OWSMRF Scope of Work

Review, modelling and trials of annual monitoring for Manx shearwaters and European storm-petrels

(Research Opportunities 4.2 and 4.3a)

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Contents

Definitions

Response rate:

This can be defined in a number of ways but in this context response rate is defined as the rate at which individuals respond to tape playback. For Manx shearwaters (*Puffinus puffinus*), this is carried out by playing a recording down each individual burrow, whereas during storm-petrels surveys playing calls along a transect within sample areas of habitat as an index of density of occupied breeding sites.

Extrapolation:

Carrying out tape playback surveys is time consuming and therefore can very rarely be carried out across an entire island, checking every burrow or area of suitable habitat. Therefore alongside surveys of sample plots or transects, the total area of suitable habitat is estimated for each species and responses (and therefore population size) can be scaled up to the entire colony/island.

Response rate calibration:

Calibration is required to account for individuals that do not respond to playback and for those responses that are not detected by providing a correction factor (1/detected response rate). Correction factors are calculated using a sample plot where burrow occupancy can be manually checked alongside playback methods.

1 Background

Offshore wind farm developments are a key part of the transition to renewable energy generation as the UK seeks to meet its target of reducing greenhouse gas emissions by 78% by 2035 and achieving Net Zero by 2050. These ambitious targets will see the rapid expansion of offshore wind developments in the UK and the geographic spread is set to increase around the west coast of the UK as well as further offshore with the advent of floating wind. However, there is still considerable uncertainty around the potential negative impacts on the marine environment, and seabirds in particular. All developments must undergo a series of steps to assess the potential impacts of each project; these include Habitats Regulations Assessment (HRA) and Environmental Impact Assessment (EIA). EIAs assess impacts to the wider environment, whilst HRAs assess whether a plan or project will have an adverse effect on a site protected under The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019, The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2019, the Conservation (Natural Habitats, &c.) (Northern Ireland) Regulations 1995 (as amended), and/or The Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended).

As the targets for offshore wind energy generation increase, there is an ever-growing likelihood that the cumulative effects on wildlife, and in particular birds, will reach unacceptable levels. If this is the case for Manx shearwaters and European storm-petrels (*Hydrobates pelagicus*), there is the potential for there to be a significant consenting risk to developments. Particularly for these species, much of the risk is associated with substantial knowledge gaps and legislative requirements to apply the precautionary principle, and although in recent years research has sought to improve understanding of some aspects of seabird behaviour, significant gaps remain. These gaps are caused in part by difficulties associated with monitoring nocturnal, burrow-nesting species at their colonies, a poor understanding of how these species, especially storm-petrels, use the marine space, and their relatively recent consideration in offshore wind farm (OWF) impact assessments. In order to combat this risk, meaningful assessments of in-combination effects need to be undertaken. These assessments rely on a good understanding of the ecology and behaviour of birds, including behaviour in response to windfarm developments.

The Offshore Wind Strategic Monitoring and Research Forum (OWSMRF) initially (in the pilot year 2020-2021) identified black-legged kittiwake (*Rissa tridactyla*) as a priority species and produced three Knowledge Gap (KG) 1, 2 & 3 reports. The focus of the OWSMRF Continuation phase has turned to Procellariiformes, specifically Manx shearwater and European storm-petrel. These species were selected by Key Stakeholders due to the geographic expansion of offshore wind developments to coincide with the distribution of shearwaters and storm-petrels in the north-west and west coasts of the UK, particularly in the Celtic/Irish seas and north-west coast of Scotland. The KG4 report (Baker *et al.* 2022) identified three main areas of uncertainty that are likely to cause consent risk to future offshore wind developments:

- Population abundance and trends;
- Demographic rates;
- At-sea distribution and behaviour.

The ecology and behaviour of Manx shearwaters and European storm-petrels make them particularly difficult to monitor, and therefore even basic information is lacking for some colonies and regions. As part of the assessment process, information on breeding distributions, populations and demographic rates is essential to make appropriate estimates of potential impacts of offshore wind farms (OWFs) on relevant populations or colonies. Whilst information on how birds use the marine environment during the breeding season (March-September) can be used to apportion predicted mortality rates at an OWF to relevant

colonies or populations, estimates of demographic rates, breeding population sizes and trends will inform the predictions of population-level impacts.

1.1 Uncertainty around population estimates of nocturnal burrow-nesting seabirds

Current breeding population estimates are thought to represent the most accurate and robust counts ever made in the UK. However, they are caveated with very large confidence intervals, which are associated with logistical and analytical challenges in the tape playback method (Perrins *et al.* 2020). These confidence intervals are caused by uncertainty in some parameters required for estimating the breeding population size of these species, such as response rate to playback calls or area/extent of suitable breeding habitat. Since Manx shearwaters and storm-petrels are nocturnal and nest in burrows, it is not possible to conduct colony counts using visual observations. Breeding number estimates are currently made by exploiting their vocal nature at the colony and playing calls and or songs down individual burrows in sample areas, calibrating for different rates of response and extrapolating up to whole colony or island levels (Perkins *et al.* 2017; Perrins *et al.* 2020).

Tape playback is the most commonly used method for population monitoring of Manx shearwater and European storm-petrel. Both field and analytical methods have been refined and improved over time to try and reduce uncertainty in breeding population estimates (Perkins *et al.* 2017). Evidence has shown that response rates can differ between sites, habitats and between males and females, and can vary with the geographic origin of the song/call played (Perrins *et al.* 2012; Perkins *et al.* 2017; Soanes *et al.* 2012). When it comes to extrapolating counts from sampled plots/transects to whole island counts, other sources of uncertainty, such as undefined colony extent, response detection and variation in nest burrow density between habitats, are likely to affect the precision of count estimates (Inger *et al.* 2022).

In addition to the lack of understanding around some key components of Manx shearwater and storm-petrel ecology and behaviour, such as survival rates, breeding success and sabbatical rates, and how some of these parameters may vary between colonies or sub-colonies, there is also significant uncertainty about the potential impacts of offshore wind at an individual and population level. There are a variety of pathways by which shearwaters and storm-petrels could be affected by OWFs, including displacement, collision and barrier effects (for further information on impact pathways see Deakin *et al.* (2022) report undertaken by Marine Scotland Science.

Estimating the magnitude of these impacts with confidence strongly relies on sufficient data and understanding of the ecology of the species in question, which is typically lacking in the offshore space. As the rate of offshore wind development accelerates and expands geographically, any improvements in the quality of colony count data will have significant benefits on OWF impact assessments. Robust and accurate population estimates are vital for use in impact assessments, including modelling of predicted population trajectories in response to potential impacts of offshore wind developments, as routinely done using Population Viability Analysis (PVA). PVA relies upon previous and/or current colony census and survey data in order to make predictions of future breeding number trends; therefore improving confidence in input parameters will provide more realistic and robust outputs.

1.2 How can uncertainty in population estimates be reduced to help produce meaningful OWF impact assessments in the short-term?

Baker *et al.* (2022) described a number of Research Opportunities (ROs) that could work towards improving our ability to accurately estimate population sizes and trends for Manx shearwaters and European storm-petrels.

These ROs fall into three main categories:

1. Review and analysis of existing knowledge and datasets;
2. Improving existing methods and exploring novel ideas;
3. Collecting more data.

The collection of more colony count data is likely to be a long-term aspiration, particularly when considering the monitoring of population trends of long-lived seabird species, for which several years of data are needed (> 5 years at least), or if monitoring is to be extended to new sites. The current programme of UK-wide population counts of seabirds is carried out every 15–20 years, so any further data on population estimates and trends is not likely to be available in the short term, at least at a regional scale, to inform upcoming OWF impact assessments in the Celtic/Irish Seas.

Developing, trialling and rolling out new methods for population estimation and monitoring, or trying to improve on less well understood existing methods such as acoustic/infra-red camera monitoring may be feasible at sites that are regularly monitored (as part of the Seabird Monitoring Programme; SMP). Once a method that is applicable and efficient has been identified, it could be rolled out to a number of sites relatively quickly to allow more frequent monitoring between census counts, although investment in development and testing would be necessary and therefore unlikely to provide immediate benefits to OWF impact assessments. Extending these methods to the UK-wide censuses without increasing the frequency at which they were conducted may only produce results over an extended period. These would be a medium- to long-term aspiration and would only be widely deployed if trials demonstrate that they could/would provide more robust population estimates.

The key benefit of this piece of work would be to make use of existing data and knowledge to deliver quick results. Improving current methods that are already used regularly and have undergone continuous improvements in recent years (e.g. tape playback), particularly when that can be done using existing data, could provide meaningful results in the short term (1–2 years). Analysis or re-analysis of recent and historic datasets can help identify the main factors explaining uncertainty in population estimates, evaluate their relative importance and also ensure that overall levels of uncertainty are realistically and consistently captured in population estimates. This sort of work could then be used to develop best practice guidance on survey techniques and data analysis for both colony monitoring and whole colony counts, which could be implemented fairly quickly for some of the well-studied sites, or in the longer term for others.

The OWSMRF Developer Group have asked JNCC to produce a detailed scope of work around this topic. This scope of work synthesises and elaborates on the ROs (RO 4.2 and 4.3a) identified in Baker *et al.* (2022) by providing a more detailed set of aims and objectives, possible methods and any other aspects that may be included or considered. It should provide the information that is required in order to draft an invitation to tender.

2 Aims and objectives

The overall aim of this scope of work is to evaluate and explore the best methods for monitoring breeding populations of Manx shearwaters and European storm-petrels, identify the key drivers of uncertainty in population estimates, refine population estimates using existing data and modelling, and make recommendations for future monitoring or methodological improvements.

This scope of work will seek to explore how current methods of estimating population sizes for this group of species can be improved, so that more frequent, robust and representative monitoring can be carried out. This can then lead to an improved evidence base where future work can be directed, with potential to lead to substantial reductions in uncertainty around currently available population estimates. These outcomes would be of significant benefit to the offshore wind industry as new developments begin to include these species in impact assessments.

While this scope of work will initially review various possible methods of estimating population size of shearwaters and storm-petrels, the focus work will largely be on the tape playback monitoring technique.

Four objectives are described below.

2.1 Objective 1

What methods are available for monitoring population abundance and trends of Manx shearwaters and European storm-petrels, what are the main priorities and opportunities?

Review of current understanding of population estimates and trends, review of all potential sources of uncertainty (methodological and environmental) and critical evaluation of methods for collecting population count data, including assessments of available datasets and consideration of methods most appropriate for a variety of sites. This could include a workshop with various stakeholders/managers to gain the best understanding of the challenges of different field settings and analytical methods. Additional insights in planning, undertaking and resourcing surveys would be collected to inform future monitoring.

2.2 Objective 2

Can existing datasets be analysed or re-analysed to identify sources of uncertainty when estimating population sizes? Can estimates of response rate and population size be improved by accounting for the potential influence of key variables?

Focussing on the tape playback method, identify the key sources of error and variation in each stage of data collection, calibration of response rate and extrapolation, and produce a list of important data and knowledge gaps to be filled. Where sources of uncertainty are identified, they should be reviewed to understand how this is conveyed to estimates of population size and the biological/ecological mechanisms that cause this. Uncertainty in response rate and colony extent could then be reduced by integrating analysis of existing colony survey data with other available data that may be influencing confidence (for example environmental or topographical variables), which may ultimately lead to refined estimates of population sizes for some of the key monitoring sites. Where uncertainty in input variables cannot be minimised, it is vital that uncertainty is incorporated appropriately into analyses and population estimates consistently.

2.3 Optional: Objective 3

Can collecting field data on key predictors of response rate, identified through modelling, validate models and refine population estimates?

Targeted data collection of topographical and/or environmental data at colonies where population monitoring is also carried out to test model predictions and reduce uncertainty in population estimates.

2.4 Objective 4

Reporting of review and modelling outcomes and providing recommendations for future monitoring work

Deliver outputs of previous Objectives and make recommendations for how to apply the outcomes to future methodological development, data collection and/or analysis.

3 Detailed tasks

The Project would involve a series of tasks in order to meet the objectives listed above.

3.1 Objective 1: Review of current data on population estimates and monitoring methods for Manx shearwater and European storm-petrel

Review of published and grey literature, reports and databases to identify the methods currently used for data collection and analysis. This review should include studies and monitoring undertaken in the UK and on the specific species in question but should also extend to other countries and sympatric species (nocturnal, burrow-nesting shearwaters and storm-petrels) that are monitored in the same way. This should build on the review conducted by Baker *et al.* (2022) and the review commissioned by Marine Scotland Science (Deakin *et al.* 2022), but should go further to include:

- Existing estimates of any/all colonies of Manx shearwaters and European storm-petrels in the UK.
- Methods used for field data collection of existing UK populations estimates.
- Methods used to analyse data (e.g. response rate calibration, extrapolation).
- Identification of all potential sources of uncertainty, both methodological and environmental, and how sources of uncertainty are incorporated into analysis.
- Alternative methods for data collection.
- Survey design for each survey method.
- The application of representative sample plots as a proxy for full colony/island counts.
- Challenges and constraints associated with data collection, specific to each method and also with different locations/habitats/colonies.
- Types of data collected (e.g. number of individuals, pairs, occupied burrows).
- How data are stored, data ownership, availability.
- Consideration of the logistical/resource requirements for carrying out monitoring across a variety of islands/colonies, including cost-effectiveness and assessment of factors that would need to be accounted for when planning surveys.

The review should also include an assessment of the datasets that are available, either publicly or privately, which would rely on engagement with data holders. Engagement would also be essential to identify and collate challenges, constraints and opportunities throughout the UK and across various land managers and organisations. How this is done can be defined by the bidder but could take the form of a questionnaire or workshop.

The focus of this objective should be to address key questions:

- Do we currently have a good understanding of census/monitoring techniques?
- What monitoring is being undertaken outside of the UK-wide censuses?
- Are the most appropriate techniques being used in suitable contexts?
- What are the key strengths and weaknesses for different sampling and modelling approaches?
- Are there techniques that are currently under-utilised or are there opportunities for development of certain approaches? This should highlight areas in which most value could be added.

A significant portion of the review should focus on population monitoring conducted using the tape playback method as this is the most commonly used method in the UK. The review should also include how methods can be refined and where improvements can be made.

3.2 Objective 2: Making use of existing data to identify sources of uncertainty when estimating population sizes

This Objective would build on the outcome of Objective 1 and will be undertaken in two stages.

3.2.1 Stage 1: Collation and re-analysis of existing survey data to identify sources of uncertainty in population estimates

Once the challenges and constraints have been recognised for a variety of circumstances (Objective 1), the potential sources of error when estimating population size can be identified. Depending on the availability of data on some of these factors on islands where colony datasets are available (identified as part of Objective 1), a sensitivity analysis could be undertaken to determine the factors that contribute the greatest uncertainty in population estimates, which may differ between colonies and islands. This stage will focus on the tape playback method of estimating populations, with an emphasis on response rate, but also considering other monitoring stages such as calibration and extrapolation.

Alternatively, in the absence of sufficiently good quality datasets (e.g. sample sizes and methods used), the outcome of the review from Objective 1 could be used to produce a qualitative or semi-quantitative assessment of the potential relative importance of a range of predictors. This would allow the testing of hypotheses and the ranking/prioritisation of areas of research that would need further improvement to refine response rates and hence population estimates.

3.2.2 Stage 2: Integrating analysis of existing monitoring data with data on influential variables

This stage will identify the aspects of the tape playback monitoring technique that may be refined with the inclusion of further ecological/biological/environmental data to improve confidence in population size estimates. Accounting for influential variables in different stages of the population estimation process, including when estimating response rate and

scaling up from sample plots to whole island/colony counts (extrapolation), should improve our ability to estimate population size accurately.

Evidence from existing surveys and monitoring have demonstrated that some environmental and topographical factors can influence tape playback response rate (these factors may be different for Manx shearwaters and storm-petrels) and make it challenging to define colony extent, both of which can affect practitioners ability to extrapolate from survey plots to whole-island population estimations. Where data on environmental and topographical variables exist (e.g. habitat mapping and drone imagery have been carried out on Skomer and Rum), these could be incorporated for example into modelling of response rate and habitat suitability analyses. This would allow both: quantification of the relative contribution of a range of environmental and topographical factors in driving variation in tape playback response rate; and assessment of the extent of suitable breeding habitat on a given island to improve confidence when extrapolating sample plot counts to whole colony or island population estimates.

3.2.2.1 Modelling of response rate

Habitat type (boulder-field, wall, grassy slopes) may impact the observer's ability to elicit a response, hear a response or accurately identify the source of a response (detection probability). Burrows on grassy slopes tend to be longer than in other habitat types and therefore the bird may be less likely to hear the tape and respond or a response may be harder to detect, this may also be the case for different soil types, they may be longer or shorter depending on the soil composition. In some areas where nests are at high density there is also the potential to underestimate occupancy if multiple birds respond at once, for example if there is more than one nest under a boulder or accessed by a single burrow entrance.

3.2.2.2 Habitat suitability analysis

For both Manx shearwaters and storm-petrels there are a variety of potential habitat types in which they may breed, including some very cryptic habitats such as deep fissures in peat covered by dense vegetation (Bolton *et al.* unpublished). The difficulties associated with defining colony extent were highlighted during the Seabirds Count by observers on Rum and during counts of storm-petrels on St Kilda (Deakin *et al.* 2021; Inger *et al.* 2022). Undertaking habitat suitability analysis, based on existing data collected during previous censuses and counts, will allow practitioners to assess the extent of suitable breeding habitat. Improving understanding of habitat extent will reduce uncertainty during the extrapolation stage of population assessments by allowing more accurate scaling-up of results from sample plots. It is likely that colony factors such as density may also be linked to habitat type and may impact our ability to accurately extrapolate from sample plots to the wider area.

It should be considered that predictors of response rate and colony extent/density are likely to vary between colonies or islands and be different for Manx shearwaters and European storm-petrels.

3.2.2.3 Considerations for modelling stages

These stages would rely on the availability, extent and quality of existing data to conduct such analysis with. This is likely to be restricted to a small number of colonies and it may therefore reduce the ability to identify key sources of error for a wide variety of colonies and islands. The likely sources of data would be islands such as Skomer, Skokholm and Rum for Manx shearwaters and Auskerry, Mousa and St Kilda for storm-petrels, where long-term

datasets exist, and the breeding populations are better understood than some other sites. A number of these colonies are located within the Irish/Celtic Seas and off the west coast of Scotland, from which the at-sea distribution of birds (both Manx shearwaters and European storm-petrels) breeding at these colonies is likely to overlap with planned offshore wind developments (ScotWind, Round 4 and in Irish waters). Improving the estimates of population size at these locations will make vital contributions to impact assessments and are likely to reduce consent risk. This initial analysis could act as a trial, which could then be rolled out to other colonies when more data become available.

If modelling identifies that there are certain variables that are good predictors of response rate and/or colony extent, and contribute to improved population estimates, further work could then be undertaken. Where these data exist, these predictors could be accounted for in models (Objective 2) to refine population estimates, which would then lead to reduced uncertainty in impact assessments. Where data do not exist, a further stage could be carried out, targeted data collection at key sites to test the predictors and further refine population estimates (see Objective 3).

The outcomes of the modelling and or analysis conducted as part of this Objective will help identify the main data and knowledge gaps that need to be filled in order to reduce uncertainty in population estimates. These will then feed into the recommendations from Objective 4, which will help prioritise evidence needs for future monitoring.

The methods for conducting the modelling and/or analysis under this Objective can be discussed with the Contractor(s) but should be designed to identify the sources of error and help improve current analytical methods or inform data collection.

3.3 Objective 3 (go/no-go based on Objective 2): Targeted data collection of key topographical or environmental variables

This Objective is dependent on the outcomes of Objective 2. If Objective 2 identified topographical or environmental variables that can explain significant levels of uncertainty in population estimates, and for which site-specific data is lacking from well monitored colonies, targeted data collection could be carried out to improve model parameterisation and test the power of the predictors. The nature of some of the variables being collected mean that only one set of data collection may be needed at a given colony/sample plot (e.g. soil depth, soil type, habitat type, slope, burrow length) and could be conducted relatively quickly (although this will depend on colony accessibility, which may be restricted due to HPAI. Which variables are being assessed and the impact of annual variation (e.g. weather conditions) would need to be considered). There may be instances, depending on the variable, where ground-truthing would be required, for example if drone/satellite imagery is used to characterise habitat types.

3.4 Objective 4: Reporting outcomes of Objectives and developing best practice guidance for undertaking monitoring, and refining estimates, of Manx shearwater and European storm-petrel breeding populations

A group of experts in Manx shearwater and storm-petrel ecology have developed a guidance document which provides advice on population monitoring techniques (Bolton *et al.* unpublished). It is envisaged that this last Objective would build on this work to include recommendations about how to reduce uncertainty in response rate and population size estimates based on the outcome of the review and modelling of existing data. This would

include recommendations on what additional variables (e.g. environmental and topographical variables) should be gathered alongside population data to refine population estimates. This stage could also make recommendations on how to best incorporate uncertainty into analyses and population estimates where it cannot be minimised by improving confidence in input variables.

Based on the outcome of this work and the recommendations already developed by Bolton *et al.*, technical guidance, or a toolkit, could be developed to provide practitioners with a framework from which to select the most appropriate methods for specific monitoring scenarios. The toolkit could be tailored to provide recommendations for different circumstances (colony type, location, etc.) as well as accounting for time and resource restrictions.

4 Outputs

It is envisaged that the main output would be a report, composed of the following three parts:

1 **Review** detailing the current knowledge of all possible monitoring methods for nocturnal burrow-nesting species that could feasibly be applied to Manx shearwaters and European storm-petrels. This should include a review of available data and where possible collation of such data. To complete the review, the Contractor(s) would be expected to engage with experts and stakeholders to gain an overview of the challenges, limitations and opportunities associated with historic, current and potential future monitoring work.

2 **Results of modelling/analysis to**:

- Identify sources of error in the tape playback methodology when estimating population sizes for Manx shearwaters and European storm-petrels and evaluate the relative importance of a range of predictors in the different stages of the population estimation process. This could include, for example, detailed analyses/modelling of the influence of environmental and topographic variables on response rates and colony extent.
- where data exist, produce updated population estimates that account for both the influence of the key predictors identified and appropriate levels of uncertainty.

3 **Recommendations** to inform future monitoring based on information/data collated under Objective 1 and the outputs of the modelling exercises from Objectives 2 & 3, and to inform best practice analytical approaches to ensure that uncertainty is consistently captured in population estimates.

5 Timescale

It is expected that this work will take approximately nine months to complete. An indicative timeline is provided below, but this is to be confirmed, and we would require detailed timelines in the form of a Gantt chart from bidders. Sufficient time for meaningful engagement with a steering group and wider stakeholders and to act upon recommendations from the steering group should be included in any proposed timeline.

- Week 1: Start-up meeting and establishment of a project steering group.
- Weeks 2 to 10: Literature review and contact experts/data holders, progress meeting.
- Weeks 10 to 15: Analysis of existing data to identify sources of error.
- Weeks 16 to 25: Modelling of key predictors data, draft report of model outputs, progress meeting.
- Weeks 26 to 32: Expert review of draft outputs.

- Weeks 33 to 35: Final outputs and project close

Contingency can be built into the timescale of this work if the outputs of the modelling work suggest that further data collection through fieldwork is required. The time required for field data collection will depend on the sort of data that is needed, as well as time of year as some data may need to be collected in the breeding or non-breeding seasons (non-breeding season field work would be restricted to environmental/topographical data collection).

6 Contractor requirements

Successful contractors would need to demonstrate a comprehensive understanding of nocturnal, burrow-nesting seabird ecology and the challenges associated with planning, undertaking and analysing data on population estimates. This understanding must include the deployment and analysis of the tape playback monitoring method which is currently the best understood and most commonly used way of making population assessments of shearwaters and storm-petrels in the UK. They should also have a background in undertaking statistical, biological and/or ecological modelling, with the expertise to carry out, interrogate and interpret complex analyses.

Also, the contractor should have the ability to identify and approach appropriate organisations, institutions, ecological consultants and other experts (e.g. within SNCBs and NGOs) across the UK in order to gather the required information and data for analysis.

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