PrePARED
Predators + Prey Around Renewable Energy Developments

Dynamic sandeel maps with uncertainty for the western North Sea

PrePARED Output Summary No. 10

Background

Lesser sandeels (*Ammodytes marinus*) are small forage fish that underpin UK marine food webs, supporting many populations of seabirds, marine mammals, and commercially important fish. Their distribution is constrained by seabed depth and the extent of sandy sediments suitable for burrowing.

Ammodytes marinus | Photo credit: Keith Mutch

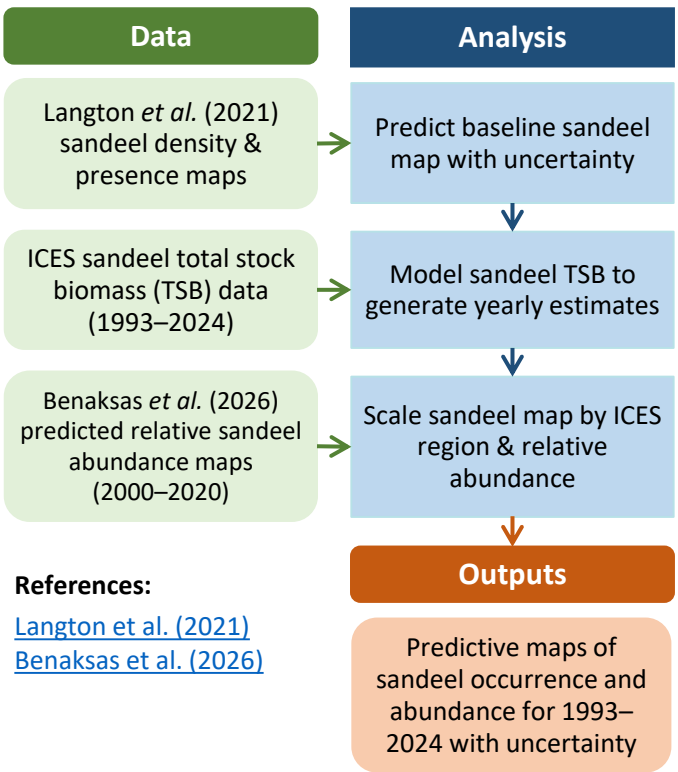
Uneven survey effort, particularly outside known fishing grounds, has increased reliance on habitat-based models to understand the spatial ecology of sandeels from sparse data. For instance, Langton *et al.* (2021) used grab samples to develop the only broad-scale predictions of sandeel abundance and occurrence currently available for the UK sector of the western North Sea. However, these predictions are static in time and lack estimates of uncertainty, limiting their value for marine spatial planning and decision-making.

PrePARED surveyed fish communities in north-east Scotland from 2022–25 to investigate how prey availability influences the distributions of seabirds, marine mammals, and predatory fish in the context of offshore wind farm development. Combined with the Langton *et al.* (2021) maps, these relationships can be applied across the wider North Sea to identify areas likely to support predators and assess their potential responses to climate-driven and anthropogenic change.

Study Aims

- Design a protocol to increase the utility of the Langton *et al.* (2021) maps for transferability.
- Generate dynamic predictions of both sandeel occurrence and abundance that adequately reflect statistical uncertainty and account for interannual changes in sandeel stock biomass.

Methodology



References:

Langton et al. (2021)
Benaksas et al. (2026)

Authors: Frantsuzova A, Bouchet PJ, Whyte KF, Langton R, Regnier T, Cooper C, Jones EL

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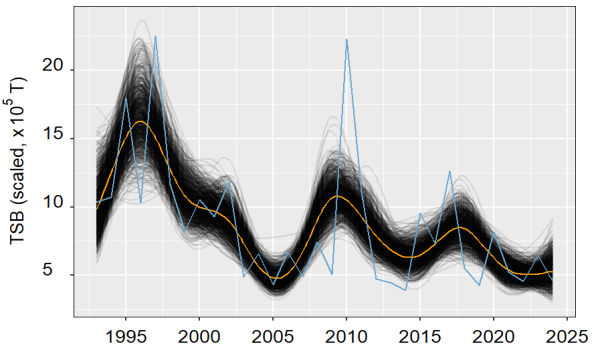
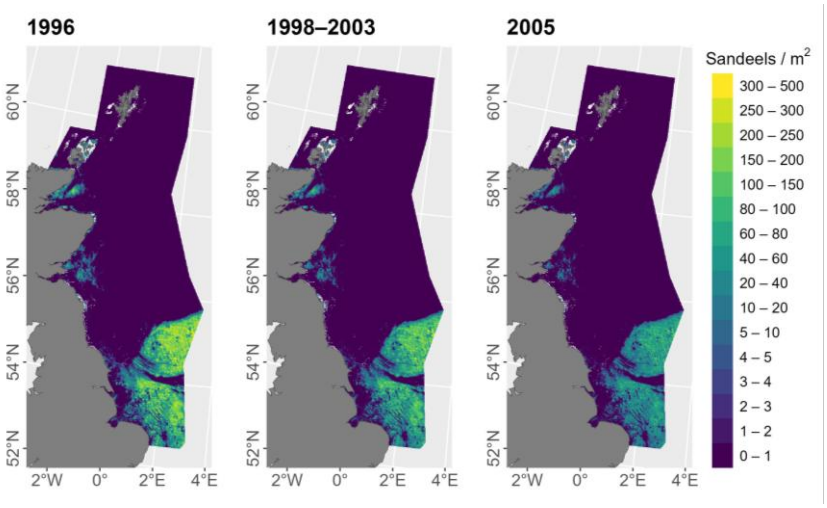
Results

We used data from ICES to model annual changes in total sandeel stock biomass (TSB) across the region covered by the Langton *et al.* (2021) maps.



Aggregated time series of sandeel TSB (blue), fitted model (orange), and 1,000 simulated trends (black) illustrating model uncertainty

We produced predictions of sandeel occurrence and abundance for each year in 1993–2024, with uncertainty.



[Left] Example of a year of *higher* sandeel abundance (1996)
[Middle] Baseline sandeel abundance from Langton *et al.* (1998-2003)
[Right] Example of a year of *lower* sandeel abundance (2005)

Caveats and limitations

1. Stock-at-age data are not publicly available – **we assumed that proportional changes in biomass reflect changes in abundance**
2. TSB estimates were scaled relative to the baseline period (1998–2003) represented by the Langton *et al.* (2021) maps. **Variation within this baseline period was not modelled**
3. Year-to-year changes were partitioned between abundance (70%) and occurrence (30%) and **applied uniformly across the maps**
4. Langton *et al.* (2021) used grab samples representative of winter sandeel distribution, **whereas PrePARED data collection took place in the summer**

APPLICATION & UTILITY

Data products

Maps with uncertainty are being produced in different formats and published as open access datasets

Predator–prey modelling

Sandeel maps can be used as explanatory covariates when assessing changes in predator behaviour and distribution in space and time across the North Sea

Uncertainty propagation

Maps allow uncertainty to be propagated into downstream models, either as a covariate or through simulation

IMPACT

Establishing baselines

Maps can be used in establishing a changing baseline in Habitats Regulations Assessments

Cumulative Impact Assessments

Environmental Impact Assessment tools can be improved by including the maps in individual-based models

Marine Spatial Planning (MSP)

Data products can be used to inform MSP in the North Sea

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