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Newfoundland and Labrador Region

Status of Atlantic Salmon (*Salmo salar* L.) stocks within the Newfoundland and Labrador Region (Salmon Fishing Areas 1-14B), 2018

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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.

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ABSTRACT

The status of Newfoundland and Labrador (NL) Atlantic Salmon populations are assessed relative to two reference points, defined on the basis of egg depositions, which separate three stock status zones (critical, cautious and healthy) as per the Fishery Decision-Making Framework Incorporating the Precautionary Approach. These reference points, the Limit Reference Point (LRP) and Upper Stock Reference (USR) point are set at 100% and 150% of the previously defined river-specific conservation egg deposition rate, respectively. In 2018, the status of Atlantic Salmon stocks within the NL Region (Salmon Fishing Areas 1-14B) was assessed using data collected from twenty-two rivers using a combination of salmon counting facilities (fishways and counting fences) and in-river snorkel surveys. Atlantic Salmon smolts migrating to sea were counted on five rivers in Newfoundland. The status of each monitored river is described by the designated stock status zone, % LRP achieved, and both short and long term trends in total adult salmon returns, smolt production and marine survival rates. Estimates of retained salmon in the 2018 recreational fishery were down by 70% and 58% compared to the previous generation averages in Newfoundland and Labrador, respectively. Labrador Food Social and Ceremonial (FSC) and subsistence fisheries harvests were estimated at 12,843 salmon in 2018 (8,762 small, 4,081 large), 7% less than the previous generation average. Of the twenty-two rivers monitored in 2018, one river was not included in the assessment due to an incomplete salmon count. Of the twenty-one other monitored rivers, sixteen had information on total returns over the previous generation (short term comparisons) and fifteen had information over the previous three generations (long term comparisons). Compared to the previous generation, total returns in 2018 were higher on three of four monitored rivers in Labrador and lower on five of twelve monitored rivers in Newfoundland. Compared to the previous three generations, total returns in 2018 were lower on one of four monitored rivers in Labrador and on five of eleven monitored rivers in Newfoundland. Conservation egg requirements were below the river-specific LRP (in the critical zone) on ten assessed rivers, between the LRP and USR on three assessed rivers, and above the river-specific USR on eight assessed rivers in the NL Region. Marine smolt survival is considered to be a major factor limiting the abundance of Atlantic Salmon within the NL Region. Smolt to adult survival of the 2018 smolt class ranged from <1% for Conne River to 9.3% for Western Arm Brook.

INTRODUCTION

In 2014, the Department of Fisheries and Oceans (DFO) implemented a five-year management plan for Atlantic Salmon (*Salmo salar*) in the Newfoundland and Labrador (NL) Region. Although management measures outlined in the plan were expected to remain the same over this five-year period, changes could be warranted if there was a dramatic change in salmon stocks, particularly declines (DFO 2017). An annual update of the stock status in 2015 indicated that no change to the five-year management plan was required. However, in 2016, preliminary estimates of total returns indicated declines of greater than 30% compared to their previous five-year mean on greater than 50% of assessed NL Atlantic Salmon stocks. These declines triggered a re-opening of the five-year management plan including full assessments of the status of the 2016 (see DFO 2017), 2017 (DFO 2018) and 2018 Atlantic Salmon stocks in the NL Region. This report provides supporting documentation for the finalized 2018 assessment data.

There are 15 Atlantic Salmon management areas, known as Salmon Fishing Areas (SFAs); 1-14B, in NL (Figure 1). Within these areas there are 394 rivers believed to contain wild Atlantic Salmon populations that are characterized by differences in life history traits, including freshwater residence time, timing of return migration, age at first spawning, and the extent of ocean migration. Juvenile Atlantic Salmon remain in freshwater habitats for two to five years in Newfoundland and three to seven years in Labrador (Figure 2) prior to undergoing smoltification and migrating to sea as smolts. The majority of rivers in Newfoundland (SFAs 3-12) contain populations of small adult salmon (e.g., <63 cm fork length), which are predominantly maiden fish (never spawned before) that have spent one-year at sea before returning to spawn (grilse, one-sea-winter, [1SW]) (Figure 3). The large salmon component in this area consists mainly of repeat spawners (repeat-spawning grilse) which are returning for a second or subsequent spawning. In Labrador (SFAs 1, 2 and 14B) and Western Newfoundland (SFAs 13 and 14A), there are important large salmon components that contain maiden fish which have spent two (two-sea-winter [2SW]) or more years (multi-sea-winter [MSW]) at sea before spawning. For most monitored rivers, small salmon are predominantly female (range of 60–92% across rivers). The adult spawning migration generally begins from late-May to mid-June for most rivers in Newfoundland and late-June to early-July for monitored rivers in Labrador. Run timing for returning salmon is influenced by climate conditions on the NL Shelf, occurring earlier in warmer years and later in years with colder water temperatures and high amounts of inshore sea ice (Dempson et al. 2017).

Commercial salmon fisheries have been closed since 1992 in insular Newfoundland (SFAs 3-14A), since 1997 in the Straits area of Labrador (SFA 14B), and since 1998 in the remainder of Labrador (SFAs 1-2). Atlantic Salmon fisheries in the NL Region are currently recreational, subsistence (Food, Social and Ceremonial [FSC]), and resident. Details regarding historical fishery management changes to salmon fisheries in the NL Region can be found in Bourgeois et al. (2012).

METHODS

The 2018 status of Atlantic Salmon stocks within NL (SFAs 1-14B) was assessed using data collected from salmon monitoring facilities (fish counting fences and fishways; Figure 1), in-river snorkel surveys and catch and effort data from the recreational fishery. The Licence Stub Return System (O’Connell et al. 1996, 1998; Dempson et al., 2012; Veinott and Cochrane, 2015) provides recreational catch and effort data for SFAs 2-14B, except for Eagle River and

Sand Hill River in SFA 2 where private fishing camps' data are used. DFO Conservation and Protection (C&P) staff and fishing camp logs provide recreational fishery data for SFA 1.

The total returns of small (<63 cm FL) and large (≥63 cm FL) Atlantic Salmon to monitored rivers in 2018 were reported and include estimates of fishery removals downstream of the monitoring facilities. In addition, total returns of small and large Atlantic Salmon during 2018 were also estimated on two rivers in SFA13 (Middle Barachois Brook and Robinsons River; Figure 1) using visual counts during in-river snorkel surveys. Smolts were assessed at a counting fence on four rivers (Campbellton River, Rocky River, Garnish River, and Western Arm Brook). Smolt numbers have been estimated at Conne River via an annual mark-recapture study since 1987 but were unavailable for 2018 due to a fence washout that resulted in an incomplete estimate.

The Fishery Decision-Making Framework Incorporating the Precautionary Approach (DFO, 2009) identifies two reference points for managing fisheries stocks, the Limit Reference Point (LRP) and Upper Stock Reference Point (USR). Populations below the LRP fall in the critical zone, so management actions should promote stock growth and fisheries-related mortality should be kept to the lowest level possible. Populations above the USR are considered to be in the healthy zone and are therefore available for exploitation at some predetermined maximum exploitation rate. Populations with a status between the LRP and USR are situated in the cautious zone, so management actions should promote stock rebuilding to the healthy zone.

Since 2017, the status of Newfoundland and Labrador Atlantic Salmon populations are assessed relative to two reference points, defined on the basis of egg depositions, as per the Fishery Decision-Making Framework Incorporating the Precautionary Approach. Conservation egg requirements for Atlantic Salmon were previously established for individual rivers in Labrador (SFAs 1-2) based on 1.9 eggs per m^2 of river rearing habitat, the Straits Area of Labrador (SFAs 14A-14B) based on 2.4 eggs per m^2 of river rearing habitat and 105 eggs per hectare of lake habitat, and Newfoundland (SFAs 3-13) based on 2.4 eggs per m^2 of river rearing habitat and 368 eggs per hectare of lake habitat (O'Connell and Dempson 1995; O'Connell et al. 1997; Reddin et al. 2006). The LRP and USR are set at 100% and 150% of the previously defined river-specific conservation egg deposition rate, respectively. Status is also described by trends in total adult salmon returns, smolt production and marine survival rates. For short term comparisons, annual Atlantic Salmon returns are compared to the previous five-year mean for Newfoundland and six-year mean for Labrador, which correspond to the average Atlantic Salmon generation time for populations in those areas. For long term comparisons, annual returns are compared to the average returns over the previous three generations (fifteen years for Newfoundland and eighteen years for Labrador). For all comparisons, changes of <10% are considered to be non-significant, and returns are reported as being similar to the comparative average.

RESULTS AND DISCUSSION

RECREATIONAL FISHERY DATA

Recreational fishery data are presented for the period from 1994–2018 (Figures 4 and 5; Tables 1 and 2) for Labrador (SFAs 1, 2 and 14B) and Newfoundland (SFAs 3-14A). Fishing effort is presented as rod days, defined as any full or partial day during which an angler fished. Retained catch of small salmon as well as the number of small and large salmon caught and released are presented separately. Catch per unit effort (CPUE) is calculated using total catch (retained plus released fish) and total rod days.

LABRADOR (SFAS 1, 2 AND 14B)

The 2018 recreational salmon fishery opened on 15 June for all Labrador rivers and closed on 15 September. The number of small salmon retained in the recreational fishery in Labrador in 2018 was an estimated 623 fish, which represents a 58% decrease compared to the previous six-year (2012–17) mean of 1,470 fish. There continues to be a significant ($r^2 = 0.81$, $p < 0.001$) declining trend in the number of small salmon retained in Labrador over the time series (1994–2018). The number of caught and released small salmon in the 2018 recreational fishery in Labrador (4,039 fish) was 1% higher than the previous six-year mean (4,013 fish). Retention of large Atlantic Salmon in the recreational fishery has been prohibited since 2011. In 2018, there was an estimated 1,232 large salmon caught-and-released in the Labrador recreational fishery, which corresponds to a 42% decrease relative to the previous six-year mean (2,109 fish). Since 1994, the number of released large salmon in Labrador has been increasing significantly ($r^2 = 0.53$, $p < 0.001$). Effort in the 2018 Labrador fishery was estimated at 3,631 rod days, which is 44% below the previous five-year mean (6,494 rod days) and is the lowest estimated effort in the time series (since 1974). CPUE in Labrador has been increasing over the time series and averaged 1.2 fish caught per rod day from 2012–17. In 2018, recreational angling CPUE for Atlantic Salmon on rivers in SFA 1 and 2 was 1.6, the highest value in the time series (Table 1, Figure 4).

NEWFOUNDLAND (SFAS 3-14A)

The 2018 recreational salmon fishery opened on 4 June for all Newfoundland rivers and closed on 7 September. Total number of small salmon retained in the 2018 recreational fishery was an estimated 7,292 fish (Table 2, Figure 5), which is 70% lower than the previous five year mean of 24,207 small salmon retained, and an order of magnitude lower than any other year since 1994. The estimated number of released small salmon in the 2018 recreational fishery was 22,339 fish, which is 21% higher than the previous five-year average (18,538 fish). Retention of large salmon has not been permitted in Newfoundland over the entire time series. In 2018, 2,426 large salmon were caught and released across Newfoundland (SFAs 3-14A), which is 53% lower than the previous five-year mean (5,158 fish) and the lowest in the time series (1994–2017; Table 2). Estimated angler effort in 2018 (27,632 rod days) was 75% below the previous five-year mean (110,094 rod days). CPUE in the 2018 recreational fishery was 1.2 salmon caught per rod day, a 169% increase compared to the previous five-year mean (0.4) and the second highest estimate in the time series after 2017 (Table 2, Figure 5).

There was a significant decline in angling effort during the 2018 recreational salmon fishery, involving a 169% decrease in Newfoundland compared to the previous five-year mean, and a 44% decline in Labrador. This observed decrease is likely due to a combination of stricter harvest regulations and a high frequency of environmental closures in 2018. Following, two consecutive years of poor salmon returns, the 2018 fishery opened with a one fish retention limit on all rivers, and switched to catch and release angling only after an in-season review (15-July and 22-July for Newfoundland and Labrador, respectively; DFO, 2019). In addition, when the recreational fishery switched to catch and release only in mid-July, the water temperature threshold for environmental river closures, which is typically set at 22°C, was reduced to 18°C. Accordingly, 29% of angler days were lost due to environmental closures in Newfoundland in 2018, which is the highest since 1987 (36.9%). Closures generally occurred in late-July and early-August in 2018 and affected all zones with the exception of Labrador, which is consistent with previous years (Dempson et al. 2001).

Despite the dramatic decrease in effort, total catch was only 33% lower in Newfoundland and 22% lower in Labrador in comparison to the previous generation mean, which resulted in the highest CPUE estimates in the time series. While there was a 70% reduction in the number of retained salmon in 2018 in Newfoundland (Table 2), the number of released small salmon in Newfoundland was 22% higher relative to the previous generation, and was not different in the Labrador fishery. This indicates a shift away from retention to catch and release angling in response to the changes in harvest regulations, particularly by Newfoundland anglers that are largely retention-oriented (Veinott and Cochrane, 2015). The high CPUE estimate in 2018 should not be interpreted as an increase in Atlantic Salmon abundance; rather it reflects changes in angler behavior in response to unprecedented changes to harvest regulations and a high frequency of environmental closures.

RECREATIONAL SALMON FISHERY LICENCES

An estimated 24,272 recreational salmon licences were sold in Newfoundland and Labrador in 2018, which is consistent with an increasing trend in licence sales since 2008 (Figure 6). In 2018, the provincial Newfoundland and Labrador government, who are responsible for licence sales in the recreational salmon fishery, reduced the price of a resident salmon licence from $23 to $5. In spite of the reduced cost, fewer licences were sold in 2018 relative to peak years in 2015 and 2016 (Figure 6).

Overall, there is a decreasing trend in the percentage of anglers that return their fishing logs (r^2=0.80, p<0.001), however, 2018 was not the lowest (22.5%) in the time series, as fewer than 20% of anglers returned their fishing logs in 2013 and 2014. In addition, the percentage of anglers that report null effort is increasing over the time series, involving 52% of the respondents (i.e., anglers that voluntarily submit their fishing logs) in 2018, which is the highest in the time series.

INDIGENOUS/SUBSISTENCE FISHERY DATA

There has been no commercial salmon fishing in Newfoundland (SFAs 3-14A) since 1992, in the Straits area of Labrador (SFA 14B) since 1997, and in the remainder of Labrador (SFAs 1-2) since 1998.

Indigenous Food, Social, and Ceremonial (FSC) fisheries for Atlantic Salmon occur in Labrador under communal licences. Labrador also has a resident subsistence fishery for trout and char with a permitted retention of salmon by-catch (three salmon since 2011). In Newfoundland, Miawpukek First Nation (MFN) holds a FSC communal salmon fishing licence, but has chosen not to harvest salmon under this licence since 1997 due to conservation concerns.

Labrador FSC and subsistence fisheries harvests were inferred from logbook returns (73% return rate), and were estimated at 12,843 salmon in 2018 (8,762 small, 4,081 large), which was 7% less than the previous six-year mean (2012–17) of 13,676 salmon (8,255 small and 5,421 large) (Figure 7, Table 3). Large salmon represented 32% of the catch by number.

Region of origin of salmon harvested in the Labrador FSC and subsistence fisheries from 2006 to 2014 has indicated that upwards of 97% of the salmon originate from Labrador (Bradbury et al. 2015; ICES 2016). In 2018, a total of 799 samples (6% of harvest by number) were collected from the Labrador subsistence fisheries: 131 from northern Labrador (SFA 1A), 308 from Lake Melville (SFA 1B), and 360 samples from southern Labrador (SFA 2). Of these, 499 were ran for genetic analysis to determine region of origin using a single nucleotide polymorphism (SNP) range wide baseline (Jeffery et al. 2018). Similar to previous years, over 99% of these salmon originated from Labrador.

The reported harvest of Atlantic Salmon in the St. Pierre et Miquelon fishery has ranged from 0.8 t to 5.3 t during 1991 to 2018. Based on genetic analyses of samples from 2004 to 2015, the majority (>70%) of salmon in this fishery originated from three main regions of eastern Canada:

Gulf of St. Lawrence (38%), Gaspe Peninsula (32%), and Newfoundland (24%) (Bradbury et al. 2016; ICES 2015). In recent years, a total of 193 (137 in 2017 and 56 in 2018) samples from the St, Pierre and Miquelon fisheries were analyzed using the SNP panel range wide baseline (Jeffery et al. 2018). Estimates of stock composition showed consistent dominance of salmon from the same three regions with little difference between the two years: Gulf of St. Lawrence, Gaspe Peninsula, and Newfoundland.

The mixed stock Atlantic Salmon fishery at West Greenland harvests Atlantic Salmon originating from eastern North America and the northeast Atlantic, consisting primarily of 1SW non-maturing salmon (i.e., fish destined to return to rivers primarily as 2SW maiden salmon). Reported harvests at West Greenland have ranged from 9 t to 58 t during 1998 to 2018, equivalent to 2,300 to 12,800 salmon of North American origin (ICES 2019). Region of origin analyses, using the SNP baseline described above, indicated that Labrador origin salmon comprised approximately 14% and 23% of the West Greenland Atlantic salmon fishery in 2017 and 2018, respectively.

MONITORING FACILITIES – TOTAL RETURNS AND CONSERVATION REQUIREMENTS

LABRADOR (SFAS 1, 2 AND 14B)

Northern Labrador (SFA 1)

Total Returns (Tables 4 and 5, Figure 8)

There are nine scheduled salmon rivers in SFA 1. In 2018, information on total returns of small and large salmon was available for one river in Northern Labrador (SFA 1): English River. In 2018, 808 small salmon and 139 large salmon returned to English River which represents a 34% increase in small salmon returns and a 27% decrease in large salmon returns compared to the previous generation mean. Returns of small and large salmon to English River were significantly higher in 2018 relative to the previous three generation mean (99% and 43% for small and large salmon respectively). A counting fence was installed on Traverspine River in Lake Melville in 2018, however, extremely high water levels shortly after installation resulted in a total washout of the fence and no count of adult salmon.

Conservation Requirement (Table 6a, Figure 15)

English River achieved 237% of its LRP in 2018 and has exceeded the LRP for eight consecutive years and the USR for six consecutive years.

Southern Labrador (SFA 2 and 14B)

Total Returns (Tables 4 and 5, Figure 8)

There are sixteen scheduled salmon rivers in SFA 2. Three rivers were assessed in 2018: Sand Hill River, Muddy Bay Brook (Dykes River) and Southwest Brook (a tributary of Paradise River). Total returns of small salmon in 2018 were higher than the previous generation on Southwest Brook (57%) and Sand Hill River (86%), and there was no change on Muddy Bay Brook. Total returns of small salmon in 2018 were 15% lower on Southwest River and 12% higher on Sand Hill River relative to the previous three-generation mean, and there was no change on Muddy Bay Brook. Total returns in 2018 of large salmon for all monitored rivers in SFA 2 were lower relative to the previous generation and long term means.

Conservation Requirement (Table 6a, Figure 13)

Of the three assessed rivers in SFA 2, only Muddy Bay Brook exceeded the river-specific LRP in 2018 (132%). Southwest Brook (77%) and Sand Hill River (95%) were both below their LRPs in 2018. Sand Hill River has not exceeded the LRP or USR since 2011 and Southwest Brook has only exceeded the LRP once during the past six years (2015).

NEWFOUNDLAND (SFAS 3-14A)

Northeast Coast (SFAs 3-8)

Total Returns (Tables 4 and 5, Figures 9 and 10)

There are 60 scheduled salmon rivers in SFAs 3-8. Five rivers were assessed in 2018: Exploits River, Campbellton River and Salmon Brook (tributary of Gander River) in SFA 4 and Middle Brook and Terra Nova River in SFA 5. Adult salmon were only partially counted on Northwest River (Port Blandford) in 2018, therefore, this river was not included in the assessment. No rivers were assessed in SFAs 3, 6, 7 and 8 during 2018. Total returns of small and large salmon on Exploits River in 2018 were below their previous generation mean (25% and 78%) and previous three generation means (35% and 83%). Total returns of small salmon on Campbellton River were 18% higher in 2018 than relative to the previous generation mean and 17% higher relative to the previous three generation mean, and there was no change in the returns of large salmon in 2018 relative to either reference period. There was no change in the total returns of small salmon to Salmon Brook in 2018 relative to the previous generation and previous three generation means, however, total returns of large salmon were 69% lower than the previous generation and 55% lower than the long-term generation mean (55%). In SFA 5, total returns of small salmon on Middle Brook and Terra Nova River were above the previous generation means (19% and 49%, respectively) and the previous three generation means (11% and 32%, respectively). Total returns of large salmon in 2018 were 32% lower on Middle Brook relative to the previous generation mean, but 30% higher relative to the previous 3 three generation mean. Total large salmon returns on Terra Nova River in 2018 were 23% lower than the previous generation mean and there was no change relative to the long-term mean.

Conservation Requirement (Table 6b, Figure 17)

Three of the five assessed Northeast Coast rivers (SFAs 4 and 5) exceeded the USR in 2018: Campbellton River (414%), Salmon Brook (114%) and Middle Brook (382%). Both the Exploits River (31%) and Terra Nova River (73%) fell below the LRP in 2018. It is important to note that large areas of rearing habitat were made accessible in the upper areas of Exploits River (above Red Indian Dam, 1989) and Terra Nova River (above Mollyguajeck Falls, 1985) which have not been fully colonized and therefore have consequences on the proportion of the total river egg deposition achieved. For Exploits River, adult salmon are counted at three locations: Bishop’s Falls (closest to the mouth of the river), Grand Falls and Red Indian Lake dam. This allows Exploits River to be assessed based on the entire watershed and on each of these individual sections. However, in 2018 adult salmon at the Grand Falls fishway were counted multiple times due to fish falling back down over the falls after their initial passage. As a result, the count at the Grand Falls fishway was inaccurate in 2018 and the allocation of estimated egg depositions between the three sections of the Exploits River was not possible. It is important to note that there were no issues with the fishway at Bishop’s Falls, and therefore the total count at Bishop’s Falls is an accurate count of all the Atlantic Salmon that entered the Exploits River in 2018.

South Coast (SFAs 9-11)

Total Returns (Tables 4 and 5, Figures 11 and 12)

There are 48 scheduled salmon rivers in SFAs 9-11. Information on total returns of small and large salmon in 2018 was available for five South Coast rivers: Rocky River (SFA 9), Northeast River (Placentia Bay) (SFA 10), Conne River (SFA 11), Little River (SFA 11) and Garnish River (SFA 11). Northeast River is a facility that operated from 1984–2002 and was re-opened in 2015, and Garnish River is a new counting facility that began operating in 2015. Therefore, short-term and long-term trends are not available for these two rivers.

There was no change in the total returns of small salmon to Rocky River in 2018 relative to the previous five-year mean and small salmon returns were 25% below the previous three-generation mean. Total returns of large salmon to Rocky River in 2018 were below the previous generation (78%) and the previous three generation means (88%). Northeast River was previously assessed from 1984 to 2002 and after a period with no counts (2003–14), assessments began again in 2015. In 2018, total returns of small and large salmon increased relative to the previous years (835 small and 105 large salmon in 2018) and represent the second highest counts since the monitoring facility resumed operations in 2015.

Total returns of small and large salmon to Conne River in 2018 were the lowest in the 33-year time series, involving a 76% and 97% decline in small and large salmon over the previous three generations. Since monitoring began in 1986, returns of small salmon to Conne River have decreased by 83%, while large salmon have declined by 91%, with no indication that salmon returns will improve. As noted in previous assessments, a retrospective analysis was previously carried out to infer a plausible range of returns to Conne River during the 10-year period prior to 1986 (1976–85) (Robertson et al. 2013). Results of this analysis indicated that the number of salmon returning to Conne River was generally similar to the range of returns observed at the fish counting facility during the first five years of operation (1986–90), further highlighting the dramatic declines since the early 1990s. The counting fence at Conne River washed out on July 12, 2018, however, throughout the time series (since 1986) over 90% of the run is complete before this date. Regardless, the number of salmon that may have migrated upstream after this date was estimated using a non-parametric bootstrap method based on the percentage of returns to July 12 during the previous ten years (2008–17), and is included in the final returns.

Returns to Little River have decreased significantly in recent years. From 1987–2016, the average count of returning salmon to Little River was 235 fish, with a range of 47 to 801. Following a record low count of 9 Atlantic salmon in 2017, a total of 8 small Atlantic salmon (0 large salmon) returned in 2018, 93% below the previous generation mean and the lowest count in the entire time series. Returning adult Atlantic Salmon were monitored for the fourth consecutive year on Garnish River in 2018. Total returns of small and large salmon to Garnish River in 2018 were the second lowest and lowest in the time series, respectively. In the absence of long-term abundance data on this river it is currently unclear how well these returns reflect the natural annual variability in the population. However, historical angling data suggest that returns to this river in recent years are significantly lower than in the 1970s (Moores et al., 1978).

Conservation Requirement (Table 6b, Figure 17)

The estimated percent conservation requirement achieved for Rocky River in 2018 was 32%. This population has never exceeded the LRP throughout the time series. Northeast River (Placentia Bay) achieved 470% of its LRP, exceeding the LRP and USR. Unlike Rocky River, this population typically exceeds its LRP every year.

Conne River achieved 21% of the LRP in 2018, which is the lowest ever recorded. This represents 70% reduction compared to the previous generation mean, and 77% reduction compared to the previous three generation mean. A population viability analysis (Robertson et al. 2013) noted that under current conditions there was a low probability (<30%) that Atlantic Salmon populations in southern Newfoundland would meet or exceed conservation spawning requirements over the next 15 years. To date, management measures remain the same with no additional measures taken to rebuild these populations. Garnish River only achieved 29% of the LRP and has been categorized within the critical zone every year since counts began in 2015.

Southwest Coast (SFAs 12-13)

Total Returns (Tables 4 and 5, Figures 13 and 14)

There are ten scheduled salmon rivers in SFA 12, however, no rivers were assessed in this SFA during 2018. There are eighteen scheduled salmon rivers in SFA 13. Information on total returns of small and large salmon in 2018 was available for four Southwest Coast rivers (SFA 13): Harry's River and Corner Brook Stream, Middle Barachois Brook and Robinson's River. Returns to Harry's River were estimated using a variety of methods from 1992–2010 (Bourgeois et al. 2012). Since 2011, annual returns have been derived from a sonar operation conducted near the mouth of the river. Returns of small salmon to Harry's River in 2018 were 20% lower than the previous generation and 11% lower than the previous three-generation mean. There was no change in the total returns of large salmon to Harry's River in 2018 relative to the previous generation and a 16% increase relative to the previous three generations. There was no change in total returns of salmon to Corner Brook stream compared to the previous generation average. Total returns of small and large salmon on two rivers in Bay St. George (Middle Barachois Brook and Robinson's River) were assessed using visual counts from in-river snorkel surveys conducted during mid-August. A raising factor, ranging from 1.0 to 1.2, was applied to the counts of salmon in each River Section to account for fish not counted (observer efficiency). Egg depositions were calculated using mean weights, percent females and fecundity for small (<63 cm) and large (≥63 cm) salmon. These two rivers have been assessed previously, however the last surveys were conducted in 2008 and consequently there are no available comparisons made to previous generations for these two rivers. Estimated total returns to Middle Barachois Brook (312 small, 81 large) and Robinsons River (932 small, 169 large) in 2018 are the lowest in the time series for both rivers.

Conservation Requirement (Table 6b, Figure 17)

Harry's River achieved 100% of its LRP in 2018, rebounding from 2017 when this river fell below the LRP for the first time since 2013. Corner Brook Stream exceeded the USR in 2018 (201% conservation achieved) and has done so every year since counts began in 2009 aside from 2017 (145%). Estimated egg deposition for Middle Barachois Brook in 2018 was 39% of the LRP which is the same as in 2008, the last time this river was assessed. Estimated egg deposition on Robinsons River in 2018 was 70% of the LRP, which is 24% below the estimate from the last time this river was assessed (2008).

Northwest Coast (SFA 14A)

Total Returns (Tables 4 and 5, Figure 15)

There are twenty-two scheduled salmon rivers in SFA 14A. Information on total returns of small and large salmon in 2017 was available for three Northwest Coast rivers (SFA 14A): Torrent River, Western Arm Brook and Deer Arm Brook (Gros Morne National Park, monitored by Parks Canada). There was no change in total returns of small salmon to Torrent River in 2018 relative to the previous generation means, respectively, however returns of large salmon in 2018 declined by 37% in comparison to previous generation. Total returns of small salmon on Western Arm Brook in 2018 was higher than the previous generation means, however, returns of large salmon were 58% lower than the previous generation and 48% lower than previous three generations. A total of 228 small and 62 large salmon were enumerated on Deer Arm Brook in 2018. Salmon were enumerated on Deer Arm Brook up to August 15 when the fence was lost. Historically the majority of salmon (93–97%) have passed through the fence by this date and no salmon were counted in the few days before the fence was lost. Therefore, the count likely reflects the total number of adult salmon in 2018.

Conservation Requirement (Table 6b, Figure 17)

Both Torrent River (720%) and Western Arm Brook (499%) exceeded the LRP and USR in 2018. Both of these rivers have exceeded the USR every year since 1992. The total 290 fish enumerated on Deer Arm Brook exceeded the estimated conservation requirement of 179 small salmon for this river.

SMOLT PRODUCTION AND MARINE SURVIVAL

In 2018, out-migrating smolts were counted at four rivers in Newfoundland: Campbellton River (SFA 4), Rocky River (SFA 9), Garnish River (SFA 11) and Western Arm Brook (SFA 14A). The number of migrating smolts on Conne River are estimated annually via a mark-recapture study, however, a fence washout resulted in no estimate in 2018. In 2018, smolt counts at Campbellton River, Rocky River and Western Arm Brook were 4%, 46% and 20% below the previous five-year means, respectively (Table 7, Figure 18). A complete smolt count was obtained for the second time on Garnish River in 2018 with a total of 10,425 fish which is 12% lower than the first count in 2017.

Marine survival estimates at Campbellton River (8.1%) and Western Arm Brook (9.3%) in 2018 were 6% below the previous five-year mean at Campbellton, but 30% higher over the same period at Western Arm Brook (Table 8. Figure 16). Marine survival at Rocky River in 2018 (6.2%) was 20% higher than the previous five-year mean. The 2018 marine survival estimate for Conne River was <1%, which is the lowest in the time series (1988–2018). Marine survival on Garnish River in 2018 was 2.8%. This is the first estimate of marine survival for this river as the first count in 2017 was compared with the 2018 returns of small salmon.

ECOSYSTEM CONSIDERATIONS

Sea ice extent is positively related to adult run timing (date) for Atlantic Salmon (Dempson et al. 2017). During 2018, annual sea surface temperature was colder than normal in offshore regions on the Newfoundland-Labrador Shelf, which is consistent with a cooling trend since 2015. However, sea ice volume during early spring (March to mid-April) in 2018 was below normal. Water temperatures in the inshore regions of Newfoundland (e.g., Comfort Cove) were above the long-term average in summer 2018. Consistent with recent trends, primary and secondary production indices on the NL Shelf show low productivity at the lower trophic levels (phytoplankton and zooplankton) and changes in zooplankton community structure involving declines in large energy-rich copepod *Calanus finmarchicus* and increases in small, warm water copepods. Lower potential energy transfer to higher trophic levels, driven by environmental conditions could potentially influence prey conditions for salmon and may have contributed to the observed declines in salmon returns since 2016.

AQUACULTURE

The consequences of a single large aquaculture escape event in 2013 for wild populations of Atlantic Salmon in a southern Newfoundland fjord have been examined in recent years using targeted genomic tools. In 2014, the unambiguous, widespread detection of first- and second-generation wild-aquaculture hybrid salmon and pure aquaculture offspring was reported (i.e., 27% hybrids in 17/18 rivers within 75 km of escape site) (Wringe et al. 2018). Repeated sampling of these rivers in recent years has shown that the number of hybrids (one wild and one aquaculture parent) and feral (two aquaculture parents) salmon peaked in 2014 and has consistently declined thereafter. In addition, separate surveys for aquaculture escapees were conducted each year in the fall of 2015, 2016, 2017 and 2018 in the Fortune Bay and Bay d'Espoir areas. In 2015, a total of 159 escapees were detected, compared to no detected escapees in 2016, 2017 and 2018 despite similar levels of effort. Following an escape event of 2,000–3,000 in late-July 2018 where 400 escapees were recaptured in the marine environment.

Monitoring of levels of hybridization and the presence and abundance of escapees continued in southern Newfoundland in the fall of 2018. Additional field work has been carried out in Placentia Bay since 2016 to establish a genetic baseline that may be used to evaluate potential impacts on wild Atlantic Salmon populations from a proposed future aquaculture expansion.

Examination of the relative survival of wild, hybrid, and feral juveniles in the wild suggests decreased survival of aquaculture salmon offspring and simulation modeling suggests negative impacts on the character and size of wild populations experiencing hybridization (Sylvester et al. 2018).

SUMMARY AND CONCLUSIONS

Twenty-two populations of Atlantic Salmon were assessed in 2018. Adult salmon were enumerated at monitoring facilities (fish counting fences and fishways) on four rivers in Labrador and sixteen rivers in Newfoundland. In addition, adult salmon abundance was estimated on two rivers in Bay St. George (SFA 13) using in-river snorkel surveys. Northwest River was not included in the 2018 assessment due to an incomplete count. Four of the assessed rivers in Newfoundland also counted juvenile salmon (smolt) migrating to sea. In 2018, five monitored rivers showed declines in total returns compared to their previous five-year mean, and three of these rivers had declines of greater than 30% (Exploits River, Conne River and Little River). For six rivers, data were unavailable to compare 2018 returns to the previous generation.

Of the twenty-two monitored rivers in 2018, six have insufficient counts from previous years to calculate a previous generation average (Garnish River, Northeast River [Placentia Bay], Northwest River [Port Blandford], Robinsons River, Middle Barachois Brook, and Deer Arm Brook). Of the 16 rivers for which there is information on returns over the previous generation, total returns in 2018 were higher on three of four monitored rivers in Labrador and lower on five of twelve monitored rivers in Newfoundland. Of the fifteen rivers for which there is information on returns over the previous three generations, total returns in 2018 were lower on one of four monitored rivers in Labrador (Southwest Brook, Paradise River) and on five of eleven monitored rivers in Newfoundland. Of these, four Newfoundland rivers had declines greater than 30% (Exploits River, Northeast River, Conne River and Little River). Conservation egg requirements were below the river-specific LRP on two of four assessed rivers in Labrador (Table 6a) and eight (40%) of the 17 assessed rivers in Newfoundland (Table 6b). Marine smolt survival is considered to be a major factor limiting the abundance of Atlantic Salmon within the NL Region. Smolt to adult survival of the 2018 smolt class ranged from <1% for Conne River to 9.3% for Western Arm Brook. Atlantic Salmon harvests in 2018 were estimated at 12,843 salmon in the subsistence/FSC fisheries and 7,915 retained salmon (plus 30,036 released) in the NL recreational fishery.

SOURCES OF UNCERTAINTY

No current assessments are available on salmon populations in SFAs 3, 6, 7, 12 and 14B as well as the Lake Melville area in SFA 1.

Salmon populations in assessed rivers may be unique and not representative of other rivers within an SFA.

Historical or estimated biological characteristics data (e.g., fecundity, sex ratio, female size) and extrapolated catch data used in the assessment adds uncertainty to the conservation egg requirement values.

Estimates of recreational catch and effort data are dependent on the number and accuracy of angler licence stubs completed and returned each year. Similarly, FSC and subsistence harvest estimates in Labrador are dependent on the number and accuracy of logbooks compiled and returned. For all salmon fisheries, uncertainty exists where either inaccurate or incomplete information is provided.

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TABLES

Table 1. Atlantic Salmon recreational fishery catch and effort data for Labrador (SFAs 1, 2 and 14B), 1994–2018.

Year	Effort (Rod Days)	Small Retained	Small Released	Small Total	Large Retained	Large Released	Large Total	Total Retained	Total Released	Total	CPUE
1994	8,449	2,549	3,681	6,230	455	347	802	3,004	4,028	7,032	0.83
1995	7,719	2,493	3,302	5,795	408	508	916	2,901	3,810	6,711	0.87
1996	9,193	2,565	3,776	6,341	334	489	823	2,899	4,265	7,164	0.78
1997	8,394	2,365	2,187	4,552	158	566	724	2,523	2,753	5,276	0.63
1998	8,288	2,131	3,758	5,889	231	814	1,045	2,362	4,572	6,934	0.84
1999	7,592	2,076	4,407	6,483	320	931	1,251	2,396	5,338	7,734	1.02
2000	10,645	2,561	7,095	9,656	262	1,446	1,708	2,823	8,541	11,364	1.07
2001	7,986	2,049	4,640	6,689	338	1,468	1,806	2,387	6,108	8,495	1.06
2002	8,751	2,071	5,052	7,123	207	978	1,185	2,278	6,030	8,308	0.95
2003	8,053	2,112	4,924	7,036	222	1,326	1,548	2,334	6,250	8,584	1.07
2004	8,302	1,808	5,968	7,776	259	1,519	1,778	2,067	7,487	9,554	1.15
2005	8,499	2,007	7,120	9,127	291	1,290	1,581	2,298	8,410	10,708	1.26
2006	6,743	1,656	5,815	7,471	227	1,133	1,360	1,883	6,948	8,831	1.31
2007	7,930	1,762	4,631	6,393	235	1,222	1,457	1,997	5,853	7,850	0.99
2008	9,025	1,936	5,917	7,853	200	1,461	1,661	2,136	7,378	9,514	1.05
2009	7,466	1,355	3,396	4,751	216	1,219	1,435	1,571	4,615	6,186	0.83
2010	6,560	1,477	4,704	6,181	197	1,080	1,277	1,674	5,784	7,458	1.14
2011	5,457	1,628	5,340	6,968	*	2,233	2,233	1,628	7,573	9,201	1.69
2012	4,952	1,376	3,302	4,678	*	1,072	1,072	1,376	4,374	5,750	1.16
2013	5,978	1,389	4,167	5,556	*	2,433	2,433	1,389	6,600	7,989	1.34
2014	7,504	1,529	4,760	6,289	*	1,607	1,607	1,529	6,367	7,896	1.05
2015	6,865	1,417	3,785	5,202	*	1,396	1,396	1,417	5,181	6,598	0.96
2016	7,173	1,609	3,668	5,277	*	3,042	3,042	1,609	6,710	8,319	1.16
2017	6,492	1,501	4,441	5,942	*	3,104	3,104	1,501	7,545	9,046	1.39
2018	3,631	623	4,039	4,662	*	1,232	1,232	623	5,271	5,894	1.62
2012–17	6,494	1,470	4,013	5,483	*	2,109	2,109	1,470	6,122	7,592	1.17
% Change	-44	-58	+1	-15	*	-42	-42	-58	-14	-22	+39

Small (<63 cm) and Large (≥63 cm); CPUE = (Total Retained + Total Released)/Effort;
Retention of large salmon has not been permitted in SFA 1, 2 and 14B since 2010.

Table 2. Atlantic Salmon recreational fishery catch and effort data for Newfoundland (SFAs 3-14A), 1994–2018.

Year	Effort (Rod Days)	Small Retained	Small Released	Small Total	Large Retained	Large Released	Large Total	Total Retained	Total Released	Total	CPUE
1994	132,935	29,225	20,761	49,986	*	4,685	4,685	29,225	25,446	54,671	0.41
1995	128,309	30,512	22,971	53,483	*	4,658	4,658	30,512	27,629	58,141	0.45
1996	153,759	35,440	30,566	66,006	*	5,720	5,720	35,440	36,286	71,726	0.47
1997	123,165	22,819	23,129	45,948	*	4,154	4,154	22,819	27,283	50,102	0.41
1998	123,041	22,668	27,610	50,278	*	3,561	3,561	22,668	31,171	53,839	0.44
1999	123,840	22,870	20,160	43,030	*	3,222	3,222	22,870	23,382	46,252	0.37
2000	127,639	21,808	22,610	44,418	*	5,033	5,033	21,808	27,643	49,451	0.39
2001	102,768	20,977	17,708	38,685	*	3,716	3,716	20,977	21,424	42,401	0.41
2002	95,143	20,913	18,019	38,932	*	3,014	3,014	20,913	21,033	41,946	0.44
2003	94,862	21,226	16,455	37,681	*	3,639	3,639	21,226	20,094	41,320	0.44
2004	91,151	19,946	17,462	37,408	*	3,649	3,649	19,946	21,111	41,057	0.45
2005	117,114	21,869	26,009	47,878	*	5,308	5,308	21,869	31,317	53,186	0.45
2006	106,900	19,394	24,676	44,070	*	4,561	4,561	19,394	29,237	48,631	0.45
2007	87,655	14,577	13,088	27,665	*	3,385	3,385	14,577	16,473	31,050	0.35
2008	143,674	27,497	26,870	54,367	*	5,573	5,573	27,497	32,443	59,940	0.42
2009	137,465	23,103	23,285	46,388	*	3,053	3,053	23,103	26,338	49,441	0.36
2010	121,705	29,018	34,342	63,360	*	5,303	5,303	29,018	39,645	68,663	0.56
2011	111,494	27,116	20,900	48,016	*	5,886	5,886	27,116	26,786	53,902	0.48
2012	108,701	21,893	17,638	39,531	*	3,017	3,017	21,893	20,655	42,548	0.39
2013	128,370	23,004	15,795	38,799	*	4,337	4,337	23,004	20,132	43,136	0.34
2014	110,718	22,591	14,853	37,444	*	3,781	3,781	22,591	18,634	41,225	0.37
2015	134,515	29,756	21,597	51,353	*	5,683	5,683	29,756	27,280	57,036	0.42
2016	142,302	28,398	22,337	50,735	*	7,015	7,015	28,398	29,352	57,750	0.41
2017	34,564	17,216	18,103	35,364	*	5,033	5,033	17,261	23,136	40,397	1.17
2018	27,632	7,292	22,339	29,631	*	2,426	2,426	7,292	24,765	32,057	1.16
2013–17	110,094	24,207	18,538	42,745	*	5,158	5,158	24,207	23,696	47,903	0.4
% Change	-75	-70	+21	-31	*	-53	-53	-70	+5	-33	+169

Small (<63 cm) and Large (≥63 cm)
CPUE = (Total Retained + Total Released)/Effort
Retention of large salmon was not allowed.

Table 3. Harvests of Atlantic Salmon in the subsistence and Food Social and Ceremonial (FSC) Fisheries in Labrador (SFA 1 and 2 combined), 2000–18.

Year	Small Number	Small Weight (kg)	Large Number	Large Weight (kg)	Total Number	Total Weight (kg)
1999	2,739	5,580	1,084	4,220	3,824	9,800
2000	5,323	10,353	1,352	5,262	6,675	15,613
2001	4,789	9,789	1,673	6,499	6,478	16,288
2002	5,806	11,581	1,437	5,990	7,243	17,572
2003	6,477	13,196	2,175	8,912	8,653	22,108
2004	8,385	17,379	3,696	14,167	12,081	31,546
2005	10,436	21,038	2,817	10,876	13,253	31,914
2006	10,377	21,198	3,090	11,523	13,467	32,721
2007	9,208	17,070	2,652	9,386	11,860	26,456
2008	9,838	19,396	3,905	16,944	13,743	36,340
2009	7,988	16,130	3,344	13,681	11,332	29,810
2010	10,156	20,945	3,840	15,511	13,996	36,456
2011	11,301	23,442	4,533	18,535	15,834	41,978
2012	9,977	18,738	4,228	17,821	14,204	36,560
2013	7,164	14,674	6,374	25,299	13,539	39,973
2014	8,953	17,550	3,991	14,847	12,944	32,397
2015	8,923	17,500	6,146	24,935	15,069	42,435
2016	7,645	14,579	5,595	25,022	13,240	39,601
2017	6,868	13,255	6,193	26,118	13,060	39,373
2018	8,762	16,691	4,081	16,357	12,843	33,049
2012–17	8,255	16,049	5,421	22,345	13,676	38,394
% Change	+7	+4	-24	-25	-5	-13

Table 4. Total returns of small (<63 cm fork length) Atlantic Salmon to rivers in Newfoundland and Labrador, 1984–2018.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1984	-	-	-	-	19,028	-	1,081	1,675	1,534	-	-	459	-	-	-	-	-	-	-	1,805	235	-
1985	-	-	-	-	17,555	-	1,663	1,283	2,012	-	-	519	-	-	-	-	-	-	-	1,621	470	-
1986	-	-	-	-	10,343	-	1,064	1,547	1,459	-	-	879	8,302		-	-	-	-	-	3,155	528	-
1987	-	-	-	-	9,481	-	493	1,053	1,404	-	80	350	10,155	64	-	-	-	-	-	2,647	437	-
1988	-	-	-	-	9,496	-	1,562	1,337	2,114	-	313	637	7,627	65	-	-	-	-	-	2,388	422	-
1989	-	-	-	-	7,577	-	596	626	1,377	-	168	809	4,968	102	-	-	-	-	-	1,510	455	-
1990	-	-	-	-	6,995	-	345	1,070	1,518	-	401	699	5,368	158	-	-	-	-	-	2,518	444	-
1991	-	-	-	-	5,659	-	245	763	1,127	-	211	368	2,411	55	-	-	-	-	-	1,590	233	-
1992	-	-	-	-	13,508	-	1,168	1,563	1,780	-	237	956	2,523	104	-	888	-	-	-	2,829	480	-
1993	-	-	-	-	22,253	4,001	1,560	2,247	3,050	-	292	980	2,703	169	-	1,808	-	-	-	4,215	947	-
1994	-	-	-	2,180	17,603	2,857	968	1,751	1,809	-	158	737	1,533	73	-	1,791	-	-	-	3,737	954	-
1995	-	-	-	2,796	16,226	3,035	1,600	1,390	2,515	-	385	811	3,502	118	-	2,213	-	-	-	6,346	823	-
1996	-	-	-	3,319	30,425	3,208	946	2,044	2,251	-	356	1,532	4,440	674	-	1,798	-	-	-	7,475	1,230	-
1997	-	-	-	-	15,263	1,975	465	1,352	1,732	-	435	749	3,200	399	-	1,747	-	1,056	1,107	4,158	509	-
1998	-	110	-	-	27,093	3,275	1,295	2,625	1,868	-	423	1075	2,931	264	-	1,659	-	-	-	5,388	1,718	-
1999	59	331	-	-	28,802	3,076	1,105	1,948	1,892	-	327	401	2,358	307	-	1,713	-	563	1,452	4,857	1,046	-
2000	367	-	-	-	12,063	1,798	742	1,749	1,629	272	277	622	5,177	564	-	1,271	-	1,142	1,501	4,154	1,492	756
2001	224	323	-	-	19,370	2,151	663	1,525	2,261	102	233	313	1,503	125	-	1,028	-	937	1,909	2,637	563	-
2002	190	235	106	3,141	15,589	1,974	714	916	1,435	443	276	534	2,573	487	-	1,640	-	569	909	4,861	1,465	-
2003	108	158	394	3,171	29,198	2,219	722	1,183	2,271	1,012	402	-	1,953	322	-	2,334	-	743	1,211	3,955	1,406	-
2004	56	615	454	4,008	27,195	2,726	983	1,520	3,006	1,207	169	-	3,818	656	-	2,828	-	1,087	1,989	5,110	1,151	-
2005	337	858	520	7,007	28,050	3,746	940	1,538	2,417	1,210	427	-	1,978	216	-	2,495	-	593	1,372	4,342	1,019	-
2006	484	326	445	4,967	24,924	2,768	741	1,173	2,546	783	352	-	2,623	136	-	3,004	-			4,030	1,300	-
2007	498	303	240	3,222	21,713	1,850	576	1,050	1,674	675	174	-	1,174	39	-	1,394	-	-	-	2,979	793	-
2008	428	495	474	4,842	31,990	3,998	1,416	2,328	3,586	1,257	695	-	2,383	71	-	3,614	-	455	1,786	5,886	1,920	-
2009	280	67	115	1,605	32,560	3,955	1,120	1,868	2,497	448	498	-	1,828	231	-	2,208	54	-	-	2,417	1,063	-
2010	306	173	-	2,225	39,417	3,790	1,480	2,798	4,183	1,146	941	-	1,762	271	-	3,175	95	-	-	4,794	1,782	531
2011	419	380	348	8,565	34,100	4,860	1,726	2,758	4,786	756	771	-	1,543	86	-	3,455	47	-	-	2,667	1,351	-
2012	423	225	-	3,599	25,113	3,755	1,434	2,708	3,745	-	430	-	1,965	65	-	1,930	101	-	-	3,839	1,173	-
2013	467	79	296	1,646	28,770	4,119	1,612	2,671	3,973	-	212	-	2,826	378	-	2,527	86	-	-	1,854	705	-
2014	839	182	152	1,835	26,927	4,055	-	2,932	3,413	-	367	-	1,234	48	-	3,224	78	-	-	4,244	1,426	-
2015	734	305	556	2,625	28,185	4,016	1,391	3,593	4,598	-	128	638	2,276	99	661	4,220	74	-	-	5,614	1,612	1,069
2016	666	74	239	1,119	21,818	2,748	707	2,225	5,255	-	244	845	1,166	51	289	3,578	119	-	-	3,871	1,344	-
2017	496	59	170	1,704	14,771	1,646	355	2,231	2,850	1,249	352	393	688	9	421	1,933	50	-	-	3,471	810	-
2018	808	242	303	3,880	18,028	3,921	981	3,243	4,458	NA	322	835	479	8	326	2,486	89	312	932	3,872	1,423	228

Table 4 continued.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Previous Generation Mean	604	154	283	2,088	24,094	3,317	1016	2,730	4017	NA	294	-	1,615	117	-	3,096	81	-	-	3,811	1,179	-
Percent Change	34	57	7	86	-25	18	-4	19	11	NA	10	-	-70	-93	-	-20	9	-	-	2	21	-
Previous 3 Generation Mean	407	286	322	3,455	27,649	3,350	1,086	2,172	3387	NA	431	-	1,969	179	-	2,795	78	-	-	3,938	1,257	-
Percent Change	99	-15	-6	12	-35	17	-10	49	32	NA	-25	-	-76	-96	-	-11	14	-	-	-2	13	-

(1) English River, (2) Southwest Brook (Paradise River), (3) Muddy Bay Brook, (4) Sand Hill River, (5) Exploits River, (6) Campbellton River, (7) Salmon Brook (Gander River), (8) Middle Brook, (9) Terra Nova River, (10) Northwest River (Port Blandford), (11) Rocky River, (12) Northeast River (Placentia Bay), (13) Conne River, (14) Little River, (15) Garnish River, (16) Harry's River, (17) Corner Brook Stream, (18) Middle Barachois, (19) Robinsons River, (20) Torrent River, (21) Western Arm Brook (22) Deer Arm Brook.

Blank cells indicate that no counting facility was in operation in that year.
Previous Generation Means: Labrador (2012–17), Newfoundland (2013–17)
Previous Three Generation Means: Labrador (2000–17), Newfoundland (2003–17).

Table 5. Total returns of large (≥63 cm fork length) Atlantic Salmon to rivers in Newfoundland and Labrador, 1984–2018.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1984	-	-	-	-	529	-	38	57	107	-	-	-	-	-	-	-	-	-	-	288	0	-
1985	-	-	-	-	183	-	26	27	112	-	-	-	-	-	-	-	-	-	-	30	1	-
1986	-	-	-	-	355	-	12	15	140	-	-	-	412	-	-	-	-	-	-	93	0	-
1987	-	-	-	-	310	-	9	19	56	-	1	-	516	3	-	-	-	-	-	68	1	-
1988	-	-	-	-	147	-	24	14	206	-	6	-	420	3	-	-	-	-	-	44	1	-
1989	-	-	-	-	89	-	24	19	142	-	9	-	320	5	-	-	-	-	-	60	0	-
1990	-	-	-	-	122	-	8	13	144	-	17	-	372	15	-	-	-	-	-	82	0	-
1991	-	-	-	-	99	-	2	14	114	-	16	-	89	6	-	-	-	-	-	71	1	-
1992	-	-	-	-	314	-	101	43	270	-	46	-	159	21	-	16	-	-	-	170	8	-
1993	-	-	-	-	627	145	97	88	472	-	72	-	100	11	-	115	-	-	-	224	8	-
1994	-	-	-	730	916	191	93	91	243	-	19	70	100	11	-	128	-	-	-	334	31	-
1995	-	-	-	560	945	218	125	169	637	-	39	74	110	17	-	80	-	-	-	617	33	-
1996	-	-	-	414	2,057	560	112	161	467	-	45	123	179	127	-	126	-	-	-	517	50	-
1997	-	-	-	-	881	321	119	262	528	-	89	185	185	79	-	201	-	189	195	676	55	-
1998	-	4	-	-	1,959	402	141	196	394	-	130	287	294	49	-	191	-	-	-	761	128	-
1999	48	43	-	-	2,236	493	138	130	344	-	77	167	241	49	-	176	-	66	204	421	22	-
2000	15	-	-	-	684	208	61	190	232	106	104	258	216	52	-	49	-	155	320	596	120	79
2001	41	32	-	-	1,347	119	93	62	330	50	60	65	140	36	-	132	-	142	232	443	28	-
2002	31	34	11	561	890	123	95	69	271	114	78	40	167	41	-	285	-	164	201	432	48	-
2003	19	16	31	627	1,336	152	139	74	330	273	73	-	51	13	-	422	-	107	188	341	23	-
2004	25	54	28	604	949	161	72	88	397	265	235	-	175	31	-	498	-	100	164	549	74	-
2005	28	54	20	875	1,967	276	138	62	316	305	95	-	105	15	-	453	-	97	118	780	43	-
2006	44	35	17	568	3,365	328	102	115	438	197	56	-	170	26	-	680	-	-	-	1,431	44	-
2007	42	32	14	693	3,956	487	62	141	241	94	35	-	49	8	-	289	-	-	-	519	17	-
2008	51	35	36	795	4,577	432	98	143	429	229	56	-	144	3	-	414	-	20	102	1,309	15	-
2009	105	13	10	723	5,579	433	52	85	224	121	34	-	67	1	-	371	31	-	-	1,400	21	-
2010	50	17	-	320	7,060	495	100	115	468	237	30	-	91	6	-	452	52	-	-	1,282	47	186
2011	156	33	19	970	7,724	583	120	195	501	223	39	-	74	1	-	569	36	-	-	1,737	75	-
2012	82	32	-	739	5,578	548	100	173	452	-	30	-	71	4	-	318	18	-	-	470	93	-
2013	160	63	36	1,271	4,922	484	90	699	391	-	31	-	91	9	-	416	26	-	-	1,621	73	-
2014	190	38	22	587	2,895	478	-	424	535	-	41	-	56	0	-	531	13	-	-	565	35	-
2015	258	58	45	1,104	3,351	479	327	425	684	-	19	114	127	0	39	695	29	-	-	641	22	350
2016	208	31	18	977	2,318	223	263	321	485	-	35	101	66	1	18	817	32	-	-	935	114	-
2017	248	10	19	532	1,232	137	39	216	430	169	19	42	22	0	27	443	22	-	-	621	79	-
2018	139	18	12	506	662	392	55	283	387	NA	7	105	3	0	13	568	23	81	169	556	27	62

Table 5 continued.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Previous Generation Mean	191	39	27	868	2,944	360	180	417	505	-	32	-	72	2	-	580	24	-	-	877	65	-
Percent Change	-27	-53	-56	-42	-78	9	-69	-32	-23	-	-78	-	-96	-100	-	-2	-6	-	-	-37	-58	-
Previous 3 Generation Mean	97	35	23	747	3,787	380	122	218	421	-	58	-	91	8	-	491	-	-	-	947	52	-
Percent Change	43	-48	-48	-32	-83	3	-55	30	-8	-	-88	-	-97	-100	-	16	-20	-	-	-41	-48	-

(1) English River, (2) Southwest Brook (Paradise River), (3) Muddy Bay Brook, (4) Sand Hill River, (5) Exploits River, (6) Campbellton River, (7) Salmon Brook (Gander River), (8) Middle Brook, (9) Terra Nova River, (10) Northwest River (Port Blandford), (11) Rocky River, (12) Northeast River (Placentia Bay), (13) Conne River, (14) Little River, (15) Garnish River, (16) Harry's River, (17) Corner Brook Stream, (18) Middle Barachois, (19) Robinsons River, (20) Torrent River, (21) Western Arm Brook, (22) Deer Arm Brook.

Blank cells indicate that no counting facility was in operation in that year.
Previous Generation Means: Labrador (2012–17), Newfoundland (2013–17)
Previous Three Generation Means: Labrador (2000–17), Newfoundland (2003–17).

Table 6a. Percentage conservation requirement achieved for rivers in Labrador 1994–2018.

Year	English River	Southwest Brook (Paradise River)	Muddy Bay Brook (Dyke's River)	Sand Hill River
1994	-	-	-	65
1995	-	-	-	70
1996	-	-	-	74
1997	-	-	-	-
1998	-	39	-	-
1999	40	139	-	-
2000	73	-	-	-
2001	63	110	-	-
2002	52	82	43	81
2003	26	52	153	82
2004	26	201	173	101
2005	80	267	190	168
2006	115	110	161	118
2007	115	102	90	89
2008	109	157	184	125
2009	117	26	46	59
2010	88	57	*	54
2011	176	124	130	204
2012	129	80	*	98
2013	188	57	125	82
2014	275	72	66	49
2015	298	117	218	95
2016	255	38	109	60
2017	249	22	79	52
2018	237	77	132	95

Table 6b. Percentage conservation requirement achieved for rivers in Newfoundland 1994–2018.

Year	5	6	7	8	9	10	11	12	13	14	15	16	17	18*	19*	20	21	22
1994	31	216	103	176	25	-	25	430	67	37	-	51	-	-	-	530	292	-
1995	39	264	151	116	44	-	56	412	145	56	-	53	-	-	-	1,033	286	-
1996	69	316	105	258	35	-	34	766	206	288	-	46	-	62	46	1,279	415	-
1997	24	180	62	193	31	-	56	482	135	200	-	50	-	100	63	797	200	-
1998	47	315	142	301	33	-	54	489	151	231	-	49	-	-	-	924	625	-
1999	44	312	124	222	33	-	39	276	122	38	-	49	-	49	82	680	370	-
2000	21	152	86	217	27	27	34	449	188	263	-	29	-	103	92	657	567	-
2001	34	148	94	132	36	11	33	168	77	69	-	33	-	86	99	400	193	-
2002	25	138	100	101	28	37	40	243	110	224	-	60	-	59	56	597	510	-
2003	51	191	114	134	42	81	50	-	76	144	-	84	-	66	65	496	466	-
2004	47	212	145	162	54	92	51	-	174	293	-	98	-	90	93	686	425	-
2005	49	328	134	163	42	93	55	-	92	99	-	89	-	56	57	675	355	-
2006	48	273	87	133	47	58	42	-	110	69	-	116	-	-	-	844	446	-
2007	44	208	72	126	29	50	22	-	55	20	-	55	-	-	-	458	258	-
2008	60	360	148	232	61	92	76	-	117	31	-	119	-	39	92	1,203	611	-
2009	62	371	127	172	40	36	54	-	72	98	-	95	181	-	-	750	341	-
2010	77	386	171	266	70	67	96	-	69	119	-	100	310	-	-	1,050	751	-
2011	70	498	201	275	79	75	81	-	61	37	-	112	189	-	-	867	458	-
2012	50	404	164	303	64	-	45	-	79	30	-	68	200	-	-	689	405	-
2013	57	399	184	374	64	-	25	-	101	169	-	78	207	-	-	802	266	-

Year	5	6	7	8	9	10	11	12	13	14	15	16	17	18*	19*	20	21	22
2014	50	370	-	363	61	-	42	-	50	21	-	137	151	-	-	711	325	-
2015	48	402	199	361	82	-	15	403	110	42	66	148	202	-	-	900	506	-
2016	37	241	117	276	86	-	29	437	56	22	20	125	273	-	-	665	405	-
2017	25	166	42	266	51	91	37	175	32	4	41	72	145	-	-	534	324	-
2018	31	414	114	382	73	-	32	470	21	3	29	100	201	39	70	720	499	>150

* Estimated from in-river snorkel surveys.

(5) Exploits River, (6) Campbellton River, (7) Salmon Brook (Gander River), (8) Middle Brook, (9) Terra Nova River, (10) Northwest River (Port Blandford), (11) Rocky River, (12) Northeast River (Placentia Bay), (13) Conne River, (14) Little River, (15) Garnish River, (16) Harry's River, (17) Corner Brook Stream, (18) Middle Barachois, (19) Robinsons River, (20) Torrent River, (21) Western Arm Brook, (22) Deer Arm Brook.

Table 7. Atlantic Salmon smolt production in Newfoundland and Labrador rivers 1971–2018. An asterisk (*) indicates a partial count.

Year	Campbellton River (SFA 4)	Rocky River (SFA 9)	Garnish River (SFA 11)	Conne River (SFA 11)	Western Arm Brook (SFA 14A)
1971	-	-	-	-	5,735
1972	-	-	-	-	11,905
1973	-	-	-	-	8,484
1974	-	-	-	-	11,854
1975	-	-	-	-	9,600
1976	-	-	-	-	6,232
1977	-	-	-	-	9,899
1978	-	-	-	-	13,071
1979	-	-	-	-	8,349
1980	-	-	-	-	15,665
1981	-	-	-	-	13,981
1982	-	-	-	-	12,477
1983	-	-	-	-	10,552
1984	-	-	-	-	20,653
1985	-	-	-	-	13,417
1986	-	-	-	-	17,719
1987	-	-	-	74,585	17,029
1988	-	-	-	65,692	15,321
1989	-	-	-	73,724	11,407
1990	-	8,287	-	56,943	10,563
1991	-	7,732	-	74,645	13,453
1992	-	7,813	-	68,208	15,405
1993	31,577	5,115	-	55,765	13,435
1994	41,663	9,781	-	60,762	9,283
1995	39,715	7,577	-	62,749	15,144
1996	58,369	14,261	-	94,088	14,502
1997	62,050	16,900	-	100,983	23,845
1998	50,441	12,163	-	69,841	17,139
1999	47,256	8,625	-	63,658	13,500
2000	35,596	7,616	-	60,777	12,706
2001	37,170	9,392	-	86,898	16,013
2002	32,630	10,144	-	81,806	14,999
2003	35,089	4,440	-	71,479	12,086
2004	32,780	13,047	-	79,667	17,323
2005	30,123	15,847	-	66,196	8,607
2006	33,304	13,200	-	35,146	20,826
2007	35,742	12,355	-	63,738	16,621
2008	40,390	18,338	-	68,242	17,444
2009	36,705	14,041	-	63,512	18,492

Year	Campbellton River (SFA 4)	Rocky River (SFA 9)	Garnish River (SFA 11)	Conne River (SFA 11)	Western Arm Brook (SFA 14A)
2010	41,069	15,098	-	54,392	19,044
2011	37,033	9,311	-	50,701	20,544
2012	44,193	5,673	-	51,220	13,573
2013	40,355	6,989	-	66,261	19,710
2014	45,630	9,901	-	56,224	19,771
2015	32,759	6,454	-	32,557	14,278
2016	44,747	4,542	2,585*	-	14,255
2017	35,910	5,233	11,833	58,803	15,439
2018	38,464	3,600	10,425	*	13,317
Previous 5-year mean	39,880	6,624	-	53,461	16,691
Percent Change	-4	-46	-	*	-20

Table 8. Percent marine survival of Atlantic Salmon smolt (migrated to sea in Adult Return Year – 1) to small adult salmon in Newfoundland and Labrador rivers 1972–2018. A dash indicates that no counting facility was in operation.

Adult Return Year	Campbellton River (SFA 4)	Rocky River (SFA 9)	Conne River (SFA 11)	Western Arm Brook (SFA 14A)
1972	-	-	-	7.1
1973	-	-	-	6.7
1974	-	-	-	6.0
1975	-	-	-	5.4
1976	-	-	-	5.8
1977	-	-	-	6.0
1978	-	-	-	3.2
1979	-	-	-	12.1
1980	-	-	-	5.6
1981	-	-	-	3.1
1982	-	-	-	3.3
1983	-	-	-	9.1
1984	-	-	-	2.2
1985	-	-	-	2.3
1986	-	-	-	3.9
1987	-	-	-	2.5
1988	-	-	10.2	2.5
1989	-	-	7.6	3.0
1990	-	-	7.3	3.9
1991	-	2.5	4.2	2.2
1992	-	3.1	3.4	3.6
1993	-	3.7	4.0	6.1
1994	9.0	3.1	2.7	7.1
1995	7.3	3.9	5.8	8.9
1996	8.1	4.7	7.2	8.1
1997	3.4	3.1	3.4	3.5
1998	5.3	2.5	2.9	7.2
1999	6.1	2.7	3.4	6.1
2000	3.8	3.2	8.1	11.1
2001	6.0	3.1	2.5	4.4
2002	5.3	2.9	3.0	9.1
2003	6.8	4.0	2.4	9.4
2004	7.8	3.8	5.3	9.5
2005	11.4	3.3	2.5	5.9
2006	9.2	2.2	4.0	15.1

Adult Return Year	Campbellton River (SFA 4)	Rocky River (SFA 9)	Conne River (SFA 11)	Western Arm Brook (SFA 14A)
2007	5.6	1.3	3.3	3.8
2008	11.2	5.6	4.4	11.6
2009	9.8	2.7	2.7	6.1
2010	10.3	6.7	2.5	9.6
2011	11.8	5.1	2.8	7.1
2012	10.1	4.6	3.9	5.7
2013	9.3	3.7	5.3	5.2
2014	10.0	5.3	1.9	7.2
2015	8.8	1.3	4.0	8.2
2016	8.4	3.8	3.6	9.4
2017	3.7	7.7	-	5.7
2018	8.5	6.2	0.8	9.3
Previous 5-year mean	8.1	5.1	3.7	7.1
Percent Change	+5.6	+20	-79	+30

FIGURES

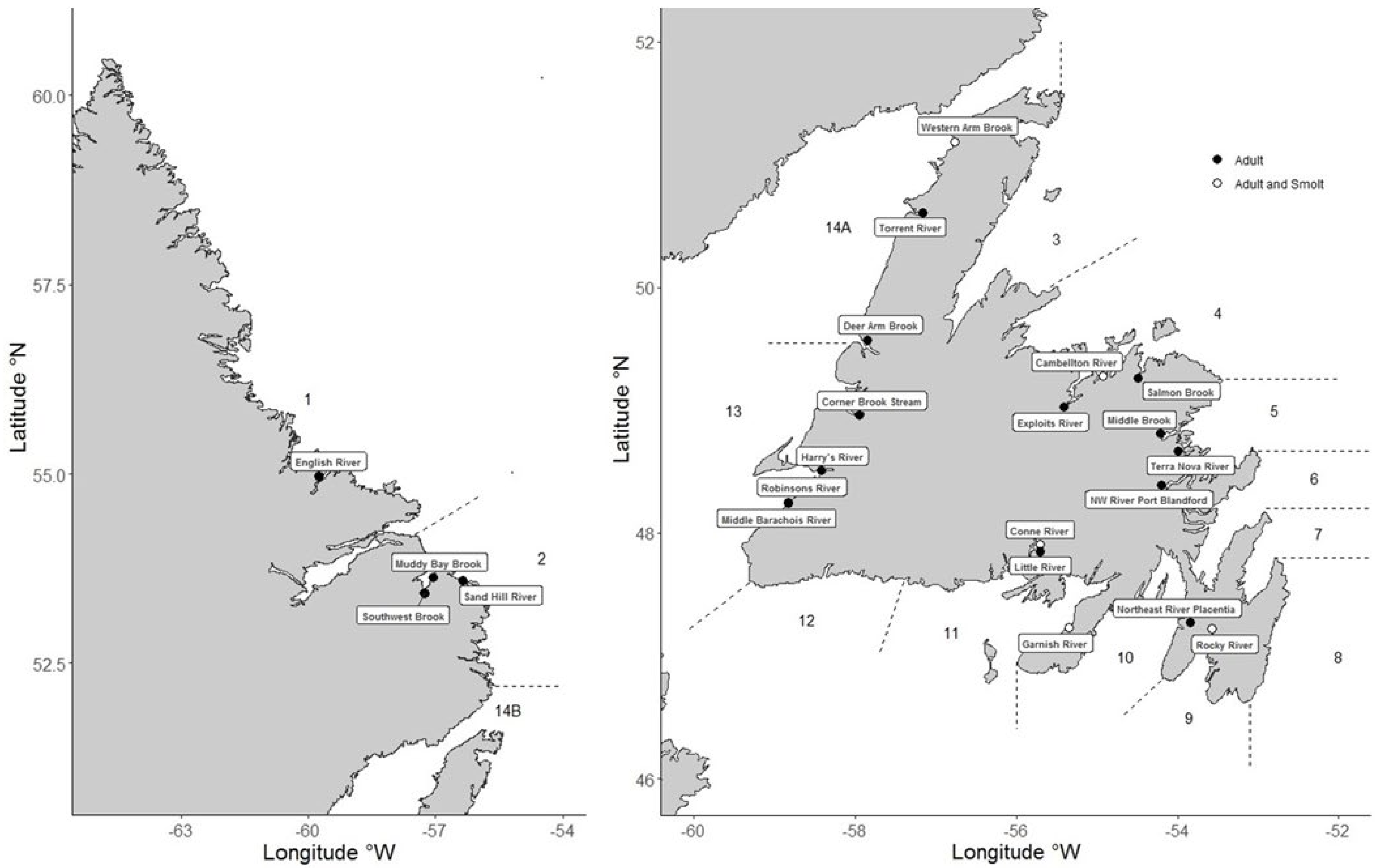

Figure 1. Map of rivers in SFAs 1-14B where Atlantic Salmon returns were monitored in 2018. Dotted lines indicated boundaries between SFAs. White circles represent monitored rivers where both Atlantic Salmon smolts and adults were counted. Black circles represent monitored rivers where only Atlantic Salmon adults were counted.

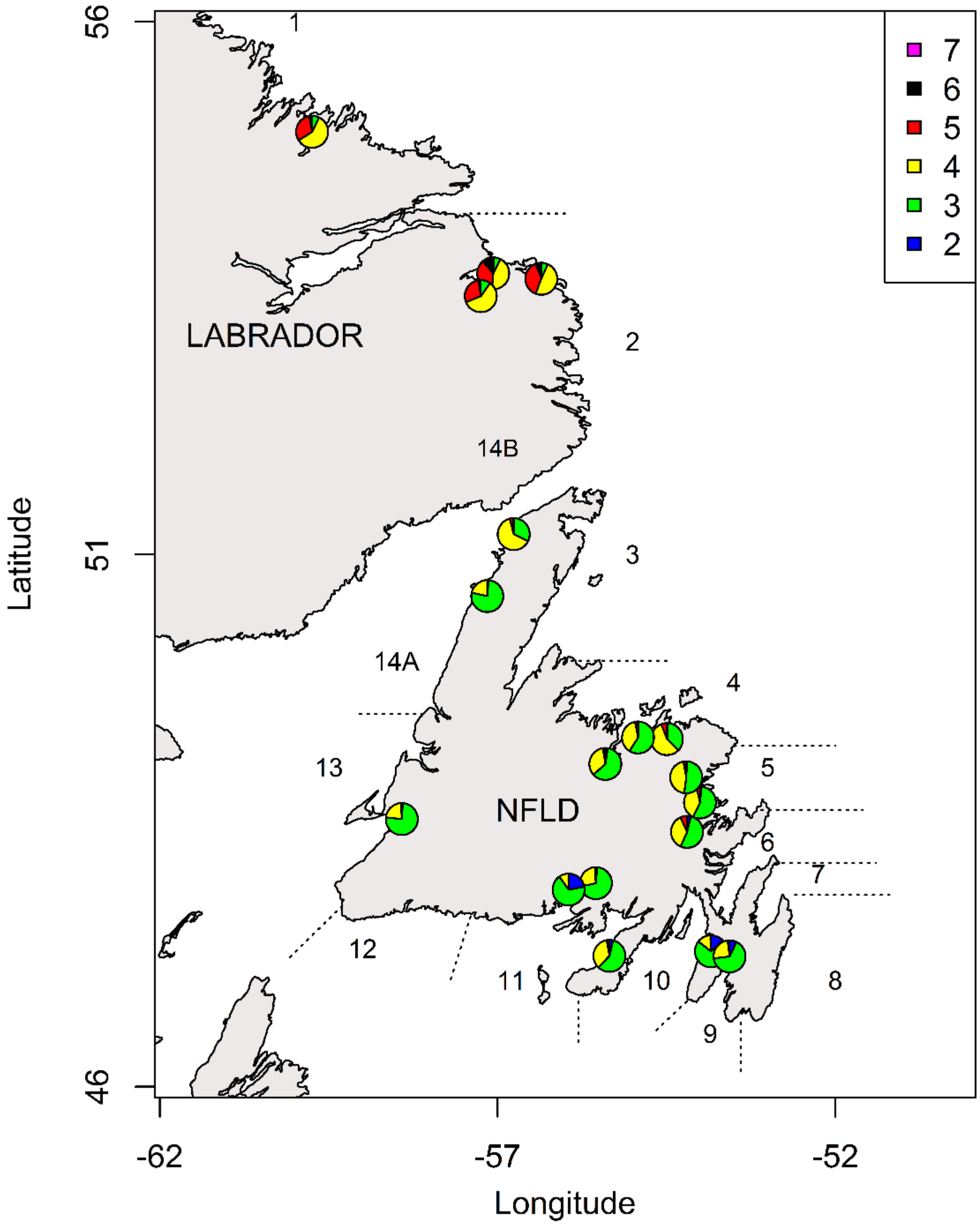

Figure 2. Smolt age distribution for eighteen rivers assessed in Newfoundland and Labrador in 2018. Average smolt age proportions were calculated for each river using smolt scale age data over the entire time series and only included years where sufficient sample sizes were available. Smolt age data were unavailable for Corner Brook Stream, Robinson's River, Middle Barachois Brook and Deer Arm Brook; therefore, these rivers are not represented. The boundary of each SFA is indicated by dotted lines.

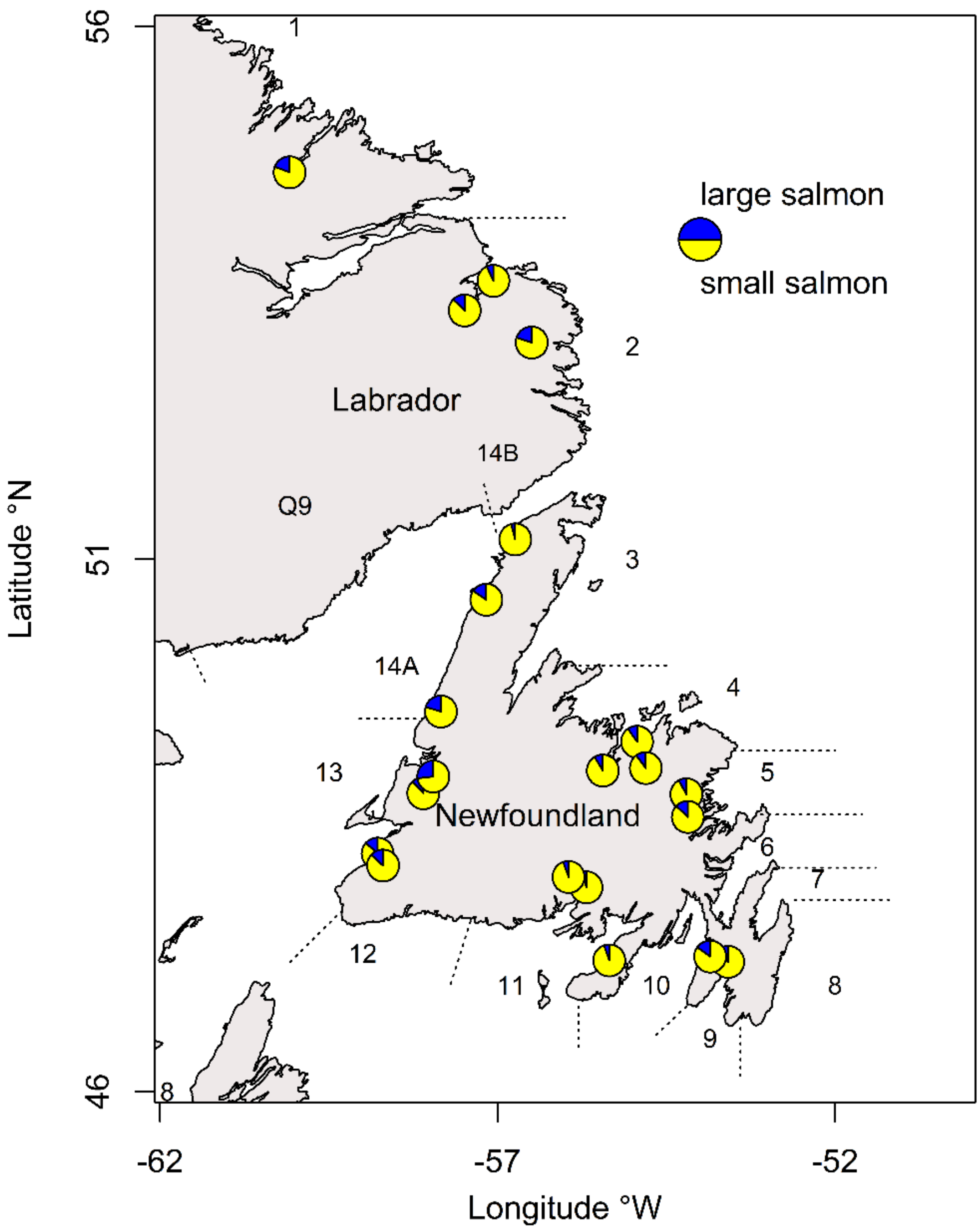

Figure 3. Proportion of small (fork length <63 cm) and large (fork length ≥63 cm) Atlantic Salmon across nineteen Newfoundland and Labrador rivers assessed in 2018. The boundary of each SFA is indicated by dotted lines.

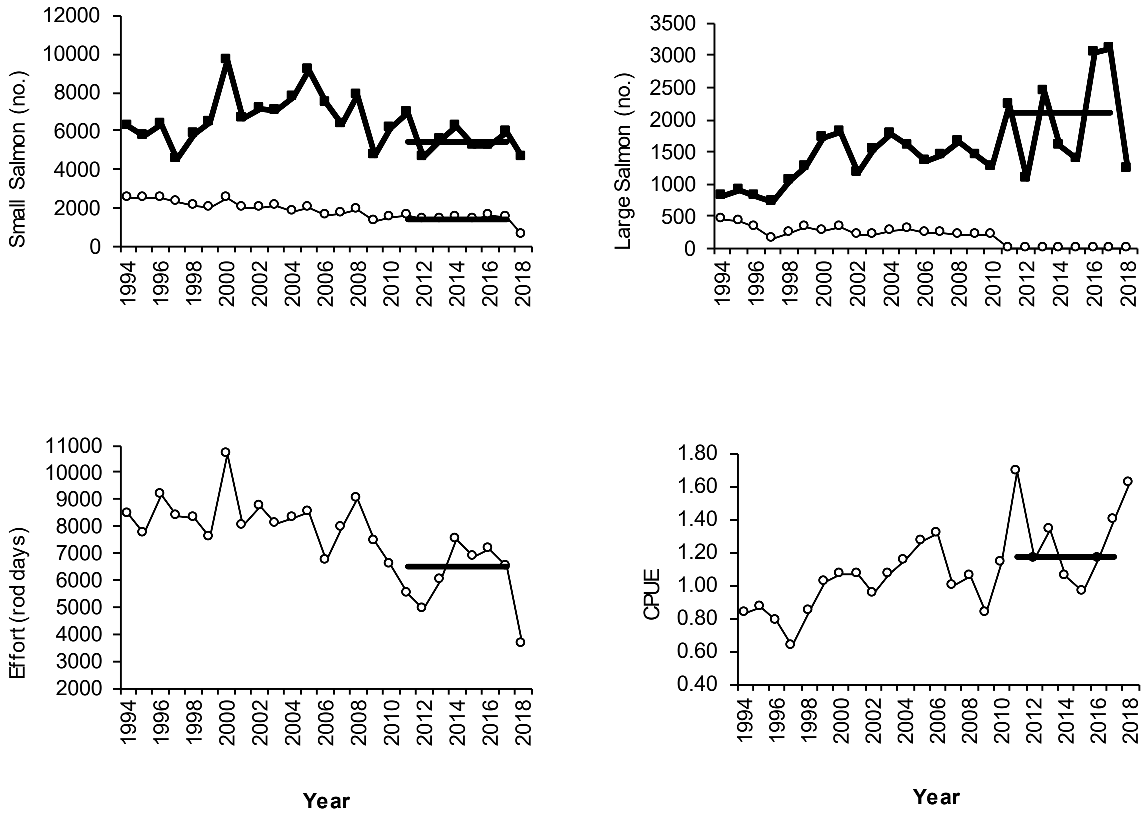

Figure 4. Recreational catch of small and large salmon (open circles – retained salmon, black squares – retained and released salmon), effort, and catch-per-unit-effort (CPUE), 1994–2018 for Labrador (SFAs 1, 2 and 14B). Horizontal lines represent the previous generation mean, 2012–17.

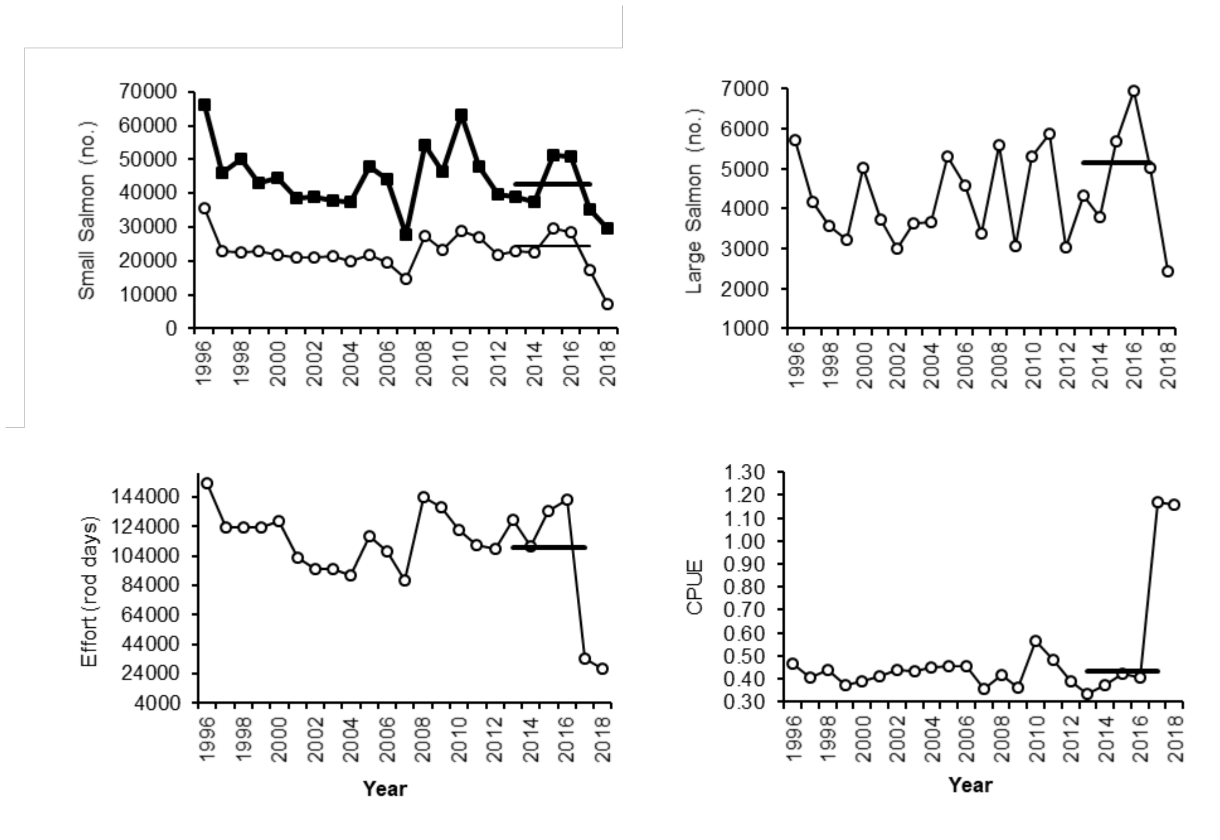

Figure 5. Recreational catch of small (open circles – retained salmon, black squares – retained and released salmon) and large salmon (released salmon only), effort, and catch-per-unit-effort (CPUE), 1994–2018 for Newfoundland (SFAs 3-14A). Horizontal lines represent the previous generation mean, 2013–17.

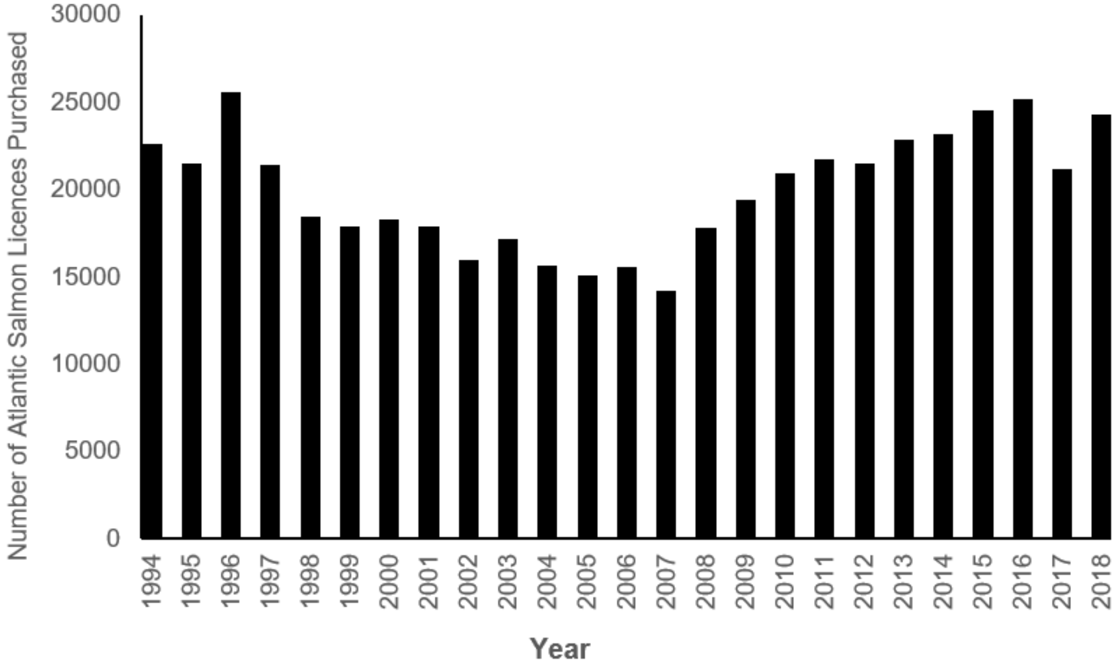

Figure 6. Number of recreational Atlantic Salmon licences sold in Newfoundland and Labrador (1994–2018).

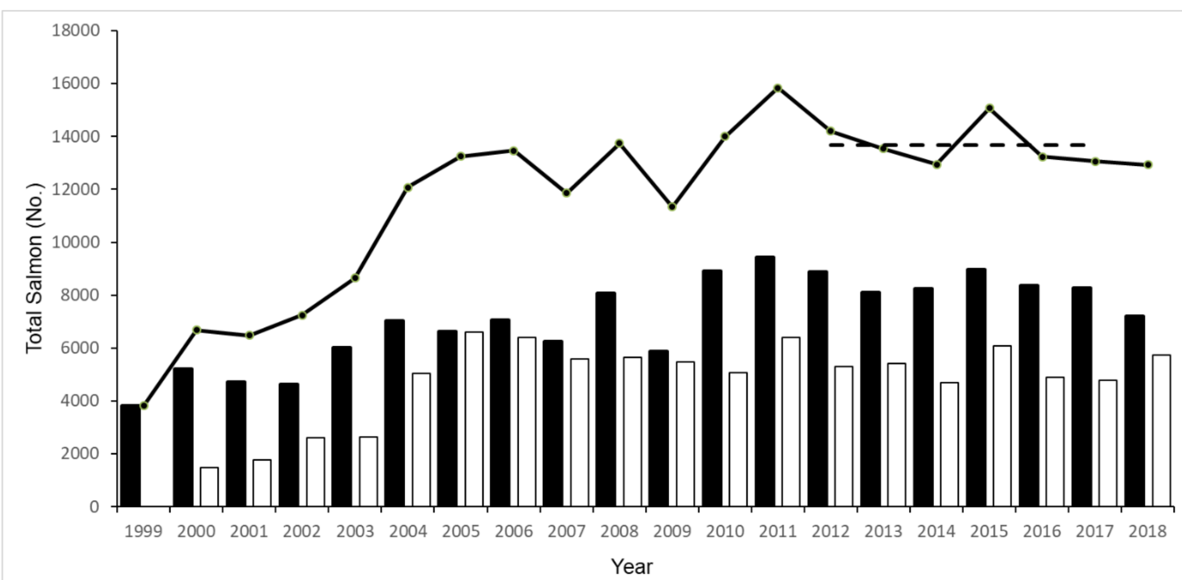

Figure 7. Numbers of estimated Atlantic Salmon harvested in Labrador Indigenous and subsistence fisheries in SFA 1 (black bars), SFA 2 (white bars) and total harvest (black circles) from 1999 to 2018. Horizontal solid line represents the previous six-year mean of total harvest (2012–17).

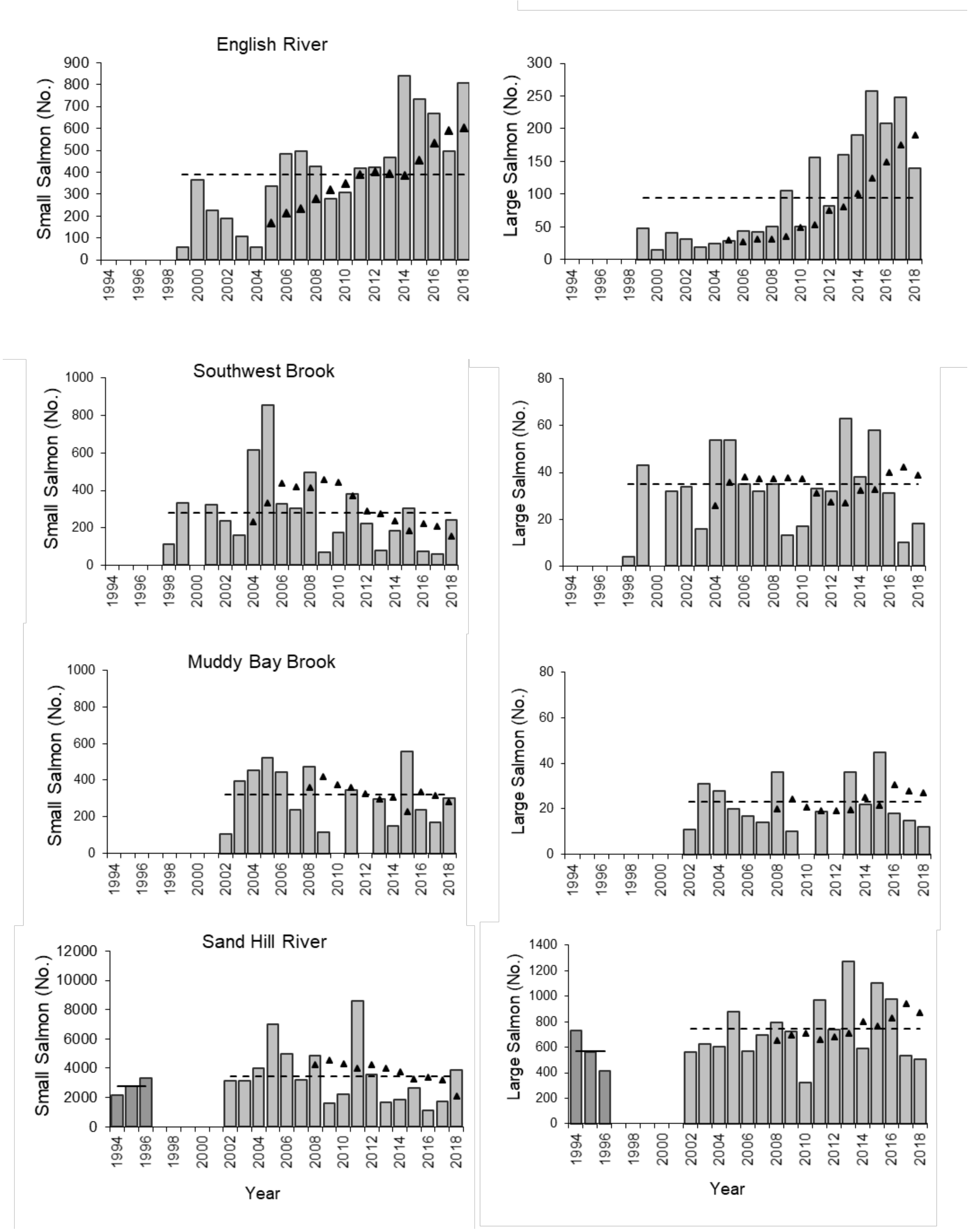

Figure 8. Total returns of small and large salmon to monitored rivers in Labrador: English River (SFA 1), Southwest Brook, Paradise River (SFA 2), Muddy Bay Brook (SFA 2) and Sand Hill River (SFA 2), 1994–2018. The black triangles represent the previous generation average (six years). The horizontal dotted line represents the moratorium average.

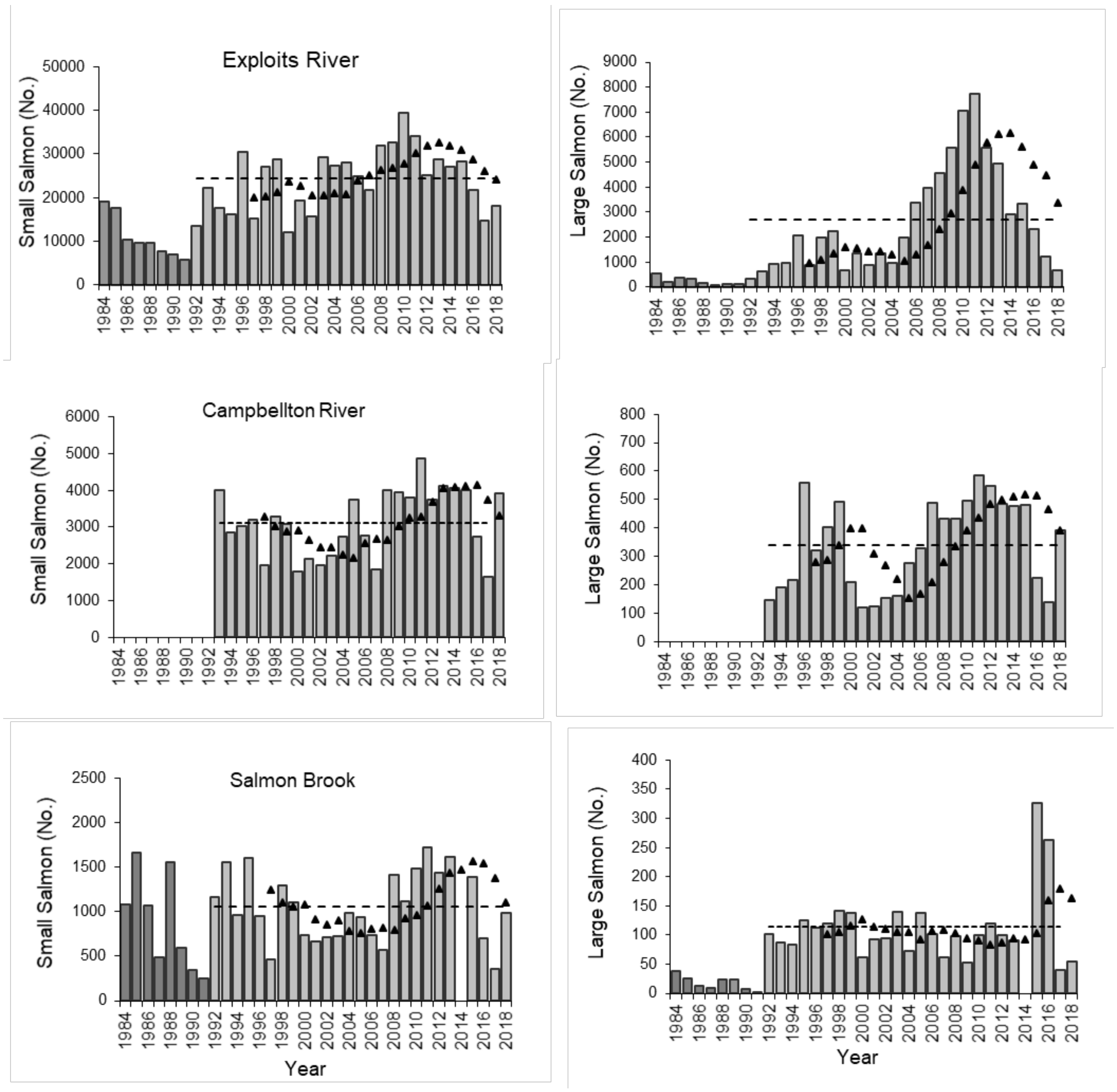

Figure 9. Total returns of small and large salmon to monitored rivers in SFA 4 on the northeast coast of Newfoundland, 1994–2018. The black triangles represent the previous generation average (five years).

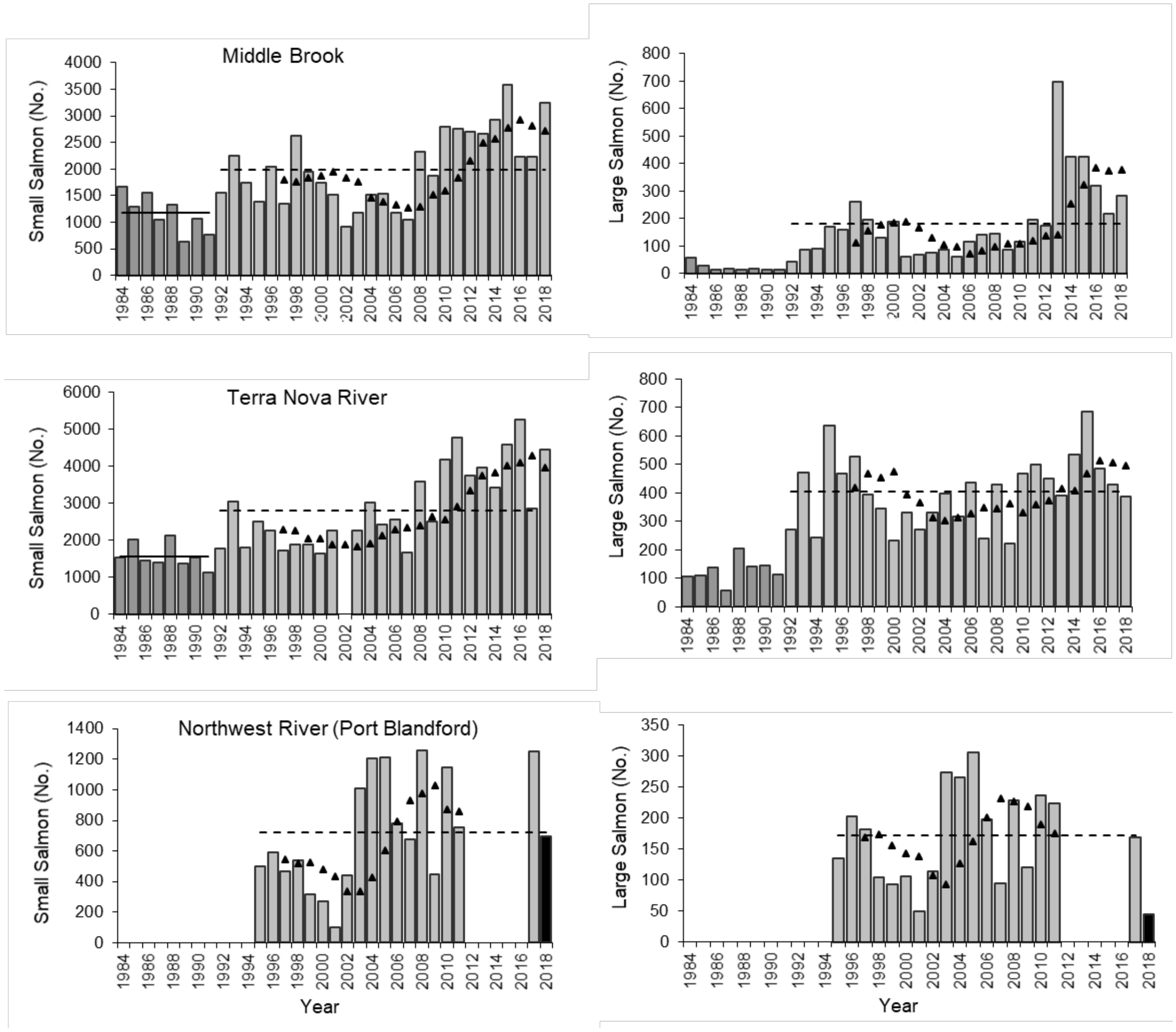

Figure 10. Total returns of small and large salmon to monitored rivers in SFA 5 on the northeast coast of Newfoundland, 1994–2018. The black triangles represent the previous generation average (five years). Black bars for Northwest River (Port Blandford) indicate partial count in 2018.

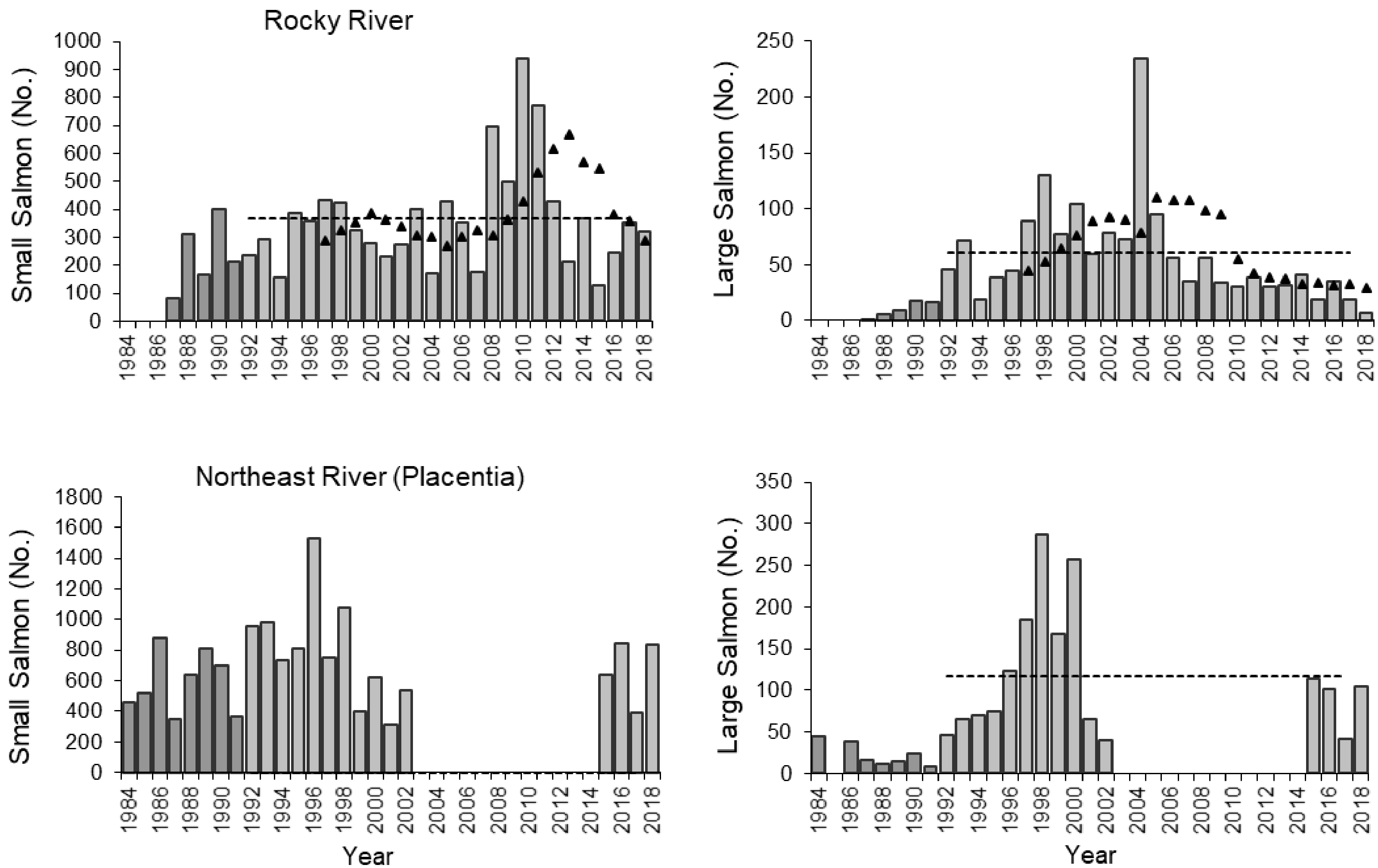

Figure 11. Total returns of small and large salmon to monitored rivers on the southeast coast of Newfoundland, 1994–2018: Rocky River (SFA 9) and Northeast River (Placentia Bay) (SFA 10). The black triangles represent the previous generation average (five years).

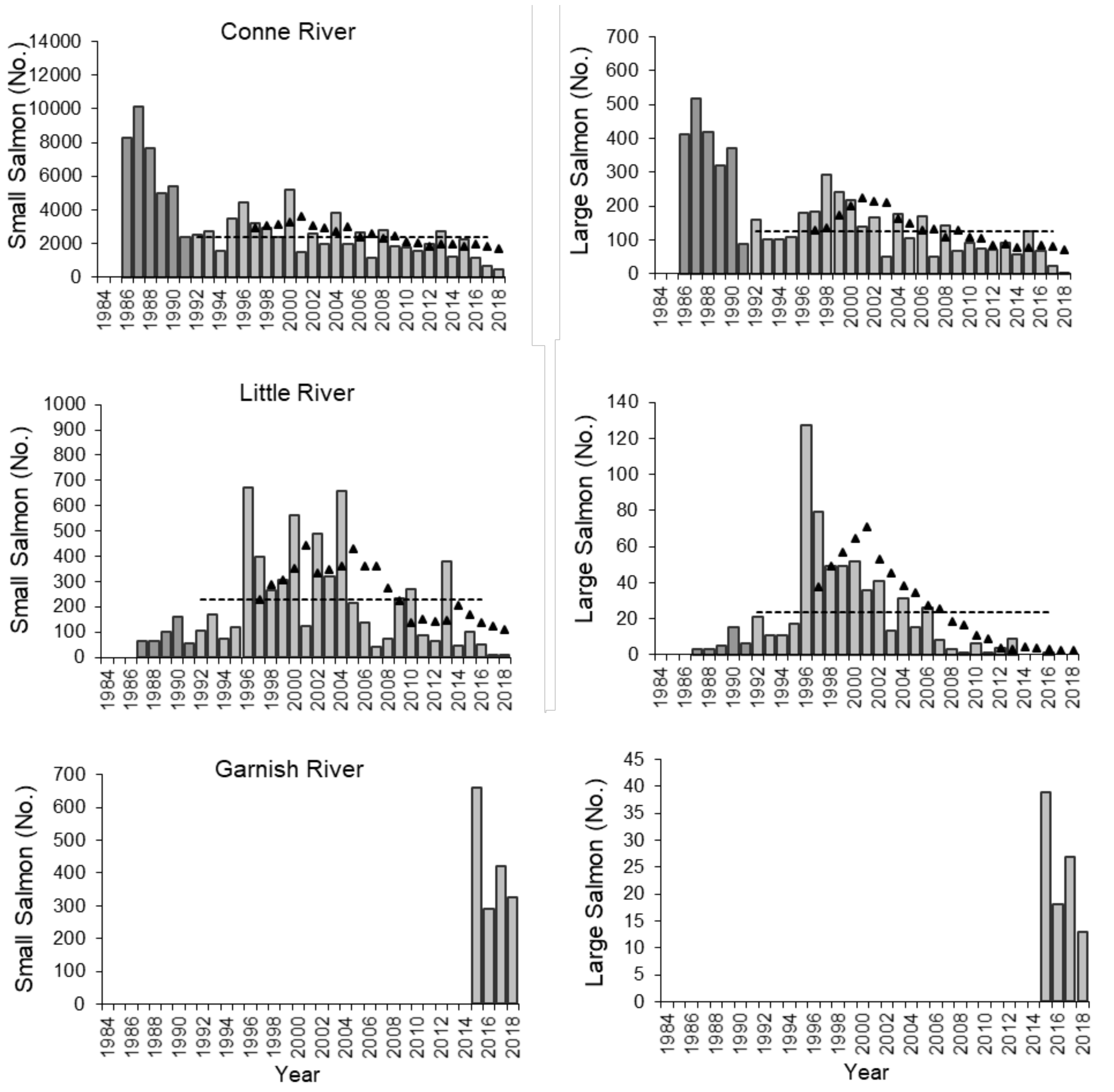

Figure 12. Total returns of small and large salmon to monitored rivers in SFA 11 on the south coast of Newfoundland, 1994–2018. The black triangles represent the previous generation average (five years).

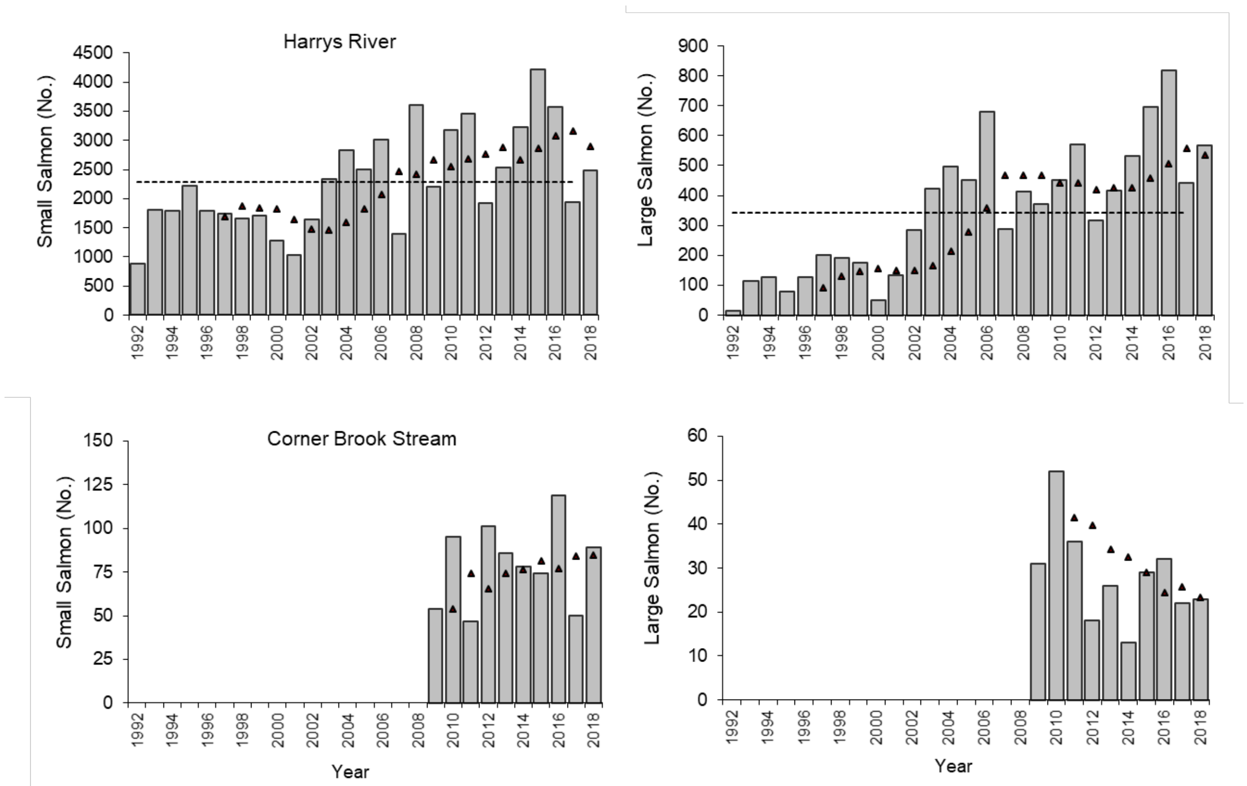

Figure 13. Total returns of small and large salmon to monitored rivers in SFA 13 on the west coast of Newfoundland, 1994–2018. The black triangles represent the previous generation average (five years). Atlantic Salmon are counted on Harry's River is carried out using a DIDSON camera. The number of large salmon is estimated based on the percent large on sonar images analyzed in a subsample of the run.

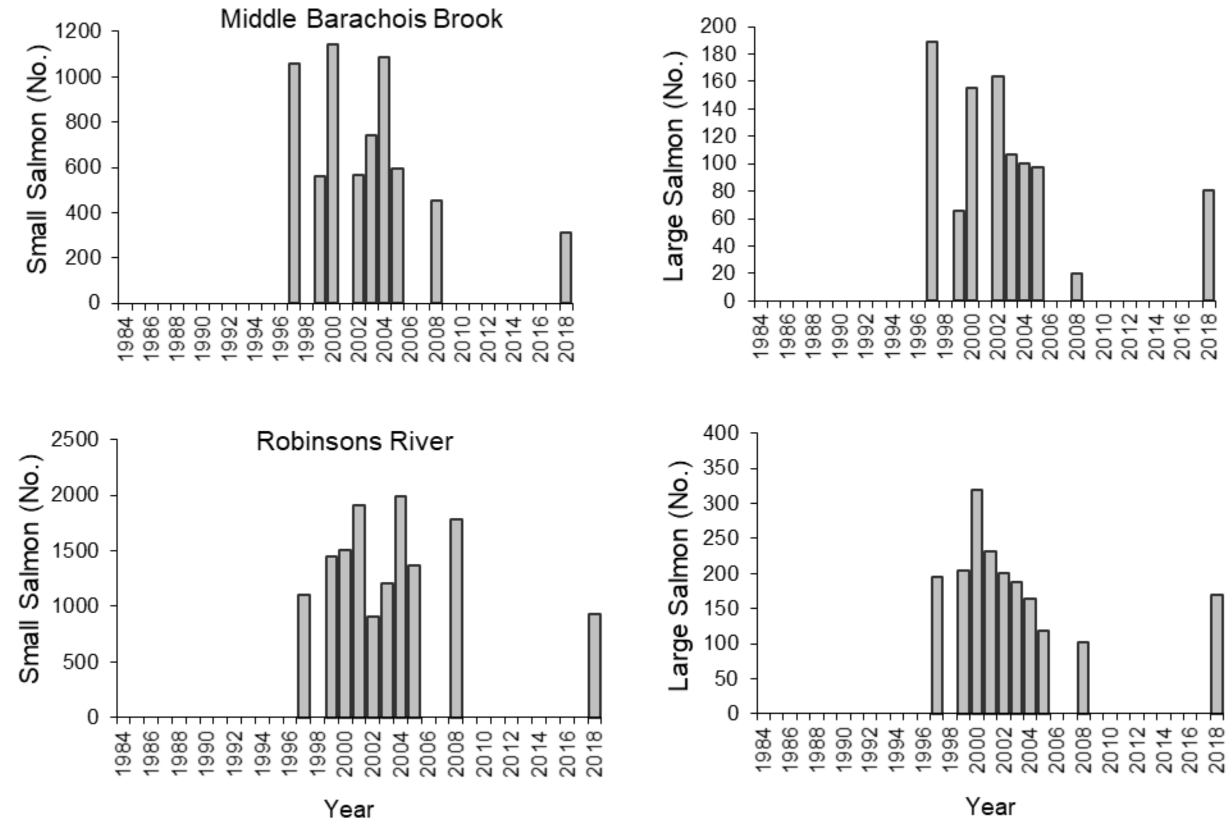

Figure 14. Estimated total returns of small and large salmon based on in-river snorkel surveys in SFA 13 on the southwest coast of Newfoundland, 1994–2018. Previous generation averages are unavailable for these two rivers.

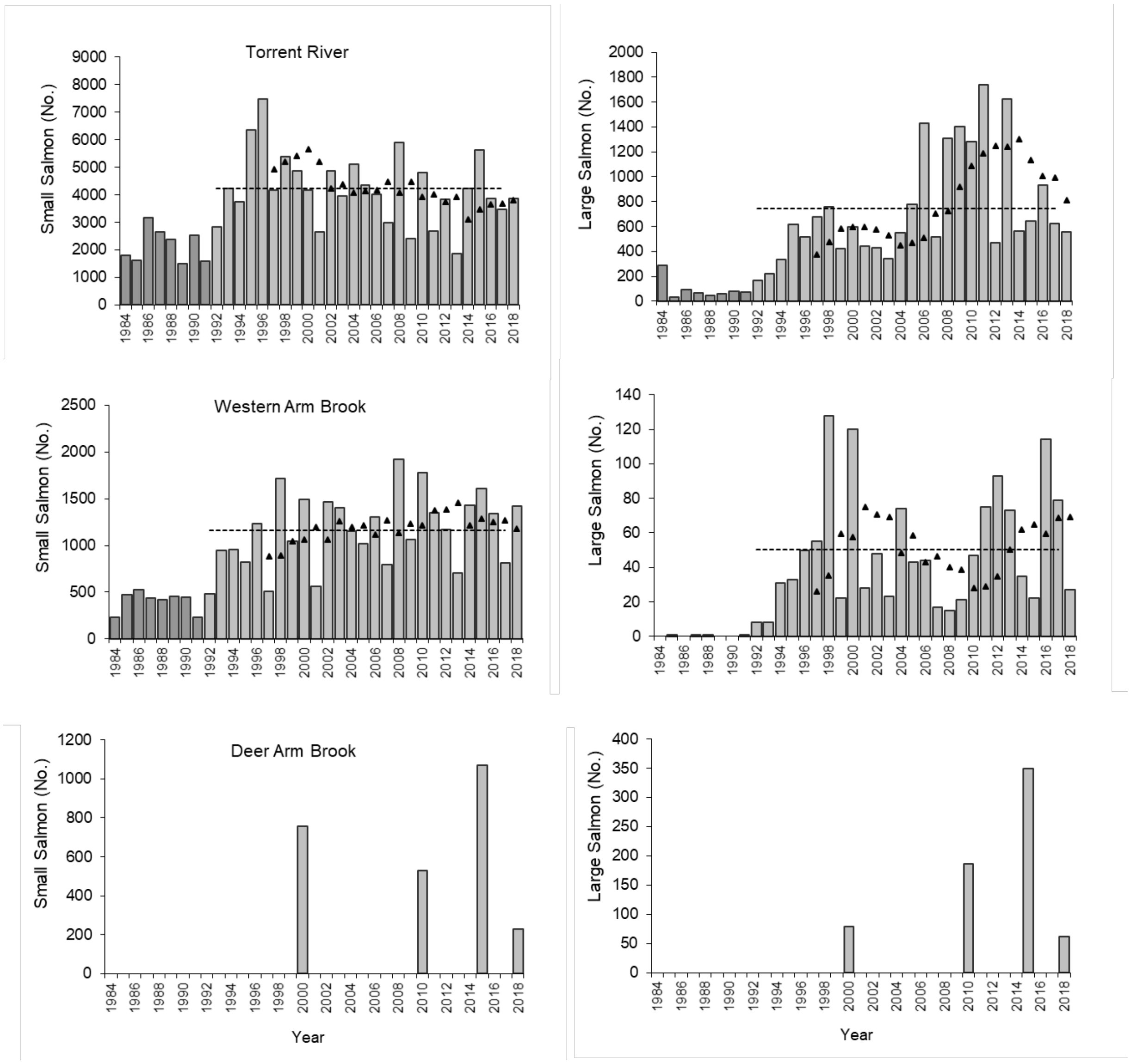

Figure 15. Total returns of small and large salmon to monitored rivers in SFA 13 on the west coast of Newfoundland, 1994–2018. The black triangles represent the previous generation average (five years). Previous generation averages are unavailable for Deer Arm Brook.

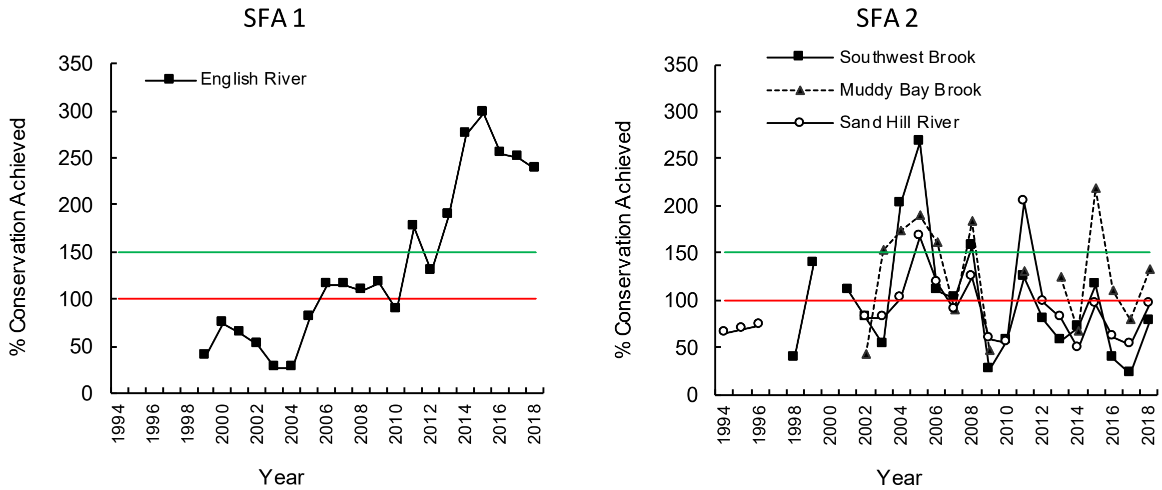

Figure 16. Percent of conservation egg requirement achieved for monitored rivers in Labrador available from 1992–2018. Horizontal line represents 100% (red; LRP) and 150% (green; USR) of the river-specific conservation requirement.

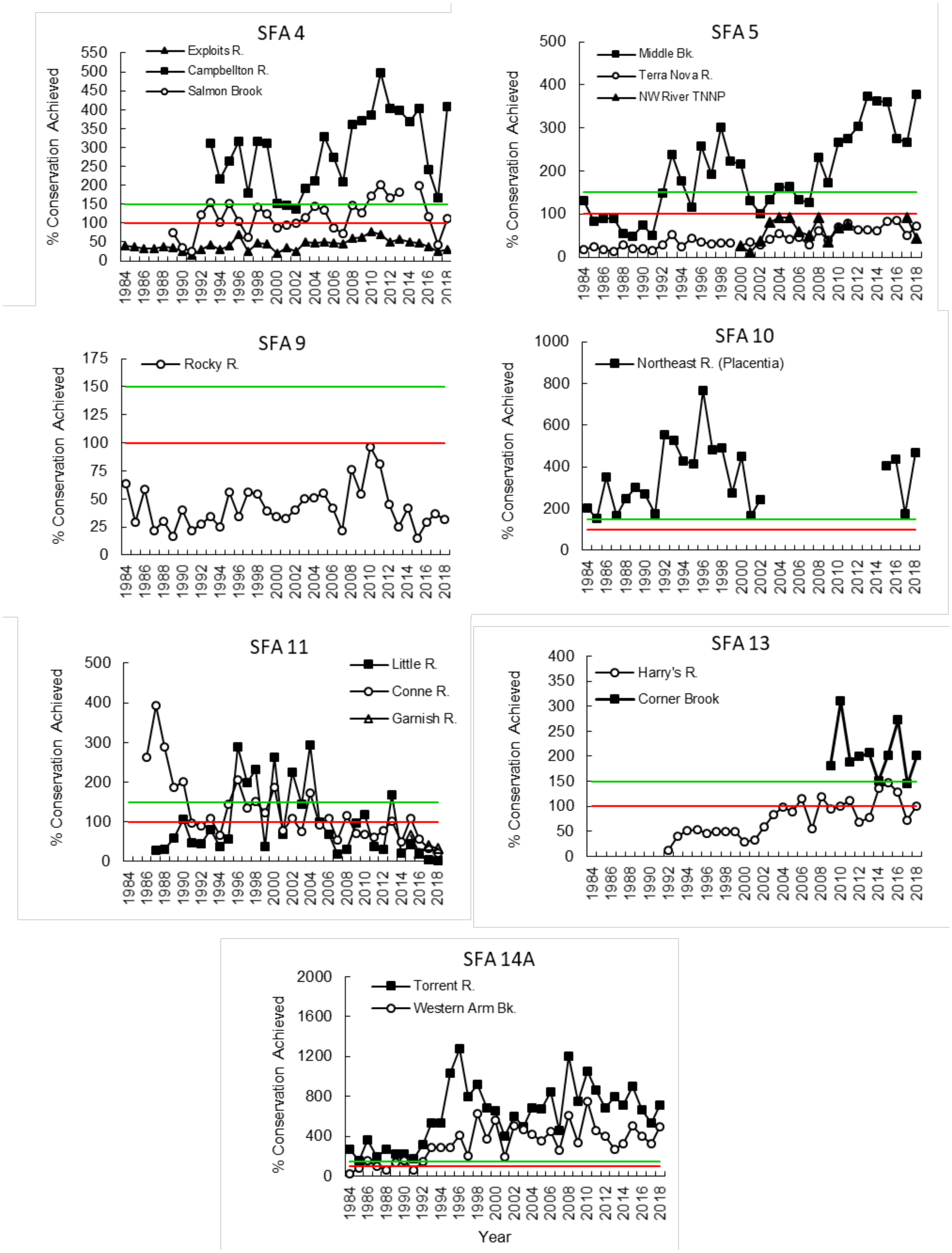

Figure 17. Percent of conservation egg requirement achieved for monitored rivers in insular Newfoundland from 1992–2018. Horizontal line represents 100% (red; LRP) and 150% (green; USR) of the river-specific conservation requirement.

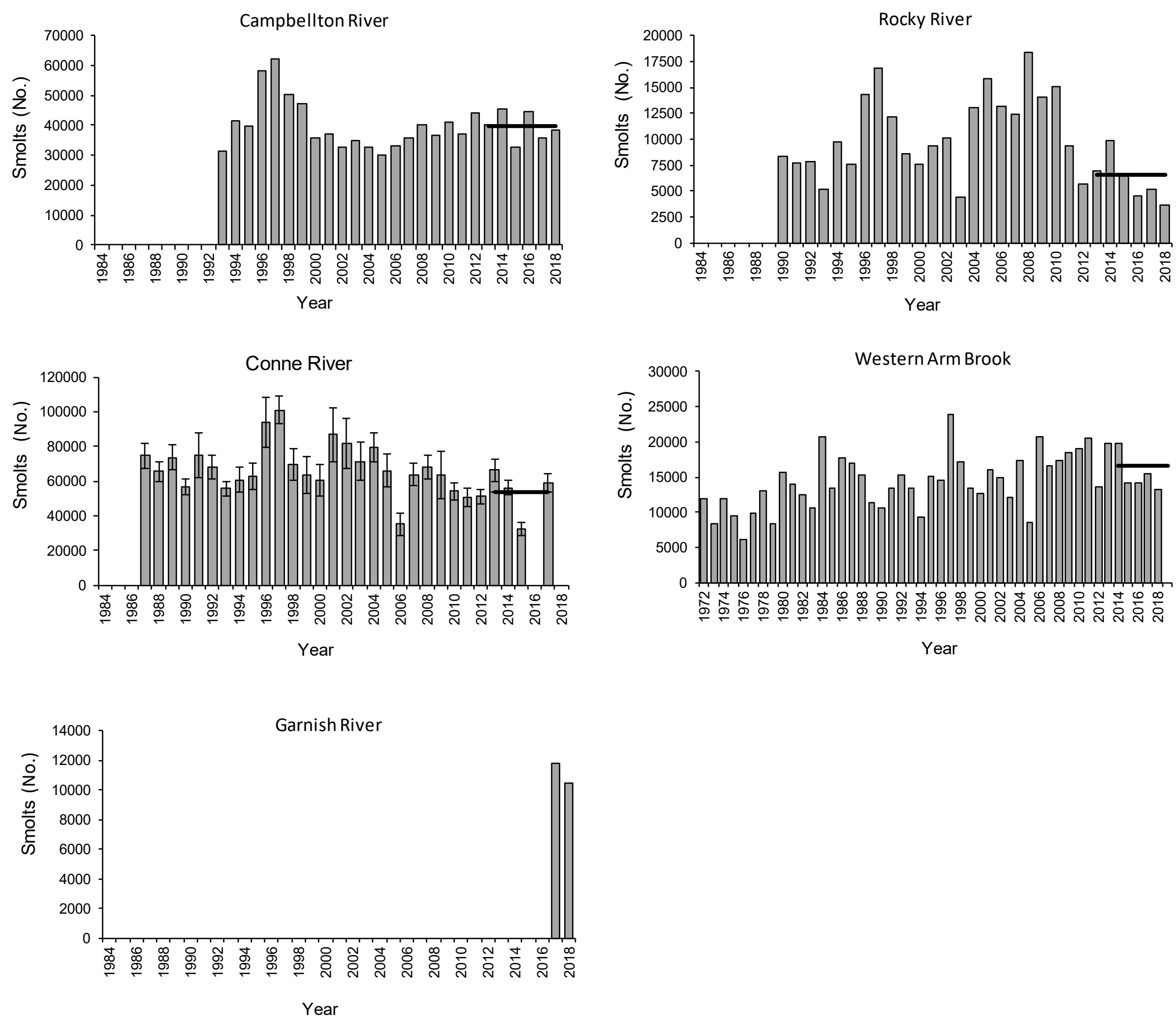

Figure 18. Atlantic Salmon smolt production (bars) of five rivers in Newfoundland. Horizontal black line represents the previous generation average (five years; 2013–17).

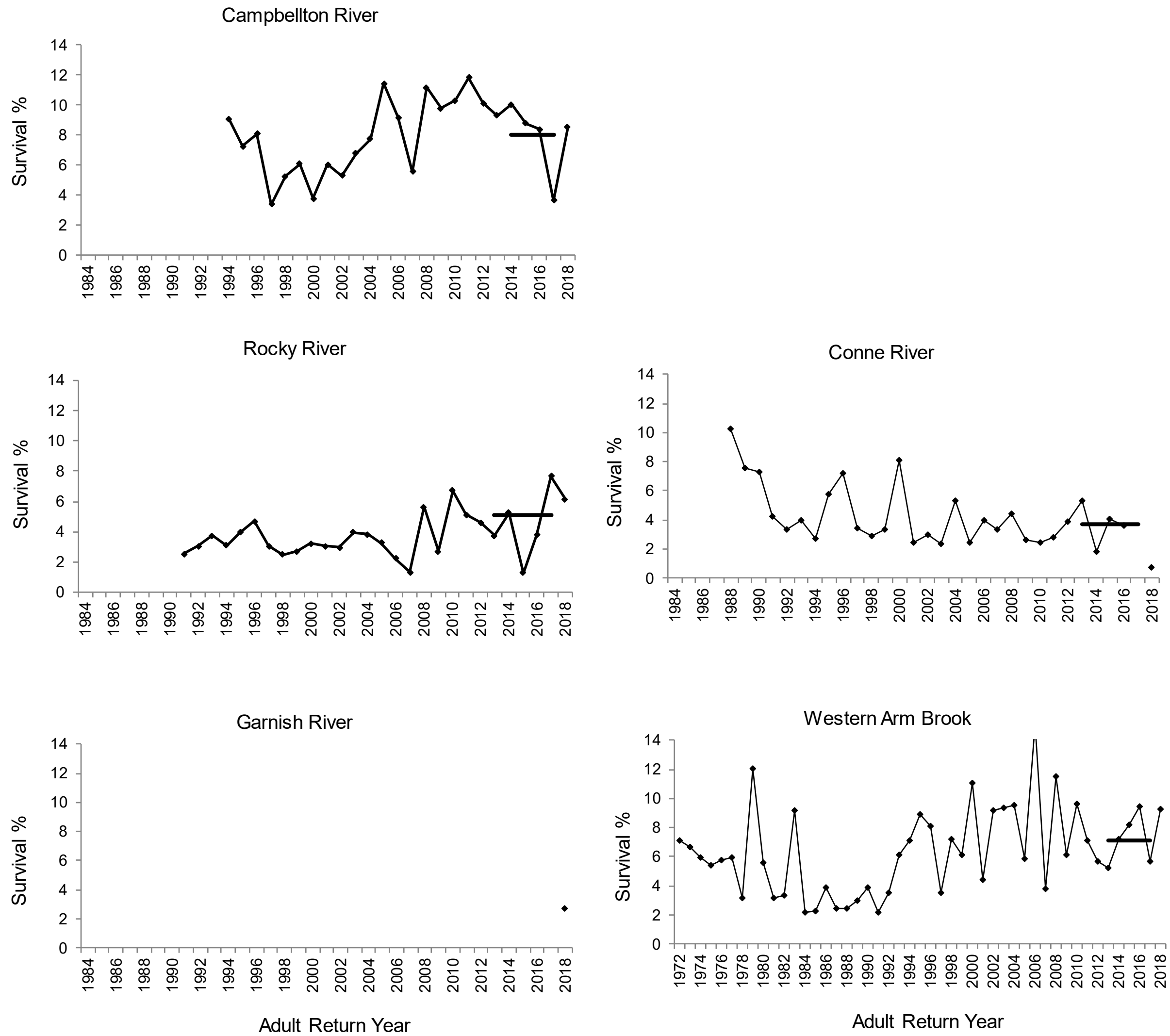

Figure 19. Marine survival of Atlantic Salmon smolt (diamonds) to small adult salmon. Horizontal black line represents previous generation average (five years; 2013–17).