

SPATIO-TEMPORAL VARIATION IN OCCURRENCE AND FORAGING OF HARBOUR PORPOISES AROUND OFFSHORE WINDFARMS



PrePARED Output Summary No. 2

Background

The harbour porpoise is the most widespread and commonly occurring cetacean UK waters and has been a key receptor in Environmental Impact Assessments (EIA) for offshore windfarm developments across the North Sea. Underpinning these assessments is the need for robust data on spatio-temporal variation in porpoise densities.

Testing predator-prey associations directly is complex due to uncertainty around predator diet and prey distribution resulting in constraints in understanding temporal changes in predicted distributions of key receptors.

The growth of offshore windfarm developments and installation of new structures may lead to changes to the baseline predator and prey distributions and foraging patterns, due to the 'reef effect' with structures attracting fish and other predators.

A key prey species in summer is the lesser sandeel (*Ammodytes spp.*). Sandeels exhibit complex seasonal and diel activity patterns, spending most of the year buried in sediment and emerging between April and August, forming large schools in the water column during the day.



Study Aim

Assess whether spatio-temporal variations in the occurrence and foraging behaviour of harbour porpoises are related to relative sandeel density



Due to their ecological importance, sandeel occurrence and density maps were previously produced to predict spatial variation of sandeels buried in sediment ([Langton et al. 2021](#)).

[This report](#) investigates whether spatio-temporal variation in the occurrence and foraging behaviour of harbour porpoises around Moray Firth windfarm sites is related to relative sandeel density predicted by the Langton et al. (2021) model.

Data Collection

This study was conducted within three windfarm sites in the Moray Firth, Scotland using Passive Acoustic Monitoring (PAM). Data were collected using echolocation click detectors (CPODs) between 2009 and 2011 (pre-construction) and 2022 (post-construction for Beatrice and Moray East, and pre-construction for Moray West).

Data Collection

CPOD data extraction of hourly presence/absence of porpoise echolocation click train detections allowed assessment of spatio-temporal variation in harbour porpoise occurrence. These click train detections were also used to infer foraging behaviour from the presence of echolocation buzzes. The predicted sandeel density values used in the analyses were extracted from the grid cell in which each CPOD was deployed.

Modelling harbour porpoise hourly occurrence and foraging behaviour in relation to local predicted sandeel density allowed assessment of the spatial relationship between porpoise and sandeel density. Windfarm developments and seasonal variations were also integrated into the models.

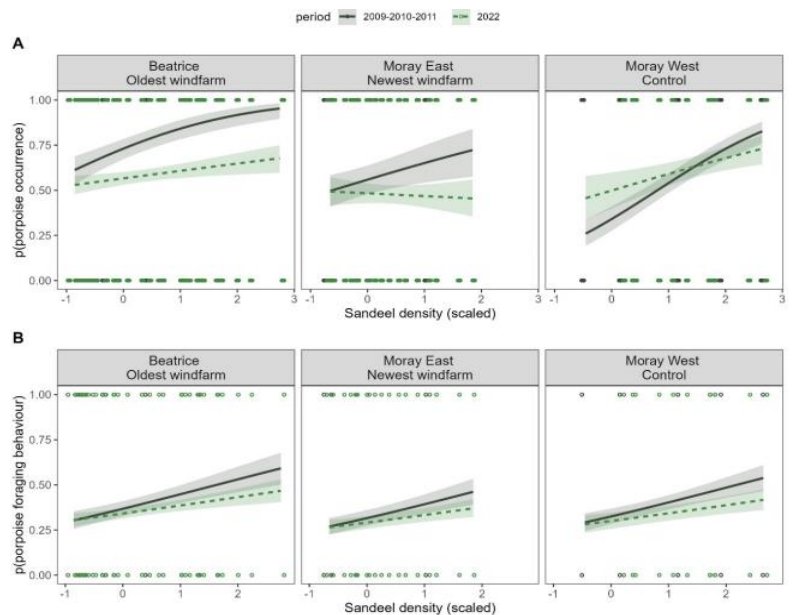
Results

Harbour porpoises were detected every day, and both occurrence and foraging activity increased with increasing sandeel density in July and August. This positive relationship was found in all years of the study.

The relationship between porpoise occurrence and predicted sandeel density varied seasonally, and was positive from April to September. Throughout the whole year, porpoise foraging activity increased at sites with higher sandeel densities and was higher at night.

During pre-construction, the probability of porpoise occurrence increased with predicted sandeel density in all windfarm sites. However, post-construction, these patterns differed across sites:

- As expected, the relationship between porpoise occurrence and predicted sandeel density remained positive at the control site.
- At the oldest windfarm, this relationship was positive but weaker: less porpoises were detected in higher sandeel density areas.
- At the newest windfarm, the differences observed between porpoise occurrence and predicted sandeel density were not significant.



Conclusions

- The sandeel model (Langton et al. 2021) can inform models used to predict spatial variation in the occurrence and foraging behaviour of harbour porpoises, with limitations.
- A consistent positive predator-prey relationship was found within the Moray Firth survey area, matching seasonal presence of prey.
- Analyses suggest that the installation of wind turbine structures may have modified predator-prey interactions. As part of the PrePARED project, further investigation will be undertaken to better understand this effect.