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Research Document 2006/023 | **Document de recherche 2006/023**

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Stock Status of Atlantic Salmon (*Salmo salar* L.) from rivers of the Gulf Region, SFA 15 to 18

État des stocks de saumon atlantique (*Salmo salar* L.) des rivières de la Région du Golfe, ZPS 15 à 18

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ISSN 1499-3848 (Printed / Imprimé)

Canada

Foreword

This document is a product from a workshop that was not conducted under the Department of Fisheries and Oceans (DFO) Science Advisory Process coordinated by the Canadian Science Advisory Secretariat (CSAS). However, it is being documented in the CSAS Research Document series as it presents some key scientific information related to the advisory process. It is one of a number of contributions first tabled at a DFO-SARCEP (Species at Risk Committee / Comité sur les espèces en péril) sponsored workshop in Moncton (February 2006) to begin the development of a 'Conservation Status Report' (CSR) for Atlantic salmon. When completed in 2007, the CSR could form the basis for a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report, recovery potential assessment and recovery strategy, and most importantly, enable DFO to implement pre-emptive management measures prior to engagement in any listing process.

Avant-propos

Le présent document est issu d'un atelier qui ne faisait pas partie du processus consultatif scientifique du ministère des Pêches et des Océans, coordonné par le Secrétariat canadien de consultation scientifique (SCCS). Cependant, il est intégré à la collection de documents de recherche du SCCS car il présente certains renseignements scientifiques clés, liés au processus consultatif. Il fait partie des nombreuses contributions présentées au départ lors d'un atelier parrainé par le MPO-SARCEP (Species at Risk Committee / Comité sur les espèces en péril) à Moncton (février 2006) en vue de commencer l'élaboration d'un rapport sur la situation de la conservation du saumon atlantique. Lorsqu'il sera terminé, en 2007, ce rapport pourrait servir de base à un rapport de situation du Comité sur la situation des espèces en péril au Canada (COSEPAC), à une évaluation du potentiel de rétablissement et à un programme de rétablissement mais, avant tout, il permettra au MPO de mettre en œuvre des mesures de gestion anticipées avant même de s'engager dans un processus d'inscription.

Abstract

The document summarizes the stock status of Atlantic salmon (*Salmo salar*) for Gulf Region rivers. Status is assessed based on measures of adult salmon, juvenile and smolt abundance. Most (64%) of the 75 rivers in this region are of relatively small size with conservation requirements of less than one million eggs for Atlantic salmon. Adult salmon abundance in the Gulf Region rivers was most important in the late 1980s and early 1990s. Salmon abundance has declined from those highs in all rivers and are generally showing a modest annual increase from the low returns of 1998 and 1999. With a few exceptions, the returns of salmon are almost at or above the river-specific conservation requirements. Juvenile abundance remains at record high levels in most of the monitored rivers and smolt production is at a moderate but lower than expected level based on juvenile salmon indices. Losses to fisheries are not considered to be a major factor limiting adult abundance. Environmental conditions, particularly warmer fresh water temperatures, are potentially negatively impacting both juvenile and adult salmon. Density dependent factors in fresh water are a possible mechanism resulting in lower than expected smolt production from at least one monitored river and acting in concert with reduced marine survival as noted in other stocks from eastern Canada may be constraining adult abundance in these rivers.

Résumé

Ce document résume l'état des stocks de saumon atlantique (*Salmo salar*) provenant des rivières de la Région du Golfe. L'état est évalué en se basant sur des mesures d'abondances de saumons adultes, juvéniles et saumonneaux. La majorité (64%) des 75 rivières de la région sont de petites tailles avec des besoins de conservation inférieurs à un million d'œufs. L'abondance de saumon adulte était plus importante durant la fin des années 80 et début des années 90. L'abondance des adultes a diminué de ces hauts précédents dans toutes les rivières mais avec une augmentation modeste suivant les faibles retours des années 1998 et 1999. A l'exception de quelques rivières, les retours de saumons adultes sont presque ou supérieurs aux besoins de conservation des rivières. Les abondances des juvéniles demeurent à des niveaux élevés et records dans presque toutes les rivières. La production de saumonneaux est à un niveau modeste mais inférieur au niveau correspondant à l'abondance des juvéniles. Les pertes associées aux pêches ne représentent pas un facteur limitant l'abondance du saumon. Les conditions environnementales, particulièrement les températures estivales élevées en eau douce, ont potentiellement un impact négatif sur les juvéniles et les adultes. Dans une rivière, on soupçonne des effets reliés à la densité dépendance en eau douce pour expliquer le niveau modeste de production de saumonneaux. Cette contrainte en eau douce, agissant en concert avec une survie en mer faible telle qu'observée dans d'autres stocks de l'est du Canada, pourrait contribuer à l'abondance diminuée des saumons adultes dans ces rivières.

INTRODUCTION

The Department of Fisheries and Oceans (DFO) Gulf Region encompasses four salmon fishing areas (SFA 15 to 18) in three provinces (New Brunswick, Nova Scotia, and Prince Edward Island) (Fig. 1). All the rivers which flow into the southern Gulf of St. Lawrence are part of this management region. The information required to assess the status of Atlantic salmon (*Salmo salar* L.) in the Gulf Region has been collected annually but the last stock status report was produced for the year 2000 (DFO 2001). Summaries of stock status have been prepared for the ICES North Atlantic Salmon Working Group and incorporated in the advisory document for NASCO (North Atlantic Salmon Conservation Organization).

This document summarizes the stock status of Atlantic salmon for Gulf Region rivers up to and including 2005. Measures of adult salmon, juvenile and smolt abundances are presented. Some factors which may be limiting salmon abundance are discussed.

FISHERIES MANAGEMENT

In this document, reference is made to small salmon which are fish with fork length less than 63 cm. Fish referred to as large salmon are of fork length greater than or equal to 63 cm. When ages are determined, fish are referred to as 1SW salmon if they are maiden fish which have spent one year at sea whereas 2SW salmon refers to maiden fish which have spent two years at sea. Repeat spawners are fish which are on a second or greater spawning migration.

All commercial fisheries for Atlantic salmon in Gulf Region have been closed since 1984.

Since 1984, Atlantic salmon have only been harvested by two user groups: Aboriginal peoples and recreational fishers. Aboriginal peoples were given first access to salmon (after conservation requirements) based on communal needs for food, social and ceremonial purposes. Aboriginal fisheries in recent years occurred in the southern Gulf of St. Lawrence rivers which were open to salmon fisheries and generally in accordance with agreements. Since 1998, all salmon fisheries have been prohibited in the southeast portion of SFA 16 in New Brunswick (Fig. 1).

All recreational fisheries for large salmon are mandatory catch and release since 1984. Retention fisheries for small salmon are regulated by daily and season bag limits. The maximum daily retention limit is two small salmon and the daily catch-and-release limit is four fish of any size. The exception being in the Miramichi River (SFA 16) where the daily small salmon retention limit has been one fish since 1998. Season retention limits are eight small salmon in New Brunswick and Nova Scotia and seven small salmon in PEI. All retained small salmon must be tagged with carcass tags specific to the license. Angling seasons varied but extended from April 15 in Miramichi River to Oct. 31 in the SFA 18 rivers of Nova Scotia. Jones et al. (2006) provide a historical summary of fisheries management in the Maritime provinces.

Mortality rates associated with catch and release angling were assumed to be 5% for the Restigouche River (and SFA 15), 3% for the Miramichi River (and SFA 16), 3% for SFA 17, and 5% for SFA 18.

DATA SOURCES

Harvest data are reported by individual First Nations communities but these are generally considered incomplete. Recreational catch as well as retained data are obtained from license stubs returns in Nova Scotia and Prince Edward Island. There is no province wide reporting system for New Brunswick; the last mail out survey to estimate catches and harvests was completed in 1997. Catch and effort data are available from the Crown Reserve waters of the Miramichi and Restigouche rivers. Restigouche River angling catches are compiled by DFO and are almost complete based on creel forms from private angling camps and returns from crown reserve waters; there are limited public angling waters in the Restigouche.

Juvenile surveys, smolt production estimates and limited adult monitoring programs occur in several rivers of the Gulf Region. The data are collected by various organizations including DFO, provincial governments, watershed groups, and First Nations. The number of rivers monitored has declined over the last decade. The assessment program in the past five years has focused on monitoring the Atlantic salmon abundance in the three main rivers of Gulf Region; Restigouche (SFA 15), Miramichi (SFA 16), and Margaree (SFA 18). Juvenile and smolt monitoring programs are conducted in all three rivers. Adult monitoring programs are conducted on the Restigouche and Miramichi rivers.

Angling catches are the primary indicator of adult abundance in the Restigouche (combined with fall spawner counts), Margaree and mainland NS rivers. Monitoring at index trapnets combined with mark and recapture experiments are the assessment tools for the Miramichi River.

Juvenile surveys in selected rivers within the region are used as an index of status.

CONSERVATION REQUIREMENTS

Conservation requirements for Atlantic salmon are based on an egg deposition rate of 240 eggs per 100 m² of fluvial habitat. Most (64%) of the 75 rivers considered to have Atlantic salmon stocks are of relatively small size with conservation requirements of less than one million eggs (Table 1; Appendix 1). The highest proportion of very small rivers, with conservation requirements of less than half a million eggs, are in PEI (SFA 17) and Gulf Nova Scotia (SFA 18). SFA 16 has the highest proportion (4 of 25 rivers) of large rivers with conservation requirements greater than 10 million eggs. The large rivers in the Gulf have conservation egg requirements ranging from 14 to 70.9 million eggs (Appendix 1).

The most common evidence for the presence of Atlantic salmon in rivers comes from angling catch reports followed by juvenile monitoring programs (Appendix 1).

ADULT RETURNS AND STATUS RELATIVE TO CONSERVATION

SFA 15

The Restigouche River is the largest river within this area. The Matapedia River, a major tributary in the lower portion of the Restigouche, is assessed separately by the province of Québec. Habitat area for juvenile production has recently been updated through interpretation of aerial photos. As well, the province of Québec has evaluated the habitat value of the main stem of the Restigouche River using the habitat characteristics and weighting described by Caron et al. (1999). Habitat area for the Restigouche River (excluding Matapedia) totals 21.62 million m². At an egg deposition rate of 1.68 eggs per m² (deposition rate for the rivers of the province of Québec), conservation requirements are 36.3 million eggs, equivalent to 5,700 large salmon (at an average of 6400 eggs per large salmon) (Table 2).

For the Restigouche River, abundance of large salmon as inferred from the angling catches and counts at headwater facilities was improved in 2005 from 2004 (Fig. 2; Table 3). Small salmon were down from 2004 and the previous five-year mean and have shown large annual variations in abundance. Fall spawner counts could not be conducted in 2005 due to high water conditions. A mid-season count of large salmon in the Matapedia River conducted in 2005 suggested that the end of season counts would be well above the conservation requirements for that river. Consequently, conservation objectives were considered to have been likely met or exceeded annually between 2000 and 2005.

Over the last two decades, assessment programs have also been conducted on the Jacquet River and the Nepisiguit River (Table 2). Counts of salmon at a protection barrier near the head of tide on the Jacquet River have frequently been incomplete due to washouts or late installations. The status of the Nepisiguit River has been uncertain. Estimates of returns and escapements based on fence counts which are generally incomplete indicated that conservation requirements had been achieved in only 2 of 15 years when the stock was assessed (1982 to 1996) (Locke et al. 1997) but estimates based on redd counts in late fall collected by the Nepisiguit Salmon Association indicated that spawning escapement had been around the conservation requirements since 1994 (DFO 2001).

SFA 16

The status of Atlantic salmon in the Miramichi River, by small salmon and large salmon, is assessed from catches at index trapnets with the efficiency calibrated using annual mark and recapture experiments. The last published assessment for this stock is for the year 2000 and similar methods and treatment have been used in all other years (Chaput et al. 2001).

Small salmon and large salmon abundances in the Miramichi River were higher in the late 1980s and early 1990s than in the recent ten years (Table 4; Fig. 3). Abundance of large salmon was lowest in 1998, 1999 and 2002. Small salmon abundance was record high in 1986 to 1993 and was lowest in 1997 to 1999 (Fig. 3). The abundance of 2SW salmon in the returns to the Miramichi River has declined from an average of 24,000 fish between 1971 to 1983, 17,000 fish between 1984 to 1999, to about 12,000 fish in the recent five years. Following the downturn of the late 1990s, abundances have increased modestly during 2000 to 2005 at an average rate of 3% per year for small salmon and 4% per year for large salmon (Fig. 3). Repeat spawning salmon abundance has increased and now averages about 6,000 fish for the recent five years.

The point estimate of the eggs in the returns of both small and large salmon to the Miramichi River in 2005 was 2.1 eggs per m^2, 87% of the conservation egg requirement. The egg deposition rate from the escapement of salmon was estimated to have been about 2.0 eggs per m^2, with large salmon contribution 88% of the estimated eggs. Between 1996 and 2005, the conservation requirement in terms of eggs was estimated to have been met or exceeded in 4 of the last 10 years whereas the conservation requirement had been met or exceeded in 9 of the 12 years between 1984 and 1995 (Fig. 4).

In the smaller rivers of SFA 16 (Table 2), the conservation requirements for the Tabusintac River had been exceeded in the four years assessed between 1994 and 1999 (Douglas and Swasson 2000). In the Buctouche River, the conservation requirements were met or exceeded in 1999, once in eight years assessed (1993 to 2000); the proportion of conservation otherwise varying from 0.33 to 0.72 (Atkinson 2004). The Buctouche River was used as an index river for the group of small rivers in the southeast portion of SFA 16 and based on those assessments, the region has remained closed to all salmon fisheries since 1998. A juvenile survey within the Buctouche and the neighbouring rivers of the region provided support for the low spawning escapements in these rivers (Atkinson 2004).

SFA 17

Salmon are stocked in up to six of PEI's larger rivers by release of smolts that have been raised semi-naturally in open impoundments. Hatchery origin salmon have been and remain most important in the Morell River where they comprised upwards of 90% of the return of small salmon annually (Cairns et al. 1996). The enhancement program on the Morell River dates to the late 1970s and salmon originating from the Miramichi (primarily) and Restigouche River were used as broodstock (Cairns et al. 1996). A small amount of natural production occurs in the Morell and other stocked rivers. Small runs of late-returning salmon persist in a number of unstocked rivers. Egg depositions have little influence on future returns because most returns are of hatchery origin.

Effort and catches in all rivers of PEI were highest in 1995 and 1996 and lowest in 2005 (Table 5).

SFA 18

Salmon Fishing Area 18 includes the rivers from the Northumberland Strait shore of Nova Scotia and western Cape Breton Island. The principal river in this area is the Margaree River in Cape Breton Island. Adults enter the rivers of the Northumberland Strait shore of Nova Scotia in late autumn, typically after September 15 whereas salmon return to the Margaree River from early June onward. Angling catches from the entire SFA and from the Margaree River are used to infer stock status. Angling catches and assumed exploitation rates have been used to assess the returns to the Margaree River since 1997. The catch rate for large salmon during 1991 to 1996 was as high as 0.57 but could have been as low as 0.26 (Marshall et al. 2000).

Large salmon catches are greater than small salmon catches in this SFA and in the Margaree River (Fig. 5). Returns of large salmon to the Margaree were estimated to have been above the conservation objective of 1,036 large salmon, every year since 1985 (Fig. 6). Conservation is not considered to be a concern in the mainland portion of SFA 18. Stock status of three other rivers on the mainland of Nova Scotia in SFA 18 has been inferred from angling catches and assumed exploitation rates. As angling success is contingent on suitable water conditions (i.e. discharge), angling catches in some years are assumed to severely underestimate the returns of salmon to those rivers (DFO 2001).

HATCHERY INTERVENTIONS

Prior to 1998, DFO enhancement programs for Atlantic salmon were conducted in a large number of rivers in the Gulf Region with stocking of fish primarily at the early juvenile stages. Since 1998, DFO divested the four fish hatcheries in the Gulf Region to non-profit groups and enhancement activities continue, financed by the watershed organizations, although at a reduced spatial scale and production level.

Hatchery origin salmon comprise small proportions (generally <1%) of the total returns to the Restigouche and Miramichi rivers. In the Margaree River, the proportions of returns have been on average less than 10% for small salmon and large salmon annually. Hatchery-origin salmon have represented important proportions of the returns to the Nepisiguit River (SFA

15), as high as 75% of both small and large salmon (Locke 1998) but the hatchery contribution to this river is much reduced in recent years.

Salmon have been stocked in up to six of PEI's larger rivers by release of smolts that have been raised semi-naturally in open impoundments. Hatchery origin salmon have been and remain most important in the Morell River (SFA 17) representing upwards of 90% of the return of small salmon annually (Cairns et al. 1996).

Stocking programs for juveniles, financed by watershed groups and First Nations communities, have recently been initiated in two rivers (Kouchibouguacis, Richibucto) of the southeast region of New Brunswick (SFA 16) where salmon fisheries are prohibited.

INDICATORS OF FRESHWATER PRODUCTION

There are extensive temporal data sets of juvenile abundance from the three principal rivers of the Gulf Region. The survey protocols for the Miramichi, which are similar to those used throughout the Gulf Region, are presented in Chaput et al. (2005). The juvenile data set from the Miramichi River has been analysed in the context of environmental determinants of size at age and climate change by Swansburg et al. (2002, 2004). The Margaree River data have been summarized by Chaput and Claytor (1989) and LeBlanc and Chaput (2003).

In the three principal rivers of the Gulf Region, mean juvenile densities increased collectively as a result of increased escapement resulting from the 1984 management plan. Juvenile levels have been at historical highs since the early 1990s (Figs. 7, 8). Juvenile abundance remains high, at least at the fry stage, in other rivers of SFA 15 (Nepisiguit and Jacquet) (Fig. 8). In the Buctouche River (SFA 16), fry densities have averaged less than 10 fish per 100 m^2 for the years when egg depositions were below conservation but were above 40 fry per 100 m^2 after the escapement of 1999 which exceeded the conservation requirement (Fig. 8).

In the Margaree River, juvenile densities of all age groups remain at historical high levels (Fig. 8). The low fry abundance measured in 2003 was considered to be partly the result of an extreme high water event in late March and early April as well as low egg depositions in 2002. Resulting parr densities in 2004 declined to the low levels observed in the late 1980s but recovered again in 2005. Abundances of juveniles in the mainland NS rivers of SFA 18 have also been high through the 1990s (Fig. 8).

Previous smolt production values from the Miramichi in 1953 to 1958 ranged from 0.8 to 2.6 million smolts, a production rate of 1.5 to 4.8 smolts per 100 m^2 (Kerswill 1971). Applying smolt production rates of 3 fish per 100 m^2 to the available habitat areas would indicate potential smolt production values of 650 thousand for the Restigouche River, 1.6 million smolts for the Miramichi, and 84 thousand smolts from the Margaree River.

Smolt monitoring programs were initiated in 1998 in the Northwest Miramichi (Chaput et al. 2002) and expanded to the Margaree River in 2001 and the Restigouche River in 2002 (Chaput et al. 2004). Smolt production estimates for the Northwest Miramichi ranged between 151 and 391 thousand annually, a production rate of 0.9 to 2.3 smolts per 100 m^2 (Table 6). Estimates for the entire Miramichi, obtained in 2001 to 2004, ranged from 578 thousand to 1.5 million smolts annually (Table 6). In the Restigouche River, smolt production has increased over the recent three years from 379 to 630 thousand smolts, a production rate of 1.8 to 2.9 smolts per 100 m^2 (Table 6). The production rate from the Kedgwick River, an upstream tributary of the Restigouche has ranged from 1.9 to 3.8 smolts per 100 m^2 (Table 6). In the Margaree River, smolt production has ranged from 90 to 108 thousand smolts, the highest production rate of any of the monitored rivers of the southern Gulf, 3.2 to 3.9 smolt per 100 m². The fork length of wild smolts varies little among rivers and years, from 125 to 135 mm modal fork length (Table 6).

MEASURES OF MARINE PRODUCTION

Returns rates of Miramichi wild smolts to 1SW salmon for the 2001 to 2004 smolt cohorts ranged from 2.1% to 7.8% whereas return rates to 2SW salmon ranged from 1.4% to 2.2% (Table 6). Estimates to the Northwest Miramichi for 1SW salmon ranged between 2.7% and 6.2% for the 1999 to 2004 smolt runs. Return rates to 2SW salmon are lower, at 0.4% to 1.2% but the branch specific returns of large salmon are less reliable than the overall Miramichi return estimates. For the Miramichi during the past ten years, two small salmon have returned (in year) relative to one large salmon (in year + 1). This suggests that large salmon abundance in 2006 is likely to remain within the range of values observed in recent years, at around 15 to 20 thousand fish.

Mean fork length at age of 2SW salmon in the Miramichi in 2004 was the highest of record at 77.1 cm continuing the trend of increased length at age since 1971 (Fig. 9). Size also increased for 1SW salmon with average fork lengths consistently greater than 56 cm in the past three years (Fig. 9). Increased size at age had initially been attributed to the elimination of size-selective fisheries (Moore et al. 1995).

The proportion of repeat spawners in the large salmon category has decreased from the peak observed in the 1997 and 1998 returns but has remained at about 20% in recent years (Fig. 10). Return rates of 1SW and 2SW maiden salmon to a second spawning have increased and are now about 20% for 2SW salmon, and 6% for 1SW salmon (Fig. 10). Repeat spawner age distribution has expanded in the last twelve years, with fish on their seventh spawning event first observed in 1995 and with frequent numbers of fish on their fourth and fifth spawnings (Chaput and Jones 2006). There has been an increase in the return rate as consecutive second spawners in both the 1SW and 2SW salmon age groups (Fig. 10). Repeat spawners have recently contributed as much as 35% of the lifetime egg production of a year class (Chaput and Jones 2006).

Although the West Greenland fishery is dramatically reduced from its historical levels (Jones et al. 2006), tagged salmon originating from Gulf Region rivers continue to be intercepted in this fishery. In 2003, two streamer tags from smolts originating in the Miramichi River from the spring 2002 were recovered at West Greenland. In 2004, a streamer tagged smolt from the Restigouche River (2003 migration), a PIT tagged smolt from the Miramichi River (2003 migration) and a repeat spawner originally tagged as an adult in the Miramichi River in 2002 were recovered at West Greenland. In 2005, two streamer tags from smolts tagged in 2004 from the Miramichi River were reported harvested by fishers in West Greenland.

A stray Miramichi smolt from the 2002 migration was recovered at the Veasie Dam fishway in the Penobscot River (Maine, U.S.) in October 2003.

STATUS SUMMARY AND REVIEW OF CONSTRAINTS

Adult salmon abundance in the Gulf Region rivers was most important in the late 1980s and early 1990s. Salmon have declined from those highs in all rivers and are generally showing a modest annual increase from the low returns of 1998 and 1999. Juvenile abundance remains at record high levels in most of the monitored rivers and smolt production is at a moderate but lower level than expected based on juvenile salmon indices.

Cairns (2001) presents and describes 62 hypotheses which may explain the decline in abundance of Atlantic salmon. Any or all of the factors described may be acting to constrain present abundance of Atlantic salmon in the Gulf rivers. A few of these factors are discussed below.

Fisheries

Losses of large salmon from fisheries are low, restricted to First Nations fisheries and from incidental mortalities associated with catch and release fisheries. Exploitation on egg bearing females is low throughout Gulf Region, the small salmon are generally less than 20% female whereas 75% of the large salmon are female. Although salmon from Gulf rivers continue to be intercepted in the West Greenland fishery, the rate of exploitation is presumed to be very low compared to levels during the peak of the fishery in the 1960s to 1980s.

Environmental Constraints

Rivers of the southern Gulf are subject to discharge and temperature events which can affect growth of juveniles and survival of juvenile and adult salmon (Swansburg et al. 2002, 2004). The summer water temperatures in portions of the Miramichi River can approach the upper lethal temperatures (25 to 28ºC) for Atlantic salmon. Water temperatures in excess of 25ºC for several hours were recorded at a major salmon holding pool in the Southwest Miramichi in 1999 and again in 2001. In 1999, a number of salmon mortalities were reported beginning in mid-July and extending into the first week of August in both branches of the Miramichi with most mortalities reported from the lower portion of the Southwest Miramichi (Chaput et al. 2000). The recorded mortalities, 120 in total for the Southwest Miramichi, corresponded to a period when maximum daily water temperatures generally exceeded 24ºC. In 2001, the reports of salmon mortalities began on July 21 and several hundred adult salmon were reported having died in the lower portion of the Southwest Miramichi in July and August (Chaput et al. 2001). Documented mortalities corresponded to days when the maximum water temperature was above 24ºC.

Overwinter survival of juveniles is also subject to variations in environmental conditions, particularly mid-winter freshets (Cunjak and Therrien 1998; Cunjak et al. 1998). Climate change models predict a 2 to 6°C increase in air temperature in the Maritime provinces from which increased water temperatures and alterations in stream flows are expected, which may ultimately impact on juvenile production and adult survival (Swansburg et al. 2002).

Disease

The bacterium *Aeromonas salmonicida*, the causative agent of a disease called furunculosis has been known from the Restigouche River since the 1970s and caused large numbers of adult mortalities in the first few years. In 1997, the first cases of furunculosis were confirmed in the Miramichi and like the Restigouche, the bacterium has since been confirmed annually in some mortalities autopsied by DFO. It is not believed to be a major threat to adult salmon in either river although it is most frequently found on the early run components, especially those which have just recently migrated from the sea.

Bacterial kidney disease (BKD) is found in the Margaree River and the Miramichi River but is not considered to pose any threat to either juvenile or adult salmon.

Land Use

Most original runs of Atlantic salmon in Prince Edward Island were eliminated due to over-exploitation, barriers to migration, and habitat degradation. The chief limitation to Atlantic salmon production in PEI is stream sedimentation caused by agriculture and other land use activities (DFO 2000; Cairns 2002;). Cultivation techniques which reduce erosion and pesticide runoff have become more widespread in recent years, but acreage devoted to potatoes remains high. Substantial self-sustaining salmon runs cannot be re-established until these impacts are severely reduced. Pesticide runoffs have also resulted in fish kills in a number of PEI streams.

Quality spawning and rearing habitat on most rivers of the southeast portion of SFA 16 (Buctouche River) appears to be limited. In general, the rearing habitat is marginal for Atlantic salmon, containing limited amounts of spawning substrate and rearing habitat that is too coarse for fry but more suitable for parr (Atkinson 2004). For the Buctouche, egg-to-fry survival is generally low but high fry abundance has resulted from high egg depositions.

Forestry, agriculture, and rural development all impact in various ways on the fresh water habitat of Atlantic salmon. The forestry industry is a major contributor to the economy of the Maritime provinces and the impact of these activities are the subject of ongoing research (Cunjak 1995).

Recent studies have demonstrated an impairment of the parr-smolt transformation and subsequent sea water adaptability resulting from exposure of smolts to endocrine disrupting compounds (Madsen and Korsgaard 1989). Fairchild et al. (1999) suggested a link between past pesticide use and declines of some Atlantic salmon populations. The estimated levels of 4 nonyl phenol (4-NP) present after forest spraying were similar to those currently found in industrial effluents, pulp mill discharges and municipal sewage outfalls (Bennie et al. 1998). Sewage treatment facilities generally do not remove endocrine disrupting compounds. Research on this issue is ongoing.

Density Dependence in Fresh Water

Juvenile abundances in most rivers of the Gulf are presently at record high levels. Randall and Chadwick (1986) examined the effect of density on production of juvenile salmon in the early portion of the time series of the Miramichi and Restigouche and indicated that the carrying capacity had not been reached. Mean standing biomass in those years (1972 to 1981 year class) was less than 150 g per 100 m^2 in contrast to mean biomass values of over 300 g per 100 m^2 since 1994 (Fig. 11). Percent Habitat Saturation index has been proposed as a valuable tool for predicting maximum densities and whether density-dependent responses may be expected in a population (Grant and Kramer 1990). PHS values are closely related to biomass and since 1994 mean PHS values in the Miramichi River have frequently exceeded an index of 27, a value at which density dependent responses could be expected (Grant and Kramer 1990). Chaput and Jones (2006) present data which suggest overcompensation from the parr age-1 stage to the adult returns. Although the high juvenile abundances in the time series have all occurred in recent years and correspond to the years of lower adult returns, the mechanism that depresses adult abundance when juvenile abundance is high remains uncertain. Low adult abundance may be purely a consequence of density independent reduction in marine survival, as has been noted in monitored stocks of eastern Canada (O'Connell et al. 2006). However, a possible density dependent factor in freshwater which could account for the lower adult returns at high juvenile abundance is an overcompensatory parr to smolt relationship. Such a function could result from diminished overwinter survival of potential smolts in their final winter resulting from inter yearclass competition for limited resources, potentially winter refuge. This hypothesis remains to be objectively and quantitatively analysed and tested but for the Gulf rivers, should not be discounted.

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Table 1. Distribution of size (based on egg conservation requirements) of Atlantic salmon rivers within salmon fishing areas 15 to 18 and overall.

Percent of rivers by river size (conservation requirement) within SFAs and overall					
Conservation requirement (eggs million)	Salmon Fishing Area (SFA) 15	16	17	18	All
<= 0.5	0	24	80	53	35
(0.5 to 1.0]	47	24	20	27	29
(1.0 to 2.0]	27	20		13	17
(2.0 to 5.0]	13	12		3	8
(5.0 to 10.0]	7			3	3
> 10.0	7	16			7
Number of rivers	15	25	5	30	75

Table 2. Summary of assessed rivers in salmon fishing areas 15 to 18, Gulf Region.

SFA	River	Years	Number of fish (range) Small salmon	Large salmon	Conservation requirement Eggs (millions)	Large salmon
15	Restigouche	2001 to 2005	5,000 to 19,000	5,400 to 9,300	36.3	5,700
	Jacquet	1994 to 2004	170 to 634	136 to 601	3.8	571
	Nepisiguit	1984 to 1996	600 to 3,100	500 to 2,000	9.5	1,626
16	Tabusintac	1993 to 1999	600 to 1,800	800 to 1400	1.98	329
	Miramichi (NW & SW)	1994 to 2005	16,000 to 46,000	10,500 to 32,000	129.0	23,600
	Buctouche	1993 to 2000	38 to 127	95 to 244	1.59	281
18	Philip	1992 to 2004	< 600	< 1,000	2.31	358
	East (Pictou)	1992 to 2004	< 200	< 600	1.75	271
	West (Ant.)	1992 to 2004	< 500	< 800	1.15	353
	Margaree	1992 to 2004	600 to 1,700	1,400 to 4,900	6.71	1,036

Table 3. Annual counts of small salmon and large salmon at fences and protection barriers within the Restigouche River watershed.

Année / Year	Petit/ Small	Grand/ Large	Petit/ Small	Grand/ Large	Petit/ Small	Grand/ Large
	Northwest Upsalquitch		**Little Main Restigouche**		**Causapscal (Matapedia)**	
1980	843	887				
1981	789	481				
1982	819	622				
1983	430	301				
1984	518	642				
1985	748	517				
1986	1738	1166				
1987	1557	1000				
1988	1121	993			49	505
1989	1051	894			7	605
1990	1324	946			37	456
1991	1267	930			9	451
1992	1351	963			8	350
1993	957	353			12	256
1994	1329	740			3	349
1995	817	946			1	462
1996	959	587			4	441
1997	1027	461			2	229
1998	834	494	496	375	4	215
1999	814	619	143	85 [1]	25	518
2000	710	399	289	392	30	332
2001	409	363	167	269 [1]	25	393
2002	955	209	574	365	39	291
2003	440	672	228	521	43	420
2004	1026	233	305	234	12	421
2005	*410*	*329* [1]	131	89 [1]	13	346
Mean / Moyenne 1999-2004	708	375			30	371

[1] incomplete count due to major washout in the fall (Sept. or Oct.)

Table 4. Estimates of returns of small salmon and large salmon to the Miramichi River, 1971 to 2005.

	Small salmon			Large salmon		
		Confidence interval (90%)			Confidence interval (90%)	
Year	Estimate	Lower	Upper	Estimate	Lower	Upper
1971	35,673			24,407		
1972	46,275			29,049		
1973	44,545			27,192		
1974	73,418			42,592		
1975	64,902			28,817		
1976	91,580			22,801		
1977	27,743			51,842		
1978	24,287			24,493		
1979	50,965			9,054		
1980	41,588			36,318		
1981	65,273			16,182		
1982	80,379			30,758		
1983	25,184			27,924		
1984	29,707			15,137		
1985	60,800			20,738		
1986	117,549			31,285		
1987	84,816			19,421		
1988	121,919			21,745		
1989	75,231			17,211		
1990	83,500	68,000	113,100	28,574	21,350	35,583
1991	60,900	45,700	76,000	29,949	22,400	37,333
1992	152,600	128,000	184,000	37,000	31,056	44,643
1993	95,000	61,500	153,800	35,000	19,732	76,695
1994	43,571	36,669	52,592	20946	15,870	28,962
1995	46,458	38,956	55,741	32015	26,643	38,747
1996	33,610	28,183	40,425	18433	14,294	24,594
1997	16,139	12,637	21,203	16399	12,931	21,554
1998	23,143	18,727	29,015	14753	10,039	24,695
1999	23,121	19,770	27,194	14078	11,329	18,002
2000	32,031	27,592	37,272	15492	12,058	20,653
2001	28,664	24,022	34,312	21027	17,780	25,060
2002	44,864	37,656	53,942	10453	7,382	16,892
2003	30,264	24,434	38,189	19361	14,849	26,305
2004	43,999	36,671	53,247	22,202	16,551	31,974
2005	32,000	25,000	45,000	17,000	10,000	30,000

Table 5. Estimates of angling effort (rod days) and angling catch (number of fish) of Atlantic salmon from rivers of PEI (SFA 17).

	Effort	Small salmon		Large salmon	Total
	(rod days)	retained	released	released	Catch
1995	7,669	484	209	139	832
1996	6,478	534	472	238	1,244
1997	5,254	320	178	77	575
1998	5,457	282	233	114	628
1999	4,291	194	197	157	548
2000	3,257	148	106	45	299
2001	3,449	171	202	103	476
2002	2,358	114	207	31	352
2003	3,457	260	240	123	623
2004	2,479	76	135	68	279
2005	2,226	97	84	84	265

Table 6. Summary of production and biological characteristics of wild Atlantic salmon smolts from Gulf Region rivers.

	Smolt	Run size estimates			Smolts per 100 m²		Size (mean)		Prop.	Proportion at freshwater age			Run-timing		Return rate	
River	Year	Estimate	95% Conf. Interval		Estimate	95% C.I.	Length (mm)	Weight (g)	Female	2	3	4	Peak	5th percentile	to 1SW	to 2SW
										.	.	.				
Restigouche River	2003	379,000	262,000	670,000	1.8	1.0 - 2.5	125	23.2	0.32	.	.	.	29-May	18-May	.	.
	2004	449,000	289,000	613,000	2.1	1.1 - 2.3	130	20.2	0.53	.	.	.	21-25-May	17-May	.	.
	2005	630,000	450,000	1,010,000	2.9	1.7 - 3.8	125	19.7	0.72	0.02	0.95	0.03	1-2 June	25-May	.	.
Kedgwick River	2002	.	.	.	.	.	125	19.4	0.54	.	.	.	24-May	12-May	.	.
	2003	91,800	55,100	128,600	2.6	1.6 - 3.7	130	22.4	0.44	.	.	.	29-May	19-May	.	.
	2004	131,500	74,200	191,400	3.8	2.1 - 5.5	130	22.1	0.53	0.06	0.9	0.04	20-May	17-May	.	.
	2005	*67,000*	*51,000*	*96,500*	1.9	1.5 - 2.8	125	22.2	0.6	0.05	0.95	0.00	2-Jun	25-May	.	.
Northwest Miramichi	1998	.	.	.	.	.	129	21.8	0.49	0.28	0.71	0.01	16-May	15-May		
	1999	390,500	315,500	506,000	2.3	1.9 - 3.0	132	22.4	0.63	0.36	0.62	0.02	19-May	15-May	4.1%	1.2%
	2000	162,000	118,000	256,000	1.0	0.7 - 1.5	131	21.2	0.58	0.34	0.63	0.03	2-Jun	18-May	4.7%	0.6%
	2001	220,000	169,000	310,000	1.3	1.0 - 1.8	130	21.1	0.53	0.38	0.60	0.01	29-May	21-May	6.2%	0.4%
	2002	241,000	198,000	306,000	1.4	1.2 - 1.8	128	20.7	0.57	0.52	0.48	0.00	2-Jun	24-May	2.2%	0.8%
	2003	286,000	224,500	388,000	1.7	1.3 - 2.3	128	21.2	0.53	0.50	0.49	0.01	28-May	24-May	4.3%	0.8%
	2004	368,000	290,000	496,000	2.2	1.7 - 3.0	131	22.1	0.57	0.41	0.58	0.01	19-May	16-May	2.7%	
	2005	*151,200*	*86,000*	*216,000*	0.9		130	21.4	0.52				8-Jun	19-May		
Southwest Miramichi	2001	358000	290000	464000	1.0	0.8 - 1.3	127	19.2	0.47	0.64	0.35	0.00	31-May	22-May	6.3%	na
	2002	633000	504000	840000	1.7	1.4 - 2.3	126	18.8	0.54	0.55	0.44	0.01	1-Jun	19-May	3.6%	na
	2003	498,000	402000	652000	1.6	1.1 - 1.8	128	19.6	0.58	0.59	0.41	0.00	22-May	22-May	6.4%	.
	2004	1,160,000	956000	1270000	3.2	2.6 - 3.5	130	21.1	0.54	0.60	0.40	0.00	17-May	16-May	.	.
Miramichi River	2001	578,000	.	.	1.1	.	.	.	.				.	.	7.8%	2.0%
	2002	874,000	.	.	1.6	.	.	.	.				.	.	3.5%	1.4%
	2003	878,000	.	.	1.6	.	.	.	.				.	.	5.6%	2.2%
	2004	1,528,000	.	.	2.9	.	.	.	.				.	.	2.1%	.
Margaree River	2001	.	.	.	.	.	125	18.8	0.70	0.39	0.59	0.02	5-Jun	16-May	.	.
	2002	.	.	.	.	.	125	19.2	0.74	0.36	0.59	0.05	30-May	14-May	.	.
	2003	89,633	76,236	103,030	3.2	2.7 - 3.7	129	20.7	0.76	0.40	0.55	0.05	2-Jun	18-May	.	.
	2004	108,300	94,700	126,500	3.9	3.4 - 4.5	135	25.2	0.75	0.39	0.55	0.06	16-Jun	26-May	.	.
	2005	94,700	81,200	111,200	3.4	2.9 - 4.0	135	24.2	0.72	0.36	0.54	0.09	2-Jun	16-May	.	.

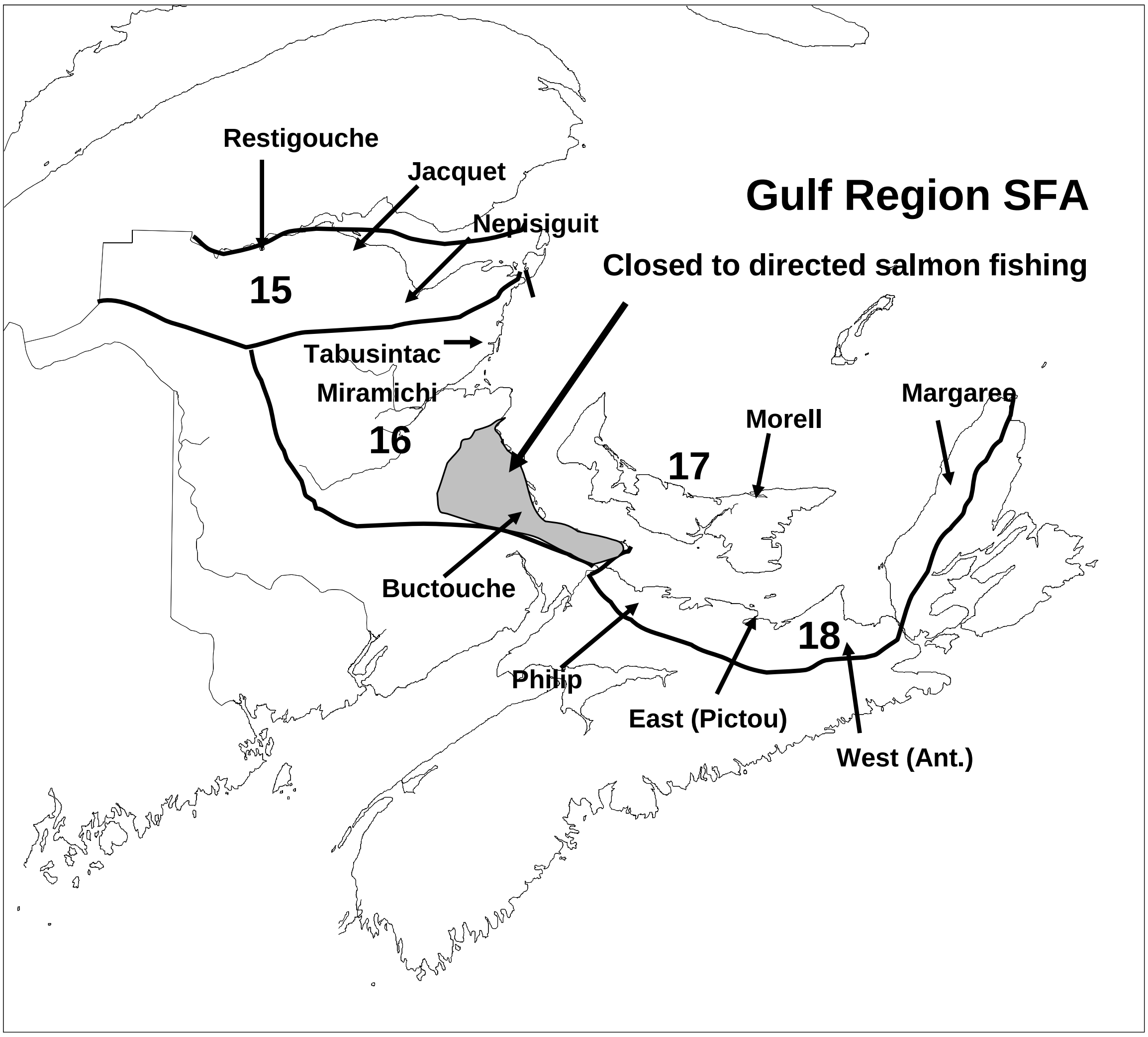


Figure 1. Salmon fishing areas (SFA) and monitored rivers in Gulf Region of DFO.

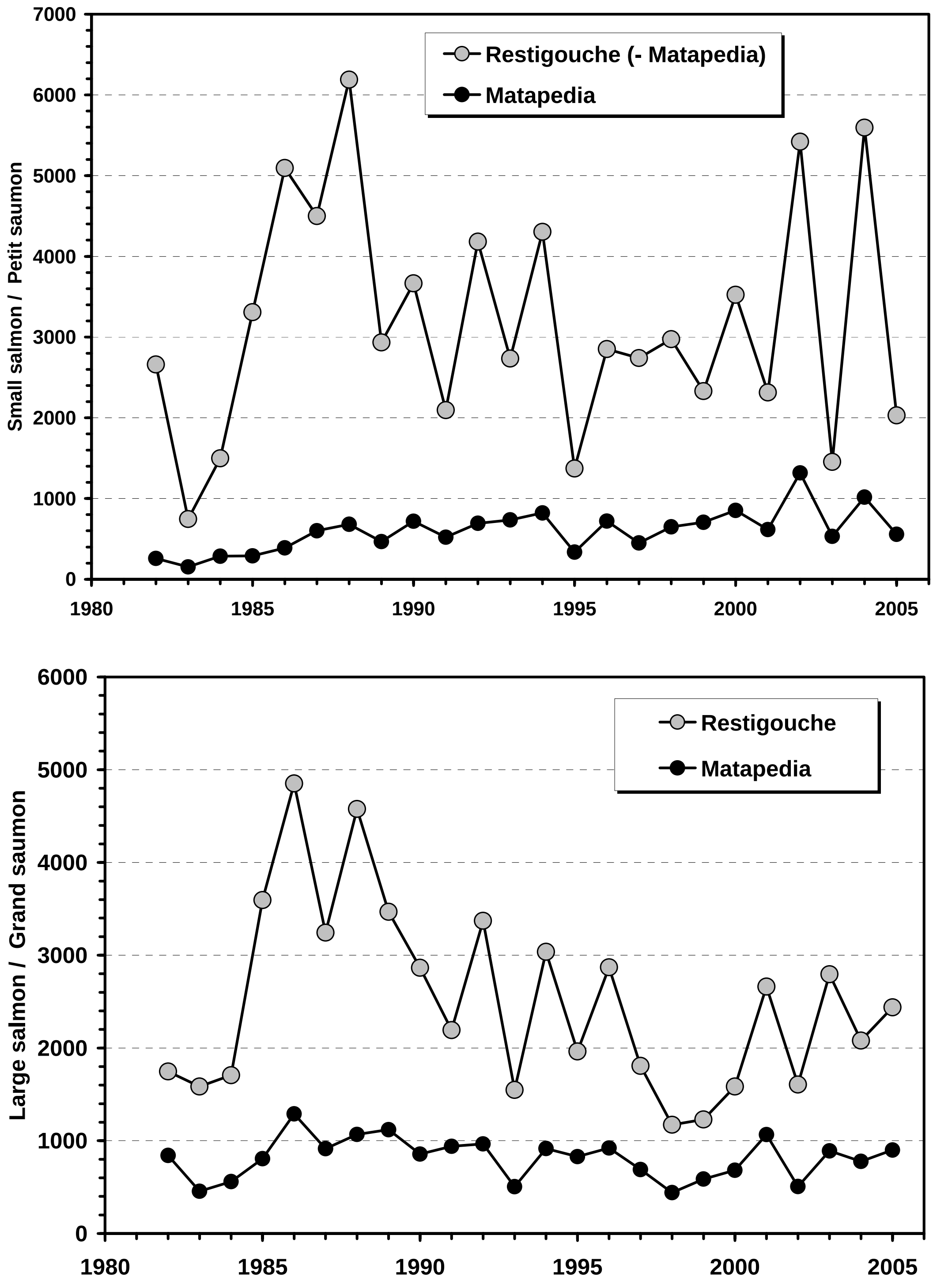


Figure 2. Angling catches of small salmon (upper panel) and large salmon (lower panel) from the New Brunswick portion of the Restigouche River (SFA 15) and the Matapedia River (Quebec), 1982 to 2005.

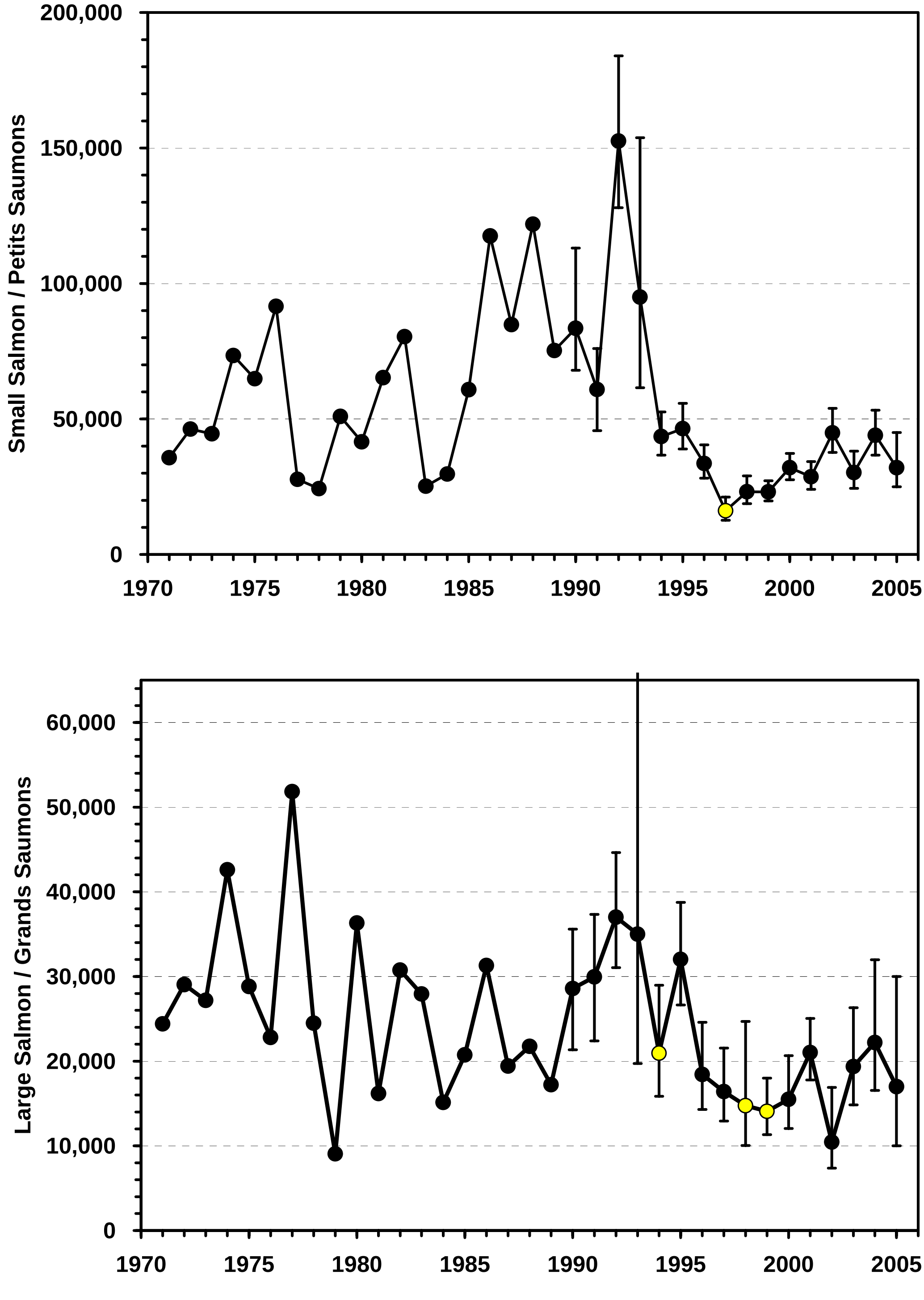


Figure 3. Estimated returns of small salmon (upper panel) and large salmon (lower panel) to the Miramichi River (SFA 16), 1971 to 2005.

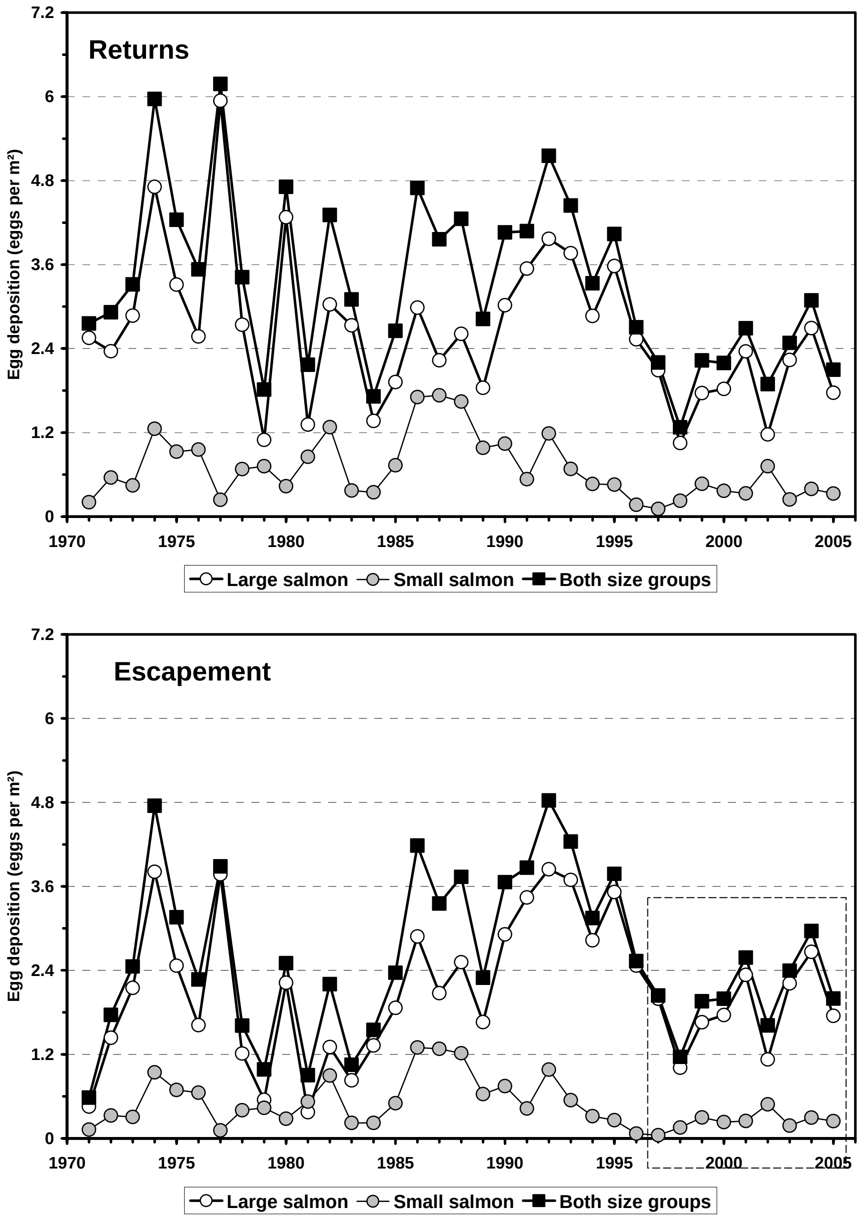


Figure 4. Estimated eggs (eggs per m²) in the returns (upper) and in the escapement (lower) by small salmon, large salmon and size groups combined in the Miramichi River, 1971 to 2005. For 1997 to 2005, the eggs in the escapements are based on assumed loss rates of 30% of the small salmon and 1% of the large salmon returns.

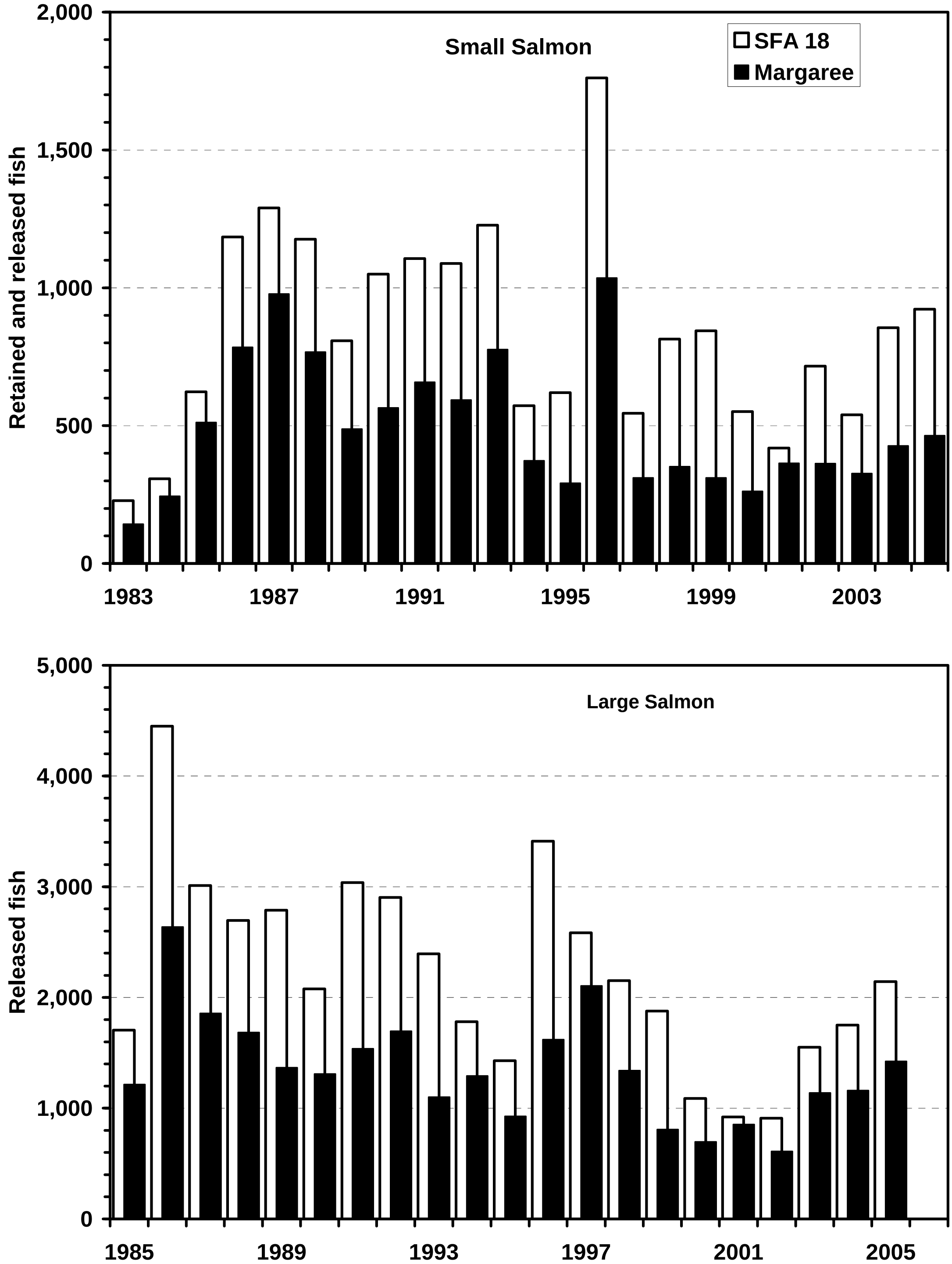


Figure 5. Estimated angling catches of small salmon (upper panel) and large salmon (lower panel) from the Margaree River and the entire SFA 18, 1985 to 2005.

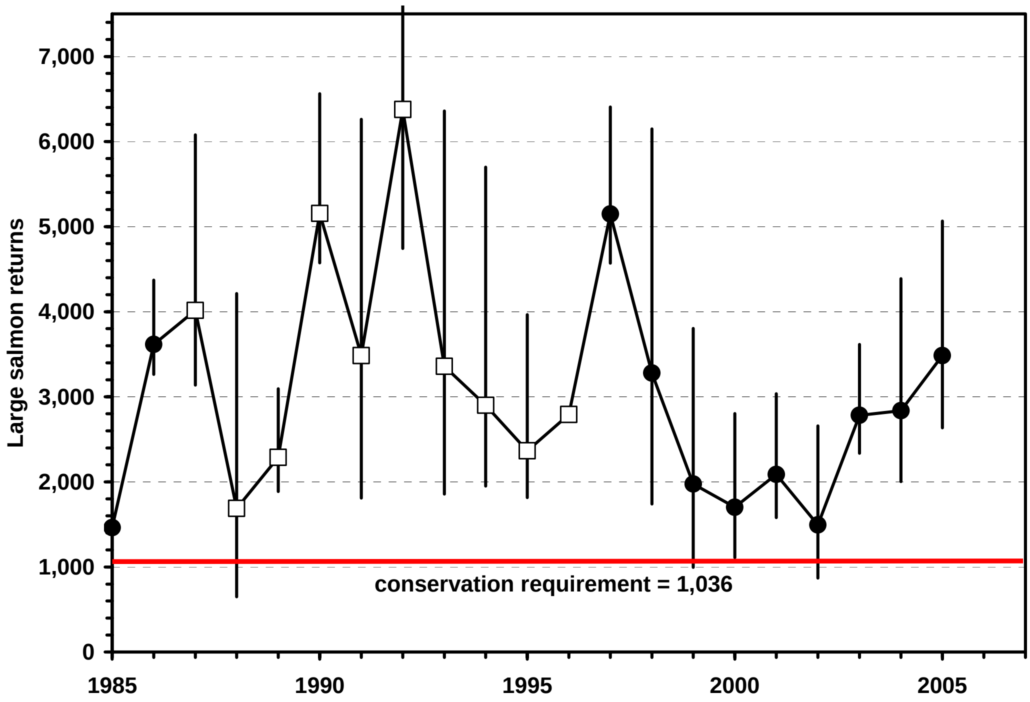


Figure 6. Estimated return of large salmon to the Margaree River, 1985 to 2005.

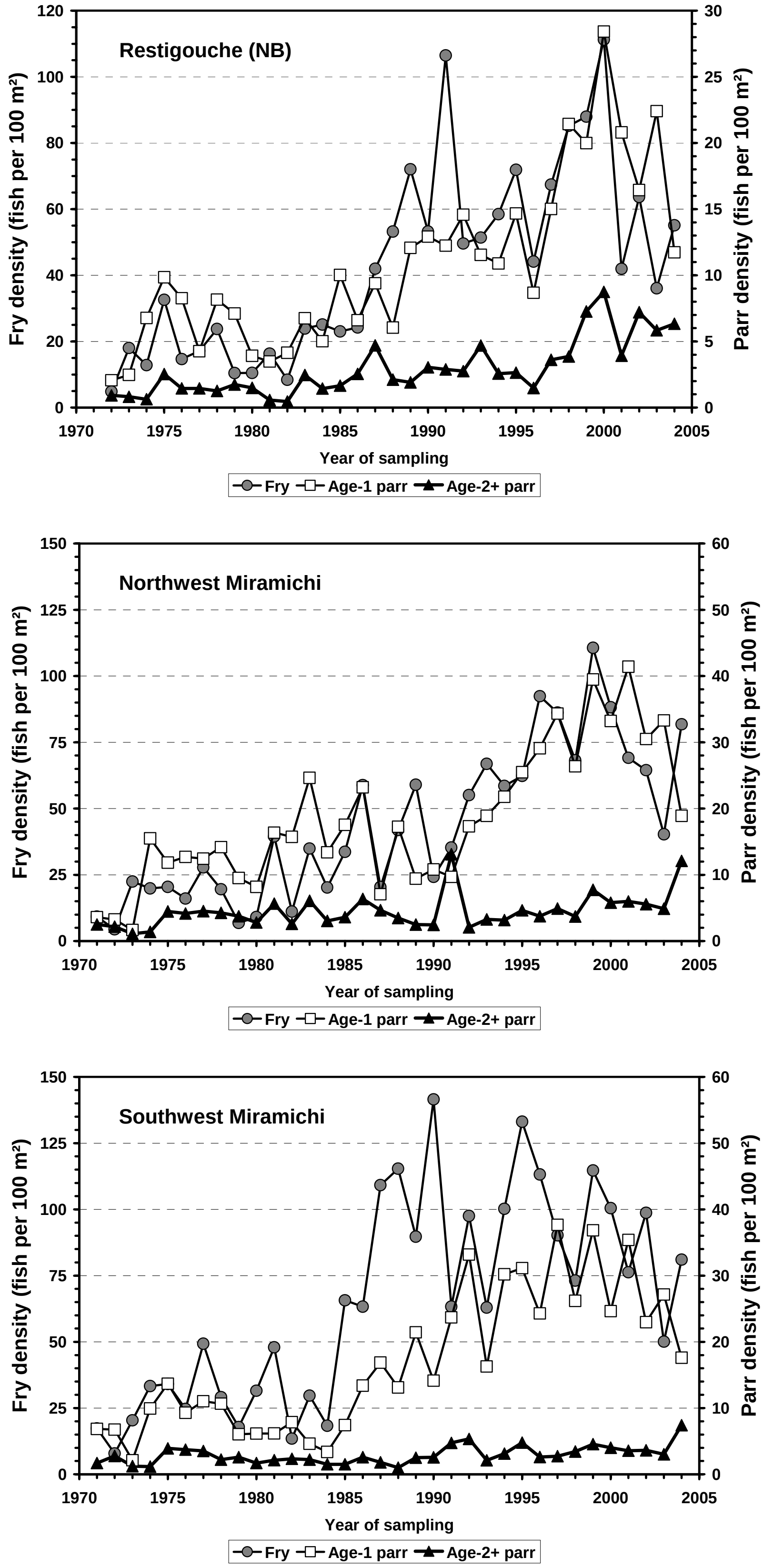


Figure 7. Abundance indices (mean fish per 100 m²over all sites surveyed) at age of Atlantic salmon juveniles in the Restigouche River (SFA 15; upper panel), Northwest Miramichi River (SFA 16; middle panel) and Southwest Miramichi River (SFA 16; lower panel), 1970 to 2005.

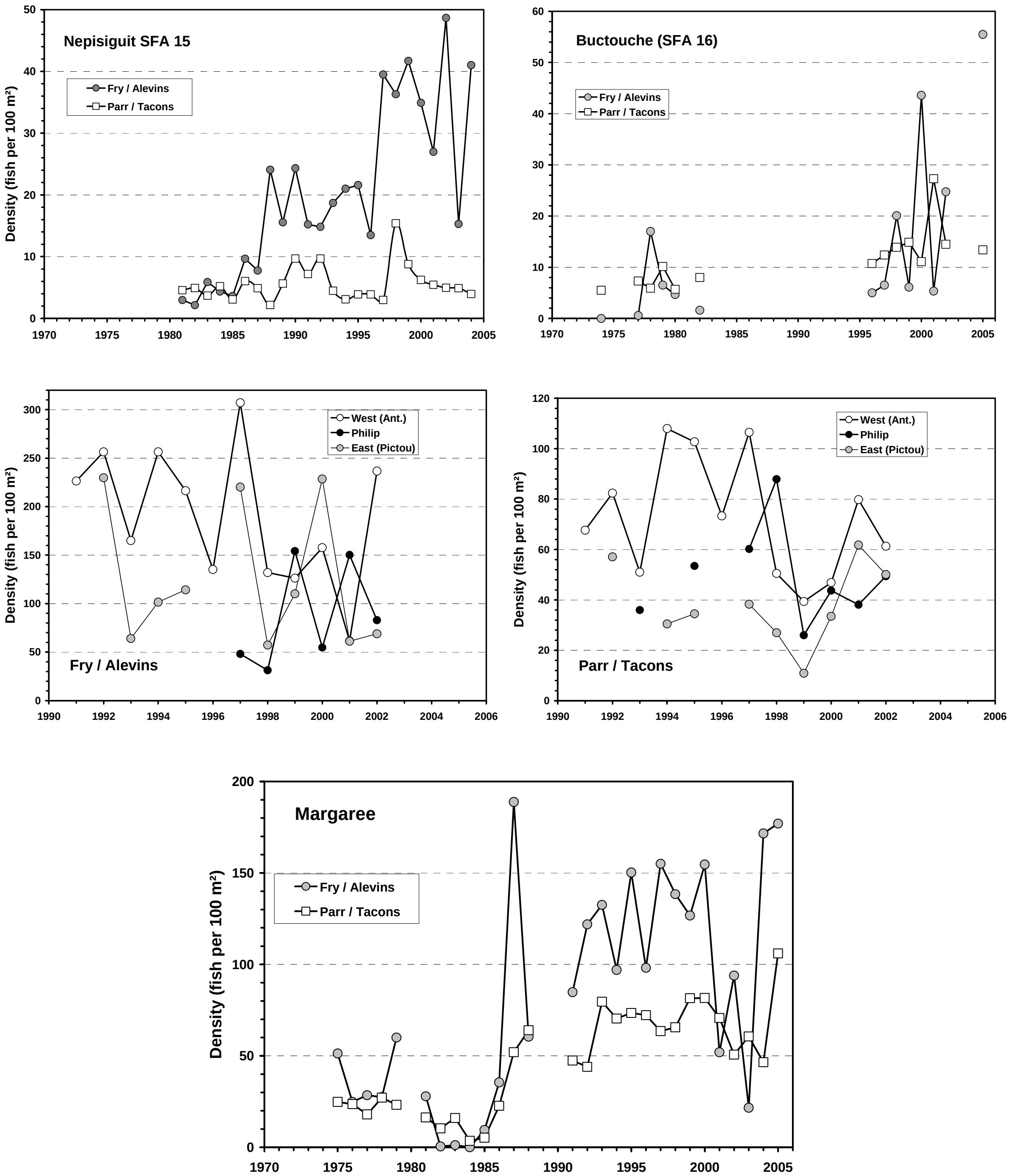


Figure 8. Abundance indices (mean fish per 100 m² over all sites surveyed) at age of Atlantic salmon juveniles in the Nepisguit River (SFA 15), Buctouche River (SFA 16), Gulf Mainland NS rivers (SFA 18) (middle panels) and Margaree River (bottom panel).

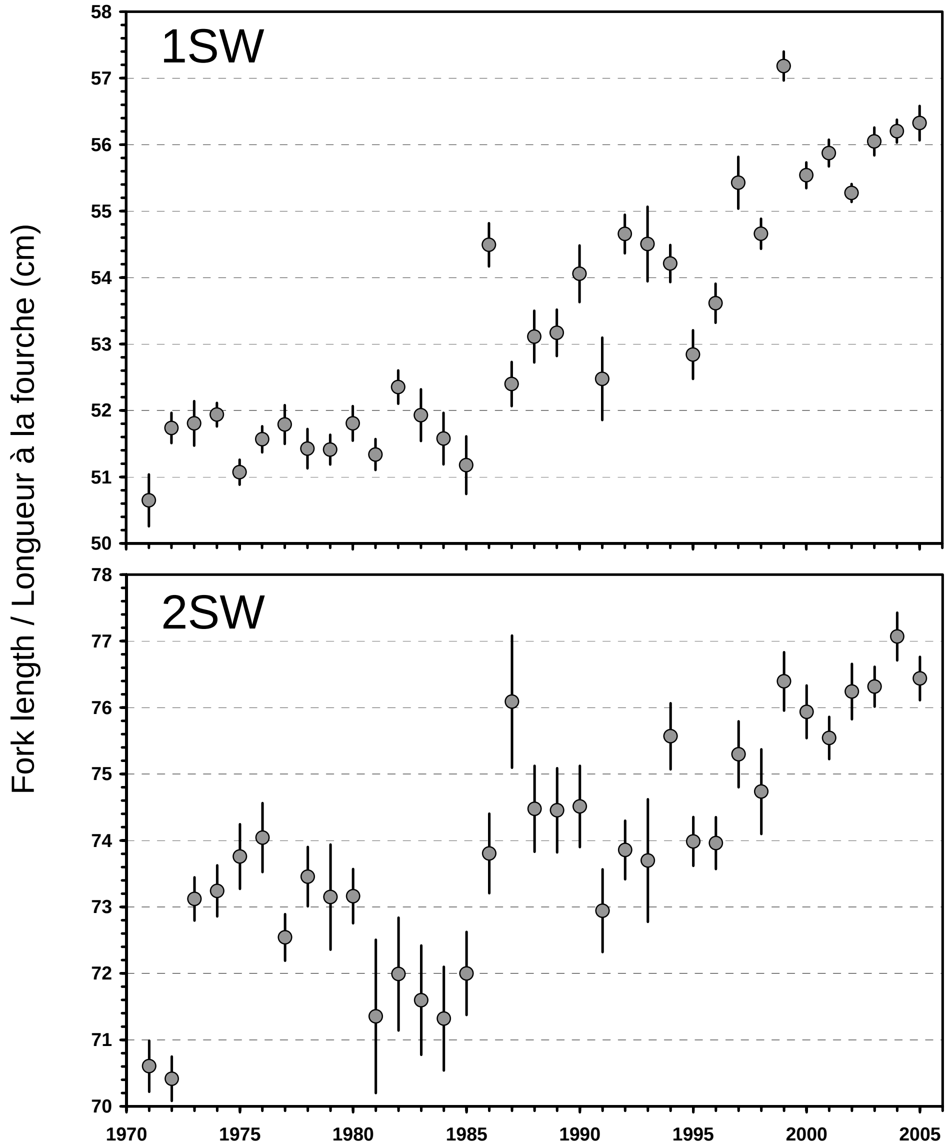


Figure 9. Fork length (cm, mean +/- 2 std errors) of 1SW and 2SW salmon sampled from the early run (prior to September) in the Miramichi River, 1971 to 2005.

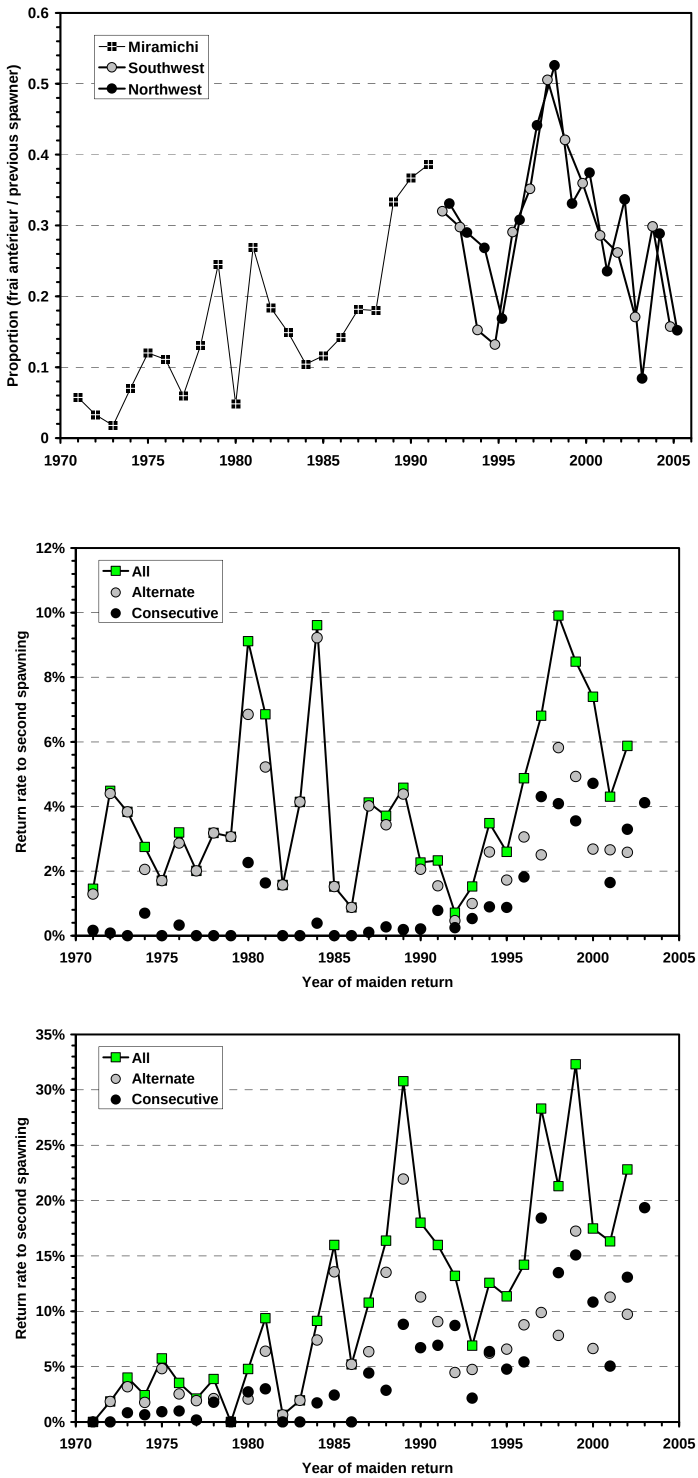
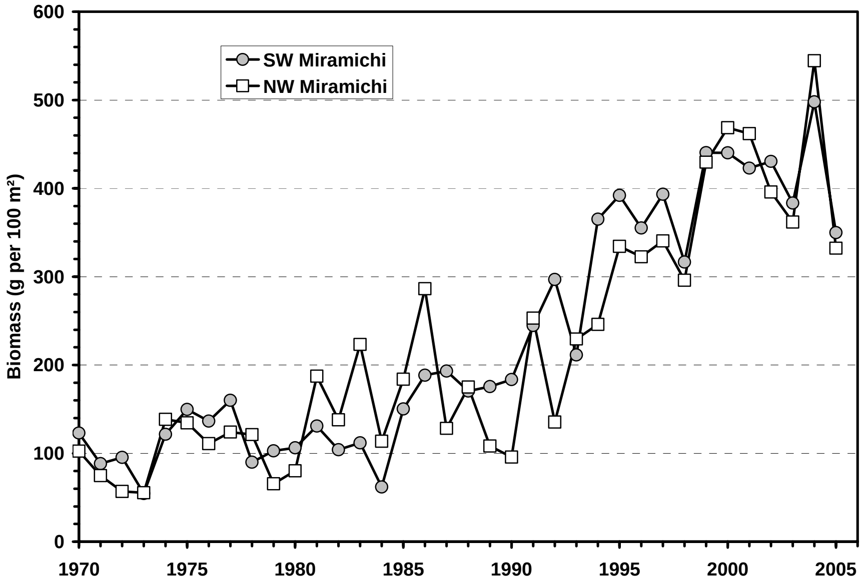


Figure 10. Proportion of the large salmon which are repeat spawners (upper) and returns rates to a second spawning of 1SW (middle) and 2SW (lower) salmon to the Miramichi River, 1971 to 2005.



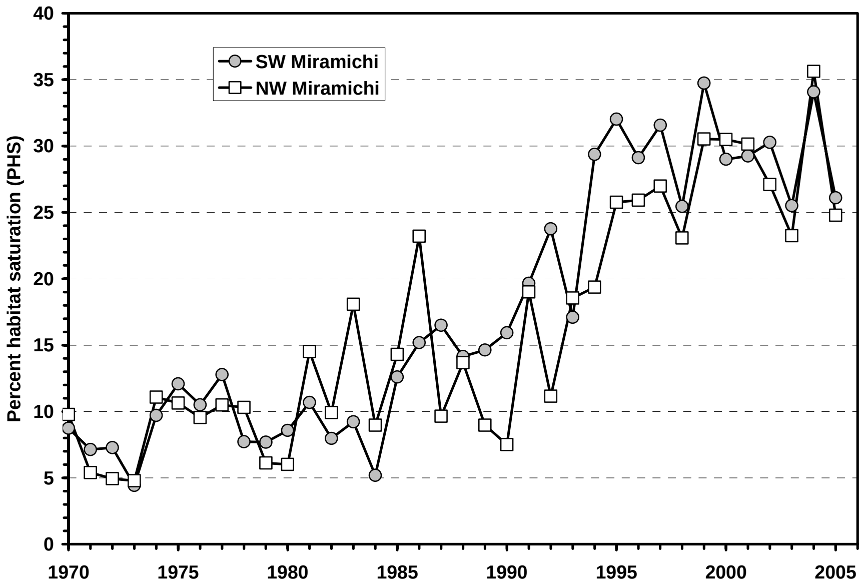


Figure 11. Mean standing biomass of juvenile Atlantic salmon (upper) and Percent Habitat Saturation Index (PHS, lower) in the Northwest and Southwest branches of the Miramichi River, 1970 to 2005.

Appendix 1. Atlantic salmon rivers characteristics by salmon fishing area. Source of evidence of salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Longitude and latitude were obtained from the Canadian Geographical Names Database (http://geonames.nrcan.gc.ca/search/search_e.php). Drainage areas for New Brunswick rivers are from the New Brunswick Aquatic Data Warehouse (http://nbwaters.unb.ca/datasets.html). Habitat areas are from various published and unpublished sources.

Salmon Fishing Area	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile	Angling
15	Restigouche	-66.3333	43.0667	44.93	6,589	21.6200	X	X	X
15	Eel River	-66.3667	48.0167	1.01	116	0.4220	X		X
15	Charlo	-66.2833	47.9833	1.44	400	0.5996	X		X
15	Benjamin	-66.1667	47.9667	0.58	161	0.2410			X
15	Jacquet	-66.0167	47.9167	2.72	510	1.1350	X	X	X
15	Nigadoo	-65.7167	47.7500	0.60	168	0.2520			X
15	Millstream	-65.7000	47.7000	0.83	229	0.3440			X
15	Tetagouche	-65.6833	47.6333	0.72	364	0.2990			X
15	Middle (Gloucester co)	-65.6667	47.6000	2.28	401	0.9500			X
15	Nepisiguit	-65.6333	47.6167	9.54	2,312	3.9730	X	X	X
15	Bass (Gloucester co)	-65.5833	47.6667	0.71	198	0.2973			X
15	Caraquet	-65.0667	47.7833	1.34	373	0.5596	X	X	X
15	Pokemouche	-64.8000	47.6667	0.60	481	0.2480	X	X	X
15	Little Tracadie	-64.9000	47.5167	0.69	192	0.2885			X
15	Tracadie	-64.8667	47.4833	1.44	527	0.6010	X	X	X

Appendix 1 (continued). Atlantic salmon rivers characteristics by salmon fishing area. Source of evidence of salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Longitude and latitude were obtained from the Canadian Geographical Names Database (http://geonames.nrcan.gc.ca/search/search_e.php). Drainage areas for New Brunswick rivers are from the New Brunswick Aquatic Data Warehouse (http://nbwaters.unb.ca/datasets.html). Habitat areas are from various published and unpublished sources.

Salmon Fishing Area	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile	Angling
16	Tabusintac	-64.9667	47.3333	1.98	704	0.8243	X	X	X
16	Burnt Church	-65.1167	47.2167	0.72	135	0.2994			X
16	Bartibog	-65.3500	47.1000	2.72	512	1.1353	X	X	X
16	Northwest Millstream	-65.7000	46.9667	1.20	210	0.4785	X	X	X
16	Northwest Miramichi	-65.8333	46.9500	20.10	2,307	8.2300	X	X	X
16	Little Southwest Miramichi	-65.8333	46.9500	19.70	1,345	8.0700	X	X	X
16	Renous	-65.7833	46.8167	14.00	1,429	5.8200	X	X	X
16	Southwest Miramichi	-65.5833	46.9667	70.90	5,840	29.5300	X	X	X
16	Barnaby	-65.6167	46.9000	3.10	490	1.3044		X	X
16	Napan	-65.3000	47.0667	0.28	115	0.1146			X
16	Black (Northumberland co)	-65.2167	47.0500	0.67	277	0.2774			X
16	Bay du Vin	-65.1333	47.0500	0.68	284	0.2837			X
16	Black (Kent co)	-64.7000	46.4833	0.82	343	0.3433	X		
16	Kouchibouguac (Kent)	-64.9333	46.8333	1.41	389	0.5880	X	X	X
16	Kouchibouguacis	-64.9000	46.7833	1.32	360	0.5490	X	X	X
16	Richibucto	-64.8500	46.7000	2.94	1,292	1.2260	X	X	X
16	Chockpish	-64.7167	46.5833	0.31	129	0.1294		X	X
16	Buctouche	-64.7000	46.4667	1.59	628	0.6610	X	X	X
16	Cocagne	-64.6167	46.3333	0.68	333	0.2830		X	X
16	Shediac	-64.5667	46.2667	0.52	219	0.2160		X	X
16	Scoudouc	-64.5500	46.2167	0.35	159	0.1460		X	X
16	Aboujagane	-64.4000	46.2167	0.29	120	0.1198		X	X
16	Kouchibouguac (Westmorland)	-64.4000	46.2333					X	
16	Gaspereau (Westmorland co)	-64.0833	46.0500	0.41	170	0.1701		X	
16	Baie Verte	-64.1000	46.0167	0.14	38	0.0575		X	

Appendix 1 (continued). Atlantic salmon rivers characteristics by salmon fishing area. Source of evidence of salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Longitude and latitude were obtained from the Canadian Geographical Names Database (http://geonames.nrcan.gc.ca/search/search_e.php). Drainage areas for New Brunswick rivers are from the New Brunswick Aquatic Data Warehouse (http://nbwaters.unb.ca/datasets.html). Habitat areas are from various published and unpublished sources.

Salmon Fishing Area	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile	Angling
17	Mill River	-64.0833	46.7667	0.14	137	0.0583	X	X	X
17	Dunk River	-63.7667	46.3667	0.46	218	0.1931	X	X	X
17	West River	-63.1667	46.2167	0.44	239	0.1845	X	X	X
17	Morell River	-62.6833	46.4167	0.57	171	0.2372	X	X	X
17	Valleyfield River	-62.6500	46.1667	0.31	94	0.1275	X	X	X
18	River Philip	-63.7325	45.8500	2.31	726	0.9621	X	X	X
18	Pugwash	-63.6658	45.8500	0.59	182	0.2470			X
18	Wallace	-63.5158	45.8167	1.50	458	0.6229		X	X
18	Waughs	-63.2992	45.7333	0.75	230	0.3132		X	X
18	River John	-63.0658	45.7500	0.95	292	0.3973		X	X
18	Graham Brook (Pictou)	-62.8658	45.5500	0.11	27	0.0456			X
18	West (Pictou)	-62.7658	45.6667	0.80	245	0.3326		X	X
18	Middle (Pictou)	-62.7325	45.6500	0.71	217	0.2953	X	X	X
18	East (Pictou)	-62.6992	45.6500	1.75	536	0.7291	X	X	X
18	Sutherland	-62.4992	45.5833	0.16		0.0666	X	X	X
18	French (Pictou)	-62.4492	45.6333	0.42	128	0.1740		X	X
18	Barney's	-62.3492	45.6667	0.51	156	0.2128		X	X
18	West (Antigonish)	-61.9658	45.6167	1.15	353	0.4803		X	X
18	South	-61.9158	45.6000	0.23	217	0.0950	X	X	X
18	Pomquet	-61.7992	45.6000	0.19	176	0.0769		X	X
18	Afton	-61.7325	45.6333	0.05	43	0.0189		X	X
18	Tracadie	-61.6158	45.6167	0.13	120	0.0525			X

Appendix 1 (continued). Atlantic salmon rivers characteristics by salmon fishing area. Source of evidence of salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Longitude and latitude were obtained from the Canadian Geographical Names Database (http://geonames.nrcan.gc.ca/search/search_e.php). Drainage areas for New Brunswick rivers are from the New Brunswick Aquatic Data Warehouse (http://nbwaters.unb.ca/datasets.html). Habitat areas are from various published and unpublished sources.

Salmon Fishing Area	River	Longitude (W)	Latitude (N)	Egg requirement (million)	Drainage area (km²)	Fluvial area (million m²)	Adult	Juvenile	Angling
18	Chisholm Brook (Inverness)	-61.4825	45.8167	0.07	17	0.0279			X
18	Judique Intv Brook	-61.4742	45.9000	0.18	44	0.0738			X
18	L. Judique Brook	?	?	0.14	34	0.0568			X
18	Mabou	-61.3825	46.0667	0.56	188	0.2351		X	X
18	Southwest Mabou	-61.4325	46.0667	0.37	123	0.1540		X	X
18	Northeast Mabou	-61.4158	46.0833	1.02	254	0.4242		X	X
18	Margaree	-61.0992	46.4333	6.71	1,100	2.7976	X	X	X
18	Cheticamp	-60.9492	46.6667	0.77	298	0.3220	X	X	X
18	Fishing Cove	-60.8825	46.8000	0.13	31	0.0521			X
18	Mackenzies (Inverness)	-60.8325	46.8167	0.30	75	0.1244			X
18	Grande Anse	-60.7992	46.8333	0.20	51	0.0852			X
18	Red (Inverness)	-60.7658	46.8500	0.14	35	0.0588			X
18	Blair (Inverness)	-60.6992	46.9167	0.23	58	0.0974			X