



STATUS 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, 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 1).

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) is currently undergoing the process of developing a SARA listing recommendation for these DUs. Scientific Recovery Potential Assessments, Socio-Economic Analyses, and public consultations have been completed and DFO is in the process of developing Regional listing recommendations for the Minister.

Science advice on the status of Atlantic Salmon in SFAs 19-21 and 23 for 2014 was requested by Fisheries and Aquaculture 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 2015. The objectives of the request were to assess the status of Atlantic Salmon stocks in SFAs 19, 20, 21 and 23 up to the end of 2014 using the following indicators:

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

Given that this request was for an update of previous advice using established methods (DFO 2014), it was decided to use the Science Special Response Process. DFO Science plans to provide annual updated advice on the status of Atlantic Salmon stocks within the Maritimes Region over the next five years via this process.

This Science Response Report results from the Science Response Process of February 26, 2015, on the Assessment of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23.

Analysis and Response

Methods

Evaluation of the status of Atlantic Salmon in the Maritimes Region is based on abundance monitoring for a number of index populations. For most index populations, 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/metre squared (m^2) multiplied by the amount of accessible fluvial rearing (of suitable gradient)

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habitat. An egg deposition of 2.4 eggs/m² is considered to be a *Limit Reference Point* 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, juvenile Salmon abundance determined from electrofishing surveys is compared to Elson's norm values of 29 fry/100m² and 38 parr/100m² (Elson 1967). A smolt production estimate of 3.8 smolts/100m² (Symons 1979) is sometimes used as a general reference value for rivers at or near conservation, and is provided here to allow for a comparison of smolt production estimates.

Eastern Cape Breton (SFA 19)

Salmon population monitoring by DFO in ECB is currently focused on three river systems: Middle, Baddeck, and North rivers (Table 1). Parks Canada 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) also conducted a smolt population assessment on Middle River in 2013 and 2014 (Table 1). 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 2014, all rivers within SFA 19 with the exception of Middle, Baddeck, and North were closed to Salmon fishing all year. 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 15th 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 2014.

In 2014, all index populations in eastern Cape Breton were assessed to be below conservation (egg) requirements (Table 1), with estimated values of 20, 24, and 37 percent of the requirements for Middle, Baddeck and North rivers respectively. The analyses for Middle and Baddeck rivers indicate a very low probability (<0.1%) of these rivers achieving conservation (egg) requirements in 2014. Parks Canada surveyed the lower section of Clyburn Brook via a dive count on December 2, 2014. The Salmon abundance in Clyburn Brook continues to remain low with no Salmon counted in 2014. A summary of the 2014 assessment results is provided in Table 1 and time series showing the status of adult Salmon populations for 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 SFA 19 during 2014, 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, Provincial stocking information, and a smolt population estimate.

	MIDDLE RIVER	BADDECK RIVER	NORTH RIVER	CLYBURN BROOK
Angling Season (2014)	October 1 - 31	October 1 - 31	June 1 - July 15 & September 1 - October 31	Closed
Assessment Information	-Recreational Catch Estimates -Dive Counts -Mark Recapture Data -Electrofishing Data -Smolt Estimate	-Recreational Catch Estimates -Dive Counts -Mark Recapture Data -Electrofishing Data	-Recreational Catch Estimates -Dive Counts -Mark Recapture Data	-Dive Counts
Conservation (egg) Requirement (millions of eggs)	2.07	2.01	0.92	0.28
Preliminary Recreational Catch Estimates*:				
Small Salmon	4	9	33	n/a
Large Salmon	30	33	100	n/a
Effort (rod-days)	224	140	276	n/a
Total Salmon Catch and Release Mortality Estimates**	1	2	5	n/a
Dive Count:				
Small Salmon	7	10	13	0
Large Salmon	71	45	38	0
Estimated Escapement:				
Small Salmon***	10	21	27	n/a
Large Salmon***	118	91	80	n/a
% Conservation (egg) Requirement (Bayesian 90% credible interval)	20 (15 - 26)	24 (18 - 32)	37	n/a
Provincial Stocking:				
Broodstock Collections	5 large, 2 small (October)	8 large, 0 small (October)	n/a	n/a
Juvenile Releases	18,504 fin clipped 0+parr (December)	12,978 fin clipped 0+parr (December)	n/a	n/a
Smolt Population Estimate (95% C.I.)****	11,522 (2,386 – 20,658)			
Fish / 100 m²	1.48	n/a	n/a	n/a

Table Notes:

n/a = not applicable

* Salmo-NS Database queried on February 15, 2015. River specific mean scaling factors for small Salmon, large Salmon, and effort were used to estimate catch and effort in 2014 (see Sources of Uncertainty).

** An assumed 4% mortality rate is applied to estimate catch-and-release mortalities (see DFO 2013).

*** For North River, escapement was estimated from a dive count conducted on October 22 and the mean observation rate for dive counts on North River. A pool count of Salmon returns was also conducted on North River during August 27-28 where a total of 25 small and 44 large Salmon were counted.

**** Source: UINR. Mark-recapture experiment consisted of 207 marked smolts, 276 captured smolts, and 4 recaptured smolts. Smolt population estimated using Adjusted Peterson estimation (Ricker 1975).

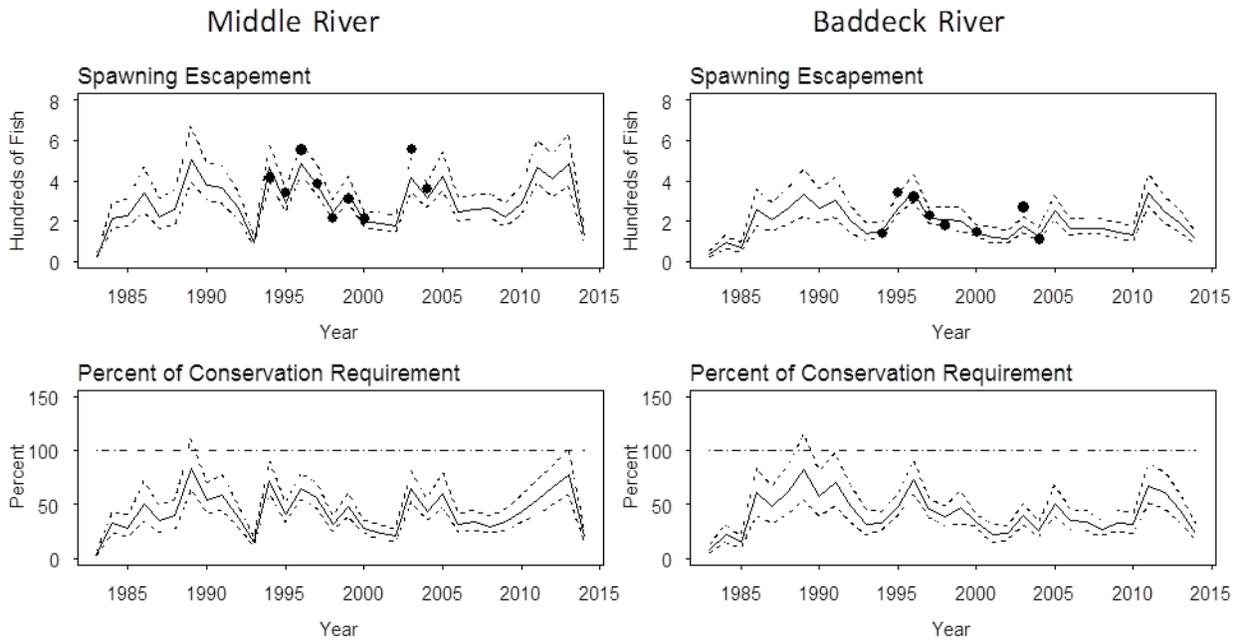


Figure 1. Estimated total number of spawners (top graph) and the percent of the conservation (egg) requirement attained (bottom graph) for Middle River (left panel) and Baddeck River (right panel), NS, from 1983 to 2014. Model fits derived from two methods are shown. The solid lines show the maximum 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.

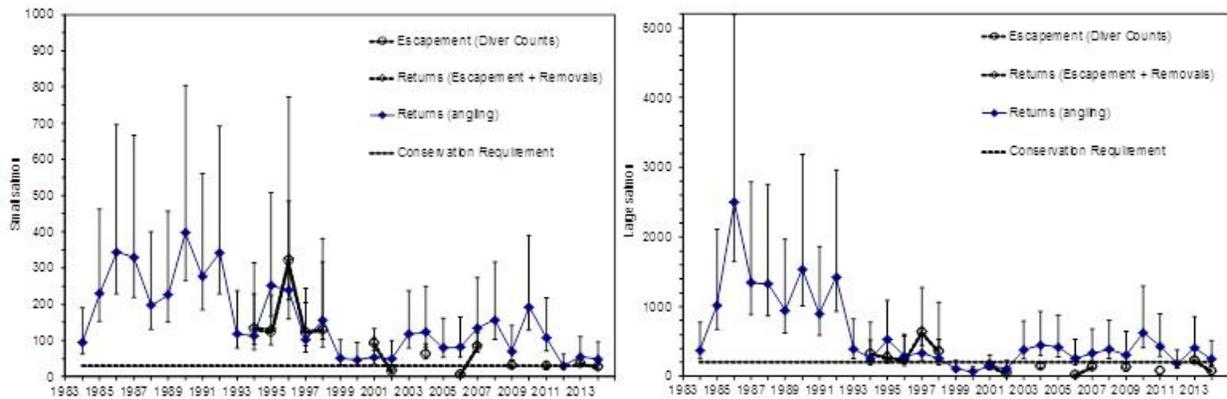


Figure 2. Estimates of the number of Salmon returning to spawn and the spawning escapement for small and large Salmon in the North River, NS, as derived from dive survey counts and from recreational catch data. The expected number of small or large Salmon necessary to meet the conservation requirement is shown by the horizontal dashed line. Error bars are 90% confidence intervals.

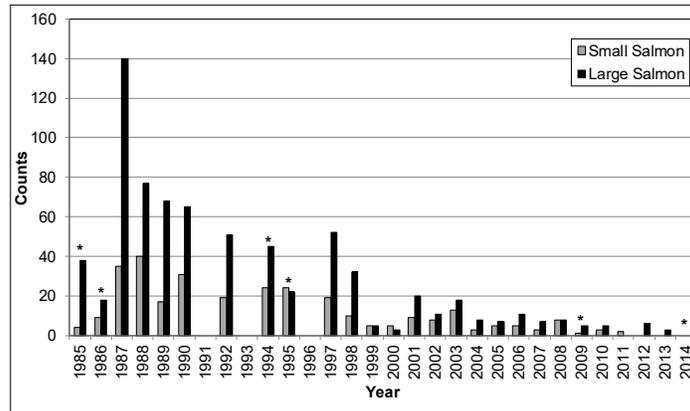


Figure 3. Counts of small and large Salmon in Clyburn Brook, NS, from 1985 to 2014. Years in which only the lower section of the river was surveyed (partial counts) are identified with an asterisk (*). Source: Parks Canada.

Southern Upland of Nova Scotia (SFAs 20, 21 and Part of SFA 22)

Atlantic 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 Atlantic 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).

In 2014, the LaHave River Salmon population above Morgan Falls remained below the conservation (egg) requirement with an estimated egg deposition of 3 percent of the requirement. Fry and total parr (age one and older) densities (Table 2) on the St. Mary’s and LaHave rivers were also low and remain below Elson’s norm values. A summary of the 2014 assessment results is provided in Table 2, and time series showing adult returns and estimated egg deposition in the LaHave River above Morgan Falls are provided in Figure 4.

Table 2. Atlantic Salmon assessment information for index rivers in SFAs 20 and 21 during 2014, including catch-and-release angling seasons, conservation (egg) requirements, fishway count, percent conservation (egg) requirement attained, and juvenile and smolt assessment results.

	ST. MARY'S RIVER	LAHAVE RIVER (ABOVE MORGAN FALLS)
Angling Season (2014)	Closed	Closed
Assessment Information	- Juvenile Electrofishing Surveys	- Juvenile Electrofishing Surveys (above and below Morgan Falls) - Smolt Assessment - Fishway Count
Conservation (egg) Requirement (millions of eggs)	9.56	6.22*
Fishway Count**		
Small Salmon	n/a	43
Large Salmon	n/a	21
% Conservation (egg) Requirement	n/a	3
Juvenile Electrofishing:		
Number of Sites	10	10
Juvenile Densities (fish/100m²):		
Age-0 Parr (Fry)	9.4	19.6
Total Age-1 and Older Parr	3.4	3.2
Smolt Population Estimate (95% C.I.)	n/a	29,175 (23,387 – 37,419)
Fish/100 m²	n/a	1.12

Table Notes:

n/a = not applicable

* 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.

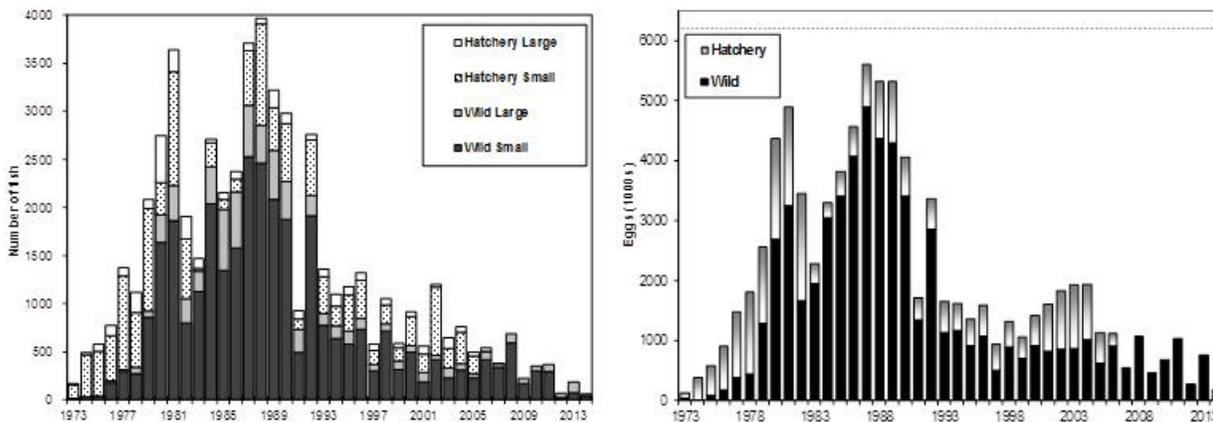


Figure 4. Counts of small and large adult Atlantic Salmon (left panel) and estimated egg deposition (1000's) relative to the conservation (egg) requirement (right panel) by wild-origin and hatchery-origin at the Morgan Falls fishway on the LaHave River, NS, from 1973 to 2014. The horizontal dashed line in the right panel indicates 100% of the conservation (egg) requirement above Morgan Falls. Hatchery-origin smolts were no longer introduced after 2005.

Outer Bay of Fundy (Outer Portion of SFA 23)

Atlantic Salmon assessment activities 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 monitors adult and juvenile Salmon abundance on the Magaguadavic River. A detailed assessment updating status to 2012 for the OBoF population was completed for the Recovery Potential Assessment of this DU (Jones et al. 2014).

All commercial fisheries for Atlantic 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 2014, 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 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 Management Advisory Committee' in 2004, the 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 for natural spawning upriver of Mactaquac Dam (Jones et al. 2004). About 90 broodstock matings are still carried out at MBF for the production of smolts for release downriver of Mactaquac Dam and fall parr for release in the Tobique River.

Returns to the three index rivers in 2014 remain below conservation (egg) requirements and have all been estimated to contribute less than 5% of the requirements (Table 3). In 2014, fry and total parr (age one and older) densities (Table 3) on the Tobique River and Nashwaak River were also low (<4 fish/100m²) and remain below Elson's norm. The pre-smolt (Tobique) and smolt (Nashwaak) abundance estimates in 2014 were both less than 0.3 fish/100m² of productive habitat which is very low in comparison to the reference value of 3.8 smolts/100m² (Symons 1979). A summary of the 2014 assessment results is provided in Table 3, and time series showing the status of Salmon populations for Saint John (upriver of Mactaquac Dam) and Nashwaak rivers are provided in Figures 5-8.

Table 3. Atlantic Salmon assessment information for index rivers in SFA 23 during 2014, including conservation (egg) requirements, fishway/fence counts, estimated returns, percentage of conservation (egg) requirements met, captive-reared and juvenile releases, and juvenile and smolt assessment results.

	SAINT JOHN RIVER (ABOVE MACTAQUAC DAM)	NASHWAAK RIVER (ABOVE DURHAM BRIDGE)	MAGAGUADAVIC RIVER
Angling Season (2014)	Closed	Closed	Closed
Assessment Information	- Fishway 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*	133	49	10
MSW Salmon*	77	14	3
Marks / Recaps / Captures	n/a	M=60 / R=12 / C=42	n/a
Estimated Returns:			
1SW Salmon*	134	163	10
Proportion hatchery	0.16	n/a	0.10
MSW Salmon*	79	48	3
Proportion hatchery	0.34	n/a	0.33
% Conservation (egg) requirement:			
Without Captive-Reared	2	4	<1
Including Captive-Reared	16	n/a	n/a
Captive-reared Adult Releases	1,179	n/a	n/a
Juvenile Releases:			
Age-1 Smolt	14,741 (May)	n/a	n/a
Unfed Fry	568,000 (June)	n/a	n/a
Age-0 Parr	247,193 (Sept/Oct)	n/a	1,900 (Oct)
Age-1 Parr	26,110 (Sept.)	n/a	n/a
Electrofishing Densities (fish/100m²):			
Number of Sites	16 ^{***}	10	11
Age-0 Parr (Fry)	1.6 ^{***}	3.2	0.5
Total Age-1 and Older Parr	3.7 ^{***}	3.5	0.6
Wild-origin Pre-smolt or Smolt Estimate (2.5 and 97.5 percentiles)	8,880 ^{***} (5,700-17,460)	11,000 (8,150-17,200)	n/a
Pre-smolt or Smolt (fish/100m²)	0.11 ^{***}	0.21	n/a

Table Notes:

n/a = not applicable

* One-sea-winter (1SW) Salmon are those which return to spawn following a single winter at sea (also termed Grilse). Multi-sea-winter (MSW) Salmon include those fish which return following two or more winters at sea and repeat spawning Salmon.

** 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%).

*** Electrofishing and pre-smolt results are for the Tobique River (index tributary upriver of Mactaquac Dam).

¹ Erratum November 2023 – 5.35 corrected to 12.8

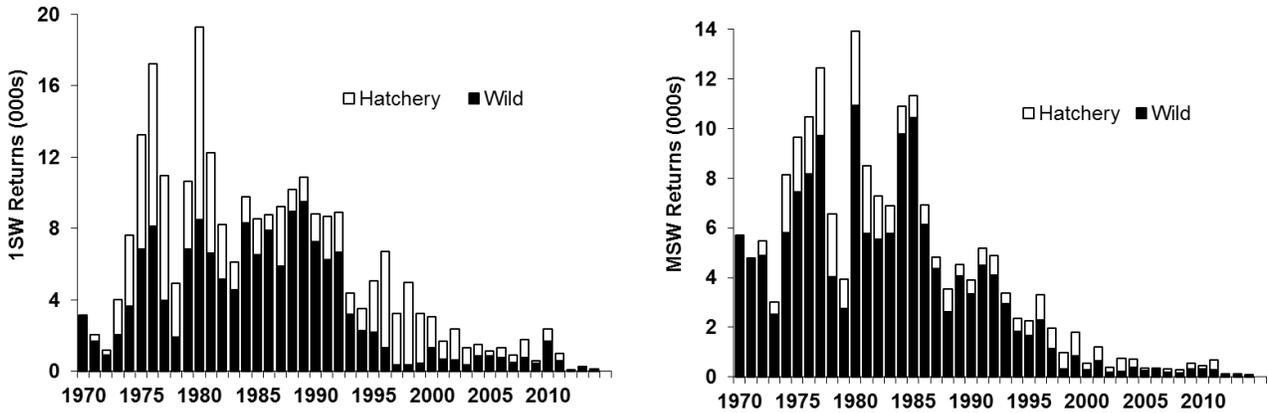


Figure 5. Estimated wild and hatchery-origin 1SW and MSW returns destined for upriver of Mactaquac Dam, Saint John River, 1970-2014. Hatchery fish were present in very small numbers between 2011-14.

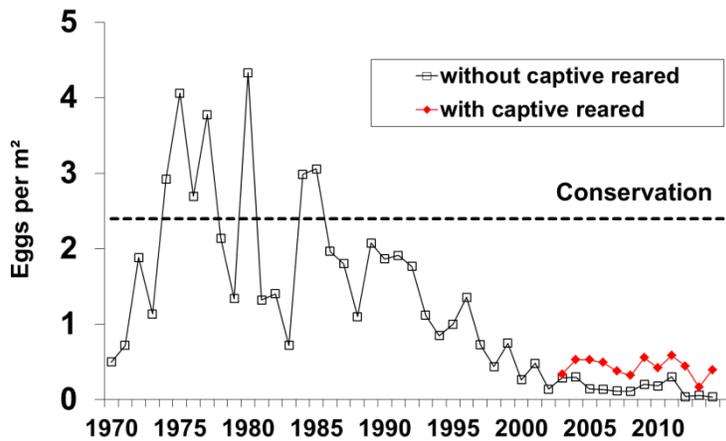


Figure 6. Estimated egg deposition (wild and hatchery combined, and captive-reared) upriver of Mactaquac Dam, Saint John River, 1970-2014. The horizontal dashed line is the conservation (egg) requirement.

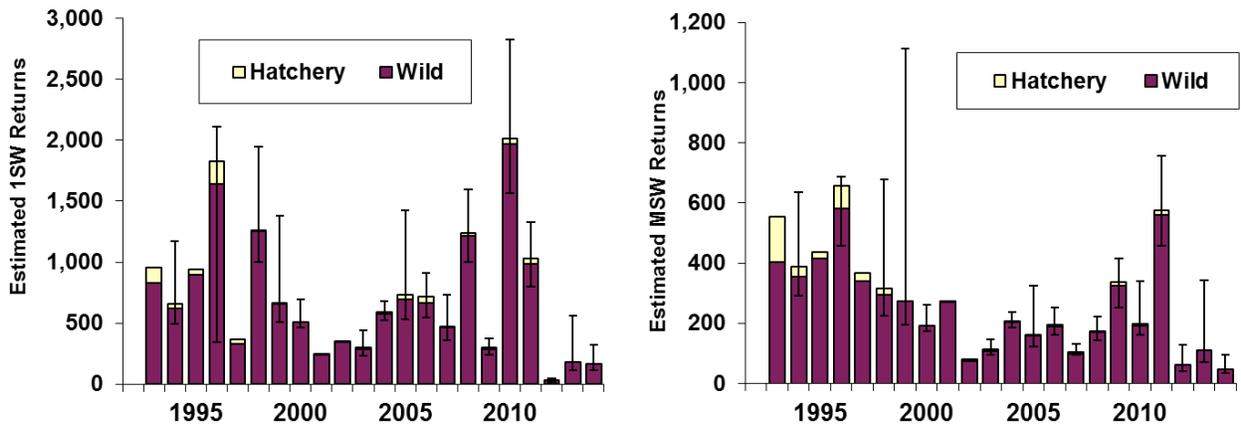


Figure 7. Estimated wild and hatchery-origin 1SW and MSW Salmon returns (and 2.5 and 97.5 percentiles) to the Nashwaak River, 1993-2014. No hatchery-origin releases since 2010.

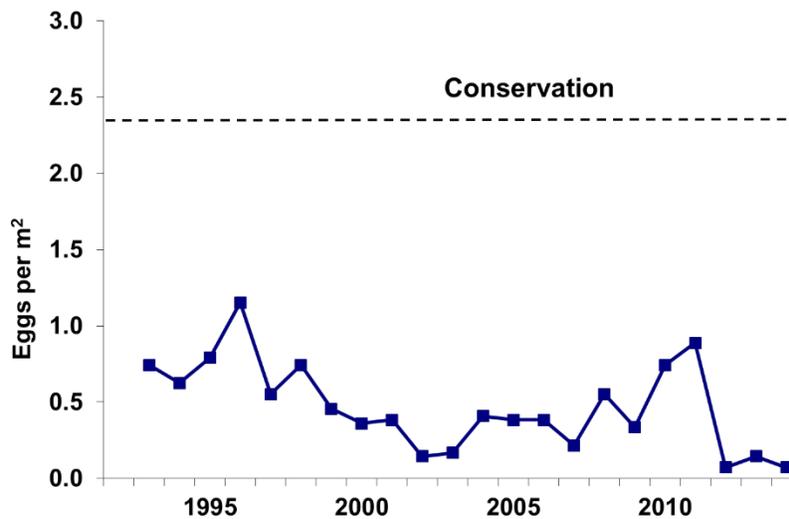


Figure 8. Estimated egg deposition upriver of the counting fence operated just below Durham Bridge, Nashwaak River, 1993-2014. The dashed line is the conservation (egg) requirement.

Sources of Uncertainty

There were informal reports of illegal fishing activities (e.g., fishing in closed areas, poaching), but the combined contribution of these activities to the depressed status of populations is not known. Preliminary FSC harvest reports indicate that there was no harvest of Atlantic Salmon from DFO's Maritimes Region in 2014.

The number of small and large Salmon caught and released, fishing effort, and catch and release mortality within SFA 19 are estimated from license 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 2014 are considered to be preliminary at the time of this assessment update, as license sale information and license stubs are still being returned. In recent years, catch and effort estimates prior to sending reminder letters have generally been systematically higher than catch and effort estimates after reminder letters have been sent to anglers. In an attempt to reduce this bias in years where reminder letters were not sent to anglers (i.e., 2004, 2008-2010, and 2014), individual river mean scaling factors (i.e., estimate after reminder letter information / reported value prior to reminder letter information) for small Salmon, large Salmon and effort has been applied to reported values to estimate catch and effort. These observations coupled with the observation that the North River Salmon abundance estimated from the recreational catch data has consistently exceeded the abundance estimated from dive counts since 2002 indicate that the recreational catch data should be interpreted with caution and field surveys should be conducted to assess whether the current use of recreational catch data is appropriate for future assessments.

Adult Salmon dive counts on Clyburn Brook are typically conducted during early November to early December, which is later than dive counts on Middle, Baddeck and North rivers.

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 and Clyburn rivers). 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).

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

Conclusions

All Atlantic Salmon index populations within DFO's Maritimes Region were assessed to be well below conservation (egg) requirements in 2014. SU and OBoF Atlantic 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 2-4% of conservation (egg) requirements in 2014. 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 declined in 2014 with estimated egg depositions ranging between 20-37% of conservation (egg) requirements.

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Sources of Information

This Science Response Report results from the Science Response Process of February 26, 2015, on the Assessment of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23.

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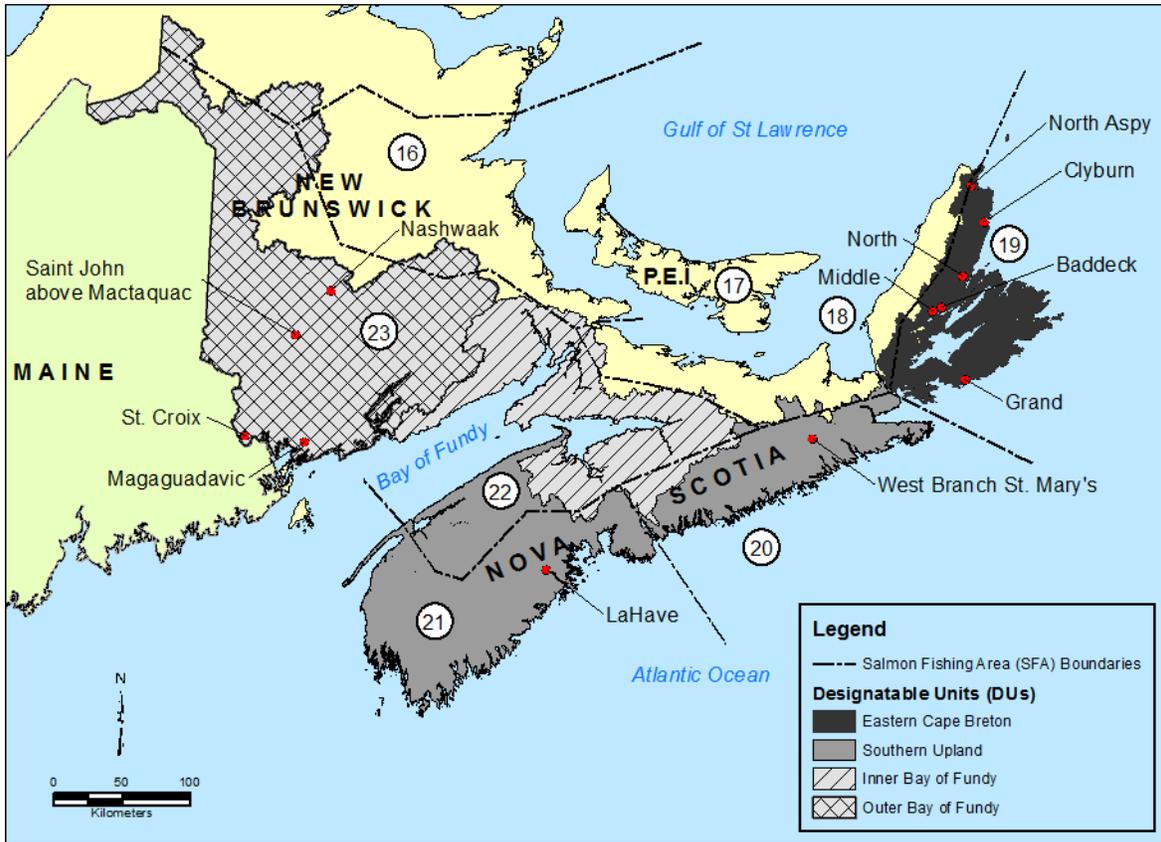
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Appendices

Note: SFA numbers are labeled inside the white circles.



Appendix 1. Map showing the locations of Atlantic Salmon rivers, Salmon Fishing Areas (SFAs), and COSEWIC DUs mentioned in this update and recent status assessments.

Data Source: DUs derived from NS Secondary Watershed Layer (NS Dept. of Environment) and NB Watershed Level 1 Layer (NB Dept. of Natural Resources).

This Report is Available from the:

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