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Status of Atlantic salmon stocks in selected rivers of Cape Breton Island, 1996

by

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ABSTRACT

Assessments of the status of adult Atlantic salmon were conducted on the Margaree, Middle, Baddeck, North, and Grand rivers of SFAs 18 and 19, Cape Breton Island. These rivers accounted for 93% of the total recreational fishing effort exerted on the Island's 24 rivers reportedly fished for salmon in 1996. Assessments of juvenile salmon abundance were conducted on the above rivers as well as the Sydney, Gaspereau and Tillard rivers in SFA 19.

Returning salmon were either counted at fishways or estimated by mark-and-recapture techniques. Estimated returns of 2,792 large and 1,685 small salmon to the Margaree River, 323 large and 243 small salmon to the North River, 12 large and 333 small to Grand River Falls and 473 large and 126 small salmon to the Middle River contributed to the attainment, in total, of 242%, 246%, 147% and 105% of respective total conservation requirements. Returns of 263 large and 66 small fish to the Baddeck River contributed to the attainment of 60% of conservation requirements. Juvenile densities on the Margaree River exceeded "normal" (Elson 1967) abundance; densities of the Middle, Baddeck and Sydney rivers approximated "normal" and those of the North, Tillard, Gaspereau and Grand rivers ranged from slightly-less to much-less than "normal".

Quantitative and qualitative prognoses are that MSW returns in 1997 should in general be similar in magnitude to those of 1996. 1SW returns in 1997 are expected to be similar to those of 1996 with the exception that returns to the North and Margaree rivers will not include 1SW fish of hatchery-origin smolts. Only the 1SW returns to the Grand River in 1997 will have a component based on stocking of hatchery smolts.

RÉSUMÉ

Des évaluations de l'état des saumons de l'Atlantique adultes ont été réalisées pour les rivières Margaree, Middle, Baddeck, North et Grand des ZPS 18 et 19 de l'Île-du-Cap-Breton. Ces rivières représentaient 93 % de l'effort total de la pêche récréative exercé sur les 24 rivières de l'île ayant fait l'objet d'une pêche du saumon en 1996. Des évaluations de l'abondance des juvéniles ont été effectuées pour ces mêmes rivières et les rivières Sydney, Gaspereau et Tillard de la ZPS 19.

Les saumons en remontée ont été dénombrés à des passes migratoires ou leurs nombres ont été estimés par marquage-recapture. Les remontées estimées ont été de 2 792 grands saumons et 1 685 petits saumons pour la Margaree, 323 grands et 243 petits pour la North, 12 grands et 333 petits pour la Grand et 473 grands et 126 petits pour la Middle, ce qui correspond à, respectivement, 242 %, 246 %, 147 % et 105 % des besoins de conservation de ces rivières. Des remontées de 263 grands et de 66 petits saumons dans la rivière Baddeck n'ont permis d'atteindre les besoins de conservation qu'à 60 %. Les densités de juvéniles dans la rivière Margaree ont été supérieures à la « normale » (Elson, 1967), celles de la Middle, de la Baddeck et de la Sydney presque « normales » et celles des rivières North, Tillard, Gaspereau et Grand légèrement ou de beaucoup inférieures à la « normale ».

Selon les prévisions quantitatives et qualitatives, les remontées de PBM de 1997 devraient être d'importance semblable à celles de 1996. Les remontées d'UBM de 1997 devraient être semblables à celles de 1996 si l'on fait exception de la North et de la Margaree où les remontées ne compteront pas de saumoneaux UBM d'élevage. Seules les remontées d'UBM de la rivière Grand en 1997 compteront des saumoneaux d'origine d'élevage.

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

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
Angling catch[2]									
Large	1,757	1,938	1,102	1,479	1,060	1,710	1,060	1,938	1,467
Small	752	678	777	429	333	964	333	777	594
First Peoples' harvest									
Large	1	-	58	50	4	89	-	-	-
Small	2	-	8	14	2	7	-	-	-
Total returns									
Large	3,484	6,375	3,358	2,900	2,365	2,792	2,365	6,375	3,696
small	1,909	1,645	2,087	708	737	1,685	708	2,087	1,417
Spawning escapement									
Large	3,323	6,222	3,224	2,759	2,308	2,579	2,308	6,222	3,567
Small	1,340	1,088	1,504	390	529	1,343	390	1,504	970
% of large required	321	601	311	266	223	249	223	601	344
Juveniles 100m^{-2} (3 tributary sites)									
Fry	133	154	122	117	186	114	117	186	142
Parr	58	50	79	69	77	81	50	79	67

[1] Min, Max and Mean are for 1991-1995.
[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 were restricted to a reported 96 fish taken by First Peoples, and an estimated 264 small salmon taken in the retention recreational fishery, September 1- October 31 (hook-and-release, only, prior to September 1).

Data and Methodology: Counts of tagged and untagged adult salmon were obtained from a swim-thru count on Aug 1, seining on October 31 and November 1, logbooks maintained by selected anglers (thru October 31) and a trap in the Lake O'Law counting fence (thru November 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 2,792 fish exceeded those of 1995; small salmon (1,685) increased over those of 1994-1995 to earlier levels. Large salmon and their egg depositions were 249% of the conservation requirement. Escapement of small salmon was 231% of requirement. Hatchery-origin small salmon were 26 and 6% of the respective summer and fall fish. Sixty-two percent of total small and 49% of total large fish captured at Levi's trap were taken before September 1. Juvenile densities of 114 age 0^+ parr and 81 age 1^+ and 2^+ parr 100 m^{-2} (3 ongoing tributary sites) are consistent with recent high levels of egg deposition.

Forecast for 1997: Forecasts of returns for 1997 range from 1,656 to 4,160 large salmon. High parr densities in 1993-94 and a possible increase in marine survival (increased returns of small salmon in 1996) suggest that returns should exceed the lower value; the higher values are fashioned on previously higher relationships between spawners and recruits. Returns of large fish should at least equal if not be greater than the 2,800 returns in 1996 (also the mean of the last 4 years), i.e., about 2.5 times the conservation requirement. Returns of small salmon will be without a hatchery component (about 25% of the summer fish). Mean returns of hatchery and wild small salmon over the last four years have averaged 1,300 fish; removals have averaged less than 400 fish.

Management considerations: Returns of small and large salmon should exceed conservation requirements. The delay of harvest fisheries until fall would maximize recreational hook-and-release opportunities in the summer and possibly assist in the preservation of an as yet unidentified summer-run genetic component in the Margaree population.

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

Year	1991	1992	1993	1994	1995	1996	MIN[1]	MAX[1]	MEAN[1]
First Peoples' harvest (small + large)									
In-river	0	38	0	15	0	0	0	38	11
Estuarial[2]	127	75	40	0	8	20	0	127	50
Angling catch									
Small (retained)	27(18)	11(8)	30(25)	24	37	61	11	37	26
Large	186	30	48	166	51	152	30	186	96
Swim-through counts									
Small	18	56	2	35	23	75	2	56	27
Large	254	212	32	324	160	284	32	324	196
Total returns[3,4]									
Small + Large	518	532	144	470	379	599	144	532	409
Proportion of holding area covered in swim-through counts									
	1.00	0.96	0.55	0.83	0.83	0.83	0.55	1.00	0.83
Estimated escapement									
Large	408	355	93	415	324	458	93	415	319
Total	437	449	99	460	371	579	99	460	363
% of adults required	79	82	18	84	67	105	18	84	66
Juveniles 100 m^{-2} (mean: 2 mainstem sites):									
Fry					108.9	30.8			
Parr					34.3	45.1			

[1]Min, Max and Mean are for 1991-1995.
[2]50% of the Wagmatcook FN harvest assumed to be of Middle River origin; all of 1996 assumed to be of Middle R. origin.
[3]Swim-through counts divided by proportion area covered, 1991-1993; mark-and-recapture modal values (no tag loss) 1994-1996, taken as 100% of area.
[4]Values, 1991-1993, now raised by mean swim-thru count efficiency of 0.622 in 1994-1996.

Harvests: Harvests of Middle River salmon were restricted to an assumed 20 salmon taken by Wagmatcook First Nation. The recreational fishery was confined to hook-and-release.

Data and Methodology: Counts of tagged and untagged adult salmon were conducted on October 22, 1996, by teams of divers floating 83% of the river's salmon holding areas (tags had been applied to 16 fish on Oct 18 and 19). 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 4 sites; two on the mainstem and two on tributaries.

State of the Stock: Total returns were estimated at 599 fish. The escapement was an estimated 458 large salmon - 97% of requirement. Age 0^+ (fry) and age 1^+ and 2^+ (parr) densities at 2 mainstem sites approximate an Elson "normal" abundance index and are consistent with suggestions that conservation requirements have been approached in the last few years.

Forecast for 1997: Data are inadequate for predictive models with which to forecast returns in 1997. However, insights to "normal" and "above normal" juvenile densities in the last few years, prospects of improving marine survival and evidence in 1996 that conservation requirements have been met are suggestive of conservation requirements (perhaps with small surpluses) being met through the remainder of the decade, i.e., 500-600 fish.

Management considerations:. The probability of surpluses accompanying requirements were approximated from the estimated in-river population in the fall of 1996, i.e., the most probable (50%- risk neutral) estimate was 579 fish; there was also a 40% probability that the population was 720 fish i.e., with a 10% greater uncertainty, there was a surplus of 140 fish.

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

Year	1991[1]	1992	1993	1994	1995	1996	MIN[2]	MAX[2]	MEAN[2]
First Peoples' harvest									
In-river	39	0	0	0	-	0	-	-	-
Estuarial	0	0	0	0	-	0	-	-	-
Angling catch (total river)									
Small	115	139	113	81	-	83	-	-	-
Large	15	46	22	10	-	26	-	-	-
% Caught and retained									
above the fishway	31	31	31	0	-	0	-	–	-
Broodstock[3]	19	10	0	7	0	0	0	19	7
Count at fishway									
Small	234	114	91	64	157	200	64	234	132
Large	18	18	5	5	8	5	5	18	11
% Hatchery	45	38	45	14	32	61	14	45	35
Fish which by-pass the fishway									
Small	176	40	32	130	105	133	32	176	97
Large	14	14	4	9	11	7	4	14	10
Population estimate above the fishway									
Small + Large	442	186	132	208	281	345	132	442	250
Estimated escapement above the fishway									
Small + Large	348	133	97	201	281	345	97	348	212
% of fish required									
above fishway	149	57	41	86	120	147	41	149	91
Juveniles 100 m^{-2} (sites 1-4)									
Fry					7.5	14.2			
Parr					7.7	2.9			

[1] Inseason variation closures.
[2] Min, Max and Mean are for 1991-1995.
[3] Broodstock collected at or above fishway.

Harvests: River open only to hook-and-release fishing.

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.

State of the stock: Conservation requirements were estimated to have been met in 1996 but only because of the contribution by hatchery fish. Wild returns were the third lowest of a 9-year record. Hatchery fish comprised 61% of returns, double their contribution in 1995. Juvenile densities were low (14.2 and 2.9 age 0^+ and age-1^+ and 2^+ parr $100m^{-2}$, respectively) relative to rivers of Cape Breton Highlands. Age 0^+ densities doubled over those of 1995, perhaps in response to increased escapements in 1995.

Forecast for 1997: There is no precedent for forecasting returns to the Grand River. However, estimated returns, 1988 to 1995, appear to have "bottomed-out" in 1993-1994. Significant returns from hatchery products have contributed to recent attainment of conservation requirements. Given that marine survival could be improving, at least for distant migrating stocks, and that stocking of 18,270 hatchery smolts occurred in 1996, returns in 1997 should again exceed conservation requirements for the area above the Falls. Without an improvement in marine survival, the long range prognosis is less optimistic. Hatchery-source returns will be finished in 1998 and current low densities of juveniles appear distant with respect to concept of a "normal" abundance.

Management considerations: Small salmon of hatchery origin should again contribute to a surplus on the Grand River - possibly 100 fish. However the wild component is below requirement and current low densities of juveniles are less than current concept of "normal" abundance. Without improved marine survival the long range prognosis is not optimistic.

INTRODUCTION

This document is background to the management of Atlantic salmon (*Salmo salar*) stocks of the **Margaree, Middle, Baddeck, North,** and **Grand** rivers of Cape Breton Island, Nova Scotia (Fig. 1). Although they are but five of the Island's 33 rivers known to support recreational angling for salmon (inc. those of Cape Breton Highlands National Park), they account for 93% of the estimated fishing effort for salmon on Cape Breton. Assessments of these stocks in 1995 were reported by Marshall et al. (MS 1996).

The main elements of this document are the assessment of the numbers of salmon that returned and spawned in 1996, an evaluation of the numbers of spawners relative to conservation requirements and, where possible, a prognosis of returns in 1997. Returns are assessed using mark-and-recapture techniques on the Margaree, Middle, Baddeck and North rivers and counts at a fishway on the Grand River. Returns minus removals equal escapement, and escapements are evaluated against spawning requirements.

Procedures and activities in 1996 were essentially the same as in 1995. Unlike 1995, no data were available for assessment of returns and escapement to the Sydney River. New in 1996 are assessments of juvenile salmon on the Baddeck, North, Sydney, Gaspereau and Tillard rivers. Progress on the requested re-evaluation of target spawning requirements on the Middle River has been slow.

A final report has yet to be received from the Gene Probe Lab, Dalhousie University, on the possible impacts of stocking hatchery-reared smolts of Grand River parentage on wild Grand River salmon. A preliminary report (Dodson and Colombani MS 1996) at Laval University indicated that no differences were detectable between tissue samples of Margaree early- and late-run salmon provided in 1995.

In 1995, spawning escapements for the Middle, Baddeck and Sydney rivers were less than the requirement. In the Margaree and North and Grand rivers, escapements exceeded requirements. Forecasts for 1996 were that returns would be similar to those of 1995 (managers were cautioned that 1SW returns to the Margaree might not meet conservation requirements). Meetings with fishery managers and First Peoples resulted in: i) allocations of salmon from the Margaree River, North River and Bras d'Or to First Peoples; ii) a hook-and-release (only) recreational fishery through August 31 on the Margaree and a "retention" fishery for small salmon or grilse (<63cm) captured September 1- October 31; and iii) hook-and-release only recreational fishery for salmon on all remaining rivers of the Island except Mabou/Mull and Judique (true also for rivers of Cape Breton Highlands National Park although regulated by Parks Canada). Food fisheries by First Peoples in bays and channels of Bras d'Or were directed at aquaculture and sea-ranched 1SW salmon.

Description of the Fisheries

Aboriginal Fisheries

The fishing of salmon with trapnets was licensed 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 were targeted on returns from sea ranching experiments, 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 1,150 small and 675 large salmon. One hundred small and 75 large salmon were allocated from the North River and 100 small and 600 large salmon were allocated from fall returns to the Margaree. Ten tags for either small or large salmon were allocated to 204 members of the Native Council of Nova Scotia (182 residing in SFA 18 inc. mainland NS and 22 residing in SFA 19, eastern Cape Breton Island; Table 1). Co-Management Agreements between DFO and First Peoples indicate that First Peoples are to report their catch and the number of participants.

Commercial

The commercial salmon fishery, shortened in 1983 and closed in 1984, remained closed in 1996. 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 most of the Island's rivers is now June 1 to October 31 (Table 2). Retention of salmon ($\geq$ 63cm) and grilse (< 63cm) was varied to 0 fish in all open rivers except the Margaree (September 1- October 31 only), Mabou/Mull 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. MS 1991).

Fishery Data

Aboriginal Harvests

Despite significant allocations of salmon to First Peoples of Cape Breton Island, only 214 "salmon" have been recorded as harvested by First Peoples. Neither the Netukulimkewe'l Commission nor four of five First Nations (FNs) had reported 1996 year-end catches at the time of writing (February 2, 1997). Indications are that I) Chapel Island FN did not fish for salmon; ii) Eskasoni FN harvested some 15 fish from rivers (Margaree, North, Benacadie, Gillis Br.) and 23 from Bras d'Or; iii) Waycobah FN took an estimated 20 fish (5 small and 15 large salmon) from the Skye River and 50 large fish (40 escapees and 10 wild) from Whycocomagh Bay; iv) Wagmatcook FN took some 20 or more fish from the approaches to the Middle River; and v) Membertou FN netted 81 large and 5 small fish from pools on the Margaree and an unknown number from the Sydney River.

In 1995, the total harvest was estimated at 212 salmon (Marshall et al. MS 1996). The principle difference between years was the decrease in aquaculture escapees captured in Wycocomagh Bay and the increased fall netting on the Margaree River.

Poaching

Estimated losses to poaching in Cape Breton are incomplete but can easily be extrapolated to exceed aboriginal harvests. Estimated removals from Richmond County waters were 4 large and 32 small salmon. Losses on the Margaree were conservatively estimated at 100 fish; losses from the Mabou/Mull and Judique Interval rivers have been suggested to be about 100 salmon.

Recreational Catches

In 1996, an estimated 10,777 rod days were spent on the Island's rivers (Table 2). Estimated catches (including releases) were 1,458 small and 2,445 large salmon. Only 275 small salmon

were reported being retained. Compared to 1995, the estimated effort was down 23%; estimated catches of small salmon were up 124% and estimated catches of large salmon were up 63% (Table 3). Compared to the 1991-95 mean values, effort was down 43%, small catch was up 37% and the large salmon catch was up 9%. Recreational effort had already 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). Effort, as estimated from NS Salmon Angling Licence stub returns, is now the lowest of record. It is purported that more salmon anglers, who only hook-and-release their catch, buy only a Nova Scotia General Fishing License and forego tags for retained salmon and the opportunity to input to salmon angling statistics as required by the Salmon Angling License.

Of the five rivers assessed in 1996, angling effort increased over that of 1995 on all but the Margaree; catch and catch-per-unit effort increased over 1995 on all but the North River (Table 4).

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 August 31) and fall-run components. The summer and usually the minor 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 (e.g., Chaput et al. MS 1994; Claytor et al. MS 1995 and Marshall et al. MS 1996). 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 (excepting 1991 when recreational catch and exploitation rates were use), 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 1992, estimates of returns were based on tags placed on summer- and fall-run fish captured in estuarial trapnets and recovered by anglers who volunteered to maintain a log of their entire fishing activity on the Margaree, or 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 3,200 to 4,400 fish, but more realistically, would range between 2,400 and 2,900 large salmon, i.e., egg depositions would be at least twice conservation requirements.

Estimation of Returns

Mark-and-recapture experiments in 1996 provided data for estimation of in-river populations on August 1, November 1, October 31 and November 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. Thirteen of the wild and 6 of the hatchery MSW salmon were also tagged with a large bright yellow Carlin tag (monofilament tie) for ready identification of fish that had been implanted with ultrasonic tags (ref. Appendix). 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 trapnet has been the principle index for tagging fish and providing in-season information on returns to the river (Claytor et al. MS 1995). It is located about 0.5 km above the East Margaree Bridge, 7 km above the Margaree breakwater where it has been fished, in the same location, since 1991. The water level at the trap is subject to tidal fluctuations and occasional salt water incursion. A description of the trap is provided in Marshall et al. (MS 1996). The trap is fished daily - on the first slack tide (either high or low) of daylight.

Orange streamer tags of 9.5 cm length were also affixed through the dorsal fin of small and large salmon captured by seining/tangle netting in the Hatchery, Swimming Hole, Little McDaniel, Twin Elm, Etheridge, Upper and Lower Cemetery and Sky Lodge pools on July 30 and 31 (seine plus 3 1/4-3 1/2 inch mesh multi- and mono- filament nets). A swim-thru count, on August 1, tallied salmon bearing streamer tags and those without tags. Total tagged salmon were used in the estimation procedure on the premise that fish retained their tags (Marshall et al. MS 1996) between tagging and swim-thru events.

Recaptures

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

August 1 (swim-thru): A count and mark-and-recapture estimate of the salmon population in the river was based on a swim-thru count of streamer-tagged and untagged (but included Carlin-tagged) 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 Tidal Pool (Fig. 2; Table 5). The design of the swim-thru was similar to that conducted in previous years, a person familiar with the lies of a salmon in that section led each of the four teams. Counts, as on all swim-thrus, are those of a team consensus.

October 31/November 1 (fall netting): On October 31 and November 1, live capture and sampling of salmon for Carlin tags and tagging scars was facilitated by tangle netting (mostly 6" mesh) at Hatchery Pool (sec G; Table 5), Lower Cemetery (sec I), Red Bank (sec G), Mad Brook (sec E), John Doyle (sec D), and Doyles Bridge (sec D) pools on the Northeast and John Archie and McDonnell pools on the Southwest Margaree.

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 38 previous-year participants and 64 potentially new participants selected from among the more successful Margaree anglers who submitted stubs from their 1995 Nova Scotia Salmon Licence. All had received their logbooks prior to the beginning of the angling season. Logbooks used in the analyses were the

sum, through January 24, of volunteer submissions and those that may have resulted from a reminder letter sent out November 14.

For population estimates based on logbooks, Carlin tags applied at Levi's trap **(M)** were reduced by the number estimated to have been shed by the fish. Unlike other tag recovery sampling techniques, anglers could not be expected to identify tag scars (tag loss). Thus, to account for tag loss among fish recorded in logbooks by anglers, tags-at-large were reduced 0.01 per day (Chaput et al. MS 1994) for the median number of days to recapture for all tags returned by recreational fishers.

November 26 (Lake O'Law trap): The Lake O'Law fence and trap (Fig. 2) operated September 14 - November 26, 1996, 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. MS 1995).

Estimation procedures

Returns of large salmon were estimated using Petersen mark-and-recapture principles described by Chaput et al. (MS 1994) and a Bayesian estimation procedure (Gazey and Staley 1986). The Bayes approach describes the most probable estimate (mode) 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 1996 (necessary only for the logbook estimate) is the average of rates determined for captive salmon in 1992 and 1993 (Chaput et al. MS 1994). Estimates of small salmon were based either on independent tagging data (logbooks and Lake O'Law) or the mark-and-recapture estimate of large salmon and the proportion of small and large salmon at Levi's trap.

Estimates of Returns

Total catch of salmon at Levi's trap in 1996 was 790 fish. The catch consisted of 300 small and 490 large salmon (Table 6; Fig. 3). An estimated 487 large and 300 small salmon were available to later recapture. Levi's was fished June 10 to October 24 - there were 8 days when the trap could not be fished: July 5-6, September 16 and 25, and October 1-2,10, and 14. The total catch was the highest since full-season operations began in 1992 (Table 6; Fig. 3).

The proportions small:large salmon for the entire catch at Levi's was 0.38:0.62. Summer- and fall-run small:large components were (0.44:0.56) and (0.32:0.68), respectively. The percentages of small salmon in the entire catch, 1992-1996, were 21%, 39%, 19%, 24% and 38%, respectively. Sixty-two percent of all small salmon and 49% of large salmon were captured before September 1 (Table 7). Hatchery-origin small salmon were 22% and 3% of the summer- and fall-run fish, respectively (Table 8). Hatchery-origin large salmon were 8% of the summer and 4% of the fall components.

Summer (August 1)

Seining and tangle net operations resulted in the capture and tagging with orange streamers, of 67 large and 27 small salmon (61 fish at Hatchery and Forks pools on July 30; 17 fish at Swimming Hole, Little McDaniel, Twin Elm and Etheridge pools; and 16 fish at Upper and Lower Cemetery, Skye and Lodge pools on July 31). Only three of the fish were identified as having been among 122 small and 303 large salmon handled at Levi's up to July 29. Conditions for the capture and tagging of salmon in 1996 were better for salmon than they were in 1995. Water temperatures at the time of seining ranged between 11.5 C and 16.5 C; river discharge was 11.7 and 10.3 $m^3 s^{-1}$.

Discharge on August 1 had subsided to 9.5 $m^3 s^{-1}$ (Fig. 3) and visibility was good. Discharge during the 1995 swim-thru was only 4 $m^3 s^{-1}$; water temperatures were in the 18 - 21 C range.

Swim-thru counts totalled 842 fish; large and small categories were not always recorded (Table 9). Tag "recoveries" numbered 47 of 94 streamers applied. Streamer tags were better distributed in 1996 than in 1995, perhaps because of a combination of lower water temperatures (Fig. 4), higher discharge and an additional 24-hour interim period for many fish to recover after handling. Counts and estimates (Fig. 5) are summarized as follows:

Method and size class		Marks	Recaps	Captures	Est.	90% CL
Streamer:	**Total**	94	47	889	**1,775**	1,452-2,337
prop [0.431 @ Levi's]	**Small**				**765**	
prop [0.569 @ Levi's]	**Large**				**1,110**	

Fall: angler logbooks (Oct 31); fall netting (Nov 1) and Lake O'Law Fence (Nov 26)

Mark-and-recapture estimates of large salmon by each of the three basic methods range from 2,238 to 6,976 fish; total returns estimated by the proportion of small and large salmon captured at Levi's range from 3,608 to 11,247 fish (Table 10; Fig. 6). The logbook estimate of large salmon was, as in 1995, the least robust of the methods and appeared to be excessive with respect to estimates from fall netting and the Lake O'Law trap. The median number of days to recapture for 40 and 48 tags returned by fishers from large and small salmon was 17.5 and 22.5 days, respectively, i.e., tags available for recapture were reduced by 17.5% and 22.5%, respectively.

Unlike 1995, summer-tagged large fish comprised 2 of 7 fish recovered at the Lake O'Law fence and 5 of 14 still-tagged fish taken in the fall netting operations. The inclusion of summer and fall components in the latter operations suggested the possibility, unlike in 1995, that the Lake O'Law population could be representative of the entire population. The cool water temperatures and moderate discharges accompanied by a steady run of fish at Levi's trap suggested that few fish remained to enter the Margaree after the Levi's trap was removed and that the fall netting estimate would include all of the fall run.

The selection of appropriate estimates was based on a review of all data, and robustness of the estimates. Chi-square analyses of the proportion recaptures among captures suggested that fall netting and fence data for large salmon were combinable; the logbook data were different. The combined fence and fall netting data provided the largest number of large salmon recaptures and an estimate of 2,792 large salmon (2,214 - 4,050; Table 10; method 4). An estimate of large and small salmon from the Lake O'Law fence data was 5,274 (4,096 - 8,162; Table 10; method 5) but with wide confidence limits (Fig. 6). An estimate of small salmon alone from the Lake O'Law data was 1,685 (1,277-2,960) fish, virtually the same as that derived from the fall netting + Lake O'Law large salmon data and the proportion large and small at Levi's trap (Table 10). Confidence intervals were relatively tight (Fig. 6). Because tag loss was not an issue in the estimate based on Lake O'Law data (all fish were examined for auxiliary mark or tagging scar; angler logbook data required the estimation of tag loss), the Lake O'Law estimate of small salmon was favoured over the estimate of 2,473 small salmon from logbook data (Table 10; method 7). Estimates of returns in 1996 were selected as **2,792 large** (Lake O'Law + fall netting) and **1,685 small** (Lake O'Law) salmon; a **total of 4,477** fish. Counts of salmon at Lake O'Law, in fall netting and reported in logbooks as well as the numbers of tags from which estimates have been developed, 1992-1996, appear in Tables 11 and 12.

Total large returns were up over the estimate for 1995 and about the same as those of 1994; small returns are more than double those estimated for 1994-1995 and comparable to those estimates, 1990-1993 (Table 13). Large returns are within the 2,400 - 2,900 range of large salmon returns projected for 1996; small salmon returns are more than twice the projected number.

Estimates of greater returns in 1996 than in 1995 are consistent with increased catches estimated from Licence stub returns (Table 4), summarized from logbooks (Table 14) and counts at Levi's and the Lake O'Law traps and netting operations. The contribution of small wild fish to small salmon catch in the summer (logbooks) ddecreased from 83% in 1995 to 76% in 1996. However the season-average of 78% was similar to that of 1995 (Table 15). A 91% contribution by large salmon of wild origin to the total fishery was similar to that of the last number of years.

Angling statistics (Tables 2, 3 and 4) and total returns indicate an overall exploitation rate of 0.61 (1,710/2,792) for large salmon in 1996. This is the mid-point of 0.41 and 0.80 values estimated for scenarios of all and a portion of the estimated returns being available to angling in 1995. The catch rate for small salmon was 0.57 (964/1,685). Returns by anglers of tags from only 40 of 402 large and 48 of 300 small salmon estimated to have retained their tags would suggest either low reporting, low tag retention or decreased vulnerability of tagged fish to angling and/ or tag retention rates. The reliability of catches compiled by DFO Fisheries Officers, 1947-1995, and previously tabled with licence stub return data (Table 13 of Marshall et al. MS 1996) has diminished in conjunction with decreasing person power dedicated to the river.

Annual efficiencies of the Levi's trap in catching large salmon, 1992-1996 (Table 16), center on values of about 16%. The independent estimate of small returns from the Lake O'Law fence suggests a similar efficiency for capture of small and large salmon.

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 of Claytor et al. MS 1995). The product of egg deposition rate and rearing units equated to an egg requirement of 6.7 million eggs. Spawners to provide those eggs were based on biological characteristics from the 1970s, with all eggs expected to be derived from large salmon and small salmon to provide a 1:1 male:female ratio among large salmon. Eggs per female were based on a value of 1,764 eggs kg^{-1} fish weight (Elson 1975). The requirement is 582 small and 1,036 large salmon (Table 7 of Claytor et al. MS op cit).

Biological characteristics, 1992-1996 (Table 17), indicate that MSW salmon are 74% female (unchanged from the 1970's); small salmon currently average 7% female - down marginally from the previous 11% value. Tabling of new conservation requirements awaits new orthophoto estimates of juvenile production area and, in the absence of measured weights, consideration of length-fecundity relationships for a number of regional salmon stocks.

The proposed conservation requirement for summer fish (river entrants prior to July 15; Claytor et al. MS 1995) is 136 small and 242 large salmon. The requirement was based on the premise that early-run salmon were the principle occupants of tributaries and mainstem above Big Interval (the Sanctuary) or about 23% of the rearing area and conservation requirements for the entire Margaree River. In 1996, a July of high river discharge and cool water temperatures, 14% of "summer" salmon counted on August 2 (28% in 1995) were in the Sanctuary (Table 9); none of 19

ultrasonically tagged fish accessed the Sanctuary before September 20 (Appendix). Only 4 of 11 fish being tracked prior to the cessation of operations on November 5 ascended to the Sanctuary.

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 and estimated losses to spawning on the Margaree in 1996 totaled 213 large and 342 small salmon. Losses included harvests by First Peoples and recreational fishers, a broodstock collection and fish used in experiments at the Margaree Hatchery or known to have died during Science Branch operations. Losses to hook-and-release mortality were assumed to be 0.05 of 1,710 large and 700 small salmon, i.e., 85 large and 35 small fish.

Over the total run, escapement of small and large salmon exceeded conservation requirements of 582 and 1,036 fish; respectively (Table 13). Escapements of large salmon, 1985-1994, have ranged from 1,378 to 6,222 fish; escapements of small salmon over the same period have ranged from 328 to 1,504 fish (Table 13). Large salmon escapements have been met in each of the last 11 years; small salmon spawning escapements have been met in 6 of the last 11 years (Table 13).

Summer-run fish in the river on August 1 were estimated at 1,110 large and 765 small salmon - approximately the conservation requirement for summer **and** fall components. The quotient of trap counts at Levi's to July 28 and an overall estimated trap efficiency for large fish of 0.176 (Table 16), would suggest that 1,341 (236/0.176) large and 1,017 (179/0.176) small salmon were in the river **and** estuary.

Egg depositions

Estimated egg depositions in 1996 numbered 15.6 million, 232% of the target of 6.7 million eggs (Table 18). Depositions in 1996 were about 120% of those for 1995 and about 85% of those estimated for 1993 and 1994. Wild large salmon contributed 95% of the total eggs just as they have since 1992 (Table 18).

Abundance of Juvenile Salmon

Estimation of juvenile densities continued at 4 tributary sites and the mainstem 'Old Bridge' site on the main Northeast. Sampling consisted of 3- or 4-sweep removal estimates in barriered sections. Population estimates were derived by exact solution for 4 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 MS 1995).

Fry (age 0^+) densities of 28-149 fish $100m^{-2}$ were down, on average, from those of 1995; parr densities (age 1^+ and 2^+) of 31-111 fish $100m^{-2}$ were, on average, similar to those of 1995 (Table 19). Recent abundances of fry and parr are two to three times the densities in the mid-1970s (Chaput and Claytor MS 1989 and Fig. 7). Fry and parr densities (wild fish only $100m^{-2}$) of 123 fry and 86 parr at the "Old Bridge" site were similar to those of 1995 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, 1970s and 1986 but not those of the 1960s (Chaput and Claytor op cit). A "normal" abundance (Elson 1967) for 129 unsprayed sites on New Brunswick rivers (mostly the Miramichi) in the 1950s was 29 fry (age 0^+) and 38 small and large parr (age 1^+ and 2^+) $100m^{-2}$.

Forecasts

Stock-recruitment relationships have been the basis of previous pre-season prognoses 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 (MS 1992) and are carried forward from Claytor et al. (MS 1995).

Stock-recruitment relationships were examined using four models, Tabular, Ricker, Beverton-Holt, and the Mean (Claytor et al. MS 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 the Microsoft EXCEL solver function (Claytor et al. MS 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 EXCEL (1993) solver function (Claytor et al. MS 1995).

Forecasts of returns in 1997 from an estimated 6,222 MSW spawners range from 1,656 (Ricker 1975) to 4,160 large salmon (Tables 21 and 22; Fig. 8) i.e., returns will meet/exceed the 1,036 large salmon conservation requirement. High juvenile densities over the past few years are not consistent with the degree of density-dependence implied by the Ricker model. Values from the Beverton-Holt and Tabular methods indicate a strong showing by the 1995 smolt class, a possible upturn in survival (see index of marine habitat in "Ecological Considerations") and support a prognosis for large salmon returns in 1997 to be at least equal to if not greater than the estimate of 2,800 in 1996 (also the mean of the last 4 years), i.e., approaching three times the conservation requirement.

Returns of small salmon have been variable in the last 5 years. High juvenile densities in 1994-1995, and a strong return of the 1995 smolt class provide optimism that small salmon returns should, without hatchery stocking (Table 23), exceed the requirement. Returns over the last 5 years have ranged from 708 to 2,087 fish; the mean number is 1,372 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 or exceeded through the end of the decade - especially if marine survival improves.

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 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; gradient and implied production profile with respect to neighbouring rivers are tabled in Marshall et al. MS 1996. In recent times, the summer component has all but disappeared. An effort to redevelop the run with summer-run stock (Table 23) 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 (Marshall et al. MS 1996; Amiro and Longard MS 1995). Spawning escapement in 1995 was estimated to have been 67% of conservation requirement, although there was concern that the complete run may not have entered the river by the October 18 survey date. The prognosis for 1996 was that returns should not be expected to exceed those of 1995. Densities of juvenile salmon were extensively examined in the late 1950s and 1960s; the most recent efforts were in 1977, 1978, 1985, 1994 and 1995 (Amiro and Longard MS 1995; Marshall et al. MS 1996).

Swim-thru counts of small and large salmon have been conducted in mid- to late-October, by teams of two divers assigned to most of six sections (Fig. 9). Mark-and-recapture estimates began in 1994; streamer tags were applied to fish netted the day previous to the swim-thru. A Bayesian estimator has been used to derive an estimate of the probable populations (Marshall et al. MS 1996; Amiro and Longard MS 1995). Adult and juvenile assessments were again conducted in 1996.

Estimation of Returns

A mark-and-recapture experiment provided data for estimation of the population on October 22, 1996. Marks, orange streamer tags, were applied to salmon captured by drift-netting (mono- and multi-filament 3.5 inch stretched mesh) at 3 locations on the mainstem (Hgwy 19, Two Churches and MacLeods Bk) on October 18 and 19. 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 main up-river holding pools below the Gold brooks, Section 1 (Fig. 9). The total number of small and large fish in the river was estimated using mark-and-recapture techniques and estimation procedures used for the derivation of returns to the Margaree; no tags were considered to have been lost. The count data was used to apportion the estimate into small and large components.

Estimates of Returns

Despite good weather, moderate flows and reasonable visibility, 1.25 days of seining yielded only 5 small and 11 large salmon for tagging (4 more than in 1995). The swim-thru on October 22, under bright sky and reasonably good water of moderate flow (more than in 1995), produced a total count of 359 fish (75 small and 284 large) of which 1 small and 9 large fish were tagged. Results are summarized as follows:

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5&6	Total
No. tagged **(M)**	4	0	7	5	0	16
Obsv. tagged **(R)**	0	2	1	6	1	10
Obsv. no-tag	22	81	94	121	31	349

Numbers large:small, 284:75; **M**=16; **C**=359; **R**=10.

The most probable estimate of total salmon in the Middle River on October 22 was **579** fish (Fig. 10; 90% CL 392-1,202). Proportioning of the estimate on the basis of the small and large salmon count suggests a population comprised of 458 large and 121 small salmon (no adjustment upwards for hook-and-release mortality prior to the census). There was one fish of aquaculture origin observed during the swim-thru. Guesstimated removals by Wagmatcook First Nation, of 15 large and 5 small salmon in the approaches to Middle River, suggest a total return of **473 large** and **126 small** salmon.

A total return of 599 fish is the highest since 1991 (Summary Sheet; total returns prior to 1994 have been adjusted upwards by the 1994-1996 average swim-thru count efficiency of 0.622). A return of 473 salmon is a 44% increase over that of 1995 and also the highest estimate of the 1990s. Estimated catches (no retention) by anglers fishing to the October 31 closing date were 152 large (Table 4), i.e., a 0.33 exploitation rate and 61 small, a 0.50 exploitation rate. Catches of both small and large salmon were up considerably over those of 1995 and about the same as those estimated in 1994 (Table 4).

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

Assuming that the modal estimate of in-river population is the escapement, **458** large salmon is **97%** of requirement and the highest estimate of escapement by large fish since 1990 (Fig. 11; escapements 1993 and prior also adjusted upwards by 3-year swim-thru count efficiency of 0.622). An escapement of **121** small salmon was **151%** of conservation requirements. Unlike 1995, moderate to high discharges in July and September of 1996 should have contributed to most fish being in the river at the time of the census. Scouring of redds was prominent in several locations on the October 22 census date. Biological information is again inadequate to estimate the attainment of conservation requirements with respect to egg depositions.

Abundance of Juvenile Salmon

Electrofishing of juvenile salmon was conducted at four sites in 1996, one more than in 1995. 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.

MacKenzie Brook was the only site repeated from 1995; densities of 171 age 0^+ parr and 65 age 1^+ and 2^+ parr $100m^{-2}$ in 1996 were virtually unchanged from those of 1995 (Table 24). New sites (but done in earlier years) included Two Churches and Finlayson on the main stem and MacLeods Brook. Age 0^+ and age$1^+$and 2^+ parr densities at Finlayson exceeded the Elson (1967) "normal index of abundance" (Fig. 12) and suggest that recent spawning escapements may be the equal of many of the last 40 years. Juvenile densities, 1995 and 1996, and an Elson (1967) "normal" index appear consistent with both the estimated conservation requirement and proximity of recent estimated escapements to that requirement. By comparison, higher densities at the Old Bridge site on the Margaree (Table 19) are indicative of the potential carrying capacity when conservation requirements, as currently estimated for the Margaree, are exceeded.

Forecast

Adult data are inadequate for predictive models with which to forecast returns in 1997. However, insights to "normal" and "above normal" juvenile densities in the last few years, prospects of improving marine survival (see index of marine habitat in "Ecological Considerations") and evidence in 1996 that conservation requirements have been met are suggestive of conservation requirements (perhaps with small surpluses) being met through the remainder of the decade, i.e., 500-600 fish. The probability of surpluses accompanying requirements can be approximated from the estimated in-river population in the fall of 1996, i.e., the most probable (50%- risk neutral) estimate was 579 fish; there was also a 40% probability that the population was 720 fish, i.e., with only a 10% greater uncertainty, there was a surplus of 140 fish.

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 1,350 ft 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 < 4 km east of the confluence of Middle River and Nyanza Bay. The gradient profile of the Baddeck River accessible to salmon is, on average, steeper and potentially of greater potential for production of juvenile salmon per unit area than that of the Middle River (Marshall et al. MS 1996). The stock has been, at least in recent times, principally of fall-run characteristics. There has been no recent effort to supplement the stock with hatchery-origin fish.

Fall counts of adult salmon began in 1994 (Amiro and Longard MS 1995). Mark-and-recapture estimates indicated that 48% and 68% of the conservation requirements had been met in 1994 and 1995, respectively. The prognosis for 1996 was that returns might be similar if not less than those of 1995.

Densities of juvenile salmon were examined in 1977, 1978, and 1994. Estimates of age 0^+, $1^+$and 2^+ juvenile salmon (total) at four of six sites in 1994 were greater than densities in 1977 and 1978 (Amiro and Longard MS 1995). Adult and juvenile assessments were made in 1996.

Estimation of Returns

A mark-and-recapture experiment provided data for estimation of the population on October 21, 1996. Marks, orange streamer tags, were applied to salmon captured by drift-netting (mono/multi-filament 3.25 - 3.5 inch stretched mesh) at 6 locations on the North Branch and mainstem on October 20. Marked and unmarked small and large salmon 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 an extended Section 5 (Fig. 13). The total number of fish in the river was estimated from mark-and-recapture data and Bayesian estimation procedures derived by Gazey and Staley (1986) to describe the modal value. The count data was used to apportion the estimate into small and large components.

Estimates of Returns

Salmon were netted and tagged at 6 locations on October 20; Glenhaven at the top of Section 1; two sites at the upper boundary of Section 3; a site at McPhee's at the upper end of Section 2; a site near the confluence of Peter's Brook in lower Section 4; and at Red Bridge on the upper boundary of Section 5. Fourteen large and three small salmon were tagged. The swim-thru, on October 21, with good visibility and moderate flows (higher than 1995) provided a total count of 214 fish of which 11 large and no small were tagged. Unlike 1995, no sighted fish had external characteristics suggestive of aquaculture origins. Results are summarized as follows:

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Total
No. tagged **(M)**	4	4	4	3	2	17
Obsv. tagged **(R)**	1	5	2	1	2	11
Obsv. no-tag	9	47	27	97	23	203

Numbers large:small:hatchery: 170:43:1; **M**=17; **C**=214; **R**=11.

The most probable number of total salmon in the Baddeck River, October 21, was **329** fish (Fig. 10; 90% CL 229-657). Returns could have been slightly greater but no losses were accorded to Aboriginal Peoples fishing Nyanza Bay or hook-and-release mortality in the recreational fishery. Proportioning of the in-river estimate on the basis of small and large salmon counts suggests a population comprised of **263** large and **66** small salmon. The estimated catch (no retention) by anglers fishing through October 31, (Tables 2, 3 and 4) was 48 small and 171 large salmon. The large salmon catch was the highest since that of 1991.

Conservation Requirements

Conservation requirements for the Baddeck River are based on a substrate area of 8,363 $*100m^2$ 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 MS 1995).

Escapement

An escapement of **329** salmon is **60%** of the 530 fish conservation requirement. Large salmon were about 58% of requirement. The 60% value is down 12% from that of 1995 when there was uncertainty as to whether or not all returning adults had entered the river at the time of the census. Fall (and summer) conditions were thought to have been ideal for entry of salmon prior to the census date in 1996.

The October 21 in-river population estimate is again a "most" probable value (Fig. 10). However, there is from the Bayesian estimator less than a 20% probability that the conservation requirement was achieved. Biological information is inadequate to estimate precise egg deposition.

Abundance of Juvenile Salmon

Electrofishing at 3 main river sites in 1996 (more comparable to tributary sites on the Middle and Margaree rivers) yielded average age 0^+ and age $1^+$and 2^+ densities of 63 and 36 fish $100m^{-2}$ respectively (Table 24). Age 1^+ and 2^+ densities approximate a "normal" abundance index; age-0^+ densities exceed those of the mainstem Middle River sites but are less than those of some tributary sites on the Middle and Margaree rivers. Cursory review suggests that 1996 densities also exceeded those of 1977-1978.

Forecast

There are no adult data from the Baddeck River with which to forecast returns in 1997. Conservation requirements for the Baddeck River, based on 3 years of fall adult census, have not been met. However, juvenile assessments and a normal abundance index (if equatable to conservation requirements) suggest that escapements may be adequate for conservation. Returns to adjacent Highland rivers appear to be improving and there is sign of an improvement in marine survival among large salmon (see "Ecological Considerations"). These elements suggest that returns in 1997 might be similar to those of 1996, i.e., 300 - 400 fish. However, based on 1996 estimates of returns, there is less probability of a surplus to requirements than on the Middle River.

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 and Margaree rivers (Fig. 1) and on the east, the Barachois River. The river arises at an elevation of 1,450 ft and travels some 30 km to St. Ann's Harbour. Gradients are steep with many small falls and several barriers to upstream fish passage; water quality is pristine (Amiro and Marshall MS 1990).

The substrate of the North River is calculated to have the most potential for production of juvenile salmon, per unit area, of the four rivers here-in evaluated by orthogradient measure (Marshall et al. MS 1996). The stock is known as early-run and principally composed of large (2SW) salmon; a late-run component has been suggested and is largely undocumented. Recent stocking with hatchery fish of North River origin began in the late 1980s and concluded in 1995 (Table 23).

Fall counts of adult salmon on the North River had been attempted since 1990 but were only completed since 1994. Fall estimates in 1994 and 1995 suggested escapements of 255% and 169% of the 230 fish conservation requirements (Marshall et al. MS 1996). Based on 1995 stock status, hatchery stocking and a stock-recruit relationship, similar or greater returns were forecast for 1996. An allocation of 175 fish was made to First Nations (Table 1); the recreational fishery remained hook-and-release only. Adult and juvenile assessments were conducted in 1996.

Estimation of Returns

An in-season mark-and-recapture experiment provided data for estimation of the population on July 18, 1996. Marks, orange streamer tags, were applied to salmon captured by drift-netting (monofilament 3.25 - 3.5 inch stretched mesh) at MacLean's, Black, Little Falls and MacKenzie pools (Fig. 14) on July 16 and 17. Marked and unmarked fish, small and large, were enumerated by three teams of divers floating Sections 1, 2, 4 and 5. Summer fish are thought to hold above the gorge (Section 3; Amiro and Marshall MS 1990).

An autumn mark-and-recapture experiment was conducted on October 23. Streamer tags were applied to fish captured at MacDonald's Pool at the boundary of Sections 4 and 5. Marked and unmarked fish, small, large and, with less certainty, hatchery were enumerated by three teams of divers floating Sections 1, 2, 4 and 5 (Fig. 14). Salmon are not known to hold in the gorge area (Section 3) and diver observation is impossible.

The total number of fish in the river on July 18 and Oct 23 was estimated using mark-and-recapture techniques and Bayesian estimation procedures derived by Gazey and Staley (1986) to describe the most probable (modal) estimate; there was assumed to be no tag loss. The count data was used to apportion the estimate into small and large components.

Estimates of Returns

July

Six large and 7 small salmon were netted and tagged at MacLean's, Black, Little Falls and MacKenzie pools on July 16 and 17. The swim-thru, on July 18, under reasonably clear and moderate discharges yielded a total count (team consensus) of 143 fish of which 2 large and 6 small were tagged. Results are summarized as follows:

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Total
No. tagged **(M)**	-	2	-	11	-	13
Obsv. tagged **(R)**	0	1	-	6	1	8
Obsv. no-tag	3	32	-	61	39	135

Numbers large:small; 56:87; **M**=13; **C**=143; **R**=8.

The most probable number of total salmon in the North River on July 18, was **234** fish (90% CL 153 - 552; Fig. 5). Proportioning of the estimate on the basis of small and large salmon count suggested a July 18 population comprised of **92** large and **142** small salmon. Fifty-four percent (77 fish) of the small fish were of hatchery origin; 13% (12 fish) of the large fish were estimated to be hatchery origin (smolts released in 1994 and 1995 [Table 23] from fall collections of North River broodfish).

October

Three large and 11 small salmon were netted and tagged at MacDonalds Pool on October 22. The swim-thru, on October 23, under reasonably good visibility but high discharges yielded a total count of 322 fish of which 3 large and 5 small were tagged. Results are summarized as follows:

	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Total
No. tagged **(M)**	-	-	-	14	-	14
Obsv. tagged **(R)**	-	-	-	7	1	8
Obsv. no-tag	13	110	-	82	109	314

Numbers large:small:unclassified: 184:138:14; **M**=14; **C**=322; **R**=8.

The most probable number of salmon in North River on October 23, was **566** fish (90% CL 367-1,350; Fig. 10). Returns could have been slightly higher given the report of one salmon being taken by an Aboriginal person and the potential for a small loss to hook-and-release angling and unreported poaching. Proportioning of the estimate on the basis of small and large salmon counts suggests a fall population comprised of **243** small and **323** large salmon. High discharge and overcast conditions prevented recognition of all hatchery fish (adipose fin removed). However, at least 75% of small salmon in Sections 4 and 5 were estimated to be of hatchery origin, i.e., about 150 fish from 23,000 smolts released at MacDonald's Pool in 1995. Several large salmon were of hatchery origins but none were identified as being aquaculture escapees (adipose fins intact; deformed fins). Estimates of both large and small salmon in 1996 were 46% greater than the number in 1995.

The estimated catch by anglers (Table 4) of 110 large fish was one-half of that of 1995; the catch of 175 small salmon was the same as that of 1995. Catches and the fall in-river population suggest exploitation rates of 0.45 and 0.54 for large and small salmon, respectively.

Conservation Requirements

Conservation requirements for the North River are based on a substrate area of 3,559 *100m^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 MS 1990; Marshall et al. MS 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 September 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 September 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 October 23 were in Sections 4 and 5. Over 30% of the count was within 1 km of the estuary.

Escapement

An escapement of the **566** salmon estimated to be in the river on October 22 is **246%** of the 230 fish requirement. This value is up considerably over that of 1995 but only because of the small salmon component (bolstered by hatchery fish). Large salmon were only **122%** (243/200) of the requirement. Biological information is inadequate to estimate egg deposition and the proportion of egg requirement that was met.

Abundance of Juvenile Salmon

Juvenile densities were determined at only 2 sites on the lower mainstem. Densities of 22 age 0^+ and 22 age 1^+ and 2^+ parr were, on average, lower than those of the Middle and Baddeck rivers (Table 24). Age 0^+ densities were about the same as those in 1978; age 1^+ and 2^+ densities were double the 1978 values (Amiro and Marshall MS 1990). A site above the gorge in 1978 had much higher densities than the sites below.

Forecast

Using Bayesian techniques, Amiro and Harvie (MS 1996) investigated probabilities for potential returns of North River stock in 1994 and 1995 from a Ricker stock-and-recruit function. Spawners (Fig. 15) 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% CL) from an estimated 800 large salmon spawners in 1989. The October estimate of return in 1995 was about 260 wild fish - fewer than the forecast. The same model solved for an estimated 1,220 spawners in 1990 suggested returns of 253-553 fish (90% CL) in 1996 - we report a population of only about 240 wild large salmon. Solution for an estimated 710 spawners in 1991 yields a forecast return of 340 - 746 (90% CL) large fish in 1997, i.e., >99% probability that returns will exceed conservation requirements.

In the last 22 years, estimated large salmon returns to the North River have never knowingly been less than conservation requirements (Fig. 15). While the conservation requirements are likely to be met in 1997, a retrospective examination of the forecast model suggests a return which is at best equal to the lower 90% CL. i.e., 300 or fewer salmon. An improving marine survival will be needed just to attain such projections. In the absence of smolt stocking in 1996, returns of small salmon in 1997 should be considerably fewer than recent years. Small:large ratios in the recreational fishery, 1971-1978, when commercial fisheries selected mostly large fish, averaged 0.11: 0.89 but were found to be increasing in favour of small fish (Amiro and Marshall MS 1990). Thus, even if wild small:large ratios were 0.2: 0.8, small salmon accompanying a return of 300 large fish might only number 5 dozen fish.

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 MS 1990). Gradient of the Grand River and tributaries accessible to salmon are, on average, the least of all rivers assessed in this document (Marshall et al. MS 1996). 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 essentially repeat-spawning 1SW fish. Returns have declined in recent years despite significant hatchery supplementation with

Grand River stock (Table 23) and the elimination of south coast Newfoundland commercial fisheries.

Annual counts of adult salmon have been made at the Grand Falls fishway since 1988, (Amiro and Longard MS 1990; Marshall et al. MS 1996). In 1995 the spawning escapement was estimated to have been 120% of conservation requirement above Grand River Falls (Marshall et al. op cit) - up from the deficit to requirements reported for 1994 (Amiro and Longard MS 1995). A prognosis that returns from the stocking of 26,000 hatchery smolts in 1995 would contribute to surpluses above the Falls contributed to a management decision to reopen the previously closed recreational fishery to hook-and-release fishing.

With assistance from Chapel Island First Nation, returns were counted at the Grand Falls fishway in 1996. Juvenile assessments were conducted at 4 sites, all of which had been done in 1995. No broodstock were collected in 1995.

Estimation of Returns

Grand River Falls is a partial barrier to salmon located 10.2 km above head-of-tide (Fig. 16). 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 by-pass rates were determined during mid-October collections of broodstock above the falls. Mean by-pass rates are 0.4 for small and 0.57 for large salmon (Amiro and Longard MS 1990 and 1995).

The trap was operated daily between June 10 and August 3, and intermittently thereafter until October 12, 1996. Fish were counted, sexed and a proportion were scale sampled. Returns above the Falls were estimated as:

Returns = Count/[1.0 - by-pass rate].

Estimates of Returns

Counts in 1996 numbered 205 salmon comprised of 79 small wild, 121 small hatchery, and 5 large wild fish. Counts were up over those of 1995 but wild returns declined by 29%. The total count was the highest since 1991 (Summary Sheet; Fig. 17). Eight percent of the run was tallied in October.

Total returns were estimated to be **333** small and **12** large salmon.

Conservation Requirements

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

Escapement

There were no removals of fish reported from Grand River. Hence the 345 fish above Grand Falls represent **147%** of the requirement above the Falls and 63% of the target for the entire river. The estimate is the highest value since 1991. The count of wild fish, however, is the third lowest of a 9-year record.

Abundance of Juvenile Salmon

Juvenile salmon abundance was assessed by electrofishing at four sites, two each on the mainstem above and below the Falls (Fig. 16). Sites were large, 6.3 - 11.3* $100m^2$; captured age 1^+ and 2^+ fish were marked and replaced in the site; recapture runs were conducted 1- 4 days later. Estimates of age 1^+ and 2^+ parr were calculated using the Petersen mark-and-recapture method. Age 0^+ fish were estimated using the efficiency of capture for older fish.

Densities averaging 14 age 0^+ and 3 age 1^+ and 2^+ parr $100m^{-2}$ are low in comparison to Cape Breton Highland rivers and newly selected sites on the Sydney River and River Tillard (Table 25). A doubling of age 0^+ densities between 1995 and 1996 could be the result of increased escapements between 1994 and 1995. Densities in 1988, following unknown escapements (but significant harvests; Table 4), were equal to or less than those of 1995. Data and sites are too few to infer similarities or differences above and below the Falls or population status with respect to potential.

Forecast

There is no precedent for forecasting returns to the Grand River. However, estimated returns, 1988 to 1995, appear to have "bottomed-out" in 1993-1994. Significant returns from hatchery products have contributed to recent attainment of conservation requirements. Given that marine survival for distant migrating stocks (see "Ecological Considerations") could be improving and that stocking of 18,270 hatchery smolts occurred in 1996 (Table 23), returns in 1997 should again exceed conservation requirements for the area above the Falls. Without improved marine survival, the long range prognosis is less optimistic. Hatchery-source returns will be finished in 1998 and current low densities of juveniles appear distant with respect to concept of a "normal" abundance.

ECOLOGICAL CONSIDERATIONS

In-river

The Margaree is the only one of the five rivers assessed for which there is river discharge data. Margaree discharge patterns and levels are likely to be reasonably representative of other Highland-origin rivers but are perhaps less representative of Lowland rivers (Cape Breton and Richmond counties). Mean monthly discharges for Margaree in July, 1996, were above the 70-year mean (Fig. 18). Raised fall discharges began in mid-September and were sooner and more sustained than any of recent years (Fig. 3). All conditions and observed early abundances of salmon suggested that few, if any, river entrants would have occurred after the late October census dates, such as was hypothesised in 1995.

Daily discharges plotted against counts at Levi's, 1992-1996 (Fig. 3), again illustrate the impact of threshold freshets and sustained flows in bringing salmon into the estuarial trap and river. In 1996, early and sustained July river discharges and relatively cool water temperatures (Fig. 4) brought fish in unprecedented numbers (107 fish on July 10 was an all-time single day record catch for Levi's trap); nearly half the entire run through October 24 was in the river before September. Additionally, in contrast to low warmer waters of July, 1995, greater numbers of summer-tagged fish were found in the river (Table 9) and a greater proportion of acoustically-tagged and tracked fish

stayed in the river (Appendix). The threshold effect on river entry is consistent with preliminary results of Dodson and Colombani (MS 1996) who failed to find a genetic basis for different run timing in samples from each of early- and late-run Margaree fish. In total, the evidence suggests that the greatest influence on changing run-timing has likely been land management practices that reduce the ability of a watershed to sustain summer discharges. It is suspected that sustained July flows and cooler water temperatures would have had a positive impact on juvenile growth and river carrying capacity in 1996.

Marine

January-March environmental conditions for salmon in the North Atlantic, 1995, did improve from those of the same months in recent years (Anon MS 1996; Fig. 19). The ICES Working Group on North Atlantic Salmon (Anon MS op cit) forecasted an increased pre-fishery abundance of non-maturing 1SW salmon available to a Greenland fishery in 1996 over that of 1995. By extension, there should be improved numbers of large (2SW) salmon returning to homewaters in the subsequent year, i.e., 1997. 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 well-being 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 1996 were met or exceeded on the Margaree, Middle, North and Grand rivers. Requirements were not met on the Baddeck River.

Returns to the Margaree, North, Grand and possibly Middle rivers in 1997 should meet spawning requirements. Surpluses to conservation requirements on the Margaree should number at least 1,000 large salmon per year through the end of the decade. Small salmon surpluses are uncertain but should equal the 5-year average total retained recreational catch (373 small salmon) minus the contribution by hatchery-stocked smolts (there were no smolts stocked in 1996) i.e., about 25% of summer catch or 10% of the total catch. The delay of harvest fisheries until fall would maximize recreational opportunities in the summer and possibly assist in the preservation of an as yet unidentified summer-run genetic component in the Margaree population.

Returns to the Middle River should approximate requirements through the end of the decade, i.e., 500-600 fish. The probability of surpluses accompanying requirements can be approximated from the estimated in-river population in the fall of 1996, i.e., the most probable (50%- risk neutral) estimate was 579 fish. There was also a 40% probability that the population was 720 fish, i.e., with only a 10% greater uncertainty, there could have been a surplus of 140 fish, particularly if catch statistics were reported from unauthorized Aboriginal fisheries in Nyanza Bay. Conservation requirements, juvenile production levels and expectations require further investigation on Cape Breton Highland rivers (there is a 20% greater number of large salmon required per unit area for the Middle River than for the Margaree River). In the interim it may be prudent to recognize the ongoing impact of unauthorized fisheries and re-allocate the former 100 food fish quota to Wagmatcook First Nation.

Returns to the Baddeck River may be adequate for conservation. Returns to adjacent Highland rivers appear to be improving and there is sign of an improvement in marine survival. These elements suggest that returns in 1997 might be similar to those of 1996, i.e., 300 - 400 fish. However, there is less probability of a surplus to requirements than on the Middle River. In the event of an allocation centered on the approaches to Middle River in Nyanza Bay, it is probable that some Baddeck-origin fish will be lost even without their allocation.

Returns to the North River appear to have met or exceeded conservation requirement over the last 22 years. While the conservation requirements are likely to be met in 1996, returns will at best equal 300 large salmon (100 fish more than requirements). However, current estimates of juvenile densities suggest a deficit of egg depositions relative to the Middle and Baddeck rivers. Returns of small salmon in 1997 should be considerably fewer than recent years, possibly numbering only 5 dozen fish. Although allocations from the North River have not been exercised by the First Nations, it may be prudent to consider food fishery allocations in 1997 similar to those of 1995.

Small salmon of hatchery origin should again contribute to a surplus on the Grand River - possibly 100 fish. However the wild component is below requirement, hatchery-source returns will be finished in 1998 and current low densities of juveniles appear distant with respect to concepts of a "normal" abundance. Without improved marine survival, the long range prognosis is not optimistic. Increased returns and the complete closure of the river in 1995 appear to have contributed to the doubling of age 0^+ parr densities and thus it may be prudent to discourage harvest fisheries for the foreseeable future.

The lack of specific information on the many rivers that appear to be of interest to Aboriginal Peoples for food fisheries, e.g., Sydney and Skye rivers, is disconcerting, especially where some First Nations have received Aboriginal Fisheries Strategy moneys to assist in the pursuit of conservation objectives. The assessed adult stock status in each of the 5 assessments are inconsistent and indicate the difficulties in attempting to extrapolate the "known" to the unknown, e.g., Skye and Sydney rivers. However, in the absence of major assessments, managers may wish to encourage and act on inferences of stock status as conveyed through juvenile densities, e.g., proximity to a "normal" abundance. Additional sites on the Sydney River (Table 25), for example, may indicate the potential for food fishery allocations and yield official declaration of ongoing removals.

No tags originating from Cape Breton stocks have been as yet returned from the renewed Greenland fishery. 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 has not been accounted for in the prognoses for returns in 1997.

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counts of salmon in the trap at Grand River Falls fishway. Special thanks are extended to Terry. Bernard and Vera Pierro, Fishery Guardians, Wagmatcook First Nation, for their support in adult and juvenile surveys.

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PEER REVIEW AND OUTSIDE CONSULTATIONS

Science consultations re: the 1996 data, preliminary assessment and views on priorities for 1997 took place before the recreational fishing community on December 17, 1996, at the A..G. Bell Museum in Baddeck. A similar presentation was provided to interested members of the Cape Breton aboriginal communities on January 17, 1997, in Eskasoni. A draft assessment of the status of Atlantic salmon in Cape Breton was vetted February 3-7, 1997, before peers in DFO, other federal and provincial departments, universities and the private sector.

Outside consultations re: stock status were continuous in 1996. They included formal meetings with interested members of the aboriginal community on May 16 and the Cape Breton Sport Fishing Advisory Committee on May 21 regarding fishing plans for 1996. Approaches to partnering in the collection of field data were discussed with members of the aboriginal community at Wagmatcook First Nation on June 25; grievances between DFO and Wagmatcook First Nation regarding failed communications on stock status and a possible late-season fishing plan were adsorbed at separate meetings with Wagmatcook Council and the Community-at-large on November 18, 1996.

Table 1. Summary of the First Peoples salmon allocations, gear type, and seasons for Cape Breton, 1996.

Location	First Peoples	Allocation Small	Allocation Large	Gear Type	Season
Margaree River					
	Eskasoni	20	100	Trapnet, angle, spear, seine	Sept 1 - Oct 31
	Chapel Island	20	100	Trapnet, angle	Sept 1 - Oct 31
	Membertou	20	100+100	Trapnet, angle, spear, seine	Sept 1 - Dec 3
	Wagmatcook	20	100	Trapnet, angle, night spear, seine	Sept 1 - Oct 31
	Waycobah	20	100	Trapnet, angle	Sept 1 - Oct 31
	Total	***100***	***600***		
North River					
	Eskasoni	10+10	10+5	Angle, snare, seine	June 1 - Oct 25
	Chapel Island	10+10	10+5	Angle, snare, seine	June 1 - Oct 25
	Membertou	10+10	10+5	Angle, snare, spear, seine, dipnet	June 1 - Oct 23
	Wagmatcook	10+10	10+5	Angle, snare, spear, seine	June 1 - Oct 25
	Waycobah	10+10	10+5	Angle, snare, seine	June 1 - Oct 23
	Total	***100***	***75***		
Bras D'Or (Christmas Brook area)					
	Eskasoni	250	-	Trapnet, snare, angle, spear	June 1 - Oct 25
Bras D'Or					
	Membertou	200	-	Angle, snare, spear, dipnet	June 1 - Oct 31
Bras D'Or (St. Peter's Inlet)					
	Chapel Island	150	-	Trapnet, angle, snare, spear	June 1 - Oct 25
Bras D'Or (Nyanza Bay)					
	Wagmatcook	100	-	Trapnet, gillnet, angle, snare, spear	July 1 - Nov 4
Bras D'Or (Whycocomagh Bay)					
	Waycobah	250	-	Trapnet, angle, snare, spear	June 1 - Oct 23
	Total	***950***			
	Grand Total	***1,150***	***675***		
TAGS (Native Council NS)					
	Gulf NS (SFA 18)	1,820*		Angle, snare, spear	
	Cape Breton East (SFA 19)	220*		Angle, snare, spear	

* Tags only; 10 tags to each of 182 and 22 applicants.

Table 2. Recreational catch and effort for Atlantic salmon on rivers of Cape Breton Island, 1996 (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	31/10 *	63	36	48	127	171	0	163	219	276	382	0.591	77.9
Barachois	1/06	31/10 *	18	9	12	11	15	0	20	27	46	64	0.435	55.0
Campbell's Brook	1/09	31/10	0											
Catalone	1/06	31/10 *	8	8	11	6	8	0	14	19	37	51	0.378	42.9
Cheticamp	18/05	30/09	14	10	13	38	51	0	48	65	93	129	0.516	79.2
Clyburne	15/08	15/10 *	3	2	3	2	3	0	4	5	5	7	0.800	50.0
Framboise	1/06	31/10 *	2	1	1	0	0	0	1	1	27	37	0.037	0.0
Gaspereaux: Cape Breton Co.	1/06	31/10 *	2	0	0	9	12	0	9	12	12	17	0.750	100.0
Gerratt	1/06	31/10 *	1	0	0	0	0	0	0	0	2	3	0.000	0.0
Grand	1/06	31/10 *	24	62	83	19	26	0	81	109	186	257	0.435	23.5
Grantmire Brook	1/06	31/10	2	6	8	8	11	0	14	19	16	22	0.875	57.1
Indian Brook	1/06	31/10 *	8	3	4	1	1	0	4	5	16	22	0.250	25.0
Ingonish	1/06	31/10 *	3	4	5	3	4	0	7	9	14	19	0.500	42.9
Inhabitants	1/06	31/10 *	13	18	24	58	78	0	76	102	84	116	0.905	76.3
Little Lorraine	1/06	31/10 *	0											
Lorraine Brook	1/06	31/10 *	0											
Mabou	1/09	31/10	4	7	9	6	8	0	13	17	15	21	0.867	46.2
MacAskill's Brook	1/06	31/10 *	0											
Margaree	1/06	31/10 *	844	716	964	1270	1710	0	1986	2673	6014	8320	0.330	63.9
Marie Joseph	1/06	31/10 *	1	0	0	0	0	0	0	0	3	4	0.000	0.0
Middle: Victoria Co.	1/06	31/10 *	110	45	61	113	152	0	158	213	358	495	0.441	71.5
Mira	1/06	31/10 *	1	0	0	0	0	0	0	0	3	4	0.000	0.0
North : Victoria Co	1/06	31/10 *	64	130	175	82	110	0	212	285	377	522	0.562	38.7
North Aspy	15/08	30/09 *	11	4	5	25	34	0	29	39	35	48	0.829	86.2
Northwest Brook (River Ryan)	1/06	31/10 *	0											
River Bennett	1/06	31/10 *	0											
River Deny's	1/06	31/10 *	1	0	0	0	0	0	0	0	1	1	0.000	0.0
River Tillard	1/06	31/10 *	5	8	11	11	15	0	19	26	18	25	1.056	57.9
Saint Esprit	1/06	31/10 *	0											
Salmon: Cape Breton Co.	1/06	31/10 *	18	12	16	26	35	0	38	51	118	163	0.322	68.4
Skye	1/06	31/10 *	0											
Sydney	1/06	31/10 *	1	4	5	1	1	0	5	7	35	48	0.143	20.0
Cape Breton totals			1221	1085	1458	1816	2445	0	2901	3903	7791	10777	0.372	62.6

* Variation Order

Table 3. Recreational catch and effort for Atlantic salmon on rivers of Cape Breton Island, 1996 (preliminary), 1995 and 1991-1995.

	1996 Preliminary				1995				1991 - 95 means							
	Grilse		Salmon		Grilse		Salmon		Grilse				Salmon		Effort	
River	retained	released	released	Effort	retained	released	released	Effort	retained	95% C.I.	released	95% CI	released	95% CI	roddays	95% CI
Cape Breton																
Aconi Brook	0	0	0	0	0	0	0	0	6.0	N/A	2.0	N/A	8.5	N/A	34.0	N/A
Baddeck	0	48	171	382	7	53	71	336	23.8	24.8	22.4	22.5	123.8	79.8	552.8	271.3
Barachois	0	12	15	64	0	7	20	43	3.0	4.1	2.6	3.4	15.8	11.3	84.4	55.8
Campbell's Brook	0	0	0	0	0	0	0	0	0.5	N/A	0.5	N/A	7.5	N/A	28.5	N/A
Catalone	0	11	8	51	0	0	0	1	2.8	4.4	0.4	0.7	1.4	1.9	101.0	132.2
Cheticamp	0	13	51	129	0	7	26	92	5.0	7.7	7.2	7.5	49.2	46.5	161.0	96.6
Clyburne	0	3	3	7	0	1	0	3	1.0	2.8	0.3	0.7	3.5	6.6	16.5	24.0
Framboise	0	1	0	37	0	1	0	8	9.2	13.1	2.2	2.4	5.4	11.8	181.8	182.7
Gaspereaux: Cape Breton Co.	0	0	12	17	0	0	0	0	0.3	0.7	0.0	0.0	0.3	0.7	22.3	28.0
Gerratt	0	0	0	3	0	0	0	3	0.2	0.6	0.2	0.6	0.0	0.0	11.2	18.0
Grand	0	83	26	257	River closed			49	95.3	90.5	29.3	40.0	26.8	16.5	1172.8	1105.5
Grantmire Brook	0	8	11	22	0	0	0	0	0.0	N/A	2.5	N/A	5.5	N/A	15.0	N/A
Indian Brook	0	4	1	22	0	2	4	19	1.0	1.8	2.6	4.1	6.4	13.7	36.0	39.8
Ingonish	0	5	4	19	0	4	10	45	5.2	9.2	3.0	3.2	8.8	10.1	73.6	48.7
Inhabitants	0	24	78	116	0	4	20	43	18.4	21.7	6.4	11.3	88.4	64.5	262.0	198.7
Little Lorraine	0	0	0	0	0	0	0	0	0.0	N/A	0.0	N/A	0.0	N/A	0.0	N/A
Lorraine Brook	0	0	0	0	0	0	0	0	4.3	N/A	2.0	N/A	3.3	N/A	52.7	N/A
Mabou	8	1	8	21	2	1	1	8	2.2	1.0	1.2	2.7	5.4	8.9	17.4	13.0
MacAskill's Brook	0	0	0	0	0	0	0	0	0.0	N/A	0.0	N/A	0.5	N/A	4.5	N/A
Margaree	264	700	1710	8320	199	134	1060	12293	432.4	216.2	161.2	49.2	1466.0	481.4	13974.6	1746.9
Marie Joseph	0	0	0	4	0	0	0	0	2.5	6.1	1.0	2.0	4.3	7.9	77.0	64.7
Middle: Victoria Co.	3	58	152	495	0	37	51	286	10.2	13.8	15.8	17.8	96.2	91.4	452.6	310.5
Mira	0	0	0	4	0	10	5	68	4.8	11.4	4.6	4.9	3.4	4.5	109.2	83.4
North: Victoria Co.	0	175	110	522	1	167	209	514	79.0	104.6	67.6	73.2	274.6	224.5	1080.6	756.3
North Aspy	0	5	34	48	0	2	9	22	3.2	4.8	3.0	6.3	21.0	14.4	68.8	44.2
Northwest Brook (River Ryan)	0	0	0	0	0	0	0	0	0.0	N/A	0.0	N/A	0.0	N/A	24.5	N/A
River Bennett	0	0	0	0	0	0	0	0	1.0	N/A	0.0	N/A	1.0	N/A	6.0	N/A
River Deny's	0	0	0	1	0	0	0	0	0.3	N/A	0.0	N/A	1.0	N/A	5.0	N/A
River Tillard	0	11	15	25	0	2	0	6	2.8	3.2	2.0	1.5	4.6	7.7	34.2	35.1
Saint Esprit	0	0	0	0	0	0	0	0	0.3	0.7	0.0	0.0	0.0	0.0	23.0	40.2
Salmon: Cape Breton Co.	0	16	35	163	1	9	14	84	3.4	4.3	3.0	4.9	6.8	6.8	177.0	165.9
Skye	0	0	0	0	0	0	0	3	2.3	N/A	0.3	N/A	0.0	N/A	10.7	N/A
Sydney	0	5	1	48	0	0	0	3	0.8	1.6	0.2	0.6	4.0	5.8	12.0	17.2
Totals	275	1183	2445	10777	210	441	1500	13929	721		343		2243		18883	

Table 4. Annual summaries of catch, effort and estimated 1SW fish retained and released from NS license stub returns for 5 rivers of Cape Breton, 1984-96. Mean = (1991-95). 1996 data are preliminary. (Unk. Obs. are undefined small/large.)

River	Year	No. Angler	Small Obs.	Small Est.	Est. Ret.	Large Obs.	Large Est.	Unk. Obs.	Total Obs.	Total Est.	Roddays Obs.	Roddays Est.	CPUE	% Large
Baddeck														
	1984	60	6	6	4	42	45	0	48	51	254	284	0.189	88
	1985	34	4	5	4	12	14	0	16	19	94	100	0.170	75
	1986	68	25	26	20	133	139	0	158	165	364	383	0.434	84
	1987	90	40	40	26	126	126	0	166	166	411	435	0.404	76
	1988	86	31	36	19	149	175	0	180	211	366	444	0.492	83
	1989	98	15	18	8	204	247	0	219	265	392	490	0.559	93
	1990	103	56	71	40	144	182	0	200	253	445	580	0.449	72
	1991	110	40	51	28	166	213	0	206	264	483	640	0.427	81
	1992	129	45	57	50	131	165	0	176	221	538	698	0.327	74
	1993	146	45	48	33	101	108	0	146	156	689	785	0.212	69
	1994	74	13	16	1	50	62	0	63	78	238	305	0.265	79
	1995	61	49	61	7	57	71	0	106	131	263	336	0.403	54
	1996	63	36	48	0	127	171	0	163	219	276	382	0.591	78
	+/- 1995	3%	-27%	-21%	-100%	123%	141%	-	54%	67%	5%	14%	47%	45%
	+/- Mean	-39%	-6%	3%	-100%	26%	38%	-	17%	29%	-38%	-31%	81%	9%
Grand														
	1984	268	367	393	338	32	34	11	410	438	2,777	3,110	0.148	8
	1985	312	520	542	471	127	132	1	648	675	2,896	3,094	0.224	20
	1986	326	336	360	298	181	194	0	517	554	2,865	3,015	0.180	35
	1987	262	311	342	308	97	107	0	408	449	1,961	2,077	0.208	24
	1988	277	276	324	303	86	101	0	362	425	2,731	3,311	0.133	24
	1989	247	258	312	290	62	75	0	320	387	2,167	2,707	0.148	19
	1990	240	327	413	335	80	101	0	407	514	2,192	2,858	0.186	20
	1991	178	100	128	115	14	18	0	114	146	1,499	1,985	0.076	12
	1992	182	127	160	148	35	44	0	162	204	1,483	1,925	0.109	22
	1993	184	117	139	118	21	25	0	138	164	1,311	1,494	0.105	15
	1994	44	58	72	0	16	20	0	74	92	321	411	0.231	22
	1995	4	4	5	0	10	12	0	14	17	38	49	0.368	71
	1996	24	62	83	0	19	26	0	81	109	186	257	0.435	24
	+/- 1995	500%	1450%	1560%		90%	117%	-	479%	541%	389%	424%	18%	-67%
	+/- Mean	-80%	-24%	-18%	-100%	-1%	9%	-	-19%	-13%	-80%	-78%	145%	-17%
Margaree														
	1984	678	233	242	190	293	305	4	530	551	5,952	6,665	0.089	56
	1985	793	473	509	399	1,130	1,215	3	1,606	1,727	7,324	7,824	0.219	70
	1986	1,131	748	782	650	2,522	2,636	2	3,272	3,420	9,724	10,232	0.336	77
	1987	1,441	925	977	826	1,757	1,857	0	2,682	2,834	12,165	12,887	0.220	66
	1988	1,455	749	879	752	1,647	1,932	0	2,396	2,810	11,582	14,042	0.207	69
	1989	1,486	464	561	434	1,298	1,570	0	1,762	2,132	10,594	13,234	0.166	74
	1990	1,383	514	649	498	1,193	1,507	0	1,707	2,156	10,792	14,073	0.158	70
	1991	1,236	586	752	559	1,370	1,757	0	1,956	2,509	10,142	13,432	0.193	70
	1992	1,426	539	678	551	1,541	1,938	0	2,080	2,616	11,483	14,909	0.181	74
	1993	1,885	696	777	562	987	1,102	0	1,683	1,879	13,920	15,863	0.121	59
	1994	1,382	346	429	291	1,193	1,479	0	1,539	1,908	10,452	13,376	0.147	78
	1995	1,268	269	333	199	856	1,060	0	1,125	1,393	9,617	12,293	0.117	76
	1996	844	716	964	264	1,270	1,710	0	1,986	2,673	6,014	8,320	0.330	64
	+/- 1995	-33%	166%	189%	33%	48%	61%	-	77%	92%	-37%	-32%	182%	-16%
	+/- Mean	-41%	47%	62%	-39%	7%	17%	-	18%	30%	-46%	-40%	117%	-10%
Middle														
	1984	83	29	33	21	66	75	0	95	108	470	526	0.202	69
	1985	39	18	21	15	24	29	0	42	50	150	160	0.280	57
	1986	76	44	44	36	107	108	0	151	152	368	387	0.410	71
	1987	114	55	58	53	111	116	0	166	174	684	725	0.243	67
	1988	131	42	49	36	121	142	0	163	191	591	717	0.276	74
	1989	144	43	52	41	231	279	0	274	332	694	867	0.395	84
	1990	153	85	107	80	156	197	0	241	304	771	1005	0.313	65
	1991	169	21	27	18	145	186	0	166	213	646	856	0.257	87
	1992	66	9	11	8	24	30	0	33	41	167	217	0.198	73
	1993	110	28	30	25	44	48	0	72	78	356	406	0.202	61
	1994	122	19	24	0	134	166	0	153	190	389	498	0.393	88
	1995	72	30	37	0	41	51	0	71	88	224	286	0.317	58
	1996	110	45	61	3	113	152	0	158	213	358	495	0.411	72
	+/- 1995	53%	50%	65%	-	176%	198%	-	123%	142%	60%	73%	30%	24%
	+/- Mean	2%	110%	136%	-71%	46%	58%	-	60%	75%	0%	9%	50%	-2%
North														
	1984	162	60	65	56	139	151	1	200	217	1,091	1,222	0.183	70
	1985	170	146	162	149	383	426	0	529	588	947	1,012	0.559	72
	1986	298	235	235	185	1,010	1,010	0	1,245	1,245	1,945	2,047	0.640	81
	1987	263	219	226	177	529	546	0	748	772	1,574	1,667	0.475	71
	1988	202	115	135	118	456	535	0	571	670	1,305	1,582	0.438	80
	1989	162	134	162	122	331	400	0	465	563	1,074	1,342	0.433	71
	1990	219	212	268	202	483	610	0	695	878	1,416	1,846	0.491	69
	1991	172	145	186	148	277	355	0	422	541	1,050	1,391	0.402	66
	1992	205	178	224	184	437	550	0	615	773	1,421	1,845	0.433	71
	1993	217	72	82	62	142	161	0	214	243	1,094	1,247	0.196	66
	1994	73	60	74	0	78	97	0	138	171	317	406	0.435	57
	1995	77	136	168	1	169	209	0	305	378	402	514	0.759	55
	1996	64	130	175	0	82	110	0	212	285	377	522	0.562	39
	+/- 1995	-17%	-4%	4%	-100%	-51%	-47%	-	-30%	-25%	-6%	2%	-26%	-30%
	+/- Mean	-57%	10%	19%	-100%	-63%	-60%	-	-37%	-32%	-56%	-52%	26%	-39%

Table 5. Pools and sections of the Margaree River, Inverness County, N.S. (Claytor et al. MS 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 1988-1996. Refer to Figure 3 (Marshall et al. MS 1996) 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
	1996	7	132	46	99	16	300	12	187	41	170	80	490	Jun 10 - Aug 31 (8)	Sep 1 - Oct 24 (9)
Lower2	1993	10	34	26	7	11	88	9	43	31	8	31	122	Jun 22 - Aug 31	Sep 1 - Oct 18 (10)

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-** Jul 5-6 trap brailed.
- **-9-** Sep 16, 25 and Oct 1-2, 10, 14 trap brailed.
- **-10-** 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 for each year the trap operated.

SMALL SALMON

	Summer					Fall			
Year	Jun	Jul15	Jul31	Aug	Total	Sep	Oct	Total	Total
Total catch									
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
1996	7	74	58	46	185	99	16	115	300
Percent of total run									
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
1996	2	25	19	15	62	33	5	38	100
Percent of season run									
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	
1996	4	40	31	25	100	86	14	100	

LARGE SALMON

	Summer					Fall			
Year	Jun	Jul15	Jul31	Aug	Total	Sep	Oct	Total	Total
Total catch									
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
1996	12	104	83	41	240	170	80	250	490
Percent of total run									
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
1996	2	21	17	8	49	35	16	51	100
Percent of season run									
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	
1996	5	43	35	17	100	68	32	100	

Table 8. Numbers of wild and hatchery salmon from summer and fall sampling on Margaree River in 1996.

SEASON:	Small Salmon			Large Salmon			Percent
	Wild	Hatchery	% Wild	Wild	Hatchery	% Wild	Large
SUMMER (June 1 - Aug. 31)							
Trapnet Levi's	144	41	78%	221	19	92%	56%
Angling Logbooks	70	22	76%	57	10	85%	42%
Netting	14	13	52%	57	10	85%	71%
Sub-Total:	228	76	75%	335	39	90%	55%
FALL (Sept. 1 - Oct. 31)							
Trapnet Levi's	111	4	97%	240	10	96%	68%
Lake O' Law Fence	24	55	30%	61	1	98%	44%
Angling Logbooks	72	17	81%	173	14	93%	68%
Netting (a)	-	-	-	77	10	89%	-
Sub-Total:	207	76	73%	551	35	94%	67%
Total Season:	***435***	***152***	***74%***	***886***	***74***	***92%***	***62%***

(a) Small:Large affected by mesh size

Table 9. Counts of adult salmon during swim-thrus of the Margaree River, summers of 1990-1996. (Streamer tags (M) applied in 1995 and 1996 numbered 65 and 94, respectively.)

Date	Section [a]	Large salmon			Small salmon			Total Captures (C)	Recaps (R)
		Unk	Hatc	Wild	Unk	Hatc	Wild		
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 (Aug 1)									
	Upper	-	-	-	-	-	-	3	
	Middle	-	-	-	-	-	-	26	
	Lower	-	-	-	-	-	-	67	
	Total							*96*	
1995 (Aug 2)									
	Upper		1	49			11	61	0
	Middle		5	23			2	30	1
	Lower	66	9	30	8	6	5	124	43
	Lower $_{\text{Forks-Seal}}$	5						5	3
	Total	*71*	*15*	*102*	*8*	*6*	*18*	*220*	*47*
1996 (Aug 1)									
	Upper	-	-	-	-	-	-	126	1
	Middle	-	-	-	-	-	-	99	24
	Lower $_{\text{Htch-Swim Hole}}$	-	-	-	-	-	-	264	11
	Lower $_{\text{Swim Hole-Forks}}$	-	-	-	-	-	-	195	10
	Lower $_{\text{Forks-Tidal}}$	-	-	-	-	-	-	205	1
	Total							*889*	*47*

[a] Upper: below Third Brook Pool to breakwater in sanctuary.

[a] Middle: Breakwater to Hatchery Pool.

[a] Lower: Hatchery Pool to Forks Pool.

Table 10. Mark-recapture and proportional estimates of salmon returning to the Margaree River, 1996. Bold numbers are modal (most probable estimate from Bayes solution), remaining run component(s) are based on the proportion small and large at Levi's; 90% CLs are of modal estimate.

Method	Primary estimate	Number			Estimate				Recaps/ marks	Rank	Recaps/ captures	Rank
		Marks	Captures	Recaps	Small	Large	Total	90% CL				
1. Logbooks	large	402	284	18	4,271	**6,976**	11,247	5,265-11,519	0.045	4	0.063	7
2. Fall netting	large	487	87	19	1,370	**2,238**	3,608	1,745- 3,496	0.039	5	0.218	1
3. Lk O'Law	large	487	62	7	2,657	**4,340**	6,997	2,975-11,165	0.014	7	0.113	5
4. Lk O'Law+Netting	large	487	149	26	1,709	**2,792**	4,501	2,214- 4,050	0.053	2	0.174	3
5. Lk O'Law	large+small	787	141	21	2,003	3,271	**5,274**	4,096- 8,162	0.027	6	0.149	4
6. Lk O'Law	small	300	79	14	**1,685**	2,752	4,437	1,277- 2,960	0.047	3	0.177	2
7. Logbooks	small	232	214	20	**2,473**	4,039	6,512	1,903- 3,936	0.086	1	0.093	6

Levi's prop. small: 0.3797

Table 11. Counts of Atlantic salmon at Lake O'Law Brook , Margaree River, 1991-1996.

	Small salmon			Large salmon			Smolt			Fishing periods	
Year	Wild	Hatchery	Total	Wild	Hatchery	Total	Wild	Hatchery	Total	Period 1	Period 2
1991	28	6	34	72	4	76	2,541	1,845	4,386	May 2 - Nov 18	
1992	14	1	15	48	10	58	2,416	1,900	4,316	May 21 - Dec 1	
1993	25	5	30	54	4	58	1,513	3,522	5,035	May 9 - Jun 19	Sep 29 - Nov 15
1994	21	9	30	79	7	86	631	8	639	May 5 - Jun 30	Sep 15 - Dec 1
1995	19	2	21	65	2	67	.	.	.	Sep 20 - Nov 26	
1996	24	55	79	61	1	62	.	.	.	Sep 14 - Dec 2	

Table 12. Mark-recapture data for population estimates of large salmon, 1992-1996.

		Logbooks			Fence			Fall netting		
Year	Tags applied	Recaps	Tot. fish	% Recaps	Recaps	Tot. fish	% Recaps	Recaps	Tot. fish	% Recaps
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
1996	487	18	313	6	7	62	11	19	87	22

Table 13. Estimates of returns, escapements, and percent of conservation requirement met for Atlantic salmon from the Margaree River, 1984 to 1996. Mean = (1991 to 1995).

Year	Large returns	Percentiles		Large escapement	Percentiles		% conservation req'm met by large	Percentiles		Eggs (10^3) collected for hatchery
	Median	5%	95%	Median	5%	95%	Median	5%	95%	
1984	412	327	563	381	296	532	37	29	51	100
1985	1,462	1,109	2,217	1,378	1,025	2,133	133	99	206	150
1986	3,616	2,738	5,680	3,461	2,583	5,525	334	249	533	150
1987	4,015	2,976	6,540	3,899	2,860	6,424	376	276	620	150
1988	1,688	1,286	2,494	1,545	1,143	2,351	149	110	227	300
1989	2,289	1,708	3,693	2,164	1,583	3,568	209	153	344	300
1990 (a)	5,156	3,481	7,933	5,022	3,347	7,799	485	323	753	380
1991	3,484	1,853	5,785	3,323	1,692	5,624	321	163	543	473
1992 (b)	6,375	4,875	9,375	6,222	4,722	9,222	601	456	890	300
1993 (b)	3,358	2,408	6,158	3,224	2,274	6,024	311	219	581	9
1994 (b)	2,900	2,350	4,500	2,759	2,209	4,359	266	213	421	.
1995 (b)	2,365	-	-	2,308	-	-	223	-	-	.
1996 (b)	**2,792**	2,214	4,050	**2,579**	2,001	3,837	249	193	370	327
+/- 1995	18%			12%			12%			
+/- Mean	-24%			-28%			-28%			

	Small returns			Small escapement			% conservation req'm met by small		
1984	504	400	688	311	158	446	53	27	77
1985	838	634	1,167	433	125	658	74	21	113
1986	1,096	838	1,420	439	56	638	75	10	110
1987	1,478	1,143	1,865	644	166	888	111	29	153
1988	2,209	1,674	2,911	1,451	795	2,032	249	137	349
1989	768	591	977	328	30	416	56	5	71
1990 (a)	1,977	940	5,077	1,471	291	4,428	253	50	761
1991	1,909	794	3,891	1,340	42	3,139	230	7	539
1992 (b)	1,645	1,258	2,419	1,088	701	1,862	187	120	320
1993 (b)	2,087	1,489	3,851	1,504	906	3,268	258	156	562
1994 (b)	708	573	1,101	394	259	787	68	45	135
1995 (b)	737	-	-	528	-	-	91	-	-
1996 (b)	**1,685**	1,277	2,960	**1,343**	935	2,618	231	161	450
+/- 1995	129%			154%			154%		
+/- Mean	19%			38%			38%		

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

(b) - Modal value from Bayes estimates.

Table 14. Summary of effort, catch and CPUE from logbook anglers on Margaree River, 1993 to 1996.

Year	Season	Month	Angler Days	Small		Large		Total	
				Catch	CPUE	Catch	CPUE	Catch	CPUE
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**
1996									
	Summer	June	94	5	0.053	15	0.160	20	0.213
		July	225	62	0.276	41	0.182	103	0.458
		August	214	49	0.229	43	0.201	92	0.430
	Sub-Total		533	116	0.218	99	0.186	215	0.403
	Fall	September	317	62	0.196	82	0.259	144	0.454
		Oct. 1-15	330	34	0.103	107	0.324	141	0.427
		Oct. 16-31	155	8	0.052	34	0.219	42	0.271
		Oct. 1-31	485	42	0.087	223	0.460	265	0.546
	Sub-Total		802	104	0.130	223	0.278	327	0.408
	Total Season		1335	220	**0.165**	322	**0.241**	542	**0.406**

Table 15. Catch of small and large, wild and hatchery salmon by anglers maintaining logbooks, 1989-1996.

Year	Summer Catch	Summer % Wild	Fall Catch	Fall % Wild	Total Catch	Total % 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
1996	92	76	89	81	181	78
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
1996	67	85	187	93	254	91

Table 16. Population estimates of large salmon (mostly), catches at Levi's trapnet and estimated trapnet efficiency 1992-1996. (Fall, 1992-1994, from Table 22, Claytor et al. MS 1995.)

		Large Salmon		
Year	*Method*	*Trapnet Catch*	*Population Estimate*	*Trapnet Efficiency (%)*
1992	Fence and logbooks (fall only)	478	2,747	17.4
"	Fence and logbooks	603	6,375	9.5
1993	Fence and logbooks (fall only)	132	1,651	8.0
"	Fence and logbooks	252	3,358	7.5
1994	Fence and logbooks (fall only)	283	1,762	16.1
"	Fence and logbooks	464	2,900	16.0
1995	Logbooks	405	4,242	9.5
"	Lk O'Law	405	2,688	15.1
"	Fall netting	405	1,288	31.4
"	Fall (fence) + Summer	405	2,365	17.1 (a)
"	Fall (trap) - minimum	340	982	34.6
1996	Logbooks	490	6,976	7.0
"	Lk O'Law	490	4,340	11.3
"	Fall netting	490	2,238	21.9
"	Lk O'Law+Fall netting	490	2,792	17.6 (a)
"	Lk O'Law (large & small)	790	5,274	15.0
"	Lk O'Law (small salmon)	300	1,685	17.8 (a)
"	Logbooks (small salmon)	300	2,473	12.1

(a) Prefered estimate.

Table 17. Biological characteristics of wild small and large salmon captured at estuarial trapnets, 1992-1996. (Eggs per female = predicted weight (kg) * 1,764 (Elson 1975)).

	Small Salmon				Large Salmon			
Year	Prop female	Female mean FL (cm)	Pred (a) wt (kg)	Eggs per fish (b)	Prop female	Female mean FL (cm)	Pred (a) wt (kg)	Eggs per fish (b)
1992	0.0690	57.4	1.7	207	0.7472	77.4	4.5	5,881
1993	0.1071	53.9	1.4	263	0.7236	80.0	5.0	6,335
1994	0.0845	55.0	1.5	221	0.8005	78.2	4.6	6,513
1995	0.0549	56.0	1.6	153	0.7484	77.9	4.6	6,014
1996	0.0296	59.0	1.9	97	0.7041	79.0	4.8	5,919
Mean	0.0690	56.3	1.6	188	0.7448	78.5	4.7	6,132

(a) - Predicted weight = 10^(3.219572 * log length - 5.431423) based on length-weight data of 72 female large salmon sampled in 1993-1994.

(b) - Weight, in eggs per fish calculation, is based on mean length; weight in eggs per fish in Table 18 uses lengths of individual fish.

Table 18. Contributions of wild and hatchery large salmon to egg depositions on the Margaree River, 1996.

Description:		*Year*	*Wild*	*Hatchery*	*Total*
Proportion Female		***1996***	0.70	0.67	0.70
Avg Wt. of Large Salmon	(a)		4.94	4.41	4.92
Fecundity (eggs/kg)			1,764	1,764	1,764
Eggs per Spawner			6,135	5,189	6,101
Total Returns			2,627	165	2,792
Estimated Returns			2,627	165	2,792
Native Harvests	(b)		0	0	0
Total Removals			198	15	213
Angling Mortality	(c)		77	8	85
Poaching	(d)		58	4	62
Trapnet Mortality			2	0	2
Broodstock	(e)		39	2	41
Native Harvests	(f)		80	5	85
Total Escapement			2,429	150	2,579
Proportion of Total Returns			0.94	0.06	1.00
Total Eggs (in millions)			14.81	0.77	15.63
Proportion of Total Eggs			0.95	0.05	1.00
Proportion of Total Eggs		1992	0.97	0.03	1.00
		1993	0.95	0.05	1.00
		1994	0.93	0.07	1.00
		1995	0.95	0.05	1.00
		1996	0.95	0.05	1.00
Total Eggs (in millions)	(g)	1992	33.41	0.90	34.32
	(g)	1993	17.92	0.91	18.82
	(g)	1994	17.03	1.21	18.24
	(g)	1995	12.17	0.64	12.82
		1996	14.81	0.77	15.63

(a) - Predicted weight = 10^(3.219572 * log length - 5.431423). The equation was derived using lengths and weights from 72 female large salmon collected in 1993-1994 and was applied to individual fish. The 1992-1995 eggs were derived from the weights predicted by equation in footnote (g).

(b) - Harvests below Levi's trap.

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

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

(e) - Broodstock and experimental collections included 41 female and 6 male large salmon and 36 male small salmon.

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

(g) - Predicted weight = 10^(3.254848 * log length - 5.514459). The equation was derived using lengths and weights from 106 large male and females collected in 1993-1994.

Table 19. Results of electrofishing surveys at barrier net sites in the Margaree River, July, 1994-1995, and August 1996.

					Age 0+					Age 1+, 2+				
Year	Tributary	Site #	Area (m^2)	No. of sweeps	Mean length (cm)	Sweep catch	Total estimate	Variance	Density ($100m^2$)	Mean length (cm)	Sweep catch	Total estimate	Variance	Density ($100m^2$)
1994	Big Brook	15	148	4	4.9	155	189	219.6	128	9.4	45	49	18.5	33
	Forest Glen Brook	40	116	3	4.0	111	116	14.6	100	7.9	88	107	142.5	92
	Forest Glen Brook	45	193	4	4.2	161	210	468.5	109	7.5	167	185	68.1	96
	MacFarlanes Brook	96	160	4	5.0	172	183	31.5	115	9.1	115	123	22.0	77
	Trout Brook	98	174	4	4.4	50	61	98.6	35	7.2	87	95	27.6	55
	Mean sites, 15,45,96								117					69
1995	Big Brook	15	147	4	5.0	268	273	8.9	186	9.8	55	57	4.9	39
	Forest Glen Brook	40	131	4	4.4	178	209	162.3	159	8.8	135	143	23.0	109
	Forest Glen Brook	45	172	4	4.5	414	440	66.9	256	8.3	198	210	30.7	122
	MacFarlanes Brook	96	288	4	5.4	300	336	135.5	117	10.0	189	201	33.7	70
	Trout Brook	98	179	4	5.0	101	107	16.3	60	8.5	81	87	17.9	48
	Old Bridge	51	443	3	5.4	496	550	264.3	127	10.0	214	247	164.0	56
	Mean sites, 15,45,96								186					77
1996	Big Brook	15	215	4	4.6	320	320	0.8	149	8.8	94	96	5.2	45
	Forest Glen Brook	45	249	4	4.2	215	219	7.4	88	7.9	273	277	6.5	111
	MacFarlanes Brook	96	317	4	4.6	328	329	1.8	104	8.8	274	278	6.3	88
	Trout Brook	98	210	3	4.4	59	59	1.4	28	8.3	64	66	6.0	31
	Old Bridge	51	477	3	4.8	575	585	17.5	123	8.9	351	412	321.0	86
	Mean sites, 15,45,96								114					81

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	2,792
1992	6,222	
1993	3,224	
1994	2,759	
1995	2,308	
1996	2,579	

Table 21. Parameter estimates, residual sums of squares, and forecasts for 1997 from stock recruitment models.

	Model			
Parameter	*Ricker*	*Beverton-Holt*	*Mean*	*Tabular*
a	1.81	4.08	.	.
b	3.59	0.28	.	.
Res SS	1.19	0.98	1.11	0.92
X value	6,222	6,222	6,222	6,222
Forecast	1,656	3,902	3,222	4,160

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		3
1200 - 2400	3	5		1
0 - 1200	1			
Number of Points	12	14	5	8
Average Spawners	401	829	1532	3145
Average Recruits	2618	2839	4243	4160
Recruits minus Spawners	2217	2010	2712	1015
Recruits / Spawners	6.53	3.42	2.77	1.32

Table 23. Numbers of hatchery smolt and parr released to Cape Breton rivers, 1988-1996.

Year	Rearing Location	Smolt 2+	Smolt 1+	Parr 1+	Parr 0+
Christmas Brook (Eskasoni)					
1992	Cobequid	4,239			
1993	Cobequid	10,017			
1994	Cobequid	7,937			
Grand River					
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
1996	Cobequid		18,270		
	Mersey				23,500
Indian Brook (Eskasoni)					
1993	Cobequid			2,805	
1994	Cobequid			1,995	
	Mersey				2,808
1995	Cobequid	9,952	5,308		
	Mersey			17,205	
1996	Cobequid		19,857		
Margaree River					
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 River					
1988	Cobequid	23,927			
1989	Cobequid	23,090			
North River					
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 Rivers (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	
1996	Cobequid		1,600		

*Reared at the Lake O'Law cages

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

Table 24. Results of electrofishing surveys at barrier net sites in the Middle, Baddeck and North rivers, 1995-96.

River	Site Name	Area m2	No. of sweeps	Age 0+ Catch	Age 0+ Est. Pop'n	Age 0+ Density 100m^2	Age 1+, 2+ Catch	Age 1+, 2+ Est. Pop'n	Age 1+, 2+ Density 100 m^2
1996									
Middle	Main, Finlayson	530	4	194	196	36.9	279	287	54.2
	Main, Two Churches	333	3	72	82	24.7	110	120	36.0
	MacLeods Bk	224	4	55	56	24.8	138	147	65.8
	MacKenzie Bk	103	4	175	176	171.0	64	67	64.6
	Mean, 2 main river sites					30.8			45.1
Baddeck	Main, Glenhaven	368	4	226	254	69.1	146	153	41.7
	N. Br, Picnic Pk	491	4	261	281	57.3	87	99	20.1
	N. Br, Bridge	378	4	235	240	63.6	168	174	46.1
	Peter's Bk	168	4	248	253	150.1	39	39	23.2$^+$
	Mean, 3 main river sites					63.3			36.0
North	Main, MacDonalds	408	3	40	41	10.1	114	121	29.8
	Main, Church	357	3	116	118	33.0	49	51	14.3
	Mean, 2 main river sites					21.6			22.1
1995									
Middle	Main, Hwy 19	181	4	191	197	108.9	59	62	34.3
	Main, ab Gold Bk	251	3	261	267	106.3	43	46	18.3
	MacKenzie Bk	95	4	159	174	174.1	63	72	75.8
	Mean, 2 main river sites					108.9			34.3

$^+$Minimum based on total catch, variance of estimate was negative.

Table 25. Results of mark-recapture electrofishing for juvenile salmon in rivers of Richmond and Cape Breton counties, Cape Breton Island, 1995 and 1996.

River	Site Name	Site No.	Marking MM	Marking DD	Recap time (days)	Site Area (m^2)	Marking Run Age 0+ count	Marking Run Age 1+2+ marked	Marking Run Mort	Recapture Run Age 0+ count	Recapture Run Age 1+,2+ Unmark	Recapture Run Age 1+,2+ Marked	Mark run efficiency	Site Estimate Age 0+	Site Estimate Age 1+,2+	Density/100 m^2 Age 0+	Density/100 m^2 Age 1+,2+
GRAND RIVER, 1996																	
	Fr. MacDonald Rd (bl Falls)	4	8	15	1	633	32	12	0	38	7	2	0.29	112	42	17.7	6.6
	Crib Pool (bl Falls)	3	8	12	3	953	46	6	0	31	3	0	0.22	207	27	21.7	2.8
	Fishway (abv Falls)	2	8	7	2	996	26	3	0	43	6	1	0.20	130	15	13.1	1.5
	Mud Hole (abv Falls)	1	8	16	4	1,130	36	7	0	38	1	3	0.78	46	9	4.1	0.8
											Avg sites 1-4		0.37	123.8	23.3	14.2	2.9
GRAND RIVER, 1995																	
	Fr. MacDonald Rd (bl Falls)	4	9	12	3	533	7	8	0	28	5	2	0.35	20	23	3.8	4.3
	Crib Pool (bl Falls)	3	9	11	2	827	44	14	0	15	9	4	0.34	129	41	15.6	5.0
	Fishway (abv Falls)	2	8	29	2	996	7	28	0	4	18	6	0.27	26	103	2.6	10.3
	Mud Hole (abv Falls)	1	9	12	3	926	25	8	1	21	6	3	0.41	61	22	6.6	2.4
	Black River		9	13	3	586	10	25	1	11	16	7	0.34	30	77	5.1	13.1
											Avg sites 1-4		0.34	61.5	60.8	7.5	7.7
GASPEREAUX																	
	Victoria Brdg	1	8	28	2	265	53	11	0	44	0	3	1.00	53	11	20.0	4.2
SYDNEY																	
	Site #1	1	8	28	2	343	24	44	0	33	20	6	0.25	94	173	27.4	50.4
TILLARD																	
	Site #1	1	8	21	2	282	43	48	0	41	9	28	0.76	56	63	19.9	22.3
	Site #2	2	8	21	2	307	8	17	0	7	17	8	0.33	24	51	7.8	16.6
											Avg sites 1-2		0.55	40.0	57.0	13.9	19.5

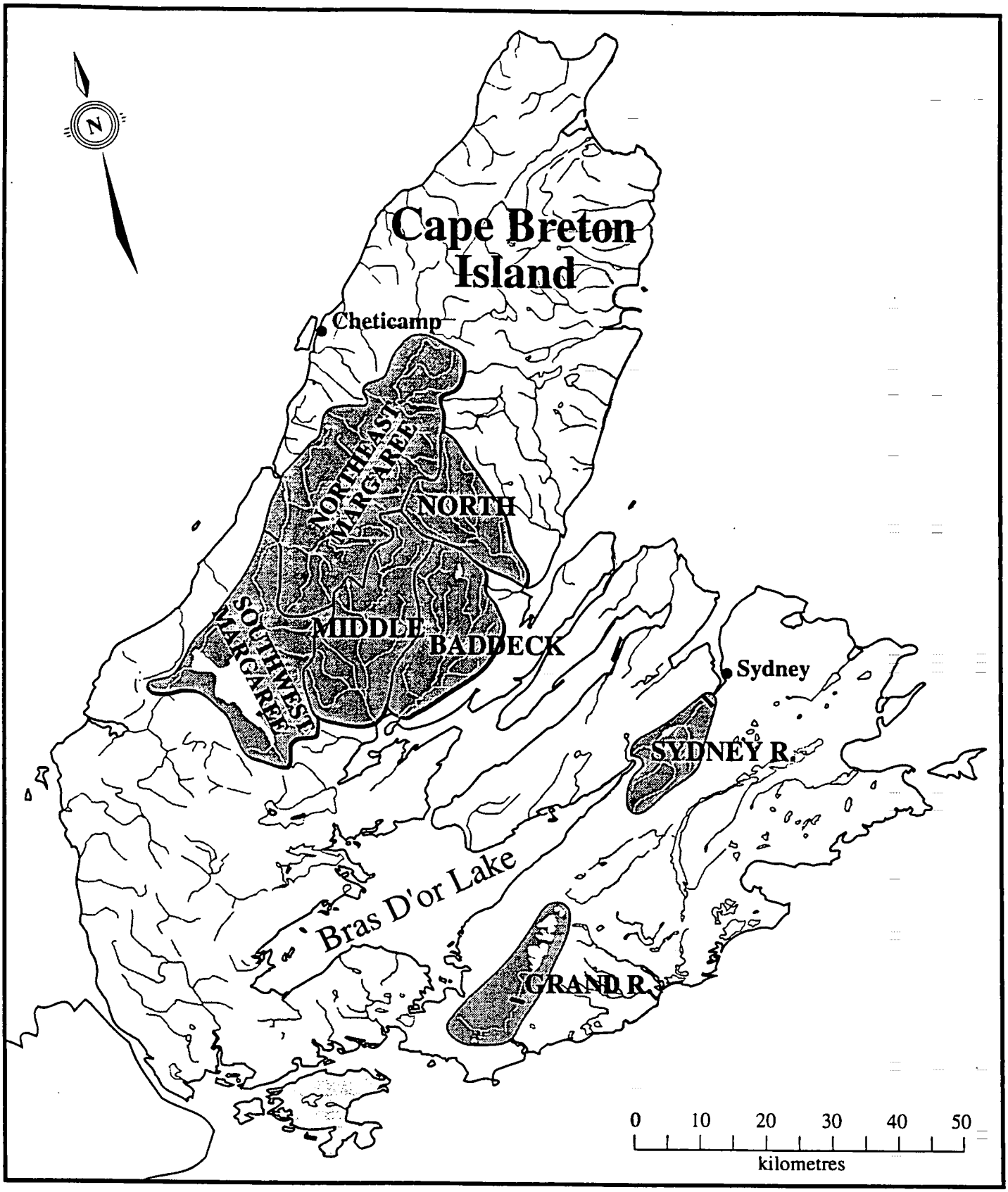


Figure 1. Cape Breton Island, showing river drainages in which Atlantic salmon stocks were assessed in 1996.

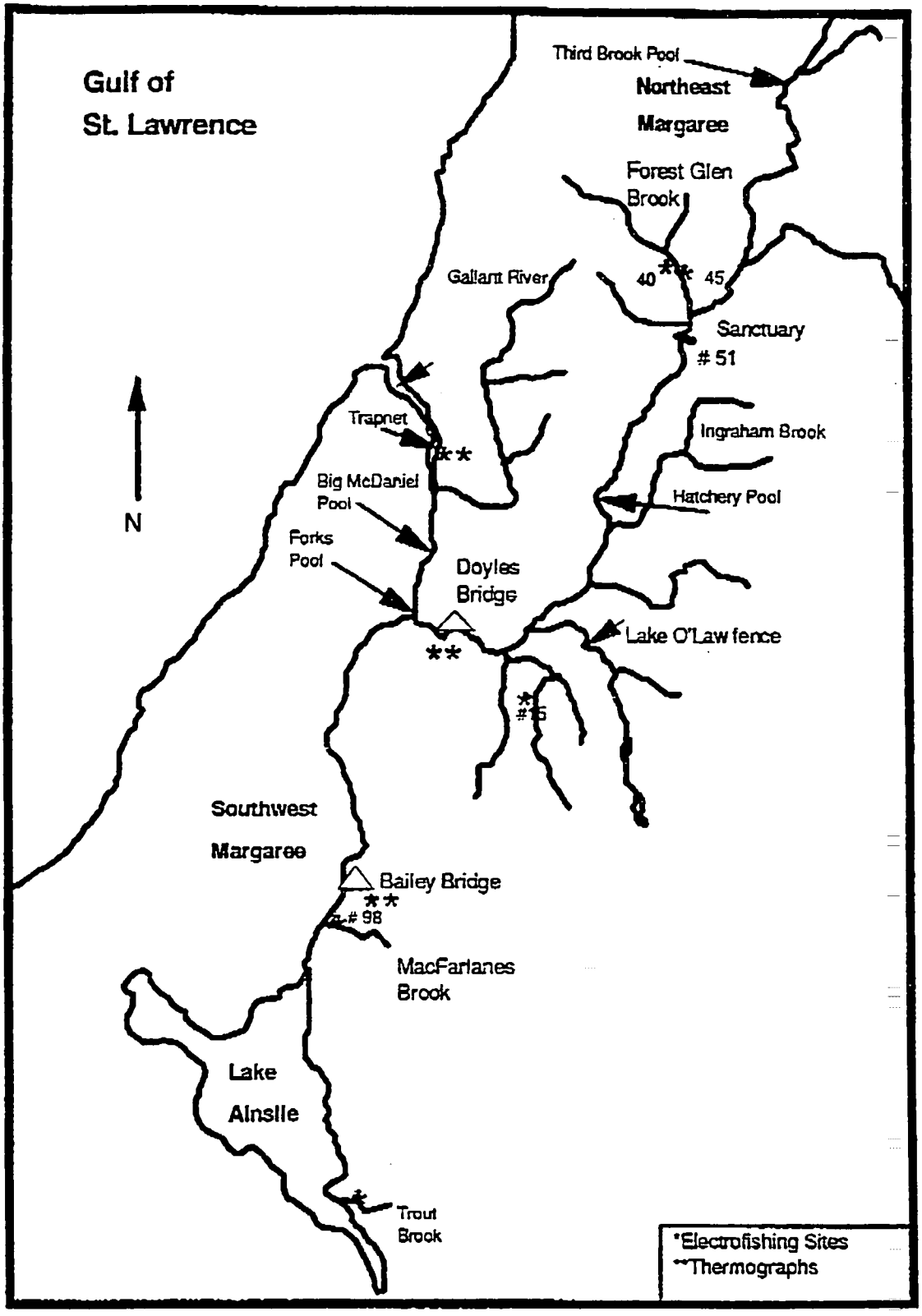


Figure 2. Margaree River, N.S. showing locations of Levi's trapnet, counting fence and electrofishing stations (*) in 1996 (from Chaput et al. MS 1994).

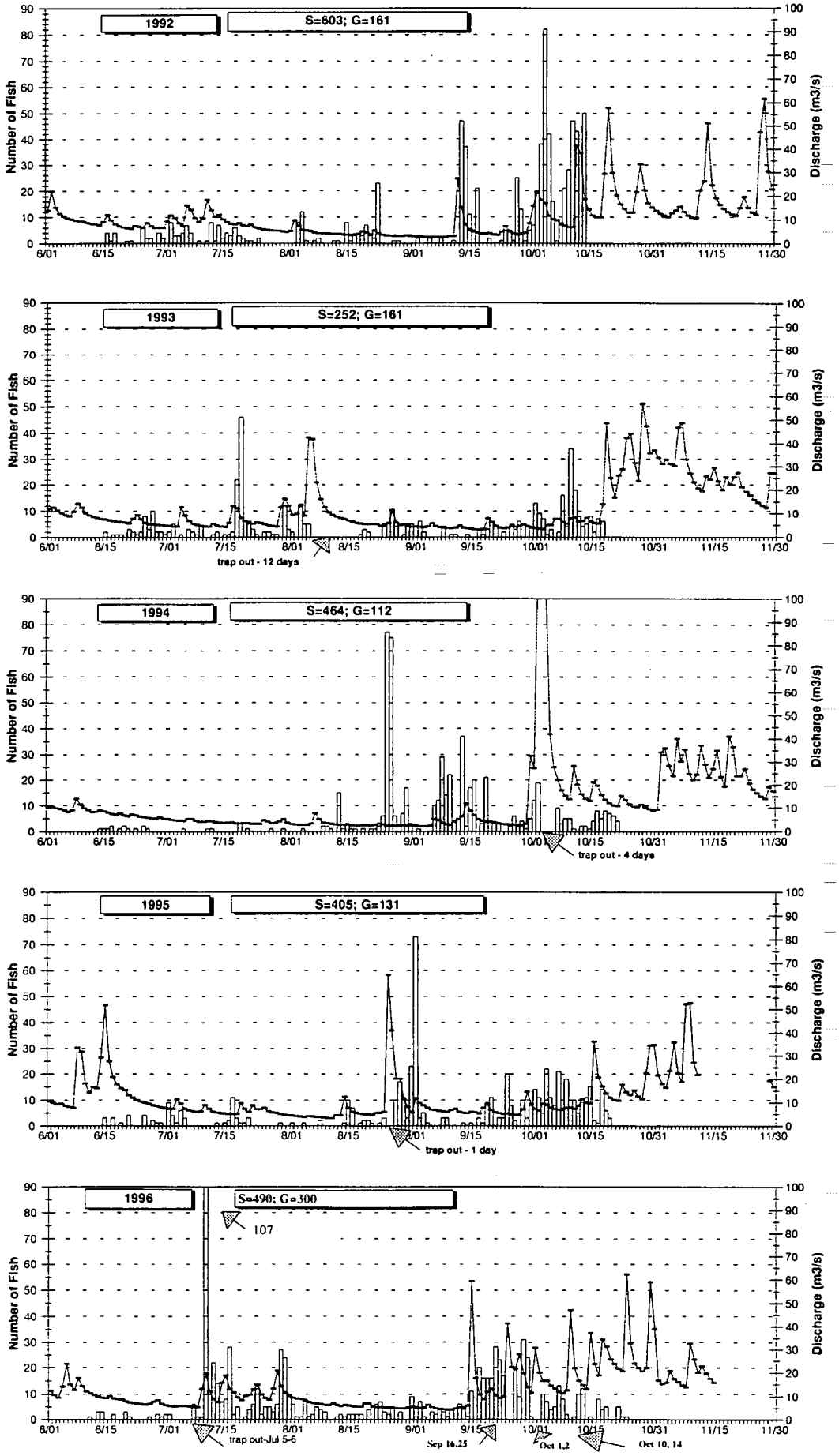


Fig. 3. Mean 24-hour discharge (m^3 s^-1) at Northeast Margaree and counts of salmon at Levi's trapnet, Margaree River, 1992-1996.

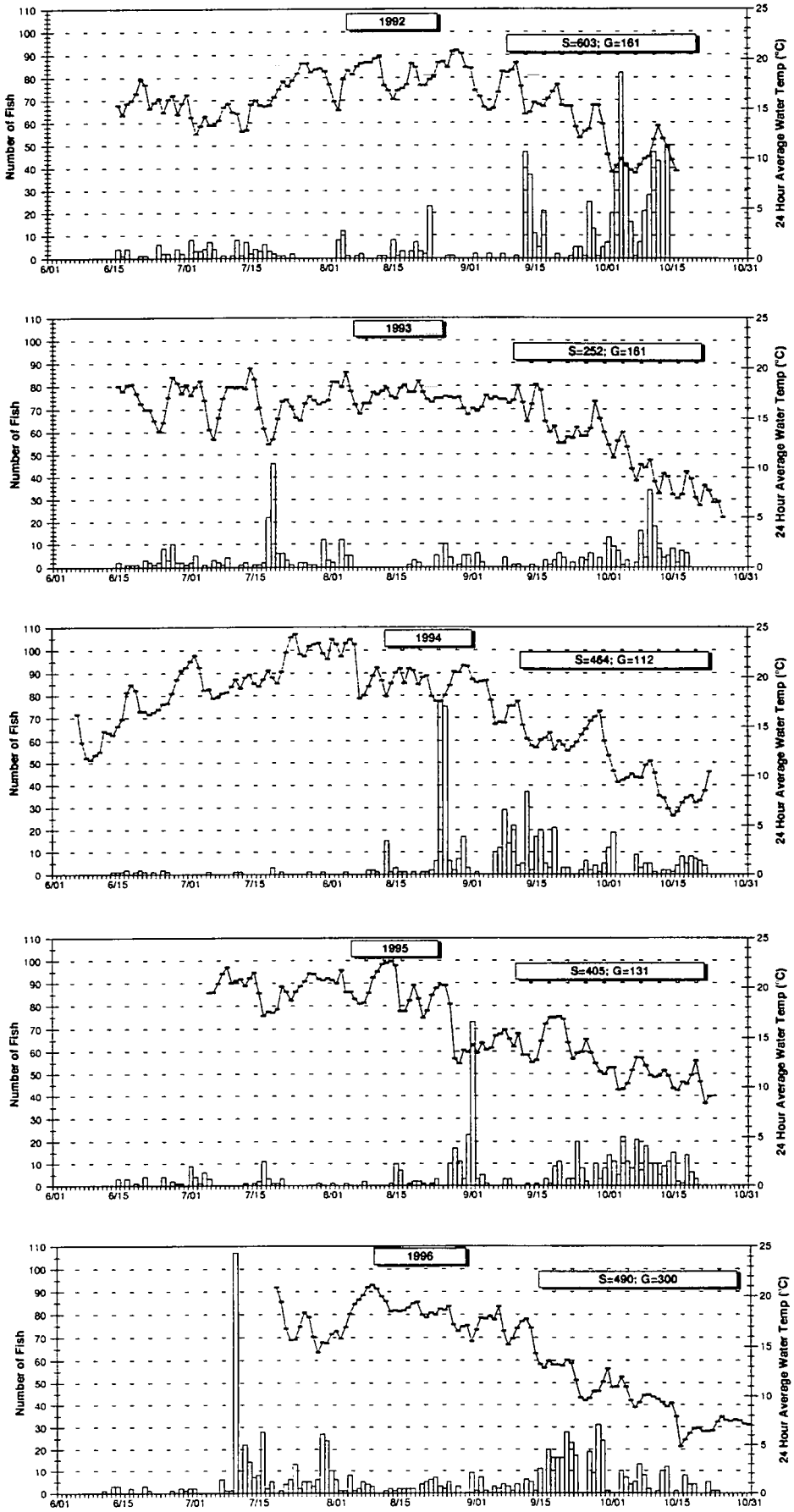


Fig. 4. Mean daily water temperatures (°C) for the Margaree estuary and Levi's trapnet counts, Margaree River, 1992-1996.

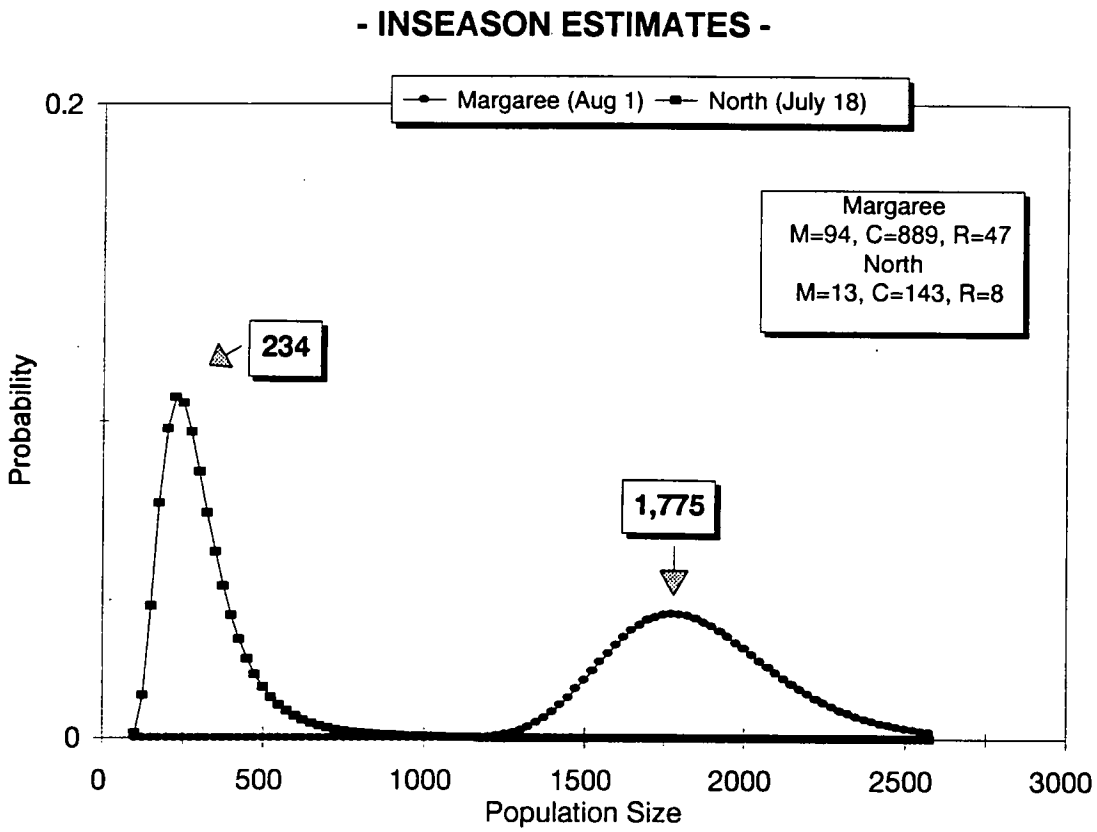
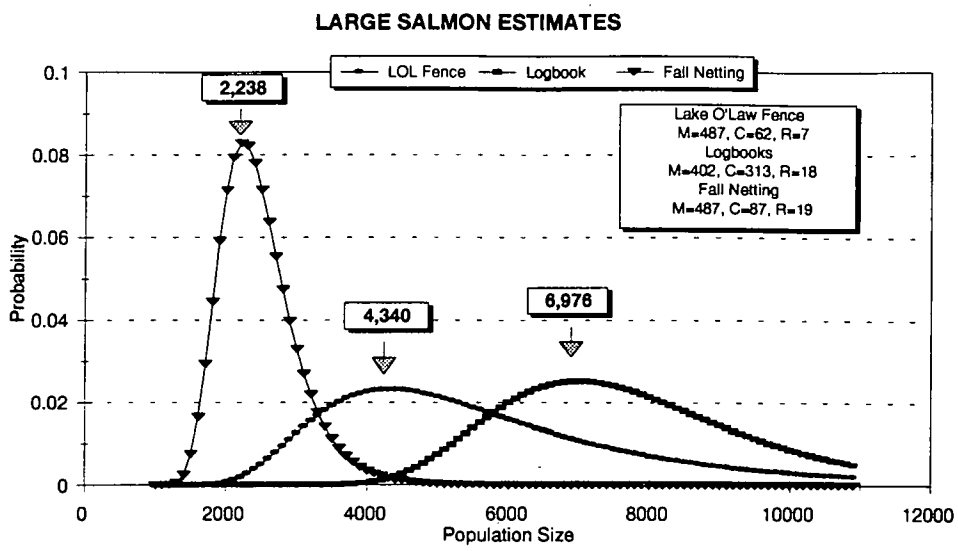
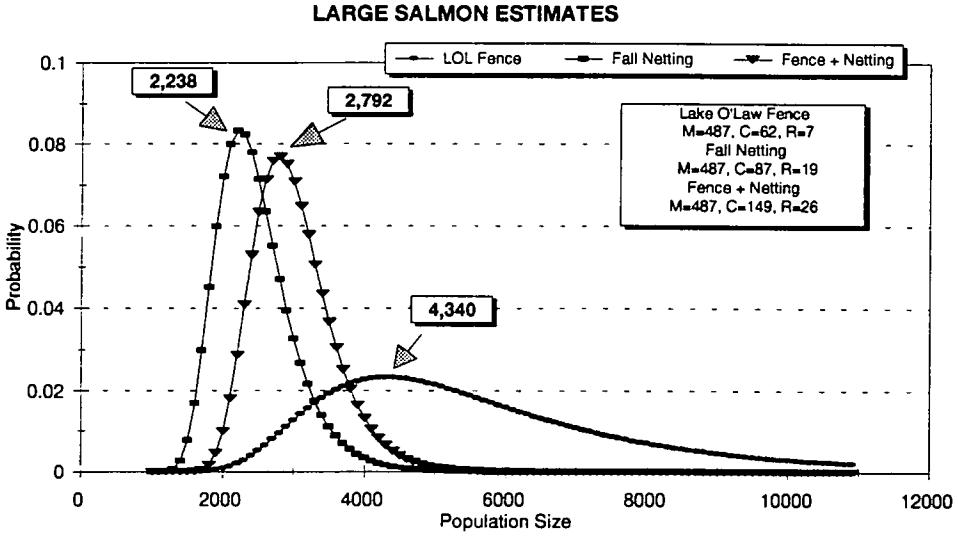


Fig. 5. Inseason estimates of small and large salmon for Margaree and North rivers based on mark-and-recapture techniques.





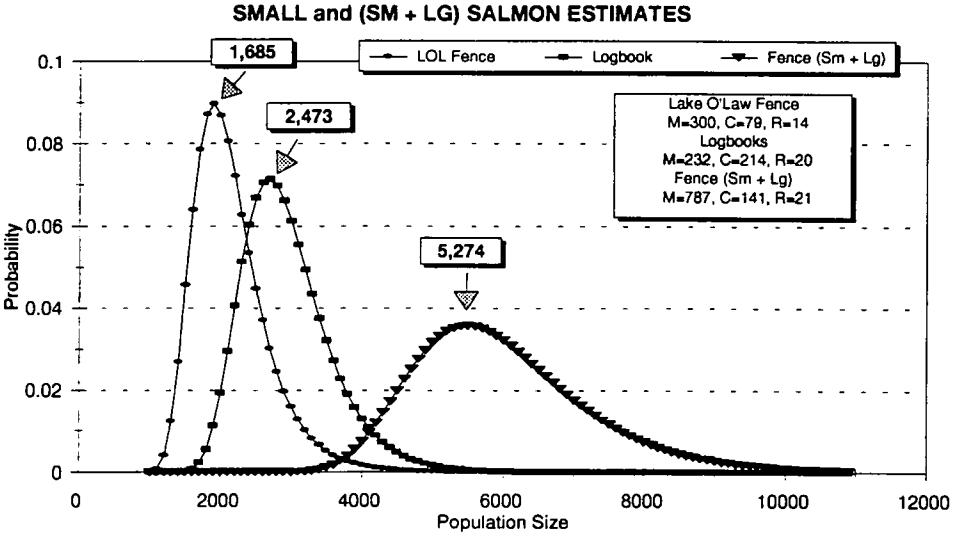
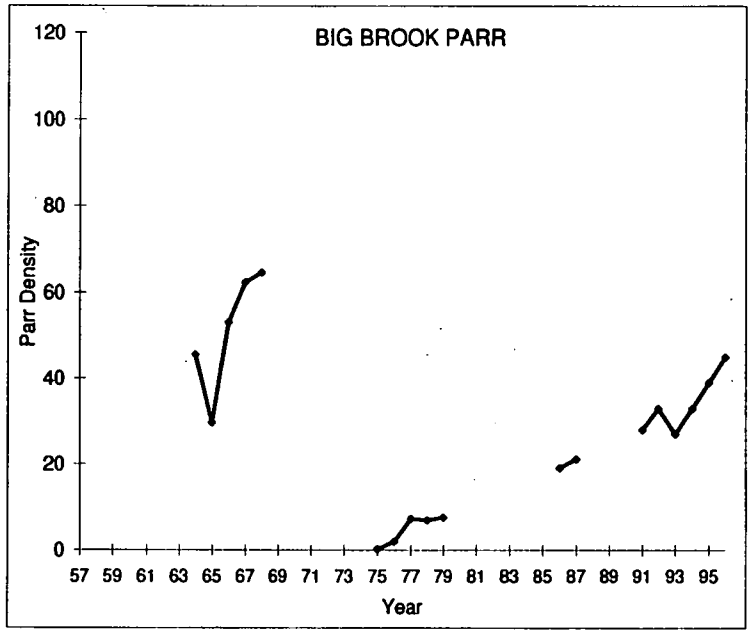
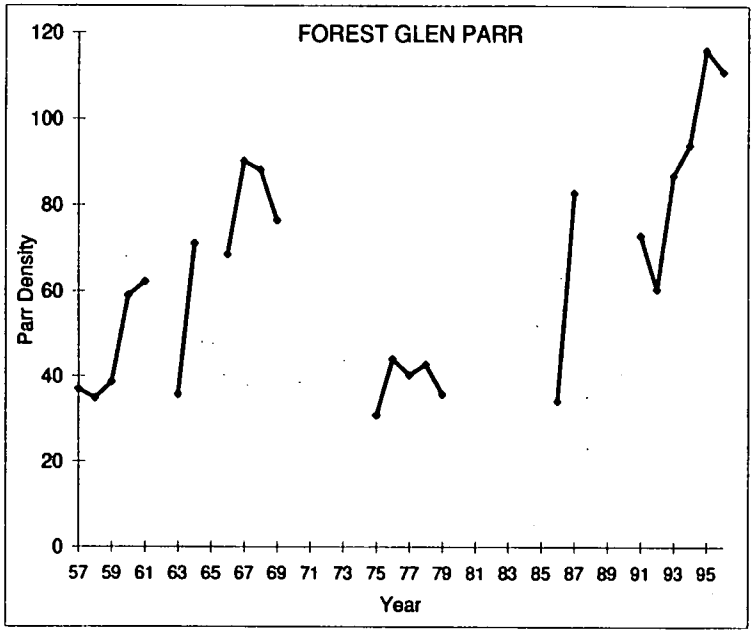
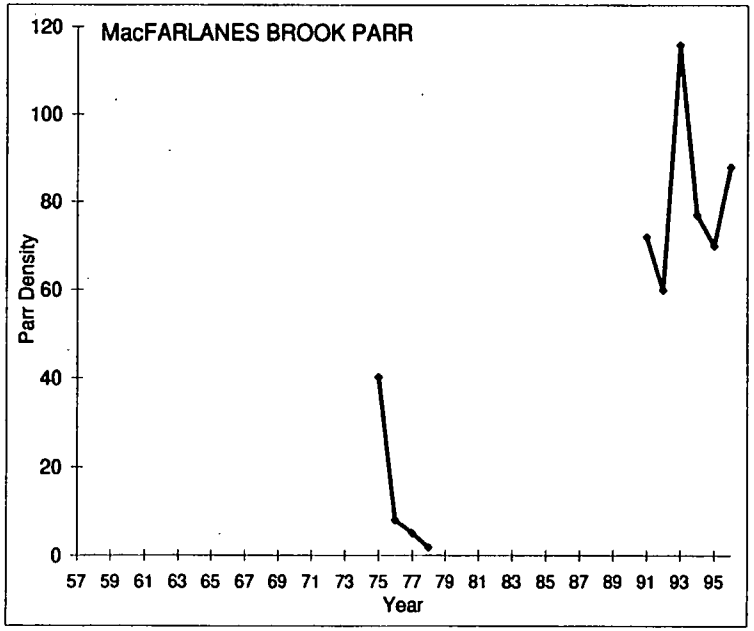


Fig. 6. Estimated returns of salmon to the Margaree River in 1996 based on mark and recapture techniques.







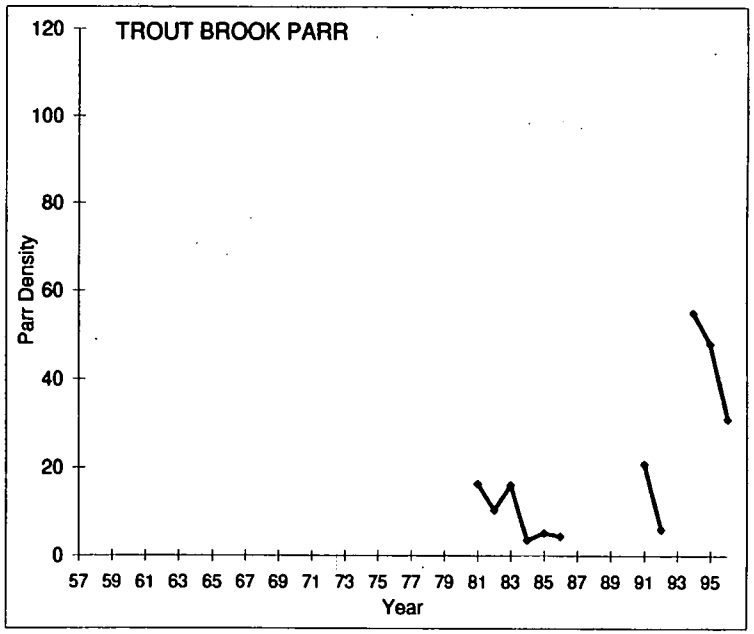
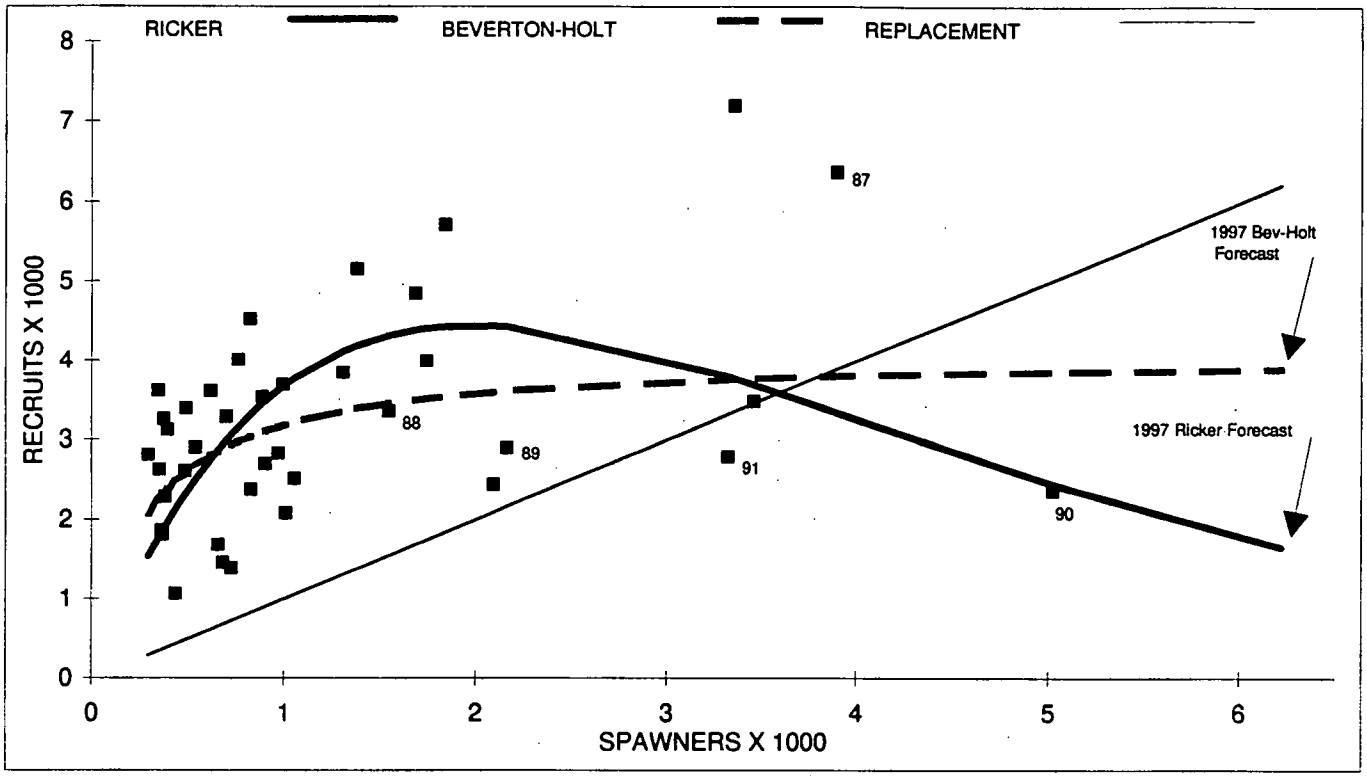


Fig. 7. Parr densities at four index sites on the Margaree River from 1957 to 1996.



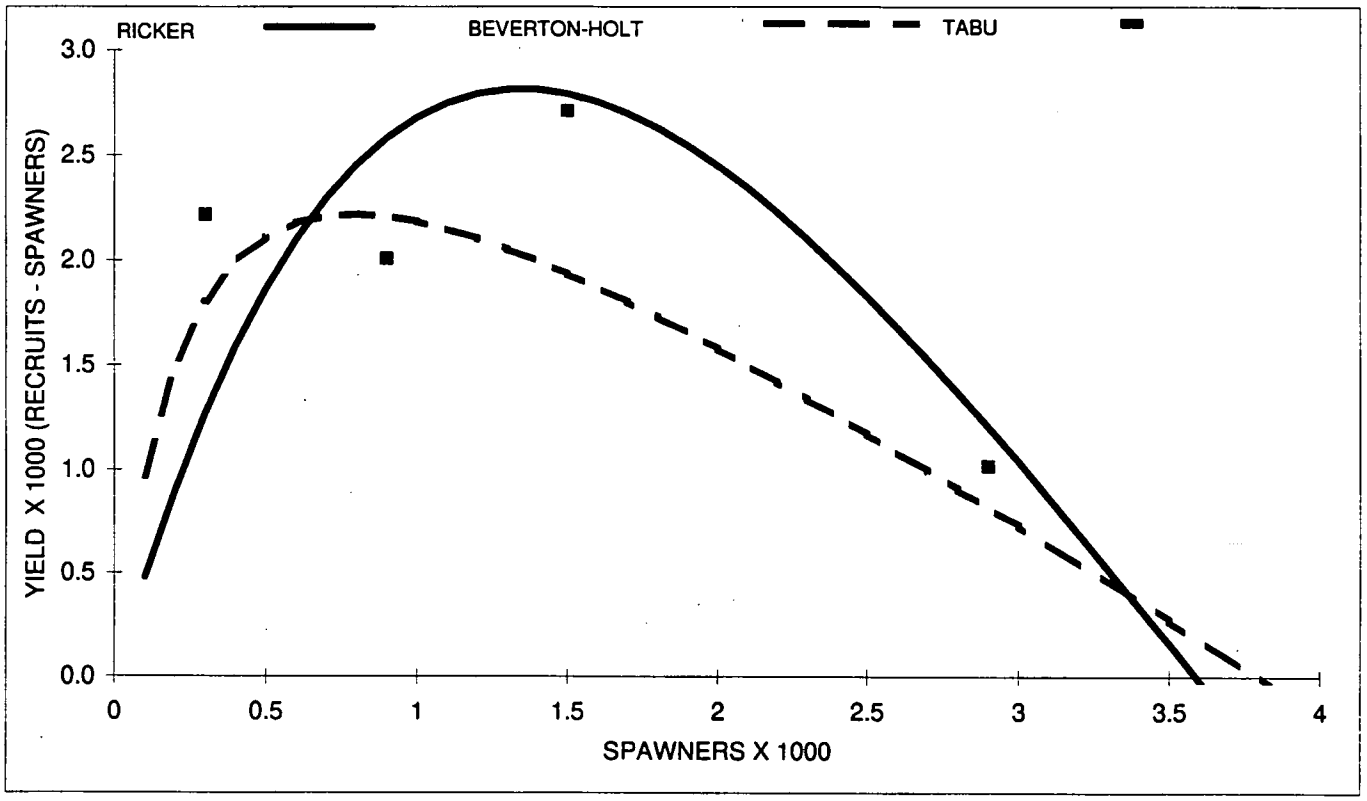


Fig. 8. Stock recruitment plot with replacement line for Ricker and Beverton-Holt models.

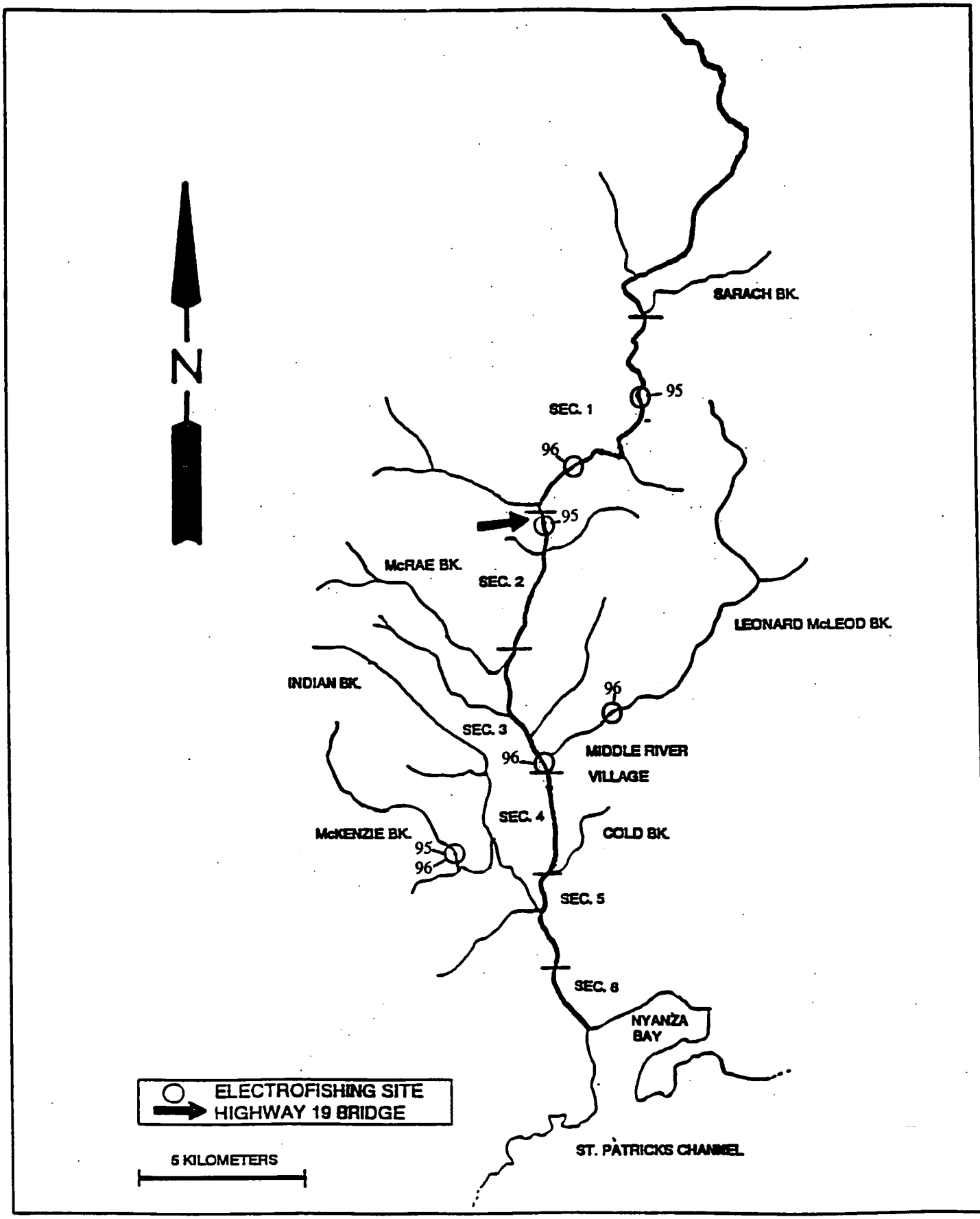


Fig. 9. Middle River, Victoria County, showing swim-thru sections and electrofishing sites in 1995 and 1996.

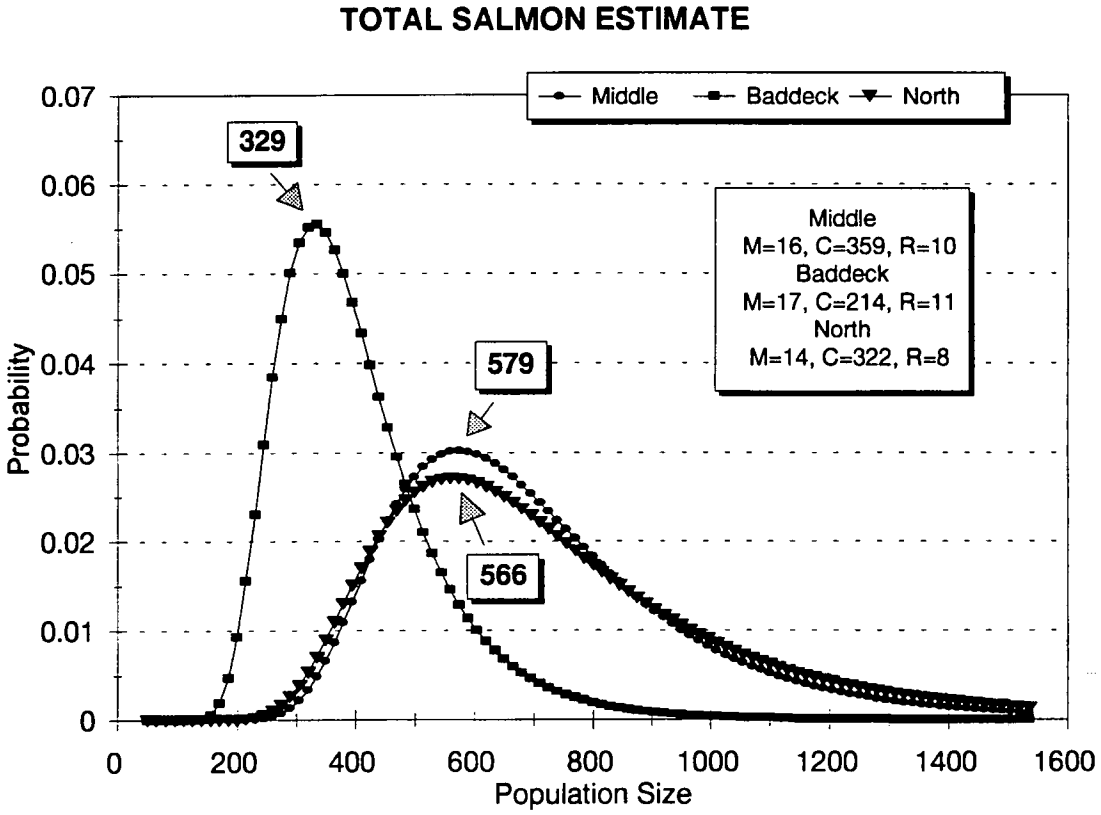


Fig. 10. Estimated returns of small + large salmon to the Middle, Baddeck, and North Rivers in 1996 based on mark and recapture techniques.

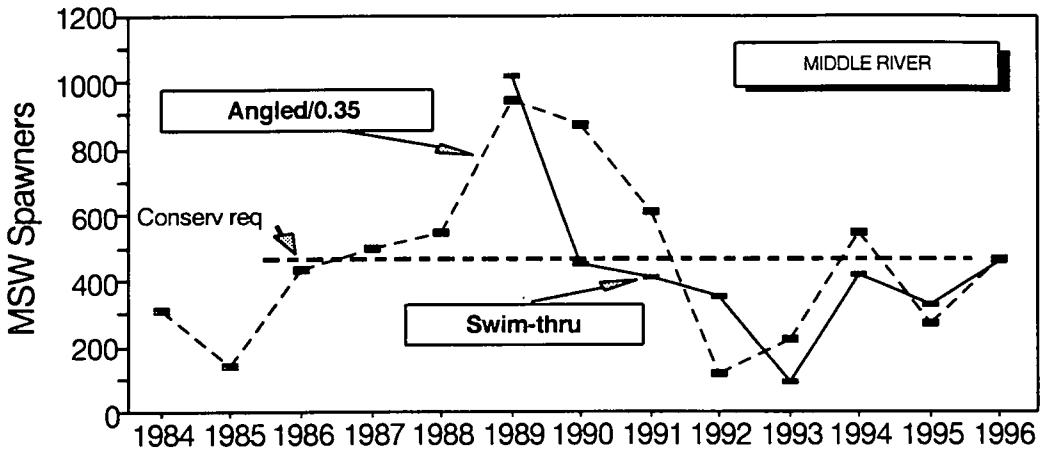


Fig. 11. Estimates of large salmon spawners in the Middle River as derived from swim-thru counts, 1989-1996, and from estimated catches by anglers, 1984 -1996.

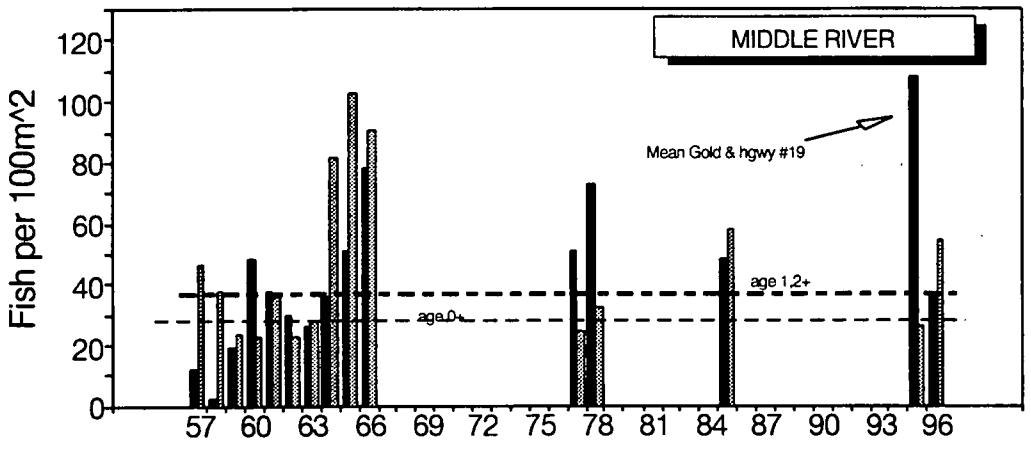


Fig. 12. Densities of age 0+ and age 1+ & 2+ parr at the Finlayson site, (except 1995), Middle River, 1957-1996. Horizontal lines are "normal" abundances of each, Elson (1967). Solid bars = age-0+ parr, light bars = age-1 &-2+ parr.

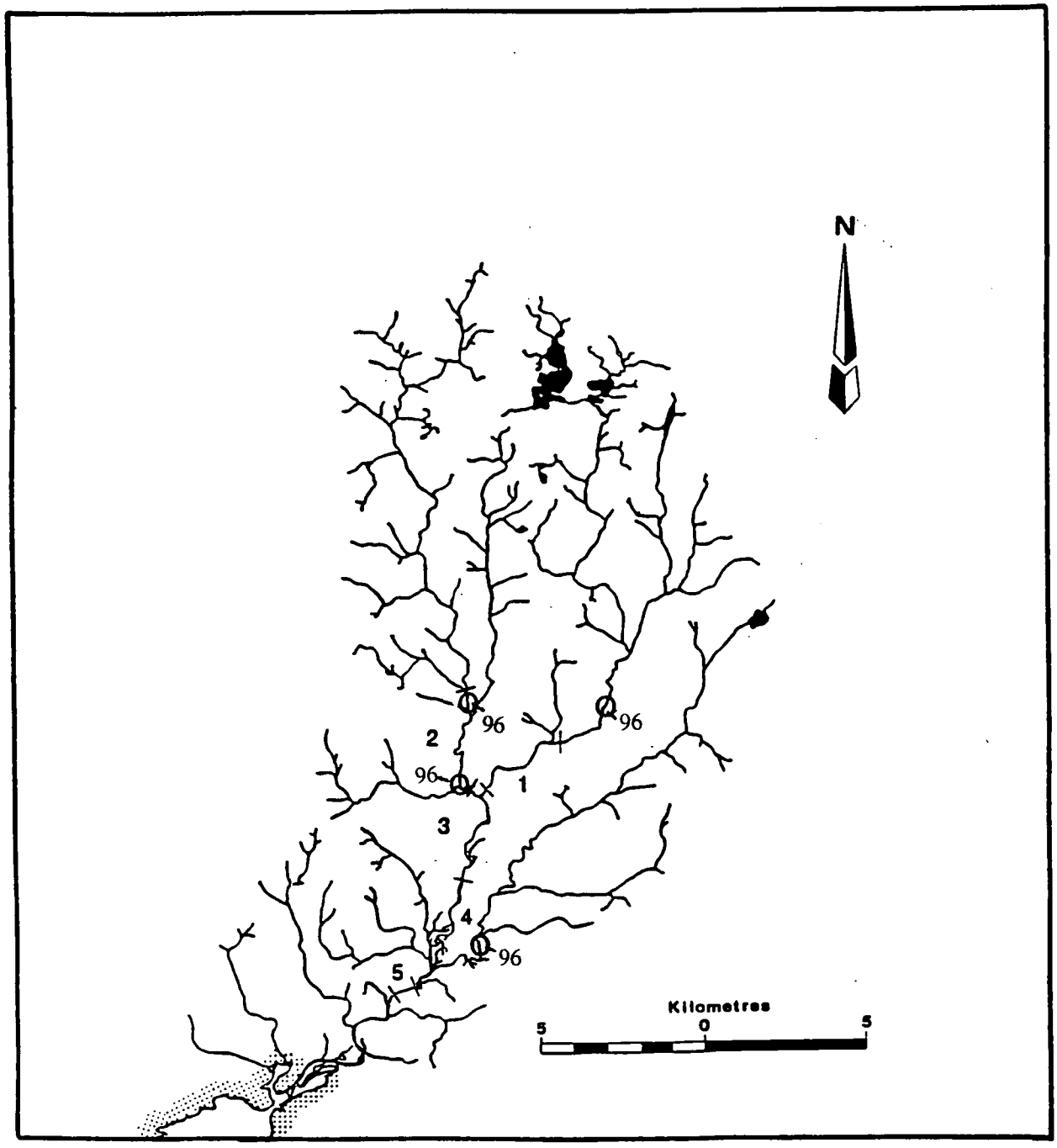


Fig.13. Baddeck River, Victoria County, showing swim-thru sections electrofishing sites in 1996.

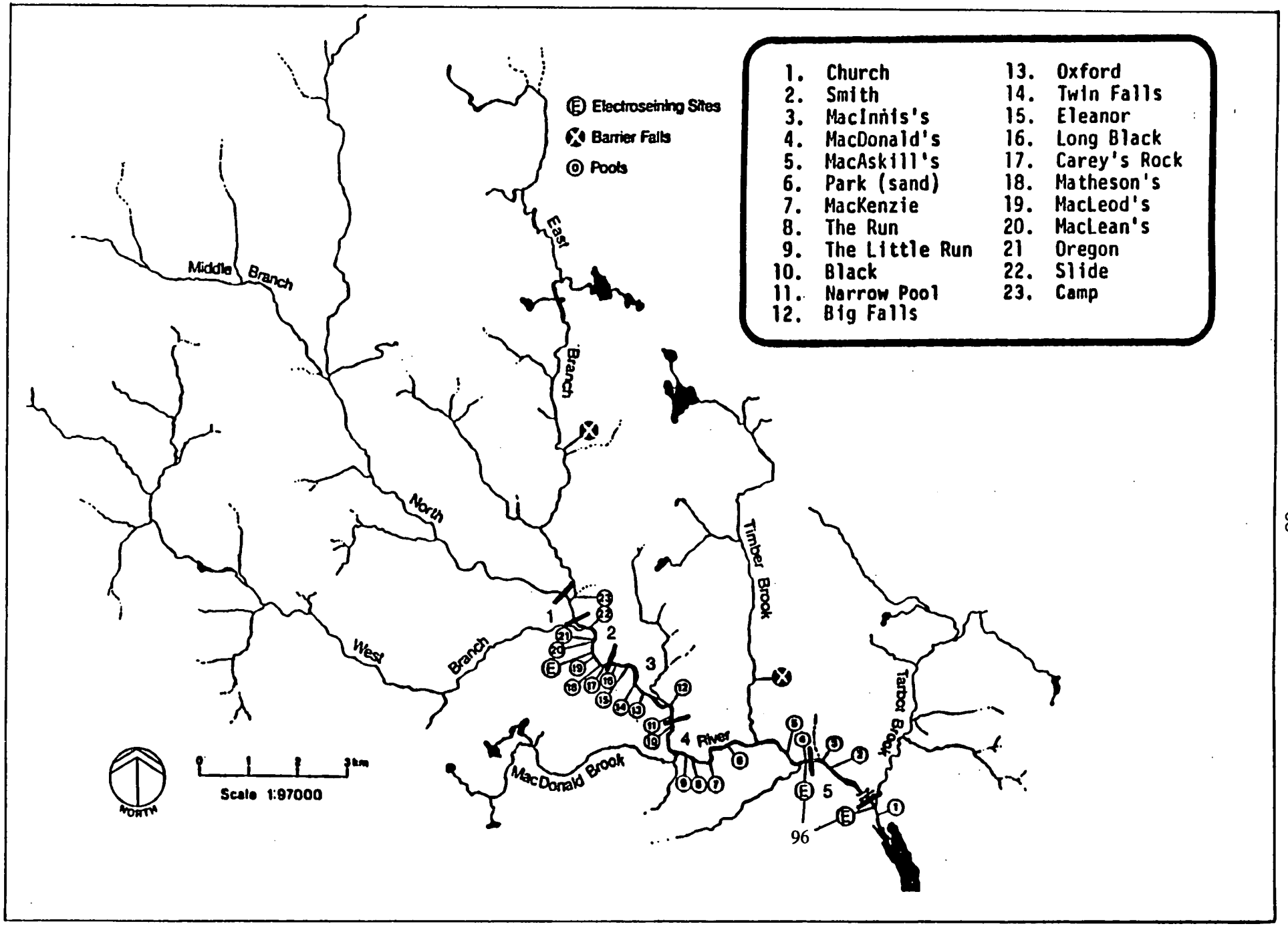


Fig.14. North River, Victoria County, showing name and location of angling pools, swim-thru sections (uncircled numbers and slash to mark section boundary) and electrofishing sites in 1996.

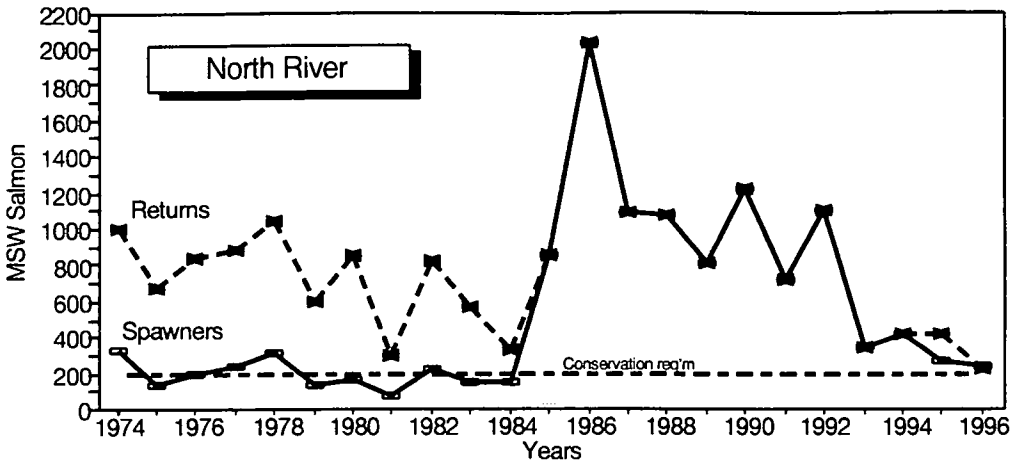


Fig. 15. Estimates of MSW salmon returning to and spawning in the North River, 1974-1996. Estimates, 1974-1994, from Amiro and Harvie MS 1996; 1994-1996 based on swim-thru counts.

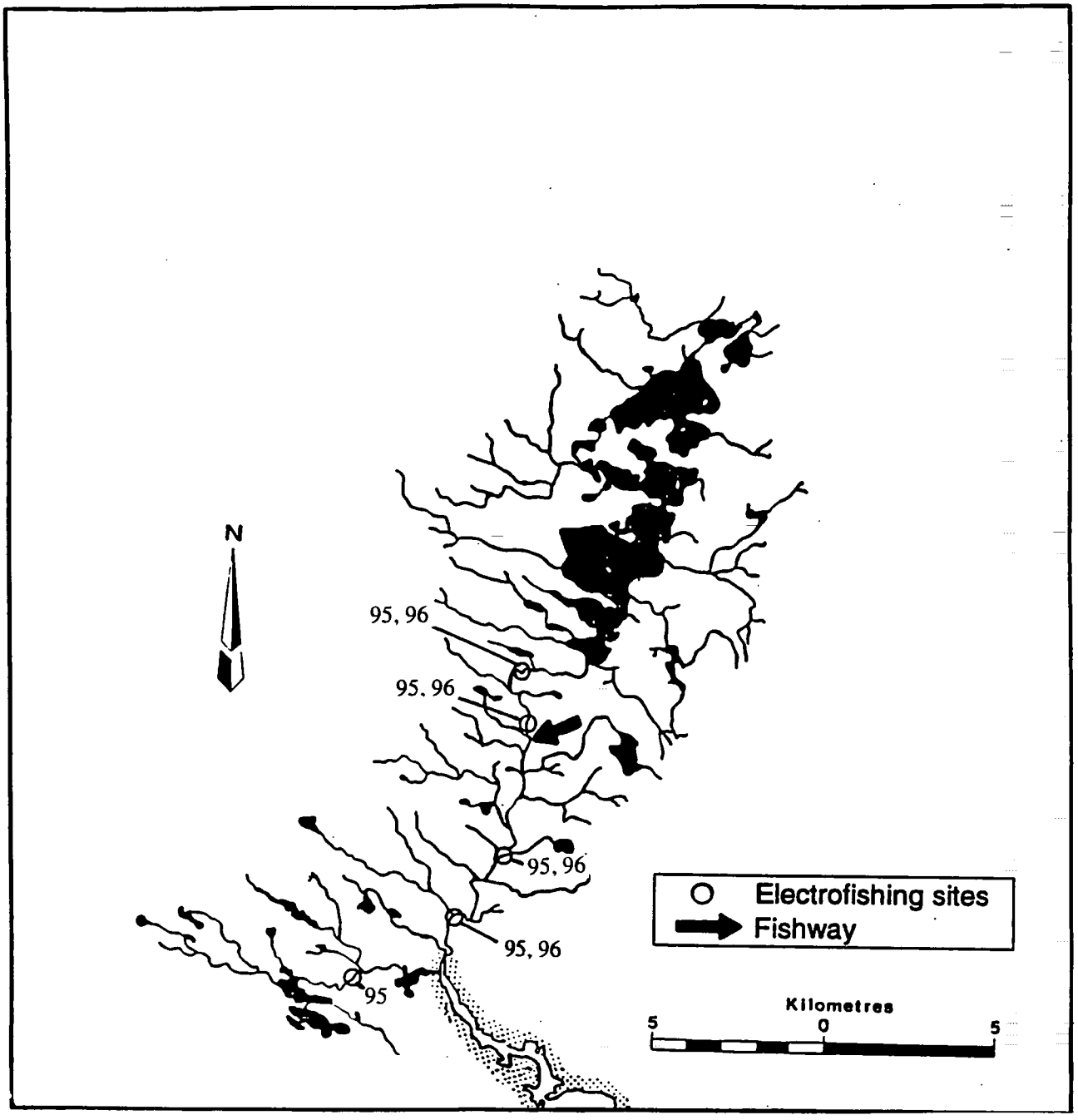


Fig. 16. Grand River, Richmond County, showing location of Grand River Falls fishway and electrofishing sites in 1995 and 1996.

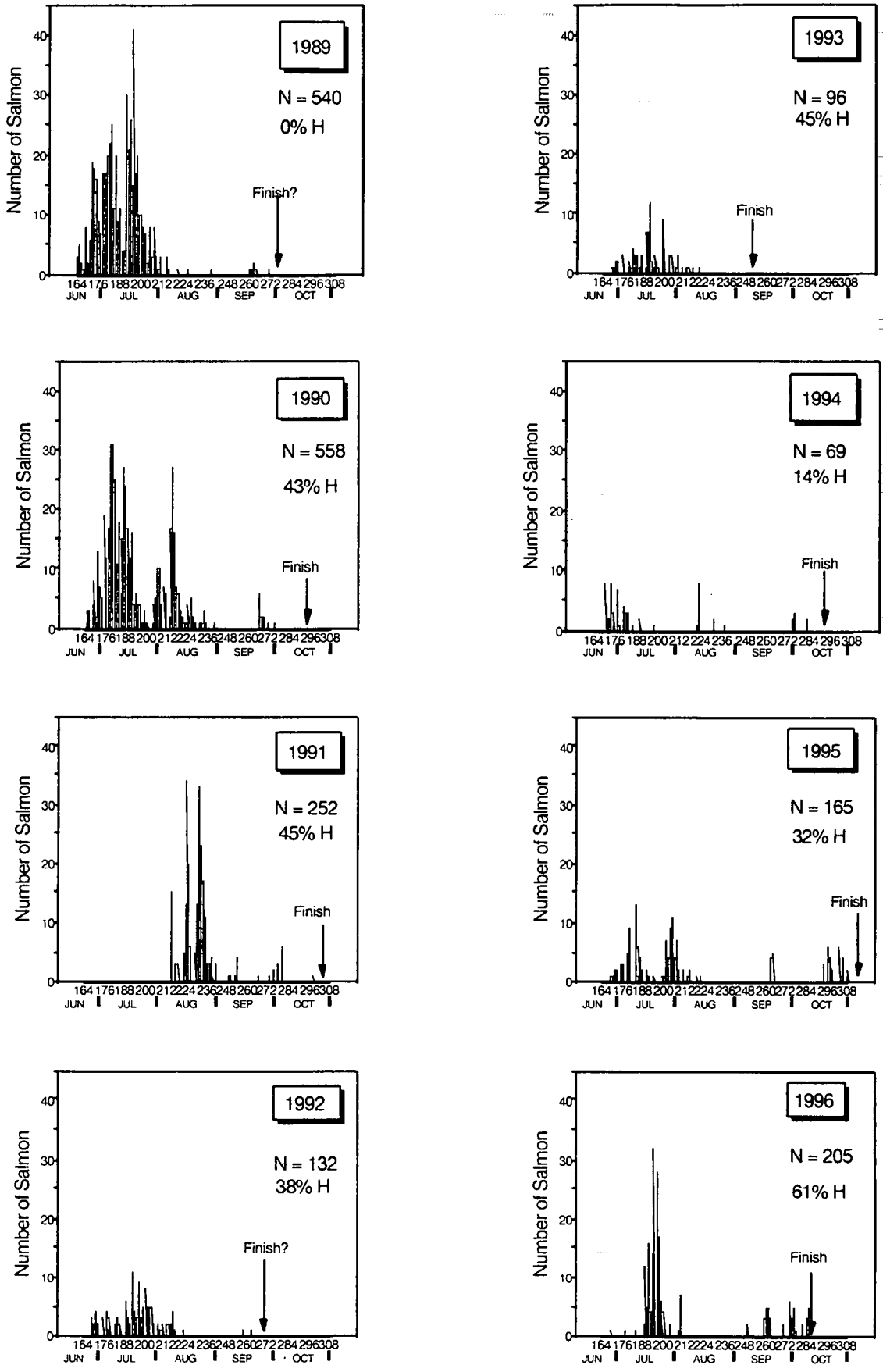


Fig. 17. Counts of salmon at the Grand River Falls fishway, June-October calendar days, 1989-1996.

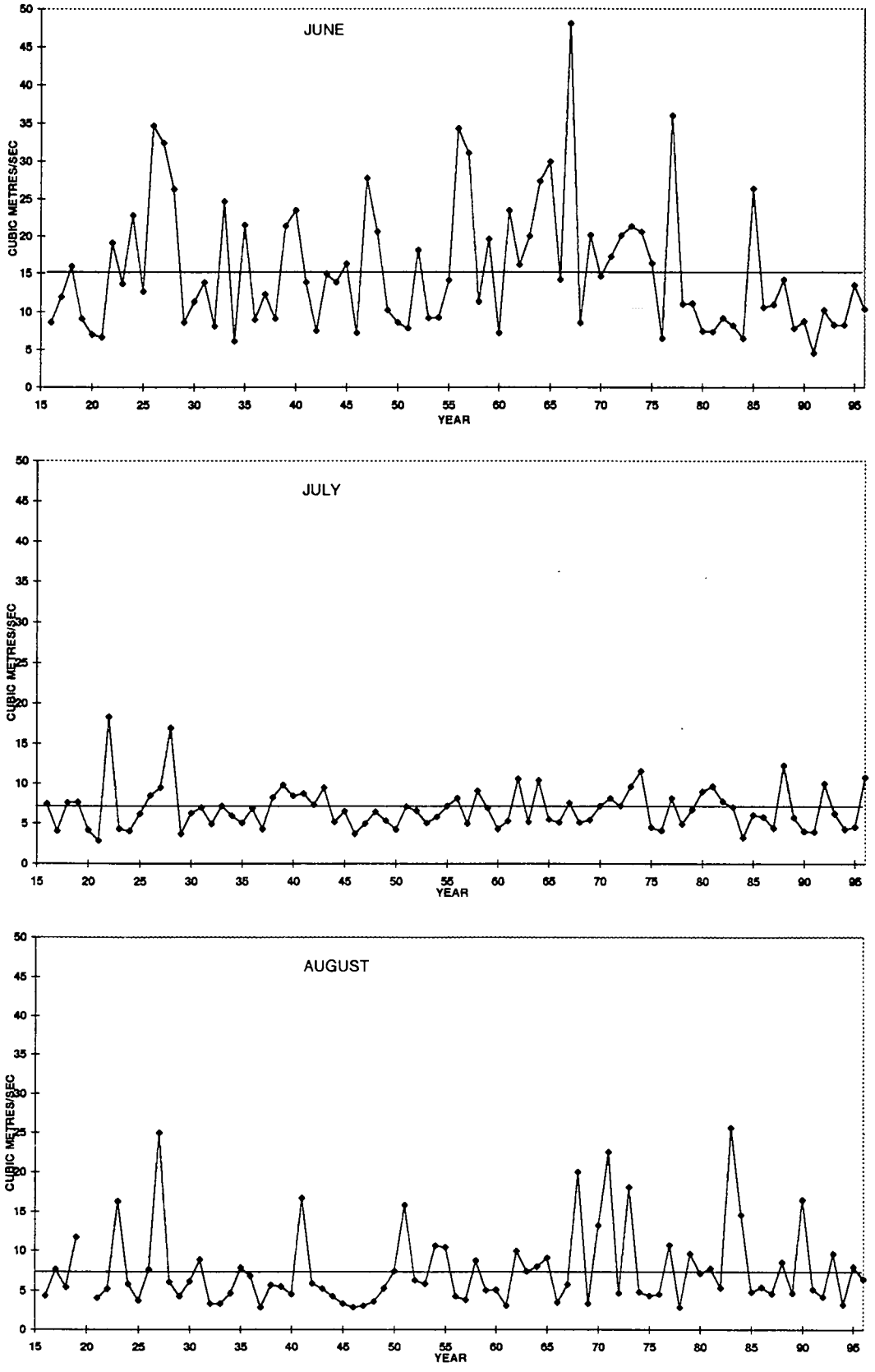


Fig. 18. Annual mean monthly discharges on Northeast Margaree. Horizontal line is long term mean.

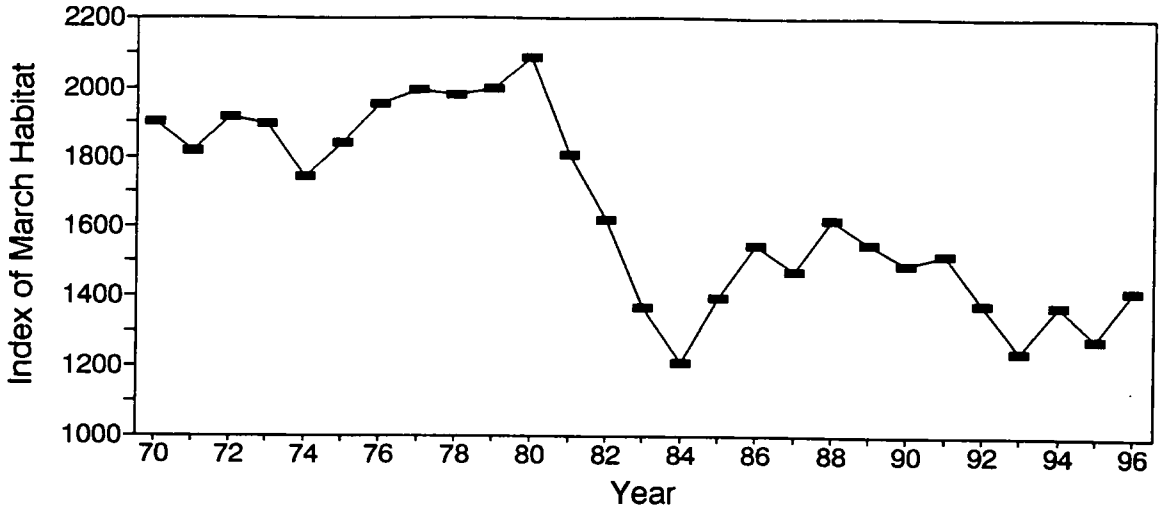


Fig. 19. March index of winter habitat in the northwest Atlantic Ocean, 1970-1996 (Anon MS 1996).

APPENDIX 1: MOVEMENT OF ULTRASONIC TAGGED ADULT ATLANTIC SALMON IN THE MARGAREE RIVER, 1995 and 1996.

Movement of summer- and fall-run wild and hatchery ISW and MSW Atlantic salmon tagged in Levi's estuarial trapnet on the Margaree River were investigated with the use of ultrasonic tags and receivers. Analysis of data are expected to provide insights[1] to: i) the origins of fish captured at Levi's trap; ii) the interpretation of mark and recapture population estimates based on fish tagged at Levi's trapnet; and iii) the use of the "sanctuary" area by summer-run fish. A pilot project was conducted in the summer and fall of 1995 and a more comprehensive study was completed in 1996.

Materials

Transmitters

Ultrasonic transmitters (pingers) transmit pulses at a fixed rate and predetermined frequency and can be used for a variety of purposes, such as monitoring the movement of fish. Pingers were inserted into the stomachs of Atlantic salmon caught in the Levi's estuarial trapnet (see Fig. 1), and their movements were recorded at monitoring stations set up at several locations along the Margaree River. The pingers used in this study were the V16 series manufactured by Vemco Limited[2], a Nova Scotian company specializing in underwater telemetry and tracking applications. The pingers were cylindrical in shape, 16 mm in diameter and 92 mm long, much of which was an epoxy-sealed lithium battery. Each pinger had a specific serial number, frequency and pulse period combination and appropriate transmitting electronics. Signal frequencies used were: 50.0, 54.0, 60.0, 65.5, 69.0, and 76.8 kHz. Pulse period ranged between 900 and 2000 milliseconds. The V16-5H pingers used in 1995 had a battery life of approximately 65 days, the V16-5L pingers used in 1996 had a battery life of approximately 150 days.

Pingers were inserted into the stomach of the fish through a rubber tube placed down the esophagus. Fish were also tagged externally with brightly colored large Carlin tags attached at the base of the dorsal fin to help with visual sighting. Biological information was collected for each fish.

Receivers

Monitoring stations were set up at several locations (Fig. 1) to detect the movement of the salmon with pingers inserted. At most sites, a VR60[3] receiver was used, positioned on the bank of the river. Two hydrophones were attached by cable and anchored approximately a hundred metres apart on the bottom of the river. Hydrophones were placed in the river such that any ultrasonically-tagged fish travelling up or downstream would be detected. The VR60 was programmed to receive and record any of the pingers being used in the study; the electronically-recorded data included the serial number, date and time of detection. The VR60 receivers were checked often (usually every day or two) with the use of a test pinger, the battery was

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[1] The purpose of this Appendix is to archive methods, data and more obvious results preliminary to further treatment, time permitting, in the DFO Technical Report Series.

[2] Vemco Limited, 100 Osprey Drive, Shad Bay, Nova Scotia, Canada

[3] VR60 receivers manufactured by Vemco Limited; two VR60s on loan from New Brunswick Power Corporation.

checked, and new pinger detection information was noted. The pinger-detection data file was usually downloaded bi-weekly.

VR20[4] submersible receivers were also used, one experimentally in Margaree Harbour in 1995; in 1996 at John Archie Pool on the Southwest Branch and at MacKenzie Pool in the Sanctuary (Fig. 1). These receivers are self-contained with the hydrophone, receiver and batteries built into the same case. VR20s were attached to a piece of metal grating, which was then anchored on the bottom of the river. VR20s can be left untended for up to five weeks and were downloaded each time the batteries were changed. Tracking was also done by boat, using a VR60 receiver and a portable hydrophone.

Methods

1995

In early July, monitoring stations were established at Margaree Harbour and Big MacDaniel Pool. These locations were chosen because pinger detection at either site would indicate the direction of passage of fish tagged and released at Levi's trapnet; i.e., upstream beyond Big MacDaniel Pool or downstream through the estuary and out of the river. Portable tracking was done outside Margaree Harbour and in sections of the river on several days in July, August and September. A VR20 was also installed, at Margaree Harbour, between September 4 and 13 and September 19 and October 23. All units were removed October 23-26.

Pingers were inserted into 11 summer-run (July 5 to 18) and 12 fall-run (August 29 to September 20) Atlantic salmon captured at Levi's trapnet.

1996

Monitoring stations were established at five locations in 1996 (mid-June to July 24): Big MacDaniel Pool, Margaree Harbour, MacKenzie Pool in the sanctuary, John Archie Pool in the Southwest Margaree and Hatchery Pool (Fig. 1). The Harbour, Big MacDaniel, Hatchery and Sanctuary sites were equipped with VR60s; two VR20s were used at John Archie Pool. One hydrophone was used at the Hatchery and Sanctuary sites, the other three sites were equipped with two hydrophones. The VR60 at MacKenzie Pool in the Sanctuary was taken out on July 23 and replaced with two VR20s that became available from the Atlantic Salmon Federation. Tracking with the portable hydrophone and VR60 was done on July 25 and August 19-20; all monitoring stations were removed between October 31 and November 6.

Pingers were inserted into 19 summer-run (June 28 - July 23) MSW Atlantic salmon captured at Levi's trapnet.

Preliminary Results

1995 Summer Run

Pingers were inserted into four 1SW and seven MSW wild salmon, between July 5 and 18 (Table 1). Nine fish (4 1SW, 5 MSW) left the river within two days of release from Levi's trapnet (Table 2). Two (MSW) of the eleven travelled upriver,

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[4] VR20s manufactured by Vemco Limited; on loan from Atlantic Salmon Federation, St. Andrews, New Brunswick.

registered on the Big MacDaniel Pool receiver and were located during tracking with the portable receiver in July and August.

Of the nine fish that left the river, five registered periodically on the Harbour receiver during July and August, but did not travel upriver. Four of these five were located just outside the Harbour entrance by portable hydrophone in August. In September two of these fish reentered the river, the first was recaptured at Levi's trapnet, the second registered at Big MacDaniel Pool and on a portable hydrophone at Twin Elms Pool (Fig. 2).

All of the four 1SW summer-run fish left the river after tagging, two are known to have returned in September before the tag batteries expired. Five of the seven MSW tagged fish left the river; it is not known if they returned at a later date.

On September 19, after the 65-day transmitters were presumed to have expired, tag frequencies of summer fish were deleted from the VR60 receivers at the Harbour and Big MacDaniel Pool. On September 22, one of these pingers was detected by the VR20, which had been installed at the Harbour on a trial basis and retained summer-fish frequencies. It is not known if this salmon travelled upriver. No other summer-run pingers were detected on the VR20 after September 22. One summer fish was detected on September 22 at Twin Elm Pool with the portable hydrophone.

1995 Fall Run

Pingers were inserted into eleven wild and one hatchery MSW salmon between August 29 and September 20 (Table 1). One of these pingers did not register anywhere after release. Nine of the 12 fish travelled upriver; the two remaining fish (1H, 1W) travelled downriver and left the river only to reenter on October 14-16 (Fig. 3).

1996 Summer Run

Pingers were inserted into six hatchery and thirteen wild MSW salmon between June 28-July 23, 1996 (Table 1). Five fish moved to Margaree Harbour within 1-2 days of release at Levi's and left the river but later returned, one in July and four in September (Table 3). Fourteen fish travelled upriver immediately after release from Levi's. In July, 16 of the 19 tagged fish had been registered below Forks Pool in the lower portion of the river (Fig. 4). In August, many of the fish remained in the lower portion of the river (Fig. 4). Seven fish were found at or downriver of the Forks Pool. Three had moved upriver, one of the three was detected at the Swimming Hole, one was hooked and released by an angler at Etheridge Pool (then travelled to the Sheer Dam Pool), and one fish was detected at the Hatchery Pool. In September, the four fish returned that had left the river after tagging in July (Fig. 4). A total of six fish travelled upriver in August and September and registered at the Hatchery Pool. One of these fish travelled to MacKenzie Pool at the Sanctuary, then returned to the Hatchery Pool. Four fish were still located at/near Big MacDaniel Pool in September. By October and early November, a total of seven fish had registered at the Hatchery Pool; four of these fish had also travelled to the Sanctuary (Fig. 4). Four fish remained downriver, two entered the Southwest Margaree, one stayed in Big MacDaniel Pool, and one remained in the main Margaree between Big MacDaniel Pool and the SW Margaree.

One of six (16.7%) hatchery-origin salmon left the river after tagging, returning on September 12. Four of 13 (30.8%) wild-origin salmon left the river, one returned on July 28 and three returned on September 9, 11 and 25.

Summary

1995

July-tagged and late-August/September-tagged fish reacted differently. Nine of the eleven July fish left the river after being released at Levi's, five of them holding just outside the Harbour entrance. Summer discharges in 1995 were low and temperatures warm relative to other years - river conditions amenable to entry are first noticed in late August (Figs. 3 and 4 this document). Experimental effect of tagging on fish behaviour in stressful circumstances is unknown.

Of the nine July fish that left the river after tagging, two re-entered and ascended the river in September, a third registered on the Harbour VR20; it is not known if this fish travelled upriver. It is unknown if the remaining six fish reentered the river at a later date.

Of the 12 fall-run salmon, eleven were known to remain in the river. This is consistent with more favorable water discharge and temperatures, and the proximity to spawning.

1996

Of the nineteen fish tagged in 1996, eleven were known to be in the river when the study concluded in early November. One pinger was found on the shore at Forks Pool, date unknown. The seven other pingers, which had travelled upriver after release from Levi's trapnet, could not be found; three of these were last detected in July at Big MacDaniel and Forks pools; three were last detected in August at Forks Pool, Sheer Dam and Gillis Island; and one last registered at Big MacDaniel in September. These fish may have been lost to angling, poaching, predation or natural mortality or the tags may have failed or been regurgitated. There was no known regurgitation of tags inserted into small (1SW) salmon in 1995 and few are known to have occurred among 72 MSW salmon carrying similar tags on the Saint John River. It is possible that some of these fish could have travelled up the Southwest Margaree before the monitoring station was installed on July 24. It is also possible, although unlikely, these fish could have passed by monitoring stations between monitoring sequences and not beenetected.

Seven of the eleven known tagged fish in the 1996 Margaree study travelled upriver, four of the seven to the sanctuary (headwater) area. The first fish was detected at the Sanctuary on September 20, two in late October and one in early November, suggesting some July entries utilized the Sanctuary area, but perhaps not immediately upon entering the river. Four of the eleven known tagged fish stayed in the lower river. Summer discharges in 1996 were higher and temperatures cooler relative to other years (Figs 3 and 4, this document).

Results from the 1995 and 1996 summer-run tagging appear to differ. In 1995, nine of eleven (82%) fish left the river after tagging; it is known that two of these fish reentered the river before their batteries expired; it is not known if the remaining seven reentered at a later date or were perhaps of non-Margaree origin. In 1996, five of the nineteen (26%) left the river after tagging, all of these fish reentered the river, one in July and the remaining four in September. All of the nineteen fish tagged in 1996 appeared to be of Margaree origin.

Ultrasonic Tag Information					Biological Information	
Serial Number	Date Installed	Frequency (KHz)	Pulse Period (mSec)	Carlin Tag # (Yellow)	Hatchery/ Wild	Fork Length
Summer Run 1995						
9457	5-Jul	65.5	1156	3903	W	52.7
9460	5-Jul	69.0	1158	3904	W	53.4
9462	5-Jul	76.8	1107	3902	W	79.8
9463	5-Jul	76.8	1160	3901	W	83.0
9470	17-Jul	65.5	1063	3909	W	71.0
9484	18-Jul	65.5	1250	3910	W	72.0
9485	13-Jul	65.5	1297	3907	W	72.0
9486	4-Jul	65.5	1344	3900	W	89.7
9487	5-Jul	69.0	1247	3906	W	57.5
9488	5-Jul	69.0	1291	3905	W	55.4
9491	17-Jul	76.8	1307	3908	W	72.0
Fall Run 1995						
1957	18-Sept	65.5	1031	3913	W	70.0
1958	19-Sept	65.5	1125	3917	W	73.7
1959	20-Sept	65.5	1219	3918	H	78.0
1960	19-Sept	69.0	1043	3915	W	94.5
1961	19-Sept	69.0	1159	3916	W	76.0
1962	20-Sept	69.0	1275	3919	W	76.0
9454	29-Aug	60.0	1161	N/A	W	76.8
9471	29-Aug	76.8	1000	N/A	W	78.9
9481	29-Aug	60.0	1263	N/A	W	77.0
9482	2-Sept	60.0	1314	3911	W	75.8
9489	19-Sept	69.0	1351	3914	W	87.8
9490	15-Sept	76.8	1253	3912	W	92.7
Summer Run 1996						
2520	28-Jun	60.0	1000	3921	W	82.5
2521	7-Jul	60.0	1050	3922	W	75.0
2522	7-Jul	60.0	1100	3923	H	70.2
2523	7-Jul	60.0	1150	3924	H	70.6
2524	7-Jul	60.0	1200	3925	W	73.4
2525	10-Jul	65.5	1031	3926	W	77.8
2526	10-Jul	65.5	1078	3927	H	78.0
2527	10-Jul	65.5	1125	3928	H	68.5
2528	10-Jul	65.5	1172	3929	W	71.8
2529	10-Jul	65.5	1219	3930	W	77.8
2530	10-Jul	69.0	1044	3931	H	78.0
2531	10-Jul	69.0	1101	3932	H	74.0
2532	10-Jul	69.0	1159	3933	W	80.0
2533	10-Jul	69.0	1217	3934	W	75.8
2534	10-Jul	69.0	1275	3935	W	79.0
2566	10-Jul	76.8	1000	3936	W	84.5
2567	22-Jul	76.8	1200	3937	W	74.5
2568	22-Jul	76.8	1500	3938	W	73.5
2569	23-Jul	76.8	2000	3939	W	82.5

Table 1. Biological and tagging information for Margaree Atlantic salmon ultrasonic tracking study, 1995 and 1996.

Table 2. Summary of 1995 Margaree Atlantic salmon ultrasonic tracking detections.

Pinger Serial No.	Date Installed	1st Registered Where	1st Registered When	2nd Registered Where	2nd Registered When	3rd Registered Where	3rd Registered When	4th Registered Where	4th Registered When	5th Registered Where	5th Registered When	6th Registered Where	6th Registered When
Summer													
9457	05-Jul	Blw old lower trap	05-Jul	Harbour	06-Jul	outside Harbour	05-Aug	Harbour	11-Aug	Big MacDaniel	19-Sep	Twin Elm	22-Sep
9460	05-Jul	Harbour	06-Jul										
9462	05-Jul	Levis Trapnet	05-Jul	Harbour	07-Jul								
9463	05-Jul	Levis Trapnet	05-Jul	Harbour	07-Jul								
9470	17-Jul	Harbour	18-Jul	Harbour	19-Jul	Harbour	22-Jul						
9484	18-Jul	Harbour	19-Jul	Harbour	06-Aug	Harbour	10-Aug	outside Harbour	11-Aug	Harbour	22-Sep		
9485	13-Jul	Barracks	14-Jul	Big MacDaniel	16-19 Jul	Big MacDaniel	21-Jul	Big MacDaniel	25-Jul	Forks	26&28Jul	Forks	4&11 Aug
9486	04-Jul	Harbour	05-Jul	Levis Trapnet	05-Jul	Harbour	07-Jul						
9487	05-Jul	Blw Levis bridge	05-06 Jul	Harbour	12-Jul	Harbour	20&23Jul	Harbour	11-Aug	outside Harbour	11-Aug	Levis Trapnet	01-Sep
9488	05-Jul	Harbour	06&10Jul	Harbour	11&22Jul	Harbour	03-Aug	outside Harbour	05-Aug	Harbour	06-Aug		
9491	17-Jul	Long Marsh	19-Jul	Long Marsh	23-Jul	Big MacDaniel	03-Aug						
Fall													
1957	18-Sep	Big MacDaniel	19-Sep										
1958	19-Sep	Big MacDaniel	20-Sep										
1959	20-Sep	Harbour	21-Sep	Harbour/Levis Bdg	23-Sep	Harbour/Levis Trap	24-Sep	Harbour	16-Oct	Big MacDaniel	17-Oct		
1960	19-Sep	Big MacDaniel	19-Sep	Forks	22-Sep								
1961	19-Sep	Big MacDaniel	20-Sep	Snag	22-Sep	Big MacDaniel	24-Sep	Big MacDaniel	27-Sep	Big MacDaniel	28/9-26/10		
1962	20-Sep	Harbour	21-22Sep	Harbour	24-Sep	Harbour	27-Sep	Harbour	14-Oct	Big MacDaniel	15-Oct		
9454	29-Aug	Big MacDaniel	30-Aug	Long	31-Aug	Big MacDaniel	01-Sep	Big MacDaniel	7-8,11Sep	Forks	22-Sep		
9471	29-Aug												
9481	29-Aug	Big MacDaniel	30-Aug	Tanner Run	31-Aug	Wash	22-Sep						
9482	02-Sep	Big MacDaniel	03-Sep	Hatchery	09-Sep								
9489	19-Sep	Big MacDaniel	20-Sep	Wash	22-Sep								
9490	15-Sep	Big MacDaniel	16-Sep	Etheridge	22-Sep								

Pinger 9487 caught/sacrificed at Levis Trapnet Sep 1

Tracking Stations: Harbour
Big MacDaniel Pool

Tracking with portable unit

Jul 5 - lower river
Jul 19 - lower river
July 23 - Big MacDaniel to Levis Bridge
Jul 26 - Doyles Bridge to Gillis Island
Jul 28 - Tidal Pool to outside Harbour
Aug 4 - SW (Creamery Brdg) and Forks, Doyles Bridge
Aug 5 - outside Harbour
Aug 11 - Brook Pool to Snag Pool
Aug 11 - outside Harbour
Aug 16 - outside Harbour
Aug 30 - Tidal Pool to 1km outside Harbour
Aug 31 - Brook Pool to Snag Pool
Sep 9 - Hatchery Pool to below Red Bank
Sep 21 - Sanctuary to Hatchery
Sep 22 - Hatchery Pool to Gillis Island

Table 3. Summary of 1996 Margaree Atlantic salmon ultrasonic tracking detections.

Pinger Serial No.	Date Installed	1st Registered Where	1st Registered When	2nd Registered Where	2nd Registered When	3rd Registered Where	3rd Registered When	4th Registered Where	4th Registered When	5th Registered Where	5th Registered When	6th Registered Where	6th Registered When
2520	28-Jun	Harbour	28-Jun	Big MacDaniel	01-Jul	Harbour	03-Jul	Harbour	17-Jul	Big MacDaniel	25-Sep	Hatchery	30-Sep
2521	07-Jul	Big MacDaniels	10-Jul	Ethridge (H&R)	12-Jul	Sheer Dam	19-Aug						
2522	07-Jul	Lower Barracks	25-Jul	Lower Barracks	20-Aug	Harbour	23-Aug	Big MacDaniel	16-Sep	SW Margaree	19-Sep	SW Margaree	23-Sep
2523	07-Jul	Big MacDaniel	08-Jul										
2524	07-Jul	Big MacDaniel	08-Jul										
2525	10-Jul	Big MacDaniel	11-Jul										
2526	10-Jul	Big MacDaniel	11-Jul	Big MacDaniel	13-Jul	Forks	25-Jul	Found Forks Pool					
2527	10-Jul	Harbour	11-Jul	Harbour	12-Sep	Levis Trapnet	13-Sep	Big MacDaniel	13-Sep	Hatchery	17-18 Sep	Hatchery	4-10 Oct
2528	10-Jul	Big MacDaniel	14-Jul	Big MacDaniel	17-Jul	Big MacDaniel	22-Jul	Gillis Island	25-Jul	Big MacDaniel	27-31Jul	Big MacDaniel	1-16 Aug
2529	10-Jul	Lower Tompkins	25-Jul	Lower Tompkins	20-Aug	Big MacDaniel	25-Sep	Big MacDaniel	02-Oct	SW Margaree	3-23 Oct	SW Margaree	1-6 Nov
2530	10-Jul	Big MacDaniels	13-Jul	Swimming Hole	19-Aug	Swimming Hole	27-Aug	Hatchery	16-Sep	Sanctuary	20-21 Sep	Hatchery	23-Sep
2531	10-Jul	Gillis Island	25-Jul	Gillis Island	20-Aug	Carlin Tag found - Forks Pool							
2532	10-Jul	Seal Pool	25-Jul	Big MacDaniel	29-Jul	below Forks Pl	20-Aug						
2533	10-Jul	Harbour	11-Jul	Harbour	11-Sep	Big MacDaniel	12-Sep	Doyles B (H&R)	16-Sep	Hatchery	19 Sept-31 Oct		
2534	10-Jul	Harbour	11-Jul	Harbour	28-Jul	Big MacDaniel	28-Jul	Hatchery	7 Aug - 24 Sep	Sanctuary	26-Oct		
2566	10-Jul	Big MacDaniel	11-Jul	Big MacDaniel	09-Sep								
2567	22-Jul	Harbour	24-Jul	Harbour	09-Sep	Hatchery	25-Sep						
2568	22-Jul	Lower Barracks	25-Jul	Lower Barracks	20-Aug	Big MacDaniel	27-30Sep	Big MacDaniel	4-30 Oct	Big MacDaniel	02-Nov		
2569	23-Jul	Big MacDaniel	28-31 Jul	Big MacDaniel	1-17 Aug	Seal Pool	20-Aug	Big MacDaniel	16-19Sep	SW Margaree	20-Sep	SW Margaree	22-Sep

(Continued)

Pinger Serial No.	7th Registered Where	7th Registered When	8th Registered Where	8th Registered When	9th Registered Where	9th Registered When	10th Registered Where	10th Registered When
2520	Sanctuary	1-3 Nov						
2521								
2522	Big MacDaniel	24-25Sep	Big MacDaniel	04-Oct	SW Margaree	09-Oct		
2523								
2524								
2525								
2526								
2527								
2528	Forks Pool	20-Aug	Hatchery	1-8 Oct	Hatchery	20-21 Oct	Sanctuary	27-Oct
2529								
2530	Hatchery	5-8 Oct	Sanctuary	12-15 Oct	Hatchery	19-22 Oct		
2531								
2532								
2533								
2534								
2566								
2567								
2568								
2569	Big MacDaniel	24 Sept-8 Oct	SW Margaree	09-Oct	Big MacD	12,22, 26-30 Oct		

Tracking Stations:
- Harbour
- Big MacDaniel Pool
- SW Margaree - John Archie's Pool
- NE Margaree - Hatchery Pool
- NE Margaree - MacKenzie Pool

Tracking with portable unit
- July 25 - Doyles Bridge to Harbour
- Aug 19 - Hatchery to Doyles Bridge
- Aug 20 - Doyles Bridge to Harbour

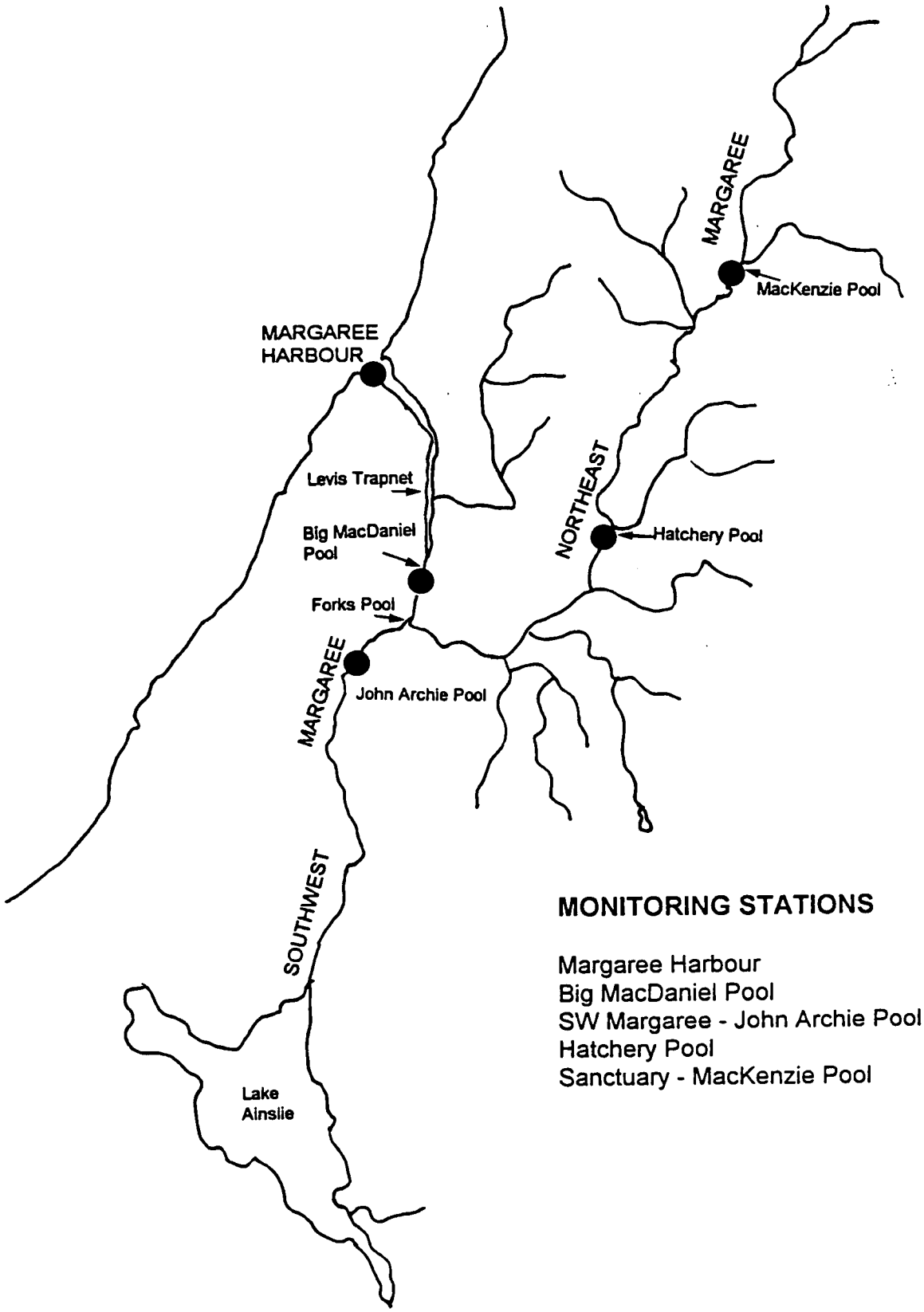

Figure 1. Map of the Margaree River, showing location of Levi's Trapnet and ultrasonic monitoring stations.

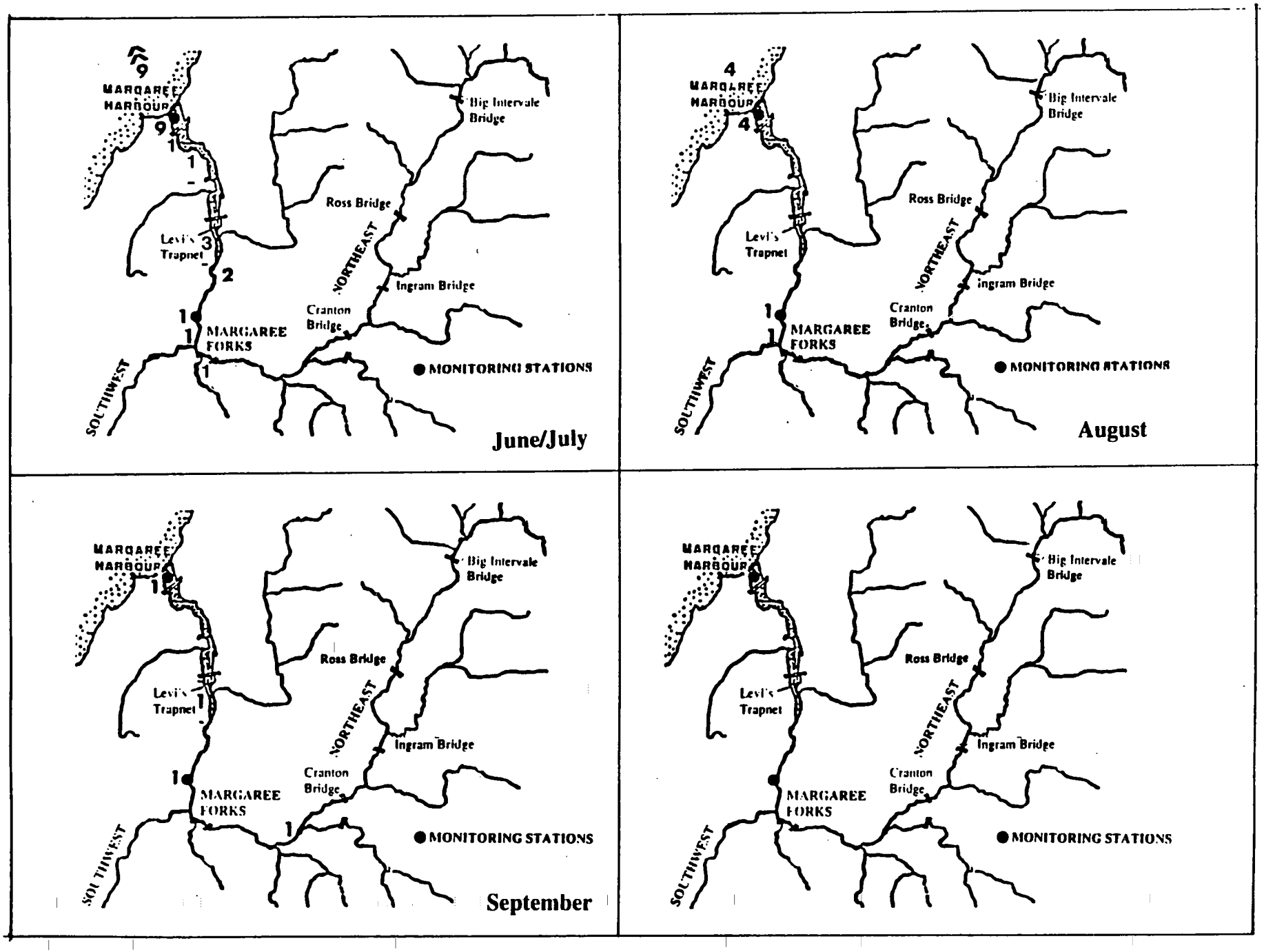

Figure 2. Detections of ultrasonically-tagged summer-run Atlantic salmon in the Margaree River, by month, 1995. Tags detected at more than one location in a month are shown at each site.

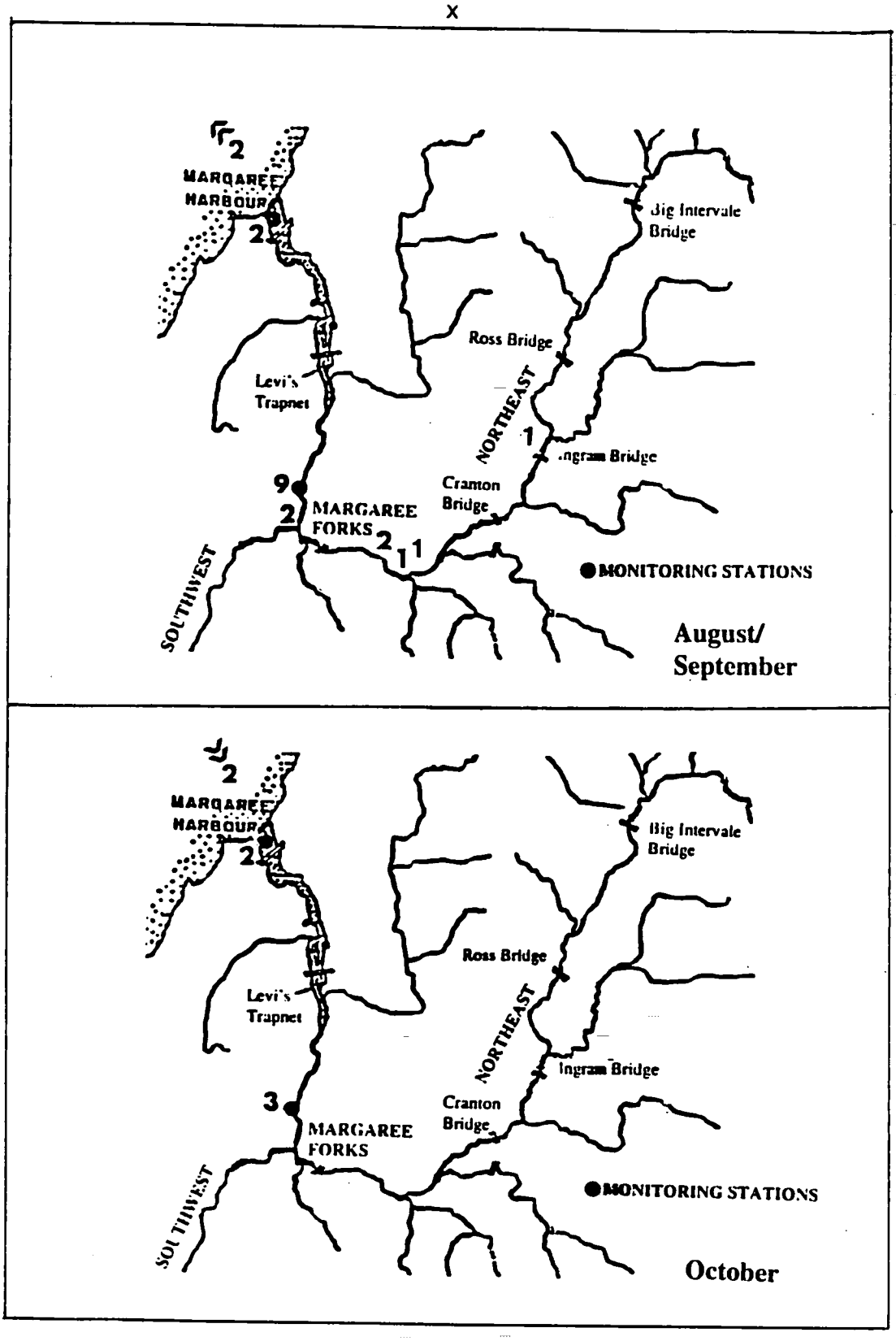

Figure 3. Detections of ultrasonically-tagged fall-run Atlantic salmon in the Margaree River, by month, 1995. Tags detected at more than one location in a month are shown at each site.

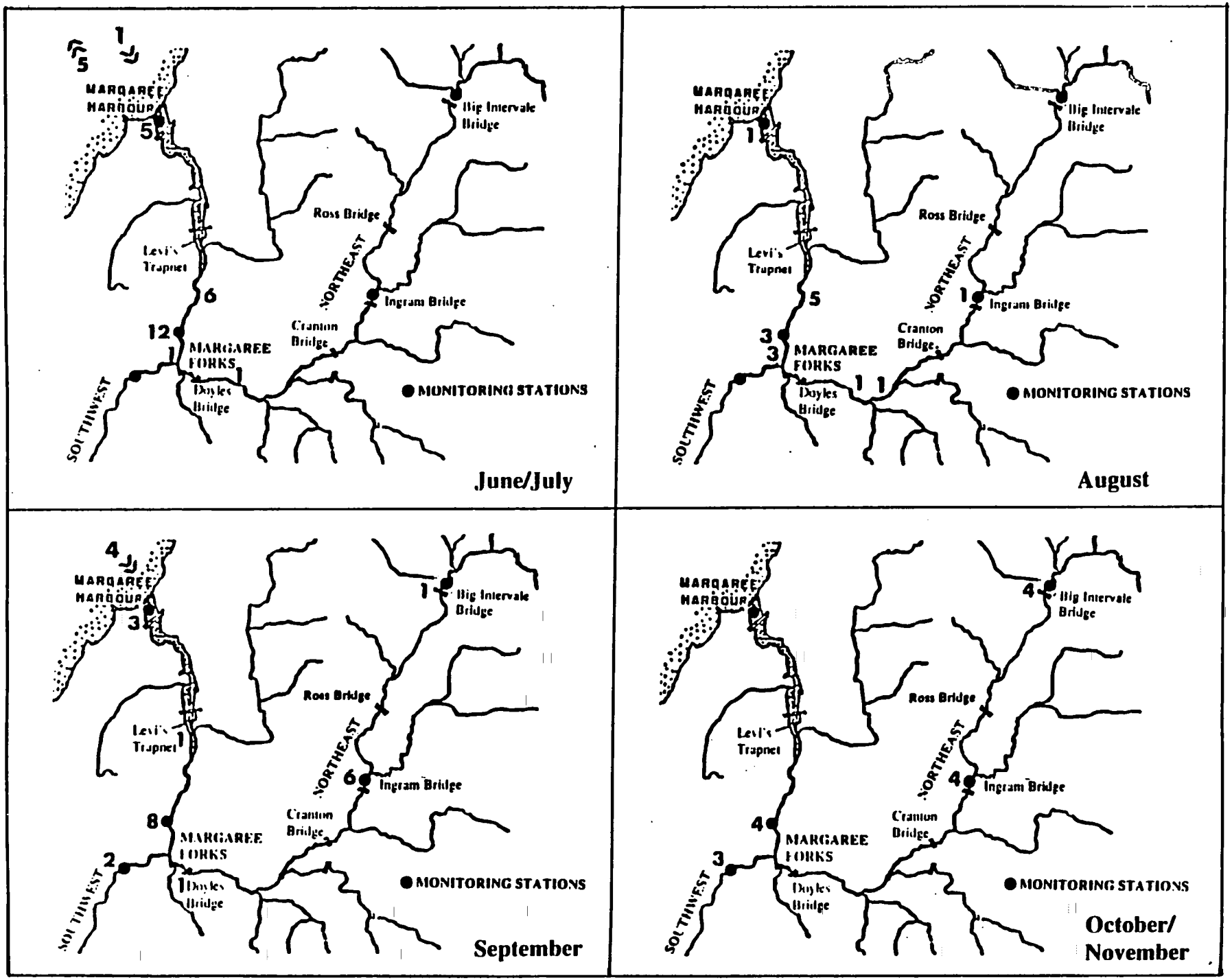

Figure 4. Detections of ultrasonically-tagged summer-run Atlantic salmon in the Margaree River, by month, 1996. Tags detected at more than one location in a month are shown at each site.