UPDATE OF INDICATORS TO 2019 OF ADULT ATLANTIC SALMON FOR THE MIRAMICHI RIVER (NB), SALMON FISHING AREA 16, DFO GULF REGION

Context

The last full assessment of stock status for Atlantic Salmon (*Salmo salar*) in Fisheries and Oceans Canada (DFO) Gulf Region was completed after the 2013 return year (DFO 2014) and updates on stock status for each of the four Salmon Fishing Areas (SFA 15-18) have been prepared annually since then (DFO 2015a, 2015b, 2016, 2017, 2018a, 2019). DFO Resource Management requested an update of the status of the adult Atlantic Salmon stock in the Miramichi River for 2019. Indicators for adult Atlantic Salmon for the Miramichi River are provided in this report. This Science Response Report results from the Science Response peer review meeting held in Moncton (N.B.) on January 9, 2020. No other publications will be produced from this science response process.

Background

All rivers flowing into the southern Gulf of St. Lawrence are included in DFO Gulf Region. Atlantic Salmon management areas in DFO Gulf Region are defined by four salmon fishing areas (SFA 15 to 18) encompassing portions of New Brunswick, Nova Scotia, and all of Prince Edward Island (Figure 1). The Miramichi River is the largest river in SFA 16 and DFO Gulf Region.

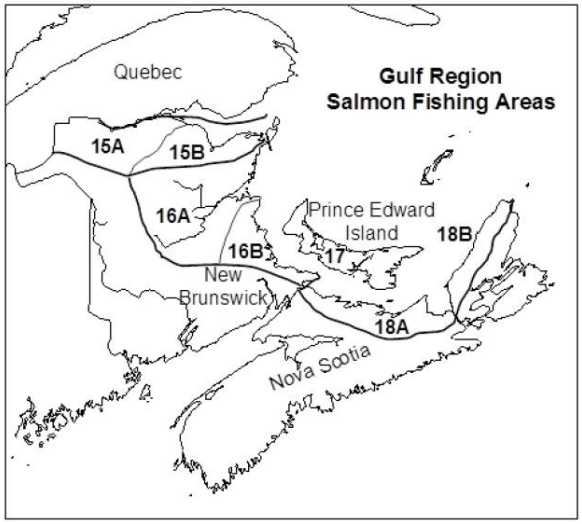

Figure 1. Salmon Fishing Areas in the DFO Gulf Region.

For management and assessment purposes, adult Atlantic Salmon are categorized as small salmon (grilse; fish with a fork length less than 63 cm) and large salmon (fish with a fork length equal to or greater than 63 cm).

Mandatory catch and release measures in the recreational fishery have been in effect for both small salmon and large salmon in all Salmon Fishing Areas of DFO Gulf Region since 2015.

This was a change from 2014 when retention of small salmon had been allowed in SFA 15, SFA 16A, and SFA 18. Since 1998, rivers in southeast New Brunswick (SFA 16B) have been closed to all directed salmon fishing.

High water temperatures during the summer of 2019 prompted angling restrictions in the Miramichi system to mornings only (6 am to 11 am) for six days between 1 August and 7 August and the closure of cold water holding pools on two occasions; the first for five days between 19 July and 23 July, and the second for ten days between 30 July and 8 August (Gulf Variation Order (GVO) 2019-063, GVO 2019-064, GVO 2019-068, GVO 2019-072, GVO 2019-073, GVO 2019-076). Management interventions in 2018 were more severe, with morning only fishing for 18 days and the closure of cold water holding pools for 47 days (DFO 2019).

Analysis and Response

Abundance indices of adult salmon

Catches and counts of adult Atlantic Salmon, by size group, are available from trapnets operated in the estuary and from headwater barrier fences (Figure 2). The annual catches at these monitoring locations are not adjusted for periods when the counting facilities were not operating due to maintenance, high water conditions, or suspension of activities due to high water temperatures.

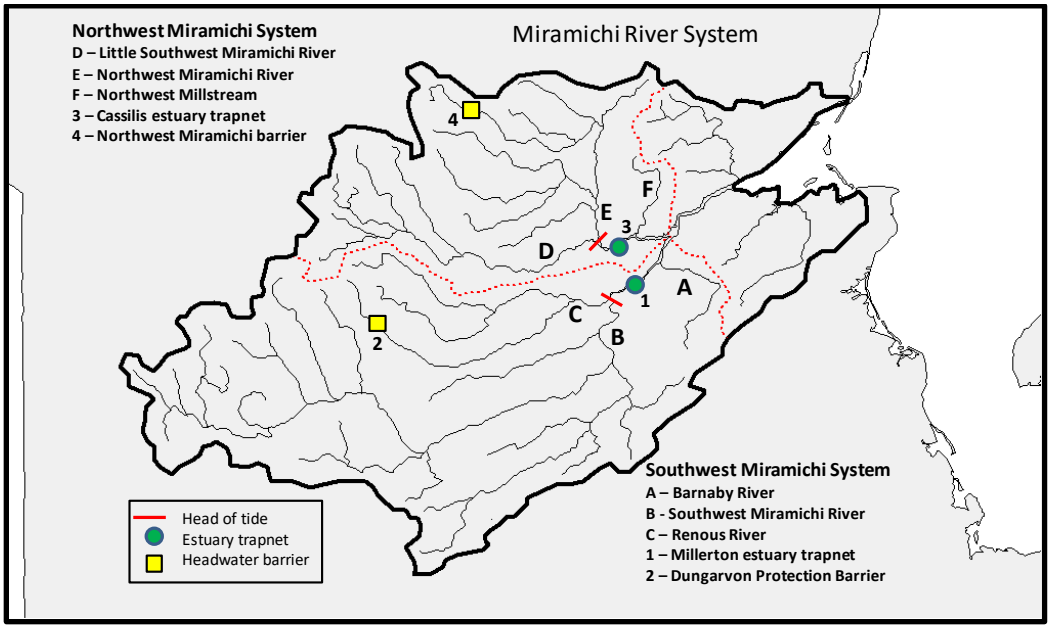

Figure 2. Rivers that make up the Miramichi River system and geographic locations of monitoring facilities in the Miramichi River, SFA 16. The dashed lines delineate the watershed boundaries of the Northwest Miramichi system and the Southwest Miramichi system.

Catches of small and large salmon have been available from DFO index trapnets located in the Southwest Miramichi at Millerton since 1994 and in the Northwest Miramichi at Cassilis since 1998 (Figure 2). In 2019, the trapnet at Millerton operated between 3 June and 25 October while the trapnet at Cassilis operated between 27 May and 24 October. Both trapnets were lifted on 6 September and reset on 10 September (Cassilis) and 11 September (Millerton) once the high water from post-tropical storm Dorian receded.

The catches of large salmon at the Millerton (n = 165) and Cassilis (n = 85) trapnets in 2019 were the lowest for this size group at each facility since monitoring began in the 1990s (Figure 3). Small salmon

catches in 2019 were lower at both the Millerton (n = 501) and Cassilis (n = 313) trapnets compared to 2018 and lower than the long term average for this size group at both facilities (Figure 3).

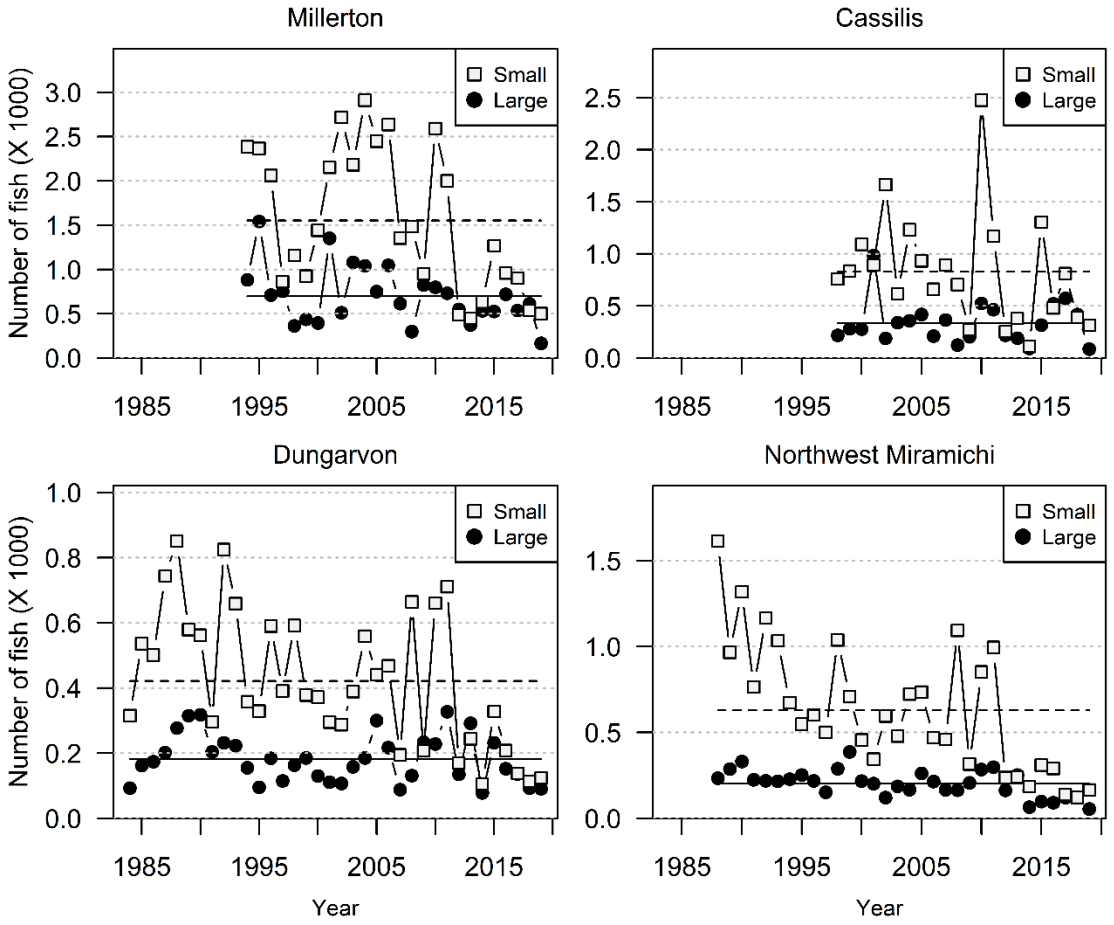

Figure 3. Catches of small salmon and large salmon at DFO index trapnets (top row) at Millerton on the Southwest Miramichi River (top left panel) and at Cassilis on the Northwest Miramichi River (top right panel) and at provincial headwater barriers (bottom row) in the Dungarvon River, tributary of the Southwest Miramichi River (bottom left panel) and the Northwest Miramichi River (bottom right panel) between 1984 and 2019.The horizontal solid and dashed lines represent the average catch or count of large and small salmon, respectively, for the time series of the facility depicted.

Annual counts of small and large salmon have been available from two headwater protection barriers operated by the NB Department of Natural Resources and Energy Development: one on the Dungarvon River, tributary of the Renous and Southwest Miramichi rivers since 1984, and the other, on the Northwest Miramichi River since 1988 (Figure 2). In 2019, the barrier on the Dungarvon River operated continuously between 5 June and 17 October while the Northwest Miramichi Barrier operated continuously between 12 June and 17 October. The count of large salmon at both the Dungarvon (n = 91) and the Northwest Miramichi (n = 55) barriers decreased from levels observed in 2018 and were below the long term average counts for large salmon at these facilities. The count of 55 large salmon at the Northwest Miramichi Barrier in 2019 was the lowest of the time series (1988 to 2019) (Figure 3). Small salmon counts at both the Dungarvon (n = 124) and Northwest Miramichi (n = 165) barriers were improved over levels observed in 2018 but below the long term average of small salmon counts at each facility (Figure 3).

Estimates of returns

Returns of small salmon and large salmon to the Miramichi River and to each of the Northwest Miramichi and Southwest Miramichi branches are estimated using mark and recapture experiments based on catches at various monitoring facilities throughout the watershed (Douglas et al. 2015). Under the hierarchical structure of the mark and recapture model, minor changes to annual estimates may occur as additional years of data are added. The largest difference in the 2019 model run results relative to those from 2018 was an increase of 4.5% in the return estimate of large salmon to the Southwest Miramichi River in 2015; all other differences, negative and positive, were smaller.

The estimated proportions of the small salmon and large salmon returns that were intercepted at the estuary trapnets in 2019 decreased relative to 2018 but remained within the range of values for the period 1998 to 2018 (Figure 4).

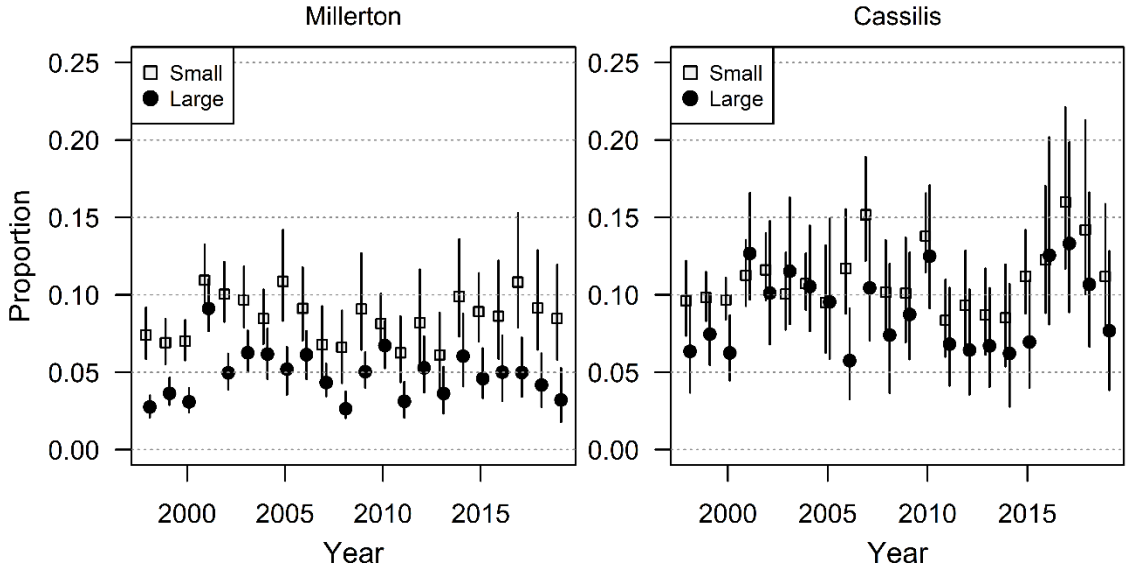

Figure 4. Estimated (median; 5th and 95th percentile error bars) proportions of the annual returns of small salmon and large salmon intercepted at the DFO index trapnets in the Southwest Miramichi at Millerton (left panel) and in the Northwest Miramichi at Cassilis (right panel) from 1998 to 2019.

The estimated return of large salmon to the Miramichi River in 2019 was 6,500 fish (median; 5th to 95th percentile range 4,300 to 10,600) and represented the lowest large salmon return estimate of the time series (1971 to 2019) (Figure 5). Small salmon returns to the Miramichi River in 2019 were estimated at 8,800 fish (median; percentile range 6,800 to 11,700), the same level as estimated in 2018, and well below the average of small salmon return estimates for the time series (1971 to 2018) (Figure 5).

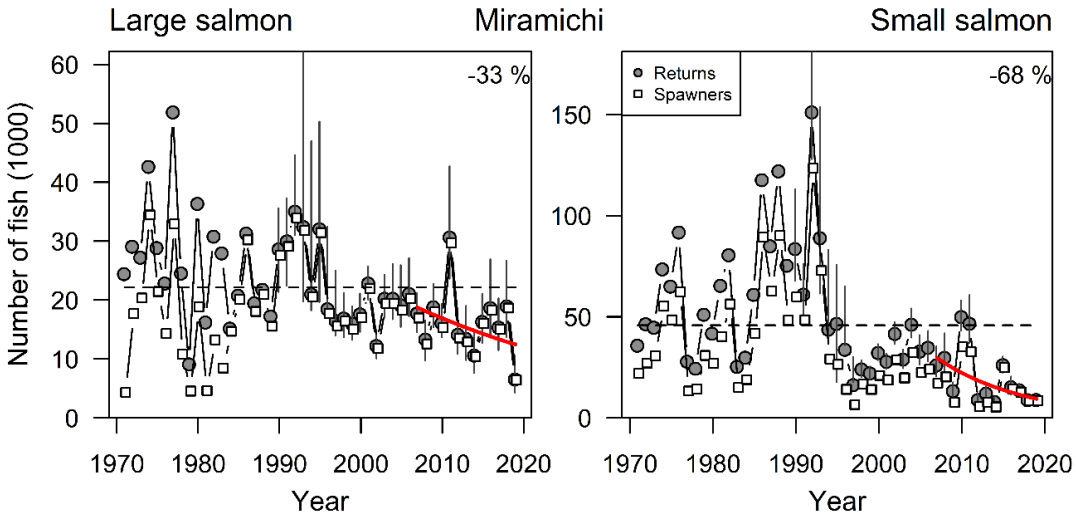

Figure 5. Estimated (median and 5th to 95th percentile range) returns and spawners of large salmon (left column) and small salmon (right column) for the Miramichi River for 1971 to 2019. The horizontal dashed line is the average of the median return estimates of large salmon or small salmon for the available time series. The trend line (exponential regression, red line) for returns over the previous twelve year time period (2007 to 2019) and the corresponding percent change is shown in the upper right corner of each panel.

The return of large salmon to the Southwest Miramichi River in 2019 was estimated at 5,200 fish (median; percentile range 3,200 to 9,300) and represented the lowest large salmon return estimate of the time series (1992 to 2019) (Figure 6). Small salmon returns to the Southwest Miramichi in 2019 were estimated at 5,900 fish (median; percentile range 4,200 to 8,600), the same abundance as estimated in 2018, and well below the average small salmon return estimate for the time series (1992 to 2018) (Figure 6).

The return of large salmon to the Northwest Miramichi River in 2019 was estimated at 1,100 fish (median; percentile range 675 to 2,300) and represented the lowest large salmon return estimate of the time series (1992 to 2019) (Figure 6). Small salmon returns to the Northwest Miramichi in 2019 were estimated at 2,800 fish (median; percentile range 2,000 to 4,100), the same abundance as estimated in 2018, and well below the average small salmon return estimate for the time series (1992 to 2018) (Figure 6).

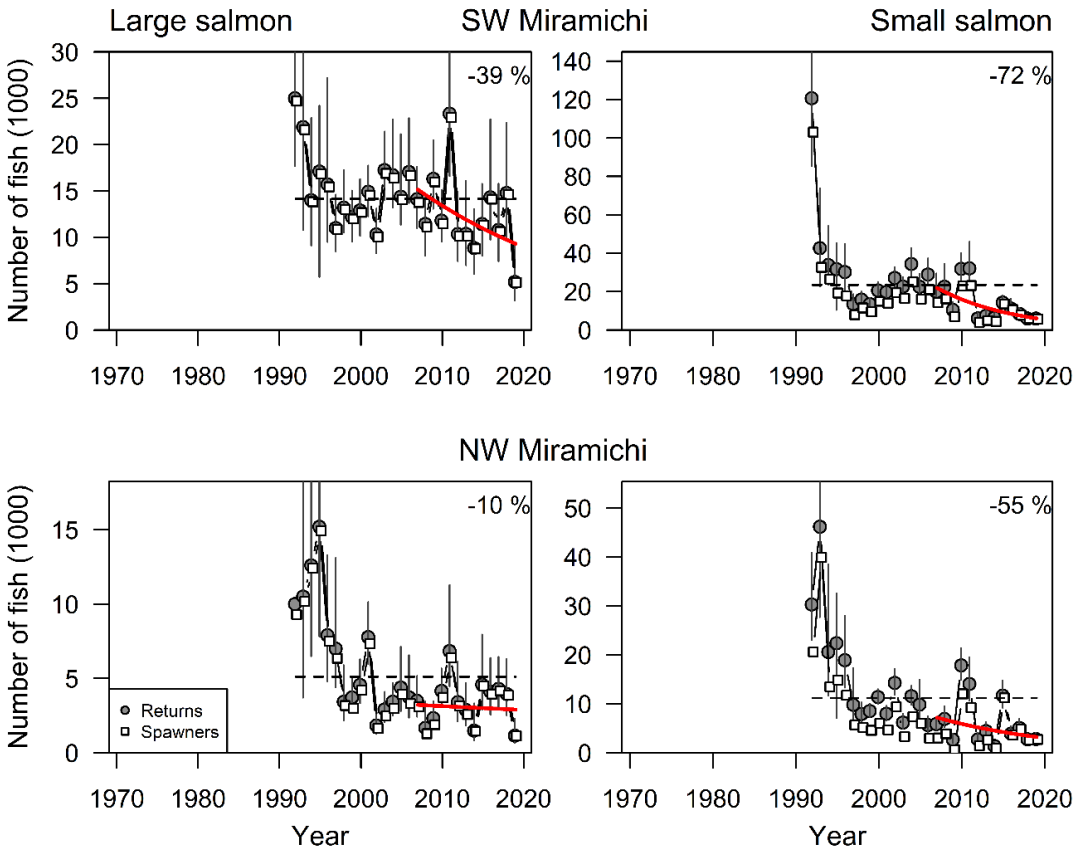

Figure 6. Estimated (median and 5th to 95th percentile range) returns and spawners of large salmon (left column) and small salmon (right column) for the Southwest Miramichi River 1992 to 2019 (top row), and the Northwest Miramichi River 1992 to 2019 (bottom row). The horizontal dashed line is the average of the median return estimates of large salmon or small salmon for the available time series. The trend line (exponential regression, red line) for returns over the previous twelve year time period (2007 to 2019) and the corresponding percent change is shown in the upper right corner of each panel.

Over the recent 12 year period, approximately two generations for Atlantic Salmon, the estimated returns of large salmon have declined in the Miramichi River overall (-33%), the Southwest Miramichi River (-39%), and the Northwest Miramichi River (-10%) (Figures 5 and 6). Similarly, the estimated returns of small salmon over the last 12 years have declined in the Miramichi River overall (-68%) and in each of the main branches (-72% in the SW, -55% in the NW) (Figures 5 and 6).

Estimates of egg depositions relative to Limit Reference Points

The Southwest Miramichi system, that includes the Barnaby River, Southwest Miramichi River, and the Renous River (Figure 2), has a Limit Reference Point (LRP) egg deposition rate value of 152 eggs per 100 m^2 (DFO 2018b). The Northwest Miramichi system, that includes the Northwest Millstream, Little Southwest Miramichi River and the Northwest Miramichi River, has an LRP egg deposition rate value of 176 eggs per 100 m^2 (DFO 2018b). The LRP for the Miramichi River (Southwest Miramichi system and Northwest Miramichi system) is calculated as the habitat weighted average of the Southwest Miramichi system and Northwest Miramichi system LRP values, and is equivalent to 160 eggs per 100 m^2.

Biological characteristics of adult Atlantic Salmon, including proportion female, mean fork length, and eggs per fish for large salmon and small salmon to 2019 are summarized in Figure 7.

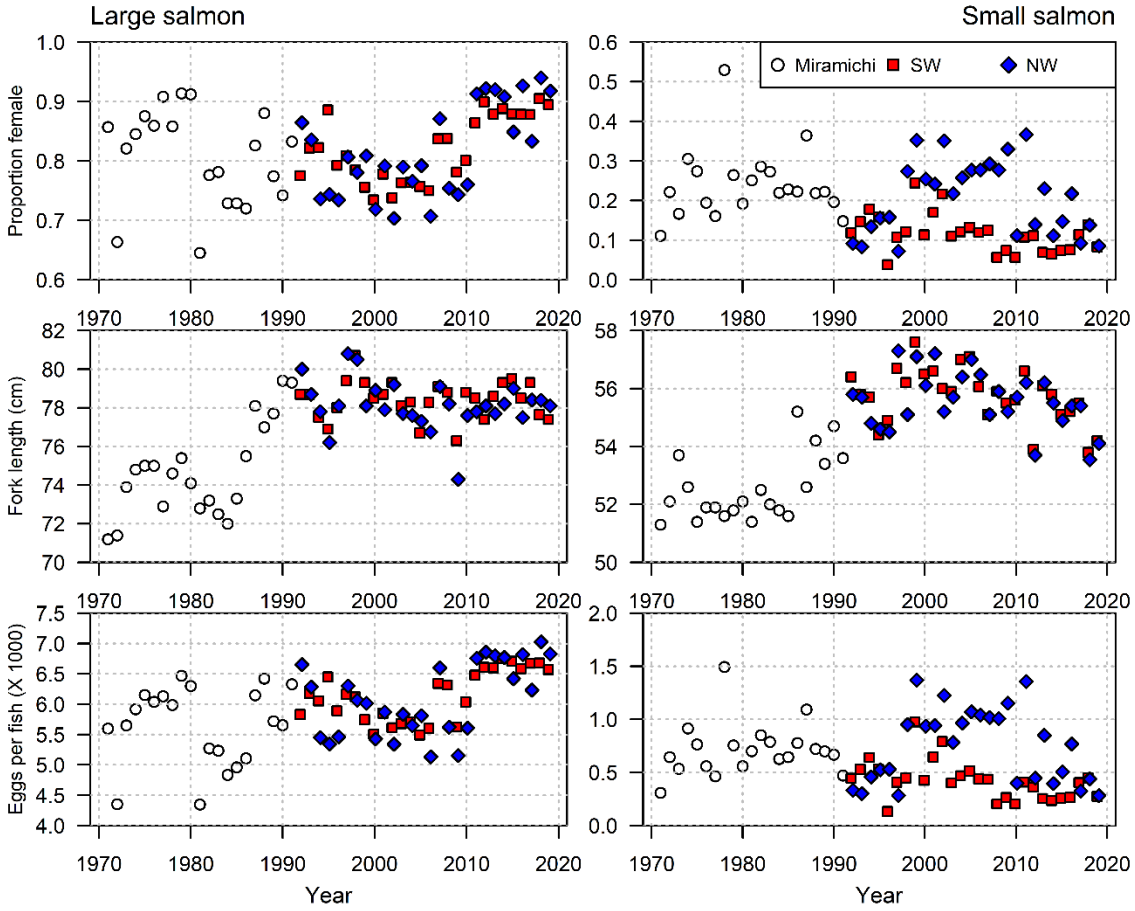

Figure 7. Biological characteristics of Atlantic Salmon by size group (large salmon left panels; small salmon right panels) including proportion female (upper panels), mean fork length (cm, middle panels), and eggs per fish (lower panels) from the Miramichi River overall (1971 to 1991) and the Southwest (SW) and Northwest (NW) Miramichi rivers, 1992 to 2019.

Considering these biological characteristics, the median egg deposition rate for returning small and large salmon combined was 84 eggs per 100 m^2 for the Miramichi River overall, 97 eggs per 100 m^2 for the Southwest Miramichi River, and 51 eggs per 100 m^2 for the Northwest Miramichi River (Table 1; Figures 8 and 9). These egg deposition rates translated into percentages of LRP attainment that ranged in 2019 from 29% (median value) in the Northwest Miramichi River to 64% (median value) in the Southwest Miramichi River (Table 1).

Table 1. Summary of estimated eggs per 100 m² in the combined returns of small salmon and large salmon by river / tributary in 2019, relative to the Limit Reference Point (LRP), and the probability of the eggs in the returns being less than the LRP.

River / tributary	Eggs in returns (eggs per 100 m²) median (5th to 95th perc. range)	Limit Reference Point (LRP); (eggs per 100 m²)	Percentage of LRP attained; median (5th to 95th perc. range)	Prob. (%) of egg deposition rate being less than the LRP
Miramichi River	84 (56 to 128)	160	53% (35% to 81%)	> 99%
Southwest Miramichi	97 (59 to 162)	152	64% (39% to 106%)	93%
Northwest Miramichi	51 (29 to 90)	176	29% (17% to 51%)	> 99%

Over the previous 12 year period, the estimated number of eggs in the returns of small and large salmon combined have declined in the Miramichi River overall (-32%), the Southwest Miramichi River (-35%), and the Northwest Miramichi River (-23%) (Figures 8 and 9).

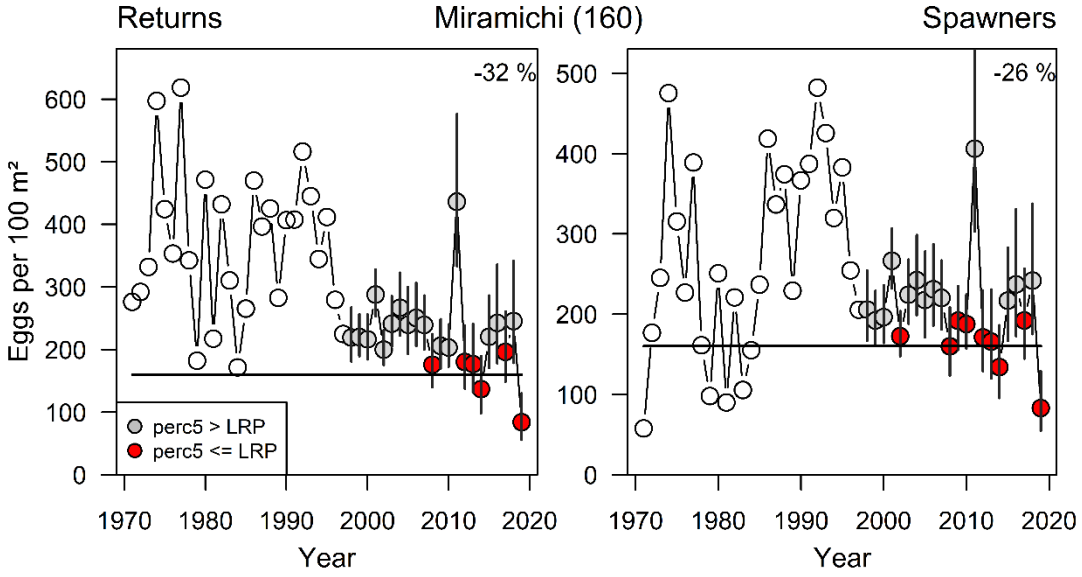

Figure 8. The estimated median (1971-2019) and 5th to 95th percentile range (1998-2019) of the number of eggs (expressed per 100 m² of habitat) from the returns (left panel) and spawners (right panel) of small and large salmon combined to the Miramichi River overall in relation to the Limit Reference Point (solid horizontal line) (DFO 2018b). Grey symbols indicate when the 5th percentile of the number of eggs was above the LRP and red symbols indicate when the 5th percentile of the number of eggs was equal to or below the LRP. The white open circles are for years without estimates of uncertainties for egg depositions. The percent change in the number of eggs in the returns (left panel) and spawners (right panel) of large and small salmon combined over the previous twelve year period (2007-2019) is identified in the top right corner of each panel.

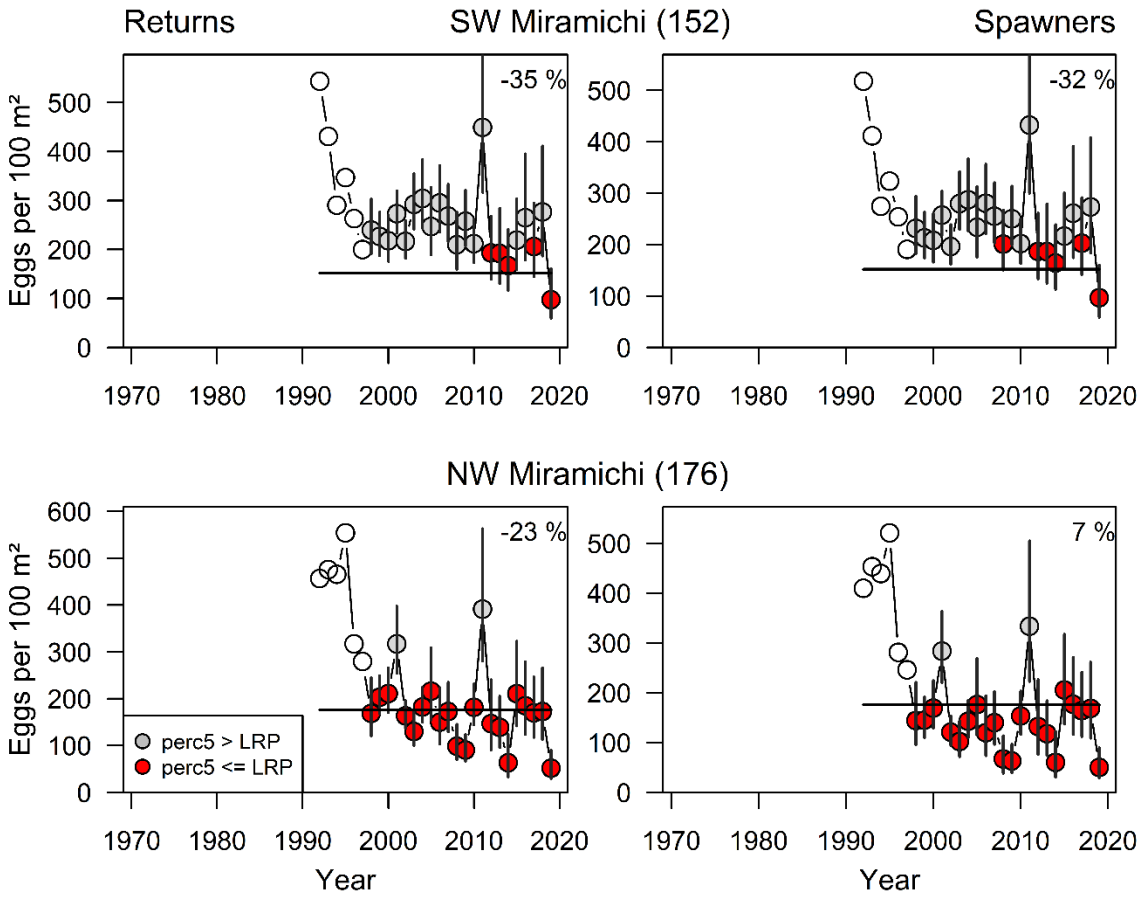

Figure 9. The estimated median (1992-2019) and 5th to 95th percentile range (1998-2019) of the number of eggs (expressed per 100 m² of habitat) from the returns (left panels) and spawners (right panels) of small and large salmon combined to the Southwest Miramichi River (top row) and the Northwest Miramichi River (bottom row) in relation to the Limit Reference Point for each river (solid horizontal line) (DFO 2018b). Grey symbols indicate when the 5th percentile of the number of eggs was above the LRP and red symbols indicate when the 5th percentile of the number of eggs was equal to or below the LRP. The white open circles are for years without estimates of uncertainties for egg depositions. The percent change in the number of eggs in the returns (left panels) and spawners (right panels) of large and small salmon combined over the previous twelve year period (2007-2019) is identified in the top right corner of each panel.

Spawners are calculated as returns minus losses from Indigenous Food, Social, and Ceremonial (FSC) fisheries (based on data available to date) and from recreational fisheries. With the introduction of the mandatory release of small salmon in the recreational fishery, losses due to catch and release mortality were assumed to be 0.9% of the total returns (3% mortality of caught and released salmon, assuming 30% of the small salmon return is caught and released), identical to the formula used for calculating large salmon losses in the recreational fishery since 1984.

After accounting for removals and losses from fisheries, the median egg deposition rate for large and small salmon combined in 2019, was 83 eggs per 100 m^2 for the Miramichi River overall, 96 eggs per 100 m^2 for the Southwest Miramichi River, and 50 eggs per 100 m^2 for the Northwest Miramichi River (Table 2; Figures 8 and 9).

Reported and estimated fisheries related losses in 2019 were low and the percentage of the LRP attained by estimated eggs in the combined spawners of small salmon and large salmon in 2019 ranged from 28% (median value) for the Northwest Miramichi to 63% (median value) for the Southwest Miramichi, similar to the estimated eggs in the returns (Table 2).

In conformity with the Precautionary Approach (PA) (DFO 2009), the management objective for a stock is to have a low probability (5% or less) of being below the LRP (i.e. in the critical zone). In 2019, the probability of being below the LRP was high for each river; >99% for the Miramichi River overall, 93% for the Southwest Miramichi River, and >99% for the Northwest Miramichi River; all were considered to be in the critical zone of the PA in 2019 (Tables 1 and 2; Figures 8 and 9).

The trends in the number of eggs from large and small salmon spawners combined shows decreases over the last 12 years for spawners in the Miramichi River overall (-26%) and the Southwest Miramichi River (-32%) but an increase in the Northwest Miramichi River (+7%) (Figures 8 and 9).

Table 2. Summary of estimated eggs per 100 m² in the combined spawners (after removals and losses from fisheries) of small salmon and large salmon by river / tributary in 2019, relative to the Limit Reference Point (LRP), and the probability of the eggs in the returns being less than the LRP.

River / tributary	Eggs in spawners (eggs per 100 m²) median (5th to 95th perc. range)	Limit Reference Point (LRP); (eggs per 100 m²)	Percentage of LRP attained; median (5th to 95th perc. range)	Prob. (%) of egg deposition rate being less than the LRP
Miramichi River	83 (55 to 128)	160	52% (34% to 80%)	> 99%
Southwest Miramichi	96 (58 to 160)	152	63% (38% to 106%)	93%
Northwest Miramichi	50 (29 to 90)	176	28% (16% to 51%)	> 99%

Conclusions

The estimates of large salmon returns in 2019 to the Miramichi River overall and to each of the Southwest Miramichi and Northwest Miramichi branches are the lowest on record and well below the long term average return estimates for large salmon to each river.

- For the Southwest Miramichi River, the estimated large salmon return in 2019 of 5,200 fish (median value) replaces the previous lowest return estimate of 8,800 fish in 2014.
- For the Northwest Miramichi River, the estimated large salmon return in 2019 of 1,100 fish (median value) replaces the previous lowest return estimate of 1,500 fish in 2014.

The estimates of small salmon returns to the Miramichi River overall and to each of the Southwest Miramichi and Northwest Miramichi branches in 2019 are low, at the same level as in 2018, and remain well below the long term average return estimates of small salmon for each river.

- For the Southwest Miramichi River, the estimated small salmon return in 2019 of 5,900 fish (median value) is just below the previous lowest return estimate of 6,000 fish in 2012.
- For the Northwest Miramichi River, the estimated small salmon return in 2019 of 2,800 fish (median value) is among the lowest of the time series (1992 to 2019) but higher than the record low of 1,300 fish in 2014.

Over the last 12 year period, estimated returns of small salmon and large salmon have declined in the Miramichi River overall, the Southwest Miramichi River, and the Northwest Miramichi River with declines ranging from 10% to 39% for large salmon and from 55% to 72% for small salmon.

The medians of the estimated egg depositions in the returns of small salmon and large salmon combined in 2019 are below the LRP in the Miramichi River overall and in both the Southwest Miramichi and Northwest Miramichi branches. Overall, the status of Atlantic Salmon in 2019 in the Miramichi River system is in the critical zone of the PA framework.

- For the Southwest Miramichi River, 2019 is the first year of the time series for which the median of the estimated eggs in the combined returns of small salmon and large salmon is below the LRP (64% of the LRP).
- For the Northwest Miramichi River, the median of the estimated eggs in the combined returns of small salmon and large salmon in 2019 is 29% of the LRP. The estimated eggs for 2019 is the lowest of the time series (1992 to 2019) and continues the consistent failing performance for the Northwest Miramichi of to meet the LRP in the majority of years since 1998.

Over the last 12 year period, estimates of eggs from returning large and small salmon combined have declined (range -23% to -35%) in the Miramichi River overall, the Southwest Miramichi River, and the Northwest Miramichi River. Similarly, estimates of eggs from large and small salmon spawners combined have declined in the Miramichi River overall (-26%) and Southwest Miramichi River (-32%) but increased in the Northwest Miramichi (7%) despite having been in the critical zone for 20 of the last 22 years since 1998.

Based on the declining trends over the last 12 years in the abundances of returning large salmon and small salmon and the subsequent spawner egg deposition rates, there is no expectation of increased abundance of either salmon size class to the Miramichi River in 2020.

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Sources of Information

This Science Response Report results from the Science Response Process of January 9, 2020 on Update of indicators to 2019 of adult Atlantic Salmon for the Miramichi River (NB), Salmon Fishing Area 16, DFO Gulf Region. No additional publications from this process are anticipated.

DFO. 2009. A Fishery Decision-Making Framework Incorporating the Precautionary Approach.

DFO. 2014. Stock status of Atlantic salmon (*Salmo salar*) in DFO Gulf Region (Salmon Fishing Areas 15 to 18) to 2013. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/057.

DFO. 2015a. Update of stock status of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region (New Brunswick Salmon Fishing Areas 15 and 16) for 2014. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/008.

DFO. 2015b. Indicators of Atlantic Salmon (*Salmo salar*) stock status for Prince Edward Island (SFA 17) and Gulf Nova Scotia (SFA 18) in DFO Gulf Region for 2014. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/016.

DFO. 2016. Update of stock status of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region (Salmon Fishing Areas 15 to 18) for 2015. DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/018.

DFO. 2017. Update of stock status of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region Salmon Fishing Areas 15 - 18 for 2016. DFO Can. Sci. Advis. Sec. Sci. Resp. 2017/013.

DFO. 2018a. Update of stock status of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region Salmon Fishing Areas 15 - 18 for 2017. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/017.

DFO. 2018b. Limit Reference Points for Atlantic Salmon rivers in DFO Gulf Region. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/015.

DFO. 2019. Update of indicators of Atlantic Salmon (*Salmo* salar) in DFO Gulf Region Salmon Fishing Areas 15 – 18 for 2018. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/021.

Douglas, S.G., Chaput, G., Hayward, J., and Sheasgreen, J. 2015. Assessment of Atlantic Salmon (*Salmo salar*) in Salmon Fishing Area 16 of the southern Gulf of St. Lawrence to 2013. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/049. v + 36 p.

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