

# SALSEA - Track

Innovative research to solve the mystery of Atlantic salmon mortality at sea



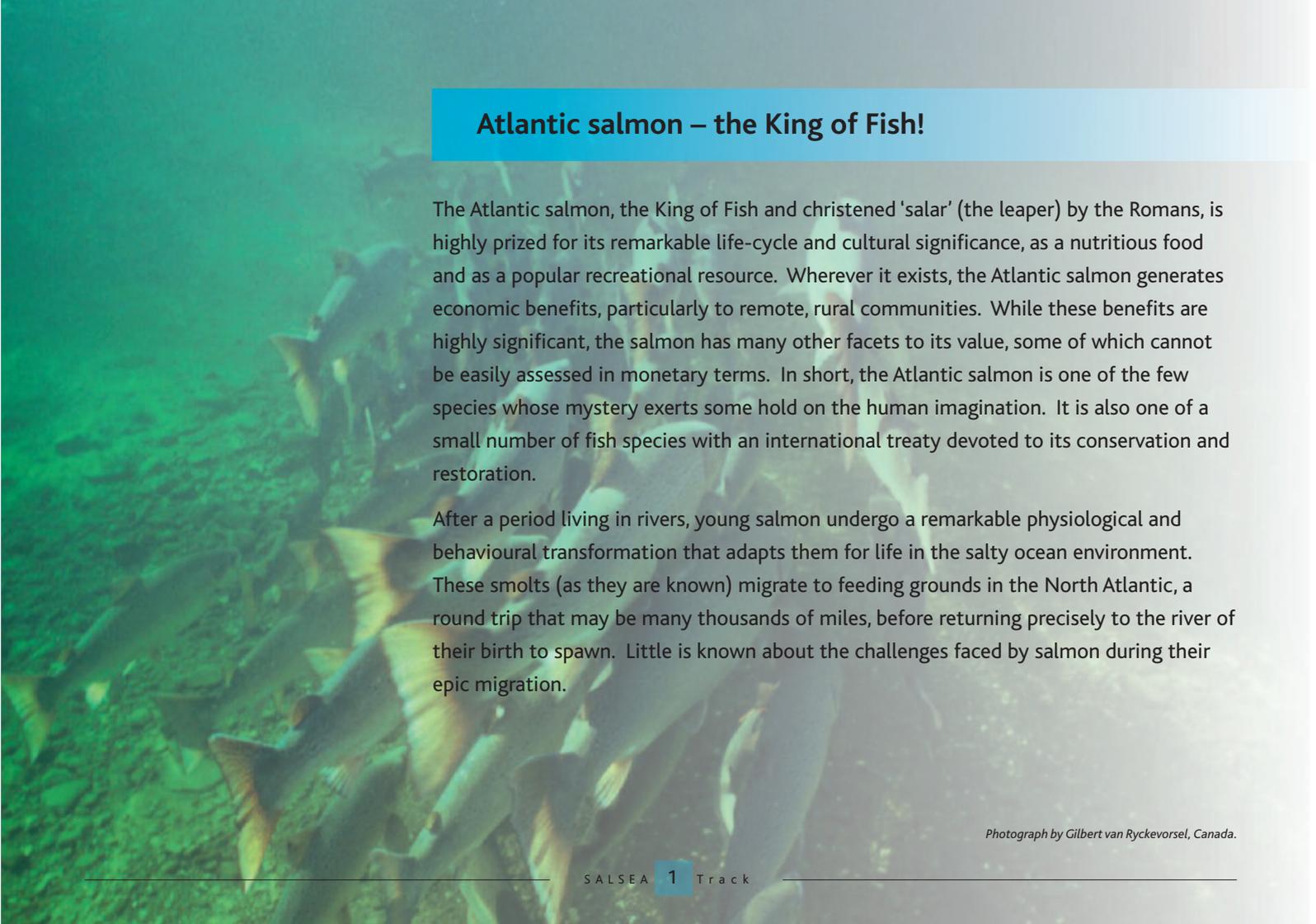
Publisher: North Atlantic Salmon Conservation Organization (NASCO), 11 Rutland Square, Edinburgh EH1 2AS, UK.

Date of Publication: March 2016.

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*Front cover photograph of salmon by Gilbert van Ryckevorsel, Canada.*



## Atlantic salmon – the King of Fish!

The Atlantic salmon, the King of Fish and christened 'salar' (the leaper) by the Romans, is highly prized for its remarkable life-cycle and cultural significance, as a nutritious food and as a popular recreational resource. Wherever it exists, the Atlantic salmon generates economic benefits, particularly to remote, rural communities. While these benefits are highly significant, the salmon has many other facets to its value, some of which cannot be easily assessed in monetary terms. In short, the Atlantic salmon is one of the few species whose mystery exerts some hold on the human imagination. It is also one of a small number of fish species with an international treaty devoted to its conservation and restoration.

After a period living in rivers, young salmon undergo a remarkable physiological and behavioural transformation that adapts them for life in the salty ocean environment. These smolts (as they are known) migrate to feeding grounds in the North Atlantic, a round trip that may be many thousands of miles, before returning precisely to the river of their birth to spawn. Little is known about the challenges faced by salmon during their epic migration.

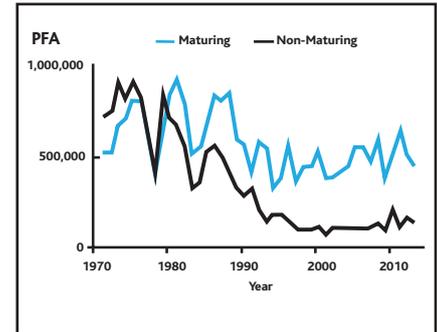
*Photograph by Gilbert van Ryckevorsel, Canada.*

## The mystery

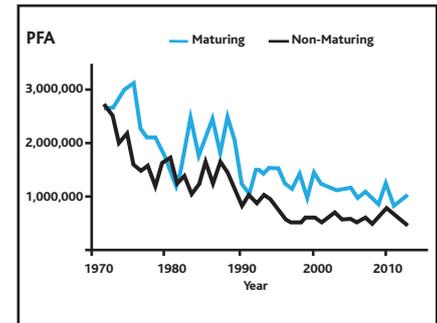
Notwithstanding evidence that some well-managed salmon rivers continue to produce stable numbers of smolts, the abundance of Atlantic salmon prior to any fisheries (known as the pre-fishery abundance or PFA) has declined over the last forty years, from about 8-10 million fish in the early 1980s to 3-4 million fish in recent years. The decline has been most marked for populations in the southern parts of the range in both Europe and North America and for salmon spending more than one year at sea (referred to as non-maturing in the graphs on the right). In some southern rivers, unique populations of Atlantic salmon are critically endangered.

Monitoring of rivers in Europe and North America indicates that marine survival has declined markedly, but we do not know what is killing the salmon at sea. This is happening despite restrictive conservation measures being taken all around the North Atlantic. Increased mortality of Atlantic salmon at sea, and a lack of understanding of the factors responsible, undermine the conservation and restoration initiatives being undertaken and are obstacles to effective conservation.

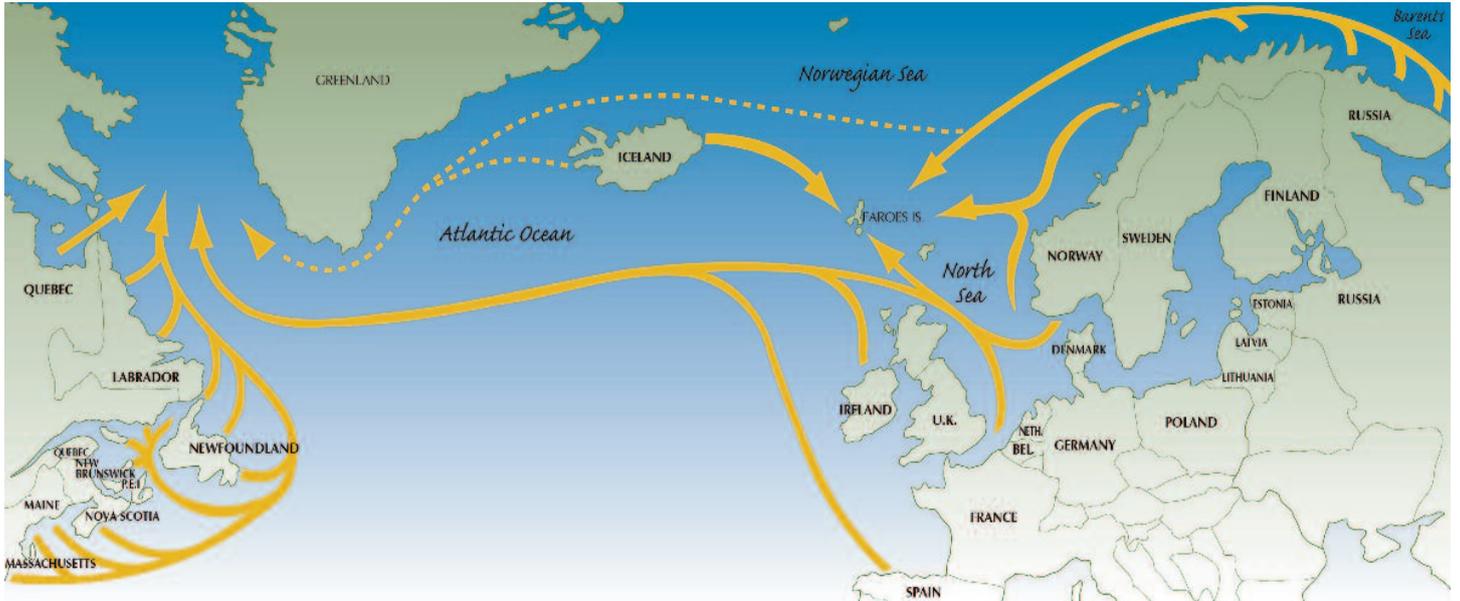
The mystery of the loss of Atlantic salmon at sea has become a compelling concern and challenge for salmon scientists, managers and others with an interest in this treasured resource.



Abundance of North American stocks of Atlantic salmon.  
Source: International Council for the Exploration of the Sea (ICES).



Abundance of Southern European stocks of Atlantic salmon.  
Source: International Council for the Exploration of the Sea (ICES).



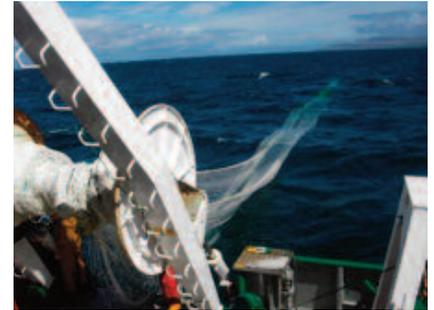
Map illustrating the oceanic migrations of Atlantic salmon.  
 Courtesy of the Atlantic Salmon Federation, Canada.

## The international response

In a concerted international effort to confront the challenge, the intergovernmental North Atlantic Salmon Conservation Organization (NASCO) has developed and supports, through a public/private partnership, a major, innovative programme of cooperative research on salmon at sea, the SALSEA Programme. An international team of scientists was assembled and, utilising recent advances in marine sampling, genetic techniques for stock identification, electronic tagging systems and scale analysis, has already set about unravelling the mystery of when and why Atlantic salmon are dying at sea. The Programme contains three main elements:

- Supporting technologies;
- Early migration through the inshore zone (fresh, estuarine and coastal waters); and
- Investigating the distribution and migration of salmon at sea.

The first phase of the SALSEA Programme focused on improving understanding of the distribution and migration of salmon at sea. To study salmon at various stages along their oceanic migration routes, ocean surveys were conducted in both the eastern and western North Atlantic and there was enhanced sampling of the fishery at West Greenland. These results were coordinated with other research efforts, review of scientific literature and analyses of samples from earlier studies using newly available analytical techniques.



*Marine trawl surveys for salmon post-smolts.  
Courtesy of the Marine Institute, Ireland.*



*Preparing the live capture trawl gear during a marine survey for salmon.  
Courtesy of the Institute of Marine Research, Norway.*



*Catching smolts for tracking, Sheepscot River, Maine, USA.  
Courtesy of Graham Goulette.*



*Applying an acoustic transmitter to a salmon smolt.  
Courtesy of the Atlantic Salmon Federation, Canada.*

## What has the SALSEA Programme delivered to date?

The first phase of the SALSEA Programme delivered greatly improved understanding of the distribution and migration of salmon at sea. New insights have been gained into the ecology of salmon at sea, including feeding and growth, competition and predation. New tools with potential to support management have been developed such as migration models that can provide estimates of migration routes under different oceanographic conditions and, in future, this might support decision-making, e.g. in relation to the siting of marine development projects. Improved understanding of the distribution and migration of post-smolt salmon at sea, obtained from both marine surveys and modelling studies, will also assist in refining estimates of by-catch of salmon in pelagic fisheries targeting species such as mackerel which occur in the same areas of the ocean as salmon post-smolts. New genetic tools capable of assigning salmon caught to their region or river of origin have been developed and validated and these will support management.

The first phase of the SALSEA Programme provided further evidence that the marked decline in the abundance of Atlantic salmon was due to increased mortality at sea, linked to a warming climate. Since management options in the ocean are limited, the goal should be to maximise the number of healthy wild salmon that go to sea by focusing actions on impact factors in fresh, estuarine and coastal waters. Tracking salmon along their inshore and oceanic migration routes can assist in identifying these impact factors and support rational management and the rebuilding of salmon stocks.



## SALSEA - Track: unravelling the mystery of the salmon's life at sea

Motivated by the importance of understanding the mystery of salmon mortality at sea, NASCO now seeks to support a second phase of the SALSEA Programme that will take advantage of advances in telemetry technology to precisely track the salmon along their migration routes. Telemetry is an automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring. For example, acoustic tags can be applied to smolts to monitor their progress along the migration route as detected by strategically placed receivers or 'listening devices'. Innovative research projects in the Gulf of Maine, US, and the Gulf of St Lawrence, Canada, have demonstrated the potential for such methods to be used to identify the migration routes of emigrating post-smolts and to quantify the mortality occurring at different points along the migration route, how this mortality varies from year to year and the factors causing the mortality e.g. predation, aquaculture or renewable energy installations. Smolts from rivers draining into the Gulf of St Lawrence have been tracked through the Strait of Belle Isle and smolts from rivers entering the Gulf of Maine have been tracked as far north as Newfoundland. There are plans to extend this capability into the Labrador Sea. Acoustic receivers deployed in studies of salmon in the Gulf of Maine have already provided valuable detections of numerous species, including great white shark, striped bass, Atlantic

*Deploying receivers in the Baie des Chaleurs, Canada.  
Courtesy of the Atlantic Salmon Federation, Canada.*

sturgeon and Atlantic cod. In the North-East Atlantic, most acoustic tagging of salmon has been conducted in estuaries and fjords but there are also ambitious plans to extend this tracking capability seaward. Tags that transmit their data via satellites can also be applied to adult salmon (e.g. at West Greenland) and to salmon that have spawned and are preparing to migrate back to sea. SALSEA - Track will require international collaboration and partnerships among scientists and industry in seeking answers to key questions relating to the conservation and management of Atlantic salmon. It will involve collaboration with researchers and organisations working on a variety of other marine species that utilise the North Atlantic and Arctic Oceans.



Downloading data from an acoustic receiver.  
Courtesy of the Atlantic Salmon Federation, Canada.



Applying a satellite tag to a salmon at West Greenland.  
Courtesy of Kai Benson.

*Salmon from North America and Southern Europe that spend more than one year at sea migrate to feed in the waters off West Greenland.  
Courtesy of Kai Benson.*

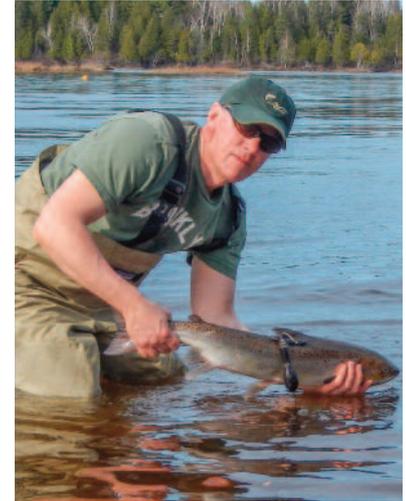
## How you can help the wild Atlantic salmon

Individuals, companies, foundations and others with an interest in the future of this iconic species are invited to contribute to this pioneering international initiative designed to increase understanding of the reasons for the losses of salmon at sea and identify the actions that can be taken to address those losses and maintain the health of the ocean environments on which this species depends.

If you would like further information on this exciting new initiative or have any questions about the proposed research please contact:

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*NASCO is an Intergovernmental Organisation established by an international treaty in 1984 to contribute to the conservation, restoration, enhancement and rational management of Atlantic salmon through international cooperation. The current Parties are Canada, Denmark (in respect of the Faroe Islands and Greenland), the European Union, Norway, the Russian Federation and the United States of America. In addition, thirty-five Non-Government Organisations contribute to the work of NASCO. NASCO is addressing a wide range of issues of relevance to salmon conservation. Through its International Atlantic Salmon Research Board, NASCO seeks to promote collaboration and cooperation on research into the causes of marine mortality of Atlantic salmon and the opportunities to counteract it. Further details of this work are available at [www.nasco.int](http://www.nasco.int) and [www.salmonatsea.com](http://www.salmonatsea.com).*



*Releasing a kelt (spawned salmon) tagged with a satellite transmitter.  
Courtesy of the Atlantic Salmon Federation, Canada.*



*SALSEA - Track will involve collaboration with scientists undertaking telemetry studies on a variety of other marine species.  
Courtesy of the Ocean Tracking Network.*

