
Technical Literature Review

Reference: Impacts of Electromagnetic Fields (EMF) on Freshwater Fish and Invertebrates in the UK

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Abstract

This technical note reviews the current scientific understanding of the effects of electromagnetic fields (EMF), generated by submerged and buried power cables, on freshwater fish and invertebrates in the UK. Drawing on national and international literature, the review examines the sources and intensities of EMF exposure in freshwater habitats, the sensory capabilities of key UK fish and invertebrate species, and the evidence for behavioural and physiological impacts. While some species, such as European eel and salmonids, can detect low-level EMF and use geomagnetic cues for migration, most studies report limited or no adverse effects at exposure levels typical of UK infrastructure projects (Gill et al., 2005; Sciencedirect, 2024; Elvidge et al., 2022). Invertebrate responses are less well documented but suggest low risk at environmental exposure levels (Chapman, 2021; Levitt et al., 2021). The review highlights knowledge gaps, particularly regarding chronic and cumulative exposure, and recommends precautionary mitigation such as deep cable burial and targeted monitoring (NorthConnect, 2019; Scottish Government, 2023). Overall, the evidence indicates minimal population-level risk under current practices but continued research and site-specific assessment remain important (Love et al., 2016; Normandeau Associates, 2011).

Introduction

The increasing deployment of high-voltage electrical infrastructure—such as buried and submerged cables for renewable energy projects—has raised concerns about the ecological effects of electromagnetic fields (EMF) on freshwater environments in the UK. While much research has focused on marine systems, the potential impacts on freshwater fish and invertebrates are less well understood but are increasingly relevant as infrastructure expands into rivers and lakes (NorthConnect, 2019; Sciencedirect, 2024).

EMF Sources and Exposure

EMF in freshwater systems typically originates from high-voltage direct current (HVDC) and alternating current (AC) cables associated with hydropower, grid interconnectors, and renewable energy projects (NorthConnect, 2019). The strength of EMF exposure depends on cable design, current, burial depth, and surrounding substrate. Field measurements show that magnetic field strengths can reach several hundred microteslas (μT) at close range, dissipating rapidly with distance from the source (NorthConnect, 2019).

Fish Sensitivity and Behavioural Responses

Many freshwater fish, particularly migratory species such as European eel (*Anguilla anguilla*) and Atlantic salmon (*Salmo salar*), use the Earth's geomagnetic field for navigation during spawning migrations (Gill et al., 2005; Love et al., 2016). Laboratory and field studies have demonstrated that eels can detect changes in magnetic fields as low as 5–12.6 μT , while salmonids respond to fields above 600–1,000 μT (Sciencedirect, 2024; Gill et al., 2005). However, evidence for adverse effects at these exposure levels is limited, with most studies reporting no significant changes in fish behaviour, physiology, or population dynamics under typical field conditions (Elvidge et al., 2022; Love et al., 2016; Normandeau Associates, 2011).

Invertebrate Sensitivity

Freshwater invertebrates, including crustaceans and molluscs, may be sensitive to EMF, particularly during early life stages. Some studies have reported physiological changes in embryos at exposures above 1 μT , and behavioural changes in adult crustaceans above 314 μT (Chapman, 2021). However, most research has focused on marine or estuarine species, and there is a lack of data on UK freshwater taxa (Levitt et al., 2021).

Ecological Implications

While individual-level responses to EMF have been observed, there is little evidence for population-level effects or changes in community structure among fish and invertebrates in field settings (Love et al., 2016; Normandeau Associates, 2011). The rapid dissipation of EMF with distance and the mobility of many species suggest that impacts are likely to be localised. However, knowledge gaps remain, particularly regarding chronic exposure, sensitive life stages, and cumulative effects (MASTS, 2020).

Management and Mitigation

Given the uncertainties, precautionary mitigation is recommended for projects involving high-voltage cables in freshwater environments. This may include deeper cable burial, baseline surveys of EMF-sensitive species, and post-installation monitoring (NorthConnect, 2019; Scottish Government, 2023).

Conclusion

Current evidence indicates that while some freshwater fish and invertebrates can detect and respond to EMF, there is no strong evidence for adverse population-level effects under typical exposure scenarios in the UK. Further research is needed, especially for freshwater invertebrates and sensitive life stages (Levitt et al., 2021; Chapman, 2021; Elvidge et al., 2022).

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