



OWSMRF III: Knowledge Gap 5. Research Opportunities on advancing knowledge of non-breeding seabirds in the context of offshore wind impact assessments

Concept Notes

Produced by JNCC on behalf of OWSMRF

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Background

The Offshore Wind Strategic Monitoring and Research Forum ([OWSMRF](#)) is an industry-led, UK-region specific, and collaborative partnership that aims to identify and develop research to fill critical knowledge gaps in our understanding of the impact of offshore wind development on seabird populations. During the third phase of OWSMRF (2025–2026), stakeholders identified uncertainty around non-breeding birds as a critical issue that is posing a constraint or challenge to the offshore wind consenting process.

For the purpose of OWSMRF III, non-breeders are classed into two main categories:

- young birds that are not mature yet and can wait several years before reproducing (referred to “immatures” or “pre-breeders”), and
- adult birds that are old enough to reproduce but skip breeding that year due to poor condition, lack of mate or suitable nesting sites, or low prey availability (referred to as “sabbaticals” or “skipped breeders”).

Specific areas of uncertainty around non-breeders in the context of offshore wind impact assessments are presented in the OWSMRF III Knowledge Gap 5 report: “Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments” ([JNCC Report 823, Hall & Ruffino 2026](#)). These include:

- At-sea distributions
- Behaviour, and how this relates to risks from collision and displacement
- Numbers and vital rates
- Role played by non-breeders in seabird population resilience

The Joint Nature Conservation Committee (JNCC) has collaborated with UK Government agencies, technical experts and researchers to identify a summary of potential research that might help address evidence gaps.

The six Research Opportunities (RO 5.1 to RO 5.6) are presented here as short concept notes, and summarised in Figure 1, which shows how the proposed research links to the specific stages of an impact assessment:

- Collision risk modelling.
- Displacement assessment.
- Apportioning impacts to different components of seabird populations (age class and breeding status).
- Apportioning impacts to relevant protected sites (in the context of Habitat Regulation Assessments/Appraisals only).
- Population viability analysis (PVA).

Each of the six ROs are presented in Figure 2 in terms of their level of priority, timescale and indicative budget.

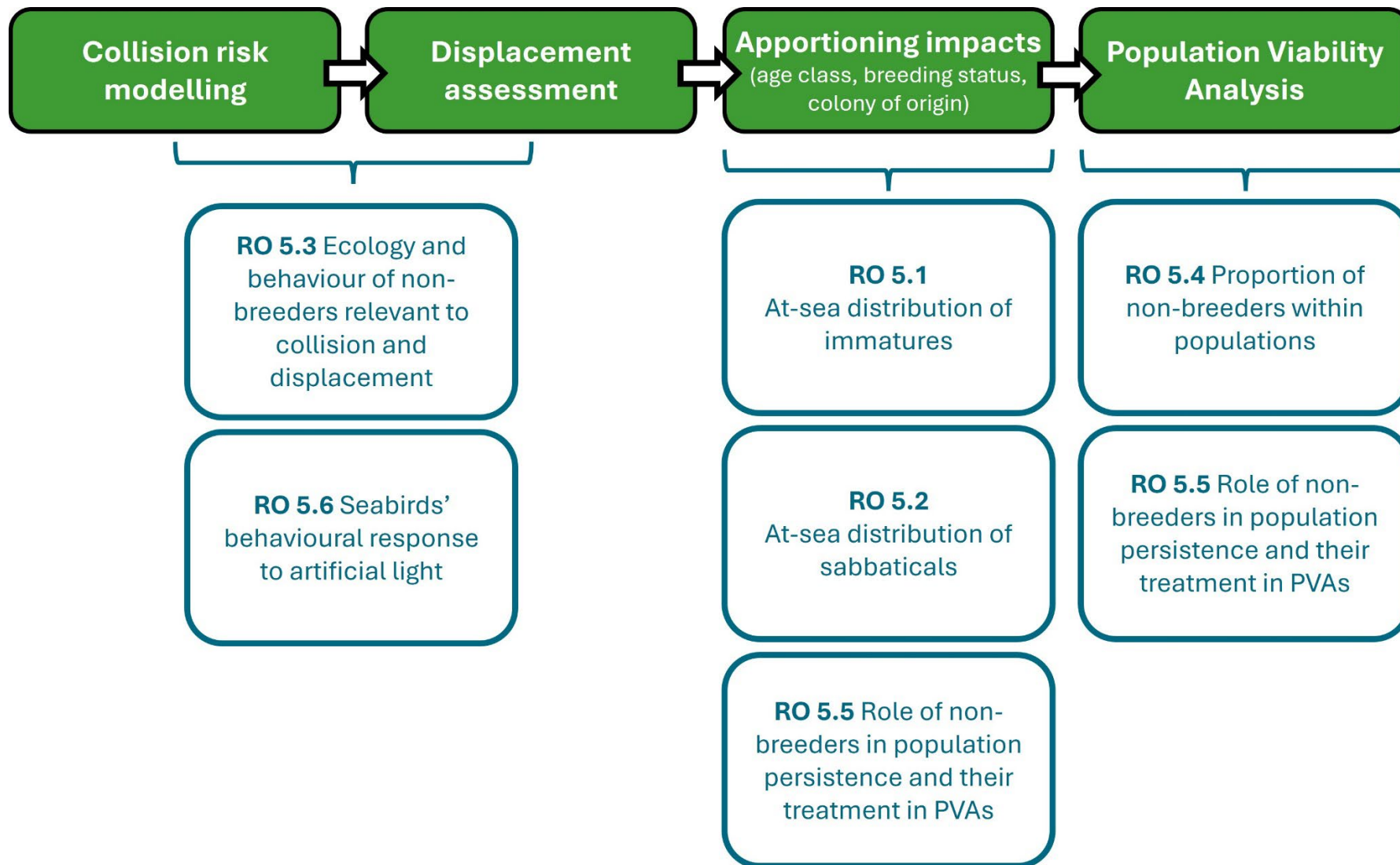


Figure 1: Summary of the six research opportunities (RO 5.1 to RO 5.6) showing how the proposed research links to the specific stages of an ornithological impact assessment. This is outlined as follows: Collision risk modelling – RO 5.3, RO 5.6; Displacement assessment – RO 5.3, RO 5.6; Apportioning impacts – RO 5.1, RO 5.2, RO 5.5; Population viability analysis – RO 5.4, RO 5.5.

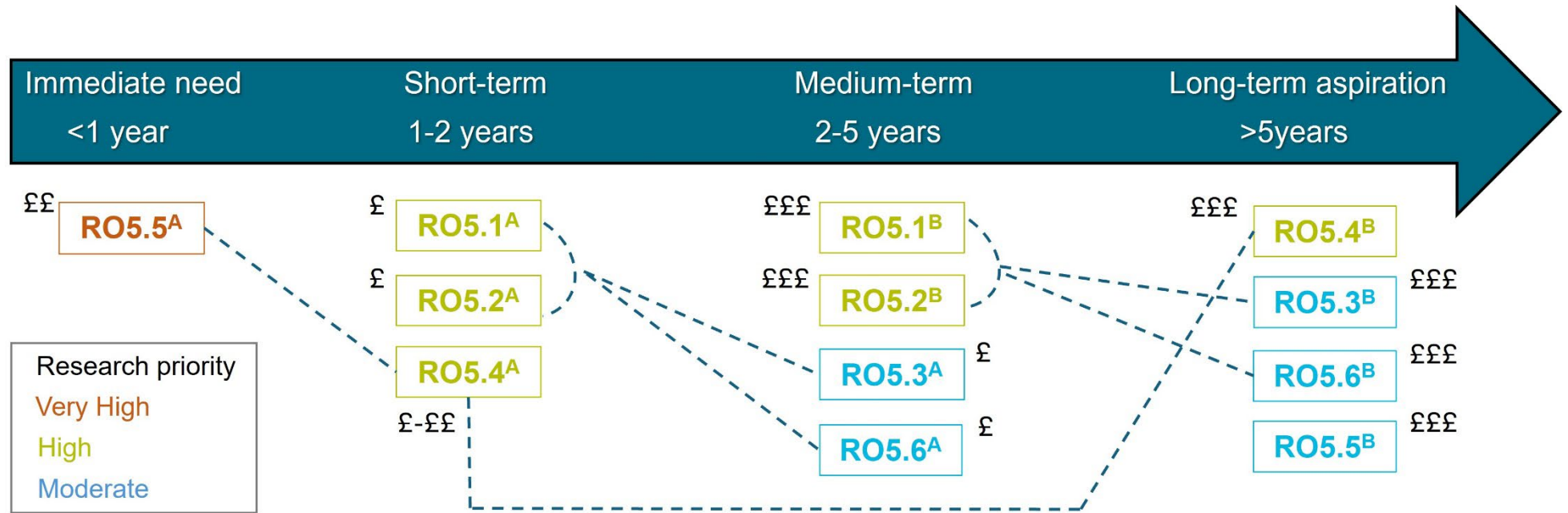


Figure 2. Synthetic diagram presenting all six Research Opportunities (ROs) in terms of their level of priority (very high, high, moderate), timescale (immediate, short-term, medium-term, longer-term) and indicative budget (low < £150,000, medium £150,000–300,000, high > £300,000). The integration of new evidence into impact assessments (not captured here) is a final and vital step across all ROs and will become possible as/when new evidence is delivered. Dotted lines indicate where synergies between ROs may lie, leading to reductions in overall project costs. “A” superscripts represent desk-based elements of a research project (typically feasibility studies), while “B” superscripts refer to work packages involving field data collection. See Hall & Ruffino (2026) for specific elements of proposed research.



Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.1: At-sea distribution of immatures

Evidence gaps

- At-sea distribution of immature seabirds is not well understood.
- It is likely that exposure of offshore windfarms differs between age classes (immatures versus breeding adults).
- Without robust evidence, quantifying proportions of immatures observed at a proposed offshore wind site relies on strong assumptions, which may not be valid.
- Current methods of apportioning offshore wind impacts to Special Protection Areas (SPA) have been developed for breeding adults and it is unclear whether these are applicable to immatures.

Short summary of proposed research

This work aims to acquire a better understanding of the at-sea distribution of immatures, and how this may differ from breeding birds. It will explore the feasibility of using existing datasets and identify new data collection needs, in order to produce year-round at-sea distribution maps of immatures. These will then be used to test the validity of current apportioning assumptions. New apportioning approaches will be developed where required and the methods for integrating new approaches into impact assessments will be set out.

Benefits and outcomes

Outputs of this study will inform the process of quantifying proportions of birds observed in baseline surveys to be characterised as immatures and breeding adults, allowing for improvements in the SPA apportioning stage of Habitats Regulation Assessments / Appraisals (HRAs).

This work will also improve understanding of exposure of immatures to offshore wind, helping establish how non-breeders distribute at-sea year-round and identify important marine areas, therefore informing marine spatial planning.

Further information

See: Hall, R. & Ruffino, L. (2026) Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments. [JNCC Report 823](#). JNCC, Peterborough, ISSN 0963-8091.

See also: [OWSMRF III Scope of Work SoW5b](#) "Improving understanding of the at-sea distribution of immature and sabbatical seabirds for use in offshore wind impact assessments – feasibility study".

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Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.2 At-sea distribution of sabbaticals

Evidence gaps

- At-sea distribution of sabbatical seabirds is poorly understood.
- It is likely that sabbaticals distribute further offshore compared to breeding adults, therefore their exposure to future far offshore development may differ.
- Estimating proportions of sabbaticals occurring at a proposed offshore wind site currently relies on limited evidence and strong assumptions.
- Current methods of apportioning offshore wind impacts to Special Protection Areas (SPA) have been developed for breeding adults, which may not be transferrable to sabbaticals.

Short summary of proposed research

This work aims to investigate the feasibility of using existing datasets to improve current understanding of at-sea distribution of sabbaticals. It also explores the practicalities of undertaking new data collection, although likely to be challenging. Knowledge of sabbatical at-sea distribution will be synthesised and compared to the distribution of breeding adults. This will help estimate with more confidence where sabbaticals are most likely to occur at sea and at different times of year. Novel apportioning methods will be developed for sabbaticals, where required.

Benefits and outcomes

This work will allow evaluating the risk of sabbaticals interacting with existing and future offshore wind developments, in order to help inform both project- and plan-level assessments, as well as future leasing particularly in areas further offshore.

This work will enable estimates to be made of the proportion of birds observed in baseline surveys to be characterised as non-breeding adults and assessed as such in subsequent stages of an impact assessment. In addition, colonies of origin of sabbaticals will be better understood, allowing for improvements in SPA apportioning and impacts to entire populations to be considered.

Further information

See: Hall, R. & Ruffino, L. (2026) Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments. [JNCC Report 823](#). JNCC, Peterborough, ISSN 0963-8091.

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Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.3 Ecology and behaviour of non-breeders relevant to collision and displacement

Evidence gaps

- Non-breeder risk of collision and displacement from offshore windfarms is not known.
- It is likely that non-breeders behave differently to breeding birds due to lack of experience (immatures) and lack of reproductive constraints (immatures, sabbaticals).
- The methods currently used to assess collision and displacement of breeding birds may not be directly applicable to non-breeders.

Short summary of proposed research

This work focuses on understanding non-breeder behaviours relevant to collision and displacement, and how this differs from breeding birds. This includes combining existing data with novel data collection, if deemed feasible, to investigate parameters influencing collision risk such as flight heights, flight speeds and nocturnal activity, as well as those influencing displacement risk such as foraging habitat flexibility and disturbance caused by anthropogenic activity. Noting that this work would probably only apply to immatures, due to the challenges of acquiring behavioural data on sabbaticals.

Benefits and outcomes

Outputs of this work will allow evaluating the risk of non-breeders (likely immatures only) interacting with offshore wind developments. When combined with improved non-breeder at-sea distribution (RO 5.1 and RO 5.2), this work will provide for the first time an assessment of non-breeders' vulnerability to offshore windfarms for use in marine spatial planning and impact assessments.

It will also inform whether changes to existing collision and displacement assessment methods are required, what these changes should be, or whether new non-breeder-specific models are needed. This will ultimately inform how mortalities of non-breeders should be treated within Population Viability Analysis.

Further information

See: Hall, R. & Ruffino, L. (2026) Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments. [JNCC Report 823](#). JNCC, Peterborough, ISSN 0963-8091.

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Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.4 Better understanding of the proportion of non-breeders within populations

Evidence gaps

- Sabbatical birds can form large proportions of seabird populations and play an important role in population resilience.
- There is large uncertainty in adult non-breeding rates across species.
- Sabbatical rates likely vary between colonies, marine regions and years.
- Currently recommended sabbatical rates for use in impact assessments are based on old and sparse evidence, which can have implications when modelling population trajectories in Population Viability Analysis (PVA).

Short summary of proposed research

This work aims to produce robust estimates of adult non-breeding rates, and variability in these rates, across a range of species, based on a combination of desk-based and field-based approaches, including modelling studies, expert consultation and the deployment of remote monitoring technology. Species-specific sabbatical rate estimates can then be compared between various approaches, helping validation.

Benefits and outcomes

From understanding the numbers of non-breeders each year at risk from offshore wind, to understanding their role in population resilience, to modelling population-level impact of anthropogenic activities, an estimate of non-breeding rate is crucial to multiple stages of an impact assessment. Outcomes include regular updates to proportions of non-breeding adults for direct use in impact assessments, leading to reduced uncertainty when modelling population trajectories in PVA.

This work will also feed directly into RO 5.5, by providing more precise estimates of non-breeding rates when quantifying the role of non-breeders in population persistence and testing apportioning assumptions.

Further information

See: Hall, R. & Ruffino, L. (2026) Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments. [JNCC Report 823](#). JNCC, Peterborough, ISSN 0963-8091.

See also: [OWSMRF Scope of Work SoW5a](#) "Role of non-breeders in population persistence and their treatment in offshore wind impact assessments"; and [OWSMRF Scope of Work SOW5c](#) "Feasibility study for improved understanding of non-breeding birds through deployment of novel monitoring technologies".

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Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.5 Role of non-breeders in population persistence and their treatment in Population Viability Analysis

Evidence gaps

- Non-breeders can form large proportions of seabird populations and play an important role in population resilience.
- Current Population Viability Analysis (PVA) approaches do not consider the mortality of all non-breeders, and it is unclear how this may influence the outcomes of an assessment.
- Sabbaticals are not modelled in PVA and immature mortality is estimated based on unverified assumptions.
- There are inconsistencies in advice between UK countries, and there is currently no agreed framework for the treatment of non-breeders in impact assessments.

Short summary of proposed research

This work aims to provide a quantitative evaluation of the relative importance of non-breeders in seabird population dynamics and growth, test common assumptions around the current treatment of non-breeders in impact assessments, identify pitfalls in current approaches and opportunities for improvement. Building on these investigations, this work will identify an appropriate framework for the inclusion of both sabbaticals and immatures in PVA.

Benefits and outcomes

This work will provide the evidence base to assess the relative importance of non-breeders to population persistence and establish the extent to which non-breeders can influence population responses to offshore wind impacts.

This work will generate methodological standards for how to account for offshore wind mortalities of different age classes and breeding status, and how to set up the population structure in PVA accounting for non-breeders. This will help inform appropriate levels of precaution required when interpreting outputs from various approaches and generate best practice guidance for the inclusion of both immatures and sabbaticals in impact assessments, enabling more biologically-meaningful evaluations of impacts.

Further information

See: Hall, R. & Ruffino, L. (2026) Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments. [JNCC Report 823](#). JNCC, Peterborough, ISSN 0963-8091.

See also: [OWSMRF III Scope of Work SoW5a](#) "Role of non-breeders in population persistence and their treatment in offshore wind impact assessments".

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Appendix: RO 5.6 Seabirds' behavioural response to artificial light

In addition to the five Research Opportunities RO 5.1 to RO 5.5 presented in the Knowledge Gap 5 report, a final RO on seabirds' behavioural response to artificial light was identified. This topic was discussed by experts during a non-breeding bird workshop in September 2025.

Light attraction, disorientation and avoidance are well-recognised issues for a number of seabird species, particularly nocturnal burrow nesting seabirds such as Procellariiformes (Deakin *et al.*, 2022). Whilst juvenile birds appear to be highly susceptible to light-induced behavioural change, a number of critical knowledge gaps are pertinent to all age classes. Moreover, it remains unclear to what extent lighting effects differ between immature and adult birds (Deakin *et al.*, 2022). This is therefore an important knowledge gap for both breeding and non-breeding seabirds, and there are efficiencies to be made by addressing this issue across age groups.

RO 5.6 is presented as an appendix to the main KG5 report in acknowledgement of the fact that this knowledge gap does not solely apply to non-breeding birds. The outputs of this RO will however help improve understanding of non-breeder (i.e. immatures) sensitivity to artificial lighting, as well as possible lethal and sub-lethal consequences from collision, displacement and barrier effect. Novel evidence will then be used to inform how non-breeder mortalities should be treated within impact assessments.

References

Deakin, Z., Cook, A., Daunt, F., McCluskie, A., Morley, N., Witcutt, E., Wright, L. & Bolton, M. (2022) A review to inform the assessment of the risk of collision and displacement in petrels and shearwaters from offshore wind developments in Scotland. Scottish Government report.



Knowledge Gap 5. Advancing knowledge of non-breeding seabirds, in the context of offshore wind impact assessments:

RO 5.6 Seabirds' behavioural response to artificial light

Evidence gaps

- Light attraction, disorientation and avoidance are well-recognised issues for a number of seabird species, particularly nocturnal burrow nesting seabirds.
- Whilst juvenile birds appear to be highly susceptible to light-induced behavioural change, a number of critical knowledge gaps are pertinent to all age classes.
- It remains unclear to what extent lighting effects differ between immature and adult birds.
- There is currently no mechanism for accounting for effects of attraction to turbines within Collision Risk Models, or effects of avoidance of lighting sources in displacement assessments.

Short summary of proposed research

This work focuses on understanding the behavioural response to lighting of nocturnal burrow-nesting seabirds (Procellariiformes, puffins), and how this differs between breeding adults and immatures. Work will include sourcing and potentially collecting new data on seabird at-sea behaviour around sources of lighting to determine whether and how artificial light may influence seabird behaviour. This work will then consider whether current collision risk models and displacement assessments require adjusting to account for, and quantify, lighting effects, and if so, how.

Benefits and outcomes

The outputs of this work will help improve understanding of the sensitivity of breeding adults and immatures to artificial lighting, as well as possible lethal and sub-lethal consequences from collision, displacement and barrier effect. Novel evidence will then be used to inform how light effects, such as attraction, should be quantified in collision and displacement assessments.

Further information

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