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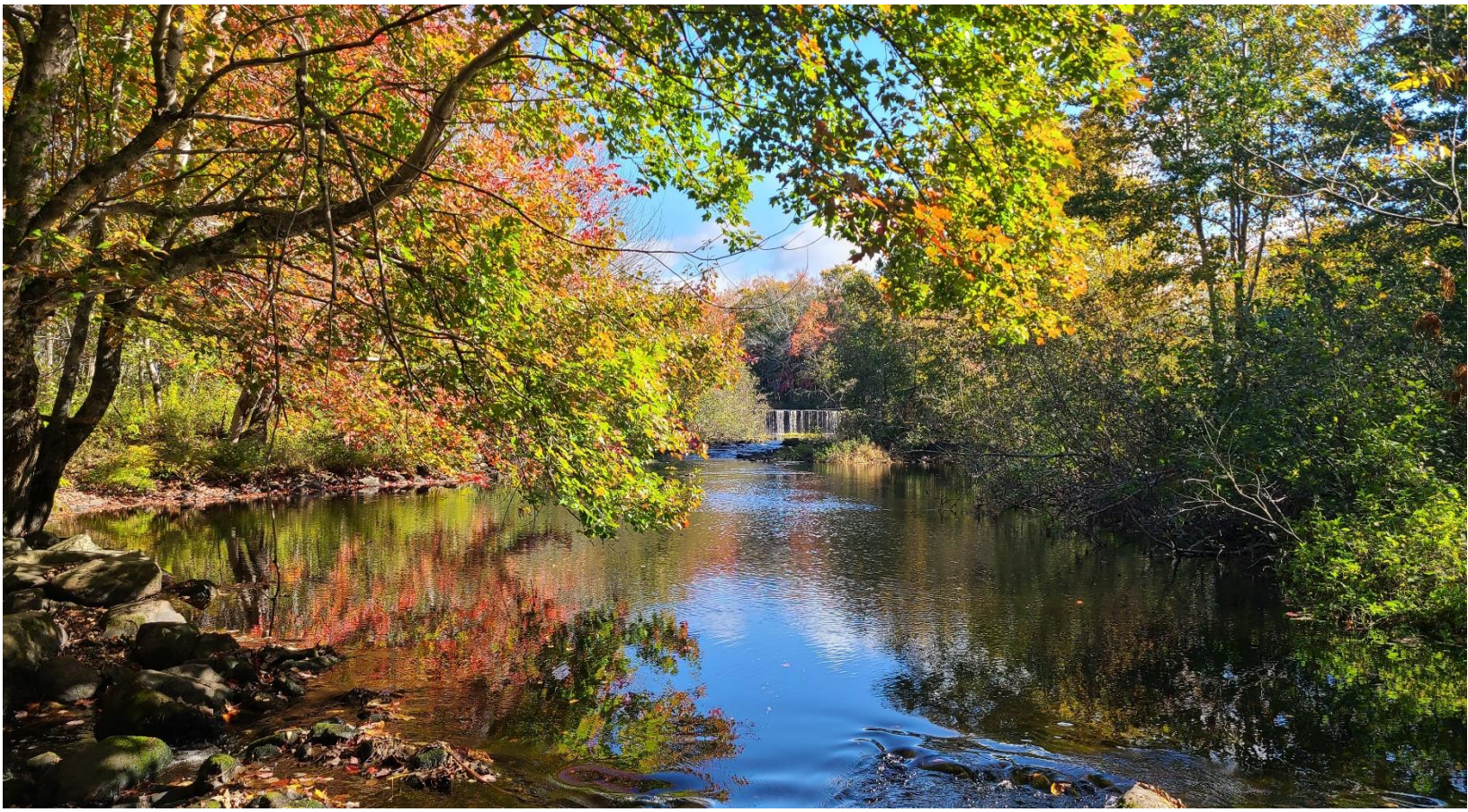

Evaluating river significance for wild Atlantic salmon (*Salmo salar*) in Nova Scotia: Data Sources

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1 Introduction

CMAR's Wild Salmon River Assessment assessed the significance of 287 rivers in Nova Scotia using a multi-criteria evaluation framework[1]. We collected and evaluated various data across five criteria, including: a river's habitat quality, population abundances, freshwater connectivity (e.g. barriers such as dams), existing stressors, and importance for conservation (**Figure 1**). For each criterion, we selected measurable indicators (e.g., Proportion of summer period >20 °C), applied standardized scoring metrics, and organized the indicators into relevant factors (e.g., temperature) under their corresponding criterion (e.g. habitat quality). The resulting indicator scores were then aggregated into a composite Significance Index score to provide an overall assessment. Finally, we categorized the Significance Index scores into distinct significance ratings to facilitate the interpretation of significance implications and assessment findings.

Figure 1. Calculation of river significance for wild Atlantic Salmon, based on an assessment of five criteria: Habitat, Abundance, Barriers, Importance, and Threats and their respective factors.

A key objective of this project was to review, compile, and organize available data on Atlantic salmon and their habitats. This effort aimed to bring together information from many sources to improve data accessibility and help inform conservation and management decisions. We recognize the many organizations, community groups, and researchers who have contributed to monitoring and assessing salmon populations and habitat over the years – their work forms the foundation of this project.

[1] For more information about this project and to view the project summary report, visit Centre for Marine Applied Research | Assessing Wild Salmon Rivers in Nova Scotia

1.1 Purpose of Report

This report serves as a centralized place for resources on wild Atlantic salmon and salmon habitat monitoring, research, assessments, and information in Nova Scotia.

This report provides the sources of data used to inform the CMAR's Wild Salmon River Assessment. Key resources provided below are organized for each of the five assessed criteria (habitat, abundance, barriers, importance, and threats), and sub-divided into relevant factors. Under each factor, a list of relevant reports and articles, databases and datasets, theses, and websites is provided.

This report is designed as a general overview of key datasets and sources that were used in this assessment. It is not a complete, comprehensive list of all data, research, or information on wild Atlantic salmon and their habitat in Nova Scotia. Datasets published or made available after December 31, 2024 were not included, as this reflects when data collation efforts for this project concluded.

2 Habitat

2.1 pH

pH is a critical chemical property of freshwater systems that influences the overall health and suitability of aquatic habitats for wild Atlantic salmon. Waters that are too acidic (generally below pH 5.4) can impair respiration, ion regulation, and survival (Amiro, 2006; COSEWIC, 2010). Evaluating pH as a factor within habitat quality allows for the identification of rivers that may be unlikely to support salmon populations due to acidification and are therefore less likely to be significant for wild Atlantic salmon.

2.1.1 Reports and Articles

Amiro, P. G. (2000). Assessment of the status, vulnerability and prognosis for Atlantic salmon stocks of the Southern Upland of Nova Scotia. Canadian Stock Assessment Secretariat. https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2000/2000_062-eng.htm

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Status, Past and Present Abundance, Life History and Trends. Fisheries and Oceans Canada (DFO), Ottawa. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/40608815.pdf

MacDonald, J. L. et al. (2023). Fish and Fish Habitat Report for Nova Scotia: Summary of the threat analysis prepared to support reporting by the Fish and Fish Habitat Protection Program - Maritimes Region (Fisheries and Aquatic Sciences 3567). Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3567-eng.pdf

2.1.2 Databases & Data Sets

Atlantic Data Stream

- Clean Foundation - Clean Foundation Watershed Restoration Monitoring Data (2024)
- Environment and Climate Change Canada, Parks Canada - Maritime Coastal Basin Long-term Water Quality Monitoring Data (2024)
- Government of Nova Scotia, Environment and Climate Change - Surface Water Quality Monitoring Network Grab Sample Water Quality Data (2024)
- Halifax Regional Municipality - HRM LakeWatchers (2024)
- Maritime Aboriginal Peoples Council - Rehabilitating and Restoring Unique Landscapes within Five Watersheds along the Bay of Fundy, Nova Scotia, Canada Water Quality Monitoring Data (2022)
- Nova Scotia Salmon Association - NSSA – WATER (2024)
- Pictou County Rivers Association - Pictou County Water Quality data 2023 (2024)
- Sackville Rivers Association - Sackville River Watershed water quality monitoring (2024)
- Eastern Charlotte Waterways Inc - Eutrophication Indicators for the Upper Bay of Fundy Watersheds (2024)
- Maritime Aboriginal Peoples Council - In-Situ Egg Incubation Project (2023)

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)
- Nature Conservancy of Canada - Stream Classification v2.0 (2019)

Sterling Hydrology and Climate Change Research Group

- Nova Scotia Watershed Assessment Program (NSWAP) 2 Database

Government of Nova Scotia – Environment and Climate change

- Nova Scotia - Surface Water Quality Monitoring Network Data.

github

- Trueman, B. - al-i-prediction (2023)

2.2 Temperature

Water temperature is a key environmental property of freshwater systems that influences the overall health and suitability of aquatic habitats for wild Atlantic salmon. Optimal temperature ranges (16 – 20 °C) support effective feeding, growth, and immune function (Jonsson and Jonsson, 2009; Bernthal et al., 2023), while elevated water temperatures (>20 – 21 °C) can lead to physiological stress and alteration of behaviour (Breau et al., 2011; Millar et al., 2019). Assessing temperature as a factor of habitat quality allows for the identification of rivers that may be unlikely to support salmon populations due to the presence of thermal stressors and are therefore less likely to be significant for wild Atlantic salmon.

2.2.1 Databases & Datasets

Restoration and Monitoring Efforts

Atlantic Data Stream

- Antigonish Rivers Association & Nova Scotia Salmon Association - Antigonish water temperature monitoring (2021)
- Environment and Climate Change Canada (ECCC) and Parks Canada - Maritime Coastal Basin Long-term Water Quality Monitoring Data (2024)
- Maritime Aboriginal Peoples Council - Rehabilitating and Restoring Unique Landscapes within Five Watersheds along the Bay of Fundy, Nova Scotia, Canada Water Quality Monitoring Data (2022)
- Coastal Action - LaHave River Water Quality Monitoring (2024)
- Clean Annapolis River Project (CARP); Annapolis River Guardians - River Guardians Water Quality Monitoring Program (2022)
- Tusket River Environmental Protection Association - TREPA: Water Quality data from the Tusket Catchment (2022)
- Nova Scotia Salmon Association - NSSA – WATER (2024)
- Pictou County Rivers Association - Temperature sensor data 2022 (2023)
- RivTemp--Pictou County Rivers Association (2021)
- McIntosh Run Watershed Association - MRWA temperature logger data (2024)
- Sackville Rivers Association - Sackville River Watershed water quality monitoring (2022)
- Clean Foundation - Clean Foundation Watershed Restoration Monitoring Data (2022)
- Atlantic Coastal Action Program (ACAP) Cape Breton - ACAP Cape Breton In-Stream Temperature Monitoring (2022)

Rivtemp - To obtain permission to access the database, please contact: **info@rivtemp.ca**

Open Government Data Portal

- Environment and Climate Change - Surface Water Quality Monitoring Network Grab Sample Water Quality Data (2024)
- Environment and Climate Change - Surface Water Quality Monitoring Network Continuous Water Quality Data (2024)

Research and Assessment Efforts

Atlantic Data Stream

- Maritime Aboriginal Peoples Council - In-Situ Egg Incubation Project (2023)
- Eastern Charlotte Waterways Inc.; Clean Annapolis River Project (CARP); Southern Gulf of St. Lawrence Coalition on Sustainability (Coalition-SGSL); Atlantic Coastal Action Program (ACAP) Humber Arm; Coastal Action; Miramichi River Environmental Assessment Committee (MREAC) - Monitoring results from select estuaries in the four Atlantic provinces (2022)

- Banook Area Residents Association (BARA) - BARA - Dartmouth, NS - Sawmill River Watershed - Baseline YSI Study (2022)
- Cheticamp River Salmon Association - Cheticamp River water temperature data 2021(2023)
- Maritime Aboriginal Peoples Council - A Comparative Assessment of Ecological Conditions for Atlantic Salmon in the Northern Minas Basin (2024)

2C1 Forest Atlas

- Nature Conservancy of Canada - Stream Classification v2.0 (2019)

2.3 Productive Habitat

River habitat quality for Atlantic salmon can be influenced by the availability and accessibility of productive freshwater habitats that are essential to supporting key life stages for wild Atlantic salmon, including spawning and rearing. These habitats include specific conditions, such as clear, cold, fast-moving water with a gravel bottom for spawning and rocky areas for juvenile fish rearing (Fisheries and Oceans Canada, 2018a). Evaluating this factor allows for the identification of rivers where the availability of productive habitat may constrain population productivity and long-term viability, that are therefore less likely to be significant for wild Atlantic salmon.

2.3.1 Reports and Articles

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Status, Past and Present Abundance, Life History and Trends. Fisheries and Oceans Canada (DFO), Ottawa. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/40608815.pdf

Gibson, A. et al. (2014). Recovery Potential Assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar): Habitat requirements and availability; and threats to populations. Fisheries and Oceans Canada, Science. https://epe.lac-bac.gc.ca/100/201/301/weekly_checklist/2015/internet/w15-03-F-E.html/collections/collection_2015/mpo-dfo/Fs70-5-2014-071-eng.pdf

Gibson, A. J. F., Claytor, R. R. (2013). What is 2.4? Placing Atlantic Salmon Conservation Requirements in the Context of the Precautionary Approach to Fisheries Management in the Maritimes Region. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/347998.pdf

3 Abundance

3.1 Conservation Requirements

Conservation requirements (or conservation limits) provide a quantitative threshold for assessing whether Atlantic salmon populations are achieving the population size required to sustain populations (ASF, 2020). Poor attainment of conservation requirements can indicate that a river may be incapable of supporting the spawning activities or the population levels necessary for long-term viability.

3.1.1 Reports and Articles

Amiro, P. G., Jefferson, E. M. (1996). Status of Atlantic salmon in Salmon Fishing Areas 22 and 23 for 1995, with emphasis on inner Bay of Fundy stocks . Fisheries and Oceans. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/209545.pdf

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Status, Past and Present Abundance, Life History and Trends. Fisheries and Oceans Canada (DFO), Ottawa. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/40608815.pdf

Breau, C. (2012). Status of Atlantic salmon (Salmo salar L.) stocks in rivers of Nova Scotia flowing into the Gulf of St. Lawrence (SFA 18). Fisheries and Oceans Canada. Gulf Region. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/347922.pdf

Daigle, A. (2023). Information on Atlantic Salmon (Salmo salar) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of a 2nd COSEWIC status report. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (CSAS). https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41107238.pdf

Fisheries and Ocean Canada. (2022). Update of Indicators of Atlantic Salmon (Salmo Salar) in DFO Gulf Region Salmon Fishing Areas 15 – 18 for 2020 And 2021. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4106415x.pdf

Fisheries and Oceans Canada. (2008). Status of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. https://www.dfo-mpo.gc.ca/csas-sccs/publications/scr-rs/2008/2008_001-eng.htm

Fisheries and Oceans Canada. (2012). Status of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. Retrieved August 18, 2021. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2012/2012_014-eng.html

Fisheries and Oceans Canada. (2015). STATUS OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19-21 AND 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-7-2015-021-eng.pdf

Fisheries and Oceans Canada. (2017). Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4062500x.pdf

Fisheries and Oceans Canada. (2018). Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. Canadian Science Advisory Secretariat Response 2018/038. http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2018/2018_038-eng.html

Fisheries and Oceans Canada. (2020a). Stock status update of Atlantic salmon (*Salmo salar*) in Salmon Fishing Areas (SFAs) 19-21 and 23. Canadian Science Advisory Secretariat 2020/031. http://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-7/Fs70-7-2020-002-eng.pdf

Fisheries and Oceans Canada. (2020b). STOCK STATUS UPDATE OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19–21 AND 23. Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-7/Fs70-7-2020-031-eng.pdf

Fisheries and Oceans Canada. (2021). Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. https://publications.gc.ca/collections/collection_2021/mpo-dfo/fs70-7/Fs70-7-2021-032-eng.pdf

Fisheries and Oceans Canada. (2023). STOCK STATUS UPDATE OF ATLANTIC SALMON TO 2021 IN SALMON FISHING AREAS (SFAs) 19–21 and 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://publications.gc.ca/collections/collection_2023/mpo-dfo/fs70-7/Fs70-7-2023-019-eng.pdf

Fisheries and Oceans Canada. (2023). STOCK STATUS UPDATE OF ATLANTIC SALMON TO 2022 IN SALMON FISHING AREAS (SFAs) 19–21 AND 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41221175.pdf

Levy, A. L., Gibson, A. J. F. (2014). Recovery potential assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar) : status, past and present abundance, life history, and trends. Ottawa: Ottawa: Canadian Science Advisory Secretariat. http://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-5-2014-099-eng.pdf

O'Neil, S. F. et al. (2000). Atlantic salmon (Salmo salar L.) stock status in the Northumberland Strait, Nova Scotia area, in 1999. Fisheries and Oceans Canada. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-1-2000-007-eng.pdf

Raab, D. et al. (2024). Updated Information on Atlantic Salmon (Salmo salar) Populations in Nova Scotia's Southern Upland (SU; Salmon Fishing Areas 20, 21, and Part of 22) of Relevance to the Development of a 2nd COSEWIC Status Report. Fisheries and Oceans Canada. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2024/2024_050-eng.pdf

Reader, J. M. et al. (2024). Updated Information on Atlantic Salmon (Salmo salar) Inner Bay of Fundy Populations (IBoF; part of Salmon Fishing Areas 22 and 23) of Relevance to the Development of a 2nd COSEWIC Status Report. Fisheries and Oceans Canada. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4126051x.pdf

3.2 Density

To understand salmon stock status, density estimates (number of salmon per area) are often calculated to assess population abundance and trends (Fisheries and Oceans Canada, 2015). Density estimates provide a standardized metric for evaluating population based on habitat area, allowing for meaningful comparisons across rivers of different sizes and to established reference values. Evaluating this factor allows for the identification of rivers with higher densities and potentially more stable populations, that are more likely to be significant for wild Atlantic salmon.

3.2.1 Reports and Articles

Amiro, P. G., Jefferson, E. M. (1996). Status of Atlantic salmon in Salmon Fishing Areas 22 and 23 for 1995, with emphasis on inner Bay of Fundy stocks . Fisheries and Oceans. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/209545.pdf

Amiro, P. G. et al. (2000). Assessments of Atlantic salmon stocks of salmon fishing areas 20 and 21, the Southern Upland of Nova Scotia, for 1999. Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-1-2000-009-eng.pdf

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Status, Past and Present Abundance, Life History and Trends. Fisheries and Oceans Canada (DFO), Ottawa. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/40608815.pdf

Breau, C. (2012). Status of Atlantic salmon (Salmo salar L.) stocks in rivers of Nova Scotia flowing into the Gulf of St. Lawrence (SFA 18). Fisheries and Oceans Canada. Gulf Region. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/347922.pdf

Breau, C. et al. (2009). Information on Atlantic salmon (Salmo salar) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of a COSEWIC status report. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/339181.pdf

Daigle, A. (2023). Information on Atlantic Salmon (Salmo salar) from Salmon Fishing Area 18 (Gulf Nova Scotia) of relevance to the development of a 2nd COSEWIC status report. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (CSAS). https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41107238.pdf

Fisheries and Ocean Canada. (2022). Update of Indicators of Atlantic Salmon (Salmo Salar) in DFO Gulf Region Salmon Fishing Areas 15 – 18 for 2020 And 2021. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4106415x.pdf

Fisheries and Oceans Canada. (2002). Atlantic Salmon Maritime Provinces Overview for 2001. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/263274.pdf

Fisheries and Oceans Canada. (2010). Recovery Strategy for the Atlantic salmon (Salmo salar), inner Bay of Fundy populations. Ottawa: Fisheries and Oceans Canada. https://www.sararegistry.gc.ca/virtual_sara/files/plans/rs_atlantic_salmon_ibof_0510a_e.pdf

Fisheries and Oceans Canada. (2012a). Status of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. Retrieved August 18, 2021. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2012/2012_014-eng.html

Fisheries and Oceans Canada. (2012b). STOCK STATUS OF ATLANTIC SALMON (SALMO SALAR) IN DFO GULF REGION (SALMON FISHING AREAS 15 TO 18). https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/347518.pdf

Fisheries and Oceans Canada. (2014). Stock Status of Atlantic Salmon (Salmo Salar) in DFO Gulf Region (Salmon Fishing Areas 15 to 18) to 2013. Fisheries and Oceans Canada (DFO). Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/364429.pdf

Fisheries and Oceans Canada. (2015). STATUS OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19-21 AND 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-7-2015-021-eng.pdf

Fisheries and Oceans Canada. (2017). Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4062500x.pdf

Fisheries and Oceans Canada. (2018). Review of the science associated with the inner Bay of Fundy Atlantic salmon live gene bank and supplementation programs. Canadian Science Advisory Secretariat Science Advisory Report 2018/041. Fisheries and Oceans Canada, Gulf Fisheries Centre, Moncton. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40726241.pdf

Fisheries and Oceans Canada. (2018b). Stock Status Update of Atlantic Salmon in Salmon Fishing Areas (SFAs) 19-21 and 23. Canadian Science Advisory Secretariat Response 2018/038. http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2018/2018_038-eng.html

Fisheries and Oceans Canada. (2020a). Stock status update of Atlantic salmon (*Salmo salar*) in Salmon Fishing Areas (SFAs) 19-21 and 23. Canadian Science Advisory Secretariat 2020/031. http://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-7/Fs70-7-2020-002-eng.pdf

Fisheries and Oceans Canada. (2020b). STOCK STATUS UPDATE OF ATLANTIC SALMON IN SALMON FISHING AREAS (SFAS) 19–21 AND 23. Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-7/Fs70-7-2020-031-eng.pdf

Fisheries and Oceans Canada. (2023a). STOCK STATUS UPDATE OF ATLANTIC SALMON TO 2021 IN SALMON FISHING AREAS (SFAs) 19–21 and 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://publications.gc.ca/collections/collection_2023/mpo-dfo/fs70-7/Fs70-7-2023-019-eng.pdf

Fisheries and Oceans Canada. (2023b). STOCK STATUS UPDATE OF ATLANTIC SALMON TO 2022 IN SALMON FISHING AREAS (SFAs) 19–21 AND 23. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41221175.pdf

Gibson, A., Bowlby, H. (2013). Recovery potential assessment for southern upland Atlantic salmon: population dynamics and viability evaluation (2012/142). Fisheries and Oceans Canada (DFO), Maritimes region. https://www.researchgate.net/publication/271764288_Recovery_Potential_Assessment_for_Southern_Upland_Atlantic_Salmon_Population_Dynamics_and_Viability_Evaluation_du_p

otentiel_de_retablissement_du_saumon_de_l'Atlantique_des_hautes_terres_du_Sud_Dynamiq

Gibson, A. J. F. et al. (2003). Densities of juvenile Atlantic salmon (Salmo salar) in inner Bay of Fundy rivers during 2000 and 2002 with reference to past abundance inferred from catch statistics and electrofishing surveys. Fisheries and Oceans Canada. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/282781.pdf

Jamie, A. et al. (2003). Abundance of Atlantic salmon (Salmo salar) in the Stewiacke River, NS, from 1965 to 2002. Fisheries and Oceans Canada. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/281757.pdf

Jamie, A. et al. (2009). Review of DFO Science information for Atlantic salmon (Salmo salar) populations in the Southern Upland region of Nova Scotia. Fisheries and Oceans Canada. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/341079.pdf

Jones, R. A. et al. (2018). Review of the Inner Bay of Fundy Atlantic Salmon (Salmo salar) monitoring activities associated with the Live Gene Bank. Canadian Science Advisory Secretariat Research Document 2018/043. http://publications.gc.ca/collections/collection_2020/mpo-dfo/fs70-5/Fs70-5-2018-043-eng.pdf

Levy, A. L., Gibson, A. J. F. (2014). Recovery potential assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar) : status, past and present abundance, life history, and trends. Ottawa: Ottawa: Canadian Science Advisory Secretariat. http://publications.gc.ca/collections/collection_2015/mpo-dfo/Fs70-5-2014-099-eng.pdf

Marshall, T. L. et al. (1998). Follow-up to the assessment of Atlantic salmon in selected rivers of Cape Breton Island, 1998. Fisheries and Oceans. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/246519.pdf

Raab, D. et al. (2024). Updated Information on Atlantic Salmon (Salmo salar) Populations in Nova Scotia's Southern Upland (SU; Salmon Fishing Areas 20, 21, and Part of 22) of Relevance to the Development of a 2nd COSEWIC Status Report. Fisheries and Oceans Canada. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2024/2024_050-eng.pdf

Taylor, A. D. et al. (2024). Updated Information on Atlantic Salmon (Salmo salar) Eastern Cape Breton Populations (ECB; Salmon Fishing Area 19) of Relevance to the Development of a 2nd COSEWIC Status Report. Fisheries and Oceans Canada. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41256785.pdf

3.2.2 Databases and Datasets

Open Government Portal

- Daigle, A. - Electrofishing Data from Nova Scotian Rivers (SFA 18A, 18B) (2023)

3.3 Presence

Overall presence of Atlantic salmon detected in a river system can provide some foundational information on reported abundance of salmon. Presence/absence data indicates whether a species has been observed in a specific location or sampling unit, providing a basic yet important indication of habitat use and population distribution. This information can help to identify rivers of high significance where salmon populations are likely persisting.

Presence data compiled for this assessment were collected through several different methodologies including electrofishing (Daigle, 2023), eDNA (Wringe et al., 2023), mark and recapture data (Fisheries and Oceans Canada, 2023a), fishway counts (Amiro et al., 2000), dive counts (Fisheries and Oceans Canada, 2020), and angling (Breau et al., 2009). Observations of salmon available through social media, local angling forums, or local and community-based knowledge were not included in this analysis[2]. Additional details on the data supporting this indicator will be provided in a subsequent documentation, to be posted on the CMAR website.

4 Barriers

4.1 Aquatic Barriers

Dams and other aquatic barriers are a major threat to freshwater biodiversity impacting sedimentation, flow, temperature regimes, and habitat connectivity (Angermeier et al., 2004; Fielding, 2011; Liermann et al., 2012; Millar et al., 2019). These barriers can disrupt salmon migration, limit access to essential habitats, and fragment populations. Evaluating this factor allows for the identification of rivers with fewer aquatic barriers and higher connectivity, that may be more capable of supporting salmon populations and are therefore more likely to be significant for wild Atlantic salmon populations.

4.1.1 Reports and Articles

MacDonald, J. L. et al. (2023). Fish and Fish Habitat Report for Nova Scotia: Summary of the threat analysis prepared to support reporting by the Fish and Fish Habitat Protection Program - Maritimes Region (Fisheries and Aquatic Sciences 3567). Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3567-eng.pdf

4.1.2 Theses

Shin, M. (2023). *Freshwater Climate Risk Index for Biodiversity (FW-CRIB): Using Climate Change Vulnerability and Risk Assessments (CCVA/CCRA) to Guide Freshwater Management in Canada's Maritime Provinces.* (Master of Marine Management). Dalhousie University, Retrieved from https://dalspace.library.dal.ca/handle/10222/83646

[2] These sources were excluded due to limited resources available to comprehensively include these data sources and check reliability and accuracy of observations.

4.1.3 Databases and Datasets

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)

Sterling Hydrology and Climate Change Research Group

- Nova Scotia Watershed Assessment Program (NSWAP) 2 Database

Canadian Wildlife Federation - Canadian Aquatic Barriers Database (2023)

4.2 Watercourse crossings

Watercourse or road crossings are locations where roads intersect with streams or rivers, typically through the use of infrastructure such as culverts or bridges. These structures can act as a barrier to fish movement, leading to habitat fragmentation and impeding salmon access to important habitat. Evaluating this factor allows for the identification of rivers with low numbers of road crossings that may have less habitat fragmentation and/or alteration, and greater ability to support populations.

4.2.1 Reports and Articles

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Status, Past and Present Abundance, Life History and Trends. Fisheries and Oceans Canada (DFO), Ottawa. Canadian Science Advisory Secretariat. https://waves-vagues.dfo-mpo.gc.ca/Library/40608815.pdf

Gibson, A. et al. (2014). Recovery Potential Assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar): Habitat requirements and availability; and threats to populations. Fisheries and Oceans Canada, Science. https://epe.lac-bac.gc.ca/100/201/301/weekly_checklist/2015/internet/w15-03-F-E.html/collections/collection_2015/mpo-dfo/Fs70-5-2014-071-eng.pdf

MacDonald, J. L. et al. (2023). Fish and Fish Habitat Report for Nova Scotia: Summary of the threat analysis prepared to support reporting by the Fish and Fish Habitat Protection Program - Maritimes Region (Fisheries and Aquatic Sciences 3567). Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3567-eng.pdf

4.2.2 Databases and Datasets

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)

Sterling Hydrology and Climate Change Research Group

- Nova Scotia Watershed Assessment Program (NSWAP) 2 Database

5 Importance

5.1 Conservation Status

Conservation status refers to the formal classifications assigned to a species or population based on their risk of extinction or extirpation, as recognized under legislation or designated by scientific bodies. These designations indicate the urgency and level of conservation attention required for Atlantic salmon populations. Evaluating this factor allows for the identification of rivers that are formally recognized as requiring more urgent conservation measures, likely contributing more to the conservation objective, and are therefore more likely to be significant for wild Atlantic salmon populations.

5.1.1 Reports and Articles

COSEWIC. (2010). Atlantic salmon (Salmo salar): COSEWIC assessment and status report on the Atlantic Salmon *Salmo salar* in Canada. COSEWIC. Ottawa, Ontario. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/atlantic-salmon.html

5.1.2 Webpages

Government of Canada. (2024). Species at Risk Public Registry. https://species-registry.canada.ca/index-en.html#/species?sortBy=commonNameSort&sortDirection=asc&pageSize=10

5.2 Restoration and Monitoring

Across Nova Scotia, many organizations and individuals conduct activities on salmon rivers to help monitor and restore habitat for Atlantic salmon. Restoration or conservation efforts in river systems refer to targeted actions aimed at improving habitat quality, connectivity, or population health, such as barrier removals or liming. The presence of these efforts in river systems suggests the importance of the system to wild salmon conservation goals. Similarly, evidence of research and monitoring of salmon and salmon habitat – such as population assessments or water quality monitoring – provides an indication of the research importance of a river for salmon.

Evidence of restoration and monitoring efforts was gathered from the public websites of a wide range of organizations, including conservation and restoration organizations (e.g. the Nova Scotia Salmon Association, Clean Annapolis River Project, etc.), government agencies (e.g. the Department of Fisheries and Oceans, Parks Canada, etc.), and Indigenous organizations (e.g. the Mi'kmaw Conservation Group, Pictou Landing First Nation, etc.). The internet was scoured for evidence of funded initiatives to restore or conserve rivers since 2014. The initiative needed to be focused primarily on restoration, monitoring, or improving knowledge or understanding of salmon populations in a river system. Data were compiled from information publicly available on

organisational websites at the time of data collection; it is recognized that these online sources may not capture the full extent of activities that have been completed or are currently underway, and that some relevant initiatives may not be publicly documented. Additionally, no organizations involved in river restoration or monitoring were contacted directly. While stocking efforts are often considered part of broader restoration or conservation strategies, they were excluded from this indicator to avoid redundancy, as stocking was assessed separately within the framework. Additional details on the data supporting this indicator will be provided in a subsequent documentation, to be posted on the CMAR website.

5.3 River stocking

River stocking is the practice of releasing hatchery-raised fish, such as Atlantic salmon, into a river system to support or enhance wild populations, often for conservation and recovery purposes. Evidence of river stocking can indicate the river's significance for wild salmon conservation and sustainability.

River stocking data were acquired from various sources, including DFO reports (e.g. Gibson et al., 2003, Fisheries and Oceans Canada, 2010, Fisheries and Oceans Canada, 2018) and the Nova Scotia Fish Hatchery Stocking Records. Only publicly available online sources that provided formal records of river stocking efforts, such as government or NGO reports and publicly accessible databases, were included in the assessment. This assessment only considered stocking records for Atlantic salmon; stocking of other species was not included. As this indicator involved a more intensive development process, additional details will be provided in subsequent reports.

6 Threats

6.1 Human Land Use

Human land use refers to the modification of natural landscapes for purposes such as agriculture, forestry, urban development, and infrastructure. These activities can impose additional stressors to salmon populations and their habitats by degrading water quality through eutrophication and contamination, increasing sedimentation, and altering temperature regimes (Cunjak, 1996; Blann et al., 2009; Millar et al., 2019). Evaluating this factor allows for the identification of rivers with low levels of nearby human land use, which are less likely to experience high levels of anthropogenic stressors and are therefore more likely to be significant for wild Atlantic salmon populations.

6.1.1 Reports and Articles

Gibson, A. et al. (2014). Recovery Potential Assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar): Habitat requirements and availability; and threats to populations. Fisheries and Oceans Canada, Science. https://epe.lac-

bac.gc.ca/100/201/301/weekly_checklist/2015/internet/w15-03-F-E.html/collections/collection_2015/mpo-dfo/Fs70-5-2014-071-eng.pdf

Guijarro-Sabaniel, J., Kelly, N. (2022). Land Use Atlas for Coastal Watersheds in the Maritimes Region. Fisheries and Oceans Canada https://publications.gc.ca/collections/collection_2022/mpo-dfo/Fs97-6-3494-eng.pdf

MacDonald, J. L. et al. (2023). Fish and Fish Habitat Report for Nova Scotia: Summary of the threat analysis prepared to support reporting by the Fish and Fish Habitat Protection Program - Maritimes Region (Fisheries and Aquatic Sciences 3567). Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3567-eng.pdf

6.1.2 Databases and Datasets

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)
- Nature Conservancy of Canada – The Active River Area Watershed Summary (2020)

Sterling Hydrology and Climate Change Research Group

- Nova Scotia Watershed Assessment Program (NSWAP) 2 Database

6.2 Climate change

Climate change may introduce additional stressors to salmon populations and their habitats, directly through habitat alterations, such as shifts in temperature and water flow, and indirectly by altering ecosystem functions, including food availability and predator-prey relationships (Angermeier et al., 2004; Millar et al., 2019; Thorstad et al., 2021). For Atlantic salmon, these changes may disrupt critical life stages, such as spawning, rearing, and migration – by reducing habitat suitability. Evaluating this factor allows for the identification of rivers that are less impacted by climatic stressors and are therefore more likely to be significant for wild Atlantic salmon populations.

6.2.1 Databases and Datasets

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)

6.2.2 Theses

Shin, M. (2023). *Freshwater Climate Risk Index for Biodiversity (FW-CRIB): Using Climate Change Vulnerability and Risk Assessments (CCVA/CCRA) to Guide Freshwater Management in*

Canada's Maritime Provinces. (Master of Marine Management). Dalhousie University, Retrieved from https://dalspace.library.dal.ca/handle/10222/83646

6.3 Aquatic Invasive Species (AIS)

Aquatic invasive species (AIS) are non-native organisms that have been introduced into the environment and have the potential to cause ecological harm. AIS can compete with native wild Atlantic salmon for habitat and resources, alter food webs, introduce disease, and degrade habitat quality (Fisheries and Oceans Canada, 2023). Evaluating this factor allows for the identification of rivers where AIS pose a current or emerging threat and are therefore less likely to be significant for wild Atlantic salmon populations.

6.3.1 Reports and Articles

Bowlby, H. D. et al. (2013). Recovery Potential Assessment for Southern Upland Atlantic Salmon: Habitat Requirements and Availability, Threats to Populations, and Feasibility of Habitat Restoration (Research Document 2013/006). Canadian Science Advisory Secretariat (CSAS). Fisheries and Oceans Canada (DFO), Dartmouth Nova Scotia. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/359664.pdf

Gibson, A. et al. (2014). Recovery Potential Assessment for Eastern Cape Breton Atlantic Salmon (Salmo salar): Habitat requirements and availability; and threats to populations. Fisheries and Oceans Canada, Science. https://epe.lac-bac.gc.ca/100/201/301/weekly_checklist/2015/internet/w15-03-F-E.html/collections/collection_2015/mpo-dfo/Fs70-5-2014-071-eng.pdf

Kingsbury, S. et al. (2024). A new tool for setting biodiversity management priorities adapted from aquatic invasive species management: A pilot using Atlantic salmon (Salmo salar) in NS, Canada. *Ecological Solutions and Evidence, 5*(2), e12340. https://besjournals.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/2688-8319.12340

MacDonald, J. L. et al. (2023). Fish and Fish Habitat Report for Nova Scotia: Summary of the threat analysis prepared to support reporting by the Fish and Fish Habitat Protection Program - Maritimes Region (Fisheries and Aquatic Sciences 3567). Fisheries and Oceans Canada. https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3567-eng.pdf

6.3.2 Databases and Datasets

2C1 Forest Atlas

- Nature Conservancy of Canada - Watershed Health Assessment (2019)