Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2022/050

Gulf Region

Information on Atlantic Salmon (*Salmo salar*) from Salmon Fishing Area 15 (Gulf New Brunswick) of relevance to the development of a 2nd COSEWIC status report

G. Dauphin

Science Branch
Gulf Region
Fisheries and Oceans Canada
P.O. Box 5030
Moncton, NB E1C 9B6

July 2022

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1919-5044
ISBN 978-0-660-44421-5 Cat. No. Fs70-5/2022-050E-PDF

Correct citation for this publication:

Dauphin, G. 2022. Information on Atlantic Salmon (*Salmo salar*) from Salmon Fishing Area 15 (Gulf New Brunswick) of relevance to the development of a 2nd COSEWIC status report. DFO Can. Sci. Advis. Sec. Res. Doc. 2022/050. iv + 50 p.

Aussi disponible en français :

*Dauphin, G. 2022. Information sur le saumon atlantique (*Salmo salar*) de la zone de pêche au saumon 15 (Golfe du Nouveau-Brunswick) pertinente pour l'élaboration d'un 2e rapport de situation du COSEPAC. Secr. can. des avis sci. du MPO. Doc. de rech. 2022/050. iv + 52 p.*

TABLE OF CONTENTS

ABSTRACT iv
INTRODUCTION 1
LIFE HISTORY CHARACTERISTICS 1
OVERVIEW OF DESIGNABLE UNITS (DU) 2
TRENDS IN POPULATION INDICATORS 3
DESCRIPTION OF THE INDICATORS 3
TRENDS OF THE INDICATORS 4
Adult returns 4
Freshwater production 4
TRENDS IN DISTRIBUTION AND DECLINE OR FLUCTUATIONS (COSEWIC CRITERION B) 5
ESTIMATE OF TOTAL POPULATION SIZE 6
RESTIGOUCHE RIVER 6
SFA 15 6
THREATS 6
FISHERIES 7
MIXED STOCK MARINE FISHERIES 7
Saint Pierre and Miquelon fishery 7
Labrador subsistence fisheries 8
West Greenland 8
HABITAT ALTERATIONS 9
TRANSPORT AND NOISE 9
ECOSYSTEM CHANGE 9
DISEASE 9
REFERENCES CITED 9
TABLES 13
FIGURES 35

ABSTRACT

This document presents information on Atlantic Salmon (*Salmo salar*) from Salmon Fishing Area (SFA) 15 (northern New Brunswick in DFO Gulf Region) of relevance to the development of the status report by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). There are 19 rivers with confirmed presence of Atlantic Salmon in this area of which the Restigouche River is the largest river. Data are presented and interpreted relative to the following: biological characteristics, stocking of fish, area of occupancy based on juvenile surveys, indicators of adult abundance from monitored rivers, freshwater production based on juvenile surveys and smolt production, and factors which may be constraining Atlantic Salmon abundance. For the rivers in this area, the indices of adult abundance suggest that there were more Salmon in the mid to late 1980s than there have been in the past 15 years. As a result of changes in fisheries management, spawning escapement has increased from the 1970s and early 1980s resulting in increased abundance of juvenile Salmon. The principal threats in SFA 15 are: habitat alteration including habitat fragmentation due to non-compliant culverts, hydroelectric power generation, disease, unreported poaching and aboriginal catches and, cumulative effect of ecosystem changes.

INTRODUCTION

This document presents information on Atlantic Salmon (*Salmo salar*) from Salmon Fishing Area (SFA) 15 of relevance to the development of the status report by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). SFA 15 is located in northern New Brunswick within the Fisheries and Oceans Canada (DFO) Gulf administrative region. There are 32 potential Atlantic Salmon rivers in this area, of which 15 have freshwater habitat areas quantified (Table 1; Fig. 1). The Restigouche River is the largest river in the area (Table 1; Fig. 1). The Matapedia River, a major tributary in the lower portion of the Restigouche, is assessed separately by the province of Québec. Most of the other rivers are comparatively small with fresh water habitat areas of less than one million m² (Table 1). A number of smaller rivers in this SFA have no confirmed presence of Atlantic Salmon but they may have small runs of Atlantic Salmon which are not exploited (Table 1).

Habitat area for the Restigouche River (excluding Matapedia) totals 26.39 million m^2 (value updated in 2019 from the 21.62 million m² value to account for the habitat in the main stem of the Restigouche River) with an additional habitat area for the Matapedia River of 6.81 million m² of wetted area equivalent to 5.12 million m² of productive habitat units. At an egg deposition rate of 1.52 eggs per m² (deposition rate for the Restigouche River, DFO 2018), the limit reference point (LRP) in terms of eggs is 47.89 million eggs, equivalent to 8470 large Salmon (at an average of 5656 eggs per large Salmon). This value is 58% of the conservation requirement previously reported for the Restigouche River (12,042 large Salmon; Randall 1984).

There are 31 other rivers in this area with potential habitat for Salmon. As of 2018, 19 of these rivers had presence of Salmon. For these rivers, the Limit Reference Point deposition rate of 1.52 eggs per m² is used and applied to estimates of wetted area (DFO 2018; Table 1). Egg requirements to 15 of these 19 rivers are less than 1.5 million eggs or roughly less than 270 large Salmon.

LIFE HISTORY CHARACTERISTICS

Smolt age varies from 90% two-year old smolts in the Nepisiguit River (Mowbray and Locke 1998) to 70% three-year old smolts in the Restigouche River. In the Restigouche River, the proportion of four-year old smolts was historically just under 10% (1972-1981; Pickard 1983). Since 2002, capture-mark-recapture experiments have allowed collecting scales samples in several tributaries and the main stem of the Restigouche River and are indicating that the large majority of smolts are three-years old (between 90 and 100% of scales depending on year and location). Two-year and four-year smolts are found in smaller proportion, between about 2-4% and, 2-6%, respectively (DFO, unpublished).

Since the mid-2000's, there has been a decrease in the amount of information collected regarding the life-histories of adult Salmon. This is partly due to the shift to catch and release angling in the NB side of the Restigouche River which reduces the opportunity to collect scales as well as the lack of adult monitoring program allowing for the handling of Salmon. Most of the information on sex ratio comes from the Restigouche River: small Salmon (< 63 cm fork length) are almost exclusively males (93.3%, 6809 small Salmon sexed from 1972 to 2016).

Large Salmon (>= 63 cm fork length) include a small number of one-sea-winter (1SW), two-sea-winter (2SW) and three-sea-winter (3SW) maiden spawners, as well as repeat spawners. Four-sea-winter (4SW) maiden Salmon have been interpreted from scales collected on Salmon from the Restigouche River (Peppar and Pickard 1975; Pickard 1983) and both 4SW and one sample of a five-sea-winter (5SW) maiden Salmon were reported from the Nepisiguit River (Mowbray

and Locke 1998). On average and based on sexed samples, the large Salmon group is mostly made of females (62%, 6731 large Salmon sexed from 1972 to 2011).

Adult Salmon in samples from the Restigouche River range in length from about 40 cm to over 120 cm (Fig. 2). By sea age history, one-sea-winter (1SW) Salmon have an average fork length of 54.5 cm (2.5-97.5 percentiles: 48.3 to 62.5 cm), 2SW maiden Salmon have an average fork length of 77 cm (2.5-97.5 percentiles: 67 to 88 cm), and 3SW maiden Salmon have an average of 92.5 cm fork length (2.5-97.5 percentiles:82 to 103 cm) (Fig. 3). Corresponding predicted mean whole weights of 1SW, 2SW and 3SW maiden Salmon are 1.6, 4.6, and 7.9 kg, respectively (Fig. 4). Repeat spawning Salmon are also commonly found in the rivers of this SFA with 11 years of spawning and sea migrations the oldest life history reported by Pickard (1983). Limited population monitoring does not allow the calculation of the mean generation time but given the importance of three-year-old smolts and the abundance of 1SW and 2SW Salmon in the adult returns, mean generation time (mean freshwater age + mean seas age +1) should be between five and six years. The latter is used in the rest of the document.

Egg to fecundity relationship for Restigouche River Salmon has been published by Randall (1989). Large Salmon (sexes combined) have a fecundity of about 5656 eggs per fish and small Salmon (sexes combined) have a fecundity of about 64 eggs per fish (DFO 2018).

Most Salmon return to the Restigouche prior to September 1 with the first bright Salmon in the river by mid to late May. Salmon continue to ascend to the spawning areas into October. Salmon are counted through the Jacquet River and Nepisiguit River counting facilities into late October. Smolts migrate from mid-May to Mid-June (Chaput et al. 2004; Peppar 1982).

Salmon from rivers in SFA 15 undertake long oceanic migrations as shown by recoveries of tagged Salmon from these rivers at West Greenland (see annual International Council for the Exploration of the Seas (ICES) Working Group on North Atlantic Salmon reports).

OVERVIEW OF DESIGNABLE UNITS (DU)

In the 2010 COSEWIC assessment (COSEWIC 2010), the Salmon populations of the Gaspé peninsula were grouped with Salmon populations of the DFO Gulf Region into one Designatable Unit, the southern Gulf DU. Recent genetic analyses and differences in biological traits (Lehnert et al. *in prep*[1]) suggest that the Gaspé populations are different than the rest of the southern gulf populations. According to this work, the Restigouche River population is classified as a Gaspé population and will be in a different DU than then rest of the SFA 15 rivers.

Stocking of several rivers of SFA 15 with Atlantic Salmon of various life stages has occurred since the government of the day established a fish culture facility on the Restigouche River in 1874 (Table 2). The Restigouche facility was operated by the government of Canada at subsequent locations in Deeside, Flatlands and Charlo in New Brunswick until it was divested to a private “not for profit” organization in 1998. This non-profit organization has continued to operate the Charlo hatchery and conduct similar stocking programs as the previous operator. A subsidiary hatchery facility also was established by the federal government on the Nepisiguit River in 1914 and operated for some years.

An examination of early reports indicates that most stocking occurred at the early life stages of fry, advanced fry and fingerlings. The reports also indicate that eyed Atlantic Salmon eggs were

[1] Lehnert, S.J., Bradbury, I.R., April, J., Wringe, B.F., Van Wyngaarden, M. ,and Bentzen, P. Pre-COSEWIC review of anadromous Atlantic Salmon (*Salmo salar*) in Canada, Part 1: Designatable units. DFO Can. Sci. Adv. Secr. Res. Doc. In preparation.

routinely transferred from one government hatchery facility to another. For example, it was common for eggs of Chaleur Bay and Restigouche origin to be transferred to hatcheries located at Grand Falls and Florenceville on the Saint John River system for grow out and stocking. Similarly, the reports indicate that eyed eggs of Miramichi origin were transferred to the Restigouche hatchery for grow out and stocking. These records also indicate that the majority of broodfish were of early run, captured near the New Brunswick shore of the Chaleur Bay and purchased from the commercial fishermen of the district and held and spawned at the government owned New Mills holding pond which had been constructed prior to 1919 (Department of Fisheries, Annual Report on Fish Culture 1937). Broodfish were also captured from the Restigouche River and held in the river in floating cages called pontoons prior to spawning from the early 1940's until the government holding pond was constructed in the early 1960's at Hailes Brook adjacent to the Restigouche River. In recent years, 1980 to present, Salmon from various tributary/river stocks were captured by various methods and the subsequent progeny utilized in area specific Salmon enhancement programs.

Hatchery stocking was especially important in the Nepisiguit River while modest stocking programs occurred in the Restigouche River. An active stocking program has been carried out in the Nepisiguit River for the past four decades, initially to restore the population following a spill of mining waste and overfishing, and subsequently for enhancement purposes (Locke 1998). Stocking still occurs in the Nepisiguit and Restigouche rivers. Returns to the Restigouche River from stocking programs are considered to be less than 1% of total returns. Hatchery-origin Salmon have represented important proportions of the returns to the Nepisiguit River, as high as 75% of both small and large Salmon (Locke et al. 1994) but the hatchery contribution to this river is much reduced in recent years (Chaput et al. 2006). In recent years, stocked fish have stopped being marked making it challenging to evaluate the contribution of this program to the entire population.

TRENDS IN POPULATION INDICATORS

DESCRIPTION OF THE INDICATORS

Information on adult Salmon abundance comes primarily from angling catches and effort (Table 3). Abundance of adult Salmon in the Restigouche River is inferred from angling catches, counts at headwater barriers, and when possible from end of year spawner counts by snorkeling (Tables 4, 5, 6; Chaput et al. 2000). Counts of Salmon to a headwater tributary are available for two tributaries of the Restigouche River (Table 4; details in Chaput et al. 2000). A counting barrier on the Jacquet River near the head of tide provides incomplete counts of adults in most years (Table 4). A counting fence has been operated on the Nepisiguit River over the past four decades but installation dates, operational details and washouts have compromised the completeness of the data (Locke et al. 1994; Locke et al. 1997a, b). Juvenile surveys have been conducted annually in the Restigouche River since 1972 (Tables 7 – 9) and abundance indices of juveniles are available for some years from the Jacquet River and the Nepisiguit River. While sampling techniques across rivers are similar, protocols and estimation methods of juvenile abundance are not necessarily standardized across organizations leading to challenges in comparing abundance levels between and sometimes within rivers.

In the Restigouche River, smolt monitoring programs began in 2002 to assess the production and biological characteristics of smolts from the Restigouche River and some of its tributaries (Chaput et al. 2004).

Abundance and trends are evaluated relative to the recent 19 years, 2001 to 2019. This time period has been chosen because it roughly represents three generations, the time period

required by COSEWIC (2015) to assess population trends. Abundances are also put in context of the longer time period when available. Trend in an abundance index (Ln(Index)) is characterized as the instantaneous rate of change (Z) over the period 2001 to 2019 With the percent change calculated as $100*(\exp^{Z*19}-1)$.

TRENDS OF THE INDICATORS

Adult returns

The Northwest Upsalquitch fence operated as a counting fence until 2012. The only count available for the Restigouche river in recent years comes from the Causapcal River (tributary of the Matapedia). Over the last 19 years there has been a significant decline in the amount of small Salmon counted at these two fences. At the Upsalquitch fence, while there was no significant decrease of large Salmon in the last 19 years, counts were much higher during the mid-80s to mid-90's time period (Table 3; Fig. 5).

Capture and Catch per unit effort (CPUE) indices from the recreational fishery for large Salmon decreased by about 30% in the Matapedia River (QC). Note that since 2000, release of Salmon has been encouraged in Quebec. However, the percentage of small and large Salmon released is only available from 2016 to 2019 and, the average proportions are used for the rest of the time-series. Additionally, since 2016 and a new Atlantic Salmon management plan in Quebec (Ministère des Forêts, de la Faune et des Parcs 2016), the retention of large Salmon has been reduced which could partly explain the decline in catches.

On average, about 7,000 Salmon (small and large) are angled annually in the Restigouche River (Table 3; Fig. 6, included released fish). In the last five years, about 5,500 Salmon were angled annually but this number could be an underestimate since some private camps have stopped reporting their captures.

Over the last three decades, assessment data have also been collected from the Jacquet River and the Nepisiguit River. 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 (Table 4). Adult abundance in the Jacquet River had exceeded the conservation requirement defined at that time at the start of the time series but in recent years, its status relative to reference points is unknown due to incomplete data (Fig. 5).

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. 1997a, b]. In recent years, number of fish captured at the fence has been variable and suggest that conservation requirements are not achieved (Table 1).

There are no measures of marine return rates for any rivers in this area.

Freshwater production

Juvenile abundance in the Restigouche River has been monitored annually since 1972. A recent effort to standardize density estimation allows the estimation of comparable densities throughout the whole Restigouche watershed (Dauphin et al. 2019, 2021). Densities of fry, small parr and large parr all increased post-1984 and seem to have declined during the 2000's and have been at the same level in the last 13 years (Figs. 7 - 9; Tables 7 - 9). Notable exception is the significant increase of large parr densities in most of the tributaries sampled. However, this needs to be put in the context of very low densities (i.e. less than 5 individuals per 100 m^2 to about 5 individuals per 100 m^2).

Smolt production has been assessed since 2002 in several tributaries of the Restigouche and for the whole watershed through capture-mark-recapture experiments (Dauphin, in prep.[2]). The current assessment ignores the fact that some years, the earlier part of the smolt run could not be sampled. Smolt production in the Kedgwick River varies between 50 and 250 thousand smolts with low abundances in the last four years (Fig. 10; Table 10). The Restigouche smolt production has declined by about 60% in the last 19 years with a production of about 400 thousand smolts in the last four years (Fig. 10; Table 11).

Salmon fry densities in the Nepisiguit River increased between the 1980s and the 2000s and seem to be varying with no significant trends in the recent years whereas parr abundance has declined (Fig. 11). However, similarly to the Restigouche River, this has to be put in the context of low densities. Juvenile abundances in the Jacquet River are only available until 2014 and during the last 13 years of available data the densities of fry and parr were on a declining trend (Fig. 12).

For all rivers, electrofishing sampling sites are usually chosen based on habitat suitability for juvenile Atlantic Salmon rearing and ease of access for sampling crews. This site selection process can be a source of bias when upscaling densities at the site-scale to the watershed-scale.

TRENDS IN DISTRIBUTION AND DECLINE OR FLUCTUATIONS (COSEWIC CRITERION B)

There are 32 rivers in this area with potential habitat for Salmon. As of 2018, 19 of these rivers had presence of Salmon confirmed. For these rivers, the Limit Reference Point (LRP) deposition rate of 1.52 eggs per m² is used and applied to estimates of wetted area (DFO 2018; Table 1). The largest river in this area is the Restigouche River with a total fluvial area of 31.51 million m² (26.39 million m² when excluding the Matapedia River, QC). Egg requirements to 15 of these 20 rivers are less than 1.5 million eggs or roughly less than 270 large Salmon. Additionally, Little River, which was considered polluted by effluent from a now closed mine seems to have improved biological characteristics (Minnow 2017) and has been stocked with juvenile Atlantic Salmon in the last few years (there are currently no egg requirement for this river). As of 2020, the sampling exercise conducted in 2008 to assess the presence of juvenile Atlantic Salmon across SFA 15 rivers has not been repeated and therefore there are no recent updates regarding the presence/absence of juveniles for the rivers who do not benefit of yearly monitoring program (e.g. Restigouche and Nepisiguit Rivers). As an illustration of typical sampling occurring in SFA 15, the presence/absence of juveniles in rivers sampled in 2019 is summarized in Figure 13.

Juvenile Salmon are distributed throughout SFA 15 and were found at various abundance levels in all rivers sampled in 2019. In many rivers surveyed, two or three cohorts (fry, small parr, large parr) were captured indicating that there had been multiple years of spawning success (Fig. 13).

Long term juvenile abundance surveys completed on Restigouche (New Brunswick) provide an indication of the temporal changes in juvenile Salmon presence and abundance, from 1972 to 2019. In the Restigouche River, there has been varying levels of site occupancy by Salmon fry with no trend in the proportion of sites sampled which had densities > 1.0 fish per 100 m². (Fig. 14). There was a significant increasing trend in the proportion of sites which had large parr (age-2+ years) at densities greater than 1 fish per 100 m² (Fig. 14).

[2] Dauphin, G. J. R. Estimating Atlantic salmon smolt abundance in a large Canadian catchment using multiple rotary screw traps. Manuscript in preparation.

ESTIMATE OF TOTAL POPULATION SIZE

RESTIGOUCHE RIVER

In the Restigouche River, based on the requirement of about 7,000 large Salmon (DFO 2018) and an assumed catch rate of 40% in the angling fishery (Randall et al. 1990), the Limit Reference Point would have been met in 4 of 13 years since 2007 (Table 1). Additionally, since 1999, snorkel counts are conducted in the Restigouche River (excluding the Matapedia River). During the last 13 years (2007-2019), snorkel counts were complete in 11 years and, based on these counts, the LRP was met once during these years. Spawning escapements under the LRP are consistent with lower fry densities in some tributaries (Fig. 7; Table 7) of the Restigouche as well as a decrease in the smolt production (Fig. 10; Tables 10-11).

There are uncertainties associated with both methodologies used to derive spawning escapement: the angling catch rate is likely to change over years and in recent years, some private camps have stopped reporting their catches; snorkel counts are subject to environmental conditions and are likely a proxy for the minimum number of spawners present in the rivers.

SFA 15

Estimates of total abundance (returns and spawners) of adult Salmon in SFA 15 are derived from indicators in the Restigouche River, the major river in this area. The returns and spawners are estimated for the Restigouche River, exclusive of returns to the Matapedia River which are included in Quebec zone Q1.

The Restigouche River stock assessment is based on angling catch with assumed exploitation rate between 30% (min.) and 50% (max) with estuary catches added to the estimates of returns. Catch and release for large and small Salmon was implemented in SFA 15 in 1984 and 2015, respectively. Catch and release mortality is assumed to be 6%. Since the mid-1990s the First Nation catches are not reported and an average value is used, an important source of uncertainty.

Return and spawner estimates for SFA 15 are based on Restigouche River data, scaled up for SFA 15 based on the average ratio of total SFA 15 to Restigouche River angling catches (1.235 and 1.145 for small and large Salmon, respectively). The minimum and maximum return and spawner estimates are derived from the minimum and maximum angling catch rate (min = 30%; max = 50%) (Fig. 15). Additionally, the Restigouche River snorkel counts are scaled up for SFA 15 based on the ratio of total SFA 15 to Restigouche fluvial area.

The estimated abundance of small Salmon and large Salmon combined (returns) has been variable throughout the time-series, oscillating around 15 thousand fish with a maximum of 30 thousand fish during in 1988 and 2011. In the recent five years, the average abundance has declined to 12 thousand fish (Fig. 15). Estimated total abundance in SFA 15 of small Salmon has decreased by 42% and for large Salmon by 21% over the past 19 years (Fig. 15). There is a large variability in estimates of small and large Salmon returns which are driven by the range of angling catch rate used to produce the minimum and maximum estimates.

THREATS

In the context of the identification and management for species at risk, a threat, is ‘an activity or process (both natural and anthropogenic) that has caused, is causing, or may cause harm, death, or behavioral changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur’ (Environment Canada 2006). In essence, it is an activity that imposes a stress on a species at risk population

which contributes to or perpetuates its decline, or limits its recovery. In the case of Atlantic Salmon, the elevated marine mortality and declining returns in recent years are stress caused by unknown (but hypothesized) threats.

A semi-quantitative assessment of the impact of habitat-related threats to Salmon is summarized in Table 12. The principal threats are: habitat alteration including habitat fragmentation due to non-compliant culverts and mining and forestry activities (DFO and MNRF 2009). Following the classification described in Master et al. (2012) these threats impact are classified as “High”. Ecosystem changes, fish diseases, aboriginal fisheries (i.e. the lack of reporting) and illegal fishing are classified as “Medium”. This would put the SFA under a very high overall threat impact.

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 restricted to First Nations fisheries and from incidental mortalities associated with catch and release fisheries. The reports of First Nations catches of Salmon in SFA 15 available to DFO are limited and/or incomplete. Based on fisheries and abundance values used in assessments since 2000, about 20% of large Salmon (range 7 - 30%) are lost to First Nations Fisheries.

In the recreational fishery, mandatory catch and release of large Salmon has been in effect since 1984 in the rivers of SFA 15 (Restigouche NB exclusive of Matapedia and portions of Patapedia). A catch and release mortality rate of 6% has been defined from studies on the Restigouche River (Courtenay et al. 1991) and is used for all recreational fisheries in SFA 15.

At an assumed exploitation rate of 40% (30% to 50% range), the losses of large Salmon from catch and release is assumed to be 2.4% (1.8% to 3.0%) of the returns to freshwater. Under these hypotheses the exploitation on egg bearing females is thus expected to be low to moderate (Table 12). However, in the context of global climate change and increasing temperatures, catch and release mortality could be and/or become higher (e.g. Van Leeuwen et al. 2020).

MIXED STOCK MARINE FISHERIES

Saint Pierre and Miquelon fishery

A marine fishery for Atlantic Salmon using gillnets takes place along the coast of the islands of Saint Pierre and Miquelon (SPM; France), off the south coast of Newfoundland. There are no anadromous Salmon producing rivers in the islands of SPM. Annual reported harvests have generally been less than 3 tonnes (t) with a peak reported harvest of 5.3 t in 2013; the reported harvest in 2019 was 1.3 t (Fig. 16). The estimated number of fish harvested annually varies dependent on the quantity of small Salmon and large Salmon in the catches. There is insufficient information from the sampling program to reliably estimate Salmon catch numbers but based on available information, the harvest of Salmon in number of fish has ranged from a low of just under 300 fish to a high of 1,800 fish size groups combined (Fig. 16)

Based on genetic analyses, the Salmon sampled from the fisheries catches in SPM come predominantly from three regional groups: southern Gulf group (part of SFA 15, all of SFAs 16 to 19), Quebec (including the Gaspé regional group that includes the Restigouche

River of SFA 15) and the Newfoundland regional group (Bradbury et al. 2016a). The proportions of the annual samples which were assigned to the Quebec reporting group ranged from 0.20 to over 0.50, for the period 2004 to 2017 (Fig. 16). The proportions of the fishery samples assigned to the Gulf reporting group (based on a single nucleotide polymorphism (SNP) panel of markers) was 0.30 in 2019 (ICES 2020).

Labrador subsistence fisheries

Historically, Atlantic Salmon originating from rivers of SFA 15 were recovered in the commercial fisheries of Newfoundland and Labrador. The commercial fishery in Newfoundland closed in 1992 and the commercial fishery in Labrador closed in 1998. Since 1998, there are four Indigenous communities with food social and ceremonial fisheries for Atlantic Salmon and there is a licensed subsistence food fishery for residents of Labrador in which a bycatch allocation of Salmon is provided. These fisheries take place in the estuaries and coastal areas of Labrador using gillnets.

The fishery is sampled for biological characteristics and tissue samples are collected for determination of the origin of Salmon in the catches. Over the period of analyses, 2006 to 2019, the estimated origin of the samples of the catches was dominated (> 95%) by the Labrador reporting groups. No samples have been assigned to the Gulf reporting group (Bradbury et al. 2015, 2018; ICES 2020).

West Greenland

The Atlantic Salmon fishery at West Greenland takes place on mixed stocks of Atlantic Salmon originating from rivers of eastern North America and Europe, with varying annual proportions of the catches from the two continents (Bradbury et al. 2016b; ICES 2020). Atlantic Salmon originating from rivers of SFA 15 undertake high seas feeding migrations to the Labrador Sea and are intercepted in the mixed stock fisheries at West Greenland, mostly during their second summer at sea and as repeat spawners. The fishery at West Greenland had peak reported catches of 2679 t in 1971 but the fishery catches have declined to generally less than 50 t since 1998. The number of Salmon originating from rivers of eastern North America harvested annually at West Greenland has ranged from 5,100 to 13,500 fish during the recent 10 years (ICES 2020). The majority (> 95%) of the Salmon harvested at West Greenland are characterized as 1SW non maturing Salmon, fish which would mostly have returned to rivers as 2SW Salmon if they had survived their second year at sea.

The exploitation rate at West Greenland on Salmon of North American origin, estimated as the ratio of the catch of 1SW non-maturing Salmon of North American origin divided by the estimated pre-fishery abundance of North American origin 1SW non maturing Salmon in the North Atlantic just prior (Aug. 1) to the fishery, declined from peak exploitation rates of just over 40% in the early 1970s to oscillating values around 10% since the early 2000s (ICES 2020). The exploitation rate on North American origin Salmon for the most recent year, 2018 catches, was estimated at 13.2% (ICES 2020).

Genetic stock identification using microsatellite markers initially and SNP panels in recent years have consistently shown that the sampled catches at West Greenland originate primarily from three regions of eastern Canada including Labrador, southern Gulf reporting group, and Quebec reporting groups (Bradbury et al. 2015; ICES 2018, 2020). The Gaspé reporting group represented 26% of the samples of North American origin Salmon in 2019 (ICES 2020).

HABITAT ALTERATIONS

Forestry, agriculture, and rural development all impact in various ways the fresh water habitat of Atlantic Salmon in this SFA.

One pulp mill is present on the Restigouche River (Atholville), its operation requires water intake and the release of a treated effluent in the Restigouche River.

There are several zinc-lead-silver-copper-gold mines located in the Bathurst mining camp area (about 50 km west of Bathurst). Due to the nature of these activities there are potential risks of chemically contaminated water spills. The Little River (Bathurst area) which has been exposed to a toxic mine effluent for years seem to show an improvement in its biological characteristics since the mine's closure in 2013 (Minnow 2017). In the last two years, instream incubators have been used to stock the Little River with juvenile Atlantic Salmon and small numbers of fry and parr have been found during the electrofishing sampling.

Several rivers in this area have natural impassable falls at varying distances from the ocean, limiting access to Salmon: South Charlo River, Millstream, Tetagouche River, Nepisiguit River.

There are a few rivers and tributaries with water control structures which impede the migration of Atlantic Salmon. These are located at the mouth of the Charlo River and the Eel River approximately five kilometers upstream from the mouth. The Eel River dam was dismantled in 2010. Dewatering of juvenile rearing areas during low flow conditions happens frequently in a short portion of the Charlo River.

TRANSPORT AND NOISE

There are several harbors in the area (e.g. Dalhousie, Belledune). Additionally, at times there are important boating activities on the river with unknown impact on Salmon population and habitat.

ECOSYSTEM CHANGE

Within the context of global climate changes, the occurrence of warm water temperatures and low water level events seems more frequent. These events likely have effects on a cold-water species such as Atlantic Salmon. In recent years, warm water protocols have been developed in the Nepisiguit and Restigouche River to reduce or stop angling when water temperatures reach a certain threshold.

DISEASE

There is a history of outbreaks of the fish disease furunculosis, caused by the bacterium *Aeromonas salmonicida* in the Restigouche River and the disease is considered ubiquitous in this river. Mortalities on Salmon in the Restigouche River were most important in the 1970s when hundreds of fish were reported dead during warm and low water events. Since then, annual reported mortalities have declined despite the confirmed presence of furunculosis in some diagnosed fish. The fungal pathogen *saprolegnia* has been occasionally associated with adult mortalities ranging from a dozen to several hundred individuals on a given year.

REFERENCES CITED

Anonymous. 1978. Biological Conservation Subcommittee Report. Prep. for Atlantic Salmon Review Task Force. 203 p.

Bradbury, I., Hamilton, L., Rafferty, S., Meerburg, D., Poole, R., Dempson, J. B., *et al*. 2015. Genetic evidence of local exploitation of Atlantic salmon in a coastal subsistence fishery in the Northwest Atlantic. Canadian Journal of Fisheries and Aquatic Sciences, 72: 83–95.

Bradbury, I.R., Hamilton, L.C., Chaput, G., Robertson, M.J., Goraguer, H., Walsh, A., Morris, V., et al. 2016a. Genetic mixed stock analysis of an interceptory Atlantic salmon fishery in the Northwest Atlantic. Fisheries Research 174: 234–244.

Bradbury, I.R., Hamilton, L.C., Sheehan, T.F., Chaput, G., Robertson, M.J., Dempson, J.B., Reddin, D., Morris, V., King, T., and Bernatchez, L. 2016b. Genetic mixed-stock analysis disentangles spatial and temporal variation in composition of the West Greenland Atlantic Salmon fishery. *ICES J. Mar. Sci. 73:* 2311-2321.

Bradbury, I.R., Wringe, B.F., Watson, B., Paterson, I., Horne, J., Beiko, R., Lehnert, S.J., Clément, M., Anderson, E.C., Jeffery, N.W., Duffy, S., Sylvester, E., Robertson, M., and Bentzen, P. 2018. Genotyping-by-sequencing of genome-wide microsatellite loci reveals fine-scale harvest composition in a coastal Atlantic salmon fishery. Evolutionary Applications.

Cairns, D.K. (ed.) 2001. An evaluation of possible causes of the decline in pre-fishery abundance of North American Atlantic salmon. Can. Tech. Rep. Fish. Aquat. Sci. No. 2358.

Chaput, G., M. Arsenault, I. Benwell, P. Cameron, C. Connell, M. Mathews, and Listiguij First Nation. 2004. Atlantic salmon (*Salmo salar* L.) smolt production estimates and biological characteristics from tributaries and the Restigouche River, 2002 and 2003. DFO CSAS Res. Doc. 2004/051.

Chaput, G., P. Cameron, D. Moore, D. Cairns and P. LeBlanc. 2006. Stock Status of Atlantic Salmon (*Salmo salar* L.) from rivers of the Gulf Region, SFA 15 to 18. DFO Can. Sci. Adv. Secr. Res. Doc. 2006/023. 31 p.

Chaput, G., R. Pickard, M. Arsenault, J.-P. Le bel, and P. D'Amours. 2000. Stock status of Atlantic salmon (*Salmo salar*) in the Restigouche River, 1999. DFO CSAS Res. Doc. 2000/001.

COSEWIC. 2010. COSEWIC assessment and status report on the Atlantic Salmon Salmo salar (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Quebec Western North Shore population, Anticosti Island population, Inner St. Lawrence population, Lake Ontario population, Gaspé-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp.

COSEWIC. 2015. COSEWIC Assessment Process, Categories and Guidelines. 15 pp.

Courtenay, S.C., G. Landry, A. Madden and R. Pickard. 1991. Status of Atlantic salmon in the Restigouche River in 1990. CAFSAC Res. Doc. 91/13.

Dauphin, G.J.R., Chaput, G., Breau, C. and Cunjak, R. 2019. Hierarchical model detects decadal changes in calibration relationships of single-pass electrofishing indices of abundance of Atlantic salmon in two large Canadian catchments. Can. J. Fish. Aquat. Sci. 76(4): 523-542.

Dauphin, G.J.R., Arsenault, M., Benwell, I., Biron, M., Cameron, P., Olive, A., Pickard, R. and Chaput G. 2021. Juvenile Atlantic salmon (*Salmo salar*) monitoring activities in the Restigouche River (Southern Gulf of St. Lawrence, Canada) 1972 to 2019. Can. Dat. Rep. Fish. Aquat. Sci. No. 1321.

Department of Fisheries. 1937. Annual Report on Fish culture 1937

DFO. 2018. Limit reference points for Atlantic salmon rivers in DFO Gulf region. DFO Can. Sci. Adv. Secr. Science Response 2018/015

DFO and MNRF. 2009. Conservation Status Report: Atlantic salmon in Atlantic Canada and Québec PART II Anthropogenic Considerations. Can. Man. Rep. Fish Aquat. Sci. No. 2870.

Environment Canada. 2006. Guidelines on identifying and mitigating threats to species at risk (Draft Sept 27, 2006) pp1-29. *In* Species at Risk Act Implementation Guidance.

ICES. 2018. Report of the Working Group on North Atlantic Salmon (WGNAS), 4–13 April 2018, Woods Hole, MA, USA. ICES CM 2018/ACOM:21. 386 pp.

ICES. 2020. Working Group on North Atlantic Salmon (WGNAS). ICES Scientific Reports. 2:21. 357 pp.

Locke, A. 1998. Modeling the effects of post-stocking survival rates on the success of stocking hatchery Atlantic salmon in a New Brunswick river. North Am. J. Fish. Manage. 18: 547-560.

Locke, A., F. Mowbray, and R.R. Claytor. 1994. Status of Atlantic salmon in the Nepisiguit River, New Brunswick in 1982-1993. DFO Atlantic Fisheries Res. Doc. 94/3.

Locke, A., F. Mowbray, and A. Madden. 1997a. Status of Atlantic salmon in the Nepisiguit and Jacquet rivers, New Brunswick, in 1996. DFO Can. Sci. Adv. Secr. Res. Doc. 97/17.

Locke, A., F. Mowbray, and A. Madden. 1997b. Status of Atlantic salmon in the Nepisiguit and Jacquet rivers, New Brunswick, in 1997. DFO Can. Sci. Adv. Secr. Res. Doc. 98/43.

Master L, Faber-Langendoen D, Bittman R, Hammerson GA, Heidel B, Ramsay L, Snow K, Teucher A, and Tomaino A. 2012. NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk. NatureServe, Arlington, VA.

Ministère des Forêts, de la Faune et des Parcs. 2016. Plan de gestion du saumon atlantique 2016-2026, ministère des Forêts, de la Faune et des Parcs, Direction générale de l'expertise sur la faune et ses habitats, Direction de la faune aquatique, Québec, 40 p.

Minnow (Minnow Environmental Inc.). 2017. Brunswick mine closure environmental effects monitoring (2015) study. Report Prepared for Glencore Canada, Brunswick No. 12

Mowbray, F.K. and A. Locke. 1998. Biological characteristics of Atlantic salmon (*Salmo salar* L.) in the Nepisiguit River, New Brunswick, 1982-1996. Can. Tech. Rep. Fish. Aquat. Sci. 2236: iv + 32 p.

Peppar, J.L. 1982. Atlantic salmon smolt investigations, Restigouche River System, New Brunswick. Can. Manus. Rep. Fish. Aquat. Sci. No. 1641. vii + 15 p.

Peppar, J.L. and P.R. Pickard. 1975. Ages at migration of Atlantic salmon in the Restigouche River. Resource Development Branch, Maritimes Region Data Record Series No. MAR/D-75-8. 7 p.

Pickard, P.R. 1983. Ages of adult Atlantic salmon, sampled from various Restigouche River sources, 1972-81. Can. Data Rep. Fish. Aquat. Sci. No. 420.vii + 25 p.

Randall, R.G. 1984. Number of salmon required for spawning in the Restigouche River, N.B. CAFSAC Res. Doc. 84/16.

Randall, R.G. 1989. Effect of sea age on the reproductive potential of Atlantic salmon (*Salmo salar*) in eastern Canada. Can. J. Fish. Aquat. Sci. 46: 2210-2218.

Randall, R.G, G. Landry, A. Madden and R. Pickard. 1990. Status of Atlantic salmon salmon in the Restigouche River in 1989. CAFSAC Res. Doc. 90/2.

Van Leeuwen, T.E., J.B. Dempson, C.M. Burke, N.I. Kelly, M.J. Robertson, R.J. Lennox, T.B Havn, M. Svenning, R. Hinks, M.M. Guzzo, E.B. Thorstad, C.F. Purchase and Bates A.E. 2020. Mortality of Atlantic salmon after catch and release angling: assessment of a recreational Atlantic salmon fishery in a changing climate. Can. J. Fish. Aquat. Sci. 77: 1518-1528.

TABLES

Table 1. River characteristics for Salmon Fishing Area 15. Source of evidence of Salmon presence include adult sampling (Adult), from juvenile monitoring (Juvenile) or from angling catches (Angling). Presence/absence for juveniles was surveyed in 2008. Fluvial area estimate references are: 1 – DFO Science Gulf Region (Unpubl. data); 2 – Anonymous (1978); 3 - Drainage area from Data Warehouse Report Sept. 2014; fluvial area based on proportion equal to 0.0015 of watershed area (average of seven index rivers from Anonymous 1978). Biological data is not available for each river therefore reference rivers are used: River 1 – Restigouche; Rivers 2-29: Nepisiguit; Rivers 30-32: Tabusintac. X: presence confirmed in 2019, (X): presence confirmed during the 2008 electrofishing sampling campaign but not repeated since.

Map index number	River	Longitude (W)	Latitude (N)	Drainage area (km²)	Fluvial area (million m²)	Fluvial area estimate reference	Prop. Eggs from large Salmon	LRP (eggs million)	Adult	Juvenile	Angling
1	Restigouche	-66.7830	47.9910	6,589	31.51	1	0.993	47.895	X	X	X
2	Eel River	-66.3667	48.0167	217	0.422	2	0.928	0.641	X	X	X
3	Charlo	-66.2833	47.9833	282	0.423	3	0.928	0.643	X	X	X
4	South Charlo	-66.2825	47.9851	118	0.177	3	0.928	0.269	na	(X)	na
5	Blackland Brook	-66.2131	47.9717	na	na	na	0.928	na	na	na	na
6	New Mills	-66.1841	47.9677	na	na	na	0.928	na	na	na	na
7	Benjamin	-66.1667	47.9667	161	0.242	3	0.928	0.366	na	(X)	na
8	Nash Creek	-66.0846	47.9232	na	na	na	0.928	na	na	na	na
9	Louison River	-66.0633	47.9270	142	0.213	3	0.928	0.324	na	(X)	na
10	Jacquet	-66.0167	47.9167	510	1.135	2	0.928	1.725	X	X	X
11	Armstrong Brook	-65.9870	47.9151	na	na	na	0.928	na	na	na	na
12	Patapat Brook (Belledune)	-65.8919	47.9126	na	na	na	0.928	na	na	na	na
13	Fournier Brook	-65.7613	47.8522	na	na	na	0.928	na	na	na	na
14	Elmtree River	-65.7319	47.8046	297	0.446	3	0.928	0.678	na	X	na
15	Little Elmtree River	-65.7235	47.7933	na	na	na	0.928	na	na	na	na
16	Nigadoo	-65.7167	47.7500	168	0.252	3	0.928	0.383	na	X	X
17	Millstream	-65.7000	47.7000	229	0.344	3	0.928	0.523	na	X	X
18	Peters River	-65.6849	47.6652	na	na	na	0.928	na	na	na	na
19	Tetagouche	-65.6833	47.6333	364	0.299	2	0.928	0.455	na	X	X
20	Middle (Gloucester co)	-65.6667	47.6000	401	0.950	2	0.928	1.444	na	X	X
21	Little River	-65.6691	47.5956	na	na	na	0.928	na	na	stocking	na
22	Nepisiguit	-65.6333	47.6167	2,312	3.973	2	0.928	6.039	X	X	X
23	Bass (Gloucester co)	-65.5833	47.6667	198	0.297	3	0.928	0.451	na	X	X
24	Miller Brook	-65.5036	47.6686	na	na	na	0.928	na	na	na	na
25	Teagues Brook	-65.4492	47.6891	237	0.356	3	0.928	0.541	na	(X)	na
26	Little Pokeshaw River	-65.2867	47.7837	na	na	na	0.928	na	na	na	na
27	Pokeshaw River	-65.2469	47.7842	na	na	na	0.928	na	na	na	na

Map index number	River	Longitude (W)	Latitude (N)	Drainage area (km²)	Fluvial area (million m²)	Fluvial area estimate reference	Prop. Eggs from large Salmon	LRP (eggs million)	Adult	Juvenile	Angling
28	Riviere du nord	-65.1268	47.7872	na	na	na	0.928	na	na	na	na
29	Caraquet	-65.0667	47.7833	373	0.556	3	0.928	0.851	X	X	X
30	Pokemouche	-64.8000	47.6667	481	0.248	2	0.967	0.377	X	X	X
31	Little Tracadie	-64.9000	47.5167	192	0.288	3	0.967	0.438	na	X	X
32	Tracadie	-64.8667	47.4833	527	0.601	2	0.967	0.914	X	X	X

Table 2. Stocking activities history for rivers of SFA 15.

River	Longitude (W)	Latitude (N)	Origin of fish stocked	Life stages of fish stocked	Range in annual numbers of fish stocked	Range in years when stocking occurred
Restigouche	-66.3333	43.0667	Chaleur Bay & Restigouche	Fry, parr	50,000 – 2,200,000	1875-1975
			Restigouche	Fry, parr	5,000 – 600,000	1977-2019 no stocking 1976, 1978-82
Charlo	-66.2833	47.9833	Chaleur Bay & Restigouche	Fry, parr	13,000-128,000	1962-1968
South Charlo	-66.2825	47.9851	Chaleur Bay & Restigouche	Fry, parr	200-34,000	1961-1970
Jacquet	-66.0167	47.9167	Chaleur Bay & Restigouche	Fry, parr	2,000 – 355,000	~1937-1972
			Jacquet	Fry, parr	5,000-37,000	1996-2008
Tetagouche	-65.6833	47.6333	Chaleur Bay & Restigouche	Fry, Parr	7,000-145,000	1958-1975
			Nepisiguit	Fry	2,400 - 50,000	1994-2003
Middle (Gloucester co)	-65.6667	47.6000	Chaleur Bay & Restigouche	Fry, parr	5,000 – 146,000	~1937-1967
Nepisiguit	-65.6333	47.6167	Chaleur Bay & Restigouche	Fry, parr	1,000 - 600,000	1914 -1975
			Restigouche	Fry, parr, smolts	16,000 – 160,000	1982-1985
			Miramichi	Fry, parr, smolts	8,000 – 770,000	1981-1986
			Nepisiguit	Fry, parr, smolts	6,000 – 850,000	1976-2019
Bass (Gloucester co)	-65.5833	47.6667	Chaleur Bay & Restigouche	Fry, parr	500-118,000	1962-1969
Caraquet	-65.0667	47.7833	Chaleur Bay & Restigouche	Fry, parr	6,000-19,000	1968-1971
Little Tracadie	-64.9000	47.5167	Chaleur Bay & Restigouche	Fry, parr	6,000-19,000	1968-1971
Tracadie	-64.8667	47.4833	Chaleur Bay & Restigouche	Fry, parr	1,000-241,000	1958-1973
			Tracadie	Fry, parr	4,500	1993-1994

Table 3. Angling catch and effort from the Restigouche River 1982 to 2008. NB refers to the Restigouche River excluding the Matapedia River. Data for 2008 are preliminary.

Year	Large Salmon				Small Salmon				Effort		
	NB	Matapedia		Total	NB	Matapedia		Total	NB	Matapedia	Total
		Catch	Release			Catch	Release				
1982	1,623	841	na	2,464	2,538	259	na	2,797	10,998	na	10,998
1983	1,553	456	na	2,009	731	154	na	885	10,301	na	10,301
1984	1,667	560	na	2,227	1,411	285	na	1,696	8,085	4,852	12,937
1985	3,539	807	na	4,346	3,202	291	na	3,493	11,272	5,581	16,853
1986	4,642	1,289	na	5,931	4,717	389	na	5,106	11,010	6,888	17,898
1987	3,026	915	na	3,941	4,137	602	na	4,739	11,127	7,816	18,943
1988	4,366	1,068	na	5,434	5,644	680	na	6,324	11,998	7,457	19,455
1989	3,373	1,119	na	4,492	2,849	466	na	3,315	10,313	7,816	18,129
1990	2,762	856	na	3,618	3,498	718	na	4,216	12,007	7,064	19,071
1991	2,062	940	na	3,002	1,967	521	na	2,488	9,831	6,650	16,481
1992	3,227	966	na	4,193	4,015	693	na	4,708	10,643	6,271	16,914
1993	1,494	505	na	1,999	2,567	735	na	3,302	10,748	6,052	16,800
1994	2,908	917	na	3,825	4,070	822	na	4,892	10,764	8,093	18,857
1995	1,868	829	na	2,697	1,318	337	na	1,655	10,524	6,404	16,928
1996	2,756	922	na	3,678	2,759	721	na	3,480	11,287	7,001	18,288
1997	1,712	689	na	2,401	2,590	450	na	3,040	11,970	7,565	19,535
1998	1,116	441	na	1,557	2,578	650	na	3,228	11,966	6,907	18,873
1999	1,144	587	na	1,731	2,103	707	na	2,810	11,380	6,391	17,771
2000	1,473	683	344	2,500	3,359	853	104	4,316	8,780	7,252	16,032
2001	2,618	1,067	361	4,046	2,270	615	109	2,994	8,094	7,927	16,021
2002	1,547	507	445	2,499	5,206	1,317	134	6,657	8,033	8,467	16,500
2003	2,772	891	250	3,913	1,447	531	75	2,053	9,174	8,545	17,719
2004	2,097	840	319	3,256	5,595	1,153	97	6,845	10,087	8,573	18,660
2005	2,408	909	219	3,536	1,710	579	66	2,355	8,088	8,742	16,830
2006	1,838	633	296	2,767	4,256	1,025	89	5,370	8,102	8,670	16,772
2007	3,014	765	211	3,990	2,032	438	64	2,534	9,458	7,968	17,426
2008	2,047	513	264	2,824	6,486	1,099	80	7,665	7,764	8,329	16,093
2009	2,803	744	232	3,779	2,445	543	70	3,058	9,388	7,682	17,070
2010	2,082	791	329	3,202	3,777	727	100	4,604	8,290	8,087	16,377
2011	5,431	1,239	366	7,036	4,814	820	110	5,745	8,493	9,391	17,884
2012	2,222	600	130	2,952	2,027	402	39	2,468	7,434	7,860	15,294
2013	3,938	1,092	196	5,226	2,287	431	59	2,777	8,504	8,513	17,017
2014	1,943	584	290	2,817	1,811	388	87	2,286	7,841	9,069	16,910
2015	2,426	675	290	3,391	2,931	733	87	3,752	7,167	8,753	15,920
2016	2,149	118	725	2,993	1,863	407	72	2,341	6,250	7,058	13,308
2017	1,681	324	528	2,533	1,711	371	124	2,206	6,083	7,874	13,957
2018	1,338	194	416	1,947	2,123	692	368	3,183	5,964	8,351	14,315

Year	Large Salmon				Small Salmon				Effort		
	NB	Matapedia		Total	NB	Matapedia		Total	NB	Matapedia	Total
		Catch	Release			Catch	Release				
2019	1,557	84	767	2,408	1,866	561	256	2,683	5,394	8,778	14,172

Table 4. Annual counts of small Salmon and large Salmon at fences and protection barriers within SFA 15. †: indicates that there were one or several washout events leading to potentially incomplete counts. Note that after 2013, the counting fence in the Northwest Upsalquitch was converted to a holding fence and therefore no counts are available.

Year	Northwest Upsalquitch			Jacquet			Causapscal (Matapedia)		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
1979	764	278	1042	na	na	na	na	na	na
1980	843	887	1730	na	na	na	na	na	na
1981	795	484	1279	na	na	na	na	na	na
1982	818	621	1439	na	na	na	na	na	na
1983	429	302	731	na	na	na	na	na	na
1984	517	641	1158	na	na	na	na	na	na
1985	734	521	1255	na	na	na	na	na	na
1986	1739	1166	2905	na	na	na	na	na	na
1987	1555	1000	2555	na	na	na	na	na	na
1988	1120	995	2115	na	na	na	49	505	554
1989	1042	901	1943	na	na	na	7	605	612
1990	1312	955	2267	na	na	na	37	456	493
1991	1268	901	2169	na	na	na	9	451	460
1992	1341	954	2295	na	na	na	8	350	358
1993	931	321	1252	na	na	na	12	256	268
1994	1326	740	2066	613	595	1208	3	349	352
1995	817	946	1763	344	589	933	1	462	463
1996	965	587	1552	634	359	993	4	441	445
1997	1027	459	1486	372	384	756	22	229	251
1998	834	494	1328	402	298	700	4	215	219
1999	814	619	1433	122	117	239	25	518	543
2000	710	399	1109	209	252	†461	30	332	362
2001	409	363	772	245	184	429	25	393	418
2002	955	209	1164	340	136	476	39	291	330
2003	440	672	1112	170	601	771	43	420	463
2004	1026	233	1259	229	185	414	12	421	433
2005	410	329	†739	118	138	†256	13	346	359
2006	689	305	994	473	338	811	20	465	485
2007	242	318	560	137	201	†338	6	279	285
2008	1119	334	†1453	308	105	†413	41	362	403
2009	617	547	1164	38	70	†108	13	413	426
2010	638	410	1048	208	303	†511	14	524	538
2011	666	700	†1366	354	243	†597	20	673	693
2012	269	282	551	198	71	†269	10	471	481
2013	287	349	†636	145	200	†345	43	651	694
2014	na	na	na	83	92	†175	24	427	451
2015	na	na	na	241	266	507	4	443	447
2016	na	na	na	156	215	371	2	280	282
2017	na	na	na	179	89	268	11	490	501

Year	Northwest Upsalquitch			Jacquet			Causapscal (Matapedia)		
	Small	Large	Total	Small	Large	Total	Small	Large	Total
2018	na	na	na	155	80	235	10	281	291
2019	na	na	na	45	87	†132	3	268	271

Table 5. Harvest and angling data and, returns and spawners estimates of small Salmon for Restigouche River and total SFA 15. Two spawners estimates are provided: one assuming a 40% exploitation rate in the Restigouche River and another one based on snorkel counts conducted in the fall in the Restigouche river and prorated to the total fluvial area available in SFA 15. †: due to environmental conditions, the snorkel counts are sometimes incomplete and will likely result in an underestimation of the total abundance. Since the mid-90's, there has been a lack of reporting from First Nations fisheries. As a consequence, historical average catches have been used in the assessments. Average values are in italic.

	Harvest				Angling				Returns		Spawners			
		Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-commercial Fishery		Restigouche		SFA 15	
Year	Commercial catch in Chaleur Bay	NB Estuaries	Québec	Inriver NB	Catches (Kept & released)	Angling Mortality	Catches (Kept & released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel counts	Angling Exploitatation Rate	Snorkel counts
1970	na	na	na	na	1340	1340	na	na	3350	4137	2010	na	2482	na
1971	na	na	na	na	999	999	na	na	2498	3084	1499	na	1851	na
1972	116	na	na	na	978	978	na	na	2445	3020	1467	na	1882	na
1973	na	na	na	na	1423	1423	na	na	3558	4394	2135	na	2637	na
1974	31	na	na	na	1038	1038	na	na	2595	3205	1557	na	1942	na
1975	na	3	na	na	1130	1130	na	na	2828	3493	1695	na	2094	na
1976	3694	13	na	na	2345	2345	na	na	5876	7256	3518	na	6556	na
1977	1132	19	na	na	2333	2333	na	na	5852	7227	3500	na	4999	na
1978	1531	23	na	na	1322	1322	na	na	3328	4110	1983	na	3361	na
1979	85	84	na	na	1990	1990	na	na	5059	6248	2985	na	3737	na
1980	1968	34	na	na	2833	2833	na	na	7117	8789	4250	na	6424	na
1981	2994	20	na	na	3010	3010	na	na	7545	9318	4515	na	7368	na
1982	901	12	na	na	2538	2538	2866	1.13	6357	7851	3896	na	5364	na
1983	1147	0	na	na	731	731	941	1.29	1828	2257	1113	na	2073	na
1984	8823	1	na	na	1411	1411	2113	1.50	3529	4358	2054	na	7672	na
1985	na	0	na	na	3202	3202	3639	1.14	8005	9886	4747	na	5862	na
1986	na	26	na	na	4717	4717	5961	1.26	11819	14596	6878	na	8494	na
1987	na	95	na	na	4137	4137	5386	1.30	10438	12890	5929	na	7322	na
1988	na	70	na	na	5644	5644	7278	1.29	14180	17512	8026	na	9912	na
1989	na	151	na	na	2849	2849	3652	1.28	7274	8983	4272	na	5276	na
1990	na	120	na	na	3498	3498	4277	1.22	8865	10948	5186	na	6405	na

	Harvest				Angling				Returns		Spawners			
		Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-commercial Fishery		Restigouche		SFA 15	
Year	Commercial catch in Chaleur Bay	NB Estuaries	Québec	Inriver NB	Catches (Kept & released)	Angling Mortality	Catches (Kept & released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel counts	Angling Exploitatation Rate	Snorkel counts
1991	na	10	na	na	1967	1967	2894	1.47	4928	6085	2951	na	3644	na
1992	na	2	na	0	4015	4015	5656	1.41	10040	12399	6023	na	7438	na
1993	na	0	na	0	2567	2567	3397	1.32	6418	7926	3851	na	4756	na
1994	na	29	na	29	4070	4070	4979	1.22	10233	12638	6076	na	7504	na
1995	na	0	na	21	1318	1318	1866	1.42	3316	4095	1956	na	2416	na
1996	na	0	na	77	2759	2759	3399	1.23	6975	8614	4062	na	5016	na
1997	na	*0*	na	*26*	2590	2590	2948	1.14	6501	8029	3859	na	4766	na
1998	na	*0*	na	*26*	2578	2578	3144	1.22	6471	7992	3841	na	4744	na
1999	na	*6*	na	*36*	2103	2103	2761	1.31	5299	6544	3119	2228†	3852	3021†
2000	na	*6*	na	*36*	3359	3359	4383	1.30	8439	10422	5003	5440	6179	7377
2001	na	*6*	na	*36*	2270	2270	na	na	5717	7060	3369	2024†	4160	2745†
2002	na	*6*	na	*36*	5206	5206	na	na	13057	16125	7773	8283	9599	11233
2003	na	*6*	na	*36*	1447	1447	na	na	3659	4519	2135	1532†	2637	2078†
2004	na	*6*	na	*36*	5595	5595	na	na	14029	17326	8357	3811†	10321	5168†
2005	na	*6*	na	*36*	1710	1710	na	na	4317	5331	2529	410†	3123	556†
2006	na	*6*	na	*36*	4256	4256	na	na	10682	13192	6348	1100†	7840	1492†
2007	na	*6*	na	*36*	2032	2032	na	na	5122	6325	3012	1277	3719	1732
2008	na	*6*	na	*36*	6486	6486	na	na	16257	20077	9693	1119†	11971	1518†
2009	na	*6*	na	*36*	2445	2445	na	na	6154	7600	3632	2271	4485	3080
2010	na	*6*	na	*36*	3777	3777	na	na	9484	11713	5630	2457†	6953	3332†
2011	na	*6*	na	*36*	4814	4814	na	na	12077	14915	7185	1570†	8873	2129†
2012	na	*6*	na	*36*	2027	2027	na	na	5109	6310	3005	1617	3711	2193
2013	na	*6*	na	*36*	2287	2287	na	na	5759	7112	3395	687†	4193	932†
2014	na	*6*	na	*36*	1811	1811	na	na	4569	5643	2681	1179	3311	1599
2015	na	*6*	na	*38*	2931	176	na	na	7371	9104	7114	4064	8787	5511
2016	na	*6*	na	*36*	1863	112	na	na	4699	5803	4510	2662	5570	3610

	Harvest				Angling				Returns		Spawners			
		Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-commercial Fishery		Restigouche		SFA 15	
Year	Commercial catch in Chaleur Bay	NB Estuaries	Québec	Inriver NB	Catches (Kept & released)	Angling Mortality	Catches (Kept & released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel counts	Angling Exploitatation Rate	Snorkel counts
2017	na	*6*	na	*36*	1711	103	na	na	4319	5334	4139	2461	5112	3337
2018	na	*6*	na	*36*	2123	127	na	na	5349	6606	5144	3158	6353	4283
2019	na	*6*	na	*36*	1866	112	na	na	4707	5813	4517	1821	5578	2470

Table 6. Harvest and angling data and, returns and spawners estimates of large Salmon for Restigouche River and total SFA 15. Two spawners estimates are provided: one assuming a 40% exploitation rate in the Restigouche River and another one based on snorkel counts conducted in the fall in the Restigouche river and prorated to the total fluvial area available in SFA 15. †: due to environmental conditions, the snorkel counts are sometimes incomplete and will likely result in an underestimation of the total abundance. Since the mid-90's, there has been a lack of reporting from First Nations fisheries. As a consequence, historical average catches have been used in the assessments. Average values are in italic.

Year	Harvest				Angling				Returns		Spawners			
	Commercial Catch in Chaleur Bay	Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-Commercial Fishery		Restigouche		SFA 15	
		Estuaries NB	Quebec	Inriver NB	Catch (kept + released)	Angling mortality	Catch (kept + released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel Counts	Angling Exploitation Rate	Snorkel Counts
1970	9124	na	na	na	1716	1716	na	na	4290	14036	2574	na	2947	na
1971	3949	na	na	na	757	757	na	na	1893	6116	1136	na	1300	na
1972	419	na	na	na	3870	3870	na	na	9675	11497	5805	na	6647	na
1973	628	na	na	na	3746	3746	na	na	9365	11351	5619	na	6434	na
1974	31	na	na	na	4785	4785	na	na	11963	13728	7178	na	8218	na
1975	900	132	na	na	2160	2160	na	na	5532	7234	3240	na	3710	na
1976	183	124	1517	na	4481	4481	na	na	11327	13152	6722	na	7696	na
1977	211	212	2738	na	5128	5128	na	na	13032	15133	7692	na	8807	na
1978	156	129	na	na	3373	3373	na	na	8562	9959	5060	na	5793	na
1979	671	148	748	na	997	997	na	na	2641	3694	1496	na	1713	na
1980	9	264	1563	na	4098	4098	na	na	10509	12042	6147	na	7038	na
1981	3647	211	na	na	2832	2832	na	na	7291	11995	4248	na	4864	na
1982	3798	155	1521	na	1623	1620	2024	1.25	4213	8621	2438	na	2791	na
1983	2522	260	1216	na	1553	1481	1811	1.17	4143	7265	2402	na	2750	na
1984	535	213	1070	na	1667	100	na	na	4381	5551	4067	na	4656	na
1985	0	241	976	na	3539	212	3693	1.04	9089	10406	8635	na	9887	na
1986	0	431	1145	na	4642	279	5390	1.16	12036	13781	11326	na	12968	na
1987	0	916	986	na	3026	182	3746	1.24	8481	9711	7383	na	8454	na
1988	0	509	921	na	4366	262	5238	1.2	11424	13080	10653	na	12198	na
1989	0	568	1081	na	3373	202	3993	1.18	9001	10306	8230	na	9423	na
1990	0	471	1135	na	2762	166	3222	1.17	7376	8446	6739	na	7716	na
1991	0	252	859	na	2062	124	2541	1.23	5407	6191	5031	na	5760	na

Year	Harvest				Angling				Returns		Spawners			
	Commercial Catch in Chaleur Bay	Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-Commercial Fishery		Restigouche		SFA 15	
		Estuaries NB	Quebec	Inriver NB	Catch (kept + released)	Angling mortality	Catch (kept + released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel Counts	Angling Exploitation Rate	Snorkel Counts
1992	0	464	948	10	3227	194	3752	1.16	8542	9780	7864	na	9004	na
1993	0	293	901	8	1494	90	1843	1.23	4036	4621	3637	na	4164	na
1994	0	348	*989*	32	2908	174	3468	1.19	7650	8759	7064	na	8088	na
1995	0	178	*989*	24	1868	112	2226	1.19	4872	5578	4534	na	5191	na
1996	0	176	*989*	37	2756	165	3242	1.18	7103	8133	6688	na	7658	na
1997	0	155	*989*	11	1712	103	2072	1.21	4446	5091	4166	na	4770	na
1998	0	197	*989*	37	1116	67	1327	1.19	3024	3462	2686	na	3075	na
1999	0	*230*	*989*	*22*	1144	69	1310	1.15	3112	3564	2769	2502†	3171	3393†
2000	0	*230*	*989*	*22*	1473	88	1919	1.3	3935	4505	3572	5590	4090	7581
2001	0	*230*	*989*	*22*	2618	157	na	na	6797	7783	6366	2882†	7289	3908†
2002	0	*230*	*989*	*22*	1547	93	na	na	4120	4717	3752	5540	4296	7513
2003	0	*230*	*989*	*22*	2772	166	na	na	7182	8224	6741	2991†	7719	4056†
2004	0	*230*	*989*	*22*	2097	126	na	na	5495	6292	5094	2868†	5833	3889†
2005	0	*230*	*989*	*22*	2408	144	na	na	6272	7182	5853	329†	6702	446†
2006	0	*230*	*989*	*22*	1838	110	na	na	4847	5550	4462	704†	5109	955†
2007	0	*230*	*989*	*22*	3014	181	na	na	7787	8917	7332	4046	8396	5487
2008	0	*230*	*989*	*22*	2047	123	na	na	5370	6149	4972	334†	5693	453†
2009	0	*230*	*989*	*22*	2803	168	na	na	7260	8313	6817	6075	7805	8239
2010	0	*230*	*989*	*22*	2082	125	na	na	5457	6249	5058	3004†	5792	4074†
2011	0	*230*	*989*	*22*	5431	326	na	na	13830	15835	13230	3711†	15148	5033†
2012	0	*230*	*989*	*22*	2222	133	na	na	5807	6649	5400	3615	6183	4902
2013	0	*230*	*989*	*22*	3938	236	na	na	10097	11561	9587	2885†	10977	3912†
2014	0	*230*	*989*	*22*	1943	117	na	na	5110	5850	4719	3237	5403	4390
2015	0	*230*	*989*	*22*	2426	146	na	na	6317	7233	5897	4736	6752	6423
2016	0	*230*	*989*	*22*	2149	129	na	na	5625	6440	5222	5324	5979	7220
2017	0	*230*	*989*	*22*	1681	101	na	na	4455	5100	4080	7603	4671	10311

Year	Harvest				Angling				Returns		Spawners			
	Commercial Catch in Chaleur Bay	Native harvest for Restigouche			Restigouche (NB)		SFA 15	Angling ratio	Pre-Commercial Fishery		Restigouche		SFA 15	
		Estuaries NB	Quebec	Inriver NB	Catch (kept + released)	Angling mortality	Catch (kept + released)	SFA 15 / Restigouche NB	Restigouche	SFA 15	Angling Exploitation Rate	Snorkel Counts	Angling Exploitation Rate	Snorkel Counts
2018	0	*230*	*989*	*22*	1338	80	na	na	3597	4119	3243	5159	3713	6996
2019	0	*230*	*989*	*22*	1557	93	na	na	4145	4745	3777	4623	4324	6269

Table 7. Average density (median, fish per 100 m²) of Atlantic Salmon fry by tributary of the Restigouche River.

Year	Main stem	Kedgwick	Little Main	Upsalquitch	Patapedia	Matapedia
1972	7.8	1.4	1.1	3.6	na	na
1973	6.2	8.3	9.2	14.7	na	na
1974	4.5	3.4	4.1	11.9	na	na
1975	25.8	18.3	7.3	44.4	na	na
1976	25.7	11.3	2.7	20	na	na
1977	16.6	4.5	7.8	17.4	na	na
1978	10	7	15.8	26	na	na
1979	6.9	5.3	1.8	19	na	na
1980	4.1	2.4	9.3	13.5	na	na
1981	5	13.8	13	18.2	na	na
1982	1.4	4.4	2.7	8.6	na	na
1983	3.7	3.9	9.3	23.2	na	na
1984	8	2.9	9.4	13.3	na	na
1985	7.2	4.2	1.9	9.1	na	na
1986	9.2	6.5	7.4	11.1	na	na
1987	48.1	33.6	6.9	na	na	na
1988	50.6	51.6	6.1	na	na	na
1989	47.7	74.2	33.1	na	na	na
1990	52.4	47.3	4.1	na	na	na
1991	49.9	74.9	93.9	na	na	na
1992	40.9	26.8	34.2	na	na	na
1993	42.5	32.6	14	na	na	na
1994	27.6	31.8	53.7	na	na	na
1995	25.7	50.4	6.7	na	na	na
1996	19.5	23.6	12.8	na	na	na
1997	23.4	41.9	18.5	30.8	na	na
1998	34.5	23.8	16.8	9.6	na	na
1999	40	37.2	29.9	50.6	na	na
2000	41.3	37.6	84.7	74	na	na
2001	19.9	13.4	23.1	9.7	36.2	24.3
2002	29.3	22.7	60.6	12	57.9	32.7
2003	12.3	10.9	7.3	6.6	na	na
2004	29.7	7.8	31.8	28.3	29.9	11.2
2005	23.7	34.4	26	19.9	35.9	19.4
2006	24.1	17.3	63.7	38.2	40.7	31.8
2007	11.1	8.7	18.7	27.5	32.7	21.4
2008	7.6	6.7	3.8	8.5	26.1	11.9
2009	19.9	6.2	16.5	12.4	32.8	8.9
2010	14.2	14.1	26.1	22.7	43.5	12.7
2011	10.9	10.7	22	20.6	23.8	18.4
2012	18.7	53.4	38.2	24.6	57.7	44.1
2013	22.9	11.8	19.1	12.4	34.3	24
2014	10	13.5	29.7	37.8	22.8	13
2015	26.4	37	33.8	16.5	51.4	19.4
2016	20.9	15.6	13.2	17.3	30.2	28
2017	14.5	14.9	15.2	29.9	31.3	15.2
2018	16.3	7.8	13.7	12.3	114.6	12.7
2019	13	16.4	34.7	8	23.2	8.2

Table 8. Average density (median, fish per 100 m²) of Atlantic Salmon small parr (age-1) by tributary of the Restigouche River.

Year	Main stem	Kedgwick	Little Main	Upsalquitch	Patapedia	Matapedia
1972	4.5	0.8	0.6	0	na	na
1973	0.8	3	0.6	1.8	na	na
1974	1.5	5.1	4.7	7.6	na	na
1975	4.8	4.7	1.9	16.5	na	na
1976	5.2	7.2	1.4	9.7	na	na
1977	2.5	4	1.4	3.9	na	na
1978	2.5	4.4	3.7	10.4	na	na
1979	2.7	5.3	3.3	9.5	na	na
1980	2.8	3.6	0.5	3.5	na	na
1981	2.3	1.6	1.2	3.6	na	na
1982	2	1	0.9	3.2	na	na
1983	4	2.7	2.3	5.2	na	na
1984	2.8	2.3	1.7	3.1	na	na
1985	6.9	4.6	2.5	7.7	na	na
1986	11.8	3.8	1.1	6.4	na	na
1987	12.6	5.7	1.5	na	na	na
1988	14.9	5.6	0.5	na	na	na
1989	8.7	11.8	1.3	na	na	na
1990	31.9	8.2	1.7	na	na	na
1991	20.2	13.5	1.7	na	na	na
1992	33.4	13.6	4	na	na	na
1993	30.4	7.2	1.6	na	na	na
1994	27.4	6	1.6	na	na	na
1995	15.6	14.8	2.7	na	na	na
1996	6.6	7.1	3.5	na	na	na
1997	15.4	10.1	7.1	16.3	na	na
1998	6.1	12.3	5.1	14.6	na	na
1999	18.2	9	5.1	21.1	na	na
2000	13.1	16.2	11.9	24.1	na	na
2001	16.8	15	13.1	25.3	44.6	21.6
2002	13.2	10.8	9.4	8.6	28	12.3
2003	17.4	18.5	8.8	9.1	na	na
2004	11.3	5.8	2.2	4.5	18.2	8.3
2005	18.9	6.9	5.5	29.8	28	5.9
2006	8.8	15.6	8.7	7.5	31.5	14.4
2007	15.4	15.5	17.4	27.1	38.6	20
2008	7.8	5.2	3.3	6.1	21.7	4.6
2009	5.3	3.8	3.2	6.4	17.8	2.1
2010	11.2	7.3	4.7	10.4	23.7	7.7
2011	3.8	6.2	3.4	7.2	10.5	16.6
2012	5.8	6.6	7.7	6.5	23	10.9
2013	12.7	11.2	7.7	7.8	37.2	12.7
2014	9.6	6.8	6.5	4.1	21.8	7.1
2015	9.4	6.7	9.6	12.4	31.7	11.5
2016	10.3	7.2	3.6	3.5	22.5	9.7
2017	8.1	6.1	6.7	8.4	16.5	6.6
2018	3.4	5.8	1.5	7.9	11.5	6.5
2019	4.5	9.8	4.7	5.4	20.3	5

Table 9. Average density (median, fish per 100 m²) of Atlantic Salmon large parr (age-2) by tributary of the Restigouche River.

Year	Main stem	Kedgwick	Little Main	Upsalquitch	Patapedia	Matapedia
1972	0.2	0.7	0.2	0	na	na
1973	0	0.7	0.2	0.4	na	na
1974	0	0.4	0.2	0.2	na	na
1975	0.6	1.1	0.5	4.7	na	na
1976	0.5	0.8	0.4	1.2	na	na
1977	0.4	1.9	0.3	0.3	na	na
1978	0.1	0.5	0.4	1.2	na	na
1979	0.3	0.7	0.6	2.3	na	na
1980	0.8	0.6	0.2	1.2	na	na
1981	0.2	0.1	0.1	0.5	na	na
1982	0.1	0.1	0.2	0.4	na	na
1983	1.6	0.8	0.7	1.6	na	na
1984	1	1	0.2	0.5	na	na
1985	1.1	0.8	0.4	1	na	na
1986	4.1	1.5	0.5	0.8	na	na
1987	2.5	3	0.5	na	na	na
1988	2.2	0.9	1	na	na	na
1989	2.2	1.3	0.4	na	na	na
1990	4	1.3	0.8	na	na	na
1991	5.3	1.2	0.3	na	na	na
1992	10.1	1	0.1	na	na	na
1993	2.6	1.8	0.8	na	na	na
1994	3.5	1.1	0.1	na	na	na
1995	0.9	1.3	1.2	na	na	na
1996	0.2	0.6	0.8	na	na	na
1997	1	2.2	1.2	2.9	na	na
1998	1.1	2.9	1	0.8	na	na
1999	0.4	2.9	0.9	1.4	na	na
2000	1.3	2	1	3.1	na	na
2001	0.9	1.4	0.7	1	6.7	2.8
2002	1.7	2.9	1.1	1	8.6	7.3
2003	2.3	2.5	0.8	1	na	na
2004	2.8	1.6	0.7	0.6	7.5	2.3
2005	1.8	2.5	0.5	1.3	7.4	2.1
2006	2.6	2	1.1	2	12.6	7.7
2007	2.2	3.2	0.7	1.4	8.2	2.8
2008	0.8	0.6	0.1	0.7	7.1	1.1
2009	1.3	0.6	0.5	1.7	3	1.6
2010	0.6	1.2	0.3	1.4	7.9	1.5
2011	0.6	0.9	0.1	0.9	3.4	4.3
2012	0.5	1.4	0.2	0.9	1.8	1.3
2013	1.4	1.5	0.5	1.2	6.5	4.5
2014	1.8	3.3	2.2	1.8	8.3	2.7
2015	3	3.9	3.5	3.2	15.9	8.4
2016	3.3	3	1.1	3.6	6.4	6.8
2017	2.8	5.2	2.4	2.4	10	5.2
2018	1.5	3.2	1.4	2.4	4.5	4.5
2019	0.5	4.3	1	2.3	3.4	5.4

Table 10. Smolt population estimate in the Kedgwick River based on annual capture-mark-recapture experiments. Weight at 13 cm (g) is predicted based on an annual length weight relationship fitted for each tributary. †: some years, due to environmental or logistic constraints it was not possible to install the smolt trap in time to catch the beginning of the smolt migration, the current abundance model does not take this in account and population abundance for these years are likely underestimated.

	Population estimate						Prop. Smolt age		
Year	2.5th	median	97.5th	Fork length (mm)	Weight at 13 cm (g)	Prop. female	2	3	4
2002	95,581	157,210	296,842	126.8	19.4	0.54	na	1	na
2003	52,868	69,247	91,836	129.1	22.4	0.44	0.08	0.9	0.01
2004	67,958	85,303	107,701	129.5	22.1	0.53	0.06	0.9	0.04
2005	55,332	73,942	100,897	126.8	22.2	0.6	0.05	0.95	na
2006	81,826	119,377	181,355	127.9	19	0.39	na	0.98	0.02
2007	91,153	109,694	132,958	127.7	19.7	0.6	na	0.97	0.03
2008	33,518	47,578	70,262	125.4	18.8	0.49	0.03	0.96	0.01
2009	102,918	135,395	180,926	128.6	19.7	0.41	0.02	0.97	0.01
2010	72,069	94,430	125,400	132.7	19.7	0.51	na	0.98	0.02
2011	175,093	250,446	368,069	131.2	19	0.62	na	1	na
2012	117,180	155,477	212,416	131.4	20	0.63	0.02	0.98	na
2013†	79,351	102,801	135,450	129.4	19.3	0.57	na	0.99	0.01
2014†	33,854	53,136	91,917	126.4	19.4	0.42	na	0.96	0.04
2015	143,383	178,952	226,740	129.7	19.9	0.55	na	0.99	0.01
2016†	42,665	57,494	79,372	126.4	19.6	0.46	na	na	na
2017†	35,730	51,528	76,602	128	20.6	na	na	1	na
2018	33,797	53,372	89,814	127.2	19.4	0.58		0.98	0.02
2019	32,470	52,269	90,910	126.4	19.5	0.55	na	1	na

Table 11. Smolt population estimate in the Restigouche River based on annual capture-mark-recapture experiments. Weight at 13 cm (g) is predicted based on an annual length weight relationship fitted for each tributary. †: some years, due to environmental or logistic constraints it was not possible to install the smolt trap in time to catch the beginning of the smolt migration, the current abundance model does not take this in account and population abundance for these years are likely underestimated.

	Population estimate						Prop. Smolt age		
Year	2.5th	median	97.5th	Fork length (mm)	Weight at 13 cm (g)	Prop. female	2	3	4
2002†	202,303	499,259	1,170,417	128.5	na	na	na	na	na
2003	433,168	588,457	820,420	127.1	24.1	0.31	0.02	0.98	na
2004	461,937	602,870	794,123	128	20	0.61	0.03	0.96	0.01
2005	470,031	606,201	787,992	125.4	19.7	0.72	0.02	0.95	0.03
2006	289,103	416,154	635,916	126.6	21.2	0.73	na	1	na
2007	706,667	930,583	1,242,898	126.2	21.1	0.63	na	0.97	0.03
2008	388,599	503,865	682,118	124.3	19.3	0.62	na	1	na
2009	426,544	566,062	754,824	126.8	21	0.6	na	1	na
2010	462,737	614,852	841,558	128	20.7	0.78	na	0.98	0.02
2011	501,078	754,862	1,284,277	125.1	na	0.73	na	1	na
2012	558,885	734,433	959,745	128.2	20.8	0.61	0.02	0.94	0.04
2013†	278,728	489,098	1,279,644	120.2	na	na	na	na	na
2014†	162,230	245,508	379,555	122.7	20	0.49	na	1	na
2015	458,574	563,824	765,698	124.8	na	0.9	na	0.8	0.2
2016	230,564	283,533	362,100	125.1	20.2	0.52	na	1	na
2017†	243,191	326,648	461,238	127.2	na	na	na	na	na
2018†	148,783	204,952	309,892	123	19.7	0.56	na	1	na
2019	262,829	354,771	482,127	125.6	18.8	0.54	na	0.96	0.04

Table 12. Summary of threats to, and rating of effects on recovery and/ or persistence of Atlantic Salmon in SFA 15, Northern NB (DFO and MNRF 2009; Master et al. 2012).Colors indicate the level of the threat factor as computed by Master et al. (2012): dark green = low ; light green = Medium; yellow = High and red = Very High.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (with examples)	Scope (next 10 years)	Severity (next 10 years)	Timing	Comments - Management Alternatives/ Mitigation
PERMITTED ACTIVITIES					
Directed Salmon Fishing	Aboriginal	Large	Moderate	High	Control harvest through agreements between DFO and First Nations, however no reporting of harvest since the 2000.
	Recreational: retention & release	Large	Slight	High	In NB, catch and release only which is believed to have low mortality. However this might change in the context of increasing water temperatures.
	Commercial (domestic)	Negligible	Neutral	Negligible	All commercial fisheries closed.
	High Seas (West Greenland / St. Pierre – Miquelon)	Small	Slight	High	Reductions in internal use fisheries in those areas.
	Illegal (poaching)	Large	Moderate	High	Continue use of compliance monitors on selected watersheds, including Aboriginal guardians.
Bycatch of Salmon in Fisheries for Other Species	Aboriginal	Negligible	Neutral	Negligible	All bycatch mandatory release.
	Recreational	Negligible	Neutral	Negligible	All bycatch mandatory release.
	Commercial near-shore	Negligible	Neutral	Negligible	All bycatch mandatory release.
	Commercial distant	Negligible	Neutral	Negligible	None apparent.
Salmon Fisheries Impacts on Salmon Habitat	Aboriginal	Negligible	Neutral	Negligible	None apparent.
	Recreational	Negligible	Neutral	Negligible	None apparent.
	Commercial	Negligible	Neutral	Negligible	None apparent.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (with examples)	Scope (next 10 years)	Severity (next 10 years)	Timing	Comments - Management Alternatives/ Mitigation
	Illegal	Negligible	Neutral	Negligible	None apparent.
Mortality Associated with Water Use	Power generation at dams & tidal facilities (turbine mortality, entrainment, stranding)	Large	Slight	High	Thermal generation stations in Dalhousie and Belledune, NB, must comply with conditions of operating license and sec. 22 of the Fisheries Act.
Habitat Alterations	Municipal waste water treatment facilities	Large	Slight	High	Few communities; Ensure current projects and future developments meet standards.
	Pulp & paper mills	Large	Slight	High	Pulp and paper mills comply with pulp and paper effluent regulations.
	Hydroelectric power generation (dams & reservoirs, tidal power): altered behavior & ecosystems	Large	Moderate	High	Must comply with section 22 and 35 of the Fisheries Act.
	Water extractions	Large	Slight	High	Must meet regulations in place; monitoring; develop regional guidelines.
	Urbanization (altered hydrology)	Large	Slight	High	Mostly small communities ; Project redesign/ existing regulation – monitoring.
	Infrastructure (roads/culverts) (fish passage)	Pervasive	Serious	High	Many culverts present all over the watersheds, many are non-compliant and can fragment the habitat. More monitoring/ enforcement of existing regulations; GMRC/DFO ongoing studies.
	Aquaculture siting	Negligible	Unknown	High	None apparent.
	Agriculture / Forestry / Mining, etc.	Large	Serious	High	Potential mineral processing; past mining/ processing; Enforcement/ monitoring of existing suite of regulations; compensations where required.
	Municipal, provincial & federal dredging	Small	Slight	High	Follow regulations in place; mitigations and compensations as required; minimize amount.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (with examples)	Scope (next 10 years)	Severity (next 10 years)	Timing	Comments - Management Alternatives/ Mitigation
Shipping, Transport and Noise	Municipal, provincial, federal & private transport activities (including land and water based contaminants/ spills)	Unknown	Unknown	High	None apparent.
Fisheries on Prey of Salmon (*e.g.* capelin, smelt, shrimp)	Commercial, Recreational, Aboriginal fisheries for species a, b, c etc.	Unknown	Unknown	High	None apparent.
Aquaculture (Salmon and other species)	Escapes from fresh water, marine facilities, disease, parasites, competition, effects on behaviour and migration, genetic introgression	Small	Slight	High	Fish health regulations, Introduction and transfer regulation.
Fish culture / stocking (non-commercial, including private, NGO, government)	Impacts on effective population size, over representation of families, domestication	Small	Slight	High	Must comply with Introduction and Transfers guidelines.
Scientific Research	Government, university, community and Aboriginal groups	Negligible	Slight	High	Minimal removals for scientific purposes. None apparent.
Military Activities	Field operations, shooting ranges	na	na	na	None apparent.
Air Pollutants	Acid rain	Negligible	Unknown	High	None apparent.
UN-PERMITTED ACTIVITIES					
Introductions of non-native / invasive species	Smallmouth bass, chain pickerel, muskellunge, rainbow trout, invertebrates, plants, algae	Unknown	Slight	High	Increase monitoring and enforcement activities -Conduct education programs.
International High Seas Targeted	Flags of convenience	na	na	na	None apparent.

Potential sources of mortality /harm Permitted and un-permitted activities	Source (with examples)	Scope (next 10 years)	Severity (next 10 years)	Timing	Comments - Management Alternatives/ Mitigation
Ecotourism and Recreation	Private companies & public at large (water crafts, swimming, etc.) effects on Salmon behaviour & survival	Large	Slight	High	Conduct education programs - Increase enforcement activities.
Ecosystem change	Climate change, changes in relative predator / prey abundances, disease	Large	Moderate	High	Rivers in the area are more and more affected by low water levels and warm water temperatures.
Fish diseases	Furunculosis, Saprolegnia	Large	Unknown	High	None apparent.

FIGURES

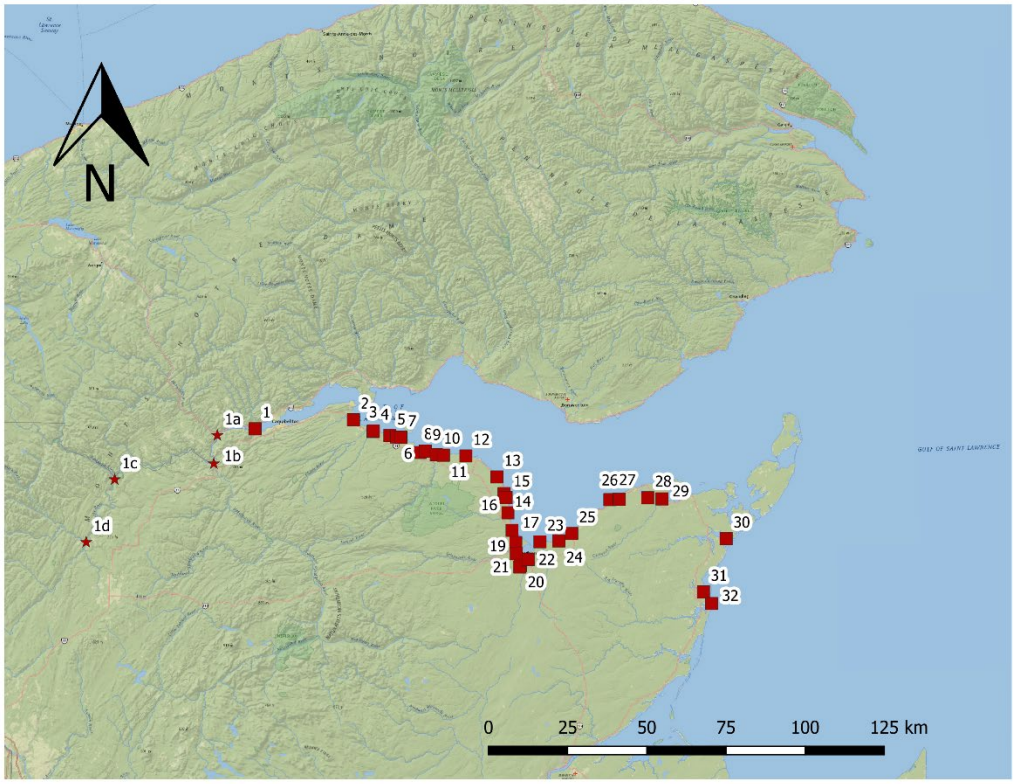


Figure 1. Rivers within Salmon Fishing Area (SFA) 15 of northern Gulf New Brunswick. Index numbers refer to rivers in Table 1. Index numbers 1a to 1d refer to position of major tributaries of the Restigouche River (Index 1): 1a = Matapedia, 1b = Upsalquitch, 1c = Patapedia, 1d = confluence of Kedgwick and Little Main Restigouche.

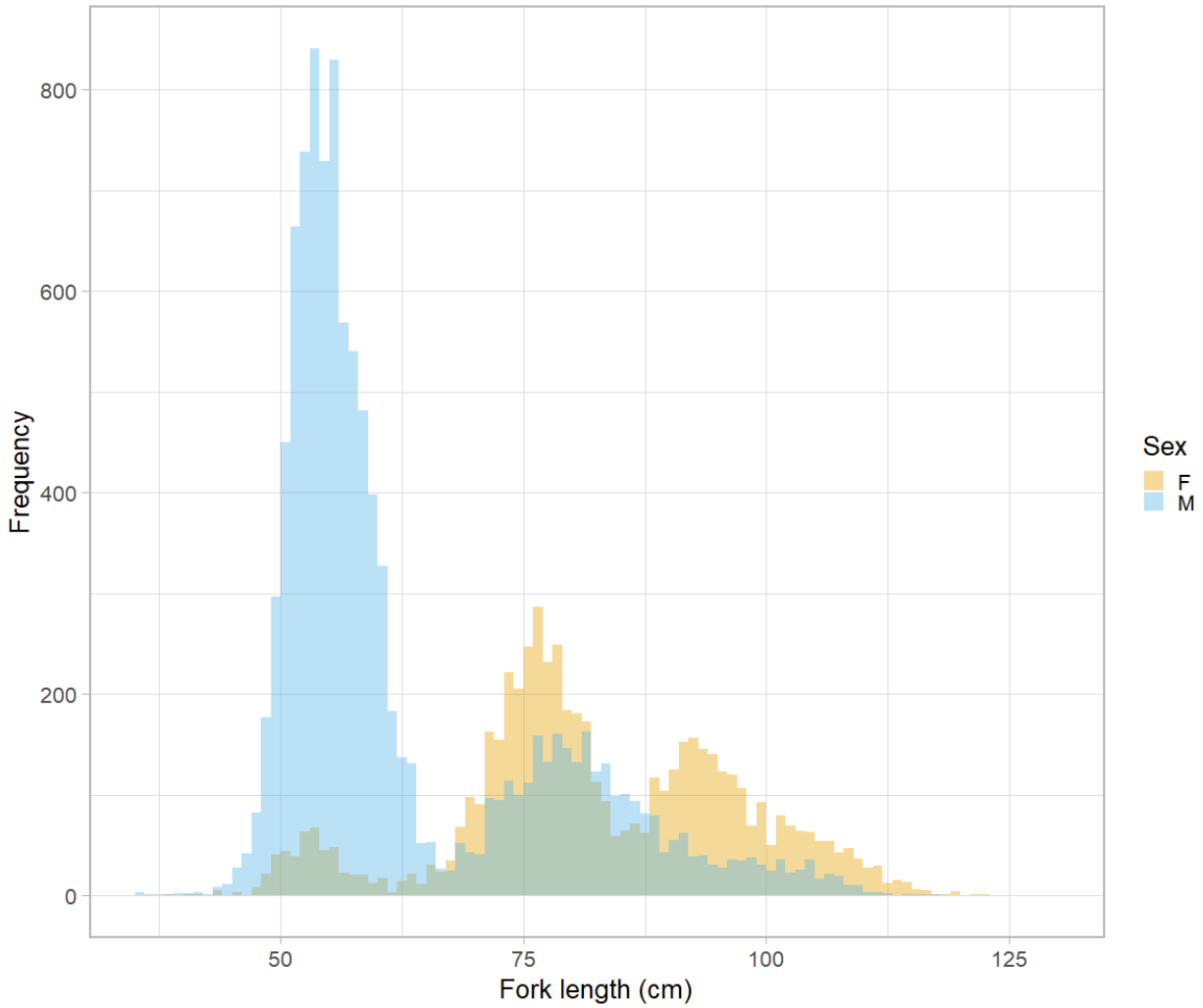


Figure 2. Size distribution (fork length; cm) for male (M), and female (F) Salmon from the Restigouche River. Data are from 1972 to 2019 and come from various fence, trapnet and angling samples. Since 2015 (catch and release implementation in NB) there has been no adult Salmon biological data collected for NB.

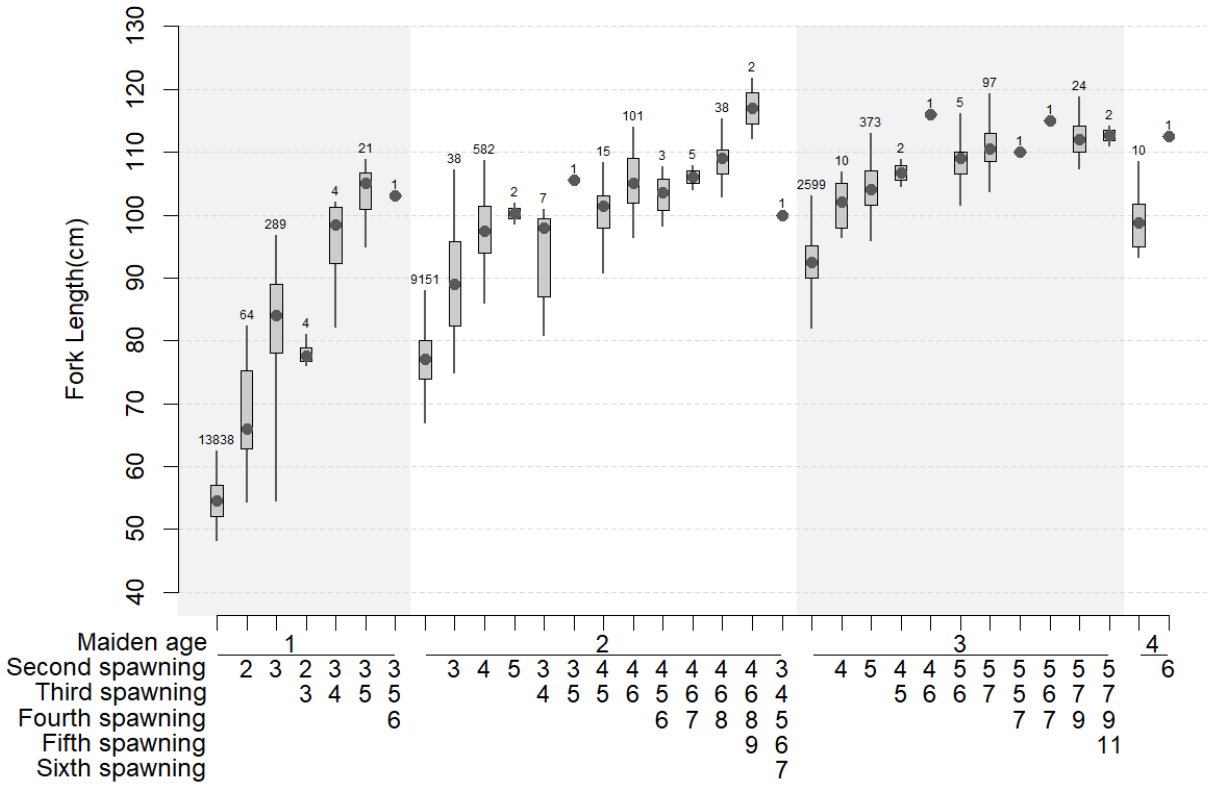


Figure 3. Fork length (cm) at age defined by sea age and spawning history for Atlantic Salmon from the Restigouche River. Each tick mark corresponds to a life-history and are organized by maiden age and total number of spawning event (i.e. maiden fish are the furthest left in each categories). Dots indicate the median fork length, boxes and vertical bars indicate the 25th-75th and 2.5th-97.5th interquantile range, respectively. Numbers above each boxplot indicate the number of fish sampled for each life-history during the period 1972-2019.

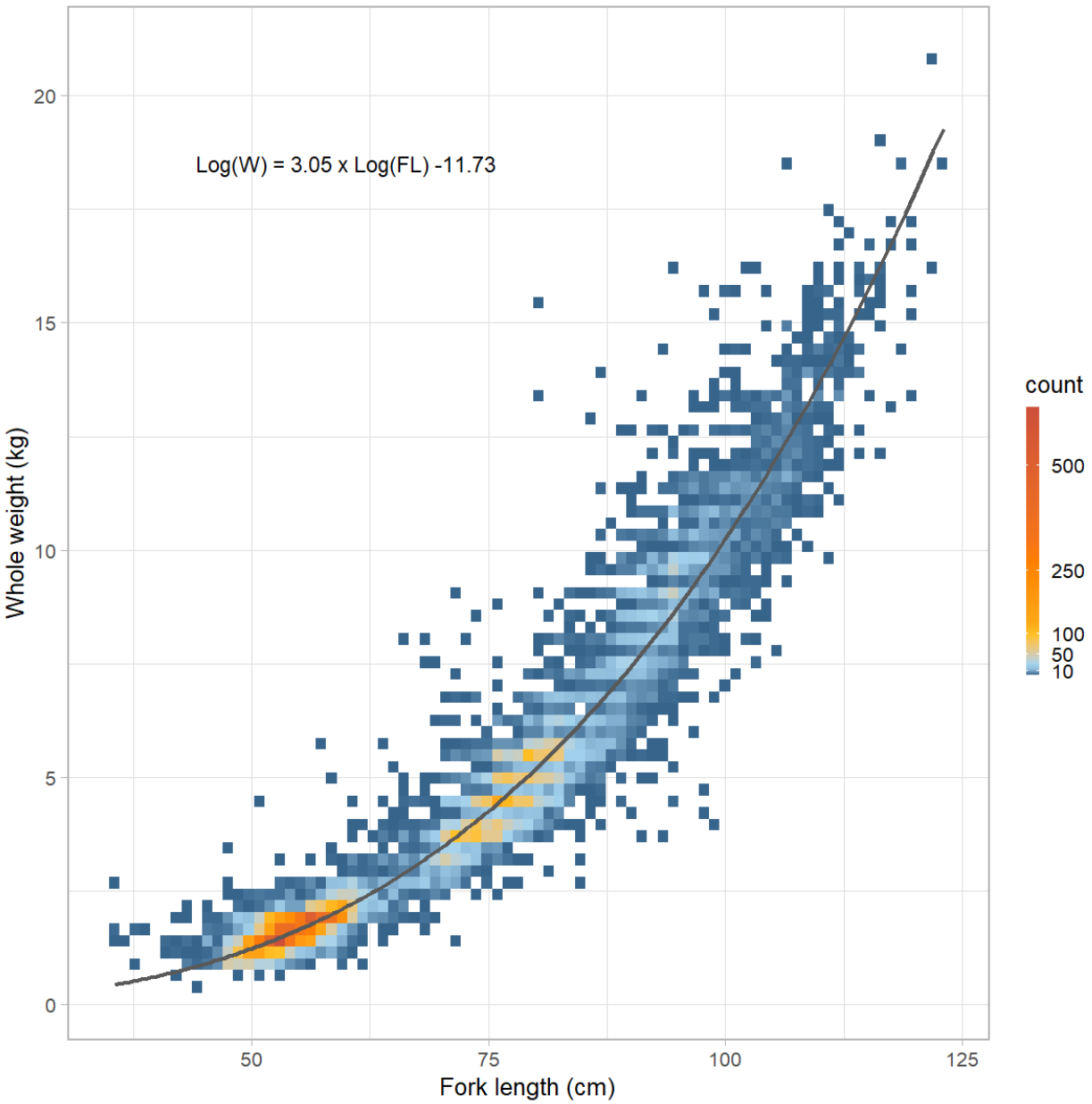


Figure 4. Weight to length relationship for Atlantic Salmon from the Restigouche River. Due to the large number of samples, data are binned and color coded in function of the number of samples. Data are from the period 1972 to 2019.

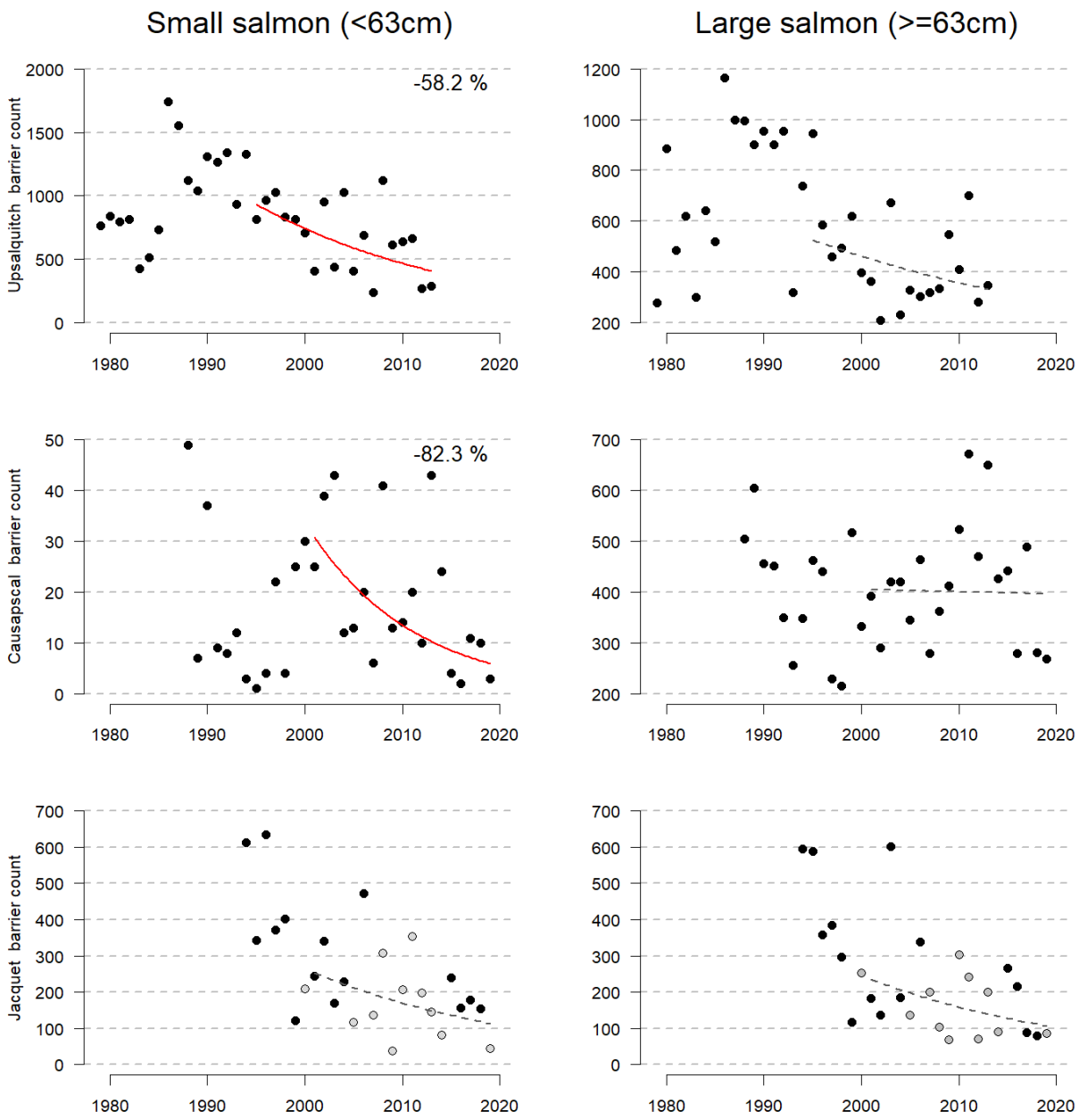


Figure 5. Counts of all small (left panels) and large (right panels) adult Salmon at the Northwest Upsalquitch Barrier (upper), Causapscal Barrier (middle) and Jacquet barrier (lower). When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

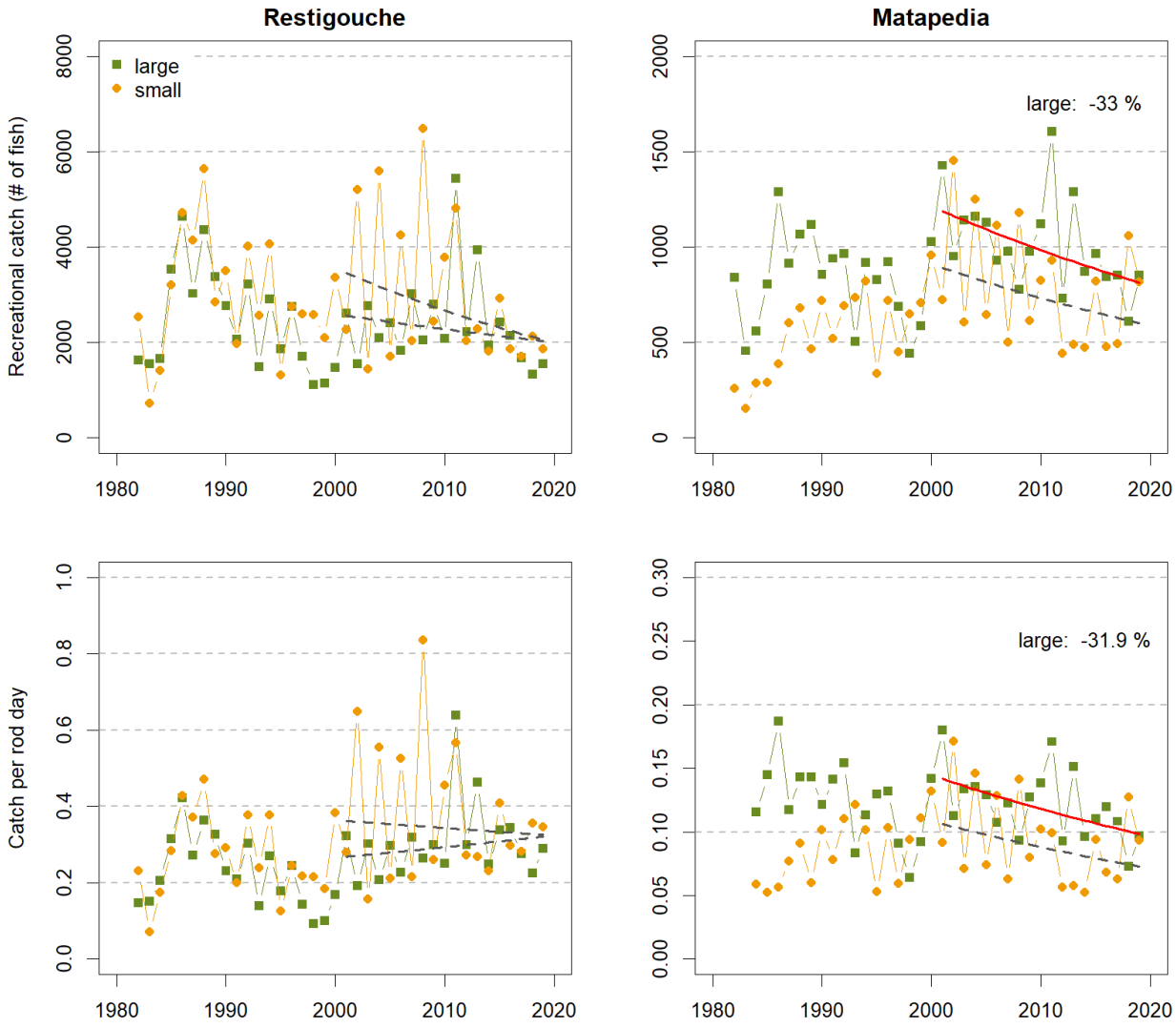


Figure 6. Recreational catch (upper panels) and catch per rod day (lower panels) in the Restigouche (left panels) and the Matapedia (right panels) rivers, 1982 to 2019. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

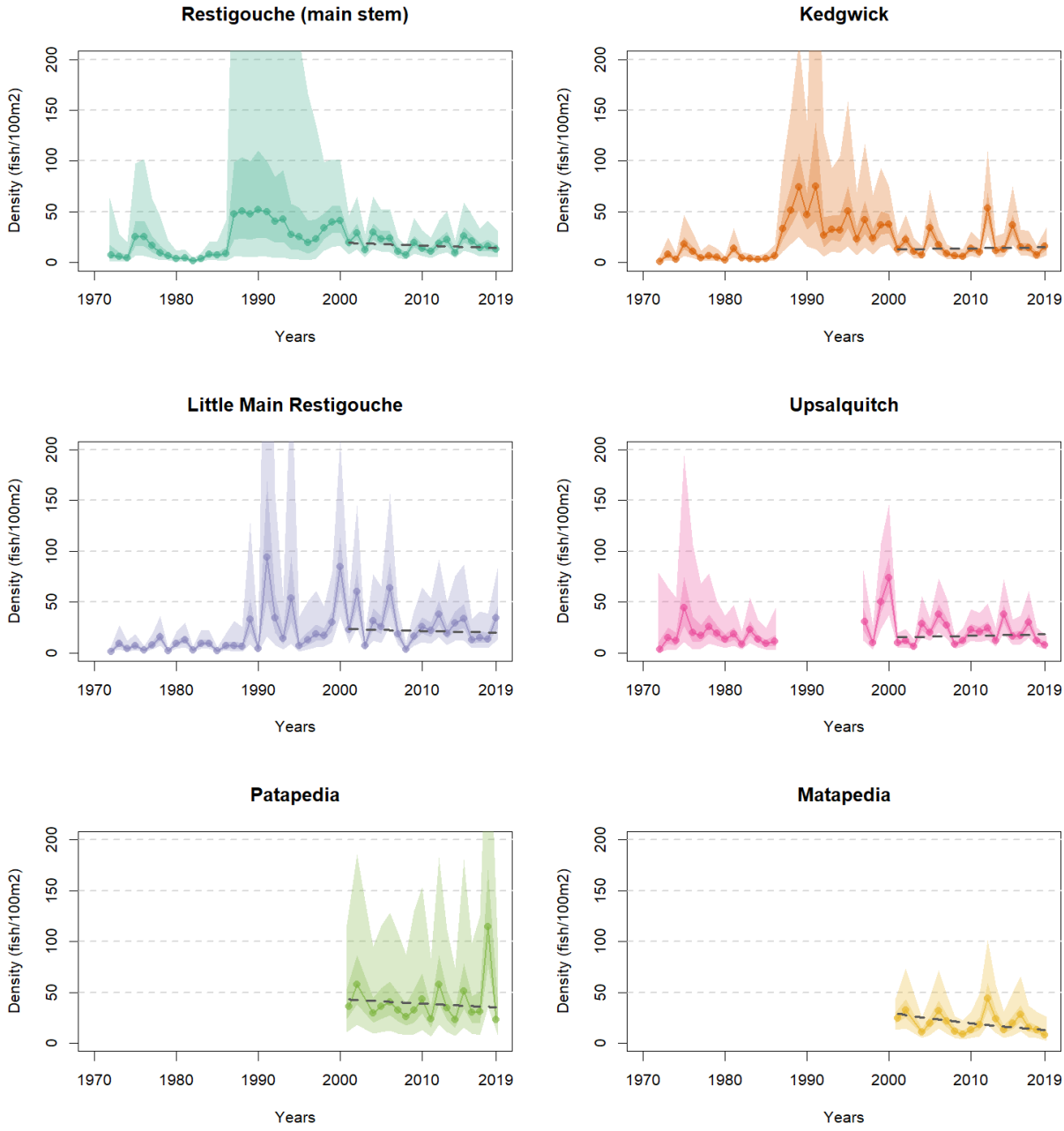


Figure 7. Average fry densities in the Restigouche River and tributaries. Dots indicate the median and light and dark ribbons indicate the 2.5th-97.5th and 25th-75th interquantile range, respectively. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

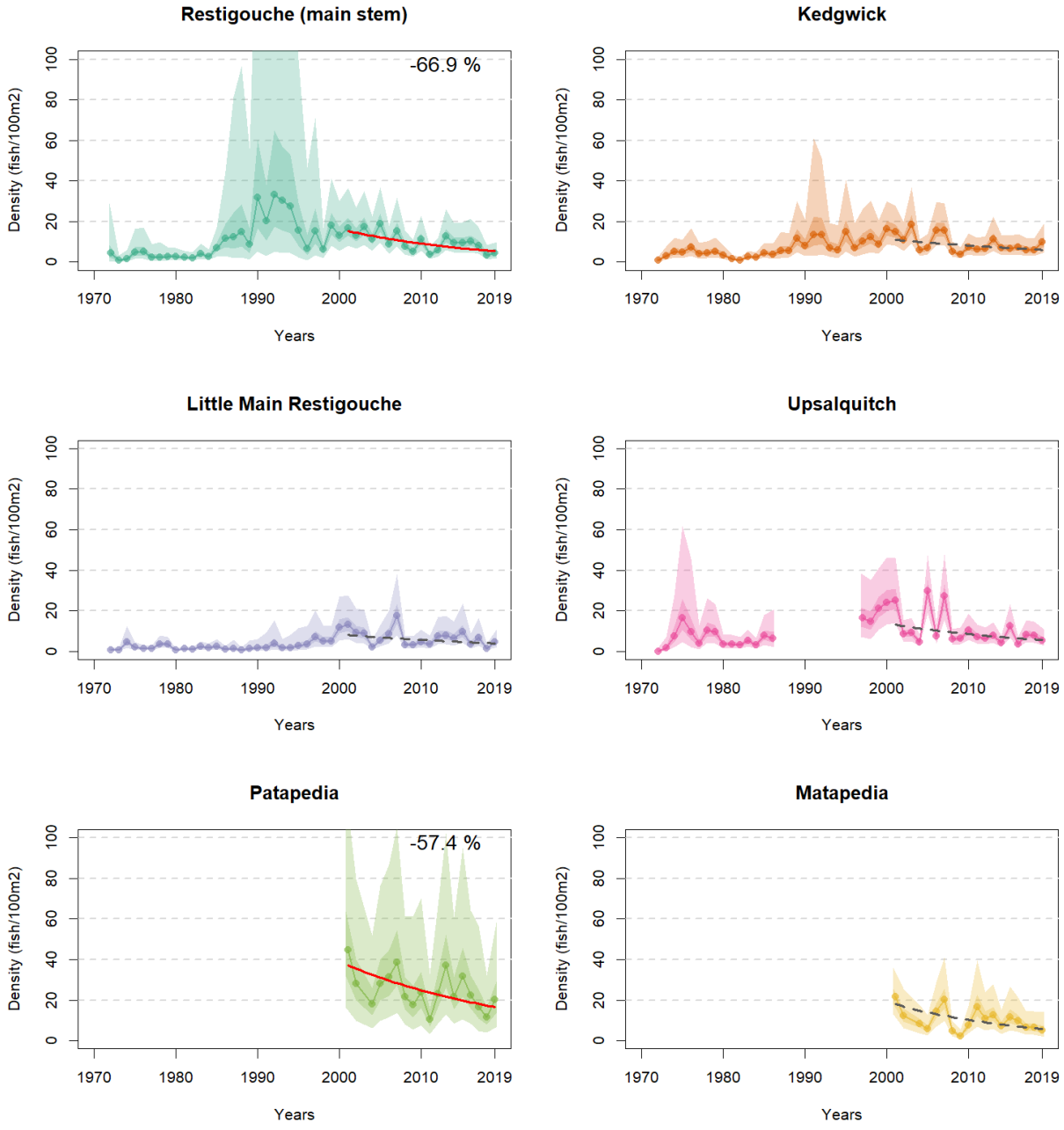


Figure 8. Average small parr densities in the Restigouche River and tributaries. Dots indicate the median and light and dark ribbons indicate the 2.5th-97.5th and 25th-75th interquantile range, respectively. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

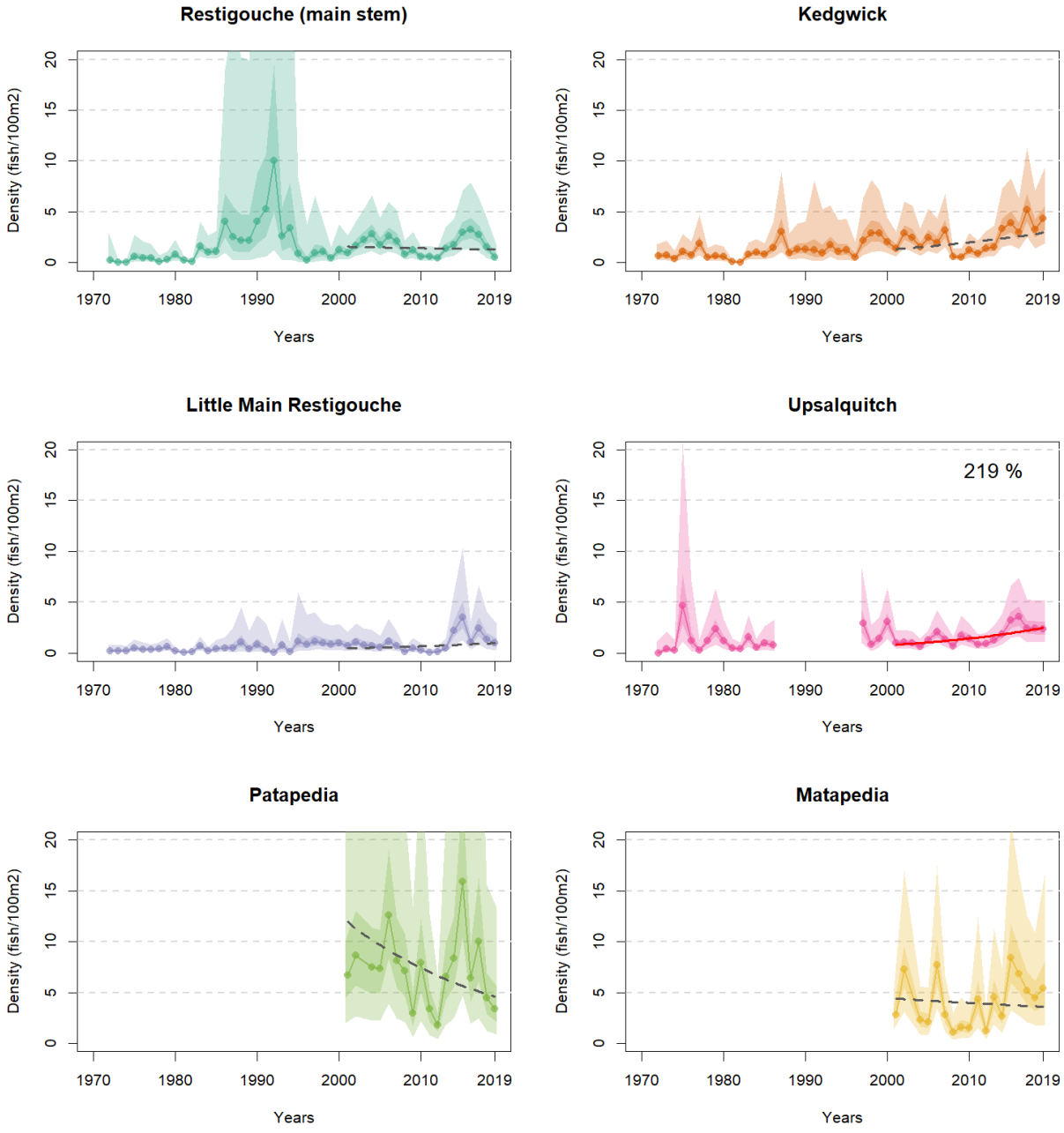


Figure 9. Average large parr densities in the Restigouche River and tributaries. Dots indicate the median and light and dark ribbons indicate the 2.5th-97.5th and 25th-75th interquantile range, respectively. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

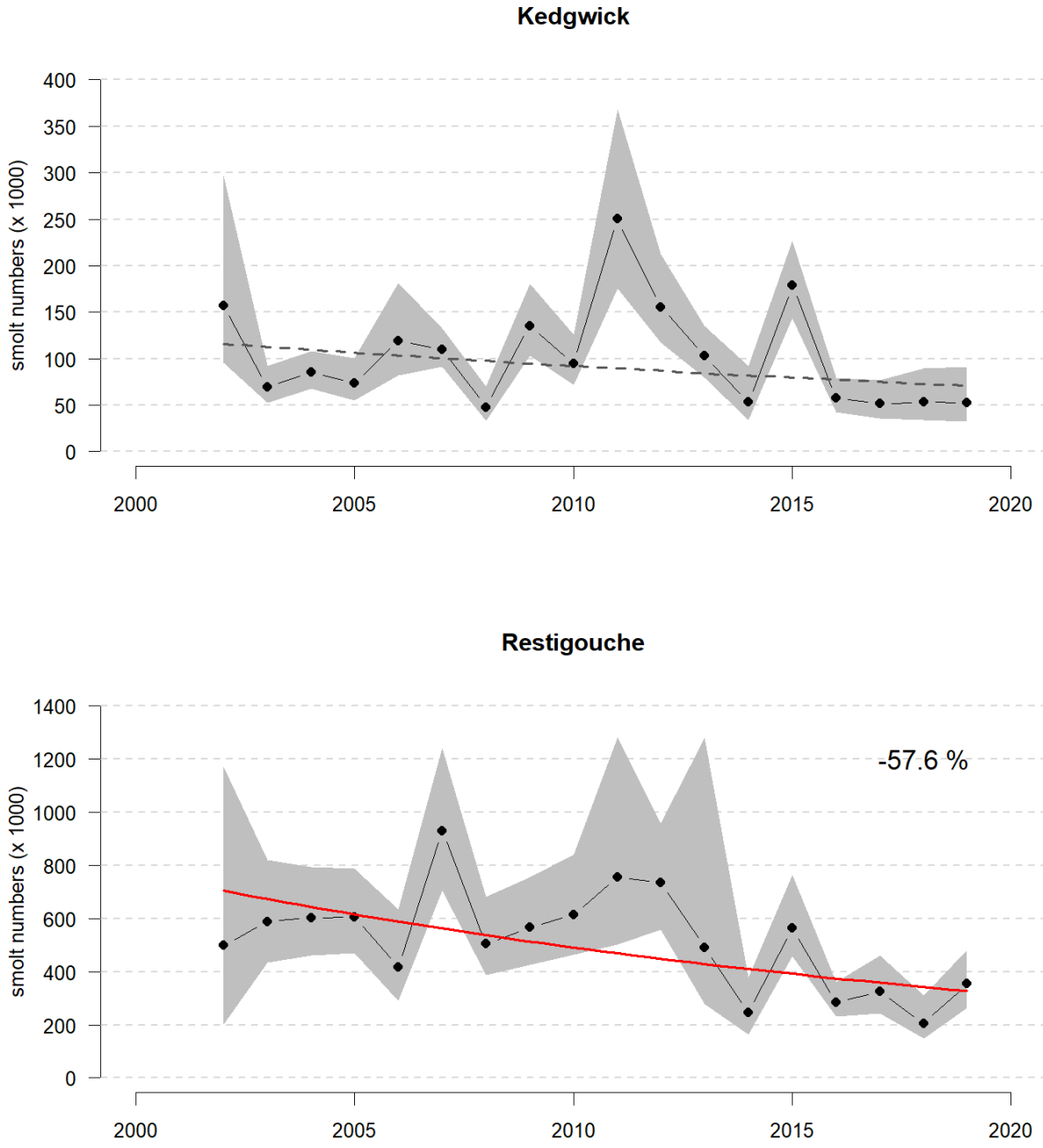


Figure 10. Smolt abundance in the Kedgwick River (upper panel) and in the whole Restigouche (Matapedia included). Dots indicate the median and the grey ribbon indicates the 2.5th-97.5th interquantile range. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

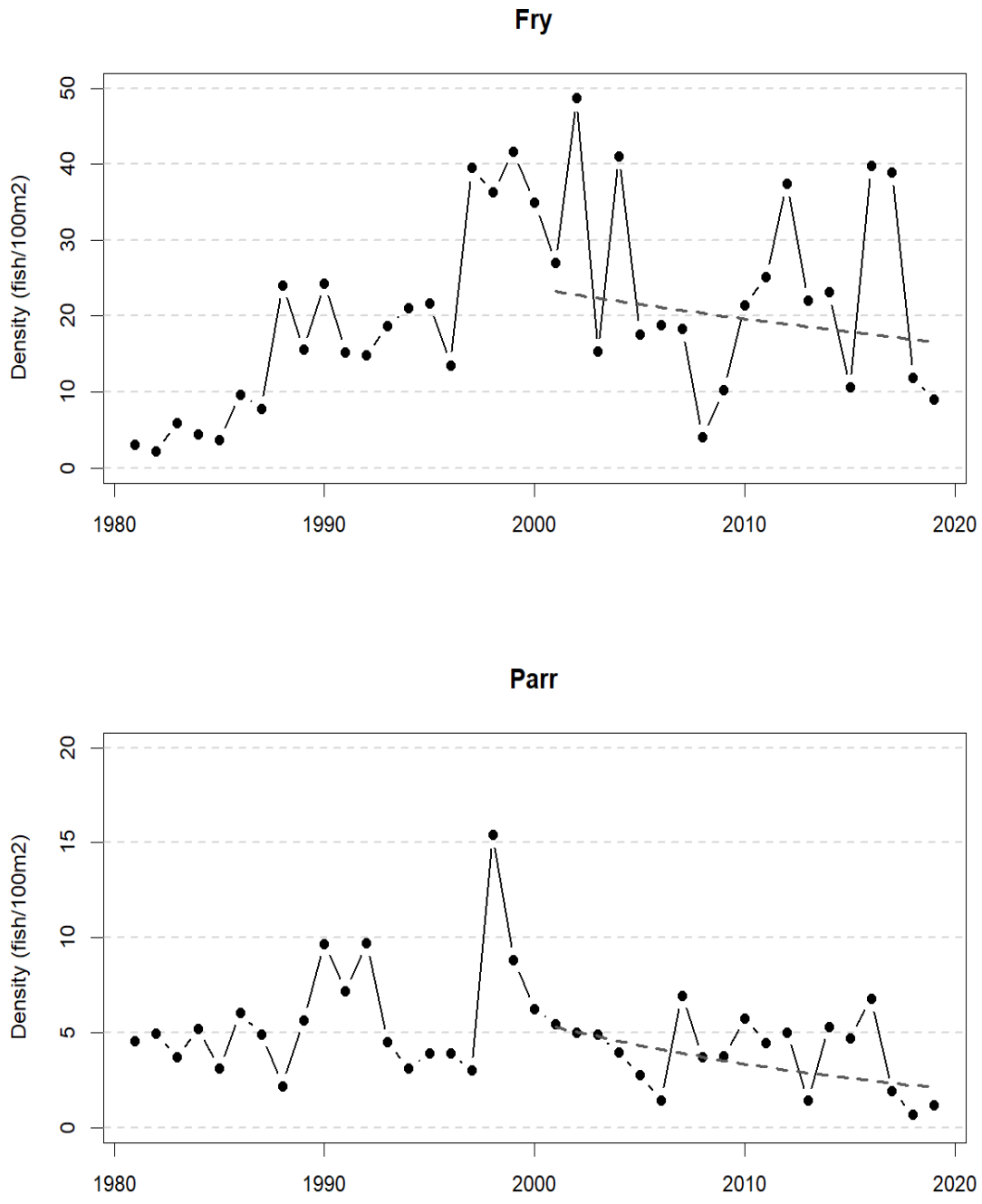


Figure 11. Average fry (upper panel) and parr (lower panel) densities in the Nepisiguit River. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

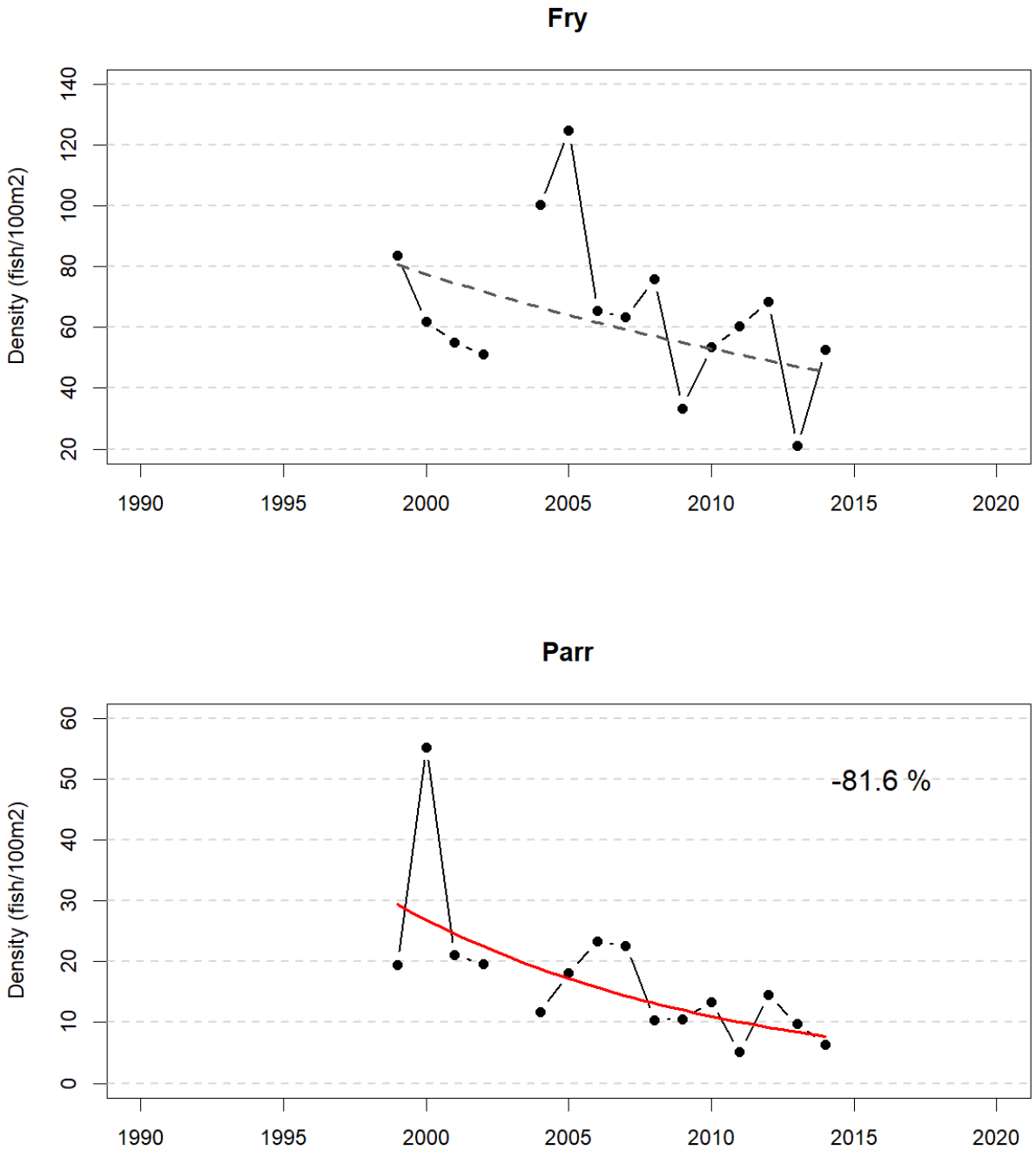


Figure 12. Average fry (upper panel) and parr (lower panel) densities in the Jacquet River. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

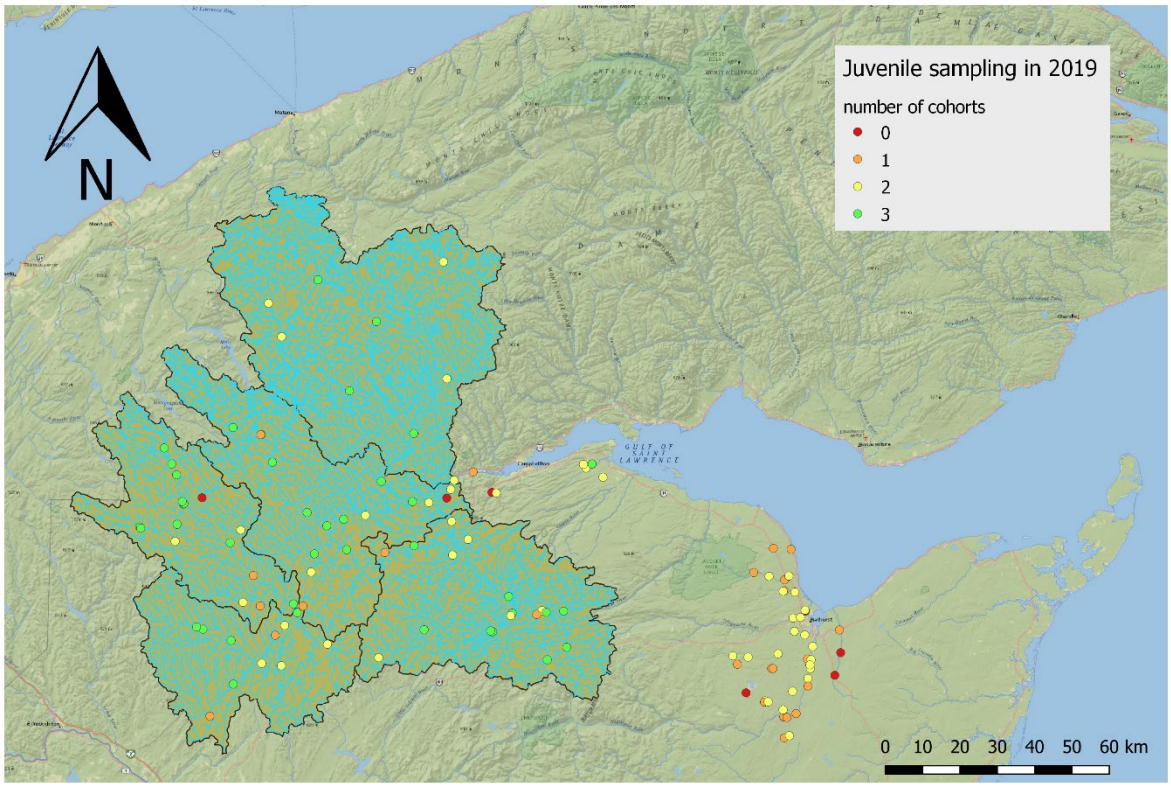


Figure 13. Presence/absence of juvenile Atlantic Salmon, by number of cohorts (fry, small parr, large parr) at electrofishing sites in rivers of SFA 15 sampled in 2019. Note: no distinction is made between small and large parr during data collection in rivers South of the Jacquet River, therefore the maximum number of cohort than can be observed in these rivers is two.

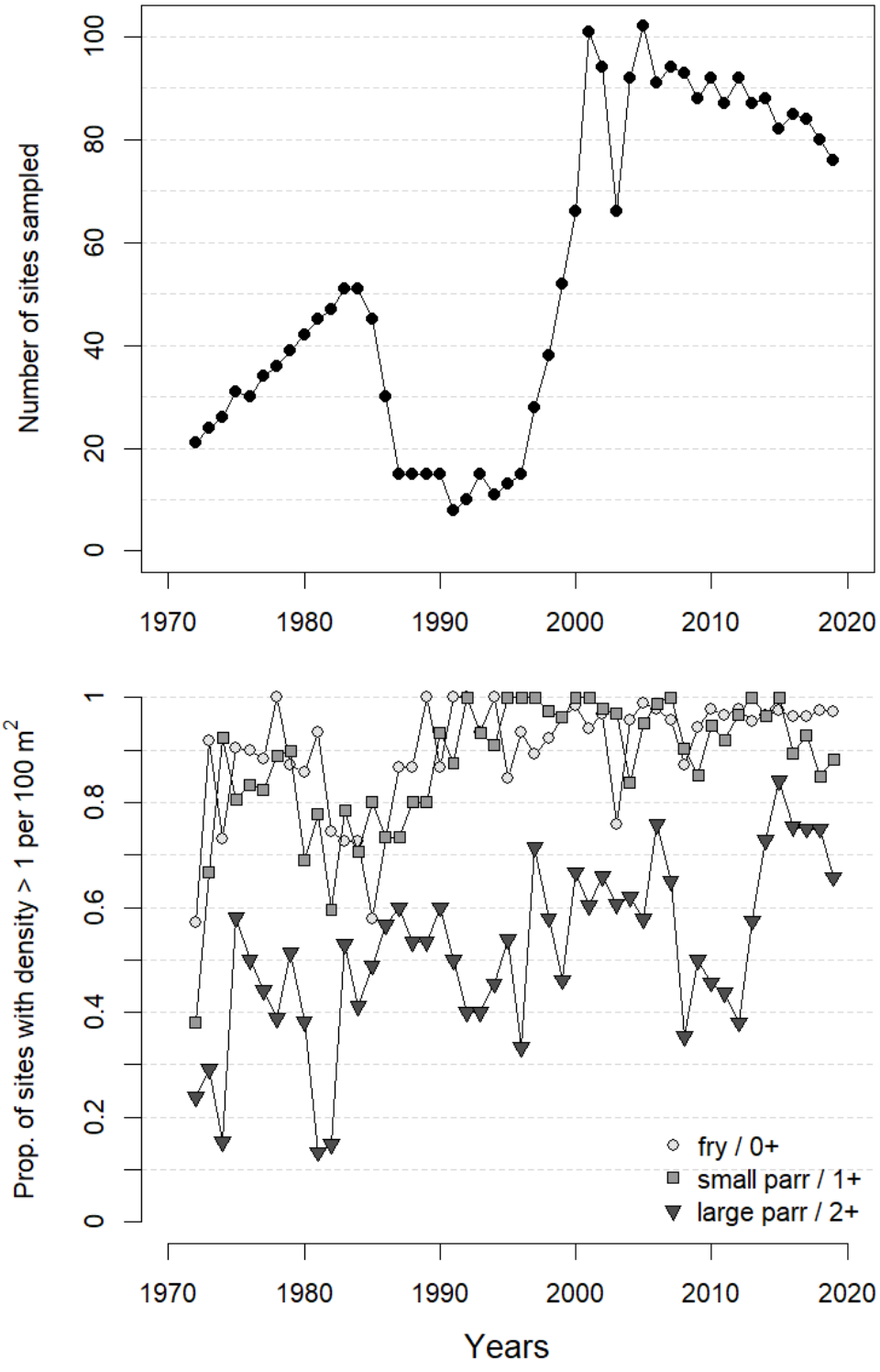


Figure 14. Number of sites sampled annually in the Restigouche River, including Patapedia and Matapedia River (upper panel) and proportion of those sites containing more than 1.0 juvenile per 100 m^2 by age/size group (lower panel).

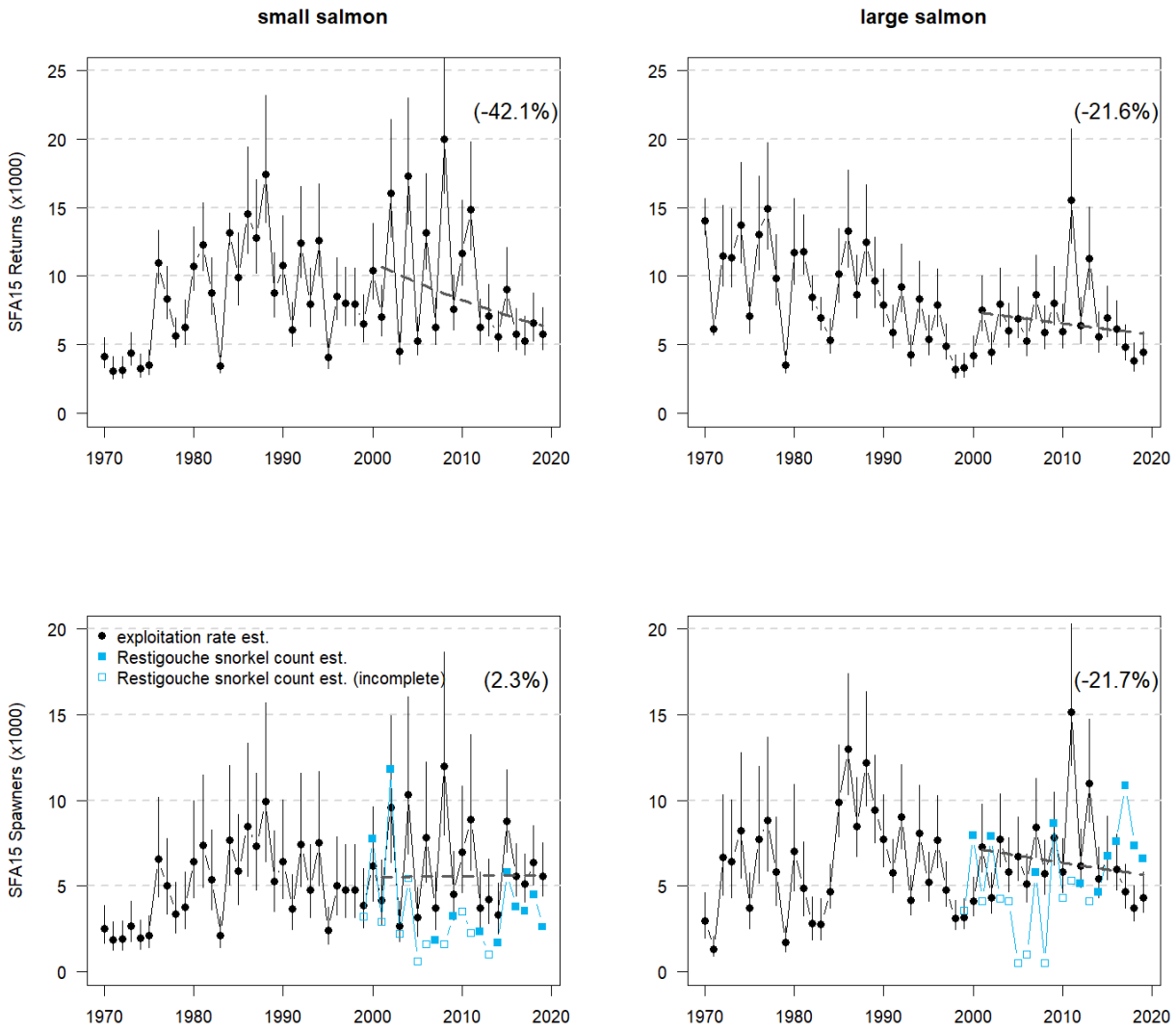
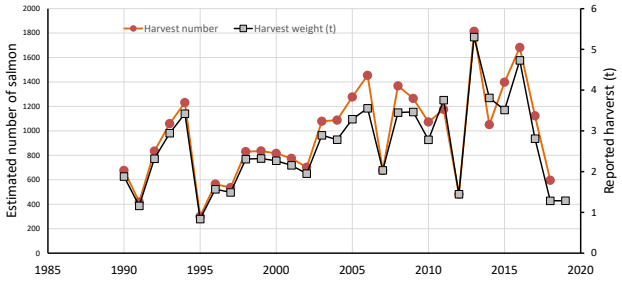
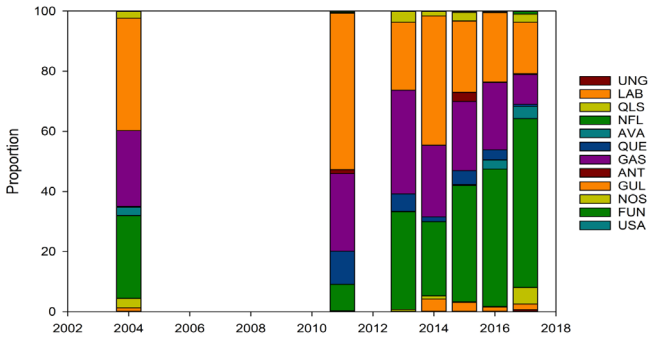


Figure 15. Estimated abundance of small (left panels) and large (right panels) Salmon prior to (returns, upper panels) and post (Spawners, lower panels) fisheries in SFA 15 from 1970 to 2019. Plain black dots indicate estimates obtain based on an angling catch rate of 40% in the Restigouche River. The vertical segments represent estimates obtained with an angling catch rate range of 30 to 50%. The blue squares indicate spawner estimates based on complete (plain squares) or incomplete (empty squares) snorkel counts conducted during the fall in the Restigouche. When the slope of the exponential linear regression is significantly different than zero ($p < 0.05$) or not the curve is displayed in plain red or dashed grey, respectively. When the slope is significantly different than zero the percentage of change over the time period is displayed in the top right corner.

A)



B)



C)

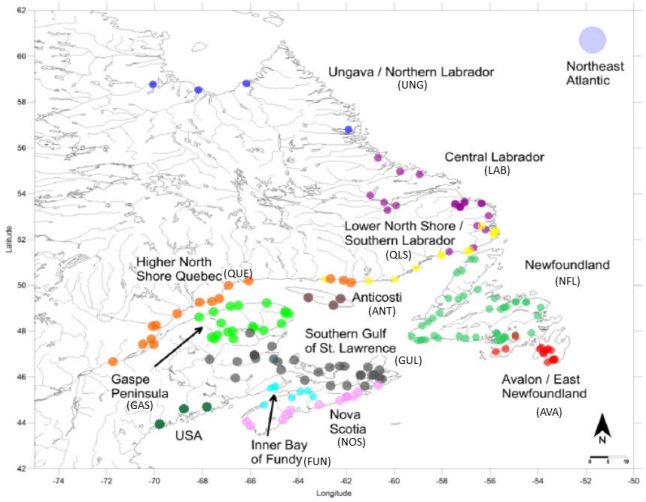


Figure 16. Panel A: time series of reported harvest weight (t) and estimated harvest number of Atlantic Salmon in the Saint-Pierre and Miquelon fishery (ICES 2020). Panel B: estimated proportion by regional group of Atlantic Salmon sampled from the fishery catches based on microsatellites markers. Panel C: regional groups of Atlantic Salmon assigned using microsatellite markers. Figures in panels B and C are from ICES (2018).