Is the wild Atlantic Salmon a Doomed Species?

The wild Atlantic salmon is not just a valuable international resource. The salmon has been at the heart of national cultures of countries in the North Atlantic region for at least twenty thousand years. The carved salmon in a Dordogne cave and the Glamis Stone testify to its importance, while in Canada and Finnmark, First Nation people still regard the salmon as a sacred birthright. More recently, the late Poet Laureate, Ted Hughes, connected us elementally with the past by celebrating the salmon's life cycle in his poem 'Salmon Eggs'.

The salmon's relationship with people spans human existence, from its mystical beginnings in the Stone Age to today's supermarket shelves crammed with slabs of farmed protein. The life strategy of the salmon also gives it a unique status as a 'barometer species', providing detailed information on our changing environment.

There are very few species of fish with an international treaty organisation to protect them. Governments of Atlantic salmon countries are signatories of the North Atlantic Salmon Conservation Organisation - NASCO, which is supported by its own research board. With access to the best fishery scientists and 34 third-sector interest groups, the existence of NASCO is a measure of the importance given by governments to conserving the wild Atlantic salmon.

Despite such heavyweight support, the future of the salmon is uncertain. The hard truth is that wild Atlantic salmon populations are in danger of extinction, perhaps not imminently everywhere, but at the very least in their southern range.

Among many possible causes for the salmon's decline, the most threatening and difficult to attribute is climate change, the most obvious effect of which is ocean warming. Salmon are cold-water fish. Higher temperatures impact on their marine and freshwater habitats, and reduce the abundance of their prey species.

The key question is, '***can human intervention make any difference at all to mitigate the effects of climate change on salmon stocks at sea?'***

Concern over the decline of stocks of wild Atlantic salmon by over 60% in 40 years prompted NASCO in 2008 to launch the SALSEA (Salmon at Sea) project. Dr Malcolm Windsor of NASCO explained the goal of the SALSEA Programme:

"*to increase understanding of how salmon use the ocean, where they go, how they utilise currents and the ocean's food resources and what factors influence their migration and distribution at sea".*

Since 2011 there have been efforts by scientists from the North Atlantic salmon countries, using the latest tracking technologies and genetics science, to answer the question, "where, when and how are such high numbers of salmon dying at sea?"

In Europe, rivers are already recording the effects of climate change. In some Pennine and Scottish river catchments for example, tree-shading planting programmes on shallow upland streams have been implemented to protect juvenile salmon from high water temperatures caused by direct sunlight.

In coastal waters, studies of effects of drought conditions on salmon waiting in estuaries indicate that up to 50% may die from a range of causes, including high temperatures, predation, coastal netting, pollution and possible disruption to migrations caused by renewable energy projects. Similar problems of high summer temperatures are also affecting North American rivers, such as the Mirimachi, and the rivers of Maine, Quebec and Nova Scotia.

The Inter-governmental Panel on Climate Change (IPCC) reports that storms are more severe than in the past. These affect the top layers of the pelagic zone of the ocean's water column, and can change surface currents and throw migrations of post-smolt salmon off course.

The Atlantic salmon is an endangered species in the United States and, while Canadian rivers flowing into the Bay of Fundy historically had annual runs of over 40,000 salmon, they now have less than 200. Portuguese rivers have lost nearly all their salmon, the rivers of Galicia and Asturias are on the edge, as are the rivers of southern France, despite heroic efforts by fishery managers. The Allier, for example, a tributary of the Loire, may soon no longer be able to sustain salmon, whose outgoing smolts and incoming adults have to negotiate more than 800 kms of the river's main stem, which for most of the year is too hot for salmon to survive.
As Dr Patrick Martin, the Loire's head conservationist, commented recently, "the Loire salmon's migration window is closing", and with that closure the opportunity for them to migrate is lost, perhaps forever.

The relentless march northwards of oceanic and terrestrial warming is squeezing the salmon's habitat at all stages of its life cycle in rivers and at sea.

The most urgent challenges, in the context of marine mortality, and with salmon now extinct in more than 300 rivers, are to address issues where human activities are damaging salmon stocks:

. **The effects of salmon farming**. With a global ratio of about one wild salmon to 200 farmed fish in open net cages 'sharing' the same coastal waters, an uncompromising precautionary approach should apply in licensing such facilities. Parasites, genetic introgression, pollution and disease from salmon farms may affect wild salmon much further away than the locality of the salmon farm.

. **The increasing number of salmon being killed by coastal nets** in West Greenland, where about 10% are spring fish originating in Scottish and Irish rivers, the other 90% being from North America

. **Mixed stocks netting** which kills salmon from unknown rivers of origin, continues despite international pressure to end it. In 2013 for example, one Scottish coastal net fishery killed over 7,000 salmon and grilse, while the total number of salmon killed by nets in England and Wales was 24% above the average of the previous five years.

. **Accidental By-Catch**: Atlantic salmon swim with other pelagic fish, including mackerel and herring. We know that some salmon are being accidentally caught up in the nets of commercial trawlers. We need to know the extent of that 'by-catch', as well as where and when it takes place.

Climate change impacts on salmon, especially ocean warming, must be assessed with the question, 'is extinction of the species inevitable?' If the answer to that question is 'yes', what is the timescale? What, if anything, can be done to delay that inevitability? If the answer is 'no', can we find ways to give the wild salmon time & space for its natural resilience to kick in?

There is evidence that wild Atlantic salmon have, in the history of the species, survived massive geophysical and climatic changes, including at least two ice ages. What can be learned from the historical and current life strategies of the species? Can we find ways of integrating our restoration efforts with that innate resilience?

Most conservation efforts concentrate on rivers. Salmon have been treated as freshwater fish with a marine migratory phase. Most resources are consequently spent on restoring riparian habitats and studying the freshwater phase of the salmon's life cycle. More needs to be known about the salmon's life at sea. Already in Canada, Ireland, Norway, and Scotland, new tracking technologies are deployed to determine where salmon go, and where obstacles to migration exist.

A 'Big Picture' strategy, encompassing the whole life of the salmon, is now badly needed. Recent advances in freshwater fisheries management must continue, because each river catchment is unique, as are the populations that comprise its stock. Their survival depends on genetic diversity. It is now time for the Atlantic salmon countries to plan on a larger scale than hitherto on the following themes:

1. *Continue to improve freshwater productivity* through river catchment, ecosystem-based assessment, monitoring and actions. The excellent work being done by agencies and rivers trusts is essential, and must continue.

2. *The precautionary approach Along the coasts and in the ocean* must be used to demand that the burden of proof for new engineering projects does not harm the environment. Issues such as by-catch, renewable energy projects, salmon farming, coastal and drift netting, illegal fishing and pollution, where human actions are the cause of disruption, are the starting point.

3. *New methods of tagging & ocean tracking*, with advances in chemical analysis, plankton sampling, genetics and DNA analysis, are already extending knowledge of salmon behaviour in the ocean. Mapping migration routes, and attributing populations to regions, and even individual rivers, should enable scientists to predict future abundance, or otherwise. Appropriate management action can then be taken in real time, as already happens to some extent in Ireland, Canada and Norway.

4. *A 'big picture' strategy to bring more salmon back to their rivers* requires a new international effort and level of cooperation. Large amounts of private sector money from the salmon countries of the North Atlantic region will be needed to pay for research and monitoring at sea. The

process of mapping out safe migration ‘corridors’ and, through NASCO, negotiating international agreements to protect salmon at sea, must follow.

Rod catches. Do they tell the whole story?
Rod catches in some rivers in North America, Iceland, Norway, Ireland and the UK in 2014 were among the lowest ever recorded. The main exception was Russia’s Kola Peninsula, probably because of its proximity to salmon feeding areas, where both the numbers and quality of salmon seem to be holding up well.

As with most issues in the natural world, the situation is more complex than might at first appear. For example, in some rivers spring salmon in 2014 were caught in reasonable numbers and were in excellent condition. The Irish Slaney, for example, had its best spring returns for thirty years, with most fish in prime condition, with many ranging from 12lbs to 15lbs. A similar spring season was enjoyed by rods on some Scottish east coast rivers. Nearly all these fish were caught and released, while coastal netting of salmon was delayed until April.
Later in 2014, low water and high temperature conditions in many North Atlantic rivers did not favour high rod catches. Grilse returns in European salmon countries were at best variable, in some cases virtually non-existent.

Some freshwater fishery managers are declaring that there is little that can be done to improve the situation at sea, so efforts should be stepped up to improve freshwater productivity. While that view is understandable, it does not address the fact that more than 90% of wild Atlantic salmon are dying at sea, whereas only forty years ago the figure was more like 65%. If the percentage of smolts that survive to become adults could be increased by only 2% or 3%, it would make a significant difference to numbers of adult fish in our rivers.

The times we live in are worrying, with ocean warming, increasingly severe storms, changing ocean currents, melting ice, and variable abundance of the salmon's prey species. There's a lot to think about. We should not despair, because the wild Atlantic salmon is the most amazingly resilient species. The salmon has endured and survived at least two ice ages, maybe more. As rivers have frozen up, or new ones

thawed (or pollution ‘barriers’ removed, as on the River Mersey), and become available to migrating fish, the salmon has adapted.

My personal view is that the salmon will adjust to climate change. This will happen more quickly if we kill fewer salmon at this difficult transitory moment in the salmon's epoch-making life cycle. We must protect their ocean migration corridors. We must render salmon farming sustainable. We must bring netting of salmon from unknown rivers of origin to an end. While the angler remains the spearhead of the salmon's economic and social connection with human beings, he/she also has a massive responsibility to ensure that the angler is not part of the problem. The angler must become the engine of sustainability by improving habitats and treating every fish caught as a 'Crown Jewel'.

Three projects, being developed by the Atlantic Salmon Trust to bring back more salmon to our rivers, are listed below. Funds are urgently needed to implement them. We cannot predict the increase of returning salmon, but we can state that these projects are a practical starting point, with more projects to follow as knowledge of migrations improves.

Accidental by-catch

This innovative e-DNA pilot project addresses the issue of accidental by-catch by pelagic trawlers. Using forensic methods routinely used at scenes of crime, we will determine whether salmon DNA is present in the holds, on the decks or on the nets of the giant pelagic trawlers. Our concern is the likelihood that post-smolt migrations, relatively densely packed within coastal currents, may be inadvertently caught up in huge purse-seine nets. It is conceivable that the entire migration of a small river could be decimated by pelagic trawlers.

Coastal waters.

There is a high risk of smolt mortality in the days after they enter the sea, which may cause huge variations in adult return rates. Research is urgently required to establish where and how smolts die in the coastal zone. If we can identify the extent of the loss and the causes we can develop remedial actions. Returning adults are also at risk in estuaries, where research shows that up to 50% die in adverse conditions.

Establishing protected migration corridors for salmon between their native river estuaries and their feeding grounds requires a coordinated international effort. In the longer term this approach may prove to be the most effective way to bring more salmon back to our rivers.

The effects of extinction of wild Atlantic salmon would be a disaster, biologically, culturally, socially and economically. Recent surveys in Canada, Scotland and England show that the salmon is often central to rural economies. Salmon fishing tourism provides income and jobs for remote communities and gives them a strong sense of identity.
As food, a driver of rural tourism, angler's quarry or cultural icon, the existence value of the wild Atlantic salmon has not yet been fully appreciated. To allow its demise would be a human catastrophe and continuing as we are is not an option.

Please support AST's campaign to bring back more salmon to our rivers.

1. There are two easy ways to donate:Go to www.atlanticsalmontrust.org and press the donate button on the Home Page. Then follow instructions.
2. E-mail or telephone AST's Administrator, Marjorie Hunter Marjorie@atlanticsalmontrust.org Tel: 01738 472032 to become an AST Friend or make a donation

Useful Links:

Salmon Summit:
http://www.nasco.int/sas/salmonsummit.htm
Salsea Merge papers:
http://www.nasco.int/sas/salseamerge_documents.htm
Ocean Silver:
http://www.atlanticsalmontrust.org/oceansilver/
Atlantic salmon at sea: Findings from recent research and their implications for management
http://www.nasco.int/pdf/reports_other/Salmon_at_sea.pdf
ICES Journal of Marine Science (2012): International Symposium on Salmon at Sea: *Scientific Advances and their Implications for Management. Volume 69, Issue 9,* November *2012.*
AST e-DNA Project:
http://www.atlanticsalmontrust.org/latest-news/pelagic-bycatch-project.html

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