|---|---|---|
| **Angling harvest** | | | | | | | | | |
| Large[1] | 1932 | 1570 | 1507 | 1757 | 1938 | 1051 | 305 | 2636 | 1741 |
| Small | 879 | 561 | 649 | 752 | 678 | 735 | 242 | 977 | 704 |
| **Native harvest** | | | | | | | | | |
| Large | - | - | - | 1 | - | 58 | | | - |
| Small | - | - | - | 2 | - | 8 | | | - |
| **Total returns** | | | | | | | | | |
| Large | 1688 | 2289 | 11144 | 3484 | 6375 | 3358 | 1462 | 11144 | 4996 |
| small | 2209 | 768 | 997 | 1909 | 1645 | 2087 | 768 | 2209 | 1506 |
| **Spawning escapement** | | | | | | | | | |
| Large | 1545 | 2164 | 11010 | 3323 | 6222 | 3224 | 1378 | 11010 | 4853 |
| Small | 1330 | 207 | 348 | 1157 | 954 | 1339 | 207 | 1339 | 799 |
| **% of Egg target met (Large + Small)** | | | | | | | | | |
| | 149 | 209 | 1063 | 321 | 601 | 311 | 133 | 1063 | 469 |

[1] All angling catches are NS license stub estimates. Angling catches for large salmon are hooked and released. For small salmon, previous estimates were based on creel surveys. Because these numbers have changed, the spawning escapement and percent of egg target met numbers have been updated.

[2] Min, Max are for 1985 to 1993. Mean for 1988 to 1992.

**Methodologies**: The drainage area equals 500 km$^2$. Rearing area surveys were conducted during the 1950s through 1970s. All the target eggs are to come from large salmon. Biological characteristics are based on data from the Margaree River stock. Summer and fall (after Aug. 31) run components occur in the river with the fall run comprising over 70% large and 45% of small salmon returns in recent years. The assessment of returns based on mark-recapture techniques. Prior to 1992, returns were estimated from angling catches and annually calculated exploitation rates in the angling fishery.

**State of the stock**: Egg depositions by large salmon have exceeded target requirements by between one third and nearly ten fold since 1985. The summer run component has increased since the 1970s but the actual number of fish available to anglers in the summer depends on river conditions in the summer.

**Forecast**: On the basis of a stock-recruit relationship for the large salmon component, and using the estimated escapement of 2164 large salmon in 1989, the predicted recruitment in 1994 should be about 4300 large salmon.

***Table 1. Native harvests by the Wagmatcook Band on the Margaree River for 1993.***

| *Sex* | *Number* | *Weight (kgs)* | *Average Weight* |
|---|---|---|---|
| ***Small Salmon*** | | | |
| Male | 8 | 12.7 | 1.6 |
| Sub-Total | 8 | 12.7 | |
| ***Large Salmon*** | | | |
| Male | 17 | 78.4 | 4.6 |
| Female | 39 | 208.7 | 5.4 |
| Unknown | 2 | 10.0 | 5.0 |
| Sub-Total | 58 | 297.1 | |
| Total | 66 | 309.8 | |

- Includes 2 small salmon kept from the index trapnet.

***Table 2. Salmon angling catch on Margaree River (1947-1993) as compiled by Department of Fisheries and Oceans fisheries officers (DFO statistics).***

| | | Large | | | | |
|---|---|---|---|---|---|---|
| Year | Small | Retained | Released | 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 |
| 1992 @ | 236 | 0 | - | - | . | 236 |
| 1993 @ | 272 | 0 | - | - | . | 272 |
| Mean (88-92) | 261 | | | | | |
| +/- Mean | 4.29% | | | | | |

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

*Table 3. Annual summaries of catch and effort for Gulf Shore Cape Breton rivers from 1984-93 using license stub returns. Mean = (1988 to 1992). The 1993 data is preliminary.*

| Year | River | No. Angler | Small Obs. | Small Est. | Large Obs. | Large Est. | Unk. Obs. | Total Obs. | Total Est. | Rods Obs. | Rods Est. | CPUE | % Large |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***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 | | 29 | 6 | 8 | 81 | 104 | 0 | 87 | 112 | 212 | 281 | 0.410 | 93.1 |
| 1992 | | 30 | 15 | 19 | 55 | 69 | 0 | 70 | 88 | 132 | 171 | 0.530 | 78.6 |
| 1993 | | 29 | 8 | 11 | 8 | 11 | 0 | 16 | 22 | 78 | 111 | 0.205 | 50.0 |
| | +/- 1992 | -3% | -47% | -42% | -85% | -84% | . | -77% | -75% | -41% | -35% | -61% | -36% |
| | +/- Mean | 1% | 43% | 57% | -88% | -87% | . | -78% | -76% | -51% | -45% | -54% | -46% |
| | ***Mabou*** | | | | | | | | | | | | |
| 1984 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.000 | . |
| 1985 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | . | . |
| 1986 | | 3 | 3 | 3 | 18 | 19 | 0 | 21 | 22 | 12 | 13 | 1.750 | 85.7 |
| 1987 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.000 | . |
| 1988 | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 0.000 | . |
| 1989 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | . | . |
| 1990 | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 16 | 0.000 | . |
| 1991 | | 3 | 2 | 3 | 2 | 3 | 0 | 4 | 5 | 7 | 9 | 0.571 | 50.0 |
| 1992 | | 5 | 6 | 8 | 14 | 18 | 0 | 20 | 25 | 20 | 26 | 1.000 | 70.0 |
| 1993 | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0.000 | . |
| | +/- 1992 | -60% | -100% | -100% | -100% | -100% | . | -100% | -100% | -90% | -88% | -100% | -100% |
| | +/- Mean | -9% | -100% | -100% | -100% | -100% | . | -100% | -100% | -77% | -73% | -100% | -100% |
| | ***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 | | 1236 | 586 | 752 | 1370 | 1757 | 0 | 1956 | 2509 | 10142 | 13432 | 0.193 | 70.0 |
| 1992 | | 1426 | 539 | 678 | 1541 | 1938 | 0 | 2080 | 2616 | 11483 | 14909 | 0.181 | 74.1 |
| 1993 | | 1404 | 533 | 735 | 762 | 1051 | 0 | 1295 | 1786 | 11010 | 15682 | 0.118 | 58.8 |
| | +/- 1992 | -2% | -1% | 8% | -51% | -46% | . | -38% | -32% | -4% | 5% | -35% | -21% |
| | +/- Mean | 1% | -7% | 4% | -46% | -40% | . | -35% | -27% | 1% | 13% | -35% | -18% |
| | ***Gulf Shore Cape Breton Island:*** | | | | | | | | | | | | |
| 1984 | | 714 | 235 | 244 | 329 | 342 | 4 | 568 | 590 | 6085 | 6814 | 0.093 | 58.3 |
| 1985 | | 817 | 488 | 524 | 1182 | 1268 | 3 | 1673 | 1792 | 7494 | 8006 | 0.223 | 70.8 |
| 1986 | | 1168 | 755 | 789 | 2590 | 2705 | 2 | 3347 | 3496 | 9844 | 10359 | 0.340 | 77.4 |
| 1987 | | 1479 | 932 | 984 | 1816 | 1917 | 0 | 2748 | 2901 | 12290 | 13019 | 0.224 | 66.1 |
| 1988 | | 1484 | 750 | 880 | 1684 | 1975 | 0 | 2434 | 2855 | 11691 | 14174 | 0.208 | 69.2 |
| 1989 | | 1519 | 470 | 568 | 1414 | 1710 | 0 | 1884 | 2280 | 10831 | 13530 | 0.174 | 75.1 |
| 1990 | | 1407 | 514 | 649 | 1237 | 1563 | 0 | 1751 | 2212 | 10908 | 14228 | 0.161 | 70.6 |
| 1991 | | 1268 | 594 | 763 | 1453 | 1864 | 0 | 2047 | 2626 | 10361 | 13722 | 0.198 | 71.0 |
| 1992 | | 1461 | 560 | 705 | 1610 | 2025 | 0 | 2170 | 2729 | 11635 | 15106 | 0.187 | 74.2 |
| 1993 | | 1435 | 541 | 746 | 770 | 1062 | 0 | 1311 | 1808 | 11090 | 15796 | 0.118 | 58.7 |
| | +/- 1992 | -2% | -3% | 6% | -52% | -48% | . | -40% | -34% | -5% | 5% | -37% | -21% |
| | +/- Mean | 1% | -6% | 5% | -48% | -42% | . | -36% | -29% | 0% | 12% | -36% | -18% |

*Table 4. Summary of effort, catch and CPUE from logbook anglers on Margaree River, 1991 to 1993.*

| | | | | Small | | Large | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| *Year* | *Season* | *Month* | *Rods* | *Catch* | *CPUE* | *Catch* | *CPUE* | *Catch* | *CPUE* |
| ***1993*** | | | | | | | | | |
| | Summer | June | 134 | 2 | 0.015 | 2 | 0.015 | 4 | 0.030 |
| | | July | 200 | 16 | 0.080 | 12 | 0.060 | 28 | 0.140 |
| | | August | 157 | 29 | 0.185 | 15 | 0.096 | 44 | 0.280 |
| | Sub-Total | | 491 | 47 | 0.096 | 29 | 0.059 | 76 | 0.155 |
| | Fall | September | 193 | 6 | 0.031 | 18 | 0.093 | 24 | 0.124 |
| | | Oct. 1-15 | 148 | 6 | 0.041 | 24 | 0.162 | 30 | 0.203 |
| | | Oct. 16-31 | 35 | 4 | 0.114 | 4 | 0.114 | 8 | 0.229 |
| | | Oct. 1-31 | 183 | 10 | 0.055 | 28 | 0.153 | 38 | 0.208 |
| | Sub-Total | | 376 | 16 | 0.043 | 46 | 0.122 | 62 | 0.165 |
| | Total Season | | 867 | 63 | **0.073** | 75 | **0.087** | 138 | **0.159** |
| ***1992*** | | | | | | | | | |
| | Summer | June | 117 | 6 | 0.051 | 3 | 0.026 | 9 | 0.077 |
| | | July | 185 | 28 | 0.151 | 40 | 0.216 | 68 | 0.368 |
| | | August | 162 | 10 | 0.062 | 20 | 0.123 | 30 | 0.185 |
| | Sub-Total | | 464 | 44 | 0.095 | 63 | 0.136 | 107 | 0.231 |
| | Fall | September | 176 | 12 | 0.068 | 26 | 0.148 | 38 | 0.216 |
| | | Oct. 1-15 | 211 | 18 | 0.085 | 66 | 0.313 | 84 | 0.398 |
| | | Oct. 16-31 | 74 | 5 | 0.068 | 49 | 0.662 | 54 | 0.730 |
| | | Oct. 1-31 | 285 | 23 | 0.081 | 115 | 0.404 | 138 | 0.484 |
| | Sub-Total | | 461 | 35 | 0.076 | 141 | 0.306 | 176 | 0.382 |
| | Total Season | | 925 | 79 | **0.085** | 204 | **0.221** | 283 | **0.306** |
| ***1991*** | | | | | | | | | |
| | Summer | June | 59 | 0 | 0.000 | 3 | 0.051 | 3 | 0.051 |
| | | July | 101 | 9 | 0.089 | 10 | 0.099 | 19 | 0.188 |
| | | August | 187 | 17 | 0.091 | 32 | 0.171 | 49 | 0.262 |
| | Sub-Total | | 347 | 26 | 0.075 | 45 | 0.130 | 71 | 0.205 |
| | Fall | September | 222 | 24 | 0.108 | 76 | 0.342 | 100 | 0.450 |
| | | Oct. 1-15 | 176 | 7 | 0.040 | 63 | 0.358 | 70 | 0.398 |
| | | Oct. 16-31 | 43 | 4 | 0.093 | 19 | 0.442 | 23 | 0.535 |
| | | Oct. 1-31 | 219 | 11 | 0.050 | 82 | 0.374 | 93 | 0.425 |
| | Sub-Total | | 441 | 35 | 0.079 | 158 | 0.358 | 193 | 0.438 |
| | Total Season | | 788 | 61 | **0.077** | 203 | **0.258** | 264 | **0.335** |

***Table 5. Numbers of wild and hatchery salmon from summer and fall sampling on Margaree River in 1993.***

| SEASON: | Small Salmon Wild | Small Salmon Hatchery | Small Salmon % Wild | Large Salmon Wild | Large Salmon Hatchery | Large Salmon % Wild | Percent Large |
|---|---|---|---|---|---|---|---|
| Summer (June 1 - Aug. 31) | | | | | | | |
| Trapnets | | | | | | | |
| Lower | 41 | 29 | 59% | 76 | 7 | 92% | 54% |
| Index | 54 | 54 | 50% | 110 | 11 | 91% | 53% |
| Broodstock * | 10 | 9 | 53% | 26 | 12 | 68% | 67% |
| Angling | | | | | | | |
| Logbooks | 24 | 19 | 56% | 22 | 4 | 85% | 38% |
| SCIP | 37 | 58 | 39% | . | . | . | . |
| Sub-Total: | 166 | 169 | 50% | 234 | 34 | 87% | 44% |
| FALL (Sept. 1 - Oct. 31) | | | | | | | |
| Trapnets | | | | | | | |
| Lower | 17 | 1 | 94% | 37 | 2 | 95% | 68% |
| Index | 56 | 1 | 98% | 137 | 4 | 97% | 71% |
| Native | 6 | 1 | 86% | 56 | 0 | 100% | 89% |
| Lake O' Law Fence | 25 | 5 | 83% | 54 | 4 | 93% | 66% |
| Angling | | | | | | | |
| Logbooks | 13 | 2 | 87% | 41 | 3 | 93% | 75% |
| SCIP | 19 | 5 | 79% | . | . | . | . |
| Sub-Total: | 136 | 15 | 90% | 325 | 13 | 96% | 69% |
| ***Total Season:*** | ***302*** | ***184*** | ***62%*** | ***559*** | ***47*** | ***92%*** | ***55%*** |

* - Note broodstock collection was held on August 11.

***Table 6. Proportion wild and proportion hatchery of small and large salmon in the angling catches based on logbook reports.***

| Year | Summer | | Fall | | Total | |
|---|---|---|---|---|---|---|
| | Catch | % Wild | Catch | % Wild | Catch | % Wild |
| ***Small Salmon*** | | | | | | |
| 1989 | 28 | 50% | 5 | 80% | 33 | 55% |
| 1990 | 37 | 81% | 32 | 88% | 69 | 84% |
| 1991 | 26 | 54% | 27 | 89% | 53 | 72% |
| 1992 | 42 | 55% | 35 | 83% | 77 | 68% |
| 1993 | 43 | 56% | 15 | 87% | 58 | 64% |
| ***Large Salmon*** | | | | | | |
| 1989 | 32 | 66% | 38 | 95% | 70 | 81% |
| 1990 | 41 | 85% | 42 | 90% | 83 | 88% |
| 1991 | 40 | 73% | 107 | 93% | 147 | 87% |
| 1992 | 50 | 78% | 120 | 92% | 170 | 88% |
| 1993 | 26 | 85% | 44 | 93% | 70 | 90% |

*Table 7. Distribution of recaptures in the angling fishery for small and large salmon for 1993.*

| Gear | Month | No. Tag | Jun | Jul | Aug | Sep1 | Sep2 | Oct1 | Oct2 | Unk | Total: | Prop. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Small Salmon*** | | | | | | | | | | | |
| Trap | June | 33 | 4 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 16 | 0.48 |
| | July | 80 | . | 3 | 11 | 1 | 1 | 0 | 0 | 1 | 17 | 0.21 |
| | August | 51 | . | . | 10 | 1 | 1 | 6 | 0 | 0 | 18 | 0.35 |
| | Sept. 1-15 | 13 | . | . | . | 1 | 1 | 1 | 0 | 0 | 3 | 0.23 |
| | Sept. 16-30 | 11 | . | . | . | . | 0 | 1 | 1 | 0 | 2 | 0.18 |
| | Oct. 1-15 | 44 | . | . | . | . | . | 4 | 5 | 0 | 9 | 0.20 |
| | Oct. 16-31 | 7 | . | . | . | . | . | . | 0 | 0 | 0 | 0.00 |
| | Sub-total: | 239 | 4 | 14 | 22 | 3 | 3 | 12 | 6 | 1 | 65 | **0.27** |
| Seine | August 11 | 18 | . | . | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0.11 |
| | Total: | 257 | 4 | 14 | 24 | 3 | 3 | 12 | 6 | 1 | 67 | 0.26 |
| | ***Large Salmon*** | | | | | | | | | | | |
| Trap | June * | 21 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 0.14 |
| | July ** | 116 | . | 1 | 7 | 2 | 1 | 4 | 0 | 1 | 16 | 0.14 |
| | August | 59 | . | . | 1 | 0 | 2 | 1 | 2 | 0 | 6 | 0.10 |
| | Sept. 1-15 | 10 | . | . | . | 0 | 1 | 0 | 0 | 0 | 1 | 0.10 |
| | Sept. 16-30 | 26 | . | . | . | . | 0 | 0 | 0 | 0 | 0 | 0.00 |
| | Oct. 1-15 | 111 | . | . | . | . | . | 5 | 4 | 0 | 9 | 0.08 |
| | Oct. 16-31 | 19 | . | . | . | . | . | . | 0 | 0 | 0 | 0.00 |
| | Sub-total: | 362 | 0 | 1 | 8 | 2 | 4 | 12 | 6 | 2 | 35 | **0.10** |
| Seine | August 11 | 41 | . | . | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 0.07 |
| | Total: | 403 | 0 | 1 | 9 | 3 | 4 | 12 | 7 | 2 | 38 | 0.09 |

* - 1 large salmon was caught and kept for broodstock on August 11.
** - 3 large salmon were caught and kept for broodstock on August 11.

***Table 8. Breakdown of the wild and hatchery large salmon contributions to the egg depositions to the Margaree River for 1992 and 1993.***

| *Description:* | *Year* | *Wild* | *Hatchery* | *Total* |
|---|---|---|---|---|
| Percent Female | ***1993*** | 74% | 75% | 74% |
| Avg Wt. of Large Salmon | | 4.50 | 3.93 | 4.46 |
| Fecundity (eggs/kg) | | 1,764 | 1,764 | 1,764 |
| Eggs per Spawner | | 5,874 | 5,199 | 5,822 |
| | | | | |
| Total Returns | | 3,170 | 188 | 3,358 |
| Estimated Returns | | 3,112 | 188 | 3,300 |
| Native Harvests | | 58 | 0 | 58 |
| Total Removals | | 120 | 14 | 134 |
| Angling Mortality | | 47 | 5 | 52 |
| Broodstock | | 12 | 9 | 21 |
| Poaching | | 3 | 0 | 3 |
| Native Harvests | | 58 | 0 | 58 |
| Total Escapement | | 3,050 | 174 | 3,224 |
| | | | | |
| Percent of Total Returns | | 94% | 6% | 100% |
| | | | | |
| Total Eggs | | 17,915,113 | 905,146 | 18,820,258 |
| | | | | |
| Percent of Total Eggs | | 95% | 5% | 100% |
| | | | | |
| Percent Female | ***1992*** | 75% | 45% | 74% |
| Avg Wt. of Large Salmon | | 4.24 | 4.28 | 4.24 |
| Fecundity (eggs/kg) | | 1,764 | 1,764 | 1,764 |
| Eggs per Spawner | | 5,610 | 3,397 | 5,535 |
| | | | | |
| Total Returns | | 6,075 | 300 | 6,375 |
| Total Removals | | 119 | 34 | 153 |
| Angling Mortality | | 85 | 12 | 97 |
| Broodstock | | 34 | 22 | 56 |
| Total Escapement | | 5,956 | 266 | 6,222 |
| | | | | |
| Percent of Total Returns | | 95% | 5% | 100% |
| | | | | |
| Total Eggs | | 33,413,160 | 903,602 | 34,316,762 |
| | | | | |
| Percent of Total Eggs | | 97% | 3% | 100% |

Angling Mortality = large catch estimate * % origin (logs) * 0.05 .
Broodstock = spawned large salmon & mortalities.

*Table 9. Estimates of returns, escapements, and percent of conservation target met for Atlantic salmon from the Margaree River, 1984 to 1993. Mean = (1988 to 1992).*

| | Large Returns | | | Large Escapement | | | Conservation Target Met by Large | | | Collected for Hatchery |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Percentiles | | | Percentiles | | | Percentiles | | |
| Year | Median | 5% | 95% | Median | 5% | 95% | Median | 5% | 95% | (eggs)* |
| 1984 | 412 | 327 | 563 | 381 | 296 | 532 | 37% | 29% | 51% | 0.100 |
| 1985 | 1462 | 1109 | 2217 | 1378 | 1025 | 2133 | 133% | 99% | 206% | 0.150 |
| 1986 | 3616 | 2738 | 5680 | 3461 | 2583 | 5525 | 334% | 249% | 533% | 0.150 |
| 1987 | 4015 | 2976 | 6540 | 3899 | 2860 | 6424 | 376% | 276% | 620% | 0.150 |
| 1988 | 1688 | 1286 | 2494 | 1545 | 1143 | 2351 | 149% | 110% | 227% | 0.300 |
| 1989 | 2289 | 1708 | 3693 | 2164 | 1583 | 3568 | 209% | 153% | 344% | 0.300 |
| 1990 | 11144 | 8073 | 16606 | 11010 | 7939 | 16472 | 1063% | 766% | 1590% | 0.380 |
| 1991 | 3484 | 1853 | 5785 | 3323 | 1692 | 5624 | 321% | 163% | 543% | 0.473 |
| 1992 | 6375 | 2865 | 5639 | 6222 | 2712 | 5486 | 601% | 262% | 530% | 0.300 |
| 1993 | 3358 | 2408 | 6158 | 3224 | 2274 | 6024 | 311% | 219% | 581% | 0.009 |
| +/- 1992 | -47% | | | -48% | | | -48% | | | -97% |
| +/- Mean | -33% | | | -34% | | | -34% | | | -97% |
| | Small Returns | | | Small Escapement | | | Conservation Target Met by Small | | | |
| 1984 | 504 | 400 | 688 | 262 | 158 | 446 | 45% | 27% | 77% | |
| 1985 | 838 | 634 | 1167 | 329 | 125 | 658 | 57% | 21% | 113% | |
| 1986 | 1096 | 838 | 1420 | 314 | 56 | 638 | 54% | 10% | 110% | |
| 1987 | 1478 | 1143 | 1865 | 501 | 166 | 888 | 86% | 29% | 153% | |
| 1988 | 2209 | 1674 | 2911 | 1330 | 795 | 2032 | 229% | 137% | 349% | |
| 1989 | 768 | 591 | 977 | 207 | 30 | 416 | 36% | 5% | 71% | |
| 1990 | 997 | 443 | 1880 | 348 | 0 | 1231 | 60% | 0% | 212% | |
| 1991 | 1909 | 794 | 3891 | 1157 | 42 | 3139 | 199% | 7% | 539% | |
| 1992 | 1645 | 1258 | 2419 | 954 | 567 | 1728 | 164% | 97% | 297% | |
| 1993 | 2087 | 1489 | 3851 | 1337 | 739 | 3101 | 230% | 127% | 533% | |
| +/- 1992 | 27% | | | 40% | | | 40% | | | |
| +/- Mean | 39% | | | 67% | | | 67% | | | |

* Eggs are in millions.

***Table 10. Movements of Atlantic salmon by life stage at Lake O'Law Brook, Margaree River for 1992 and 1993.***

| *Life Stage* | *Origin* | *Sex* | *Upstream* | *Downstream* |
|---|---|---|---|---|
| ***1993 ***** | | | | |
| Parr | | | | 77 |
| Smolt | Wild | | | 1513 |
| | Hatchery | | | 3522 |
| Small Salmon | Wild | Male | 24 | |
| | | Female | 1 | |
| | Hatchery | Male | 5 | |
| | | Female | 0 | |
| | Sub-Total: | | 30 | |
| Large Salmon | Wild | Male | 15 | |
| | | Female | 39 | |
| | Hatchery | Male | 0 | |
| | | Female | 4 | |
| | Sub-Total: | | 58 | |
| Total Adults: | | | 88 | |
| ***1992 **** | | | | |
| Parr | | | 56 | 96 |
| Smolt | Wild | | | 2416 |
| | Hatchery | | | 1900 |
| Small Salmon | Wild | Male | 13 | |
| | | Female | 1 | |
| | Hatchery | Male | 1 | |
| | | Female | 0 | |
| | Sub-Total: | | 15 | |
| Large Salmon | Wild | Male | 19 | |
| | | Female | 29 | |
| | Hatchery | Male | 0 | |
| | | Female | 10 | |
| | Sub-Total: | | 58 | |
| Total Adults: | | | 73 | |

* In 1992 fenced was operated from May 21 until Dec. 1.
**In 1993 fence was operated from May 9 until June 19 and from Sept. 29 until Nov. 15.

*Table 11. Results of electrofishing surveys at barrier net sites in the Margaree River, July, 1992 and 1993.*

| Tributary | Year | Site # | Area ($m^2$) | No. of Sweeps | Life Stage | 5 Min Catch | Sweep Catch | Estimated Numbers | Total Estimate | Variance | Density ($100m^2$) | Mean Length | PHS | Total PHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Big Brook** | **1993** | 15 | 216 | 4 | Fry | 29 | 67 | 79 | 108 | 71.6 | 50 | 3.9 | 3.1% | |
| | | | | | Parr | 16 | 35 | 42 | 58 | 62.1 | 27 | 9.4 | 16.4% | 19.5% |
| **Forest Glen Brook** | | 40 | 136 | 4 | Fry | 58 | 126 | 161 | 219 | 300.1 | 161 | 3.6 | 8.0% | |
| | | | | | Parr | 32 | 69 | 76 | 108 | 26.5 | 79 | 7.7 | 28.8% | 36.8% |
| | | 45 | 226 | 4 | Fry | 51 | 333 | 416 | 467 | 599.7 | 207 | 3.5 | 9.6% | |
| | | | | | Parr | 31 | 175 | 184 | 215 | 20.9 | 95 | 7.2 | 28.9% | 38.5% |
| **MacFarlanes Brook** | | 96 | 185 | 4 | Fry | 26 | 162 | 178 | 204 | 57.9 | 110 | 3.8 | 6.3% | |
| | | | | | Parr | 52 | 159 | 163 | 215 | 8.1 | 116 | 8.5 | 54.5% | 60.8% |
| **Big Brook** | **1992** | 15 | 209 | 4 | Fry | 2 | 63 | 89 | 91 | 436.5 | 44 | 4.1 | 3.0% | |
| | | | | | Parr | 6 | 55 | 62 | 68 | 35.9 | 33 | 9.3 | 19.3% | 22.3% |
| **Forest Glen Brook** | | 40 | 128 | 4 | Fry | 33 | 116 | 130 | 163 | 59.3 | 127 | 3.8 | 7.3% | |
| | | | | | Parr | 14 | 56 | 66 | 80 | 66.2 | 63 | 8.5 | 29.3% | 36.6% |
| | | 45 | 171 | 4 | Fry | 63 | 409 | 588 | 651 | 2564.5 | 381 | 3.6 | 19.0% | |
| | | | | | Parr | 15 | 83 | 85 | 100 | 6 | 58 | 8.3 | 25.8% | 44.8% |
| **MacFarlanes Brook** | | 96 | 135 | 4 | Fry | 5 | 44 | 45 | 50 | 2.6 | 37 | 4.3 | 2.9% | |
| | | | | | Parr | 13 | 63 | 68 | 81 | 19.5 | 60 | 9.9 | 41.9% | 44.8% |
| **Trout Brook** | | 98 | 199 | 3 | Fry | 3 | 32 | 36 | 39 | 22.5 | 20 | 3.6 | 1.0% | |
| | | | | | Parr | 0 | 12 | 12 | 12 | 0.4 | 6 | 8.4 | 2.7% | 3.7% |

***Table 12. Estimation of spawner requirements for conservation, maximum gain and maximum recruitment targets for the Margaree River.***

| | | | | | |
|---|---|---|---|---|---|
| ***Conservation Requirements:*** | | | | | |
| Rearing Units | | = | 27,976 | (100 m²) | (Marshall 1982) |
| Optimal Egg Deposition | | = | 240 | per unit | (Elson 1975) |
| Total Egg Requirements | | = | 6,714,240 | | |
| Biological Characteristics: | | | | | |
| Fecundity | eggs / kg | = | 1,764 | | (Elson 1975) |
| Small | % Female | = | 11% | | (Marshall 1982) |
| | Mean Wt (kg) | = | 1.7 | | (Marshall 1982) |
| Large | % Female | = | 75% | | (Marshall 1982) |
| | Mean Wt (kg) | = | 4.9 | | (Marshall 1982) |
| Eggs per spawner | Small | = | eggs/kg * mean wt (kg) * %female | | |
| | | = | 1,764 * 1.7 * 11% | | |
| | | = | 330 | | |
| | Large | = | eggs/kg * mean wt (kg) * %female | | |
| | | = | 1,764 * 4.9 * 75% | | |
| | | = | 6,483 | | |
| Required number of large salmon | | = | egg requirements / eggs per large salmon | | |
| | | = | 6,714,240 / 6,483 | | |
| | | = | 1,036 | | |
| | Females | = | 777 | | |
| | Males | = | 259 | | |
| Deficit Males | | = | 518 | | |
| Required number of small salmon | | = | deficit males / %male | | |
| | | = | 518 / 89% | | |
| | | = | 582 | | |
| ***Minimum Requirements:*** | ***Large*** | = | ***1,036*** | | |
| | ***Small*** | = | ***582*** | | |
| ***Maximum Gain:*** | | | | | |
| Required number of large salmon | | = | 1,352 | | |
| | Females | = | 1,014 | | |
| | Males | = | 338 | | |
| Deficit Males | | = | 676 | | |
| Required number of small salmon | | = | deficit males / %male | | |
| | | = | 676 / 89% | | |
| | | = | 760 | | |
| ***Maximum Gain Requirements:*** | ***Large*** | = | ***1,352*** | | |
| | ***Small*** | = | ***760*** | | |
| ***Maximum Recruitment:*** | | | | | |
| Required number of large salmon | | = | 1,974 | | |
| | Females | = | 1,481 | | |
| | Males | = | 493 | | |
| Deficit Males | | = | 988 | | |
| Required number of small salmon | | = | deficit males / %male | | |
| | | = | 988 / 89% | | |
| | | = | 1,110 | | |
| ***Maximum Recruitment Requirements:*** | ***Large*** | = | ***1,974*** | | |
| | ***Small*** | = | ***1,110*** | | |

***Table 13. 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). 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 | | | |
| 1992 | MAR | 21,800 * | | 20,000 | | 33,600 | | 92,500 | |
| | COB | 16,900 | | | | 3,500 | | 9,800 | |
| 1993 | MAR | 17,083 * | | 20,000 | | 27,554 | | 52,728 | |
| | COB | 15,000 | | | | 5,712 | | | |

* Reared at the Lake O'Law cages.

@ 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.

? Millbank broodstock.

*Table 14. Summary of tag recaptures from smolt and adult releases in the Margaree River 1986 to 1993.*

| Release Year | Stock | Stage | No. Tags Applied | Tag Type | Series | | Greenland | | | | | | Newfoundland | | | | | | | Quebec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1A | 1B | 1C | 1D | 1E | 1F | 1 | 2 | 3 | 4 | 8 | 13 | 14 | Q9 | 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 | | | | | | | | | | | | | | | | 0 |
| | | | | | P22500-P23199 | | 1 | 1 | 1 | | | | | | | | | | | | 3 |
| | | | | | P23300-P23499 | | | | | | | | | | | | | | | | 0 |
| 1987 | Margaree River | small/large | 138 | Carlin | zz23000-zz23137 | | | | | | | | | | 2 | | | | | 2 | 4 |
| 1988 | Margaree River | 2+ smolt | 4116 | CWT | 55 16/12 | | | | | | | | | | | | | | | | |
| | | small/large | 340 | Carlin | zz23138-zz23299 | | | | | | | | | | 2 | 2 | | | | 1 | 5 |
| | | | | | zz23401-zz23581 | | | | | | | | | | | | | | | | |
| 1989 | Margaree River | small/large | 425 | Carlin | zz23583-zz23999 | b | | | | | 1 | | | 1 | 3 | | 1 | | | | 6 |
| | | | | | zz23300-zz23309 | | | | | | | | | | | | | | | | |
| 1990 | Margaree River | small/large | 576 | Carlin | zz23310-zz23399 | c | | | | | | | | | 1 | | | 1 | 1 | 2 | 5 |
| | | | | | zz24000-zz24489 | | | | | | | | | | | | | | | | |
| 1991 | Margaree River | small/large | 494 | Carlin | zz24490-zz24799 | d | | | | | | | | 2 | | | | | | 1 | 3 |
| | | | | | zz24900-zz24999 | | | | | | | | | | | | | | | | |
| | | | | | zz35000-zz35087 | | | | | | | | | | | | | | | | |
| 1992 | Margaree River | small/large | 1175 | Carlin | zz35088-zz35991 | e | | | | | | | | | | | | | | 2 | 2 |
| | | | | | zz36000-zz36280 | | | | | | | | | | | | | | | | |
| 1993 | Margaree River | small/large | 661 | Carlin | zz36281-zz36943 | f | | | | | | | | | | | | | | | 0 |

a - May also be Neisiguit River origin as same series used for those released.
b - Excluding tags 23950 and 23951.
c - Excluding tags 24287, 24443, and 24482.
d - Excluding tags 24510, 24713, 24719, and 24763.
e - Excluding tags 35124,35213, 35563, 35569, 35576, 35787, 36018, 36019, 36079, and 36213.
f - Excluding tags 36727 and 36871.

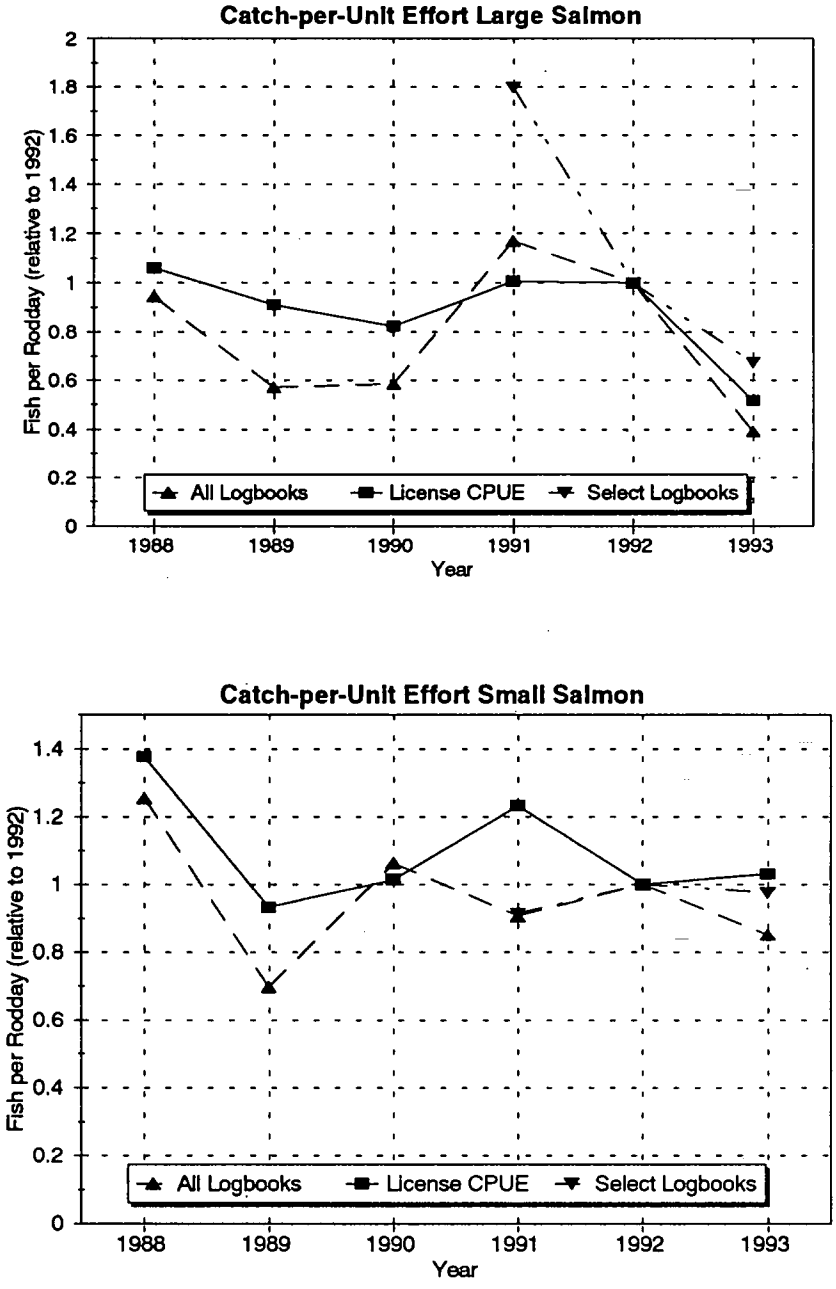



Figure 1. Catch-per-unit of effort (fish per rodday) between 1988 and 1993 based on volunteer logbooks and license stub data.

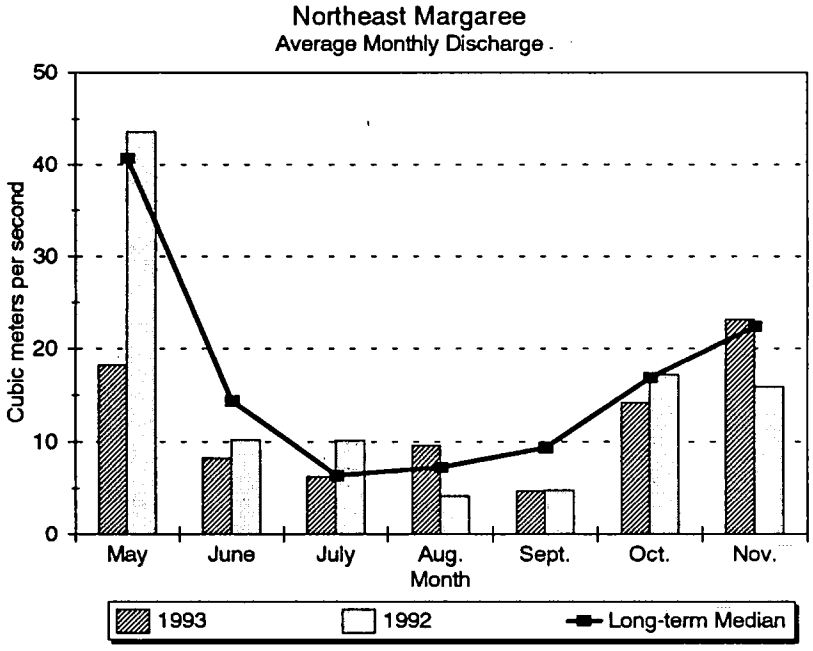
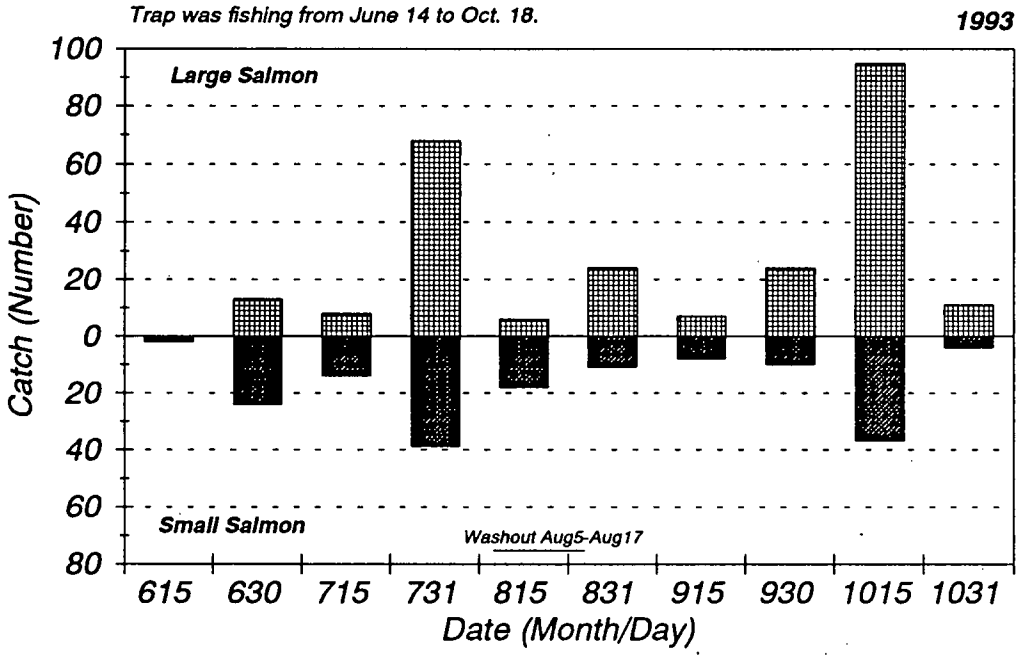



Figure 2. Average monthly discharge (cubic metres per second) in the Northeast Margaree, 1992 and 1993.



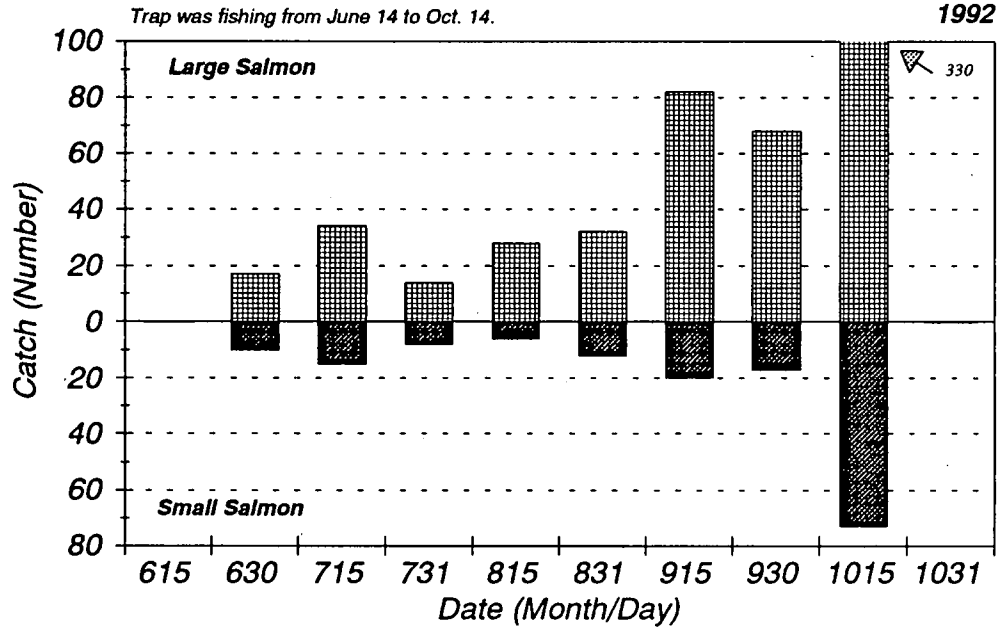




***Figure 3. Timing of catches of small salmon and large salmon at the Index trapnet (Levis) on the Margaree River for 1992 and 1993.***

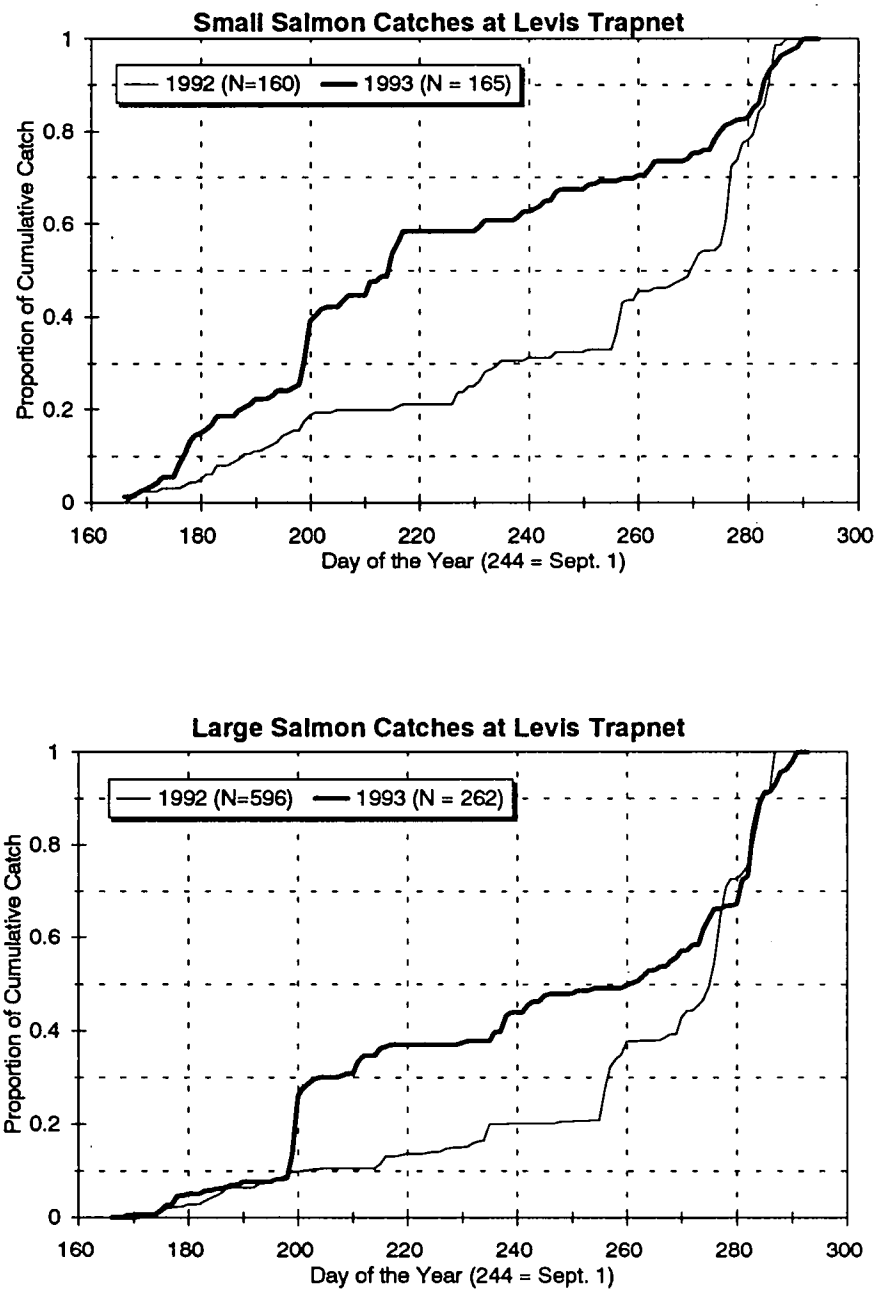



Figure 4. Timing of catches of small salmon (upper) and large salmon (lower) at the index trapnet (Levis), Margaree River, for 1992 and 1993.

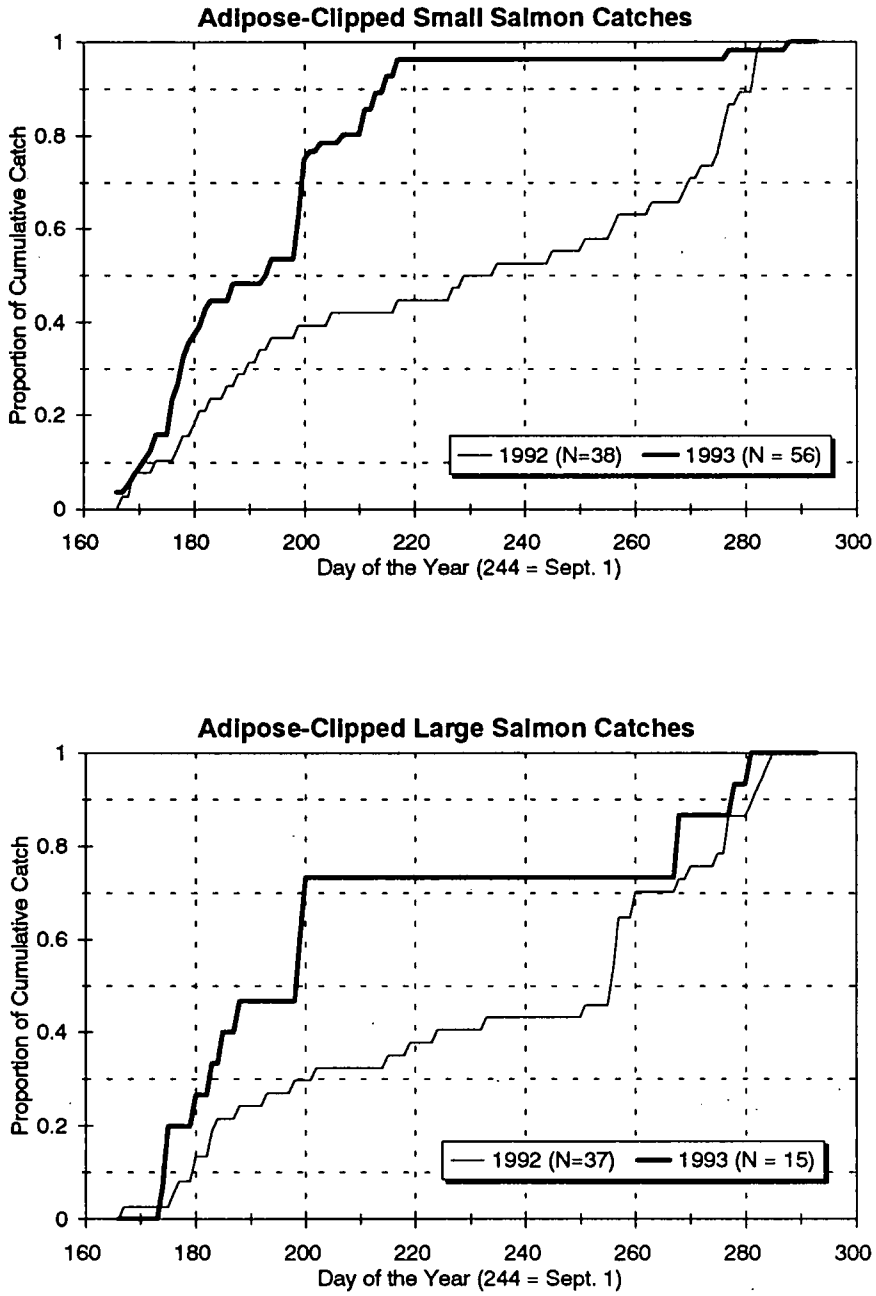



Figure 5. Timing of catches of adipose-clipped small salmon (upper) and large salmon (lower) at the Levis trapnet, Margaree River, for 1992 and 1993.

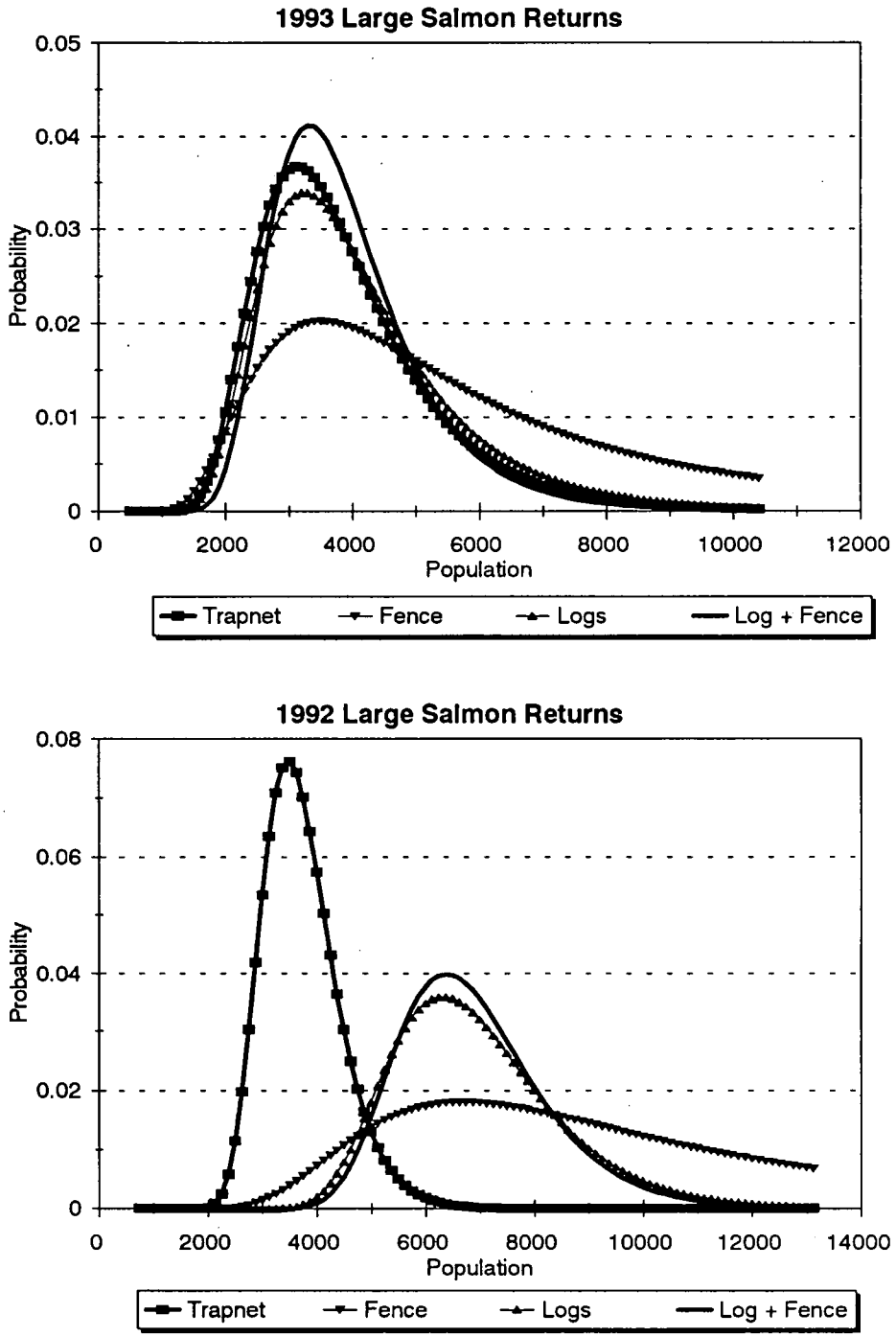
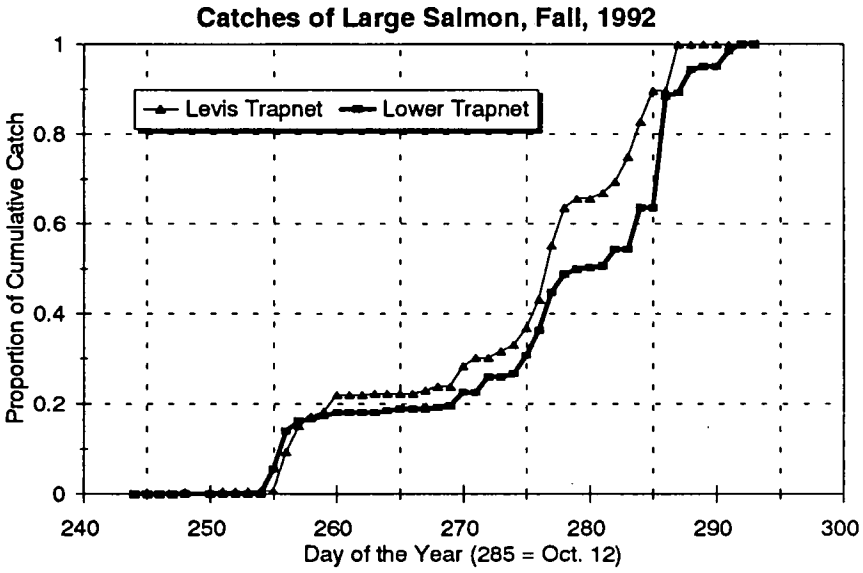



Figure 6. Estimated returns of large salmon to the Margaree River in 1993 (upper) and in 1992 (lower) based on mark/recapture using tags from the index trapnet only.



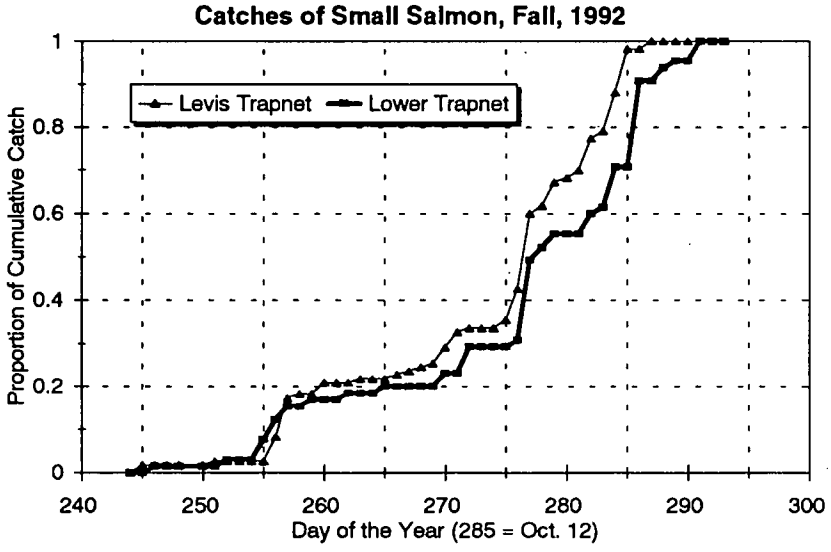




Figure 7. Catches of large (upper) and small (lower) salmon at the two trapnets in the fall of 1992.

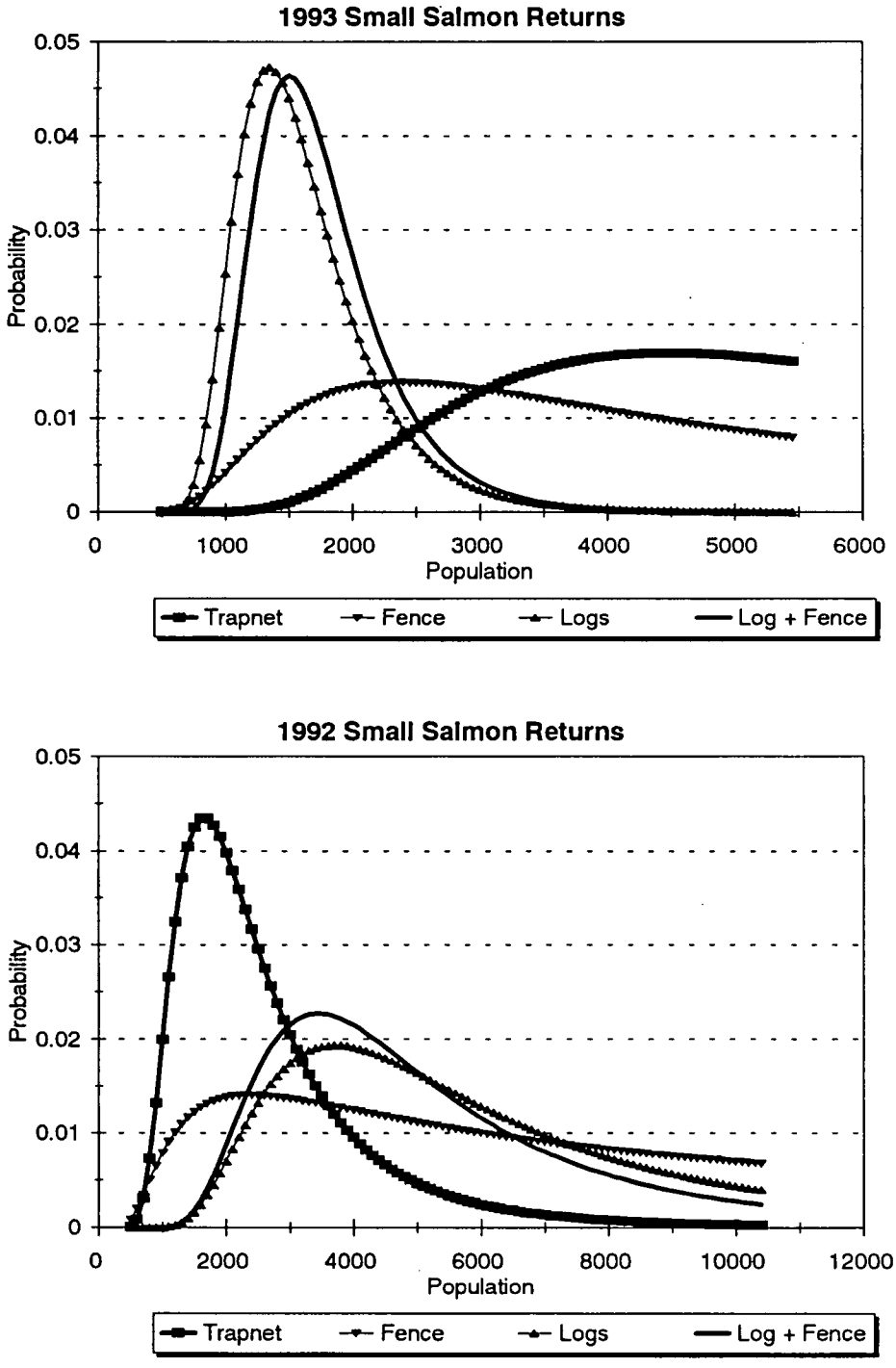
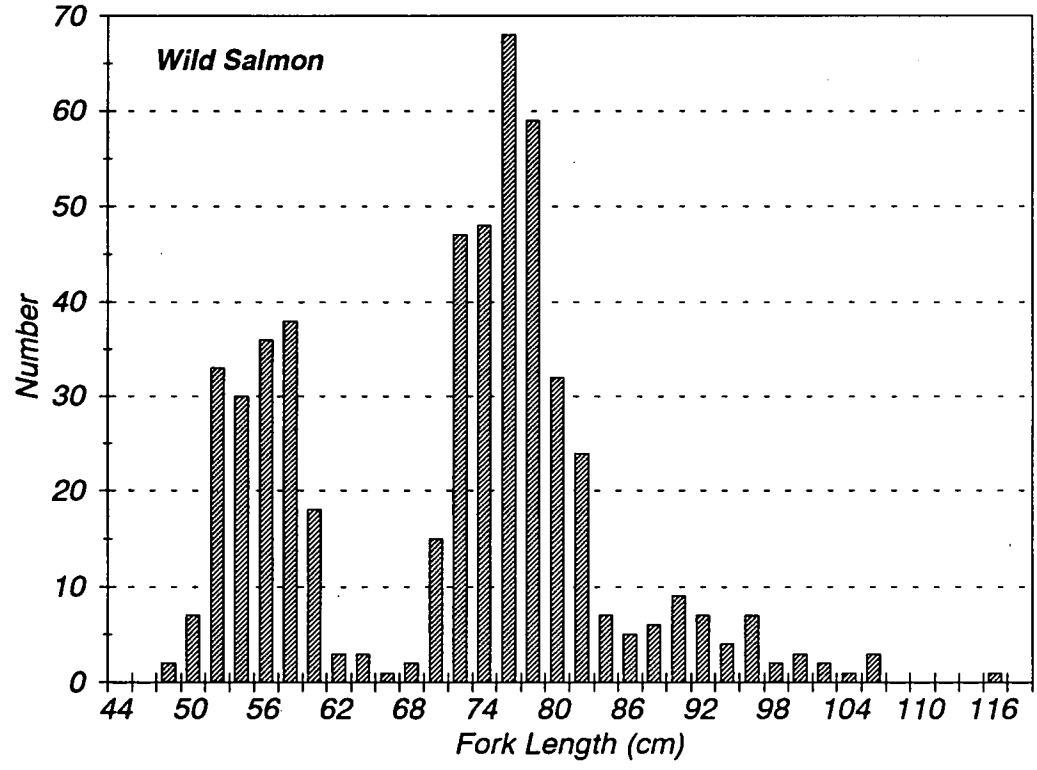



Figure 8. Estimated returns of small salmon to the Margaree River in 1993 (upper) and in 1992 (lower) based on mark/recapture using tags from the index trapnet only.



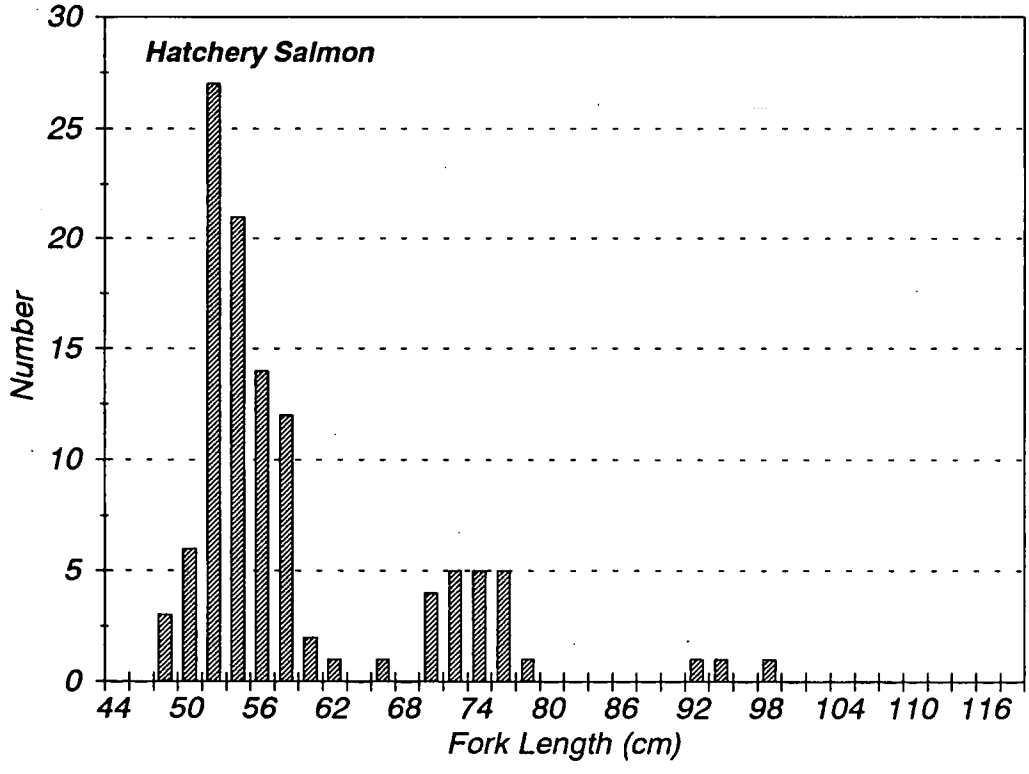




*Figure 9. Length frequency distribution of wild and hatchery salmon at the trapnets on the Margaree River, 1993.*

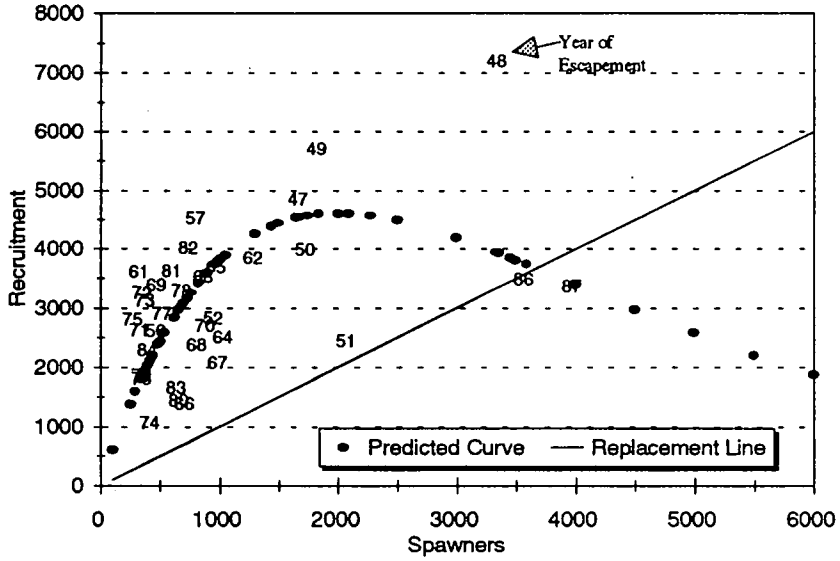



Figure 10. Spawner/recruitment relationship for large salmon from the Margaree River.

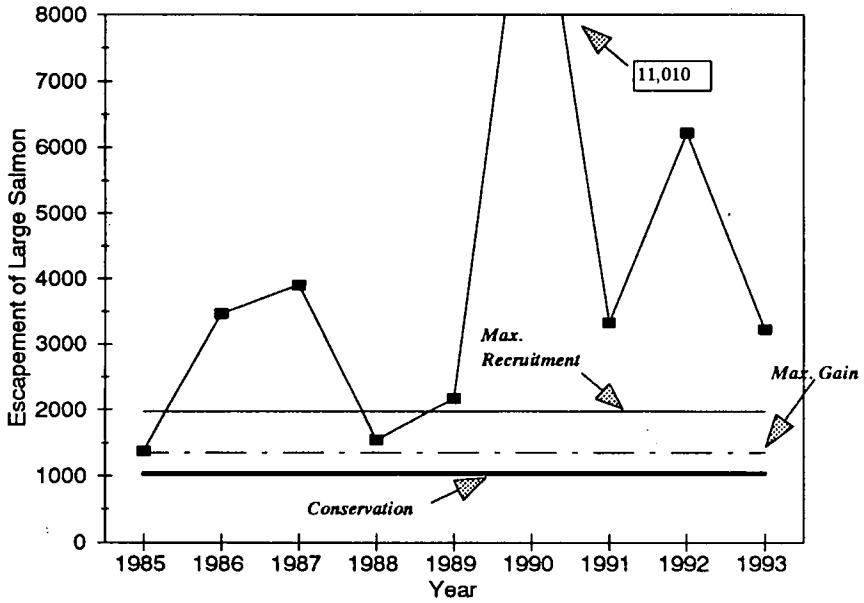



Figure 11. Escapement of large salmon to the Margaree River since 1985 relative to reference levels for escapement.

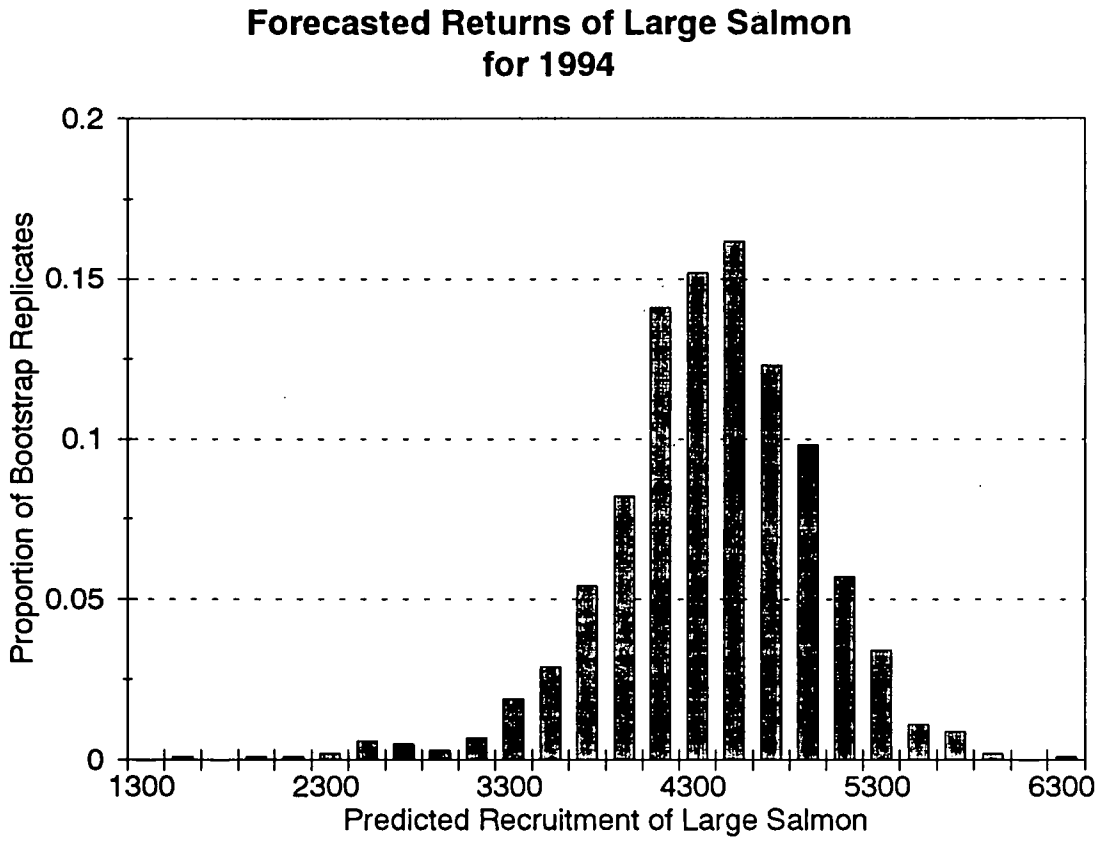



Figure 12. Predicted return of large salmon to the Margaree River in 1994 based on spawner/recruitment relationship.

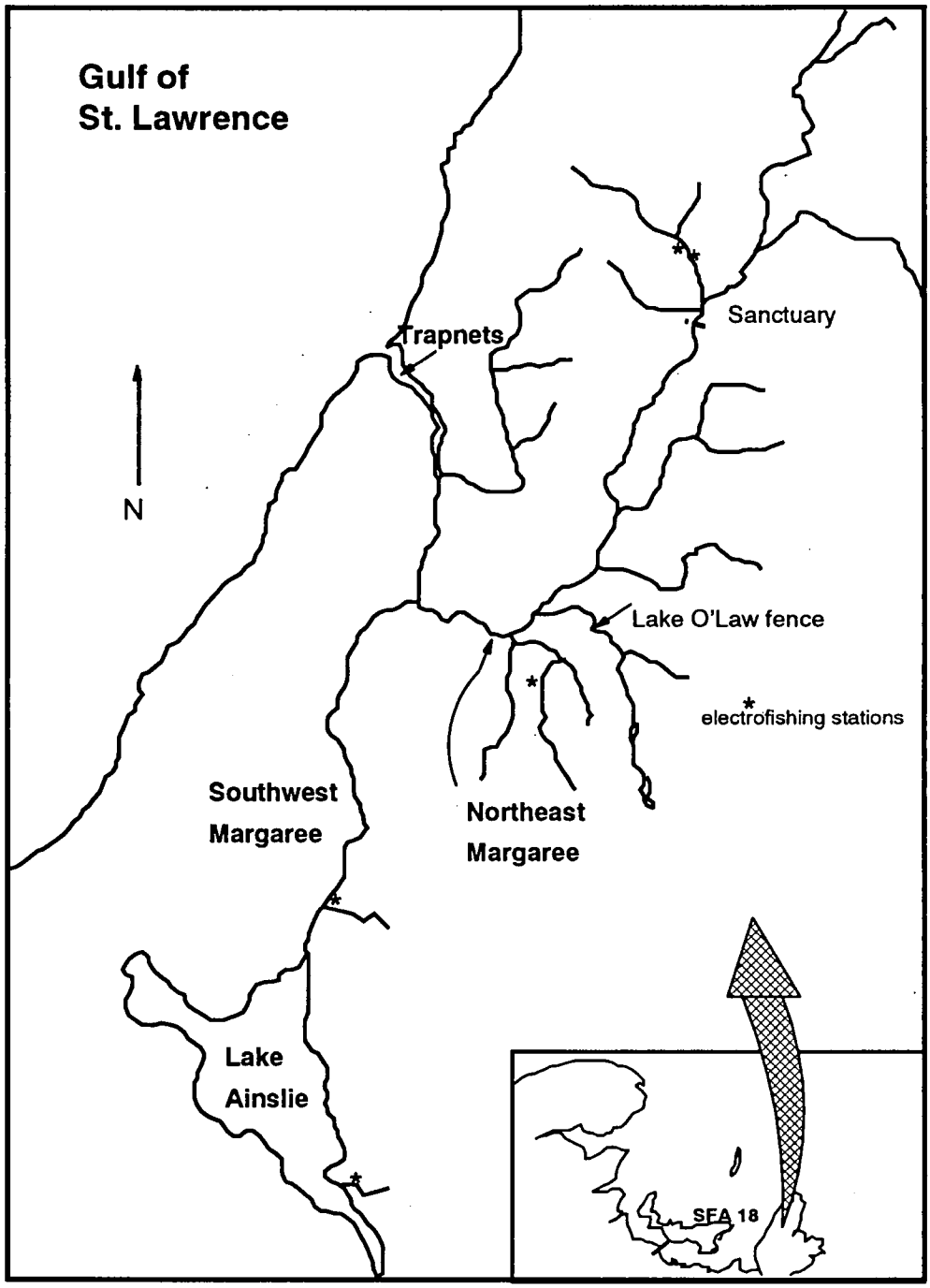



Figure 13. Margaree River, NS, showing trapnet, counting fence and electrofishing stations (*) on the Margaree River, 1993.