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Canadian Science Advisory Secretariat
Newfoundland and Labrador Region **Science Advisory Report 2020/038**

STOCK ASSESSMENT OF NEWFOUNDLAND AND LABRADOR ATLANTIC SALMON IN 2018

Image: Atlantic Salmon (Salmo salar).

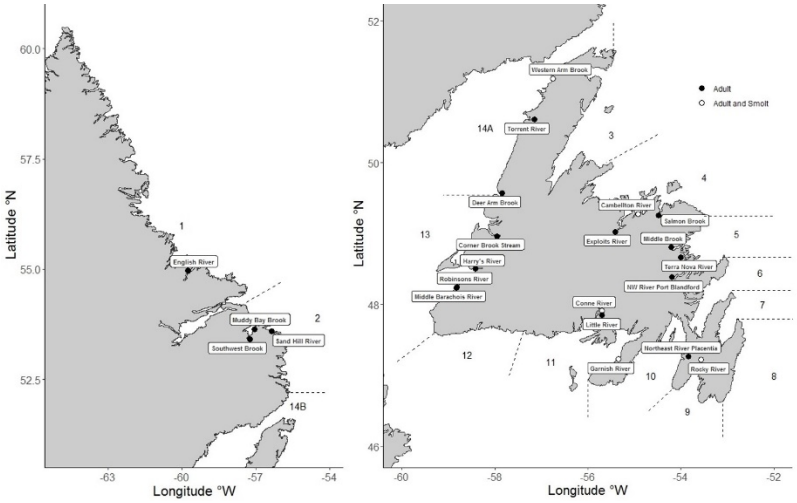

Figure 1. Map of the Newfoundland and Labrador Region showing Salmon Fishing Areas (SFAs) 1-14B.

Context:

There are 15 Atlantic Salmon (Salmo salar) management areas, known as Salmon Fishing Areas (SFAs); 1-14B, in Newfoundland and Labrador (NL) (Figure 1). Within these areas there are 394 rivers known 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.

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). Conservation egg requirements were considered to be equivalent to a Limit Reference Point (LRP).

The Fishery Decision-Making Framework Incorporating the Precautionary Approach (Fisheries and Oceans Canada [DFO] 2009, 2015) identifies two reference points for managing fisheries stocks, the LRP and Upper Stock Reference Point (USR). As per the Precautionary Approach Framework, Atlantic Salmon stock status is assessed based on the proportion of the river-specific LRP and USR achieved. The LRP corresponds to the previously defined conservation egg requirement; in 2017, an interim USR was defined as 150% of the previously defined conservation egg requirement. Status is also described in terms of trends in salmon returns (abundance prior to in-river exploitation), smolt production and marine survival rates.

Annual comparisons are generally made to:

1. *the previous five-year mean for Newfoundland and six-year mean for Labrador, which correspond to the average Atlantic Salmon generation time in those areas; and*

2. *the previous three generation average (15 and 18 years for Newfoundland and Labrador, respectively).*

This Science Advisory Report is from the March 5-7, 2019 Regional Peer Review Process on the Assessment of Atlantic Salmon in Newfoundland and Labrador. Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available.

SUMMARY

- Twenty-two populations of Atlantic Salmon were monitored in 2018, 20 using counting fences and fishways and two by snorkel surveys.
    - Of the 22 rivers monitored in 2018, 21 were included in the stock assessment; four in Labrador and 17 in Newfoundland. Northwest River-Port Blandford was not assessed in 2018 since the count was incomplete. Four of the 21 assessed rivers in Newfoundland also counted juvenile salmon (smolt) migrating to sea (Figure 1).
- In 2018, five assessed rivers showed declines in total returns, and three of these had declines of greater than 30% compared to their previous generation mean (2012-17 and 2013-17 for Labrador and Newfoundland, respectively). Seven rivers had declines in total returns compared to the generation mean prior to 2016 (2010-15 for Labrador and 2011-15 for Newfoundland), four of which were greater than 30%. Data were unavailable during the previous generation and the generation prior to 2016 for six rivers (Table 3).
- Of the 15 assessed rivers for which there is information on returns over the previous three generations (2000-17 and 2003-17 for Labrador and Newfoundland, respectively), total returns in 2018 were lower on one of four rivers in Labrador and on five of eleven rivers in Newfoundland. Of these, four Newfoundland rivers had declines greater than 30% (Table 3).
- In 2018, estimated spawning escapements (eggs) were below the river-specific Limit Reference Point (LRP) (critical zone) on two of the four assessed rivers in Labrador. Estimated spawning escapement exceeded the river-specific Upper Stock Reference Point (USR) (healthy zone) on English River and fell between the LRP and USR (cautious zone) on Muddy Bay Brook.
- In Newfoundland, estimated spawning escapements (eggs) were below the LRP (critical zone) for eight of the 17 assessed rivers in 2018. Of the remaining nine Newfoundland rivers, seven rivers exceeded the USR (healthy zone) and two fell between the LRP and USR (cautious zone).
- The Labrador Indigenous and subsistence fisheries harvest in 2018, inferred from logbook returns (73% return rate), was 12,930 salmon (8,793 small, 4,137 large), which was 5.5% less than the previous six-year mean (2012-17) of 13,496 salmon (8,255 small, 5,241 large).
- Estimates of recreational catches for NL have been highly variable since 2005 (total catch range of 38,900 to 76,100 salmon). Preliminary estimates of retained and released salmon in 2018 were 13,626 and 25,055 (38,681 total).
- Returns of Atlantic Salmon to rivers on the south coast of Newfoundland (Salmon Fishing Areas [SFAs] 9-11) remain poor. Record low returns occurred at Conne River and Little River (>30 years for each river). All three monitored rivers in SFA 11 remain in the critical zone and marine survival rates also remain low (less than 3%).
- Marine survival continues to be the major factor limiting the abundance of Atlantic Salmon in the NL region. Returns in any given year are determined primarily by marine survival rather than variations in smolt production. Inter-annual estimates of marine survival continue to

fluctuate, with survival in 2018 ranging between 0.8% and 9.3% for the five monitored rivers where marine survival estimates were available. The 2018 marine survival estimate for Conne River in SFA 11 (0.8%) is a record low in a 32 year time series.

Genetics

- Genetic analysis of mixed stock Atlantic Salmon fisheries in coastal Labrador (2017-18), West Greenland (2017-18) and St. Pierre et Miquelon (2015, 2017-18) revealed significant differences in stock composition, with Labrador exploiting 98-99% Labrador-origin salmon. The other two fisheries exploited mixtures of North American migratory stocks. In West Greenland, there was also a significant contribution from United Kingdom and Iceland stocks.
- Research on the distribution and abundance of Atlantic Salmon from marine aquaculture cages and hybridization with wild salmon continued in 2018.
    - Five escapees were recaptured at the Garnish River counting fence during regular monitoring activities. Additionally, 400 escapees were recaptured in the marine environment following an escape event of 2,000-3,000 farmed salmon in late-July, 2018.
    - 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.

Catch-and-Release Mortality

- Consistent with published findings, results from a catch-and-release mortality model indicate that the probability of mortality for a caught and released Atlantic Salmon increases significantly with increasing water temperature.

Environment

- Mean annual air temperature in Newfoundland and southern Labrador in 2018 was near the long-term average (1981-2010) characterized by a warm winter and summer, and a cold spring. Summer sea surface temperatures were colder than the long-term average in offshore regions, a trend observed since 2015. Driven by the warm summer, the water temperature in the inshore regions of Newfoundland (e.g., Comfort Cove) were above the long-term average in summer 2018.
- Since 2015, primary and secondary production indices in the NL Shelf show overall low productivity at the lower trophic levels (phytoplankton and zooplankton) and changes in zooplankton community structure with potential impacts on energy transfer to higher trophic levels including Atlantic Salmon.

River Temperatures

- Summer river temperatures fluctuate throughout the day and vary considerably by geographic location in NL, with some rivers experiencing changes in excess of 5°C.
- Average water temperatures in July and August for nine monitored rivers in Newfoundland from 1960-2016 showed a significant increase over time.
- Average water temperatures in July for four monitored rivers in Labrador showed no significant change over time, whereas water temperatures in August showed a slight increase.

River Closure Trends in Newfoundland

- The number of river closures due to environmental conditions (high water temperature and/or low water level) across all SFAs in Newfoundland during 2018 was the highest on record (131 rivers closed) while the percentage of angling days closed in 2017 and 2018 were the highest since 1987.

BACKGROUND

Species Biology

Juvenile Atlantic Salmon remain in freshwater habitats for two to five years in Newfoundland and three to seven years in Labrador (Figure 3) prior to smolting and migrating to sea. Spawning populations in NL consist of small (fork length < 63 cm) and large (fork length ≥ 63 cm) adult salmon (Figure 4). For the majority of rivers in Newfoundland (SFAs 3-12 and 14A), the small adult salmon population is predominantly grilse (one-sea-winter, 1SW salmon) that have spent one year at sea before returning to spawn for the first time. The large adult salmon population in Newfoundland rivers is composed mainly of repeat-spawning grilse which are either a consecutive or alternate spawning fish. In contrast, Labrador (SFAs 1, 2 and 14B) and southwestern Newfoundland (SFA 13) populations are comprised of important large salmon components that contain maiden fish that have spent two (two-sea-winter, 2SW) or more years (multi-sea-winter, MSW) at sea before returning to spawn. The adult spawning migration generally runs from late-May to mid-June for most rivers in Newfoundland and from 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 colder years with low water temperatures and high amounts of inshore sea ice. For most monitored rivers in NL, small salmon are predominantly female (range of 60-92% across rivers).

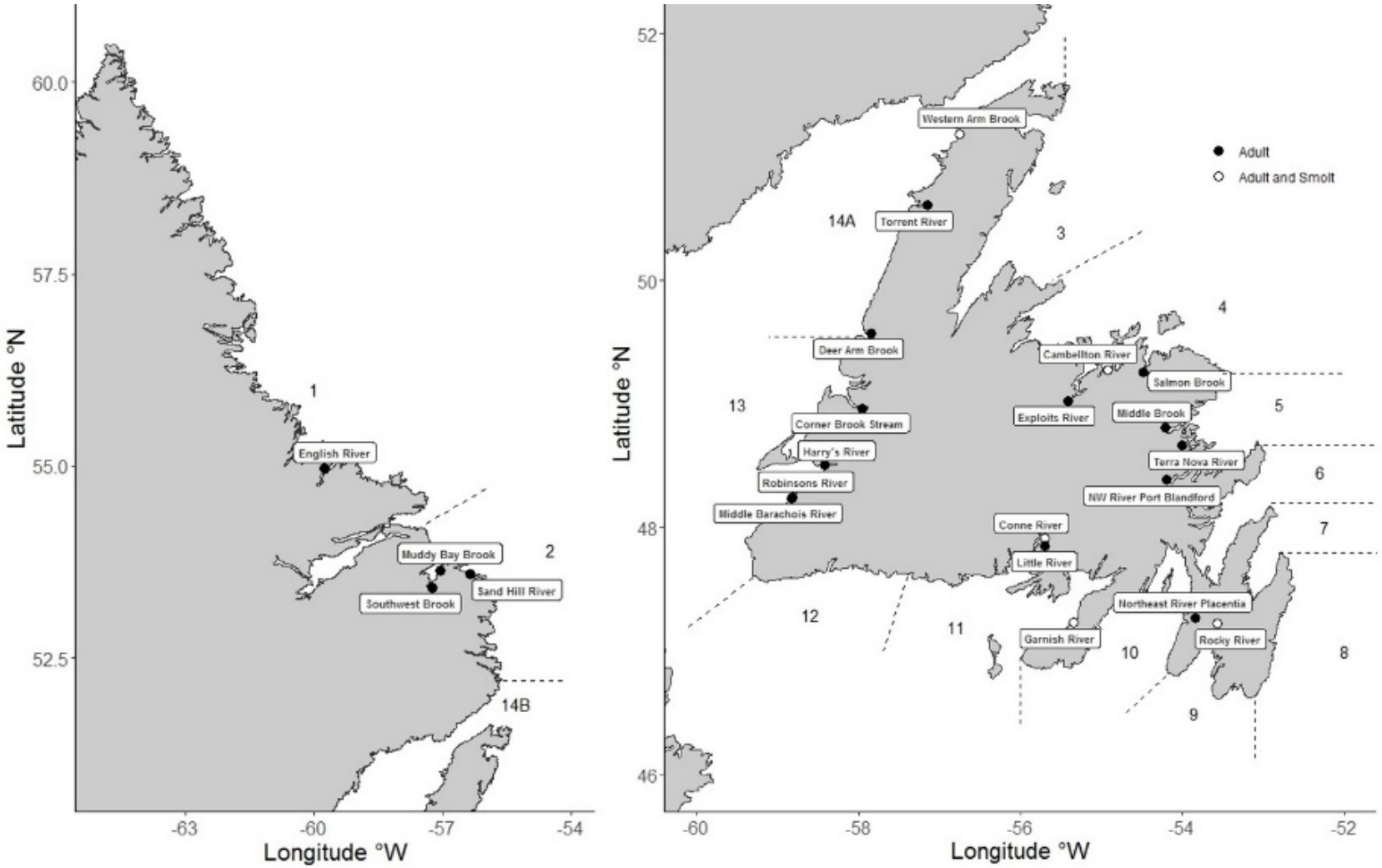

Figure 2: Map showing the locations of rivers in SFAs 1–14B where Atlantic Salmon populations were monitored in 2018. Adult salmon were counted at twenty monitoring facilities (incomplete count on NW River-Port Blanford) and estimated on two rivers using snorkel surveys. Five facilities counted or estimated salmon smolts (white circles) in 2018. The smolt count at Conne River was incomplete due to a significant washout event. SFA boundaries are indicated by dotted lines.

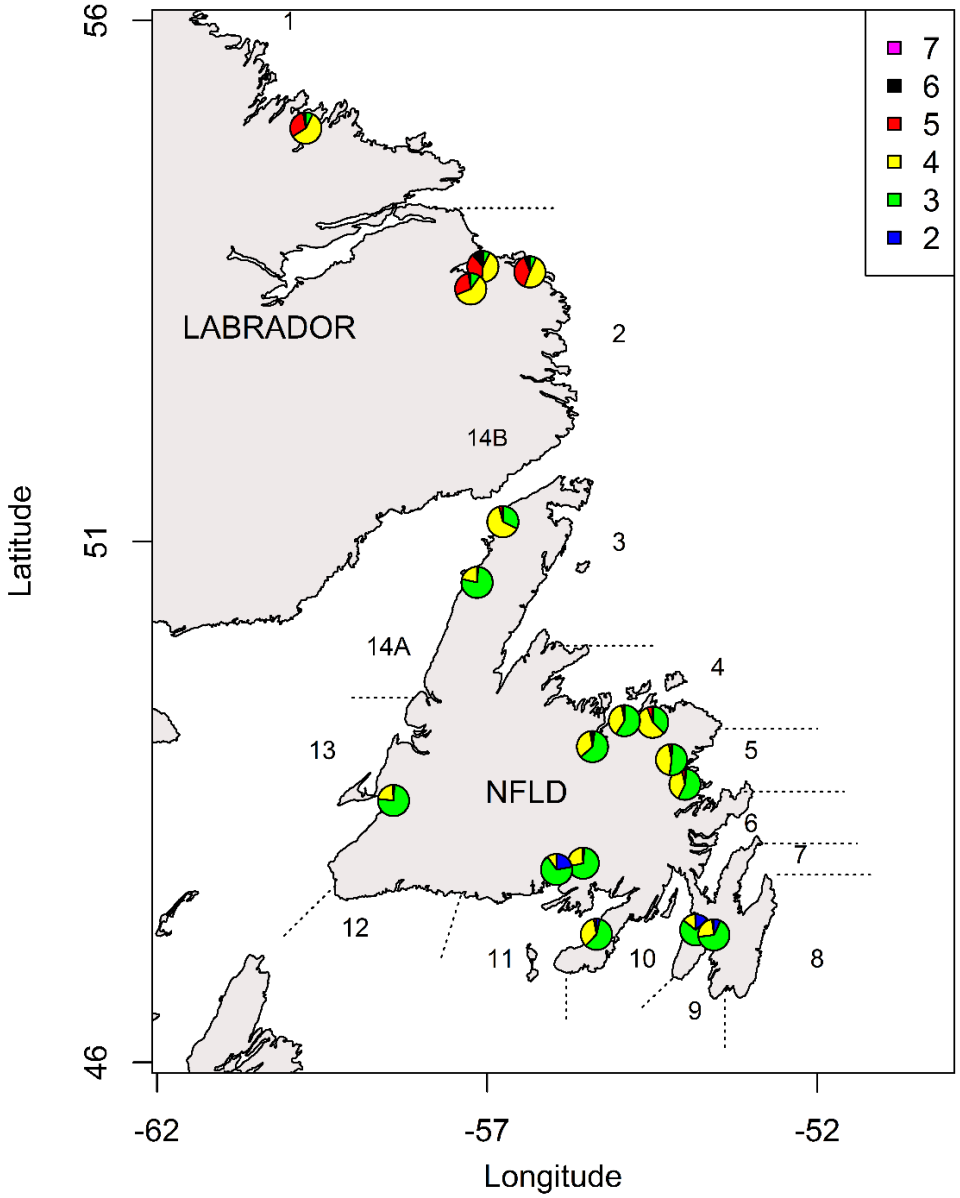

Figure 3: Smolt age distribution for seventeen of twenty-one rivers assessed in NL in 2018. Average smolt age proportions were calculated for each river using either adult or smolt scale age data over the entire time series and only included years where sufficient sample sizes were available. Where both adult and smolt scales were available for a particular river, estimates were based on smolt data. Smolt age data were unavailable for Corner Brook Stream, Middle Barachois Brook, Robinson's River and Deer Arm Brook; therefore, these rivers are not represented. The boundary of each SFA is indicated by dotted lines.

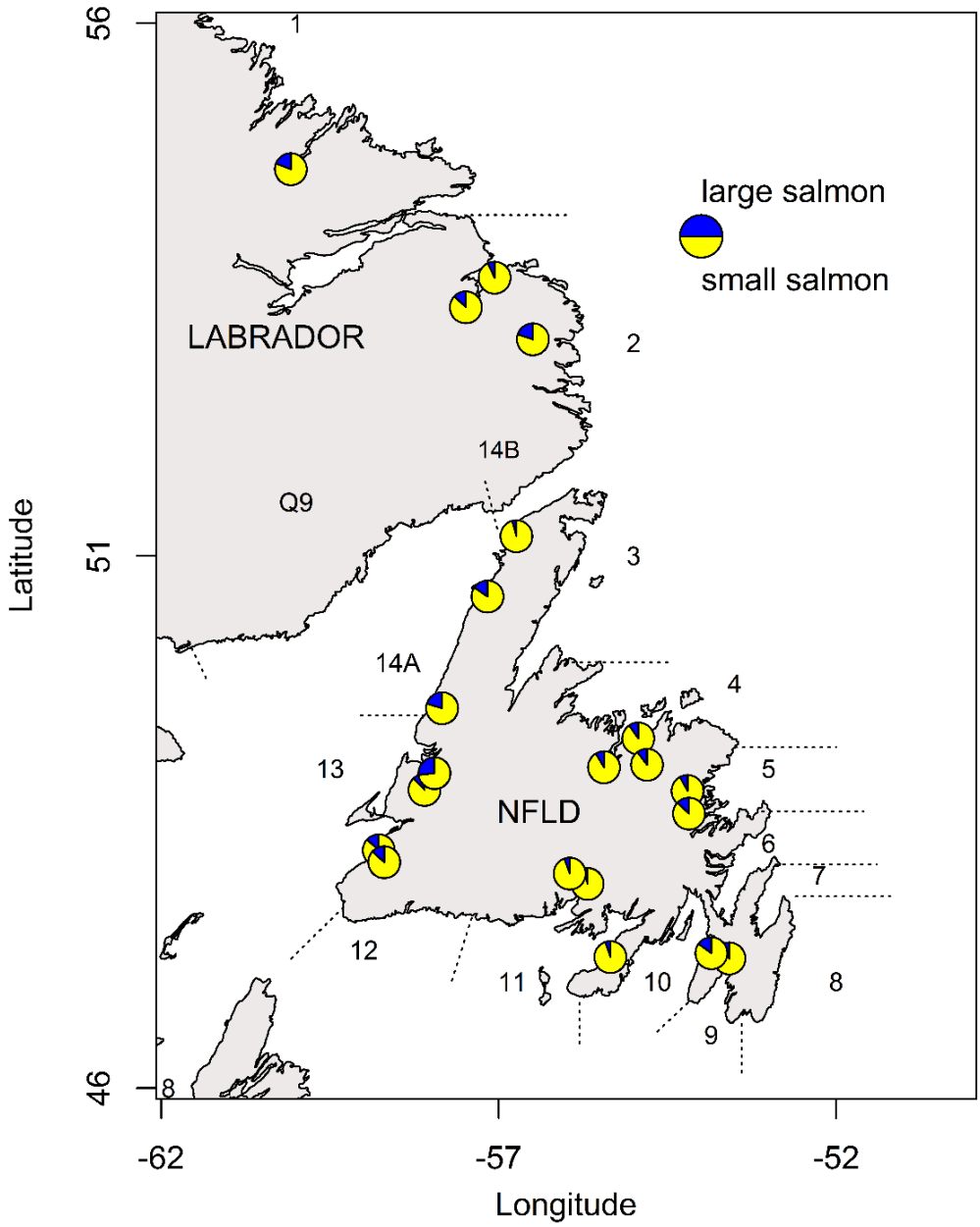

Figure 4: Proportion of small (fork length <63 cm) and large (fork length ≥63 cm) Atlantic Salmon across twenty-one rivers assessed in 2018. The boundary of each SFA is indicated by dotted lines.

Recreational Fisheries

The 2018 recreational salmon fishery for all Newfoundland rivers opened on 4 - June (with a short delay due to the late availability of salmon licences) and closed September 7. Retention of large salmon in Newfoundland has not been permitted since 1984. A fall catch-and-release angling fishery occurred on the Gander River, Exploits River, and Humber River from September 8 to October 7.

The recreational salmon fishery for all Labrador rivers opened June 15 and closed September 15. Retention of large salmon has not been permitted in Labrador since 2011. Recreational catch data were derived from outfitting camp logbooks for SFA 1, a combination of logbook and Licence Stub Return data for SFA 2, and Licence Stub Return data only for SFA 14B.

The recreational Atlantic Salmon fishery is managed according to a River Classification System, which is used to establish retention levels based on the health of individual salmon populations without jeopardizing conservation goals (Veinott et al. 2013). A two-year salmon management cycle was introduced in 2017, which was used to guide management decisions for 2018. Due to low salmon returns in 2016 and 2017, Class 4, Class 6, and unclassified rivers were temporarily changed to Class 2 to allow for a one fish retention at the beginning of the 2018 angling season and an additional one fish retention dependent on the results of an in-season review. The daily limit for catch-and-release angling was reduced from four to three salmon per day, with a seasonal limit of ten salmon. Based on the recommendations of an in-season Science review (DFO 2019), all rivers were closed to retention angling and continued as catch-and-release only after July 20 in Newfoundland and after August 3 in Labrador.

In the event of extreme environmental conditions during the recreational angling season (e.g. low water levels, high water temperatures), there is a process in place for closing rivers which involves field observations by fisheries guardians, regular measurements of water temperature and forecasted changes in weather. These data sources are compiled and provided to DFO Resource Management to make a decision on river closures. The water temperature threshold is typically set at 22°C; however, when the recreational fishery switched to catch-and-release only (no retention) in August 2018, this threshold was reduced to 18°C. During the 2018 angling season, 131 out of 158 (83%) scheduled rivers in Newfoundland were closed for part of the angling season due to environmental conditions, the highest on record (since 1975). Closures generally occurred in late-July and early-August and affected all zones except SFAs 12, 13 and 14A on the south and west coasts of the island, consistent with previous years (Dempson et al. 2001). No rivers were closed in Labrador. In total, 30.9% of angler days were lost due to environmental closures in Newfoundland in 2018, the highest since 1987 (36.9%).

The 2018 recreational catch statistics for NL were derived from Licence Stub Return data. The 2018 data are considered preliminary and will be updated following the analysis of a phone survey conducted in March 2019 of anglers who did not return their logs (non-respondents). Recreational catch and effort data may also be adjusted if sufficient new information (e.g. receipt of additional vendor licences) is received by DFO. Recreational catch estimates for the NL Region from 1994 to 2018 are presented in Figure 5 and Table 1. Estimates of recreational catches for NL have been highly variable since 2005 with total catch (retained and released) ranging from 38,681 to 76,121 salmon. Preliminary estimates of retained and released salmon in 2018 were approximately 13,626 and 25,055 fish, respectively (Table 1, Figure 5). This represents a 47% and 17% decline for retained and released salmon, respectively as compared to the previous five-year mean (2013-17) and the lowest estimate of retained salmon in the time series (1994-2018). The observed decline in preliminary retained and released estimates in 2018 are likely due to a combination of factors including:

1. A decrease in the seasonal retention limits to one fish per angler;
2. A decrease in the daily catch-and-release limit from four to three fish per day and the implementation of a seasonal catch-and-release limit of ten fish;

3. The mid-season closure of the retention fishery that may deter many of the largely retention-oriented NL anglers (Veinott and Cochrane 2015) from participating in the recreational fishery; and
4. The high frequency of environmental closures across Newfoundland in 2018.

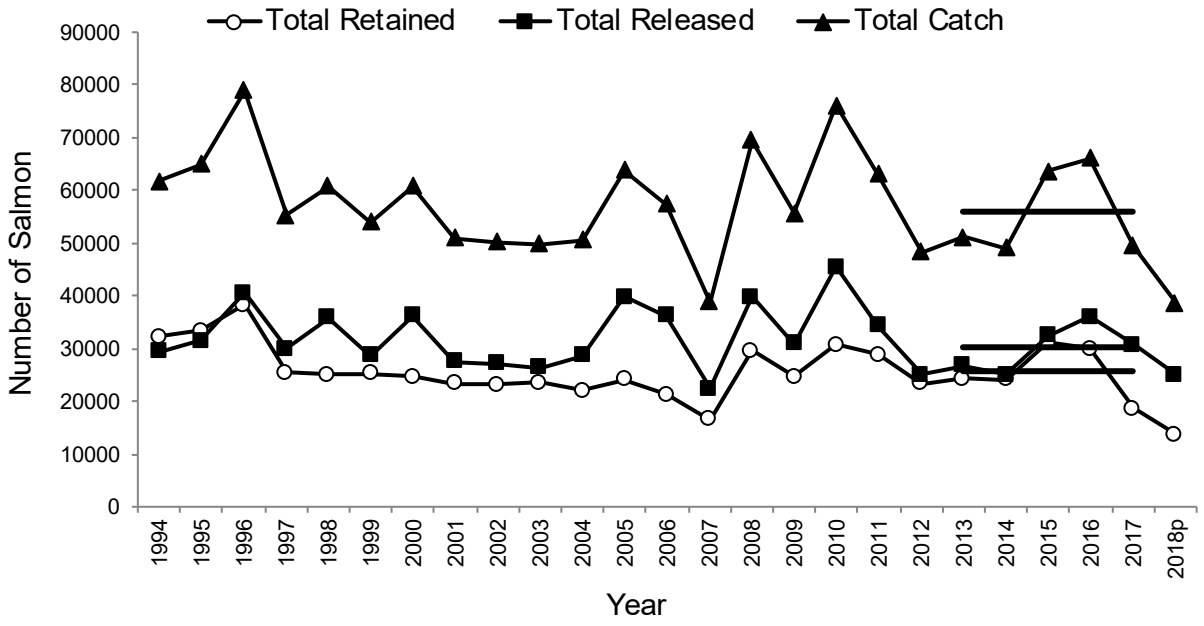

Figure 5: Recreational catch of Atlantic Salmon, size groups combined, for the NL Region (1994-2018): total retained (open circles), total released (black squares) and total catch (black triangles). Horizontal solid lines represent the previous five-year mean (2013-17). Recreational catch and harvest estimates for 2018 are preliminary (2018p). Catches (number of retained and released) for small and large salmon and effort are summarized in Table 1.

Indigenous/Subsistence Fisheries

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 rest of Labrador (SFAs 1-2) since 1998.

Indigenous Food, Social and Ceremonial (FSC) fisheries for Atlantic Salmon, Arctic Char and Brook Trout 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 hold a FSC communal salmon fishing licence, but have 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 (76% return rate), and were estimated at 12,900 salmon in 2018 (8,800 small, 4,100 large), which was 5% less than the previous six-year mean (2012-17) of 13,700 salmon (Figure 6, Table 2). Large salmon represented 32% of the catch by number. Harvest estimates for 2018 are preliminary.

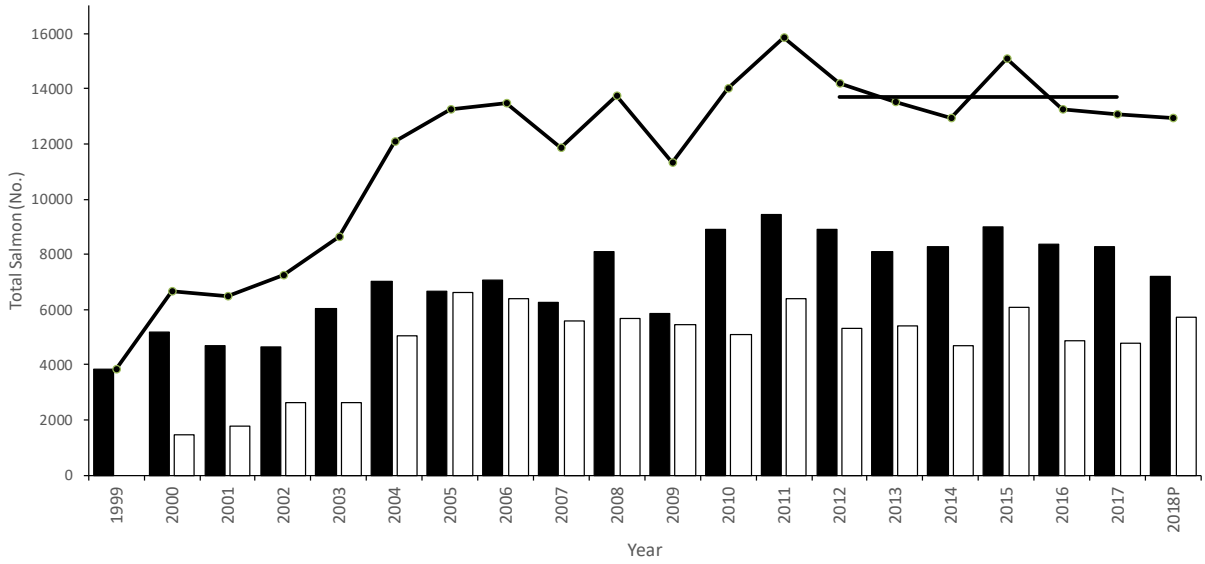

Figure 6: Numbers of estimated Atlantic Salmon harvested in Labrador Indigenous and subsistence fisheries in SFA 1 (black bars), SFA 2 (white bars) and total harvest (black circles) from 1999 to 2018p. Horizontal solid line represents the previous six-year mean of total harvest (2012-17). Harvest estimates for 2018 are preliminary (2018p).

Genetic Analysis of Mixed Stock Fisheries

From 2017 and 2018, a total of 994 individual salmon from the Labrador subsistence salmon fisheries were analysed using the Single Nucleotide Polymorphism (SNP) panel with 31 range-wide regional reporting groups. As in past years, estimates are dominated by the Labrador group >98%. Although two individuals of USA origin were detected in 2017, none were detected in 2018. The dominance of the Labrador reporting group is consistent with previous analysis conducted for the period 2006–14 which estimated >95% of the harvest was attributable to Labrador stocks. Regional contributions within Labrador suggest largely local harvest within each of the regions.

A total of 193 individuals collected from the Saint Pierre and Miquelon fishery between 2017 and 2018 were analyzed using the SNP panel range wide baseline. Contrasting previous years when samples of the catch were dominated by large salmon $\geq$63 cm, samples for 2017 and 2018 were dominated by small individuals <63 cm. Regional analysis using the SNP panel of the 193 individuals showed the consistent dominance of three regional groups and little differences between the two years (83–89%: Southern Gulf of St Lawrence, Gaspe Peninsula, and Newfoundland). The largest contributor in both years were individuals from Newfoundland reporting groups totaling >60% in each year.

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 2016, equivalent to 2,300 to 12,800 salmon of North American origin (ICES 2015). Region of origin analyses, using the genetic baseline described above, indicated that Labrador origin salmon comprised approximately 20% of the total salmon originating from eastern North America with Newfoundland origin salmon representing a smaller proportion at <4% (Bradbury et al. 2016, ICES 2015).

ASSESSMENT

Since 2017, the status of Atlantic Salmon populations has been assessed relative to two reference points, defined on the basis of egg depositions, as per the Fishery Decision-Making Framework Incorporating the Precautionary Approach. The LRP is set at 100% of the previously defined conservation egg deposition rate. Populations below the LRP fall in the critical zone, in which management actions should promote stock growth and fisheries-related mortality should be kept to the lowest level possible. The interim USR is set at 150% of the previously defined conservation egg deposition rate. 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 fall within the cautious zone, in which management actions should promote stock rebuilding to the healthy zone.

DFO Science also examined trends over time in salmon abundance on each monitored river. In each year, the estimated number of returns on a given river was compared to the previous five- and six-year average for NL rivers, respectively. These time frames represent the average generation time for Atlantic Salmon in each region. In addition, during the assessment of 2017 Atlantic Salmon stocks in NL, it was agreed that Atlantic Salmon returns in 2018 would also be compared to the generation average prior to the significant declines observed on monitored rivers in 2016 and 2017 (2011-15 average for Newfoundland and 2010-15 average for Labrador) (DFO 2018). To investigate long-term trends in Atlantic Salmon returns, annual comparisons were also made to the previous three generations (fifteen years and eighteen years for Newfoundland and Labrador populations, respectively). For all comparisons, DFO Science used a minimum threshold of ten percent difference between an annual abundance and a multi-year average to determine whether the abundance of a monitored population had increased or decreased.

In 2018, 22 populations of Atlantic Salmon were monitored in NL (Figure 1, Table 3). Returning adult salmon were enumerated on fishways or counting fences on four rivers in Labrador and sixteen rivers in Newfoundland. In addition, adult salmon abundance was estimated on two rivers (Robinsons River and Middle Barachois Brook) in Bay St. George (SFA 13) using snorkel surveys in 2018. The count on Northwest River-Port Blandford was incomplete in 2018 due to significant washout events. Therefore, the assessment of the 2018 Atlantic Salmon stocks in NL was based on the other twenty-one monitored populations (seventeen in Newfoundland and four in Labrador). Four assessed rivers in Newfoundland also counted juvenile salmon (smolt) migrating to sea (Figure 1). Migrating smolt abundance is typically estimated on Conne River via a mark recapture program, however, this was unsuccessful in 2018 due to extreme high water that resulted in a fence washout.

Resource Status – Adult Salmon

Newfoundland and Labrador (SFAs 1 to14B)

In 2018, estimated Atlantic Salmon spawning escapements (eggs) exceeded the USR on one of four assessed rivers in Labrador (English River) and on seven of seventeen assessed rivers in Newfoundland (Campbellton River, Middle Brook, Northeast River-Placentia, Corner Brook Stream, Torrent River, Western Arm Brook and Deer Arm Brook; Table 3). Estimated egg deposition fell within the cautious zone (i.e. between the USR and LRP) on one Labrador river (Muddy Bay Brook) and on two Newfoundland rivers (Salmon Brook, Harry's River). During 2018, estimated egg depositions were below the LRP and assessed as being in the critical zone on two of four assessed rivers in Labrador and eight of seventeen assessed rivers in Newfoundland (Table 3). Five of the sixteen rivers that have been assessed during the previous

generation (five and six years for Newfoundland and Labrador, respectively) recorded relative declines in total returns in 2018 (Table 3). Two of these rivers (Conne River and Little River, SFA 11) recorded the lowest total returns on record (since 1986 and 1987, respectively) with declines of 71% on Conne River and 93% on Little River relative to the previous generation. During 2018, thirteen of sixteen NL rivers with information during previous generation reported declines in returns of large salmon relative to the previous generation (Figures 7 to 14) involving all four assessed rivers in Labrador and nine of twelve assessed rivers in Newfoundland.

Northern Labrador and Lake Melville (SFA 1)

There are nine scheduled salmon rivers in SFA 1. One river (English River, near Postville) was assessed in 2018. A counting fence was also installed on Traverspine River in Lake Melville in 2018, however, extremely high water levels shortly after installation resulted in a fence wash out and no count of adult salmon.

Total returns of small and large salmon on English River in 2018 were higher (19%) than the previous six-year generation mean, however there was a decrease (27%) in large salmon returns in 2018 (Figure 7, Table 3). Total returns on English River in 2018 were higher compared to the generation before 2016 (39%) and in comparison to the previous three generations (Table 3). English River exceeded the USR in 2018 (Table 3) which is consistent with all years during the previous generation (2012-17).

Southern Labrador (SFA 2)

There are 16 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).

In 2018, total returns were higher than the previous six-year mean (2012-17) on Southwest Brook and Sand Hill River and there was no change (<10% difference) on Muddy Bay Brook (Figure 8, Table 3). Despite increases in returns of small salmon, large salmon returns decreased by more than 40% on all rivers in SFA 2 relative to the previous six years (Figure 8). In comparison to the generation prior to 2016, total returns in 2018 were lower on Muddy Bay Brook (13%) but there was no change on Southwest Brook or Sand Hill River (Table 3). Total returns in 2018 relative to the previous three generations were lower on Southwest Brook (19%) and there was no change on Southwest Brook or Muddy Bay Brook (Figure 8, Table 3). During 2018, estimated egg depositions were below the LRP on Southwest Brook (77%) and Sand Hill River (95%) and fell within the cautious zone on Muddy Bay Brook (132%; Table 3). In comparison to the previous six-year mean, estimated egg depositions increased on Southwest Brook and Sand Hill River and showed no change on Muddy Bay Brook in 2018 (Table 3).

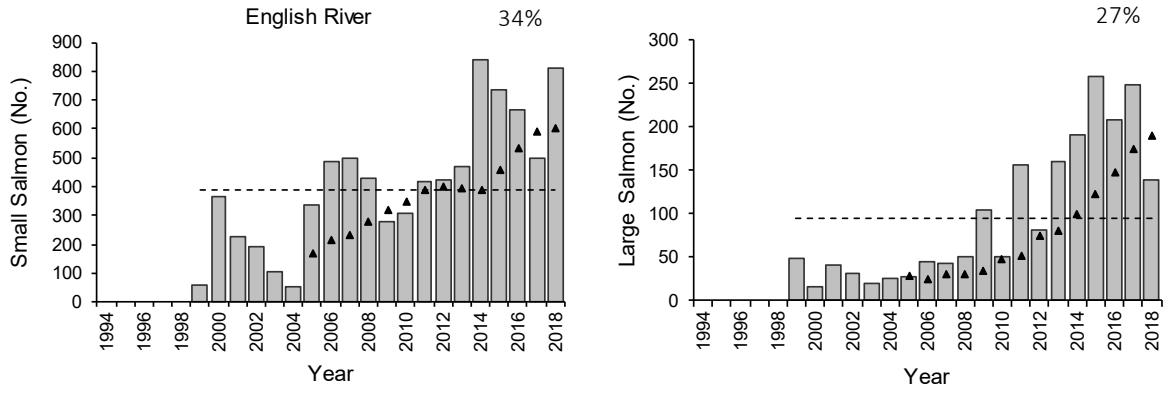

Figure 7: Total returns of small and large salmon on English River (SFA 1) from 1999 to 2018. The dashed line shows average returns for the post-moratorium time series (1997-2017). Black triangles show the previous generation average (six years) for each year. Large black arrows represent the percent change in returns of small and large salmon during 2018 relative to the previous generation.

Labrador Straits (SFA 14B)

There are three scheduled salmon rivers in SFA 14B. No rivers were assessed in 2018.

Northeast and Eastern Newfoundland (SFAs 3-8)

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.

Compared to the previous five-year means (2013-17), total returns of salmon in 2018 were lower on the Exploits River and Salmon Brook and higher on Campbellton River and Middle Brook (Figures 9 and 10, Table 3). There was no change in total returns on Terra Nova River in 2018 relative to the previous five years (Figures 9 and 10, Table 3). Four of five rivers showed large declines in returns of large salmon in 2018 relative to the previous generation, ranging from 23% decline on Terra Nova River to a 78% decline on Exploits River (Figures 9 and 10). In comparison to the generation prior to 2016, total returns of salmon in 2018 were lower on the Exploits River (44%) and Salmon Brook (39%), with no change on all other assessed rivers (Table 3). Total returns in 2018 relative to the previous three generations were lower on Exploits River (41%) and Salmon Brook (14%), but were higher by comparison on Campbellton River, Middle Brook and Terra Nova (Figures 9 and 10, Table 3).

Estimated egg depositions exceeded the USR on Campbellton River and Middle Brook in 2018 (Table 3). These two rivers have exceeded the LRP every year since 1992. Estimated egg depositions of Atlantic Salmon on Exploits River and Terra Nova River were below the LRP in 2018 (Table 3). These two rivers have consistently been below the LRP over the time series of assessments. Estimated egg depositions on Salmon Brook fell within the critical zone in 2018 (Table 3).

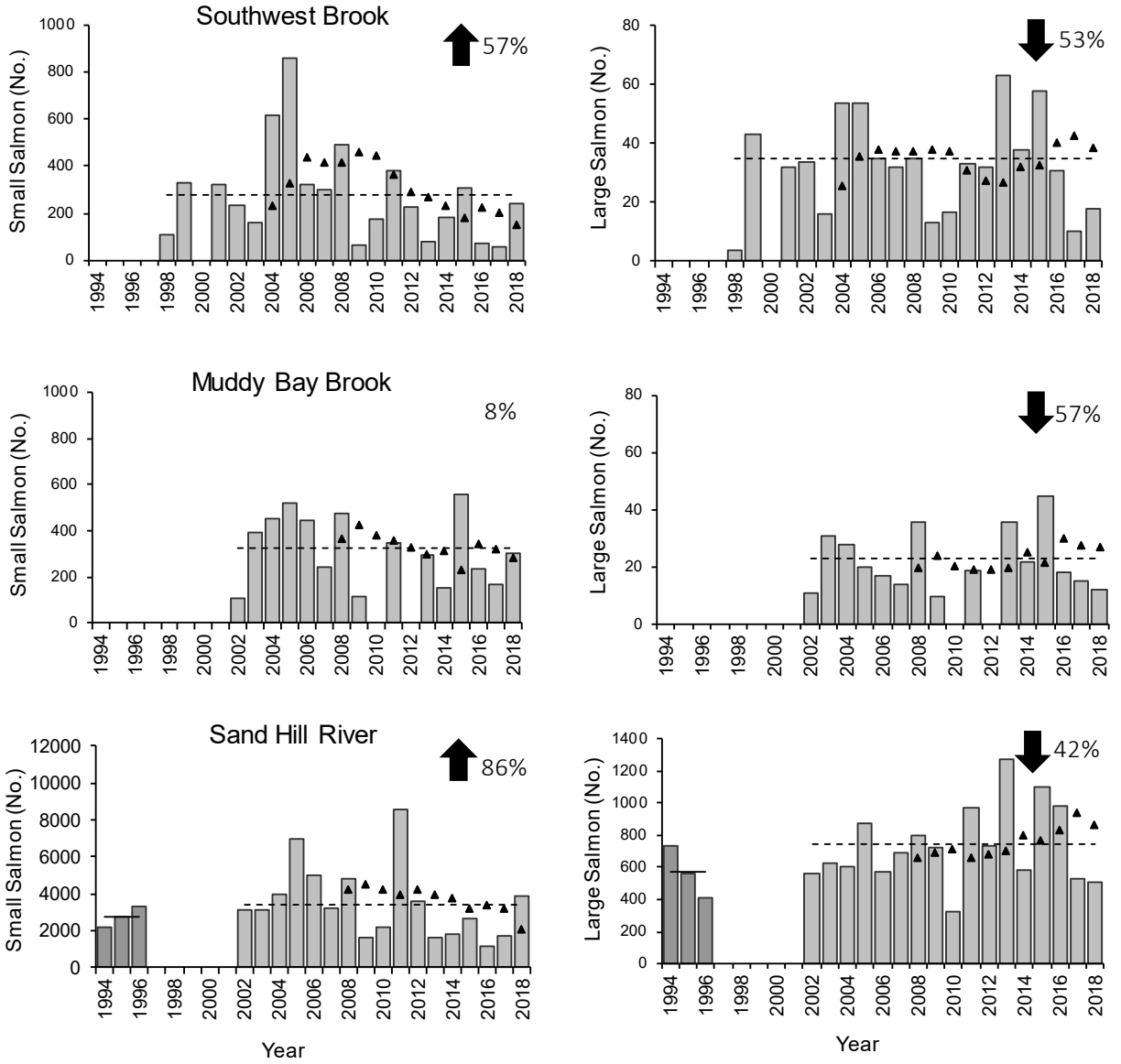

Figure 8: Total returns of small and large salmon at three monitored rivers in SFA 2, 1994 to 2018. The solid black line is the average pre-moratorium time series (1994-1996) and the dashed horizontal line is the post-moratorium average (2002-17). Black triangles show the previous generation average (six years) for each year. Large black arrows represent the percent change in returns of small and large salmon during 2018 relative to the previous generation.

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. However, 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.

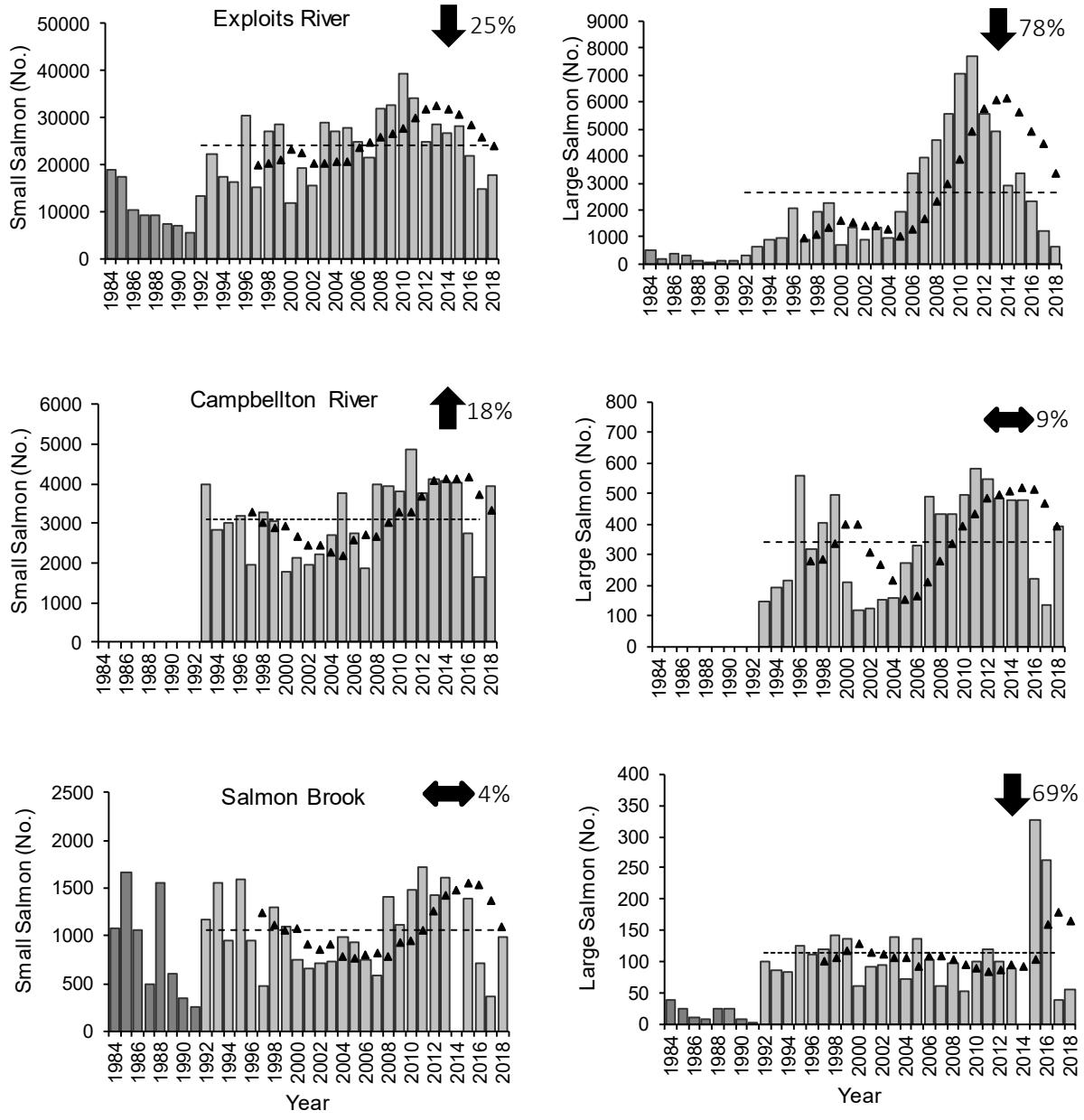

Figure 9: Total returns of small and large salmon at three monitored rivers in SFA 4, 1984 to 2018. The solid black line is the average of the pre-moratorium time series (prior to 1992) and the dashed horizontal line is the post-moratorium average (post-1992). Black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years).

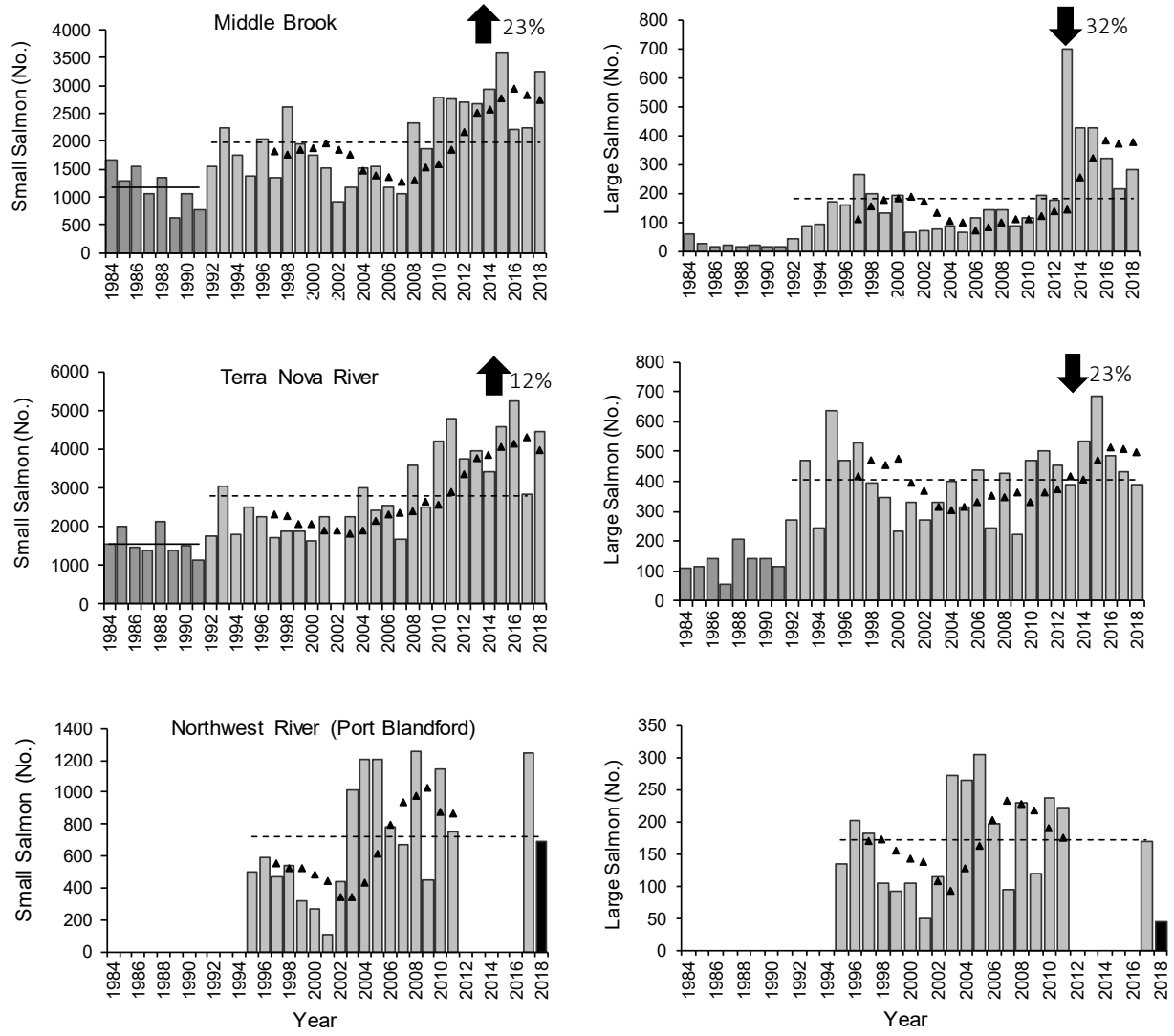

Figure 10: Total returns of small and large salmon at the three monitored rivers in SFA 5, 1984 to 2018. The solid black line is the average of the pre-moratorium time series (prior to 1992) and the dashed horizontal line is the post-moratorium average (post-1992). Black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years). Note: the black bars on Northwest River (Port Blandford) indicate a partial count in 2018.

South Newfoundland (SFAs 9-11)

There are 48 scheduled salmon rivers in SFAs 9-11. Five rivers were assessed in 2018: Rocky River in SFA 9, Northeast River-Placentia in SFA 10, Garnish River, Conne River and Little River in SFA 11.

In 2018, total returns of small and large salmon on Rocky River were unchanged from the previous five-year mean (which does not include the 2015 return year), however returns of large salmon declined by 78% (Figure 11). Total returns at Rocky River in 2018 were lower in comparison to the generation prior to 2016 and in comparison to the three previous generations (Table 3). Estimated egg deposition for Rocky River was below the LRP in 2018 and during all

years in the previous generation (Table 3). The fishway on Rocky River was not operational in 2015 as it was undergoing reconstruction. During the return migration, fish were intercepted below the fishway and transferred further upstream. However, returns likely do not reflect the number of fish that would have returned to the river naturally had the fishway been operational, as there were challenges in capturing and transferring fish due to environmental conditions. Although fishway construction was completed in 2016 prior to the upstream salmon migration, there were still some operational issues that may have prevented a portion of returning fish from entering the river that year. The majority of Rocky River smolts are two to three years old (Figure 3), therefore, the low returns in 2015 and 2016 could influence adult returns in subsequent years, particularly in 2019 and 2020.

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 (Figure 11, Table 3) and represent the second highest counts since the monitoring facility resumed operations in 2015. Estimated egg depositions were above the USR for the third consecutive year (Table 3).

The counting fence at Conne River washed out on July 12, 2018. For most years in the Conne River time series (since 1986) over 90% of the run is over before this date. However, 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). Total returns of salmon to Conne River in 2018 were 72% below the previous five-year mean which is the lowest year on record over the 33-year time series (Figure 12). Total returns in 2018 were also lower than the generation prior to 2016 and the previous three generations (Table 3). Conne River achieved 21% of the LRP in 2018 which is a 70% reduction compared to the previous generation. 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 (Figure 12). Little River showed a similar declining trend in 2018 with a > 90% decline in total returns relative to all previous generations (Figure 12, Table 3). Little River achieved 3% of the LRP (Table 3), which is the lowest value on record since 1987. Assessments of Atlantic Salmon on Garnish River began in 2015. In 2018, returns of small and large salmon were 30% below the 2015-17 mean (Figure 12). In 2018, estimated egg deposition remained below the LRP (32%) for the fourth consecutive year. Overall, salmon returns to Garnish River are well below historical levels based on the reported angling catches during the period 1974-1993 where reported harvest exceeded 2,000 salmon in some years (Moores et al. 1978).

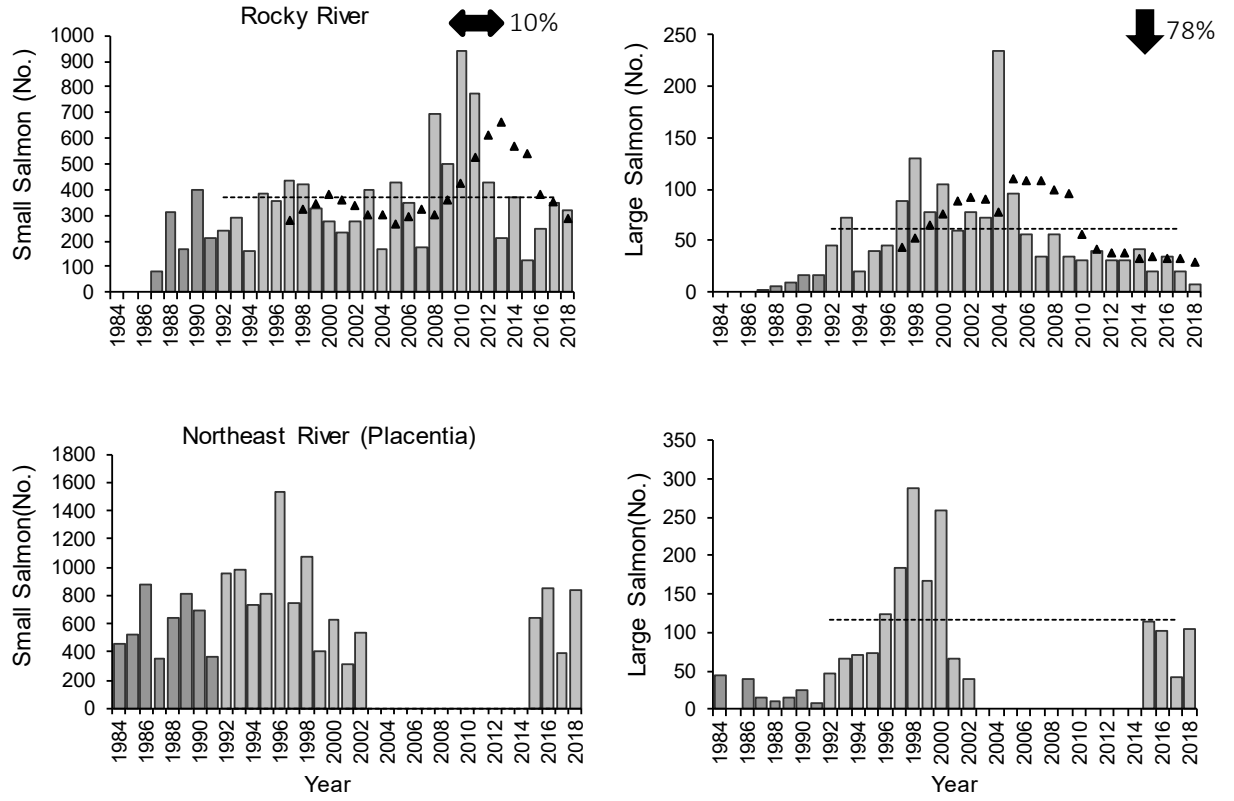

Figure 11: Total returns of small and large salmon at the two monitored rivers in SFAs 9 and 10, 1984 to 2018. The solid black line is the average of the pre-moratorium time series (prior to 1992) and the dashed horizontal line is the post-moratorium average (post-1992). The black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years).

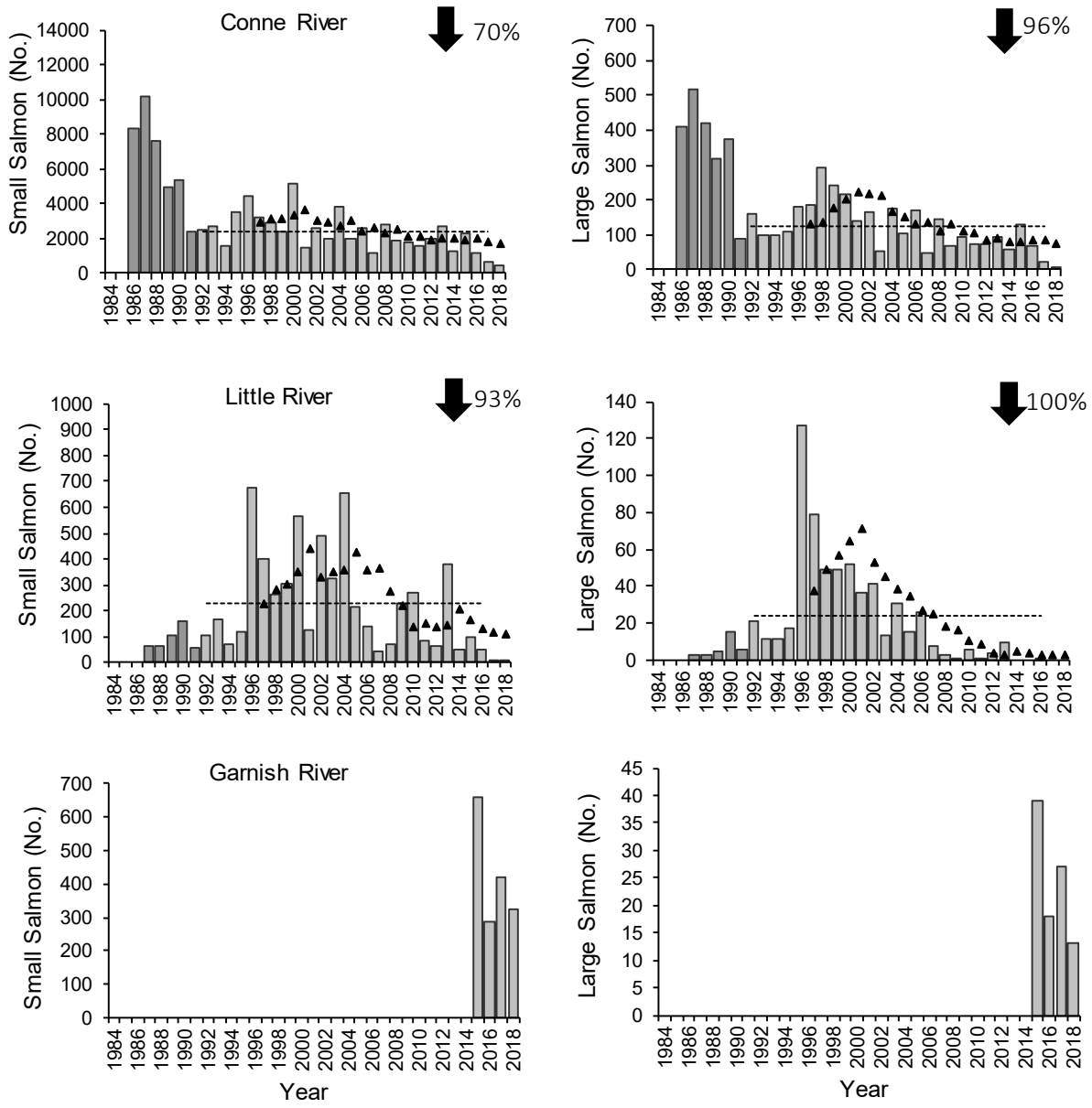

Figure 12: Total returns of small and large salmon at the three monitored rivers in SFA 11, 1984 to 2018. The solid black line is the average of the pre-moratorium time series (prior to 1992) and the dashed horizontal line is the post-moratorium average (post-1992). The black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years).

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.

Southwest Newfoundland (SFAs 12-13)

There are 10 scheduled salmon rivers in SFA 12. No rivers were assessed in 2018.

There are 18 scheduled salmon rivers in SFA 13. Four rivers were assessed in 2018: two using monitoring facilities (Harry's River and Corner Brook Stream) and two using snorkel surveys (Robinsons River and Middle Barachois Brook). On Harry's River, Atlantic Salmon were monitored at a location approximately 3 km upstream from the river mouth using a DIDSON (dual-frequency identification sonar) system. Total returns of salmon on Harry's River in 2018 were lower than the previous five-year mean and the generation prior to 2016, however there was no change on comparison to the previous three generations (Figure 13, Table 3). In 2018, estimated egg deposition for Harry's River was just above the LRP (101%) which represents an increase over 2017. The counting fence on Harry's River experienced two washout events in 2018 (June 18-20 and 29-30). However, the DIDSON system was running throughout these washout periods, thus it is highly likely that very few migrating salmon were missed. Returns of small and large salmon to Corner Brook Stream in 2018 did not change relative to the previous five-year mean or the generation before 2016 (Figure 13, Table 3) and estimated egg depositions were above the USR in 2018 (Table 3).

Atlantic Salmon in Robinsons River and Middle Barachois Brook were assessed using visual counts during snorkel surveys. 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. Estimated total returns to Robinsons River in 2018 are the lowest in the time series (Figure 14). The egg deposition in 2018 was 70% of the LRP, which is 24% below the estimated value from 2008. Estimated total returns of salmon to Middle Barachois Brook in 2018 were also the lowest on record (Figure 14). The estimated egg deposition for Middle Barachois Brook in 2018 was 39% of the LRP, which is the same as during the previous assessment in 2008.

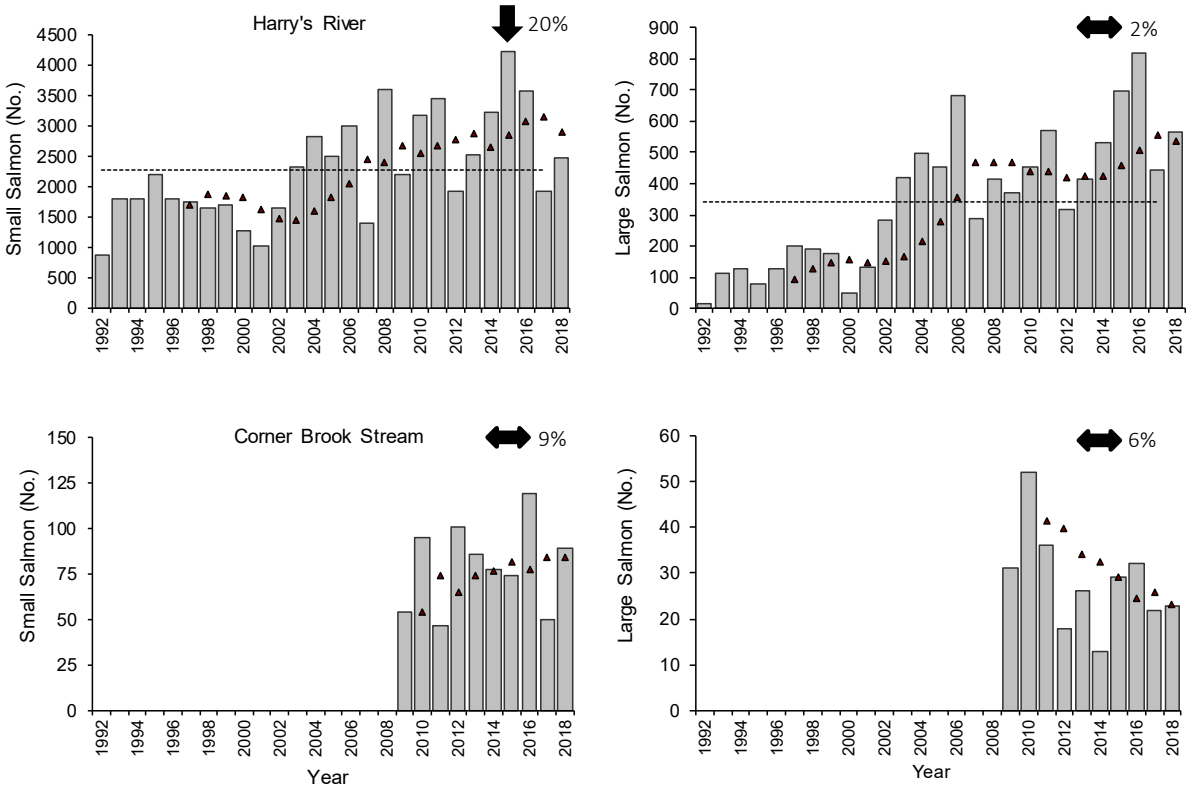

Figure 13: Total returns of small and large salmon at the three monitored rivers in SFA 13, 1992 to 2018. The dashed horizontal line is the post-moratorium average (post-1992). The black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years).

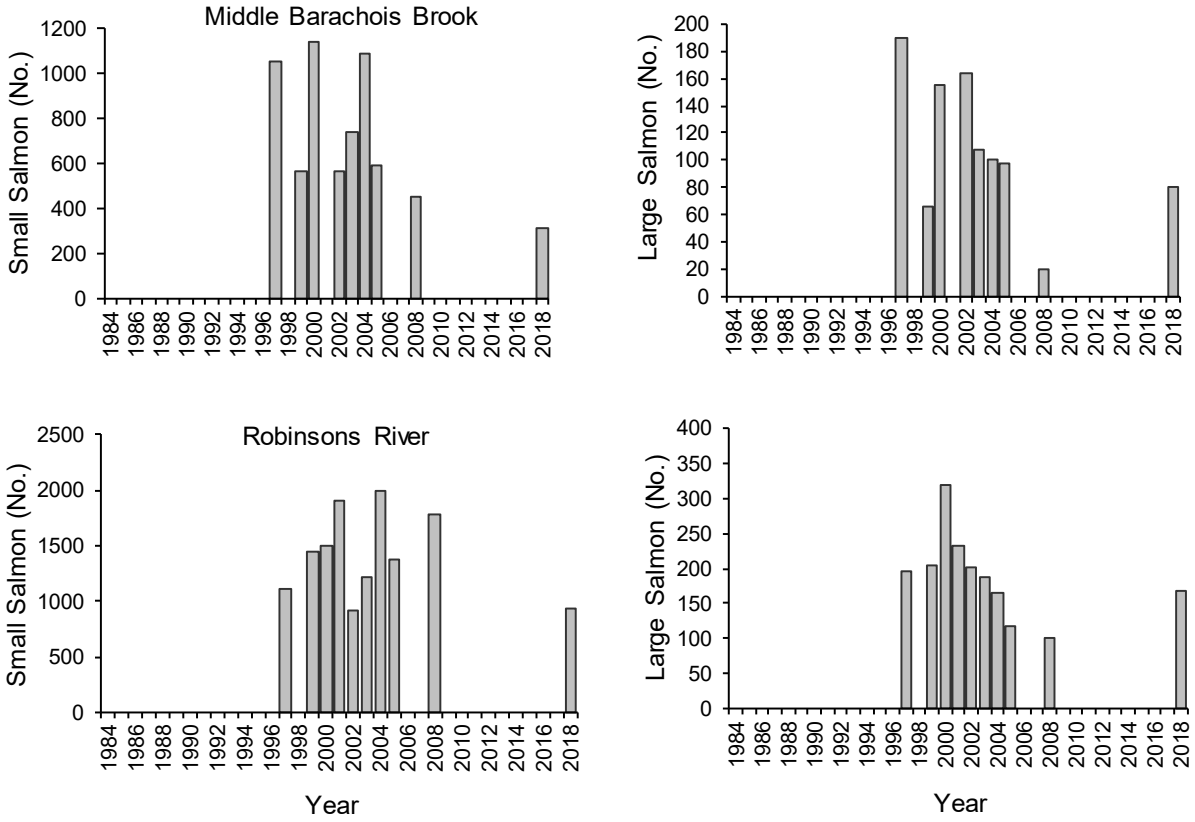

Figure 14: Estimated total returns of small and large salmon at the two rivers in SFA 14A based on snorkel surveys during intermittent years from 1987 to 2018.

Northwest Newfoundland (SFA 14A)

There are 22 scheduled salmon rivers in SFA 14A. Three rivers were assessed in 2018: Torrent River, Western Arm Brook and Deer Arm Brook. Total returns of small and large salmon in 2018 were higher than the previous five-year mean on Western Arm Brook with no change on Torrent River (Figure 15, Table 3). There was no change in total returns on Torrent River in 2018 relative to the generation before 2016 and only a slight increase on Western Arm Brook (Table 3). In 2018, there was no change in total returns on Torrent River relative to the previous three generations and a slight increase on Western Arm Brook (Figure 15, Table 3). Estimated egg depositions on Torrent River and Western Arm Brook exceeded the USR for both rivers in 2018 (712% and 499% of the LRP, respectively) and have done so annually since 1984 and 1992, respectively. In 2018, Atlantic Salmon on Deer Arm Brook in Gros Morne National Park were monitored by Parks Canada using a counting fence. A total of 228 small and 62 large salmon were enumerated on Deer Arm Brook in 2018 which exceeded the estimated conservation requirement of 179 small salmon (Figure 15). Salmon were enumerated on Deer Arm Brook up to August 15th when the fence was lost. Historically however 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.

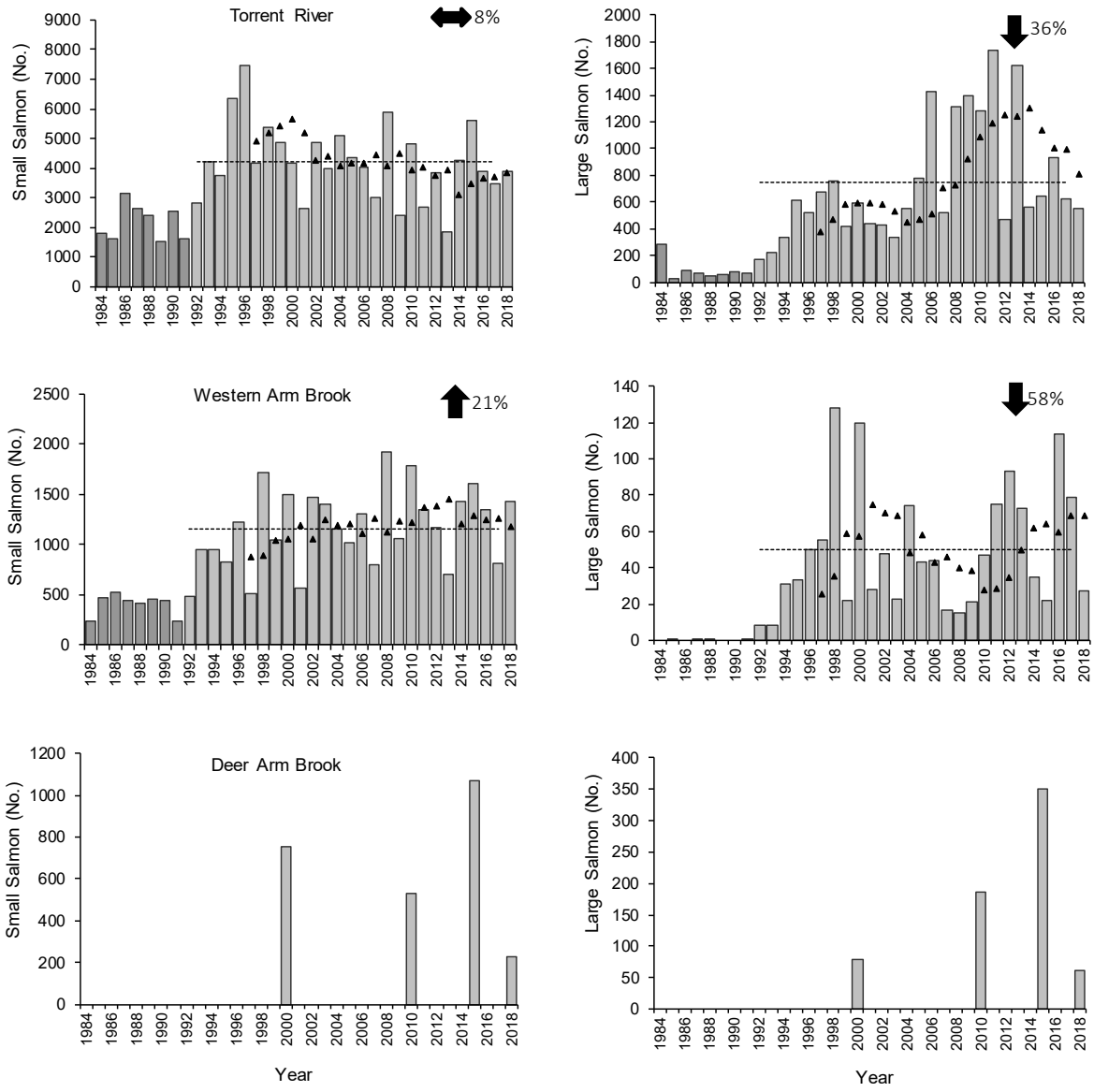

Figure 15: Total returns of small and large salmon at the three monitored rivers in SFA 14A, 1984 to 2018. The solid black line is the average of the pre-moratorium time series (prior to 1992) and the dashed horizontal line is the post-moratorium average (post-1992). The black triangles are the previous generation average (five years) for each year. Black arrows represent the percent change in returns during 2018 relative to the previous generation (five years).

Smolt Production and Marine Survival

Atlantic Salmon smolt migrations were monitored on four rivers in 2018: Campbellton River (SFA 4), Rocky River (SFA 9) , Garnish River (SFA 11) and Western Arm Brook (SFA 14A). Smolts are counted directly at monitoring facilities during downstream migration. Smolt abundance is typically estimated at Conne River each year using mark-recapture, however, this was unsuccessful in 2018 due to extreme environmental conditions (high water) resulting in a fence washout. Smolt counts obtained during downstream migration in a given year can be

combined with the adult count the following year to estimate smolt to adult survival on a given river, and provide insights into marine survival trends over time.

Smolt production

In 2018, smolt production decreased on Western Arm Brook (SFA 14A), Rocky River (SFA 9) and Campbellton River (SFA 4) in comparison with the previous five-year means (2013-17) (Figure 16). A complete smolt count, was obtained for Garnish River (SFA 11) for the second year in 2018 (10,425) and showed a 12% decline from 2017 (Figure 16). Smolt production on Rocky River appears to be low and is expected to continue as adult returns have also been in decline. Low returns on Rocky River in 2015 and 2016 can be partially explained by disruptions to upstream migration caused by replacement of the fishway and related operational challenges.

Since 1996, the first year of expected increase in smolt production resulting from the commercial salmon moratorium, there has been a general declining trend of smolt numbers on Conne River and no significant trend on Western Arm Brook. The number of smolts on Campbellton River declined following the moratorium but has increased since 2005.

Marine survival

Marine survival estimates for 2018 are based on 2017 smolt migrations and corresponding small salmon returns in 2018. Inter-annual estimates of marine survival continues to fluctuate, with survival ranging between 0.8% and 9.3% for the five monitored rivers in 2018 where marine survival estimates were available (Figure 17). In 2018, Conne River had the lowest survival rate over the time series (0.8%) and is the lowest among all assessed rivers (Figure 17). Survival has been decreasing on Campbellton River in recent years, however there was an increase in 2018 relative to 2017 which was the second lowest recorded survival estimate in the time series. In contrast, survival has been increasing on Western Arm Brook since 1992 and showed an increase in 2018 relative to 2017. This was the first year that survival was estimated at Garnish River, and was the second lowest among assessed rivers (2.8%). Marine survival in 2018 was lower at southern locations (Conne River, Garnish River and Rocky River) by comparison with northern populations (Western Arm Brook and Campbellton River). As returns of small salmon include a portion of repeat spawners, marine survival of smolt to maiden one-sea-winter salmon will be slightly less than numbers reported here.

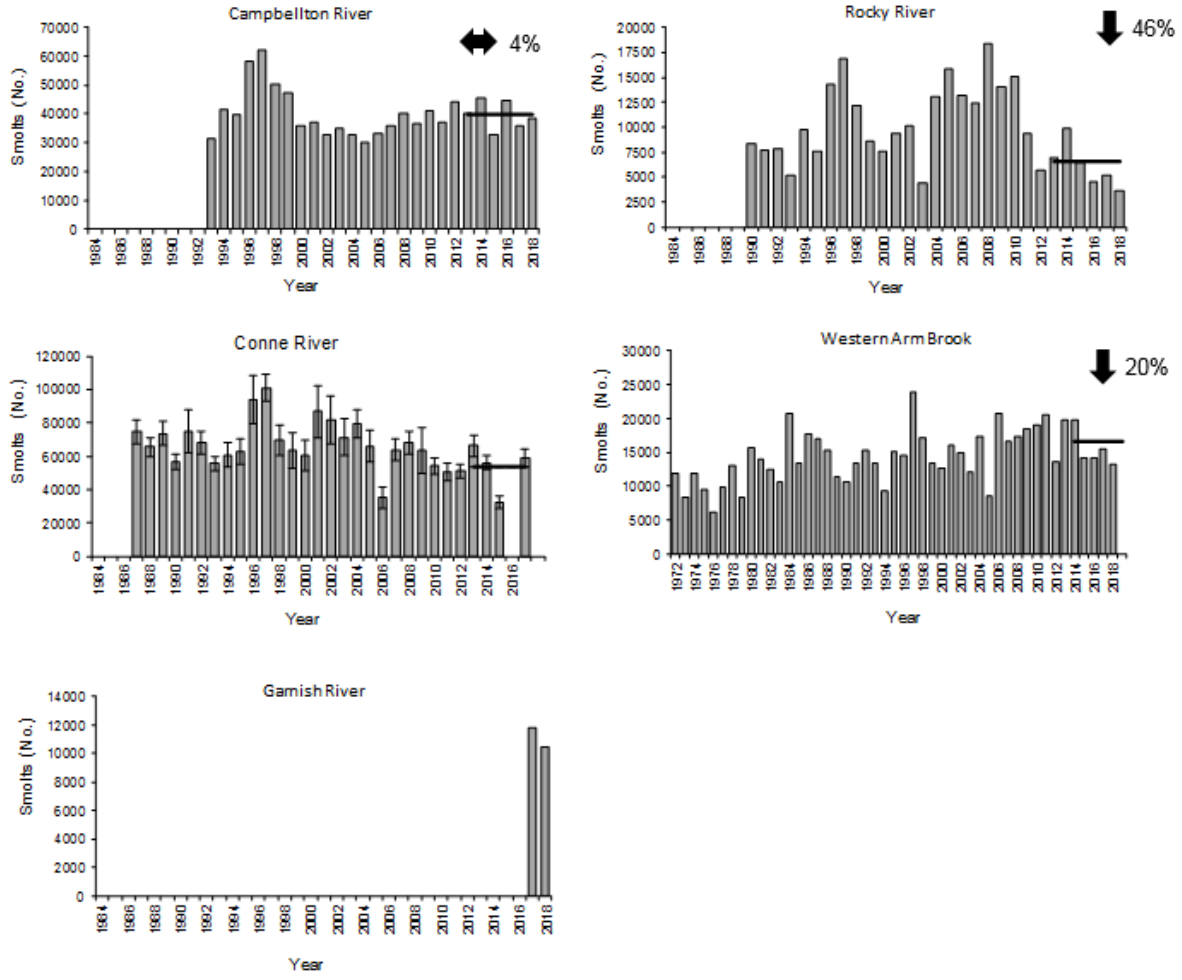

Figure 16: Smolt production on monitored Newfoundland Atlantic Salmon rivers. Horizontal solid line illustrates the previous five-year mean (2013-17). For Conne River, the error bars represent 95% confidence intervals for the annual smolt production estimates obtained from a mark-recapture program. Note: There is no smolt production estimate for Conne River in 2018.

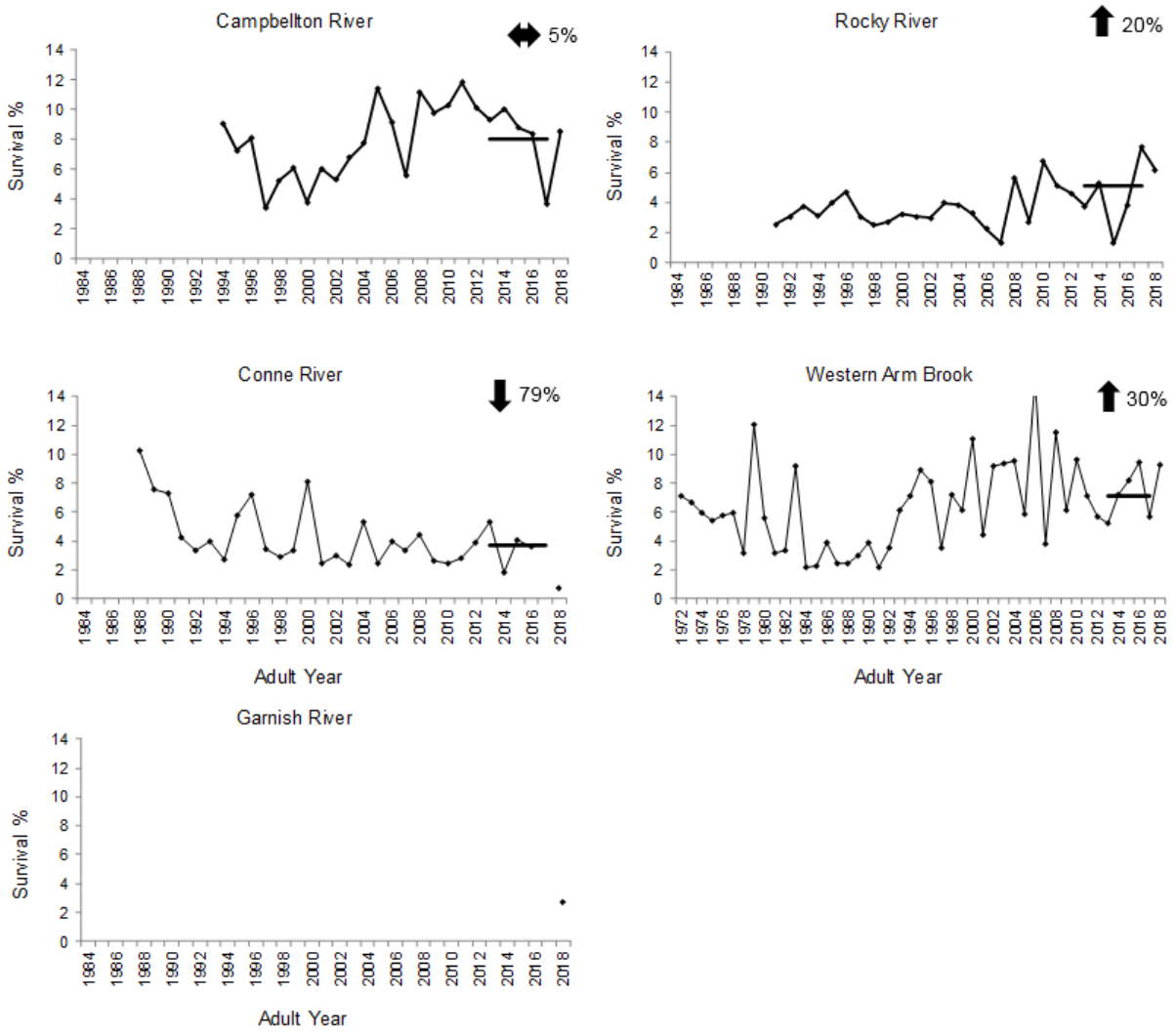

Figure 17: Marine survival rates of smolt to adult small salmon for monitored Newfoundland rivers. Survival rates have not been adjusted for marine exploitation during the commercial salmon fishery (prior to 1992) thus values represent survival of salmon back to the river. Horizontal solid line illustrates the previous five-year mean (2013-17).

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. Primary and secondary production indices on the NL Shelf continued below the long-term average in 2018. The combined biomass of small and large zooplankton declined by 75% in 2017 compared to the reference period mean. This is consistent with the observed reduction in zooplankton biomass since 2015 across the Northwest Atlantic Ocean. This trend is driven by a shift in community structure with declines in the abundance of large energy-rich copepod *Calanus finmarchicus* and an increase in small

copepod taxa. 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 declines in salmon returns since 2016.

Sources of Uncertainty

No current assessments are available on salmon populations in SFAs 3, 6, 7, 8, 12 and 14B and the Lake Melville area of SFA 1.

Salmon populations in assessed rivers may not be representative of all rivers in the SFA.

Historical or estimated biological characteristic data (e.g. fecundity, sex ratio, female size) are generally used in the assessment process. Given that these values can vary annually and are not collected on an annual basis, there is uncertainty in the estimation of egg depositions.

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.

CONCLUSIONS AND ADVICE

Twenty-one river populations of Atlantic Salmon were assessed in 2018. Five of these populations recorded declines in total returns, three of which declined by greater than 30% in comparison to previous generation averages and four of these rivers had record low returns. However, six monitored rivers in Newfoundland and all four monitored rivers in Labrador recorded similar (<10% difference) or higher total returns compared to previous generation averages. For monitored rivers with previous generation averages available, the abundance of large salmon in 2018 declined on all four monitored rivers in Labrador and nine out of twelve monitored rivers in Newfoundland. Following two consecutive years (2016 and 2017) of declines, returns of small salmon have improved slightly on monitored rivers in Labrador and on the west coast, northeast coast and northern peninsula of Newfoundland. However, the monitored rivers on the south coast continue to show significant declines, particularly in SFA 11 where Conne River and Little River had record low returns in 2018 (>30 year time series for each river).

In 2018, spawning escapements (eggs) were below the river-specific LRP on two of the four assessed rivers in Labrador. Estimated spawning escapement exceeded the river-specific USR on English River (healthy zone) and fell between the LRP and USR (cautious zone) on Muddy Bay Brook. In Newfoundland, estimated spawning escapements (eggs) were below the LRP (critical zone) for eight of the seventeen assessed rivers. Of the remaining Newfoundland rivers assessed in 2018, seven out of seventeen rivers exceeded the USR (healthy zone) and two fell between the LRP and USR (cautious zone).

The South Newfoundland (SFAs 9-12) Atlantic Salmon populations remain a concern, Conne and Little rivers in particular. Total returns to Little River was eight fish, the lowest on record in the 32-year time series. Total returns of salmon to Conne River in 2018 were slightly below 500 fish (21% of the LRP) and the lowest recorded in the 33 year time series. 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. Marine survival estimates for monitored rivers in this region continue to be relatively low, at 2.3% and 0.8% in 2018 for Garnish River and Conne River, respectively. This estimate for Conne River is

a record low in the time series. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010) designated south Newfoundland (Designatable Unit, DU 4) salmon populations as threatened. There is genetic evidence that farmed salmon escapees are breeding with wild Atlantic Salmon in southern Newfoundland rivers. The consequences of continued farmed salmon escapes and subsequent interbreeding with wild Atlantic Salmon could be a loss of genetic diversity although the long term consequences on wild salmon populations are uncertain.

Broad-scale ocean climate conditions associated with primary and secondary production in the Northwest Atlantic region show a general decline in productivity indices. The large reduction in zooplankton biomass observed since 2015 suggests lower potential energy transfer to higher trophic levels, including Atlantic Salmon which may subsequently affect marine survival. In general, low marine survival continues to be an area of concern and is likely the limiting factor affecting abundance of NL salmon.

Management Advice

Caution is warranted in the management of salmon stocks in 2019. Total returns in 2018 rebounded slightly in several regions of the province after significant declines were observed in 2016 and 2017. However, significant declines in large salmon abundance were recorded on most monitored rivers in Newfoundland and Labrador in 2018.

There should be no human induced mortality on populations that are below the LRP (100% CL) except possibly for areas which have in-season reviews or special management plans.

Efforts should be made to increase returns to south coast rivers (DU 4), and options to mitigate known effects of finfish aquaculture escapees on wild salmon stocks should be explored

OTHER CONSIDERATIONS

Indicators and procedure to trigger full assessment during interim years

In 2014, DFO began implementing a five-year management plan for Atlantic Salmon in the NL region. Although management measures outlined in the plan were expected to remain the same over this five-year period, changes would be warranted if there was a dramatic change in salmon stocks, particularly declines. To this end, DFO Science was asked by Resource Management to identify ‘triggers/indicators’ that would warrant revisiting the salmon management plan earlier than the planned five years. Thus, these triggers mainly reflect significant conservation concerns related to the health and abundance of salmon stocks within the NL Region.

There are two scenarios where DFO Science would recommend revisiting the two-management plan earlier:

1. >30% **decline** in total returns on ≥50% of monitored rivers in any given year; or
2. >25% **decline** in total returns on ≥50% of monitored rivers in two consecutive years.

All comparisons will be made using both the previous five-year mean (short-term trends) as well as the previous ten-year mean (long-term trends).

In 2016, declines of Atlantic Salmon returns were significant enough to trigger re-visiting the five-year salmon management plan. Following this recommendation, a decision was made by DFO to move to a two-year salmon management plan in the NL Region, which included a full salmon assessment for 2018 returns in March, 2019.

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Frédéric Cyr	DFO Science
Geoff Veinott	DFO Science Retired
George Russell	NunatuKavut Community Council
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Kristin Loughlin	DFO Science
Nick Kelly	DFO Science
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SOURCES OF INFORMATION

This Science Advisory Report is from the March 5 to March 7, 2019 Regional Peer Review Process on the Assessment of Atlantic Salmon in Newfoundland and Labrador. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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APPENDIX I – DETAILS ON CATCHES AND HARVESTS AND STATUS OF ATLANTIC SALMON IN NEWFOUNDLAND AND LABADOR

Table 1: Recreational fishery catch (retained plus released), harvest (retained), and effort estimates for Newfoundland and Labrador (SFAs 1-14B), 1994-2017. Estimates for 2017 are preliminary.

Year	Effort (rod days)	Small Salmon Retained	Small Salmon Released	Large Salmon Retained	Large Salmon Released	Total Retained	Total Released
1994	141,384	31,774	24,442	455	5,032	32,229	29,474
1995	136,028	33,005	26,273	408	5,166	33,413	31,439
1996	162,952	38,005	34,342	334	6,209	38,339	40,551
1997	131,559	25,184	25,316	158	4,720	25,342	30,036
1998	131,329	24,799	31,368	231	4,375	25,030	35,743
1999	131,432	24,946	24,567	320	4,153	25,266	28,720
2000	138,284	24,369	29,705	262	6,479	24,631	36,184
2001	110,754	23,026	22,348	338	5,184	23,364	27,532
2002	103,894	22,984	23,071	207	3,992	23,191	27,063
2003	102,915	23,338	21,379	222	4,965	23,560	26,344
2004	99,453	21,754	23,430	259	5,168	22,013	28,598
2005	125,613	23,876	33,129	291	6,598	24,167	39,727
2006	113,643	21,050	30,491	227	5,694	21,277	36,185
2007	95,585	16,339	17,719	235	4,607	16,574	22,326
2008	152,699	29,433	32,787	200	7,034	29,633	39,821
2009	144,931	24,458	26,681	216	4,272	24,674	30,953
2010	128,265	30,495	39,046	197	6,383	30,692	45,429
2011	116,951	28,744	26,240	*	8,119	28,744	34,359
2012	113,653	23,269	20,940	*	4,089	23,269	25,029
2013	134,348	24,393	19,962	*	6,770	24,393	26,732
2014	118,222	24,120	19,613	*	5,388	24,120	25,001
2015	141,380	31,173	25,382	*	7,079	31,173	32,461
2016	147,359	30,007	26,005	*	10,057	30,007	36,062
2017	41,108	18,709	22,544	*	8,137	18,709	30,681
2018p	28,712	13,626	19,768	*	5,287	13,626	25,055
Previous five-year mean (2013-17)	116,483	25,680	22,701	*	7,486	25,680	30,187
2017 % Change from previous five-year mean	-75%	-47%	-13%	*	-29%	-47%	-17%

* Retention of large salmon has not been permitted since 2011.

Table 2: Estimated harvests of Atlantic Salmon in Indigenous and Subsistence Fisheries in Labrador (SFAs 1 and 2), 1999-2018. Estimates for 2018 are preliminary.

Year	Small salmon: Number	Small salmon: Weight (kg)	Large salmon: Number	Large salmon: 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	8,793	16,768	4,137	16,709	12,930	33,477
Previous six-year mean (2012-17)	8,255	16,049	5,421	22,345	13,676	38,394
2018 % Change from previous six-year mean	+7	+4	-24	-25	-5	-13

Table 3: Summary of Atlantic Salmon stock status in Newfoundland and Labrador (SFAs 1-14B). The Limit Reference Point (LRP) and Upper Stock Reference point (USR) correspond to 100% and 150% of the previously defined conservation egg requirement, respectively. A generation corresponds to five years in Newfoundland and six years in Labrador.

River (SFA)	Total Returns (2018)	Percent Change in Returns from Previous Generation Average (16 rivers)	Percent Change in Returns from Pre-2016 Generation Average (16 rivers)	Percent Change in Returns from Previous 3 Generations Average (15 rivers)	Proportion of LRP Attained (2018)	% Change Conservation Egg Requirement from Previous Generation Average	No. Years LRP met or exceeded (2018, previous generation)
English River (SFA 1)	947	+19%	+39	+88%	237%	+2%	7 of 7
Southwest Brook (SFA 2)	260	+35%	-2	-19%	77%	+20%	1 of 7
Muddy Bay Brook (SFA 2)	319	+2%	-13	-8%	132%	+10%	4 of 6
Sand Hill River (SFA 2)	4,386	+48%	+3	+1%	95%	+31%	0 of 7
*Exploits River (SFA 4)	18,690	-31%	-44	-41%	31%	-29%	0 of 6
Campbellton River (SFA 4)	4,313	+17%	-8	+16	408%	+29%	6 of 6
Salmon Bk., Gander River (SFA 4)	1,036	-13%	-39	-14%	113%	-16%	4 of 5
Middle Brook (SFA 5)	3,638	+16%	+10	+52%	378%	+15%	6 of 6
*Terra Nova River (SFA 5)	4,884	+8%	+6	+28%	72%	+5%	0 of 6
†Northwest River (SFA 5)	785	-	-	-	-	-	-
*Rocky River (SFA 9)	329	+1%	-21	-33%	32%	-3%	0 of 6
Northeast River-Placentia (SFA 10)	876	-	-	-	467%	-	4 of 4
*Little River (SFA 11)	8	-93%	-94	-96%	3%	-94%	1 of 6
*Conne River (SFA 11)	482	-72%	-76	-77%	21%	-70%	2 of 6
Garnish River (SFA 11)	339	-	-	-	32%	-	0 of 4

River (SFA)	Total Returns (2018)	Percent Change in Returns from Previous Generation Average (16 rivers)	Percent Change in Returns from Pre-2016 Generation Average (16 rivers)	Percent Change in Returns from Previous 3 Generations Average (15 rivers)	Proportion of LRP Attained (2018)	% Change Conservation Egg Requirement from Previous Generation Average	No. Years LRP met or exceeded (2018, previous generation)
Harry's River (SFA 13)	3,054	-17%	-15	-7%	101%	-10%	4 of 6
Corner Brook Stream (SFA 13)	112	+6%	-10	-	201%	+3%	6 of 6
††Robinsons River (SFA 13)	1,101	-	-	-	70%	-	0 of 1
††Middle Barachois Brook (SFA 13)	393	-	-	-	39%	-	0 of 1
Torrent River (SFA 14A)	4,657	-1%	0	-5%	712%	-1%	6 of 6
Western Arm Brook (SFA 14A)	1,450	+17%	+10	+11%	499%	+37%	6 of 6
†††Deer Arm Brook (SFA 14A)	290	-	-	-	>150%	-	2 of 2

*these rivers have undergone various enhancement activities in the past.

†incomplete count in 2018

††assessed using snorkel surveys

††† counts to 15-Aug when the fence was lost

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