OWSMRF Scope of Work

Co-ordinated, strategic GPS tracking programme: multiple colonies

(Research Opportunity 1.2)

This document should be cited as: JNCC. 2022. OWSMRF Research Opportunity 1.2: Co-ordinated, strategic GPS tracking programme: multiple colonies. Joint Nature Conservation Committee, Peterborough.

Contents

1 Background

Offshore wind farms (OWF) are seen as a key part of efforts to combat climate change (Snyder & Kaiser, 2009). However, there are a number of concerns about the potential for these wind farms to have a negative impact on wildlife and biodiversity, particularly in relation to birds (Drewitt & Langston, 2006; Gibson *et al*., 2017). To inform the planning process of the potential impacts of the effects associated with wind farms, new proposed developments require detailed Environmental Impact Assessments (EIAs) and Habitats Regulations Appraisal (HRA). 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 number of wind energy developments increase globally both onshore and offshore, the potential associated environmental impacts are receiving considerable attention, particularly avian impacts. This is of particular concern at the cumulative scale (i.e. considering impacts of wind farms combined rather than of individual developments in isolation). As the scale of offshore wind farm development expands, the risk of reaching unacceptable levels of cumulative impacts increases. In order to undertake meaningful cumulative impact assessments, there is a need for improved understanding of how birds respond to offshore wind farms and how to quantify the risk to populations of concern. Without such information, decision making is necessarily precautionary, and there is a risk that offshore wind farms may not be deployed at sufficient scale to contribute fully to emission reduction targets and ambitions.

The Offshore Wind Strategic Monitoring and Research Forum (OWSMRF) Pilot Year identified uncertainty around in-combination and cumulative impacts of offshore wind development on black-legged kittiwake (*Rissa tridactyla*) populations posed the greatest consent risk (https://jncc.gov.uk/our-work/owsmrf/). Three knowledge gaps (KG) to inform cumulative/in-combination assessments for black-legged kittiwake were identified:

- KG1: reducing uncertainty around estimates of windfarm collision mortality
- KG2: improving understanding of connectivity between OWFs and SPAs
- KG3: improving confidence in modelling population consequences of wind farm effects

As part of the impact assessment process, the likely effects (e.g. collision, barrier effects and/or displacement effects) of a planned offshore wind farm on birds are estimated (KG1). Once the magnitude of these effects has been estimated, it is necessary to understand which SPA colonies (if any) and wider populations these affected birds originate from (KG2). Finally, the potential SPA (for HRA assessments) and/or wider population (for EIA assessments) response to these OWF effects (i.e. reduced productivity or increased mortality) are assessed using population modelling (KG3). Data to inform this process are frequently scant, leading to high uncertainty in magnitude of effects and a lack of confidence in predicted population response to effects.

1.1 Estimating effects of OWFs on kittiwakes

The main pathway of effect for kittiwakes and OWFs is thought to be mortality from collision with moving rotor blades. At present, there is little empirical evidence for collision rates at offshore wind farms (although see Skov *et al*., 2018 for an example). Further, given the importance in turbine design and numbers, as well as bird factors such as breeding status, behaviour, and season when estimating collision risk, estimates from one wind farm do not directly translate to a different wind farm. Therefore, proposed wind farm developments use

collision risk models such as Band (2012) and its stochastic implementation (Masden, 2015; McGregor *et al.,* 2018), to estimate the number of collisions expected. The collision estimates are sensitive to input parameters, particularly several related to bird behaviour, which are difficult to measure and have a high degree of uncertainty associated with them. This leads to high uncertainty in individual wind farm project estimates of collision mortality, which is further exacerbated when assessing cumulative levels of collision across projects.

Black *et al.* (2019) described several research opportunities (ROs) which could improve the evidence base for understanding collision effects of offshore windfarms on black-legged kittiwake. As part of the OWSMRF Continuation work, the OWSMRF Developer Group (DG) has asked JNCC to produce a detailed scope of work for RO1.2, as described in Black *et al*. (2019). This scope of work will provide additional detail regarding the project aim and objectives, possible methods that might be anticipated and aspects that would be included or considered. It should provide the information that is required in order to draft an invitation to tender and to judge the quality of applications, should OWSMRF or others wish to proceed with this project.

1.2 Tracking of kittiwakes

Tracking studies offer vast improvements in our understanding of in-flight behaviour of kittiwakes and risk of collision with offshore wind turbines. GPS tracking, when deployed with multi-sensor devices, can provide information such as flight height distributions, flight speeds, behavioural changes within/outside wind farms, and potentially avoidance rates to be able to parameterise collision risk models. Fine-scale movement data will provide valuable insights into how kittiwakes interact with turbines, offering evidence-based assessments of avoidance behaviour. Better estimates of variability and uncertainty can then be used to improve stochastic collision risk models.

There is also a need for better understanding of spatial and temporal variation in behaviour and distribution of kittiwake in order to understand seasonal variation of key parameters for assessing collision risk, such as flight heights and speed as well as changes in density and nocturnal behaviour. Data collected throughout the year, for instance via long-term tag attachment methods, could help achieve this. A coordinated programme, with data collected in a standard format allowing collective data analysis, would also aid in understanding how behaviour evolves spatially and temporally, particularly over the course of a wind farm development.

In addition, at-sea distributions will help understand linkage between colonies and some potential wind farm footprints or zones would be provided through these tracking studies, further aiding KG2 (improving understanding of connectivity between OWFs and SPAs; Black & Ruffino, 2019).

Current GPS tracking of kittiwakes is limited to the 2–3 weeks that short-term attachment techniques (e.g. using glue to attach tags to birds' backs) allow, and has therefore only been deployed on breeding adults in the late stages of the breeding season (birds then have a high probably to return at the nest where data can be downloaded). However, other attachment methods such as harnesses have the potential to allow tracking for longer periods of time (e.g. laying to fledging, non-breeding season) and offer a promising method for tracking juvenile and immature birds too before they recruit to their new breeding sites. Data collected from outside the chick-rearing season, and on juveniles and immatures, will further allow us to understand how transferable existing tracking data from chick-rearing adults are to early breeders and non-breeding kittiwakes.

Harnesses have been used to track birds for a number of years across a range of species. However, the suitability of harness attachment methods appears to vary by species (Mallory

& Gilbert, 2008; Thaxter *et al*. 2014; Thaxter *et al*. 2015). Tagging studies on kittiwakes have in the past shown some negative effects, e.g. to in-flight activity and foraging trip duration (Cleasby *et al.*, 2020) and time spent flying (Chivers *et al.*, 2016); therefore the use of tags and attachment methods needs to be carefully assessed, particularly where long-term studies are considered.

RO1.2 aims to undertake a programme of co-ordinated strategic tracking across multiple kittiwake colonies in order to give a better understanding of spatial and temporal patterns in behaviour and how these may influence collision risk. The work described under this research opportunity within Black *et al*. (2019) is broken down into three parts: a trial of harness attachment methods, a review of existing and planned kittiwake tracking efforts and formation of a strategic plan for complementary studies, and finally UK roll-out of tracking studies over multiple colonies and years.

2 Aims and objectives

The primary aim of strategic kittiwake tracking across multiple colonies is to improve the understanding of spatial and temporal patterns in kittiwake behaviour and how this may influence collision risk. The key ecological aspects this project aims to investigate are how key in-flight behavioural parameters that contribute to collision risk vary between individuals, age classes, seasons, and years, as well as any behavioural differences throughout the development stage of a wind farm.

2.1 Aim

The aim of this work is to plan and undertake strategic tracking of black-legged kittiwake across UK colonies with standardised data collection methods in order to help understand the spatial and temporal patterns in kittiwake behaviour, as well as at-sea distribution, and hence reduce uncertainty in OWF collision risk estimates.

2.2 Objective 1

How feasible and suitable are harness attachment methods for kittiwake? Which tracking technologies are most suitable? This includes:

- Review of harness trials carried out (including ethical/welfare considerations e.g. tag effects), assess whether/what further trials/methods are required;
- Harness trial on kittiwakes if required;
- Review tracking technologies available to determine the best combination of sensors/devices required to answer the research questions.

2.3 Objective 2

Generation of a deployment plan of strategic studies and guidelines for data collection. This will be based on the outcome of Objective 1 and whether kittiwake harnesses are suitable and can be used or other attachment methods will be required. This includes:

- Review of existing and planned kittiwake tracking studies to understand what data other studies are/will be producing, what the current knowledge gaps are, and the data needs to address our key questions;
- Assessment of the scale of deployment required to obtain reliable data to address key questions around spatial and temporal changes in behaviour;

- Identification of suitable colonies and data requirements to ensure that data analysis is comparable, across both short-term and long-term attachment studies. Produce a plan for UK-wide, multiple year tracking studies, including data requirements and guidelines.

2.4 Objective 3

UK roll-out over multiple colonies and years. This includes:

- Deployment of, ideally, harness-mounted devices to collect data over a longer period including the non-breeding season;
- Coordination of multiple studies and data management.

3 Detailed tasks

3.1 Objective 1.1: Review of kittiwake harness trials

A review of kittiwake harness trials previously carried out to determine whether there is a consensus on suitable attachment methods and materials, for breeding adults but also juveniles and immature birds. An assessment of whether further trials, using methods previously trialled or new methods, are required.

3.2 Objective 1.2: Kittiwake harness trial

If required, trial harness attachment method(s) identified from the kittiwake harness review, and report on the suitability of the technique(s) trialled. Make recommendations for wider roll-out of harnesses on kittiwake. Should harnesses not be suitable for kittiwake tracking, other attachment methods should be recommended.

3.3 Objective 1.3: Review of literature on tracking technologies

A review of published and grey literature to identify tracking technologies which have been deployed to infer kittiwake flight behaviour (particularly collision risk model parameters e.g. flight height, flight speed, fine-scale movements), and a description of the data which they gather, with their associated levels of accuracy and rates of success. These technologies would include for example the use of GPS tags, combined with barometers, altimeters and/or accelerometers. The logistical requirements of different technologies, such as the need to recapture birds to download data, or requirements of receiver stations should also be noted. The data that the technology collects and the behavioural characteristics that can be obtained, and its applicability to information relevant to collision risk should be assessed.

In addition, expert elicitation will provide additional detail and context that might not be available within literature. Experts would include:

- Institutions with experience in undertaking kittiwake tagging studies to better understand the intricacies of deploying different types of tags and logistical issues.
- Institutions with experience in undertaking large-scale seabird monitoring in order to better understand the requirements and issues associated with strategic monitoring carried out by multiple parties and approaches to ensuring comparable studies.

A clear audit of literature sources and experts contacted, with a link to the information provided by each source, will be required so that developers interested in hosting equipment can go to source for further detail if required.

3.4 Objective 2.1: Review of past, ongoing and planned kittiwake tracking studies across the UK

A review of past, ongoing, and planned kittiwake tracking studies within the UK describing the colony location and attributes, the tracking technology including various technical information, logistical requirements, sample sizes (e.g. number of tracked birds per colony, number of tracking days per bird and season, number of tracking years per colony), and behavioural parameters recorded with associated levels of uncertainty.

An assessment of the comparability of the data collection and data analysis of ongoing and planned tracking studies, along with the availability of the data.

As for Objective 1.3, expert elicitation will provide additional detail and context that might not be available within literature.

3.5 Objective 2.2: Analysis of study scale required

There are several aspects to any analysis of study scale that would need to be considered, including:

- numerical scale of deployment (e.g. the number of individuals and individuals within each age class to be tagged at each colony);
- tracking effort through time (e.g. duration of the study, number of person-hours spent tagging birds);
- tracking effort through space (spatial area covered by individual SPA tagging effort, spatial area covered by multiple SPA tagging effort);
- spatial and temporal requirement for overlap with current and future OWF development areas;
- rate of tag maintenance (e.g. resighting, replacement of lost or failed tags, retrieval of data, number and placement of receiver stations if required).

These aspects may be answered through for example a power analysis, gap analysis, or other technique, but is likely to be dependent on data available from past tagging studies. The best way to approach an analysis of study scale should be designed in consultation with experts. The analysis should assess whether previous studies have sufficient power to address our key ecological questions, and then propose the scale required for future studies.

The key ecological questions to be addressed by deployment are how the following dependant variables change with the independent variables. The analysis should therefore provide the scale of studies required to answer those questions.

Independent variables:

- season
- year
- SPA
- age class
- development stage of wind farm
- weather.

Dependant variables:

- behavioural parameters relevant to collision risk models
  - flight height
  - flight speed
  - movements within operational wind farms
  - behaviour and activities such as commuting and foraging
  - nocturnal activity
- kittiwake distribution
- overlap of kittiwake distribution and wind farm development areas (planned or operational).

Key behavioural parameters to be collected relevant to collision risk are flight height and flight speed. Other parameters could then be inferred from the data, such as density, distribution, avoidance behaviour, and nocturnal activity.

The outputs from this analysis of study scale would then inform the framework for individual and strategic tracking studies. This would be useful for the future studies set up within this coordinated monitoring, and also external studies to understand how sufficient study scale might be achieved. Depending on the outcomes of the previous tasks, it may be that both long-term and short-term tags are deployed, therefore the design of both studies will be optimised, as well as how to make data collection and analyses from both deployment types compatible for combined analysis.

3.6 Objective 2.3: Produce a plan for UK-wide, multiple year tracking studies, including data requirements and guidelines

Assess and prioritise the aspects of tracking studies that need to be standardised in order to make the results comparable and compatible for combined analysis. Generate a set of requirements and guidelines for tracking studies, including a standard for the types and format of data to be recorded, specific to the type of device and attachment method used, be it short-term or long-term deployment.

Generate a plan for strategic tracking studies using the outcomes of the study scale analysis to inform the scale of the UK-wide plan. The plan should consider colony location, size, access, and geography or location ‘type’ (e.g. direct access to open sea or enclosed). The deployment plan should provide information on which kittiwake colonies should be targeted to ensure good coverage of key areas of interest and ensuring good spatial coverage. The SPA colonies chosen to be studied should take into consideration the location of offshore wind development areas, such that potential changes in behavioural responses to wind farms and distribution can be investigated.

The plan should specify the number of kittiwakes to tag (adults and/or chicks) at each location each year, including the minimum number of individuals to be tagged to ensure data of sufficient quality are acquired. Issues with access to kittiwake nests at colonies should be described. Where tags need to be retrieved to obtain the data contained on them, recapture effort should be described. Where tags require receiver stations, the locations of these should also be described.

The deployment plan should also consider ongoing or planned kittiwake tracking studies and the compatibility of studies, in terms of both data collection methods, data format, and spatial and temporal coverage.

The deployment plan should also include a risk analysis and mitigation measures around deployment, as well as all other considerations such as experimental design to check for device effects and health and safety considerations.

A plan should also be made for the collation of data from strategic monitoring studies, including consideration of the hosting and format of a database, and responsibilities for maintenance and uploads.

Questions to consider:

- What parameters need to be standardised for compatible studies to be undertaken?
- What parameters cannot be standardised?
- Identify potential problems in standardising studies and potential resolutions
- Can/should templates for standardised data collection be generated?
- Where will data be stored so that it is available for future analysis? Could an existing database be used or is a new bespoke database required? Who will be responsible for uploading and maintaining such a database?

3.7 Objective 3: UK roll-out of kittiwake tracking over multiple colonies and years

UK roll-out of kittiwake tracking studies over multiple colonies and years as determined in the deployment plan including data management. Data analysis and reporting are external to the scope of this work.

4 Outputs

It is envisaged that the main outputs would be:

Report detailing the technologies that have been deployed to track kittiwake populations, the ongoing and planned kittiwake tracking studies, and the study scale analyses undertaken. The format for this report will be agreed with the Contractor(s) at the start of the contract.

A review of published and grey literature should identify technologies that have been deployed to track kittiwake populations, the data which they gather, the colony location and attributes, logistical requirements, behavioural parameters studies, and their applicability to providing behavioural information relevant to collision risk.

A review of tracking studies, ongoing and planned, would describe the colony location and attributes, the tracking technology including various technical information, logistical requirements, behavioural parameters to be recorded, as well as an assessment of the comparability of the data collection and data analysis, and the availability of the data.

The report would also describe the results of the study scale analysis. This would lay out the requirements for individual studies, specific to the tag deployment type, as well as requirement for a set of strategic studies.

The report would deliver outputs from Objectives 1.1, 1.2, 1.3, 2.1, and 2.2.

Comparison spreadsheet which would provide readily accessible information for each ongoing or planned tracking study. This would capture a lot of the same information as the

report but potentially additional technical details and in a format allowing easy comparison and cross-referencing across studies.

The comparison spreadsheet would deliver outputs from Objective 2.1.

Framework for deployment providing a plan of when and where tracking is to be carried out and the scale of monitoring. A series of guidelines to allow comparable data to be collected across the studies.

The framework for deployment would deliver outputs from Objective 2.3.

Tracking of multiple colonies providing multiple years of data at multiple UK colonies, with data stored in an accessible database.

The tracking of multiple colonies would deliver outputs from Objective 3.

5 Timescale

An indicative timeline of the basic desk-based work is provided below, with further temporal considerations listed in the paragraph below. These timescales are to be confirmed, and suggested timelines from bidders are welcomed.

- Week 1: start-up meeting
- Weeks 2–6: literature review, consultation with experts, review of kittiwake harness trials and planning for further trials if required
- Weeks 7–11: study scale analysis to determine scope of studies
- Weeks 11–13: production of deployment plan and guidelines for individual and strategic tracking studies

Sufficient time for meaningful engagement with a steering group and to act upon recommendations from the steering group should be included in any proposed timeline. Sufficient time should also be allowed for consultation with experts and may require longer timescales if, for instance, a workshop is required. In addition to the desk-based work, if it is determined that a trial of kittiwake harnesses is required, the time scale for this work will be determined by the contractor. Logistical requirements for database configuration may also extend the timescale. The timescale for roll-out of multiple colony tracking studies will be determined by the Contractor(s) following the study scale analysis and production of the deployment plan.

The key objectives, milestones, and deliverables of this contract are:

- Review of prior tracking studies and existing tracking works
- Review of kittiwake harness trials, recommendations for attachment method, and trial of harness method if required
- Assessment of scale of deployment required to deliver data capable of addressing the key ecological questions
- Generation of deployment plan for individual and strategic studies
- Begin UK roll-out of compatible studies

There are dependencies throughout this project such that objectives, milestones, and deliverables outlined above must be undertaken in a certain order. The need for kittiwake harness trials will be dependent on the outcomes of the kittiwake harness review. The

deployment plan will be based on the results of analysis of study scale, kittiwake harness review, and kittiwake harness trial, should it be required. Finally, the UK-roll out of multiple colony studies will be based upon the deployment plan.

6 Contractor requirements

Contractors would need to:

- Demonstrate a comprehensive understanding of black-legged kittiwake ecology
- Have experience in deploying seabird tracking and tracking studies
- Have an understanding of best practice and issues around handling and attaching devices to kittiwakes
- Have experience in ecological analysis

7 References

Band, B. 2012. Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms. Report by British Trust for Ornithology (BTO), Bureau Waardenburg bv and University of St Andrews. Report for The Crown Estate.

Black, J. & Ruffino L. 2019. Better linking effects of offshore windfarms on black-legged kittiwakes to populations. *JNCC Report No. 645*. JNCC, Peterborough, ISSN 0963-8091.

Black, J., Cook, A.S.P.C. & Anderson, O.R. 2019. Better estimates of collision mortality to black-legged kittiwakes at offshore windfarms. *JNCC Report No. 644*. JNCC, Peterborough, ISSN 0963-8091.

Chivers, L.S., Hatch, S.A. & Elliot, K. 2016. Accelerometry reveals an impact of short-term tagging on seabird activity budgets. *The Condor*, **118**, 159-168.

Cleasby, I.R., McCluskie, A., Owen, E., Wischnewski, S., Wilson, S., Wright, L.J. & Bolton, M. 2020. An investigation of the effects of GPS tagging on the behaviour of black-legged kittiwakes *Rissa tridactyla*. RSPB Technical Report.

Drewitt, A.L. & Langston, R.H.W., 2006. Assessing the impacts of wind farms on birds. *Ibis*, **148**, 29-42.

Gibson, L., Wilman, E.N. & Laurance, W.F., 2017. How Green is “Green” Energy? *Trends in Ecology & Evolution*, **32**, 922-935.

Mallory, M. L. & Gilbert, C. D. 2008. Leg-loop harness design for attaching external transmitters to seabirds. *Marine Ornithology*, **36**, 183-188.

Masden, E. 2015. Developing an avian collision risk model to incorporate variability and uncertainty. *Scottish Marine and Freshwater Science*, vol. 6, no. 14.

McGregor, R.M., King, S., Donovan, C.R., Caneco, B. & Webb, A. 2018. A Stochastic Collision Risk Model for Seabirds in Flight. Report for Marine Scotland.

Skov, H., Heinänen, S., Norman, T., Ward, R.M., Méndez-Roldán, S. & Ellis, I. 2018. ORJIP Bird Collision and Avoidance Study. Final report, The Carbon Trust.

Snyder, B. & Kaiser, M.J., 2009. A comparison of offshore wind power development in europe and the U.S.: Patterns and drivers of development. *Applied Energy*, **86**, 1845-1856.

Thaxter, C.B., Ross-Smith, V.H., Clark, J.A., Clark, N.A., Conway, G.J., Marsh, M., Leat, E.H. & Burton, N.H.K. 2014. A trial of three harness attachment methods and their suitability for long-term use on Lesser Black-backed Gulls and Great Skuas. *Ringing & Migration*, **29**, 65-76.

Thaxter, C.B., Ross-Smith, V.H., Clark, J.A., Clark, N.A., Conway, G.J., Masden, E.A., Wade, H.M., Leat, E.H., Gear, S.C., Marsh, M. & Booth, C. 2015. Contrasting effects of GPS device and harness attachment on adult survival of Lesser Black-backed Gulls Larus fuscus and Great Skuas Stercorarius skua. *Ibis*, **158**, 279-290.