

# Habitat preferences of minke whales in the Moray Firth: Implications for dynamic MPA management

EM-03

Duncan A.I. MacDougall & Kevin P. Robinson

Cetacean Research & Rescue Unit (CRRU), 48 Seatown, Gardenstown, Banff AB45 3YQ, Scotland, UK



**Introduction:** Effective conservation of highly mobile marine predators, such as cetaceans, requires an understanding of the underlying ecological variables driving their distribution (Hooker et al. 2011). These drivers can be investigated using habitat models, but inclusion of prey data can greatly improve such models and their interpretation (Pendleton et al. 2020). This study assessed the temporal preferences of minke whales (figure 1) for oceanographic fronts and prey density from a long-term sightings database for the Moray Firth in northeast Scotland, using a presence-absence generalized additive model (GAM).

**Methods:** Sightings data were collected between May and October 2009 to 2022 from dedicated boat surveys in the study area (figure 2) (see Robinson et al. (2023) for methodology). Using only sightings of foraging whales and survey effort data, 2 km presence-absence grids were created for each month of each survey year. A GAM was then used to relate whale presence to sea surface temperature (SST), SST standard deviation (SD) as a proxy for fronts, depth and burrowed sandeel density. A tensor product smooth interaction between sandeel density and month and between SST SD and month, enabled assessment of the seasonal changes in minke whale habitat use.

## Results:

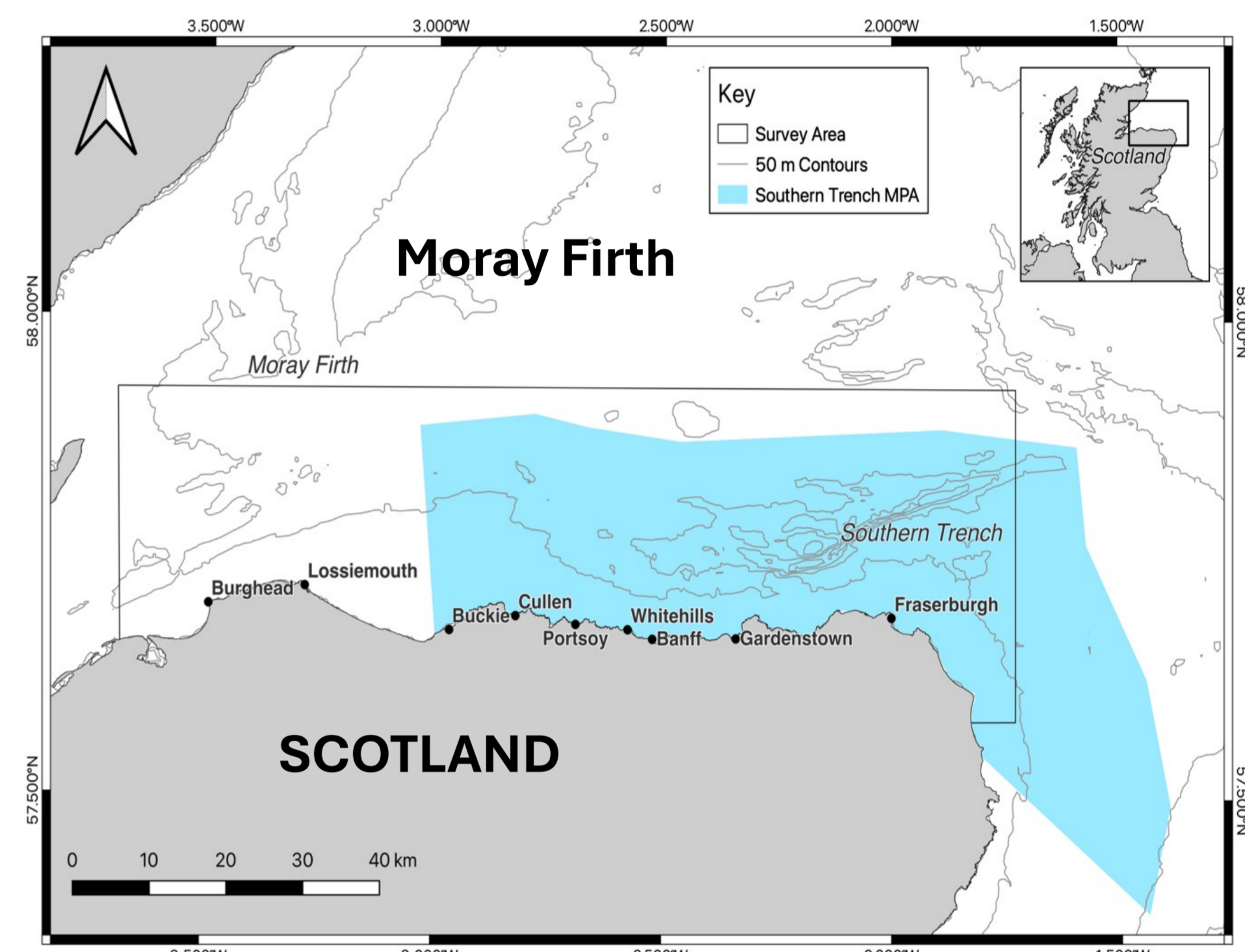
- 478 sightings of foraging whales were recorded between 2009 and 2022
- Whales were found to show a strong preference for depths > 40 metres and especially > 75 metres
- A strong preference for high burrowed sandeel densities was observed in May and June, whilst in October there was higher occurrence of whales at low sandeel densities (figure 3a)
- Foraging whales strongly associated with high SST SD frontal areas during Jul and August (figure 3b).

## Conclusions:

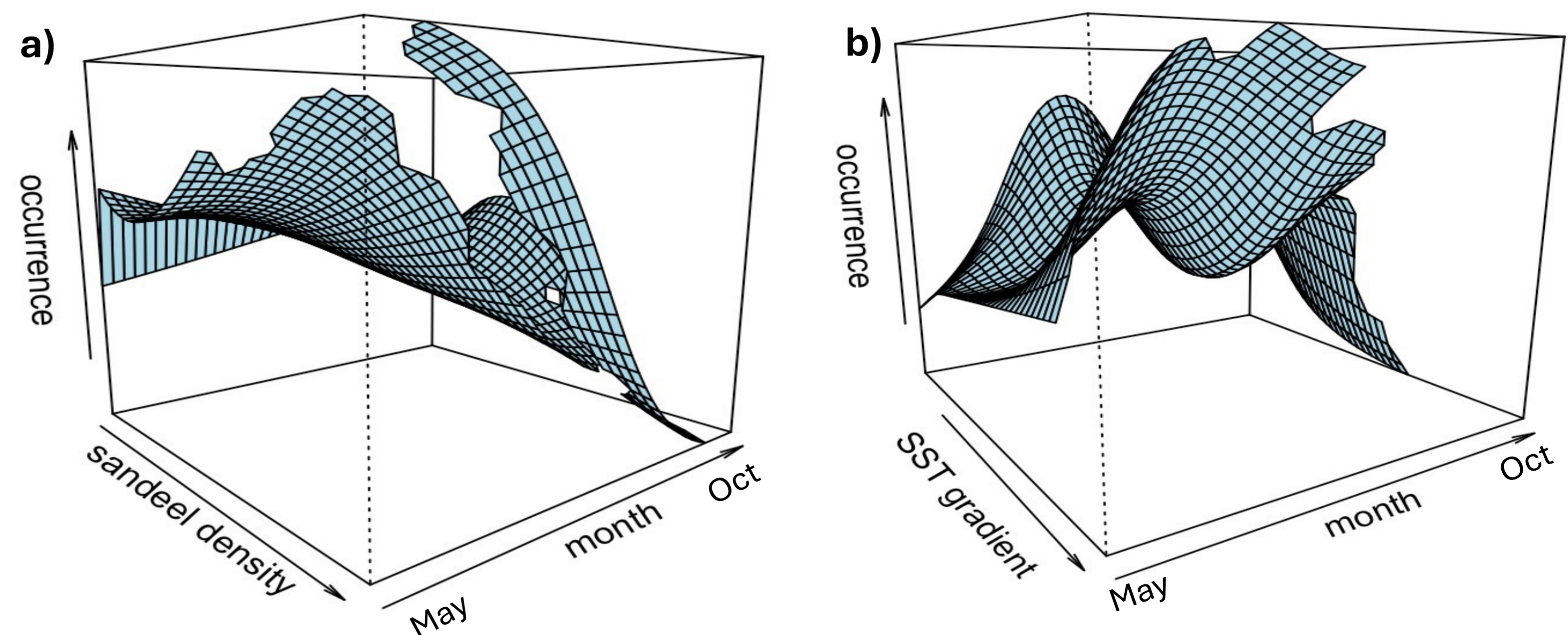
- The association of whales with high burrowed sandeel densities in May and June is reflected by high sandeel availability in the water column during this time (Winslade et al. 1974)
- This respective decline later in the season is thus presumably due to declining sandeel availability and the increased availability of more readily available clupeid prey species in different areas (Maravelias et al. 2000)
- The strong preference for high SST gradients indicated a preference for frontal areas where aggregations of clupeid prey species subsequently occur (Franks et al. 1992)



**Fig. 1.** Lunge feeding minke whale (*Balaenoptera acutorostrata*) showing the expanded ventral pleats during a prey entrapment manoeuvre.



**Fig. 2.** Map of the study area showing the position of the Southern Trench MPA.



**Fig. 3.** Partial effect for the tensor smooth interaction between (a) sandeel density and month, and (b) SST gradient (frontal activity) and month.

## Management Recommendations:

This study highlights the importance of spatio-temporal changes in whale distributions arising due to seasonal changes in targeted prey, and further demonstrates the importance of prey data utilisation in habitat modelling. These findings provide a baseline for informing adaptive management of the newly-designated Moray Firth MPA.

## References

