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Predators + Prey Around Renewable Energy Developments

The role of acoustic telemetry to assess the effects of offshore wind infrastructure on fish

Bicknell et al. (2025) Renewable and Sustainable Energy Reviews
https://doi.org/10.1016/j.rser.2024.115306

PrePARED Output Summary No. 7

Background

Inshore and offshore coastal regions are becoming increasingly occupied by human infrastructure. This trend will continue with the demand for offshore renewable energy developments, which reduce carbon emissions and provide energy security. The introduction of structures to the marine environment can have direct and indirect effects on marine habitats, and subsequent impacts on species contributing to these environments, including fish.

Following the movements of individual fish using acoustic telemetry can provide insights into the movement and behaviour of fish at scales from single wind turbines to regional networks of offshore wind farm developments.

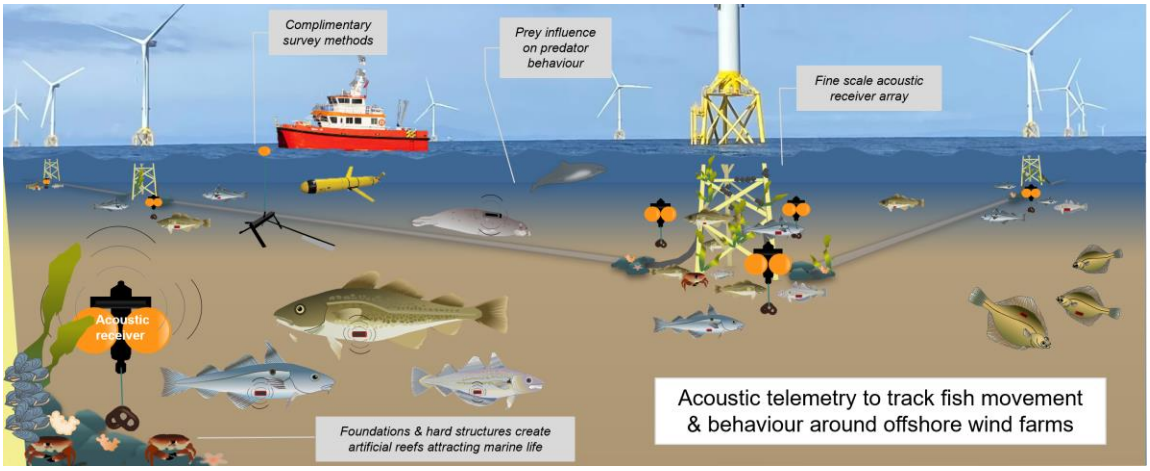
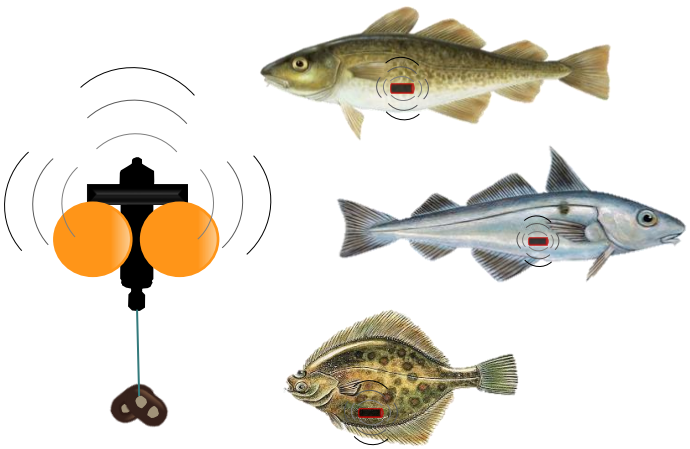


Figure 1. Overview of fish tracking methods in the context of offshore engineering developments.

Acoustic telemetry

The technique relies on attaching acoustic transmitters ('tags') to individual animals, which then emit a unique identification signal (or 'ping'). These may be detected ('heard') and stored by sub-surface data-logging hydrophones ('receivers'), which provide presence data at fixed locations, or tracked from receivers on vessels or gliders (Figure 1). Tags can transmit sensor data, such as depth, temperature and acceleration, which can enhance knowledge of movement behaviour and ecosystem interactions.



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Fish Interactions with Structures

Fish are both predators and prey and are important contributors to the functioning of food webs in marine environments. Should their behaviour, distribution and/or populations be altered by introduced structures then it is important to understand the direction and magnitude of effects, both at local and regional seascape scales, to better understand how these effects may influence ecological interactions. The migratory behaviour of some fish species also contributes variability and uncertainty to observed patterns, which should be recorded to provide a fuller understanding of the consequences of introduced structures.

What We Did

We conducted a systematic review of published studies to summarise how acoustic telemetry has added to the understanding of fish behaviour around introduced structures and discuss how its use can be (and is being) expanded to provide a wider ecological understanding of the impacts of offshore wind farms through collaborative networks, and integrated research techniques and analyses.

Challenges and opportunities provided by acoustic telemetry research in and around offshore wind farm sites include:

Challenges

- Managing and maintaining receiver arrays in proximity to wind farm structures to reduce equipment loss/damage and interference with marine operations.
- Considerable time, effort, equipment, funding and regulatory frameworks required to conduct long-term studies at offshore sites.
- Conserving the health & post-tagging survival of swim-bladdered fish captured in deep water sites (>30m).

Opportunities

- Observing predation events:

Tag temperature and pressure data or specific 'predation' sensors can identify predation events of tagged fish. These data can be ecologically informative on how the offshore structures act as prey aggregation devices for higher trophic level marine mammals or seabirds

- Collaboration and wider networks:

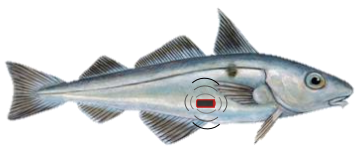
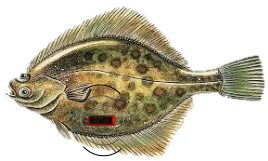
Wider networks of receiver arrays at wind farms across a region or sea can open the scope of ecological studies and collaborations to address more broad scale movement and behavioural processes.

Strategic Review

The review identified and discussed the following principal topics:

- Potential effects on fish and their predators
- Acoustic telemetry technology
- Acoustic receiver arrays and integration
- Contemporary analyses and modelling
- Telemetry evidence around offshore structures
- Future telemetry research around wind farms



For more the full review see:

Bicknell, A.W.J., Gierhart, S., Newton, M., Main, R., Thompson, P. & Witt, M.J. (2025). The role of acoustic telemetry to assess the effects of offshore wind infrastructure on fish behaviour, populations and predation. Renewable and Sustainable Energy Reviews 212, 115306.

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