IS STRIPED BASS (*MORONE SAXATILIS*) PREDATION THE CAUSE OF THE DECLINE IN AND LOW ATLANTIC SALMON (*SALMO SALAR)* RETURNS TO THE MIRAMICHI RIVER?

Introduction

Significant concern exists within Conservation organizations and Indigenous Peoples in New Brunswick about the severe decline in and low returns of Atlantic salmon to the Miramichi River. While the decline in salmon returns is common to all parts of the Miramichi, the lowest returns are to the Northwest Miramichi and its various tributaries. Conservation organizations, Indigenous Interests and the University of New Brunswick (UNB) have investigated the decline in and low salmon returns to the Miramichi and have arrived at the same conclusion that Striped Bass predation of migrating salmon smolts is a principal contributor to the current low salmon returns to the Miramichi River (Daniels et al. 2018; Wilbur and Collins 2024; and K. Phillips, pers. comm.[1]).

The Northwest Miramichi is the main spawning ground for Striped Bass in the Gulf of St. Lawerence, and its spawning occurs during the spring period when salmon smolts make their migration to sea (DFO 2023a). Despite the apparent evidence from acoustic tagging studies that Striped Bass predation is a main contributor to the current downturn in Small and Large salmon returning to the Miramichi system (Daniels et al. 2018; Wilbur and Collins 2024; and K. Phillip, pers. comm.[1]), the Department of Fisheries and Oceans (DFO) refuses to accept this explanation and instead claims Atlantic salmon are declining everywhere in Eastern Canada, including rivers where Striped Bass are absent (Minister of DFO, pers. comm.[2]). In an assessment of available data Chaput (2022) concluded that it's not clear that reducing Striped Bass abundance to the levels of the early 2000s (i.e., less than 100,000 spawners) would improve smolt survival and salmon returns to the Miramichi River. Advocates for stopping the decline and restoring the salmon stocks of the Mirmaichi River system have requested of DFO that measures be

[1] Results of acoustic tagging studies on the Miramichi River, carried out 2021-2023 by the Canadian Rivers Institute, Atlantic Salmon Federation (ASF), Miramichi Salmon Association (MSA) and Anqotum Resource Management, provided by K. Phillips, Canadian Rivers Institute, UNB (*karl.phillips@unb.ca*).

[2] Stated in a letter (date Feb. 13, 2024) from The Honourable Diane Lebouthillier, P.C., M.P. to representatives of a number of New Brunswick organizations concerned about the decline in and low Atlantic salmon returns to the Miramichi River system, and the lack of action by DFO to address the apparent main cause of the decline (i.e., the massive Striped Bass spawning population in the Northwest Miramichi).

undertaken to reduce the Bass population on the Northwest Miramichi to 100,000 spawners (J. Bagnall, pers. comm.[3]). DFO refuses to implement any measures that would significantly reduce the Bass spawning population.

Striped Bass Abundance

Below is a graph of DFO's estimates of the numbers of Striped Bass spawning in the Northwest Miramichi River. The data for the plot were provided by DFO Science and as shown in DFO (2023a).

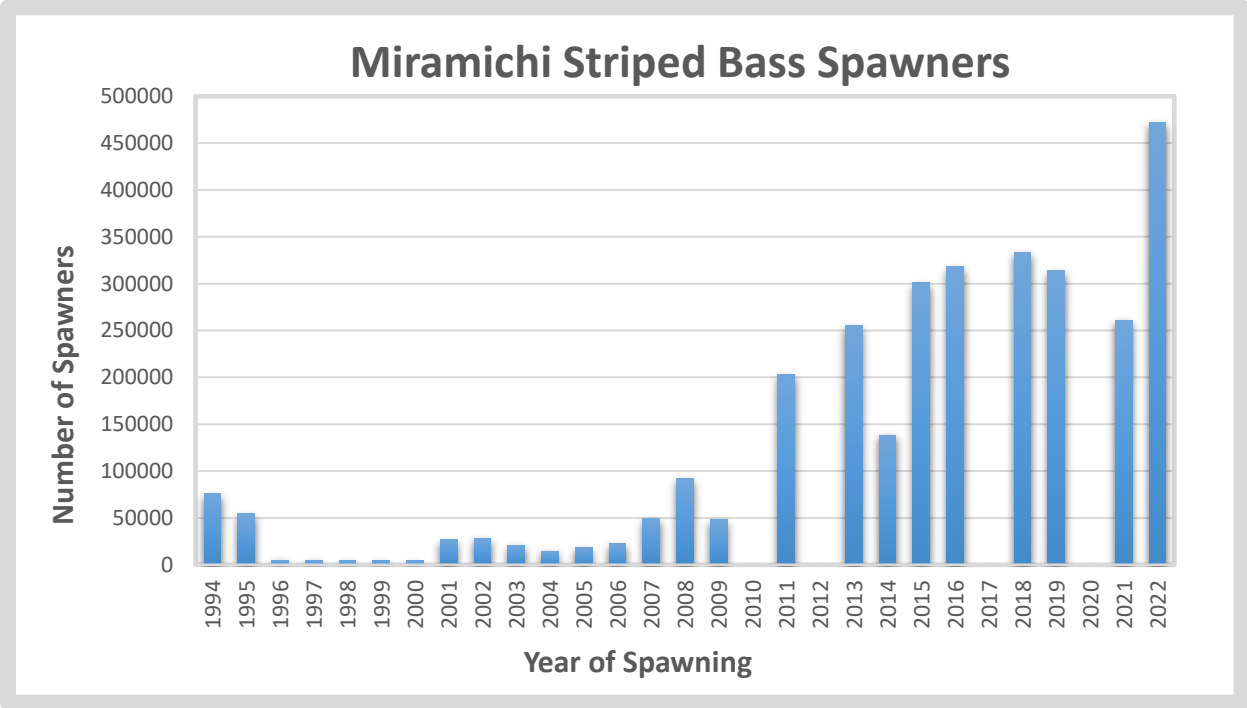

Figure 1. Estimates of the Number of Striped Bass spawning in the Northwest Miramichi River system for years 1994 through 2022. Estimates of the Numbers of Spawners in 2010, 2012, 2017 and 2020 are not available/included. The estimate for 2010 was incomplete, no estimates were made of the 2012 and 2020 populations, and the estimate for 2017 (994,000 spawners) was excluded because it was excessively greater than can be accounted for in population estimates in prior years (i.e, 2015 and 2016) and also, in later years (i.e., 2018 and 2019).

DFO reported the first major increase in the Striped Bass spawner population to have occurred in 2011 (DFO 2013). The spawner population in 2022 is estimated

[3] J. Bagnall (Fisheries Committee Chair and Past President, New Brunswick Salmon Council), acting on behalf of multiple Conservation and Indigenous interest groups, made oral presentations to representatives of DFO.

to be close to 500,000 (DFO 2023a). While no official report has be made as to the abundance of spawners in 2023, DFO has stated that the number is around 500,000 spawners.

Atlantic Salmon Abundance

Atlantic salmon abundance in the Miramichi River system is assessed against measures of adult salmon returns or smolt survival for salmon populations of other rivers emptying into the Gulf of St. Lawrence. The data sets for the graphs below include counts and population estimates of the numbers of Small (< 63 cm fork length) and Large (= or > 63 cm fork length) salmon returning, recreational catches of Small plus Large salmon, and smolt-to-adult survival rates for one river population. The plots vary in length as a result of data availability.

Figures 2 and 3 below are Counts of Small and Large Salmon at Salmon Protection Barriers operated by the MSA for the New Brunswick Department of Natural Resources and Energy Development (NB DNRE). Data on the counts were provided by NB DNRE.

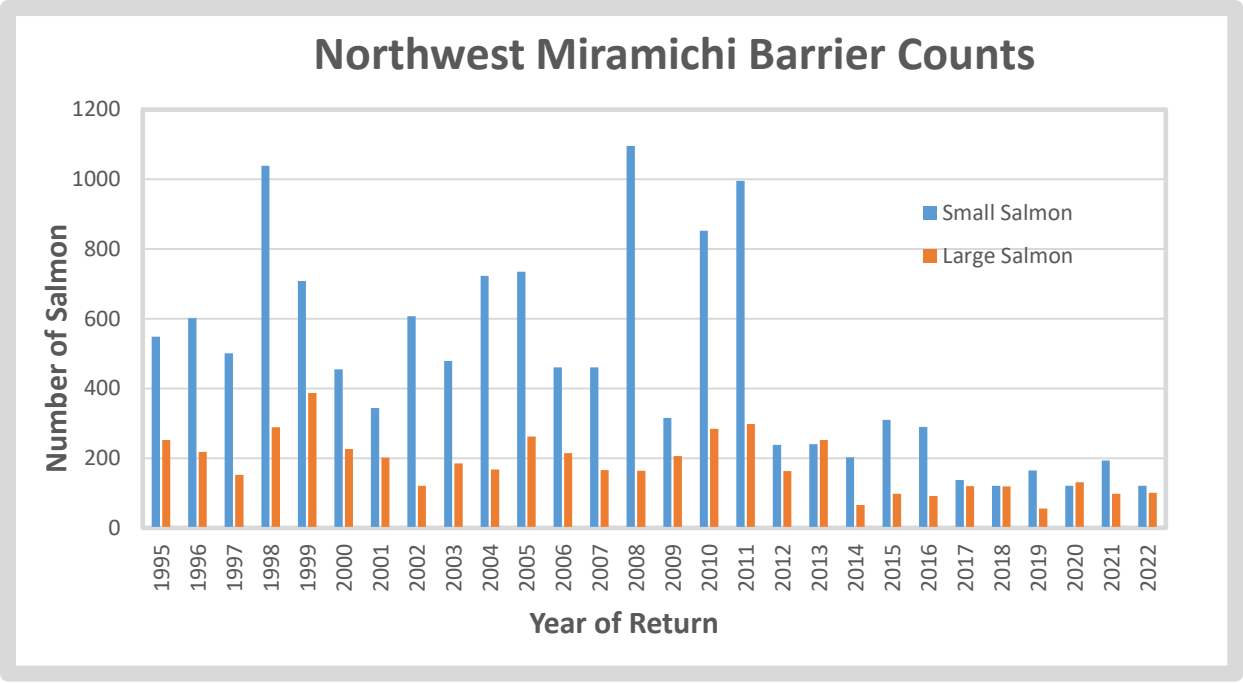

Figure 2. Annual Counts of Small and Large Salmon at the Salmon Protection Barrier on the Northwest Miramichi River for years 1995 through 2022.

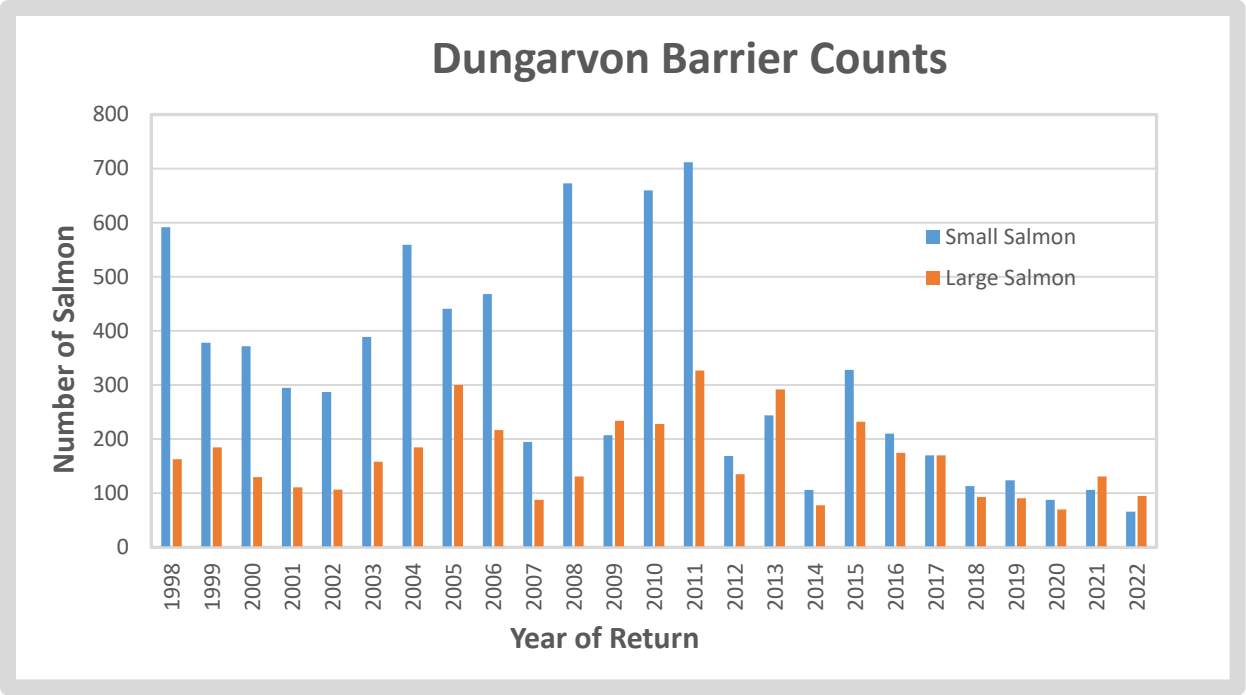

Figure 3. Annual Counts of Small and Large Salmon at the Salmon Protection Barrier on the Dungarvon River for years 1998 through 2022.

Counts at both Barriers show the same pattern for Small Salmon for which Counts drop off to lower levels beginning in 2012, a pattern that appears to persist and even worsen in the later years (i.e., in years 2018 through 2022). Numbers of Large Salmon are considerably fewer than the Numbers of Small Salmon throughout the time series, and the drop-offs in their Counts are later in time for the Barrier on the Northwest (2014) (Fig. 2), and not as apparent for the Dungarvon Barrier (Fig. 3).

The next two graphs are DFO Science's estimates of the Numbers of Small and Large Salmon returning to the Northwest Miramichi and the Southwest Miramichi, respectively (Fig. 4 and 5). The data for both plots were from various DFO Science documents (DFO 2015, 2020, 2022 and 2023b) and provided by DFO Science. No estimates were made of the Numbers of Small and Large Salmon returning in 2020.

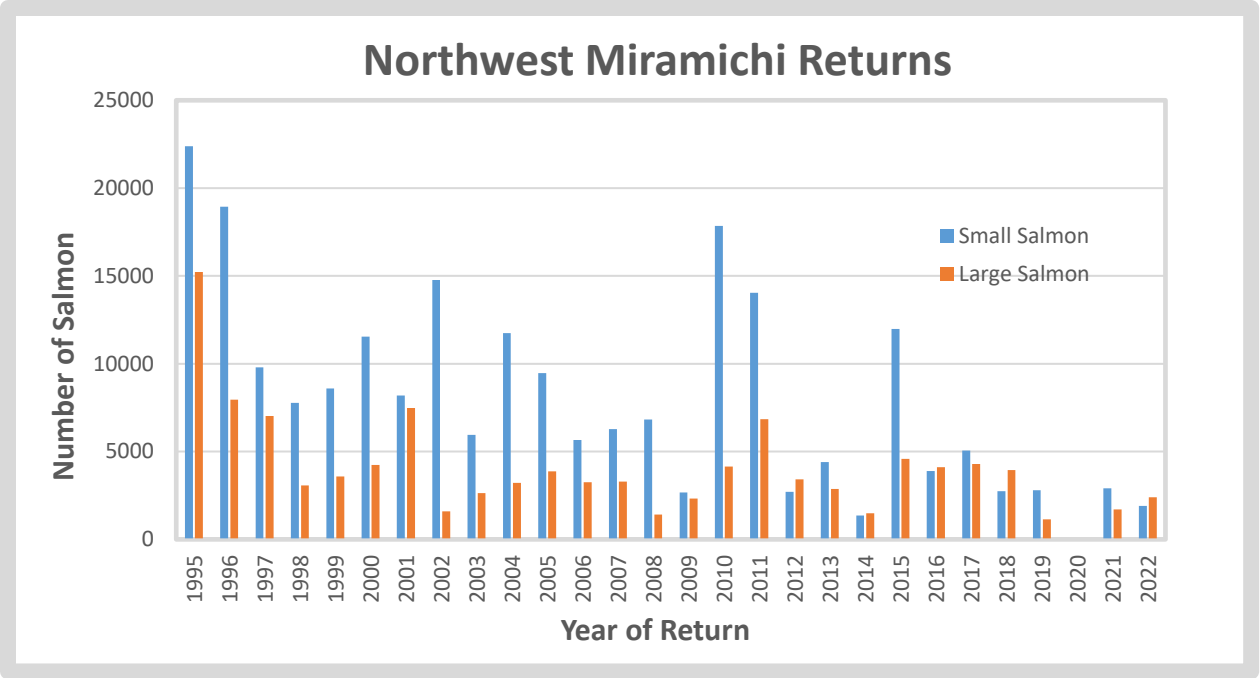

Figure 4. Annual estimates of the Number of Small and Large Salmon Returns to the Northwest Miramichi River for years 1995 through 2022.

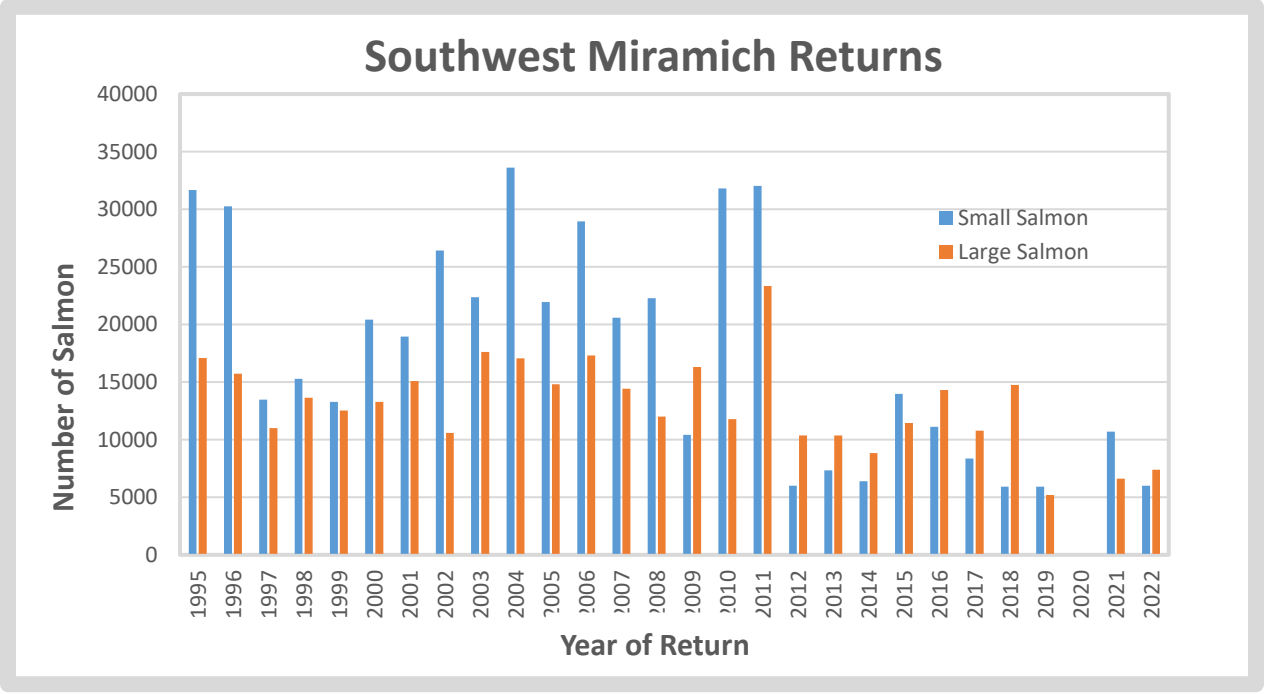

Figure 5. Annual estimates of Small and Large Salmon Returns to the Southwest Miramichi River for years 1995 through 2022.

Figures 2, 3, 4 and 5 confirm that both the Northwest and Southwest Miramichi have been experiencing lower Returns of Small and Large Salmon since 2011.

To assess the claim of DFO that the decline in and low salmon returns to Miramichi since 2011 are consistent with declines in Atlantic salmon everywhere in Eastern Canada (Minister of DFO, pers. comm.[4]), measures of adult salmon abundance or smolt survival for salmon populations of river systems within the Gulf of St. Lawrence are presented in graph-form below. The assessment is limited to salmon populations within the Gulf because they likely experienced the same at-sea perils as salmon from the Miramichi. The first of the plots is for the Margaree River (Figure 6). The Margaree population is presented as being representative of Southern Gulf salmon populations outside the Miramichi River system. The graph presents DFO Science's estimates of Small and Large Salmon Returns to the Margaree River. The data were taken from DFO assessment documents (DFO 2015, 2020, 2022 and 2023b) and provided by DFO Science.

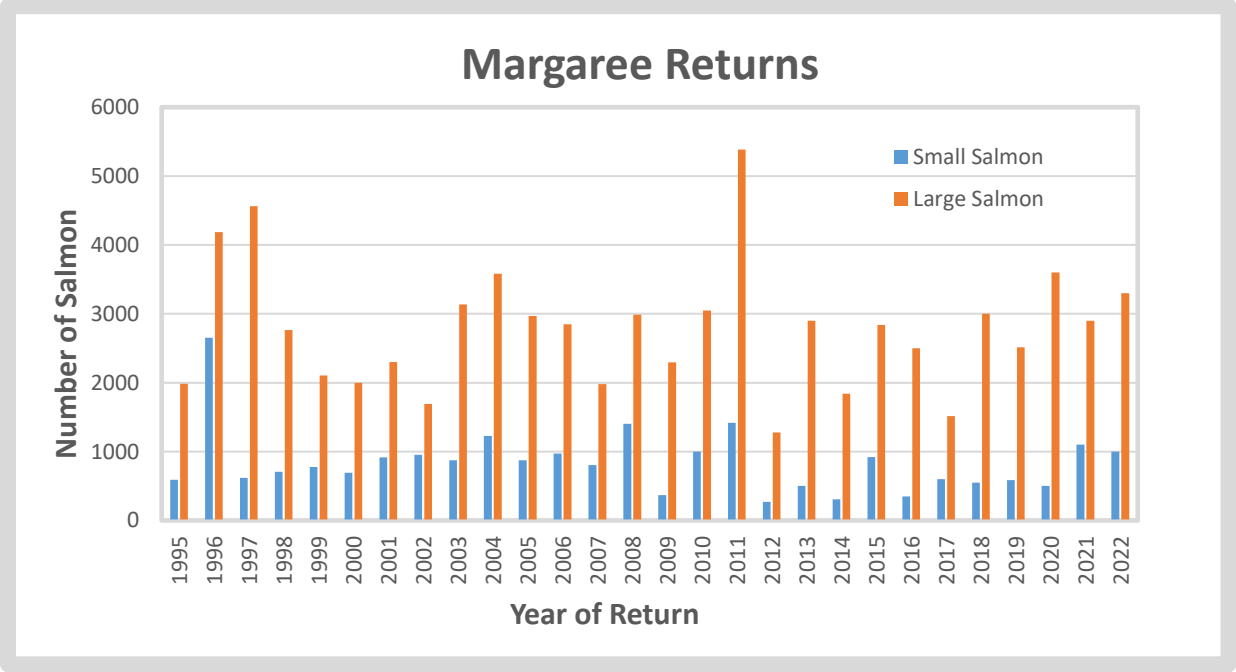

Figure 6. Annual estimates of the Numbers of Small and Large Salmon Returns to the Margaree River for years 1995 through 2022.

[4] Stated in a letter (date Feb. 13, 2024) from The Honourable Diane Lebouthillier, P.C., M.P. to representatives of a number of New Brunswick organizations concerned about the decline in and low Atlantic salmon returns to the Miramichi River system, and the lack of action by DFO to address the apparent main cause of the decline (i.e., the massive Striped Bass spawning population in the Northwest Miramichi).

Both Small and Large Salmon Returns to the Margaree show no decline over the period 1995 through 2022. This is confirmed by DFO's statement '*The changes in estimated returns (to the Margaree) over the recent 12-year period do not result in a statistically significant trend for either Small or Large salmon.'* (DFO 2023b).

Figure 7 below is for the West Coast of Newfoundland's Western Arm Brook. The graph details annual Smolt-to-Adult Survival rates for smolts emigrating from Western Arm Brook for years 1994 through 2021. No survival rate was determined for smolts emigrating in 2020. Data for the graph was extracted from a plot of the same in the document detailing DFO's most recent stock assessment of Newfoundland and Labrador salmon stocks (DFO 2024).

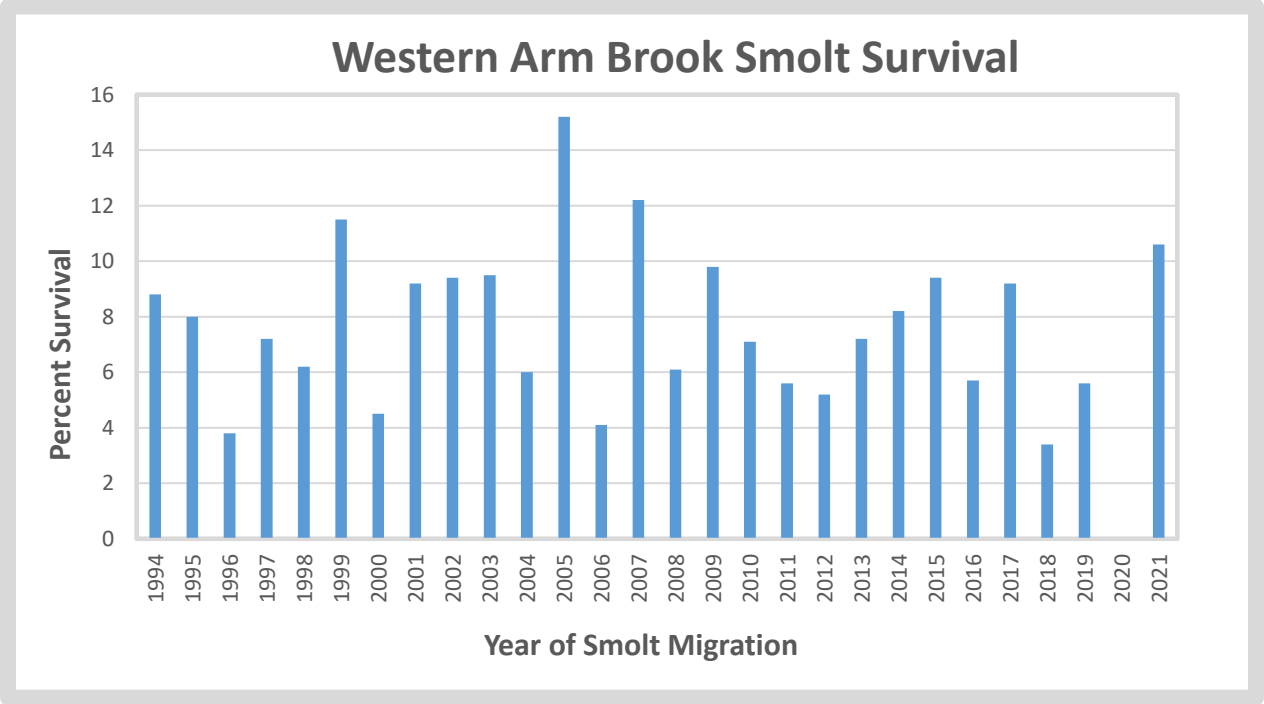

Figure 7. Percent survival rates for Atlantic salmon smolts emigrating from Western Arm Brook, Newfoundland in years 1994 through 2021.

While Smolt-to-Adult Survival varied from less than 4% to over 15% over the period 1994 through 2021, no trend in smolt survival is apparent over both the complete duration of monitoring or over the most recent 15 years.

Figures 8 and 9 below show the Numbers of Small and Large Salmon Returns to the Cascapedia and Saint-Jean rivers on the Gaspe, Quebec (MFFP 2024).

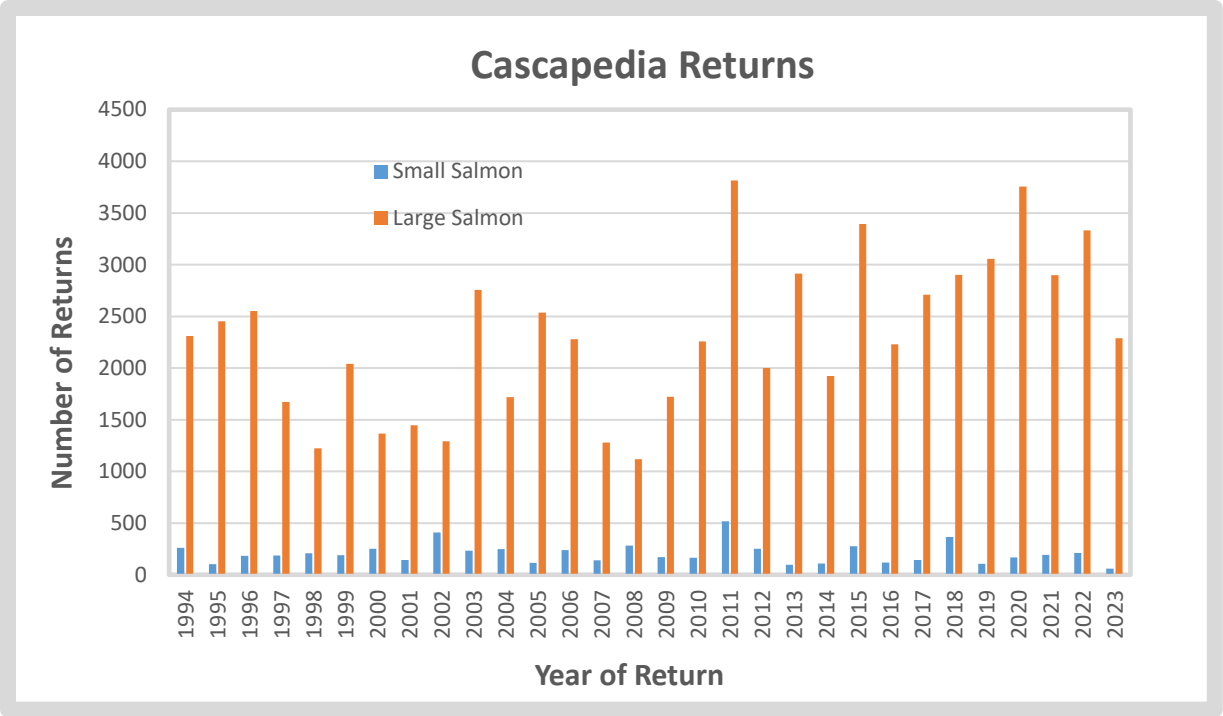

Figure 8. Numbers of Small and Large Atlantic Salmon Returns to the Cascapedia River, Gaspe, Quebec for years 1994 through 2023.

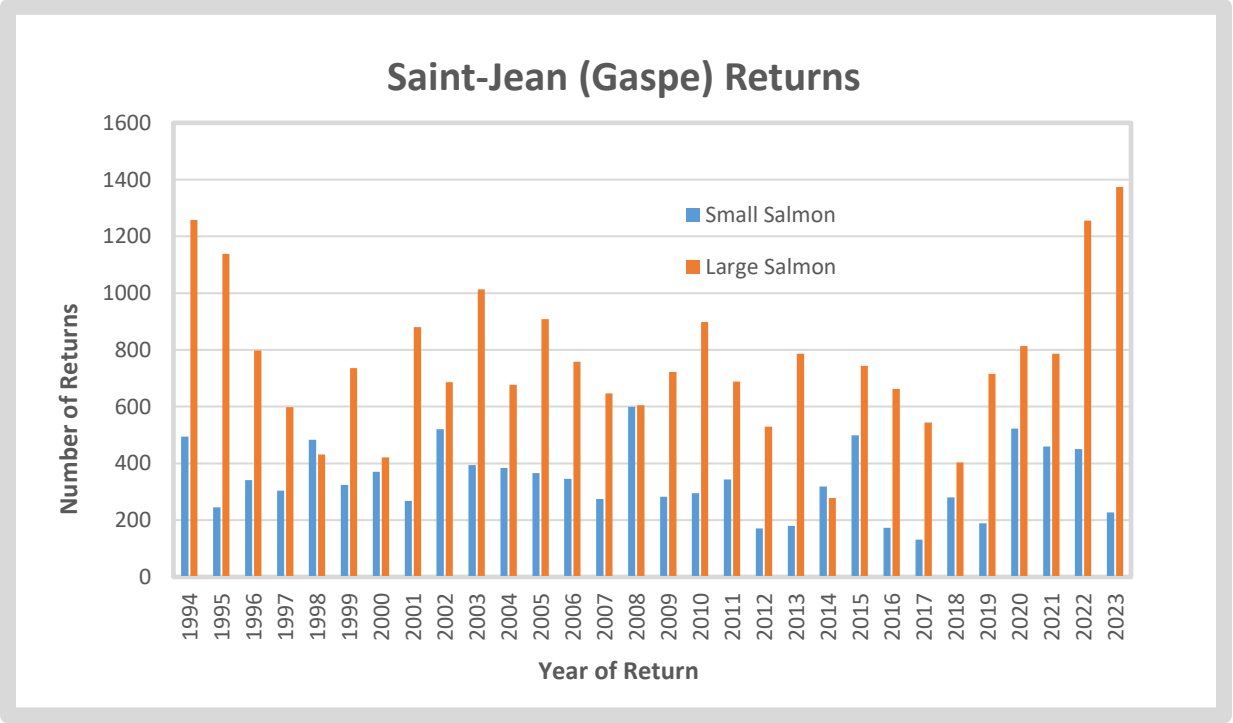

Figure 9. Numbers of Small and Large Atlantic Salmon Returns to the Saint-Jean River, Gaspe, Quebec for years 1994 through 2023.

Figures 8 and 9 show the Numbers of Salmon returning to the Cascapedia and Saint-Jean rivers to be variable. They show no decline in Salmon Returns over the time frame of the series (i.e., 1994 through 2023) and in particular, no downturn since 2011. To the contrary, Salmon Returns to the Cascapedia are generally greater since 2010.

Figures 9, 10 and 11 below depict Recreational Catches of Atlantic salmon for rivers in the Province of Quebec's three composite areas bordering the Gulf of St. Lawrence and where salmon angling takes place (i.e., the Gaspe, Anticosti Island and the North Shore) (MFFP 2024). The catches are the sum of the three size class designations for Adult Salmon for Quebec's recreational fishery for salmon (i.e., Grilse, Small salmon and Large salmon), and include both Retained and Released fish. Released salmon entered the Catch figures in the mid-to-late 1990s with the imposition of Provincial Regulations Limiting the Retention of Large salmon.

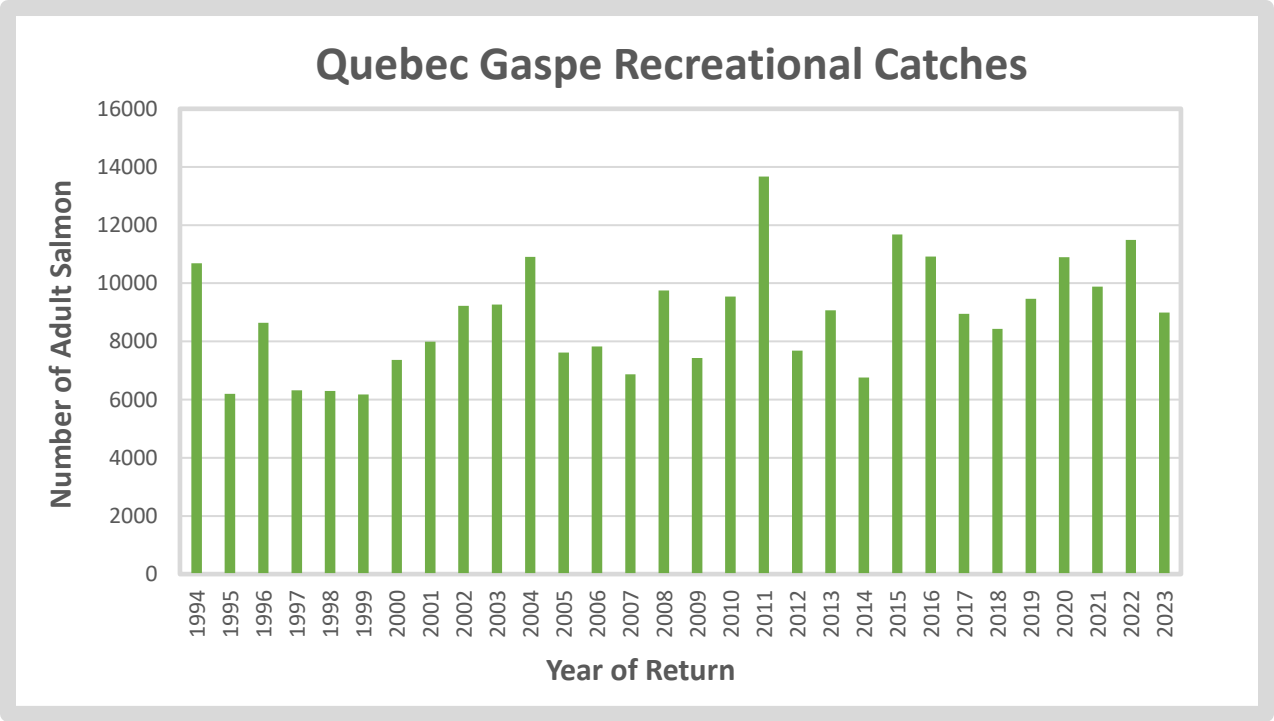

Figure 9. Catch Numbers (retained and released) for Adult Salmon in the Recreational Fishery on the Gaspe, Quebec for year 1994 through 2023.

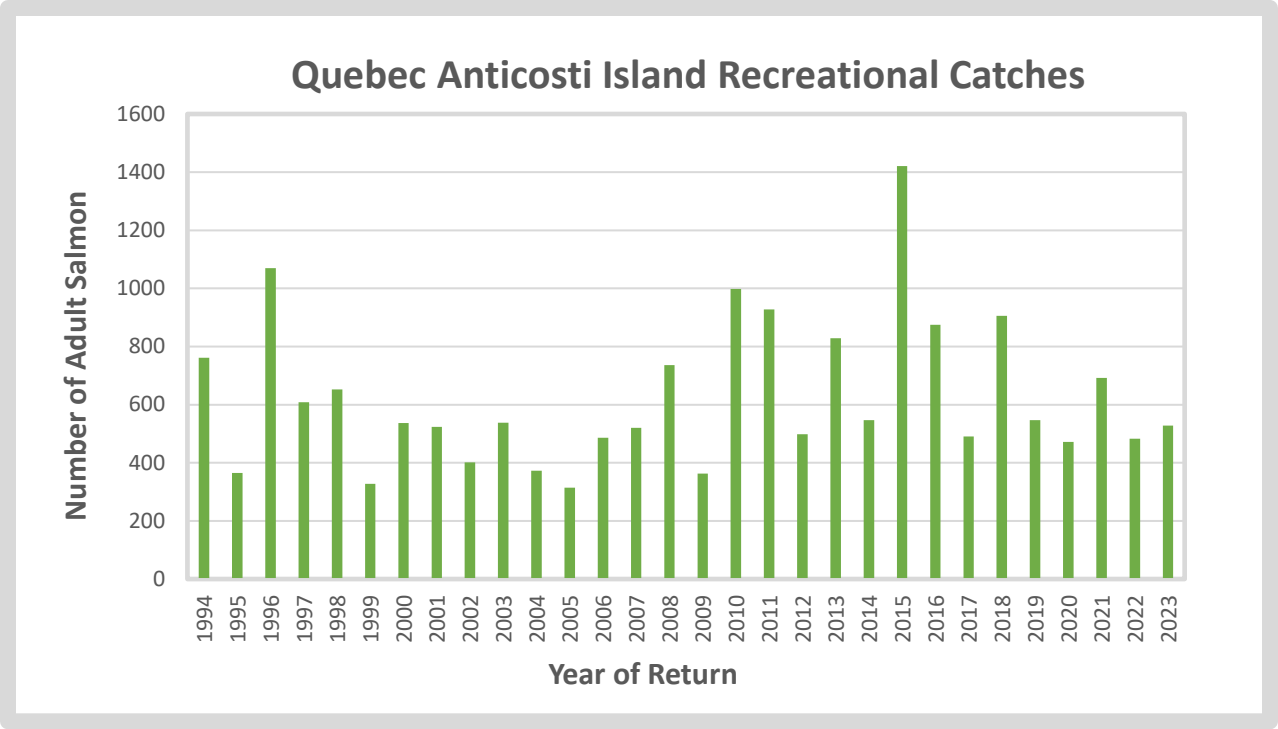

Figure 10. Catch Numbers (retained and released) for Adult Salmon in the Recreational Fishery on Anticosti Island, Quebec for years 1994 through 2023.

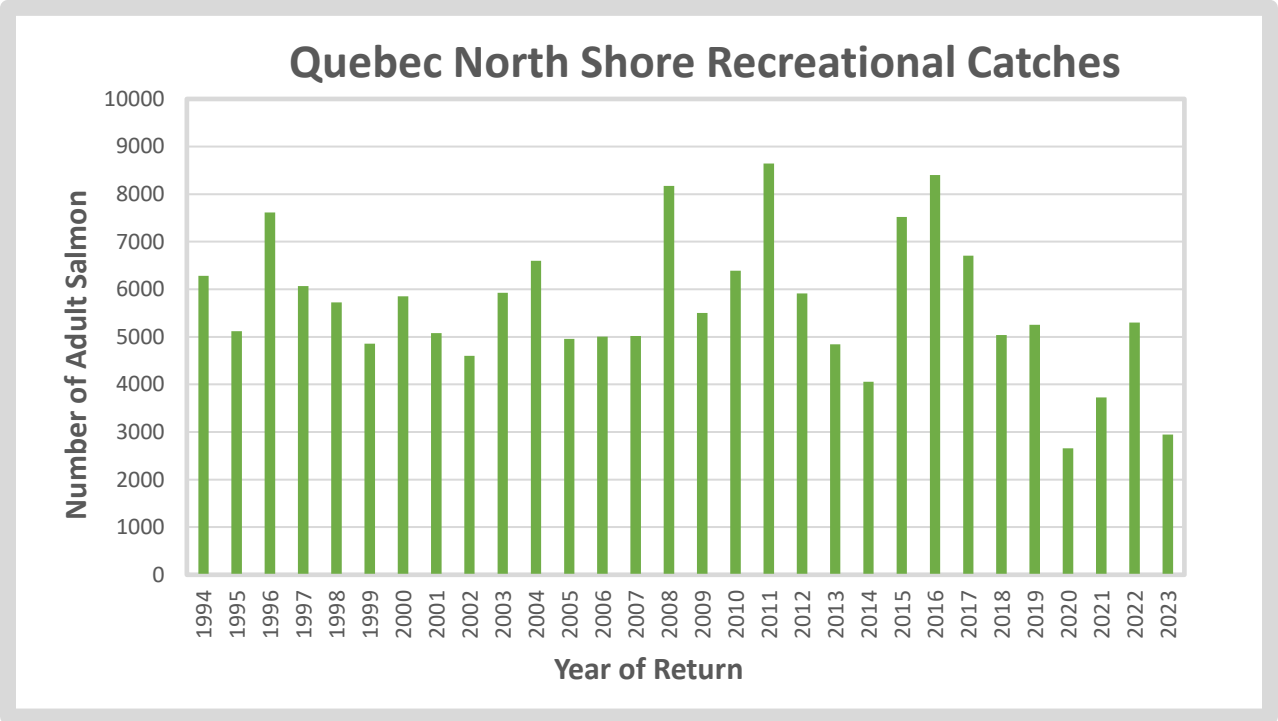

Figure 11. Catch Numbers (retained and released for Adult Salmon in the Recreational Fishery on the North Shore, Quebec for years 1994 through 2023.

Both the Gaspe and Anticosti Island Fishing Areas show relatively uniform annual catches of salmon over the time span shown (1994 through 2023). The catches on the North Shore are also relatively uniform over time except for the most recent four years (2020 through 2023) when catches for three of the years appear lower. Catches in all three Areas appear uniform through 2019.

Analyses and Discussion

The timing and declines in salmon returns to the Miramichi River system shown in Figures 2, 3, 4, and 5 are supported by telemetry studies reported by Chaput et al. (2018) which show lower survival rates for smolts of the Northwest Miramichi passing through the Miramichi estuary and Bay for the years 2013 through 2016 than for smolts migrating in the years 2003 through 2008. The studies demonstrated a similar pattern for smolts emigrating from the Southwest Miramichi although the survival rates for the later period were less depressed than for smolts of the Northwest Miramichi. The same study showed no difference in survival rates between the two periods for smolts migrating through the tidal waters of the Restigouche and Cascapedia river systems.

Excluding the salmon populations of the Miramichi River System (Figures 2, 3, 4 and 5), none of the graphs for salmon populations in the Gulf of St. Lawrence show a major decline over the past decade in adult salmon abundance (Figures 5, 7, 8, 9, 10, 11 and 12) or survival at sea (Figure 6). This discrepancy between the decline in salmon returns to the Miramichi system and the absence of decline in the salmon populations of other Gulf rivers strongly suggests that the cause of the decline in salmon returns to the Miramichi River is local in origin.

Claims made that salmon populations of some rivers emptying into the Gulf of St. Lawrence and outside the Miramichi system are experiencing low returns of Atlantic salmon were investigated by searching data for Quebec rivers (MFFP 2024). While the claims are correct, the rivers with low salmon returns are relatively few and the patterns of their downturn do not align with the significant decline in salmon returns to the Miramichi River system beginning in 2012 (Figures 2, 3, 4 and 5). Given that the Quebec rivers experiencing low returns of salmon are in the midst of rivers for which good and stable abundances of salmon are reported (MFFP 2024), and shown here (Figures 7, 8, 9, 10, 11 and 12), it seem logical that the causes of their low returns of salmon are of local origins.

Adult salmon population numbers of rivers of the Outer Bay of Fundy (e.g., Saint John River) and along the Atlantic coast of Nova Scotia (e.g., LaHave and St. Mary's rivers) continue to remain low after the severe declines they experienced in marine survival beginning in the early-1990s (DFO 2023c). Their declines were more severe than that of salmon populations of rivers emptying into the Gulf of St. Lawrence (Fig. 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11). The degree of their declines, and general lack of recovery experienced by these southern populations, do not coincide with those of Gulf salmon populations. Further, the general trends in adult salmon returns to both Newfoundland and Labrador rivers, and smolt-to-adult survival rates for populations of rivers on Newfoundland, do not show the sharp decline and continuing low levels since 2011 like that evident for populations of the Miramichi River system (DFO 2024).

The pattern in the decline in and low returns of salmon to both the Northwest and Southwest systems (Fig. 2, 3, 4, and 5) is consistent with the build-up in the Northwest Miramichi's Striped Bass spawning population (Fig. 1). Results from the continuing acoustic tagged smolt study on the Miramichi are showing strong evidence of significant predation of smolts by Striped Bass in the lower Miramichi River (Daniels et al. 2018; Wilbur and Collins 2024; and K. Phillip, pers. comm.[5]). A very low survival rate of 6.4% was recorded for 249 acoustic tagged smolts, migrating from the Northwest and Southwest Miramichi systems, to the Gulf of St. Lawrence in 2023 (K. Phillips, pers. comm.[5]). While the losses of 93.6% of the tagged smolts included all types of losses, the digestion sensory telemetry system employed enabled the determination that 65.1% of the tagged smolts were lost to cold-blooded predators (K. Phillips, pers. comm.[5]). As there is no obvious evidence of any abundant cold-blooded predator in the tidal waters of the Miramichi in May other than Striped Bass, it is likely that the majority of the losses to cold-blooded predators are due to Striped Bass predation.

Further supporting the conclusion that Striped Bass predation is the main cause of the recent decline in salmon returns to the Miramichi systems is the timing of the major decline being 2012 (Fig. 2, 3, 4 and 5), the year following 2011 when

[5] Results of acoustic tagging studies on the Miramichi River, carried out 2021-2023 by the Canadian Rivers Institute, ASF, MSA and Anqotum Resource Management, provided by K. Phillips, Canadian Rivers Institute, UNB (*karl.phillips@unb.ca*).

the Striped Bass population dramatically increased to more than 200,000 spawners (Fig. 1).

While returns of salmon to the Miramichi River system have continued to remain low, and even decline further, the Striped Bass population has continued to expand to close to 500,000 spawners in 2022 (DFO 2023b), and seemly to the same level or greater in 2023 according to DFO. Of immediate concern are the extremely low returns of salmon to the Northwest Miramichi. Consistent with these low returns are salmon egg deposition levels below 100 eggs per 100 m^2 of rearing habitat in recent years (DFO 2023b), and as low as 51 eggs per 100 m^2 in 2019 (DFO 2020). Such low egg deposition levels put at risk the recovery of the Northwest salmon population, a risk that will heighten if this pattern of low salmon returns persists or worsens. This critical state in the Northwest Miramichi salmon population depicts the urgency for action be taken to reduce the Striped Bass spawning population size in the Miramichi River system. A significant reduction in the Bass population is also required to prevent harm to the Southwest salmon population and to enable its recovery.

The recent massive expansion in the Northwest Miramichi Striped Bass spawning population coincides with the rising annual sea temperatures (May-November) in the Gulf of St. Lawrence (Galbraith et. al. 2022). Given this improvement in marine conditions for Striped Bass recruitment, the numbers of Striped Bass are likely to continue to increase further in the Miramichi, and to become more abundant in the Southern Gulf through the establishment of new populations in other rivers. Reports of Striped Bass spawning in the Southwest Miramichi and Tabusintac River (McGee 2020) are evidence of spawning outside the Northwest Miramichi. As well, anecdotal reports of the presence of Striped Bass juveniles in the Hillsborough River annually over the past eight years further support the likelihood that the numbers of Striped Bass will continue to increase in the Southern Gulf. The extension of the spawning of Striped Bass to these rivers, and possibly to others yet to be discovered, along with the massive increase in the Northwest spawning population (Fig. 1), reflect a large and growing abundance of Striped Bass in the Southern Gulf of St. Lawrence and their improved harmonization with the warming environmental conditions in the Gulf (Galbraith et al. 2022). Given the resilience of the Northwest population and the magnitude in abundance and expanse of Striped Bass in the Southern Gulf, it is likely that a

major reduction in the Northwest spawner population could be made without harm to its sustainability at a designated lower level, or to its regrowth if such were desired in the future.

Conclusions

1. Atlantic salmon returns to the Miramichi River are low and the salmon population of the Northwest Miramichi is at/or approaching risk of population-level damage that endangers its recovery.
2. DFO's claim that the decline in and low returns of salmon to Miramichi River system are like that common to salmon populations throughout Eastern Canada, is not valid.
3. The cause(s) of the decline in and low salmon returns to the Miramichi system is/are local in origin and the massive Striped Bass spawning population in the Northwest Miramichi is a main contributing factor.
4. Further increases in the numbers of Striped Bass may occur in the Miramichi and are likely in the Southern Gulf as a result of changes in environmental conditions in the Gulf being more favorable to Striped Bass recruitment.
5. Without action being taken to reduce the numbers of Northwest Miramichi Striped Bass, an annual population of 500,000 spawners, or more, is likely.
6. A significant reduction in the Miramichi Striped Bass spawning population is urgently required to curtail the threat that its large numbers pose to the recovery of the salmon populations of the Miramichi River system.
7. It is likely that the Northwest Striped Bass population could be reduced to 100,000 spawners with no harm to the population given its resilience and the growing expansion of Bass spawning to other rivers in the Southern Gulf.

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