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Stock status of Atlantic salmon (*Salmo salar*) in the Restigouche River, 1999

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Abstract

The status of the Atlantic salmon (*Salmo salar*) resource of the Restigouche River is assessed as two components: status of the Matapedia River, and the remaining watershed, referred to as Restigouche (NB). Aboriginal and recreational fisheries exploited Atlantic salmon in 1999. The commercial fishery has remained closed since 1985. Aboriginal fisheries occurred under agreements specifying gear, fishing time and season restrictions but the harvest data are incomplete. Recreational fisheries occurred under gear, season and individual daily and season catch limits. Angling catches in all the tributaries of the Restigouche (NB) declined during 1985 to 1999 with the strongest and most significant declines occurring for large salmon. Returns and escapement of large salmon to the Matapedia River in 1999 were estimated to have exceeded the conservation requirement for this river. For Restigouche (NB), the returns and escapement of large salmon were estimated to have been about 4500 large salmon, 50% of the defined conservation requirement. Small salmon catches were down in 1999 and the estimates of returns and spawners indicate a lower abundance than in 1998 and relative to the previous five years. Good fry densities were observed throughout the Kedgwick, Little Main, Upsalquitch and Main Restigouche rivers. Age 1 and 2 year old parr were also widely distributed throughout the Restigouche system. Sustained juvenile levels in the river during the 1990s suggest that returns should be similar to recent years if the smolt production levels and the sea survivals are sustained.

Résumé

L'état de la ressource de saumon atlantique (*Salmo salar*) de la rivière Restigouche a été évalué pour deux composantes : la rivière Matapédia et le reste du bassin de la rivière surnommé Restigouche (NB). Les pêcheurs autochtones et sportifs ont eu accès au saumon de la Restigouche en 1999. La pêche commerciale est demeurée fermée depuis 1985. Les pêcheries autochtones ont été éffectuées sous des conditions d'ententes qui ont définies la saison, les engins et les jours de pêche. Les données de captures ne sont pas disponibles. La pêche sportive s'est éffectuée sous des limites de saison, engins, et contingents quotidien et annuel individuel. Depuis 1985, les captures dans la pêche sportive ont diminuées dans tous les tributaires avec le plus grand déclin pour les grands saumons. Les retours et géniteurs de grand saumon dans la rivière Matapédia en 1999 étaient supérieurs au besoin de conservation. Pour la Restigouche (NB), les retours et géniteurs de grand saumon ont été évalués à environ 4 500 grands saumons, soit 50% du besoin de conservation. Les captures de petit saumon ainsi que les estimations de retours et de géniteurs suggèrent une baisse dans l'abondance par rapport à 1998 et aux cinq années antérieures. Les densités d'alevins étaient bonnes dans les tributaires Kedgwick, Little Main, Upsalquitch et le tronçon principal de la rivière. Les tacons de 1 et 2 ans étaient grandement dispersés à travers le bassin. Les abondances de juvéniles soutenues durant la dernière décennie laissent croire que les retours dans les années à venir seront similaires à ceux des dernières années si la production de saumonneau et les taux de survie en mer demeurent inchangés.

INTRODUCTION

The Restigouche River is the largest river within Salmon Fishing Area 15 (SFA 15) draining about 10,000 km^2 and emptying into the Gulf of St. Lawrence at the head of Chaleur Bay. The Restigouche River and part of its tributary, the Patapedia River, define the provincial borders of New Brunswick and Québec (Fig. 1). There are three main tributaries branching off the main stem of the Restigouche River before the latter bifurcates about 108 km above head of tide into the Little Main Restigouche River heading west and northwest and the Kedgwick River heading northwest. The lower most tributary is the Matapedia River which drains southerly into the Restigouche River about 10 km above the head of tide. The Matapedia River is entirely contained within the province of Québec. The Upsalquitch River branches southward about 22 km above the head of tide and is contained entirely in New Brunswick. The Patapedia River branches northwest from the main stem at 73 km above head of tide. It borders the two provinces for 35 km of its length with the remaining headwaters within the province of Québec.

The river is accessible to salmon along its entire length and is not obstructed by natural or artificial barriers. The salmon run is predominantly early (before September 1) and comprised of generally equal numbers of small salmon (< 63 cm fork length) and large salmon (>= 63 cm fork length). Small salmon are mostly fish which have spent one year at sea (1SW) before returning to the river to spawn. Large salmon are comprised of about 70% fish which have spent two years at sea (2SW), 30% fish which spent three years at sea (3SW) and previous spawners (Randall 1984).

The status of the Atlantic salmon resource of the Restigouche River has been assessed annually since 1982 (Chadwick and Randall 1983; Randall and Pickard 1983; Randall et al 1985, 1986, 1987, 1988, 1989, 1990; Courtenay et al. 1991, 1992;. Claytor et al. 1994; Locke et al. 1993, 1995, 1996, 1997, 1998; Marshall et al. 1999). A tributary-specific assessment has been conducted annually since 1984 on the Matapédia River by the Ministère de l'Environnement et de la Faune, province of Québec (Tremblay et al. 1998). In this document, the Restigouche River is assessed as two components. Stock status of the Matapedia River is provided separately from the rest of the Restigouche River because: 1) the former empties into the Restigouche River just above the head of tide, 2) there is minimal angling activity and production area for salmon in the main Restigouche River downstream of the mouth of the Matapedia, 3) fisheries are managed by the province of Québec, and 4) specific assessment information is collected by the provincial ministry. Most of the remaining watershed, referred to as Restigouche (NB), is combined because: 1) most of the water borders or is within the province of New Brunswick with exception to the upper portion of the Patapedia and Kedgwick rivers, 2) most of the fisheries are managed under the New Brunswick angling regulations, and 3) there is a large angling fishery which occurs in the main stem of the Restigouche River over fish originating from the different tributaries.

This assessment document addresses the following topics:

- fisheries management and harvests
- estimation of returns
- estimation of escapement (spawners) and relative to conservation
- verification of estimates using abundance indices
- prospects - short term (2000) and long term (beyond 2000)
- management considerations
- assessment and research initiatives/priorities

Description of Fisheries

A distinction is made between catches and harvests. Harvests refer to fish which are caught and retained. Catches refer to fish which are caught but not necessarily retained, generally in angling fisheries.

Aboriginal fisheries and recreational fisheries exploited Atlantic salmon in the Restigouche River in 1999. The commercial fishery has remained closed since 1985.

Aboriginal fisheries

The Listuguj First Nation fished under an agreement with the province of Québec which provided for a mandatory two-day per week tie-up of gillnets in the tidal waters on the Québec side of the estuary. Eel River Bar First Nation had access to salmon fished in the estuary with gillnets (plus 1 to 2 trapnets some years) and in the Restigouche (NB) river by angling under a communal fishing agreement with DFO. The New Brunswick Aboriginal Peoples Council had access by angling under a fishing agreement with DFO. The St. Basile First Nation also had access by angling. Seasons for the estuary fisheries of the Restigouche River are summarized in Table 1.

Aboriginal fishery harvest data from the estuary were not available. Between 1982 and 1993, large salmon comprised 88 to 100% of the reported harvests (Table 2).

Recreational fishery

The recreational fishery (Table 3) in New Brunswick and the border waters with Québec was managed under a fishing plan similar to that of 1998; daily limit of two small salmon retained or a maximum of four hook-and-release salmon (of any size). The season retention limit was unchanged at eight small salmon. The angling season in 1999 extended from May 1 to Sept. 30 but small salmon could only be retained between June 1 and August 31. The recreational fishery in the Matapedia River and in sections of the Patapedia and Kedgwick rivers within the province of Québec were managed under Québec regulations: maximum of seven retentions for the year, one large salmon per day or if the first fish retained was a small salmon, a second fish of any size could be retained. The general retention angling fishery in most Québec waters extended from May 1 to Sept. 30 but with mandatory catch-and-release of large salmon after Sept. 15 on the Matapédia River. A hook and release fishery on the Matapedia River was allowed from April 24 to May 23.

Angling catch in Restigouche (NB) was 1235 large salmon and 2331 small salmon, a 43% decline for large salmon and a 16% decrease for small salmon from the previous five-year average (Table 4; Fig. 2). Angling catches in all the tributaries of the Restigouche (NB) have declined during 1985 to 1999 with the strongest and most significant declines occurring for large salmon.

Temporal trend in angling catches for 1985 to 1999				
	Small salmon		Large salmon	
	Trend	P-value	Trend	P-value
Restigouche (NB)	↓	P = 0.05	↓↓	P = 0.001
Upsalquitch	↓	P = 0.03	↓↓	P < 0.01
Patapedia	↓	P = 0.03	↓	P = 0.03
Kedgwick	↓	P = 0.09	↓↓	P = 0.02
Little Main	↓	P = 0.19	↓	P = 0.07
Main Restigouche	↓	P = 0.03	↓↓	P < 0.001
Matapédia	↑	P = 0.12	↓↓	P = 0.01

A total of 98 large salmon and 1845 small salmon were removed in 1999 (retained or assumed lost as a result of hook and release mortality at a rate of 6%) (Table 5). In 1998, 24% of the small salmon catch was released compared to 9% in 1997. This change was attributed to the 1998 management plan. In 1999, 22% of the small salmon catch was released.

The angling catch in the Matapedia River in 1999 was 606 large salmon and 731 small salmon, a 21% decline for large salmon and a 21% increase for small salmon from the previous five-year average (Table 4). There is a slight increasing trend in the small salmon catch but a significant declining trend in the large salmon catch from the Matapedia River since 1985. Removals (kept plus 6% hook and release mortality) from the angling fishery of the Matapedia in 1999 were 588 large salmon and 708 small salmon (Table 5).

Broodstock Removals

Large salmon were collected for enhancement purposes on Sept. 1 from Junction Pool (at the confluence of the Little Main Restigouche and Kedgwick River), on Sept. 8 from Kedgwick Forks Pool (51 km upriver) and in October from the Northwest Upsalquitch River (Table 6). A total of 45 females and 47 males (excluding the Northwest Upsalquitch River) were removed from the river, all were large salmon. The broodstock target was not met in 1999 because of the low number of fish seined at Junction Pool; 74 fish in total compared to 157 in 1998.

Total Removals

Total removals of small salmon and large salmon in 1999 from Restigouche (NB) were 1882 and 210 fish, respectively (Table 7). The removals in 1999 were down 27% for small salmon and down 38% for large salmon relative to the previous five-year average. For the Matapédia River, removals of 708 small salmon in 1999 were up 19% and removals of 588 large salmon were down 23% from the previous five-year average (Table 7).

Conservation Requirement

The conservation requirement for the Restigouche River system is 71.4 million eggs based on an egg deposition rate of 2.4 eggs per m^2 of habitat area applied to an estimated area of 29.8 million m^2 (Randall 1984). This habitat area measurement was derived from the ratio of rearing area to

drainage area of a surveyed river applied to the drainage area of the Restioguche River (Randall 1984). Recent estimates of drainage area provided by DNRE (New Brunswick Dept. of Natural Resources and Energy) and MEF (Québec Ministère de l'Environnement et de la Faune) total 30.1 million m^2 (unpublished revision 1998).

Habitat areas for the Restigouche have not been estimated using a standardized approach (Amiro 1983, 1993). The habitat area of the Matapédia was estimated from measurements of airphotos (Groupe Salar 1992). The remaining habitat area estimates were derived from field surveys of parts of the watershed with adjustments for unsurveyed areas. Until the habitat has been appropriately quantified, the estimate of 29.8 million m^2 from previous assessments will be used with 6.8 million m^2 attributed to the Matapedia River and the remaining 23.0 million m^2 attributed to the Restigouche (NB) watershed. Habitat measurements using a standardized approach from air photos for the New Brunswick portion of the Restigouche River commenced in 1998 and were essentially completed in 1999. A revised value is not yet available but a substantial portion of the wetted area is of low gradient (<0.12% slope), primarily in the main stem of the Restigouche River.

The habitat areas are considered to represent the total wetted area. For New Brunswick, the egg deposition rate of 2.4 eggs per m^2 is applied to all habitat as per the operational definition of conservation (CAFSAC 1991).

For the Matapédia River specifically, an egg deposition rate of 1.68 eggs per m^2 has been used (Tremblay et al. 1998). The 1.68 rate was derived by Elson (1975) for the production of fry from the Miramichi River. Elson (1975) concluded that an egg deposition of 140 eggs per 100 yd^2 (or 168 eggs per 100 m^2) was sufficient to produce the perceived upper limit of 5 to 6 smolts per 100 yd^2 even for rivers producing 3-year old smolts. Elson (1975) concluded that this value was not out of line with the 200 eggs per 100 yd^2 value from the Pollett River which did not account for losses of as much as 25% of the fish prior to spawning. The 2.4 eggs per m^2 deposition rate is assumed to provide a margin of safety, albeit modest, for losses of adults between the time salmon enter the river and subsequent spawning (CAFSAC 1991).

Additionally in Québec, the egg deposition rate used depends upon the habitat area measurements available. When total wetted area is measured, an egg deposition rate of 1.68 eggs per m^2 is applied (Caron 1990). For rivers where the habitat has been categorized, an egg deposition rate of 2.4 eggs per m^2 is applied to the area of good to fair habitat (Caron 1990). Poor habitat areas are characterized by slow currents, small substrate with abundant quantities of sand (Dulude and Caron 1990) and these are excluded. For the Matapédia River, the habitat area measured is the total wetted area, therefore a rate of 1.68 is used.

Spawner requirements in terms of fish were estimated using the average biological characteristics for 1972 to 1980 (Randall 1984). The average fecundity per large salmon spawner was 5933 eggs (Randall 1984). Spawner requirements in terms of large salmon for the Restigouche River are 12,042 fish at a rate of 2.4 eggs per m^2 or 8,429 fish at a rate of 1.68 eggs per m^2.

Conservation requirements / Objectifs de conservation

	Habitat	Egg deposition rate / Taux de déposition d'oeufs	
	million m²	at / à 2.4	at / à 1.68
Eggs required / Oeufs requis (millions)			
Matapédia	6.8	16.35	11.44
Restigouche (NB)	23.0	55.10	38.57
Restigouche River	29.8	71.44	50.01
Large salmon required (number) / Grands saumons requis (nombre)			
Matapédia		2,755	1,929
Restigouche (NB)		9,286	6,501
Restigouche River		12,042	8,429

The choice of egg deposition rate (2.4 versus 1.68) on the Restigouche River depends upon the method of estimating the spawning escapement. In previous assessments, adjustments of 16% and 14% were applied to the population of large salmon and small salmon entering the river before angling fisheries. Estimates of spawners were based on angling catches and exploitation rates, unadjusted for any in-river losses due to poaching and disease (Locke et al. 1997). The mark and recapture estimates of spawners were also not adjusted for in-river losses. For both these methods, a conservation requirement of 2.4 would be appropriate.

When spawning escapement is estimated just prior to spawning, as for example by visual counts of spawners or redds in the fall, then the egg deposition rate of 1.68 would be appropriate.

Resource Status

Sources of data

Returns and escapements are estimated from angling catches and by visual counts of spawners. Other indicators of abundance include juvenile surveys and counts at the protection barriers at 10-mile Pool in the Northwest Upsalquitch and the Causapscal River, tributary of the Matapedia River (Fig. 1).

Adult counts

Visual counts of spawners were conducted in mid-July to the end of July in all the tributaries of the Restigouche River. The tributaries were surveyed by teams of divers from DFO Science, Listiguij First Nation (LMFN) and the Corporation de Gestion des Rivières Matapédia et Patapédia (CGRMP). Fall spawner counts were also attempted in October in all tributaries and a redd count was conducted in the main stem of the Restigouche in late October.

Because of poor visibility in October due to high water conditions in the Matapedia, the average of the previous years values was used to derive the escapement.

Juvenile surveys

Electrofishing surveys were conducted at 52 sites in Restigouche (NB) waters in 1999. Fifteen of these sites have been sampled almost every year since 1972. A combination of open (38 in total) and closed (14 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 perpendicular to shore, in an upstream direction, with three to four people. 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. Results from calibrations made at the 14 sites in 1999 are given in Appendix 1.

In 1998 and 1999, juvenile surveys were also conducted on the Matapedia and Patapedia rivers. Open sites were used exclusively. The CPUE values are used for comparative purposes within and among the Matapedia and Patapedia rivers and because the same crew was generally involved in all the surveys, comparisons in 1999 are also made among tributaries.

All fish were identified to species and counted. Atlantic salmon juveniles were measured for fork length. Fish were anesthetized, using sodium bicarbonate salts or MS-222, before measuring.

Juvenile Index Model

Catch rates in the large salmon angling fishery of Restigouche (NB) were modelled using the annual juvenile fry abundance. The average fry abundance estimated from the index sites sampled annually in Restigouche (NB) waters was assumed to be representative of the relative spawning escapement in the previous year. Relative spawning escapement was translated to absolute escapement using the estimated angling catch adjusted by the annual catch rate. The model was applied to the Restigouche (NB) waters only because there was no juvenile sampling in the Matapedia River.

The association between fry abundance and spawner abundance was assumed to be linear. The modelling approach is summarized below:

1. Fry abundance is assumed to be a function of spawner abundance (i.e. Fry = $f(S)$).
2. Predicted spawning escapement is calculated as returns minus removals

   $S_i = Returns_i - H_i$

   where

	S_i	=	spawners in year i
	$Returns_i$	=	C_i / ER_i
	C_i	=	angling catch in year i
	ER_i	=	catch rate in the angling fishery in year i
	H_i	=	removals (harvest) in year i

Some of the uncertainty of the predicted spawning escapement was quantified by accounting for the uncertainty in the annual average fry index values.

3. Annual fry index values were generated by random draws from a normal distribution described by the mean and associated standard error (standard deviation divided by square root of N-1 where N = the number of sites sampled in the year).
4. Set initial starting values for ER_i between 0.2 and 0.4.

5. Solve for ER_i such that the correlation between the fry index and the predicted spawning escapement is maximized. In the tuning process, catch rates were constrained between 0.01 and 0.99.
6. Repeat steps 3 to 5 a large number of times (500 in this simulation).
7. Compare the distributions of the spawner equivalent values from step 6 to the conservation requirement (expressed as the number of large salmon) to determine the probability of having met or exceeded the conservation requirement.

The 1999 spawning escapement was estimated using the catch rates from 1995 to 1998 applied to the 1999 angling catches (1235 fish) and adjusted for the removals (210 fish). A retrospective-adjusted catch rate was selected at random from the 1994 to 1997 catch rates estimated from the simulation. The vector of 500 catch rates was applied to the 1999 angling catch.

Returns and Escapements

Matapédia River

Mid-season counts of the Matapédia River were conducted from July 27 to Aug. 4 in 1999 (D'Amours 1999). A total of 1079 small salmon and 2246 large salmon were estimated to have been in the river (exclusive of angling removals and salmon in the Causapscal barrier). Small salmon estimates were the highest ever mid-season counts and were higher than the end of season estimates of 1997 and 1998.

Because of poor visibility due to high water conditions in the fall of 1999, end of season estimates of escapement were derived from the mid-season to end-of-season ratios from previous years or the average of previous years (D'Amours 1999). The end of year escapement to the Matapedia River system was estimated at 2004 large salmon and 853 small salmon. Returns in 1999 were estimated at just under 2600 large salmon and 1600 small salmon, similar to returns from 1998 but still less than 1995 and 1996. The catch rates in the angling fishery in 1999 were estimated at 47% on small salmon and 23% on large salmon with a combined catch rate of 32%.

A spawning escapement in the Matapedia River of 2004 large salmon represents 104% of the requirement at an egg deposition rate of 1.68 eggs per m^2 but only 73% of requirement at the higher egg deposition rate (2.4 eggs per m^2). Returns in 1999 were 135% of the defined requirement but were 94% of the requirement at the higher egg deposition rate. Since 1984, egg depositions in the Matapedia River exceeded the requirement at the lower rate of egg deposition in only the recent years, 1994 to 1999 (Tremblay et al. 1998). The recently improved performance of the Matapedia is believed to be partially the result of an improved spawner counting technique introduced in 1994 (snorkel-based counts versus canoe-based counts). At the higher egg deposition rate, requirements were exceeded in 1996 only.

Restigouche (NB)

Mid-July counts of small salmon and large salmon in the New Brunswick tributaries indicated that there were as many as 650 large salmon and 450 small salmon in the Kedgwick River, less than 50 large salmon and 200 small salmon in the Little Main Restigouche, and over 800 large salmon and 1600 small salmon in the Upsalquitch River at the time of survey. Totals were about 1500 large salmon and 2250 small salmon (Table 8).

October spawner count estimates for the Restigouche (NB) waters in 1999 were 3200 large salmon (Table 8, 9). The estimate of large salmon escapement for the Main Restigouche (752 fish) is based on a redd count of 1804 redds adjusted for 2.4 redds per large salmon spawner (A. Madden, DNRE, pers. comm.) (Table 9). Counts of small and large salmon in October were lower than mid-July counts in the Kedgwick River (Table 8). Water conditions in July were more appropriate for counting than in October.

Based on the juvenile index model, the escapement of large salmon to Restigouche (NB) in 1999 was estimated at 4500 fish (Fig. 3). This estimate assumed the catch rates calculated for 1995 to 1998 (about 24% adjusted for the retrospective pattern) applied to the 1999 fishery. The catch rate in 1998 was estimated to be lower than in 1995 to 1997, probably as a result of water conditions (Fig. 4). The catch rates in 1999 are also likely lower than the value used in the assessment because of low water conditions and warm water temperatures. Estimates of large salmon spawners from fall canoe counts have been consistently lower by 18 to 78%, generally outside the confidence limits and uncorrelated ($R = 0.14$) to the juvenile index model spawner estimates since 1991 (Fig. 3). The estimates from mark and recapture in three of four years were higher than the modelled estimates but were correlated and within the confidence limits of the juvenile model estimates (Fig. 3). The mark and recapture estimates were 21 to 34% above the modelled estimates in 1994 to 1996.

There were minimal in-river fisheries losses in 1999 (210 fish). Returns of large salmon in 1999 were estimated at about 4500, within the errors of the juvenile model estimate (Fig. 3). Returns after estuary fisheries have improved since 1985 but returns in 1997 and 1999 are estimated to have been as low as those observed in the early 1980s when commercial fisheries removed between 2000 and 4500 large salmon.

Small salmon returns and escapement are not estimated with the juvenile index model. Small salmon catch rates are higher than large salmon catch rates. For the Upsalquitch River, the ratio of catch rates of small salmon to large salmon averaged 1.5 between 1985 and 1998. The catch rates are calculated from the estimates of spawners from the fall canoe counts. The ratio of the catch rates of the two size groups should be a measure of the relative catchability of small salmon and large salmon regardless of the accuracy of the actual spawner estimates if the estimated ratio of small to large salmon spawners is unbiased. Small salmon spawners in 1999 were estimated at about 4000 fish with returns of about 6000 fish.

Large salmon spawners in 1999 represented 50% of the 2.4 rate requirement or 70% of the lower egg deposition rate requirement. Returns of large salmon after the estuary fisheries would have been similarly deficient. Since 1985, conservation requirements were met in 9 of 15 years. At the lower egg deposition rate, requirements were met every year since 1986 except for 1999 (Fig. 3). Spawning requirements were not met in any year prior to 1986.

Indicators of Escapement

The count of large salmon at the Northwest Upsalquitch River protection barrier (10-mile) was up 45% from 1998 and 11% from the previous five-year mean (Fig. 5). Small salmon were increased 5% from 1998 but down 12% from the previous five-year mean. There was a significant ($P < 0.05$) declining trend in the large salmon count since 1988 and a declining but non-significant trend in the small salmon count.

Count of large salmon at the Causapscal barrier was up 19% from 1998 and down 24% from the previous five-year average (Fig. 5). The 1999 count is exclusive of the additional 262 large salmon which were retained within the barrier prior to the installation of the counting trap. Adjustments to the counts could be made to the 1997 and 1998 counts but not before.

Summary of stock status

Large salmon catches in the Matapedia River in 1999 were among the lowest since 1983. The escapement of large salmon in 1999 was among the lowest since the improved spawner counting method was introduced in 1994. Count of large salmon at the Causapscal barrier was improved from the last two years but still among the lowest since counting began in 1988. Improved counts of large salmon at the two barriers and high mid-season count in the Matapedia, suggest large salmon returns were improved from 1998. Small salmon catches in 1999 were lower in Restigouche (NB) but improved in Matapedia. The count of small salmon at the Upsalquitch barrier was unchanged from 1998 and among the lowest of the time series. Mid-season estimates of small salmon in the Matapedia were unchanged from recent years. These indicators suggest small salmon returns in 1999 were similar to or lower than those of recent years.

Ecological Considerations

Habitat Constraints

There are no major habitat constraints identified on the Restigouche River. Forest harvesting activities are widespread through the basin and localized erosion and siltation events are present. There is industry and municipal development in the estuary whose discharge of effluent may impact on salmon during the migration through the estuary as smolts or as returning adults (D'Amours 1996).

Spawner Distribution

Good fry densities were observed throughout the Kedgwick, Little Main, Upsalquitch and Main Restigouche rivers. Age 1 and 2 year old parr were also widely distributed (Fig. 6). Juvenile salmon are also widely distributed throughout the Matapedia and Patapedia rivers.

Fry abundance in 1999, based on the median fry catch per unit effort, was highest in the Upsalquitch followed closely by Patapedia and Matapedia rivers (Table 10). With exception to the Humqui (upper Matapedia), the parr densities were lowest in the Kegwick and Little Main (Table 10). The observed distribution and abundance of fry and parr in these systems indicates a broad spawner distribution since 1997.

Adult Biological Characteristics

Salmon were sampled for length, sex and scales during the broodstock seining efforts at Junction Pool at the mouth of the Little Main Restigouche and the Kedgwick rivers in September 1998 and 1999. There were fewer fish captured in 1999 than in 1998 at the two pools.

There were fewer of the longer-bodied large salmon in 1999 than in 1998. These differences were especially evident in the average smaller size of male and female salmon

retained for broodstock (Table 6). The lower sized mode of salmon was also larger in 1999 compared to 1998 (Fig. 7 & 8).

Exotic Species

Young-of-the-year rainbow trout (*Onchorhynchus mykiss*) were collected at one site on the Little Southeast Upsalquitch River on October 13, 1998. The four specimens ranged from 5.8 to 7.5 cm fork length. Brook trout (*Salvelinus fontinalis*) and Atlantic salmon juveniles were also sampled at the site. It is unknown whether the juvenile rainbow trout were the result of unauthorized stocking in the brook or were progeny of natural spawning. No rainbow trout were observed at two other upstream sites nor in any other locations in the Restigouche River nor were any other rainbow trout juveniles sampled in 1999.

Prospects

Short term and long-term prospects for the Restigouche are mostly based on the performance of recent years and the trends in abundance of juveniles.

For the Matapedia River, returns of small and large salmon have approximated or exceeded 4000 fish annually since 1995. There is no reason to expect the total returns and the egg depositions to be less than the conservation requirement for the river.

The relativley high juvenile abundance levels observed since 1990 suggest that returns should be similar to those of the last five years

Densities of fry (young-of-the-year), small parr and large parr remain at greatly improved levels relative to the 1970s and early 1980s (Fig. 9). Annual variations in densities represent both variations in egg depositions and survival rates.

Enhancement activities on the Restigouche River in 1998 and 1999 involved primarily the stocking of eyed eggs to incubation boxes and feeding fry to satellite rearing facilities for release as 0+ parr in the fall (Table 11).

Inseason assessment

An in-season assessment has been conducted on the Matapedia River since 1995. Counts of large salmon at the end of July are used to assess the likelihood of achieving conservation requirements by the end of the year. The mid-season assessment is targetted for the week of July 22. The mid-season criterion for management intervention is 1000 large salmon counted on the main stem of the Matapedia River from the forks pool at the mouth of the Causapscal downstream to the mouth of the Matapedia River. Subsequent to the mid-season count, retention of large salmon for the remainder of the year is prohibited if less than 1000 large salmon are estimated in the river. The intervention at mid-season would be expected to save 15% more eggs (J.-P. le Bel, MEF, pers. comm.).

In 1999, mid-July counts were obtained for the Restigouche (NB) tributaries. In the Kedgwick River, mid-July counts were as high as the October counts (Table 8). Mid-July count of small salmon on the Upsalquitch River was higher than the October count but large salmon count was 70% of the October count (Table 8). In the Little Main Restigouche, the mid-July counts were 47% for small and 5% for large salmon of the respective October counts.

Summary

Were conservation requirements met in 1999?

Returns and escapement of large salmon to the Matapedia River in 1999 were estimated to have exceeded the conservation requirement for this river, based on an egg deposition rate of 1.68 eggs per m^2. Returns in 1999 would not have been sufficient if an egg deposition rate of 2.4 eggs per m^2 had been used to define the requirement for the river. Small salmon returns increased in 1999 relative to 1998.

For Restigouche (NB), the returns and escapement of large salmon were estimated to have been about 50% of the defined conservation requirement (at 2.4 eggs per m^2) with no chance of having met or exceeded the requirement. At a lower egg deposition requirement of 1.68 eggs per m^2, spawning escapement of large salmon would have approximated 70% of the requirement with a slim chance of having met the egg deposition level. Small salmon catches were down in 1999 and the estimates of returns and spawners indicate a lower abundance than in 1998 and relative to the previous five years.

Will conservation be met in 2000?

There is no reason to expect the returns of small and large salmon to the Matapedia River to be less than those observed in the last four years and to be less than the conservation requirement for the river.

Sustained juvenile levels in the river during the 1990s suggest that returns should be similar to recent years if the smolt production levels and the sea survivals are sustained. Based on this and the trend in returns of small and large salmon in the past five years, the returns in 2000 are expected to be of similar magnitude to recent years, at around conservation.

What is the impact of the present fishing practices on spawning escapement in the Restigouche River?

The impact of the aboriginal fisheries prosecuted in the estuary remains unknown because the harvests are not completely reported. In the past and present assessments, the status of the Restigouche (NB) and Matapedia River stocks are after the estuary fisheries. Since 1985, the spawning escapement to the Restigouche (NB) has met or exceeded requirement in 9 of 15 years, but only two of the last five years. Matapedia River stock has fared better although at equivalent egg deposition rate to the rest of the river, would have achieved the conservation requirement only in 1996 with the returns in other years being insufficient to meet the requirement.

In the Matapedia River, in-river angling removals in the last four years have been less than or equal to the surplus to conservation requirement of large salmon in the river.

In Restigouche (NB) waters, angling fisheries are estimated to result in about 1% mortality of the large salmon returns. Small salmon removals are much greater because this size group can be retained by anglers but because of the high proportion male component, there is negligible loss of eggs. Aboriginal food fisheries prosecuted in-river have resulted in a very small loss of fish and eggs (most removals are small salmon).

The juvenile model results suggest that catch rates in the Restigouche (NB) angling fisheries have declined over time and since 1994 appear to be less than 25%. The catch rate in 1998 was estimated to be about 12% and it is possible that a similarly low catch rate occurred in 1999. Declining catch rates would be expected as a direct result of changes in management from the 1970s to the 1980s. Low and warm water conditions were suggested as a reason for lower catch rates in recent years (user groups at the science workshop). Catch rates have also declined in the Matapedia River in recent years with the 1998 catch rates the lowest since 1984. Lower catch rates may also reflect decreased effort. Effort is measured in rod days and is likely not a sufficiently precise meaure of actual angling activity affecting catchability. There has been an increase in canoe traffic, primarily on the Main Restigouche River, and user groups have indicated that this increased alternate use of the water resource has significantly reduced the daily angling activity.

Canoe traffic would intuitively seem irrelevant to Atlantic salmon conservation concerns. However, the stress of surface disturbance on salmon in pools, especially under low and warm water conditions may not be negligible especially if traffic is intense and fish are additionally disturbed by swimmers. Both traffic and swimming activities have increased in recent years. Natural resource use other than fisheries is becoming a conservation issue for Atlantic salmon in the Restigouche River.

What is the contribution of enhancement intiatives to conservation?

Enhancement initiatives on the Restigouche are of a small-scale relative to the size of the watershed. The contribution of the enhancement efforts to the return and spawning escapement of Atlantic salmon are difficult to assess because very few of the stocked fish can be identified at the adult stage. A large part of the stocking occurs at early life stages and not all the stocked products have been marked before release.

What are the assessment and research priorities for Atlantic salmon of the Restigouche?

1) Returns and spawning escapements of Atlantic salmon to the Restigouche River are presently estimated using less than satisfactory techniques.

Although visual spawner counts have been conducted in recent years, this technique remains a partial count estimate and the proportion of the total fish present in the river and enumerated by the observers has yet to be quantified. Previous efforts indicate that variable proportions of previously marked fish are subsequently seen by divers (28%, 44%, 70% Locke et al. 1998). Within and among observer variability are also factors which need to be addressed (Locke 1998). Within the Restigouche River, there are large sections which are difficult to sample. Attempts were made in 1997 and 1998 to provide wide coverage of the system in the fall but high water conditions in 1998 prevented the collection of useable data.

Catch rates in the angling fishery were modelled using the index of juvenile abundance. This model indicated that catch rates have declined over time. The approach provides previous year estimates of catch rates but catch rates for the current year must be borrowed and assumed similar to previous years. Retrospective patterns in the model also produce annual estimates which change as additional years data become available.

Mark and recapture experiments conducted in previous years produced estimates of returns and escapements which were generally much higher than all the other estimates (Locke et al. 1997). The Restigouche River has a history of furunculosis which can be most important when water levels are

low with warm water temperatures. Capturing and handling of salmon in this type of river may not be wise.

Alternate methods of estimating returns which could be considered include non-obtrusive techniques such as acoustic or video counting systems. Ultimately, these new technologies may be the most readily publicly acceptable and minimally intrusive approaches to estimating the total returns of Atlantic salmon.

2) Tributary-specific assessments

Salmon from the Restigouche River System are exploited in Aboriginal fisheries in the estuary and in-river and in angling fisheries in-river. Although tributary-specific assessments have been suggested as more appropriate for the Restigouche River (Locke et al. 1998), both fisheries and assessment constraints preclude any such approach in the near future. Aboriginal fisheries proscecuted in the estuary undoubtedly exploit salmon from the entire watershed. Until both the level of harvests and the tributary-specific composition of the harvests are estimated, total returns to the river before homewater fisheries and tributary specific returns will remain unknown.

In-river fisheries of the Main Restigouche River also exploit salmon from the four tributaries of the Restigouche. Losses of large salmon in the angling fishery are assumed to be low (6% hook and release mortality), therefore end of season spawner counts could provide tributary specific spawning escapement estimates. Small salmon returns could not be appropriately estimated. The Matapedia River is the only tributary within the Restigouche River System which can practically be assessed separately from the remainder of the river.

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Table 1. Operating dates of First Nations fisheries in Chaleur Bay and Restigouche River, 1979 to 1999.

	New Brunswick		Québec
Year	Gillnet	Trapnet[a]	Gillnet
1979	May 14 - Oct 24		Jun 6 - Aug 1
1980	May 19 - Jul 13		Jun 2 - Jul 28
1981	May 15 - Aug 30		
1982	May 17 - Aug 1		Jun 9 - Aug 2
1983	May 16 - Aug 28		Jun 3 - Aug 7
1984	May 14 - Aug 27		Jun 5 - Aug 10
1985	May 20 - Aug 25		Jun 3 - Jul 31
1986	May 19 - Aug 10	May 26 - Jul 20	Jun 2 - Jun 26
1987	May 24 - Jul 27	May 24 - Jul 15	Jun 1 - Jun 30
1988	May 16 - Aug 26	May 16 - Aug 14	Jun 6 - Jul 6
1989	May 15 - Aug 20	May 29 - Aug 20	Jun 5 - Jun 30
1990	May 14 - Jul 22	May 22 - Jul 25	Jun 11 - Jul 6
1991	May 12 - Jul 27	May 26 - Jul 27	Jun 3 - Jun 28
1992	May 25 - Aug 23	May 26 - Aug 2	Jun 10, 11, 12, 16, 17, 25 & 30 Jul 1, 6, 9, 10, 14, 15 & 19
1993	May 17 - Aug 8		May 17 - Aug 8
1994	May 16 - Jul 16		not available
1995	May 29 - Oct 1		? - Jul 26[b]
1996	Jun 3 - Jul 15		Jun 5 - Jul 21[b]
1997	Jun 16 - Jul 25		Jun 6 - Jul 22[b]
1998	Jun 8 - Sep 27		Jun 10 - Jul 26[b]
1999	not available		Jun 9 – Jul 23[b]

[a] One trap net in 1986. Two trap nets in 1987 to 1992

[b] Includes weekly tie-ups (Québec) in 1995 to 1999.

Table 2. First Nations salmon landings (number of fish) for Chaleur Bay and Restigouche River, 1975 to 1998. The 1999 data are not available.

	New Brunswick / Nouveau-Brunswick									Québec			
	Estuary / Estuaire			River / Rivière			Total			Estuary / Estuaire			
Année / Year	Petit / Small	Grand / Large	Total	Petit / Small	Grand / Large	Total	Petit / Small	Grand / Large	Total	Petit / Small	Grand / Large	Total	Total
1975	3	132	135				3	132	135				135
1976	13	124	137				13	124	137	0	1517	1517	1654
1977	19	212	231				19	212	231	0	2738	2738	2969
1978	23	129	152				23	129	152				152
1979	84	148	232				84	148	232	85	748	833	1065
1980	34	264	298				34	264	298	24	1563	1587	1885
1981	20	211	231				20	211	231				231
1982	12	155	167				12	155	167	148	1521	1669	1836
1983	0	260	260				0	260	260	32	1216	1248	1508
1984	1	213	214				1	213	214	177	1070	1247	1461
1985	0	241	241				0	241	241	35	976	1011	1252
1986	26	431	457				26	431	457	4	1145	1149	1606
1987	95	916	1011				95	916	1011	5	986	991	2002
1988	70	509	579				70	509	579	3	921	924	1503
1989	151	568	719				151	568	719	12	1081	1093	1812
1990	120	471	591				120	471	591	16	1135	1151	1742
1991	10	252	262				10	252	262	9	859	868	1130
1992	2	464	466	0	10	10	2	474	476	53	948	1001	1477
1993	0	293	293	0	8	8	0	301	301	0	901	901	1202
1994	29	348	377	29	32	61	58	380	438	*18*	*985*	*1003*	1441
1995	0	178	178	21	24	45	21	202	223	*18*	*985*	*1003*	1226
1996	0	176	176	77	37	114	77	213	290	*18*	*985*	*1003*	1293
1997	0	155	155	26	11	37	26	166	192	*18*	*985*	*1003*	1195
1998	0	197	197	26	37	63	26	234	260	*18*	*985*	*1003*	*1253*
Mean / Moyenne (1993 - 1997)	6	230	236	31	22	53	36	252	289				
1998 Change relative to the mean / Différence de 1998 par rapport a la moyenne	-100%	-14%	-16%	-15%	65%	19%	-29%	-7%	-10%				

Table 3. Salmon angling seasons and quotas for 1999.

New Brunswick and boundary waters for New Brunwick licenses

Waters upstream of the J.C. Van Horn Bridge at Campbellton
Season: May 1 to August 31
Quota: Daily retention limit of 2 small salmon (< 63 cm fork length)
Daily catch and release limit of 4 salmon any size
Season retention limit of 8 small salmon, 0 large salmon (>= 63 cm fork length)

Exceptions to general regulations and season

Catch and release angling only
Season: May 1 to June 1
Quota: Daily retention limit of 0 salmon (any size)
Unlimited catch and release

1. From the confluence of the Patapedia River downstream to the the J.C. Van Horn Bridge at Campbellton

Season: September 1 to September 30
Quota: Daily retention limit of 0 salmon (any size)
Daily release limit of 4 salmon any size

1. Waters upstream of the J.C. Van Horn Bridge at Campbellton

Québec and boundary waters for Québec licenses

General season: June 1 to September 15
Quota: Québec waters

1. Daily retention of 1 salmon (>= 63 cm fork length) or 2 salmon if first fish retained is a small salmon (< 63 cm fork length)
2. Daily catch and release of 4 salmon any size
3. Season retention limit of 7 salmon any size

Boundary waters

1. Daily retention limit of 2 small salmon, 0 large salmon
2. Daily catch and release limit of 4 salmon any size
3. Season retention limit of 7 small salmon

Exceptions to the general regulations and season

Season: June 1 to August 31

1. Matapedia River between the downstream side of the Causapscal Bridge and the downstream side of the bridge facing the church at Amqui, except Lac au saumon
2. Assemetquagan River: between its confluence with the Matapedia River and its confluence upstream at Creux Brook
3. Du Moulin River: between its confluence with the Matapedia River and 1 km upstream from point 48˚04'N, 67˚06'28"W

4. Milnikek River: between its confluence with the Matapedia River and its confluence with Grande rivière Milnikek Nord
5. Patapedia River: Québec – New Brunswick boundary waters and Québec waters up to 300 m downstream from the mouth of the Patapedia est River.
6. Restigouche River: all Québec and New Brunswick boundary waters

Season: May 15 to July 15

1. Causapscal River: between downstream side of the Highway 132 bridge and 50 m upstream from Martel Salmon Pool

Season: May 15 to September 30

1. Kedgwick River: between its source and the Québec – New Brunswick border

<u>Catch and release angling only</u>

Season: April 24 to May 23

Quota: Daily catch and release limit of 4 salmon (any size)

1. Matapedia River: between 50 m upstream from its confluence with Restigouche River and its confluence with Gilmour Brook, except the stretch along lot 3 (Rang 1, Matapedia township)

<u>Catch and release angling of large salmon</u>

Season: September 16 to September 30

Quota: Daily retention limit of 2 small salmon, 0 large salmon
Daily catch and release limit of 4 salmon (any size)

1. Matapedia River: between 50 m upstream from its confluence with Restigouche River and the downstream side of the Causapscal Bridge

Table 4. Tributary-specific angling catches (number of fish) from the Restigouche River, 1970 to 1999.

Année / Year	Matapédia		Upsalquitch		Patapédia		Kedgwick		Little Main		Main Restigouche		Restigouche (NB)	
	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large
1970	162	290	270	122	4	24	323	205			747	1401	1344	1752
1971	153	217	344	90	20	40	128	67			527	602	1019	799
1972	102	1010	362	984	7	144	165	425			453	2478	987	4031
1973	147	1098	498	512	0	43	128	548			797	2691	1423	3794
1974	124	1083	433	579	5	63	80	289			525	3934	1043	4865
1975	131	692	462	262	18	31	136	316			532	1600	1148	2209
1976	296	922	767	753	80	88	209	348			1370	3399	2426	4588
1977	278	1312	554	901	181	227	368	684			1411	3583	2514	5395
1978	251	1457	449	507	31	158	143	423			730	2480	1353	3568
1979	466	754	507	135	90	60	316	123			1167	751	2080	1069
1980	311	1784	1178	592	95	229	284	468			1374	3084	2931	4373
1981	485	1176	1234	221	148	175	356	473			1422	2195	3160	3064
1982	259	841	818	214	143	112	322	190	59	50	1250	1175	2592	1741
1983	154	456	203	218	27	103	68	224	14	0	430	1067	742	1612
1984	285	560	483	346	44	59	149	164	102	27	725	1120	1503	1716
1985	291	807	1175	507	104	84	330	185	163	50	1539	2781	3311	3607
1986	389	1289	1397	630	163	187	566	519	481	155	2421	3403	5028	4894
1987	602	915	819	410	193	77	583	409	407	142	2506	2220	4508	3258
1988	680	1068	1296	659	185	107	807	707	524	74	3381	3060	6193	4607
1989	466	1119	836	515	73	62	208	544	43	31	1734	2332	2894	3484
1990	718	856	905	375	81	45	304	258	152	108	2164	2093	3606	2879
1991	521	940	403	195	30	29	277	403	121	75	1170	1495	2001	2197
1992	693	966	1180	561	122	57	420	320	238	141	2098	2310	4058	3389
1993	735	505	644	221	80	16	231	104	85	42	1493	1167	2533	1550
1994	822	917	1212	508	147	51	455	231	269	106	1935	2166	4018	3062
1995	337	829	307	304	32	71	119	202	32	32	762	1354	1252	1963
1996	721	922	798	311	49	84	268	311	49	42	1689	2153	2853	2901
1997	450	719	878	236	73	56	295	170	130	37	1365	1313	2741	1812
1998	697	460	697	197	83	27	471	104	351	33	1371	812	2973	1173
1999	731	606	484	128	68	40	196	196	206	61	1377	810	2331	1235
Mean / Moyenne 1994-1998														
	605	769	778	311	77	58	322	204	166	50	1424	1560	2767	2182
Change 1999 from mean / Différence relative 1999 par rapport à la moyenne														
	21%	-21%	-38%	-59%	-11%	-31%	-39%	-4%	24%	22%	-3%	-48%	-16%	-43%
from 98	5%	32%	-31%	-35%	-18%	48%	-58%	88%	-41%	85%	0%	0%	-22%	5%

Table 5. Tributary-specific removals (number of fish) from the recreational fisheries of the Restigouche River, 1970 to 1999.

Année / Year	Matapédia		Upsalquitch		Patapédia		Kedgwick		Little Main		Main Restigouche		Restigouche (NB)	
	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large
1970	162	290	270	122	4	24	323	205			747	1401	1344	1752
1971	153	217	344	90	20	40	128	67			527	602	1019	799
1972	102	1010	362	984	7	144	165	425			453	2478	987	4031
1973	147	1098	498	512	0	43	128	548			797	2691	1423	3794
1974	124	1083	433	579	5	63	80	289			525	3934	1043	4865
1975	131	692	462	262	18	31	136	316			532	1600	1148	2209
1976	296	922	767	753	80	88	209	348			1370	3399	2426	4588
1977	278	1312	554	901	181	227	368	684			1411	3583	2514	5395
1978	251	1457	449	507	31	158	143	423			730	2480	1353	3568
1979	466	754	507	135	90	60	316	123			1167	751	2080	1069
1980	311	1784	1178	592	95	229	284	468			1374	3084	2931	4373
1981	485	1176	1234	221	148	175	356	473			1422	2195	3160	3064
1982	259	841	818	214	143	112	322	190	59	50	1250	1175	2592	1741
1983	154	456	203	218	27	103	68	224	14	0	430	1067	742	1612
1984	285	560	483	17	44	35	149	18	102	2	725	56	1503	128
1985	291	807	1175	41	104	35	330	27	163	4	1539	222	3311	329
1986	389	1289	1397	31	163	93	566	67	481	8	2421	170	5028	369
1987	602	915	819	20	193	42	583	35	407	7	2506	111	4508	215
1988	680	1068	1296	26	185	33	807	58	524	3	3381	123	6193	243
1989	466	1119	836	36	73	30	208	53	43	2	1734	163	2894	284
1990	718	856	905	23	81	24	304	29	152	6	2164	126	3606	208
1991	521	940	403	12	30	14	277	27	121	4	1170	90	2001	147
1992	693	966	1180	34	122	23	420	35	238	8	2098	139	4058	239
1993	735	505	644	13	80	8	231	8	85	2	1493	70	2533	101
1994	822	917	1212	31	147	22	455	38	269	6	1935	130	4018	227
1995	337	829	307	18	32	39	119	12	32	2	762	82	1252	153
1996	721	922	793	19	49	54	253	44	49	2	1530	129	2674	248
1997	450	691	843	14	73	36	269	15	116	2	1205	79	2506	146
1998	653	442	549	12	83	17	370	6	350	2	952	49	2304	86
1999	708	588	438	8	68	20	156	17	203	4	980	49	1845	98
Mean / Moyenne 1994-1998	597	760	741	19	77	34	293	23	163	3	1277	94	2551	172
Change 1999 from / Différence relative 1999 par rapport à Mean / average	19%	-23%	-41%	-57%	-11%	-40%	-47%	-26%	24%	43%	-23%	-48%	-28%	-43%

Prior to 1982, Little Main catches included in Main Restigouche.
Avant 1982, les captures de Little Main étaient incluses dans Main Restigouche.

Removals of large salmon (1984 to 1999) and small salmon (1996 to 1999) include catch-and-release mortalities in New Brunswick.
Prélèvements de grand saumon (1984 à 1999) et petit saumon (1996 à 1999) incluent les mortalités dues aux remises à l'eau au Nouveau-Brunswick

Removals of large salmon (1997 to 1999) and small salmon (1998 and 1999) include catch-and-release mortalities in Québec.
Prélèvements de grand saumon (1997 à 1999) et petit saumon (1998 et 1999) incluent les mortalités dues aux remises à l'eau au Québec

Table 6. Biological characteristics of broodstock collected from the Restigouche River in 1999 compared to the collections of 1998.

Broodstock removals from the Restigouche River in 1999			
	Female	Male	Total
Junction Pool (01-09-1999)			
Retained	5	8	13
Fork length (cm)			
Mean	81	70	74
(Min. - Max.)	(78 - 84)	(64 - 88)	(64 - 88)
Kedgwick Forks (8-09-1999)			
Retained	40	39	79
Fork length			
Mean	87	87	87
(Min. - Max.)	(76 - 112)	(76 - 102)	(76 - 102)
Northwest Upsalquitch			
Retained	2	3	5
Fork length			
Mean	98	79	87
(Min. - Max.)	(95 - 100)	(62 - 98)	(62 - 100)

Broodstock removals from the Restigouche River in 1998			
	Female	Male	Total
Junction Pool (02-09-1998)			
Retained	24	23	47
Fork length (cm)			
Mean	100	93	97
(Min. - Max.)	(76 - 116)	(80 - 107)	(76 - 107)
Kedgwick Forks (09-09-1998)			
Retained	42	37	79
Fork length (cm)			
Mean	98	92	95
(Min. - Max.)	(79 – 111)	(80 - 107)	(79 - 111)

Table 7. Tributary specific removals (number of fish) resulting from all activities (First Nations harvests, removals (including catch-and-release mortalities) in recreational fisheries, broodstock removals) from the Restigouche River, 1970 to 1999.

Année / Year	Matapédia		Upsalquitch		Patapédia		Kedgwick		Little Main		Main Restigouche		Restigouche (NB)	
	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large	Petit / Small	Grand / Large
1970	162	290	270	122	4	24	323	205			747	1401	1344	1752
1971	153	217	344	90	20	40	128	67			527	602	1019	799
1972	102	1010	362	984	7	144	165	425			453	2478	987	4031
1973	147	1098	498	512	0	43	128	548			797	2691	1423	3794
1974	124	1083	433	579	5	63	80	289			525	3934	1043	4865
1975	131	692	462	262	18	31	136	316			532	1600	1148	2209
1976	296	922	767	753	80	88	209	348			1370	3399	2426	4588
1977	278	1312	554	901	181	227	368	684			1411	3583	2514	5395
1978	251	1457	449	507	31	158	143	423			730	2480	1353	3568
1979	466	754	507	135	90	60	316	123			1167	751	2080	1069
1980	311	1784	1178	592	95	229	284	468			1374	3084	2931	4373
1981	485	1176	1234	221	148	175	356	473			1422	2195	3160	3064
1982	259	841	818	214	143	112	322	190	59	50	1250	1175	2592	1741
1983	154	456	203	218	27	103	68	224	14	0	430	1067	742	1612
1984	285	560	483	17	44	35	149	52	102	2	725	56	1503	162
1985	291	807	1175	41	104	35	330	64	163	4	1539	222	3311	366
1986	389	1289	1397	31	163	93	566	104	481	8	2421	170	5028	406
1987	602	915	819	20	193	42	583	75	407	7	2506	111	4508	255
1988	680	1068	1296	26	185	33	807	76	524	3	3381	123	6193	261
1989	466	1119	836	36	73	30	208	142	43	2	1734	163	2894	373
1990	718	856	905	23	81	24	304	111	152	6	2164	126	3606	290
1991	521	940	403	12	30	14	277	121	121	4	1170	90	2001	241
1992	693	966	1184	56	122	23	420	143	238	8	2098	141	4062	371
1993	735	505	664	47	80	8	231	98	85	51	1493	70	2553	274
1994	822	917	1224	39	147	22	472	148	269	52	1935	130	4047	391
1995	337	829	318	32	32	39	131	168	40	14	762	82	1283	335
1996	721	922	856	40	49	54	257	165	62	51	1530	129	2754	439
1997	450	691	869	31	73	36	269	104	116	33	1205	79	2532	283
1998	653	442	576	49	83	17	370	97	350	37	952	49	2331	249
1999	708	588	475	28	68	20	156	99	203	14	980	49	1882	210

Removals of large salmon (1984 to 1999) and small salmon (1996 to 1999) include catch-and-release mortalities in New Brunswick.
Removals of large salmon (1984 to 1999) and small salmon (1992, 1993, 1995, 1996, and 1999) include broodstock removals in New Brunswick.
Removals of large salmon (1992 to 1999) and small salmon (1994 to 1999) include First Nations removals in New Brunswick.
Removals of large salmon (1997 to 1999) and small salmon (1998 to 1999) include catch-and-release mortalities in Québec.
Removals of small salmon (1998 to 1999) include First Nations catch-and-release mortalities in New Brunswick.

Table 8. Visual counts of small salmon and large salmon in three tributaries of Restigouche (NB) during mid-July and October, 1999.

	July count					October count				
	Small		Large			Small		Large		
	Min	Max	Min	Max	Date	Min	Max	Min	Max	Date
Kedgwick River										
North Branch (PQ)	0	0	0	0	Jul-19	6	6	10	10	Oct. 7
North Branch (NB)	7	7	1	1	Jul-19	15	36	27	53	Oct. 4 & 7
South Branch	.	.	.	.	Jul-19	6	7	15	22	Oct. 4
Forks to Fraser Lodge	137	288	165	262	Jul-19	63	116	108	218	Oct. 5
Fraser to Connor's	90	120	351	373	Jul 19&20	95	119	124	155	Oct. 5
Connor's to Junction	22	48	5	13	Jul-20	85	102	108	166	Oct. 6
(exlcuding main part of Junction)										
Estimate	256	463	522	649		270	386	392	624	

	July count					October count				
	Small		Large			Small		Large		
	Min	Max	Min	Max	Date	Min	Max	Min	Max	Date
Little Main Restigouche										
Upper Gounamitz	.	.	.	.		22	29	41	51	Oct. 6
Lower Gounamitz	.	.	.	.		1	1	0	0	Oct. 7
Upper Little Main to Boston Brook	.	.	.	.		225	264	286	350	Oct. 7 & 8
Boston Brook fence	94	94	22	22	Jul-23	.	.	.	.	
Boston Brook to Jardine	47	59	2	3	Jul-20	36	36	41	46	OCt. 8
Jardine to Junction (excluding)	20	30	2	7	Jul-20	62	62	243	243	Oct. 8
Estimate	161	183	26	32		346	392	611	690	
Junction Pool (Main Restigouche portion)	3	66	0	5		0	0	10	12	Oct. 6

	July count					October count				
	Small		Large			Small		Large		
	Min	Max	Min	Max	Date	Min	Max	Min	Max	Date
Upsalquitch										
Southeast (Ramsays to SE Falls)	67	108	1	14	Jul-20	130	161	132	152	Oct. 9
Little Southeast	.	.	.	.		0	0	0	0	Oct. 10
SE Falls to Forks	18	19	0	0	Jul-21	32	37	16	27	Oct. 10
Northwest Upsalquitch										
10-mile fence count	301	301	288	288	Jul-15	858	858	643	643	Oct. 8
10-mile to Forks	153	187	15	25	Jul-21	147	184	117	144	Oct. 9
Upsalquitch										
Forks to Two Brooks (including Forks)	791	892	286	461	Jul-21	132	163	96	146	Oct. 10
Two Brooks to Bridge	76	113	18	41	Jul-22	14	21	29	31	Oct. 11
Bridge to mouth	28	30	3	4	Jul-22	25	26	40	45	Oct. 11
Estimate	1434	1650	611	833		1338	1450	1073	1188	

Table 9. (a) Pre-spawning salmon counts, primarily by divers, of the Restigouche River system, 1994 to 1999.

	Matapédia		Upsalquitch		Patapédia		Kedgwick		Little Main		Main Restigouche		Restigouche System	
Year	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1994	383	1389	1795	1282	282	670	847	660	685	526	458	1157	4450	5684
1995	669	2461	1497	2002	232	825	447	796	372	523	213	963	3430	7570
1996	1291	2807	-	-	338	777	391	812	158	668	-	-	-	-
1997	751	1993	1217	722	150	448	215	492	317	846	-	-	-	-
1998	823	1643	-	-	218	454	-	-	-	-	-	-	-	-
1999	946	2215	1500	1200	246	529	400	650	400	700	-	-	-	-

(b) Salmon spawner counts, primarily by canoeists, of the Restigouche River system, 1985 to 1999.

	Matapédia		Upsalquitch		Patapédia		Kedgwick		Little Main		Main Restigouche		Restigouche System	
Year	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
1985	321	892	925	1174	61	548	108	968	525	1859	343	2342	2283	7783
1986	336	1114	2632	2451	311	728	281	976	1241	2541	413	1708	5214	9518
1987	622	946	1948	2179	80	953	582	1729	610	1418	357	949	4199	8174
1988	791	1243	1761	2140	317	1117	602	1546	536	2128	238	962	4245	9136
1989	764	1834	1387	2223	178	1012	289	1640	923	2442	803	2837	4344	11988
1990[a]	1080	1289	-	-	214	783	-	-	-	-	-	-	-	-
1991	640	1152	2247	1575	162	586	423	1204	332	862	453	1713	4257	7092
1992	711	1023	1986	1434	141	502	161	515	200	665	73	565	3272	4704
1993	628	1010	1183	570	98	442	127	370	175	500	141	620	2352	3512
1994	-	-	1909	1534			518	1111	611	1192	686	988	-	-
1995	-	-	1263	1578			83	1244	96	1319	294	877	-	-
1996	-	-	724	1469			478	1069	398	1265	262	562	-	-
1997	-	-	542	937					340	1183	282	711	-	-
1998	-	-	1122	1013			758	601	674	675	604	456	-	-
1999	-	-	-	-	-	-	-	-	-	-	481	752	-	-

[a] - Count incomplete (1990). High water prevented field spawner count in New Brunswick

Table 10. Abundance (CPUE) of salmon juveniles in the Restigouche River in 1997 and 1999.

Median catch per effort in 1997 to 1999
Médianes des captures par effort en 1997 à 1999

	Catch per minute / captures par minute								
	Fry / Alevins			Parr / Tacon			Sites (N)		
	1997	1998	1999	1997	1998	1999	1997	1998	1999
Kedgwick	2.00	1.74	1.87	0.90	0.64	1.04	8	9	12
Little Main	3.00	1.39	2.95	0.22	0.44	0.60	7	10	10
Main Restigouche	1.13	1.90	2.63	0.96	0.54	1.40	3	8	13
Upsalquitch	1.92	3.64	2.88	1.03	1.53	1.53	10	11	17
Matapedia		3.61	3.40		1.73	3.30		33	32
Humqui		0.63	0.20		0.43	0.10		6	6
Assemetquagan			1.10			2.40			6
Patapedia		3.19	3.80		1.35	1.90		25	6
Restigouche (NB)	2.03	2.04	2.63	0.93	0.67	1.10	28	38	52

Table 11. Distributions of Atlantic salmon to the Restigouche River system (by system of broodstock origin) by the Charlo Salmonid Enhancement Centre in 1999. Fish were not adipose-clipped or otherwise marked unless noted under Destination.

River	Number	Stage	Destination
Kedgwick	150,000	Eyed eggs	MSRT[1] incubation boxes
	22,000	Feeding fry	MSRT[1] satellite site
	92,367	0+ parr	Kedgwick River
Little Main	50,000	Eyed eggs	MSRT[1] incubation boxes
	22,000	Feeding fry	MSRT[1] satellite site
	5,500	Feeding fry	Larrys Gulch Lodge satellite site (Main Restigouche River)
	9,900	Feeding fry	Camp Harmony Lodge satellite site (Main Restigouche River)
	33,000	Feeding fry	Runnymede Lodge satellite site (Main Restigouche River)
	25,000	Feeding fry	Boston Brook Lodge satellite site (Little Main Restigouche River)
	90,103	O+ parr	Little Main Restigouche River

[1] MSRT = Management of Salmon in the Restigouche and Tributaries

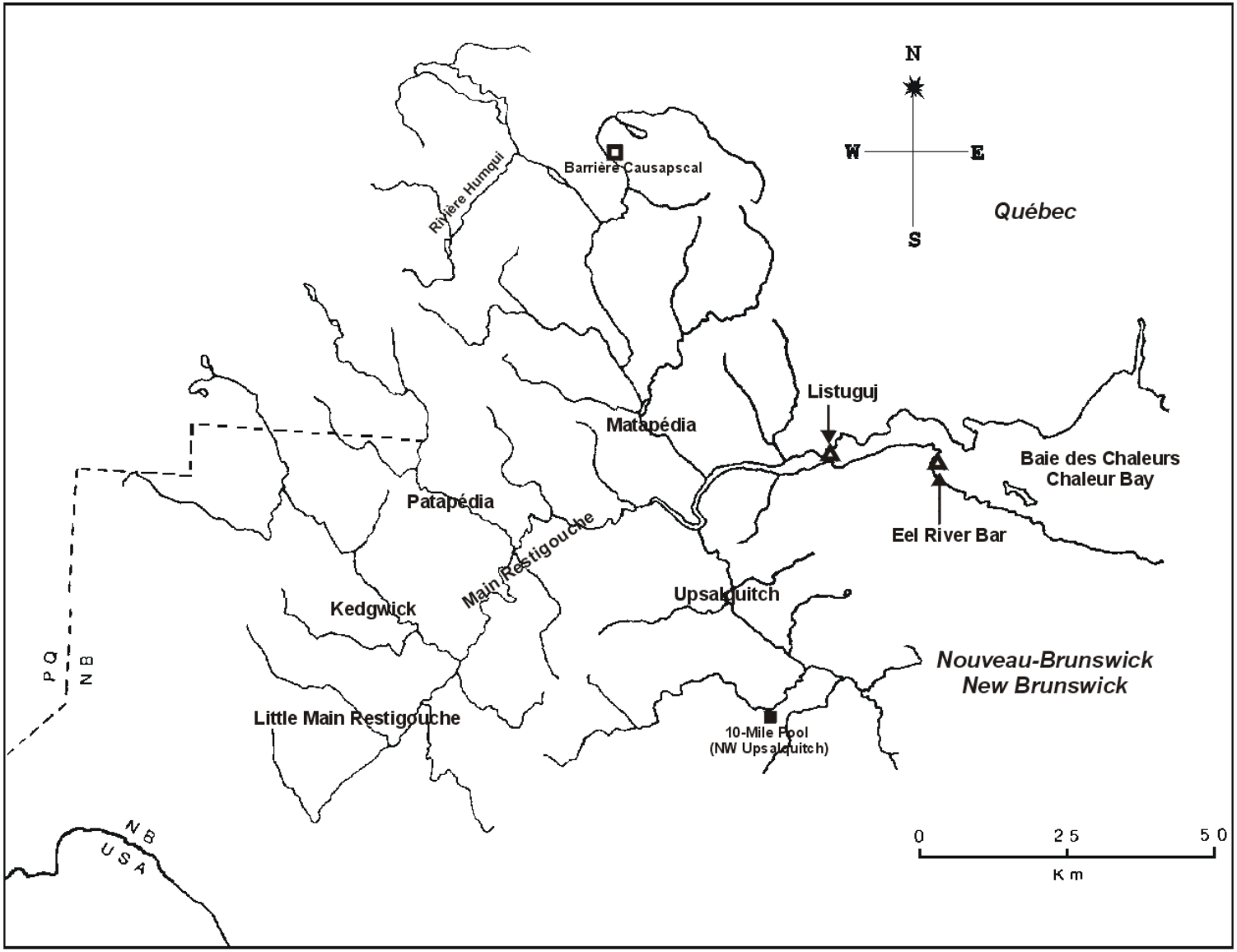

Figure 1. Restigouche River system showing tributaries, location of aboriginal estuary fisheries and protection barriers.

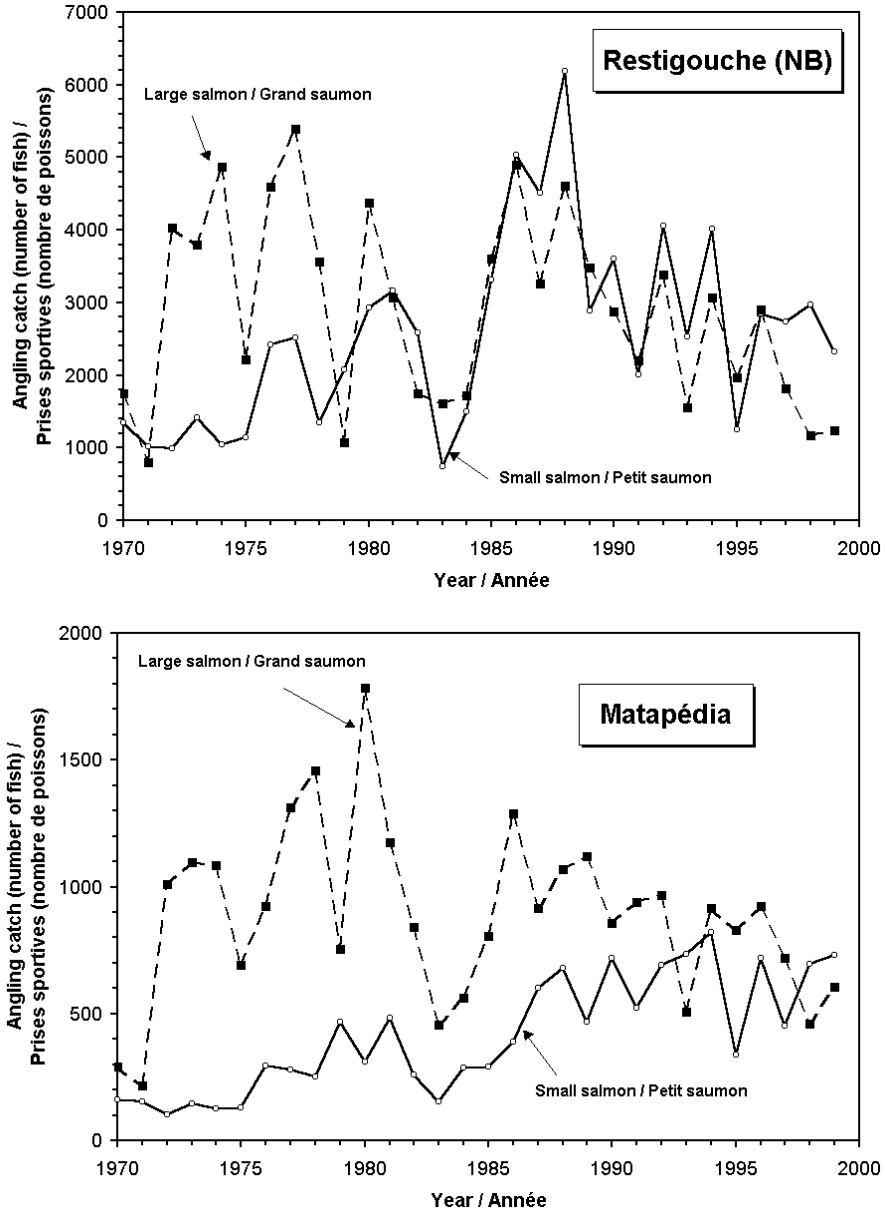

Figure 2. Annual angling catches (number of fish) of small salmon and large salmon from the Restigouche (NB) waters (upper panel) and the Matapédia River (lower panel), 1970 to 1999.

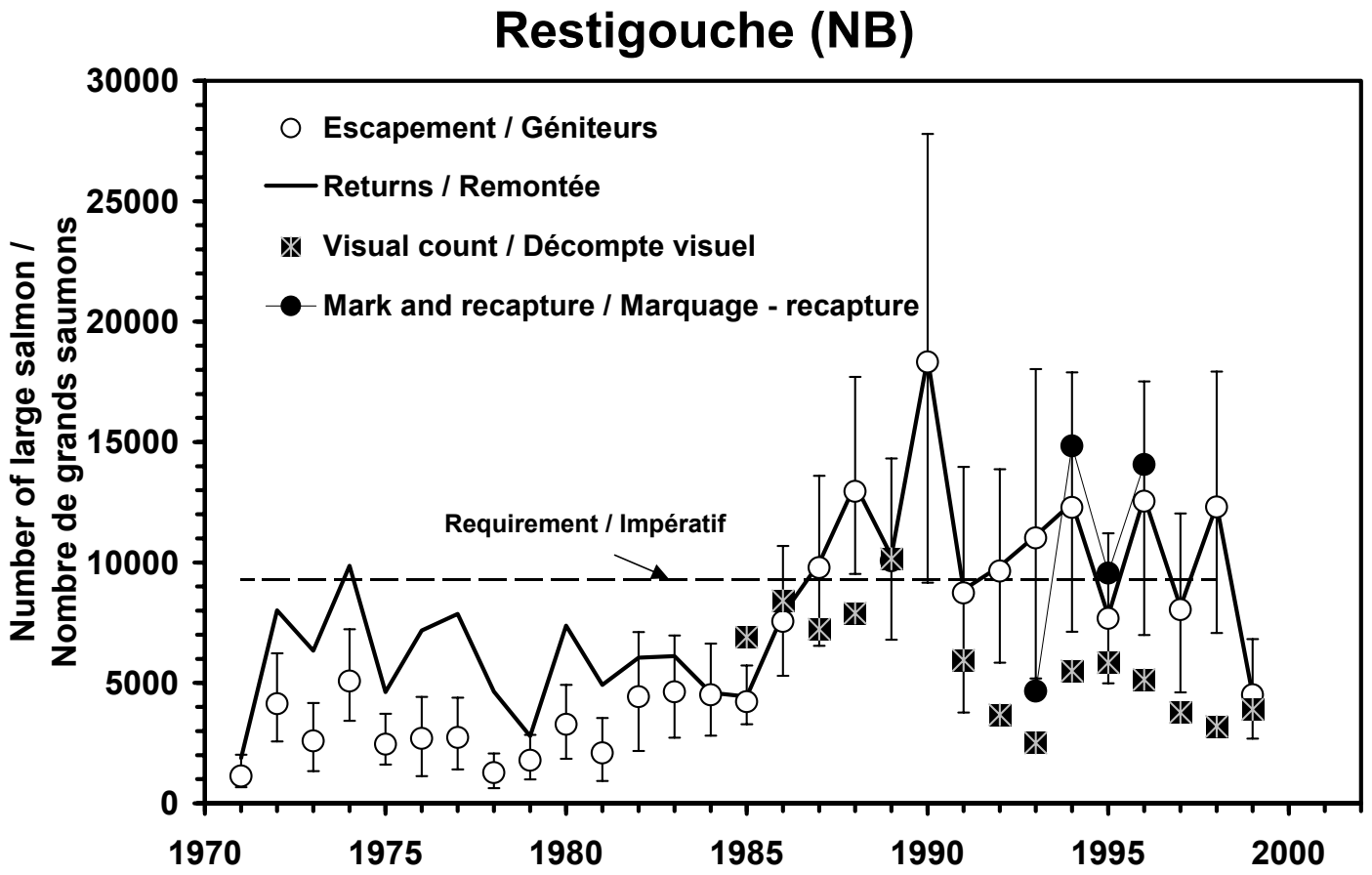

Figure 3. Predicted large salmon spawners in the Restigouche (NB) waters. Open circles joined by thick line are the medians of the simulation and vertical bars define the 5th to 95th percentile range. Returns are spawning escapement plus angling removals. Estimates for 1994 to 1999 are adjusted for the retrospective pattern. Solid square symbols are canoe estimates of spawners. Solid bullets joined by thin line are the mark and recapture estimates of large salmon spawners for Restigouche (NB) (Locke et al. 1997).

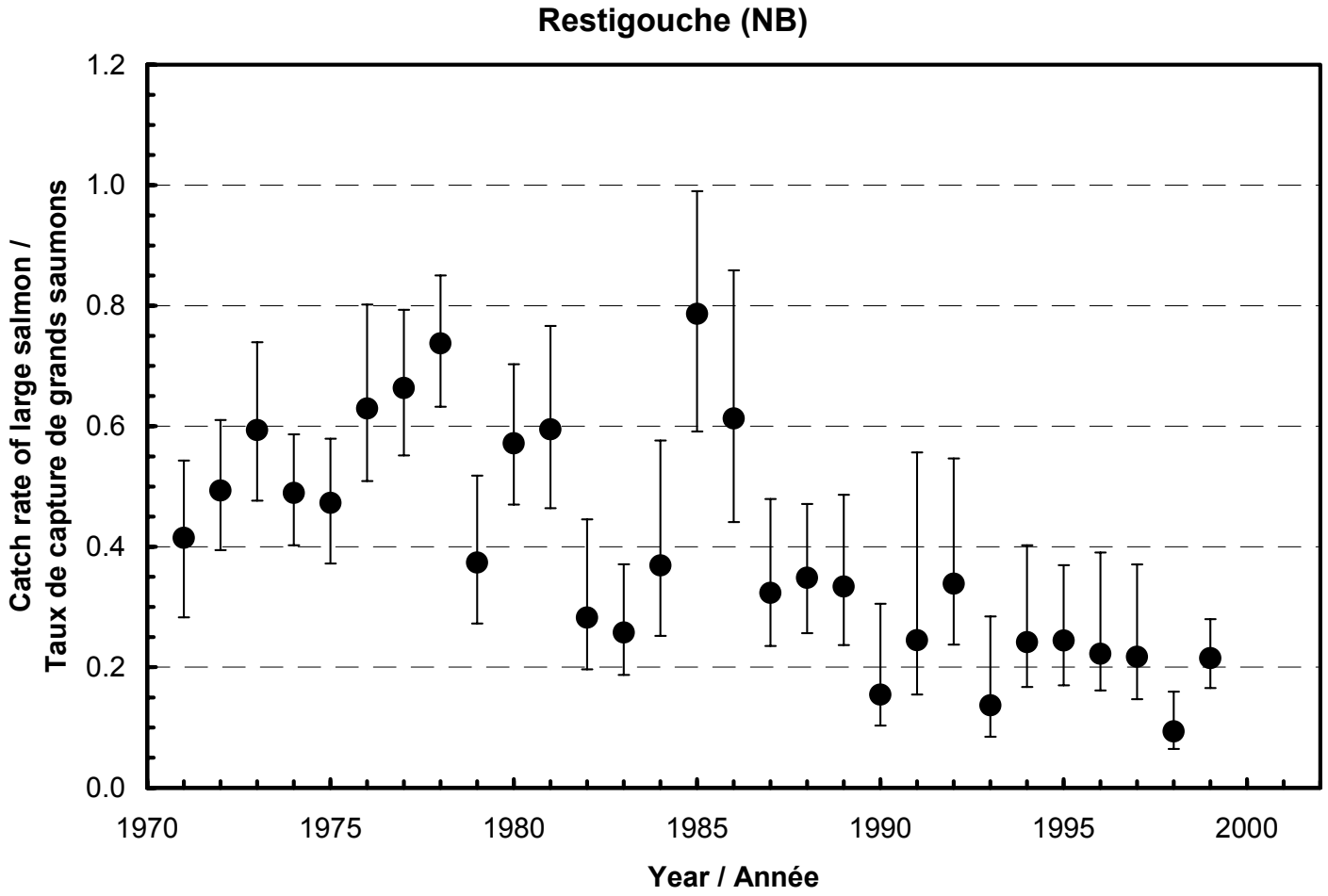

Figure 4. Estimated catch rates of large salmon from the recreational fishery of Restigouche (NB).

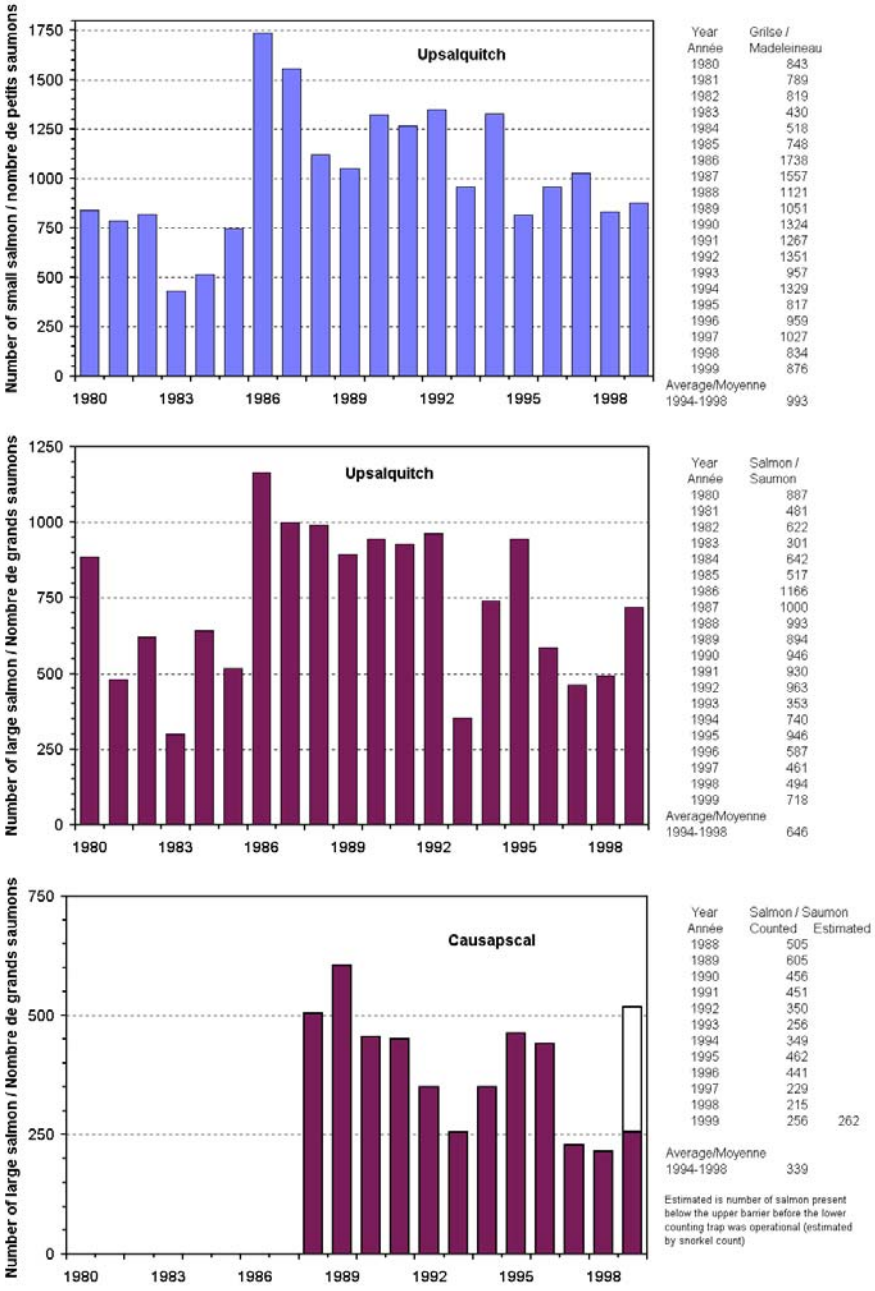

Figure 5. Counts of small salmon and large salmon at the protection barriers in the Northwest Upsalquitch River (upper and middle panels) and the Causapscal River of the Matapédia (lower panel). For Causapscal, the white bar for 1999 represents the estimated number of salmon in the containment pool (as estimated by snorkel count) before the lower counting fence became operational on June 14. The upper barrier was in place June 2.

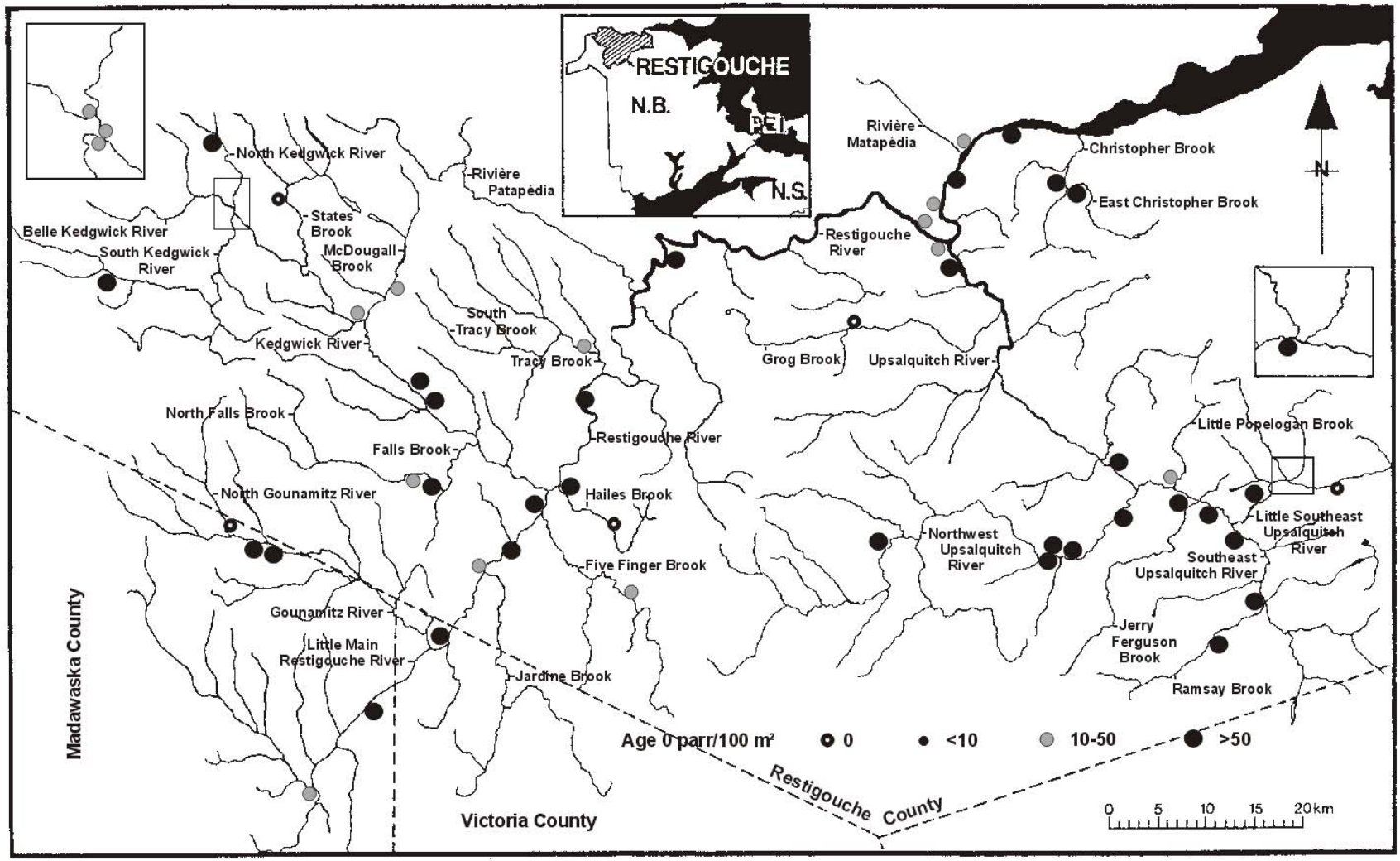

Figure 6a. Densities of fry (age 0 parr) sampled from the Restigouche (NB) waters in 1999.

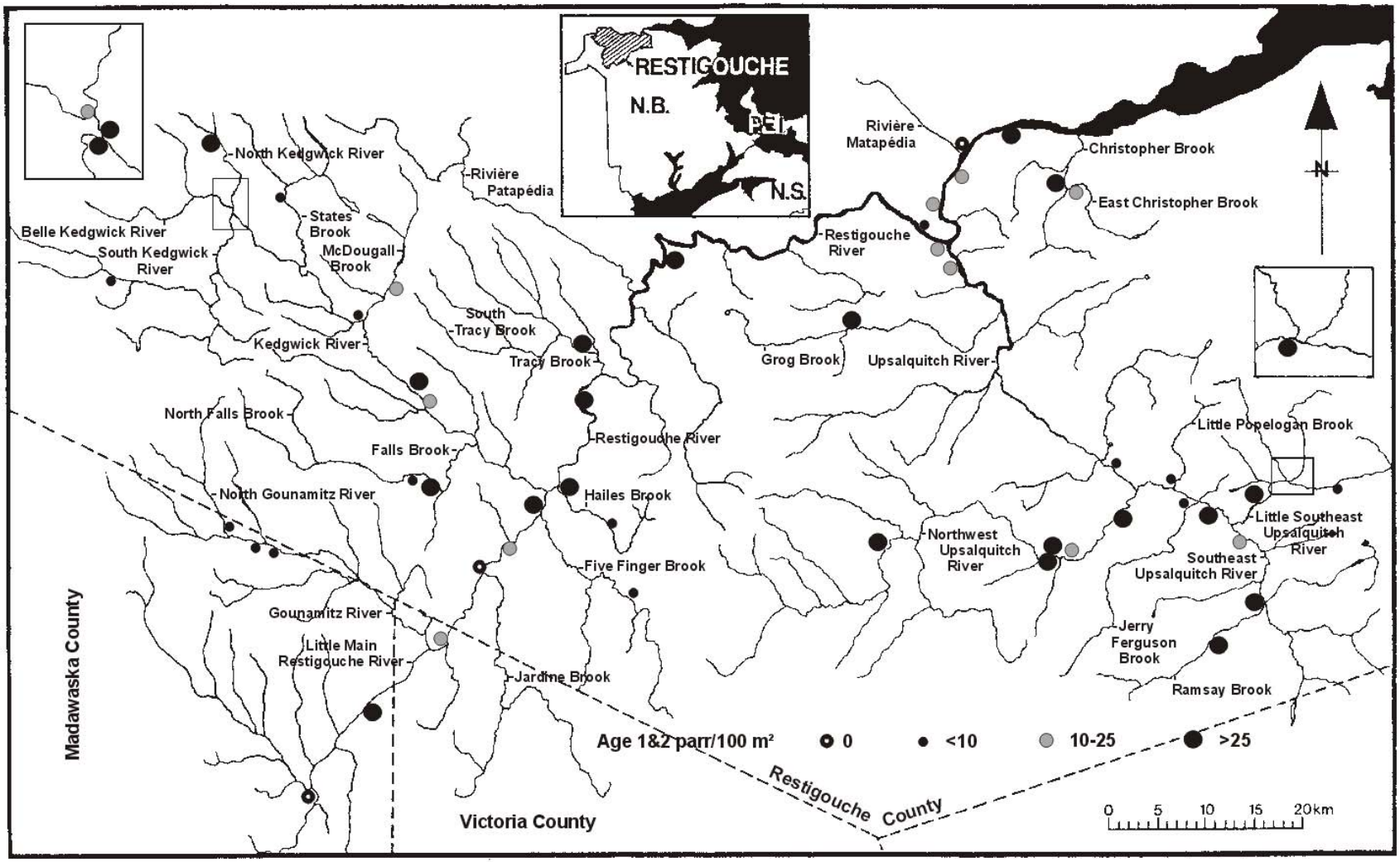

Figure 6b. Densities of parr (age 1 and older parr) sampled from the Restigouche (NB) waters in 1999.

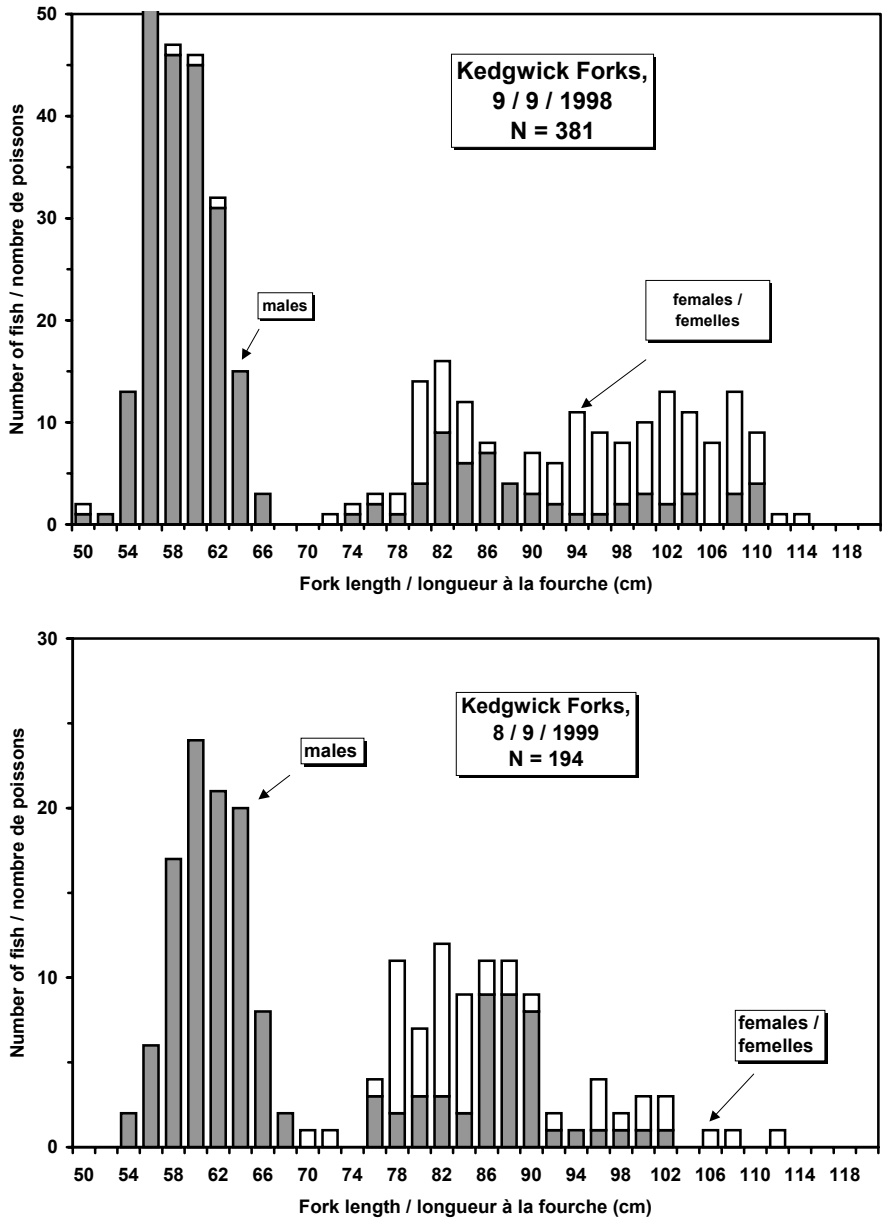

Figure 7. Comparative biological characteristics of Atlantic salmon sampled from Kedgwick River, September 1998 (upper) and 1999 (lower).

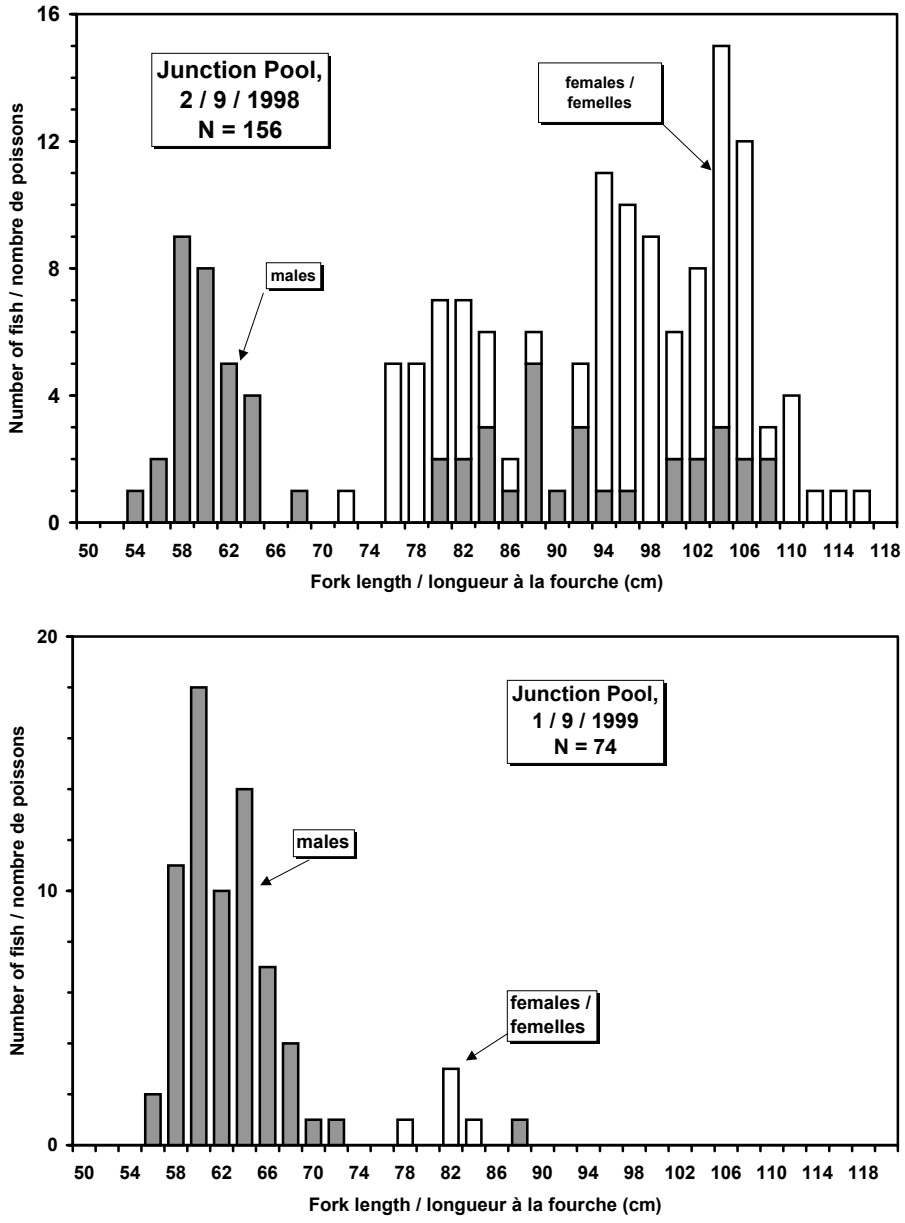

Figure 8. Biological characteristics of Atlantic salmon sampled from Junction Pool, confluence of the Kedgwick River and Little Main Restigouche, September 1998 (upper) and 1999 (lower).

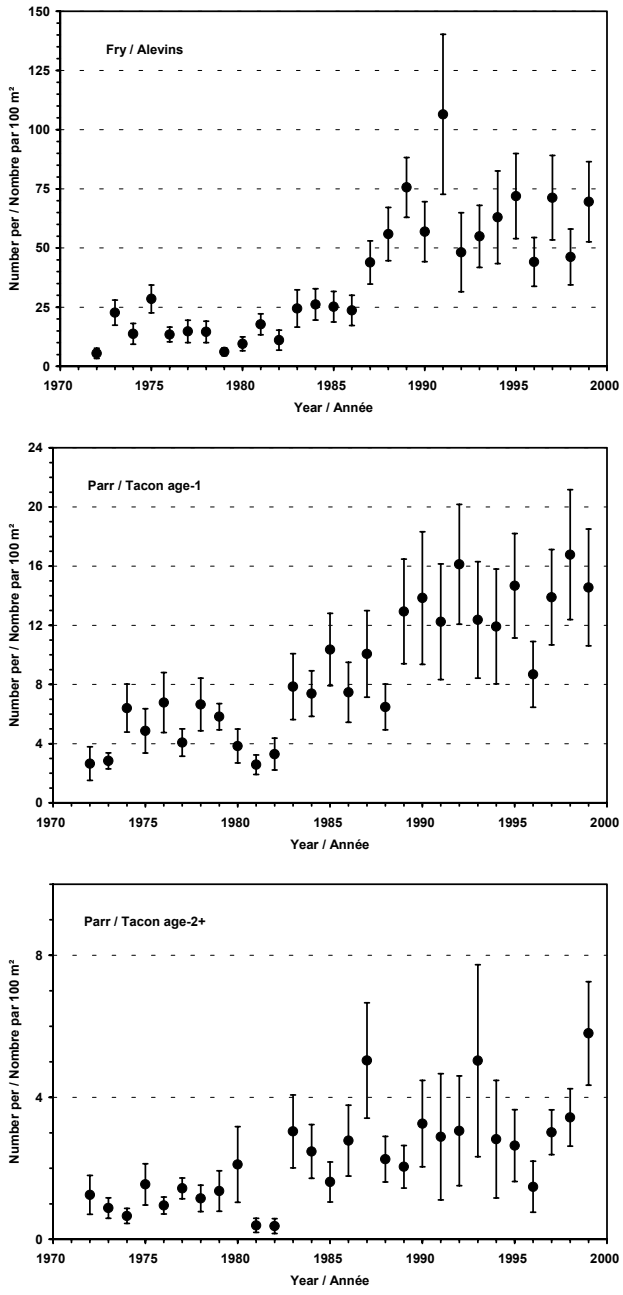

Figure 9. Mean densities (+/- one standard error bars) of fry (upper), age-1 parr (middle) and age-2 and older parr (lower) at index sites in the Restigouche River, 1972 to 1999. A total of 15 sites were sampled in 1972-1990, 1993 and 1996-1999. Fewer sites were sampled in other years: 8 sites in 1991, 10 sites in 1992, 11 istes in 1994 and 13 sites in 1995.

Appendix 1. Results of the calibration of catch per unit of effort (CPUE) to density (fish per 100 m²) for fry (upper panel) and parr (lower panel) in 1999. For parr, CPUE and density data are plotted separately for age-1 and age-2 and older parr but fitted to a common relationship.