DFO Atlantic Fisheries
Research Document 96/142

MPO Pêches de l'Atlantique
Document de recherche 96/142

# Status of Atlantic salmon stocks of the Margaree and other selected rivers of Cape Breton Island, 1995

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## ABSTRACT

Assessments of the stock status of Atlantic salmon were conducted on the Margaree, Middle, Baddeck, North, Sydney and Grand rivers of SFAs 18 and 19, Cape Breton Island. These rivers account for >90% of the total recreational fishing effort exerted on the Island's 33 rivers fished for salmon in 1995.

Returning salmon were either counted at fishways or estimated by mark-and-recapture techniques. Estimated returns of 2,365 large and 737 small salmon to the Margaree, 268 large and 120 small salmon to the North and 19 large and 262 small to Grand River Falls contributed attainment of 192, 169 and 120% of respective conservation requirements. Returns of 328 large and 51 small fish to the Middle River, 265 large and 96 small fish to Baddeck River and 104 large and 18 small salmon to the Sydney River contributed to the attainment of 67, 68 and 61% of their respective conservation requirements. Evidence of lateness of salmon returning to some rivers raised uncertainty about completeness of estimates to the Middle, Baddeck and perhaps, North rivers.

Prognoses for 1996, based on forecast models, juvenile salmon densities, recent estimates of area of overwinter habitat in the North Atlantic and numbers of hatchery smolts stocked in 1995 are that returns should be similar to those of 1995. MSW escapements to the Margaree River have exceeded conservation requirements during the last decade. Escapement of 1SW fish to the Margaree was less than conservation requirements in 1994-1995 and might benefit from additional protection.

## RÉSUMÉ

Des évaluations de l'état des stocks de saumon de l'Atlantique ont été réalisées pour les rivières Margaree, Middle, Baddeck, North, Sydney et Grand des ZPS 18 et 19, de l'île du Cap-Breton. Ces rivières comptent pour plus de 90 % de l'effort total de la pêche récréative qui a été exercé dans les 33 rivières de pêche du saumon de l'île en 1995.

Le nombre de saumons en montaison a été déterminé à des passes à poisson ou estimé par techniques de marquage-recapture. Les remontées estimées de 2 365 gros saumons et 737 petits saumons dans la Margaree, de 268 gros et 120 petits saumons dans la North et de 19 gros et 262 petits saumons à Grand River Falls ont permis de satisfaire les besoins de conservation à raison de, respectivement, 192, 169 et 120 %. Par ailleurs, des remontées de 328 gros et 51 petits saumons dans la Middle, de 265 gros et 96 petits saumons dans la Baddeck et de 104 gros et 18 petits saumons dans la Sydney représentaient une atteinte des besoins de conservation de, respectivement, 67, 68 et 61 %. Des indices d'une remontée tardive dans certaines rivières soulèvent des doutes quant au caractère complet des estimations obtenues pour les rivières Middle, Baddeck et, peut-être, North.

Selon les prévisions par modélisation pour 1996, les densités de saumons juvéniles, les estimations récentes de la superficie des habitats d'hiver dans l'Atlantique Nord et le nombre de saumoneaux d'élevage relâchés en 1995, les remontées devraient être semblables à celles de 1995. Les échappées de saumons PBM de la rivière Margaree ont dépassé les besoins de conservation au cours de la dernière décennie. Les échappées de UBM de la Margaree ont été inférieures aux besoins de conservation en 1994-1995 et des mesures de protection supplémentaires pourraient s'avérer utiles.

**STOCK:** **Margaree River**, Inverness Co. (SFA 18)
**CONSERVATION REQUIREMENT:** 6.7 million eggs (1,036 large, 582 small salmon)

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | MIN[1] | MAX[1] | MEAN[1] |
|---|---|---|---|---|---|---|---|---|---|
| **Angling catch[2]** | | | | | | | | | |
| Large | 1,507 | 1,757 | 1,938 | 1,102 | 1,479 | 1,040 | 1,102 | 2,636 | 1,557 |
| Small | 649 | 752 | 678 | 777 | 429 | 323 | 429 | 977 | 657 |
| **First Peoples' harvest** | | | | | | | | | |
| Large | - | 1 | - | 58 | 50 | 4 | - | - | - |
| Small | - | 2 | - | 8 | 14 | 2 | - | - | - |
| **Total returns** | | | | | | | | | |
| Large | 5,156 | 3,484 | 6,375 | 3,358 | 2,900 | 2,365 | 1,462 | 6,375 | 4,255 |
| small | 1,977 | 1,909 | 1,645 | 2,087 | 708 | 737 | 708 | 2,209 | 1,665 |
| **Spawning escapement** | | | | | | | | | |
| Large | 5,022 | 3,323 | 6,222 | 3,224 | 2,759 | 2,308 | 1,378 | 6,222 | 4,110 |
| Small | 1,471 | 1,340 | 1,088 | 1,504 | 390 | 529 | 328 | 1,504 | 1,159 |
| **% of large required** | 485 | 321 | 601 | 311 | 266 | 223 | 133 | 601 | 397 |
| **Juveniles per 100m$^2$** | | | | | | | | | |
| # of sites | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Fry | | 133 | 154 | 122 | 117 | 186 | 117 | 186 | 132 |
| Parr | | 58 | 50 | 79 | 69 | 77 | 50 | 79 | 64 |

[1] Min and Max are for 1985-1994; juveniles, 1991-1994. Mean corresponds to 1990-1994; juveniles 1991-1994.
[2] All angling catches are NS license stub estimates. Angling catches for large salmon are hook-and-release estimates; small salmon include retained and released fish.

**Harvests:** Harvests included a reported 6 salmon taken by First Peoples, and an estimated 199 small salmon taken in the recreational fishery.

**Data and Methodology:** Counts of tagged and untagged adult salmon were obtained from a swim-thru count on Aug 2, seining on Oct 25, logbooks maintained by selected anglers (thru Oct 31) and a trap in the Lake O'Law counting fence (thru Nov 26). Most fish were tagged at the Levi's estuarial trap; additional tags were applied to fish seined in the Hatchery and Forks pools. Petersen mark-and-recapture principles and a Bayesian estimation procedure were used to describe the most probable (mode) number of large and small salmon returns. Densities of juvenile salmon were estimated at four tributary and one mainstem sites.

**State of the Stock:** Estimated large salmon returns of 2,365 fish were the lowest since 1989; small salmon (737) numbered about the same as those of 1994 and were among the fewest of the last 11 years. However, large salmon and their egg depositions were 223% of the conservation requirement. Escapement of small salmon was 91% of target. Hatchery-origin small salmon were 17 and 5% of the respective summer and fall fish. As much as 45% of the salmon population ascended the river after October 25. Juvenile densities of 166 fry and 72 parr per unit (3 ongoing sites) are consistent with recent high levels of egg deposition.

**Forecast for 1996:** Forecasts of returns for 1996 range from 3,200 to 4,400 large salmon. However declining estimates of large salmon returns since 1992, and low returns of small salmon support the contention for many stocks, that sea survival is now lower than previously experienced. Present low sea survivals is not accounted for in most forecast models and therefore can contribute to optimistic forecasts e.g., forecasts of large salmon returns for 1995 ranged from 2,700 to 4,700 salmon; 2,400 may have returned. Therefore, large salmon returns in 1996 will exceed target but may be no greater than those of 1994-95 (2,400-2,900 fish); small salmon should also exceed the target but may also be similar to those of 1994-95 (700 fish).

**Management considerations:** Returns of small and large salmon should exceed conservation requirements; small salmon escapement may not meet conservation requirements. Summer-run large fish may comprise as few as 15% of the total run. Allocations of surplus fish should be in proportion to the relative abundances of summer-and fall-run fish. Mid-summer assessments offer the potential to adjust fishing plans.

**STOCK:** **Middle River**, Victoria Co. (SFA 19)
**CONSERVATION REQUIREMENT:** 2.07 million eggs (470 large, 80 small)

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | MIN[1] | MAX[1] | MEAN[1] |
|---|---|---|---|---|---|---|---|---|---|
| **First Peoples' harvest (small + large)** | | | | | | | | | |
| In-river | 0 | 0 | 38 | 0 | 15 | 0 | - | - | - |
| Estuarial[2] | 65 | 127 | 75 | 40 | 0 | 8 | 0 | 127 | 61 |
| **Angling catch** | | | | | | | | | |
| Small | 107 | 27 | 11 | 30 | 24 | 39 | 11 | 107 | 40 |
| Large | 197 | 186 | 30 | 48 | 166 | 54 | 30 | 197 | 125 |
| **Swim-through counts** | | | | | | | | | |
| Small | 69 | 18 | 56 | 2 | 35 | 23 | 2 | 69 | 36 |
| Large | 234 | 254 | 212 | 32 | 324 | 160 | 32 | 324 | 211 |
| **Total returns[3]** | | | | | | | | | |
| Small + Large | 510 | 417 | 362 | 127 | 470 | 379 | 127 | 470 | 377 |
| **Proportion of holding area covered in swim-through counts** | | | | | | | | | |
| | 0.83 | 1.00 | 0.96 | 0.55 | 0.83 | 0.83 | 0.55 | 1.00 | 0.83 |
| **Estimated escapement** | | | | | | | | | |
| Large salmon | 281 | 254 | 191 | 58 | 415 | 324 | 58 | 415 | 240 |
| Small + Large | 365 | 272 | 241 | 62 | 460 | 371 | 62 | 460 | 280 |
| **% of adults required** | | | | | | | | | |
| | 66 | 49 | 44 | 11 | 84 | 67 | 11 | 84 | 51 |

[1] Min, Max, and Mean are for 1990-1994.
[2] 50% of the Wagmatcook First Nation harvest assumed to be of Middle River origin.
[3] Swim-through counts/divided by proportion area covered, 1990-1993; mark-and-recapture modal values (no tag loss) 1994-1995, taken as 100% of area.

**Harvests:** Eight salmon of Middle River origins were estimated to be among 15 fish reported as being harvested by Wagmatcook First Nation. The recreational fishery was restricted to hook-and-release fishing.

**Data and Methodology:** Counts of tagged and untagged adult salmon were conducted on Oct 18, 1995, by teams of divers floating 83% of the river's salmon holding areas. (Tags had been applied to 12 fish on Oct 17.) Petersen mark-and-recapture principles and a Bayesian estimation procedure were used to describe the most probable number of fish in the river. Juvenile salmon densities were estimated at only 3 sites; two on the mainstem and one on MacKenzie Brook.

**State of the Stock:** Conservation requirements were estimated not to have been met on Oct 18, 1995. Target spawners as described by mid-, late-October counts and/or estimates have not been met since 1989. There has been no hatchery stocking since 1989. Fry densities resultant of 1994 spawning were as high as those of the Margaree where conservation requirements have been exceeded for the last 11 years. Parr densities of 18, 34 and 76 per $100m^2$ were not as high as those of all Margaree sites but, respectable given that escapements in 1992-1993 were estimated, on average, to have been only 27% of requirements.

**Forecast for 1996:** Returns in 1996 are not expected to exceed those of 1995. This prognosis is based on the fact that estimated returns in 1995, principally from target spawners in 1989, did not knowingly meet conservation requirements; fewer spawners in 1990, which would contribute to returns in 1996, are unlikely to generate more returns than those of 1995; low sea-survival rates, calibrated with hatchery smolts stocked in other rivers, are, on the basis of an index of winter habitat in the North Atlantic, not expected to improve. Together these elements suggest that returns in 1996 should not be expected to exceed those of 1995. The prognosis would be more optimistic if, in fact, returns in 1995 were estimated prior to completion of the run. Evidence from the Margaree, Sydney and Grand rivers suggests that salmon runs may have been unusually late in 1995.

**Management considerations:** Vestiges of the summer-run component deserve full protection; total returns may be somewhat underestimated because of late-run timing and unreported removals.

**STOCK:** **Grand River**, Richmond Co. (SFA 19)
**CONSERVATION REQUIREMENT:** 1.1 million eggs, (545 salmon total river; 234 above Falls)

| Year | 1990 | 1991[1] | 1992 | 1993 | 1994 | 1995 | MIN[2] | MAX[2] | MEAN[2] |
|---|---|---|---|---|---|---|---|---|---|
| **First Peoples' harvest** | | | | | | | | | |
| In-river | 24 | 39 | 0 | 0 | 0 | - | - | - | - |
| Estuarial | 0 | 0 | 0 | 0 | 0 | - | - | - | - |
| **Angling catch (total river)** | | | | | | | | | |
| Small | 416 | 115 | 139 | 113 | 81 | - | 81 | 416 | 173 |
| Large | 98 | 15 | 46 | 22 | 10 | - | 10 | 98 | 38 |
| **% Caught and retained above the fishway** | | | | | | | | | |
| | 31 | 31 | 31 | 31 | 0 | - | 0 | 31 | 25 |
| **Broodstock[3]** | 18 | 19 | 10 | 0 | 7 | 0 | 0 | 19 | 11 |
| **Count at fishway** | | | | | | | | | |
| Small | 527 | 234 | 114 | 91 | 64 | 157 | 64 | 527 | 206 |
| Large | 27 | 18 | 18 | 5 | 5 | 8 | 5 | 27 | 15 |
| % Hatchery | 43 | 45 | 38 | 45 | 14 | 32 | 14 | 45 | 37 |
| **Fish which by-pass the fishway** | | | | | | | | | |
| Small | 52 | 176 | 40 | 32 | 130 | 105 | 32 | 176 | 86 |
| Large | 20 | 14 | 14 | 4 | 9 | 11 | 4 | 20 | 61 |
| **Population estimate above the fishway** | | | | | | | | | |
| Small + Large | 626 | 442 | 186 | 132 | 208[4] | 281 | 132 | 626 | 319 |
| **Estimated escapement above the fishway** | | | | | | | | | |
| Small + Large | 455 | 348 | 133 | 97 | 201[4] | 281 | 97 | 455 | 247 |
| **% of fish required** | | | | | | | | | |
| above fishway | 194 | 149 | 57 | 41 | 86[4] | 120 | 41 | 194 | 105 |

[1] Inseason variation closures.
[2] Min, Max and Mean are for 1990-1994.
[3] Broodstock collected at or above fishway.
[4] Revised.

**Harvests:** River closed to all fishing in 1995.

**Data and methodology:** Partial counts are obtained from a trap in a fishway at Grand Falls - 10.2 km from the head-of-tide. Total returns are estimated as Count/[1 - by-pass rate] where by-pass rates (0.4 for small and 0.57 for large) were estimated from the proportions of marked and unmarked fish found in broodstock collections above the Falls. Juvenile salmon densities were estimated at two sites each above and below the Falls and in Black River.

**State of the stock:** Conservation requirements were estimated to have been met in 1995 - the first time since 1991. Counts (70% of conservation requirements) were the highest since 1991; 20% of the run was tallied in late-October, early-November when normally the trap would have been removed. Hatchery fish comprised 32% of returns; double their contribution in 1994. Juvenile densities were low (4-16 and 2-13 fry and parr/100m$^2$, respectively) relative to rivers of Cape Breton Highlands. Densities at two sites in 1995, that were fished in 1988, were $\geq$ densities of 1988.

**Forecast for 1996:** Returns to Grand Falls in 1996 should at least equal, if not exceed, returns in 1995. This prognosis is based on estimated returns to Grand River Falls increasing since 1993 when retention of small salmon was last allowed in the recreational fishery; and the number of hatchery smolts stocked in 1995 and which will be contributing to returns in 1996 being 3.5 times that of 1994.

**Management considerations:** By-pass rates at Grand Falls are based on few data; estimates of returns above Grand Falls are not made without error. Returns to Grand Falls in 1996 from 1995 hatchery stocking should equal conservation requirements; there is no certainty that conservation requirements will be met below Grand Falls or in other coastal rivers with stocks similar to those of Grand River and which have received no hatchery stocking.

## INTRODUCTION

This document is background to the management of Atlantic salmon (*Salmo salar*) stocks of the **Margaree, Middle, Baddeck, North, Sydney**, and **Grand** rivers of Cape Breton Island, Nova Scotia (Fig. 1). Although they are but six of the Islands' thirty-three rivers known to support recreational angling for salmon (inc. those of Cape Breton Highlands National Park), they account for >90% of the total fishing effort for salmon on Cape Breton. Assessments of these stocks in 1994 were reported by Claytor et al. (1995) and Amiro and Longard (1995); in 1993 they were reported by Chaput et al. (1994) and Cutting et al. (1994).

The main elements of this document are the assessment of the numbers of salmon that returned and spawned in 1995, an evaluation of the numbers of spawners relative to conservation requirements and, where possible, a prognosis of returns in 1996. Returns are assessed using mark-and-recapture techniques on the Margaree, Middle, Baddeck and North rivers and counts at a fishway on each of the Grand and Sydney rivers. Returns minus removals equal escapement, and escapements are evaluated against spawning requirements reported by Chaput et al. (1994), Amiro and Longard (1990) and Marshall et al. (1992).

Procedures and activities in 1995 were essentially the same as in 1994. Minor exceptions were the addition of two adult mark-and-recapture assessments and a preliminary study of the movement of tagged salmon in the Margaree River. Smolt monitoring was discontinued on the Lake O'Law Brook, tributary to the Margaree, and measurements of juvenile salmon densities on all rivers were fewer than planned. No progress was made in the requested re-evaluation of target spawning requirements on some rivers.

Scale material was again provided to the Gene Probe Lab, Dalhousie University, for study [DNA micro-satellite markers] of the possible impact of stocking hatchery-reared smolts of Grand River parentage on wild Grand River salmon. Tissue samples were also provided to Laval University for a study of the possible genetic differences in early- and late-run salmon of the Margaree River. Results are not yet available.

In 1994, spawning escapements for the Middle, Baddeck and Grand rivers were less than the target. In the Margaree and North rivers, escapements exceeded requirements. Forecasts for 1995, were that returns would be similar to those of 1994. Meetings with fishery managers and First Peoples resulted in: (i) allocations of salmon from the Margaree and North rivers to First Peoples, (ii) the maintenance of a "retention" fishery for small salmon or grilse (<63cm) captured by anglers on the Margaree and other rivers tributary to the Gulf and (iii) with the exception of the Grand River, a hook-and-release recreational fishery for salmon on all remaining rivers of the Island (true also for rivers of Cape Breton Highlands National Park although regulated by Parks Canada). The Grand River was closed to all salmon fishing. Food fisheries by First Peoples were also directed toward Bras d'Or Lake and associated channels where significant numbers of aquaculture salmon were at large.

### Description of the Fisheries

Native Fisheries

The fishing of salmon with trapnets occurred in the Margaree River estuary and Bras d'Or Lake, channels and bays, specifically, in the vicinity of Christmas Brook, Eskasoni, St. Peter's Inlet, Whycocomagh Bay and Nyanza Bay (Table 1). Harvests at Eskasoni targeted on sea-ranched fish, those at Whycocomagh targeted on aquaculture escapees. Angling, snaring, spearing and seining were also permitted methods of achieving site-specific quotas for each of five First Nations and non-site-specific allocations to member harvesters of the Native Council of Nova Scotia. Allocations to First

Peoples totalled 1,100 small and 680 large salmon and, as well, 10 tags for either small or large salmon to 182 members of the Native Council of Nova Scotia (Table 1). Fishery Agreements between DFO and First Peoples indicate that First Peoples are to report catch statistics.

Commercial

The commercial salmon fishery, shortened in 1983 and closed in 1984, remained closed in 1995. Only two commercial salmon fishing licenses held on Cape Breton Island, one at Margaree Harbour and one at Mabou, remain eligible for re-entry.

Recreational Fishery

The salmon angling season for eighteen of the Islands' rivers was June 1 to Oct 31 (Table 2). The Middle, Baddeck and North rivers had seasons of June 1 to Oct 25, the Sydney and Margaree rivers had seasons of June 1 to Oct 31 and the Grand River was closed. Retention of salmon ($\geq$ 63cm) and grilse ($<$ 63cm) was varied to 0 fish in all open rivers except the Margaree, Mabou and other small coastal streams tributary to the Gulf of St. Lawrence exclusive of those in Cape Breton Highlands National Park. In non-Park Gulf rivers, a licensed angler could retain two small salmon daily; a total of eight fish could be retained over the year from any Nova Scotia river where retention was legal.

Estimates of the recreational catch and effort for Atlantic salmon in all rivers of Cape Breton Island, as well as those of mainland Nova Scotia, have been synthesised annually, since 1984, from Nova Scotia Salmon License stubs returned by anglers (e.g., O'Neil et al. 1991).

**Fishery Data**

Native Harvests

Despite significant allocations of salmon to First Peoples of Cape Breton Island, only 212 salmon were reported as being harvested by First Peoples. Waycobah First Nation, fishing principally with trapnet in Wycocomagh Bay reported a catch of 147 fish of aquaculture origins and 29 small and 5 large fish of unknown origins. (A major escape of salmon from cages occurred at Waycobah, June 1995) Eskasoni First Nation harvested 8 salmon of uncertain origin; Membertou First Nation caught 4 large and 2 small salmon in the Margaree River in late October. Wagmatcook First Nation reported a late-October catch of 8 large and 7 small salmon from Nyanza Bay (Middle and Baddeck river origins). The Netukulimkewe'l Commission reported only 2 small salmon being taken from Bras d'Or by members of the Native Council of Nova Scotia.

In 1994, the total harvest was estimated at 199 salmon (Claytor et al. 1995; Amiro and Longard 1995). The principle difference between years was the failure of trapnet initiatives on the Margaree, which had accounted for 64 salmon in 1994, and the increase in aquaculture escapees captured in Wycocomagh Bay.

Recreational Catches

In 1995, an estimated 1,410 anglers spent 13,569 rod days on the Islands' rivers (Table 2). Estimated catches (including releases) were 661 small and 1,496 large salmon. Compared to 1994, the estimated effort was down 14%; estimated catches of small salmon were about the same and estimated catches of large salmon were down 24% (Table 3). Compared to the 1990-1994 mean values, effort was down 34%, small catch was down 47% and the large salmon catch was down 40%. Recreational effort dropped an average of 58% between 1993 and 1994 for those rivers (essentially all but the Margaree) in which regulations changed from retention to hook-and-release of small salmon (Table 4). However, it is purported that some salmon anglers, who only hook-and-release their catch, (i.e., have no need of tags for killed salmon) now only purchase a Nova Scotia General Fishing License. Only purchasers of a Nova Scotia Salmon Angling License are required to contribute to angling statistics for Atlantic salmon.

Angling effort, catches and CPUE on the Baddeck and North rivers in 1995 increased over those of 1994 (Table 4). The Middle River experienced an increase in small salmon catch but a decrease in large salmon catch, effort and CPUE over that of 1994. The Margaree River, in 1995, was below 1994 and the 1990-1994 mean in all catch and effort categories.

## MARGAREE RIVER

The Margaree River, Inverness County, lies in Salmon Fishing Area 18 (SFA 18). The two principle branches, the Northeast Margaree and Southwest Margaree unite at Margaree Forks to flow north and west into the Gulf of St. Lawrence (Fig. 2). Salmon of the Margaree River have traditionally been considered to be of separate early- or summer-run (thru Aug 31) and fall-run components. The summer and least populated component of the total run has been the object of enhancement through nearly 20 years of fishery management and many decades of hatchery stocking.

Annual assessments of the Atlantic salmon stocks of the Margaree River have been prepared since 1985 (Chaput et al. 1994). Assessments prior to 1992 are published in the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) research document series; those since 1992 have been published in the Department of Fisheries and Oceans series of Atlantic Fisheries Research Documents.

Since 1988, stocks have been assessed using mark-and-recapture techniques. In the first years, marks (Carlin tags) were applied to fall-run salmon captured in an estuarial trapnet and recovered in a second estuarial trapnet. In 1991 the assessment of returns was based on an estimate of recreational catch raised by an exploitation rate (tag returns from anglers). In 1992, estimates of returns were based on tags placed on summer- and fall-run fish captured in estuarial trap nets and recovered (i) by anglers who volunteered to maintain a log of their entire fishing activity on the Margaree, or (ii) in a trap in the Lake O'Law Brook counting fence.

Conservation requirements for egg depositions are estimated to have been exceeded in every year since 1985. Forecasts made in 1995 suggested that returns of large salmon could number 2,700 to 4,600 fish and again contribute to egg depositions in excess of conservation requirements.

### Estimation of Returns

Mark-and-recapture experiments in 1995 provided data for estimation of in-river populations on Aug 2, (2 methods), Oct 25, Oct 31 and Nov 26. Assumptions inherent to the experiments (Ricker 1975) are that (i) marked and unmarked fish have the same mortality, (ii) marked and unmarked fish are equally vulnerable to recapture, (iii) marked fish retain their mark, (iv) marked fish are randomly mixed among unmarked fish at the time of sampling, (v) all marks are recognized and reported and (vi) recruitment is negligible during the recovery period.

Marks

Serially numbered small blue Carlin tags were affixed with stainless steel ties to all small and large salmon captured in the Levi's trapnet. Each fish was given a caudal punch to assist in later identification of tag loss or removal. As well, 58 fish captured Jun 25 - Aug 8, and 9 fish captured in mid-Sep were also tagged with large Carlin tags affixed with a monofilament tie. Twenty three of the large tags were bright yellow for ready identification of fish that had been implanted with ultrasonic tags. All captured fish were measured (fork length), scale sampled and sexed on the basis of external characteristics and classified as to wild or hatchery origin on the basis of a missing adipose fin and/or dorsal fin erosion.

Levi's trap net has been the principle index trap for tagging fish and providing in-season information on returns to the river (Claytor et al. 1995). It is located about 0.5 km above the East Margaree Bridge, 7 km above the Margaree breakwater (Fig. 3) where it has been fished, in the same location, since 1991. The water level at the trap, under constant river discharge, is subject to tidal fluctuations of up to 1.1m. A salt wedge, found at East Margaree Bridge (10 ppt) and several hundred meters above the East Margaree Bridge (7.75 ppt) during slack tide of one of the higher tides in July, failed to reach the trap [river discharge was low]. The trapnet is held in position by a frame work supported by pickets and is positioned in the deepest part of the river channel. Leads, supported by pickets, angled downstream and outwards from the trap and on the east side of the river, terminate in the river channel. The lead on the west side is affixed to the shore so that in total about 50% of the river width or 60% of the channel could be said to be fished. Trap mesh-size was reduced from 2 1/4 to 1 3/8 inch knotless nylon in 1993 to reduce meshing or bi-catch; the west side leader was increased from 3 inch to 4 inch mesh in 1995. The former may have reduced trap efficiency; the latter may have increased trap efficiency. The trap is fished daily on the first slack tide (either high or low) of day light.

Orange streamer tags of 9.5 cm length were affixed through the dorsal fin of small and large salmon captured by seining in the Forks and Hatchery pools on August 1. A swim-thru count, on August 2, tallied large and small, hatchery and wild salmon bearing Carlin tags, streamer tags or no tags. Similar tags had been used on the North, Middle and Baddeck rivers in 1994 (Amiro and Longard 1995) and tag-loss over 24 hours was thought to be negligible. All eighteen tags applied to fish of 56.0 - 72.7cm length being reared in a 25' circular pool at the Margaree Salmon Enhancement Centre in September had retained their tags on last observation several weeks later. Tagged small and large salmon were used in the estimation procedure on the premise that no tagged small fish were likely to have been removed from the population in the ensuing 24 hours.

Recaptures

Four different approaches/ dates were utilized to sample marked and unmarked large and small salmon for input to mark-and-recapture population estimation techniques.

**August 2** (swim-thru): A count and two mark-and-recapture estimates of the salmon population in the river was based on a swim-thru count of marked (streamer and Carlin tags) and unmarked fish. Counts were tallied by four teams of divers floating the entire Northeast and main Margaree from about 0.5 km below Third Brook Pool [near headwaters] to Seal Pool [just above head-of-tide] (Fig. 2; Table 5). The design of the swim-thru was similar to those conducted in 1990-1992 and 1994; a person familiar with the salmon holding areas of a section led each of the four teams. Counts are those of a team consensus. For estimates based on Carlin tags, "marks" applied at Levi's trap were reduced only by tags returned from anglers and those estimated to have been shed by the fish. Unlike other tag recovery sampling techniques, divers and anglers (logbooks below) could not be expected to identify tag scars (tag loss). Thus, to account for tag loss among fish observed by divers (and anglers in their logbooks, below), tags-at-large were reduced 0.01 per day (Chaput et al. 1994) for the median number of days to recapture for all tags returned up to the date of the estimate.

**October 25** (fall netting): On Oct 24-25, live capture and sampling of salmon for tags and tagging scars was facilitated by seining Hatchery and Wash pools on the Northeast Margaree and tangle netting (drifting of 2.5 and 5.25 inch mesh monofilament net) at John Archie, Bailey Bridge, McDonnell's (each on the Southwest) and Upper and Lower Cemetery (Northeast) pools. Carlin-tagged and untagged fish were counted by swim-thru techniques while searching for sufficient numbers of fish to net between John Doyles and Forks pools but were not used in the analyses. As expected, fewer Carlin tags per untagged fish were observed by divers than were found among netted salmon.

**October 31** (logbooks): Logbooks provided useable information on the angler catch of tagged and untagged large salmon. Only fish which were handled were used, fish released by cutting the line at a distance from the fish were excluded. Logbook contributors were from among 50 previous-year participants and 48 potentially new participants selected from among the more successful Margaree anglers who submitted stubs from their 1994 Nova Scotia Salmon Licence. All had received their logbooks prior to the beginning of the angler season. Logbooks used in the analyses were the sum, through January 15, of volunteer submissions and those that may have resulted from a reminder letter sent out November 2. Because large salmon could not be retained, tagged fish available for recapture were reduced by only an estimate of tag loss.

**November 26** (Lake O'Law trap): The Lake O'Law fence and trap (Fig. 2) operated Sep 20 - Nov 26, 1995, and provided a base from which to tally marked (tagged, tagging scars, caudal punch marks that accompanied tags) and unmarked salmon. The fence is located 2.2 km above the confluence of Lake O'Law Brook and the Northeast Margaree and 6.8 km below the First Lake O'Law (Davidson et al. 1995).

Estimation procedures

Returns of large salmon were estimated using Petersen mark-and-recapture principles described by Chaput et al. (1994) and a Bayesian estimation procedure (Gazey and Staley 1986). The modal solution from the Bayes procedure describes the most probable estimate among a binomial distribution of less probable solutions. It is assumed that there is no tagging mortality and that tag loss on riverine fish in 1995 [necessary only for the end-of season logbook estimate] is the average of rates determined for captive salmon in 1992 -1993 (Chaput et al. 1994). Estimates of small salmon are based on the mark-and-recapture estimate of large salmon and the proportions of small and large salmon at Levi's trap.

## Estimates of Returns

Total catch of salmon at Levi's trap in 1995 was 536 fish. The catch consisted of 131 small and 405 large salmon (Table 6; Fig. 4). An estimated 401 large salmon were available to later recapture. Levi's was fished June 13 to Oct 20 - there were no washouts but the trapnet was tied up for 24 hours following fishing on June 14 and August 25. The total catch was down 7% from that of 1994 and up 30% from 1993 - years in which there were washouts and, in all probability, numbers of salmon missed (Fig. 4). The 1992 count through Oct 14 (when it washed out) exceeded that of 1995 by 43%. In the 4 days following the washout of 1992, "Upper1" trapnet captured 40% of its entire large salmon catch for the Sep 1 to Oct 18 fishing interval (Chaput et al. 1994).

The proportions small:large salmon for the entire catch at Levi's was 0.244:0.756. Summer- and fall-run components were (0.284:0.716) and (0.227:0.773), respectively. The proportions of small salmon in the entire catch in 1992, 1993 and 1994 were 0.21, 0.39 and 0.19, respectively. Thirty-five percent of all small salmon and 29% of large salmon were captured before September 1 (Table 7). Hatchery-origin small salmon were 17% and 5% of the summer- and fall-run fish, respectively (Table 8) - a decrease from those values of 1994. Hatchery-origin large salmon were 13% and 2% of the respective summer and fall components - similar to that of 1994.

August 2

Seining operations at the Hatchery and Forks pools on August 1 resulted in the capture and tagging with orange streamers of 58 large and 7 small salmon. Only one tag-scarred fish from among 40 large fish tagged at Levi's between June 14 and July 29 was among the 58 large fish seined. Water temperatures at the time of seining the Forks Pool were circa 22°C; temperatures in the Southwest Margaree were higher, those of the Northeast were lower. Wild:hatchery composition of large salmon at the Forks and Hatchery pools was 14:3 and 25:16, respectively.

Swim-thru counts conducted under ideal flow and visibility on August 2 totalled 220 fish comprised of 188 large and 32 small salmon (Table 9). Tag "recoveries" numbered 47 streamers (46 large and 1 small) and 9 Carlins (5 large; 2 small and included 2 tag-scarred fish). Observation efficiency of salmon was 72% if based streamer tags; 15% if based on Carlin tags. Streamer tags were concentrated in and downstream of Hatchery Pool. Few streamers were sighted in the Forks Pool area where handling and warm water temperatures may have caused fall-back to the estuary which was not censused. Counts and estimates (Fig. 5) are summarized as follows:

| Method and size class | | Marks | Recaps | Captures | Est. | 90% CI |
|---|---|---|---|---|---|---|
| **Streamer tags** | Total | 65 | 47 | 220 | 304 | 254 - 392 |
| prop [0.145 in swim] | Small | | | | 44 | |
| prop [0.854 in swim] | Large | | | | 260 | |
| **Carlin tags** | Total | 58 | 9 | 220 | 1,430 | 955 - 3,130 |
| prop [0.394 @ Levi's] | Small | | | | 563 | |
| prop [0.606 @ Levi's] | Large | | | | 867 | |

Estimates using streamer tags are preferred even though tagged fish may not have been well distributed in a variety of holding habitat (fish are rarely in transit in warm daylight hours but rather, congregated in significant holding areas). Hatchery Pool, which held the greatest number of tagged and untagged fish of any pool surveyed, yielded high counts even when divers could be overwhelmed by numbers, movement and fleeting seconds to make mental notes.

The Carlin-based estimate of salmon suffers from the difficulty in observing (recovering) the small light-blue tags on a swim-thru, removal of fish/tags by anglers or the migration of some tagged fish from the census area. Deployment of 60-day ultrasonic tags in the stomach of 11 fish (3 large and 4 small on July 4 and 5,1995, and 4 large salmon July 13 to 18, 1995) captured and Carlin-tagged at Levi's trap indicated that some fish were in the Gulf of St. Lawrence on August 2. Although there were some sporadic difficulties with two stationary hydrophones at each of Big McDaniel Pool and at the Harbour breakwater (Fig. 3), excursions with portable hydrophones/ receiver validated the following:

-2 fish moved upriver and were registered at the upper hydrophones at various times in July and August.

-9 fish descended to and exited Margaree Harbour to the Gulf of St. Lawrence. Four fish were later detected on three searches within 1 km of the Harbour entrance; those and others were sporadically logged by the most sea-ward of the two hydrophones at the Harbour. Three of the 9 emigrants re-entered the river in September before the batteries expired.

Of 12 fish tagged Aug 29 to Sep 20, and monitored up to October 24, 9 fish quickly moved upriver, 2 fish remained in the estuary/area of the trap until ascending the river on Oct 15 and 17. No signal was ever received from the 12th transmitter.

Fall (Oct 25, 31, and Nov 26)

Data, resultant estimates and 90% confidence limits for large salmon on October 25 (fall netting), on October 31 (angler logbooks) and on November 26 (Lake O'Law trap) are as follows:

| Date and size | | Marks | Recaps(*) | Captures | Est. | 90% CI |
|---|---|---|---|---|---|---|
| **Oct 25** | Large | 401 | 18 (2) | 58 | 1,288 | 1,006 - 1,993 |
| prop [0.244 @ Levi's] | Small | | | | 416 | |
| **Oct 31** | Large | 363 | 7 (1) | 81 | 4,242 | 2,786 -10,794 |
| **Nov 26** | Large | 401 | 10 (3) | 67 | 2,688 | 1,869 - 5,457 |
| prop [0.244 @ Levi's] | Small | | | | 868 | |

(*) number with tagging scars

The Oct 25 estimate, made just after the conclusion of tagging at Levi's trap (Oct 20), is the most precise (Fig 6). Lake O'Law counts through Nov 26 (Fig. 6; data, Table 10) contributed to the next best estimate. The later estimate suggests that the Oct 25 estimate excluded about 52% of the run.

The Oct 31 estimate based on logbooks is the least precise (Fig. 6) and highest even though logbook catch data was not unduly weighted to the last week of October. The median number of days to recapture for 36 tags returned by all anglers was 9.5; i.e., tags available for recapture were reduced by 9.5%. The proportion of recaptures among captures (0.31, 0.09 and 0.15) for the respective Oct 25, Oct 31 and Nov 26 estimates was sufficiently different to discourage combination of data sets, as had been done 1992-1994 (Table 11).

The above analyses suggest that there was a late-run component entering the Margaree after Levi's trap was removed on Oct 20, 1995. Cumulative count data at Lake O'Law trap, 1992-1995 (Fig. 7) indicate that the arrival of tagged small and large fish at the fence in 1995 preceded, on average, the untagged fish, i.e., marked fish appear to be less frequent in the sample at later dates. Also, late fish entering the trap were bright, bore sea lice and more readily shed scales (males included) than fall fish handled at Levi's through Oct 20 or Lake O'Law trap into early November. Data from the Sydney and Grand rivers (later sections of this document) also suggest that run-timing of salmon in those rivers was unusually late in 1995.

Pooling of data for small and large salmon failed to alter the relative magnitudes of the above estimates based on large salmon.

| Date and size | | Marks | Recaps | Captures | Est. | 90% CI |
|---|---|---|---|---|---|---|
| **Oct 25** | Total | 530 | 19 | 67 | 1,871 | 1,449 - 2,861 |
| prop [0.756 @ Levi's] | Large | | | | 1,414 | |
| prop [0.244 @ Levi's] | Small | | | | 457 | |
| **Oct 31** | Total | 470 | 9 | 100 | 5,251 | 3,550 -11,426 |
| **Nov 26** | Total | 530 | 17 | 88 | 2,735 | 2,082 - 4,422 |
| prop [0.756 @ Levi's] | Large | | | | 2,067 | |
| prop [0.244 @ Levi's] | Small | | | | 667 | |

The Oct 25 estimate increased by 126 large fish; logbook estimates (Oct 31) increased by 1,000 fish; the Lake O'Law estimate (Nov 26) decreased by 621 large salmon and, relative to that of Oct 25, suggests that only 32% of the run was missed.

To resolve differences between the two more precise estimates (Oct 25 and Nov 26) and concerns raised because of the paucity of summer-applied tags among fall recoveries and relative scarcity of tagged fish among untagged fish at Lake O'Law in mid-late November, Bayes estimates were repeated for data truncated to various dates.

The favoured approach conceded that both the Oct 25 and Nov 26 estimates were principally of the fall-run population. The Oct 25 estimate was also conceded to be incomplete but perhaps indicative of the numbers of fall-run fish available through the Oct 31 closure of the recreational fishery. Bias towards estimation of the fall component was based on evidence that large fish tagged prior to the raise in river discharge Aug 24-29, 1995, (Fig. 4), appeared in neither the fall seining nor the Lake O'Law trap (Fig. 8), i.e., summer-run large salmon had moved beyond sampled areas or had lost or had their tags removed (Fig. 9 and 10).

Logbooks, on the other hand, included tags from both summer- and fall- run components and had greater potential to represent summer and fall components. However, logbook estimates inferred that there were many more summer fish in the river than estimated on Aug 2 with either streamer or Carlin tags. The probability that catchability is similar among tagged and untagged fish is untested.

The most realistic estimates of returns in 1995 were derived as the sum of separate summer- and fall-run estimates. Complete fall estimates (Nov 26) of large salmon were derived from Lake O'Law fence data and tags applied at Levi's only during the fall. Summer estimates were derived from the Oct 25 incomplete estimate of fall fish in the river up to the dismantling of Levi's trap and, the proportions of summer and fall fish counted at Levi's trap. The summer-run component was calculated as ([fall $est_{[Oct\ 25]}$ * Levi's summer count]/Levi's fall count) and assumed that all summer fish at Levi's were in or returned to the Margaree and, that summer and fall trapping efficiencies at Levi's were similar. The fall run was regarded as beginning either after Aug 23 ($MAX_{Fall}$) or after Aug 29 ($MIN_{Fall}$). Input data and MIN/MAX of the complete fall run of large salmon (Nov 26) and MIN/MAX estimates of the fall salmon during the operation of Levi's (Oct 25) are:

| Date | Marks | Recaps | Captures | Est. | 90% CI |
|---|---|---|---|---|---|
| Nov 26 $MIN_{Fall,\ complete}$ | 305 | 10 | 67 | 2,047 | 1,424 -4,156 |
| Nov 26 $MAX_{Fall,\ complete}$ | 336 | 10 | 67 | 2,245 | 1,589 -4,574 |
| Oct 25 $MIN_{Fall/Levi's}$ | 305 | 18 | 58 | 982 | 729 -1,522 |
| Oct 25 $MAX_{Fall/Levi's}$ | 336 | 18 | 58 | 1,084 | 842 -1,677 |

The maximum estimate of summer large salmon is 318 fish, i.e., [(982 $_{MIN\ Fall/Levi's}$ * 99 $_{Levi's\ summer}$)/306 $_{Levi's\ Fall}$]. The minimum estimate of summer large salmon is 207 fish, i.e., [(1,084 $_{MAX\ Fall/Levi's}$* 65 $_{Levi's\ summer}$)/340 $_{Levi's\ Fall}$]. Both estimates are consistent with streamer estimates and counts (to Aug 2).

Fall estimates of small salmon returns were estimated by ratio from i) counts of small salmon $MIN_{Fall}$ (91) and $MAX_{Fall}$ (101) at Levi's, ii) corresponding numbers of large salmon counts (99 and 65) and iii) fall netting estimates through Oct 25. Summer returns of small salmon were estimated by ratio from

estimates of summer large salmon and counts of small and large salmon to MIN $_{Fall}$ and MAX $_{Fall}$ dates, i.e., MIN (41) and MAX (31). Results are:

| Run component | Large (MIN $_{Aug\ 29}$) | Small (MIN $_{Aug\ 29}$) | Large (MAX $_{Aug\ 23}$) | Small (MAX $_{Aug\ 23}$) |
|---|---|---|---|---|
| Fall (complete) | 2,047 | 609 | 2,245 | 667 |
| Summer | 318 | 128 | 207 | 95 |
| **Complete run** | **2,365** | **737** | 2,452 | 762 |

Estimates of **2,365** large salmon returns and **737** small returns (Aug 29 for start of fall run) are preferred because only these estimates incorporate summer fish that exceed the numbers determined independently on Aug 2.

The estimate of 2,365 large salmon suggests that 45% of large fish entered the river after Oct 25. Total large returns are the lowest since 1988-1989; small returns are comparable to those of 1994 but down 56% from the previous 5-year mean (Table 12). Large returns are about 90% of the lowest of four forecasts of returns for 1995.

Estimates of fewer returns in 1995 than in 1994 are consistent with catches reported by DFO Fishery Officers (Table 13), deciphered from Licence stub returns (Table 4), and summarized from logbooks (Table 14) and counts at the Lake O'Law. The contribution of small hatchery fish to small salmon catch declined to 17% in the summer but increased to 27% of the fall component (Table 15). The contribution by large salmon of hatchery origin to the fall fishery was consistent with past years, i.e., 11-12%. Samples provided to the Salmon Check in Program (SCIP; Table 16) are the fewest since inauguration of the program.

Angling statistics and total returns indicate an overall catch rate of 0.44 (1,040/ 2,365) for large salmon in 1995. However, if only an estimated 1,300 salmon (982+ 318) were available to the fishery, the actual catch rate is 0.80. Such a high value has been reported for the North River (Amiro and Marshall MS 1990), but is undocumented for the Margaree River. Returns by anglers of only 32 of 363 large salmon estimated to have retained their tags would suggest either low reporting and/ or tag retention rates. Respective catch rates for small salmon would have been 0.44 and 0.77 depending on the estimate of the number of fish available to anglers. Only 27 of an estimated 107 tags were returned by anglers.

Annual efficiencies of Levi's trap in catching salmon, 1992-1994, (Claytor et al. 1995) have been calculated from counts and total estimated large salmon returns. In the last 3 years, values for the total estimated run were either 8% or 16% (Table 17). Efficiencies in 1995 ranged from 9.5% to 34.6% depending on population estimate or component of the population. Thus, caution is required in using trap efficiency for in-season estimation and forecasting of returns, esp., summer-run fish. Similar caution is required in assuming that summer- and fall-run fish and small and large salmon are caught in equal proportions to their respective abundance's. Chaput et al. (1995), using mark-and-recapture techniques, indicate differences in summer and fall efficiencies of Miramichi trap nets. All of the above measures necessarily rely on assumptions for mark-and-recapture estimates (the denominator) having been met.

## Conservation Requirements

The conservation requirement for the entire Margaree River system is based on an egg deposition of 2.4 eggs/$m^2$, historical biological characteristics, and a rearing area of 27,976 units of habitat, 100 $m^2$ (Table 6; Claytor et al. 1995). The product of egg deposition rate and rearing units equates to a conservation requirement of **1,036** large **582** small salmon (Table 7; Claytor et al. 1995). Claytor et al. (op cit) further examined stock and recruit models for 38 years of data and suggest that spawner (eggs from large salmon alone) requirements would be 1,000 - 1,500 fish if the objective was to maximize production.

Claytor et al. (1995) also proposed a requirement in the estuary, by July 15, of **242** large and **136** small salmon, i.e., 23% of the respective totals. This requirement was based on the premise that early-run salmon were the principle occupants of tributaries and mainstem above Big Interval which encompasses about 23% of the total Margaree rearing area. The status of the early-run was to be evaluated by comparing the requirements with counts at Levi's trap divided by an estimate of the traps' catch efficiency.

## Escapement

Fish not harvested from among estimated returns are considered escapement. Fish lost to poaching and disease are spawners by definition of the requirement for 2.4 eggs $m^{-2}$.

Known removals from the Margaree include 4 large and 2 small salmon reported by Membertou First Nation and one large and one small salmon mortality at Levi's trap. The estimated harvest by anglers was 199 small salmon (Table 4). Additional losses to escapement include an estimated 25 large salmon lost to poaching (but included as spawners), and 52 large and 6 small salmon lost to hook-and-release mortality (5% of estimated stub return releases; Table 4). Thus total spawners numbered **2,308** large and **529** small salmon.

Over the total run, escapement of large salmon exceeded requirements of 1,036 fish; small salmon numbered less than requirement of 582 fish (Table 12) - not unlike 1994. Escapements of large salmon, 1985 to 1994, have ranged from 1,378 to 6,222 fish; escapements of small salmon over the same period have ranged from 328 to 1,504 (Table 12). Large salmon conservation requirements have been met in each of the last 10 years; small salmon spawning escapements have been met in 6 of the last 10 years (Table 12).

Summer-run fish in the river (Aug 2) were estimated at 260 large and 44 small salmon. The estimates of large and small fish could be deficient by fish not counted in the lower reaches. The small salmon do not include removals by recreational fishers. The number of large salmon in the river on Aug 2 was equal to the Claytor et al. (1995) July 15 requirement of 242 fish. The 44 small salmon were only one-third of requirement. The quotient of trap counts at Levi's, to July 31, (Table 6) and an overall estimated trap efficiency for large fish of 0.171 in 1995 (Table 17), suggests that 240 large fish and perhaps 152 small salmon had entered the estuary. This estimate of large salmon past Levi's is consistent with the Aug 2 estimate and 242 fish requirement. Small salmon at Levi's may represent returns but not escapement.

### Egg depositions

Estimated egg depositions in 1995 numbered 13.14 million - twice the target of 6.7 million eggs (Table 18). Depositions in 1995 were about 70% of those estimated for 1993 and 1994 and only about 40% of those estimated for 1992. Wild large salmon made up 95% of large salmon returns in 1995 and have contributed 93 to 97% of the total eggs from 1992 to 1995 (Table 18).

**Juveniles**

Estimation of juvenile abundance continued at five tributary sites and was re-instated at 'Old Bridge' (Chaput and Claytor 1989) on the main Northeast. Sampling consisted of 3- or 4-sweep removal estimates in barriered sections. Population estimates were derived by exact solution for 3 sweeps (Junge and Libosvarsky 1965) and by an iterative solution to Zippin's (1956) maximum-likelihood technique for four or more sweeps (Amiro and Longard 1995).

Fry (age 0+) densities of 60-256 fish $100m^{-2}$ exceeded, on average, those of 1994; parr densities (age 1+ and 2+) of 48-122 fish $100m^{-2}$ were, on average, similar to those of 1994 (Table 19). Recent abundances of fry and parr are about three times the densities in the mid-1970s (Chaput and Claytor 1989 and Fig. 11). Spawners, 1973-1977, which would have contributed to those lower densities are estimated to have averaged only about 10% (ref Table 20) of the 1989-1993 spawners contributing to recent densities. Fry and parr densities (wild fish only) of 127 fry and 56 parr at the "Old Bridge" site were $\geq$ than those of Big and Trout brooks and may be representative of a large proportion of mainstem production area. Old Bridge fry densities exceeded those of any previous sampling, 1957-1986; parr densities exceeded those of the 1950s, 1970's and 1986 but not those of the 1960s (Chaput and Claytor 1989). A "normal" abundance (Elson 1967) for 129 unsprayed sites on New Brunswick rivers (mostly the Miramichi) in the 1950's, was 29 fry and 38 small and large parr per $100m^2$.

**Forecasts**

Stock-recruitment relationships have been the basis of previous pre-season forecasts on the Margaree River. The stock-recruitment relationship assumes a 5-year lag between spawning and subsequent return of large salmon recruits to the river, i.e., a predominance of 2-year old smolts. Spawners and recruits (Table 20) were developed by Chaput and Jones (1992) and are carried forward from Claytor et al. (1995).

Stock-recruitment relationships were examined using four models, Tabular, Ricker, Beverton-Holt, and the Mean (Claytor et al. 1995). For the Tabular approach the spawning stock was divided into four intervals of 600 spawners and recruits into 11 intervals of 1200 recruits. The number of times each level of recruitment occurred at each spawning level was entered into the table. The average number of spawners and recruits at each spawning stock level is calculated and the average yield (recruits minus spawners) and recruit per spawner (recruits divided by spawners) is estimated for each level.

The Ricker curve was developed using the relationship:

$$R = S\,x\,e^{a(1-S/b)}$$

where ***R*** is the number of recruits, ***S*** is the number of spawners, $e^a$ is the initial slope of the curve, and ***b*** is the value at which spawners equal recruits or the value at which the stock will just replace itself (Hilborn and Walters 1992). The ***a*** and ***b*** parameters were estimated using Microsoft EXCEL (1993) solver function (Claytor et al. 1995).

The Beverton-Holt model was developed using the relationship:

$$R = \frac{aS}{b + S}$$

where ***R*** and ***S*** are as in the Ricker model, ***a*** is the maximum number of recruits produced, and ***b*** is the recruitment (on average) equal to ***a/2*** (Hilborn and Walters 1992). The ***a*** and ***b*** parameters were estimated using the Microsoft EXCEL (1993) solver function (Claytor et al. 1995).

Forecasts of returns in 1996 range from **3,200** to **4,400** large salmon (Table 21 and 22; Fig 12) i.e., returns will exceed the 1,036 large salmon spawning requirement. However, declining estimates of large returns since 1992 (Table 12) and recent low returns of small salmon support the contention that marine survival is now lower than previously (see: "ecological considerations") and not accounted for in the models. Thus a conservative forecast allows that large salmon returns in 1996 will exceed target but may be no greater than those of 1994-1995 (2,400 - 2,900 fish); small salmon should exceed the target but may also fall in the range of returns for 1994-1995 (700 fish).

Current densities of juvenile salmon and those densities associated with the attainment of conservation requirements by large salmon (since 1985) suggest that conservation requirements for large salmon will continue to be met, barring unforeseen decreases in marine survival, through the end of the decade.

## MIDDLE RIVER

The Middle River, Victoria County, lies in Salmon Fishing Area 19 (SFA 19). The watershed is surrounded by those of the Margaree, North and Baddeck rivers (Fig. 1). The mainstem arises in the Cape Breton Highlands, about 450 m above sea level, and flows in a southward direction to its confluence with Nyanza Bay, St Patrick's Channel, of Great Bras d'Or at Wagmatcook First Nation. The Middle River has a more gentle gradient profile than the neighbouring Baddeck and North watersheds. Modelling (Amiro 1993) suggests that 30% of substrate area between 0.12 and 0.49% grade (Table 23) has about one-half the juvenile salmon production of proportionally-more-abundant higher gradients of the Baddeck and North Rivers. Historically, the salmon stock consisted of summer and fall components. In recent times, the summer component has all but disappeared. An effort to redevelop the run with summer-run stock (Table 24) from the North River, 1985-1989, was largely unsuccessful.

Autumn swim-thru counts of adult salmon have been made annually in the main river since 1989 ref. Amiro et al. (1991), Amiro and Longard (1995), and are published in the CAFSAC Research Document Series and later, the DFO Atlantic Fisheries Research Document Series. Spawning escapement in 1994 was estimated to have been 86% of conservation requirement. Densities of juvenile salmon were extensively examined in the 1960's and late 1950's; the most recent efforts were in 1977, 1978, 1985, and 1994 (Amiro and Longard 1995).

Through 1993, swim-thru counts of small and large salmon were conducted in mid- to late-October, by teams of two divers assigned to most of six sections (Fig. 13). In-river returns were estimated as the quotient of counts over the proportion of the total main stem holding area for adults that divers floated. In 1994, mark-and-recapture estimates for the entire main-stem holding area were instituted. Streamer tags were applied to fish netted the day previous to the swim-thru; the Bayesian estimator was used to derive a median estimate of the probable populations (Amiro and Longard 1995). Adult and some juvenile assessments were conducted in 1995.

### Estimation of Returns

A mark-and-recapture experiment provided data for estimation of the population on Oct 18, 1995. Marks, orange streamer tags, were applied to salmon captured by drift-netting (monofilament 2.5 inch stretched mesh) at 5 locations on the mainstem on Oct 17. The numbers of marked and unmarked fish, by small and large size category, were tallied by four teams of divers floating Sections 2 to 5, part of Section 6 and the two main up-river holding pools below the Gold brooks, Section 1 (Fig. 13). The total number of small and large fish in the river was estimated using mark-and-recapture techniques and

Bayesian estimation procedures derived by Gazey and Staley (1986) to describe the most probable estimate (modal value, which is usually less than the median value); no tags were considered to have been lost. The count data were used to apportion the estimate into small and large components.

**Estimates of Returns**

Despite good weather and reasonable visibility, divers had difficulty finding enough salmon to make netting worthwhile. Eight locations were examined or netted on Oct 17, resulting in the tagging of 11 large and 1 small salmon. The swim-thru, on Oct 18, yielded a total count of 183 fish of which 5 large and 1 small were tagged. Visibility was good in all but Section 6, the deepest, flattest and darkest water of the river. Results are summarized as follows:

| | Sec 1 | Sec 2 | Sec 3 | Sec 4 | Sec 5&6 | Total |
|---|---|---|---|---|---|---|
| No. tagged | 3 | 1 | 4 | 2 | 2 | 12 |
| Obsv. tagged | 0 | 1 | 2 | 3 | 0 | 6 |
| Obsv. no-tag | 12 | 41 | 33 | 60 | 32 | 177 |

Numbers large:small, 160:23; **M**=12; **C**=183; **R**=6.

The most probable estimate of total salmon in the Middle River, Oct 18, was **371** fish (Fig. 14; 90% CI 224-1,090). Proportioning of the estimate on the basis of the small and large salmon count suggests a population comprised of 324 large and 47 small salmon. There were no fish of aquaculture origins observed during the swim-thru. Reported removals by Wagmatcook First Nation, of 8 large and 7 small salmon in Nyanza Bay (Middle and Baddeck origins perhaps equal) suggest a total return of **328** large and **51** small salmon. A return of 379 salmon is down 20% from 1994 but greater than those returns of 1992-1993 (Fig. 15). Estimated catches (no retention) by anglers fishing to the Oct 25 closing date (Table 4) were only 54 large and 39 small salmon - the former down by 67% over that of 1994.

**Conservation Requirements**

Conservation requirements for the Middle River are based on a substrate area of 8,646 *100 $m^2$ and 2.4 eggs $m^{-2}$. Egg requirements of 2.07 million are to be provided, on average by **470** large and **80** small salmon (Marshall et al. 1992).

**Escapement**

An escapement of the **371** salmon (no accounting for the few fish that might have been lost to hook-and-release mortality) estimated to have been in the river on Oct 18 is **67%** of the 550 fish requirement. This value is about 20% less than the median mark-and-recapture value estimated in 1994 but above counts, raised by proportion of river floated by divers, for 1990-1993 (Summary Sheet; Fig. 15). Persistent low discharge and apparent lateness of the fall runs on the Margaree, Sydney and Grand rivers in 1995 support the hypothesis that salmon could have entered the Middle River after the Oct 18 census.

The Oct 18 estimate of escapement is not a definitive value but rather, a "most" probable value (Fig. 14). There is from the same analyses, a 35% probability that the requirement was achieved. Similarly stated, there is a 60% probability that 75% of the requirement was achieved, or a 90% probability that 50% of the requirement was attained. Biological information is inadequate to estimate the actual egg deposition and the proportion of conservation eggs that was met on Oct 18.

**Juveniles**

Electrofishing of juvenile salmon was conducted at only three sites in 1995, down from the 15 sites done with the assistance of First Peoples in 1994. Sampling consisted of 3-sweep removal estimates in unbarriered sections - the same technique as in previous years. Population estimates were derived in the same manner as those of the Margaree.

Two sites, MacKenzie Brook and mainstem at Highway 19, were done in both 1994 and 1995. Respective densities were 174 and 109 age-0+ parr and 76 and 34 age-1+ and -2+ parr. Only total juvenile densities could be estimated for 1994; values for the respective sites were 65 and 43 fish or 25 to 30% of the total for all ages of juveniles in 1995. The third site done in 1995 was in the mainstem Middle River at the confluence of Second Gold Brook, about 40% of the distance upstream from the lower demarcation of Section 1 (Fig. 13). Densities at that site were 106 age-0+ parr and 18 age 1+ and -2+ parr. Fry (age 0+) densities and the MacKenzie Brook parr density are comparable with those of tributaries to the Margaree and more than double the "normal" abundance of Elson (1967). Mainstem Middle River parr densities are about 0.5 of those of Old Bridge, Margaree, and 0.7 of an Elson (op cit) "normal" abundance. Densities in 1995 are suggestive of escapements that met/exceeded requirements in 1994 and either very good recruitment from the estimated number of spawners in 1993 or additional late-run escapement following the 1993 census.

**Forecast**

Data are inadequate for predictive models with which to forecast returns in 1996. However, it is prudent to note that returns in 1995 from conservation requirements in 1989 (Fig. 15) have not knowingly (see "ecological considerations") met conservation requirements. Further, if low returns in recent years are the result of reduced sea survival (see "ecological consideration) and, estimates of low winter habitat area in the North Atlantic are an index of survival, returns to the Middle River in 1996 from less than requirement escapements in 1990 should not be expected to exceed those of 1995.

## BADDECK RIVER

The Baddeck River, Victoria County, lies in Salmon Fishing Area 19 (SFA 19). The watershed is bounded by those of the Middle and North rivers (Fig. 1). The river arises in the Cape Breton Highlands at about 430 m elevation and flows in a south and westward direction to its confluence with Nyanza Bay, St Patrick's Channel of Great Bras d'Or at a point < 4km east of the mouth of Middle River. The gradient profile of the Baddeck River accessible to salmon is on average, steeper than that of the neighbouring Middle, but not as steep as that of the North River (Table 23). The gradient of the Baddeck River suggests a greater potential for production of juvenile salmon per unit area than that of the Middle River (Amiro 1993). The stock has been, at least in recent times, principally of fall-run characteristics. Stocking of juveniles of North River origin (presumably early-run characteristic) in the mid 1980's had no discernible effect.

Counts of adult salmon were first made in 1994 (Amiro and Longard 1995). A mark-and-recapture estimate on Oct 20 indicated that only 48% of the conservation requirement had been met. Densities of juvenile salmon were extensively examined in 1977, 1978, and again in 1994. Estimates in 1994 of total juvenile salmon at four of six sites were greater than those of 1977 and 1978 (Amiro and Longard op cit). Adult, but not juvenile assessments were made in 1995.

**Estimation of Returns**

A mark-and-recapture experiment provided data for estimation of the population on Oct 22, 1995. Marks, orange streamer tags, were applied to salmon captured by drift-netting (monofilament 2.5 inch stretched mesh) at 4 locations on the North Branch and mainstem on Oct 21. Marked and unmarked fish, small and large were enumerated by four teams of divers floating most of Sections 1 and 2 and all of Section 3 (A-B; 1994), Section 4 (B-C; 1994) and Section 5 (Fig. 16). The total number of fish in the river was estimated using mark-and-recapture techniques and Bayesian estimation procedures derived by Gazey and Staley (1986) to describe the most probable estimate (mode; not median as in 1994); tag loss was considered a non-factor. The count data was used to apportion the estimate into small, large and aquaculture components.

**Estimates of Returns**

Salmon were netted and tagged at 4 main stream locations on Oct 21; two sites at the upper boundary of Section 3, a site at the "forks" within Section 3 and a site near the confluence of Peter's Brook in lower Section 4. Twenty large (two of aquaculture origins i.e., significant fin deformities, "broomtail" and presence of adipose fin) and 8 small (one of aquaculture origin) were tagged. The swim-thru, on Oct 22, under light rain but relatively clear (poor light for Section 5) and low water conditions provided a total count of 154 fish of which 8 large and 4 small were tagged. Results are summarized as follows:

| | Sec 1 | Sec 2 | Sec 3 | Sec 4 | Sec 5 | Total |
|---|---|---|---|---|---|---|
| No. tagged | - | - | 14 | 14 | - | 28 |
| Obsv. tagged | 1 | 0 | 6 | 5 | 0 | 12 |
| Obsv. no-tag | 14 | 17 | 43 | 46 | 22 | 142 |

Numbers large:small:aquaculture, 110:34:10; **M**=28; **C**=154; **R**=12.

The most probable number of total salmon in the Baddeck River, Oct 22, was **361** fish (Fig. 14; 90% CI 255-679). The number does not include 4 large and 3 small salmon netted in Nyanza Bay by Wagmatcook FN which have been arbitrarily assigned Baddeck River origins. Proportioning of the in-river estimate on the basis of small, large and aquaculture salmon count suggests a wild population comprised of **258** large, **80** small salmon. Aquaculture-origin fish numbered **7** large and **16** small salmon. The estimated catch (no retention) by anglers fishing through Oct 25, (Table 4) was 64 small and 74 large salmon - both values up over those of 1994.

**Conservation Requirements**

Conservation requirements for the Baddeck River are based on a substrate area of 8,363 *100 $m^2$ and 2.4 eggs $m^{-2}$. Egg requirements of 2.0 million are to be provided, on average by **450** large and **80** small salmon (Amiro and Longard 1995; Marshall et al. 1992).

**Escapement**

An escapement of the **361** salmon (includes aquaculture and the few fish that may have been later lost to hook-and-releases mortality; there were no reported removals) on Oct 22 is **68%** of the 530 fish requirement. This value is up 20% over the median estimate for 1994. As in the case of the Middle River, however, there is uncertainty as to whether or not all returning adults had entered the river at the time of the census.

The Oct 22 estimate of escapement is a "most" probable value (Fig. 14). There is from the same analyses, a 20% probability that the target was achieved. Similarly stated, there is a 65% probability that 75% of the requirement was achieved, or a 95% probability that 50% of the requirement was attained. Biological information is inadequate to estimate precise egg deposition.

**Forecast**

There are no data from the Baddeck River with which to forecast returns in 1996. Conservation requirements for the Baddeck River have not knowingly been met, returns from adjacent Highland rivers appear to be declining and there is little prospect for improved marine survival among large salmon (see "ecological considerations"). These elements suggest that returns in 1996 might be similar if not less than those of 1995.

## NORTH RIVER

The North River, Victoria County, lies in Salmon Fishing Area 19 (SFA 19) on the eastern slope of the Cape Breton Highlands. The watershed is bounded by the Baddeck, Middle, Margaree rivers (Fig. 1) and on the east, the Barachois River. The river arises at an elevation of about 475 m and travels some 30 km to St. Ann's Harbour (Amiro and Marshall 1990). Gradients are steep (Table 23) with many small falls and several barriers to upstream fish passage (Fig. 17); water quality is pristine and relatively unstained by organic acids or oxides of iron Amiro and Marshall (op cit).

The substrate of the North River is calculated to have the most potential for production of juvenile salmon, per unit area, of the five rivers here-in evaluated by orthogradient measure (Table 23). The stock as known, is early-run and principally composed of large 2SW salmon; a late-run component has been suggested but is undocumented. Recent stocking with hatchery fish of North River origin commenced in the mid 1980's to compensate for eggs diverted to the Middle and Baddeck rivers and later, for eggs diverted to a sea-ranching venture at Eskasoni First Nation. No broodstock have been taken from the North River since 1993.

Fall counts of adult salmon on the North River had been attempted, 1990-1993, but were prevented by high water conditions (Amiro and Longard 1995). Mark-and-recapture estimates were successful in the summer and fall of 1994. Fall, 1994, estimates suggested an escapement of 587 salmon - 255% of conservation requirements (Amiro and Longard op cit). Based on 1994 status and rationale for similar returns in 1995, an allocation of 50 fish was made to First Nations (Table 1); the recreational fishery remained as hook-and-release. Adult assessments were again conducted in 1995.

**Estimation of Returns**

An in-season mark-and-recapture experiment provided data for estimation of the population on July 11 and 12, 1995. Marks, orange streamer tags, were applied to salmon captured by drift-netting (monofilament 2.5 inch stretched mesh) at one location, MacLean's Pool on the main river on July 11. Marked and unmarked fish, small and large were enumerated by two teams of divers floating most of Section 1, Sections 2, 3, 4 but not Section 5 (Fig. 17). Summer fish essentially hold above the gorge (Section 3)(Amiro and Marshall 1990).

An autumn mark-and-recapture experiment was conducted on Oct 19 and 20. Streamer tags were again applied to fish captured in MacLean's Pool (Section 2) and at the boundary of Sections 4 and 5. Marked and unmarked fish, small, large and hatchery/ aquaculture were enumerated by three teams

of divers floating Sections 1, 2, 4 and 5 (Fig. 17). Salmon are not known to hold in the gorge area (Section 3).

The total number of fish in the river on July 12 and Oct 20 was estimated using mark-and-recapture techniques and Bayesian estimation procedures derived by Gazey and Staley (1986) to describe the most probable estimate (mode; not median as in 1994); tag loss was considered a non-factor. The count data was used to apportion the estimate into small and large components.

**Estimates of Returns**

July

Seventeen large and one small salmon were netted and tagged at MacLean's Pool (Section 2) on July 11. The swim-thru, on July 12, under reasonably clear and low water conditions yielded a total count of 94 fish of which 10 large and one small were tagged. An attempt to have three divers keep separate counts while descending the river together, proved unsuccessful because the first person to approach undisturbed fish frequently saw more fish than those persons following. Thus, as in all other Cape Breton swim-thru's, counts are a team consensus of what was seen at the time of encounter. Results are summarized as follows:

| | Sec 1 | Sec 2 | Sec 3 | Sec 4 | Sec 5 | Total |
|---|---|---|---|---|---|---|
| No. tagged | - | 18 | - | - | - | 18 |
| Obsv. tagged | 0 | 11 | 0 | 0 | - | 11 |
| Obsv. no-tag | 6 | 68 | 0 | 9 | - | 83 |

Numbers large:small; 90:4; **M**=18; **C**=94; **R**=11.

The most probable number of total salmon in the North River on July 12, was **153** fish (90% CI 86-281; Fig. 5). Proportioning of the estimate on the basis of small and large salmon count suggested a July 11 population comprised of **146** large and **7** small salmon.

October

Sixteen large and 4 small salmon were netted and tagged at MacLean's Pool (Section 2) on Oct 21. As well, one large and 7 small salmon (4 of hatchery origin) were netted and tagged on the boundary of Sections 4 and 5. The swim-thru, on Oct 22, under reasonably clear and low water conditions yielded a total count of 181 fish of which 10 large and 3 small were tagged. Results are summarized as follows:

| | Sec 1 | Sec 2 | Sec 3 | Sec 4 | Sec 5 | Total |
|---|---|---|---|---|---|---|
| No. tagged | - | 20 | - | 8 | - | 28 |
| Obsv. tagged | 1 | 9 | - | 2 | 1 | 13 |
| Obsv. no-tag | 1 | 67 | - | 75 | 25 | 168 |

Numbers large:small:htch/aqua, 120:47:14; **M**=28; **C**=181; **R**=13.

The most probable number of all salmon in the North River, Oct 22, was **388** fish (Fig. 14; 90% CI 280-716). Proportioning of the estimate on the basis of small, large and hatchery/aquaculture salmon counts suggests a fall population comprised of **268** large and **120** small salmon. Of the large salmon only eight were of hatchery/aquaculture origin; 21 of the small salmon were of hatchery origin -

ostensibly from the 10,000 smolts stocked in 1994. Estimates of both large and small salmon were between 65 and 70% of those estimated at the same date in 1994.

Estimated catches (not harvests) by anglers (Table 4) of and 217 large 178 small salmon through the Oct 25 closing date were more than double those of 1994 (effort also increased by 30%). Hook-and-release catches that suggest catch rates of 0.8 to 1.5 are not inconsistent with a catch rate of 0.84 estimated for total retention fisheries in 1974 and 1978 (Amiro and Marshall 1990).

**Conservation Requirements**

Conservation requirements for the North River are based on a substrate area of 3,559 *100 $m^2$ and 2.4 eggs $m^{-2}$. Egg requirements of 0.85 million are to be provided, on average by **200** large and **30** small salmon (Amiro and Marshall 1990; Marshall et al. 1992). Requirements by mid July have not been established but historical angling data (Amiro and Marshall op cit) indicated that for an angling season which lasted to Sep 30, "effective harvest below Carey's Rock is 86.9% complete by July 15". The inference is that in excess of 80% of the run through Sep 30 could be available by July 15. There is as stated previously, no documentation of a fall-run even though more than one-half of the fish observed by divers on Oct 22 were between "Black (Hole)" and "Church" pools, i.e., below the gorge.

**Escapement**

An escapement of the **388** salmon (includes the few fish that may have been lost to hook-and-release mortality; there were no reported removals) estimated to be in the river on Oct 22 is **169%** of the 230 fish requirement. This value is down 34% over the median estimate for 1994.

The Oct 22 estimate of escapement is not a definitive value but rather, a "most" probable value (Fig. 14). There is, however, a 99% probability that the target was achieved. Biological information is inadequate to precisely estimate egg deposition and the proportion of egg requirement that was met.

**Forecast**

Using Bayesian techniques, Amiro and Harvie (MS 1996) investigated probabilities for potential MSW returns of North River stock in 1994 and 1995 from a Ricker stock-and-recruit function. Spawners and recruits were developed for spawner years 1974 -1989 from recreational harvests in North River, an angling exploitation rate of 0.5, and 0.83 of total commercial harvests reported for St Ann's Bay and Harbour. To compensate for significant first order auto-correlation and forecasts that would have exceeded returns in 1993 and 1994, the 1992 point was excluded and the 1994 value was used as prior weighting. The function $Recruit_{adj} = Spawner * e^{(2.61009 - 0.00331 * Spawner)}$, forecast returns in 1995 of 331-727 salmon (90% CI) from an estimated 800 spawners in 1989. The Oct estimate of return in 1995 was 260 wild MSW fish. The same model (Amiro and Harvie MS 1996) solved for an estimated 1,220 spawners in 1990 suggests that returns in 1996 will be 253-553 MSW salmon (90% CI) i.e., >95% probability that returns will exceed conservation requirements.

The need to adjust the above model (Amiro and Harvie MS 1996) is consistent with uncertainties experienced in forecasting from simple and complex models (Margaree, [this paper] and, Saint John [Marshall and Jones 1996], i.e., recruit per spawner values in the last three years appear to be inconsistent with data to which models have been fit. While the conservation requirements are likely to be met in 1996 there is, however, less confidence that returns to the North River in 1996 should increase over those of 1995 unless, it is a result of supplementation with hatchery smolts (Table 24). Smolts stocked in 1995 and a modest return rate of 0.5% (Saint John River, Marshall and Jones 1996) would in themselves meet conservation requirements for small salmon.

## SYDNEY RIVER

The Sydney River, Cape Breton County, lies in Salmon Fishing Area 19 (SFA 19). The watershed is bounded by the Mira River and Gaspereaux tributary on the south, and the East Bay Hills on the north (Fig. 1). The river arises in the East Bay Hills at an elevation of about 170 m and flows in a north easterly direction to its confluence with South Arm, Sydney Harbour. The relief of the Sydney River is, as would be expected, more gentle than that of Highland rivers (Table 23) and would be expected to have less production capacity per unit area than higher gradient rivers. The stock has always been considered to be solely of late run-timing. There has been little effort in this century to stock, manage or investigate the salmon resource.

Counts of adult salmon entering a newly installed trap in the Sydney River fishway, Coxheath N.S., were first made in 1994 by Fishery Guardians of Membertou First Nation. Counts were again made in 1995; adults were sexed on the basis of external characteristics and measured for fork length. A few scales were also removed for age determination. Juvenile salmon have not been surveyed.

### Estimation of Returns

The trap was operated continuously Oct 6 to Nov 18, 1994, and Oct 23 to Nov 20, 1995. Fish are not known to ascend the fishway before October; early fall counts may have been missed in either year although water levels were low and no signs of a run were observed before installation of the trap. Angling effort to October 31 in each year was estimated at 3 rod-days and 0 catch (Table 3). Trapped fish were counted, sexed and measured; data and scale samples were forwarded to DFO, Halifax.

### Estimates of Returns

Counts in 1994 numbered only 29 small and large salmon; those of 1995 numbered 122 fish and were comprised of **18** small and **104** large salmon. Daily counts (Fig. 18) for 1994 and 1995 illustrate a 2-week difference in run-timing. Ninety-five percent of the run in 1995 was tallied Nov 16-18, dates which observers considered to be very late (R.C. Thompson[1] pers comm). Other salmon (number unknown) were reported to have been removed from and below the fishway (J. Brown[1] pers comm).

Biological Characteristics

Data provided for 18 small and 104 large salmon indicate respective male:female proportions of 0.67:0.33 and 0.22:0.78. Mean fork length of small females was 55.1 cm (n=6), large females measured 77.6 cm (n=81); A length-fecundity relationship of $Fec = 340.892e^{0.038925\,FL}$ established for fish of the St. Mary's River, N. S. (Marshall 1986) suggests an average fecundity of 2,906 eggs for small and 6,982 eggs for large female salmon. One hundred and thirteen scale samples from returns in 1995 revealed a sea-age composition of 0.14 1SW, 0.78 2SW, 0.01 3SW and 0.07 repeat spawners (all readable scales from repeats having first spawned as 2SW fish).

### Conservation Requirements

Conservation requirements for the Sydney River are based on a substrate area of 4,024 *100 $m^2$ > 0.12% orthograde (Table 23) and 2.4 eggs $m^{-2}$. Requirements number 0.966 million eggs and on the basis of large and small, male and female composition in 1995 are calculated to be **30** small and **170** (172) large salmon i.e., **200** salmon in total. Males have not been added to correct the natural imbalance of males for a 1:1 male:female ratio.

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[1] DFO, P.O. Box Sydney, N.S. B1P 6J7

### Escapement

The proportion of the run that may have ascended the fishway before installation of the trap is unknown. An estimated angling effort of 3 rod-days and 0 catch may, however, suggests that there were few, if any uncounted fish above the fishway before Oct 31. The 122 fish through the fishway and their eggs represent **61%** of conservation requirement.

### Forecast

There are no data with which to forecast returns in 1996. Returns approached conservation requirements but escapement has not knowingly met those requirements. There is no evidence, particularly with respect to marine conditions, to anticipate significant changes between the number of returns in 1995 and those of 1996.

## GRAND RIVER

The Grand River (Fig. 1), Richmond County, lies in Salmon Fishing Area 19 (SFA 19). The mainstem flows southerly from Loch Lomond a distance of 15.7 km to tidal waters of the Atlantic at Grand River (Amiro and Longard 1990). Headwater elevation (~100m), gradient and tributaries accessible to salmon are, on average, the least of all rivers assessed in this document (Table 23). Unlike most other Cape Breton stocks, salmon of the Grand river are principally small (1SW) and of June/July run timing. The few large salmon are almost entirely repeat spawning 1SW fish. Returns in the last 5 years are fewer than those of 1989-1990 despite significant hatchery supplementation with Grand River stock (Table 24) and the implementation of allowances (quotas), 1990-91 and, finally, closure, 1992, of south coast Newfoundland commercial fisheries.

Annual counts of adult salmon have been made at Grand River Falls fishway since 1988, (Amiro and Longard 1990) and are published in the CAFSAC Research Document Series and later, the DFO Atlantic Fisheries Research Document Series. Densities of juvenile salmon were assessed but not reported by the Richmond County Wildlife Association in 1988. Spawning escapement in 1994 was estimated to have been 71% (later corrected to 86%) of conservation requirement above Grand River Falls (Amiro and Longard 1995) and contributed to a management decision to close the river to all fishing.

With assistance from Chapel Island First Nation, returns were counted at the Grand Falls fishway in 1995. Juvenile assessments were conducted at five sites, two of which had been done in 1988. Broodstock were again collected but, unlike most years, below, rather than above the Falls.

### Estimation of Returns

Grand River Falls is a partial barrier to salmon located 10.2 km above head-of-tide (Fig. 19). Forty-five percent of the juvenile salmon producing area is estimated to be above the falls; 55% of the total river production area is below the falls. Fishway bi-pass rates have been determined during mid-October collections of broodstock above the falls. Mean bi-pass rates determined from values provided in Amiro and Longard (1990; 1995) are 0.4 for small and 0.57 for large salmon.

The trap was operated continuously June 18 to Nov 5, 1995. Previously, significant numbers of fish were neither known to ascend the fishway before mid-June nor after mid- October. Fish were counted, sexed and, a proportion were scale sampled. Returns to the Falls are estimated as:

*Returns = Count/[1.0 - bi-pass rate].*

**Estimates of Returns**

Counts in 1995 numbered 165 salmon comprised of 105 small wild, 52 small hatchery, 7 large wild and 1 large hatchery. Counts and hatchery contribution to returns more than doubled over those of 1994; counts were the highest since 1991 (Summary Sheet Fig. 20). Twenty percent of the run in 1995 was tallied in late-October early-November when normally, the trap would have been removed.

Total returns were estimated to be **262** small and **19** large salmon.

Biological Characteristics

Length data for 183 small salmon, including broodstock, averaged 53.1 cm; the average length of 8 large fish was 70.9 cm. Sex ratios for the entire run could not be ascertained, 51 small fall fish were 0.29 male: 0.71 female, the same as that used in the original calculation (Amiro and Longard 1990) for egg requirements.

**Conservation Requirements**

Conservation requirements for the Grand River are based on a substrate area of 4,618 *100 $m^2$ > 0.12% orthograde (Table 23) and 2.4 eggs $m^{-2}$. Requirements number 1.1 million eggs or 545 salmon in total of which **234** fish are required **above the falls**.

**Escapement**

There were no removals of fish reported from the Grand River. Hence the 281 fish above Grand Falls represent **120%** of the target above the Falls and 52% of the requirement for the entire river. This is the highest escapement, count or estimate since 1991.

**Juveniles**

Juvenile salmon abundance was assessed by electrofishing at five sites, two each on the mainstem above and below the Falls and one on Black River (Fig. 19). Sites were large, 5.3 - 10.0 * $100m^2$; captured fish age ≥1+ were marked and replaced in the site; recapture runs were usually conducted two days later. Estimates of age-1+ and -2+ parr density were calculated using the adjusted Petersen mark-and-recapture method. Age-0+ fish were estimated using the efficiency of capture for older fish. Results are:

| Site # and Location | Area ($m^2$) | Age 0+ * $100m^{-2}$ | Age ≥ 1+ * $100m^{-2}$ |
|---|---|---|---|
| 1. Abv Falls: Mud Hole | 926 | 6.6 | 2.4 |
| 2. Abv Falls: Fishway | 996 | 2.6 | 10.3 |
| 3. Bl Falls: Crib Pool | 827 | 15.6 | 5.0 |
| 4. Bl Falls: MacDonald Rd | 533 | 3.8 | 4.3 |
| 5. Black R. | 586 | 5.1 | 13.1 |

Densities are low by Margaree and Middle river standards. Main river sites are of low gradient i.e., <0.5% orthogradient, but low gradient areas constitute one-half of the juvenile production area

(Table 23). In 1988 their were no salmon found in site no. 2; densities in site no. 5 were 7.2 age 0+ and 8.7 age-1+ and -2+ parr * $100m^{-2}$. Escapements in 1986-1987 are unknown but are presumed, on the basis of counts in 1989 (Fig. 15), to be greater than those counts and escapements of 1993-1994. Data and sites are too few to infer similarities, differences or population status with respect to potential.

### Forecast

There is no precedent for forecasting returns to the Grand River. Estimated returns, 1988 to 1995 reached their lowest point in 1994. Significant returns from hatchery products, have contributed to recent attainment of conservation requirements. Given that marine survival (see "ecological considerations"), at least for distant migrating stocks, is unlikely to be worse than in 1995 and that stocking of 26,000 hatchery smolts in 1995 (Table 24) was triple that of 1994, returns in 1996 should again exceed conservation requirements, at least for the area above the Falls.

## ECOLOGICAL CONSIDERATIONS

### In-river

The Margaree is the only one of the six rivers assessed for which river discharge data is still collected. Margaree discharge patterns and levels are likely to be reasonably representative of other Highland-origin rivers but are perhaps less representative of the Sydney and Grand rivers. Claytor et al. (1995) investigated discharge patterns and run-timing of salmon and suggested that the relationship between the returns of small salmon and mean monthly discharge is more predictable than for large salmon. At low mean monthly discharges (Claytor et al. op cit.) small salmon were more likely to be late than early. Large salmon could be early or late at low mean monthly summer discharges. In the fall, low water delays large salmon but high water appeared to have no effect on run-timing.

Mean monthly discharges for Margaree in June, July and August in 1995 were not as low as those of 1994 but were at or below the 70-year mean (Fig. 23). The mean monthly discharge for September was as low as that of 1994. Daily values in October increased very gradually, the exceptions being during short-duration high-water events in mid and late October, Twenty-four hour average values better illustrate the importance of threshold discharges and temperatures in affecting salmon behaviour. Daily discharges plotted against counts at Levi's, 1992-1994 (Fig. 4) illustrate the impact of threshold freshets in bringing fish into the trap. Temperature changes may (August 1994) or may not (August 1995) be a factor (Fig. 21) during the summer months. Summer water temperatures in 1995 (Fig. 21 and 22) were similar to those of 1994, both years exceeded the temperatures of 1993. Hourly temperature data at Levi's trap and in the fishway at Grand River indicate the daily extremes to which salmon may be exposed (Fig. 24 and 25). Each of the years, 1992-1995 appears to have many threshold discharges and temperatures associated with the entry of salmon. However major discharge events are often associated with the entry of significant numbers of salmon, witness mid-September 1992 (Fig. 4).

In 1995, population estimates on Oct 25 and Nov 26 provided insight into the possible magnitude and lateness of salmon ascending the Margaree. Conditions contributory to a later-than-"normal" fall run to the Margaree, and quite possibly the Sydney and Grand rivers could significantly influence the estimation of total returns, trap efficiencies and angler exploitation rates. Environmental conditions in 1995 may have been different with respect to discharges and temperatures, 1992-1994, (Fig. 4 and 21) but have not been tested. Moderate numbers of salmon were caught at Levi's over the last 3 weeks of operation, 1995, despite low discharges and waters temperatures that failed, for the most part, to dip below 10°C. Patterns of counts in each year, (Fig. 4 and 21) except perhaps in 1994, and temperature

or discharge events suggest the potential for some high daily counts of salmon if it had been possible to continue the operation of Levi's trap to a later date.

Given that Cape Breton rivers appear to have significant late-run components, that Highland rivers may have similar temperature and discharge patterns and that salmon returns to Middle, Baddeck and North rivers were all assessed within a few days of the Margaree estimate for Oct 25, it is probable that escapements to rivers surveyed Oct 18 to 23 were under-estimated. This is not necessarily a contradiction to the observation that perhaps 5 to 10% of salmon were already spawning during the surveys.

**Marine**

January-March environmental conditions for salmon in the North Atlantic, 1995, did not improve from those of the same months in recent years (Anon 1995; Fig. 26). The ICES Working Group on North Atlantic Salmon (Anon op cit) forecasted a low pre-fishery abundance of non-maturing 1SW salmon available to a Greenland fishery in 1995. By analogy, there should be low numbers of 2SW (large) salmon returning to homewaters in the subsequent year, i.e., 1996. Two-sea winter salmon stocks of Cape Breton that have been tagged, have in the past contributed to distant water fisheries including those of Greenland. Marshall and Jones (MS 1996) demonstrate several relationships that implicate the "index" of over-winter habitat to the survival of Saint John River 1SW and MSW hatchery components but data, so far, are inadequate to demonstrate such relationships for Cape Breton stocks.

## MANAGEMENT CONSIDERATIONS

Conservation requirements in 1995 were met or exceeded on the Margaree, North and Grand rivers. Requirements were not knowingly met on the Middle, Baddeck and Sydney rivers. However, evidence of the lateness of salmon returning to some rivers raises uncertainty about the completeness of some October estimates of returns and the possibility, in 1995, that conservation requirements were met on the Middle and Baddeck rivers in particular.

Returns to the Margaree, North and Grand rivers in 1996 should meet spawning requirements. Significant surpluses will occur only in Margaree late-run large salmon. Small salmon of hatchery origin should contribute to a small surplus on the Grand River, the eggs of which could be readily adsorbed by what may be relatively vacant juvenile habitat. Surplus wild fish in the North River may be fewer than in 1994; hatchery 1SW fish could number four times the requirement of 30 small fish.

The uncertainty about the completeness of returns on the Middle and Baddeck impacts heavily on qualitative forecasts of returns to those rivers in 1996, i.e., if targets had been met, the prognosis for 1996 would have been that targets would again be met. Juvenile densities at the few sites on the Middle River support management scenarios to maximize adult escapements. Juvenile densities on the North and Baddeck rivers may provide similar insights and retrospective assessments of escapements. With that data, and a review of production potential of these rivers, Science will be in a better position to reconsider conservation targets and the methods by which escapements might be assessed.

No tags originating from Cape Breton stocks have been as yet returned from the re-inaugurated Greenland fishery in 1995. Previous experience with tagged 2SW stocks of Cape Breton suggests that some fish are destined to be harvested in Greenland. The continuation of that fishery in 1995 (77 t allocation; 68 t harvest or about 12,000 potential 2SW of North American origin) has not been accounted for in the prognoses for returns in 1996.

## ACKNOWLEDGEMENTS

Compilation and synthesis of these assessments have been made possible only with the support of co-workers in Moncton, Cardigan, Mersey and Halifax, seasonal staff at Margaree and Grand River, students at Margaree, First Peoples and, volunteers from the angling community. First Peoples, Fishery Guardians in particular, of Eskasoni, Wagmatcook, Waycobah, Membertou and Chapel Island First Nations variously assisted in electrofishing, swim-thru counts of adults, a broodstock collection and operation of the Grand Falls Fishway. Fishery Guardians of Membertou First Nation operated and provided counts and scales of salmon captured in the Sydney River fishway.

Conservation and Protection personnel of DFO, Baddeck, Sydney and North Sydney provided important ground/safety support for swim-thru counts of adult salmon. Volunteers included members of the Margaree Salmon Association, Bras d'Or Wildlife Association as well as anglers-at-large from the Mainland and Cape Breton. K. Rutherford, DFO, Halifax co-ordinated the ultra-sonic tracking study, and assisted in various other activities; D. Longard, DFO Halifax and D. MacPhail, Silvacare interpreted ages of salmon scales; A. Pate, L'Ardoise, N.S. voluntarily operated the trap in the Grand River fishway for the last 4 weeks of the season; R. Claytor and G. Chaput, DFO, Moncton, shared their statistical expertise.

Special thanks are extended to T. Bernard, Fishery Guardian, Wagmatcook First Nation for his untiring efforts in support of the adult collections and swim-thru counts and P. Amiro, DFO, Halifax and D. Longard for their expertise and guidance in the assessment of adult salmon populations using swim-thru/ mark-and-recapture techniques.

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## PEER REVIEW/ OUTSIDE CONSULTATIONS

**Special Meeting of Cape Breton Sports Fishing Advisory Committee**

| Attendees | |
|---|---|
| Marshall Kaiser | Chairperson |
| Charlie Dennis | Eskasoni Fish and Wildlife Commission |
| Cory Francis | Native Council of Nova Scotia, Truro |
| M.J. Martin | " " " " , Tatamagouche |
| Lynda Calvert | Fish Unlimited, Margaree Valley |
| John Hart | Margaree Salmon Association |
| Edsel Hart | " " " |
| Harry Vickers | Cape Breton Anglers Association |
| Stu Vickers | " " " " |
| John F. Kennedy | Nova Scotia Wildlife Federation, Port Morien |
| Vernon Boone | Port Morien Wildlife Association |
| Michael McAdam | Atlantic Salmon Federation, Truro |
| Don MacLean | Nova Scotia Dept. Fisheries, Pictou |
| Tim Reynolds | Cape Breton Highlands National Park, Ingonish Bch |
| Gordon Delaney | " " " " " , Cheticamp |
| Randy G. Thompson | " " " " " " |
| Jennifer Hoffman | " " " " " " |
| Clarence Barrett | " " " " " " |
| R.C. Thompson | Dept. Fish. & Oceans, Sydney |
| Warren Parsons | " " " , Antigonish |
| Leonard Forsyth | " " " , Margaree |
| Paul LeBlanc | " " " , Margaree/Moncton |
| Larry Marshall | " " " , Halifax |

This special **consultation on the assessment of the status of Atlantic salmon stocks of Cape Breton Island** was called to order by Chairman Kaiser at the Coast Guard College, 2:00 pm, Dec 12, 1995. He introduced Larry Marshall, DFO, Science, who outlined the requirement for Science Branch to consult with the public on the available data, the assessment processes, and preliminary findings prior to the actual drafting of assessment documents.

Dr. Marshall invited the contribution of data, observations or concerns from anyone who now, or in the future, had, or would have information that could enhance the knowledge base of the Island's salmon stocks. He acknowledged the important contribution now being made by First Peoples and volunteer citizens to collect data and the cooperation of Membertou First Nation in providing their database for salmon ascending the Sydney River fishway.

The session reviewed available data from Grand, Sydney, Middle, Baddeck, North and Margaree rivers. Tabled data consisted of counts or partial counts of adults on each of the six rivers, counts of juvenile salmon

within sites on the Grand, Middle and Margaree rivers and catches by anglers voluntarily returning stubs from their Nova Scotia Salmon Angling Licence or voluntarily returning logbooks provided to a subset of anglers that fished the Margaree.

Target spawning requirements previously established for each of the six rivers were also tabled. Dr. Marshall mentioned his intention to examine all "targets" for Cape Breton from the perspective of estimated production area i.e., the denominator in the underlying target requirement of 2.4 eggs/$m^2$. He proposed that "area" for the Margaree River and Pollett River (a point source of the 2.4 eggs/$m^2$ target) would be measured in the same manner as other Cape Breton rivers, i.e., remote-measure weighted by gradient and that each would be "scaled" against the Pollett for a derivation of "relative" river requirements. Results should be available in about one year.

The estimation of in-season and/or end-of-season returns for Middle, Baddeck, North and Margaree rivers by mark-and-recapture experiments was discussed at length. Different approaches (and answers) to estimating the run-size at time revealed the difficulties in assuming that either all tagged and or all untagged fish were available to recapture. Evidence of late run-timing and results from tracking of ultrasonic-tagged fish were used to support the choice of the "best" estimate, where there were multiple estimates, or suggest, where there was only one estimate, that the true number may exceed the estimate.

Stock status for each of the six rivers, 1995, was summarily examined by comparing the general estimates of adult returns with adult target spawning requirements. Stocks of three rivers met or exceeded existing requirements, stocks of two rivers *may* have met requirements and the stock of one river met only about half of its' requirement.

Forecasting of abundance in 1996 was not examined in detail. Methodology is currently only available for the Margaree; a method for the North River is still under review. Dr. Marshall indicated that he knew of no glaring evidence to suggest that returns in 1996 will vary greatly from those of 1995.

Observations, expressions of concern, recommendations etc., from the floor have been summarized under the following headings.

Catch:

- The decline in rod days shown in the summary of logbook data, 1995, may be the result of declining stocks as well as fewer log book participants.

- There is an inconsistency between fishing regulations and data shown for the Baddeck River (a grilse was reported as having been retained when the fishery was closed to retention).

Data:

- There were reports by Fishery Officers of salmon showing up in coastal streams such as Frenchvale Brook in late Nov. early Dec.

- It was questioned if Levi's trap (Margaree) could be installed so that the efficiency is consistent from year to year and if one could apply the current years estimated efficiencies to past years. (The response indicated that the trap efficiency could be expected to vary annually with river conditions [discharge in particular], experience in setting the net more effectively and, that the estimated number of returns in 1991 [important to the 1996 forecast] unlike that of 1990 [adjusted at the peer review assessments in February, 1995, for forecasting 1995 returns] is, on casual observation, unlikely to be different from most values since 1985.)

Targets:

- There is a continuing concern that target spawning requirements for the Middle and Baddeck rivers, in particular, are over estimated. (Solution proposed in para 4.)

Stock status:

- Assurance was sought that aquaculture fish would be identified as a separate component within the estimates of adult returns to North and Baddeck rivers, in particular, in 1995.

Other:

- A better understanding was sought by the group of the work being done on Atlantic salmon within Cape Breton Highlands National Parks and of the communication between DFO and Parks. Parks staff related there past involvement in operating a fence on the Cheticamp River, collecting harvest data when there was a retention fishery, electroseining of juveniles and in swim-thru counts of adults in the Cheticamp and Clyburne rivers and, on occasion, the North Aspy River. Adult returns to Cheticamp and Clyburne rivers have in the past been in the range of 200-300 and 50-100 fish respectively (only a partial count was conducted on the Clyburne River in 1995). Assessments are not normally published but Park staff have in the past shared their data with and are interested in continuing, and possibly expanding, the dialogue and cooperation with DFO Science.

The session adjourned at about 4:45 pm; no Minutes were retained on a closing "non-agenda" item re: the recently released allocation of harvestable numbers of fish inc., salmon, to First Peoples represented by the Native Council of Nova Scotia.

TLM 12/15/95

***Table 1. Summary of the First Peoples salmon allocations, gear type, and seasons for Cape Breton, 1995.***

| Location | First Peoples | Allocation Small | Allocation Large | Gear Type | Season |
|---|---|---|---|---|---|
| **Margaree River** | | | | | |
| | Eskasoni | 6 | 30 | Trapnet, angling, and seining. | June 1 - Aug 31 |
| | | 20 | 100 | Trapnet, angling, and seining. | Sept 1 - Oct 31 |
| | Chapel Island | 6 | 30 | Trapnet, angling, and seining. | June 1 - Aug 31 |
| | | 20 | 100 | Trapnet, angling, and seining. | Sept 1 - Oct 31 |
| | Membertou | 6 | 30 | Trapnet, angling, and seining. | June 1 - Aug 31 |
| | | 20 | 100 | Trapnet, angling, and seining. | Sept 1 - Nov 5 |
| | Wagmatcook | 6 | 30 | Trapnet, angling, and seining. | June 1 - Aug 31 |
| | | 20 | 100 | Trapnet, angling, and seining. | Sept 1 - Nov 5 |
| | Waycobah | 6 | 30 | Trapnet, angling, and seining. | June 1 - Aug 31 |
| | | 20 | 100 | Trapnet, angling, and seining. | Sept 1 - Oct 31 |
| | Total Summer | 30 | 150 | | June 1 - Aug 31 |
| | Total Fall | 100 | 500 | | Sept 1 - Oct 31/Nov 5 |
| | Total Season | 130 | 650 | | June 1 - Oct 31 |
| **North River** | | | | | |
| | Eskasoni | 4 | 6 | Angling, snaring, and seining. | June 1 - Oct 25 |
| | Chapel Island | 4 | 6 | Angling, snaring, and seining. | June 1 - Oct 25 |
| | Membertou | 4 | 6 | Angling, snaring, and seining. | June 1 - Oct 25 |
| | Wagmatcook | 4 | 6 | Angling, snaring, and seining. | June 1 - Oct 25 |
| | Waycobah | 4 | 6 | Angling, snaring, and seining. | June 1 - Oct 25 |
| | Total Season | 20 | 30 | | June 1 - Oct 25 |
| **Bras D'Or (Christmas Brook area)** | | | | | |
| | Eskasoni | 250 | - | Trapnet, snares, angling, and spearing. | June 1 - Oct 31 |
| **Bras D'Or** | | | | | |
| | Membertou | 200 | - | Angling, snaring, and spearing. | June 1 - Oct 31 |
| **Bras D'Or (St. Peter's Inlet)** | | | | | |
| | Chapel Island | 150 | - | Trapnet, angling, snaring, and spearing. | No season. |
| **Bras D'Or (Nyanza Bay)** | | | | | |
| | Wagmatcook | 100 | - | Trapnet, angling, snaring, and spearing. | July 1 - Oct 31 |
| **Bras D'Or (Whycocomagh Bay)** | | | | | |
| | Waycobah | 250 | - | Trapnet, angling, snaring, and spearing. | No season. |
| | Total Season | 950 | | | Varied. |
| **Cape Breton Island** | | | | | |
| | Native Council N.S. | 1,820* | | Angling, snaring, and spearing. | |
| **Cape Breton Totals; Fish:** | | **1,100** | **680** | | |
| **Tags:** | | **1,820** | | | |

* Tags only; 10 tags to each of 182 applicants.

*Table 2. Recreational catch and effort for Atlantic salmon on rivers of Cape Breton Island, 1995.*

**PRELIMINARY**

| River | Season dates Begin D/M | Season dates End D/M | Observed no. of anglers | Numbers caught (including releases) Grilse Obs. | Grilse Est. | Salmon Obs. | Salmon Est. | Unknown obs. | Total obs. | Total Est. | Effort No. of rod days Obs. | Effort No. of rod days Est. | Catch per effort fish/day | Percent large salmon |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aconi Brook | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Baddeck | 1/06 | 25/10 * | 59 | 49 | 64 | 57 | 74 | 0 | 106 | 138 | 260 | 351 | 0.408 | 53.8 |
| Barachois | 1/06 | 31/10 * | 14 | 6 | 8 | 16 | 21 | 0 | 22 | 29 | 34 | 46 | 0.647 | 72.7 |
| Campbell's Brook | 1/09 | 31/10 | 0 | | | | | | | | | | | |
| Catalone | 1/06 | 30/09 * | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0.000 | 0.0 |
| Cheticamp | 16/05 | 30/09 | 11 | 6 | 8 | 21 | 27 | 0 | 27 | 35 | 66 | 89 | 0.409 | 77.8 |
| Clyburne | 1/06 | 31/10 * | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 0.500 | 0.0 |
| Framboise | 1/06 | 30/09 * | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 6 | 8 | 0.167 | 0.0 |
| Gaspereaux: Cape Breton Co. | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Gerratt | 1/06 | 30/09 * | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0.000 | 0.0 |
| Grand | "River closed" | | | | | | | | | | | | | |
| Grantmire Brook | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Indian Brook | 1/06 | 31/10 * | 11 | 2 | 3 | 3 | 4 | 0 | 5 | 7 | 15 | 20 | 0.333 | 60.0 |
| Ingonish | 1/06 | 31/10 * | 3 | 2 | 3 | 8 | 10 | 0 | 10 | 13 | 27 | 36 | 0.370 | 80.0 |
| Inhabitants | 1/06 | 31/10 * | 10 | 3 | 4 | 15 | 20 | 0 | 18 | 24 | 32 | 43 | 0.563 | 83.3 |
| Little Lorraine | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Lorraine Brook | 1/06 | 30/09 * | 0 | | | | | | | | | | | |
| Mabou | 1/09 | 31/10 | 2 | 3 | 4 | 1 | 1 | 0 | 4 | 5 | 3 | 4 | 1.333 | 25.0 |
| MacAskill's Brook | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Margaree | 1/06 | 31/10 * | 1123 | 247 | 323 | 796 | 1040 | 0 | 1043 | 1363 | 8867 | 11960 | 0.118 | 76.3 |
| Marie Joseph | 1/06 | 30/09 * | 0 | | | | | | | | | | | |
| Middle: Victoria Co. | 1/06 | 25/10 * | 70 | 30 | 39 | 41 | 54 | 0 | 71 | 93 | 218 | 294 | 0.326 | 57.7 |
| Mira | 1/06 | 25/10 * | 7 | 8 | 10 | 4 | 5 | 0 | 12 | 16 | 53 | 71 | 0.226 | 33.3 |
| North : Victoria Co | 1/06 | 25/10 * | 74 | 136 | 178 | 166 | 217 | 0 | 302 | 395 | 391 | 527 | 0.772 | 55.0 |
| North Aspy | 1/06 | 31/10 * | 5 | 2 | 3 | 7 | 9 | 0 | 9 | 12 | 12 | 16 | 0.750 | 77.8 |
| Northwest Brook (River Ryan) | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| River Bennett | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| River Deny's | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| River Tillard | 1/06 | 31/10 * | 2 | 2 | 3 | 0 | 0 | 0 | 2 | 3 | 5 | 7 | 0.400 | 0.0 |
| Saint Esprit | 1/06 | 31/10 * | 0 | | | | | | | | | | | |
| Salmon: Cape Breton Co. | 1/06 | 25/10 * | 12 | 7 | 9 | 11 | 14 | 0 | 18 | 24 | 62 | 84 | 0.290 | 61.1 |
| Skye | 1/06 | 31/10 * | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0.000 | 0.0 |
| Sydney | 1/06 | 31/10 * | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0.000 | 0.0 |
| Cape Breton totals | | | 1410 | 505 | 661 | 1146 | 1496 | 0 | 1651 | 2159 | 10060 | 13569 | 0.159 | 69.3 |

* Variation Order

Table 3. Recreational catch and effort for Atalntic salmon on rivers of Cape Breton Island, 1994, 1995 and 1990-94.

| River | 1995 Preliminary | | | | 1994 | | | | 1990 - 94 means | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grilse | | Salmon | | Grilse | | Salmon | | Grilse | | | | Salmon | | Effort | |
| | retained | released | released | Effort | retained | released | released | Effort | retained | 95% C.I. | released | 95% C.I. | released | 95% C.I. | roddays | 95% C.I. |
| Cape Breton | | | | | | | | | | | | | | | | |
| Aconi Brook | | | | | | | | | 8.3 | N/A | 1.7 | N/A | 10.7 | N/A | 44.3 | N/A |
| Baddeck | 8 | 56 | 74 | 351 | 1 | 15 | 62 | 305 | 30.4 | 22.8 | 17.8 | 11.3 | 146.0 | 75.1 | 601.6 | 226.2 |
| Barachois | 0 | 8 | 21 | 46 | 0 | 1 | 6 | 50 | 4.2 | 3.8 | 2.8 | 3.9 | 16.0 | 11.5 | 95.4 | 47.9 |
| Campbell's Brook | | | | | | | | | 0.5 | N/A | 0.5 | N/A | 7.5 | N/A | 28.5 | N/A |
| Catalone | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 5 | 8.2 | 13.6 | 1.0 | 1.5 | 5.2 | 9.7 | 181.4 | 190.6 |
| Cheticamp | 0 | 8 | 27 | 89 | 0 | 7 | 10 | 91 | 5.0 | 7.7 | 5.8 | 8.5 | 55.2 | 43.7 | 170.6 | 86.6 |
| Clyburne | 0 | 1 | 0 | 3 | 0 | 0 | 10 | 23 | 1.0 | 2.8 | 0.0 | 0.0 | 3.5 | 6.6 | 16.5 | 24.0 |
| Framboise | 0 | 1 | 0 | 8 | 0 | 0 | 0 | 59 | 15.6 | 16.5 | 3.8 | 4.2 | 11.2 | 16.7 | 273.0 | 190.8 |
| Gaspereau: Cape Breton Co. | | | | | 0 | 0 | 0 | 17 | 0.4 | 0.7 | 0.0 | 0.0 | 0.2 | 0.6 | 21.0 | 22.0 |
| Gerratt | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 4 | 1.0 | 2.2 | 1.4 | 3.2 | 0.0 | 0.0 | 18.0 | 21.6 |
| Grand | River closed | | | | 0 | 72 | 20 | 411 | 143.2 | 150.5 | 39.0 | 41.1 | 41.6 | 43.2 | 1734.6 | 1105.3 |
| Grantmire Brook | | | | | | | | | 0.0 | N/A | 2.5 | N/A | 5.5 | N/A | 15.0 | N/A |
| Indian Brook | 0 | 3 | 4 | 20 | 0 | 0 | 1 | 10 | 1.2 | 1.6 | 2.4 | 4.2 | 7.4 | 13.7 | 40.2 | 38.0 |
| Ingonish | 0 | 3 | 10 | 36 | 0 | 2 | 7 | 47 | 7.2 | 8.7 | 2.2 | 3.4 | 9.6 | 10.5 | 74.8 | 47.5 |
| Inhabitants | 0 | 4 | 20 | 43 | 0 | 22 | 61 | 155 | 25.8 | 19.1 | 7.6 | 11.3 | 105.4 | 43.7 | 351.2 | 159.7 |
| Little Lorraine | | | | | | | | | 0.0 | N/A | 0.0 | N/A | 0.0 | N/A | 0.0 | N/A |
| Lorraine Brook | | | | | | | | | 7.0 | 9.9 | 1.8 | 2.1 | 3.3 | 5.6 | 89.5 | 103.3 |
| Mabou | 3 | 1 | 1 | 4 | 1 | 0 | 1 | 31 | 1.8 | 1.6 | 1.0 | 2.8 | 5.2 | 9.1 | 19.0 | 11.4 |
| MacAskill's Brook | | | | | | | | | 0.3 | N/A | 2.0 | N/A | 3.3 | N/A | 24.7 | N/A |
| Margaree | 199 | 124 | 1040 | 11960 | 291 | 138 | 1479 | 13376 | 492.2 | 143.3 | 164.8 | 46.3 | 1555.4 | 391.8 | 14330.6 | 1312.1 |
| Marie Joseph | | | | | 0 | 1 | 12 | 60 | 4.8 | 7.9 | 0.8 | 1.6 | 3.8 | 6.4 | 80.8 | 51.1 |
| Middle: Victoria Co. | 0 | 39 | 54 | 294 | 0 | 24 | 166 | 498 | 26.2 | 39.2 | 14.0 | 13.9 | 125.4 | 99.2 | 596.4 | 404.3 |
| Mira | 0 | 10 | 5 | 71 | 0 | 7 | 2 | 49 | 7.6 | 11.7 | 2.6 | 3.6 | 5.0 | 7.1 | 157.2 | 130.7 |
| North: Victoria Co. | 1 | 176 | 217 | 527 | 0 | 74 | 97 | 406 | 119.2 | 106.4 | 47.4 | 27.8 | 354.8 | 282.3 | 1347.0 | 733.0 |
| North Aspy | 0 | 3 | 9 | 16 | 0 | 12 | 27 | 67 | 3.2 | 4.8 | 2.6 | 6.5 | 21.2 | 14.1 | 76.4 | 32.1 |
| Northwest Brook (River Ryan) | | | | | | | | | 0.3 | N/A | 0.0 | N/A | 3.3 | N/A | 29.3 | N/A |
| River Bennett | | | | | | | | | 1.0 | N/A | 0.0 | N/A | 1.0 | N/A | 6.0 | N/A |
| River Dany's | | | | | | | | | 0.3 | 0.7 | 0.0 | 0.0 | 0.8 | 2.1 | 4.0 | 5.7 |
| River Tillard | 0 | 3 | 0 | 7 | 0 | 2 | 0 | 8 | 6.6 | 9.0 | 2.2 | 1.6 | 6.6 | 7.4 | 48.4 | 35.2 |
| Saint Esprit | | | | | 0 | 0 | 0 | 64 | 0.4 | 0.7 | 0.0 | 0.0 | 0.2 | 0.6 | 21.0 | 31.7 |
| Salmon: Cape Breton Co. | 0 | 9 | 14 | 84 | 0 | 0 | 0 | 18 | 5.4 | 5.5 | 1.4 | 2.6 | 6.2 | 5.6 | 224.4 | 166.9 |
| Skye | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 6 | 3.5 | N/A | 0.5 | N/A | 0.0 | N/A | 14.5 | N/A |
| Sydney | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0.8 | 1.6 | 0.2 | 0.6 | 4.0 | 5.8 | 12.8 | 16.5 |
| Totals | 211 | 449 | 1496 | 13569 | 294 | 377 | 1961 | 15763 | 924 | | 326 | | 2507 | | 20644 | |

*Table 4. Annual summaries of catch, effort and estimated 1SW fish retained from NS license stub returns for assessed rivers of Cape Breton, 1984-95. Mean = (1990 to 1994). The 1995 data are preliminary. (Unk. Obs. are undefined small/large.)*

| Year | River | No. Angler | Small Obs. | Small Est. | Est. Ret. | Large Obs. | Large Est. | Unk. Obs. | Total Obs. | Total Est. | Roddays Obs. | Roddays Est. | CPUE | % Large |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Margaree*** | | | | | | | | | | | | | |
| 1984 | | 678 | 233 | 242 | 190 | 293 | 305 | 4 | 530 | 551 | 5,952 | 6,665 | 0.089 | 55.7 |
| 1985 | | 793 | 473 | 509 | 399 | 1,130 | 1,215 | 3 | 1,606 | 1,727 | 7,324 | 7,824 | 0.219 | 70.4 |
| 1986 | | 1,131 | 748 | 782 | 650 | 2,522 | 2,636 | 2 | 3,272 | 3,420 | 9,724 | 10,232 | 0.336 | 77.1 |
| 1987 | | 1,441 | 925 | 977 | 826 | 1,757 | 1,857 | 0 | 2,682 | 2,834 | 12,165 | 12,887 | 0.220 | 65.5 |
| 1988 | | 1,455 | 749 | 879 | 752 | 1,647 | 1,932 | 0 | 2,396 | 2,810 | 11,582 | 14,042 | 0.207 | 68.7 |
| 1989 | | 1,486 | 464 | 561 | 434 | 1,298 | 1,570 | 0 | 1,762 | 2,132 | 10,594 | 13,234 | 0.166 | 73.7 |
| 1990 | | 1,383 | 514 | 649 | 498 | 1,193 | 1,507 | 0 | 1,707 | 2,156 | 10,792 | 14,073 | 0.158 | 69.9 |
| 1991 | | 1,236 | 586 | 752 | 559 | 1,370 | 1,757 | 0 | 1,956 | 2,509 | 10,142 | 13,432 | 0.193 | 70.0 |
| 1992 | | 1,426 | 539 | 678 | 551 | 1,541 | 1,938 | 0 | 2,080 | 2,616 | 11,483 | 14,909 | 0.181 | 74.1 |
| 1993 | | 1,885 | 696 | 777 | 562 | 987 | 1,102 | 0 | 1,683 | 1,879 | 13,920 | 15,863 | 0.121 | 58.6 |
| 1994 | | 1,382 | 346 | 429 | 291 | 1,193 | 1,479 | 0 | 1,539 | 1,908 | 10,452 | 13,376 | 0.147 | 77.5 |
| 1995 | | 1,123 | 247 | 323 | 199 | 796 | 1,040 | 0 | 1,043 | 1,363 | 8,867 | 11,960 | 0.118 | 76.3 |
| | +/- 1994 | -19% | -29% | -25% | -32% | -33% | -30% | - | -32% | -29% | -15% | -11% | -20% | -2% |
| | +/- Mean | -23% | -54% | -51% | -60% | -37% | -33% | - | -42% | -38% | -22% | -17% | -27% | 9% |
| | ***Middle*** | | | | | | | | | | | | | |
| 1984 | | 83 | 29 | 33 | 21 | 66 | 75 | 0 | 95 | 108 | 470 | 526 | 0.202 | 69.5 |
| 1985 | | 39 | 18 | 21 | 15 | 24 | 29 | 0 | 42 | 50 | 150 | 160 | 0.280 | 57.1 |
| 1986 | | 76 | 44 | 44 | 36 | 107 | 108 | 0 | 151 | 152 | 368 | 387 | 0.410 | 70.9 |
| 1987 | | 114 | 55 | 58 | 53 | 111 | 116 | 0 | 166 | 174 | 684 | 725 | 0.243 | 66.9 |
| 1988 | | 131 | 42 | 49 | 36 | 121 | 142 | 0 | 163 | 191 | 591 | 717 | 0.276 | 74.2 |
| 1989 | | 144 | 43 | 52 | 41 | 231 | 279 | 0 | 274 | 332 | 694 | 867 | 0.395 | 84.3 |
| 1990 | | 153 | 85 | 107 | 80 | 156 | 197 | 0 | 241 | 304 | 771 | 1005 | 0.313 | 64.7 |
| 1991 | | 169 | 21 | 27 | 18 | 145 | 186 | 0 | 166 | 213 | 646 | 856 | 0.257 | 87.3 |
| 1992 | | 66 | 9 | 11 | 8 | 24 | 30 | 0 | 33 | 41 | 167 | 217 | 0.198 | 72.7 |
| 1993 | | 110 | 28 | 30 | 25 | 44 | 48 | 0 | 72 | 78 | 356 | 406 | 0.202 | 61.1 |
| 1994 | | 122 | 19 | 24 | 0 | 134 | 166 | 0 | 153 | 190 | 389 | 498 | 0.393 | 87.6 |
| 1995 | | 70 | 30 | 39 | 0 | 41 | 54 | 0 | 71 | 93 | 218 | 294 | 0.326 | 57.7 |
| | +/- 1994 | -43% | 58% | 63% | - | -69% | -67% | - | -54% | -51% | -44% | -41% | -17% | -34% |
| | +/- Mean | -44% | -7% | -2% | -100% | -59% | -57% | - | -47% | -44% | -53% | -51% | 20% | -23% |
| | ***Baddeck*** | | | | | | | | | | | | | |
| 1984 | | 60 | 6 | 6 | 4 | 42 | 45 | 0 | 48 | 51 | 254 | 284 | 0.189 | 87.5 |
| 1985 | | 34 | 4 | 5 | 4 | 12 | 14 | 0 | 16 | 19 | 94 | 100 | 0.170 | 75.0 |
| 1986 | | 68 | 25 | 26 | 20 | 133 | 139 | 0 | 158 | 165 | 364 | 383 | 0.434 | 84.2 |
| 1987 | | 90 | 40 | 40 | 26 | 126 | 126 | 0 | 166 | 166 | 411 | 435 | 0.404 | 75.9 |
| 1988 | | 86 | 31 | 36 | 19 | 149 | 175 | 0 | 180 | 211 | 366 | 444 | 0.492 | 82.8 |
| 1989 | | 98 | 15 | 18 | 8 | 204 | 247 | 0 | 219 | 265 | 392 | 490 | 0.559 | 93.2 |
| 1990 | | 103 | 56 | 71 | 40 | 144 | 182 | 0 | 200 | 253 | 445 | 580 | 0.449 | 72.0 |
| 1991 | | 110 | 40 | 51 | 28 | 166 | 213 | 0 | 206 | 264 | 483 | 640 | 0.427 | 80.6 |
| 1992 | | 129 | 45 | 57 | 50 | 131 | 165 | 0 | 176 | 221 | 538 | 698 | 0.327 | 74.4 |
| 1993 | | 146 | 45 | 48 | 33 | 101 | 108 | 0 | 146 | 156 | 689 | 785 | 0.212 | 69.2 |
| 1994 | | 74 | 13 | 16 | 1 | 50 | 62 | 0 | 63 | 78 | 238 | 305 | 0.265 | 79.4 |
| 1995 | | 59 | 49 | 64 | 8 | 57 | 74 | 0 | 106 | 138 | 260 | 351 | 0.408 | 53.8 |
| | +/- 1994 | -20% | 277% | 300% | 700% | 14% | 19% | - | 68% | 77% | 9% | 15% | 54% | -32% |
| | +/- Mean | -48% | 23% | 32% | -74% | -52% | -49% | - | -33% | -29% | -46% | -42% | 21% | -28% |
| | ***North*** | | | | | | | | | | | | | |
| 1984 | | 162 | 60 | 65 | 56 | 139 | 151 | 1 | 200 | 217 | 1,091 | 1,222 | 0.183 | 69.8 |
| 1985 | | 170 | 146 | 162 | 149 | 383 | 426 | 0 | 529 | 588 | 947 | 1,012 | 0.559 | 72.4 |
| 1986 | | 298 | 235 | 235 | 185 | 1,010 | 1,010 | 0 | 1,245 | 1,245 | 1,945 | 2,047 | 0.640 | 81.1 |
| 1987 | | 263 | 219 | 226 | 177 | 529 | 546 | 0 | 748 | 772 | 1,574 | 1,667 | 0.475 | 70.7 |
| 1988 | | 202 | 115 | 135 | 118 | 456 | 535 | 0 | 571 | 670 | 1,305 | 1,582 | 0.438 | 79.9 |
| 1989 | | 162 | 134 | 162 | 122 | 331 | 400 | 0 | 465 | 563 | 1,074 | 1,342 | 0.433 | 71.2 |
| 1990 | | 219 | 212 | 268 | 202 | 483 | 610 | 0 | 695 | 878 | 1,416 | 1,846 | 0.491 | 69.5 |
| 1991 | | 172 | 145 | 186 | 148 | 277 | 355 | 0 | 422 | 541 | 1,050 | 1,391 | 0.402 | 65.6 |
| 1992 | | 205 | 178 | 224 | 184 | 437 | 550 | 0 | 615 | 773 | 1,421 | 1,845 | 0.433 | 71.1 |
| 1993 | | 217 | 72 | 82 | 62 | 142 | 161 | 0 | 214 | 243 | 1,094 | 1,247 | 0.196 | 66.4 |
| 1994 | | 73 | 60 | 74 | 0 | 78 | 97 | 0 | 138 | 171 | 317 | 406 | 0.435 | 56.5 |
| 1995 | | 74 | 136 | 178 | 1 | 166 | 217 | 0 | 302 | 395 | 391 | 527 | 0.772 | 55.0 |
| | +/- 1994 | 1% | 127% | 141% | - | 113% | 124% | - | 119% | 131% | 23% | 30% | 77% | -3% |
| | +/- Mean | -58% | 2% | 7% | -99% | -41% | -39% | - | -28% | -24% | -63% | -61% | 97% | -16% |
| | ***Grand*** | | | | | | | | | | | | | |
| 1984 | | 268 | 367 | 393 | 338 | 32 | 34 | 11 | 410 | 438 | 2,777 | 3,110 | 0.148 | 8.0 |
| 1985 | | 312 | 520 | 542 | 471 | 127 | 132 | 1 | 648 | 675 | 2,896 | 3,094 | 0.224 | 19.6 |
| 1986 | | 326 | 336 | 360 | 298 | 181 | 194 | 0 | 517 | 554 | 2,865 | 3,015 | 0.180 | 35.0 |
| 1987 | | 262 | 311 | 342 | 308 | 97 | 107 | 0 | 408 | 449 | 1,961 | 2,077 | 0.208 | 23.8 |
| 1988 | | 277 | 276 | 324 | 303 | 86 | 101 | 0 | 362 | 425 | 2,731 | 3,311 | 0.133 | 23.8 |
| 1989 | | 247 | 258 | 312 | 290 | 62 | 75 | 0 | 320 | 387 | 2,167 | 2,707 | 0.148 | 19.4 |
| 1990 | | 240 | 327 | 413 | 335 | 80 | 101 | 0 | 407 | 514 | 2,192 | 2,858 | 0.186 | 19.7 |
| 1991 | | 178 | 100 | 128 | 115 | 14 | 18 | 0 | 114 | 146 | 1,499 | 1,985 | 0.076 | 12.3 |
| 1992 | | 182 | 127 | 160 | 148 | 35 | 44 | 0 | 162 | 204 | 1,483 | 1,925 | 0.109 | 21.6 |
| 1993 | | 184 | 117 | 139 | 118 | 21 | 25 | 0 | 138 | 164 | 1,311 | 1,494 | 0.105 | 15.2 |
| 1994 | | 44 | 58 | 72 | 0 | 16 | 20 | 0 | 74 | 92 | 321 | 411 | 0.231 | 21.6 |
| 1995 | | | River closed | | | | | | | | River closed | | | |
| | +/- 1994 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | +/- Mean | - | - | - | - | - | - | - | - | - | - | - | - | - |

*Table 5. Pools and sections of the Margaree River, Inverness County, Nova Scotia (Claytor et al. 1995).*

| River Section | km from Breakwater | Length of Section (km) | Angling Pools Within Section | Distinguishing features |
|---|---|---|---|---|
| A | 6.50 | 1.50 | Chapel, Barracks, Ram Island, Long Marsh, Tidal | Upper limit of average tidal influence. |
| B | 8.00 | 5.25 | Tippy Toes, Lower Thompkins, Seal, Gillis Island, Big McDaniel, Rift, Snag, Long, Short, Dollar, Hut | Lower pools above head of tide and below confluence of southwest and northeast Margaree branches. |
| C | 13.25 | 0.50 | Thornbush, Forks | Confluence of southwest and northeast Margaree. |
| Z | 13.75 | 21.00 | Noon, Red Bank, Martin Camerons, Peter McFarlanes, Carrols, Camerons, Collins, Peter Gillis', McDonnell, Gillis, Black Angus | Above the confluence of southwest Margaree branch up to Scotsville bridge. |
| D | 13.75 | 4.75 | Barrack, Libbus, Doyles Bridge, Point, Upper Thompkins, Tanner, Wash, Etheridge, Garden, Brook | Upstream of Margaree Forks to the mouth of Big Brook. |
| E | 18.50 | 1.25 | Brush, Corner, Shepard's Rock, Little McDaniel, Swimming Hole | Between Big Brook and Lake O'Law Brook . |
| F | 19.75 | 4.25 | Plaster Rock, Lairds, Sheardam, Swallow Bank, Rock Pile, Cranton Bridge, Faheys, Crowdis | Between Lake O'Law Brook and Nile Brook. |
| G | 24.00 | 3.00 | Redbank, Sweetharts, Harts, Ingram Bridge, Rock, Whitley, Hatchery, Ledges, Cliff | Between Nile Brook and Ingram Brook. |
| H | 27.00 | 6.00 | Morrison, Slide, Marsh Brook, Jim Easter, Boars Back, Maple, Tingleys Rock, Coady Brook, Ross Bridge, Chance, Tent, Black Rock | Upper valley pools accessible from main paved road, above Ingraham Bridge. |
| I | 33.00 | 6.00 | Old Bridge, Wards Rock, Skye Lodge, Cemetery | Pools accessible from Big Intervale road, below Big Intervale Bridge. |
| Sanc. | 39.00 | 15.50 | McKenzie, Big Intervale, First Brook, McLeods, Marsh, Second Brook, Rocky, McKay, Blue, Reed, Third Brook | Headwaters of northeast Margaree, above Big Intervale Bridge. |

*Table 6. Historical monthly estuarian trapnet catches and fishing periods on the Margaree River 1988-1995. Refer to Figure 3 for trapnet locations.*

| | | Small Salmon | | | | | | Large Salmon | | | | | | Fishing Periods | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trap | Year | Jun | Jul | Aug | Sep | Oct | Tot | Jun | Jul | Aug | Sep | Oct | Tot | Summer | Fall |
| Lower1 | 1988 | . | . | . | 68 | 31 | 99 | . | . | . | 41 | 74 | 115 | | Sep 2 - Oct 23 |
| | 1989 | . | . | 4 | 29 | 10 | 43 | . | . | 7 | 96 | 84 | 187 | | Aug 28 - Oct 16 (1) |
| | 1990 | 2 | . | . | 29 | 42 | 73 | 15 | 2 | . | 50 | 69 | 136 | Jun 5 - Jul 20 | Sep 4 - Oct 16 |
| Upper1 | 1988 | . | . | 18 | 64 | 16 | 98 | . | . | 3 | 30 | 49 | 82 | | Aug 29 - Oct 22 (2) |
| | 1989 | . | . | . | 31 | 10 | 41 | . | . | . | 98 | 71 | 169 | | Aug 29 - Oct 16 (3) |
| | 1990 | . | 5 | . | 40 | 45 | 90 | . | 1 | . | 89 | 76 | 166 | Jun 28 - Jul 26 | Sep 5 - Oct 17 |
| | 1991 | 1 | 8 | 30 | . | . | 39 | 5 | 6 | 32 | . | . | 43 | Jun 11 - Aug 28 (4) | |
| | 1992 | . | 3 | . | 19 | 46 | 68 | . | 9 | . | 68 | 201 | 278 | Jul 7 - Jul 26 | Aug 31 - Oct 20 |
| Levi's | 1991 | . | 33 | 102 | . | . | 135 | . | 33 | 129 | . | . | 162 | Jul 6 - Aug 30 | |
| | 1992 | 10 | 23 | 18 | 37 | 73 | 161 | 17 | 48 | 60 | 149 | 329 | 603 | Jun 15 - Aug 31 | Sep 1 - Oct 14 |
| | 1993 | 25 | 52 | 28 | 18 | 38 | 161 | 13 | 77 | 30 | 29 | 103 | 252 | Jun 14 - Aug 31 (5) | Sep 1 - Oct 18 |
| | 1994 | 4 | 4 | 58 | 31 | 15 | 112 | 9 | 5 | 167 | 197 | 86 | 464 | Jun 13 - Aug 31 | Sep 1 - Oct 22 (6) |
| | 1995 | 2 | 24 | 20 | 39 | 46 | 131 | 17 | 23 | 76 | 132 | 157 | 405 | Jun 13 - Aug 31 (7) | Sep 1 - Oct 20 |
| Lower2 | 1993 | 10 | 34 | 26 | 7 | 11 | 88 | 9 | 43 | 31 | 8 | 31 | 122 | Jun 22 - Aug 31 | Sep 1 - Oct 18 (8) |

**Washouts or Non Fishing Periods:**

- **-1-** Sep 27 trapnet completely underwater.
- **-2-** Sep 30 not set to try and correct seal problem.
- **-3-** Sep 27 trap underwater, Oct 11 not able to reset because strong current.
- **-4-** Jul 17 - Aug 2 trap was not set because of jellyfish and green algae.
- **-5-** Aug 5 - Aug 17 washout.
- **-6-** Oct 2- Oct 6 washout.
- **-7-** Jun 15 and Aug 26 trap brailed.
- **-8-** Aug 5 - Aug 9 washout.

*Table 7. Counts at Levi's trapnet and percentages of small & large salmon returning during the summer, fall and entire season, 1992-1995.*

| | Summer | | | | | Fall | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Jun | Jul15 | Jul31 | Aug | Total | Sep | Oct | Total | Total |
| **SMALL SALMON** | | | | | | | | | |
| **Count** | | | | | | | | | |
| 1992 | 10 | 15 | 8 | 18 | 51 | 37 | 73 | 110 | 161 |
| 1993 | 25 | 14 | 38 | 28 | 105 | 18 | 38 | 56 | 161 |
| 1994 | 4 | 1 | 3 | 58 | 66 | 31 | 15 | 46 | 112 |
| 1995 | 2 | 13 | 11 | 20 | 46 | 39 | 46 | 85 | 131 |
| **% of total** | | | | | | | | | |
| 1992 | 6 | 9 | 5 | 11 | 32 | 23 | 45 | 68 | 100 |
| 1993 | 16 | 9 | 24 | 17 | 65 | 11 | 24 | 35 | 100 |
| 1994 | 4 | 1 | 3 | 52 | 59 | 28 | 13 | 41 | 100 |
| 1995 | 2 | 10 | 8 | 15 | 35 | 30 | 35 | 65 | 100 |
| **% of summer/fall** | | | | | | | | | |
| 1992 | 20 | 29 | 16 | 35 | 100 | 34 | 66 | 100 | |
| 1993 | 24 | 13 | 36 | 27 | 100 | 32 | 68 | 100 | |
| 1994 | 6 | 2 | 5 | 88 | 100 | 67 | 33 | 100 | |
| 1995 | 4 | 28 | 24 | 43 | 100 | 46 | 54 | 100 | |
| **LARGE SALMON** | | | | | | | | | |
| **Count** | | | | | | | | | |
| 1992 | 17 | 34 | 14 | 60 | 125 | 149 | 329 | 478 | 603 |
| 1993 | 13 | 8 | 69 | 30 | 120 | 29 | 103 | 132 | 252 |
| 1994 | 9 | 2 | 3 | 167 | 181 | 197 | 86 | 283 | 464 |
| 1995 | 17 | 12 | 11 | 76 | 116 | 132 | 157 | 289 | 405 |
| **% of total** | | | | | | | | | |
| 1992 | 3 | 6 | 2 | 10 | 21 | 25 | 55 | 79 | 100 |
| 1993 | 5 | 3 | 27 | 12 | 48 | 12 | 41 | 52 | 100 |
| 1994 | 2 | 0 | 1 | 36 | 39 | 42 | 19 | 61 | 100 |
| 1995 | 4 | 3 | 3 | 19 | 29 | 33 | 39 | 71 | 100 |
| **% of summer/fall** | | | | | | | | | |
| 1992 | 14 | 27 | 11 | 48 | 100 | 31 | 69 | 100 | |
| 1993 | 11 | 7 | 58 | 25 | 100 | 22 | 78 | 100 | |
| 1994 | 5 | 1 | 2 | 92 | 100 | 70 | 30 | 100 | |
| 1995 | 15 | 10 | 9 | 66 | 100 | 46 | 54 | 100 | |

***Table 8. Numbers of wild and hatchery salmon from summer and fall sampling on Margaree River in 1995.***

| SEASON: | Small Salmon | | | Large Salmon | | | Percent |
|---|---|---|---|---|---|---|---|
| | Wild | Hatchery | % Wild | Wild | Hatchery | % Wild | Large |
| Summer (June 1 - Aug. 31) | | | | | | | |
| Trapnets | | | | | | | |
| Index | 38 | 8 | 83% | 101 | 15 | 87% | 72% |
| Angling | | | | | | | |
| Logbooks | 5 | 1 | 83% | 23 | 3 | 88% | 81% |
| SCIP | 9 | 4 | 69% | . | . | . | . |
| Sub-Total: | 52 | 13 | 80% | 124 | 18 | 87% | 69% |
| FALL (Sept. 1 - Oct. 31) | | | | | | | |
| Trapnets | | | | | | | |
| Index | 81 | 4 | 95% | 282 | 7 | 98% | 77% |
| Lake O' Law Fence | 19 | 2 | 90% | 65 | 2 | 97% | 76% |
| Angling | | | | | | | |
| Logbooks | 8 | 3 | 73% | 50 | 6 | 89% | 84% |
| SCIP | 3 | 0 | 100% | 2 | 0 | 100% | 40% |
| Sub-Total: | 111 | 9 | 93% | 399 | 15 | 96% | 78% |
| ***Total Season:*** | ***163*** | ***22*** | ***88%*** | ***523*** | ***33*** | ***94%*** | ***75%*** |

***Table 9. Number of salmon counted on "swim-thru's" of the Margaree River, 1990-1995, (full survey not done in 1993).***

| | | Large salmon | | | Small salmon | | | |
|---|---|---|---|---|---|---|---|---|
| *Year/mon/day* | *Section(a)* | *Unk* | *Hatc* | *Wild* | *Unk* | *Hatc* | *Wild* | *Total* |
| ***1990/Aug 9*** | Upper | 0 | 6 | 83 | 0 | 1 | 14 | 104 |
| | Middle | 57 | 24 | 34 | 21 | 3 | 14 | 153 |
| | Lower | 115 | 28 | 53 | 10 | 7 | 18 | 231 |
| | Total | 172 | 58 | 170 | 31 | 11 | 46 | 488 |
| ***1991/Aug 1*** | Upper | 0 | 1 | 5 | 1 | 1 | 1 | 9 |
| | Middle | 0 | 0 | 0 | 3 | 6 | 1 | 10 |
| | Lower | 2 | 10 | 4 | 2 | 3 | 3 | 24 |
| | Total | 2 | 11 | 9 | 6 | 10 | 5 | 43 |
| ***1992/Jul 29*** | Upper | 0 | 4 | 59 | 0 | 6 | 10 | 79 |
| | Middle | 0 | 12 | 31 | 0 | 13 | 14 | 70 |
| | Lower | 0 | 41 | 85 | 0 | 42 | 18 | 186 |
| | Total | 0 | 57 | 175 | 0 | 61 | 42 | 335 |
| ***1994/Aug1*** | Upper | - | - | - | - | - | - | 3 |
| | Middle | - | - | - | - | - | - | 26 |
| | Lower | - | - | - | - | - | - | 67 |
| | Total | - | - | - | - | - | - | 96 |
| ***1995/Aug 2 (b)*** | Upper | | 1 | 49 | | | 11 | 61 |
| | Middle | | 5 | 23 | | | 2 | 30 |
| | Lower | 66 | 9 | 30 | 8 | 6 | 5 | 124 |
| | Lower2 | 5 | | | | | | 5 |
| | Total | 71 | 15 | 102 | 0 8 | 6 | 18 | 220 |

(a) Upper: below Third Brook Pool to Breakwater in sanctuary (ref. Table 5 for pool locations).
Middle: Breakwater to Hatchery Pool.
Lower: Hatchery Pool to Forks Pool.
Lower2: "run" below Forks Pool to Seal Pool.

(b) In 1995, streamer tags were applied to 17 large and 2 small fish in Forks Pool and 41 large and 5 small fish in the Hatchery Pool on Aug 1. On Aug 2, 46 large and 1 small streamer-tagged fish and 7 Carlin and 2 tag-scarred fish were tallied in the swim-thru.

*Table 10. Counts of Atlantic salmon at Lake O'Law Brook , Margaree River, 1991-95.*

| | Small salmon | | | Large salmon | | | Smolt | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Wild | Hatc | Total | Wild | Hatc | Total | Wild | Hatc | Total |
| 1991 | 28 | 6 | 34 | 72 | 4 | 76 | 2,541 | 1,845 | 4,386 |
| 1992 | 14 | 1 | 15 | 48 | 10 | 58 | 2,416 | 1,900 | 4,316 |
| 1993 | 25 | 5 | 30 | 54 | 4 | 58 | 1,513 | 3,522 | 5,035 |
| 1994 | 21 | 9 | 30 | 79 | 7 | 86 | 631 | 8 | 639 |
| 1995 | 19 | 2 | 21 | 65 | 2 | 67 | . | . | . |

- In 1991 fence was operated from May 2 until Nov. 18.
- In 1992 fence 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.
- In 1994 fence was operated from May 5 until June 30 and from Sept. 15 until Dec. 1.
- In 1995 fence was operated from Sept. 20 until Nov. 26.



*Table 11. Mark-recapture data for population estimates of large salmon returns to the Margaree, 1992-95.*

| | Tags applied | Logbook | | | Fence | | | Seine | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | in estuary | Recaps | Tot. fish | Percent | Recaps | Tot. fish | Percent | Recaps | Tot. fish | Percent |
| 1992 | 577 | 16 | 189 | 8% | 5 | 58 | 9% | . | . | . |
| 1993 | 242 | 5 | 71 | 7% | 4 | 58 | 7% | . | . | . |
| 1994 | 456 | 15 | 120 | 13% | 14 | 86 | 16% | . | . | . |
| 1995 | 401 | 7 | 81 | 9% | 10 | 67 | 15% | 18 | 58 | 31% |

***Table 12. Estimates of large and small Atlantic salmon returns and escapement to and percent of conservation requirements met for the Margaree River, 1984-95.***

| | Returns | | | Escapement | | | % of conservation Req'm | | | Eggs (10^6) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Percentiles | | | Percentiles | | | Percentiles | | collected for |
| Year | Mode (a) | 5% | 95% | Mode (a) | 5% | 95% | Mode (a) | 5% | 95% | hatchery |
| ***Large salmon*** | | | | | | | | | | |
| 1984 | 412 | 327 | 563 | 381 | 296 | 532 | 37% | 29% | 51% | 0.100 |
| 1985 | 1,462 | 1,109 | 2,217 | 1,378 | 1,025 | 2,133 | 133% | 99% | 206% | 0.150 |
| 1986 | 3,616 | 2,738 | 5,680 | 3,461 | 2,583 | 5,525 | 334% | 249% | 533% | 0.150 |
| 1987 | 4,015 | 2,976 | 6,540 | 3,899 | 2,860 | 6,424 | 376% | 276% | 620% | 0.150 |
| 1988 | 1,688 | 1,286 | 2,494 | 1,545 | 1,143 | 2,351 | 149% | 110% | 227% | 0.300 |
| 1989 | 2,289 | 1,708 | 3,693 | 2,164 | 1,583 | 3,568 | 209% | 153% | 344% | 0.300 |
| 1990 (b) | 5,156 | 3,481 | 7,933 | 5,022 | 3,347 | 7,799 | 485% | 323% | 753% | 0.380 |
| 1991 | 3,484 | 1,853 | 5,785 | 3,323 | 1,692 | 5,624 | 321% | 163% | 543% | 0.473 |
| 1992 | 6,375 | 4,875 | 9,375 | 6,222 | 4,722 | 9,222 | 601% | 456% | 890% | 0.300 |
| 1993 | 3,358 | 2,408 | 6,158 | 3,224 | 2,274 | 6,024 | 311% | 219% | 581% | 0.009 |
| 1994 | 2,900 | 2,350 | 4,500 | 2,759 | 2,209 | 4,359 | 266% | 213% | 421% | . |
| 1995 | **2,365** | - | - | **2,308** | - | - | **223%** | - | - | . |
| +/- 1994 | -18% | | | -16% | | | -16% | | | -100% |
| +/- Mean90-94 | -44% | | | -44% | | | -44% | | | -100% |
| ***Small salmon*** | | | | | | | | | | |
| 1984 | 504 | 400 | 688 | 311 | 158 | 446 | 53% | 27% | 77% | |
| 1985 | 838 | 634 | 1167 | 433 | 125 | 658 | 74% | 21% | 113% | |
| 1986 | 1096 | 838 | 1420 | 439 | 56 | 638 | 75% | 10% | 110% | |
| 1987 | 1478 | 1143 | 1865 | 644 | 166 | 888 | 111% | 29% | 153% | |
| 1988 | 2209 | 1674 | 2911 | 1451 | 795 | 2032 | 249% | 137% | 349% | |
| 1989 | 768 | 591 | 977 | 328 | 30 | 416 | 56% | 5% | 71% | |
| 1990 (b) | 1977 | 940 | 5077 | 1471 | 291 | 4428 | 253% | 50% | 761% | |
| 1991 | 1909 | 794 | 3891 | 1340 | 42 | 3139 | 230% | 7% | 539% | |
| 1992 | 1645 | 1258 | 2419 | 1088 | 701 | 1862 | 187% | 120% | 320% | |
| 1993 | 2087 | 1489 | 3851 | 1504 | 906 | 3268 | 258% | 156% | 562% | |
| 1994 | 708 | 573 | 1101 | 390 | 255 | 783 | 67% | 44% | 135% | |
| 1995 | **737** | - | - | **529** | - | - | **91%** | - | - | |
| +/- 1994 | 4% | | | 36% | | | 36% | | | |
| +/- Mean90-94 | -56% | | | -54% | | | -54% | | | |

(a) - Median estimates, 1984-89 and 1991.

(b) - Returns re-estimated using average trapnet efficiency and average summer/fall proportion (Claytor et al.1995).

***Table 13. Salmon angling catch on Margaree River (1947-1995) as compiled by Department of Fisheries and Oceans fisheries officers (DFO statistics).***

| Year | Small | Large | | | Unsized | Total |
|---|---|---|---|---|---|---|
| | | Retained | Released | 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 (a) | N/A | N/A | | | . | 334 |
| 1959 (a) | N/A | N/A | | | . | 235 |
| 1960 (a) | 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 (b) | 208 | 0 | 314 | 314 | . | 522 |
| 1991 (b) | 246 | 0 | - | - | . | 246 |
| 1992 (b) | 236 | 0 | - | - | . | 236 |
| 1993 (b) | 272 | 0 | - | - | . | 272 |
| 1994 (b) | 175 | 0 | - | - | . | 175 |
| 1995 (b) + (c) | 86 | 0 | - | - | . | 86 |
| Mean (90-94) | 227 | | | | | |
| +/- Mean | -62.18% | | | | | |

(a) - Information regarding small and large salmon for 1958-1960 are not available.

(b) - Note: Season was extended from October 15 to October 31.

(c) - less effort in collecting statistics than in previous years.

*Table 14. Catch, effort, and CPUE by logbook anglers on Margaree River, 1992-95.*

| Year | Season | Month | Angler days | Small | | Large | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Catch | CPUE | Catch | CPUE | Catch | CPUE |
| *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** |
| *1993* | | | | | | | | | |
| | Summer | June | 134 | 2 | 0.015 | 2 | 0.015 | 4 | 0.030 |
| | | July | 204 | 16 | 0.078 | 12 | 0.059 | 28 | 0.137 |
| | | August | 157 | 29 | 0.185 | 16 | 0.102 | 45 | 0.287 |
| | | Sub-total | 495 | 47 | 0.095 | 30 | 0.061 | 77 | 0.156 |
| | Fall | September | 193 | 6 | 0.031 | 18 | 0.093 | 24 | 0.124 |
| | | Oct. 1-15 | 154 | 6 | 0.039 | 26 | 0.169 | 32 | 0.208 |
| | | Oct. 16-31 | 40 | 4 | 0.100 | 5 | 0.125 | 9 | 0.225 |
| | | Oct. 1-31 | 194 | 10 | 0.052 | 31 | 0.160 | 41 | 0.211 |
| | | Sub-total | 387 | 16 | 0.041 | 49 | 0.127 | 65 | 0.168 |
| | **Total season** | | 882 | 63 | **0.071** | 79 | **0.090** | 142 | **0.161** |
| *1994* | | | | | | | | | |
| | Summer | June | 80 | 3 | 0.038 | 13 | 0.163 | 16 | 0.200 |
| | | July | 71 | 1 | 0.014 | 3 | 0.042 | 4 | 0.056 |
| | | August | 98 | 9 | 0.092 | 5 | 0.051 | 14 | 0.143 |
| | | Sub-total | 249 | 13 | 0.052 | 21 | 0.084 | 34 | 0.137 |
| | Fall | September | 141 | 4 | 0.028 | 34 | 0.241 | 38 | 0.270 |
| | | Oct. 1-15 | 136 | 5 | 0.037 | 56 | 0.412 | 61 | 0.449 |
| | | Oct. 16-31 | 79 | 1 | 0.013 | 27 | 0.342 | 28 | 0.354 |
| | | Oct. 1-31 | 215 | 6 | 0.028 | 83 | 0.386 | 89 | 0.414 |
| | | Sub-total | 356 | 10 | 0.028 | 117 | 0.329 | 127 | 0.357 |
| | **Total season** | | 605 | 23 | **0.038** | 138 | **0.228** | 161 | **0.266** |
| *1995* | | | | | | | | | |
| | Summer | June | 56 | 1 | 0.018 | 6 | 0.107 | 7 | 0.125 |
| | | July | 90 | 2 | 0.022 | 12 | 0.133 | 14 | 0.156 |
| | | August | 71 | 3 | 0.042 | 8 | 0.113 | 11 | 0.155 |
| | | Sub-total | 217 | 6 | 0.028 | 26 | 0.120 | 32 | 0.147 |
| | Fall | September | 150 | 4 | 0.027 | 23 | 0.153 | 27 | 0.180 |
| | | Oct. 1-15 | 129 | 8 | 0.062 | 26 | 0.202 | 34 | 0.264 |
| | | Oct. 16-31 | 98 | 1 | 0.010 | 19 | 0.194 | 20 | 0.204 |
| | | Oct. 1-31 | 227 | 9 | 0.040 | 45 | 0.198 | 54 | 0.238 |
| | | Sub-total | 377 | 13 | 0.034 | 68 | 0.180 | 81 | 0.215 |
| | **Total season** | | 594 | 19 | **0.032** | 94 | **0.158** | 113 | **0.190** |

*Table 15. Catch of small and large, wild and hatchery salmon by anglers maintaining logbooks, 1989-95.*

| Year | Summer | | Fall | | Total | |
|---|---|---|---|---|---|---|
| | Catch | % Wild | Catch | % Wild | Catch | % Wild |
| **Small salmon** | | | | | | |
| 1989 | 37 | 43% | 8 | 75% | 45 | 49% |
| 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% |
| 1994 | 13 | 69% | 10 | 80% | 23 | 74% |
| 1995 | 6 | 83% | 11 | 73% | 17 | 76% |
| **Large salmon** | | | | | | |
| 1989 | 48 | 63% | 41 | 90% | 89 | 75% |
| 1990 | 41 | 85% | 42 | 90% | 83 | 88% |
| 1991 | 40 | 73% | 107 | 93% | 147 | 87% |
| 1992 | 50 | 78% | 120 | 92% | 170 | 88% |
| 1993 | 26 | 85% | 46 | 91% | 72 | 89% |
| 1994 | 20 | 100% | 99 | 94% | 119 | 95% |
| 1995 | 26 | 88% | 56 | 89% | 82 | 89% |

***Table 16. Weekly small salmon counts from Salmon Check In Program (SCIP) on the Margaree River, 1991-95.***

| | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| **Week** | **1991** | **1992** | **1993** | **1994** | **1995** | **+/- 1994** | **+/- Mean** |
| Jun 11 - Jun 17 | 0 | 2 | 0 | 2 | 0 | . | -100% |
| Jun 18 - Jun 24 | 0 | 6 | 2 | 3 | 0 | -100% | -100% |
| Jun 25 - July 1 | 3 | 6 | 8 | 0 | 1 | . | -76% |
| July 2 - July 8 | 2 | 7 | 8 | 5 | 4 | -20% | -27% |
| July 9 - July 15 | 5 | 16 | 7 | 1 | 1 | 0% | -86% |
| July 16 - July 22 | 3 | 13 | 13 | 2 | 3 | 50% | -61% |
| July 23 - July 29 | 5 | 3 | 7 | 3 | 2 | -33% | -56% |
| July 30 - Aug 5 | 4 | 2 | 3 | 1 | 0 | -100% | -100% |
| Aug 6 - Aug 12 | 11 | 1 | 17 | 2 | 0 | -100% | -100% |
| Aug 13 - Aug 19 | 9 | 0 | 11 | 4 | 0 | -100% | -100% |
| Aug 20 - Aug 26 | 12 | 4 | 18 | 2 | 1 | -50% | -89% |
| Aug 27 - Sept 2 | 10 | 3 | 7 | 6 | 1 | -83% | -85% |
| Sept 3 - Sept 9 | 4 | 4 | 3 | 2 | 0 | -100% | -100% |
| Sept 10 - Sept 16 | 4 | 3 | 1 | 3 | 0 | -100% | -100% |
| Sept 17 - Sept 23 | 14 | 2 | 3 | 3 | 1 | -67% | -82% |
| Sept 24 - Sept 30 | 5 | 1 | 3 | 0 | 0 | . | -100% |
| Oct 1 - Oct 7 | 4 | 11 | 5 | 0 | 1 | . | -80% |
| Oct 8 - Oct 14 | 5 | 4 | 3 | 0 | 1 | . | -67% |
| Oct 15 - Oct 21 | 1 | 7 | 5 | 3 | 1 | -67% | -75% |
| Oct 22 - Oct 28 | 2 | 6 | 3 | 0 | 0 | . | -100% |
| Oct 29 - Oct 31 | 0 | 0 | 1 | 0 | 0 | . | -100% |
| **Total** | 103 | 101 | 128 | 42 | 17 | -60% | -82% |

***Table 17. Estimates of efficiency of Levi's trapnet in catching large salmon, 1992-95. (Data source, 1992-94, Tables 6 and 12 of this document and Claytor et al. 1995.)***

| *Year* | *Method* | *Trapnet Catch* | *Population Estimate* | *Trapnet Efficiency (%)* | |
|---|---|---|---|---|---|
| 1992 | Fence and logbooks | 603 | 6,375 | 9.5 | |
| " | Fence and logbooks (fall only) | 478 | 2,741 | 17.4 | |
| 1993 | Fence and logbooks | 252 | 3,358 | 7.5 | |
| " | Fence and logbooks (fall only) | 132 | 1,651 | 8.0 | |
| 1994 | Fence and logbooks | 464 | 2,900 | 16.0 | |
| " | Fence and logbooks (fall only) | 283 | 1,762 | 16.1 | |
| 1995 | Logbooks | 405 | 4,242 | 9.5 | |
| " | Fence | 405 | 2,688 | 15.1 | |
| " | Seine | 405 | 1,288 | 31.4 | |
| " | Fall (fence) + Summer | 405 | 2,365 | 17.1 | (a) |
| " | Fall (trap) - minimum | 340 | 982 | 34.6 | |

(a) prefered estimate.

***Table 18. Derivation of egg depositions by wild and hatchery large salmon in the Margaree River, 1995, and summary egg depositions, 1992-95.***

| Year | Description: | | Wild | Hatchery | Total |
|---|---|---|---|---|---|
| ***1995*** | Proportion female | | 0.748 | 0.583 | 0.742 |
| | Avg wt. of large salmon | (a) | 4.40 | 3.63 | 4.35 |
| | Fecundity (eggs/kg) | | 1,764 | 1,764 | 1,764 |
| | Eggs per spawner | | 5,806 | 3,733 | 5,694 |
| | Total Returns | | 2,237 | 128 | 2,365 |
| | Estimated returns | | 2,237 | 128 | 2,365 |
| | Native harvests | (b) | 0 | 0 | 0 |
| | Total Removals | | 51 | 6 | 57 |
| | Angling mortality | (c) | 46 | 6 | 52 |
| | Poaching | (d) | 24 | 1 | 25 |
| | Trapnet mortality | | 1 | 0 | 1 |
| | Native harvests | (e) | 4 | 0 | 4 |
| | Total Escapement | | 2,186 | 122 | 2,308 |
| | Proportion of total returns | | 0.95 | 0.05 | 1.00 |
| | Total eggs (millions) | | 12.69 | 0.45 | 13.14 |
| | Proportion of total eggs | | 0.97 | 0.03 | 1.00 |
| 1992 | Total eggs (millions) | | 33.41 | 0.90 | 34.32 |
| 1993 | | | 17.92 | 0.91 | 18.82 |
| 1994 | | | 17.03 | 1.21 | 18.24 |
| ***1995*** | | | 12.69 | 0.45 | 13.14 |
| 1992 | Proportion of total eggs | | 0.97 | 0.03 | 1.00 |
| 1993 | | | 0.95 | 0.05 | 1.00 |
| 1994 | | | 0.93 | 0.07 | 1.00 |
| ***1995*** | | | 0.97 | 0.03 | 1.00 |

(a) - Predicted weight = 10^(3.254848*log(length)+(-5.514459)). The 1993 and 1994 samples were combined (

(b) - Harvests below Levi's trap.

(c) - Angling mortality = large catch *proportion wild or hatchery from logbooks*0.05.

(d) - Excluded from removals. Elson's (1975) optimal egg deposition accounts for poaching.

(e) - Harvests above and below Levi's trap.

*Table 19. Results of electrofishing surveys at barrier net sites in the Margaree River, July, 1994-95.*

| Age group | Tributary | Year | Site # | Area ($m^2$) | No. of sweeps | Mean length (cm) | Catch | Total estimate | Variance | Fish/ $100m^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| *Age-0+* | Big Brook | 1994 | 15 | 148 | 4 | 4.9 | 155 | 189 | 219.6 | 128 |
| | Forest Glen Brook | | 40 | 116 | 3 | 4.0 | 111 | 116 | 14.6 | 100 |
| | Forest Glen Brook | | 45 | 193 | 4 | 4.2 | 161 | 210 | 468.5 | 109 |
| | MacFarlanes Brook | | 96 | 160 | 4 | 5.0 | 172 | 183 | 31.5 | 115 |
| | Trout Brook | | 98 | 174 | 4 | 4.4 | 50 | 61 | 98.6 | 35 |
| " | Big Brook | 1995 | 15 | 147 | 4 | 5.0 | 268 | 273 | 8.9 | 186 |
| | Forest Glen Brook | | 40 | 131 | 4 | 4.4 | 178 | 209 | 162.3 | 159 |
| | Forest Glen Brook | | 45 | 172 | 4 | 4.5 | 414 | 440 | 66.9 | 256 |
| | MacFarlanes Brook | | 96 | 288 | 4 | 5.4 | 300 | 336 | 135.5 | 117 |
| | Trout Brook | | 98 | 179 | 4 | 5.0 | 101 | 107 | 16.3 | 60 |
| | Old Bridge | | 51 | 443 | 3 | 5.4 | 496 | 550 | 264.3 | 127 |
| *Age-1+,2+* | Big Brook | 1994 | 15 | 148 | 4 | 9.4 | 45 | 49 | 18.5 | 33 |
| | Forest Glen Brook | | 40 | 116 | 3 | 7.9 | 88 | 107 | 142.5 | 92 |
| | Forest Glen Brook | | 45 | 193 | 4 | 7.5 | 167 | 185 | 68.1 | 96 |
| | MacFarlanes Brook | | 96 | 160 | 4 | 9.1 | 115 | 123 | 22.0 | 77 |
| | Trout Brook | | 98 | 174 | 4 | 7.2 | 87 | 95 | 27.6 | 55 |
| " | Big Brook | 1995 | 15 | 147 | 4 | 9.8 | 55 | 57 | 4.9 | 39 |
| | Forest Glen Brook | | 40 | 131 | 4 | 8.8 | 135 | 143 | 23.0 | 109 |
| | Forest Glen Brook | | 45 | 172 | 4 | 8.3 | 198 | 210 | 30.7 | 122 |
| | MacFarlanes Brook | | 96 | 288 | 4 | 10.0 | 189 | 201 | 33.7 | 70 |
| | Trout Brook | | 98 | 179 | 4 | 8.5 | 81 | 87 | 17.9 | 48 |
| | Old Bridge | | 51 | 443 | 3 | 10.0 | 214 | 247 | 164.0 | 56 |

***Table 20. Estimates of spawners and recruits used in the stock recruitment relationships.***

| Spawning Year | Spawners | Recruits |
|---|---|---|
| 1947 | 1,685 | 4,852 |
| 1948 | 3,358 | 7,204 |
| 1949 | 1,839 | 5,716 |
| 1950 | 1,744 | 4,000 |
| 1951 | 2,093 | 2,440 |
| 1952 | 969 | 2,833 |
| 1956 | 486 | 2,616 |
| 1957 | 822 | 4,534 |
| 1961 | 344 | 3,620 |
| 1962 | 1,306 | 3,850 |
| 1963 | 887 | 3,538 |
| 1964 | 1,053 | 2,515 |
| 1965 | 993 | 3,694 |
| 1966 | 727 | 1,393 |
| 1967 | 1,009 | 2,083 |
| 1968 | 828 | 2,378 |
| 1969 | 488 | 3,394 |
| 1970 | 901 | 2,702 |
| 1971 | 351 | 2,630 |
| 1972 | 373 | 3,261 |
| 1973 | 393 | 3,131 |
| 1974 | 436 | 1,066 |
| 1975 | 293 | 2,813 |
| 1976 | 366 | 1,819 |
| 1977 | 538 | 2,909 |
| 1978 | 699 | 3,292 |
| 1979 | 363 | 1,868 |
| 1980 | 681 | 1,462 |
| 1981 | 618 | 3,616 |
| 1982 | 760 | 4,015 |
| 1983 | 657 | 1,688 |
| 1984 | 381 | 2,289 |
| 1985 | 1,378 | 5,156 |
| 1986 | 3,461 | 3,484 |
| 1987 | 3,899 | 6,375 |
| 1988 | 1,545 | 3,358 |
| 1989 | 2,164 | 2,900 |
| 1990 | 5,022 | 2,365 |
| 1991 | 3,323 | |
| 1992 | 6,222 | |
| 1993 | 3,224 | |
| 1994 | 2,759 | |
| 1995 | 2,308 | |

*Table 21. Parameter estimates, residuals and forecasts of returns in 1996 from stock-recruitment models.*

| | Model | | | |
|---|---|---|---|---|
| *Parameter* | *Ricker* | *Beverton-Holt* | *Mean* | *Tabular* |
| **a** | 1.80 | 4.20 | . | . |
| **b** | 3.67 | 0.31 | . | . |
| **Res SS** | 1.16 | 0.96 | 1.23 | 0.98 |
| **x value** | 3,323 | 3,323 | 3,323 | 3,323 |
| **Forecast** | 3,941 | 3,848 | 3,226 | 4,355 |

*Table 22. Tabular stock-recruitment model for Margaree River Atlantic Salmon.*

| | Spawning stock | | | |
|---|---|---|---|---|
| *Recruitment* | *0 - 600* | *600 - 1200* | *1200 - 1800* | *>1800* |
| > 7800 | | | | |
| 7200 - 7800 | | | | 1 |
| 6600 - 7200 | | | | |
| 6000 - 6600 | | | | 1 |
| 5400 - 6000 | | | 1 | 1 |
| 4200 - 4800 | | 1 | 1 | |
| 3600 - 4200 | 1 | 3 | 2 | |
| 3000 - 3600 | 3 | 2 | 1 | 1 |
| 2400 - 3000 | 4 | 3 | | 2 |
| 1200 - 2400 | 3 | 5 | | 1 |
| 0 - 1200 | 1 | | | |
| **Number of points** | 12 | 14 | 5 | 7 |
| **Average spawners** | 401 | 829 | 1532 | 3119 |
| **Average recruits** | 2618 | 2839 | 4189 | 4355 |
| **Recruits minus spawners** | 2217 | 2010 | 2658 | 1235 |
| **Recruits / spawners** | 6.53 | 3.42 | 2.74 | 1.40 |

*Table 23. Area (m^2x100) by percent orthogradient and distance above mean sea level for five rivers of Cape Breton (Amiro, pers. comm).*

| River | Dist. Interval (km) | Orthograde (%) | | | | | | | | | | | Totals | % total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-0.12 | 0.121-0.249 | 0.25-0.49 | 0.5-0.99 | 1-1.49 | 1.5-1.99 | 2-2.49 | 2.5-2.9 | 3-3.49 | 3.5-5.0 | >5.0 | | |
| **Middle** | 00-10.0 | | 2,538 | 685 | 300 | 72 | 80 | 24 | | 15 | | | 3,713 | 42.9 |
| | 10.1-20.0 | | | 849 | 1,260 | 20 | 32 | | 10 | 12 | | | 2,184 | 25.3 |
| | 20.1-30.0 | | | | 1,723 | 287 | 83 | 46 | | | | | 2,139 | 24.7 |
| | 30.1-40.0 | | | | 246 | 160 | 137 | 16 | 51 | | | | 611 | 7.1 |
| | Totals | | 2,538 | 1,534 | 3,530 | 539 | 331 | 85 | 62 | 27 | | | 8,646 | 100 |
| | % Total Area | | 29.4 | 17.7 | 40.8 | 6.2 | 3.8 | 1 | 0.7 | 0.3 | | | | |
| **Baddeck** | 00-10.0 | | | 842 | 77 | 23 | | 4 | 5 | | | | 952 | 11.4 |
| | 10.1-20.0 | | 494 | 1,479 | 2,612 | 175 | 43 | 44 | | | 10 | | 4,857 | 58.1 |
| | 20.1-30.0 | | | | 698 | 675 | 573 | 326 | 149 | 68 | 65 | | 2,554 | 30.5 |
| | Totals | | 494 | 2,321 | 3,387 | 873 | 616 | 374 | 155 | 68 | 75 | | 8,363 | 100 |
| | % Total Area | | 5.9 | 27.8 | 40.5 | 10.4 | 7.4 | 4.5 | 1.9 | 0.8 | 0.9 | | | |
| **North** | 00-10.0 | | | 391 | 873 | 970 | 83 | 96 | 6 | 11 | 38 | 25 | 2,492 | 70 |
| | 10.1-20.0 | | | | 26 | 266 | 106 | 137 | 115 | 187 | 113 | 9 | 959 | 26.9 |
| | 20.1-30.0 | | | | 56 | 40 | 11 | | | | | | 108 | 3 |
| | Totals | | | 391 | 955 | 1,277 | 201 | 233 | 121 | 198 | 151 | 33 | 3,559 | 100 |
| | % Total Area | | | 11 | 26.8 | 35.9 | 5.7 | 6.6 | 3.4 | 5.6 | 4.2 | 0.9 | | |
| **Sydney** | 00-10.0 | 1,135 | 722 | 580 | 474 | 98 | 18 | | | | | | 3,026 | 58.7 |
| | 10.1-20.0 | | 362 | 142 | 616 | 495 | 101 | 38 | 28 | 25 | 36 | 21 | 1,864 | 36.1 |
| | 20.1-30.0 | | | 150 | 38 | 36 | 12 | 13 | 13 | | | 5 | 268 | 5.2 |
| | Totals | 1,135 | 1,084 | 872 | 1,128 | 630 | 131 | 51 | 41 | 25 | 36 | 26 | 5,159 | 100 |
| | % Total Area | 22 | 21 | 16.9 | 21.9 | 12.2 | 2.6 | 1 | 0.8 | 0.5 | 0.7 | 0.5 | | |
| **Grand** | 00-10.0 | 48 | 2,175 | 548 | 144 | 53 | 64 | 13 | 8 | | 5 | 1 | 3,058 | 55.7 |
| | 10.1-20.0 | 595 | 38 | 725 | 108 | 28 | 49 | 27 | 5 | 6 | 8 | 6 | 1,596 | 29.1 |
| | 20.1-30.0 | 230 | 78 | 57 | 191 | 97 | 32 | 26 | 11 | 5 | 14 | 3 | 745 | 13.6 |
| | 30.1-40.0 | | 62 | | | 8 | 9 | 6 | 2 | | 5 | | 92 | 1.7 |
| | Totals | 873 | 2,353 | 1,329 | 443 | 187 | 154 | 72 | 27 | 11 | 32 | 10 | 5,491 | 100 |
| | % Total Area | 15.9 | 42.8 | 24.2 | 8.1 | 3.4 | 2.8 | 1.3 | 0.5 | 0.2 | 0.6 | 0.2 | | |

*Table 24. Numbers of hatchery smolt and parr released to Cape Breton rivers, 1988-1995.*

| River | Year | Rearing Location | Smolt | | Parr | |
|---|---|---|---|---|---|---|
| | | | Age 2+ | Age 1+ | Age 1+ | Age 0+ |
| **Christmas Brook (Eskasoni)** | 1992 | Cobequid | 4,239 | | | |
| | 1993 | Cobequid | 10,017 | | | |
| | 1994 | Cobequid | 7,937 | | | |
| **Grand** | 1988 | Cobequid | | | | 15,975 |
| | 1989 | Coldbrook | | 10,913 | 6,205 | |
| | | Cobequid | | | 4,515 | 19,050 |
| | 1990 | Cobequid | 18,625 | | 2,562 | 23,200 |
| | 1991 | Cobequid | 10,772 | | 4,386 | 14,938 |
| | 1992 | Cobequid | 13,884 | | | 4,848 |
| | 1993 | Cobequid | 10,447 | | 555 | 6,824 |
| | 1994 | Cobequid | 7,448 | | 1,998 | |
| | | Mersey | | | | 12,140 |
| | 1995 | Cobequid | 14,618 | 11,258 | | |
| | | Mersey | | | | 21,617 |
| **Indian Brook (Esksoni)** | 1993 | Cobequid | | | 2,805 | |
| | 1994 | Cobequid | | | 1,995 | |
| | | Mersey | | | | 2,808 |
| | 1995 | Cobequid | 9,952 | 5,308 | | |
| | | Mersey | | | 17,205 | |
| **Margaree** | 1988 | Margaree | 4,140 | 22,323 | 2,202 | 49,436 |
| | | Cobequid | 12,504 | | | 6,345 |
| | 1989 | Margaree | *2,611 | 10,648 | 10,177 | 140,466 |
| | | Cobequid | 16,124 | | | |
| | 1990 | Margaree | *4,119 | 14,303 | 21,370 | 69,124 |
| | | Cobequid | 16,512 | | | |
| | 1991 | Margaree | *12,100 | 20,000 | 22,000 | 110,000 |
| | | Cobequid | 11,392 | | 4,000 | 8,400 |
| | 1992 | Margaree | *21,800 | 22,903 | 34,018 | 92,500 |
| | | Cobequid | 16,889 | | 3,500 | 9,800 |
| | 1993 | Margaree | *12,628 | 20,000 | 27,554 | 52,728 |
| | | Cobequid | 14,996 | | 5,712 | |
| | 1994 | Margaree | | 18,000 | 6,780 | |
| | | Cobequid | 11,584 | | | |
| | 1995 | Margaree | **5,400 | 19,500 | 33,043 | |
| **Middle** | 1988 | Cobequid | 23,927 | | | |
| | 1989 | Cobequid | 23,090 | | | |
| **North** | 1988 | Cobequid | 3,993 | | | |
| | 1989 | Cobequid | 5,449 | | | |
| | 1992 | Cobequid | | | | 9,520 |
| | 1993 | Cobequid | | | 3,704 | 4,837 |
| | 1994 | Cobequid | 10,065 | | 3,793 | |
| | 1995 | Cobequid | 23,143 | | | |
| **Salmon/ Gaspereaux (Mira)** | 1989 | Cobequid | | | | 11,514 |
| | 1990 | Cobequid | 8,225 | | 3,657 | |
| | 1991 | Cobequid | 13,022 | | 8,439 | |
| | 1992 | Cobequid | 11,126 | | 3,710 | 6,422 |
| | 1993 | Cobequid | 9,966 | | 285 | |
| | 1994 | Cobequid | 9,018 | | | |
| | 1995 | Cobequid | | | 4,944 | |

*Reared at the Lake O'Law cages

**also an additional 13,000 2+ smolts escaped from vandalized cages

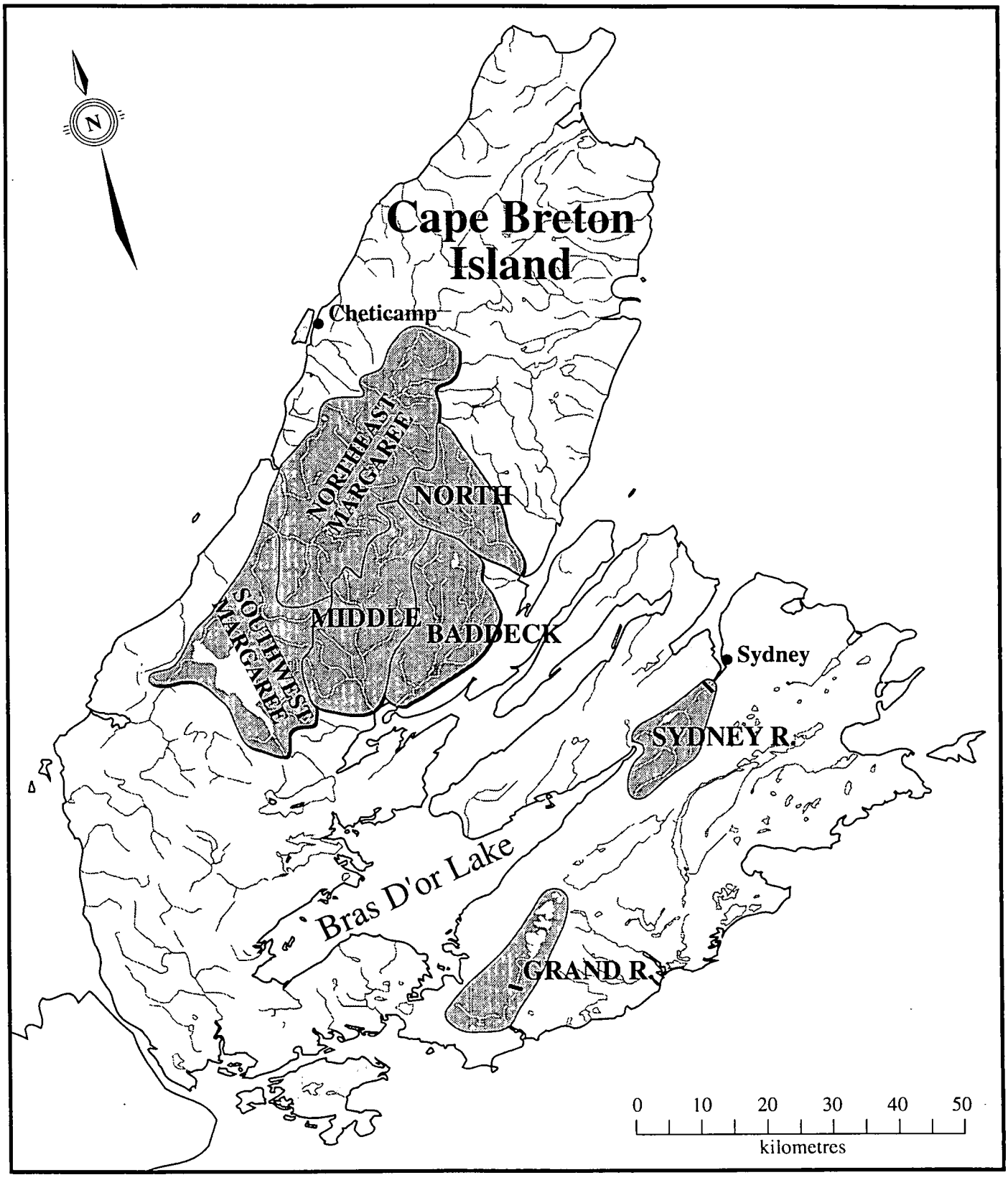



Fig. 1. Cape Breton Island, showing river drainages in which Atlantic salmon stocks were assessed in 1995.

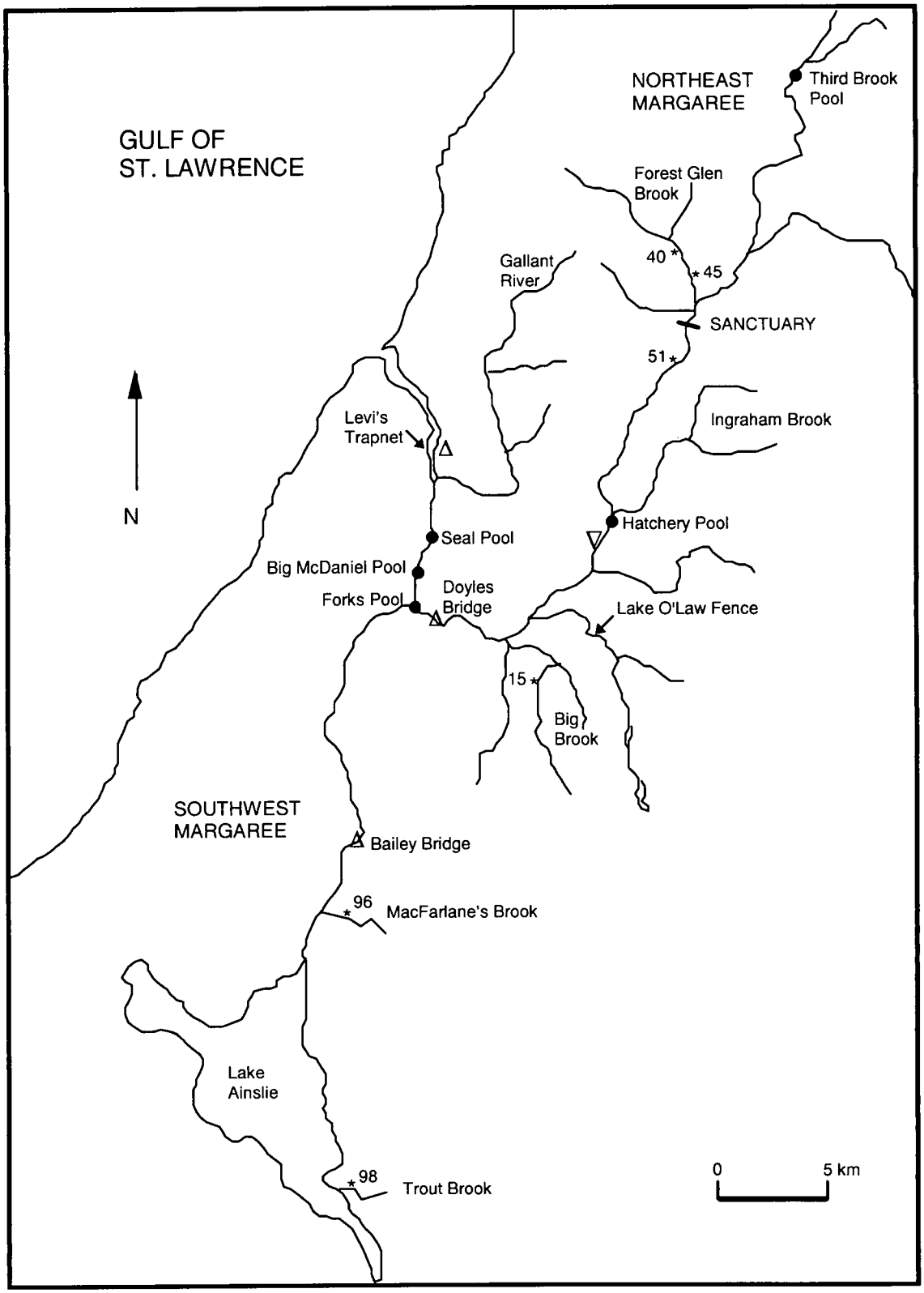



Fig. 2. Location of Levi's Trapnet, Lake O'Law counting fence, electrofishing stations (*), reference pools (•), thermographs (Δ), and the gauging station (∇) on the Margaree River, 1995 (from Chaput et al. 1994).

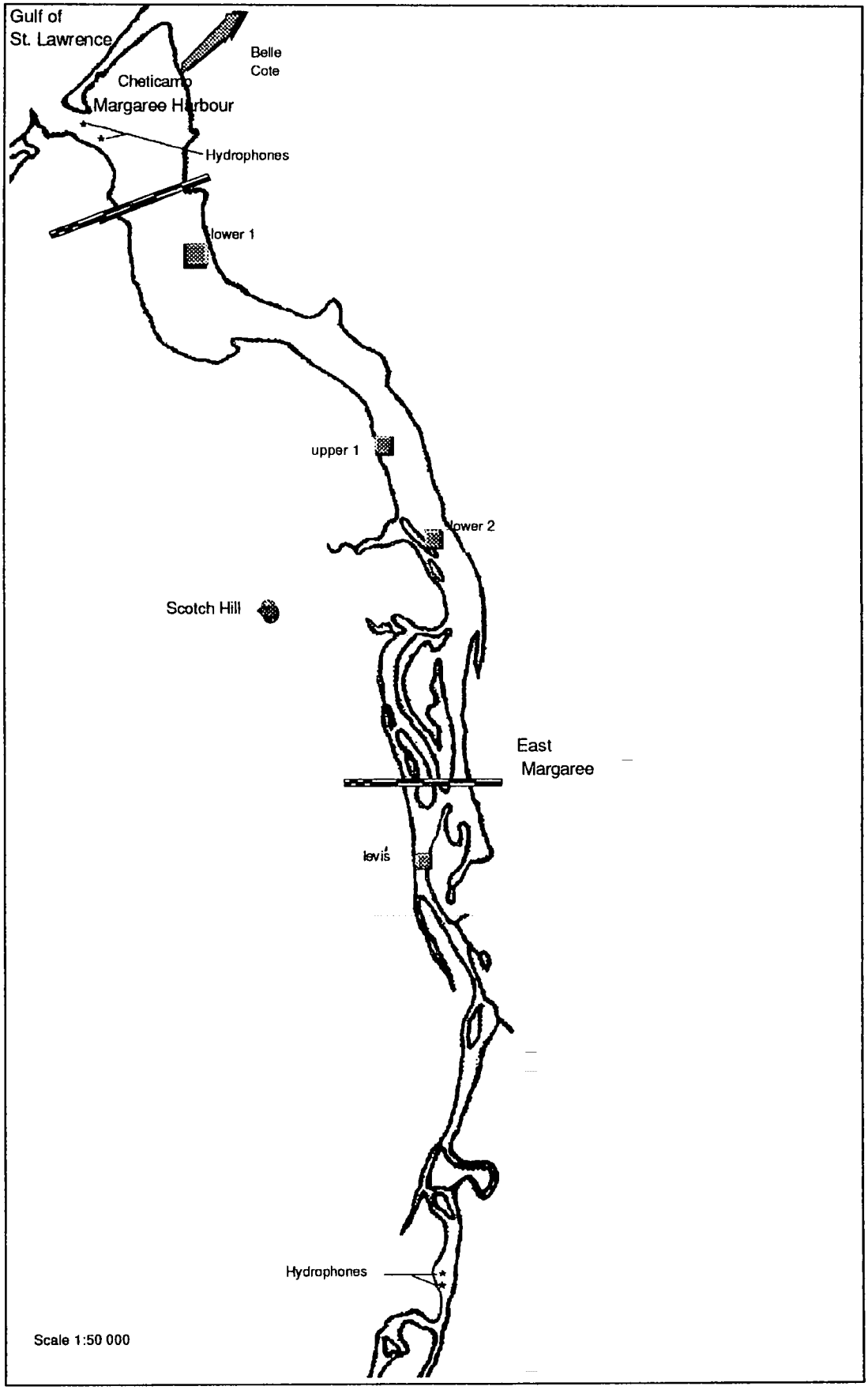



Fig. 3. Location of Margaree River trapnets (1988-95) and ultrasonic receivers (hydrophones), 1995.

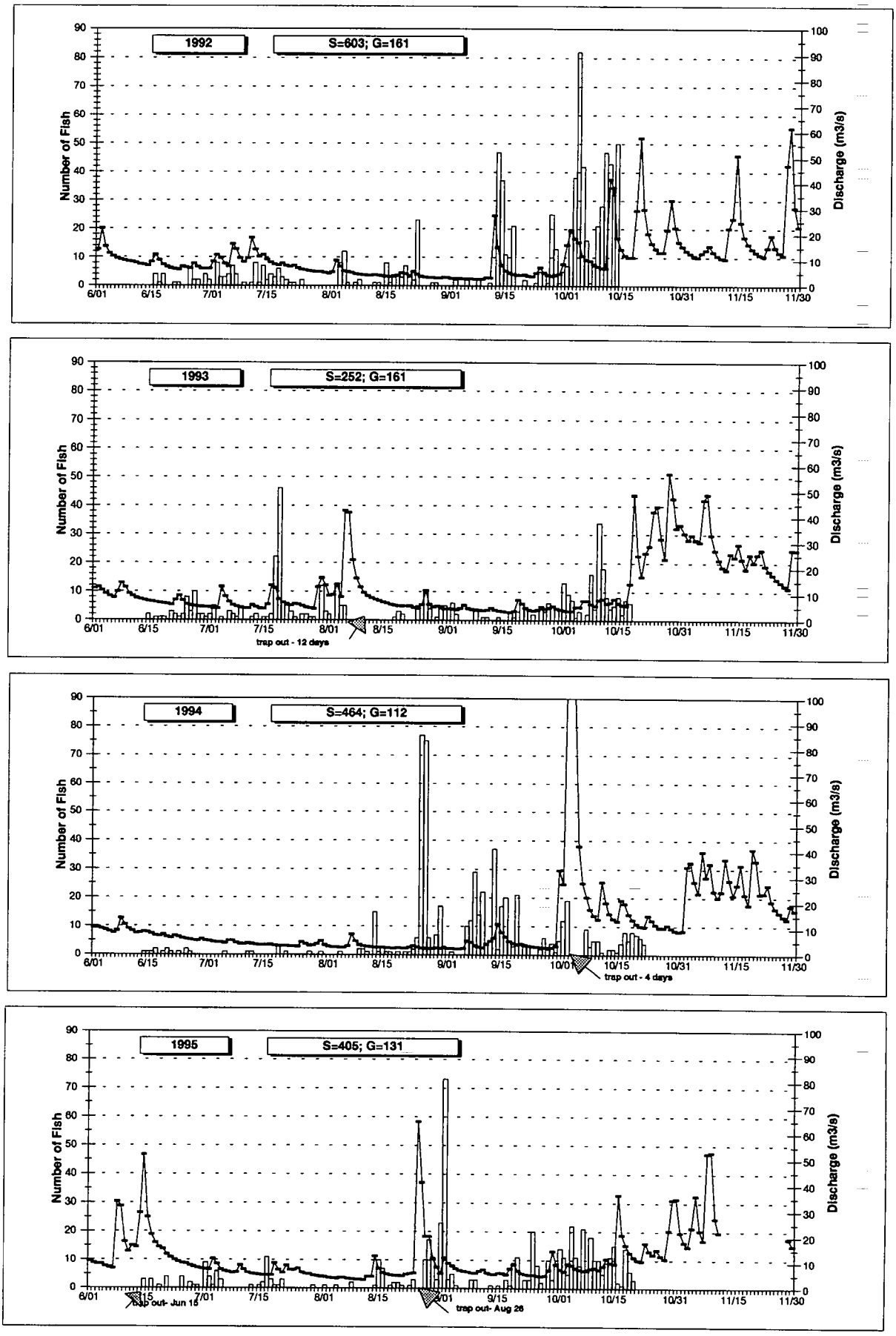
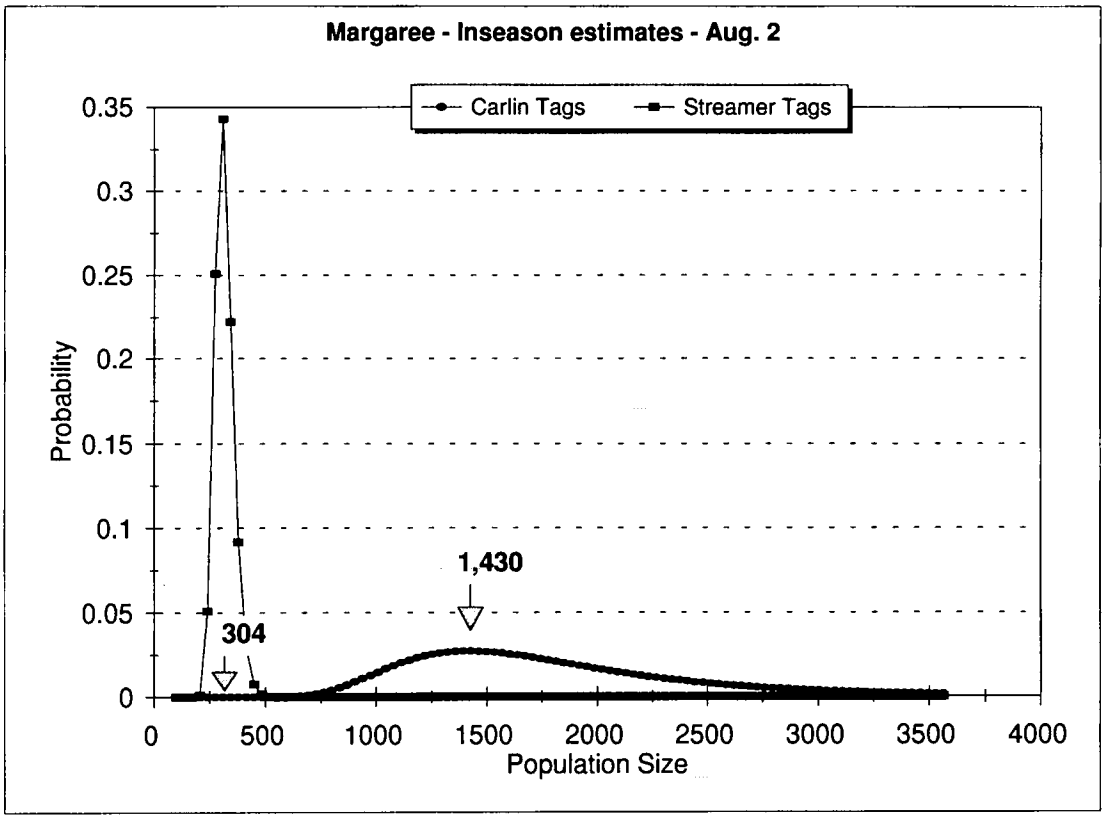



Fig. 4. Average daily discharge (m3/s) for Northeast Margaree and fish counts (bars) at Levi's trapnet, 1992-95.



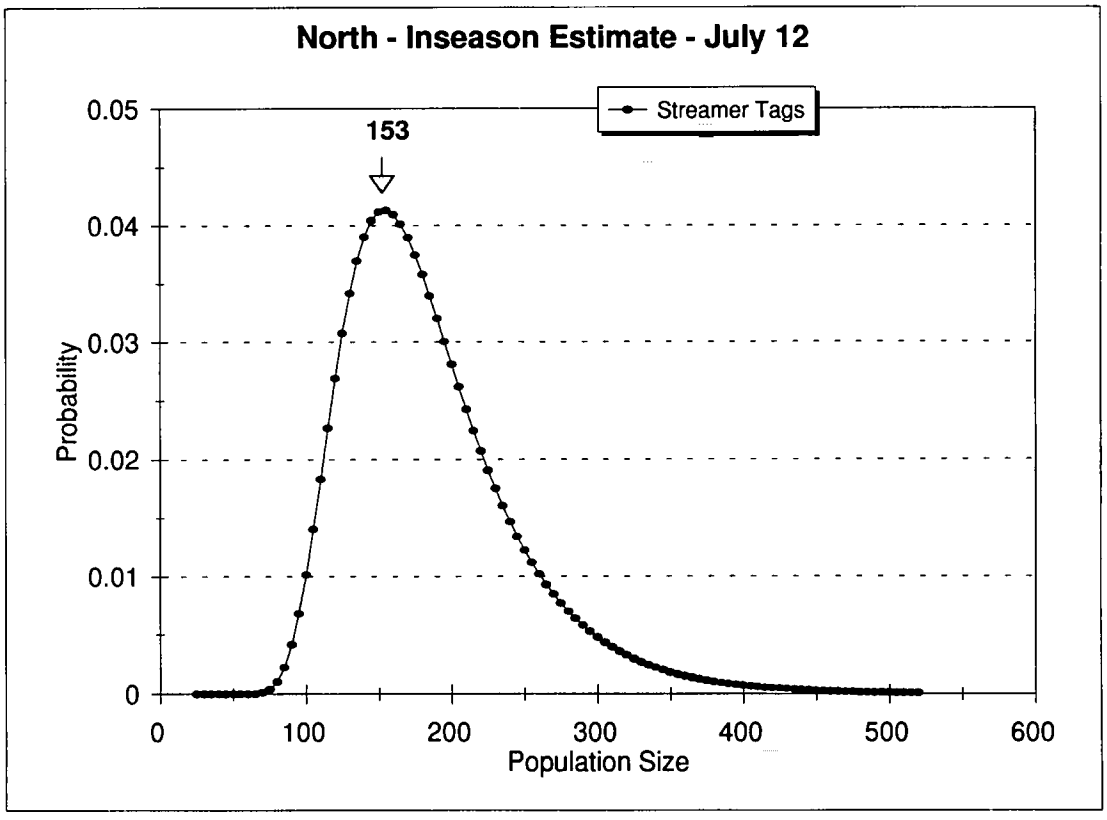
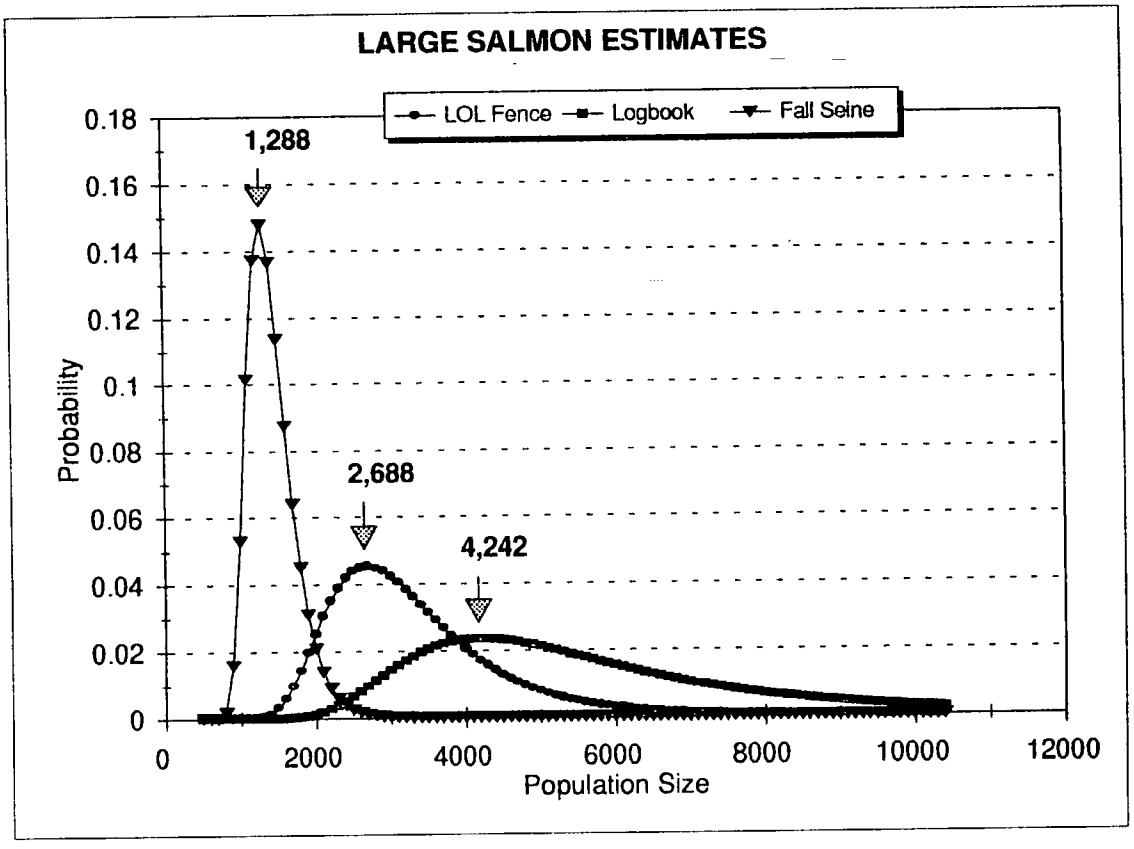




Fig. 5. Inseason estimates of small and large salmon for Margaree (upper) and North (lower) rivers based on mark and recapture techniques.



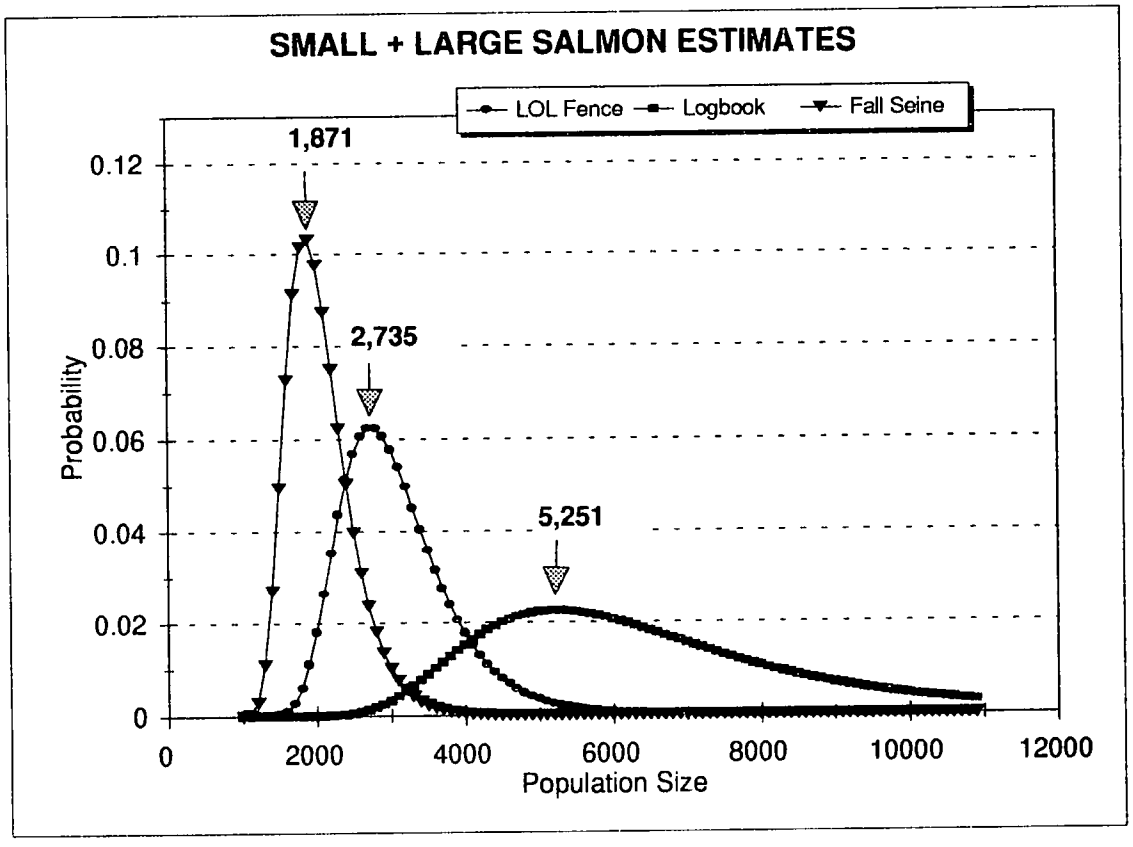




Fig. 6. Estimated returns of large salmon (upper) and small + large salmon (lower) to the Margaree River in 1995 based on mark and recapture techniques.

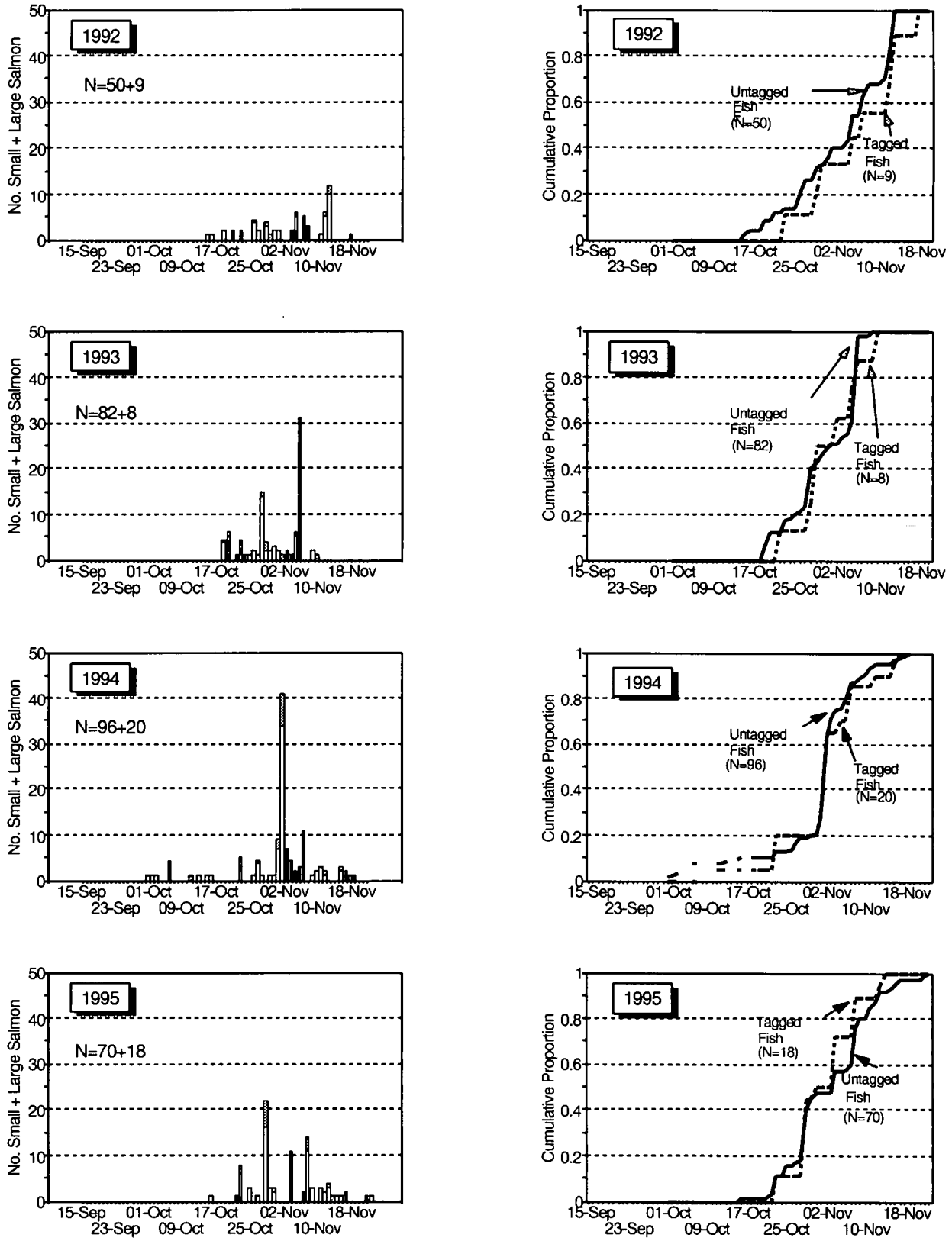
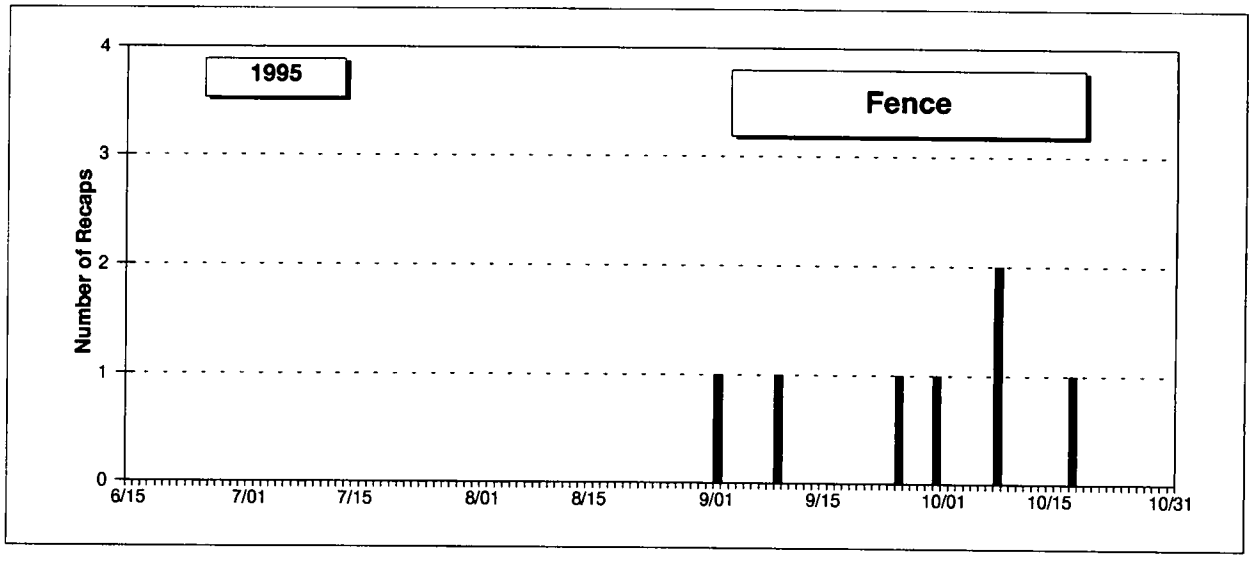
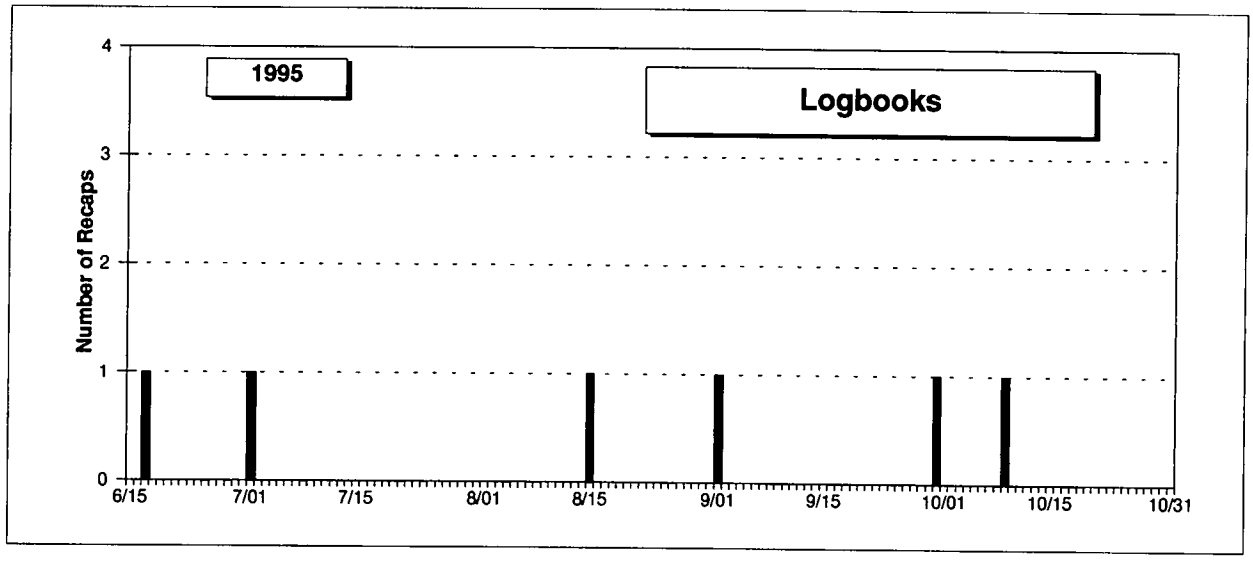



Fig. 7. Daily and cumulative counts of small and large, tagged and untagged salmon at Lake O'Law trap, 1992-1995.



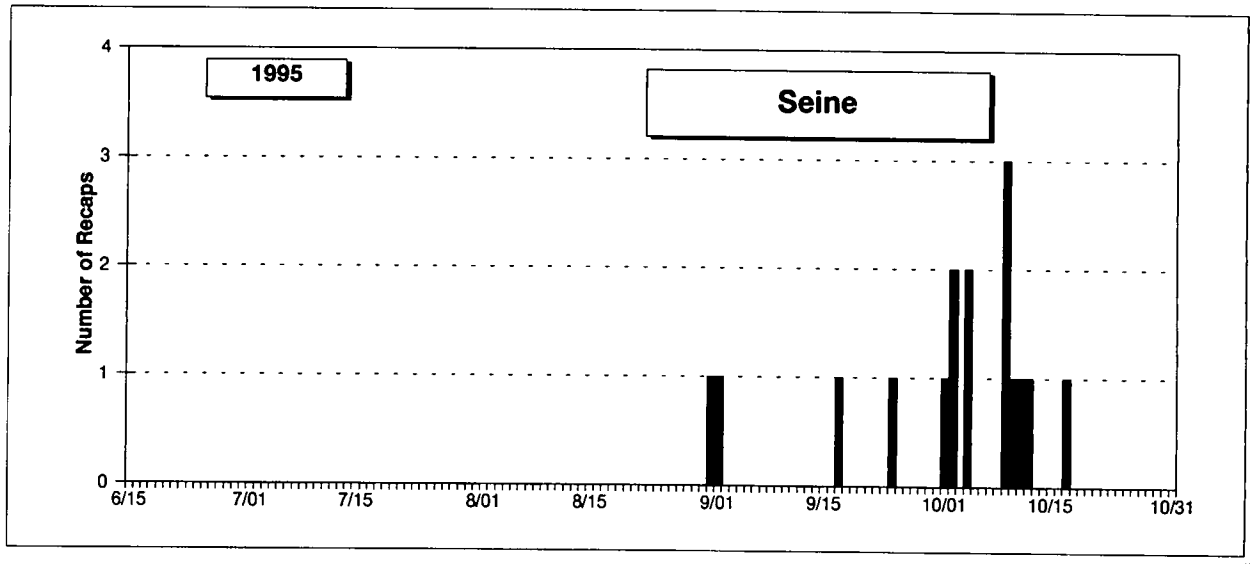




Fig. 8. Tagging dates of large salmon recaptured (Lake O'Law fence, seine/gillnets, anglers[logbooks]) in the Margaree River, 1995.

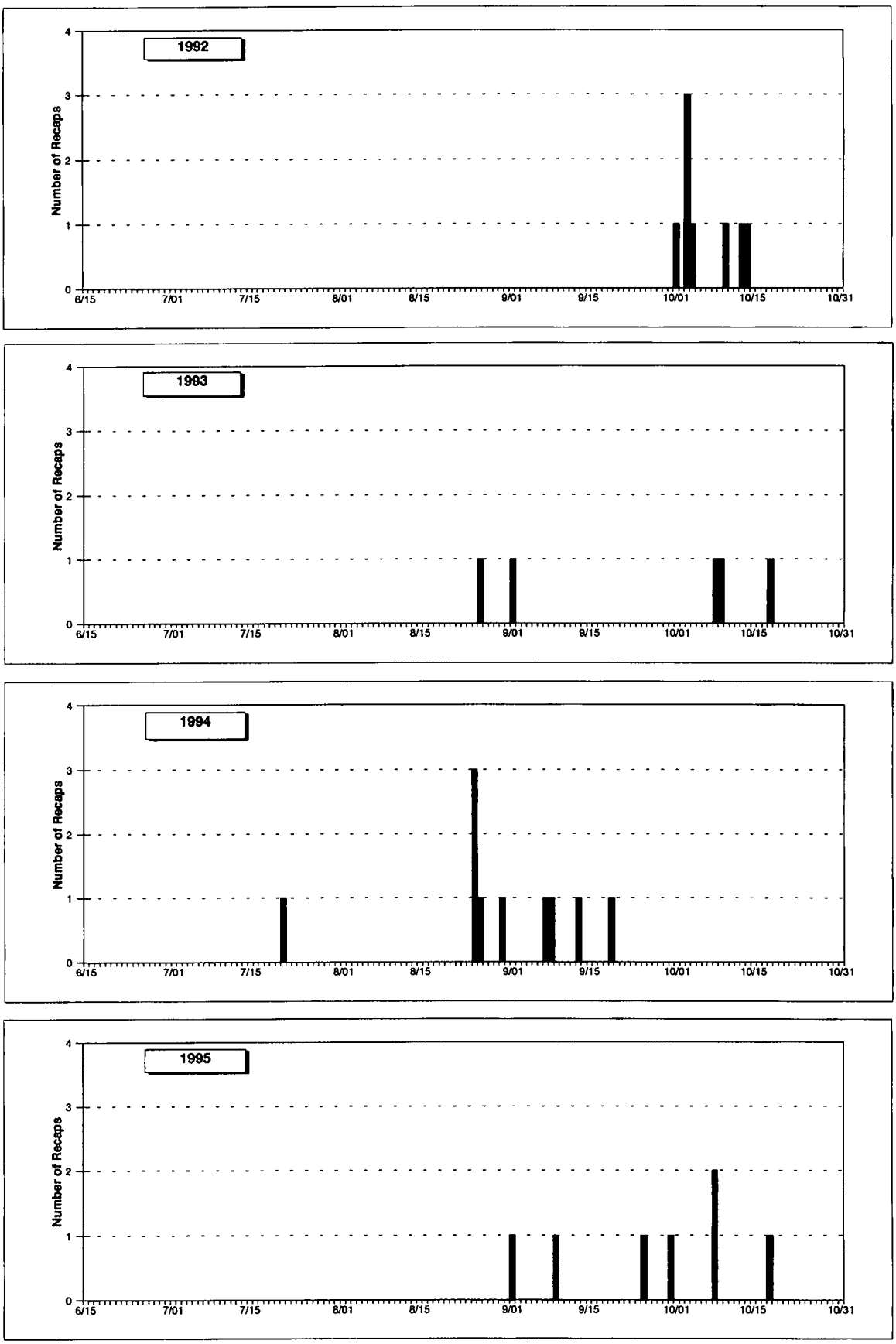



Fig. 9. Tagging dates of large salmon recovered at the Lake O'Law counting fence Margaree River, 1992-95.

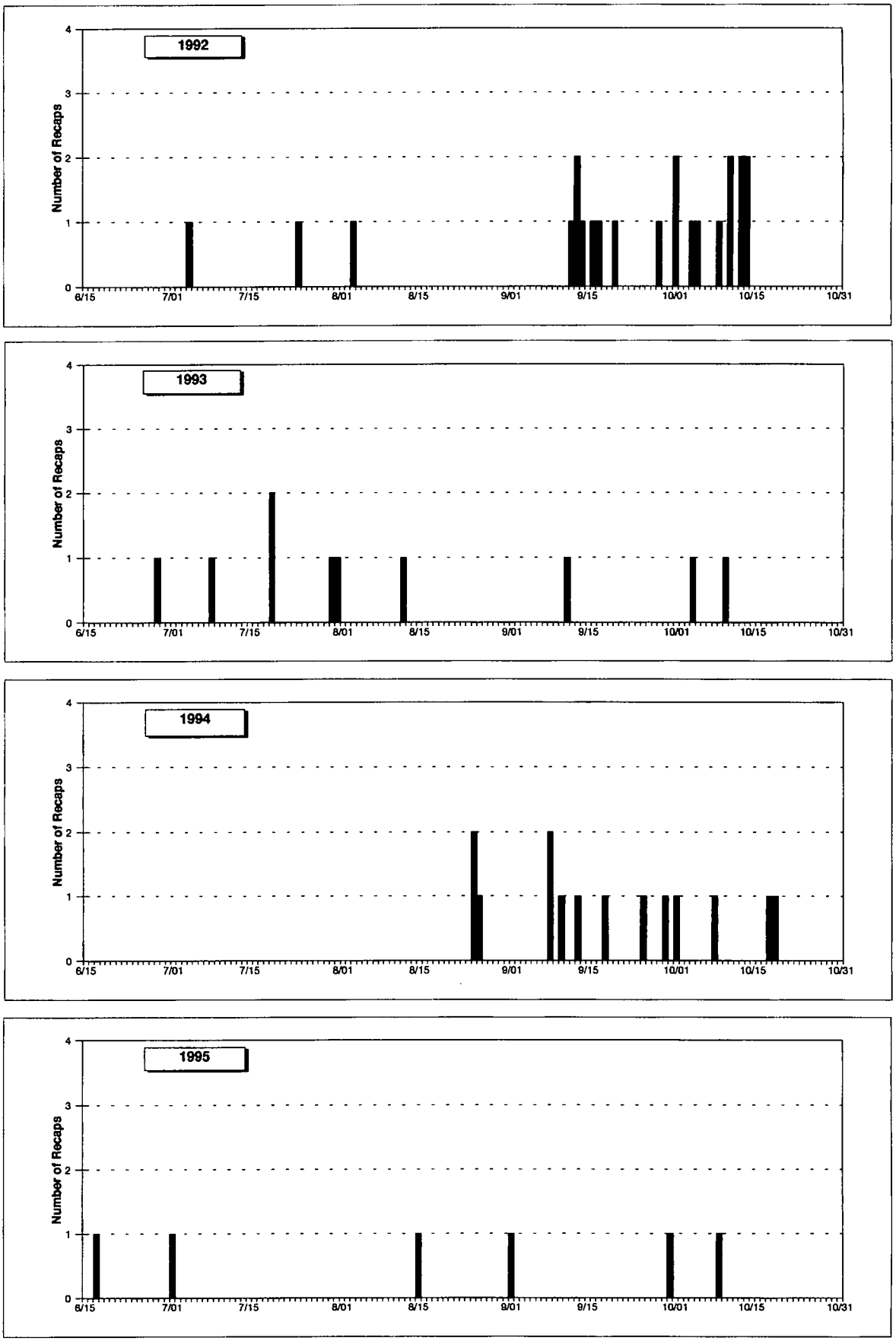
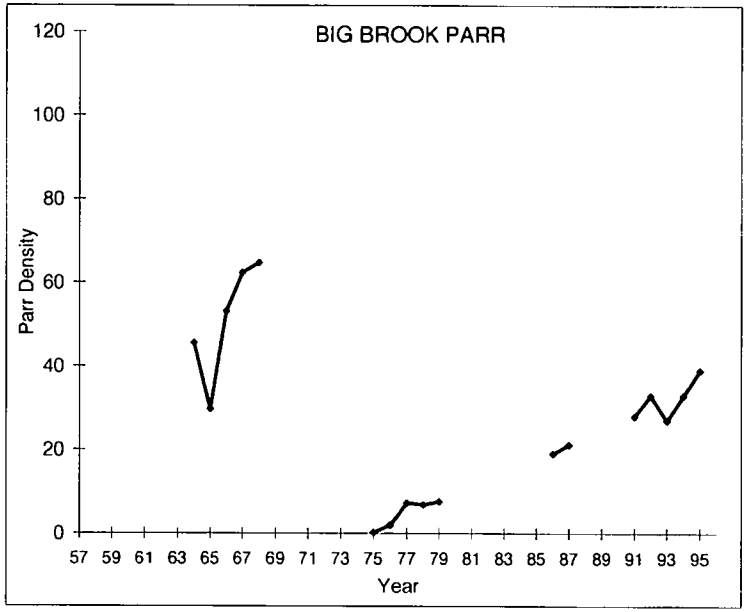
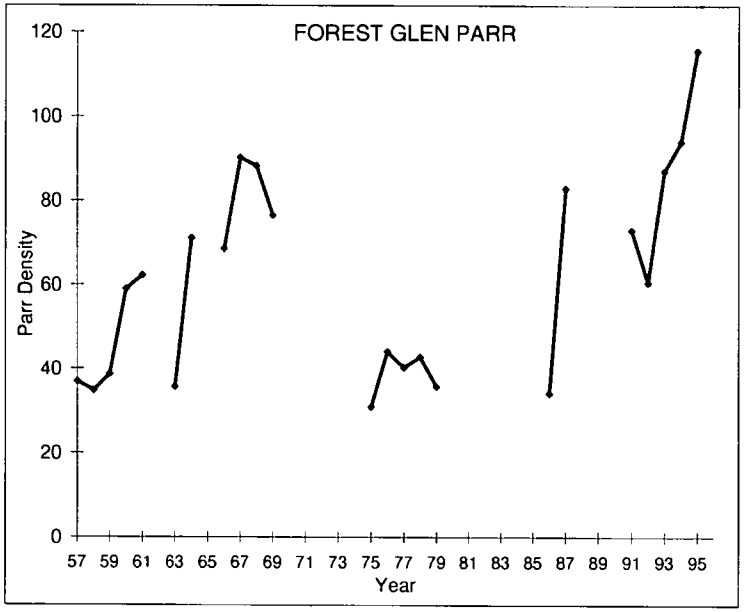
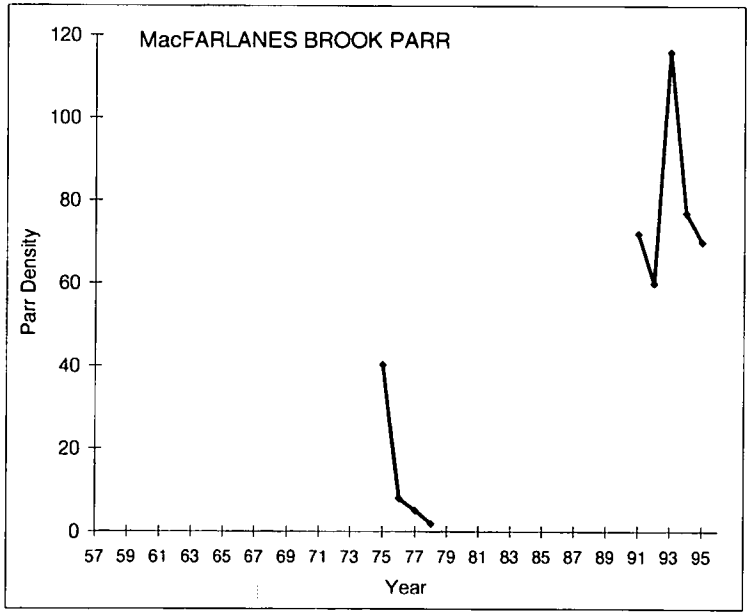



Fig. 10. Tagging dates of large salmon reported in angler logbooks, Margaree River, 1992-95.



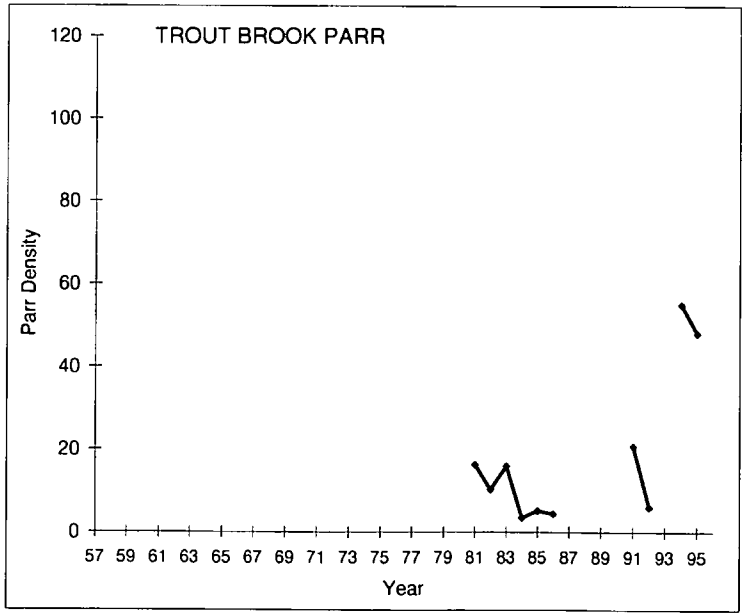
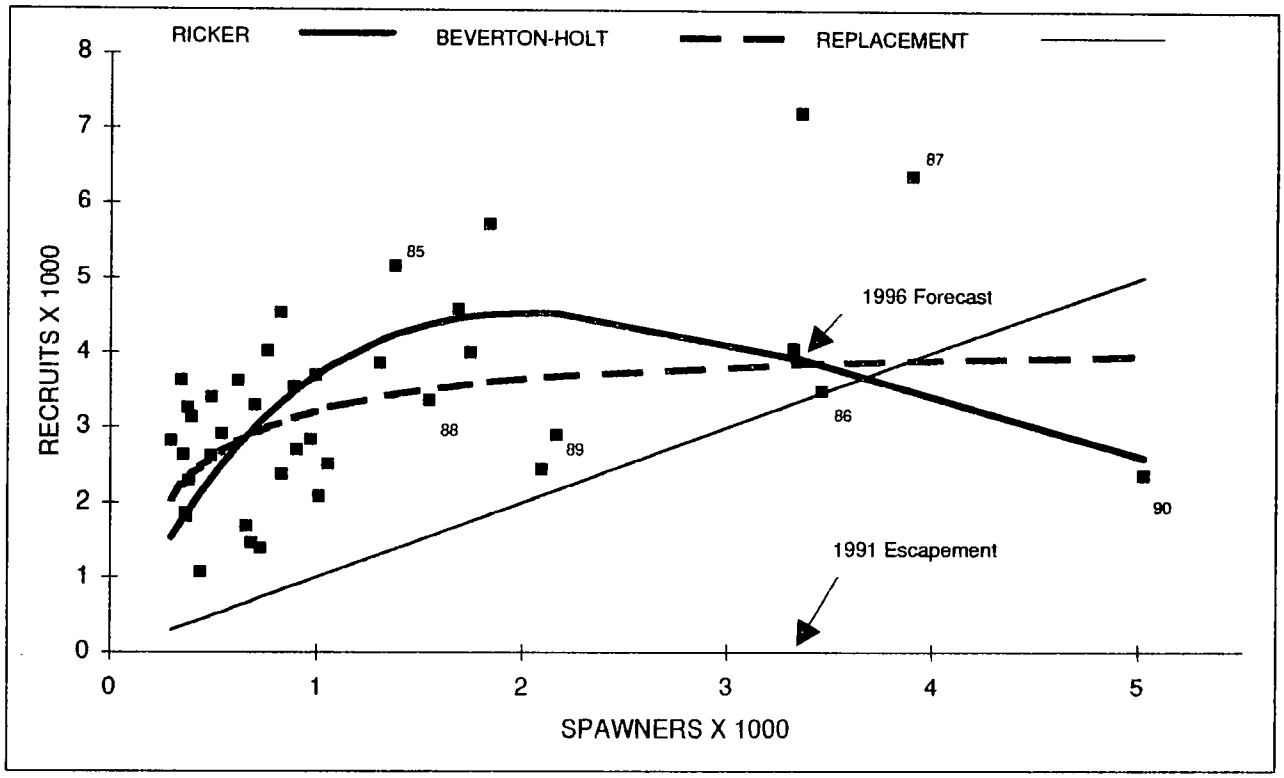




Fig. 11. Parr densities at four index sites on the Margaree River from 1957 to 1995.



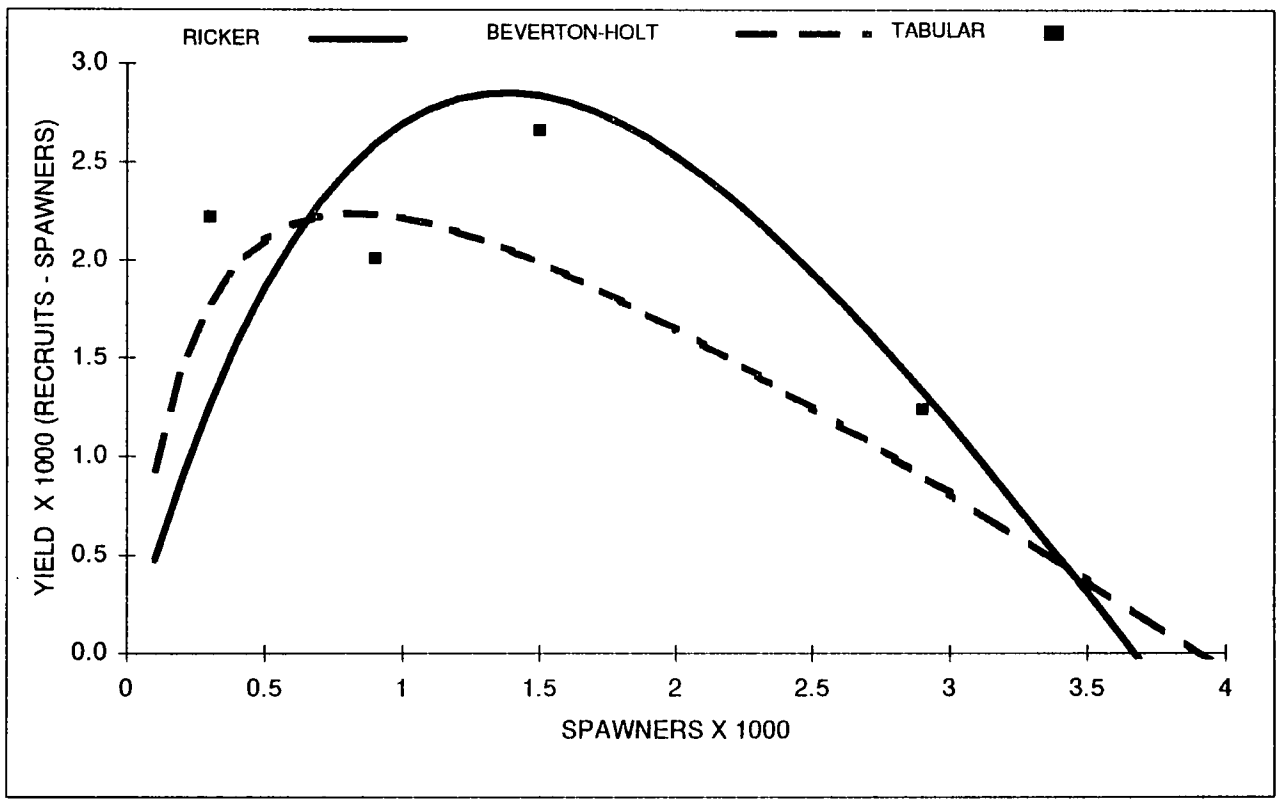




Fig. 12. Stock recruitment plot with replacement line for Ricker and Beverton-Holt models.

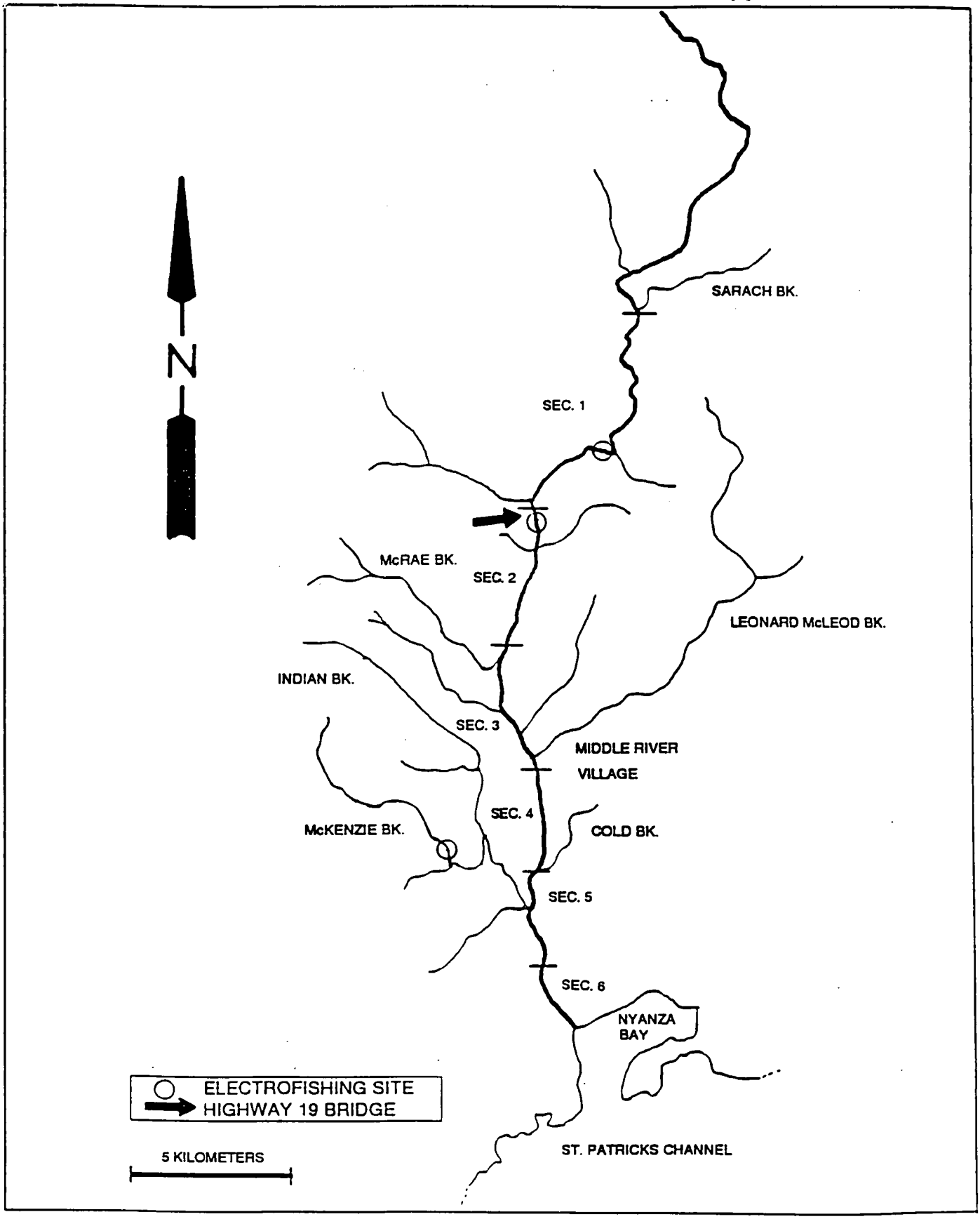



Fig. 13. Middle River, Victoria County, showing swim-thru sections and electrofishing sites, 1995.

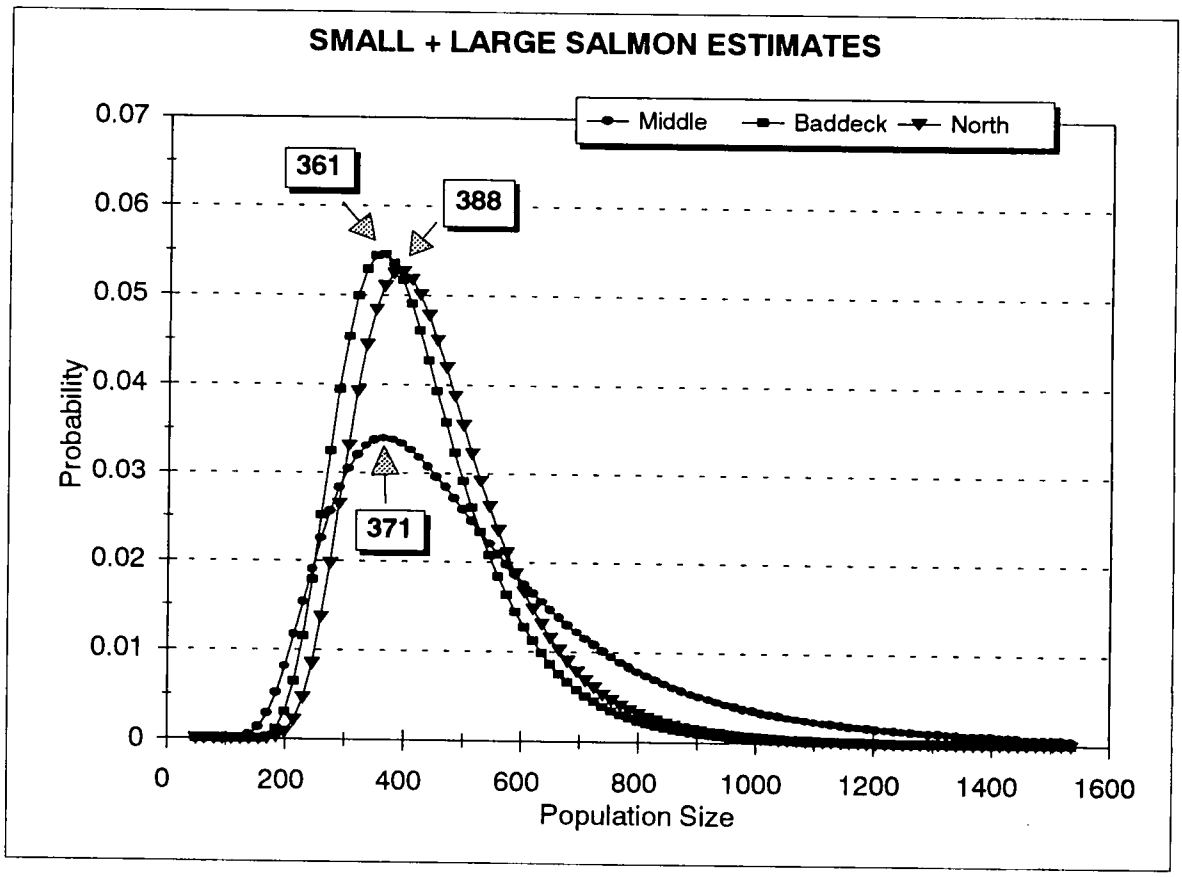



Fig. 14. Estimated returns of small + large salmon to the Middle, Baddeck, and North Rivers in 1995 based on mark and recapture techniques.

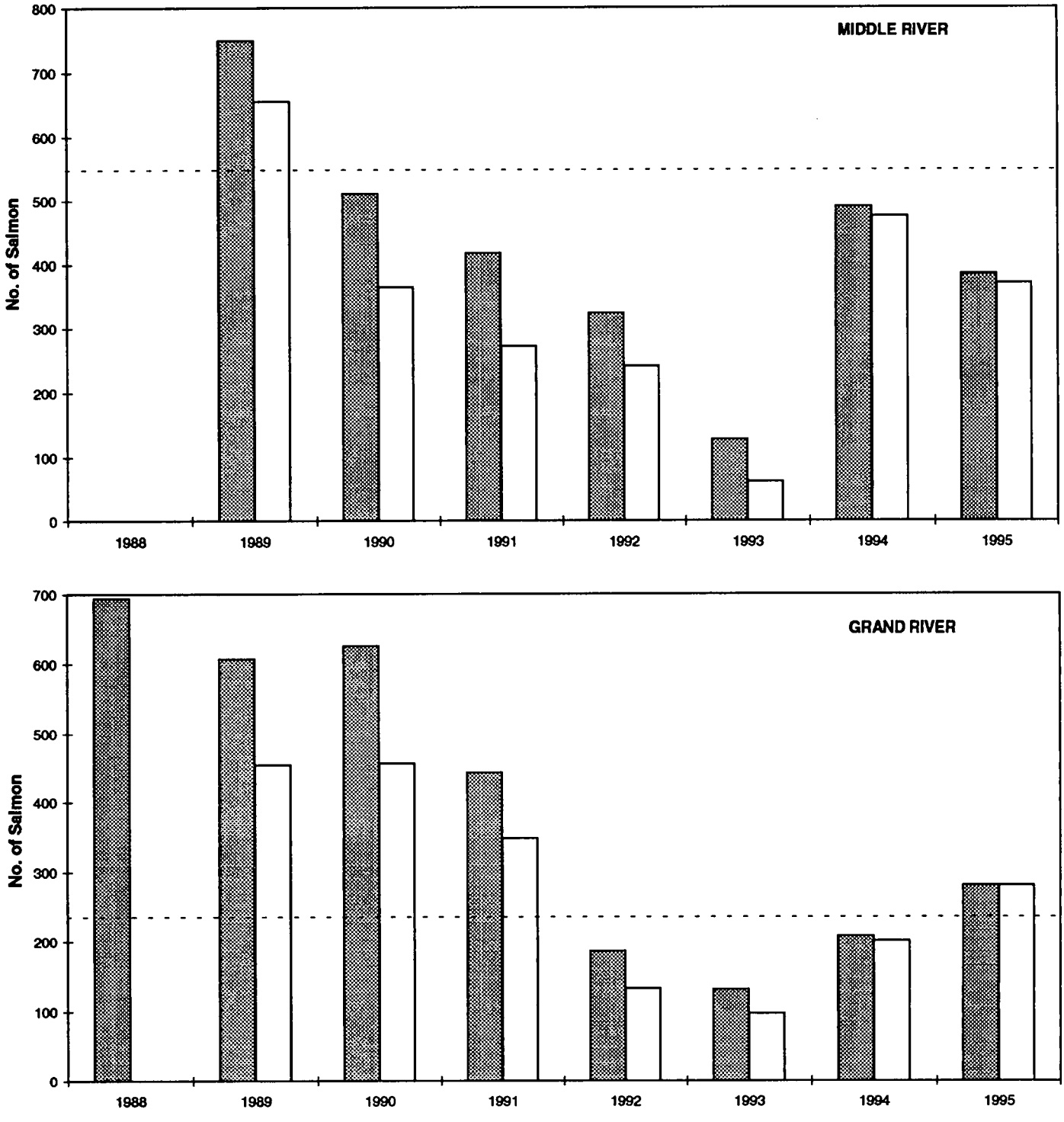



Fig. 15. Estimated returns [cross hatch] and escapement [open bars] of large and small Atlantic salmon on the Middle and Grand rivers, Cape Breton, 1988-95. Horizontal line indicates the conservation requirement (above Falls on Grand river).

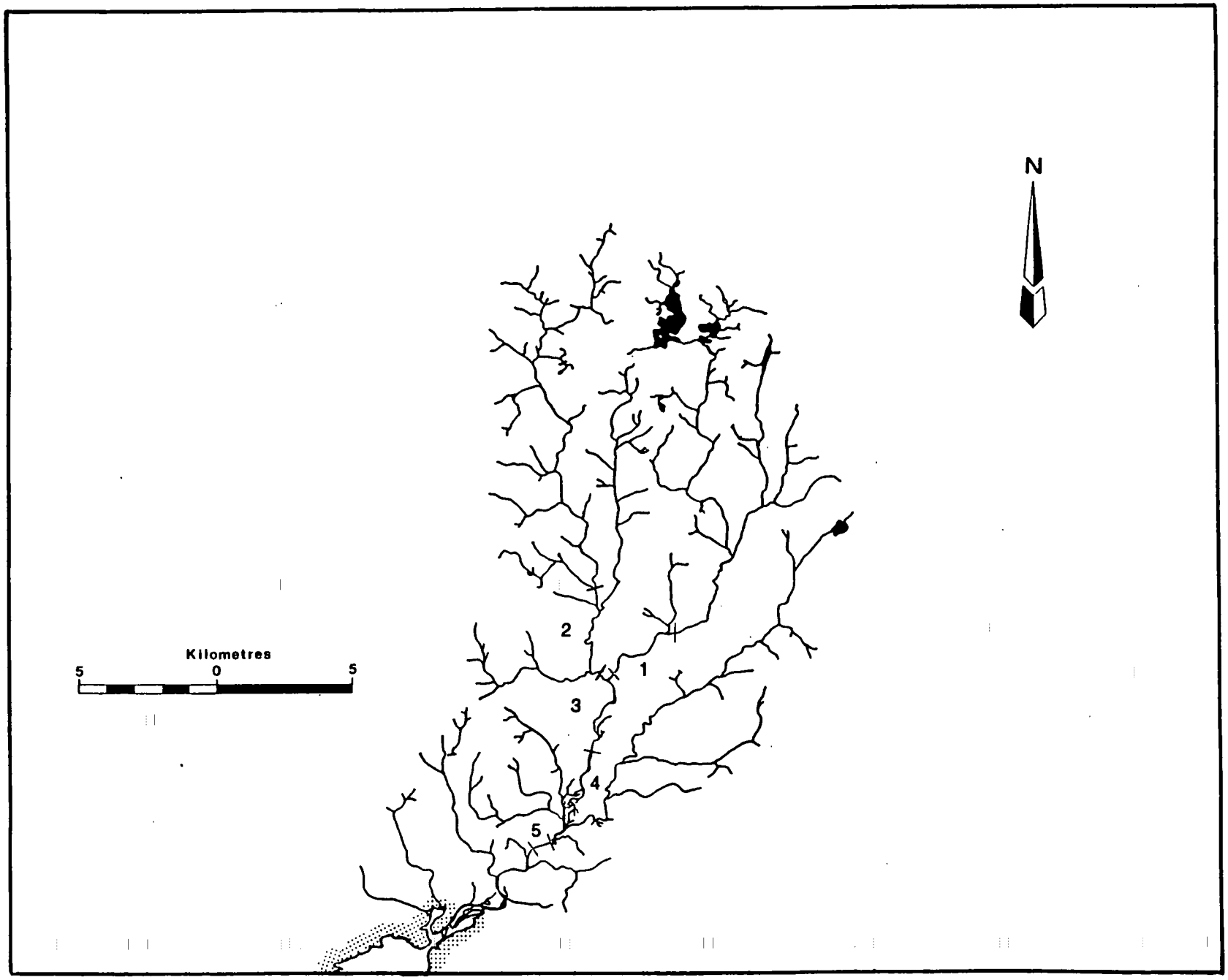



Fig. 16. Baddeck River, Victoria County, showing swim-thru sections, 1995.

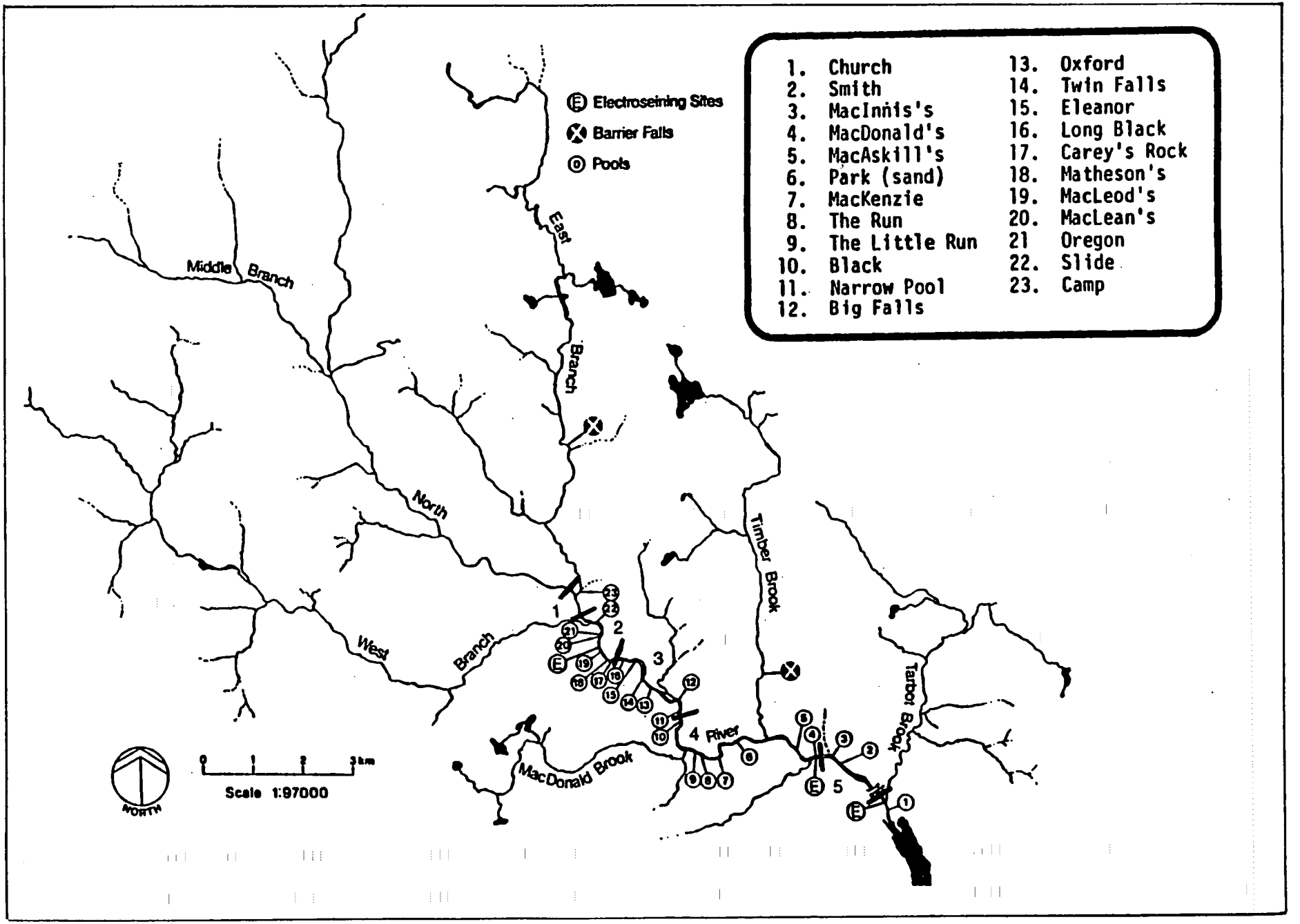
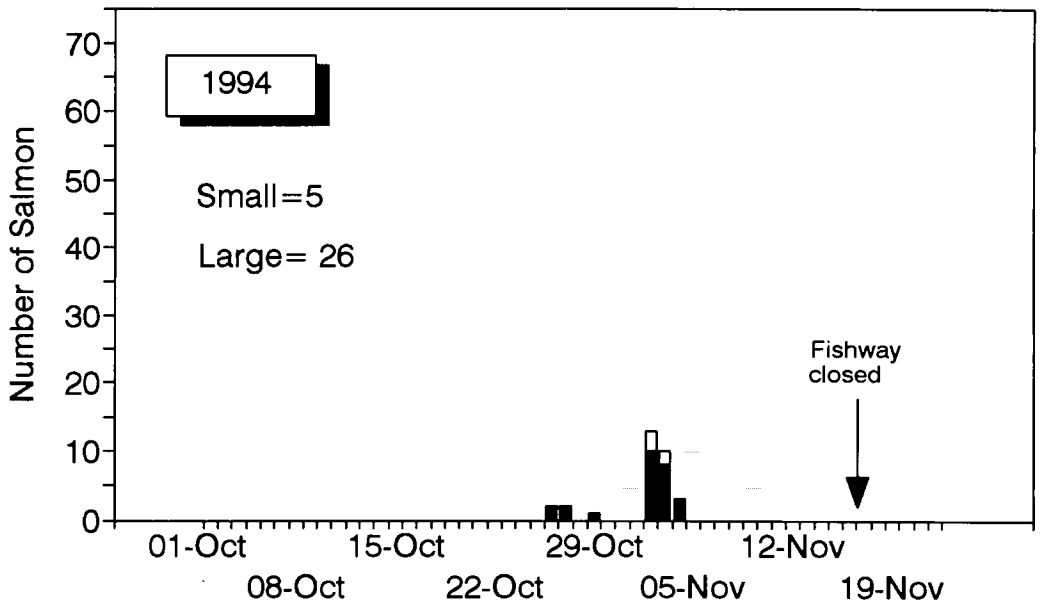



Fig. 17. North River, Victoria County, showing name and locations of angling pools and swim-thru sections (uncircled numbers and slash to mark section boundary).



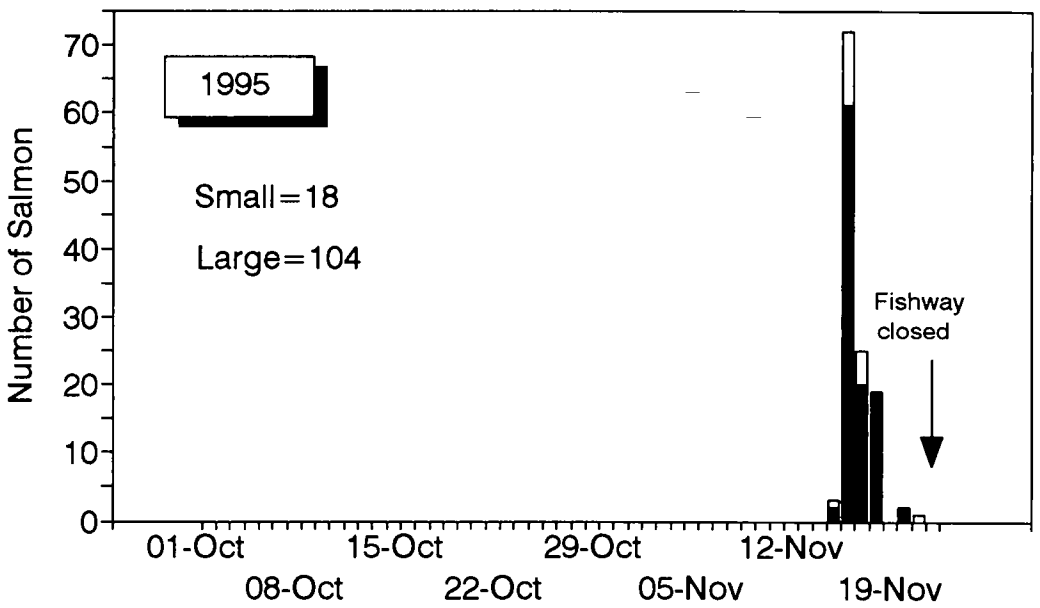




Fig. 18. Daily counts of salmon at the Sydney River fishway, 1994-1995.

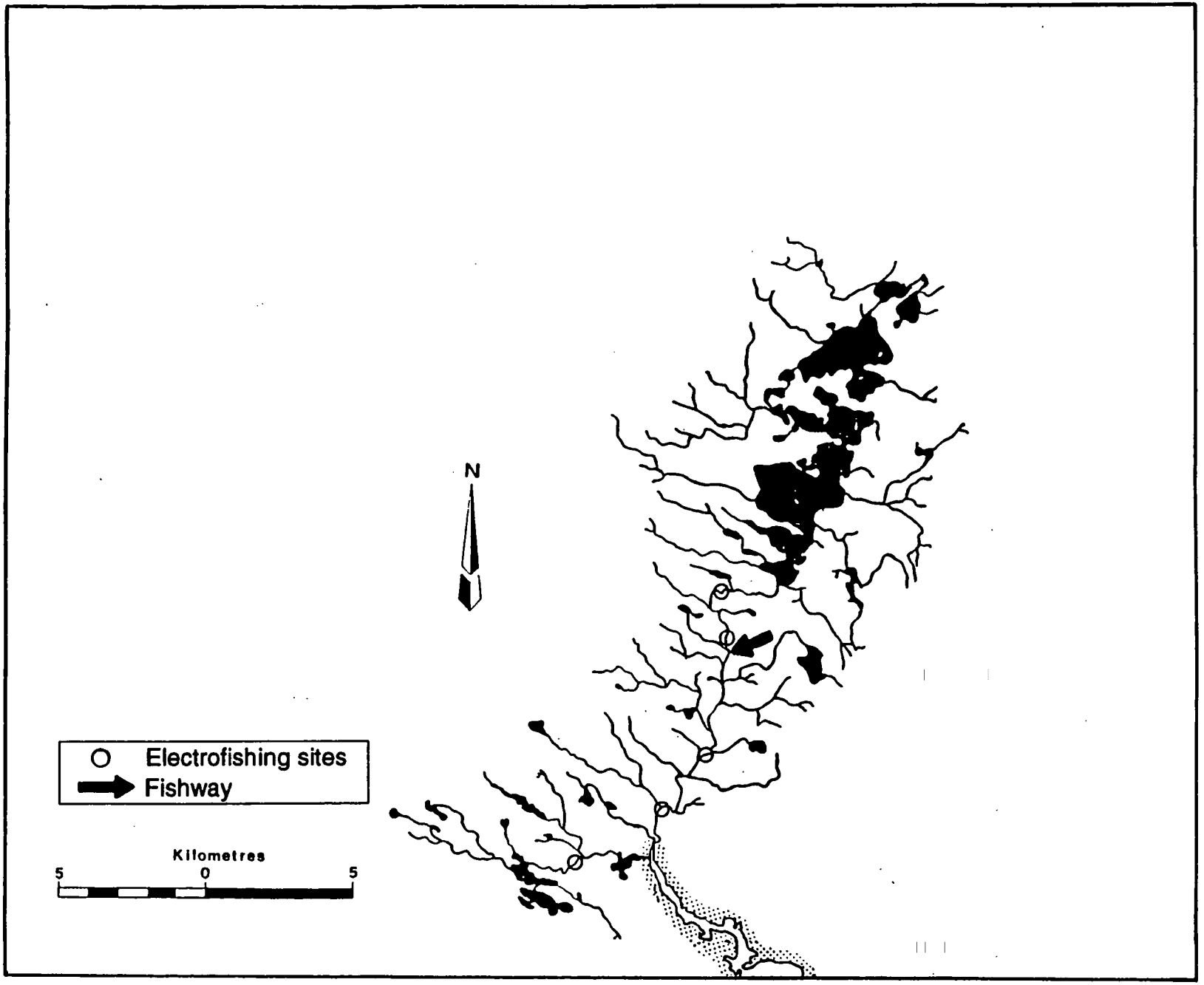



Fig. 19. Grand River, Richmond County, showing location of Grand River Falls fishway and electrofishing sites, 1995.

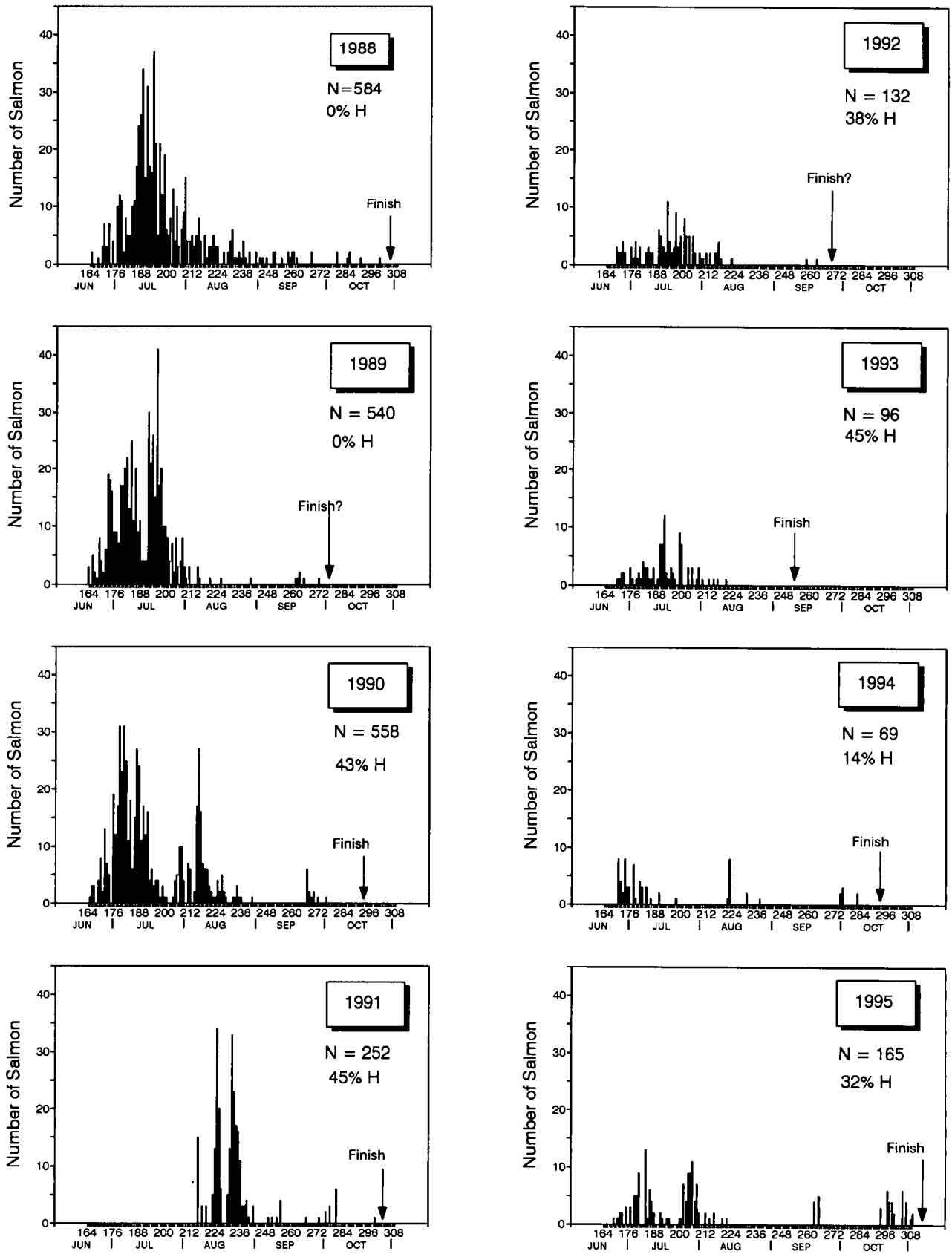



Fig. 20. Daily counts of salmon at the Grand River Falls fishway, 1988-1995.

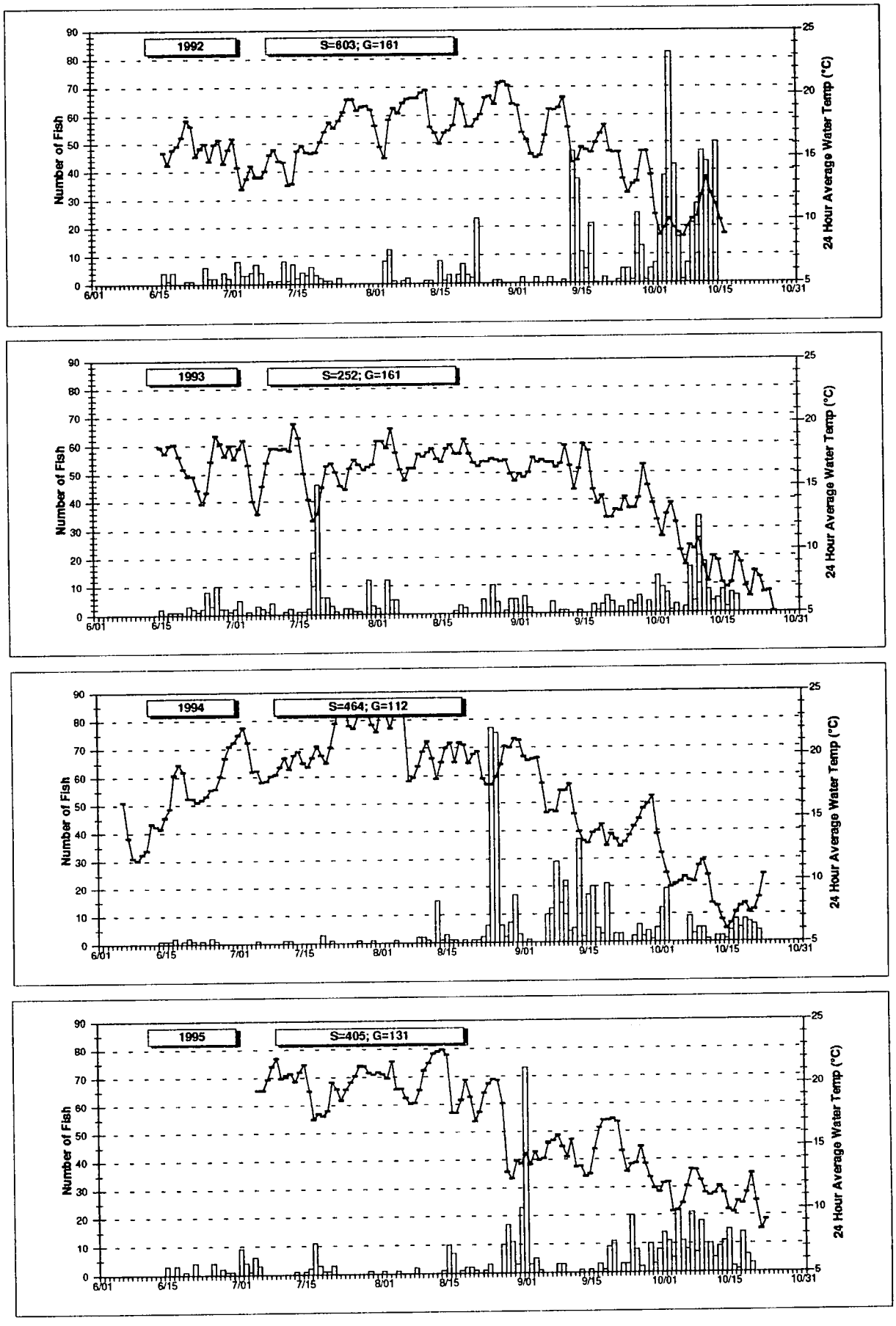
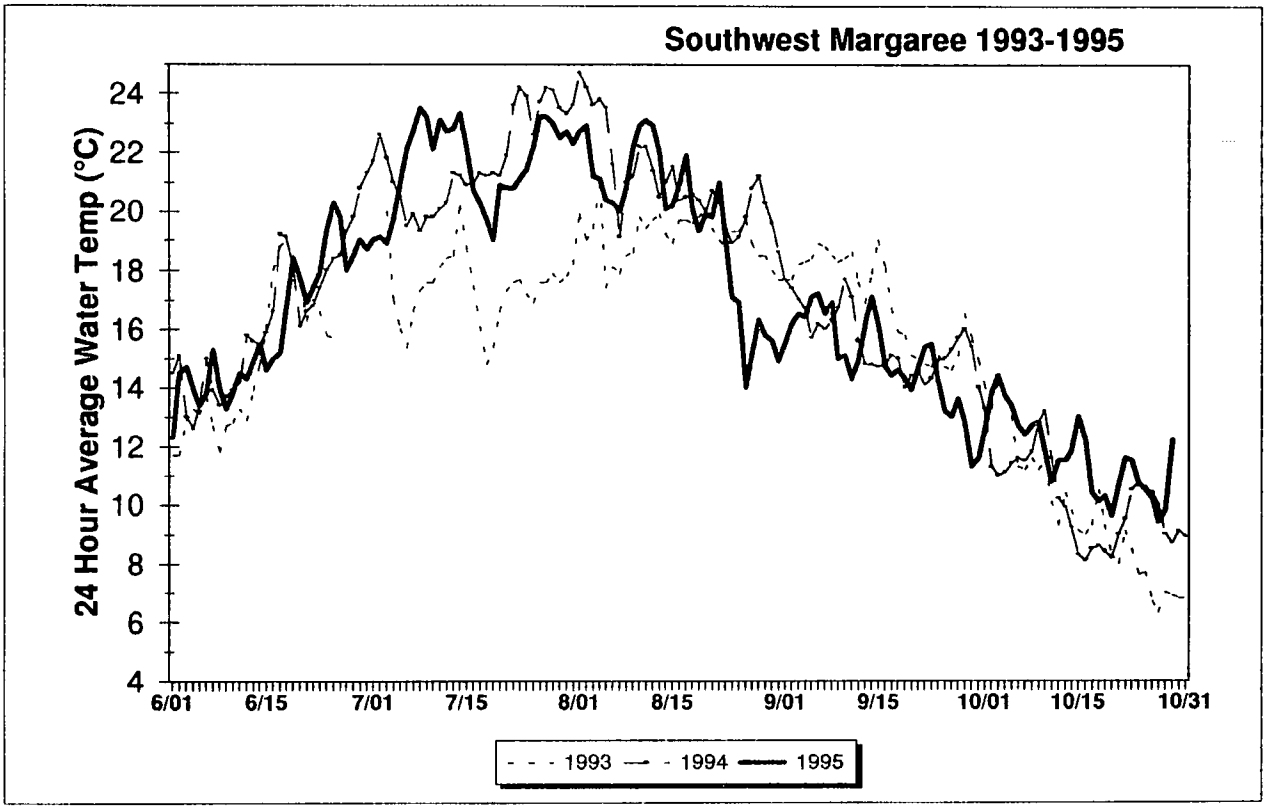



Fig. 21. Mean daily water temperatures (°C) for the Margaree estuary and counts at Levi's trapnet, Margaree River, 1992-95.



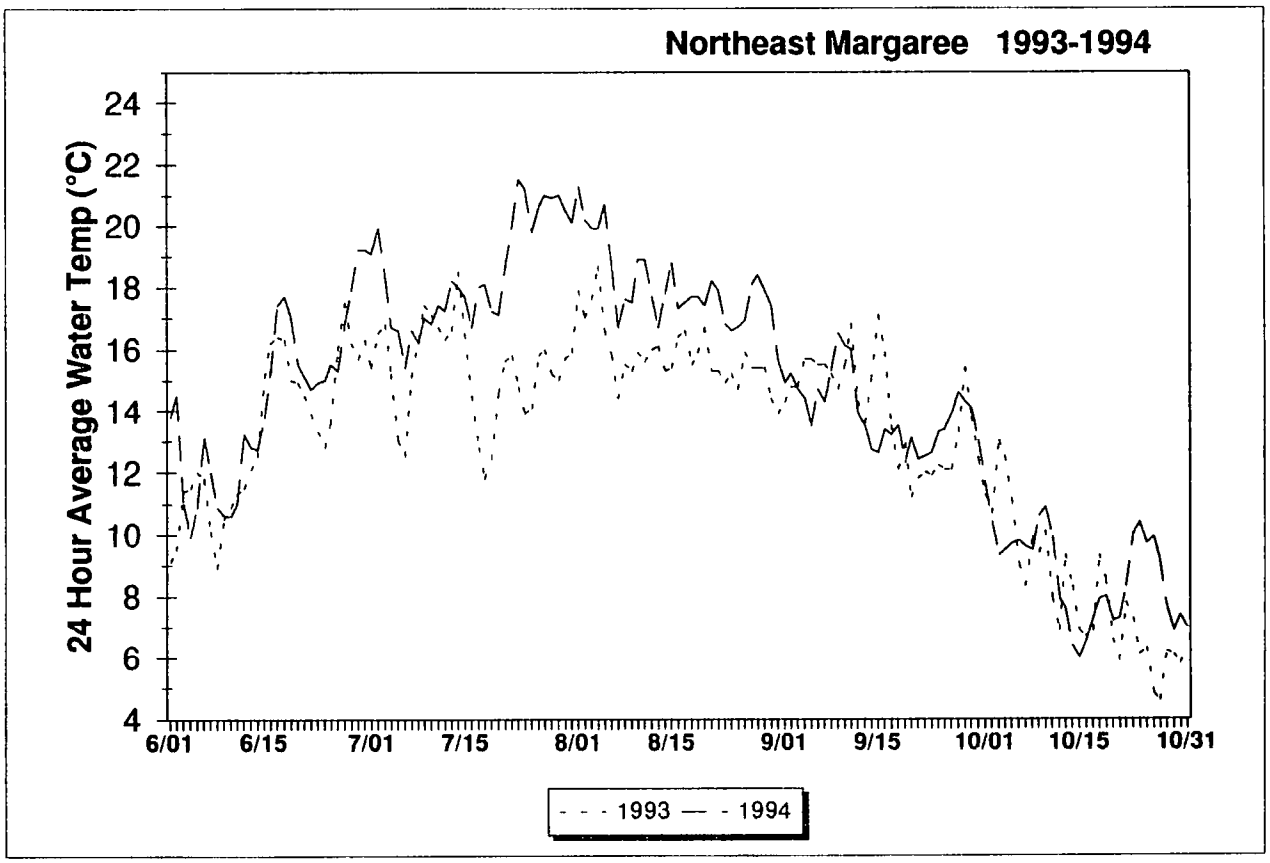




Fig. 22. Mean daily water temperatures for the Southwest (Baily Bridge) and Northeast (above Doyles Bridge) Margaree River. The 1995 Northeast data lost due to a thermograph memory malfunction.

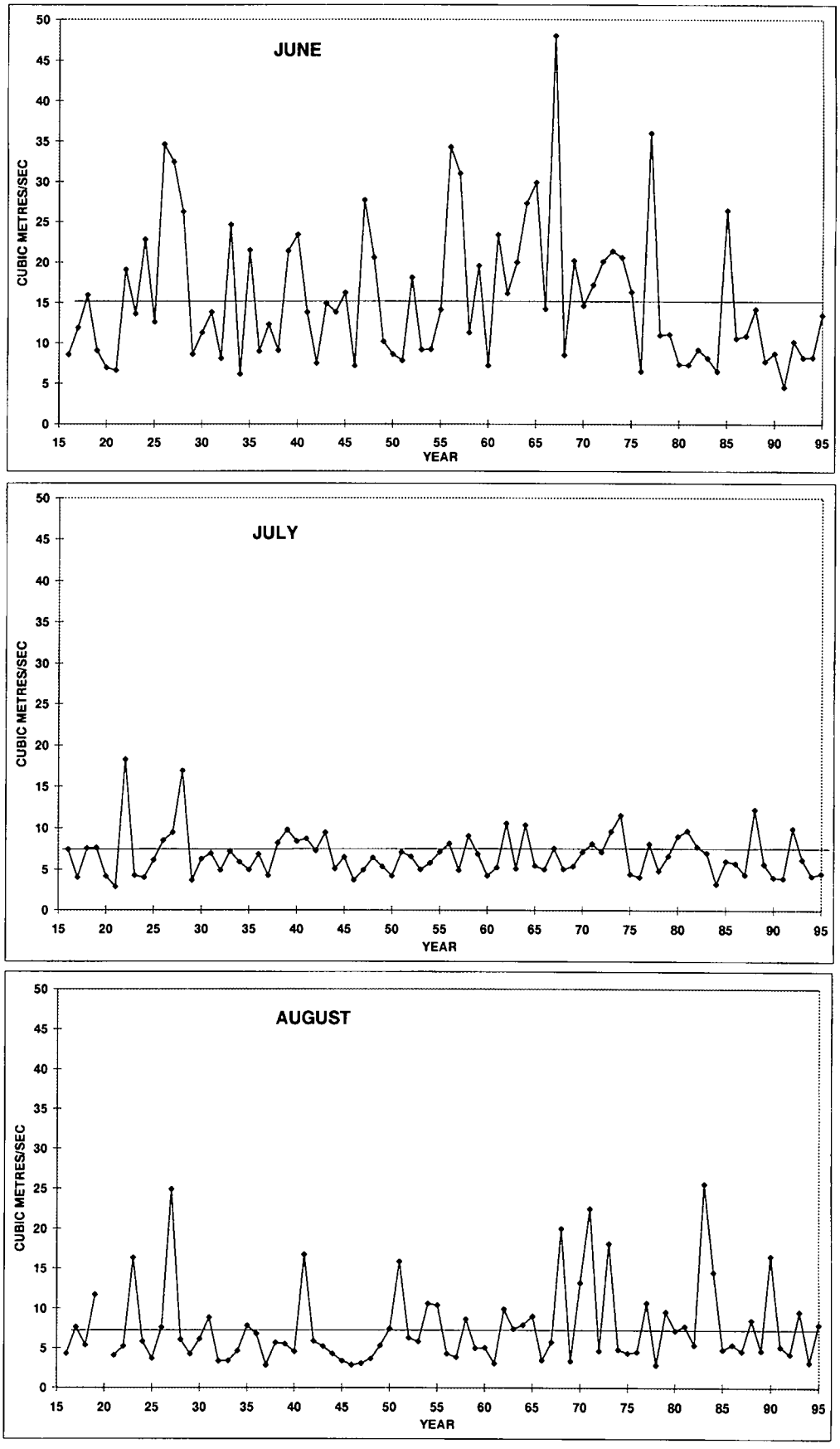



Fig. 23. Mean monthly river discharges on the Northeast Margaree, 1916-95. Horizontal line is long-term mean.

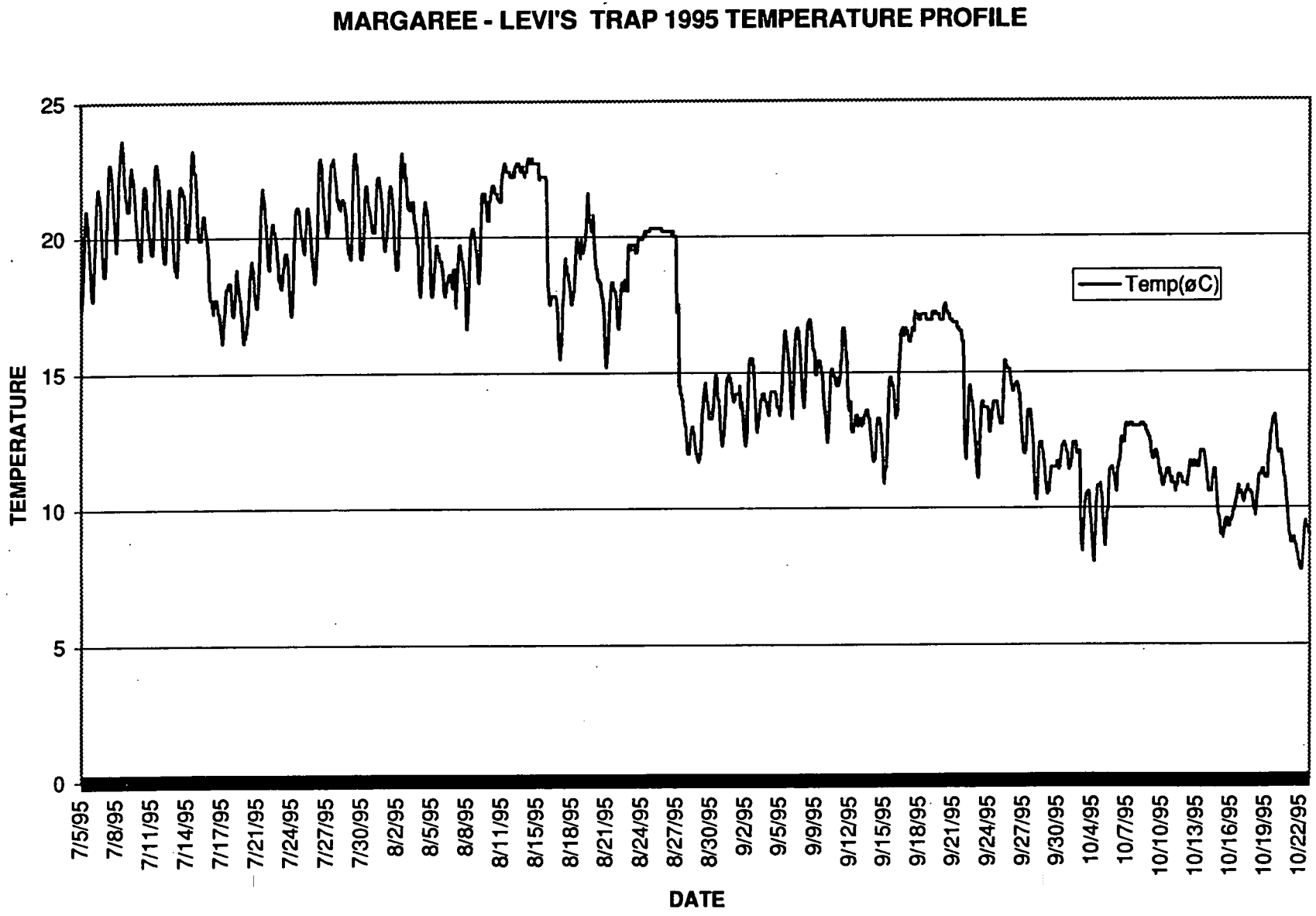



Fig. 24. Hourly temperature data, Levi's trap, Margaree River, July 5 to Oct 2, 1995.

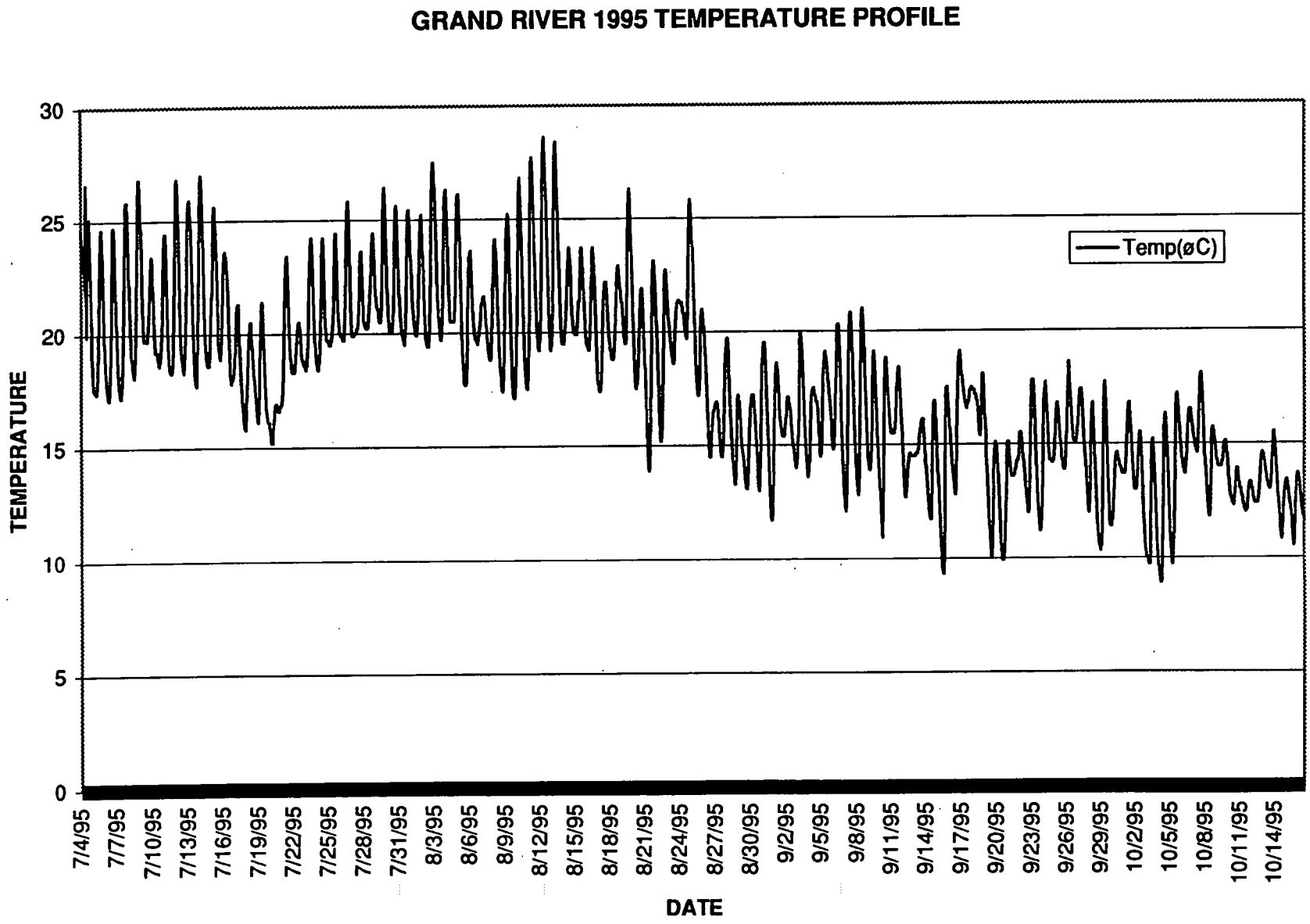



Fig. 25. Hourly temperature data, Grand River Falls fishway, July 4 to Oct 14, 1995.

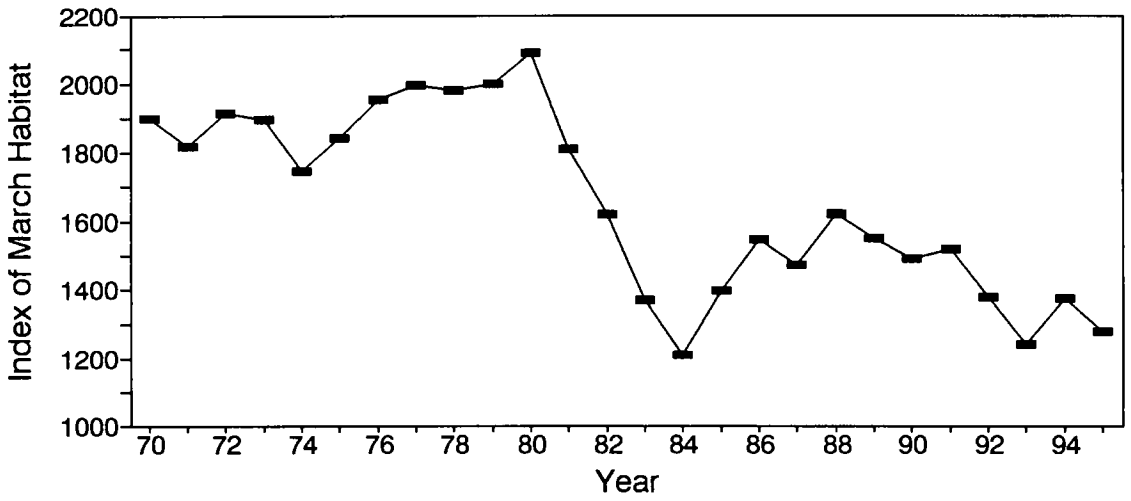



Fig. 26. March index of winter habitat in the N.W. Atlantic,1970-1995 (Anon. 1995).