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Canadian Science Advisory Secretariat
Maritimes Region **Science Response 2021/032**

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 (hereafter referred to as 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 2020 was requested by Fisheries Management. This advice is used to inform Aboriginal communities, Fisheries Management, 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 2021. 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 2020 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.

As a result of the COVID-19 pandemic, certain fieldwork activities were restricted in 2020. Limited data are available for index rivers in SFAs 20, 21, and 23; however, assessments of Salmon stock status and trends were not able to be completed for these areas and are not contained within this report. For ECB, due to the timing of activities and the value of this information to Fisheries Management for decision-making on Indigenous Food, Social, and Ceremonial (FSC) allocations, all usual field activities were conducted and data are available to provide an update on the status of Salmon on index rivers in SFA 19.

This Science Response Report results from the Regional Science Response Process of March 4, 2021, on the Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 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).

Within a recent working paper to update information on ECB Atlantic Salmon populations of relevance to a COSEWIC status report, a review of all available data and abundance estimates was conducted for ECB (Taylor et al. unpublished manuscript[1]). This process resulted in some updates to escapement estimates in the North River time series. Updates include adjustments to annual dive-survey counts based on the mean observation efficiency calculated from mark recapture experiments from 1994–2020. In addition, a scaling factor was applied to data from 2004–2012 to account for an expansion to the dive count survey beginning in 2013 (McLeans Pool to West Confluence Pool). The scaling factor was calculated based on the mean counts in the additional reach from 2013–2020, and an expected increase of 24% was applied to all dive counts from 2004–2012. No scaling factor was applied for years prior to 2004, as the extent of the dive-count survey is not well documented. Recreational catch data are presented without a catch-rate scaling factor applied as they were found to be highly variable and unlikely to provide an accurate measure of abundance. These changes to the time series are reflected in updated visualization for North River within this document; however, the annual estimate for North River presented in this update is unchanged from the methodology as described within Levy and Gibson (2014).

In this report, Salmon less than 63 cm in fork length are referred to as small, which are typically 1-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.

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. Details on the assessment methods for ECB Salmon populations are provided in Levy

[1] Taylor, A.D., D. Raab, D.C. Hardie, and E.B. Brunsdon. In prep. Updated Information on Atlantic Salmon (*Salmo salar*) Eastern Cape Breton Populations (ECB; SFA 19) of Relevance to the Development of a 2nd COSEWIC Status Report. DFO Can. Sci. Advis. Sec. Res. Doc.

and Gibson (2014), DFO (2013), Gibson and Bowlby (2009), and Robichaud-LeBlanc and Amiro (2004).

In 2020, 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 2020; however, the 2020–2021 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 2020, the ECB index populations of Middle and Baddeck rivers were assessed to be below conservation egg requirements (Table 1), with estimated values of 70 and 64 percent of the requirements, respectively. North River was assessed to be above the conservation egg requirement, estimated at 102 percent. The Salmon abundance in Clyburn Brook continues to remain low, with 13 Salmon counted in 2020. A summary of the 2020 assessment results is provided in Table 1, 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 2020, 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	- Dive Counts
Conservation Egg Requirement (millions of eggs)	2.07	2.01	0.92	0.28
Preliminary Recreational Catch Estimates:*				
Small Salmon	18	4	12	Not Applicable
Large Salmon	64	48	25	Not Applicable
Effort (rod-days)	231	123	118	Not Applicable
Total Catch and Release Mortality Estimates**	4	2	1	Not Applicable
Dive Counts:***				
Small Salmon	35	19	15	4
Large Salmon	390	154	106	9
Marks / Recaptures‡	Not Applicable	Not Applicable	30 / 9	Not Applicable
Estimated Escapement:				
Small Salmon	49	22	32	Not Applicable
Large Salmon	407	247	226	Not Applicable
% Conservation Egg Requirement (Bayesian 90% credible interval)	**70 (54–93)**	**64 (49–85)**	**102**	**Not Applicable**
Provincial Stocking:				
Broodstock Collections	8 large (October)	5 large; 3 small (October)	Not Applicable	Not Applicable
Juvenile Releases	21,090 fin clipped 0+ parr (October)	14,042 fin clipped 0+ parr (October)	Not Applicable	Not Applicable

*Salmo-NS Database queried on Feb. 18, 2021. River specific mean scaling factors for small Salmon, large Salmon, and effort were used to estimate catch and effort in 2020 (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 November 5, 2020. North River dive count was conducted October 22, 2020, and Baddeck River dive count was conducted November 6, 2020. Parks Canada conducted the Clyburn Brook dive count on Nov 5, 2020.
‡Marking was conducted October 13–14, 2020 on North River.

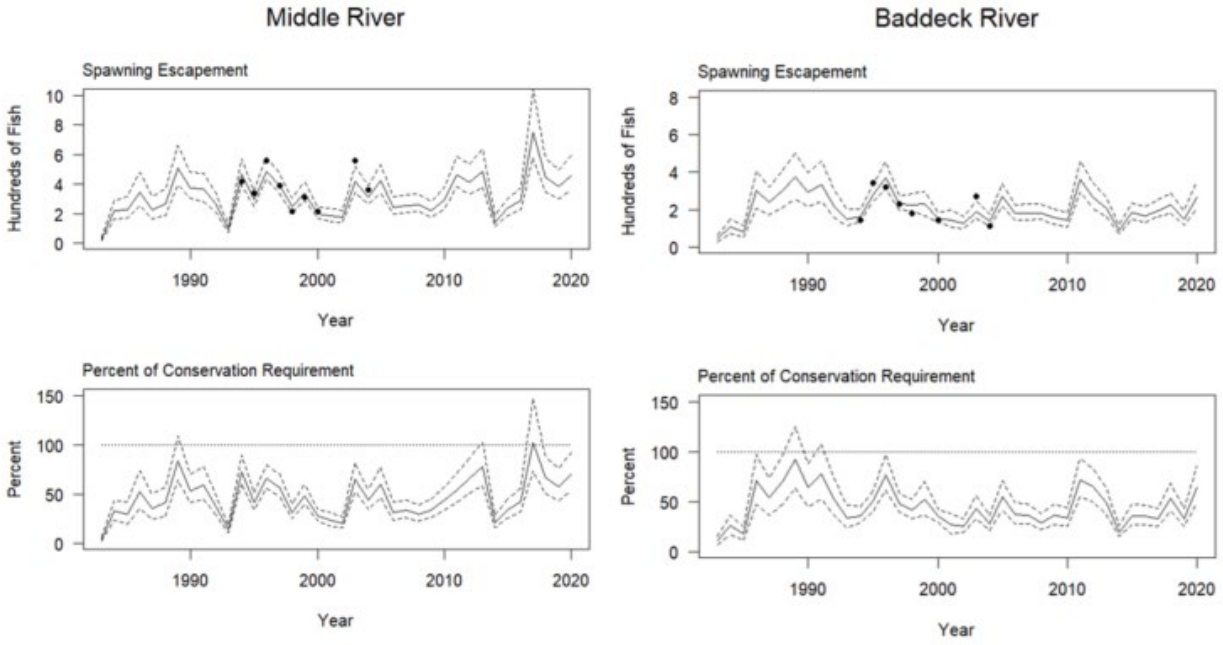

Figure 1. Estimated total number of spawners (top graph) and the percent of the conservation egg requirement attained (bottom graph) for Middle River (left panel) and Baddeck River (right panel), NS, from 1983 to 2020. Model fits derived from two methods are shown. The solid lines show the maximum likelihood 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.

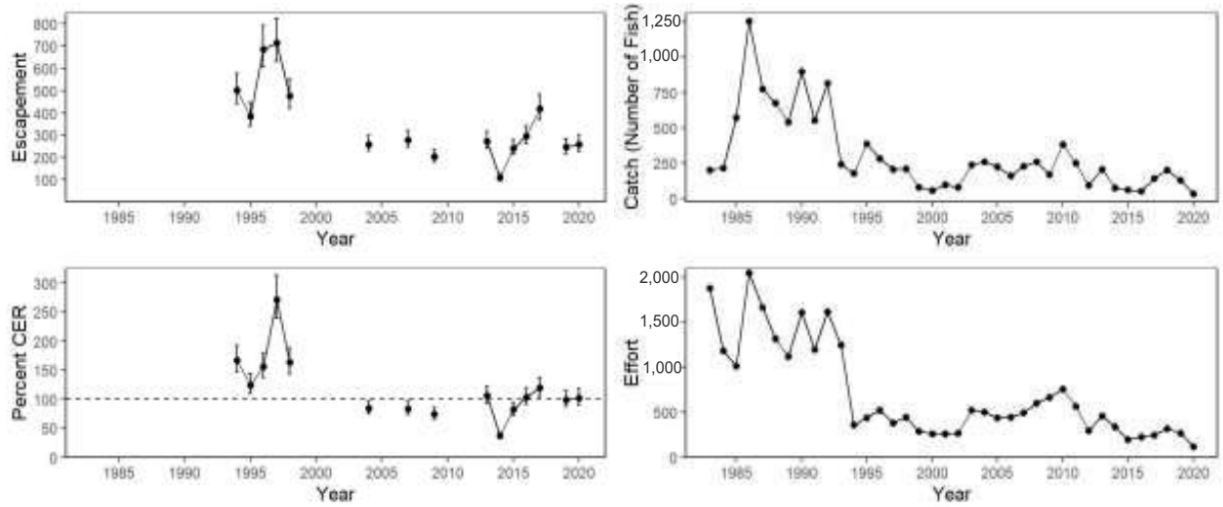

Figure 2. Estimated spawning escapement (top left) and percent of the conservation egg requirement (bottom left) of Atlantic Salmon returning to North River, NS, as derived from dive-survey counts and catch (top right) and effort (bottom right) adjusted for non-returned stubs from the license stub return program (see Sources of Uncertainty). The horizontal dashed line in the bottom left indicates 100% of the conservation egg requirement. Error bars represent 95% confidence intervals.

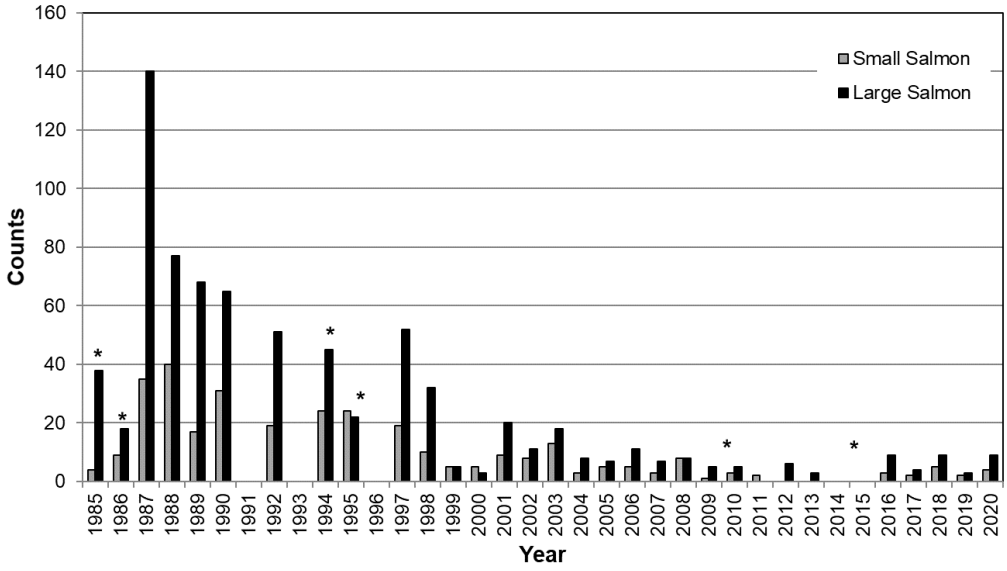

Figure 3. Counts of small and large Atlantic Salmon in Clyburn Brook, NS, from 1985 to 2020. Years where only the lower section of the river was surveyed (partial counts) are identified with an asterisk (*). No count was conducted in 1991, 1993, 1996, and 2015. Source: Parks Canada.

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

Although COVID-19 restrictions prevented the completion of many annual assessment activities in SFA 23, essential services and priority activities were conducted. The Mactaquac Fishlift was operated throughout the 2020 season, providing adult return information for the Saint John River above the Mactaquac Dam. The fall pre-smolt assessment and collection on the Tobique River was also completed in 2020.

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 2020 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 19, 2020, where 108 large and 48 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).

Conclusions

In SFA 19, two index populations in ECB had estimated egg depositions below conservation egg requirements and one index population had estimated egg depositions above conservation egg requirements, with values ranging between 64–102% of these requirements in 2020. Although limited data were collected on index rivers in SFAs 20, 21, and 23, Salmon assessments were not completed and information concerning stock status and trends of these SFAs are not contained within this report.

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Sources of Information

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Appendix

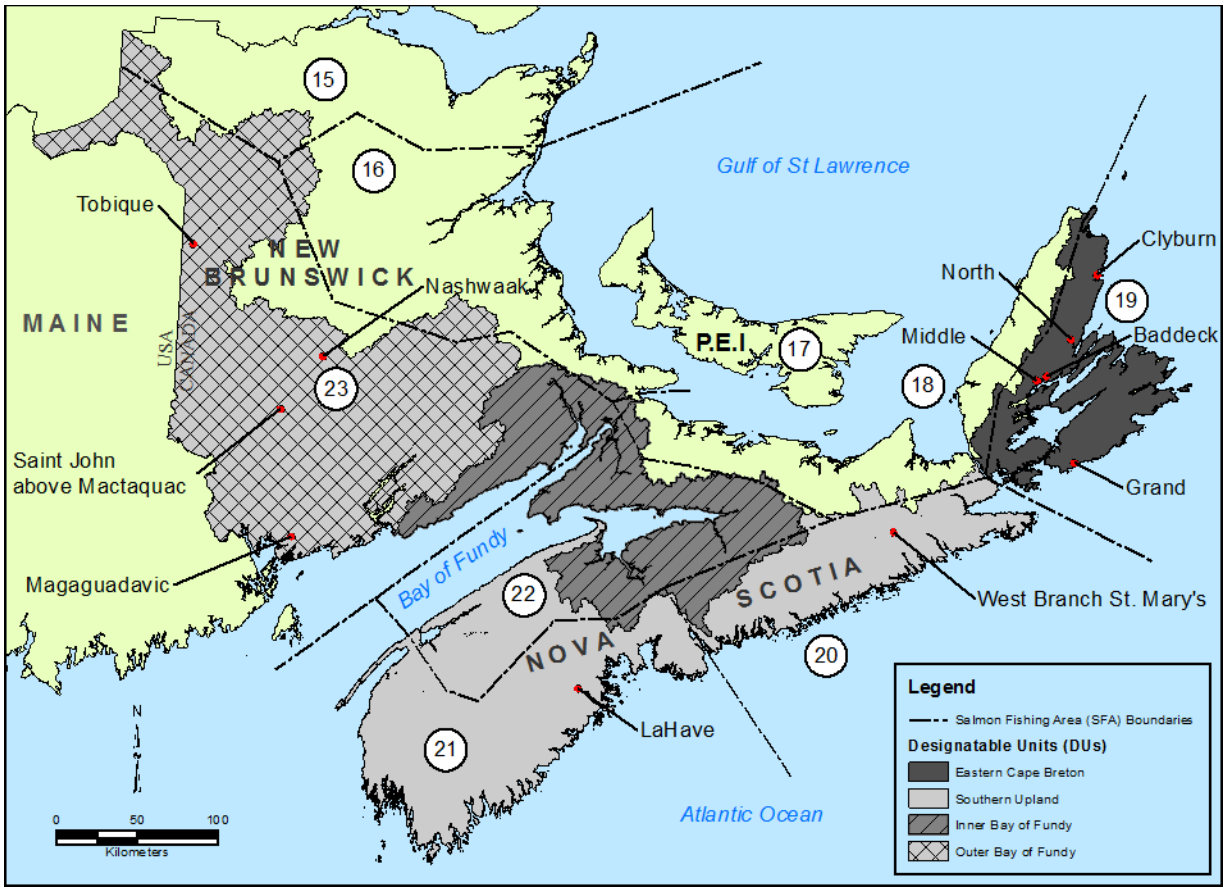

Figure A1. Map showing the locations of Salmon rivers where monitoring predominately occurred, Salmon Fishing Areas (SFAs), and Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Designatable Units (DUs) mentioned in this update. SFA numbers are labeled inside the white circles. Data 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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