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Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi river, 1997

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TABLE OF CONTENTS

ABSTRACT

Atlantic salmon (*Salmo salar*) in the Miramichi River, New Brunswick, were harvested by two user groups in 1997; First Nations and recreational fishers. The Aboriginal food fishery catches in 1997 represented a decrease of 45% for small and an increase of 67% for large salmon relative to the previous five years. Harvest of large salmon were 65% from the early-run (prior to Sept. 1) while 82% of the small salmon harvests were taken prior to Sept. 1 in 1997. Recreational fishery catches for 1997 were 21% below the previous five-year mean. The Crown Reserve catches also decline by more than 30% relative to the previous five-year mean. For the Southwest Miramichi, 13486 small salmon and 10999 large salmon were estimated to have returned in 1997. After accounting for all removals, egg depositions in the Southwest Miramichi by both small and large salmon were 78% of the conservation requirement. For the Northwest Miramichi, 9788 small salmon and 7024 large salmon were estimated to have returned. Egg depositions by small and large salmon in the Northwest in 1997 were 104% of conservation requirement. Egg depositions had exceeded the conservation requirements in each branch during the last five years. The 1998 forecast for large salmon returning to the Miramichi is 22178 with a 78% probability of not meeting spawning requirements. The increased densities of juvenile salmon, since 1985 for fry and 1986 for parr, at the index sites sampled since 1971, indicate that the long-term prospect for the Atlantic salmon stock of the Miramichi is for continued and increased abundance of salmon. Furunculosis induced mortalities of Atlantic salmon were confirmed for the first time in the Miramichi River during 1997.

RÉSUMÉ

Le saumon de l'Atlantique (*Salmo salar*) de la rivière Miramichi, Nouveau-Brunswick, a été exploité dans les pêches autochtones et dans les pêches récréatives. En 1997, les captures de grands saumons dans les pêches autochtones ont augmentés de 67% par rapport à la moyenne des années antérieures tandis que les captures de madeleineaux (<63 cm longueur à la fourche) ont diminué de 45%. Près de 65% des grands saumons et 82% des madeleineaux récoltés par les autochtones provenaient de la remontée d'été (avant le 1er septembre). Dans la pêche récréative, les captures estimées en 1997 étaient inférieures de 21% par rapport à la moyenne des cinq années précédentes. La même tendance des captures a été observée dans les eaux de réserves de couronne, une diminution de 30% par rapport à la moyenne des années antérieures. La montaison de saumon dans la rivière Miramichi sud-ouest s'est situé à 13 486 madeleineaux et 10 999 grands saumons. Les géniteurs auraient contribué à une ponte d'oeufs équivalente à 78% des besoins de la conservation pour la rivière Miramichi sud-ouest. Dans la Miramichi nord-est, la montaison a été estimée à environ 9 788 madeleineaux et 7 024 grands saumons. Les géniteurs de cette montaison auraient contribué une ponte d'oeufs équivalente à 104% des besoins de la conservation. Durant les cinq dernières années, les pontes d'oeufs ont été supérieures aux besoins pour les deux affluents principales de la Miramichi, le sud-ouest et le nord-est. La prévision de la remontée de grands saumons pour 1998 est 22 178 poissons. Il est toutefois improbable, à 78%, que la remontée soit inférieure au niveau de conservation. Une amélioration des densités de juvéniles depuis 1985 pour les tacons d'age 0+ et de 1986 pour les plus vieux, a été observée aux sites repères échantillonnées annuellement depuis 1971. Les prévisions à long-terme pour le stock de saumon de l'Atlantique de la rivière Miramichi sont de montaisons soutenues voire supérieures à celles observées récemment. Des mortalités de saumon en 1997 induites par le furuncolose ont été confirmées pour la première fois dans le stock de la rivière Miramichi en 1997.

INTRODUCTION

The Miramichi River, at a maximum axial length of 250 km and draining an area of about 14,000 km^2, has the largest Atlantic salmon run of eastern North America. There are two major branches: the Northwest Branch covers about 3,900 km^2 and the Southwest Branch about 7,700 km^2 of drainage area (Randall et al. 1989). The two branches drain into a common estuary and subsequently drain into the Gulf of St. Lawrence at latitude 47°N (Fig. 1).

Annual assessments of the Atlantic salmon (*Salmo salar*) stock of the Miramichi River have been prepared since 1982. Until 1991, the assessments dealt exclusively with returns and escapement to the entire river (Randall and Chadwick MS1983a, b; Randall and Schofield MS1987, MS1988; Randall et al. MS1985, MS1986, MS1989, MS1990; Moore et al. MS1991, MS1992). Since 1992, assessments of the Northwest and Southwest branches have been prepared (Courtenay et al. MS1993; Chaput et al. MS1994b, MS1995, MS1996, MS1997).

Two size groups of salmon return to the river to spawn. The small salmon category consists of salmon of fork length less than 63 cm and are generally referred to as grilse. These fish have usually spent only one full year at sea (one-sea-winter) prior to returning to the river but the size group may also contain some previously spawned salmon. The large salmon category consists of fish of fork length greater than or equal to 63 cm. This size group is generally referred to as multi-sea-winter or just salmon and contains varying proportions of one-sea-winter, two-sea-winter and three-sea-winter maiden (first time) spawners as well as previous spawners (Moore et al. 1995). Salmon which have spawned and have not returned to sea in the spring of the year are referred to as kelts or black salmon in contrast to bright salmon which are mature adult salmon moving into freshwater from the ocean.

In addition to the different runs and size groups, the Miramichi River also contains several stocks of Atlantic salmon (Saunders 1981, Riddell and Leggett 1981). Separate branch assessments were introduced to account for some of this diversity and for the differences in exploitation between the Northwest and Southwest branches. Aboriginal fisheries were historically conducted almost exclusively in the Northwest Miramichi (exploitation also occurs in the estuarial waters of the Miramichi River, downstream of the confluence of the two branches) and recreational fisheries exploitation also differs between the Northwest and Southwest branches.

Temporal stock distinctiveness has also been highlighted as an important component of the Atlantic salmon resource (Saunders 1967). The early-run consists of salmon returning to the river up to August 31 whereas the late-run is considered to consist of salmon returning from September 1 onwards. Early runs and late runs have different composition in terms of small and large salmon proportions and sex ratios. The early runs in both branches are also exploited more heavily than the late runs.

The objectives of the assessment are to estimate the returns of salmon, the spawning escapement after removals and to compare the egg deposition to the conservation requirement for the river. The status of the resource is assessed on the basis of whether the conservation requirement was attained/exceeded, on the trends in returns, the juvenile densities, and the prospects. The returns and escapements are estimated on a spatial and temporal scale corresponding to the available data. Returns by size group to the whole river are partitioned into Northwest and Southwest Miramichi returns and when possible into early and late run. The egg depositions in each branch were estimated by incorporating the variability in run composition (sex ratio and size of fish which determines the fecundity) and the uncertainty in the estimates of escapement. Juvenile surveys provide finer spatial scale assessments of spawning activity in the previous year. Finally, using time series of returns, escapements, and juvenile surveys, we provide a prognosis of the future stock status of Atlantic salmon from the Miramichi River.

Specific features of this assessment include:

1. analysis of factors which may have contributed to the low returns in 1997
2. prognosis for 1998 based on relative indices of survival from parr to adults
3. an evaluation of the possibility for in-season assessment of the probability of meeting or exceeding the conservation requirements for the Miramichi,
4. risks to meeting conservation requirements relative to harvest options in 1998 are presented by combining the uncertainty in the expected returns of large salmon in 1998 and the variability in the biological characteristics of salmon returning annually.

Input from industry, user groups and other government agencies was obtained during a science assessment workshop held in Miramichi City (NB) on December 9, 1997 (minutes in Appendix 1). Peer review notes are available under separate cover (Anon. 1998).

DESCRIPTION OF FISHERIES

A distinction is made between catches and harvests. Catches consist of fish which are caught but not necessarily retained. Harvests represent fish which are caught and retained.

Atlantic salmon were harvested by two user groups in 1997: First Nations and recreational fishers. Aboriginal food fishery harvesting agreements were signed between DFO, the Eel Ground First Nation and the Red Bank First Nation (Table 1). The agreements focused on the selective harvest of small salmon over large salmon through the use of food fishery trapnets. In 1997, the Eel Ground First Nation fished two food fishery trapnets in the Northwest Miramichi and two food trapnets in the Southwest Miramichi. A partial counting fence was also operated at Big Hole Tract for the selective harvest of small and large salmon, similar to 1996 (Table 1). Two food trapnets were fished by Red Bank First Nation at similar locations to previous years (confluence of the Northwest and Little Southwest Miramichi). A communal license was issued to Burnt Church First Nation (Table 1).

There were no significant changes in recreational fishery regulations in 1997 relative to previous years (Moore et al. MS1995) (Table 2). Individual recreational quotas remained in effect: daily limits of 2 small salmon kept (<63cm fork length) and a maximum of 8 kept for the year, hook and release only of all large salmon (>= 63 cm fork length). There were no river closures in 1997 resulting from low water levels or warm temperatures (Table 2). An extended hook-and-release angling fishery for the period Oct. 1 to 15 was in effect in the Southwest Miramichi River between Doaktown and Deersdale bridge (a length of about 75 km). The season extension to Sept. 15 for the Little Southwest crown reserve stretches remained in effect although under complete hook-and-release regulations. Other changes introduced in 1996 and which remained in effect in 1997 are described in Chaput et al (MS1997).

Aboriginal Food Fisheries

With the exception of the Burnt Church fishery, which occurred in estuary waters of Miramichi Bay, large salmon harvests were exclusively from the Northwest Miramichi. Small salmon harvests were divided 73% from the Northwest Miramichi and 27% from the Southwest Miramichi River. The catches by size and week are summarized in Table 3. Reported harvests from food fisheries in the Northwest Miramichi in 1997 were 548 large salmon and 871 small salmon. A total of 326 small salmon were harvested from the Southwest Miramichi. The harvests reported in Table 3 are exclusive of those taken off waters specified in the Aboriginal Communal Fishing licenses.

Gillnets accounted for 39% of the large salmon harvest and 20% of the small salmon harvest from the Northwest. The Eel Ground First Nation released all the large salmon from the food fishery trapnets (906 salmon) and 59% of the small salmon catch (718 of 1208 small salmon, mostly from the fall run). The Red Bank First Nation released 11% of the large salmon catch (40 of 373 large salmon) and 9% of the small salmon catch (45 of 508 small salmon). The food fisheries mainly targeted the early run for small salmon (82% of harvests were taken prior to September 1) but just 65% of the large salmon were harvested from the early-run. The Aboriginal food fishery harvests in 1997 represented a decrease of 45% for small salmon and an increase of 67% for large salmon relative to the previous 5-year mean (Table 4).

Recreational Fisheries

Angling catch data have in the past been available from two sources: FISHSYS from the New Brunswick Department of Natural Resources and Energy (DNRE), and from the Government of Canada Department of Fisheries and Oceans (DFO) (Moore et al. MS1995). For the Miramichi River system, the DNRE estimates are considered to be more accurate than the DFO estimates (Randall and Chadwick MS1983a). DFO estimates of catch, which have generally been lower than the DNRE estimates, were not collected after 1994.

Preliminary FISHSYS catch values for 1997 were 8311 small salmon harvested, 3181 small salmon released and 5078 large salmon released during the bright salmon fishery (Table 5, Fig. 2). The Southwest Miramichi represented 65% of the catch of small and 72% of the large salmon catch. The catches in 1997 were 21% below the 1991 to 1995 mean catch. The FISHSYS survey was not conducted in 1996.

Historical catches from the Miramichi and each branch are summarized in Figure 2. Large salmon catches (kept and released) in the Miramichi peaked in 1986 and declined to 3146 salmon in 1995 (Fig. 2). Small salmon catches have fluctuated annually, having peaked in 1989 at almost 31000 fish and declining to 5622 in 1995. The catches of small and large salmon increased the most in the Northwest Miramichi since the closure of commercial fisheries and the introduction of hook and release angling in 1984 (Fig. 2). Catches of large salmon in the Southwest Miramichi decreased after 1986 and declined to less than 2600 fish in 1995. Catches in 1995 were abnormally low because of numerous closures resulting from warm and low water conditions (Chaput et al. MS1996).

The Crown Reserve waters of the Northwest Miramichi are regulated in terms of effort and catches in these waters represent the best indicator of relative availability and abundance of salmon from the early-run component in the Northwest Miramichi. Total effort in 1997 was among the highest since 1982 (Fig. 3; Table 5). Catches of small salmon were 31% below the 1991 to 1995 mean but down 33% from 1996. Large salmon catches were just 1% lower than the five-year mean but down 12% from 1996.

Timing of Harvests

Recreational fisheries exploit both the early and late runs. The small salmon catch from the Miramichi River has been historically comprised of 81% early and 19% late (after Aug. 31) run whereas 74% of the large salmon catch is taken in the summer (Moore et al. MS1995). These proportions differed for the two major branches. Catches in the Northwest tend to be high from the early run whereas Southwest catches are only slightly higher in the early season: 75% of large and 83% of small for the Northwest, 56% of large and 61% of small for the Southwest.

In 1997, recreational exploitation of tagged small salmon was greatest for fish marked in July and September. Exploitation has generally been heaviest on the early run fish and decreases progressively for September and October tag groups.

Percent of tags returned by anglers from fish marked in each month					
Grilse	June	July	August	September	October
1992	16%	16%	10%	9%	6%
1993	11%	14%	13%	8%	5%
1994	6%	6%	6%	8%	2%
1995	3%	5%	4%	3%	2%
1996	8%	6%	3%	4%	3%
1997	3%	5%	2%	5%	2%

Illegal removals/seizures

The total number of fish in seizures reported by Conservation and Protection personnel was 3 small salmon and 13 large salmon from the Northwest Miramichi. From the Southwest Miramichi, two small salmon and five large salmon were seized.

Broodstock collections

In 1997, a total of 64 large salmon and 32 small salmon were collected and spawned at the Miramichi Salmonid Enhancement Centre (Table 6). Collections were made from specific tributaries and the number of fish removed corresponded to the intended stocking intensity at the specified locations. The largest single removal was from the Dungarvon River for subsequent production of smolts at the semi-natural rearing ponds on the Renous River. The collections in 1997 were reduced from 1996 and 1995 (Chaput et al. MS1997).

Furunculosis losses

Atlantic salmon mortalities were found by fisheries workers of the Eel Ground First Nation operating the the partial counting fence at Big Hole in the Northwest Miramichi. Mortalities were first recovered both above and below the fence between June 22 and 26, 1997. From five of the six carcasses sent to the Dept. of Fisheries and Oceans Fish Health Laboratory in Halifax on June 26, 1997, the causative agent of furunculosis, *Aeromonas salmonicida* (bacterium), was isolated. This was the first confirmed incidence of this disease causing agent in Atlantic salmon in the Miramichi River.

Subsequently, a total of 13 grilse and 23 salmon were positively diagnosed with the fucunculosis bacterium (Appendix 2). The bacterium was isloated from fish collected throughout the Southwest and Northwest branches indicating that the disease incidence was wide-spread. Total losses are unknown but based on 1 or 2 fish lost at each of the protection barriers, the losses were probably small relative to the returns to the river.

CONSERVATION REQUIREMENT

The conservation spawning requirement for the Miramichi River and each branch separately was based on an egg requirement of 2.4 eggs/m^2 of spawning and rearing habitat area (CAFSAC 1991). Habitat area estimates are from Amiro (MS1983). The objective is to obtain all the egg depositions from large salmon. Fish required are calculated using the average biological characteristics of the Miramichi stock. The small salmon requirement is to provide a theoretical 1:1 sex ratio. The spawning requirements in terms of fish were based on the average biological characteristics of salmon during 1971 to 1983: 86% female and a fecundity of 6816 eggs per female resulting in an average of 5862 eggs per large salmon spawner, 75% male for the small salmon (Randall MS1985).

			Fish required	
	Habitat area (million m^2)	Egg requirement (millions)	Large salmon	Small salmon
Miramichi River	54.6	132	23,600	22,600
Main Miramichi	1.1	3	554	531
Southwest Miramichi	36.7	88	15,730	15,063
Northwest Miramichi	16.8	41	7,316	7,006

Point estimates of the required number of spawners ignore the annual variation in fecundity and the female proportion of the large salmon returning to the Miramichi River. It has also been shown that the fish returning to the Miramichi since 1984 are larger than was observed prior to 1985 (Moore et al. 1995). Larger fish contribute more eggs which results in fewer fish required to achieve the conservation egg requirements. Based on the biological characteristics of salmon from 1992 to 1996 (corresponding to the most recent significant change in management, the moratorium in the insular Newfoundland commercial salmon fishery), the spawning requirements for the Miramichi are reduced to 21800 large salmon and 21095 small salmon (averaging 86% male).

The conservation principles for Atlantic salmon also include provision for the complex stock structure within a river. There are natural boundaries for the further stratification of the Miramichi River beyond the Southwest/Northwest separation. Tidal influence extends to just above the junction of the Renous River and the Southwest Miramichi. Production of juveniles in the main stem of the Southwest Miramichi below this point is expected to be minimal. Similarly in the Northwest Miramichi, the junction of the Little Southwest Miramichi and the Northwest Miramichi would be an appropriate dividing line. This stratification produces three production areas in each of the main branches with the following egg and spawner requirements:

			Fish equivalents	
	Habitat area (m^2)	Eggs required	Large	Small
Southwest Miramichi				
Barnaby	1.31 million	3.1 million	560	536
Renous/Dungarvon	5.82 million	14.0 million	2499	2393
Southwest (above Renous)	29.53 million	70.9 million	12671	12133
Northwest Miramichi				
Northwest Millstream	0.49 million	1.2 million	212	203
Little Southwest	8.07 million	19.7 million	3517	3368
Northwest Miramichi	8.23 million	20.1 million	3587	3435

The estimation of risk of meeting or exceeding conservation requirements relative to the number of salmon returning to the Miramichi was calculated as follows. Large salmon returning to the Miramichi River were allocated to one of the six production areas based on the relative sizes of each area (for example, the Southwest Miramichi above Renous represents 55.2% of the total area therefore 55.2% of the large salmon returning to the Miramichi would return to the Southwest Miramichi). Using the entire 26 years of biological characteristics variation, an escapement of 21400 large salmon to the Miramichi provides a 50% chance of meeting or exceeding the Miramichi River conservation requirements but only a 25% chance of meeting or exceeding the conservation requirements in all six subareas simultaneously. For a high probability (90%) of meeting or exceeding conservation requirements, escapements of 26100 large salmon for the entire Miramichi River and 27400 large salmon for simultaneous escapement into all six sub-areas would be required.

RESEARCH DATA

Data collected in 1997 pertain to the estimation of returns, size distribution, sex ratios, abundance of juvenile salmon, and hatchery stocking. Returns are estimated from mark and recapture experiments. The size distribution and sex ratio data are collected at the tagging and recapture trapnets, from food fishery trapnets and from broodstock seining operations. The abundance of juvenile salmon is estimated from electrofishing surveys.

Estimation of returns

Trapnets were operated below head of tide in both branches of the Miramichi River (Fig. 1). Details of trapnet construction are provided in Chaput et al. (MS1997). The food/science trapnets operated by Eel Ground First Nation (two in each branch) upstream of the confluence of the Southwest and Northwest branches of the Miramichi River were the main tagging trapnets. An upstream trapnet on the Southwest Miramichi (Millerton, Fig. 1) was used for tagging and recapture. The Red Bank trapnets were the main recapture gear for the Northwest Miramichi. The trapnets were fished once a day at slack tide, sometimes twice a day at Red Bank. The dates of operation, total fish caught, and total tags released, by size group, are summarized in Table 7. In addition, salmon were sampled at the partial fence at Big Hole tract in the Northwest Miramichi.

Salmon were marked with individually numbered blue Carlin tags (dimensions 9.5 mm by 4.6 mm by 1.0 mm thick) attached to the back just anterior to the dorsal fin with narrow gauge stainless steel wire. Fork length and external sex determination (fall period) were obtained from all salmon at the tagging trapnets. Scale samples, for determination of age, were removed from the standard location (along the imaginary line joining the posterior of the dorsal fin and the anterior of the anal fin, two to four rows above the lateral line) from all large salmon and from every second small salmon. Scale samples were stored dry.

Food fishery catches at Eel Ground and Red Bank were sampled for number of salmon caught (by size) and number as well as sex of salmon harvested (by internal examination). Almost all the large salmon from the Eel Ground trapnets were tagged before being released (Table 7). The number of tags placed and the time and location of recaptures, by size group and month, at each of the tagging facilities in 1997 are summarized in Appendix 3.

Recaptured fish at all trapnets had the tag number recorded, the size (small or large), date and trapnet location where recaptured before being released or when sampled from the food fishery harvests.

Daily counts of salmon, by size, were obtained at several barrier fence and counting fence facilities within the Northwest and Southwest Miramichi (Fig. 1). Tag numbers of marked fish passing through these barriers were recorded prior to release upstream. Broodstock seining also provided samples of size, number of fish, tag numbers of marked fish, and sex ratios.

Voluntary returns of tags from the angling fishery were used to describe the emigration of tagged fish outside the branch where they were originally marked (Appendix 3).

Juvenile Surveys in the Miramichi River

Electrofishing surveys were conducted at 70 sites (29 in the Northwest Miramichi and 41 in the Southwest Miramichi) between August 25 and October 3, 1997. Thirteen of these sites have been sampled every year since 1970. A combination of open (63 in total) and closed (7 in total) sites were sampled. The density of salmon juveniles at closed sites was estimated using the removal method after enclosing a section of stream with fine mesh barrier nets (Zippin 1956). Open sites provided estimates of abundance based on catch per unit effort. Fishing was conducted bank to bank, in an upstream direction, with three people: one person with the shocker unit, a second person with a meter wide by 0.75 meter high seine, and a third person with the fish holding bucket and dip net. The amount of fishing effort was recorded from a timer on the shocker unit and represented the total seconds of actual shocking time. Catch per unit effort was transformed to density (number of fish per 100 m^2) by calibrating the open site technique within closed sites (see Chaput et al MS1995). Results from calibrations made at 44 sites between 1993 and 1997 are given in Appendix 4. Percent habitat satuation (PHS) values were calculated for each site (Grant and Kramer 1990).

All fish were identified to species and measured for length (fork length except for lamprey and American eel for which total length were recorded). Large eels were counted but not measured. Fish were anesthetized, using sodium bicarbonate salts, before measuring.

ESTIMATION OF STOCK PARAMETERS

Estimation of Returns

Returns are estimated to each branch and to the Miramichi River.
Two approaches have been used previously to estimate returns to each branch:

1 - calculate returns to each branch separately by adjusting the tags available for recapture based on the emigration rate estimates described below, or

2 - use spatially stratified estimators to estimate returns to each branch, and the total, simultaneously.

The tag and recapture matrices differ between the two methods. In the first approach, fish tagged at Millerton in the Southwest Miramichi and recaptured at the Red Bank (Northwest Miramichi) trapnets can be used. These data would be ignored in method 2 because the Millerton trapnet would be treated exclusively as a recapture trapnet. Method 2 is attractive because it directly accounts for emigration between branches (Table 8). The emigration rates, based on trapnet recoveries, do not necessarily correspond to the rates obtained using angling recoveries.

In the assessments of the previous two years, temporally stratified models were used. In 1997, a temporally stratified estimate was used for large salmon and the small salmon returns were estimated from the trapnet efficiencies calculated for large salmon. The emigration adjusted models used in previous assessments were not used because early-run small salmon were not tagged at the tagging trapnets in 1997 which resulted in very uncertain estimates of the emigration rates. As a consequence, a spatially stratified model formulation was used which did not require the estimation of emigration rates of tagged fish between the branches. Such model formulations were also considered in previous assessments.

The uncertainty around the estimation of returns in the spatially stratified model consists of two components:

1 - Random variation in the tag loss/tag mortality factor was incorporated as a uniformly distributed function between 0% and 20% (mean of 10%).

2 - Uncertainty in the temporally-stratified recapture matrix was estimated by resampling within the rows of the observed matrix of recaptures at the trapnets. In this case, the prior probabilities for a marked fish in the catches at the trapnets was set at the observed proportion

for each tag release stratum. Recoveries were assigned to one of the temporal strata (movement of tagged fish among recovery strata) based on the observed distribution of recoveries.

Returns by size and branch were obtained using a resampling technique as follows:
Step 1: select a tag loss/tag mortality factor and define recapture matrix.
Step 2: calculate returns using Schaeffer, Darroch and Petersen, save result.
Step 3: repeat steps 1 and 2 a large number of times (1000 replications were performed)
Step 4: summarize distribution of returns from step 3.

Only marks placed up to and including Oct. 15 are considered to be available for recapture.Tagging in the Southwest finished on Oct. 17 while in the Northwest, the last day of tagging was Oct. 14. The recapture trapnets in the Northwest Miramichi fished until Oct. 15 and the Millerton trapnet on the Southwest Miramichi fished until Oct. 21. Returns are estimated up to the point of the recapture trapnets in each branch (would exclude harvests which occurred downstream of each recapture trapnet) and constitute the returns up to and including Oct. 15.

At the recapture traps, both the previously marked fish and the unmarked fish are known without error but the marks available for recapture are not.

1 - In 1997, salmon with tagging scars were recorded at the tagging trapnets in the Northwest and Southwest and at the Millerton recapture trap. The tags may have been shed or could have resulted from anglers removing tags and releasing the fish. This would necessitate a fall-back to tidal waters of angled fish which does occur because in the fall of 1997, one salmon was caught at the trapnets with an artificial fly embedded in its jaw (two such fish were observed in 1995, one in 1996). Since all fish at the trapnets are examined for tags and tagging scars, recaptures were considered known without error.

2 - In the 1994 tag retention experiment, none of the tagged broodstock fish held for about 60 days had shed their tags in the hatchery tank. This result was similar to the 1992 experiment on small salmon (Courtenay et al. MS1993). Similar experiments conducted for the Margaree River assessment indicated that tag shedding for large salmon was in the order of 1% per day (Chaput et al. MS1994a). Mortality of tagged fish resulting from tagging and handling has not been estimated although there have not been any recorded mortalities of tagged fish held in hatchery facilities (Chaput et al. MS1994a, Courtenay et al. MS1993). One mortality of a tagged fish (1 large salmon) was recorded in the river in 1997 (Appendix 3). In the absence of survival rate data, a combined tag loss/tagged fish mortality factor of 10% was assumed (varying between 0% and 20%), similar to previous assessments (Randall et al. MS1989).

Returns to the Southwest Miramichi in 1997

Large salmon returns were estimated at 10993 fish with a 95% probability that the returns were at least 8455 fish (Table 9). The Darroch model estimates were lower but unreliable (negative lower confidence interval). Based on the estimated efficiency of the recapture trapnet for large salmon, a total of 13158 small salmon returned to the recapture trapnet in the Southwest Miramichi in 1997 with a 95% probability that the returns were more than 10100 fish (Fig. 4). Aggregated for both seasons, the Schaeffer estimates were about 10% lower (Table 9). Total returns to the Southwest Miramichi in 1997 (after accounting for removals downriver of the Southwest recapture trapnet) were 10999 large salmon and 13486 small salmon (Table 11).

The overall efficiency of the Millerton recapture trap for large salmon in 1997 was about 7%. No washouts occurred in 1997 (nor in 1994 and 1995) in contrast to 1996 when high water levels prohibited the fishing of the trapnet between July 13 and 18.

	Efficiency			
	1997	1996	1995	1994
Small salmon		7.5%	7.7%	7.9%
Large salmon	6.7%	4.8%	8.8%	6.9%

An alternate estimate of the efficiency of the Southwest Miramichi recapture trapnet was obtained from recoveries of fish tagged downstream of Millerton and recovered upstream of the trapnet. These recaptures of salmon in freshwater in the Southwest Miramichi included recoveries from angling, at barriers and fences, and from broodstock seining. The data for this estimate were:

M=57 Tags applied downstream of the Millerton trap and recaptured upstream in the Southwest Miramichi (22 large and 35 small). These fish had to pass by the Millerton trapnet.

R=4 A total of 4 of the 57 tags recovered upstream were initially intercepted at the Millerton trapnet and released (all 4 were small salmon).

This provides an efficiency estimate for the Millerton trapnet for the entire season of 7.0% (4/57). A total of 733 large salmon were sampled at the Millerton trapnet which gives a return estimate to the Southwest of 10445 fish, identical to the estimate from the complete mark and recapture experiment. A similar calculation for small salmon (875 sampled) yields an estimated return of 12500 fish.

Returns to the Northwest Miramichi in 1997

About 6924 large salmon returned to the Northwest Miramichi in 1997 with a 95% probability that the returns were more than 4300 fish (Table 9, Fig. 4). Based on the estimated efficiencies of the Reb Bank trapnets for large salmon, the small salmon return was estimated at 9420 fish with a 95% probability that the returns were at least 6100 fish (Fig. 4).The Darroch model estimates were unreliable. Aggregated for both seasons, the Schaeffer estimates were slightly higher (Table 9). The total returns to the Northwest Miramichi in 1997 (by accounting for removals in Northwest Miramichi downstream of the Red Bank trapnets) were 7024 large salmon and 9788 small salmon (Table 11).

The Red Bank trapnets in 1997 had an overall efficiency of 5.3%. As with the Southwest Millerton trapnet, the overall efficiency of the Red Bank recapture trapnets in 1997 was higher than in 1996. A lower efficiency in 1996 would have been expected as a result of the high water conditions in late July which prohibited fishing one of the trapnets for a period of 10 days and the other for 5 days between July 13 and 23.

	Efficiency			
	1997	1996	1995	1994
Small salmon		4.1%	6.5%	6.7%
Large salmon	5.3%	4.5%	5.6%	3.9%

Returns to the Miramichi River in 1997

In 1997, 18275 large salmon and 21869 small salmon returned to the Miramichi River (Table 9, Fig. 4). There was a 5% chance that returns of large salmon to the Miramichi were less than 13846 fish and small salmon returns were less than 17110 fish (Table 9, Fig. 4). The pooled Petersen estimate for large salmon was 5% less than the Schaeffer derived estimate.

Accounting for removals downriver of the recapture trapnets, returns in 1997 were 18381 large salmon and 22565 small salmon (Table 11).

Effect of 1997 Model Formulation on Estimates for 1995 and 1996

In the 1995 and 1996 assessments, a seasonally stratified model after adjusting for emigration of tags between the branches was used. The spatially stratified model used in 1997 was run on the 1995 and 1996 data to assess the effect of model formulation on estimated returns. For large salmon returns in 1995, the point estimates are similar but the precision was better with the 1997 model formulation (Fig. 5). The 1996 returns were much less than those used in the 1996 assessment, indicating that returns to the Miramichi of large salmon in 1997 were similar to 1996. Small salmon returns to the Miramichi in 1995 and 1996 were estimated to be slightly higher than previously published. Returns of small and large salmon were reallocated between the Northwest and Southwest branches: Northwest estimates declined, Southwest estimates increased with the exception of the large salmon in 1996 for which returns declined in both branches. This retrospective look indicates that the low returns of small and large salmon estimated in 1997 are not due to model formulation changes. The spatially stratified model also provides better precision than the emigration-adjusted approach and in 1997, the estimates for the Miramichi had a CV of 19%.

Small salmon in 1997 were estimated using the trapnet efficiencies of large salmon. The relative efficiency (calculated as small efficiency divided by large efficiency) was less variable in 1995 than in 1996 but in both years, the median estimate was close to 1.0 for the Miramichi and the individual branches (Fig. 6). The relative efficiency estimates were variable (accounts for the uncertainty in both the small salmon and large salmon efficiencies) but this variation was not included in the small salmon estimates for 1997.

Estimation of Egg Depositions in 1997

The estimated egg depositions were obtained from the estimates of the escapement of small and large salmon and the biological characteristics of the salmon in 1997.

Escapement in 1997

The escapement of salmon refers to fish which were not harvested in fisheries or otherwise removed from the river. Known losses are included: seizures in nets and reported mortalities in the river. Removals also include broodstock collections, scientific sampling, and incidental mortalities at the tagging trapnets.

The total harvests and removals of salmon from the Miramichi River in 1997 were 9586 small salmon and 826 large salmon (Table 10). Total removals in the Northwest Branch were 4077 small salmon and 652 large salmon whereas Southwest Branch removals were 5509 small salmon and 174 large salmon.

The estimates of escapements of small and large salmon are summarized in Table 11. Escapements to the Northwest Miramcihi of small salmon and large salmon were about 5700 and 6452 fish respectively (Table 11). In the Southwest Miramichi, about 8000 small salmon and 17600 large salmon were estimated to have escaped the fisheries. Overall for the Miramichi, escapements of 13000 small salmon and 17600 large salmon were estimated for 1997.

Biological Characteristics of Salmon in 1997

All salmon sampled at the tagging trapnets were measured for fork length. All large salmon and every second small salmon were scale sampled. Sex of large salmon from the early run in the Northwest Miramichi was determined from the internal examinations of the Red Bank food fishery harvests. Sex of small salmon from the early run was determined by internal examinations of food fishery harvests of Eel Ground and Red Bank. In the fall, both internal and external sex determinations of small salmon were obtained from Red Bank and Eel Ground harvests. Only external determinations of sex were obtained for large salmon from the Southwest Miramichi in the fall. Additional sex ratio information was obtained from the broodstock seining samples.

Sex ratios

Large salmon were the majority female in both the Northwest and Southwest branches (Table 12). The proportion female (79%) observed in 1997 was similar to the values observed in 1996 and 1994 (81% and 80%) but lower than the 89% female component observed in 1995 (Fig. 7). Small salmon sex ratio was heavily favoured towards the males, with 86% male for the Miramichi, 81% male for the Northwest Miramichi and 90% male for the Southwest Miramichi (Table 12, Fig. 7). There tends to be a higher proportion female in the small salmon from the early run (Table 13).

Size and age

Previous spawners made up 29% of the large salmon returns in 1997 with a higher proportion in the Northwest Miramichi (36%) than in the Southwest Miramichi (28%) (Table

12). In the Southwest Miramichi, just under 50% of the large salmon in the early run were previous spawners.

Egg depositions in 1997

Large salmon contributed 93% of the egg depositions (114 million eggs) in the Miramichi River in 1997 (Table 14). In the Southwest Miramichi, large salmon contributed 96% of the 69 million eggs while in the Northwest Miramichi, large salmon contirbuted 90%of the 43 million eggs (Fig. 8, Table 14). The contibution by small salmon to egg depositions is low because of their smaller size and lower proportion female; in 1997 one large salmon egg contribution was equivalent to more than 11 small salmon (Table 12).

STATUS OF STOCK

The point estimate of the total egg deposition to the **Miramichi River** by large salmon was 81% of conservation requirements with a 20% probability of having met or exceeded the conservation requirement. Egg depositions by both small and large salmon were 87% of requirement, with a 30% probability of having met or exceeded the conservation requirement (Fig. 9). Egg depositions to the Miramichi River had been met or exceeded every year since 1985 (Fig. 10). Conservation requirements (2.4 eggs per m^2) had been met by large salmon alone every year since 1990. Large salmon egg depositions equalled or exceeded the conservation level in only four years between 1971 and 1989. The relative contribution of small salmon to the total egg depositions in the Miramichi in 1997 was 7%. Since the 1984 management plan, small salmon have contributed on average 22% of the total egg deposition, the most important contribution by small salmon occurred in 1981 at 58% (Fig. 10).

Returns and escapements of small salmon to the Miramichi peaked in 1992 and have since declined (Table 15, Fig. 11). The return in 1997 of 22565 small salmon is 72% below and 66% below the previous 5-year and historical (1971 to 1996) average returns to the river. The escapement of small salmon was 79% below the 5-year average and 72% below the historical average. The large salmon returns since the closure of the commercial fisheries in 1984, peaked in 1992. The return in 1997 of 18381 large salmon is the lowest since 1989 and was 41% below and 33% below the previous 5-year and historical averages respectively. The large salmon escapement was 43% below and 15% below the respective averages (Fig. 11, Table 15). Since 1992 (the first year of the insular Newfoundland commercial salmon fishery moratorium), large salmon returns have averaged 31400 fish which is 36% higher than the average return between 1984 and 1991 (23000) (Fig. 11). The average small salmon returns have been similar.

About 75% of the conservation requirements for the **Southwest Miramichi** were attained by large salmon in 1997 (Table 14). There was a 13% probability that the egg depositions by large salmon in the Southwest Miramichi exceeded the conservation requirement (Fig. 9). Egg depositions by both small and large salmon were 78% of conservation requirements, with a 17% probability of having met or exceeded the conservation requirements. Egg depositions had exceeded the conservation requirements every year since 1992 (Fig. 10).

In the **Northwest Miramichi**, the 43 million eggs contributed by large salmon represented 94% of the conservation requirements (Table 14). There was a 45% probability that the conservation egg reuirements were exceeded by large salmon alone (Fig. 9). Egg depositions by small and large salmon were 104% of conservation requirements with a 58% probability of having met or exceeded the requirements. Egg depositions have exceeded the conservation requirements every year since 1992 (Fig. 10).

In the Southwest and Northwest branches, returns of small salmon have declined since 1992, returns of both small and large salmon in 1997 are the lowest estimated since 1992 (Table 16).

Headwater Barrier Fences

Large and small salmon have been enumerated at headwater barrier fences on the Southwest branch (North Branch of SW Miramichi, Dungarvon River) since 1981 and on the Northwest branch (Northwest Miramichi River) since 1988 (Table 17). The fences are operated for varying periods each year but generally cover the entire migration period. The trend in the counts of large salmon in 1997 at the barrier fences of the Southwest Miramichi were down by 35% to 47% relative to the previous 5-year mean and the counts of small salmon were 30% to 54% lower (Table 17). Counts of small and large salmon at the north branch of the Southwest Miramichi barrier were the lowest since 1991 but at the Dungarvon Barrier, lower counts had occurred in 1995, the low water year.

Returns of large salmon at the Northwest Barrier were down 33% from the previous 5-year average (Table 17). Small salmon counts were down 38%. The 1997 counts of small and large salmon were the lowest since the beginning of operations in 1988. The counts at Catamaran Brook, a mainly fall-run tributary, were the lowest ever for small salmon and among the lowest for large salmon (Table 18).

Overall trends in returns/escapements since 1992

The returns to each branch as estimated from the mark and recapture experiments and the counts at the headwater barriers and the counting fences provide a concise summary of trends in each branch.

<u>Northwest Miramichi</u>

	Small	Large
NW Barrier	1997<1995=1996=1994<1993<1992	1997<1993=1996=1992<1994<1995
Catamaran	1997<1994<1996<1993<1995<1992	1997=1994<1996<1993<1992<1995
DFO trapnets	1997<1996=1994=1995<1992<1993	1997<1996<1992<1993<1994<1995

For large salmon, returns were highest in 1995 at all facilities with 1997 and 1996 being the lowest or equal to the lowest. For small salmon, 1997 was the lowest at all the facilities whereas 1992 was the highest or second highest returns year.

<u>Southwest Miramichi</u>

	Small	Large
NBr Southwest	1997<1995<1994<1993=1992=1996	1997<1996<1994<1995<1992<1993
Dungarvon	1995=1994<1997<1996<1993<1992	1995<1997<1994<1996<1993=1992
DFO trapnets	1997<1996=1995=1994<1993<1992	1997<1994<1996<1995<1993<1992

For large salmon, 1997 was the lowest to second lowest returns at all three facilities with 1992 and 1993 being the highest. For small salmon, the returns in 1997 were the lowest at two of the three facilities with 1992 the highest return year. The extent of the decline of small salmon in 1997 was most evident at the Southwest Miramichi recapture trapnet:

Total catch at the Southwest Miramichi recapture trapnet				
	1994	1995	1996	1997
Small	2684	2628	2323	958
Large	964	1734	796	856

Declines in angling catches, declines in the estimated returns, declines in catches at the Southwest Miramichi recpature trapnet, declines at the headwater barriers all indicate that the returns of small and large salmon in 1997 were the lowest observed or estimated since 1992.

ECOLOGICAL CONSIDERATIONS

Seasonal and Environmental Conditions

Discharge profiles were higher during May in 1997 than in the previous two years. A precipitation event in late June to early July resulted in higher discharges in 1997 relative to 1995 and 1996 but subsequently, discharges declined and remained low through to the end of October (Fig. 12).

Run timing of small salmon and large salmon at the Millerton trapnet in the Southwest Miramichi in 1997 was similar to that of 1994 and 1995. By July 11, 25% of the small salmon summer run had been counted, similar to 1994 and 1995 (July 12 and July 13 respectively). Large salmon run timing was less consistent but by Sept. 26 in all years, 50% of the total large salmon run had been counted (Fig. 13).

Water temperatures are described by Caissie (1998).

Spawner Distribution and Habitat Utilization

In 1996, spawning occurred throughout the Northwest and Southwest Miramichi with the exception of 5 sites, three on the Northwest Miramichi and two on the Southwest Miramichi (Fig. 14):

1- as in 1994 and 1995, salmon did not spawn at the Catamaran Brook site (Site 46) because a beaver dam blocked access to that part of the stream (R. Cunjak, pers. comm.)

2- Northwest Millstream at a site just below the bridge on the Chapel Island Road (site 159). Salmon have spawned here in only 5 of the 14 years this site has been sampled (note Northwest Millstream is not shown on Figure 14).

3- Northwest Millstream at a site upstream of site 159 where the Telly Road crosses (site 135). Spawning had not occurred near this site when it was last sampled in 1994.

4- North Branch of the Cains River where the Bantalor Rd. crosses (Site 7). This is a headwater site on the Cains. Spawning is intermittant in the area having occurred in 7 of the 11 years the site has been sampled from 1955-62 and then 1992, 1993, and 1997.

5- Lower Otter Brook, 2 km upstream from the mouth - tributary of the Cains River just downstream of the North Branch of the Cains River. This site was sampled in 1991-93 by DNRE and spawning had occurred in two of the three years.

Fry densities were greater than 50 fish per 100 m^2 at 52% of the sites in the Northwest Miramichi (Fig. 14). At sites with fry, densities in the Northwest averaged 100 fry per 100 m^2. Parr densities were above 30 fish per 100 m^2 at 16 of 29 sites (55%) and averaged 38 fish per 100 m^2 overall (Fig. 14).

In the Southwest Miramichi spawning had occurred in the vicinity of 39 of the 41 (95%) sites (Fig. 14). Fry densities averaged 98 fish per 100 m^2 at sites with fry. Parr densities were greater than 30 fish per 100 m^2 at 30 of 41 sites (73%) and averaged 41 fish per 100 m^2 overall.

Spawning has been monitored using this method since 1993 (Chaput et al MS 1994, 1995, 1996) and results have indicated that spawning has been successful each year in all parts of the Miramichi accessible to anadromous Atlantic salmon.

Salmon juveniles are territorial and territory size has been shown to be correlated with the size of the fish (Grant and Kramer 1990). Percent habitat saturation (PHS) index is a relative measure of the habitat use and potential interaction between juveniles within the stream. It considers both the densities of fish and body lengths. A PHS value of 28 is used as a reference point; it represents the value at which density dependent effects have a 50% probability of being expressed (Grant and Kramer 1990). The PHS values in the Northwest ranged between 4 and 111 (mean = 30), excluding the Northwest Millstream where no juvenile salmon were found. PHS values at Little Southwest Miramichi sites averaged 25, slightly less than the 32 value for the remaining Northwest sites. In the Southwest, PHS values were above 28 at 23 of the 41 sites, averaging 33 overall (range 5 to 71).

FORECAST/PROSPECTS

Short Term

The forecast model for large salmon returns is based on a relationship with small salmon returns in the preceding year (Claytor et al. MS1991, Claytor et al. 1992) (Fig. 15). Based on this relationship and a 1997 return of small salmon to the Miramichi of 22500 fish, the 1998 point estimate forecast for large salmon returning to the Miramichi is 22,178 with a 22% probability of meeting spawning requirements (23,600 large salmon). This model has been used to forecast returns since 1992 (95% confidence interval):

Forecast year	Forecast value	Actual return	Performance
1992	29,000	37,000	under predicted by 22%
1993	18,315	35,200	under predicted by 48%
1994	28,200	27,500	over predicted by 3%
1995	30,040	32,583	under predicted by 8%
1996	30,507	24,000	over predicted by 27%
1997	29,933	18,422	over predicted by 62%
	(13,114 to 51,275)		
1998	22,178		
	(7,055 to 33,835)		

Considering the very wide confidence intervals, it is very probable that the returns in 1998 will be within the interval.

Since 1991 large salmon returns have averaged just over 31,000 fish but the annual returns have been on a general decline since 1992. In two monitored rivers of Québec in the Gulf of St. Lawrence, sea survivals of smolts peaked for the 1989 smolt migration and have since declined with the lowest sea survivals to both small and large salmon returns observed for the 1993 and 1994 smolt migrations (Anon. 1996). Similarly low sea survival of Miramichi origin smolts would explain the decline in large salmon returns to the Miramichi since 1992. Crude survival estimates of smolts from Catamaran Brook do not show a similar declining trend in sea survival (Table 18). The estimates may not be applicable because of the confounding effects of parr migrations out of the brook as well as the potential for removals of Catamaran Brook fish in native and recreational fisheries.

The contribution of previous spawners to the returns of salmon and to the egg depositions has increased since 1986 in terms of the proportion of the large salmon returns and the absolute number (Fig. 16). Moore et al. (1995) provided evidence that the changes in age composition of the salmon returning to the Miramichi River and the increased abundance of previous spawners was due to reduced fishing exploitation resulting from closures of commercial fisheries as well as hook and release measures in the recreational fisheries. The increased egg depositions since 1984 are in large part the result of higher contributions by previous spawners because the 2SW maiden abundance has essentially remained unchanged (Fig. 16). Previous spawners also have a higher fecundity per fish than 2SW maiden fish. At the present time, the abundance of previous spawners can not be predicted. Survival of kelts from the Miramichi appears to be naturally high, probably because of large numbers of holding areas in the river and the abundant food supply early in the spring (smelt for example). Survival rates of 1SW maiden salmon to returns as consecutive spawners has been increasing since 1990 with the 1996 1SW maiden spawners having the highest observed consecutive spawning survival (Fig. 17). Survival as alternate spawners was high in the late 1980's and early 1990's but declined through 1992 to 1994 (Fig. 17). In the last four years, survival to the alternate and consecutive spawning stages have been about equal for 1SW and 2SW maiden salmon. Previous spawners destined to return to the Miramichi in 1998 have been intercepted in the Greenland fishery of 1997 : one large salmon kelt tagged as a bright in 1996 was intercepted in Greenland in August 1997. Previous spawners which were destined to return to the Miramichi in 1997 were intercepted in the Greenland fishery in the fall of 1996; 3 large salmon and 1 small salmon. The Greenland fishery had previously been suspended in 1994 and 1995. Only one other tagged previous spawner has been intercepted in the Greenland fishery since 1990; a grilse tagged in 1993 was recaptured in 1994.

There is no forecast model for small salmon but based on the smolt counts at Catamaran Brook in 1997 and the observed temporal trend in smolt counts in year i, small salmon returns to the Northwest in year i+1, the small salmon returns in 1998 should be improved relative to 1997.

The relative index of parr to adult survival for the Miramichi indicates that the relative survival has been very low for 1SW maiden salmon in the last four years, varying between 0.2% and 1.5% (Fig. 18). During 1984 to 1991, the relative index varied between 2.7% and 13.2%. For 2SW salmon, the relative index has been especially low for the 1994 and 1995 smolt runs; 0.1% to 0.3% relative survival rate. Based on the parr densities observed in 1996 and assuming similar relative survival rates to small salmon in 1998, the returns of small salmon in 1998 would be in the order of 10000 fish. A similar calculation for the 1997 returns based on the 1995 parr densities produced an expectation of 18000 small salmon.

Hatchery Stocking

Various life stages are reared and stocked annually to the Miramichi River. Satellite rearing, initiated in 1984, has resulted in about 80,000 young-of-the-year released annually as fall fingerlings. The survivors of these would return three to four years later. Smolt stocking has also been an important component of the hatchery program. Just under 60,000 2+ smolts were released to the Miramichi in 1997, an increase of 50% from the previous year (Table 19). About 35% of these smolts were stocked in the Northwest Miramichi (-47% relative to 1996). Stocking of 0+ parr increased by 260% in 1997 relative to 1996, occurring primarily in the Southwest Miramichi. These parr would not be expected to become smolts until the spring of 1999.

Returns of small and large salmon from stocking in previous years are not expected to make up more than 1% of the total returns in 1998, a level consistent with the observed contribution of adipose-clipped salmon in previous years. Adipose-clipped fish return mostly as small salmon, the contribution to large salmon returns being less than 0.3% in the 1997 returns. Detailed descriptions of releases by date, location and life stage are available in Appendix 5.

Long Term

Fry densities in the Southwest Miramichi and in the Northwest Miramichi in 1997 were down from the highest levels observed in 1996 (Fig. 19 and 20). Parr densities decreased in the Northwest Miramichi but were the highest ever observed in the Southwest Miramichi. PHS values have increased since the 1970's (Fig. 21) corresponding to an increase in juvenile poduction resulting from higher egg depositions and/or higher survival in the river. PHS values declined from 1996 but remain among the highest ever (Fig. 21). Increased abundance of juveniles is evident throughout the Miramichi River. The improvements in juvenile abundance have occurred in all the areas with about four-fold increases in fry abundance in the Northwest Miramichi, the Little Southwest Miramichi, the Dungarvon River and the Cains River. At least in the freshwater portion of the life cycle, the abundance of the cohorts is increasing in both the Northwest and Southwest Miramichi and the long-term prospect for the Atlantic salmon stock of the Miramichi is for continued and increased abundance of salmon.

Large salmon returns have averaged 31,400 fish between 1992 and 1996, a 36% increase from the average return between 1984 and 1991 (23,000) (Fig. 11). Given an average life cycle of 5 to 6 years (migration to migration) for large salmon, the returns to the Miramichi in 1996 to 2001 will be the progeny of the 1990 to 1995 escapements. Between 1971 and 1989, large salmon escapements equalled or exceeded 30,000 spawners 3 times and the returns of large salmon 6 years later from these escapements ranged from 28000 to 37000 fish (Table 15, Fig. 11). Returns of small and large salmon since 1992 however have declined. It appears that Atlantic salmon from the Miramichi may also be experiencing reduced sea survival in recent years, as has been noted for other Gulf of St. Lawrence stocks. Returns of large salmon had remained above the conservation requirements in part because of an abundance of previous spawners which may not be affected by the same sea survival constraints as smolts. As well, the smolt output from the Miramichi must be higher than the levels of the 1970's to mid 1980's (as inferred from the increased abundance of juveniles) and these are compensating for the declining sea survival.

CONCLUSIONS AND MANAGEMENT CONSIDERATIONS

Was conservation met in 1997?

The point estimates of the egg depositions were below the conservation requirements for the Southwest Miramichi and the Miramichi River system total but jsut above the conservation requirement for the Northwest Miramichi. There was a very low chance (20%) that conservation requirements were met in the Miramichi River. There is a higher exploitation rate on the early run small and large salmon but the overall exploitation rate on large salmon in 1997 remained low; less than 5% in the Northwest Miramichi and less than 2% in the Southwest Miramichi with overall exploitation rate for the Miramichi River of 3%. This is similar to the previous three years. Small salmon are more heavily exploited; 38% of the total returns in the Northwest, 41% from the Southwest Miramichi and 44% from the Miramichi River.

Were returns to the Miramichi in 1997 before any removals sufficient to meet the conservation requirments?

In the absence of any removals from fisheries, the egg depositions in 1997 would have been exceeded in the Northwest Miramichi (120% of conservation), would have improved from 78% to 83% for the Southwest Miramichi and would have been at about 95% of conservation for the Miramichi River (compared to 87% with fisheries) (Fig. 9). Under hook and release fisheries management for small salmon in 1997, egg depositions would theoretically have increased by 4 million eggs, an improvement of 3.3% in total egg depositions.

What caused the low returns in 1997?

A workshop convened in early February 1998 addressed the issue of low returns of Atlantic salmon to rivers of eastern Canada in 1997. The low returns and low sea survivals were widespread throughout eastern Canada suggesting that the factors contributing to low returns occurred in the ocean. The smolt counts from Catamaran Brook in 1996 were low and if a similar situation occurred through the Miramichi River, then overall smolt production for 1996 may also have been low. It is difficult to reconcile low smolt production in 1996 with the high juvenile densities observed in 1995 (Fig. 19 and 20). Juvenile survival rates in Catamaran Brook during the 1995/96 winter were low relative to other years and the hypothesized cause was the atypical flood event of January 1996 (Cunjak et al. 1997). The relative survival rate of small parr to large parr during 1995/96 (calculated using the juvenile data for the entire Miramichi) were low but not the lowest of recent years (Fig. 22). Although reduced smolt production in 1996 may have contributed to the lower returns of small salmon in 1997, the lower sea survivals of the monitored stocks in eastern Canada would also have affected the Miramichi smolts.

The sea survivals of repeat spawners returning as alternate spawner has been lower during 1993 to 1997 than for the 1988 to 1992 time period (Fig. 17). Consecutive spawner survival rates have improved for 1SW maiden salmon and been similar for 2SW maiden salmon over the same time period (Fig. 17). This difference in survival rate trends suggests that the survival constraint has occurred in the offshore marine environment and consequently may be affecting smolts in the same manner.

Adults returning to the Miramichi in 1997 were among the longest in the more than 25 year time series (Fig. 23). The 1SW maiden salmon lengths from the early run and late runs were at maximum in 1997. The 2SW maiden salmon lengths were among the largest in the time series, surpassed only by the 1986 early run returns. The large body size of these fish suggests that growth conditions were good or that all the smaller body size fish were lost during 1996/97, with the candidate cause being predation.

Although furunculosis was confirmed for the first time in the Miramichi in 1997, this is insufficient to explain the low returns. Low returns were observed throughout eastern Canada in rivers where furunculosis is known to occur as in rivers where furunculosis is not present.

Will the returns of large salmon in 1998 exceed the conservation requirements for the Miramichi River?

The most probable return of large salmon in 1998 based on the small salmon to large salmon retrun model is 22,178 fish. The usefulness of this model for 1998 is suspect for several reasons. Firstly, the probability profile of the predicted value is flat-topped with equivalent probability levels over a wide range of predictions from 14,000 to 26,000 fish. In recent years, the relationship has overpredicted the actual returns. Finally, the observed returns of small salmon in 1997 are the lowest ever in the time series and the model therefore predicts outside the range of previously observed values. The trends in returns in recent years, the low return of small salmon in 1997 and the observed low sea survivals of the 1996 smolts for the monitored stocks of eastern Canada suggest that returns of large salmon in 1998 will also be low and likely lower than in 1997.

What are the risks of not acheiving the conservation egg depositions in 1998 if harvesting of large salmon occurs in 1998?

The egg depositions from salmon in 1998 depend upon the actual number of salmon escaping to spawn, the proportion female and the fecundity of the females in the escapement. The proportion female and the average fecundity (based on average length of large salmon) varies annually. Returns of large salmon in 1998 are expected to be between 7000 fish and 34000 fish (95% confidence interval; Fig. 15). Any evaluation of risk for management scenarios requires three components:

1 - Long-term decision rule: in the case of Atlantic salmon, the management strategy is to potentially harvest all fish surplus to the conservation level.

2 - Undesirable event: for a management strategy to have risk, an undesirable event has to be defined. In the case of Atlantic salmon, the undesirable event is that the egg depositions from the escapement will be below the conservation requirement. There is no gradient of undesirability relative to the level of egg deposition below conservation; an underescapement of 1 egg is as undesirable as an underescapement of 1 million eggs. This is a consequence of treating the conservation requirement as a threshold reference point rather than a target.

3 - Evaluate the chances of the undesirable event: to evaluate the risk of the undesirable event, uncertainties in the forecast, variability in the proportion female and fecundity all have to be considered. In addition, the likelihood of achieving at least the conservation egg requirements in all the production areas of the river must be included. For the Miramichi, it is proposed that six production areas be used as identified in the "Conservation Requirement Section".

For the Miramichi River situation, the risks of not meeting the conservation egg requirements in 1998 under a few possible management scenarios are summarized in Table 20. In the absence of any large salmon losses due to fisheries (no First Nations harvest of large salmon, no hook and release losses in the recreational fishery), there is a 69% risk that the large salmon escapement will not be sufficient to meet the conservation egg requirements for the Miramichi. With a management plan in 1998 identical to that of 1997 (scenario 4, Table 20), the risk of not meeting conservation requirements rises to 87%. Any number of management scenarios can be considered.

What are the options for inseason assessments of the risk of not meeting conservation requirements?

A clear and complete analysis of the possibilities for in-season managment of Atlantic salmon in southern Gulf of St. Lawrence rivers was presented by Claytor (1996). Keypoints from the analysis were (Claytor 1996):

1. the best dates for single allocation adjustments were when 60% of the salmon had returned to the site,
2. a principal effect of in-season allocation adjustments was to increase the annual variation in harvest,
3. improved in-season forecasts do not necessarily lead to improved in-season management and allocation plans,
4. when mean returns to a site were well above the spawning escapement objective, in-seson adjustments made no difference and the best strategy was to keep the exploitation rate low and to maintain the allocation on the basis of the preseason forecast, and
5. in-season allocation requires a precise definition of the management objectives and criteria.

The Southwest Miramichi recapture trapnet is the best source for in-season assessment. For large salmon, about 30% of the counts for the year have generally occurred during September 12 to 14 (Fig. 13). There is no date for reliably determining the size of the early run of large salmon. Small salmon run timing was more predictable: 25% of the total early run and 10% of the total run had been enumerated by July 12 in 3 of 4 years (Fig. 13). Assuming a trapnet efficiency of about 7%, preliminary estimates of run size into the Southwest Miramichi could be provided bimonthly. How these assessments will be used to adjust management measures remains to be determined. Until the most suitable location and installation of the trapnets in the Northwest Miramichi is determined, the catches of salmon in these traps will not be useful for inseason predictons.

The exploitation rate on the large salmon from the Miramichi River is low. Between 1992 and 1996, the First Nations fisheries and losses from catch-and-release have represented less than 2% on average of the total returns to the river. In 1997, just under 4% of the total returns were lost to fisheries. The exploitation rates were higher in the Northwest Miramichi in 1997 (8%) compared to the Southwest Miramichi (1%). Small salmon exploitation levels have been higher. In 1997, the total exploitation rate on small salmon was 42%. The fixed pre-season allocation of large salmon to the First Nations has been distributed by season which provides an important control on the potential for higher exploitation rates on the early-run fish.

What is the contribution of hatchery origin salmon to the Miramichi?

The broodstock collections in 1997 amounted to about 0.1 million eggs from the Northwest and 0.3 million eggs from the Southwest. These represent less than 0.2% and 0.4% of the in-river egg depositions in the Northwest and Southwest branches, respectively.

The contribution of adipose-clipped fish to the returns and subsequent egg depositions in the Miramichi is negligible (Table 21). In 1997, small salmon sampled at the trapnets in the Southwest Miramichi and Northwest Miramichi were predominantly (99%) wild in both the early and late runs. In other years, returns to tributaries which received adipose-clipped stocking (for example smolt stocking in Little River, satellite rearing stocking in Rocky Brook), were comprised of a slightly higher percentage adipose-clipped fish but never more than 16% (Chaput et al. 1997). In 1997, returns of adipose-clipped fish in all areas were low.

Other projects

There are a large number of projects being conducted in the Miramichi River.

- Clearwater Brook ecology study (Atlantic Salmon Federation / Irving)
- Cains River fish habitat study (Cains River Enhancement Association)
- Rocky Brook fisheries study (Avenor Inc.)
- Tomogonops River rehabilitation study (Heath Steele)
- Satellite rearing initiatives (Miramichi Salmon Association)
- Subwatershed monitoring of Napan River (Miramichi River Environmental Assessment Committee)
- Salmon Pool Restoration Projects (Dept. of Natural Resources and Energy / stakeholders)
- Little River enhancement (Northumberland Salmon Protection Association / Heath Steele)

- Catamaran Brook Ecology (DFO / UNB / REPAP / Others)

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Table 1. Food fishery agreements for First Nations on the Miramichi River for 1997.

Location	Allocation Small	Allocation Large	Gear	Time Period
Eel Ground First Nation				
Northwest Miramichi	1880	195	2 trapnets, 11 gillnets, and recreational[1]	May 1 to Aug 31
	780	-	2 trapnets, 11 gillnets, and recreational[1]	Sept 1 to Oct 31
	200	5	1 counting fence or trap net	April 15 to July 31
	40	-	1 counting fence or trap net	Aug 1 to Oct 31
Southwest	1320	-	2 trapnets, 1 gillnet, and recreational[1]	May 1 to Aug 31
	780	-	2 trapnets, 1 gillnet, and recreational[1]	Sept 1 to Oct 31
Red Bank First Nation				
Northwest Miramichi	1320	150	1 trapnet, 4 gillnets[2], and recreational[1]	June 1 to Aug 31
	680	150	1 trapnet and recreational[1]	Sept 1 to Oct 31
Little Southwest	1320	100	1 trapnet, 2 gillnets[2], and recreational[1]	June 1 to Aug 31
	680	100	1 trapnet and recreational[1]	Sept 1 to Oct 31
Burnt Church First Nation[3]				
Miramichi Bay	1300	80	25 gillnets and recreational[1]	May 1 to July 31
	700	120	25 gillnets and recreational[1]	Aug 1 to Oct 15

Notes:
[1] Native recreational fishing gear
[2] Gillnets only between June 1 and June 14 and are not to exceed 40 feet in length and
[3] Communal fishing licence only

Table 2. Bright salmon angling seasons for 1997.

General Season: **April 15 - October 31**

Exceptions to General Season:

Opens April 15; Closes August 31
- NW Miramichi River upstream from Little River
- Rocky Brook, tributary of SW Miramichi River

Opens April 15; Closes September 15
- All tributaries of SW Miramichi River upstream of the Cains River except Rocky Brook
- Big Sevogle River upstream from Square Forks
- Dungarvon River upstream of the Furlong Bridge
- LSW Miramichi River upstream of Catamaran Brook
- North and South Branches of the SW Miramichi River
- North and South Branches of the Renous River

Opens April 15; Closes September 30:
- SW Miramichi River upstream of the mouth of Burnt Land Bk. to the forks of the North and South Branches at Juniper

Opens April 15; Closes October 15:
- Big Sevogle River, downstream from Square Forks
- Bartholowmew River
- Cains River
- Dungarvon River, downstream from the Furlong Bridge
- LSW Miramichi River downstream from Catamaran Bk.
- NW Miramichi River, downstream from Little River
- Renous River, downstream from the confluence of the North and South Branches.
- Southwest Miramichi River downstream from Burnt Land Bk.
- Southwest Miramichi River tributaries downstream of the Cains River which are not mentioned above

Hook and Release Only Angling (with salmon angling licence)

Opens October 1; Closes October 15:
- Southwest Miramichi River upstream from Burntland Bk to the forks of the North and South Branches at Juniper

Opens September 16; Closes October 15:
- Little Southwest Miramichi River upstream from Catamaran Bk to and including Cleland's Pool

Opens September 1; Closes September 15:
- Northwest Miramichi River upstream from Little River to a point 200m upstream of the forks of the North and South Branches of the Northwest Miramichi River

Hook and Release Only Angling (with a Hook and Release Licence)

Opens July 1; Closes September 15:
- North Pole Stream from its mouth upstream to Lizard Bk
- Little Southwest Miramichi River , from and including Big Rock Pool upstream to include the east and west branches, not including tributaries or lakes

Opens June 1; Closes September 15:
- Lower North Branch of the LSW Miramichi River, from and including Rocky Rapids Pool upstream to its source including all tributaries
- Cains River, from the river ford located approximately 3/4 km upstream from Hopewell Lodge to and including Lower Otter Brook Pool exclusive of all tributaries

Table 3. Catch and effort (net days) for native food fisheries on the Miramichi River in 1997 for early and late runs as reported by band councils.

	Burnt Church		Eel Ground							Red Bank				
	Gillnets		Gillnets			SW Trapnets	NW Trapnets	Big Hole counting fence		Gillnets			NW & LSW Trapnets	
	Small	Large	Effort	Small	Large	Small	Small	Small	Large	Effort	Small	Large	Small	Large
Early run														
May 26 - June 1	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	0	0
June 2 - 8	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	0	0
June 9 - 15	n.a.	n.a.	0	0	0	0	0	0	0	20	23	56	0	0
June 16 - 22	n.a.	n.a.	66	8	37	13	10	0	2	20	44	69	15	3
June 23-June 29	n.a.	n.a.	51	8	51	8	16	0	0	0	0	0	33	1
June 30 - July 6	n.a.	n.a.	48	14	0	10	4	0	0	0	0	0	16	1
July 7 - 13	n.a.	n.a.	48	62	18	31	31	0	0	0	0	0	38	20
July 14 - 20	n.a.	n.a.	60	17	9	66	14	1	1	0	0	0	40	15
July 21 - 27	n.a.	n.a.	18	0	0	52	29	0	0	0	0	0	515	8
July 28 - Aug. 3	n.a.	n.a.	36	11	20	79	35	0	0	0	0	0	49	51
Aug. 4 - 10	n.a.	n.a.	18	3	3	10	7	0	0	0	0	0	13	7
Aug. 11 - 17	n.a.	n.a.	0	0	0	19	9	0	0	0	0	0	20	23
Aug. 18 - 24	n.a.	n.a.	0	0	0	24	4	0	0	0	0	0	5	9
Aug. 25 - 31	n.a.	n.a.	0	0	0	9	5	0	0	0	0	0	5	6
Subtotal	n.a.	n.a.	0	175	86	321	164	1	3	0	67	125	249	144
Late run														
Sept. 1 - 7	n.a.	n.a.	0	0	0	5	0	0	0	0	0	0	10	15
Sept. 8 - 14	n.a.	n.a.	0	0	0	0	0	1	0	0	0	0	9	9
Sept. 15 - 21	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	25	22
Sept. 22 - 28	n.a.	n.a.	0	0	0	0	0	0	1	0	0	0	91	50
Sept. 29 - Oct. 5	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	39	31
Oct. 6 - 12	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	38	46
Oct. 13 - 19	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	2	16
Oct. 20 - 26	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	n.a.	n.a.	0	0	0	5	0	1	1	0	0	0	214	189
Total season	n.a.	n.a.	345	175	86	326	164	2	4	40	67	125	463	333
% Early run	n.a.	n.a.	100%	100%	100%	98%	100%	50%	75%	100%	100%	100%	53.8%	43.2%

Table 4. Recorded harvests of salmon in all fisheries (commercial, by-catch, recreational, and native) Miramichi River and Bay, 1951 to 1997. Kelts angled in year i are added to harvests in year i-1. The 1997 angling data are preliminary. All numbers are in fish X 1000.

	Commercial Fishery			Angling Fisheries: Kelts (yr i+1)			Angling Fisheries: Brights (yr i)			Angling Fisheries	Native Fishery			All
Year	Small	Large	Total	Small	Large	Total	Small	Large	Total	All	Small	Large	Total	Fisheries
1951		27.6	27.6			12.0			9.6	21.6				49.2
1952		27.3	27.3			11.3			15.9	27.2				54.5
1953		24.4	24.4			10.1			18.2	28.3				52.7
1954		50.6	50.6			11.2			23.5	34.7				85.3
1955		15.3	15.3			8.9			14.7	23.6				38.9
1956		24.7	24.7			9.3			28.9	38.2				62.9
1957		29.9	29.9			8.4			19.5	27.9				57.8
1958		25.2	25.2			10.2			36.7	46.9				72.1
1959		37.3	37.3			9.5			10.3	19.8				57.1
1960		30.8	30.8			5.6			4.5	10.1				40.9
1961		30.0	30.0			9.5			11.0	20.5				50.5
1962		41.6	41.6			7.3			10.3	17.6				59.2
1963		40.7	40.7			5.2			50.9	56.1				96.8
1964		69.8	69.8			9.0			35.1	44.1				113.9
1965		69.5	69.5			16.0	38.7	3.9	42.6	58.6				128.1
1966		72.9	72.9			20.0	51.7	5.9	57.6	77.6				150.5
1967		102.2	102.2			14.1	41.8	4.1	45.9	60.0				162.2
1968		48.5	48.5			6.9	7.0	1.5	8.5	15.4				63.9
1969		41.3	41.3	3.7	1.6	5.3	24.3	3.8	28.1	33.4				74.7
1970		39.7	39.7	2.4	1.4	3.8	19.6	3.3	22.9	26.7				66.4
1971		18.3	18.3	1.5	0.5	2.0	13.7	1.8	15.5	17.5				35.8
1972		2.5	2.5	1.5	3.0	4.5	19.1	8.9	28.0	32.5				35.0
1973		0.9	0.9	1.5	3.0	4.5	13.9	6.0	19.9	24.4				25.3
1974		1.0	1.0	1.8	3.1	4.9	18.2	7.2	25.4	30.3				31.3
1975	0.4	0.7	1.1	2.3	1.4	3.7	15.6	6.3	21.9	25.6	0.4	0.2	0.6	27.3
1976	1.8	0.9	2.7	2.4	2.2	4.6	27.2	7.4	34.6	39.2	0.2	0.2	0.4	42.3
1977	0.4	6.9	7.3	1.4	2.1	3.5	13.6	11.6	25.2	28.7	0.5	0.4	0.9	36.9
1978	1.2	8.4	9.6	1.5	1.7	3.2	8.3	4.9	13.2	16.4	0.4	0.4	0.8	26.8
1979	5.5	1.7	7.2	2.2	1.5	3.7	14.5	2.7	17.2	20.9	0.1	0.2	0.3	28.4
1980	2.7	10.9	13.6	1.7	2.1	3.8	12.0	6.5	18.5	22.3				35.9
1981	1.6	7.8	9.4	2.7	1.4	4.1	22.7	3.2	25.9	30.0	1.0	0.5	1.5	40.9
1982	2.3	12.5	14.8	2.1	1.0	3.1	21.4	4.6	26.0	29.1	0.7	0.4	1.1	45.0
1983	1.6	17.1	18.7	0.9	0.7	1.6	8.4	2.2	10.6	12.2	0.4	0.2	0.6	32.5
1984	0.0	0.0	0.0	2.4	0.0	2.4	18.8	0.0	18.8	21.2	0.4	0.3	0.7	21.9
1985	0.0	0.0	0.0	2.5	0.0	2.5	18.4	0.0	18.4	20.9	0.5	0.3	0.8	21.7
1986	0.0	0.0	0.0	2.7	0.0	2.7	26.2	0.0	26.2	28.9	2.0	0.6	2.6	31.5
1987	0.0	0.0	0.0	4.2	0.0	4.2	20.8	0.0	20.8	25.0	1.3	0.9	2.2	27.2
1988	0.0	0.0	0.0	5.4	0.0	5.4	30.6	0.0	30.6	36.0	0.9	0.3	1.2	37.2
1989	0.0	0.0	0.0	3.9	0.0	3.9	24.4	0.0	24.4	28.3	1.1	0.5	1.6	29.9
1990	0.0	0.0	0.0	2.4	0.0	2.4	21.7	0.0	21.7	24.1	2.1	0.6	2.7	26.8
1991	0.0	0.0	0.0	2.3	0.0	2.3	11.3	0.0	11.3	13.6	1.1	0.5	1.6	15.2
1992	0.0	0.0	0.0	1.8	0.0	1.8	21.5	0.0	21.5	23.3	1.7	0.6	2.3	25.6
1993	0.0	0.0	0.0	0.9	0.0	0.9	15.3	0.0	15.3	16.2	0.6	0.2	0.8	17.0
1994	0.0	0.0	0.0	0.6	0.0	0.6	11.2	0.0	11.2	11.8	3.0	0.1	3.1	14.9
1995	0.0	0.0	0.0	1.6	0.0	1.6	5.6	0.0	5.6	7.2	3.0	0.2	3.2	10.4
1996	0.0	0.0	0.0	1.4	0.0	1.4	16.9	0.0	16.9	18.3	2.6	0.4	3.0	20.9
1997	0.0	0.0	0.0	-	-	-	8.3	0.0	8.3	8.3	1.2	0.5	1.7	
1992-96 Mean (1991-95 Mean used for angling)							13.0				2.2	0.3	2.5	
change = (97-mean)/mean							-36%				-45%	67%	-31%	

Note: Angling catches from 1951-68 are from DFO while catches from 1969-97 are from DNRE FISHSYS - with the exception of 1996. 1996 kelt catches are estimated as the 1991-95 average and 1996 bright catches are estimated as the 1990-94 average (1995 was excluded because the bright salmon season was shortened due to low water)

Table 5. Recreational Atlantic salmon fishery statistics from the Miramichi River, 1997. % change represents 1997 minus mean divided by mean. Detailed catches are in Moore et al. (MS1995) of which 1995 data have been finalized. FISHSYS data for 1997 are preliminary.

		Miramichi River		**Northwest**		**Southwest**	
Black salmon Fishery							
Effort (rod days)	1997	6628		1635		4993	
	1991-1995 mean	8511		1453		7058	
	% change	-22.1%		12.5%		-29.3%	
		Harvest	*Released*	*Harvest*	*Released*	*Harvest*	*Released*
Small salmon	1997	1400	2542	397	813	1003	1729
	1991-1995 mean	1666	3098	270	580	1396	2517
	% change	-16.0%	-17.9%	47.0%	40.1%	-28.2%	-31.3%
Large salmon	1997		3365		1363		2002
	1991-1995 mean		3175		541		2634
	% change		6.0%		151.9%		-24.0%
Bright Salmon Fishery							
Effort (rod days)	1997	72334		23549		48785	
	1991-1995 mean	99134		32443		66691	
	% change	-27.0%		-27.4%		-26.8%	
		Harvest	*Released*	*Harvest*	*Released*	*Harvest*	*Released*
Small salmon	1997	8311	3181	3153	899	5158	2282
	1991-1995 mean	13284	4666	4405	1525	8879	3141
	% change	-37.4%	-31.8%	-28.4%	-41.1%	-41.9%	-27.3%
Large salmon	1997		5078		1432		3646
	1991-1995 mean		6404		1602		4802
	% change		-20.7%		-10.6%		-24.1%

Crown Reserve Angling		Total	Little Southwest	Sevogle	Northwest
Effort (rod days)	1997	2494	523	728	1243
	1996	2607	565	752	1290
	1991-1995 mean	2407	524	773	1109
	% change	3.6%	-0.2%	-5.8%	12.1%
Small salmon (catch)	1997	868	95	191	582
	1996	1301	151	267	883
	1991-1995 mean	1256	165	332	760
	% change	-30.9%	-42.4%	-42.5%	-23.4%
Large salmon (released)	1997	115	16	43	56
	1996	131	31	33	67
	1991-1995 mean	116	30	34	53
	% change	-0.9%	-46.7%	26.5%	5.7%

Table 6. Summary of broodstock collections in 1997.

Stock Collected	Date Collected	Female		Male		Collection Site
		Large	Small	Large	Small	
Northwest Miramichi						
Little Southwest	Sept. 25	6	0	1	5	Moose Landing
Northwest	Sept. 26	2	0	1	1	Barrier Pool
	Oct. 31	1	1	0	2	Little River
	Nov. 1	1	0	0	0	Little River
Sevogle	Oct. 10	1	3	0	3	Trash Heap Pool
Subtotal		11	4	2	11	
Southwest Miramichi						
Southwest Miramichi	Sept. 12	0	1	0	0	Behind Juniper Lumber
	Oct. 8	7	0	1	1	South branch bridge at Juniper.
Clearwater	Sept. 25	6	0	6	0	Avenor Bridge
Rocky Brook	Sept. 10	4	0	2	2	Cold Spring
Cains	July 24	1	0	0	3	Island Pool
Sabbies	Nov. 6	4	0	0	0	Road Crossings
Dungarvon	Sept. 19	3	0	0	10	Furlong Bridge
	Sept. 29	12	0	5	0	Furlong Bridge
Subtotal		37	1	14	16	
Total		48	5	16	27	

Table 7. Summary of trapnet operation dates, catch, and tags applied in the Miramichi River, 1997. Catch represents all fish sampled, including recaptures.

		Catch		Tagged	
Trapnets	Time Period	Small	Large	Small	Large
NW Miramichi					
Eel Ground Lower	June 18 to Sept. 7	60	33	5	31
Eel Ground Upper	June 18 to Oct. 17	278	320	147	284
Red Bank NW	June 18 to Oct. 15	174	115	0	0
Red Bank LSW	June 19 to Oct. 15	334	258	0	0
SW Miramichi					
Eel Ground Lower	June 16 to Sept. 21	189	76	63	70
Eel Ground Upper	June 18 to Oct. 14	681	477	393	419
Millerton	May 27 to Oct. 21	958	856	845	732

Table 8. Mark and recapture matrices used in the estimation of returns of small salmon and large salmon to the Miramichi River in 1997.

Small Salmon

Stratified by branch and season

From		Tagged	To NWEarly	NWLate	SWEarly	SWLate
	NWEarly	8	0	0	0	0
	NWLate	144	0	4	0	4
	SWEarly	27	0	0	0	0
	SWLate	428	0	0	0	29
Unmarked			253	237	356	486
Total Catch			253	241	356	519

Stratified by branch

From		Tagged	To NW	SW
	NW	152	4	4
	SW	455	0	29
Unmarked			490	842
Total Catch			494	875

Large Salmon

Stratified by branch and season

From		Tagged	To NWEarly	NWLate	SWEarly	SWLate
	NWEarly	107	3	2	0	5
	NWLate	210	0	1	0	1
	SWEarly	155	0	1	5	6
	SWLate	353	0	1	0	23
Unmarked			142	224	198	495
Total Catch			145	229	203	530

Stratified by branch

From		Tagged	To NW	SW
	NW	317	6	6
	SW	508	2	34
Unmarked			366	693
Total Catch			374	733

Table 9. Summary of estimates of returns of large salmon by model and stratification using the point estimates of tag loss / mortality (10%) and based on the resampling algorithm. For the point estimate calculation, estimate = most probable value, LCI and UCI define the 95% confidence interval. For the resampling approach, estimate = median of the 1000 replications, LCI and UCI represent the 90% confidence interval. CV = coefficient of variation (%).

			Using point estimates			From resampling			
	Stratification	Model	Estimate	LCI	UCI	Estimate	LCI	UCI	CV
Miramichi	Branch and Season	Darroch	25,241	<0	63,988	15,851	<0	44,731	459%
		Schaefer	17,024			18,275	13,846	24,908	19%
	Branch	Darroch	21,111	10,894	31,328	19,402	13,689	41,105	124%
		Schaefer	17,827			17,042	13,097	22,917	17%
	Pooled	Petersen	16,383	12,048	20,718	17,439	13,809	22,541	15%
Northwest	Branch and Season	Darroch	23,099			7,918	<0	37,830	5064%
		Schaefer	6,820			6,924	4,334	13,045	37%
	Branch	Darroch	13,046			11,724	5,884	35,168	217%
		Schaefer	7,691			7,204	5,047	10,921	28%
Southwest	Branch and Season	Darroch	2,141			6,081	<0	45,999	273%
		Schaefer	10,204			10,993	8,455	14,578	17%
	Branch	Darroch	8,065			7,256	3,522	10,937	79%
		Schaefer	10,136			9,718	7,584	12,816	17%

Table 10. Removals of Atlantic salmon by size and season from the Northwest Miramichi, Southwest Miramichi and total Miramichi River system in 1997.

	Northwest Miramichi			Southwest Miramichi			Miramichi River		
	Early	Late	Total	Early	Late	Total	Early	Late	Total
Small salmon									
Food fisheries	656	215	871	321	5	326	977	220	1197
Angling	.	.	3153	.	.	5158	.	.	8311
Seizures	3	0	3	2	0	2	5	0	5
Broodstock	15	0	15	14	3	17	29	3	32
Incidental mortalities	26	0	26	2	0	2	28	0	28
Furunculosis[1]	9	0	9	4	0	4	13	0	13
Total	709	215	4077	343	8	5509	1052	223	9586
Large salmon									
Food fisheries	358	190	548	0	0	0	358	190	548
Angling	.	.	46	.	.	106	.	.	152
Seizures	11	1	12	5	0	5	16	1	17
Broodstock	13	0	13	43	8	51	56	8	64
Incidental mortalities	14	0	14	7	0	7	21	0	21
Furunculosis[1]	19	0	19	4	1	5	23	1	24
Total	415	191	652	59	9	174	474	200	826

Notes: [1]Furunculosis mortalities include fish sent to the DFO Fish Health Unit and 4 mortalities observed at Big Hole Tract (2 salmon and 2 grilse) which were not confirmed by DFO.

Table 11. Estimated returns, removals, and escapements of small and large salmon to the Northwest Miramichi, Southwest Miramichi and Miramichi River in 1997.

		Returns to recapture trapnets	Harvest below recapture trapnets	Total returns	Total removals	Escapement
Northwest Miramichi						
Small	Median	9,420	368	9,788	4,077	5,711
	5th	6,122		6,490		2,413
	95th	16,966		17,334		13,257
Large	Median	6,924	100	7,024	652	6,372
	5th	4,334		4,434		3,782
	95th	13,045		13,145		12,493
Southwest Miramichi						
Small	Median	13,158	328	13,486	5,509	7,977
	5th	10,113		10,441		4,932
	95th	18,349		18,677		13,168
Large	Median	10,993	6	10,999	174	10,825
	5th	8,455		8,461		8,287
	95th	14,578		14,584		14,410
Miramichi River						
Small	Median	21,869	696	22,565	9,586	12,979
	5th	17,110		17,806		8,220
	95th	29,464		30,160		20,574
Large	Median	18,275	106	18,381	826	17,555
	5th	13,846		13,952		13,126
	95th	24,908		25,014		24,188

Table 12. Biological characteristics (fork length, sex ratio, and fecundity[1]) of small salmon and large salmon for the Southwest and Northwest Miramichi and Miramichi River system for 1997.

		Small salmon		Large salmon	
		Estimate	Std. Dev.	Estimate	Std. Dev.
Northwest Miramichi					
% Female	early	27.7		83.1	
	late	10.5		71.2	
	total	19.3		76.0	
Fork length	early	56.2	2.06	81.5	8.69
(cm)	late	57.1	3.47	81.2	7.91
	total	56.6	2.71	81.3	8.34
Fecundity[1]	early	1024		6556	
	late	408		5597	
	total	730		5985	
% Previous	early			36.6	
spawners	late			36.2	
	total			36.4	
Southwest Miramichi					
% Female	early	16.7		84.7	
	late	8.5		78.2	
	total	9.8		80.3	
Fork length	early	55.1	2.80	82.9	10.19
(cm)	late	57.9	2.68	78.2	7.64
	total	56.8	3.06	79.5	8.63
Fecundity[1]	early	580		6856	
	late	345		5829	
	total	375		6127	
% Previous	early			48.2	
spawners	late			20.4	
	total			27.5	
Miramichi River					
% Female	early	24.3		83.4	
	late	9.1		76.9	
	total	14.0		78.9	
Fork length	early	55.2		82.4	
(cm)	late	57.9		78.6	
	total	56.8		79.9	
Fecundity[1]	early	849		6694	
	late	276		5774	
	total	535		6063	
% Previous	early			43.7	
spawners	late			22.6	
	total			29.4	

1 Fecundity (eggs per fish) calculated using fecundity-length relationship (Randall 1989) and sex ratios.
Fecundity (small salmon) = % female * exp(3.1718*Ln(fork length) - 4.5636)
Fecundity (large salmon) = % female * exp(1.4132*Ln(fork length) + 2.7560)

Table 13. Sex ratios (% female) of small and large salmon observed during broodstock collections and at the Little River counting fence. All determinations based on external characteristics.

	Small salmon			Large salmon		
	Female	Male	% female	Female	Male	% female
Southwest Miramichi						
Rocky Brook, Coldstream Pool (Sept. 10, 1997)	15	33	31%	19	2	90%
Rocky Brook, Hurd , Lower Hurd,McGrath and Cold Spring pools, (Sept. 10, 1997)	8	27	23%	8	0	100%
Dungarvon - Furlong Bridge (Sept. 19, 1997)	4	26	13%	7	0	100%
Dungarvon - Furlong Bridge (Sept. 29, 1997)	2	23	8%	20	8	71%
Northwest Miramichi						
Sevogle, Trash Heap Pool (Oct. 10, 1997)	3	7	30%	1	0	100%
Little Southwest Moose Landing (Sept. 25, 1997)	2	10	17%	8	1	89%
Little River counting fence (Nov. 5 - Nov. 15, 1997)	7	9	44%	9	2	82%

Table 14. Egg deposition (millions of eggs) and percent of conservation requirement met for early, late and total spawners for the Northwest Miramichi, Southwest Miramichi and Miramichi River system in 1997.

	Small	Large	Total	Contribution by large	% of conservation requirement
Northwest Miramichi					
Total	4.2	38.5	42.9	90%	
95% Conf. Int.	1.2 to 12.2	20.1 to 88.0	21.6 to 100.6		
Conservation requirement			41.0	94%	104%
					53% to 246%
Southwest Miramichi					
Total	3.0	65.9	69.0	96%	
Confidence interval	1.5 to 5.9	40.9 to 107.5	43.4 to 113.3		
Conservation requirement			88.0	75%	78%
					49% to 129%
Miramichi River					
Total	7.5	106.7	114.4	93%	
Confidence interval	3.8 to 15.2	67.6 to 176.2	72.0 to 188.5		
Conservation requirement			132.0	81%	87%
					55% to 143%

Table 15. Estimated returns and escapement to the Miramichi River (to Millbank 1971 to 1991; to Enclosure area 1992 to 1997) of small and large salmon. % change is 1997 minus mean relative to the mean.

	Small Salmon		Large Salmon	
Year	Returns	Escapements	Returns	Escapements
1971	35,673	21,946	24,407	4,347
1972	46,275	27,135	29,049	17,671
1973	44,545	30,668	27,192	20,349
1974	73,418	55,186	42,592	34,445
1975	64,902	48,469	28,817	21,448
1976	91,580	62,380	22,801	14,332
1977	27,743	13,247	51,842	32,917
1978	24,287	14,353	24,493	10,829
1979	50,965	30,848	9,054	4,541
1980	41,588	26,894	36,318	18,873
1981	65,273	39,929	16,182	4,608
1982	80,379	56,000	30,758	13,258
1983	25,184	14,849	27,924	8,458
1984	29,707	18,929	15,137	14,687
1985	60,800	41,815	20,738	20,122
1986	117,549	89,398	31,285	30,216
1987	84,816	62,777	19,421	18,056
1988	121,919	90,278	21,745	20,980
1989	75,231	48,385	17,211	15,540
1990	83,448	59,524	28,574	27,588
1991	60,869	48,269	29,949	29,089
1992	152,647	129,288	37,000	35,927
1993	95,000	76,416	35,000	34,702
1994	56,929	42,479	27,544	27,147
1995	54,145	33,347	32,627	32,093
1996	44,377	24,180	24,812	23,478
1997	22,565	12,980	18,381	17,555
Mean				
1992 to 1996	80,620	61,142	31,397	30,669
1984 to 1991	79,292	57,422	23,008	22,035
1971 to 1996	65,740	46,423	27,403	20,604
% change in 1997				
1992 to 1996	-72.0%	-78.8%	-41.5%	-42.8%
1971 to 1996	-65.7%	-72.0%	-32.9%	-14.8%

Table 16. Estimated returns of small and large salmon to the Southwest Miramichi and the Northwest Miramichi, 1992 to 1997.

	Small salmon		Large salmon	
	Median	5^{th} to 95^{th} Percentile	Median	5^{th} to 95^{th} Percentile
Southwest Miramichi				
1992	120,701	85,263 to 157,794	25,028	17,657 to 32,744
1993	42,600	22,700 to 73,800	21,900	10,800 to 58,900
1994	33,775	23,450 to 54,150	14,000	9,100 to 22,850
1995	31,675	10,410 to 45,342	17,097	5,661 to 24,150
1996	30,241	20,161 to 44,875	15,734	9,454 to 27,225
1997	13,486	10,441 to 18,677	10,999	8,461 to 14,584
Northwest Miramichi				
1992	30,321	23,040 to 40,864	10,000	-
1993	46,200	27,700 to 97,500	10,541	3,700 to 37,500
1994	20,600	11,750 to 38,525	12,600	6,450 to 31,300
1995	22,379	7,100 to 32,595	15,227	7,752 to 31,450
1996	18,943	13,256 to 28,044	7,957	4,824 to 13,278
1997	9,788	6,490 to 17,344	7,024	4,434 to 13,145

Table 17. Numbers of large and small salmon counted at barriers in three tributaries of the Miramichi River, 1981 to 1997.

Tributary	Year	Large	Small	Total	Dates Operated	No. of Days
North Branch of SW Miramichi River						
	1981	54	671	725	Jul. 5-Oct. 4	92
	1982	282	621	903	Jun. 30-Oct. 8	101
	1983	219	290	509	Jul. 4-Oct. 10	99
	1984	297	230	527	Jul. 10-Oct. 16	99
	1985	604	492	1096	Jul. 1-Oct. 20	112
	1986	1138	2072	3210	Jun. 30-Oct. 19	110
	1987	1266	1175	2441	Jul. 2-Oct. 19	110
	1988	929	1092	2021	Jun. 30-Oct. 24	117
	1989	731	969	1700	Jul. 1-Oct. 24	116
	1990	994	1646	2640	Jun. 29-Oct. 14	108
	1991	476	495	971	Jun. 30-Oct. 21	107
	1992	1047	1383	2430	Jun. 30-Oct. 20	113
	1993	1145	1349	2494	Jun. 30-Oct. 22	115
	1994	877	1223	2100	June 29-Oct. 30	124
	1995	1019	811	1830	June 15-Oct. 28	136
	1996	819	1388	2207	June 20-Oct. 27	130
	1997	519	566	1085	June 23-Oct. 29	131
1992-96	Mean	981	1231	2212		
Change (97-mean)/mean		-47%	-54%	-51%		
Dungarvon River						
	1981	112	550	662	Jun. 24-Oct. 8	107
	1982	122	483	605	Jun. 28-Oct. 15	110
	1983	126	330	456	Jun. 28-Oct. 14	109
	1984	93	315	408	Jul. 5-Oct. 12	100
	1985	162	536	698	Jun. 25-Oct. 10	108
	1986	174	501	675	Jun. 25-Oct. 21	119
	1987	202	744	946	Jun. 25-Oct. 14	112
	1988	277	851	1128	Jun. 2-Oct. 25	151
	1989	315	579	894	Jun. 1-Oct. 10	132
	1990	318	562	880	Jun. 1-Oct. 11	133
	1991	204	296	500	Jun. 4-Oct. 14	133
	1992	232	825	1057	Jun. 4-Oct. 16	135
	1993	223	659	882	Jun. 14-Oct. 27	131
	1994	153	358	511	June 7-Oct. 20	136
	1995	95	329	424	May 31-Oct. 13	136
	1996	188	616	804	June 4-Oct. 24	143
	1997	115	391	506	June 10-Oct. 30	155
1992-96	Mean	178	557	736		
Change (97-mean)/mean		-35%	-30%	-31%		
Northwest Miramichi River						
	1988	234	1614	1848	Jun. 27-Oct. 26	122
	1989	287	966	1253	May 30-Oct. 12	136
	1990	331	1318	1649	May 29-Oct. 18	143
	1991	224	765	989	Jun. 4-Oct. 18	137
	1992	219	1165	1384	Jun. 3-Oct. 16	136
	1993	216	1034	1250	Jun. 14-Oct. 27	136
	1994	228	673	901	June 5-Oct. 14	132
	1995	252	548	800	June 1-Oct. 12	134
	1996	218	602	820	June 3-Oct. 24	144
	1997	152	501	653	June 3-Oct. 29	149
1992-96	Mean	227	804	1031		
Change (97-mean)/mean		-33%	-38%	-37%		

Table 18. Counts of salmon of various life stages migrating upstream and downstream at Catamaran Brook, Little Southwest Miramichi River, 1990 to 1997. Data courtesy of R. Cunjak (University of New Brunswick, Fredericton, N.B.).

			Upstream					**Smolt Survival to**		
	Downstream		**By Size**		**By Age**			**1SW**	**2SW**	**Total**
Year	**Parr**	**Smolts**	**Small**	**Large**	**1SW**	**2SW**	**PS**	**Salmon**	**Salmon**	**Salmon**
1990	851[2]	760	82[2]	28[2]	83	15	12	10.4%	4.4%	14.6%
1991	1684	1165	78	49	78	26	23	11.2%	2.6%	13.7%
1992	1229	2135	127	65	129	33	30	5.0%	0.9%	5.9%
1993	1371	426	106	43	107	30	12	13.6%	10.3%	24.0%
1994	1779	887	57	25	58	20	4	13.5%	2.7%	16.2%
1995	1620	935	118	72	120[1]	44[1]	26[1]	8.5%	1.9%	10.4%
1996	n.a.	472	78	39	79[1]	24[1]	14[1]	9.9%	n.a.	n.a.
1997	1732	723	46	29	47[1]	18[1]	10[1]	n.a.	n.a.	n.a.
						median		**10.3%**	**2.7%**	**12.9%**

[1] Numbers at age for 1995-97 are estimated from average age composition of large and small salmon for 1990-94.

[2] Incomplete count because of damage to counting fence

Table 19. Distribution of salmon juveniles in the Miramichi River in 1997. AC = adipose-clip, NM = unmarked.

River	Life stage	Mark	Number of fish stocked	Absolute difference from 1996 (%)
Northwest Miramichi	2+ smolts	AC	21,068	-18,674 (-47%)
	1+ smolts	AC	0	-1,736
	1+ parr	AC	37,566	29,106 (+344%)
	0+ parr (June - July)	NM	6,038	-9,343 (-61%)
	0+ parr (Sept.-Oct.)	AC	23,778	10,930 (+85%)
	Non-feeding fry	NM	38,500	1,492 (+4%)
Southwest Miramichi	2+ smolts	AC	38,504	35,614 (+1,232%)
	1+ smolts	AC	0	3,891
	0+ parr (June - July)	NM	8,951	-41,164 (-82%)
	0+ parr (Sept.-Nov.)	AC	234,767	175,588 (+297%)
	0+ parr (Oct.)	NM	8,624	8,624
	Non-feeding fry	NM	23,000	-19,793 (-46%)
Miramichi (total)	2+ smolts	AC	59,572	19,830 (+50%)
	2+ smolts	NM	0	-2,890
	1+ smolts	AC	0	-5,627
	1+ parr	AC	37,566	29,106 (+344%)
	0+ parr (June - July)	NM	14,989	-50,115 (-70%)
	0+ parr (June)	AC	0	-15,381
	0+ parr (Sept.-Nov.)	AC	258,545	186,518 (+259%)
	0+ parr (Oct.)	NM	8,624	8,624
	Non-feeding fry	NM	61,500	-18,301 (-23%)

Table 20. Risk of not achieving conservation requirements in 1998 for different harvesting scenarios. Harvest scenarios are for large salmon only.

	First Nations Harvests			Angling harvests		Risk of not achieving conservation requirements in 1997		
Scenario	Estuary	Northwest	Southwest	Northwest	Southwest	Northwest	Southwest	Miramichi
1	**0**	**0**	**0**	**0**	**0**	**68%**	**67%**	**69%**
2	**200**	**700**	**0**	**0**	**0**	**81%**	**80%**	**82%**
3	**0**	**0**	**0**	**71**	**156**	**73%**	**71%**	**74%**
4	**200**	**700**	**0**	**60**	**155**	**87%**	**80%**	**87%**

Scenario 1: no fisheries in 1998

Scenario 2: only First Nations harvests, no angling fisheries

Scenario 3: no harvest of large salmon by First Nations, angling harvests are incidental mortalities from catch and release of large salmon
Scenario 4: status quo management plan of 1997

Table 21. Relative contribution of wild (non-adipose clipped) salmon to the returns in 1997.

	Small salmon			Large salmon		
	Wild	Adipose-clip	% wild	Wild	Adipose-clip	% wild
Southwest Miramichi (received 27000 smolts in 1995, 5000 smolts in 1996)						
Sampling at Millerton trapnets						
June to Aug.	357	3	99.2%	206	0	100.0%
Sept. to Oct.	564	7	98.8%	627	2	99.7%
Total	921	10	98.9%	833	2	99.8%
Dungarvon River (received smolt stocking in 1995 and 1996)						
Seining at Furlong Bridge						
Sept. 19	30	0	100.0%	7	0	100.0%
Seining at Furlong Bridge						
Sept. 25	25	0	100.0%	28	0	100.0%
Rocky Brook (received satellite-reared fall fingerlings annually since 1984)						
Seining at McGrath, Coldspring and Hurd Brook pools.						
Sept.10	35	0	100.0%	8	0	100.0%
Seining Coldstream pool.						
Sept.10	48	0	100.0%	21	0	100.0%
Northwest Miramichi (received 2700 smolts in 1995, 41500 smolts in 1996)						
Sampling at Eel Ground trapnets						
June to Aug.	102	2	98.1%	106	0	100.0%
Sept. to Oct.	163	0	100.0%	231	0	100.0%
Total	265	2	99.3%	337	0	100.0%
Sampling at Red Bank trapnets						
June to Aug.	220	3	98.7%	145	0	100.0%
Sept. to Oct.	228	0	100.0%	207	0	100.0%
Total	448	3	99.3%	352	0	100.0%
Sevogle River (Trash Heap Pool) (non-feeding fry stocking only)						
Oct. 10	10	0	100.0%	1	0	100.0%
Little River counting trap (2700 smolts released in 1995, 5000 in 1996)						
Oct. 21 to Nov. 15	16	0	100.0%	11	0	100.0%
Little Southwest Miramichi (8500 1+ parr in 1996, non-feeding fry stocking)						
Seining at Moose Landing						
Sept. 25	12	0	100.0%	9	0	100.0%

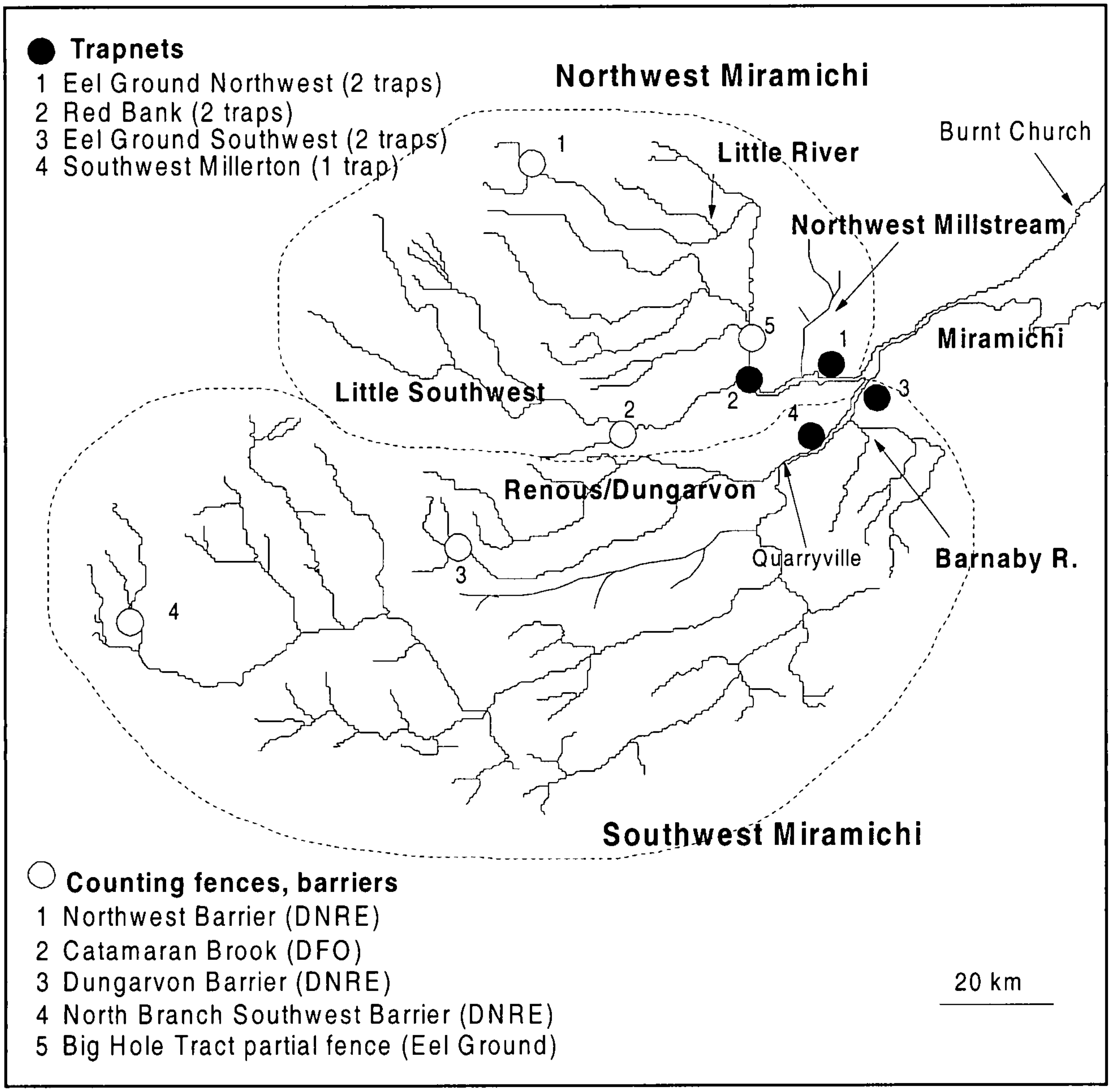


Figure 1. The Miramichi River indicating major branches, major tributaries and location of trapnets and counting fences operated in 1997.

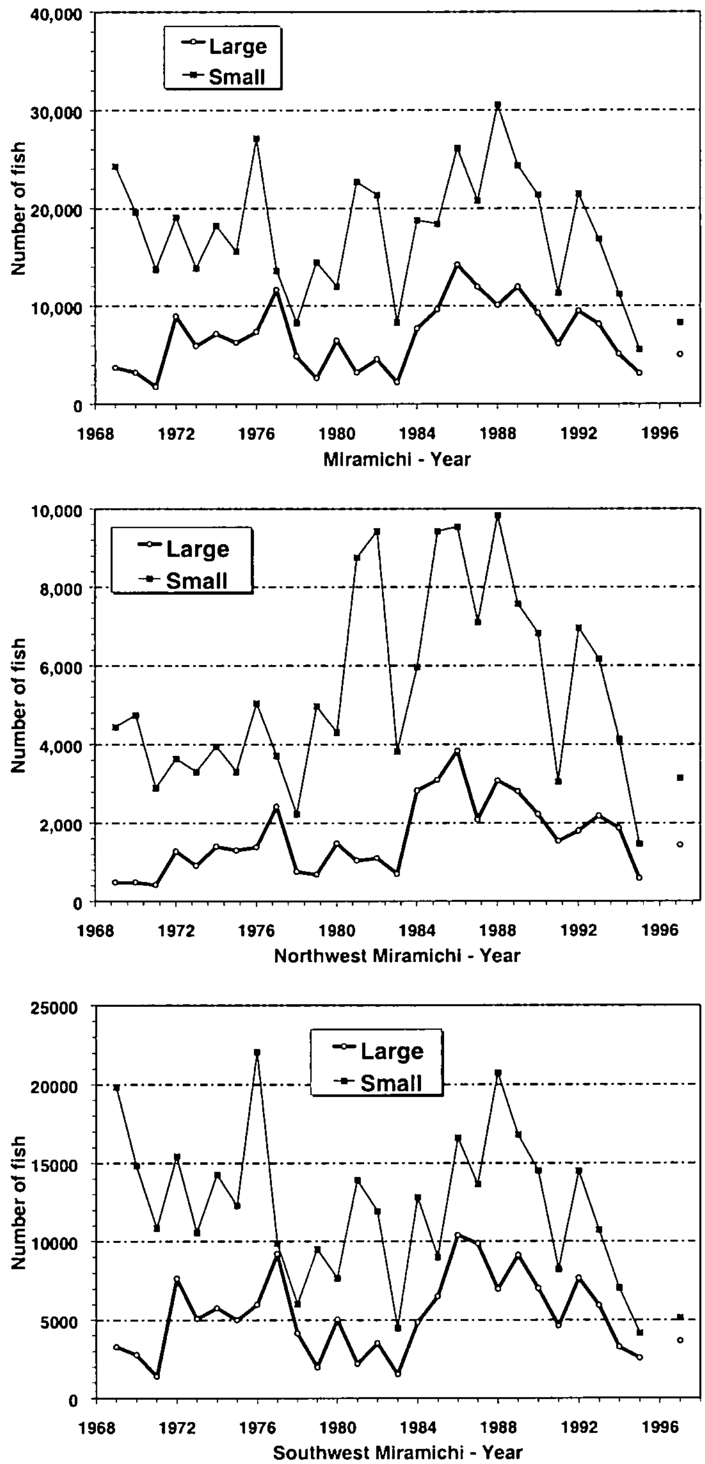


Figure 2. Angling trends of small (harvest) and large (catch) salmon from the Miramichi River (top), Northwest Miramichi (middle) and Southwest Miramichi (bottom) rivers. 1996 data are not available. 1997 data are preliminary.

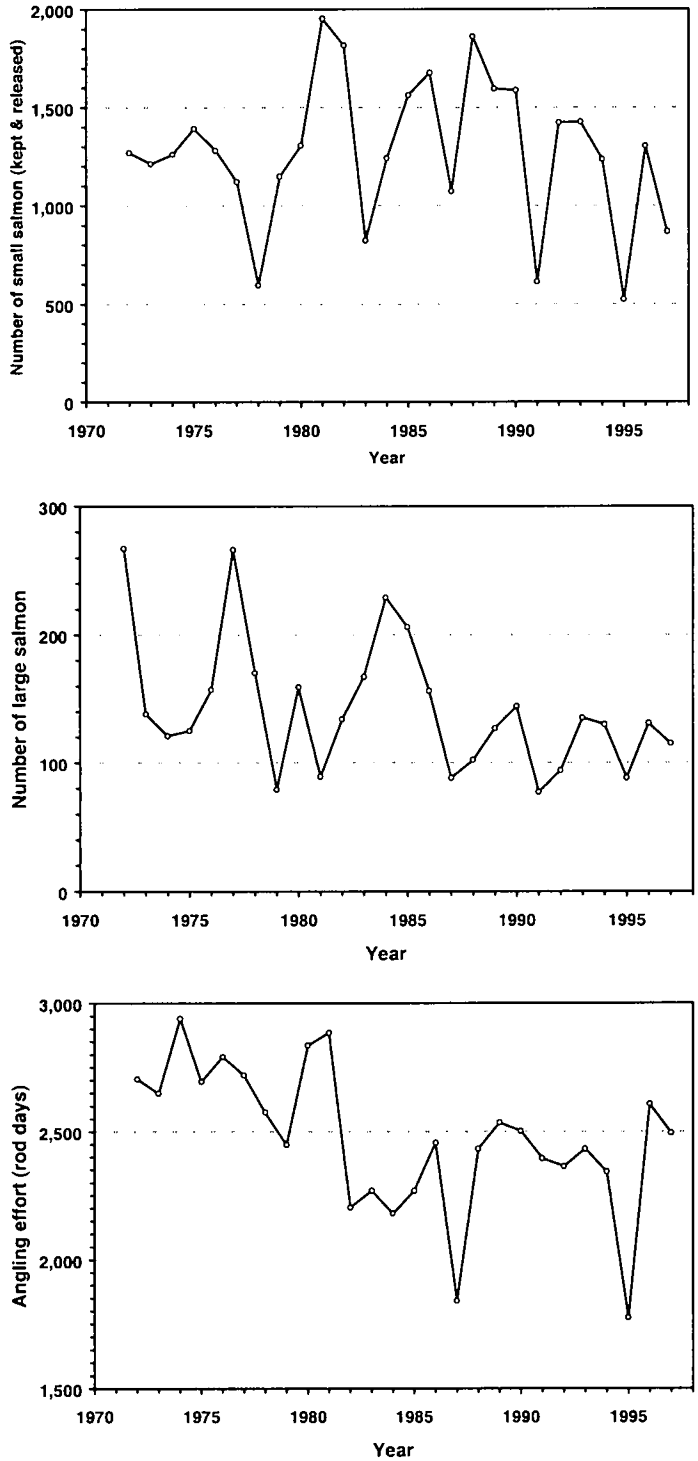


Figure 3. Trends in catches of small salmon (top), large salmon (middle), and angling effort (bottom) from the Crown Reserve waters of the Northwest Miramichi, 1972 to 1997.

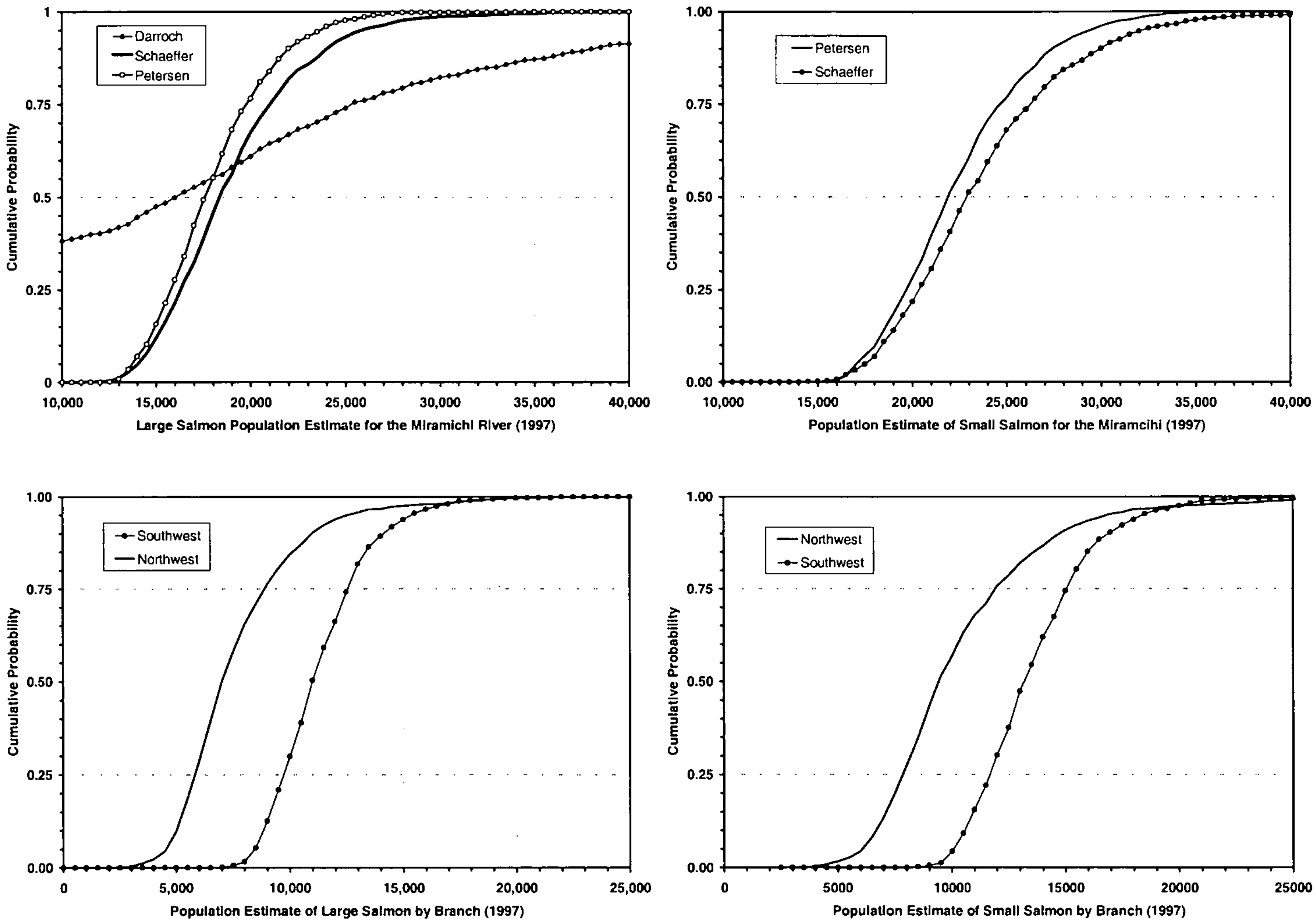


Figure 4. Population estimates of large salmon (left panels) and small salmon (right panels) for the Miramichi (upper panels) and to the Northwest and Southwest branches in (lower panels) in 1997.

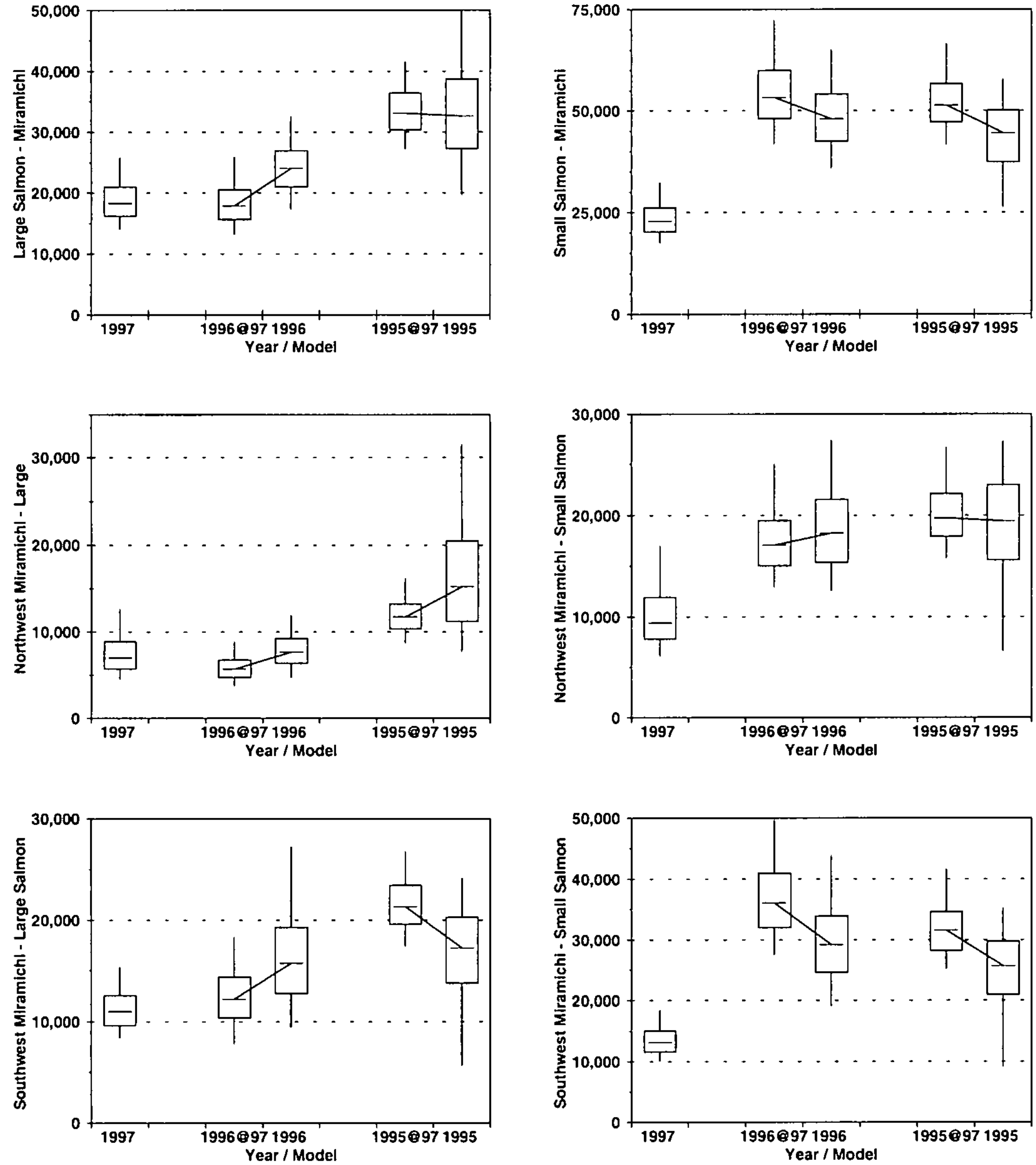
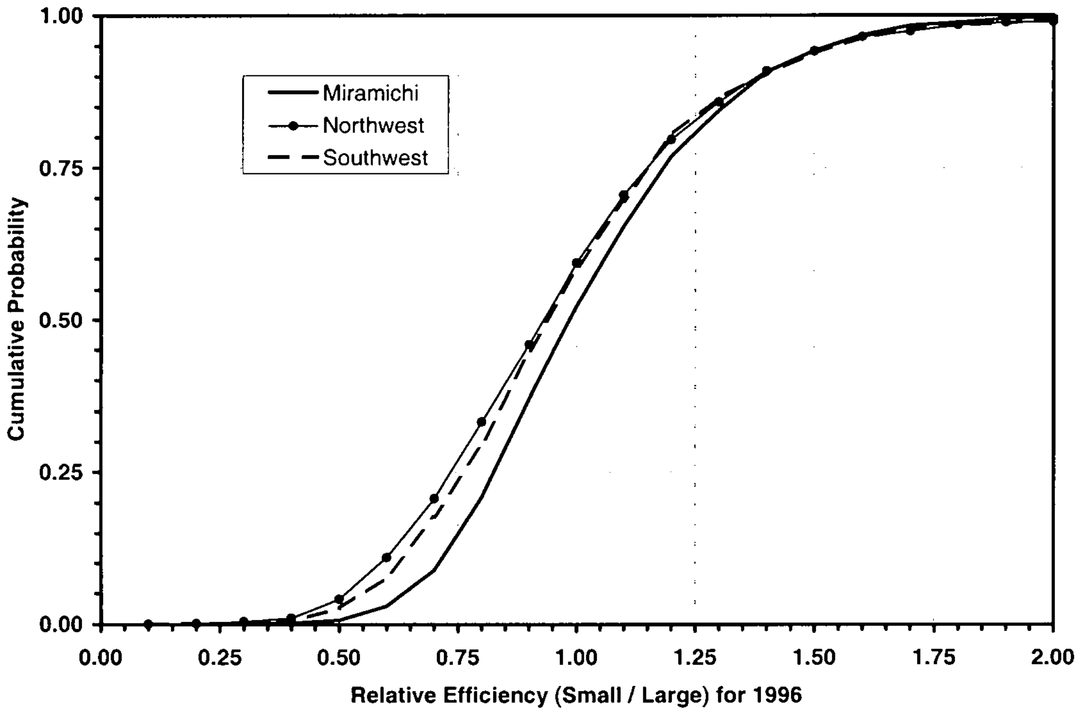


Figure 5. Comparisons of estimates of large salmon (left panels), small salmon (right panels) for the Miramichi River (upper panels), Northwest Miramichi (middle panels) and Southwest Miramichi (lower panels) relative to the model used and published values in 1995 and 1996.



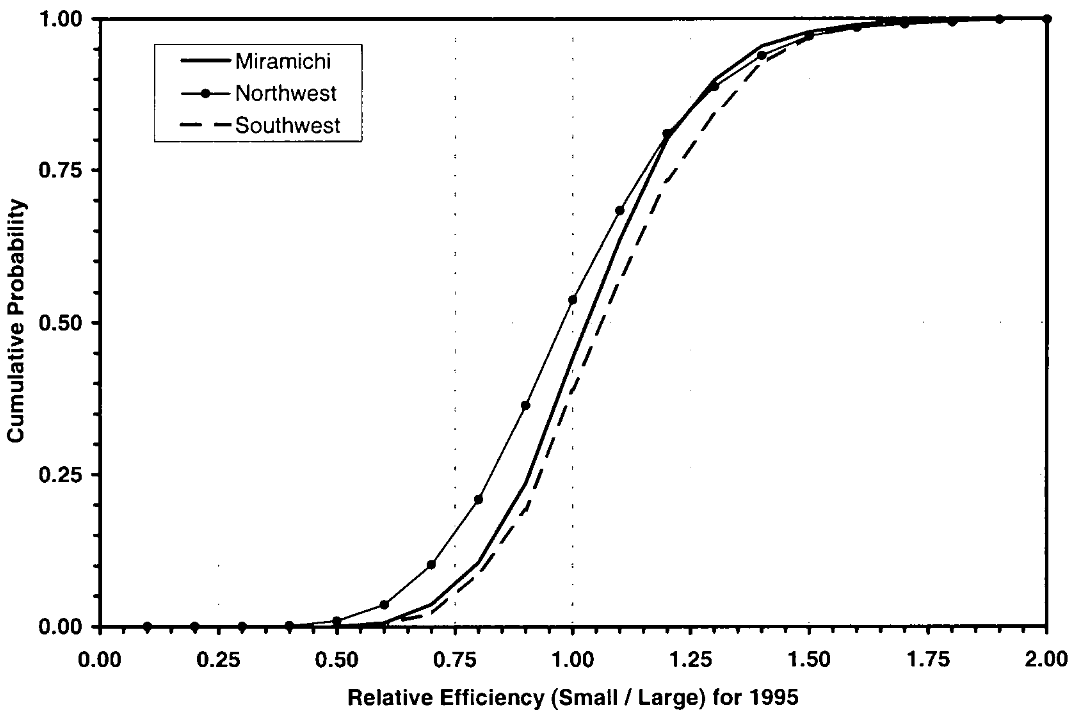
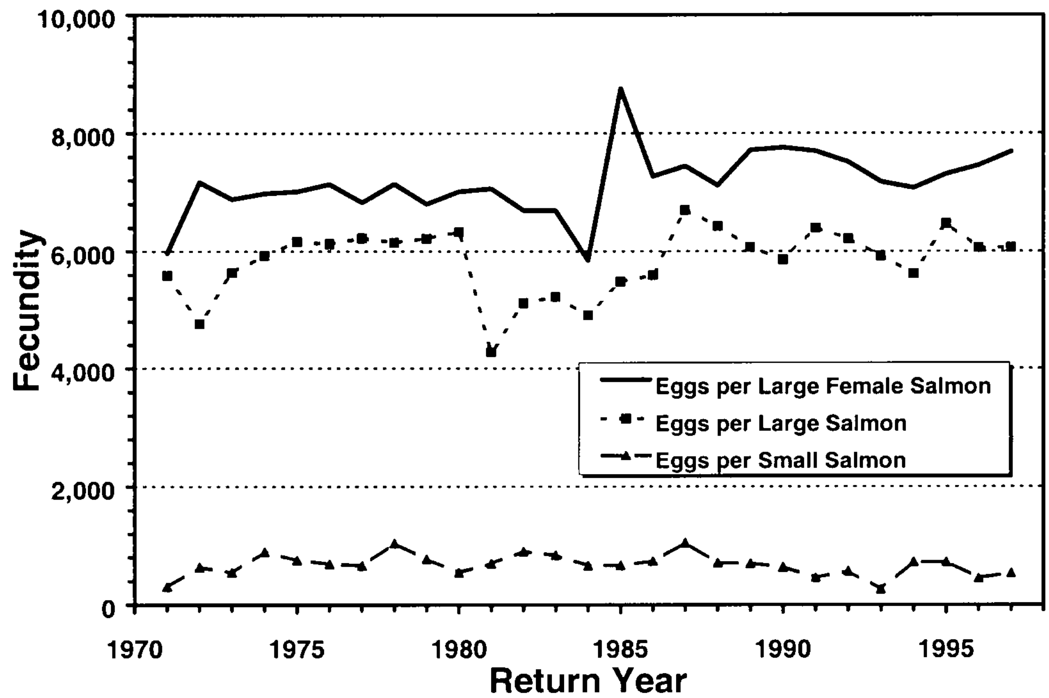


Figure 6. Relative trapnet efficiency (small / large) comparisons for the Miramichi River, Northwest Miramichi and Southwest Miramichi in 1995 (lower panel) and 1996 (upper panel) Trapnet efficiencies, estimated using the Schaeffer model, were similar for small and large salmon in 1995 and slightly less for small salmon in 1996.



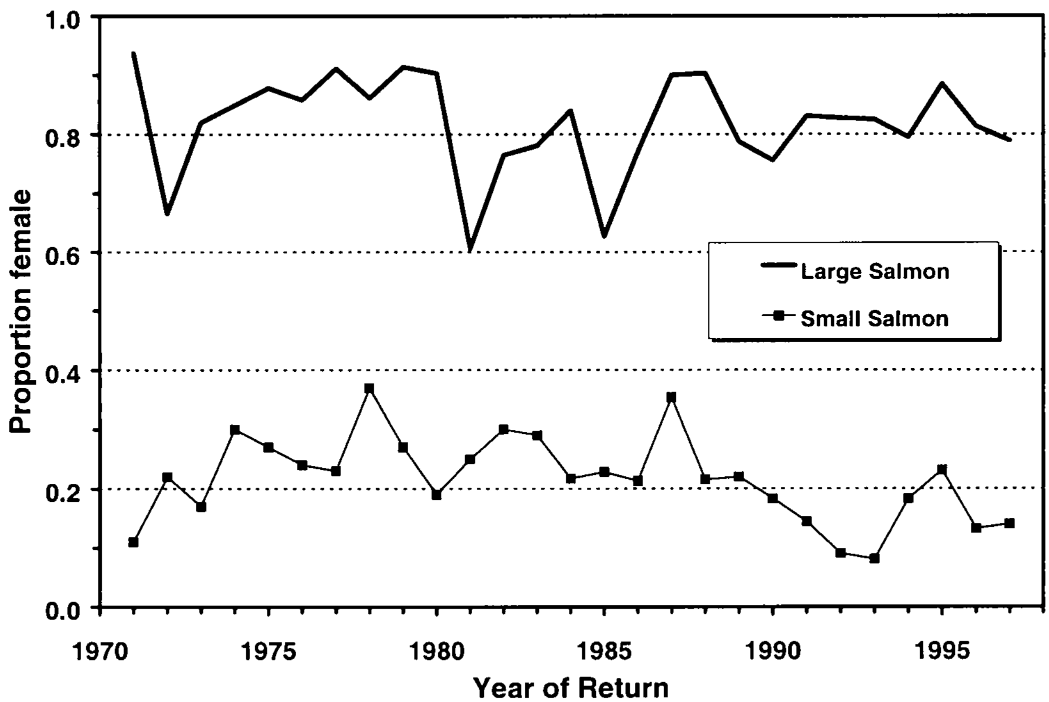


Figure 7. Annual variation in the fecundity (upper, number of eggs) and proportions female (lower) of small and large salmon from the Miramichi River, 1971 to 1997.

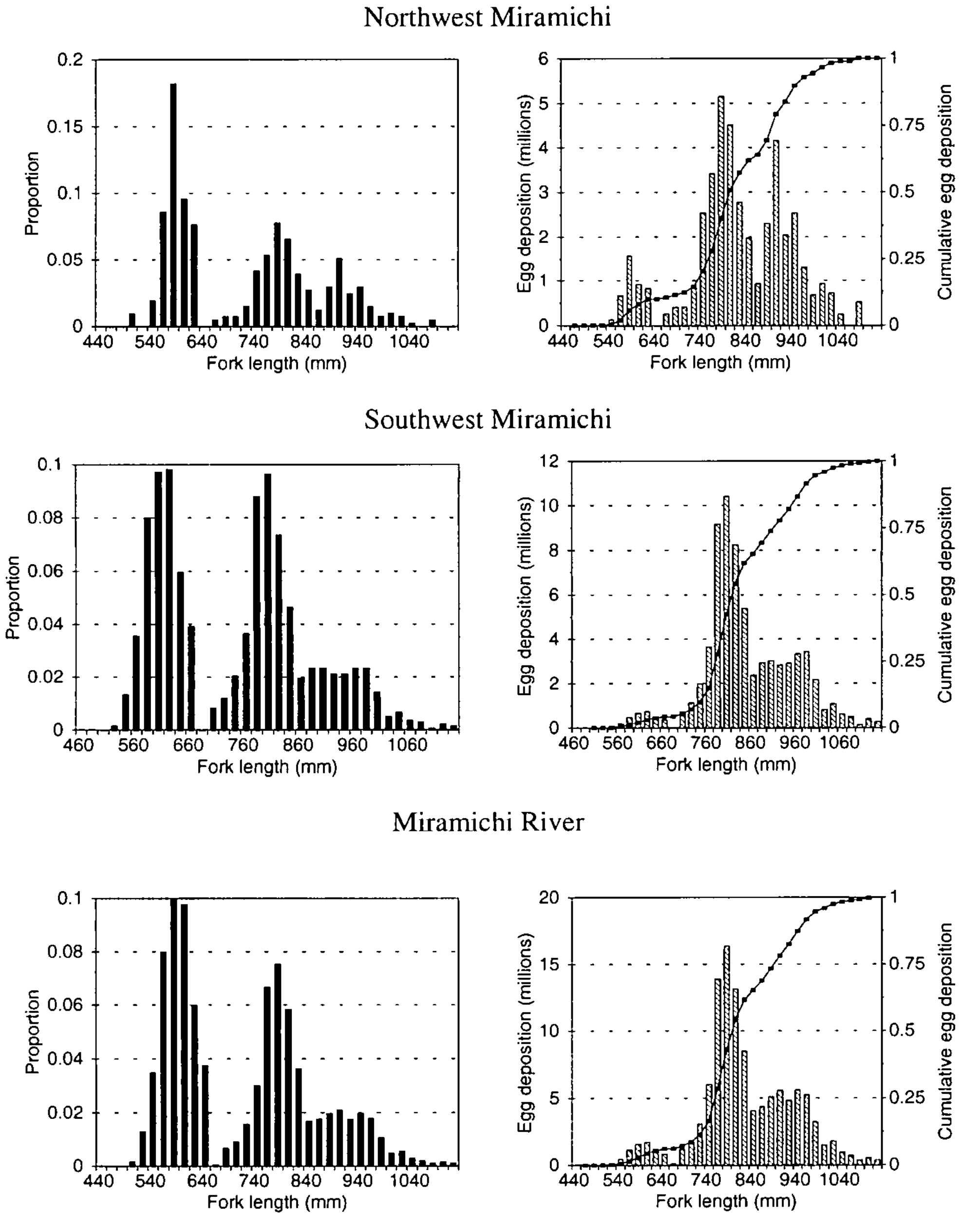


Figure 8. Proportion at length, egg deposition at length and cumulative egg deposition at length for the total spawners of the Northwest Miramichi (top panel), Southwest Miramichi (middle panel) and the Miramichi River (bottom panel) during 1997.

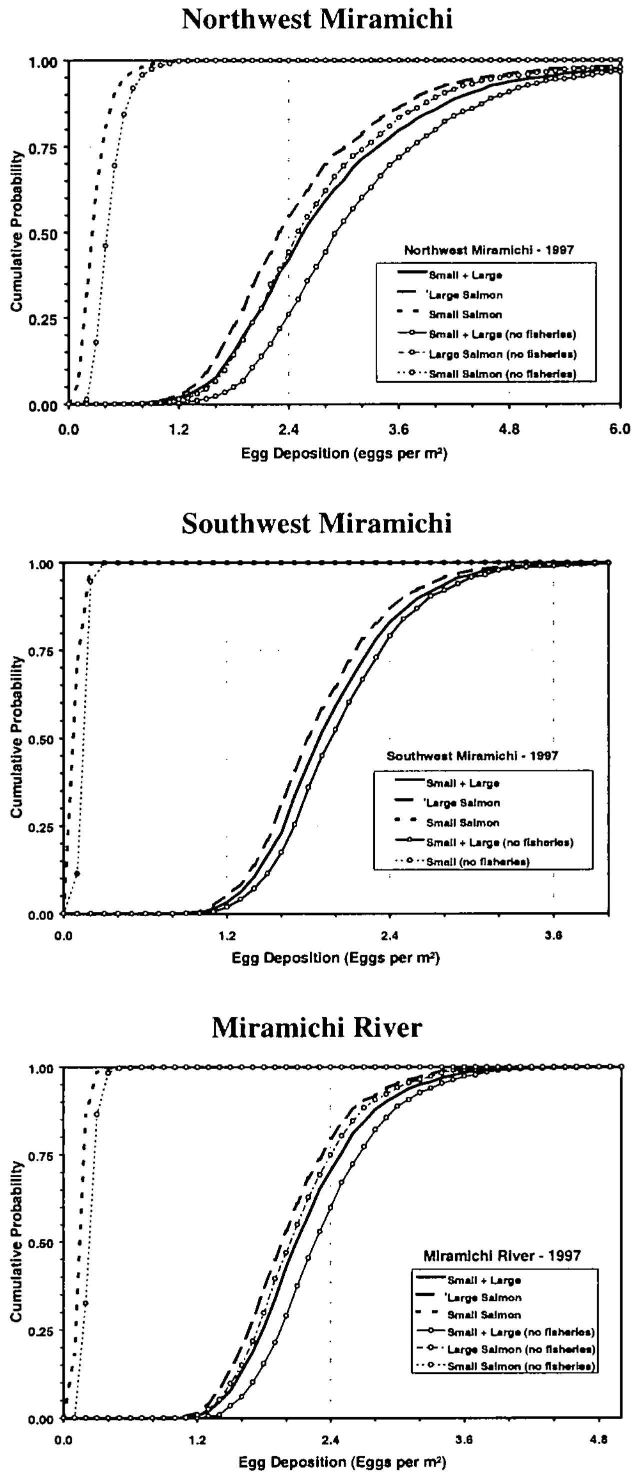


Figure 9. Probable egg depositions (eggs per m^2) in the Northwest Miramichi (top), Southwest Miramichi (middle) and Miramichi River (bottom) by small salmon, large salmon, small and large combined in 1997. Egg depositions are plotted for the estimated escapement and for illustrative purposes for the estimated returns (assuming no removals had occurred in 1997).

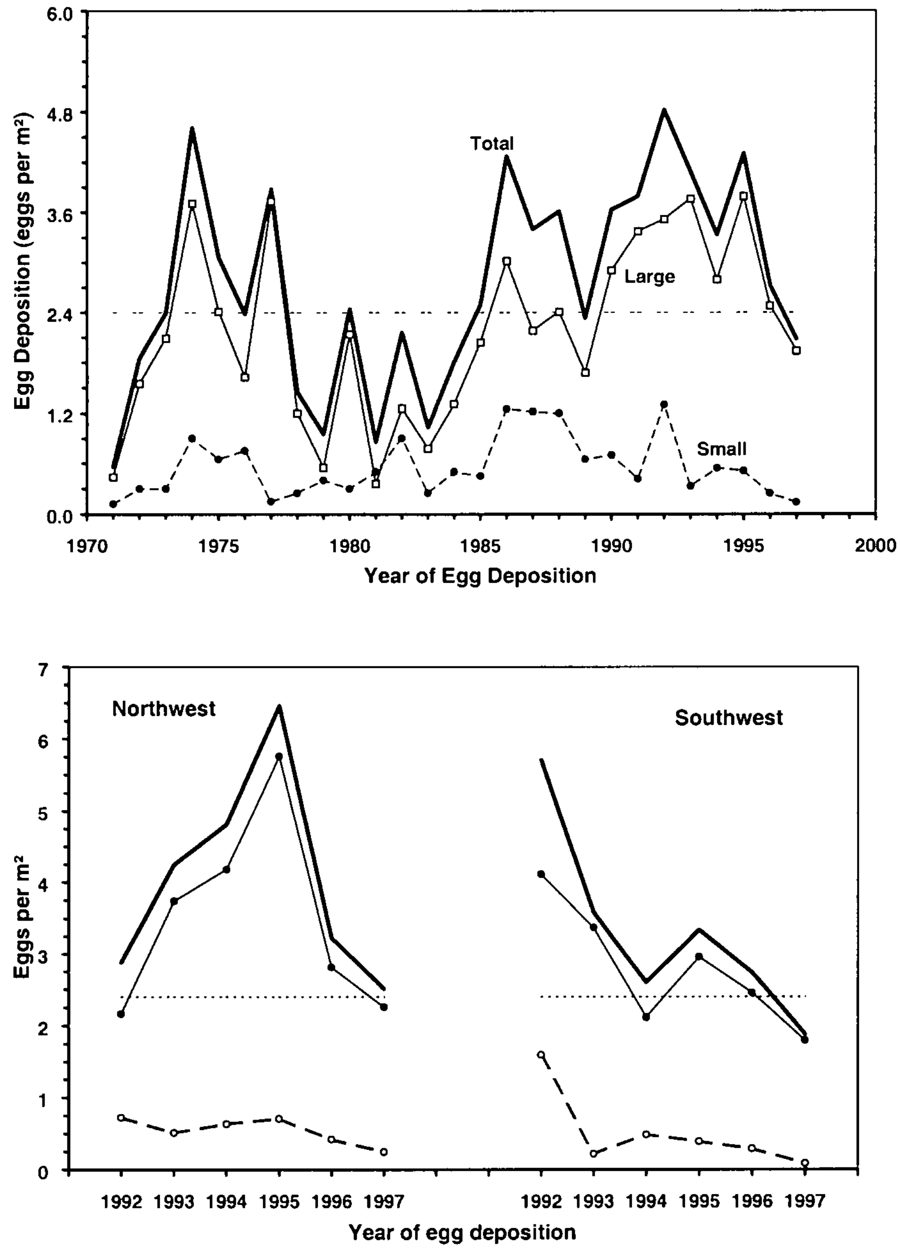


Figure 10. Point estimate annual egg depositions (eggs per m^2) by small (circle dashed line), large (dots and narrow line) and combined (thick line) for the Miramichi River, 1971 to 1997 (upper panel) and for the Northwest and Southwest branches, 1992 to 1997 (lower). Dashed line is the conservation egg requirement of 2.4 eggs per m^2.

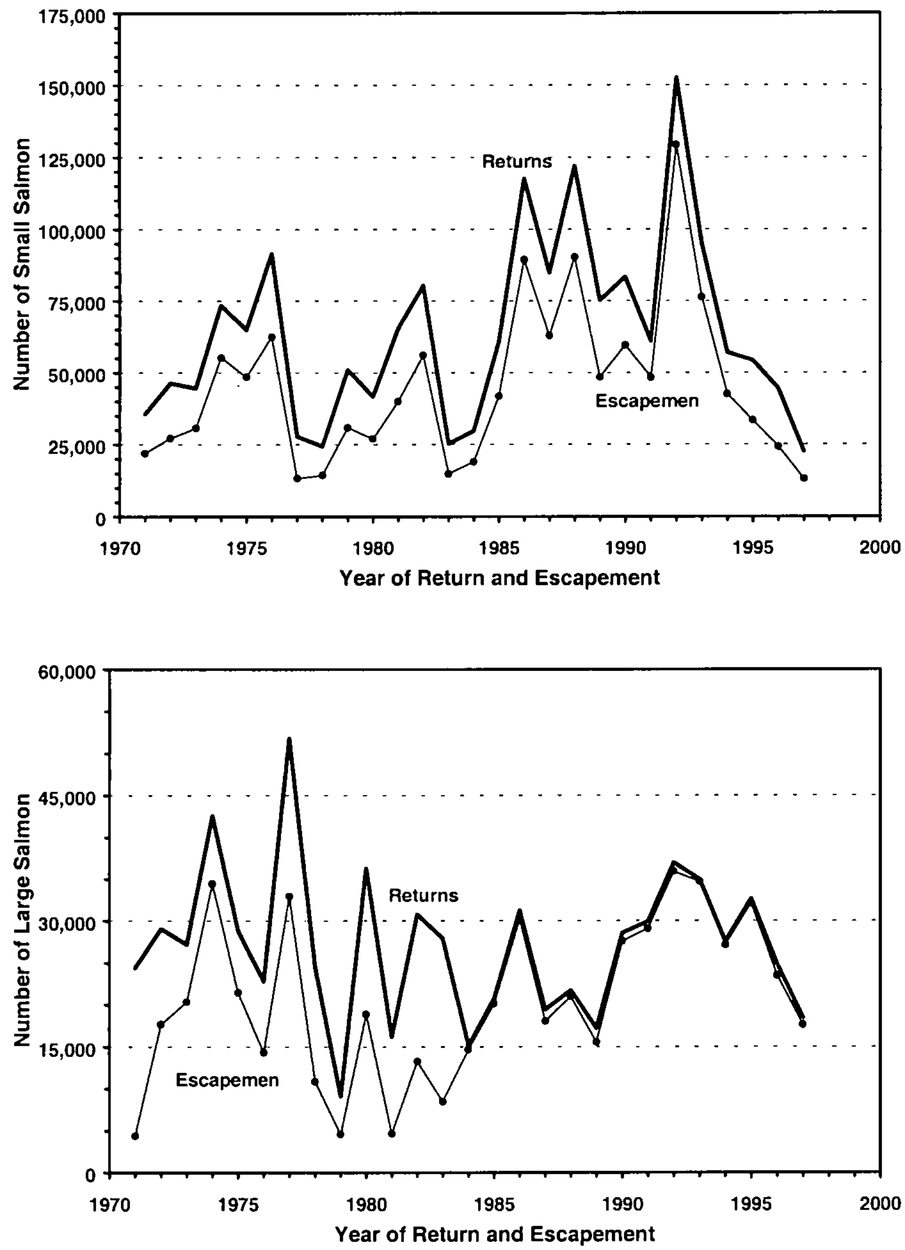


Figure 11. Point estimates of total returns to the Miramichi River estuary and number of spawners for small salmon (upper) and large salmon (lower), 1971 to 1997.

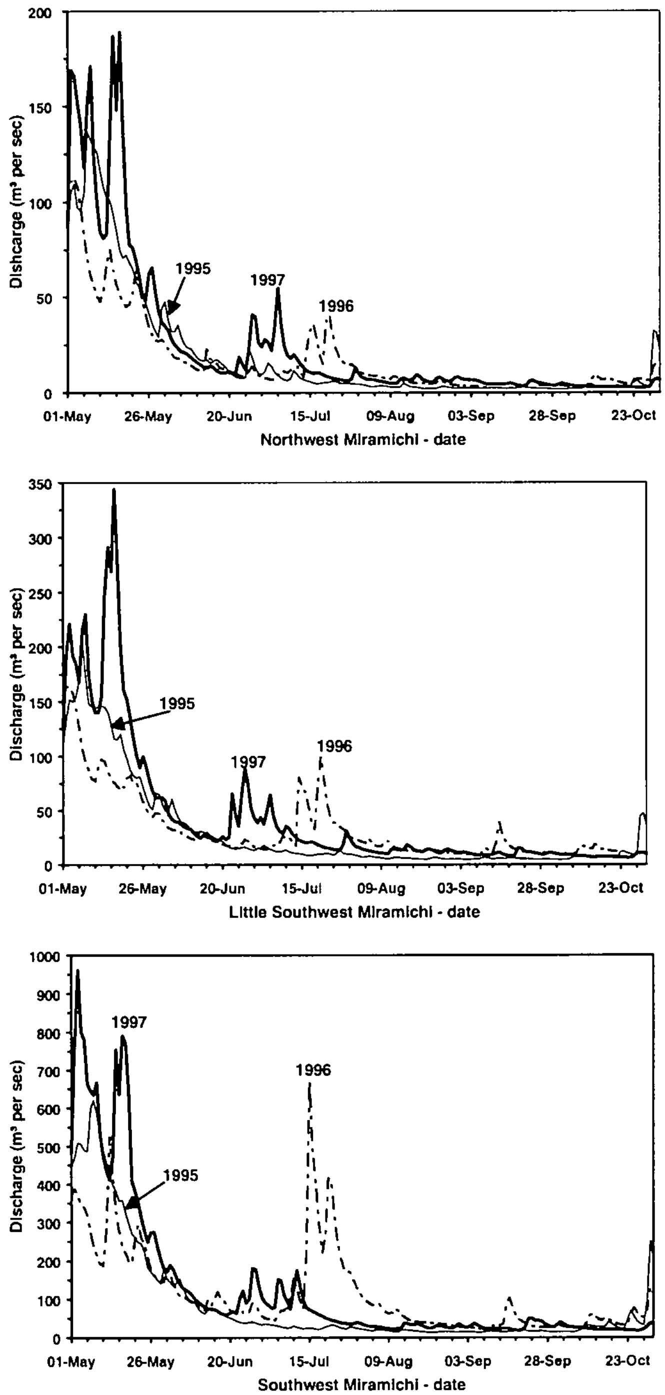


Figure 12. Discharge (m^3 per sec) profiles for the Northwest Miramichi (upper), Little Southwest Miramichi (middle) and Southwest Miramichi (lower) from May 1 to October 31, 1995 to 1997.

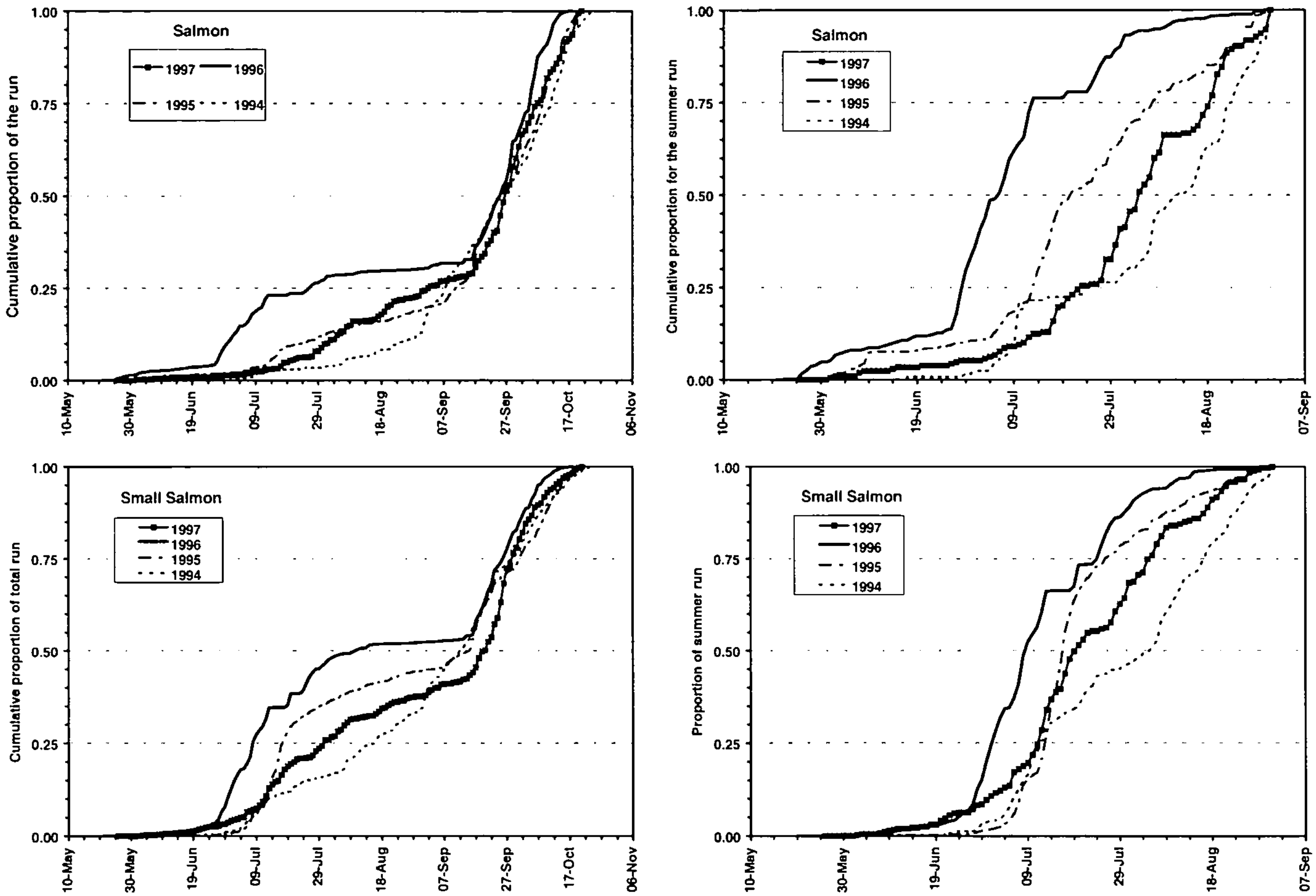


Figure 13. Timing of large salmon (upper panels) and small salmon (lower) catches at the Millerton trapnet (Southwest Miramichi) for the entire year (left panels) and for the summer run (right panels) during 1994 to 1997.

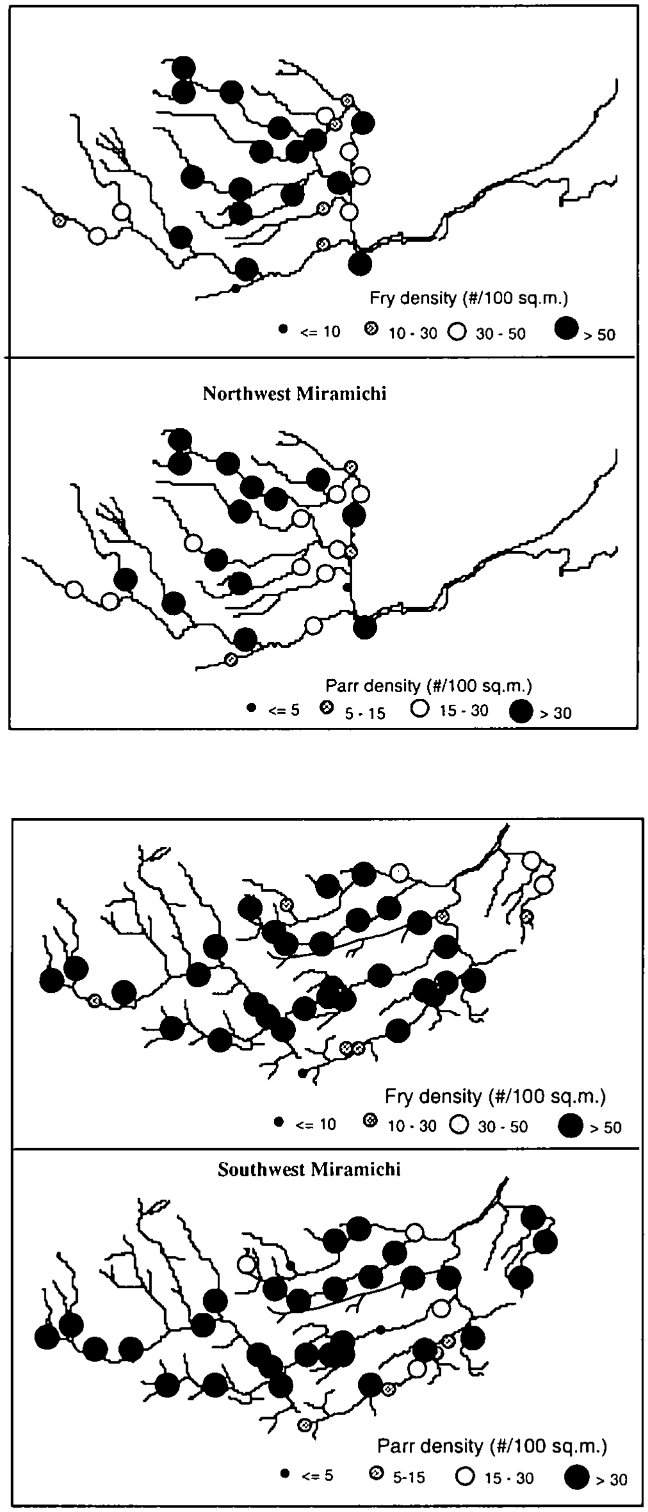


Figure 14. Observed fry and parr densities in the Northwest Miramichi (upper) and Southwest Miramichi sites sampled in 1997.

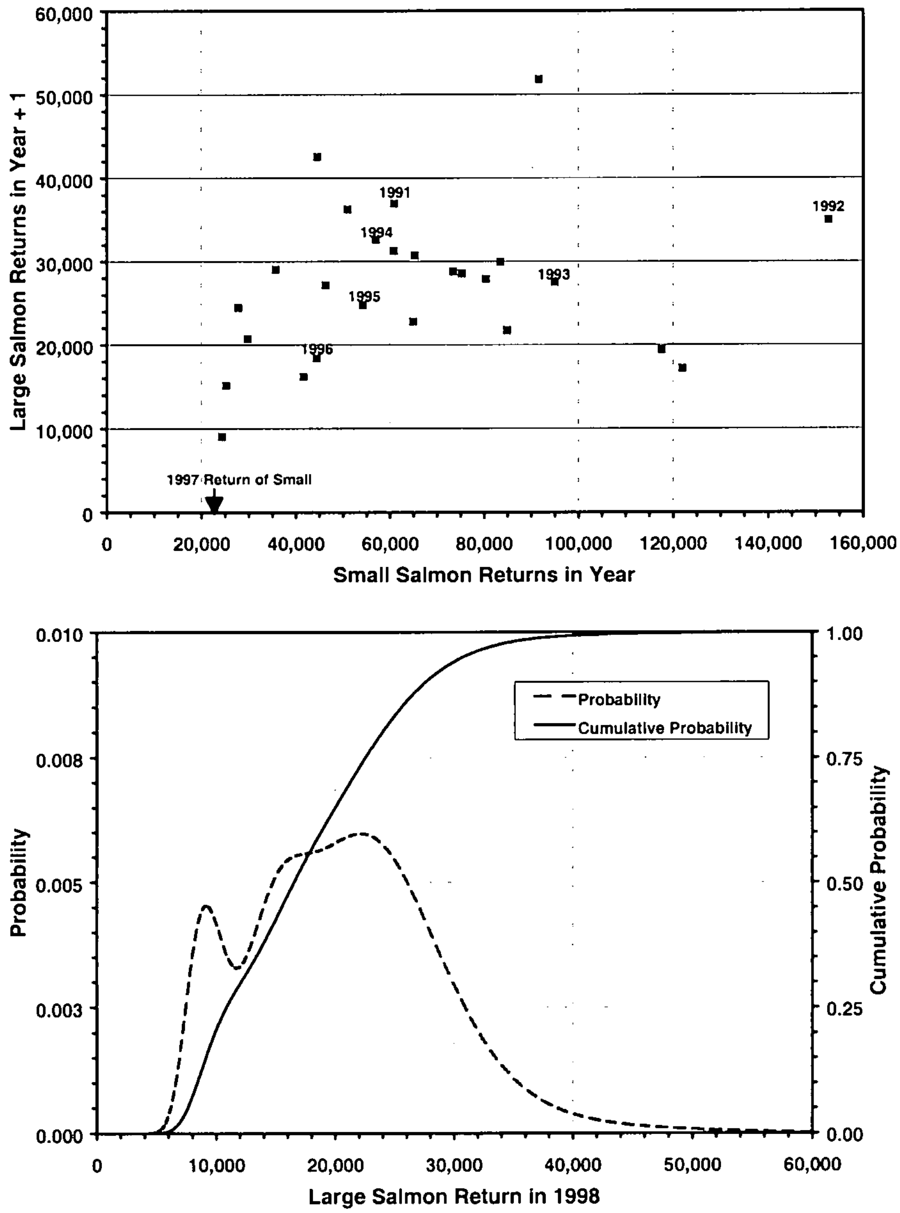


Figure 15. Preseason forecast model of the large salmon returns to the Miramichi River (upper) and the 1998 large salmon return forecast probability (bottom).

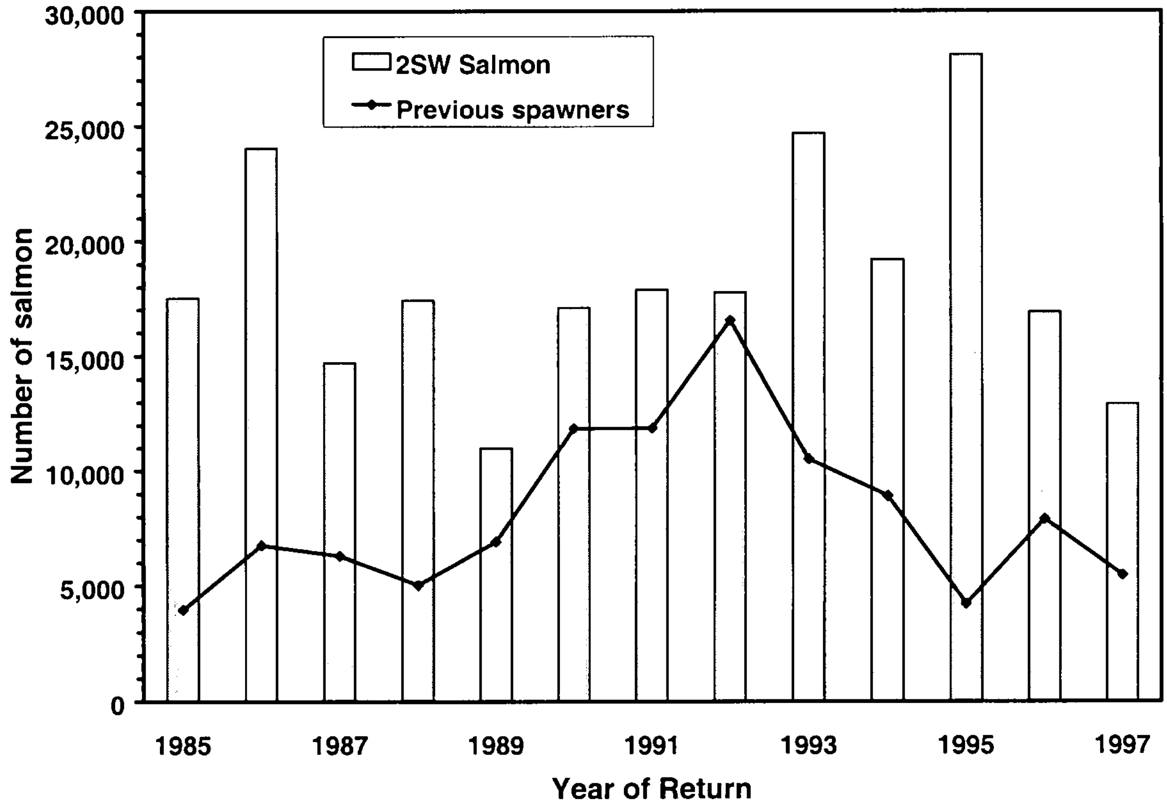


Figure 16. Estimates of abundance of 2SW maiden salmon and previous spawner salmon in the annual returns of large salmon to the Miramichi River for 1971 to 1997.

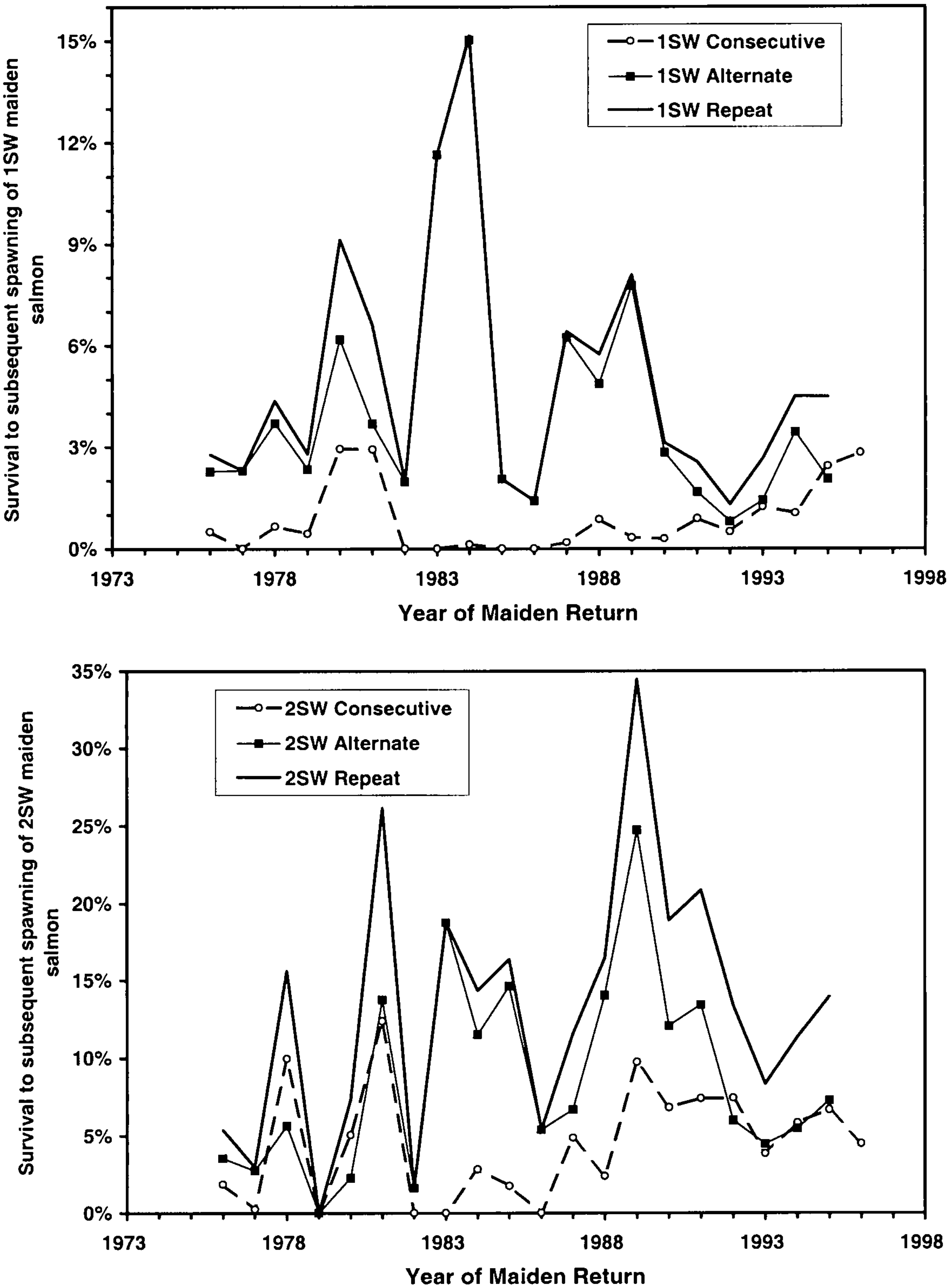
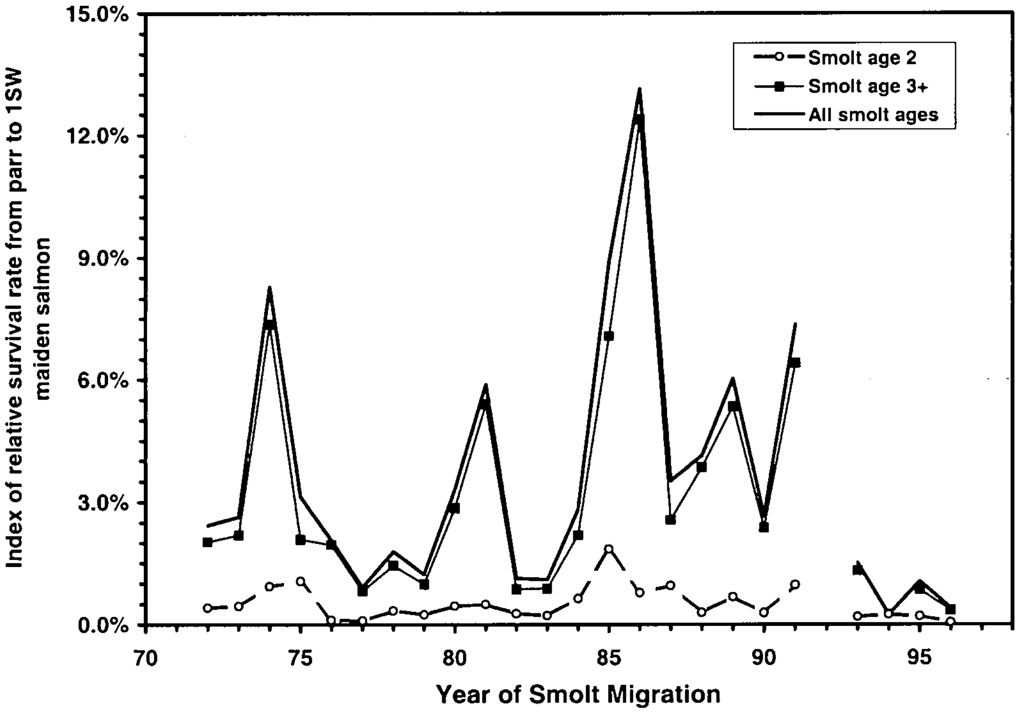


Figure 17. Survival rate of maiden 1SW salmon (upper) and maiden 2SW salmon (lower panel) to consecutive, alternate and combined second spawning return to the Miramichi. Survival rates are calculated from the escapement of each group during the year of maiden return.



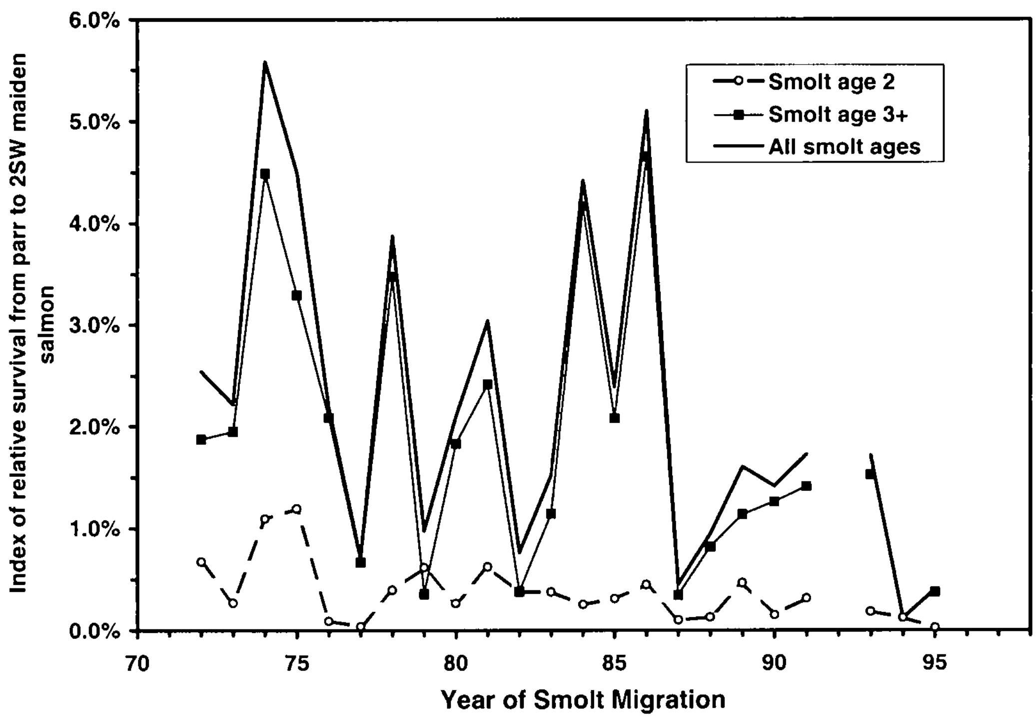


Figure 18. Index of relative survival of small parr to age 2+ smolt and large parr to age 3+ smolt for 1SW maiden salmon (upper panel) and 2SW maiden salmon (lower panel) for the Miramichi River, 1972 to 1997.

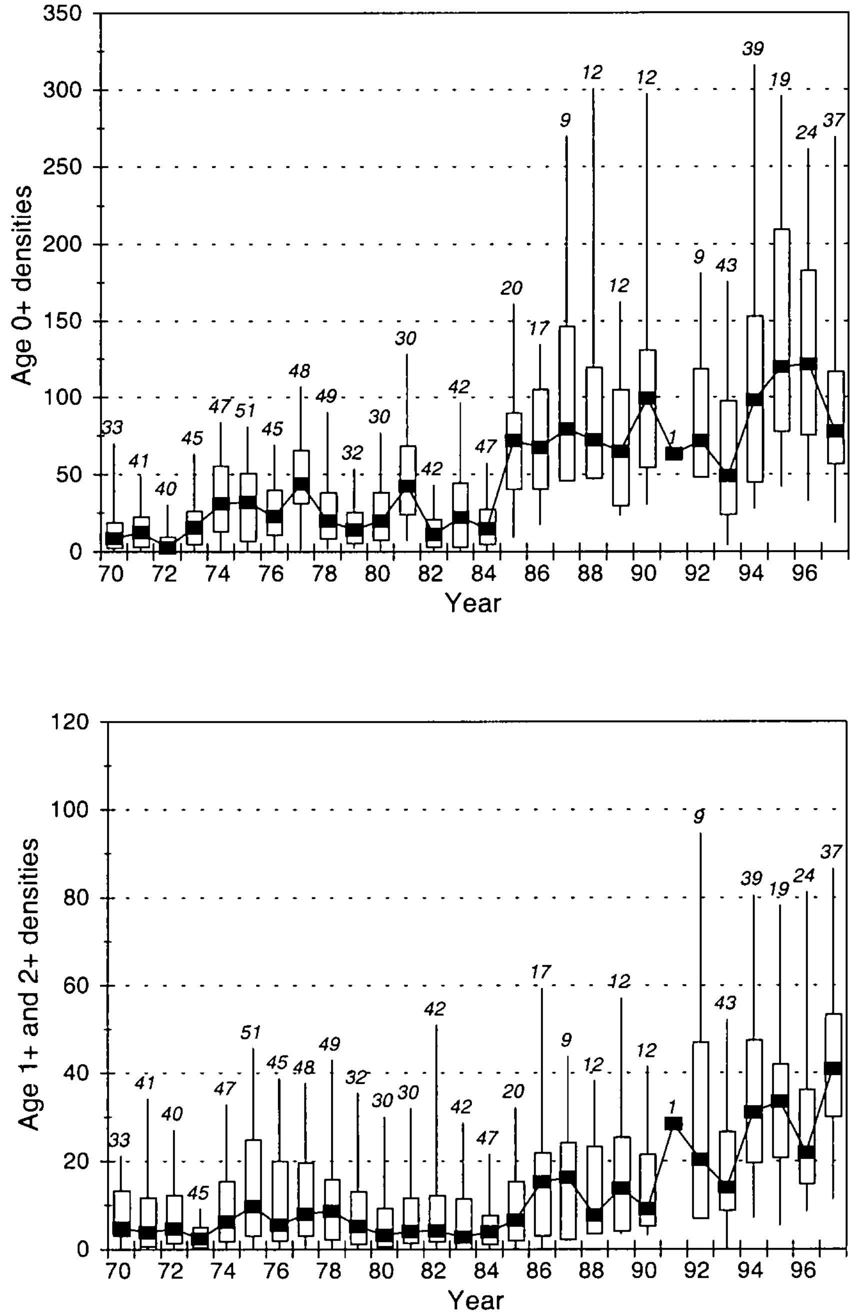
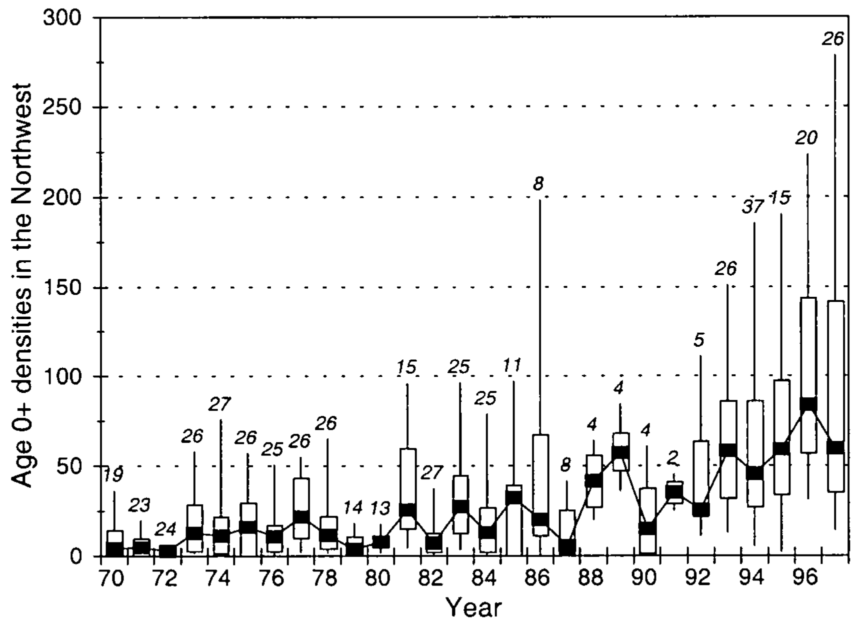


Figure 19. Atlantic salmon fry (upper) and parr (lower) densities at all sampled sites in the Southwest Miramichi, 1970 to 1997. Box plots are interpreted as follows: vertical line = 5^{th} to 95^{th} percentile range, box = 25^{th} to 75^{th} percentile range, square = median value. Number above the vertical line is the number of sites sampled.



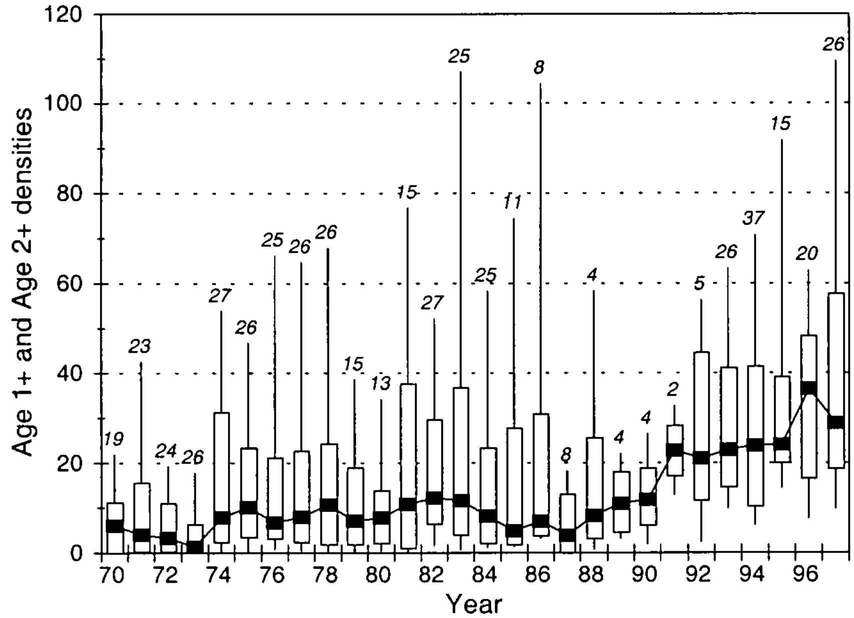
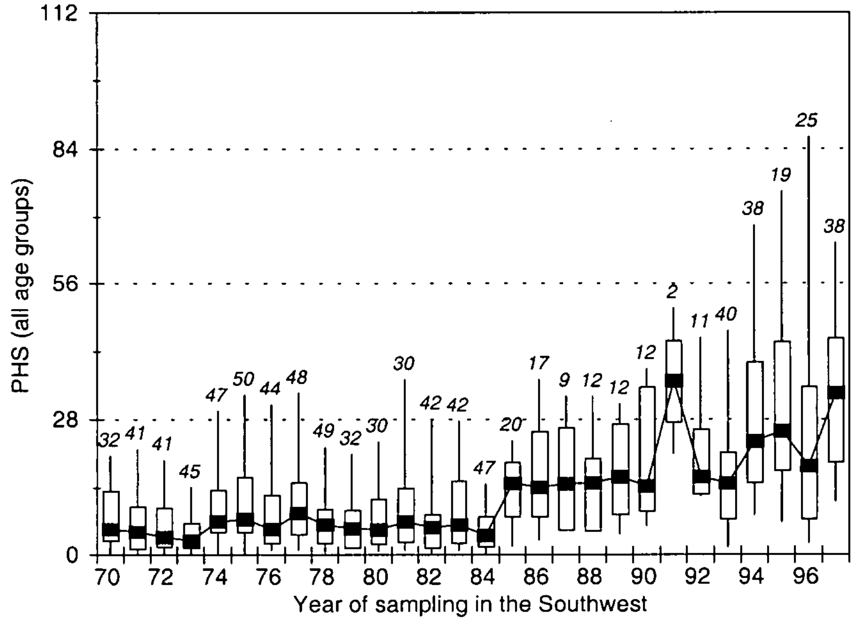


Figure 20. Atlantic salmon fry (upper) and parr (lower) densities at all sampled sites in the Northwest Miramichi, 1970 to 1997. Box plots are interpreted as in Figure 19.



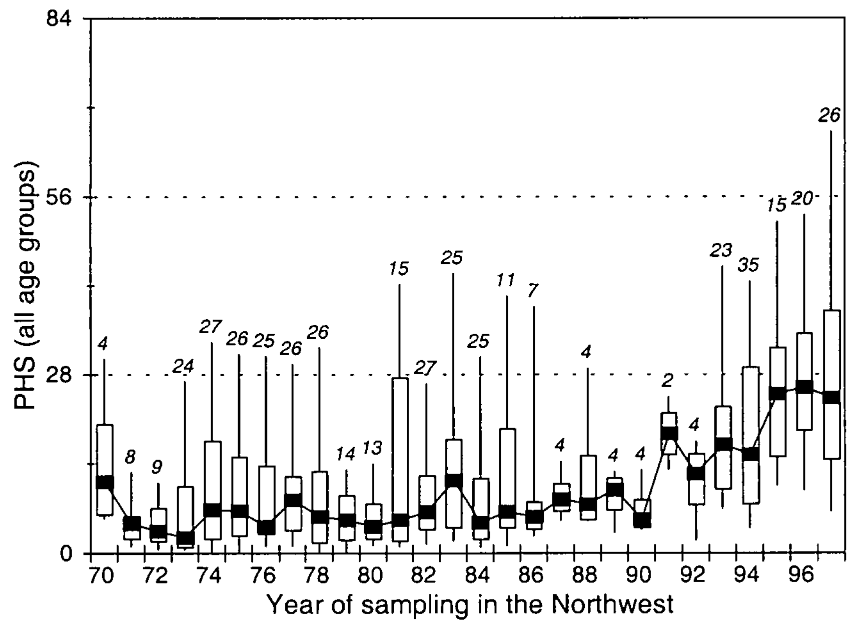


Figure 21. Percent habitat saturation (PHS) index of juvenile Atlantic salmon at all sampled sites in the Southwest Miramichi (upper) and four index sites in the Northwest Miramichi (lower) for 1970 to 1997. Box plots are interpreted as in Figure 19.

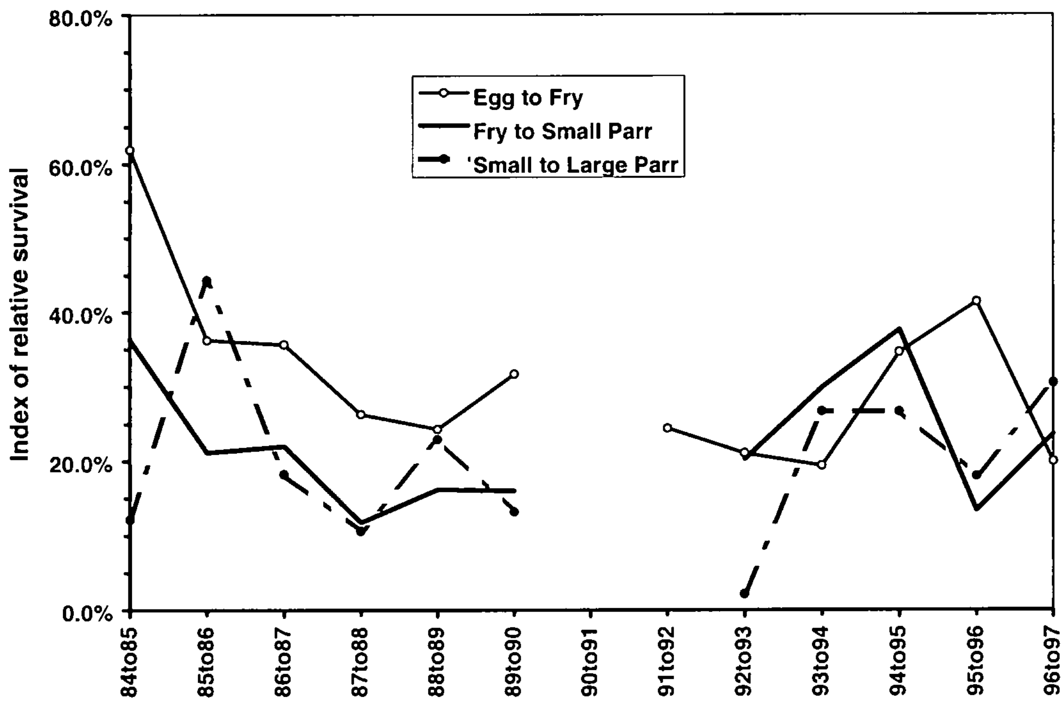


Figure 22. Index of relative annual survival in the freshwater stages of juvenile Atlantic salmon in the Miramichi River, 1984 to 1997.

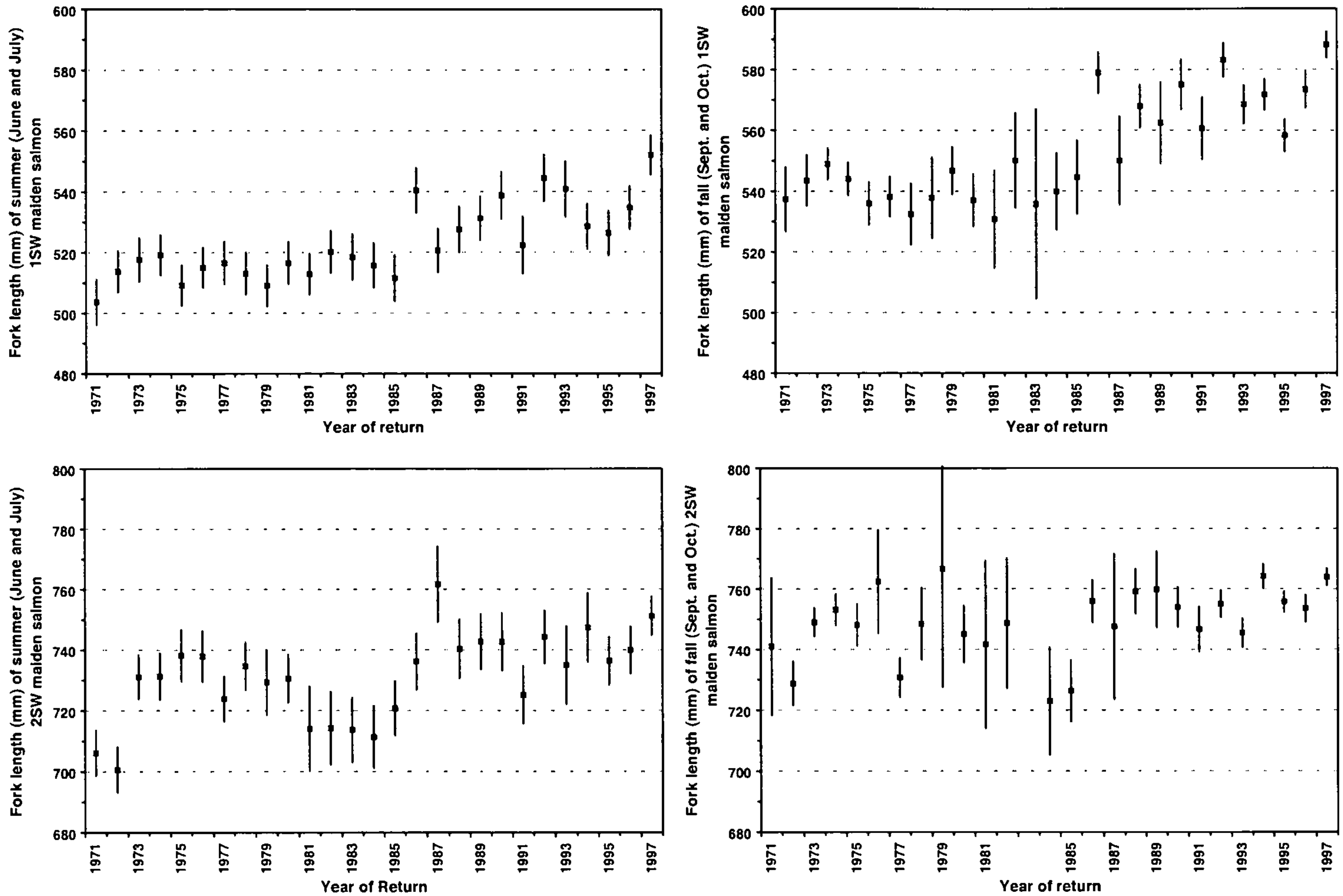


Figure 23. Fork length (mean ± 2 standard errors) of 1SW maiden salmon (upper panels) and 2SW maiden salmon (lower panels) for the summer run (June and July - left panels) and the fall run (Sept. and Oct. - right panels) from the Miramichi River, 1971 to 1997.

Appendix 1. Record of client consultation for the Atlantic salmon stock of the Miramichi River.

RECORD OF CLIENT CONSULTATION

1. SPECIES / STOCK:
- **Atlantic salmon - Miramichi River**

2. ARRANGEMENTS:
DATE: December 9, 1997
TIME: 9:00 to 16:00
LOCATION: REPAP Building, Newcastle (Miramichi City), New Brunswick

3. FORM OF CONSULTATION (Science Workshop, ZMAC, ETC..)
- **Science workshop**

4. PARTICIPANTS (Name and Affiliation)
- **Millie Augustine, Big Cove First Nation**
- **William Basco, Cains River Enhancement Association**
- **Hank Bear, Tobique Maliseet**
- **Don Boucher, Miramichi Headwaters**
- **Claire Caron, New Brunswick Wildlife Council**
- **Gérald Chaput, DFO Science, Moncton**
- **Winston Clowater, J.D. Irving Ltd.**
- **Harry Collins, Executive Director, Miramichi River Environmental Assessment Committee, Miramichi City**
- **Bill Donald, Chair, Miramichi Watershed Management Committee, Miramichi City**
- **Bernie Dubee, Regional Biologist, Dept. of Natural Resources and Energy, Miramichi City**
- **Alton Dunn, J.D. Irving Ltd.**
- **Dave Dunn, DFO, Recreational Fisheries, Moncton**
- **John Gilbert, J.D. Irving Ltd.**
- **Mark Hambrook, DFO Science, Miramichi Salmonid Enhancement Centre, Miramichi City**
- **John Hayward, DFO Science, Miramichi Salmonid Enhancement Centre, Miramichi City**
- **George Holmes, Cains River Enhancement Association**
- **Ron Jenkins, Cains River Enhancement Association**
- **Tim Lutzac, DFO Science, Aboriginal Fisheries Coordination, Moncton**
- **Dave Moore, DFO Science, Moncton**
- **Ross Paul, St. Mary's First Nation**
- **Tim Paul, St. Mary's First Nation**
- **Larry Perley, Saint John River Maliseet**
- **Manley Price, Rocky Brook Camp / Avenor inc., Boiestown, New Brunswick**
- **Grant Ross, Miramichi Salmon Association**
- **Mary Sabine, Avenor Inc.**
- **Bill Scott, DFO Conservation and Protection, Miramichi City, New Brunswick**
- **Wilmot Tompkins, Juniper Lumber Co. Ltd.**
- **Bob Weir, Cains River Enhancement Association**
- **Vince Swazey, Miramichi Salmon Association, Boiestown, New Brunswick**
- **Bruce Whipple, Northumberland Salmon Protection Association, Miramichi City**

5. NEW INFORMATION BROUGHT FORWARD (what? by who?)-*(Only a brief description is required)*
• **Crown Reserve angling catches and preliminary FISHSYS data for 1997 (Benie Dube, DNRE NB)** • **Update on Little River project (Bruce Whipple, Northumberland Salmon Protection Association)** • **Habitat surveys and satellite rearing monitoring, Rocky Brook (Manley Price, Avenor inc.)** • **Update of Clearwater Brook (John Gilbert, DNRE / ASF / Irving)**
6. CONCERNS RAISED BY CLIENTS (include concerns, plus follow-up action/response made or committed). - (*Only a brief description is required)*
• **Very few seizures of illegal nets in 1997 may reflect reduced enforcement activities on the river rather than reduced poaching. Recent court rulings have imposed important fines and this may also have deterred poaching activity. No follow-up action or response required.** • **Juvenile densities in the Little Southwest Miramichi are consistently lower than in other parts of the Miramichi. A similar trend was noted in the 1970s suggesting that the Little Southwest has either consistently received poor spawning escapements, the habitat quality may be different or both. An assessment of the Little Southwest Miramichi would require additional resources from user groups. No specific plans were made but a collaboration between DFO Science and user groups is possible.** •
7. RECOMMENDATIONS: *(Only a brief description is required)*
a.) Pertaining to Assessment • **Need to determine the consequences to the long-term sustainability of the resource of not meeting conservation requirements. This will guide management is assessing the consequences to the resource of risk adverse, risk neutral or risk prone strategies**
b.) Pertaining to next year's workplans
• **Continued assessment is required** • **Estimates of smolt production from the Miramichi River would be a valuable addition to the assessment** • **Low returns in 1997 are major concern especially in terms of expectations for 1998** •
Other Concerns: •

Various
NAME OF PRESENTER

Gérald Chaput
NAME OF RAPPORTEUR

Appendix 2. Furunculosis laboratory report summary for Miramichi River for 1997.

Case #	Date	Location	Tributary	Species	Number of fish	Size	Furunculosis bacterium isolated	Antibiotic resistance	Similarity
97166	June 27, 1997	Northwest Miramichi	Big Hole Tract	Atlantic Salmon	5		5 of 5	0 of 5	Saint John wild strain
97174	July 8, 1997	Northwest Miramichi	Estuary at Red Bank	Atlantic Salmon	1	grilse	0 of 1		Vibriosis
97177	July 4, 1997	Northwest Miramichi	Blacks Pool, above Wayerton	Atlantic Salmon	1	80 cm	1 of 1	0 of 1	Saint John wild strain
97178	July 22, 1997	Southwest Miramichi	Quarryville	Atlantic Salmon	1	51 cm	1 of 1	0 of 1	Saint John wild strain
97179	June 27, 1997	Northwest Miramichi	Big Hole Tract	Atlantic Salmon	1	87 cm	1 of 1	0 of 1	Saint John wild strain
97180		Northwest Miramichi	mouth of Otter Brook, Little Southwest Miramichi	Atlantic Salmon	1		1 of 1	0 of 1	Saint John wild strain
97183	July 7, 1997	Northwest Miramichi	Big Hole Tract	Atlantic Salmon	1	76 cm	1 of 1		Saint John wild strain
97184	July 11, 1997	Northwest Miramichi	Little Southwest Miramcihi (Upper Oxbow Adventures)	Atlantic Salmon	1	grilse	1 of 1	0 of 1	Saint John wild strain
97196	July 22, 1997	Northwest Miramichi	Northwest Eel Ground, Red Bank	Atlantic Salmon	4		4 of 4		
97197	July 22, 1997	Northwest Miramichi	Sevogle River, Lime Kiln Pool	Atlantic Salmon	1		1 of 1		
97200	July 24, 1997	Northwest Miramichi	Dr. Wilson's Pool and Mountain back area	Atlantic Salmon	2		2 of 2		
97201	July 18 to 20, 1997	Northwest Miramichi	Sevogle River (Cruikshank Club)	Atlantic Salmon	3	54 - 72 cm	3 of 3	0 of 3	Saint John wild strain

Appendix 2 (continued).

Case #	Date	Location	Tributary	Species	Number of fish	Size	Furunculosis bacteriuem isolated	Antibiotic resistance	
97206	July 7 to Aug. 1, 1997	Southwest Miramichi	below Cains River	Atlantic Salmon	5	52.5 to 86 cm	3 of 5	0 of 3	Saint John wild strain
97207	July 25 to Aug. 4, 1997	Northwest Miramichi		Atlantic Salmon	3	50 to 70 cm	3 of 3	0 of 3	Saint John wild strain
97208	July 28, 1997	Southwest Miramichi	Dungarvon River barrier	Atlantic Salmon	1	75 cm	1 of 1	0 of 1	Saint John wild strain
97209	July 19, 1997	Northwest Miramichi	North Branch, Sevogle River	Atlantic Salmon	1	60 cm	1 of 1		
97210	Aug. 12, 1997	Northwest Miramichi	Little Southwest Miramichi	Atlantic Salmon	1		0 of 1		Negative for pathogens
97212	July, 1997	Southwest Miramichi	Juniper Barrier	Atlantic Salmon	1	56 cm	1 of 1	0 of 1	Saint John wild strain
97275	Oct. 12, 1997	Southwest Miramichi	Main river	Atlantic Salmon	2		0 of 2		Negative for pathogens
97181		Northwest Miramichi	Big Hole Tract	Lamprey	1		0 of 1		
97182		Northwest Miramichi	Big Hole Tract	Fallfish	1		0 of 1		
97211	July 5, 1997	Southwest Miramichi		White sucker	1		0 of 1		

Between 1977 and 1996, a total of over 5,100 fish (all species) from the Miramichi drainage were processed at the Fish Health Laboratory (DFO). This would include samples from the hatchery. During that time, no "positive furunculosis" diagnosis cases were confirmed for the Miramichi, aside from an atypical bacterium isolated from tomcod of the Miramichi estuary. Other pathogens may be affecting the Atlantic salmon of the Miramichi either at the juvenile, smolt and adult stages. Such pathogens identified from Miramichi River Atlantic salmon include "Bacterial Kidney Disease" (severe outbreak in salmon kelts held at the Miramichi Salmonid Enchancement Centre in 1992/93 (Chaput et al. 1994).

Appendix 3. Tag and recapture histories for small salmon in the Southwest Miramichi, 1997.

	Tagging Area	Southwest Food/Science Lower					Southwest Food/Science Upper					Millerton Trapnet - Southwest Miramichi							
		June	July	August	Sept.	Total	June	August	Sept.	Oct. 1-15	Total	May	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
	Tags Placed	12	6	0	46	64	6	0	265	117	391	0	33	201	111	342	142	17	846
Recapture Data																			
Percent reported																			
Angling	Total	0.0%	33.3%	.	2.2%	4.7%	0.0%	.			5.9%	.	3.0%	5.5%	3.6%	7.0%	4.9%	0.0%	5.6%
Traps	NW	0.0%	0.0%	.	2.2%	1.6%	0.0%				1.5%	.	0.0%	1.5%	0.0%	2.6%	0.0%	0.0%	1.4%
	SW	0.0%	0.0%	.	10.9%	7.8%	0.0%				13.8%	.	0.0%	5.0%	7.2%	7.9%	12.7%	17.6%	7.8%
Angling Recaptures																			
In Southwest		0	2	0	1	3	0	0	18	3	22	0	1	10	4	24	7	0	46
	Unknown	.	.	.	.	0	.	.	1	.	1	.	.	.	.	2	1	.	3
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	2	.	.	2	.	.	.	.	0	.	.	5	.	.	.	.	5
	August	.	.	.	.	0	.	.	.	.	1	.	.	3	2	.	.	.	5
	Sept.	.	.	.	.	0	.	.	8	.	8	.	1	2	2	11	.	.	16
	Oct.	.	.	.	1	1	.	.	9	3	12	.	.	.	.	11	6	.	17
In Northwest		0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1
	Unknown	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	1	.	.	.	.	1
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Oct.	.	.	.	.	0	.	.	1	.	1	.	.	.	.	.	.	.	0
Miramichi	Unknown	.	.	.	.	0	.	.	.	1	1	.	.	.	.	.	.	.	0
Mortalities recovered upriver (in freshwater)																			
Northwest		.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Southwest		.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Unmarked fish recovered at facility above		26	95	14	51	186	16	59	285	125	631	0	35	209	112	344	142	18	860
Fish with tagging scars recovered at facility above		.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Recaptured fish lost before reading tag number at facility above		.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Recoveries of tags placed at facility above																			
Southwest Food/Science Lower		0	0	0	0	0	0	0	2	0	2	0	0	1	0	0	0	0	1
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	1	.	.	.	.	1
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	2	.	2	.	.	.	.	.	.	.	0
Southwest Food/Science Upper		0	0	0	3	3	0	0	15	10	25	0	0	1	3	6	2	0	12
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	1	.	.	.	.	1
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	3	3	.	.	13	.	13	.	.	.	1	4	.	.	5
	Oct. 1-15	.	.	.	.	0	.	.	2	10	12	.	.	.	2	2	2	.	6
Millerton Trapnet		0	0	0	2	2	0	0	21	6	27	0	0	8	5	21	16	3	53
	May	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	3	.	.	.	.	3
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	3	.	.	.	3
	Sept.	.	.	.	2	2	.	.	17	.	17	.	.	3	1	12	.	.	16
	Oct. 1-15	.	.	.	.	0	.	.	4	6	10	.	.	2	.	8	13	.	23
	> Oct. 15	.	.	.	.	0	.	.	.	.	0	.	.	.	1	1	3	3	8

Appendix 3. Tag and recapture histories for small salmon in the Southwest Miramichi, 1997.

Tagging Area		Southwest Food/Science Lower					Southwest Food/Science Upper					Millerton Trapnet - Southwest Miramichi							
		June	July	August	Sept.	Total	June	August	Sept.	Oct. 1-15	Total	May	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
Tags Placed		12	6	0	46	64	6	0	265	117	391	0	33	201	111	341	142	17	845
Northwest Food/Science Lower		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Northwest Food/Science Upper		0	0	0	1	1	0	0	1	1	2	0	0	2	0	5	0	0	7
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	1	1	.	.	1	.	1	.	.	2	.	3	.	.	5
	Oct. 1-15	.	.	.	.	0	.	.	.	1	1	.	.	.	.	2	.	.	2
Red Bank Trapnets		0	0	0	0	0	0	0	3	1	4	0	0	1	0	4	0	0	5
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	0	.	.	1	.	.	.	.	1
	Sept.	.	.	.	.	0	.	.	1	.	1	.	.	.	.	2	.	.	2
	Oct. 1-15	.	.	.	.	0	.	.	2	1	3	.	.	.	.	2	.	.	2
Big Hole Patial Fence		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	June	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Oct. 1-15	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	> Oct. 15	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Barrier Fences		0	0	0	0	0	0	0	4	0	4	0	1	2	1	2	0	0	6
Dungarvon	June-Aug.	.	.	.	.	0	.	.	.	.	0	.	1	2	.	.	.	.	3
	Sept.-Oct.	.	.	.	.	0	.	.	1	.	1	.	.	.	1	1	.	.	2
SW Miramichi	June-Aug.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.-Oct.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Clearwater Brook	June-Aug.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.-Nov.	.	.	.	.	0	.	.	2	.	2	.	.	.	.	1	.	.	1
NW Miramichi	June-Aug.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.-Oct.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Catamaran	June-Aug.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.-Nov.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
Little River	Nov.	.	.	.	.	0	.	.	1	.	1	.	.	.	.	.	.	.	
Broodstock Seining		1	0	0	0	1	0	0	0	0	0	0	1	1	2	0	0	0	4
	Dungarvon	.	.	.	.	0	.	.	.	.	0	.	.	1	2	.	.	.	3
	Southwest	.	.	.	.	0	.	.	.	.	0	.	1	.	.	.	.	.	1
	Little Southwest	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sevogle	1	.	.	.	1	.	.	.	.	0	.	.	.	.	.	.	.	0
	Northwest	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	0

Appendix 3. Tag and recapture histories for small salmon from the Northwest Miramichi River, 1997.

Tagging Area

	Northwest Food/Science Lower										
	June	July	August	Sept.	Oct. 1-15	Total	July	August	Sept.	Oct.	Total
Tags Placed	2	0	0	3	.	5	6	0	89	52	**147**
Recapture Data											
Percent reported											
Angling Total	0.0%	.	.	0.0%	.	0.0%	0.0%	.	7.9%	1.9%	5.4%
Traps NW	0.0%	.	.	33.3%	.	20.0%	0.0%	.	10.1%	9.6%	9.5%
SW	0.0%	.	.	0.0%	.	0.0%	0.0%	.	12.4%	7.7%	10.2%
Angling Recaptures											
In Southwest	0	0	0	0	0	**0**	0	0	7	1	**8**
Unknown	.	.	.	.	.	0	.	.	.	.	0
June	.	.	.	.	.	0	.	.	.	.	0
July	.	.	.	.	.	0	.	.	.	.	0
August	.	.	.	.	.	0	.	.	.	.	0
Sept.	.	.	.	.	.	0	.	.	4	.	4
Oct.	.	.	.	.	.	0	.	.	3	1	4
In Northwest	0	0	0	0	0	**0**	0	0	0	0	**0**
Unknown	.	.	.	.	.	0	.	.	.	.	0
June	.	.	.	.	.	0	.	.	.	.	0
July	.	.	.	.	.	0	.	.	.	.	0
August	.	.	.	.	.	0	.	.	.	.	0
Sept.	.	.	.	.	.	0	.	.	.	.	0
Oct.	.	.	.	.	.	0	.	.	.	.	0
Miramichi	.	.	.	.	.	0	.	.	.	.	0
Mortalities recovered upriver (in freshwater)											
Northwest	.	.	.	.	.	0	.	.	.	.	0
Southwest	.	.	.	.	.	0	.	.	.	.	0
Unmarked fish recovered at facility above	12	44	7	3	.	**66**	73	23	89	52	**258**
Fish with tagging scars recovered at facility above	.	.	.	.	.	**0**	.	.	.	.	**0**
Recaptured fish lost before reading tag number at facility above	.	.	.	.	.	**0**	.	.	.	.	**0**
Recoveries of tags at facility above											
Southwest Food/Science Lower	0	0	0	0	0	**0**	0	0	0	0	**0**
June	.	.	.	.	.	0	.	.	.	.	0
July	.	.	.	.	.	0	.	.	.	.	0
August	.	.	.	.	.	0	.	.	.	.	0
Sept.	.	.	.	.	.	0	.	.	.	.	0
Southwest Food/Science Upper	0	0	0	0	0	**0**	0	0	3	2	**5**
June	.	.	.	.	.	0	.	.	.	.	0
July	.	.	.	.	.	0	.	.	.	.	0
August	.	.	.	.	.	0	.	.	.	.	0
Sept.	.	.	.	.	.	0	.	.	2	.	2
Oct. 1-15	.	.	.	.	.	0	.	.	1	2	3
Millerton Trap	0	0	0	0	0	**0**	0	0	8	2	**10**
May	.	.	.	.	.	0	.	.	.	.	0
June	.	.	.	.	.	0	.	.	.	.	0
July	.	.	.	.	.	0	.	.	.	.	0
August	.	.	.	.	.	0	.	.	.	.	0
Sept.	.	.	.	.	.	0	.	.	4	.	4
Oct. 1-15	.	.	.	.	.	0	.	.	3	1	4
> Oct. 15	.	.	.	.	.	0	.	.	1	1	2

Red Bank Trapnets - Northwest Miramichi

	June	July	August	Sept.	Oct. 1-15	Total
Unmarked fish recovered at facility	53	148	52	141	96	**490**
Fish with tagging scars recovered at facility	.	.	.	.	.	**0**
Recaptured fish lost before reading tag number at facility above	.	.	.	.	.	**0**

Big Hole Partial Fence

	June	July	August	Sept.	Oct. 1-15	Total
Unmarked fish recovered at facility	.	.	.	.	.	**0**
Fish with tagging scars recovered at facility	.	.	.	.	.	**0**
Recaptured fish lost before reading tag number at facility above	.	.	.	.	.	**0**

Appendix 3. Tag and recapture histories for small salmon from the Northwest Miramichi River, 1997.

Tagging Area	Northwest Food/Science Lower											Red Bank Trapnets - Northwest Miramichi					
	June	July	August	Sept.	Oct. 1-15	Total	July	August	Sept.	Oct.	Total	June	July	August	Sept.	Oct. 1-15	Total
Tags Placed	2	0	0	3	.	5	6	0	89	52	147						
Northwest Food/Science Lower	0	0	0	0	0	0	0	0	0	0	0						
June	.	.	.	.	.	0	.	.	.	.	0						
July	.	.	.	.	.	0	.	.	.	.	0						
Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.	.	.	.	.	.	0	.	.	.	.	0						
Northwest Food/Science Upper	0	0	0	1	0	1	0	0	7	3	10						
June	.	.	.	.	.	0	.	.	.	.	0						
July	.	.	.	.	.	0	.	.	.	.	0						
August	.	.	.	.	.	0	.	.	.	.	0						
Sept.	.	.	.	1	.	1	.	.	7	.	7						
Oct. 1-15	.	.	.	.	.	0	.	.	.	3	3						
Red Bank Traps	0	0	0	0	0	0	0	0	2	2	4						
June	.	.	.	.	.	0	.	.	.	.	0						
July	.	.	.	.	.	0	.	.	.	.	0						
August	.	.	.	.	.	0	.	.	.	.	0						
Sept.	.	.	.	.	.	0	.	.	.	.	0						
Oct. 1-15	.	.	.	.	.	0	.	.	2	2	4						
Big Hole Partial Fence	0	0	0	0	0	0	0	0	0	0	0						
June	.	.	.	.	.	0	.	.	.	.	0						
July	.	.	.	.	.	0	.	.	.	.	0						
August	.	.	.	.	.	0	.	.	.	.	0						
Sept.	.	.	.	.	.	0	.	.	.	.	0						
Oct. 1-15	.	.	.	.	.	0	.	.	.	.	0						
> Oct. 15	.	.	.	.	.	0	.	.	.	.	0						
Barrier Fences	0	0	0	0	0	0	0	0	0	0	0						
Dungarvon June-Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	.	0	.	.	.	.	0						
SW Miramichi June-Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	.	0	.	.	.	.	0						
NW Miramichi June-Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	.	0	.	.	.	.	0						
Catamaran June-Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.-Nov.	.	.	.	.	.	0	.	.	.	.	0						
Clearwater June-Aug.	.	.	.	.	.	0	.	.	.	.	0						
Sept.-Nov.	.	.	.	.	.	0	.	.	.	.	0						
Broodstock Seining	0	0	0	0	0	0	0	0	0	0	0						
Southwest Miramichi	.	.	.	.	.	0	.	.	.	.	0						
Dungarvon	.	.	.	.	.	0	.	.	.	.	0						
Little Southwest	.	.	.	.	.	0	.	.	.	.	0						
Sevogle	.	.	.	.	.	0	.	.	.	.	0						
Northwest	.	.	.	.	.	0	.	.	.	.	0						

Appendix 3. Tag and recapture histories for large salmon in the Southwest Miramichi, 1997.

Tagging Area		Southwest Food/Science Lower					Southwest Food/Science Upper						Millerton Trapnet - Southwest Miramichi							
		June	July	August	Sept.	Total	June	July	August	Sept.	Oct. 1-15	Total	May	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
	Tags Placed	6	23	20	24	73	2	56	48	163	166	435	0	11	68	111	279	212	70	751
Recapture Data																				
Percent reported																				
Angling	Total	0.0%	4.3%	.	8.3%	4.1%	0.0%	5.4%	.			2.1%	.	9.1%	1.5%	0.0%	3.6%	1.4%	0.0%	2.0%
Traps	NW	0.0%	4.3%	0.0%	0.0%	1.4%	0.0%	1.8%				1.6%								
	SW	0.0%	13.0%	10.0%	8.3%	9.6%	0.0%	5.4%				10.6%								
Angling Recaptures																				
In Southwest		0	0	0	2	2	0	3	0	5	1	9	0	1	1	0	9	3	0	14
	Unknown	.	.	.	.	0	.	.	.	3	.	3	.	.	.	.	.	1	.	1
	June	.	.	.	.	0	.	.	.	.	.	0	.	1	.	.	.	.	.	1
	July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	2	.	.	.	2	.	.	.	.	2	.	.	2
	Oct.	.	.	.	2	2	.	1	.	2	1	4	.	.	1	.	7	2	.	10
In Northwest		0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1
	Unknown	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	1	.	.	1	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	Oct.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	1	.	.	1
Miramichi	Unknown	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Mortalities recovered upriver (in freshwater)																				
Northwest		.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Southwest		.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Unmarked fish recovered at facility above		7	25	20	24	76	4	60	49	163	176	452	0	11	73	114	281	214	71	764
Fish with tagging scars recovered at facility above		.	.	.	.	0	.	.	.	.	.	0	.	.	1	.	.	.	.	1
Recaptured fish lost before reading tag number at facility above		.	.	.	.	0	.	.	.	.	1	1	.	.	.	.	.	.	.	0
Recoveries of tags placed at facility above																				
Southwest Food/Science Lower		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Southwest Food/Science Upper		0	0	0	0	0	0	1	1	11	3	16	0	0	1	0	3	1	0	5
	June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	.	.	.	0	.	1	.	.	.	1	.	.	.	.	.	.	.	0
	August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	Sept.	.	.	.	.	0	.	.	1	9	.	10	.	.	1	.	2	.	.	3
	Oct. 1-15	.	.	.	.	0	.	.	.	2	3	5	.	.	.	.	1	1	.	2
Millerton Trapnet		0	3	2	2	7	0	2	3	11	14	30	0	0	0	5	17	12	5	39
	June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	July	.	1	.	.	1	.	.	.	.	.	0	.	.	.	.	.	.	.	0
	August	.	.	2	.	2	.	1	1	.	.	2	.	.	.	4	.	.	.	4
	Sept.	.	2	.	2	4	.	.	2	8	.	10	.	.	.	1	8	.	.	9
	Oct. 1-15	.	.	.	.	0	.	1	.	1	12	14	.	.	.	.	7	8	.	15
	> Oct. 15	.	.	.	.	0	.	.	.	2	2	4	.	.	.	.	2	4	5	11

Appendix 3. Tag and recapture histories for large salmon in the Southwest Miramichi, 1997.

Tagging Area	Southwest Food/Science Lower					Southwest Food/Science Upper						Millerton Trapnet - Southwest Miramichi							
	June	July	August	Sept.	Total	June	July	August	Sept.	Oct. 1-15	Total	May	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
Tags Placed	6	23	20	24	**73**	2	56	48	163	166	**435**	0	11	67	111	279	212	70	750
Northwest Food/Science Lower	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Northwest Food/Science Upper	0	1	0	0	**1**	0	0	1	3	1	**5**	0	0	0	0	2	2	0	**4**
June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
August	.	1	.	.	1	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.	.	.	.	.	0	.	.	.	3	.	3	.	.	.	.	.	.	.	0
Oct. 1-15	.	.	.	.	0	.	.	1	.	1	2	.	.	.	.	2	2	.	4
Red Bank Trapnets	0	0	0	0	**0**	0	1	0	1	0	**2**	0	0	0	0	0	0	0	**0**
June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.	.	.	.	.	0	.	1	.	1	.	2	.	.	.	.	.	.	.	0
Oct. 1-15	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Big Hole Patial Fence	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
June	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
July	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
August	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Oct. 1-15	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
> Oct. 15	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Barrier Fences	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0	2	3	0	0	**5**
Dungarvon June-Aug.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
SW Miramichi June-Aug.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Clearwater Br(June-Aug.	.	.	.	.	0							.	.	.	.	.	.	.	0
Sept.-Nov.	.	.	.	.	0							.	.	.	2	3	.	.	5
NW Miramichi June-Aug.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Catamaran June-Aug.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sept.-Nov.	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Little River Nov.	.	.	.	.	0							.	.	.	.	.	.	.	0
Broodstock Seining	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0	1	3	0	0	**4**
Dungarvon	.	.	.	.	0	.	.	.	.	.	0	.	.	.	1	2	.	.	3
Cains	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	1	.	.	1
Southwest	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Little Southwest	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Sevogle	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0
Northwest	.	.	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	0

Appendix 3. Tag and recapture histories for large salmon from the Northwest Miramichi River, 1997.

Tagging Area			Northwest Food/Science Lower					Northwest Food/Science Upper						
			June	July	August	Sept.	Total	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
		Tags Placed	2	20	8	1	31	4	44	29	118	91	9	295
Recapture Data														
Percent reported														
Angling	Total		0.0%	5.0%	0.0%	0.0%	3.2%	0.0%	4.5%	3.4%	0.0%	0.0%	0.0%	1.0%
Traps		NW	50.0%	0.0%	0.0%	0.0%	3.2%	0.0%	9.1%	6.9%	1.7%	6.6%	0.0%	4.7%
		SW	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	6.8%	4.4%	0.0%	4.4%
Angling Recaptures														
In Southwest			0	0	0	0	0	0	1	1	0	0	0	2
	Unknown		.	.	.	.	0	.	1	.	.	.	.	1
	June		.	.	.	.	0	.	.	.	.	.	.	0
	July		.	.	.	.	0	.	.	.	.	.	.	0
	August		.	.	.	.	0	.	.	.	.	.	.	0
	Sept.		.	.	.	.	0	.	.	1	.	.	.	1
	Oct.		.	.	.	.	0	.	.	.	.	.	.	0
In Northwest			0	1	0	0	1	0	1	0	0	0	0	1
	Unknown		.	.	.	.	0	.	.	.	.	.	.	0
	June		.	.	.	.	0	.	.	.	.	.	.	0
	July		.	.	.	.	0	.	.	.	.	.	.	0
	August		.	.	.	.	0	.	.	.	.	.	.	0
	Sept.		.	.	.	.	0	.	1	.	.	.	.	1
	Oct.		.	1	.	.	1	.	.	.	.	.	.	0
Miramichi			.	.	.	.	0	.	.	.	.	.	.	0
Mortalities recovered upriver (in freshwater)														
Northwest			.	.	.	.	0	.	.	.	.	.	.	0
Southwest			.	.	.	.	0	.	.	.	.	.	.	0
Unmarked fish recovered at facility above			2	21	9	1	33	5	45	29	119	91	9	298
Fish with tagging scars recovered at facility above			.	.	.	.	0	.	.	.	.	.	.	0
Recaptured fish lost before reading tag number at facility above			.	.	.	.	0	.	.	.	.	.	.	0
Recoveries of tags at facility above														
Southwest Food/Science Lower			0	0	0	0	0	0	0	0	0	0	0	0
	June		.	.	.	.	0	.	.	.	.	.	.	0
	July		.	.	.	.	0	.	.	.	.	.	.	0
	August		.	.	.	.	0	.	.	.	.	.	.	0
	Sept.		.	.	.	.	0	.	.	.	.	.	.	0
Southwest Food/Science Upper			0	0	0	0	0	0	0	1	2	1	0	4
	June		.	.	.	.	0	.	.	.	.	.	.	0
	July		.	.	.	.	0	.	.	.	.	.	.	0
	August		.	.	.	.	0	.	.	.	.	.	.	0
	Sept.		.	.	.	.	0	.	.	1	1	.	.	2
	Oct. 1-15		.	.	.	.	0	.	.	.	1	1	.	2
Millerton Trap			0	0	0	0	0	0	0	0	6	3	0	9
	May		.	.	.	.	0	.	.	.	.	.	.	0
	June		.	.	.	.	0	.	.	.	.	.	.	0
	July		.	.	.	.	0	.	.	.	.	.	.	0
	August		.	.	.	.	0	.	.	.	.	.	.	0
	Sept.		.	.	.	.	0	.	.	.	3	.	.	3
	Oct. 1-15		.	.	.	.	0	.	.	.	2	1	.	3
	> Oct. 15		.	.	.	.	0	.	.	.	1	2	.	3

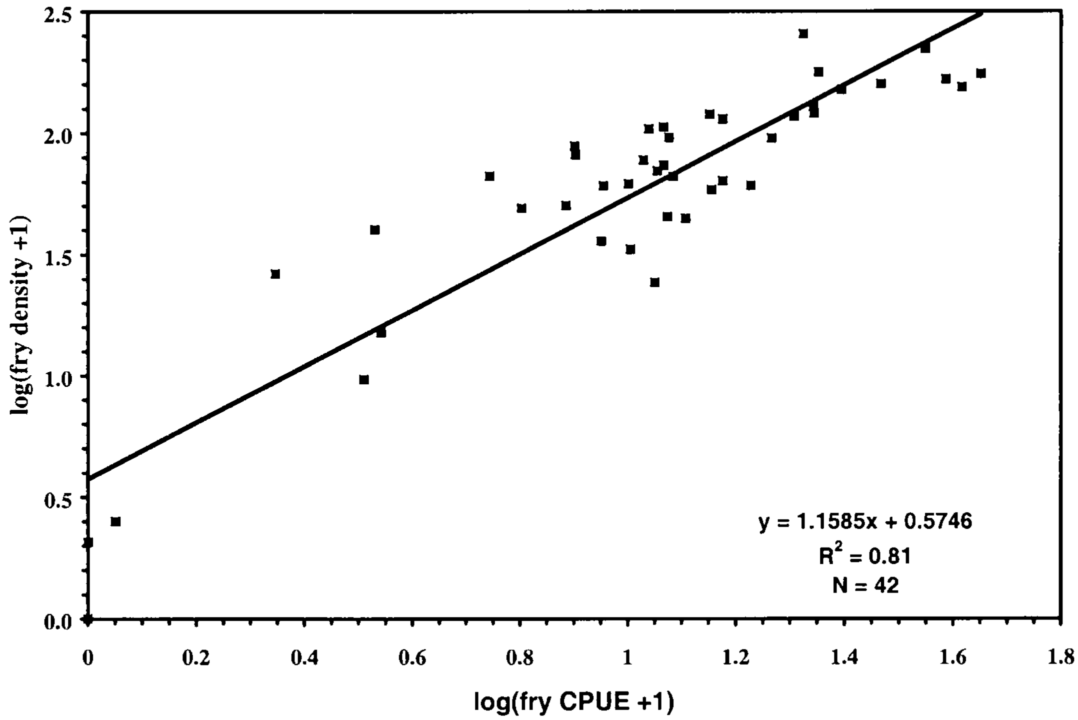
Red Bank Trapnets - Northwest Miramichi						
June	July	August	Sept.	Oct. 1-15		Total
Unmarked fish recovered at facility						
4	81	57	121	103	.	366
Fish with tagging scars recovered at facility						
.	.	.	.	.	.	0
Recaptured fish lost before reading tag number at facility above						
.	.	.	.	.	.	0

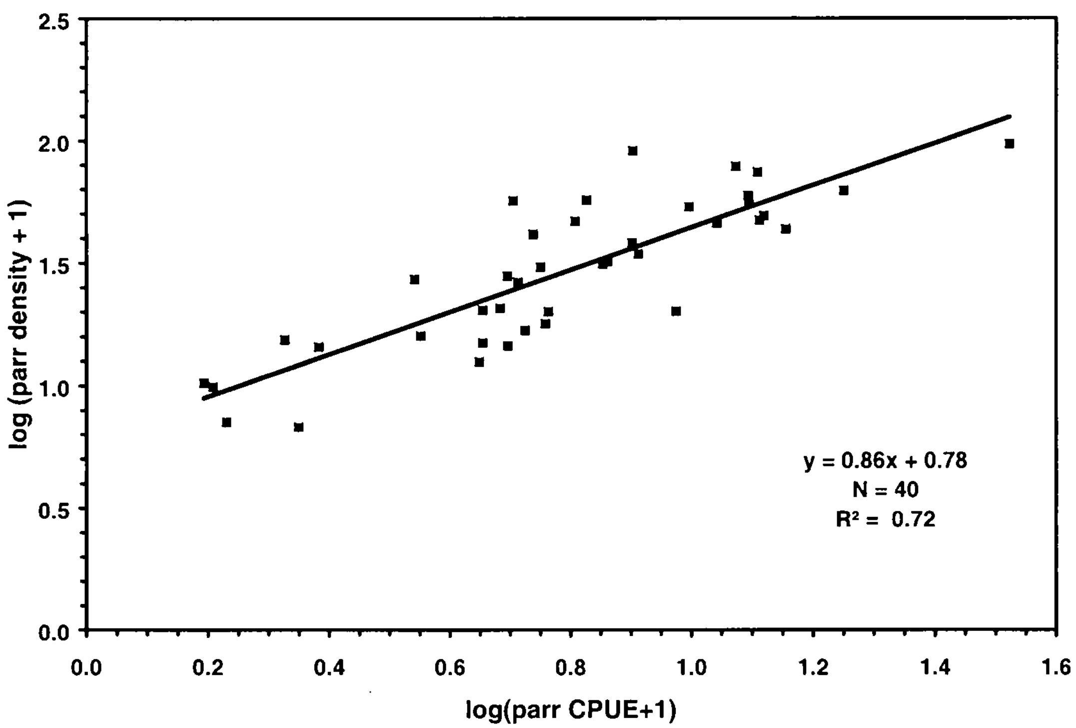
Big Hole Partial Fence						
June	July	August	Sept.	Oct. 1-15	> Oct. 15	Total
Unmarked fish recovered at facility						
0	0	0	0	0	0	0
Fish with tagging scars recovered at facility						
.	.	.	.	.	.	0
Recaptured fish lost before reading tag number at facility above						
.	.	.	.	.	.	0

Appendix 3. Tag and recapture histories for large salmon from the Northwest Miramichi River, 1997.

Tagging Area	Northwest Food/Science Lower					Northwest Food/Science Upper							Red Bank Trapnets - Northwest Miramichi					
	June	July	August	Sept.	Total	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total	June	July	August	Sept.	Oct. 1-15	Total
Tags Placed	2	20	8	1	**31**	4	44	29	118	91	9	**295**						
													Unmarked fish recovered at facility					
Northwest Food/Science Lower	0	0	0	0	**0**	0	0	0	0	0	0	**0**						
June	.	.	.	.	0	.	.	.	.	.	.	0						
July	.	.	.	.	0	.	.	.	.	.	.	0						
Aug.	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.	.	.	.	.	0	.	.	.	.	.	.	0						
Northwest Food/Science Upper	1	0	0	0	**1**	0	0	1	2	5	0	**8**						
June	.	.	.	.	0	.	.	.	.	.	.	0						
July	1	.	.	.	1	.	.	.	.	.	.	0						
August	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.	.	.	.	.	0	.	.	.	.	.	.	0						
Oct. 1-15	.	.	.	.	0	.	.	.	2	4	.	6						
> Oct. 15						.	.	1	.	1	.	2						
Red Bank Traps	0	0	0	0	**0**	0	4	1	0	1	0	**6**						
June	.	.	.	.	0	.	.	.	.	.	.	0						
July	.	.	.	.	0	.	1	.	.	.	.	1						
August	.	.	.	.	0	.	2	.	.	.	.	2						
Sept.	.	.	.	.	0	.	1	1	.	.	.	2						
Oct. 1-15	.	.	.	.	0	.	.	.	.	1	.	1						
Big Hole Partial Fence	0	0	0	0	**0**	0	0	0	0	0	0	**0**						
June	.	.	.	.	0	.	.	.	.	.	.	0						
July	.	.	.	.	0	.	.	.	.	.	.	0						
August	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.	.	.	.	.	0	.	.	.	.	.	.	0						
Oct. 1-15	.	.	.	.	0	.	.	.	.	.	.	0						
> Oct. 15	.	.	.	.	0	.	.	.	.	.	.	0						
Barrier Fences	0	0	1	1	**2**	0	0	0	0	0	0	**0**						
Dungarvon June-Aug.	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	.	0						
SW Miramichi June-Aug.	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	.	0						
Clearwater Br June-Aug.	.	.	.	.	0													
Sept.-Nov.	.	.	.	1	1													
NW Miramichi June-Aug.	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.-Oct.	.	.	.	.	0	.	.	.	.	.	.	0						
Catamaran June-Aug.	.	.	.	.	0	.	.	.	.	.	.	0						
Sept.-Nov.	.	.	.	.	0	.	.	.	.	.	.	0						
Little River Oct.-Nov.	.	.	1	.	1													
Broodstock Seining	0	0	0	0	**0**	0	0	0	0	0	0	**0**						
Dungarvon	.	.	.	.	0	.	.	.	.	.	.	0						
Little Southwest	.	.	.	.	0	.	.	.	.	.	.	0						
Sevogle	.	.	.	.	0	.	.	.	.	.	.	0						
Northwest	.	.	.	.	0	.	.	.	.	.	.	0						

Appendix 4. Juvenile survey CPUE to density calibration for the Miramichi River. CPUE is expressed as fish per 180 seconds of fishing effort, density expressed as fish per 100 m^2.





Appendix 5. Detailed distribution records of salmonids from the Miramichi Salmonid Enhancement Centre in 1997.

SCODE	LOCATION	DD	MM	YY	MRK	SPC.	STOCK	RIVER	RCODE	Program	STG	AVG.LEN	FISH/KG	#KILOS	#FISH
219303	Tuadook River	13	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	16.0	26.0	130.7	3,398
219303	Tuadook River	13	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	120.5	1,892
219303	Tuadook River	13	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	122.5	1,923
219303	Tuadook River	13	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	122.4	1,922
219303	Tuadook River	14	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	123.0	1,931
219303	Tuadook River	14	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	121.0	1,900
219303	Tuadook River	14	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	18.0	15.7	84.0	1,319
219319	Smith Forks	27	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	17.9	19.1	123.3	2,355
219319	Smith Forks	28	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	17.9	19.1	123.6	2,361
219319	Smith Forks	28	5	97	3	A	LSWMir	NW	401	Dun/Ren Pds	G	17.9	19.1	108.2	2,067
219306	Devil's Br.	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219307	Libbies Br.	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219309	Bridge by Warden Camp	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219318	Moose landing	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219319	Below Smith Forks	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219319	Smith Forks	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219303	Tuadook River	14	6	97	2	J	LSWMir	NW	401	Hatchery	D	0.8	5000.0	1.1	5,500
219319	Smith forks	19	6	97	3	J	LSWMir	NW	401	Dun/Ren Pds	G	12.0	68.0	124.3	8,452
219310	West Branch Bridge	20	6	97	3	J	LSWMir	NW	401	Dun/Ren Pds	G	11.7	70.4	134.1	9,441
219303	Tuadook River	21	6	97	3	J	LSWMir	NW	401	Dun/Ren Pds	G	11.9	69.0	126.4	8,722
219288	Miner's Bridge	25	6	97	3	J	LSWMir	NW	403	Hatchery	G	11.4	73.0	90.4	6,599
219316	Tractor's&Equipment	26	6	97	3	J	LSWMir	NW	401	Hatchery	G	13.1	58.5	74.4	4,352
219316	Tractor's&Equipment	26	6	97	2	J	LSWMir	NW	401	Hatchery	1	1.2	2222.2	0.9	2,000
219249	Chester Mines Bridge	8	7	97	2	J	Sevogle	NW	405	Hatchery	1	1.8	1923.0	2.1	4,038
219255	NW Mir. Camp Adam	5	9	97	3	J	NW Mir.	NW		Satellite	3	6.4			4,852
219292	Barracks Brook	28	10	97	3	J	Sevogle	NW		Hatchery	4	6.2			9,463
219292	Barracks Brook	28	10	97	3	J	Sevogle	NW		Satellite	4	6.2			9,463
220001	Buctouche River	4	11	97	3	J	Buctouche	OTHER		Hatchery	4		256.0	132.3	33,869
219302	Renous Ponds Outflow	7	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	17.9	18.7	1037.0	19,392
219046	Mouth of Dungarvon	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	221.6	3,701
219252	Halfway Inn	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	147.2	2,458
219046	Mouth of Dungarvon	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	210.6	3,517
219046	Mouth of Dungarvon	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	189.4	3,163
219252	Halfway Inn	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	156.5	2,614
219252	Halfway Inn	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	155.6	2,599
219046	Mouth of Dungarvon	8	5	97	3	A	Dungarvon	SW	435	Dun/Ren Pds	G	18.6	16.7	63.5	1,060
219254	Holtville Bridge	13	6	97	2	J	Dungarvon	SW	435	Hatchery	D	0.8	5000.0	2.3	11,500
219315	Russell&Swim Rd.	13	6	97	2	J	Dungarvon	SW	435	Hatchery	D	0.8	5000.0	2.3	11,500
219154	Sisters Br.	27	6	97	2	J	Rocky Br	SW	453	Hatchery	1	1.5	2632.6	3.4	8,951
219255	Camp Adam	5	9	97	3	J	NWM	SW		Hatchery	3	6.4			4,852
219298	Deadman Brook	26	9	97	3	J	MSW	SW		Satellite	4	7.1			4,946
219297	Kelly Brook	29	9	97	3	J	Clearwater	SW		Satellite	3	6.8			2,478
228215	Gillman Brook	6	10	97	3	J	MSW	SW		Satellite	4	6.5			7,380
	Little Porter Brook	8	10	97	2	J	Clearwater	SW		Satellite	4				4,312
219040	Salmon Brook & MSW	9	10	97	3	J	Clearwater	SW		Satellite	4	8.1			4,991
219301	Wades Fishing Lodge, Cains	12	10	97	3	J	Cains	SW		Hatchery	4	8.4			3,916
219038	Cains River, Island pool	12	10	97	3	J	Cains	SW		Satellite	4	8.4			1,084
219062	Black Brook	14	10	97	3	J	Cains	SW		Hatchery	4	7.1			4,905
219062	Mountain Channel	14	10	97	3	J	Cains	SW		Hatchery	4	6.3			2,128
219063	Six Mile Brook	14	10	97	3	J	Cains	SW		Satellite	4	7.1			4,905
219062	Mtn Chl. Brk. & MSW	14	10	97	3	J	Cains/Clearwatr	SW		Satellite	4	6.3			4,256
	Astles Brook	16	10	97	3	J	Clearwater	SW		Satellite	4	6.4			2,988
219328	Harris Brook (Ludlow) & MSW	18	10	97	3	J	Clearwater	SW		Satellite	4	6.8			4,968
	Slate Is. Brk / Msw	18	10	97	3	J	MSW	SW		Satellite	4	6.7			5,379
219154	Sisters Brook	22	10	97	3	J	Rocky Brook	SW		Hatchery	4	6.2			4,925
219277	Salmon Falls, Clearwater	22	10	97	3	J	Clearwater	SW		Hatchery	4	6.5			4,834
219261	Hurd Brook	22	10	97	3	J	Rocky Brook	SW		Satellite	4	6.2	256.4	19.2	4,923
219256	Clearwater	22	10	97	3	J	Clearwater	SW		Satellite	4	6.4			4,834
	L. Clearwtr Brk./Eliot Brk	24	10	97	3	J	MSW	SW		Satellite	4	7.7			10,000
228218	Clearwater Brk. (headwaters)	30	10	97	3	J	Clearwater	SW		Satellite	4				35,400
229016	N. & S. Br. MSW	31	10	97	3	S	Juniper	SW		Satellite	4	10.3			5,000
219196	Rocky Brook	3	11	97	3	J	Rocky Brook	SW		Satellite	4	6.9	256.4	18.1	4,641
	Beadle Brook	3	11	97	3	S	Beadle Brook	SW		Satellite	4				8,000
	SW Miramichi R	7	11	97	3	J	Juniper	SW		Hatchery	4		235.0	16.6	3,901
	SW Miramichi R	7	11	97	2	S	Juniper	SW		Hatchery	4		86.0	13.5	1,161
219196	Rocky Brook (Irving LL Rd.)	7	11	97	3	J	Rocky Brook	SW		Satellite	4	6.9	256.4	13.6	3,487
219196	Rocky Brook	3 & 7	11	97	3	J	Rocky Brook	SW		Hatchery	4	6.9			8,132
	Shippagan Marina	6	5	97	3	A	LSWMir		401	Dun/Ren Pds	G	16.0	26.0	1.1	29
															394029

Codes:

A - Smolts
J - Non-smolts
S - Brook trout

Mrk - 3; adipose clip
- 2; no mark