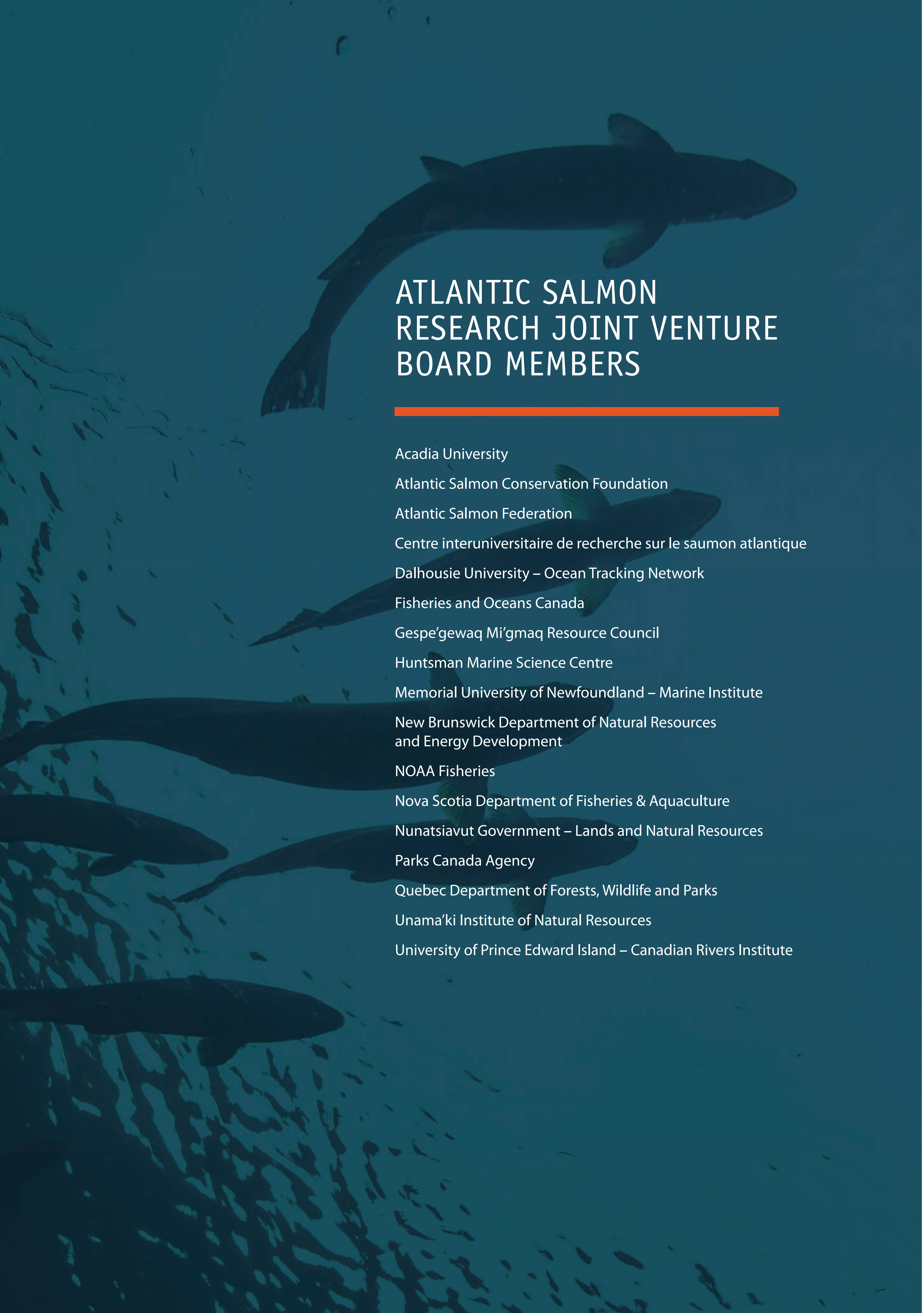
Annual Report
2018-2019

# ATLANTIC SALMON RESEARCH JOINT VENTURE

Shaping the Future of Wild Atlantic Salmon Research and Conservation

ATLANTIC
SALMON RESEARCH
JOINT VENTURE

PLAN CONJOINT
DE RECHERCHE SUR LE
SAUMON ATLANTIQUE



# ATLANTIC SALMON RESEARCH JOINT VENTURE BOARD MEMBERS

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Atlantic Salmon Conservation Foundation

Atlantic Salmon Federation

Centre interuniversitaire de recherche sur le saumon atlantique

Dalhousie University – Ocean Tracking Network

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Nunatsiavut Government – Lands and Natural Resources

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University of Prince Edward Island – Canadian Rivers Institute

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"We are focused on understanding why salmon are declining especially in the face of climate heating and the cascading effects of rapid environmental change in rivers and oceans."

**DOUGLAS BLISS**

CHAIR, ATLANTIC SALMON RESEARCH JOINT VENTURE

*__The Atlantic Salmon Research Joint Venture Annual Reports__ follow the federal government fiscal year: 1 April to 31 March. This Annual Report covers the period between 1 April 2018 and 31 March 2019.*

*Cover Photograph: Wild Atlantic Salmon/ Nick Hawkins*

## ABOUT THE ATLANTIC SALMON RESEARCH JOINT VENTURE

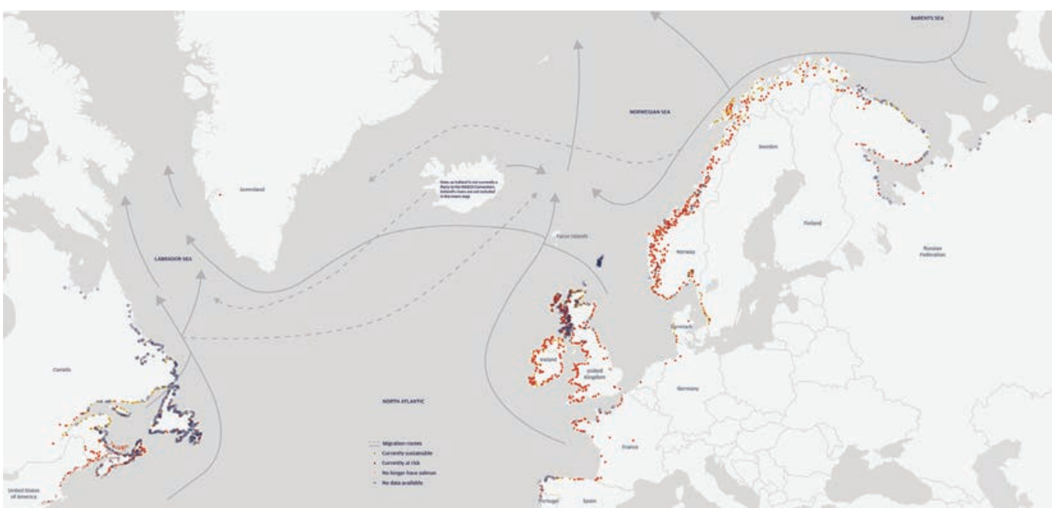
Once abundant across the North Atlantic Ocean from North America to Europe and in associated freshwater river systems, populations of wild Atlantic Salmon have declined by nearly 50 per cent since 1983. Natural dangers like predation and competition from other species as well as human-caused threats, like changing environmental conditions (water temperature changes, contaminants, etc.), pose enormous challenges to the species' survival, and to our understanding of their remarkable declines, particularly over the past decades. The implications of this decline are not only detrimental to the species but to biodiversity and cultural and recreational traditions.

To understand where and why salmon losses are occurring necessitates research over a massive area. It requires the combined international capacity of many agencies conducting and supporting studies to advance our knowledge so that management actions and solutions are well informed and implemented. The Atlantic Salmon Research Joint Venture was established to forge the partnerships and collaboration needed to address the urgent scientific questions to ensure the species' survival for the benefit of biodiversity and people for generations to come.

The Joint Venture, established in 2016, includes representatives from federal, provincial, state, and Indigenous government agencies, non-governmental organizations, Indigenous communities, and academia in Canada and the United States, all actively engaged in conducting or supporting wild Atlantic Salmon research. The Joint Venture includes a Management Board and a Science Committee, and is administered by Fisheries and Oceans Canada through the provision of a full-time coordinator.

The following 2018-2019 Annual Report builds on the 2016-2018 Annual Report. It highlights the Joint Venture's progress and accomplishments to date and reiterates the significance of this species to ocean and riverine biodiversity and to humanity.

***Status of Wild Salmon***
*Credit: North Atlantic Salmon Conservation Organization*



The Atlantic Salmon was given its scientific name by zoologist and taxonomist Carl Linnaeus in 1758. The name, *Salmo salar*, derives from the Latin *salmo*, meaning salmon and *salar*, meaning leaper, according to M. Barton.[1]

## MISSION

» **To enable scientific collaboration that generates and shares knowledge to enhance the recovery, conservation, and management of wild Atlantic Salmon in North America.**

[1] Barton, M.: "Biology of Fishes.", pages 198–202 Thompson Brooks/Cole 2007

“A great deal is known about salmon and their difficulties, but a great deal remains unknown or controversial despite the expenditure of large amounts of money and time on research. Part of the reason for the lack of knowledge is that people have not agreed on what information is needed, have duplicated each other’s work, and have been unwilling to fund needed research. An independent, multidisciplinary, standing scientific advisory board should be established to ensure that the limited money available for research is spent most productively to answer the most critical questions in a timely manner.”

UPSTREAM: SALMON AND SOCIETY IN THE PACIFIC NORTHWEST, NATIONAL ACADEMIES PRESS (1996)

*Wild Atlantic Salmon/Nick Hawkins*

## WHERE ARE WILD ATLANTIC SALMON FACING CHALLENGES?

Wild Atlantic Salmon navigate freshwater rivers, estuaries, and coastal waters to reach the open ocean, where they mature for up to three years before returning to their natal streams to spawn. Each generation then repeats this arduous and complex life cycle. While most direct human-caused stressors occur in freshwater habitats, this environment represents but one component of the Atlantic Salmon's migratory path. Salmon must continue their journey through estuarine and coastal habitats as vulnerable juveniles, grow to mature adults in the open ocean and return to their natal streams to breed. They face many pressures in each of these environments. Current research results indicate that oceanic transformation over the past 20 to 30 years, whether the ocean itself or what salmon eat and what eats salmon, are the primary factors causing the decline and limiting the recovery of the populations to previous levels. There is also growing consensus that the causes of low marine survival begin while young salmon are in freshwater rivers making it imperative that scientific research be undertaken in both freshwater and marine environments.

*Wild Atlantic Salmon Parr, Miramichi River, New Brunswick./Nick Hawkins*

# SHAPING THE FUTURE OF WILD ATLANTIC SALMON SCIENCE AND CONSERVATION

The Joint Venture Science Plan, 2018 to 2023, will guide the strategic planning and implementation of research initiatives and projects to better understand the trends and causes of variation and/or decline in the abundance and distribution of wild Atlantic Salmon.

This year's research addresses a broad range of issues from developing complete life-cycle models for the species, to examining the species' second year at sea in detail. These projects represent the highest-priority conservation goals and will set the stage for future work through ongoing collaborative efforts.

INTERNATIONAL YEAR OF THE SALMON

"Our impacts on salmon have reached a critical point – it's time to bring people together to share and develop knowledge more effectively, raise awareness, and take action."

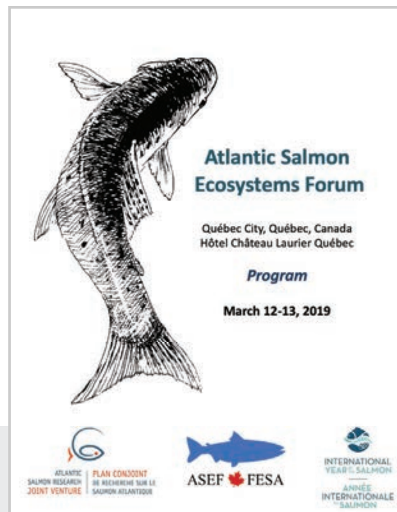
**yearofthesalmon.org**

### The International Year of the Salmon – Salmon and People in a Changing World

Environmental changes and human impacts across the Northern Hemisphere have been endangering wild Atlantic Salmon populations for decades. The 2019 International Year of the Salmon (IYS) brought people together to share and advance knowledge more effectively, raise awareness, and take action to better understand and manage this iconic species. 2019 was the focal year of the IYS, with research and outreach continuing through to 2022.

The Joint Venture contributed to the IYS goal to share scientific knowledge by hosting the first-ever Canadian Atlantic Salmon Ecosystems Forum in Quebec City in March 2019.

More than 150 scientists attended the forum to discuss and share their expertise regarding the critical role and deep connection between people and salmon, how new technologies are advancing and expanding the ways in which innovative research can be undertaken – all for the benefit of current and future wild Atlantic Salmon populations.




### Atlantic Salmon Research Priorities

The Joint Venture Science Plan identifies three research themes to help establish and understand trends and causes of the variation and decline of wild Atlantic Salmon populations.

#### 1. PHYSICAL ENVIRONMENT INTERACTIONS

- How are oceanic and freshwater environmental conditions, such as water temperature, impacting wild Atlantic Salmon populations?
- What effects do a mismatch in the seasonal timing of wild Atlantic Salmon movements and the prey they consume have on survival rates?
- What is driving or impacting the dispersal and migration patterns of wild Atlantic Salmon?
- How are contaminants and water chemistry impacting salmon survival and fitness?

#### 2. BIOTIC INTERACTIONS

- To what extent do predation on salmon, and competition among salmon and other species for food and space, impact marine and freshwater survival for salmon?
- How does the quality, availability, and diversity of prey impact wild Atlantic Salmon fitness?

#### 3. POPULATION-LEVEL EFFECTS

- How can technology advance the understanding of wild Atlantic Salmon genetics and population changes?

# MAPPING SPATIAL AND TEMPORAL DISTRIBUTION OF ATLANTIC SALMON MIXED STOCKS IN THE NORTH ATLANTIC

## Atlantic Salmon have precipitously declined in North America and Europe since the 1980s, and poor marine survival is thought to be the primary driver. Complex broad scale climatic oceanographic changes are likely influencing wild Atlantic Salmon distribution, but the causal mechanisms are poorly understood.

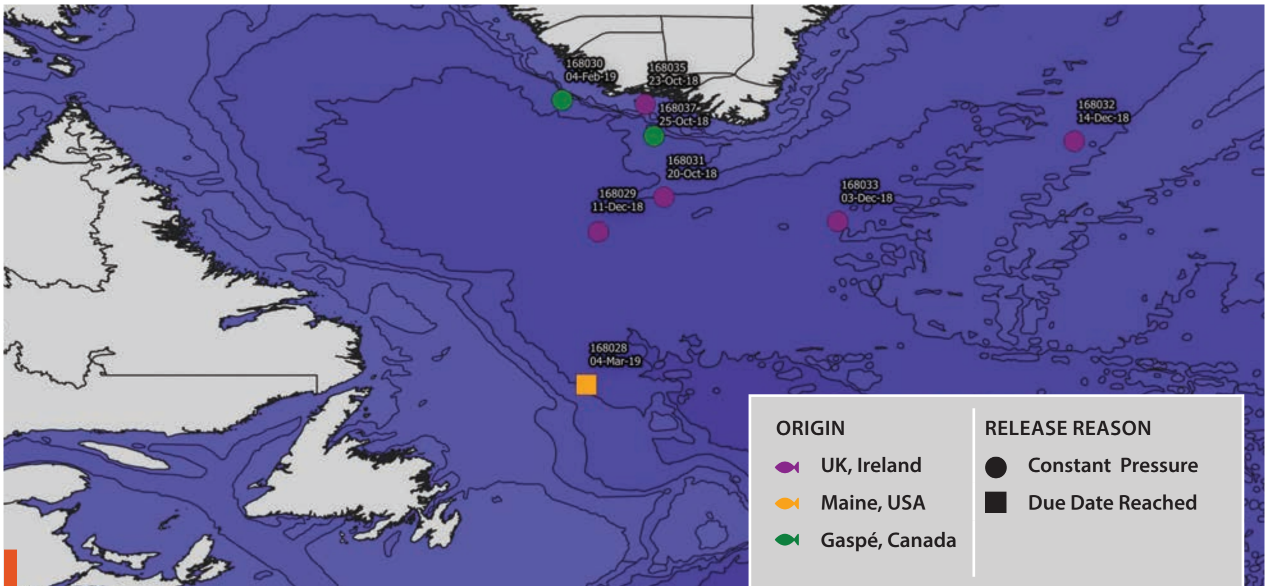
*Scientists from the Atlantic Salmon Federation, National Oceanic Atmospheric Administration, Fisheries and Oceans Canada, and the Association of Fishers and Hunters in Greenland are using telemetry to address knowledge gaps in the salmon's spatial and temporal distribution at sea.*

*ASF and NOAA researchers troll for salmon off the coast of West Greenland./Jonathan Carr*

*Jonathan Carr releases a satellite-tagged Atlantic Salmon back to the sea./Tim Sheehan*

While great advances have been made to understand the mortality, dynamics, and ecology of Atlantic Salmon during their first few months at sea, very little is known about salmon during the second year at sea. In the summer and early fall, salmon are in close proximity to the West Greenlandic coast. The waters off the coast of West Greenland serve as an important summer feeding area for wild Atlantic Salmon originating both from North America and southern Europe that spend two or more winters at sea before returning to home rivers. These larger fish are a critical component of the spawning stock for many salmon populations across the broad range as they contribute a significant number of eggs due to their larger size.

Given the constraints of poor marine survival on salmon from North America and southern Europe, and the importance of this life history type to the overall productivity of these stocks, a tracking program in combination with genetic assignment methods will provide information on stock-specific migration routes, behaviour, and mortality during the second year at sea.




*Pop off locations for eight salmon satellite-tagged off the coast of west Greenland in 2018. (The colours represent the region of origin for the tagged fish.)*

## Trolling as a method for capturing salmon

In 2018, three weeks were spent in west Greenland (Qaqortoq Region) from late September to mid-October. The intention was to assess the feasibility of several methods to capture fish (trolling, fyke nets, trap nets, gill nets) for the purpose of pop satellite archival tagging (PSAT) and acoustic tagging. Fourteen salmon were tagged (12 PSAT and 2 acoustic). Biological data were collected from all fish (fork length, weight, tissue and scale sample, parasite load, general observations). Of the fish tagged, eight originated from North America, and six from Europe. For the North American origin salmon, one was from the United States, one from Labrador, five from the Gaspé Peninsula, and one from Ungava Bay. All six European origin salmon were from the United Kingdom/Ireland.

Trolling was determined to be the most reliable method of capture and least likely to injure the salmon compared to other methods used.

## The results are promising

Of the 12 satellite-tagged salmon, eight tags popped off and transmitted. Seven tags released prematurely due to the constant depth release mechanisms (i.e., fish died), and one tag released in March 2019 at the preprogrammed pop-off date. No information is expected from the acoustic tagged fish until the acoustic receivers deployed around the east coast of North America are retrieved and downloaded. The battery life for acoustic tags is approximately three years.

This project marks the beginning of a five-year telemetry program for Atlantic Salmon at West Greenland.

Knowledge of spatial and temporal distribution and migratory routes for mixed stocks of maiden and post spawned salmon on both sides of the Atlantic will be beneficial on many levels. The data will be compared with biotic and abiotic oceanography to examine how these could be influencing marine survival for Atlantic Salmon populations.

*For more information, contact Jonathan Carr, Atlantic Salmon Federation, jcarr@asf.ca.*

This project marks the beginning of a five-year telemetry program for Atlantic Salmon at West Greenland.

# DEVELOPING A LIFE-HISTORY MODEL FOR ATLANTIC SALMON MARINE SURVIVAL

**The current status of Atlantic Salmon varies considerably in eastern Canada. More southerly populations that enter the ocean through the Bay of Fundy in Nova Scotia and New Brunswick generally have a poor conservation status, with population health increasing for those fish on the more northern coasts of Newfoundland and Labrador.**

*Following the closure of Canada's commercial Atlantic Salmon fisheries, particularly those in Newfoundland and Labrador in 1992, it became evident that while some salmon populations were responding well to the reductions in fishing mortality, others were not. Dr. Jeffrey Hutchings and Dr. Sebastián Pardo from Dalhousie University have set out to discover why.*

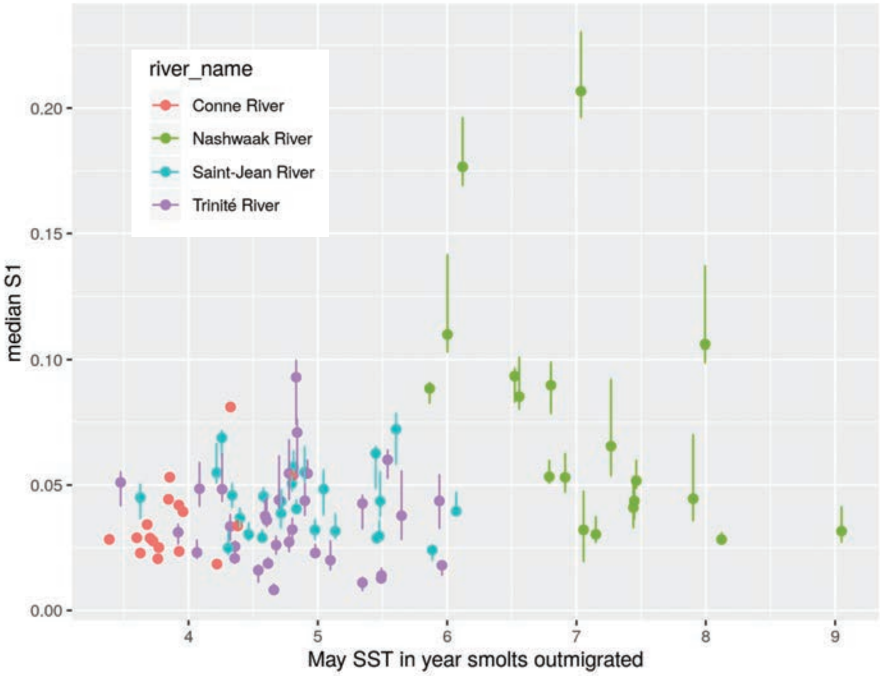
## Understanding why more salmon are dying at sea

One of the main causes of declining salmon populations in some areas appears to be increased mortality at sea since the 1970s and 1980s.

The increased at sea mortality on salmon viability was well known by the early 2000s. Multiple causes were suspected. The hypotheses for why salmon were dying at greater rates in the ocean than previously offered a rich research template for understanding why the population dynamics of salmon had changed.

However, something was missing in these analyses: empirically defensible estimates of survival at sea for multiple salmon populations. Some estimates were considerably better than others. The most reliable ones were for populations dominated by salmon that spend only one winter at sea (1SW) before returning to their natal river to spawn, such as the Conne River on the south coast of Newfoundland. For these populations, one could obtain reliable estimates of the at sea survival by comparing the number of smolts that left the river in one year with the number of returning 1SW salmon the following year.

But for populations comprised of 1SW, 2SW, and 3SW salmon, such calculations are not so simple.




*May Sea Surface Temperature in year smolts outmigrated*

One of the main causes of declining salmon populations in some areas appears to be increased mortality at sea since the 1970s and 1980s.

*Wild Atlantic Salmon in the Gaspé Penninsula. /Nick Hawkins*

### Modelling enables better understanding of the salmon life history

Instead, a modelling approach is required. Building on a previously supported Joint Venture study, the current work focuses on developing and comparing several life-history models to estimate at sea survival parameters, integrating data across life stages, analyzing data for salmon populations throughout the species' range, and continuing collaborative research and communications with key government and non-government Atlantic Salmon researchers.

The research will determine whether the sea mortality experienced by populations is similar to nearby populations (suggests geographically local causes of mortality) or to both nearby and distant populations (suggests a common cause of at sea mortality for all populations).

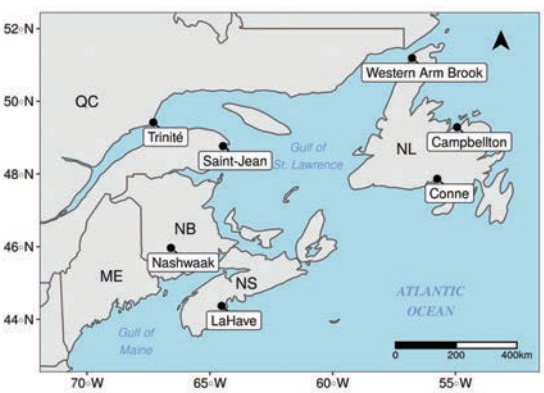
Preliminary results indicate that nearby populations do experience greater similarity in at sea mortality over time, suggesting that local, rather than regional causes, might be primary drivers of mortality, particularly at the time when smolts enter the sea as relatively small (12-15 centimetres) fish. They also indicate several different time-related patterns in at sea survival. Mortality in the ocean is declining for some, possibly increasing for others, or has remained roughly stationary.

The study also examines the reputed environmental correlates of marine survival. Preliminary results suggest that southerly populations may be more susceptible to temperature increases than more northerly populations. The graph shows preliminary estimates of marine survival during the first year at sea (S1) as a function of sea surface temperature (SST) in May when the smolts are leaving their rivers.

The green points suggest that survival at sea declines as water temperature increases for Nashwaak River salmon but not for salmon in regions where colder water temperatures predominate.

The research undertaken thus far has contributed to two manuscripts that have been submitted for publication in a peer-reviewed journal. More will follow.

*For more information, contact Dr. Jeffrey Hutchings, Dalhousie University, jeff.hutchings@dal.ca.*




*Wild Atlantic Salmon rivers studied*

# HYDROTHERMAL MODELLING AND ANALYSIS OF WILD ATLANTIC SALMON RIVERS IN EASTERN CANADA

Climate change is expected to impact the hydrological (seasonal water flow) and thermal (temperature) regimes of many rivers in eastern Canada – wild Atlantic Salmon (*Salmo salar*) populations and many other riverine species depend on these habitats for their survival.

*Dr. André St-Hilaire and his team of researchers from Quebec's National Institute for Scientific Research are setting out to define homogenous hydrothermal regions (regions where river temperature regimes are similar) in wild Atlantic Salmon rivers in eastern Canada and to provide future scenarios of how these habitats could change over time.*

The impacts of climate change on eastern Canada's rivers are expected to include water temperature fluctuations and changes to flow that could result in earlier spring flooding, higher winter flow, and lower summer flow. Because water temperature, along with flow, is one of the master variables that influences wild Atlantic Salmon recruitment, growth, distribution, and survival, understanding and anticipating river temperature and flow variations caused by a changing climate is critical to managing the species. A reliable model that combines process-based and statistical approaches to predict and analyze these variations is needed.

### THIS STUDY WILL PRODUCE:

- A first complete methodology for the delineation of hydrothermal regions for Atlantic Salmon rivers
- A short-term (few days) water temperature forecasting model

The project will consider Atlantic Salmon rivers throughout the range of this species in Eastern Canada (Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador).

*Atlantic Salmon in the Gaspé Penninsula/ Nick Hawkins*

## Forecasting water temperatures for short-term management and to better understand climate change implications

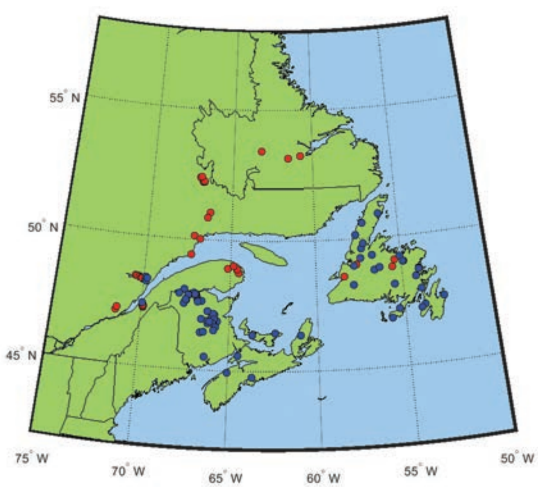
In the first year of this two-year project, two modelling approaches were tested. First, a local statistical forecast model was developed and tested on two rivers (Ste-Marguerite, Quebec, and Restigouche, New Brunswick) with real time water temperature monitoring stations. The model was tested on historical data, using air temperature as input, and successfully reproduced measured temperatures. This model can provide water temperature forecasts that are the river equivalent to the weather forecasts that are produced daily by meteorologists.

Secondly, a regional analysis model was tested using all water temperature monitoring stations with over five years of measured water temperatures.

Regional analysis uses information from gauged stations to estimate water temperature metrics (e.g., maximum temperature, annual maximum number of consecutive days over a stressful threshold, etc.) at engaged sites. The approach was tested with a Generalized Additive Model on 141 stations with water temperature data in Eastern Canada (QC, NB, NS, PE, NL). The model was tested using a leave-one-out cross validation. In this procedure, one station is taken out and the temperature metric of interest is estimated.

Then, this station is put back in the database, and the next one is taken out for estimation, etc.

*Spatial distribution of the water temperature stations used in this study.*




## Refining the data means management can make more informed decisions

The results are promising, with a Root Mean Square Error (a combined measurement of bias and variance) of 1.7 deg C for the estimation of maximum temperature. The regional model will be further tested at different sets of stations, with four years of historical temperature data, while eliminating duplicate stations on the same river.

Indeed, some of the drainage basins included in the study have over 10 stations, which may be very similar with respect to their thermal regime. In the second year, studies will be more specific with a maximum of two stations per river. Stations with four years of data will be included. The regional analysis will be repeated with this refined dataset. Once this is determined and once we have three or four thermal regions, temperature metrics used by managers (e.g., to decide if angling should be closed because the water is too warm) can be estimated in rivers with no or very few measurements.

*For more information, contact Dr. André St-Hilaire, National Institute for Scientific Research, andre.st-hilaire@ete.inrs.ca.*

# EVALUATING THE POTENTIAL OF OPEN-OCEAN ACOUSTIC TELEMETRY OF ATLANTIC SALMON

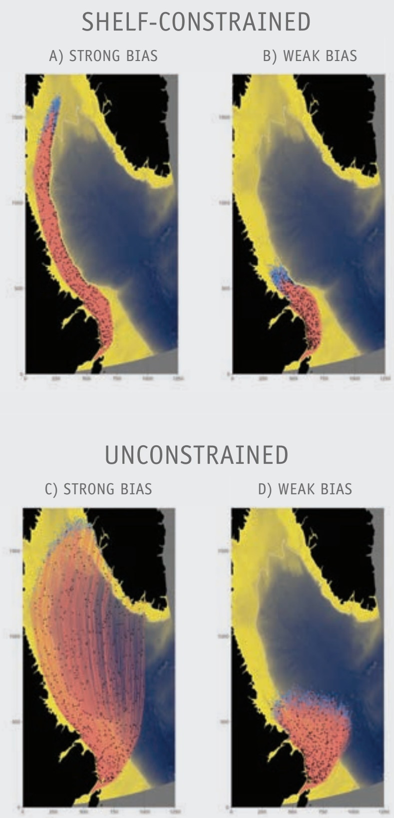
*A collaborative team led by the Nova Scotia Salmon Association's Dr. Eddie Halfyard is working to begin addressing a major gap in our understanding of Atlantic Salmon by using acoustic telemetry to determine their spatial distribution in the marine environment and the location and timing of marine mortality. The project was a partnership between the Nova Scotia Salmon Association, the Ocean Tracking Network, MacQuarrie University (Australia), the Atlantic Salmon Federation, the American National Oceanic and Atmospheric Administration, and Dalhousie University.*

Acoustic telemetry is a tool to monitor the movements of Atlantic Salmon, however, projects that could follow salmon in the open ocean and provide advice to managers are very large-scale; larger than previous coastal acoustic telemetry projects. This has discouraged research due to the assumption that an excessively large numbers of acoustic receivers and funding would be required to provide meaningful data.

To simulate the migration of Atlantic Salmon in the North Atlantic, a spatially realistic, Individually Based Animal Movement Model (IBMM) was created.

One way to encourage the development of future acoustic telemetry projects in the open ocean is knowledge of the likelihood of encountering Atlantic Salmon, and an understanding of what receiver array design or coverage best balances logistic constraints (e.g., funding) and likelihood of success.

In 2018, the Joint Venture funded the development of models to simulate an open-ocean acoustic telemetry project to track Atlantic Salmon. The research aimed to optimize the design of North Atlantic Ocean Atlantic salmon acoustic telemetry projects. Researchers simulated the probability of detecting Atlantic Salmon post-smolts under several scenarios that account for potentially diverse migration strategies, environmental forcing/ drivers, realistic acoustic gear performance, and varying levels of effort (e.g., number of receivers or receiver array design).




***Examples of simulated post-smolt migration patterns, where the migration of 100 post-smolts is:***

*(a) constrained to the continental shelf with a strong affinity to reaching Greenland,*

*(b) constrained to the continental shelf with a weak affinity to reaching Greenland,*

*(c) unconstrained movement with a strong affinity to reaching Greenland, and,*

*(b) unconstrained movement with a weak affinity to reaching Greenland.*

## Getting started with the research meant finding a common starting point

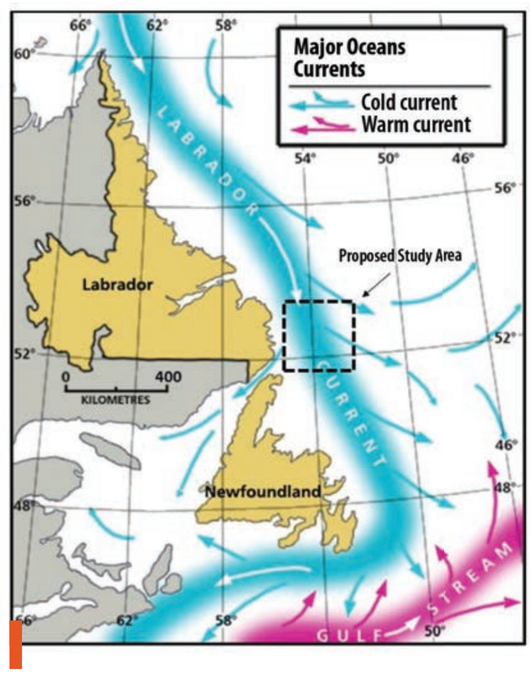
To simulate the migration of Atlantic Salmon in the North Atlantic, a spatially realistic, Individually Based Animal Movement Model (IBMM) was created. The model incorporated assumptions on swimming speed and other biological characteristics that were either supported by scientific literature or field-measured in previous telemetry studies. For the purpose of this research, a common starting point for the simulation was selected – the Strait of Belle Isle was the best choice because of existing Atlantic Salmon acoustic telemetry datasets compiled by the Atlantic Salmon Federation. These data provided estimates of migration rate and the survival of fish from home rivers to the Strait. The model assumed one of four migration scenarios based on smolt preference for a northward bias and/or orientation over continental shelf areas. This migration model was paired with a simulated acoustic telemetry model that predicted the likelihood of successfully detecting a salmon post-smolt if present. Input parameters for the performance of equipment was estimated using field-measured data from previous research.

### Learning how wild Atlantic Salmon move through the ocean and when and where mortality occurs

The findings of our study suggest that meaningful acoustic telemetry data from the open-ocean migration of Atlantic Salmon may be more feasible than previously thought. Although the probability of detecting a tagged post-smolt was dependent on the level of sampling effort (i.e., the number of receivers), a realistic scenario of only 113 receivers yielded a detection probability of 0.35 – sufficient to answer many questions about migration routes and survival. The findings also suggest that coarse grids of acoustic receivers may offer a likelihood of detection comparable to the commonly used 'lines' or 'gates' but also offer alternative options for spatial analyses with a broader geographic coverage despite their coarser spacing.

Finally, an important aspect of our work is the revelation that it may be possible to generate testable hypotheses regarding how salmon move through the ocean and when and where mortality occurs. Current hypotheses regarding salmon migration necessitate assumptions about rates of movement, dispersion patterns, environmental constraints or drivers, and potential sensory mechanisms. By incorporating these assumptions into the model, expected patterns of acoustic detections can be generated. These hypotheses and expected patterns in acoustic detections can then be contrasted with real-world telemetry data to further refine our understanding of Atlantic Salmon migration.

*For more information, contact Dr. Eddie Halfyard, Nova Scotia Salmon Association, eahalfyard@hotmail.com.*




*Map of Proposed Area of Interest for the Simulation Model (Modified from: Gary E. McManus and Clifford H. Wood, Atlas of Newfoundland and Labrador (St. John's, NL: Breakwater, ©1991 MUNCL) Plate 5.2) .*

# THE IMPACTS OF NATURAL TEMPERATURE VARIABILITY ON ATLANTIC SALMON FITNESS

**In natural temperate aquatic ecosystems, environmental temperature is highly variable. Despite this natural variability, much of our understanding of the effects of temperature on Atlantic Salmon fitness (growth, activity, reproduction, etc.) comes from laboratory-based studies conducted on fish acclimated to stable thermal profiles.**

*Dr. Andrea Morash of Mount Allison University and Dr. Suzie Currie of Acadia University have teamed up to address the gap in our understanding of how wild Atlantic Salmon respond to thermal variability in their natural environment.*

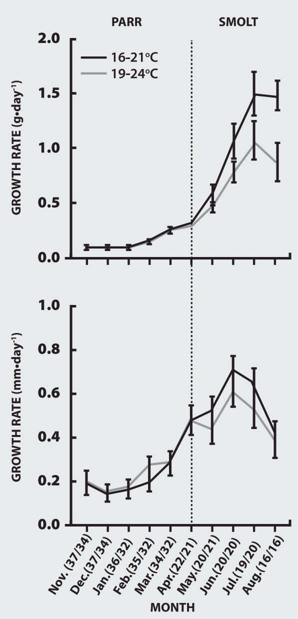
*A collection site on the Restigouche River./Andrea Morash*

Understanding the effects of thermal variability is important. Climate models predict that not only will the average global temperature increase, but so will temperature variability and extreme weather events. Recent theoretical models incorporating thermal variation has shown that variation is as strong, or stronger, than average temperature alone at predicting future salmon performance in forecasted climate scenarios.

This project focuses on how natural temperature variability from thermally distinct river systems (Miramichi vs. Restigouche) affects the fitness of wild Atlantic Salmon at multiple life stages.

## High river temperatures are contributing to declining wild Atlantic Salmon populations

In the Miramichi River, for example, high river temperatures have been implicated as a contributing factor to the recent Atlantic Salmon population declines. The river temperature can reach 25 to 30°C, with daily fluctuations of up to 9°C during summer. The commonly accepted optimum temperature for Atlantic Salmon to maximize growth is about 16 to 17°C, and the onset of thermal stress is estimated to begin around 23°C. It is clear that the thermal profile of the Miramichi River can far exceed optimum temperatures for Atlantic Salmon.




*Atlantic Salmon Parr and Smolt Growth Rates in the Miramichi River, 2019.*

Current management strategies for Atlantic Salmon are based, in part, on data from stable temperature lab experiments, and rely on maximum temperatures alone to trigger river closures. However, these strategies do not yet consider the daily variation in temperature and may not accurately reflect how salmon respond to warming temperatures.

This project focuses on how natural temperature variability from thermally distinct river systems (Miramichi vs. Restigouche) affects the fitness of wild Atlantic Salmon at multiple life stages. The team is studying growth rates, metabolism, and thermal tolerance in juvenile and adult salmon under two different thermal regimes in the Miramichi and Restigouche rivers. Early findings indicate that smolts may be more vulnerable to temperature variation than parr. Smolts seem to have a limited capacity for acclimation to warmer thermal profiles and this may be inhibiting their overall growth. Their smaller size leads to a faster exhaustion rate and exposes smolts to increased predation during their migration out to sea. This research will continue into the adult life stage of the Miramichi salmon with similar testing on parr from the Restigouche River to understand the effects of river origin and historical exposure. The Restigouche River has lower maximum summer temperatures and thermal variability, on average, than the Miramichi River, and these cooler acclimated fish may respond differently to these fluctuating thermal profiles than the salmon from the Miramichi.

*Electro-fishing for Atlantic Salmon parr at Chain of Rocks Brook, Restigouche River. Left to Right: James Barnaby, Jessica Gideon, and Carole-Anne Gillis of the Gespe'gewaq Mi'gmaq Resource Council./Charlene Labillois*

## The results of this research will lead to better wild Atlantic Salmon management strategies

Understanding the thermal physiology and limitations of the various life stages of Atlantic Salmon from different river systems will allow us to make informed decisions based on empirical data for management within these river systems. This may include refining the response thresholds for river closures, considering water temperature and weather forecast triggers that are distinct for each location. Management strategies should also include measures of thermal variation and thermal history, in addition to maximum temperatures. Understanding how wild Atlantic Salmon cope with natural thermal variability in a warming world will be key to determining their future performance and will help to refine management practices.

*For more information, contact Dr. Andrea Morash, Mount Allison University, amorash@mta.ca or Dr. Suzie Currie, Acadia University, suzie.currie@acadiau.ca.*

# OUR IMPACT

In 2018-2019, Atlantic Salmon Research Joint Venture partners contributed over $1.2 million CDN to fund five new research projects and one ongoing project.

"In the United States, wild Atlantic Salmon are in trouble and need our help. The Atlantic Salmon Research Joint Venture is enabling us to work together on both sides of the border to better understand threats and ensure success in our recovery programs throughout the species' range in Maine."

**KIM DAMON-RANDALL**

HEAD OF UNITED STATES DELEGATION TO THE NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION

## THE ATLANTIC SALMON RESEARCH JOINT VENTURE: THREE YEARS AT A GLANCE

**1.23M CDN**
*Invested in 2018-2019*

**2.33M CDN**
*Total over 3 years*

**4** → *4 Symposia*

**11** → *11 Projects*

**51** → *51 Partners & Contributors*

**20+** → *20+ ASRJV Member Organizations*

These contributions, along with Fisheries and Oceans Canada's Science Partnership Fund, have been matched 1:1 by partners interested in the future of wild Atlantic Salmon populations. In other words, funding was doubled by interested parties with the same conservation priorities.

The success of this funding model is a testament to the Joint Venture's relevance to science and conservation and to its potential for making a significant impact on our understanding of declining salmon populations, and indeed the understanding of many fish species facing similar fates.

Like all scientific research, it takes time to collect and analyze data. This second Annual Report illustrates how the Joint Venture's momentum is creating a foundation that will inform and guide future salmon management strategies. One of the Joint Venture's noteworthy initiatives during 2018-2019 was hosting the Atlantic Salmon Ecosystems Forum in Quebec City, Canada. More than 150 researchers, conservationists, and managers convened to share information, learn from each other, and plan future research initiatives for conserving this iconic and once prolific species.

**THANK YOU** TO THE CANADIAN, U.S., AND EUROPEAN FEDERAL AGENCIES, PROVINCIAL GOVERNMENTS, INDIGENOUS GROUPS, NON-GOVERNMENTAL ORGANIZATIONS, AND ACADEMICS THAT HAVE CONTRIBUTED TO JOINT VENTURE INITIATIVES IN 2016-2018 THROUGH FUNDING, EXPERTISE, OR PARTICIPATION. YOU HAVE MADE OUR FIRST THREE YEARS A SUCCESS.

- Acadia University
- Agri-food and Biosciences Institute (Northern Ireland)
- Atlantic Salmon Conservation Foundation
- Atlantic Salmon Federation
- Atlantic Salmon Trust
- Association of Fishermen and Hunters in Greenland (KNAPK)
- Canadian Rivers Institute
- Cascapédia Society
- Centre for Environment, Fisheries and Aquaculture Science (Cefas)
- Centre interuniversitaire de recherche sur le saumon atlantique
- Dalhousie University – Ocean Tracking Network
- Equinor Canada Ltd.
- Fisheries and Marine Institute of Memorial University of Newfoundland
- Fisheries and Oceans Canada
- Fort Folly First Nation / Fort Folly Habitat Recovery
- Gespe'gewaq Mi'gmaq Resource Council
- Gulf of Maine Research Institute
- Huntsman Marine Science Centre
- Hydro-Québec
- Inland Fisheries Ireland
- Innovasea / Vemco
- Institut national de la recherche scientifique
- Ireland Marine Institute
- Laval University
- Listiguj First Nation
- Macquarie University
- MetOcean Telematics
- Miramichi Salmon Association
- Mount Allison University
- National Institute of Agricultural Research (INRA)
- National Science and Engineering Research Council
- New Brunswick Department of Natural Resources and Energy Development
- New Brunswick Environmental Trust Fund
- NOAA Fisheries
- North Atlantic Salmon Conservation Organization
- Norwegian Institute for Nature Research
- Nova Scotia Department of Fisheries & Aquaculture
- Nova Scotia Salmon Association
- Nunatsiavut Government – Lands and Natural Resources
- Ocean Tracking Network
- Parks Canada Agency
- Prince Edward Island Department of Communities, Land and Environment – Forests, Fish and Wildlife Division
- Quebec Department of Forests, Wildlife and Parks
- Restigouche River Watershed Management Council
- UK Centre for Environment, Fisheries and Aquaculture Science
- Unama'ki Institute of Natural Resources
- United States Geological Survey
- University of Massachusetts
- University of New Brunswick
- University of Prince Edward Island – Canadian Rivers Institute
- Woods Hole Oceanographic Institute

*Wild Atlantic Salmon, Miramichi River/Nick Hawkins*

"The survival of wild Atlantic Salmon is very important for Indigenous peoples and all Canadians. The efforts of the Atlantic Salmon Research Joint Venture to assist the science community to tackle the big questions affecting salmon will help us find possible ways to conserve this species into the future."

**SERGE DOUCET**

HEAD OF CANADA DELEGATION TO THE NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION

ATLANTIC SALMON RESEARCH JOINT VENTURE | PLAN CONJOINT DE RECHERCHE SUR LE SAUMON ATLANTIQUE

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