Fisheries and Oceans Canada | Pêches et Océans Canada
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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2020/002**

STOCK STATUS UPDATE OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19–21 AND 23

Context

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified four large groups of Atlantic Salmon (*Salmo salar*), referred to as Designatable Units (DUs), in the Maritimes Region: Eastern Cape Breton (ECB; corresponding to Salmon Fishing Area [SFA] 19), Nova Scotia Southern Upland (SU; SFAs 20, 21 and part of 22), Outer Bay of Fundy (OBoF; corresponding to the western part of SFA 23), and Inner Bay of Fundy (IBoF; part of SFAs 22 and 23)—see Appendix.

Abundance of Atlantic Salmon in the Maritimes Region has been in decline for more than two decades. Populations in many rivers are extirpated, and IBoF salmon are listed as Endangered under the *Species at Risk Act* (SARA). In November 2010, COSEWIC assessed the ECB, SU and OBoF population assemblages as Endangered. Fisheries and Oceans Canada (DFO) has completed scientific Recovery Potential Assessments (RPAs), socio-economic analyses, and public consultations for these DUs to inform the decision on whether or not they will be listed under SARA.

Science advice on the status of Salmon in SFAs 19–21 and 23 for 2019 was requested by Fisheries Management. This advice is used to inform Aboriginal communities, clients, and the provinces of Nova Scotia and New Brunswick of the status of the Salmon resource in advance of developing harvest agreements and recreational fishing plans for 2020. The objective of the request was to assess the status of Salmon stocks in SFAs 19, 20, 21 and 23 up to the end of 2019 using the following indicators:

- adult abundance relative to reference levels;
- juveniles densities; and
- smolt production estimates.

Given that this request is for an update of previous advice using established methods (DFO 2020 and references therein), the Science Response Process was used.

This Science Response Report results from the Science Response Process of March 12, 2020, on the Stock Status Update of Atlantic Salmon in Salmon Fishing Areas 19–21, and 23.

Analysis and Response

Methods

Evaluation of the status of Salmon in the Maritimes Region is based on abundance monitoring for a number of index populations. For most index populations where adult returns are available, status is evaluated using a comparison of the estimated egg deposition (calculated from the estimated abundance and biological characteristics of Salmon stocks) relative to a reference point known as the conservation egg requirement. The river-specific conservation egg requirement is based on an egg deposition of 2.4 eggs/m^2 multiplied by the amount of

accessible fluvial rearing habitat that is of suitable gradient. An egg deposition of 2.4 eggs/m^2 is considered to be a Limit Reference Point (LRP) in the context of DFO's Precautionary Approach Framework (DFO 2009, DFO 2012, Gibson and Claytor 2012) for DFO's Maritimes Region. Conservation requirements for many of the rivers in the Maritimes Region are reported in O'Connell et al. (1997).

In this report, Salmon less than 63 cm in fork length are referred to as small, which are typically one-sea-winter (1SW) Salmon that return to spawn following a single winter at sea (also termed grilse); Salmon greater than or equal to 63 cm in fork length are referred to as large, which are typically multi-sea-winter (MSW) Salmon that return following two or more winters at sea and repeat spawners. Juvenile Salmon abundance determined from electrofishing surveys is compared to Elson's norm values of 29 fry/100 m^2 and 38 parr/100 m^2 (Elson 1967). A smolt production estimate of 3.8 smolt/100 m^2 (Symons 1979) is used as a general reference value for rivers at, or near, the egg conservation requirement, and is provided here to allow for a comparison of smolt production estimates.

Eastern Cape Breton (Salmon Fishing Area 19)

Salmon population monitoring by DFO in ECB is currently focused on three river systems: the Middle, Baddeck, and North rivers (Table 1, Appendix). Parks Canada (PC) monitors adult Salmon abundance on Clyburn Brook (Table 1) using dive surveys similar to those conducted by DFO. The Unama'ki Institute of Natural Resources (UINR) began monitoring smolts on Middle River in 2011, and smolt population estimates are available for 2013–2016, and 2018 (Table 2). Details on the assessment methods for ECB Salmon populations are provided in Levy and Gibson (2014), DFO (2013), Gibson and Bowlby (2009), and Robichaud-LeBlanc and Amiro (2004). In 2019, all rivers within SFA 19, with the exception of the Middle, Baddeck, and North rivers, were closed to Salmon fishing all year. The Middle and Baddeck rivers were open to catch-and-release angling from October 1st to October 31st, and North River (downstream from the area known as "The Benches") was open to catch-and-release angling from June 1st to July 14th and September 1st to October 31st (Table 1). A Provincial stocking program exists on Middle and Baddeck rivers, which aims to numerically offset anticipated catch and release mortalities on these rivers (DFO 2010). Food, Social and Ceremonial (FSC) allocations were available to First Nations on these three rivers in 2019; however, the 2019-2020 Atlantic Salmon, Plamu, Conservation Harvesting Plan discouraged FSC harvest where rivers are not expected to exceed their conservation egg requirement, and no harvest of returning Salmon was reported by Indigenous communities in ECB.

Indicators of Stock Status

In 2019, all index populations in ECB were assessed to be below conservation egg requirements (Table 1), with estimated values of 57, 44, and 96 percent of the requirements for the Middle, Baddeck, and North rivers, respectively. The Salmon abundance in Clyburn Brook also continues to remain low, with 5 Salmon counted in 2019. A summary of the 2019 assessment results is provided in Tables 1 and 2, and time series showing the status of adult Salmon populations for the Middle and Baddeck, North, and Clyburn rivers are provided in Figures 1, 2, and 3, respectively.

Table 1. Atlantic Salmon assessment information for index rivers in Salmon Fishing Area 19 during 2019, including catch-and-release angling seasons, conservation egg requirements, preliminary recreational catch and effort estimates, catch and release mortality estimates, dive count results, escapement estimates, percent conservation egg requirement attained, and Provincial stocking information.

	Middle River	Baddeck River	North River	Clyburn Brook
2019 Angling Season	October 1st–31st	October 1st–31st	June 1st –July 14th; September 1st – October 31st	Closed
Assessment Information	- Recreational Catch Estimates - Dive Counts - Mark Recapture Data (historical) - Electrofishing Data (historical)	- Recreational Catch Estimates - Dive Counts - Mark Recapture Data (historical) - Electrofishing Data (historical)	- Recreational Catch Estimates - Dive Counts - Mark Recapture Data (historical)	- Dive Counts
Conservation Egg Requirement (millions of eggs)	2.07	2.01	0.92	0.28
Preliminary Recreational Catch Estimates:*				
Small Salmon	16	6	30	Not Applicable
Large Salmon	81	50	87	Not Applicable
Effort (rod-days)	339	148	185	Not Applicable
Total Catch and Release Mortality Estimates**	4	2	4	Not Applicable
Dive Counts:***				
Small Salmon	34	14	12	2
Large Salmon	292	89	104	3
Marks / Recaptures‡	1 / 0	2 / 2	Not Applicable	Not Applicable
Estimated Escapement:				
Small Salmon	39	21	25	Not Applicable
Large Salmon	331	167	215	Not Applicable
% Conservation Egg Requirement (Bayesian 90% credible interval)	**57 (43–74)**	**44 (33–57)**	**96**	**Not Applicable**
Provincial Stocking:				
Broodstock Collections	6 large, 1 small (October)	8 large (September)	Not Applicable	Not Applicable
Juvenile Releases	~25,000 fin clipped 0+ parr (November)	Not Applicable	Not Applicable	Not Applicable

*Salmo-NS Database queried on Feb. 10, 2020. River specific mean scaling factors for small Salmon, large Salmon, and effort were used to estimate catch and effort in 2019 (see Sources of Uncertainty).
**An assumed 4% mortality rate is applied to estimate catch-and-release mortalities (DFO 2013).
***Middle River dive count was conducted October 29, 2019. North River dive count was conducted October 30, 2019, and Baddeck River dive count was conducted October 31, 2019. Parks Canada conducted the Clyburn Brook dive count twice, first on Nov. 1, 2019 and then November 15, 2019. A greater number of Salmon were observed on the Nov. 15 count and this is the reported count.
‡Marking was attempted October 15–18, 2019 on Middle and Baddeck rivers, but an insufficient number of individuals were marked to obtain an observation efficiency estimate.

Table 2. Estimates of wild and hatchery Atlantic Salmon smolt abundance, production per unit area of habitat (smolts/100 m^2), as well as one-sea-winter (1SW) and two-sea-winter (2SW) return rates for Middle River.

Smolt Year (t)	Smolt Estimate*	95% Confidence Interval	Production Per Unit Area (smolts/100 m^2)	Return Rate (%)**	
				1SW (t+1)	2SW (t+2)
2013	11,103	6,848–15,359	1.43	0.20	1.68
2014* **	11,907	2,471–21,343	1.53	0.37	1.52
2015	24,110	12,057–36,164	3.10	0.15	1.96
2016	14,848	8,451–21,244	1.91	0.90	2.15
2017‡	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2018* **	9,554	1,265–17,842	1.23	0.41	Not Applicable
2019‡	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

*Source: Smolt estimates provided by Unama'ki Institute of Natural Resources. For 2013–2016 and 2018, the smolt population was estimated using a single trap mark-recapture experiment and the Adjusted Peterson Estimate (Ricker 1975).
**Ninety percent of large Salmon were assumed to be maiden 2SW Salmon based on the aging of scale samples collected from adult Salmon on Middle River during 1995–1998, 2003, and 2004. All small Salmon were assumed to be 1SW Salmon for these return rate calculations.
***The number of recaptures were low in 2014 (207 marked smolts, 276 captured smolts, and 4 recaptured smolts) and 2018 (193 marked smolts, 196 captured smolts, and 3 recaptured smolts), resulting in greater uncertainty associated with these estimates.
‡ Smolt estimates were attempted in 2017 and 2019, but were not successful due to inoperable periods during high flow events.

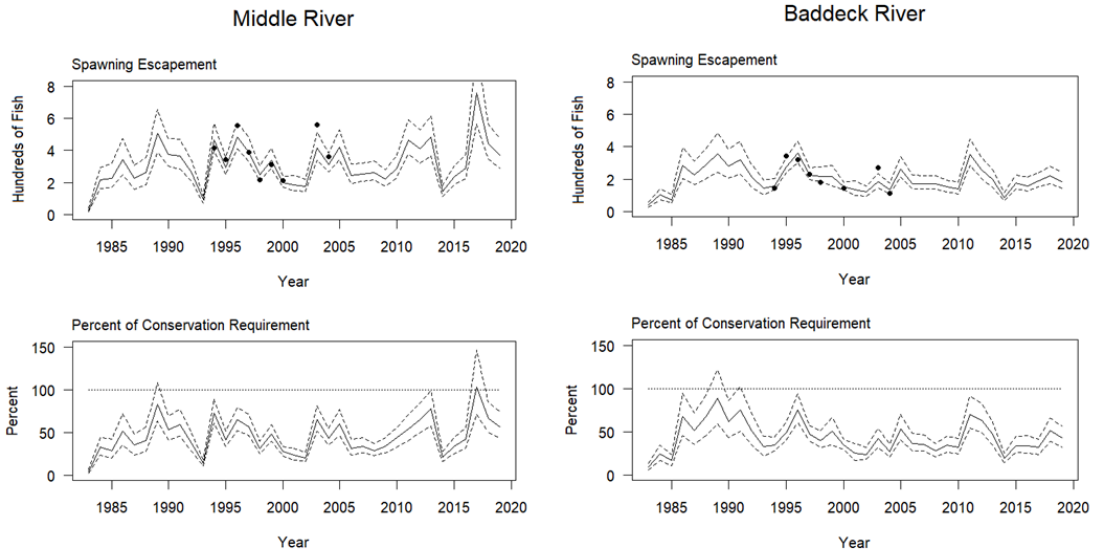

Figure 1. Estimated total number of spawners (top graph) and the percent of the conservation egg requirement attained (bottom graph) for Middle River (left panel) and Baddeck River (right panel), NS, from 1983 to 2019. Model fits derived from two methods are shown. The solid lines show the maximum likelihood estimates of annual abundance. The dashed lines show the Bayesian 90% credible interval for the annual abundance estimates. The points in the top graphs are the population estimates obtained by mark recapture during the dive surveys. The horizontal dashed line in the bottom graphs indicates 100% of the conservation egg requirement for each river.

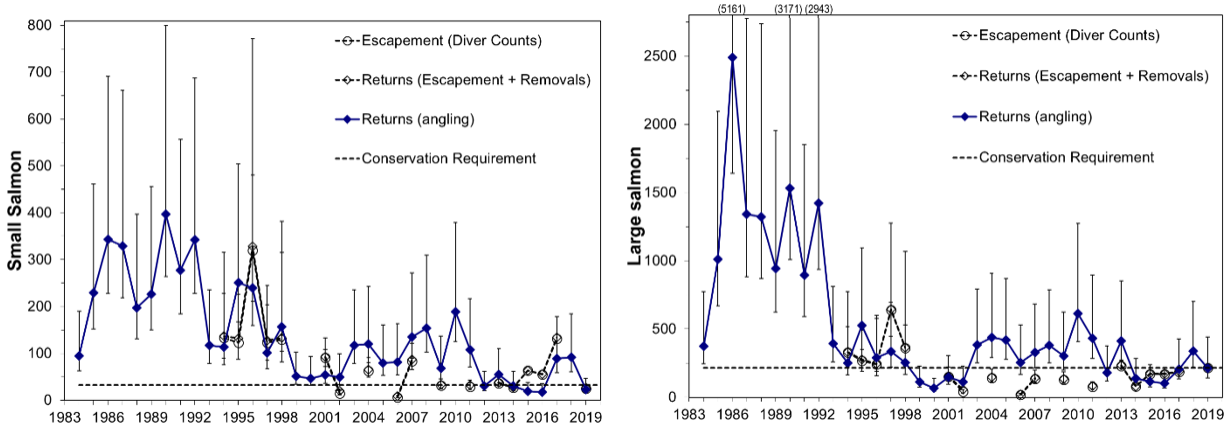

Figure 2. Estimates of the number of Atlantic Salmon returning to spawn and the spawning escapement for small and large Salmon in North River, NS, as derived from dive survey counts and from recreational catch data. The expected number of small or large Salmon necessary to meet the egg conservation requirement is shown by the horizontal dashed line. Error bars represent 90% confidence intervals; values for truncated error bars provided in brackets above figure margin.

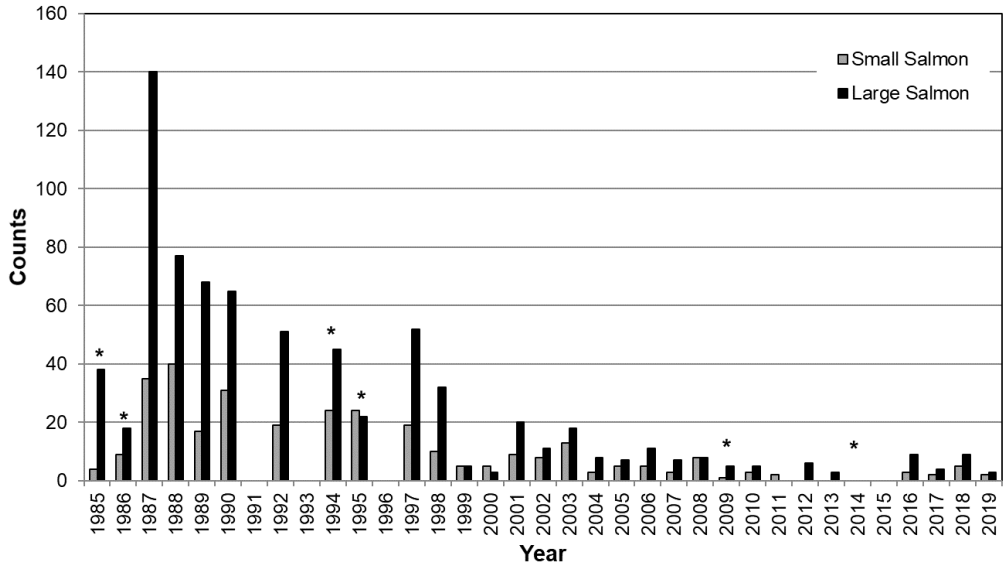

Figure 3. Counts of small and large Atlantic Salmon in Clyburn Brook, NS, from 1985 to 2019. Years where only the lower section of the river was surveyed (partial counts) are identified with an asterisk (*). No count was conducted in 1991, 1993, 1996, and 2015. Source: Parks Canada.

Southern Upland of Nova Scotia (Salmon Fishing Areas 20, 21 and Part of 22)

Salmon assessment activities in the SU region are currently focused on two populations: the St. Mary's River, the index population for SFA 20, and the LaHave River, the index population for SFA 21. Beginning in 2010, all rivers within SFA 20 and SFA 21 were closed to recreational fishing for Salmon, and there were no FSC allocations. Details on the assessment methods for SU Salmon populations are provided in DFO (2013) and Gibson et al. (2009).

Indicators of Stock Status

In 2019, the LaHave River Salmon population above Morgan Falls remained below the conservation egg requirement with an estimated egg deposition of 4% of the requirement (Table 3, Figure 4). Fry and total parr (Age 1 and older) densities (Table 3) on the St. Mary's and LaHave rivers were also low and remain well below Elson's norm values. Smolt-to-adult return rates (a proxy for marine survival) for 1SW Salmon on the LaHave River have declined to values less than 1% from 2013 to 2016 (Table 4, Figure 5). A summary of the 2019 assessment results is provided in Table 3. Time series showing adult returns and estimated egg depositions in the LaHave River above Morgan Falls are provided in Figure 4, and a time series showing smolt-to-adult Salmon return rates is provided in Figure 5.

Table 3. Atlantic Salmon assessment information for index rivers in Salmon Fishing Areas 20 and 21 during 2019, including angling seasons, conservation egg requirements, fishway counts, percent conservation egg requirement attained, and juvenile assessment results.

	St. Mary's River	LaHave River
2019 Angling Season	Closed	Closed
Assessment Information	- Juvenile Electrofishing Surveys	- Juvenile Electrofishing Surveys (above and below Morgan Falls) - Fishway Count (above Morgan Falls)
Conservation Egg Requirement (millions of eggs)	9.56	6.22*
Fishway Count:**		
Small Salmon	Not Applicable	142
Large Salmon	Not Applicable	11
% Conservation Egg Requirement:	Not Applicable	**4**
Number of Sites Surveyed and Electrofishing Densities (fish/100 m^2):		
Number of Sites	10	6
Age-0 Parr (Fry)	8.2	9.3‡
Total Age-1 and Older Parr	2.4	2.6

*The conservation egg requirement reported by O'Connell et al. (1997) has been scaled according to the proportion of habitat area above Morgan Falls (i.e., 51%).
**Corrected for observed fallbacks (i.e., Salmon are marked when they ascend the fishway for the first time, and they are not included in the count if they ascend the fishway again).
‡LaHave River average electrofishing fry densities were heavily influenced by a single site on the West Branch LaHave River in 2019 (see Sources of Uncertainty).

Table 4. Estimates of wild-origin Atlantic Salmon smolt abundance (and 95% confidence interval), production per unit area of habitat (smolts/100 m^2), and the smolt-to-adult return rates for the LaHave River.

Smolt Year (t)	Wild Smolt Estimate	95% Confidence Interval	Production Per Unit Area (smolts/100 m^2)	Return Rate (%)	
				1SW (t+1)	2SW (t+2)
1996	20,511	19,886–21,086	0.79	1.47	0.23
1997	16,550	16,000–17,100	0.63	4.33	0.43
1998	15,600	14,675–16,600	0.60	2.04	0.34
1999	10,420	9,760–11,060	0.40	4.82	0.86
2000	16,300	15,950–16,700	0.63	1.16	0.11
2001	15,700	15,230–16,070	0.60	2.70	0.59
2002	11,860	11,510–12,210	0.46	1.95	0.45
2003	17,845	8,821–26,870	0.68	1.75	0.17
2004	20,613	19,613–21,513	0.79	1.13	0.33
2005	5,270	4,670–5,920	0.20	7.95	0.54
2006	22,971	20,166–26,271	0.88	1.48	0.40
2007	24,430	23,000–28,460	0.98	2.33	0.16
2008	14,450	13,500–15,500	0.55	1.16	0.30
2009	8,644	7,763–9,659	0.33	3.47	0.88
2010	16,215	15,160–17,270	0.62	1.81	0.19
2011*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2012*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2013	7,159	5,237–10,259	0.27	0.60	0.24
2014	29,175	23,387–37,419	1.12	0.55	0.15
2015	6,664	6,011–7,413	0.26	0.35	0.35
2016	25,849	23,311–28,750	0.99	0.74	0.20
2017*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2018*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2019*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

*Smolt assessments were not conducted on the LaHave River in 2011, 2012, 2017, 2018, and 2019.

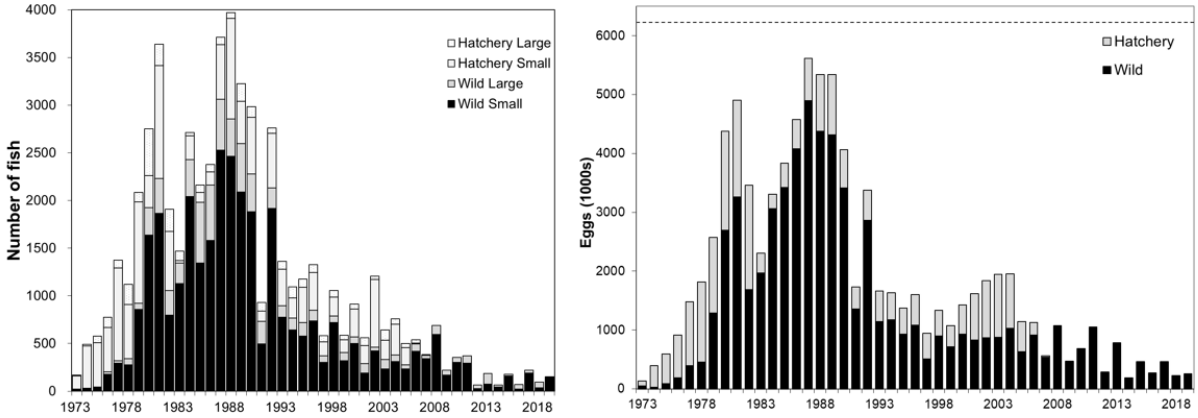

Figure 4. Counts of small and large adult Salmon (left panel) and estimated egg deposition (1000's) relative to the conservation egg requirement (right panel) by wild-origin and hatchery-origin Salmon at the Morgan Falls fishway on the LaHave River, NS, from 1973 to 2019. The horizontal dashed line in the right panel indicates the conservation egg requirement above Morgan Falls. Hatchery-origin smolts were no longer introduced after 2005. Genetic sex determination was used when available (2012–2017) to estimate egg deposition, and visual external sex identification was used in all other years.

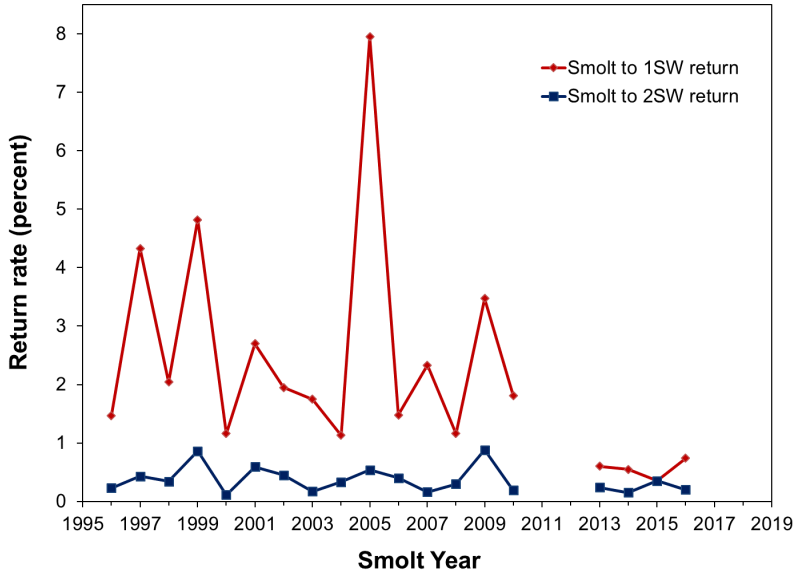

Figure 5. Estimated smolt-to-adult return rates for one-sea-winter (1SW) and maiden two-sea-winter (2SW) Salmon on the LaHave River (above Morgan Falls).

Outer Bay of Fundy (Outer Portion of Salmon Fishing Area 23)

Salmon assessment activities led by DFO in the OBoF region are currently focused on two river systems: Saint John River (upriver of Mactaquac Dam, which includes the Tobique tributary) and Nashwaak River (tributary of Saint John River downriver of Mactaquac Dam). The Atlantic Salmon Federation (ASF) monitors adult and juvenile Salmon abundance on the Magaguadavic River. A detailed assessment to update status until 2012 for the OBoF population was completed for the Recovery Potential Assessment of this DU (Jones et al. 2014).

All commercial fisheries for Salmon in SFA 23 have been closed since 1984. Low abundance of Salmon has resulted in no FSC allocations and no recreational fisheries since 1998. In 2019, all rivers within SFA 23 remained closed to Salmon fishing all year.

The Mactaquac Biodiversity Facility (MBF) was constructed to numerically offset the effects of hydroelectric development on Salmon populations in the Saint John River, primarily by producing smolts from sea-run broodstock captured at fish collection facilities at Mactaquac Dam. Based on an agreement within the 'Saint John River Management Advisory Committee' in 2002, the Salmon supplementation program at the MBF was modified to focus on conserving and restoring a declining resource utilizing captive-reared adults, originally collected from the wild as juveniles, for both broodstock and adult releases to naturally spawn upriver of Mactaquac Dam (Jones et al. 2004). Approximately 90 broodstock matings per year are still carried out at the MBF for the production of smolts to release downriver of Mactaquac Dam and unfed fry to release in the Tobique River. Unfed fry have also been released into the Nackawic River since 2018. In 2019, unfed fry were also distributed to River de Chute, a tributary of the Saint John River above Mactaquac Dam.

Indicators of Stock Status

Returns to the three SFA 23 index rivers in 2019 were all estimated to contribute less than 6% of their conservation (egg) requirements (Table 5). Although egg depositions from spawners in the Saint John (upriver of Mactaquac Dam) and Nashwaak rivers increased slightly from record low values in 2018, estimates in 2019 for each of the three OBoF index rivers remained below 8% of their conservation egg requirements for the eighth consecutive year. Assuming the captive-reared adults spawn successfully, spawners released upriver of Mactaquac Dam in 2019 potentially increased the estimated egg depositions to 11% of the requirement on that section of the Saint John River. In 2019, fry and total parr (Age 1 and older) densities (Table 5) on the Tobique, Nashwaak, and Magaguadavic rivers were also low at <3 fish/100 m^2 and remain well below Elson's norm values. Fry densities on the Tobique River were particularly low (0.1 fry/100 m^2). The pre-smolt (Tobique) and smolt (Nashwaak) abundance estimates in 2019 were both less than 0.2 fish/100 m^2 of productive habitat, which is very low in comparison to the reference value of 3.8 smolts/100 m^2 (Symons 1979). Smolt-to-adult return rates for 1SW and 2SW Salmon on the Nashwaak River were not possible to calculate in 2019. Smolt-to-1SW (2.84) and 2SW (0.41) return rates for the 2016 smolt cohort, the most recent year for which return data is available, were lower than the long-term means (1998–2015; 4.38 and 1.08) and the previous 10-year means (2006–2015; 4.34 and 1.11) shown in Table 6. There were 78 suspected aquaculture-origin escapes (38 small salmon and 40 large salmon) captured at the St. George fishway and trap near the head of the tide on the Magaguadavic River in 2019. All aquaculture Salmon were sacrificed for disease testing. A summary of the 2019 assessment results is provided in Table 5. Time series showing the status of Salmon populations for the Saint John (upriver of Mactaquac Dam) and Nashwaak rivers are provided in Figures 6–9, and a time series showing smolt-to-adult Salmon return rates is provided in Figure 10.

Table 5. Salmon assessment information for index rivers in Salmon Fishing Area 23 during 2019, including angling seasons, conservation egg requirements, fish collection facilities/fishway/fence counts, estimated returns, percentage of conservation egg requirements attained, captive-reared adult and juvenile releases, and juvenile and smolt assessment results.

	Saint John River (Above Mactaquac Dam)	Nashwaak River (Above Durham Bridge)	Magaguadavic River
Angling Season (2019)	Closed	Closed	Closed
Assessment Information	- Fish Collection Facilities Count - Juvenile Electrofishing Surveys - Pre-smolt Assessment	- Counting Fence (Mark Recapture) - Juvenile Electrofishing Surveys (above and below Counting Fence) - Smolt Assessment (Mark Recapture)	- Fishway Count - Juvenile Electrofishing Surveys
Conservation Egg Requirement (millions of eggs)	32.30	12.8 [1*]	1.35
Fishway or Fence Count:			
1SW Salmon	502	122	0
MSW Salmon	197	43	1
Suspected Aquaculture Escapes	3	0	78
Marks (M) / Recaptures (R) / Captures (C)	Not Applicable	M=126 / R=11 / C=26	Not Applicable
Estimated Returns:			
1SW Salmon	507	238	0
MSW Salmon	202	68	1
% Conservation Egg Requirement:			
Without Captive-Reared	**4**	**5**	**0**
Including Captive-Reared	11	Not Applicable	Not Applicable
Captive-reared Adult Releases	582**	Not Applicable	Not Applicable
Juvenile Releases:			
Age-1 Smolt (below Dam)	20 (Research)	Not Applicable	160 (Research)
Unfed Fry (Tobique)	38,719 (June)	Not Applicable	Not Applicable
Unfed Fry (River de Chute)	42,000 (June)	Not Applicable	Not Applicable
Unfed Fry (Nackawic)	182,000 (June)	Not Applicable	Not Applicable
Green Eggs (Tobique)	18,000 (Research)	Not Applicable	Not Applicable
Number of Sites Surveyed and Electrofishing Densities (fish/100 m^2):			
Number of Sites	16***	10	7
Age-0 Parr (Fry)	0.1***	1.2	0.0
Total Age-1 and Older Parr	2.3***	2.0	0.0
Wild-Origin Pre-Smolt or Smolt Estimate (2.5 and 97.5 percentiles)	2,625***, ‡ (1,310–17,880)‡	8,710 (5,690–17,815)	Not Applicable
Pre-Smolt or Smolt (fish/100 m^2)	0.03***	0.16	Not Applicable

*The conservation egg requirement reported by Marshall et al. (1997) is calculated based on the habitat area above the counting fence (above Durham Bridge) on the Nashwaak River (i.e., 90%).
**535 captive reared adults were released into the Tobique River, while 47 adults (originally collected from the Beechwood Hydroelectric Facility) were released into the main Saint John River below Perth-Andover and allowed to free swim throughout the upper part of the system.
***Electrofishing and pre-smolt results are for the Tobique River (index tributary and represents 54.4% of the accessible rearing habitat upriver of Mactaquac Dam within Canadian boundaries).
‡The number of pre-smolt recaptures were low in 2019 (38 marked, 206 captured, and 3 recaptured), resulting in greater uncertainty associated with this estimate.

[1] Erratum November 2023 – 5.35 corrected to 12.8

Table 6. Estimates of wild-origin Salmon smolt abundance from upriver of Durham Bridge (and 2.5 and 97.5% percentiles), production per unit area of habitat (smolts/100 m^2), and the smolt-to-adult return rates for the Nashwaak River, 1998–2019.

Smolt Year (t)	Wild Smolt Estimate	95% Confidence Interval	Production Per Unit Area (smolts/100 m^2)	Return Rate (%)	
				1SW (t+1)	2SW (t+2)
1998	22,750	17,900–32,850	0.43	2.91	0.67
1999	28,500	25,300–33,200	0.54	1.79	0.84
2000	15,800	13,400–19,700	0.30	1.53	0.28
2001	11,000	8,100–17,400	0.21	3.11	0.90
2002	15,000	12,300–19,000	0.28	1.91	1.26
2003	9,000	6,800–13,200	0.17	6.38	1.58
2004	13,600	10,060–20,800	0.26	5.13	1.28
2005	5,200	3,200–12,600	0.10	12.73	1.52
2006	25,400	21,950–30,100	0.48	1.81	0.62
2007	21,550	16,675–30,175	0.41	5.63	1.26
2008	7,300	5,500–11,200	0.14	3.86	2.05
2009	15,900	12,150–22,850	0.30	12.41	3.31
2010	12,500	9,940–16,740	0.24	7.86	0.35
2011	8,750	7,130–11,300	0.17	0.33	0.98
2012	11,060	8,030–17,745	0.21	1.63	0.29
2013	10,120	8,840–11,800	0.19	1.61	0.45
2014	11,100	8,150–17,200	0.21	2.86	0.60
2015	7,900	6,520–9,980	0.15	5.04	1.18
2016	7,150	5,575–9,925	0.13	2.84	0.41
2017*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2018*	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
2019	8,710	5,690–17,815	0.16	Not Applicable	Not Applicable

*A smolt estimate was attempted but was not successful due to a high flow event that prevented operation of the Rotary Screw Trap during the full smolt migration period.

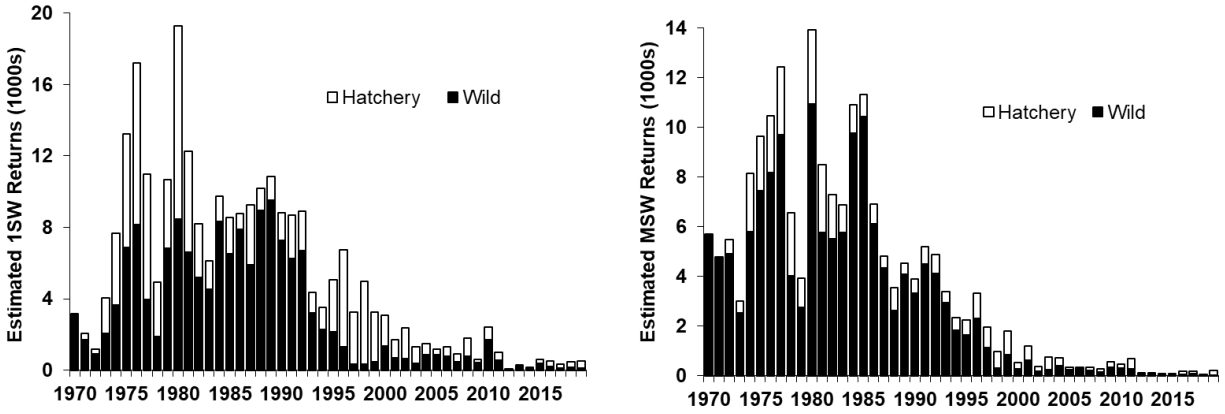

Figure 6. Estimated wild and hatchery-origin one-sea-winter (1SW) and multi-sea-winter (MSW) Salmon returns destined for upriver of Mactaquac Dam, Saint John River, 1970–2019.

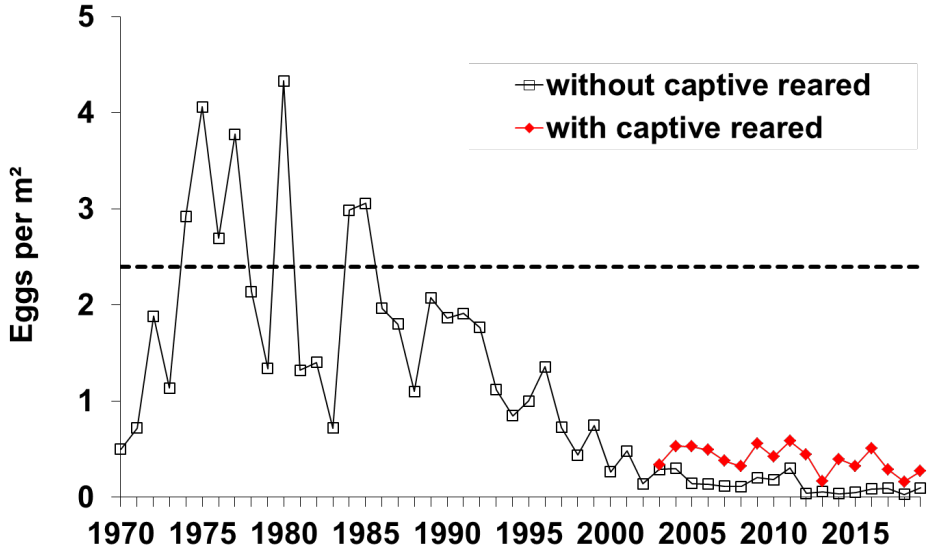

Figure 7. Estimated egg deposition per m^2 (wild and hatchery combined, and captive-reared) upriver of Mactaquac Dam, Saint John River,1970–2019. The horizontal dashed line is the conservation egg requirement (2.4 eggs per m^2).

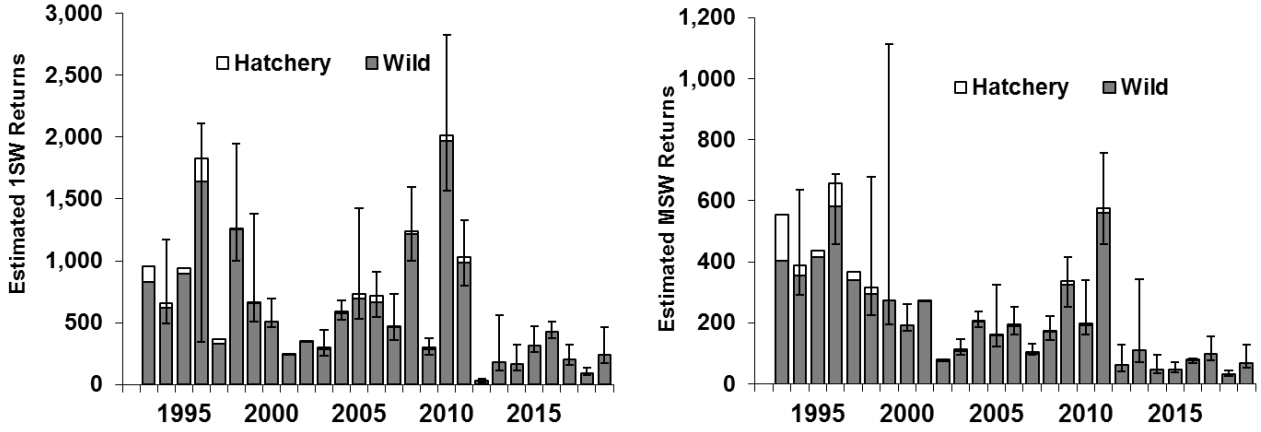

Figure 8. Estimated wild and hatchery-origin one-sea-winter (1SW) and multi-sea-winter (MSW) Salmon returns (and 2.5 and 97.5 percentiles) to the Nashwaak River, 1993–2019. No hatchery-origin releases since 2010.

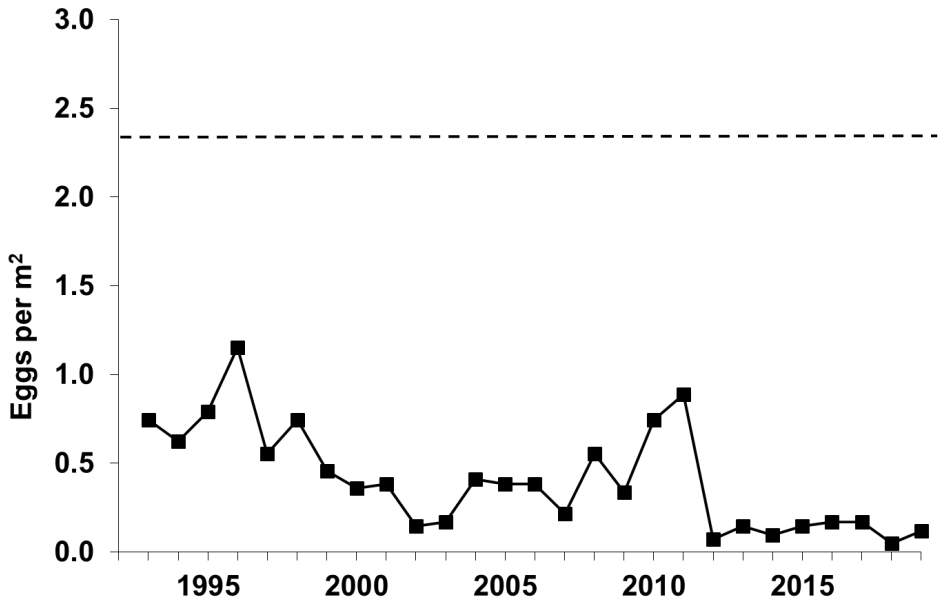

Figure 9. Estimated egg deposition per m^2 upriver of the counting fence operated just below Durham Bridge, Nashwaak River, 1993–2019. The horizontal dashed line is the conservation egg requirement (2.4 eggs per m^2).

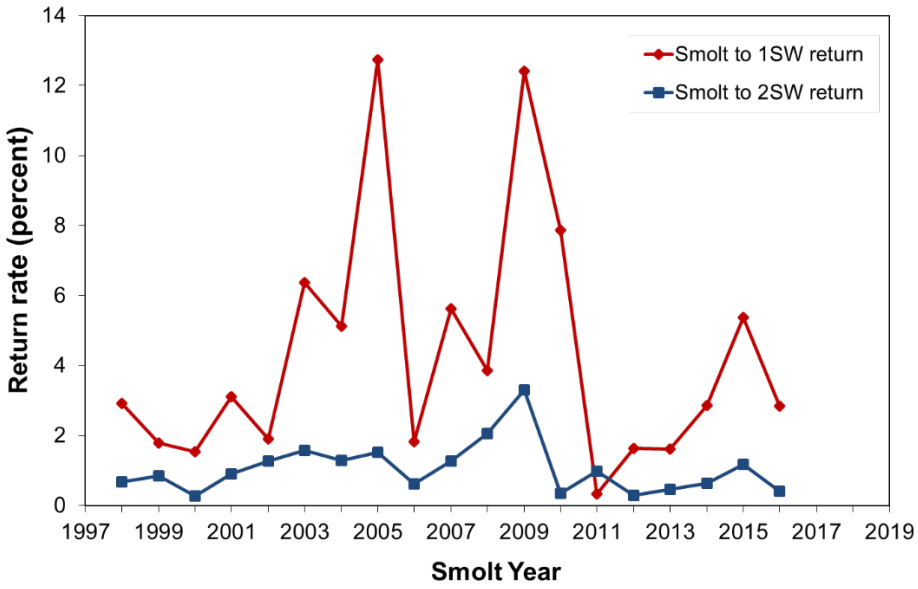

Figure 10. Estimated smolt-to-adult return rates for one-sea-winter (1SW) and maiden two-sea-winter (2SW) Salmon on the Nashwaak River (above Durham Bridge).

Sources of Uncertainty

There are on-going informal reports of illegal fishing activities (e.g., fishing in closed areas and poaching), but the combined contribution of these activities to the depressed status of populations is not known.

Further details on the uncertainty associated with these assessment methods can be found in DFO (2013).

Eastern Cape Breton

The number of small and large Salmon caught and released, fishing effort, and catch and release mortality within SFA 19 are estimated from licence stub returns from the recreational Salmon fishery. Catch and effort values are adjusted for non-returned stubs using a relationship based on the reported catch as a function of the number of reminder letters sent to licensed anglers. For recreational catch data, under- or over-reporting of numbers of Salmon caught and fishing effort would impact assessment results based on these data. Estimates for 2019 are considered to be preliminary at the time of this status update since licence sale information and licence stubs are still being returned. In recent years, catch and effort estimates prior to sending reminder letters to anglers have generally been systematically higher than catch and effort estimates after reminder letters have been sent. In an attempt to reduce this bias in years where reminder letters were not sent to anglers (i.e., 2004, 2008–2010, and 2018), individual river mean scaling factors (i.e., estimate after reminder letter information divided by reported value prior to reminder letter information) for small Salmon, large Salmon and effort have been applied to reported values to estimate catch and effort.

A pool count of Salmon returns was conducted on North River on August 20, 2019, where 106 large and 11 small Salmon were counted. Water levels were low and the visibility was considered to be moderate to good during this count; however, high summer water

temperatures preclude a mark-recapture approach to determine observation efficiency; therefore, it was not used for population assessment purposes.

Although some populations in ECB have been closer to their conservation egg requirements than those in the OBoF and SU regions, substantial declines are evident in other ECB populations (e.g., Grand River and Clyburn Brook). There is uncertainty in the status of populations in non-index rivers, which has been inferred from recreational catch data and limited electrofishing data (Levy and Gibson 2014).

Southern Upland

LaHave River electrofishing fry and parr densities were low at the majority of survey sites in 2019; while the average densities reported were similar to data from recent years, the average values were influenced by sites on the West Branch LaHave River. There is uncertainty as to the effect of drought conditions on LaHave River in 2016 on juvenile Atlantic Salmon, particularly in the absence of smolt estimates since 2017. Low returns of large Salmon in 2019 may be reflective of low smolt output in 2017 caused by freshwater mortality from this event.

Outer Bay of Fundy

The very low densities of fry on the Tobique River in 2019 may be attributed to record low egg depositions in 2018 for the Saint John River (upriver of Mactaquac Dam). The estimates were, the lowest in the time series for both without captive-reared and including captive-reared spawners, at 1% and 6% of the conservation egg requirements, respectively (DFO 2020). Exceptionally high discharges noted in several Saint John River tributaries above Mactaquac Dam in early to mid-spring may have negatively impacted survival of emergent fry. This may also have contributed to the low abundance indices derived from electrofishing surveys, although there are no empirical data to confirm this. The potential consequences of these events on future smolt abundance and adult recruitment is uncertain and needs to be examined with the combined effects of Age 1 and older parr survival, downstream mortality of smolts, and at-sea survival rates.

Conclusions

All Salmon index populations within DFO's Maritimes Region were assessed to be below conservation egg requirements in 2019. The SU and OBoF Salmon populations remain critically low. Adult Salmon returns to the LaHave River (SU), the Saint John River upriver of Mactaquac Dam, and the Nashwaak River (OBoF) remain among the lowest returns on record with estimated egg depositions ranging between 4–5% of conservation egg requirements in 2019. Moreover, recent smolt-to-adult return rates (a proxy for marine survival) for 1SW and 2SW Salmon on the LaHave River were estimated to be the lowest on record with values less than 1% from 2013–2016, the most recent years for which data are available. Smolt-to-adult return rates on the Nashwaak River were not available for both 1SW and 2SW returns for the first time since 1999 because a smolt assessment was not possible in 2017 and 2018. Some populations in the ECB region have been closer to conservation egg requirements than those in the OBoF and SU regions, although egg depositions for ECB index populations remained below conservation egg requirements with values ranging between 44–96% of these requirements in 2019.

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Appendix

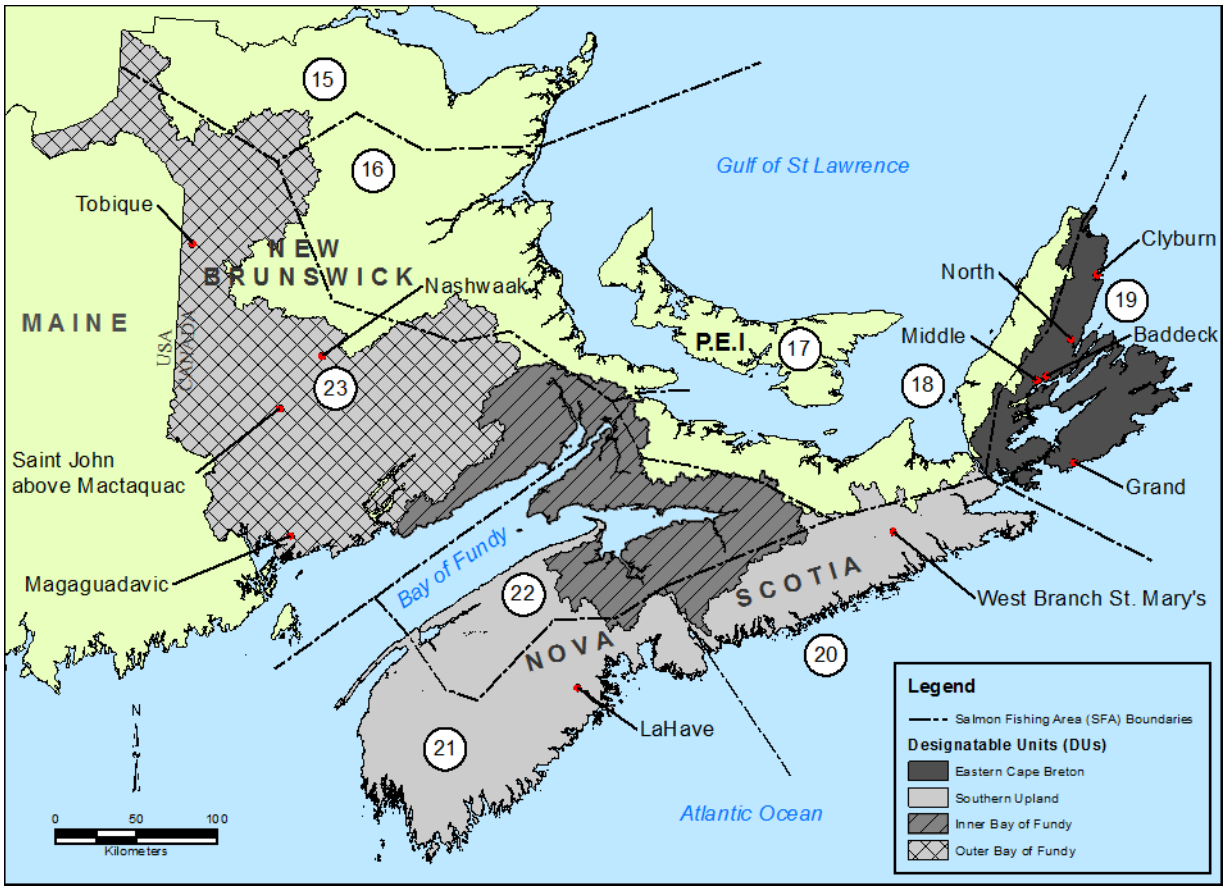

Figure A1. Map showing the locations of Salmon rivers where monitoring predominately occurred, Salmon Fishing Areas (SFAs), and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Designatable Units (DUs) mentioned in this update. SFA numbers are labeled inside the white circles. Data Source for DUs derived from NS Secondary Watershed Layer (NS Dept. of Environment) and NB Watershed Level 1 Layer (NB Dept. of Natural Resources).

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