13. European eel *(Anguilla anguilla)*

Irish name: Easgann Eorpach

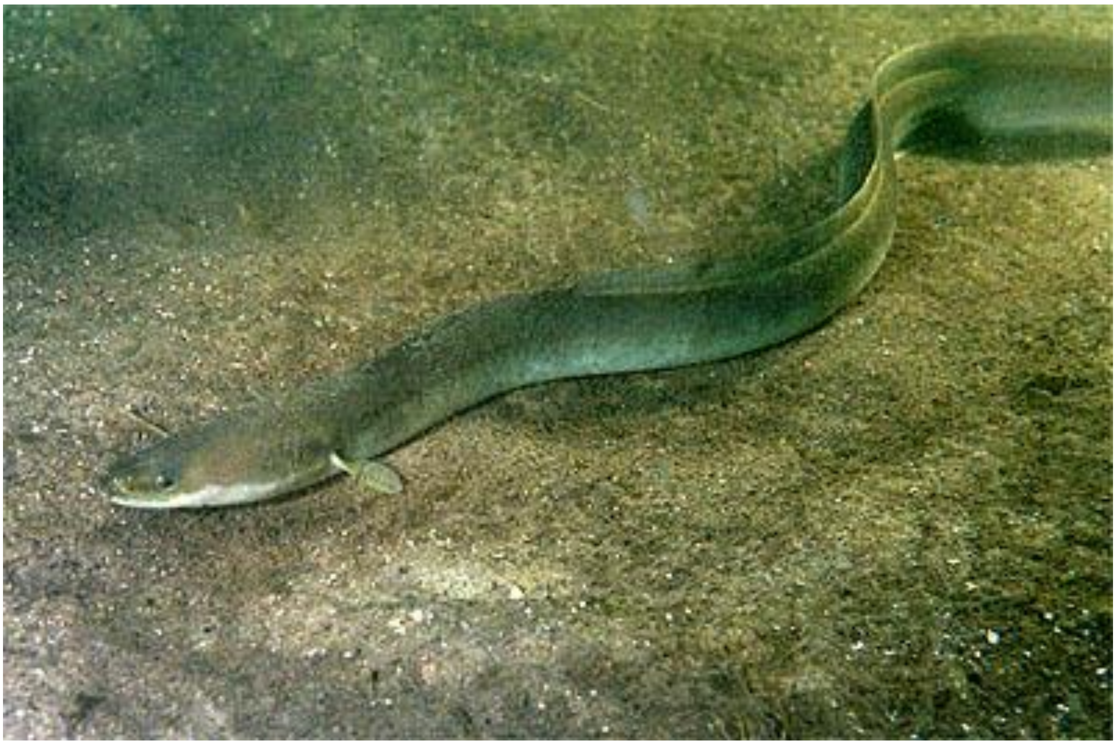

Figure A10.13.1. European Eel (*Anguilla anguilla*) © By GerardM - CC BY-SA 3.0.

This case report has been updated from the western Irish Sea case report published in 2023. A new Web of Science literature review was conducted to assess whether any new research on the species had been conducted since the western Irish Sea report was published, and used to inform both the report and the sensitivity analysis.

Background

The European eel is long and snake-like in shape with a tough, slimy skin, which can be black, brown or dark olive green in colour above, paler and yellowish on the underside (Avant, 2007). The adult eel is most abundant in estuaries and low salinity pools but is also found around the coast in permanent tide pools, on the lower shore and shallow sublittoral; being nocturnal it is inactive during the day under rocks or weed or in soft sediment (Avant, 2007). European eel has a complex life history that is poorly understood. It involves migration of mature adults from European rivers and estuaries to the Sargasso Sea in the west Atlantic for spawning, and the subsequent return of juveniles. They metamorphose twice, once changing from the leaf like leptocephalus larva through a glass eel stage into the pigmented immature “yellow” eel phase, and a second time on maturation from the yellow phase into a maturing adult pre-spawner “silver” phase. Both yellow and silver phases can take place, partly or wholly in either freshwater or saline habitats.

European eel is an OSPAR listed species with the latest Quality Status Report (QSR) stating “*the European eel is widely distributed in marine, coastal, brackish and freshwater habitats of Europe and occurs from the Atlantic coast of north Africa, in all of Europe (including Baltic Sea) and in the Mediterranean waters of Europe and northern Africa. In addition, the European eel also occurs in the Canary Islands, Madeira and the Azores Islands, and in Iceland”* (Figure A10.13.2).

The status of European eel remains critical (ICES, 2023). Indices of both glass and yellow eel recruitment to the continent strongly declined from 1980 to 2011. Index values correspond to the recruitment as a percentage of the 1960–1979 geometric mean. In the “Elsewhere Europe” index series, which includes the Celtic Sea, it was 8.8% in 2023 (provisional) and 11.3% in 2022 (final). The yellow eel recruitment index for 2022 was 9% (final) of the 1960–1979 geometric mean. Time-series from 1980 to 2023 show that eel recruitment remains at a very low level.

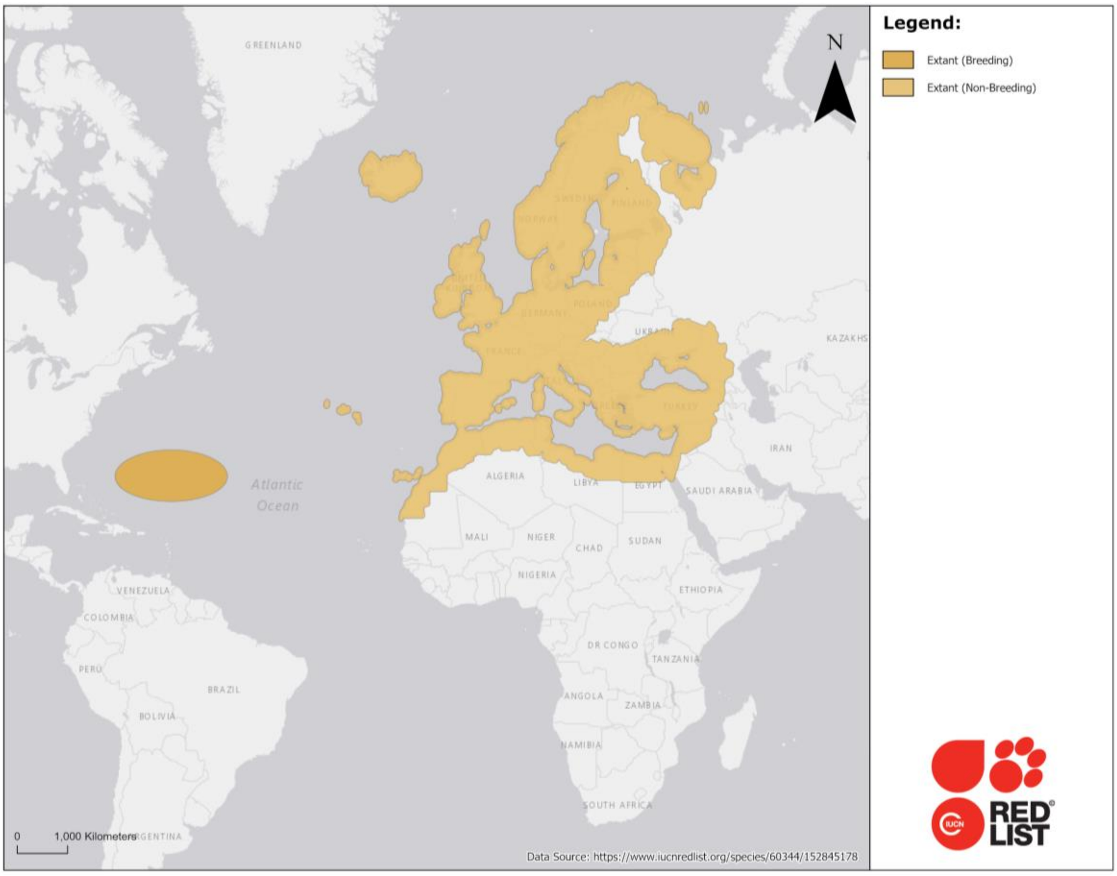

Figure A10.13.2. Distribution of European Eel (*Anguilla anguilla*), Source: OSPAR QSR 2022 (adapted from Adam, 1997).

Rationale for spatial protection in the Celtic Sea

European eel 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). European eel is listed as Critically Endangered by the global IUCN Red List, Irish and European Red List. According to the 2022 OSPAR assessment "*The status of European eel is still very poor in all OSPAR Regions where the species occurs, as glass eel recruitment, although stable since 2010, remains at a very low level with no clear sign of an upturn. Eel is a panmictic species which affects its management. While the pressure of commercial fishing on the stock appears to be decreasing in the current assessment period (2010 to 2021), other pressures (dams, turbines, habitat loss, pollution, poaching, diseases and pathogens, climate change, etc.) still pose a significant threat to the species.*"

Fishing restrictions: ICES (2023) advises that when the precautionary approach is applied, there should be zero catches in all habitats in 2024. This applies to both recreational and commercial catches and includes catches of glass eels for restocking and aquaculture.

It is known that many of the rivers emptying into the Celtic Sea AOI contain European eel (Table 1). Eels use the Celtic Sea as a migration route, incoming as juvenile glass eel and outgoing as maturing silver eel heading for spawning grounds. The exact routes taken by eels in the Celtic Sea are not known and distributional data for the marine portion of their life-cycle are very sparse.

Based on current knowledge certain stages of the European eel's life-cycle are amenable to spatial protection (excluding the freshwater phase, which does not fall within the scope of the current project study but of course relies on successful migration in marine waters). ICES (2023) advises, based on ecosystem based management considerations, that "all non-fisheries related anthropogenic mortalities should be zero; and that the quantity and quality of eel habitats should be restored; this includes restoring connectivity and the physical, chemical, and biological properties of the habitats." Estuaries are an important habitat (both as a migration route, and as habitat for growing yellow eel) for the species (high confidence) that fall within the area of interest and are amenable to spatial protection.

Sensitivity assessment

The highest associated sensitivity scoring for European eel was in relation to 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 European eels is poorly understood (high confidence). Targeted and non-targeted removals of eels are currently prohibited, so although sensitivity is high, incidence is low. Physical loss of estuarine habitat has been identified as a key sensitivity (high confidence) and adult eels are known to be abundant in this habitat.

Offshore energy impacts on European eel are poorly understood, however, based on existing knowledge eel may be sensitive to some of the associated sectoral pressures. There is evidence that electromagnetic fields can affect eel movement but it is not yet known whether the magnitude of such disturbance is significant over the scale of their entire migration. However, due to the large distances over which European eels migrate, the effects of a pressure (or indeed local spatial protection) may not be immediately evident, spatially or temporally.

European eel were identified as sensitive to chemical pollutants. "*A number of laboratory and field studies have shown that eels can bioaccumulate high concentrations of environmental contaminants, depicting a relation between exposure to these chemicals and adverse effects. Several of these contaminants have been shown to cause mortality, growth delay, reproductive alterations, tumours, malformations and immunological changes, among several other negative effects"* (Guimarães et al., 2009 and 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, European eel are long-lived and solely rely on stores of fat for their migration, so any contamination of essential estuarine habitats is to be avoided. Sensitivity to chemical pressures was therefore included under the precautionary principle.

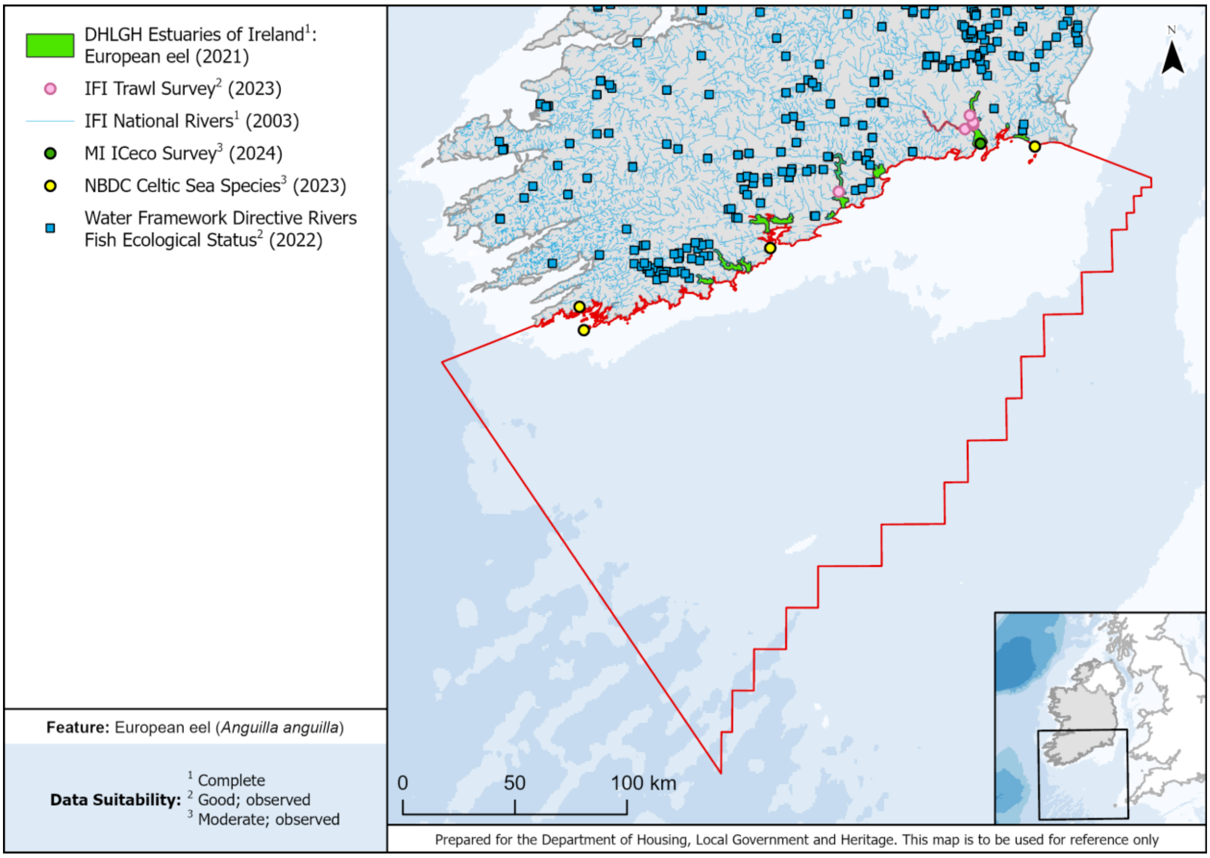

Figure A10.13.3. Data available for European eel (*Anguilla anguilla*) in the Celtic Sea AOI, including rivers and associated estuaries included in the analysis.

Data sources available

Very few data relating to the distribution of European eel in the Celtic Sea were available, this species having been recorded just a handful of times in decades of at-sea surveys. It is known that eel migrate through the area to many rivers on the south coast of Ireland but their exact route is unknown. Estuaries are an essential habitat for European eel, therefore estuaries associated with known eel rivers were included in the conservation prioritization process (Figure A10.13.3, Table A10.13.1). Surveys of estuaries have shown considerable stocks of eels 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) and estuaries are considered important areas contributing to eel spawner biomass (Ireland Reports to the EU under EU Regulation EC No.1100/2007, 2018, 2021). 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 a visualisation of layers used, see Appendix 5e, section 5e.4.

Further research needs

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

It seems possible that incoming eel larvae imprint with a geomagnetic map, which in turn is retraced by migrating silver eel years later as a guide to returning to the spawning grounds (Durif et al., 2022).

Table A10.13.1. List of rivers included in the analysis, including tributaries (Source: IFI Water Framework Directive Rivers Fish Ecological Status 2008-2022 dataset).

Argideen	Glashaboy
Bandon	Lee
Barrow	Licky
Blackwater	Mahon
Bride	Martin
Colligan	Nore
Duncormick	Owenduff
Finisk	Suir
Funshion	Womanagh

Some effects from High Voltage Direct Current (HVDC) cables on eel migration seems likely and have been demonstrated, but the consequences may be small (Westerberg, unpublished; Westerberg & Lagenfelt, 2008). There is no indication that a cable constitutes a permanent obstacle for migration, neither for the adult eel nor for elvers. A compass effect has been demonstrated for adult eels, but the effect of fields created by HVDC cables may only be local (Westerberg & Begout-Anras, 1999). It is not known whether the geomagnetic retracing map indicated by Durif (2022) can be influenced or reset by the presence of underwater HVDC cables.

Submerged cables transverse seas and lakes and as a consequence fishes are exposed to magnetic fields. With the increasing numbers of offshore wind turbines, the presence of magnetic fields is increasing. Studies indicate that fishes are influenced by magnetism but that this does not necessarily mean that submarine cables will have an impact. As there is paucity in terms of scientific information on how fishes are affected by wind turbine cables more research is needed, especially field studies that in a direct manner address these issues (Ohman et al, 2007; Westerberg & Lagenfelt, 2008).

The detection of sound from wind turbines by fish varies between species and is typically between 0.4-25 km at wind speeds of 8-13 m/s (Wahlberg & Westerberg, 2004). The detection distance depends on the size and number of wind turbines, the hearing abilities of the fish, the background noise level, wind speed, water depth and type of sea bottom. The noise from the wind turbines may decrease the effective range for sound communication of fish. However, it is unknown to what extent this decrease in active space affects the behaviour and fitness of the fish. The wind turbine noise is not expected to have any destructive effects upon the hearing abilities of fish even at ranges within a few metres. It is estimated that fish are consistently scared away from wind turbines only at ranges shorter than about 4 metres, and only at high wind speeds (higher than 13 m/s). Thus the acoustic impact of wind turbines on fish is expected to be restricted to masking communication and orientation signals rather than physiological damage or consistent avoidance reactions. This conclusion should be treated with caution and requires further investigation.

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