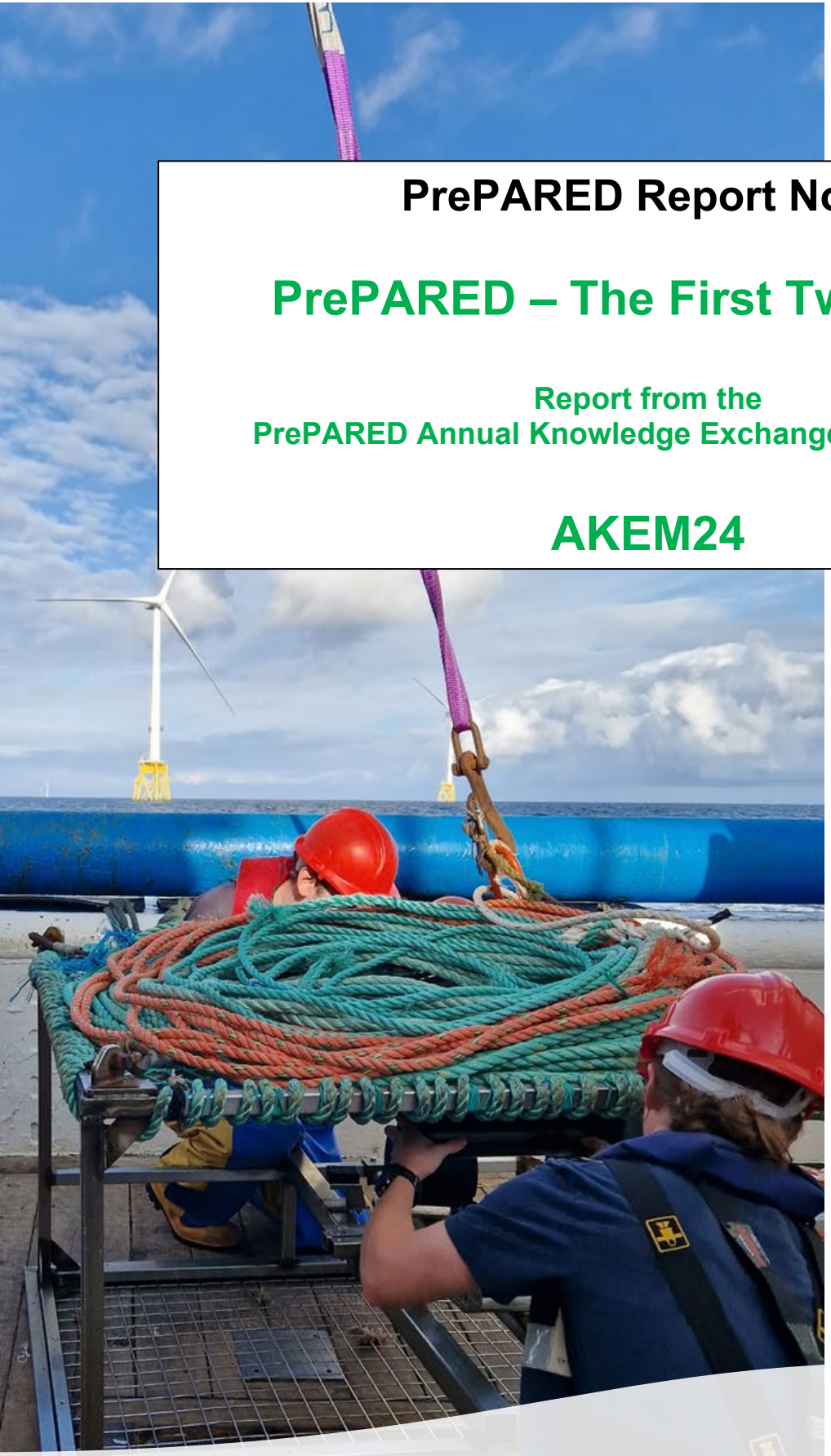

PrePARED Report No. 3

PrePARED – The First Two Years

Report from the PrePARED Annual Knowledge Exchange Meeting 2024

AKEM24

Scottish Government
Riaghaltas na h-Alba

UK Centre for Ecology & Hydrology

BioSS

University of Exeter

SMRU Consulting

Sea Mammal Research Unit

University of Aberdeen

Aarhus University

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NatureScot

Funded by:

Offshore Wind Evidence + Change Programme

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PrePARED

Predators + Prey Around Renewable Energy Developments

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PrePARED – The First Two Years

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AKEM24

Author	Affiliation	Email
Tony Bicknell	University of Exeter	a.bicknell@exeter.ac.uk
Cormac Booth	SMRU Consulting	cgb@smruconsulting.com
Adam Butler	BioSS	adam.butler@bioss.ac.uk
Francis Daunt	UK Centre for Ecology & Hydrology	frada@ceh.ac.uk
Lauren Donachie	Scottish Government	lauren.donachie@gov.scot
Samuel Gierhart	University of Exeter	S.Gierhart@exeter.ac.uk
Gordon Hastie	Sea Mammal Research Unit	gdh10@st-andrews.ac.uk
Chris Pollock	UK Centre for Ecology & Hydrology	chrpol@ceh.ac.uk
Esther Jones	BioSS	esther.jones@bioss.ac.uk
Thomas Regnier	Scottish Government	thomas.regnier@gov.scot
Kate Searle	UK Centre for Ecology & Hydrology	katrle@ceh.ac.uk
Paul Thompson	University of Aberdeen	paul.thompson@abdn.ac.uk
Bill Turrell	Scottish Government	bill.turrell@gov.scot
Katherine Whyte	BioSS	katherine.whyte@bioss.ac.uk
Jared Wilson	Scottish Government	jared.wilson@gov.scot
Matthew Witt	University of Exeter	m.j.witt@exeter.ac.uk
Philippa Wright	Sea Mammal Research Unit	pfcw1@st-andrews.ac.uk

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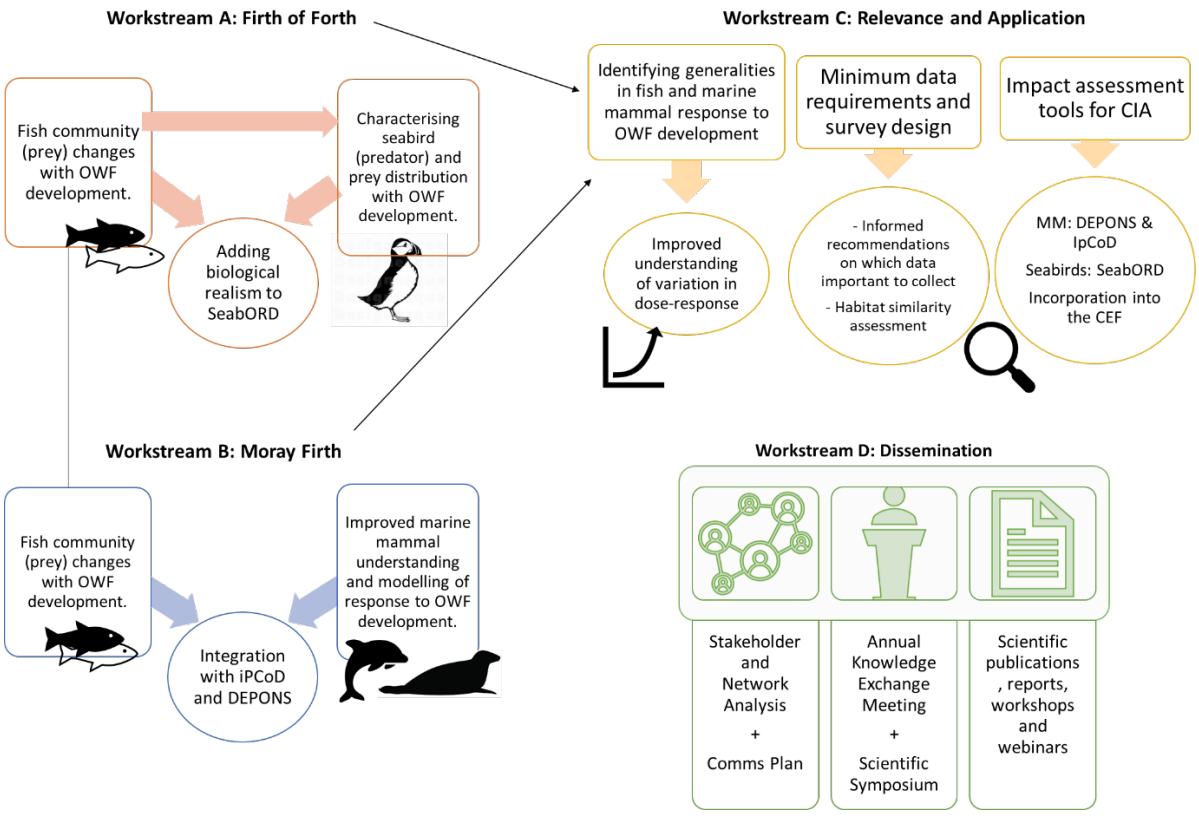
Introduction

This PrePARED Output Summary aims to briefly document the PrePARED project results that were presented at the Annual Knowledge Exchange Meeting 2024 (AKEM24). This meeting was held at Dynamic Earth, Edinburgh, 27 February 2024. There were approximately 90 attendees at the meeting from the offshore wind industry, offshore wind regulators, nature conservation agencies, academia, fisheries and government. The meeting summarised available results following completion of year 2 of the 5-year PrePARED project. All results below are preliminary and may change when further data and analysis becomes available. However, we present this summary in order to facilitate rapid information exchange and dissemination. Principal contacts are provided for each section of the summary, and all email details are in the author table on page 2. Please use these to obtain updates related to the work. A summary of the PrePARED project can be found in PrePARED Output Summary No. 1 and on our web site (www.owecprepared.org).



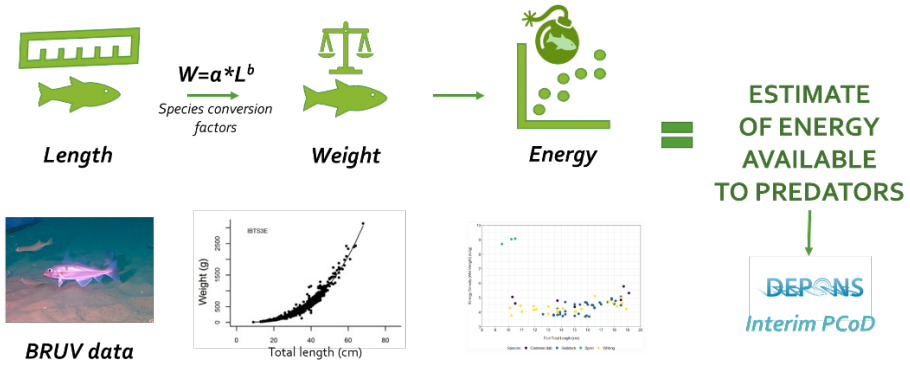
Summary of the PrePARED project work package structure.

Foodscapes

Within this PrePARED theme, baited remote underwater video (BRUV) monitoring is integrated with bomb calorimetry to improve the understanding of the value of offshore wind farms in terms of food availability and prey quality to predators. Data from BRUV monitoring are used to assess the presence, abundance and size of demersal fish species close to offshore wind farm turbines. Bomb calorimetry is used to measure the energy content of prey fish in the context of food for predators (seabirds and marine mammals) and this information can provide insights about the value of offshore wind farms compared to reference areas outside wind farms to predators. This information aims to improve cumulative impact assessments and support developments in relation to “net gain” strategies.

What Has Been Done So Far?

- A survey of the Beatrice (BOWL) and Moray East (MEOW) wind farms was conducted in August 2022
- There were 108 BRUV deployments at 21 survey sites within 30 m of turbines, 6 sites within 500 m of turbines (inside OWF reference sites), and 9 sites >2 km from turbines (outside OWF reference sites). At each site there were 3 replicate deployments.
- In all, 81 hours of video footage were collected. The first 30 minutes of each deployment have been analysed.
- This study provides a snapshot in time (summer 2022) and does not address seasonal or inter-annual variation or address diel patterns as the survey was conducted during daylight hours.
- 500 fish samples have been processed using bomb calorimetry, providing 247 new energy density (kJ/g) estimates for 21 fish species with sizes across the species ranging from 7 cm to 47 cm.



Summary of the process using biomass observations derived from BRUV data, fish sampling and energy estimations using bomb calorimetry to estimate the energy available to predators within OWF sites, a parameter needed by EIA models such as Interim PCoD and DEPONS.

Preliminary Results

- A predator's foodscape in and around an OWF will depend on the abundance of the fish, the size of the fish and the energy content per unit mass (kJ/g) of the fish. These may differ due to the species present and how they are affected by the presence of the wind farm turbines.
- Flatfish abundance: At BOWL there were ~2.5 times more flatfish near turbines (i.e., < 30 m) than at reference sites. No increase was observed at MEOW turbines.
- Haddock abundance: There was ~3 times more haddock near turbines at BOWL and ~2 times more haddock near turbines at MEOW compared to reference sites.
- Fish size: Fish were slightly bigger close to turbines than at reference sites for both haddock and flatfish. However, small size differences can markedly change the total energy content (kJ) of the fish.
- Foodscape: The total mean energy content (kJ) of the prey (fish) found close to turbines (i.e., <30 m) in BOWL and MEOW was estimated to between 2 and 3 times larger than at reference sites and such estimates (covering the small spatial scale BRUVs monitor) represent significant energy sources for top predators (i.e., 2-3 times daily energy requirements). See summary figure.

Impact

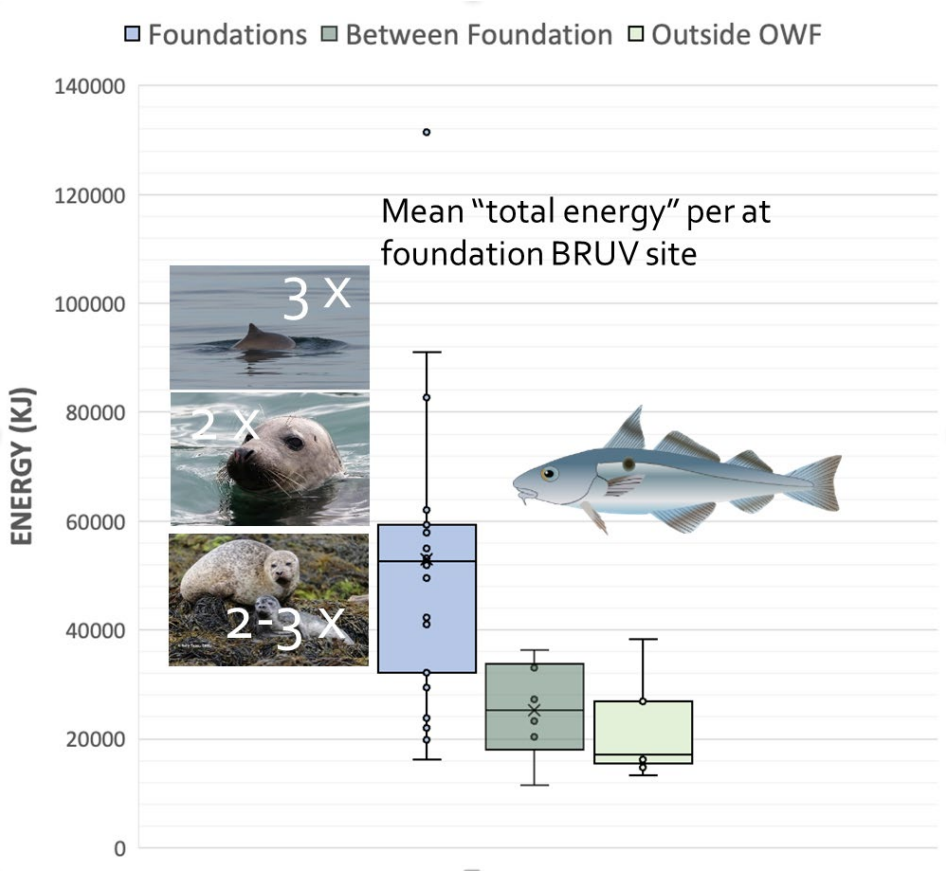
- Cumulative Impact Assessments (CIAs): Energy available to predators (mammals and seabirds) is an important parameter in many cumulative assessment models. The results of PrePARED will allow these estimates to be more realistic. Traditionally more windfarms have been assumed to have an increasingly negative impact on predator species, whereas there may well be positive impacts of individual sites on prey and hence on predators that should be included in CIAs.
- Marine Net Gain (MNG): The results of PrePARED will help us to understand some of the requirements of MNG, by helping to describe changes in carrying capacity (e.g., energy available to predators) and changes in individual species abundance and distributions due to OWFs.

Next Steps

- Further fish samples were collected during the summer of 2023 to improve weight-energy relationship models for various fish (prey) species. More will be collected in summer 2024.
- A second camera survey campaign will be conducted in summer 2024 to further assess the effect of turbines on fish presence and distribution.
- These data will be analysed and results integrated with Firth of Forth BRUV data to assess (dis-) similarity in patterns related to geography and OWF presence.

PrePARED Contacts

Tony Bicknell and Matthew Witt (Fish assessments), Cormac Booth (Prey energy and predators) and Philippa Wright (bomb calorimetry)



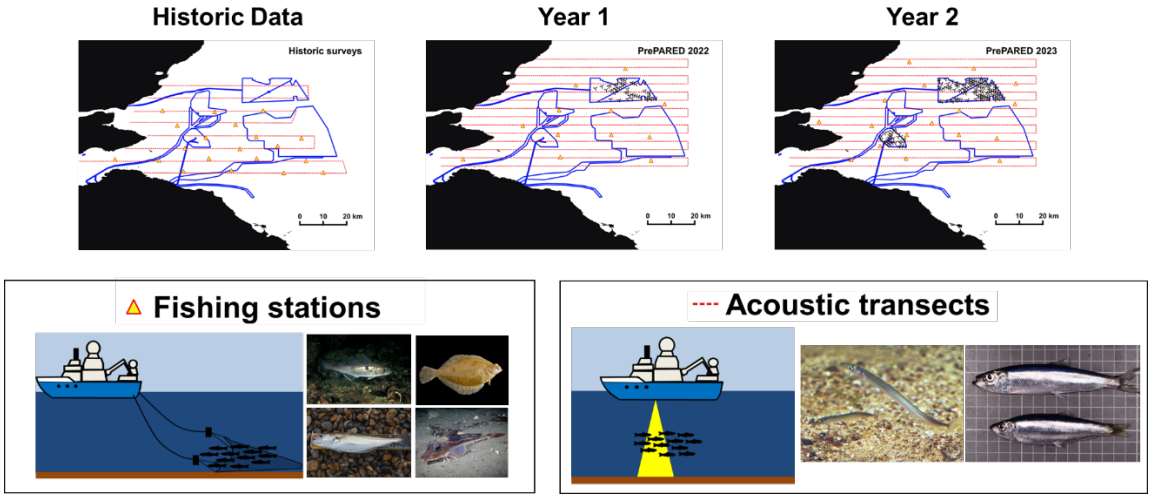
Results from the estimation of total prey energy available at the BOWL and MEOW offshore wind farm sites in the Moray Firth.

Fish in the Forth and Tay

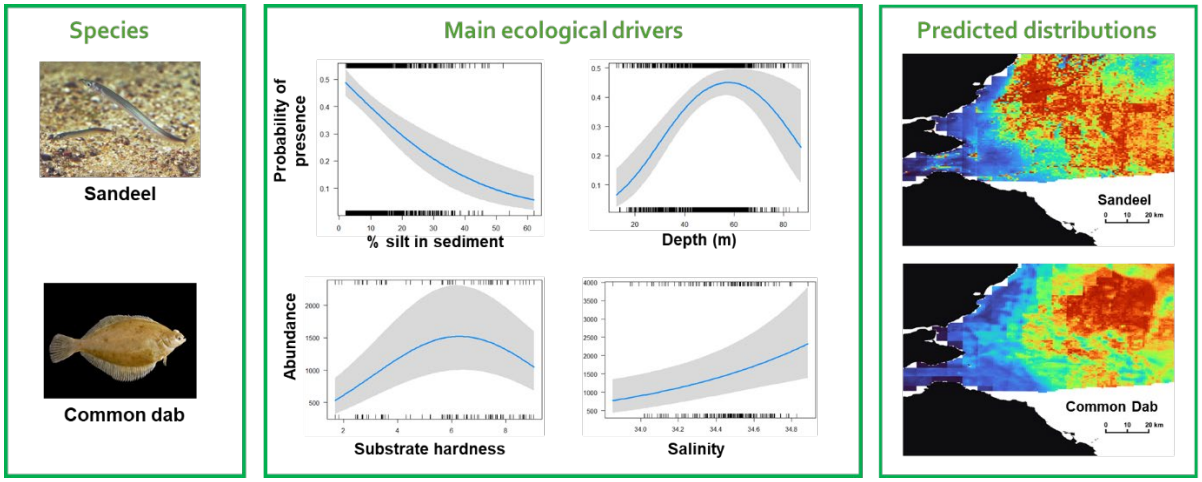
The objectives of this component of PrePARED is to understand the ecological drivers of broad-scale fish distributions in the regions of OWFs and to provide baseline scenarios prior to OWF construction. Then, using finer spatial scale observations, to understand the impact of the presence of OWFs on fish distribution. This improved understanding of ecological processes will then allow better predictions of baseline and post-OWF fish distributions thereby decreasing uncertainties in predator distribution and key species movement models. Ultimately the outputs of this work will be used to improve Environmental Impact Assessment (EIA) tools by increasing their biological realism, and hence decreasing the uncertainty in EIAs. Additionally, the aim is to improve the transferability of the EIA modelling tools between regions by understanding the underlying biological processes that influence their predictions.

What Has Been Done So Far?

- The Forth and Tay region was surveyed for pelagic fish (e.g., sandeel and clupeids) abundance and distribution using broad-scale high-density acoustic surveys in 2022 and 2023. These added to historic pre-OWF construction surveys of the region.
- In situ trawl sampling was also carried out to gain information on demersal fish.
- For specific species (e.g., sandeel, common dab, haddock) species distribution models were developed which use habitat and environmental variables to predict fish distributions.
- In addition to the broad-scale surveys, BRUVs and fish traps were deployed within the Forth and Tay OWF sites (Seagreen, NnG, Berwick Bank and Inch Cape). In these surveys, observations were not made less than 500 m from turbines owing to operational restrictions.



Fishing and acoustic surveys conducted in the Forth and Tay region during the first two years of PrePARED.



Examples of broad-scale distributional models for key prey species (sandeel and common dab) developed during the first two years of the PrePARED project in the Forth and Tay region.

Preliminary Results

- At the broad-scale, key environmental drivers of fish distributions were identified. For example, it was found that sandeel avoid areas of high silt content in the seabed sediment and express a specific depth preference (50 m to 70 m) while common dab were preferentially located on hard seabed substrates and were associated with higher salinities.
- Such habitat preferences were used to develop models that can predict fish distribution based on known distributions of habitat and environmental variables.
- Distributional models using habitat suitability were also developed for sprat, herring, haddock, whiting, poor cod, Norway pout, long-rough dab and plaice.
- In terms of small-scale effects, none were observed for sandeels within the OWFs, but common dab abundance was found to decrease with increasing turbine density.
- It should be noted that in the Forth and Tay the small-scale survey data was collected outwith 500 m from turbines, while in the Moray Firth results were collected within 500 m from turbines. The decrease in common dab outside the 500 m range may indicate an effect of an attraction of the species to turbines. The greater the density of turbines, the greater the effect as fish are attracted to the areas close to the turbines thereby reducing their abundance further away from the turbines.
- The results from the BRUVs and fish traps in the Forth and Tay study region will allow the prediction of fish distributions on the scale of wind farm sites rather than on the scale of turbines.

Impact

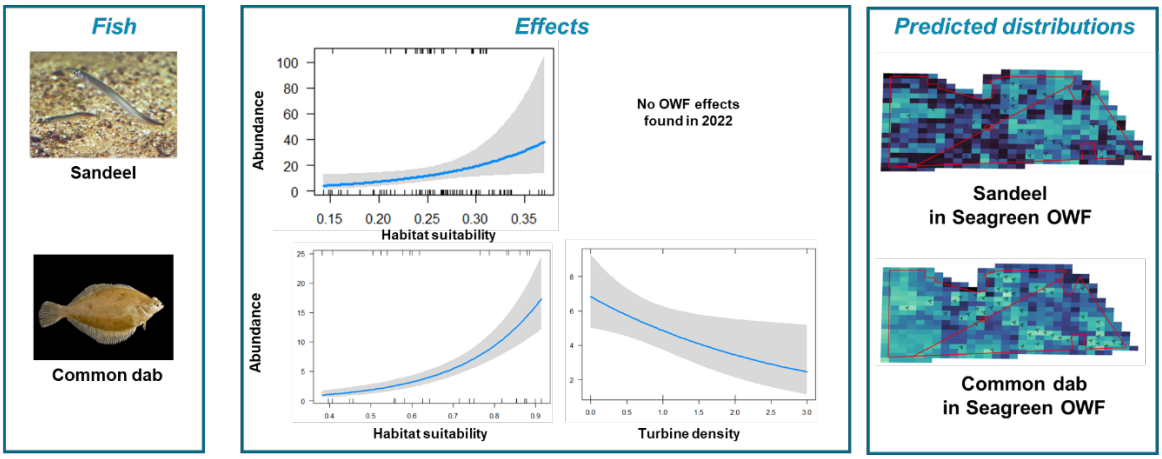
- The impact of an OWF on fish distribution can be more accurately assessed if habitat suitability is taken into consideration. The results of PrePARED will facilitate this for a range of key prey species.
- The models being developed by PrePARED predicting fish distributions on a broad-scale, and on the scale of OWF sites, based on readily observed habitat and environmental variables will provide improved prey surfaces for use in predator (seabird) distribution models such as SeabORD.

Next Steps

- The surveys will be repeated in 2024 and all data will be used to improve the fish distribution models
- The small-scale observations in the Forth and Tay region and the Moray Firth will be compared and contrasted to improve the transferability of the results.

PrePARED Contact

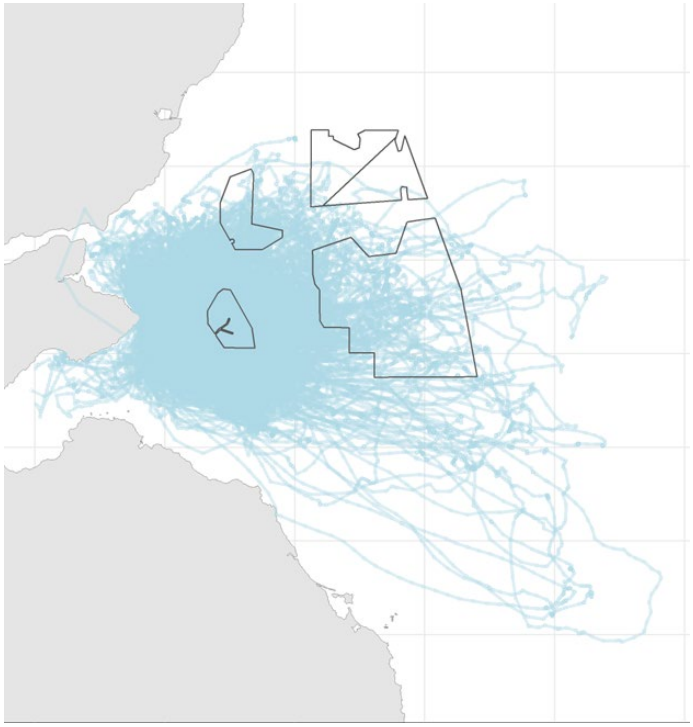
Thomas Regnier



Examples of small-scale distributional models for key prey species (sandeel and common dab) developed during the first two years of the PrePARED project in the Forth and Tay region.

Seabirds in the Forth and Tay

In this component of PrePARED, a number of seabird species have been monitored using GPS tracking data. Post-consent monitoring data funded by the Neart na Gaoithe (NnG), Seagreen and Berwick Bank wind farm developers were also made available to the project. The original objective of the post-consent monitoring was to estimate population-level consequences of OWFs on protected seabird species but the data has also been made available to PrePARED for further analyses. Within PrePARED, spatial and temporal matching between the seabird GPS data and prey data collected by the fish surveys (described above) is being performed over seabird breeding seasons. The aims are to identify predator-prey interactions between seabirds and fish, quantify these ecological relationships, establish how these relationships alter in the presence of wind farms, and use historic data to build robust baseline descriptions of seabird populations so that changes due to OWFs can be more accurately determined.



Example of the GPS seabird tracking performed by UK Centre for Ecology & Hydrology in the Forth and Tay region. This data was collected in 2021 using kittiwakes tagged on the Isle of May.

What Has Been Done So Far?

- Unfortunately, the advent of avian flu meant that no bird GPS tracking was possible in 2022.
- Contemporaneous fish distributions, seabird (guillemots, kittiwakes, puffins, razorbills) GPS tracking and in situ seabirds-at-sea observations (species counts, descriptions of activities) were collected in the summer of 2023.

Preliminary Results

- Predator-prey interactions occur on a range of spatial scales, and PrePARED has developed modelling approaches to address research questions at these different scales.
- On a regional scale, using average fish distribution model predictions and spatial modelling of seabird GPS tracking data, PrePARED is addressing the drivers behind long-range and long-term seabird movements. Data from 2021 and 2023 have been used to investigate the influence of fish distribution on seabird movements and to improve spatial models previously dependent on distance from breeding colonies. Using 2021 tracking data, the prevalence of different kittiwake movement behaviours (i.e., foraging, commuting, resting) have been related to predicted regional sandeel densities. More commuting behaviour has been observed in regions of low sandeel density.
- On an area-specific scale, the fish distribution models developed by the PrePARED fish in the Forth and Tay component described above are being used alongside the seabird tracking data to understand the drivers of foraging activity on individual seabird foraging trips. Traditionally, seabird movement models have used parameters such as step length (time taken between two consecutive locations) and turn angle (relating to the direction of movement). In PrePARED the influence of prey distribution and availability on these movement parameters will be investigated.
- On the finest spatial scale, at that of individual fish schools, the in situ seabirds-at-sea observations coupled with GPS tracking data and fish distributional data are being used to investigate which fish schools seabirds forage on. Using the in situ seabirds-at-sea observations, contemporaneous sightings of guillemots at the surface are being compared to information on the depth and density of underlying fish schools.
- PrePARED has produced and used unique datasets at these different spatial scales, allowing us to investigate how processes are influenced at different scales, and identify the linkages between these scales.

Impact

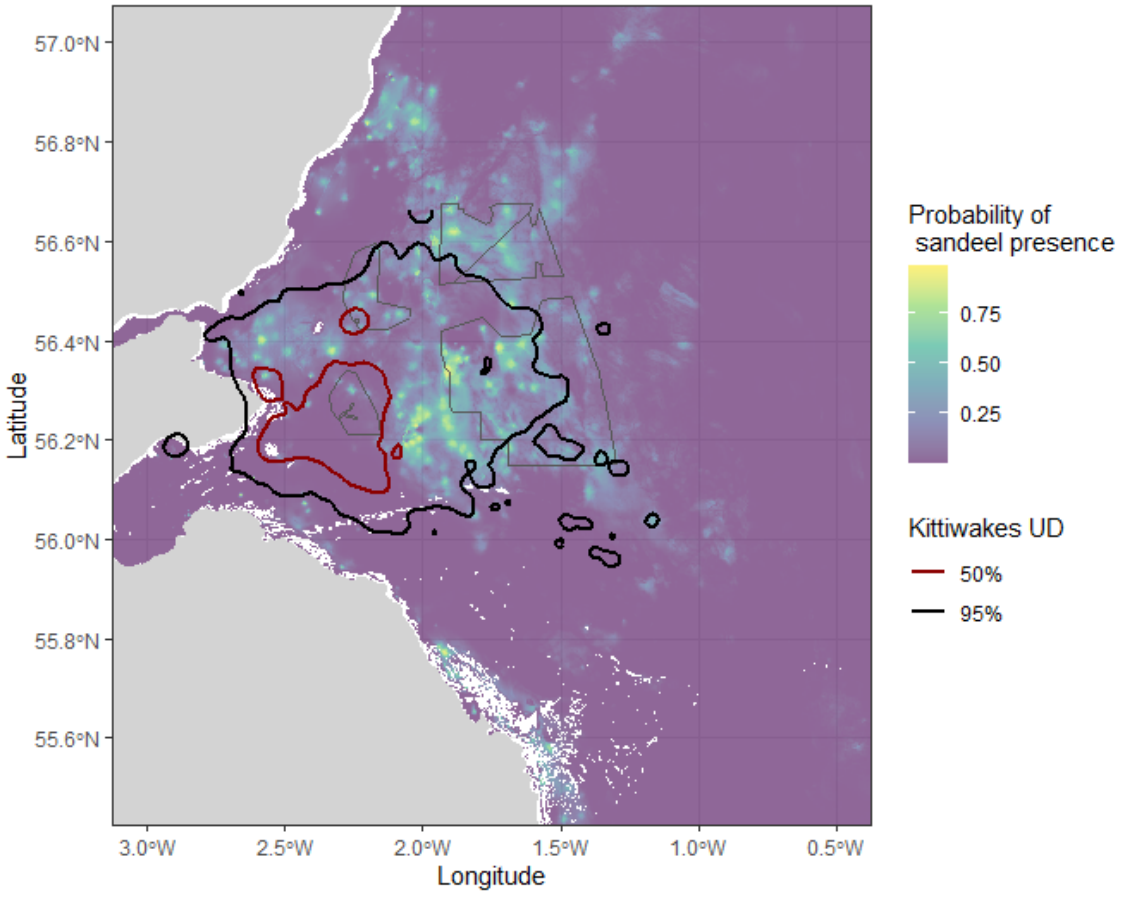
- The seabird spatial and movement analyses being undertaken in PrePARED will be used to produce behavioural classifications and distribution maps which can improve simulations of seabird foraging tracks in individual-based models (IBMs) including SeabORD.
- Key metrics of predator-prey interactions will be developed which will inform simulation improvements and hence help develop improved EIA tools.

Next Steps

- More contemporaneous seabird tracking data, fish distributional data and in situ seabird-at-sea data will be collected in the summer of 2024.

PrePARED Contacts

Katherine Whyte and Esther Jones



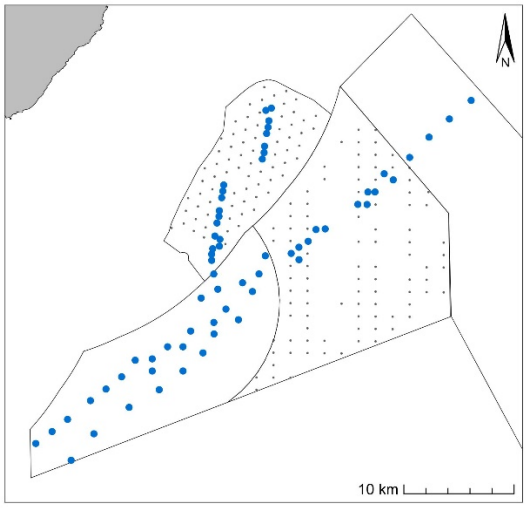
Example of the spatial modelling of seabird distributions in relation to prey (sandeel) distributions used to better understand predator-prey overlaps and how prey may act as a driver of seabird distributions. This example is from 2021.

Responses of marine mammals to piling noise

One of the principal challenges posed by OWF development to marine mammals is the effect of noise from pile driving. Currently, the impact of piling noise on cetaceans is estimated using models of sound propagation combined with information about the sound sources and estimates of sound levels which produce avoidance responses by the animals. Information on the abundance and distribution of specific species is then used to estimate the number of animals affected by piling operations, and using population level models such as iPCoD, an interim version of the Population Consequences of Disturbance (PCoD) model, to assess population-level impacts. This approach has been hampered by the absence of in situ data quantifying the relationships between noise levels and avoidance behaviours, particularly in harbour porpoises which are particularly sensitive to pile driving noise. Some data has previously been generated in the Moray Firth, but questions remain such as (1) do these observed dose (noise level) - response (avoidance probability) relationships apply in other areas, (2) are they affected by prey densities and distributions, and (3) do mammals become more tolerant of pile driving noise with time? PrePARED aims to reduce these uncertainties by determining the minimum data requirements needed to replicate the Moray Firth dose-response relationships in other regions, providing guidance for the optimisation of survey design using passive acoustic monitoring (PAM) devices for dose-response studies, and conducting studies during the Moray West construction phase to further explore the context dependency of dose-response relationships, especially with respect to prey abundance and distribution.

What Has Been Done So Far?

- Data from 60 PAMs deployed during the construction of the Beatrice wind farm (2017 / 2018) is available to PrePARED.
- Additionally, in the latter half of 2023, during the Moray West construction period, 65 PAMs were deployed in the Moray West development site.



The array of Passive Acoustic Monitoring (PAM) devices deployed during the Moray West offshore wind farm construction phase in 2023. Blue dots are PAMs, grey dots are the locations of turbines.

Preliminary Results

- Using the extensive Beatrice data set, a “data thinning” approach has been used to investigate the effect of different survey designs on the produced dose-response curves.
- Low numbers (<20) of PAMs could be used to replicate the dose-response curve derived from the intensive 60-PAM array.
- However, the shape of the curve is strongly influenced by the spatial extent of the array, and the design of comparative studies would benefit from clearer understanding of the maximum distance at which animals are disturbed.
- 18 piles were installed while the 2023 PAM array was deployed. No large scale displacement was observed, and preliminary analyses highlight that animals return to affected areas within a few hours of the end of piling.

Impact

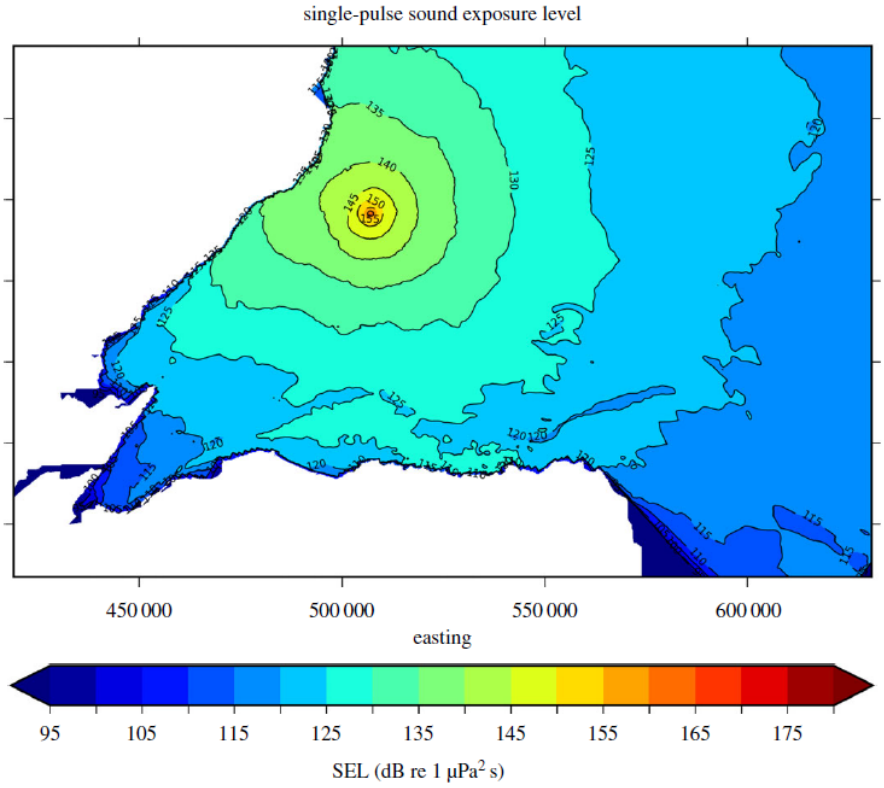
- In an EIA, uncertainty in dose (noise) – response (animal displacement) functions used in models such as iPCoD and DEPONS likely translate to conservative predictions in numbers of animals displaced by a piling activity.
- PrePARED aims to reduce this uncertainty by improving the estimation of dose-response curves, both through improved survey techniques and designs, and through the addition of biological realism by including factors such as prey availability.
- The 2023 data set will provide dose-response curves for louder piling activities than currently available. They will also provide information on variation in dose-response curves along gradients within and outwith windfarms.
- Correct consideration of noise impacts on marine mammals can help reduce uncertainties in the consenting process as well as improve project delivery by ensuring operational constraints are optimal.

Next Steps

- The 2023 Moray West PAM data will now be analysed in detail, specifically focussing on 6 locations with >3 days baseline data before and after piling events. Animal responses along exposure gradients both within existing windfarms and outside existing windfarms will be assessed in relation to both vessel movements and prey (sandeel) distributions.
- The data will also be used to investigate recovery times for harbour porpoises following piling noise.

PrePARED Contacts

Gordon Hastie and Paul Thompson



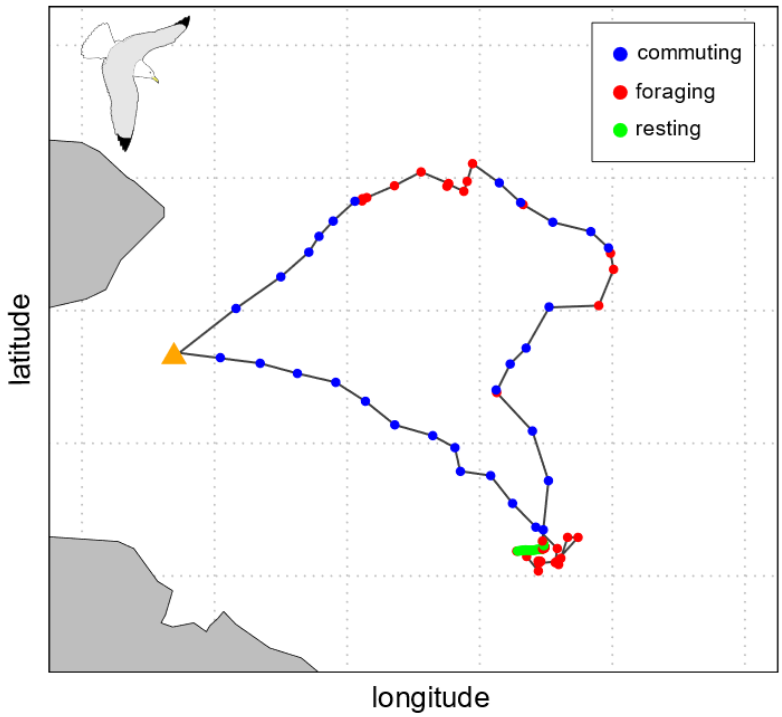
Example of predicted underwater sound levels due to a piling operation in a Moray Firth OWF.

Improving EIA tools

The observations of predator (seabirds) and prey (fish) distributions and behaviours in and around OWFs is being used to improve EIA tools such as SeabORD. SeabORD is an individual-based model (IBM) which predicts the time/energy budgets of breeding seabirds during the chick-rearing period for four species of UK seabirds (puffin, common guillemot, black-legged kittiwake and razorbill). The model translates these into projections of population level adult annual survival and productivity. The model simulates foraging decisions of individual seabirds under the assumption that they are acting in accordance with optimal foraging theory. In the model, foraging behaviour of individual seabirds is driven by prey availability, travel energy costs, provisioning requirements for offspring, and behaviour of conspecifics. The model estimates productivity and adult survival, the latter resulting from estimates of adult mass at the end of the breeding season and published relationships between adult mass and subsequent survival. When SeabORD is used in an EIA, the model is run with and without the presence of a planned OWF, and the influence of an OWF on the model parameters must be estimated. This can also be done for the presence of multiple OWFs when considering cumulative impact.

What Has Been Done So Far?

- Currently, it is common practice to assume uniform prey distributions in the SeabORD model. Under this assumption, if OWFs displace seabirds, because there is no change in the amount of prey in alternative foraging areas, seabird intake is only influenced by the density of conspecific competitors in different parts of the marine habitat. In PrePARED, the observed fish distributions described above are being used to include more realistic prey landscapes within SeabORD, allowing the model to simulate effects of displacement due to OWFs under more realistic conditions.
- Currently SeabORD has several simplifying assumptions around movement, e.g.; individual seabirds travel in straight lines, visit the same foraging location within daily time steps, and exhibit no site fidelity between foraging locations on different dates. Interactions with OWFs are highly simplified and unverified by observation. In reality, seabird movements are highly complex with varying step lengths and turning angles, and varying drivers of different behaviours and activities. Seabird tracking data within PrePARED is being used to improve the parametrisation of these key processes within SeabORD.



An example of seabird tracking data used to derive different bird behaviours in relation to environmental and prey cues. Such modelling will help improve the representation of seabird behaviour in EIA models such as SeabORD.

Impact

- By simulating more realistic foraging tracks in SeabORD, PrePARED hopes to capture ecological processes more accurately (i.e., different movement modes explicitly modelled), include more realistic interactions with prey and more realistic interaction with OWFs thus increasing confidence in model predictions.
- PrePARED is improving the prediction of fish distributions in response to environmental drivers and offshore wind farms, developing methods for quantifying predator-prey interactions on different spatial and temporal scales and developing methods to simulate more realistic seabird foraging tracks.

Next Steps

- PrePARED now aims to consolidate the work of the first 2 years. Work will focus on combining seabird tracking data with PrePARED broad-scale prey maps to quantify interactions during the breeding season, linking fish distribution models to energetic analyses to explore marine predator foodscapes (seabirds, marine mammals), assessing the relevance of the findings outside the Forth and Tay, and building more realistic interactions between seabirds and prey into SeabORD.

PrePARED Contacts

Chris Pollock and Kate Searle

Exploring External Factors

Effects of the development of offshore wind power do not operate in isolation. External factors are operating simultaneously. Particular challenges that impose extreme shocks to ecosystems include marine heatwaves, the occurrence of storms and the occurrence of disease in key populations. These same ecosystems and species are also impacted by the construction and operation of OWFs, and hence cumulative effects between external factors such as extreme events and OWFs need to be considered. As extreme events become more common with climate change, the requirement to quantify their impact will increase and PrePARED aims to address this need.

Marine Heatwaves

- For cold bodied species such as fish, heatwaves can increase their metabolic rates which in turn increases their consumption rates. If they cannot maintain these increased consumption rates, their quality as prey decreases. Additionally, as predator fish metabolic rates increase, they consume more quantities of forage fish leaving less for predators such as seabirds. These processes caused large-scale seabird mortalities off the Alaskan coast in 2013 to 2018.
- Many warm bodied species such as marine mammals may need to manage thermal stresses during heatwaves. There will be a balance issue related to losing heat to the environment as well as complexities involving the storage of fat. Currently it is unclear how heatwaves may challenge these species. They will also be impacted by the indirect effects of changes in prey availability and quality.
- During the PrePARED project there was a severe heatwave in the study region in the summer of 2023. Recoveries of dead ringed seabirds unusually increased during these months. The effect on numbers returning to breeding colonies is yet to be determined. A similar event in the summer of 2021 is also being investigated.

Storms

- Severe storms can cause nest destruction in many seabird species. Turbulent seas and surface waves can restrict or stop at-sea feeding.
- For the seabird species relevant to PrePARED, puffins appear to be particularly impacted by storms. Storms Arwen and Barra in December 2021 resulted in high puffin mortalities.

Avian Flu

- Severe seabird mortalities due to avian flu were first seen in Great Skuas in 2021, followed by widespread mortalities in many seabird species in 2022. Kittiwake and guillemots were particularly badly impacted. There was less evidence of the impact of avian flu in 2023, possibly due to increasing immunity in populations.

Impact

- A better understanding of how these extreme events interact with OWFs is needed to reduce the uncertainty in impact assessments.
- First order impacts of extreme events may include reductions in population size, shifting baselines and changing age structures (i.e., increased proportions of younger birds) in key assessed populations. After mass mortalities there will be a reduction in population density which can reduce competition for food, but can also result in loss of collective memory in a population, thereby reducing foraging effectiveness. Birds that have recovered from diseases may still experience health impacts such as changes in body condition of surviving individuals.
- Second order impacts include changes in predator numbers positively impacting some seabird species, while declines in competing species may benefit other species in terms of food availability.

Next Steps

- The heatwave of 2023 and its impacts will be explored further using data collected in PrePARED.
- The inclusion of the effects of extreme events into EIA and CIA assessments will be investigated.

PrePARED Contact

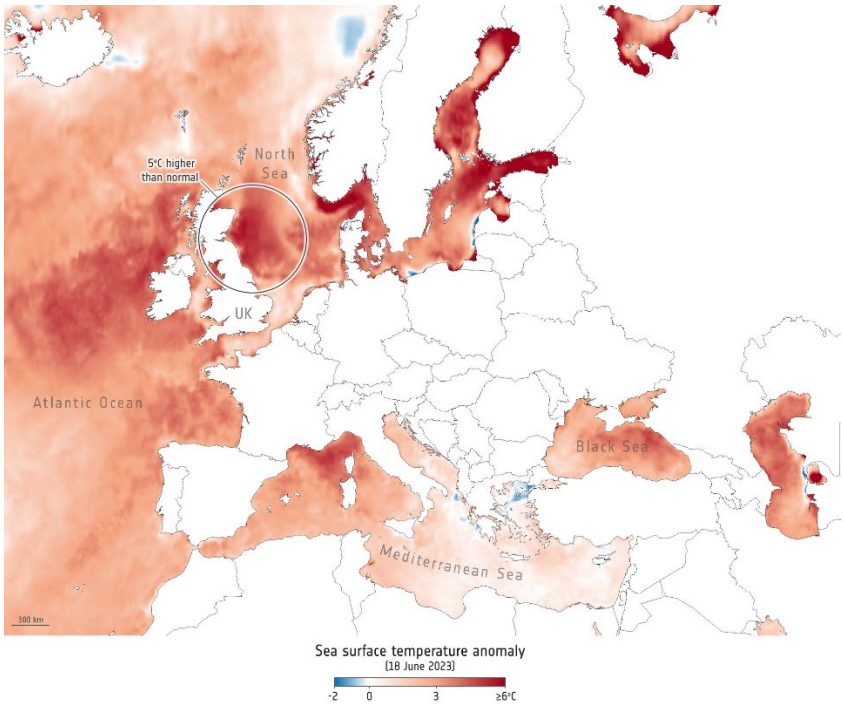
Francis Daunt

Potential to incorporate external shocks into assessment tools

Within PrePARED, empirical findings will be used to enhance the data and tools used in EIAs and CIAs. These tools aim to capture variability and uncertainty. However, their ability to do this is itself variable with many current knowledge gaps. A key priority which has been highlighted is to improve the quantification of uncertainty and variability. PrePARED is exploring how external shocks such as avian flu and marine heatwaves can be incorporated quantitatively into assessments. Uncertainty and variability in the assessment of the impact of OWFs on seabirds includes systematic uncertainties (e.g., uncertainty in the value of model parameters, the structure of the models themselves, variability in the language used in decision making) and natural uncertainties (e.g., variability between individual animals, and environmental variability).

Quantifying OWF Impacts

- Offshore windfarms may impact populations via direct mortality (e.g., through collision) or indirect effects on mortality and productivity (e.g., through displacement and/or disturbance).
- Impacts can be quantified through mechanistic models or simpler approaches that encapsulate expert judgement.
- External shocks may alter baseline characteristics (e.g., spatial distributions, population sizes, flight heights, foraging ranges) and alter the spatial interactions between individual animals and OWFs.



An example of an external shock. The marine heatwave experienced in Year 2 of the PrePARED project, June 2023. Image courtesy of the European Space Agency.

EIA Tools - Population Viability Analysis

- These tools are used to evaluate long-term consequences of annual and/or sub-annual effects for a population.
- They are used to generate baseline simulations and simulations of the population when impacted by an OWF and these two simulations are compared using a range of different metrics.
- PVA models attempt to account for variability both in individuals and their behaviours as well as in the environment within which the population operates.
- External shocks may modify the effects OWFs have on individuals, increase levels of short-term variability and introduce long-term shifts in demography.
- Standard PVA models (such as the NE/JNCC PVA Tool for seabirds), assume environmental variability is independent from year to year and that the distribution of the variability is the same each year.
- This may provide a plausible assumption in the context of transient external shocks, but not in the context of longer-term changes. Work is underway across a range of research projects including PrePARED to understand and quantify systematic changes in baseline demography over time and the effects of shocks that may persist across multiple years (e.g. avian flu), and to account for these effects within the models used in EIAs

Next Steps

- Uncertainty and variability are explicitly considered within a range of assessment tools currently used to assess the impact of proposed OWFs. These include SeabORD, iPCoD and DEPONS.
- There are important gaps and limitations in the way this is currently done, but projects such as PrePARED are helping to overcome these limitations
- This work will provide mechanisms by which external shocks can be incorporated into the quantification of impacts, and associated uncertainties.

PrePARED Contact

Adam Butler

Research Results

Two talks at AKEM24 presented preliminary results from research which will form the basis of future PrePARED Output Summaries.

Environmental and Habitat Similarity

The first considered how the study regions being used in PrePARED (i.e., the Moray Firth and the Forth and Tay regions) compare in terms of habitat types and environmental conditions with other regions of the northwest European shelf seas. This analysis will demonstrate the relevance of PrePARED results to other regions of UK and European waters.

PrePARED Contact: Samuel Gierhart

Transferability

A second talk addressed the critical question of how results from science projects such as PrePARED are transferred into the consenting and decision making process. The concept of "evidence bridges" was introduced and discussed. This talk will form the basis of a future PrePARED report.

PrePARED Contact: Cormac Booth

The Policy Context

AKEM24 concluded with presentations from the Scottish Government Marine Directorate describing the licensing and consenting process in Scotland, as well as the planning context. Further details can be found in the following links:

- Marine licensing and consenting in Scotland
- Marine licensing and consenting in Scotland (Guidance)
- Marine licensing and consenting in Scotland (Fact Sheet)

- Marine planning in Scotland
- A blue economy vision for Scotland
- Scotland's National Marine Plan
- Scotland's National Marine Plan 2

- NatureScot Offshore Wind advice

Contact us

Email

PrePARED@gov.scot

Social Media

#PrePAREDProject

Website

https://owecprepared.org/