15. Atlantic salmon (*Salmo salar*)

Irish name: Bradán Atlantach

Figure A10.15.1. Atlantic Salmon, *Salmo salar* (Linnaeus, 1758)

Background

Inland Fisheries Ireland synopsis of Atlantic salmon[1]

"The Atlantic salmon is native to Ireland, and its geographic range includes the North Atlantic Ocean and in rivers around the Atlantic coasts of Europe and eastern North America. The Atlantic salmon is one of the most widespread fish in Ireland and is found in most of our rivers.

The life cycle of the Atlantic salmon is fascinating, with different stages occurring in both freshwater and saltwater. …. Salmon that mature after one year at sea are called grilse and usually return to rivers in the summer. Bigger, older fish that return after multiple winters at sea are often called springers and usually return to rivers in the spring or early summer. …. Salmon usually spawn between November and March in gravelly, well-oxygenated rivers…

In Ireland, juvenile salmon usually stay in the river for two to three years. After hatching as larvae called alevins, immature salmon develop into fry in their first year and then into parr in their second year and subsequent years in the river. ... Salmon fry and parr require rivers with good water quality, cool temperatures, stony river beds and adequate cover provided by aquatic vegetation. Parr feed primarily on freshwater invertebrates.

As salmon parr prepare to migrate to sea from the river, they become smolts, turning more silver in appearance and undergoing physiological changes to prepare for saltwater conditions. Salmon have a remarkable homing instinct. They migrate from Ireland to their feeding grounds thousands of kilometres away around the Norwegian Sea and the coast of Greenland, before migrating back to the rivers in which they were born after one or more winters at sea.

Atlantic salmon are an emblematic species for Ireland and are extremely valuable for angling tourism. Their conservation status in Ireland is classified as vulnerable due to a decline in abundance, caused primarily by mortality at sea, habitat loss, barriers to migration, poor water quality, overfishing and sea lice."

[1] https://www.fisheriesireland.ie/species/atlantic-salmon-salmo-salar

The ICES Working Group on North Atlantic Salmon (WGNAS)[1] elaborates:

> *"Environmental conditions in both freshwater and the sea have a marked effect on salmon stocks. A range of factors in freshwater, from contaminants to river obstructions, changing river flows to temperatures, are known to impact on stocks. Return rates of adult salmon (the percentage of juveniles migrating to sea that survive to return to freshwater) have also declined since the late 1980s. For many stocks, return rates are now at the lowest levels in the time-series, even after the closure of marine fisheries. This reduced survival is thought to reflect climatic factors and broad-scale changes in ocean ecosystems as well as factors in freshwater."*

Atlantic salmon is used in aquaculture in Ireland, mainly outside the Celtic Sea AOI; this feature report and associated sensitivity assessment relates only to the wild populations.

Rationale for spatial protection in the Celtic Sea

Salmon was nominated for inclusion with particular reference to its conservation listing under OSPAR and listing as Near Threatened or greater (Irish, EU or Global Red List). Salmon are listed as Near Threatened by the IUCN Red List and Vulnerable by the Irish and European Red Lists. According to the 2022 OSPAR assessment "*The status of Atlantic salmon is still poor in Arctic Waters (OSPAR Region I), Greater North Sea (Region II), Celtic Seas (Region III) and Bay of Biscay and Iberian Coast (RegionIV). Its range of distribution has remained stable for the past decade, but abundance and condition are often decreasing.*"

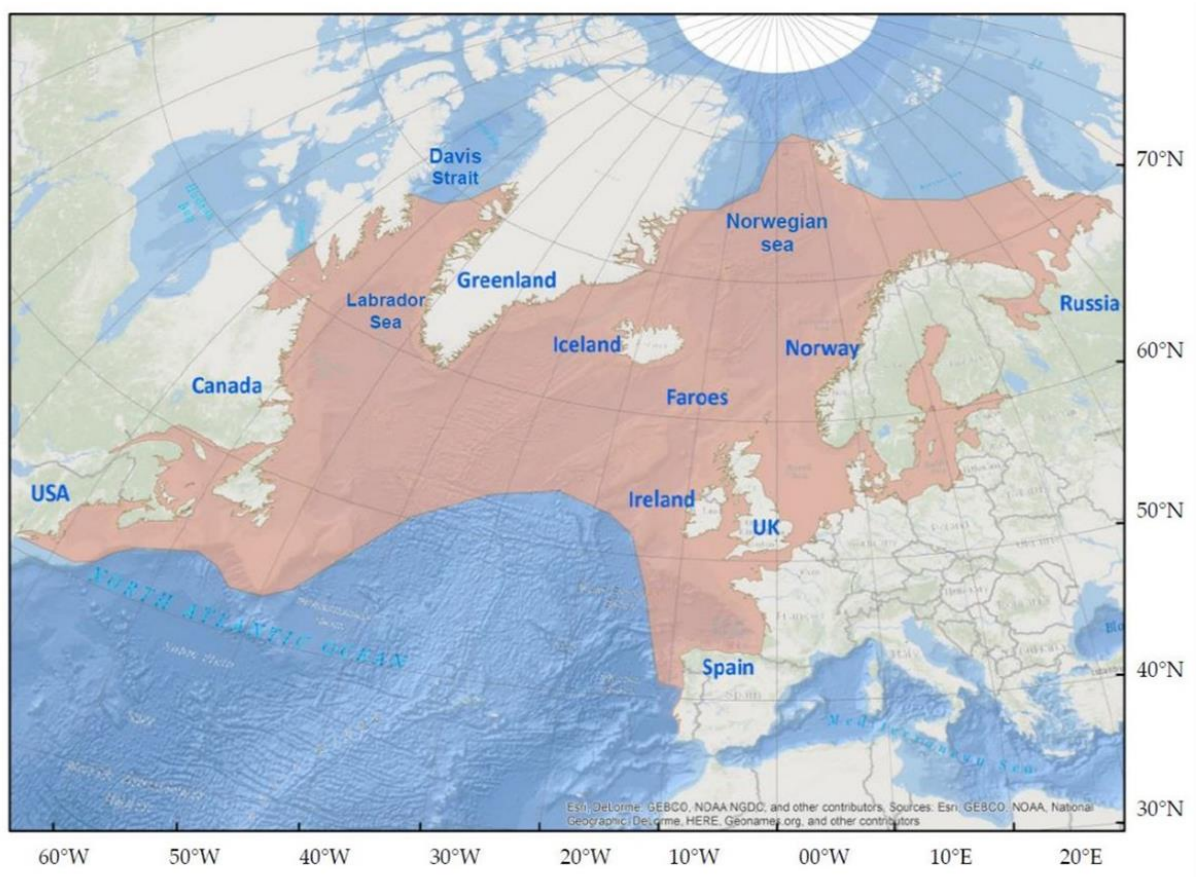

Figure A10.15.2. Geographic distribution of Atlantic Salmon, Source: Maoiléidigh et al. 2018.

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[1] https://www.ices.dk/community/groups/pages/wgnas.aspx

Sensitivity assessment

A full MarESA literature review and sensitivity assessment was conducted and is detailed in the Atlantic salmon appendix. In addition, Gillson et al. (2022) conducted a comprehensive review of the principal stressors impacting Atlantic salmon in estuarine and marine environments. The current MarESA assessment of sensitivity was supplemented with the conclusions of their review. Gillson et al. state that "*Climate change and predation were identified as the biggest threats at present and over the next decade*" but both of these issues are outside of the scope of this ecological sensitivity analysis. Of direct relevance though "*Poor water quality and bycatch were classified as relatively high impact stressors, but with a lower likelihood of becoming more prevalent in the future due to available mitigation measures. Other, less influential, stressors included tidal barrages, artificial light at night, impingement in power-station cooling waters and thermal discharges, pile-driving noise pollution, invasive non-native species, electromagnetic fields, salmon mariculture, and tidal lagoons.*

Salmon fisheries exploitation was not regarded as an important stressor currently because effective exploitation rate controls have been implemented to substantially reduce fishing pressure."

The highest associated sensitivity scoring for salmon was therefore barriers to movement, physical loss of (estuarine) habitat, and targeted and non-targeted removal (bycatch) by fishing. Barriers to movement primarily relate to river access being impeded by dams, weirs, turbines *etc*., which are outside of the scope of this study, but the cumulative effect of ORE installations on the migration routes of salmon is poorly understood. Targeted and non-targeted removals of salmon are currently prohibited in the Celtic Sea, so although sensitivity is high, incidence is low. Physical loss of estuarine habitat has been identified as a key sensitivity (high confidence) as returning adult salmon must pass through these areas to reach their natal spawning rivers.

Offshore energy impacts on Atlantic salmon are poorly understood, however, based on existing knowledge salmon may be sensitive to some of the associated sectoral pressures. There is limited evidence that electromagnetic fields and underwater noise can affect teleost movement but it is not yet known whether the magnitude of such disturbance is significant over the scale of their entire migration. Finer scale migratory movements are led by olfactory senses for salmon. However, due to the large distances over which salmon migrate, the effects of a pressure (or indeed local spatial protection) may not be immediately evident, spatially or temporally.

Salmon were identified as sensitive to chemical pollutants as effects are well documented but it was not possible to accurately score the resistance and resilience. A number of studies, albeit primarily for aquaculture purposes, have demonstrated responses of salmon to varying concentrations of environmental contaminants such as mortality, growth delay, reproductive alterations, tumours, malformations and immunological changes. For example, the review by Gillson et al. (2022) state "*Physiological effects of sublethal contaminant exposure on smolts include reduced salinity tolerance when entering marine waters, with the effects of some contaminants such as aluminium increasing with higher water acidity. Adult returns may also be impacted by sublethal contaminant levels modifying olfactory cues required for successful homing to spawning grounds*." (See references therein.) MarESA guidelines state that pollutant pressures (transition elements, organo-metal, hydrocarbon and PAHs) are assessed as 'Not sensitive at the pressure benchmark', which assumes compliance with all relevant environmental protection standards. In these cases, resistance, resilience, and relevant confidence assessments are recorded as 'Not relevant' (see Tyler-Walters et al., 2018, section 2.5.23 for further explanation). Nevertheless, Atlantic salmon are long-lived, highly migratory, and vulnerable so any contamination of essential estuarine habitats is to be avoided. Sensitivity to chemical pressures was therefore included under the precautionary principle.

Introduction or spread of invasive non-indigenous species. Salmon farming can impact wild salmon populations by transferring diseases, lice infestations, and genetic material between escaped farmed fish and wild conspecifics. The severity of the impacts of salmon mariculture on wild salmon stocks depends on the scale of the facilities, with salmon mariculture being identified as a major stressor for wild salmon stocks in Norway (Forseth et al., 2017). Long-term and controlled field studies in Ireland have shown that wild Atlantic salmon exposed to sea lice experience reduced marine survival and returns (Shephard & Gargan, 2017, 2020). However, there are no salmon aquaculture sites in the Celtic Sea AOI and aquaculture was therefore not included in the MarESA literature search, which resulted in the less specific score of "Sensitive" for this pressure. If salmon aquaculture were to expand in the AOI, this would need to be revisited.

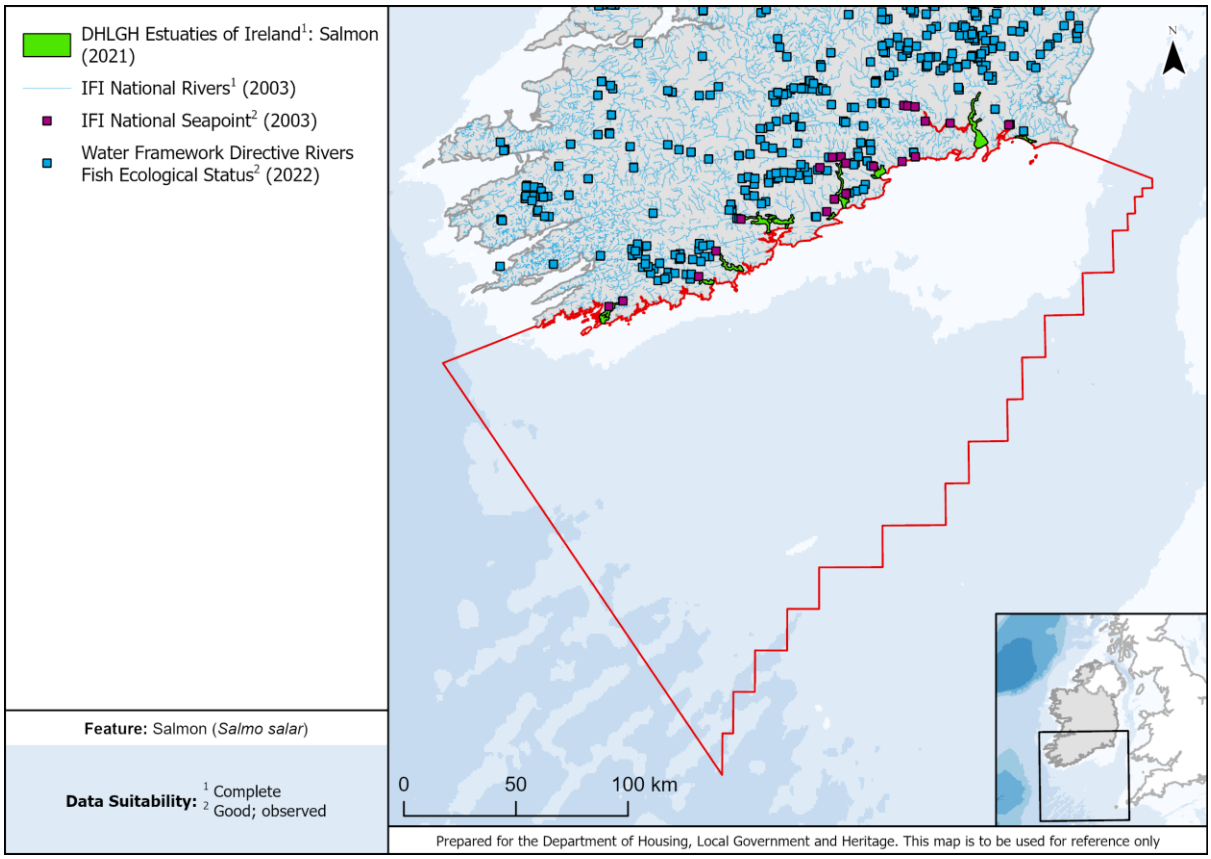

Figure A10.15.3. Data available for Atlantic Salmon, *Salmo salar,* in the Celtic Sea AOI, including rivers and associated estuaries included in the analysis.

Data sources available

Very few data relating to the distribution of salmon in the Celtic Sea were available, this species having been recorded just a handful of times in decades of at-sea surveys (Elliot et al., 2022). It is known that salmon migrate through the area to many rivers on the south coast of Ireland but their

exact marine routes are diffuse and largely unknown. Estuaries are an essential habitat for salmon, therefore estuaries associated with known salmon spawning rivers were included in the conservation prioritization process (Figure A10.15.3, Table A10.15.1). Surveys of estuaries have shown considerable stocks of salmon to be present in some estuaries entering the Celtic sea, such as the Three Sisters (Barrow, Nore, Suir), the Cork Blackwater and the Lee (Water Framework Directive Surveys, IFI) . For explanation of data suitability, refer to Table 3.2.1 Main Report. For information on how data were prepared for use in prioritization analyses, and for visualisation of layer used, see Appendix 5e, section 5e.4.

Table A10.15.1. List of salmon rivers emptying into the Celtic sea AOI that were included in the analysis (Source: Water Framework Directive Rivers Fish Ecological Status 2008-2022; IFI Open Data Portal[1])

Aherlow (Assaroola)	Bandon (Bealanscartane)	Bandon	Duag
Aherlow (Clydagh)	Bandon (Brewery)	Blackwater (Munster)	Duncormick
Aherlow (Knockanebrack)	Bandon (Bridewell)	Blackwater Munster	Finisk
Aherlow (Knockastakeen)	Bandon (Brinny)	Bride Waterford (Collatrim)	Funshion
Aherlow (Moneynaboola)	Bandon (Caha)	Bride Waterford (Douglas)	Glashaboy (Ballymadree)
Aherlow (Rossadrehid)	Bandon (Cashel More)	Bride Waterford (Dunmoon)	Glashaboy (Bultlerstown)
Aherlow (Toureen)	Bandon (Coom)	Bride Waterford (Flesk)	Glashaboy (Watergrasshill)
Aherlow	Bandon (Cummernamart)	Bride Waterford (Glashanabrack)	Glashaboy

Ara	Bandon (Curraghnacarton)	Bride Waterford (Glenaboy)	Lee Cork
Araglin	Bandon (Derragh)	Bride Waterford (Glenkeen)	Licky
Argideen (Ihernagh)	Bandon (Derrymeeleen)	Bride Waterford (Moanlanan)	Mahon
Argideen (Lisroe)	Bandon (Enniskean)	Bride Waterford (Shanakill)	Martin
Argideen (Owenkeagh)	Bandon (Garranbeg)	Bride Waterford (Shanowen)	Nier
Argideen (Owenkeagh)	Bandon (Garrown)	Bride Waterford (Shanowennadrimia)	Owenduff
Argideen	Bandon (Kealrootha)	Bride Waterford (Toor)	Suir
Argideen	Bandon (Sall)	Bride Waterford	Womanagh (Dower)
Awbeg Buttevant	Bandon (Shehy Beg)	Colligan (Reandampaun)	
Bandon (Ballynacarriga)	Bandon (Tuough)	Colligan	

Further research needs

Key knowledge on the distribution of Atlantic salmon in the Celtic Sea remains limited and requires further investigation. The limited number of research studies on the effect of electromagnetic fields and underwater noise means it is difficult to recommend specific measures. More research is needed, particularly field studies on the cumulative effect of multiple ORE installations.

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[1] https://opendata-ifigis.hub.arcgis.com/datasets/1034e20d4cce499695a5bd020e594331_0/explore

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