Nomination

Salmo salar, Atlantic Salmon

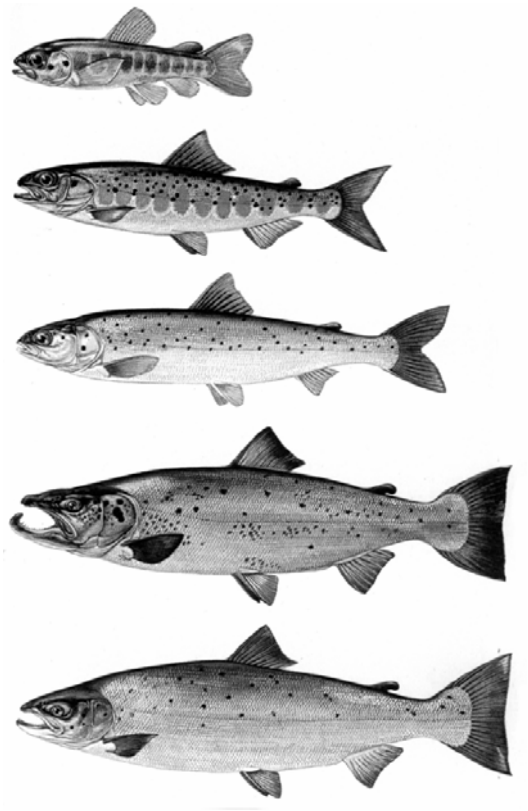


Illustration (from top) of fry, parr, smolt, male and female adult salmon. From Maitland (1977)

Geographical extent

OSPAR Region; I,II,III,IV
Biogeographic zones: 1-4,6-9, 11-15
Region & Biogeographic zones specified for decline and/or threat: as above

The Atlantic salmon is an anadromous species. Most of its growth takes place in the sea but the salmon migrate up rivers to spawn in freshwater. There are four main genetic groups of Atlantic salmon. Two of these, the Eastern Atlantic and the Northern Atlantic salmon, occur in the OSPAR Maritime Area.

On mainland Europe the Atlantic salmon is known to have had a freshwater distribution that included most of the large rivers from Portugal to NW Russia as well as in the UK, Ireland and Iceland. It is widely distributed in the marine environment.

Atlantic salmon are globally and regionally important to the fish farming industry. Many thousands of farmed fish are known to have escaped into the wild and now mix and interbreed with wild Atlantic salmon in the NE Atlantic.

Application of the Texel-Faial criteria

S.salar was nominated for inclusion on the OSPAR list with particular reference to its global/regional importance, sensitivity, and decline, with information also provided on threat.

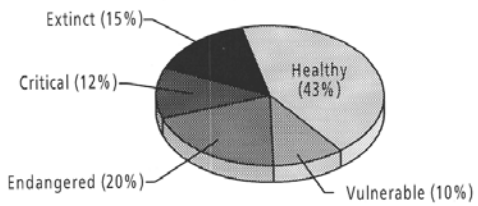
Global/Regional importance

The results of a river by river assessment of the status of Atlantic salmon in Europe and North America concludes that nearly 90% of the known healthy populations of wild salmon are found in Norway, Iceland, Scotland and Ireland (WWF, 2001). This makes the OSPAR Maritime Area of global importance for this species.

Decline

An assessment of the status of Atlantic salmon populations in rivers throughout its range, for which there are sufficient data, concludes that 43% can be categorised as healthy. The remainder are vulnerable, endangered, critical or extinct (Figure A).

FIGURE A._Status of wild salmon populations in 2,005 rivers in 19 countries throughout its range (WWF, 2001).



Poor water quality and habitat damage in the 18th and 19th century contributed to the decline of the salmon population in rivers such as the Rhine, the Thames and the Seine. Records show that the Rhine was once the largest and most important salmon river in Europe. Catches of the order of 250,000 fish were reported in the late 1880's but this had fallen to zero by 1960 (ICPR, 2000). Rivers in Belgium, Germany and Netherlands had entirely lost salmon populations by the 1960s (MacCrimmon & Gots, 1979). In Portugal catches in the Minato river fell by 97% from 1,400 in 1914, to less than 50

in 1989 (Correia & Fidalgo, 1995) and this population is now considered to be in critical condition. The Atlantic salmon is considered to be extinct in the other six historic Portuguese salmon rivers (WWF, 2001).

There has been an improvement in the status of Atlantic salmon in some of the rivers of northern Europe in recent years. Better water quality, installation of fish passes and reintroduction programmes have had some success in bringing wild salmon back to these waters. Small numbers have been caught in Dutch rivers since the mid-late 1990's for example (Pringnon *et al*., 1999), and catches in the Thames which were non-existent in the 1970s, are now of the order of few hundred a year (Environment Agency, 1999). In other cases, such as Numedal and Namsen rivers in central Norway, catch statistics suggest that the populations have remained fairly stable.

ICES report that although there is variation among rivers, in general, the total returns of salmon and spawning stock to rivers in the northern North East Atlantic Commission (NEAC) area (Finland, Iceland, Norway, Russia, Sweden) have fluctuated for the past 20 years, but show an increase in recent years. In contrast, wild salmon stocks in Iceland have declined since the 1980s. Salmon stocks in the southern NEAC area show a consistent decline over the past 20–30 years. This relates especially to salmon that spend more than one winter at sea (ICES, 2002a & b).

Sensitivity

The Atlantic salmon is known to be highly sensitivity to water quality when migrating up river particularly in relation to eutrophication, chemical contaminants and increased sedimentation of salmon rivers.

Threat

Threats to Atlantic salmon occur in both the freshwater and marine environment. Changes in land use, agricultural and forestry practices have affected salmon rivers where they result in changes in run-off, water flow and sedimentation of watercourses. Other threats include the construction of dams, navigation locks, and hydroelectric power stations that have impeded the progress of salmon migrating up river. Poor water quality as a result of sewage pollution, chemical contamination and acid rain are also a threat to salmon in rivers. Loss or deterioration of freshwater habitat by factors such as these are implicated in the decline of pre-smolts. for example (ICES, 2002a).

The directed fishery for salmon in both the freshwater and marine environment is another threat. Exploitation has not been kept below sustainable levels and therefore has contributed to the decline in abundance of Atlantic salmon (ICES, 2002a). An additional consideration is that there are still some salmon fisheries in the marine environment. These are the drift net fisheries that target salmon around the entrances to rivers so they are unable to reach spawning grounds. These are a threat to wild salmon stocks in particular locations such as the North East coast of England and off the coast of Ireland .

The marine fish farming industry poses another threat to wild salmon. The large number of escaped fish from fish farms are know to interbreed with wild salmon and dilute the genetic stock. The intensive nature of the industry has also been implicated in the spread of sea lice infestations to wild salmon stocks affecting their survivability.

Coastal and open sea fisheries such as those carried out around the UK, Ireland, the Faeroes and Norway are another threat to the Atlantic salmon. There is concern that herring and mackerel fisheries in the Norwegian Sea may be taking salmon smolts as a by-catch, for example, but the impact of this has not been quantified (NASCO, 1998). In 2001 the reported catch in the NEAC area was 2,887 tonnes and the estimated unreported catch 1,079 tonnes (ICES, 2002b).

Relevant additional considerations

Sufficiency of data

There are many sources of data on the abundance and distribution of Atlantic salmon in the OSPAR Maritime Area. This includes more than a century of records of salmon catches in some rivers, extensive monitoring data linked to reintroduction programmes, collation of landings data and estimates of unreported catches for the region through the North Atlantic Salmon Conservation Organisation (NASCO).

Changes in relation to natural variability

Natural variability through factors such as recruitment and natural mortality, will have undoubtedly had an influence on the status of the Atlantic Salmon however this was probably masked by the considerable impact of human activity on salmon in the 18th and 19th centuries. Now, with a much lower overall population size, the effects of natural variability may be a much more significant component in fluctuations in the population of wild salmon.

Marine survival of wild (and hatchery-reared) smolts in both northern and southern North East NEAC areas (which cover the OSPAR Maritime Area) has declined constantly over the past twenty years. The steepest decline is in the wild smolts in the southern NEAC area (France, Ireland, UK). The survival of both wild and hatchery fish returning after two winters at sea in the northern NEAC area has increased slightly in most recent years (ICES, 2002b).

The cause of this decline is uncertain but reduction in marine survival is thought to be a likely contributory factor, probably coupled with changing conditions in the freshwater environment of juveniles (ICES, 1996). Climate change is one possible influence as the surface water temperature of the Norwegian coast and the North Sea has been correlated with salmon survival (Friedland *et al.,* 1998). Some of the large-scale variations in salmon populations in the past may also have coincided with a general cooling of the North Atlantic (Friedland *et al*., 2000).

Expert judgement

There are a considerable amount of data on the status and trends of Atlantic salmon. These come from commercial catch statistics, recreational landings figures, river surveys etc. The work of ICES and NASCO in collating and assessing these data are particularly relevant in relation to Atlantic salmon in the OSPAR Maritime Area. There is therefore considered to be a sound information base on which to judge the status and threats to the Atlantic salmon.

ICES evaluation

The ICES evaluation of the case for including the Atlantic salmon on the OSPAR list confirms that some degree of decline has been documented for *S.salar* throughout its range. There is support for the view that this species should be a priority throughout entire OSPAR Maritime Area (ICES, 2002a). There may be a case for giving priority to stocks from some individual rivers or groups of rivers. The rationale for excluding salmon stocks in Norway and Iceland is weak and not readily reconciled with the assessment material because, although it is the case that trends in Norwegian rivers are not all downward, this is also the case for rivers of many other countries.

ICES also confirm that there is good documentation of threats linked to fishing and low marine survival but that documentation of other threats are generally concerned with local impacts. Declines in marine survival may have been compensated for, at least partially, by decreases in harvest, to maintain spawning escapement to rivers (ICES, 2002a).

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species; Chemical – nutrient changes, synthetic compound contamination.

Degradation of freshwater habitat by human activity has been a significant factor in the decline of catches of salmon in European rivers. In France for example, an estimated 800,000 fish returned to the rivers to spawn in the 18th century but by 1900, 75% of the spawning sites had become inaccessible because of dams. In the Meuse in the Netherlands and Belgium the construction of navigation locks at the beginning of the 19th century have been identified as the main cause of the disappearance of salmon from this river (MacCrimmon & Gots, 1979).

In the marine environment, commercial fishing for salmon is another threat linked to human activity. Overexploitation is believed to be the greatest single threat to Irish salmon stocks for example and takes place on the High Seas, around the Irish coast with drift nets, at estuaries with specialised nets, and by angling and poaching once the fish are in freshwater (WWF, 2001).

In more recent years the decline in wild salmon has been linked to salmon farming operations particularly in Norway, Ireland and the UK. Escapees from salmon farms, which number in the millions every year, compete with natural stocks for spawning partners and sites, yet their reproductive success (especially males) may be lower) (Lura, 1995). The young can also be more aggressive and have been shown to displace the young of wild salmon (McGinnity *et al.,* 1997). Another consideration is that the incidence of sea lice infestation in wild salmon using rivers near fish farms has increased dramatically. A Norwegian study of smolts in Sognefjorden reported infection rates in 86% of smolts returning to the sea to be so bad that these fish were likely to suffer a high mortality (Marine Research Institute, 1999).

Little is known about the interaction of wild and farmed fish in the open sea but they do now make up a significant part of some catches (e.g. in the Faeroes fishery 20%) (Hansen *et al.,* 1997).

Management considerations

Significant scientific effort, management actions, and community-based conservation programmes are already implemented for salmon throughout much of its range (ICES, 2002). These include clean up and reintroduction programmes (e.g. in the Meuse and the Rhine), which are having some success as adult fish are returning to the rivers to spawn. In the marine environment the phasing out (or buy-out) of drift net fisheries that catch salmon at the mouths of rivers, is helping to restore numbers but there are still major management issues to address such as the effect of fish farming on wild salmon and targeted and mixed stock commercial fishing for salmon.

Further information

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