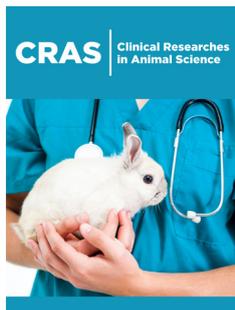


Factors Affecting Atlantic Salmon Populations Adversely

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Opinion



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The stocks of the Atlantic salmon (*Salmo salar*) in many rivers in North America and Europe have declined in recent years. Despite their high degree of legal protection, the quality of their aquatic environments within rivers and in the sea, including local coastal waters, is deteriorating. Their survival, has declined, both within the sea and within rivers.

Atlantic Salmon (*Salmo salar*) have been economically important fish in some countries, including Scotland, and they are found in many rivers connecting with the North Atlantic. They may enter their rivers from the sea, and then breed within their river systems, both within the headwaters, and river tributaries. Eggs are placed by the female within well-oxygenated loose gravel and are then fertilized by a male. The hatched salmon initially stay and feed in fresh water, their stages including fry, parr (juveniles beginning to grow), and smolts (that eventually migrate downstream). The parr feed mainly upon small invertebrates, insects and plankton. They later undergo a preparatory smolting process, involving morphological, biochemical, physiological and behavioral changes that pre-adapt them for life in the high salinity water found in the sea. After several years, the smolts move downstream to enter the sea. They are termed post-smolts as soon as they have entered the sea, and their migrations within the coastal environment can involve active directed swimming at speeds in excess of the prevailing water currents.

The post smolts can migrate thousands of miles north, to live in the North Atlantic, feeding on small pelagic marine invertebrates and fishes, and growing rapidly, due to the rich food resources available. They migrate through various portions of the North Atlantic Ocean. European and North American populations of Atlantic salmon can intermix while living in the ocean, where they can share summer feeding grounds, especially off Greenland. In recent years, the overall marine survival of Atlantic salmon, has declined, but for unknown reasons. Better understanding is needed of their mortality causes, and the changes in their migration patterns. The Atlantic salmon enter to spawn in the coastal rivers of northeastern North America & Canada; Greenland, Iceland and Europe; and the shores of the Baltic Sea. Problems for the salmon within rivers may include poor access to their spawning grounds, and habitat degradation within their rivers. Within the sea they may experience poor marine feeding, migration difficulties, and perhaps poor survival.

The marine phase of the salmon's life may, in some cases, last little more than a year, some of them maturing and returning as grilse (one sea-winter fish), but many juvenile salmon remain in the sea for two or even more years. Many of the mature adults then return to their rivers of origin to spawn. The salmon may navigate through the sea using the earth's magnetic field, and they possibly locate their rivers using their sense of smell. However, there is little information available on how they detect their home rivers.

Once the salmon have entered their rivers, many of them then rest within large parts of their river, and in the autumn and winter they may go back to the part of the river where

they were hatched. As adults, they do very little feeding within the river, but eventually take part in spawning there, to generate new juvenile salmon. Having spawned, the adult salmon are weak, because they have not been feeding well, and are susceptible to disease and predation, and many of them die.

Within their rivers the salmon need a good spawning habitat, with a suitable substrate to allow the successful deposition and hatching of their eggs. For the juvenile salmon, that are then born, there is a need for a diverse in-river habitat for them to feed, grow, and protect themselves from predators. It must then be possible for the smolts to migrate downstream through the river, enter the sea, and then migrate successfully as post-smolts, to their northern feeding grounds. At sea, there must be lots of food to enable them to grow to maturity and obtain sufficient energy to later return through thousands of miles of the sea to their native rivers. Ideally, they need to be short of predators within the sea, and they need to be able to find their home rivers without being adversely affected by coastal and estuarine human activities. Within their home rivers, once the adults have returned, there is a need for a suitable habitat for them to spend time within the river until they are ready to spawn. It must also be possible for them to move upstream, without experiencing any natural or human barriers.

Salmon in Scottish rivers, and those in other countries, are now declining, despite measures that have been taken to improve the salmon stocks. In Scotland, coastal netting fisheries, both in the sea and in estuaries, have now largely been closed down to protect the salmon. In addition, fishers operating within rivers are sometimes encouraged to release the fish that they have caught, so that their numbers are not reduced. However, it is possible that wild Atlantic salmon may become extinct in the future, because of habitat changes in their North Atlantic feeding areas, the coastal areas, and within the rivers themselves.

There appears to have been a marked increase in the mortality of salmon and other fishes in the sea, with the return rates of salmon to rivers now at their lowest levels. Thus, it is necessary to determine the problems that are affecting salmon, especially in

the sea. Climate change is having an adverse effect, with changes in the sun's intensity, large volcanic eruptions, and changes in naturally occurring greenhouse effects. Acidification and increasing temperatures contribute to a loss of oxygen from the sea. These processes may have an adverse impact on marine life. It seems that climate change may result in changes in the water, both in the sea and in rivers, and changes in soil moisture and runoff. Over the 20th century, precipitation has mostly increased over land in high northern latitudes, while decreases have dominated in southern areas. Water stored in glaciers and snow cover are expected to decline, reducing water availability.

However, in addition to climate changes, human activities in coastal waters and estuaries, and also within the rivers themselves, may also be affecting the salmon adversely. The harmful human activities include those that create underwater noise and water pollution, changes in riverbanks, drainage of water, water abstraction, fouled water entry from sewage processing centers, and in the sea the problems may include fishing and shipping, exploration activities including seismic surveys, the development of offshore oil and gas facilities, and the construction of offshore wind farms.

There are particular problems that may be arising for salmon and other fishes as a result of human activities in coastal waters. Developments are taking place along the coast which may be harmful to migrating salmon that are leaving or returning to rivers. There are also problems from human activities within the rivers. Measures for monitoring and preventing sediments entering rivers and burns must be taken, so that the habitat quality for salmon is not allowed to deteriorate. Salmon and other freshwater animals require water that is clean and relatively free from pollutants. Rivers are especially subject to threat from the abstraction of water, and the release of processed water. Sewage disposal systems may be especially harmful, as they can release especially harmful chemicals into the river. There is now a real need to examine the effects of human activities upon Atlantic salmon, both within rivers and in the sea.

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