



**JNCC Report
No. 675**

**Review of priority evidence needs around the impact of offshore wind
development on key receptors and research underway
A report for the Offshore Wind Evidence and Change Programme Steering
Group, No. OW001**

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Summary

The Crown Estate and UK Government (Department for Environment, Food & Rural Affairs and Department for Business, Energy & Industrial Strategy, BEIS) have formed a partnership, the [Offshore Wind Evidence and Change Programme](#), which aims to ensure the UK offshore wind sector can deliver at pace while protecting the natural environment. The Offshore Wind Evidence and Change Programme's work includes funding a programme of strategic evidence projects to address gaps in knowledge of the cumulative environmental impacts and benefits of offshore wind deployment. A call for project proposals to members of its Programme Steering Group was issued in January 2021 and is expected to be followed by additional calls at six-month intervals. To assist with prioritising and evaluating proposals, The Crown Estate commissioned JNCC to identify receptors and topics that pose greatest risk in terms of future offshore wind farm consents and deployment, and to list research already underway.

JNCC (Joint Nature Conservation Committee) has a statutory advisory role to the UK Government and devolved administrations on issues relating to nature conservation in UK offshore waters. Given this remit, JNCC works closely with marine industries, including the offshore wind sector, providing environmental advice on benthic, marine mammal and ornithological receptors and these are the focus of this report. JNCC's UK-wide perspective and impartial, scientific, evidence-based approach mean JNCC is well-placed to identify key environmental evidence priorities for the Offshore Wind Evidence and Change Programme. This report represents independent advice from JNCC.

For benthic, marine mammal and ornithology receptors, lists of priority evidence needs for the UK have been collated previously by various groups, such as the Scottish Marine Energy Research (ScotMER) programme, the Offshore Wind Strategic Monitoring and Research Forum (OWSMRF), Offshore Renewables Joint Industry Programme (ORJIP), the Statutory Nature Conservation Bodies Marine Industry Groups (SNCB MIG) and others. For each receptor group, these existing lists were reviewed and collated to form a single list of high priority evidence needs, except for ornithology for which no UK-wide overarching list exists. The ScotMER evidence map provides a good overview of Scottish priority evidence needs for ornithology and OWSMRF lists evidence needs for black-legged kittiwake across the UK. Additionally, Defra's Offshore Wind Enabling Actions Programme identifies high priority evidence needs but a comprehensive review for English and Welsh waters is needed.

Lists of relevant research currently underway were compiled for benthic and marine mammal receptors from ScotMER, ORJIP, BEIS Offshore Energy Strategic Environmental Assessment research programme and the SNCB MIGs. For ornithology receptor research, key stakeholders were emailed, asking for details of their current research. Spreadsheets listing priority evidence needs and current research for each receptor accompany this report.

From this review, key recommendations for future work include developing a UK-wide list of high priority evidence needs for ornithological receptors with prioritisation carried out in consultation with key stakeholders, such as the Statutory Nature Conservation Bodies and industry, and collating a Europe-wide database of current research being carried out on species and issues of relevance to offshore wind consenting in the UK.

Summary of Priority Evidence Needs

Prioritising evidence needs is difficult as additional evidence on all stages of an impact assessment is needed, for many receptors. Evidence needs can be prioritised, to some extent, by their ability to reduce consent risk, but many other factors besides environmental evidence also influence consent risk. A more effective criterion for prioritising research needs is to select research projects that have the highest likelihood of reducing scientific uncertainty around understanding predicted impacts.

On this basis, JNCC's experienced impartial, scientific advisors have prioritised evidence needs for offshore wind and the offshore marine environment in the UK (see Table 1). JNCC recommends that the SNCBs, industry and other key stakeholders are also consulted on their evidence need priorities.

Table 1: Summary of priority species and evidence needs for benthic, marine mammal and ornithological receptors.

Benthic	
Priority species/habitats:	Sandbanks which are slightly covered by sea water all the time; Reefs (biogenic, especially <i>Sabellaria</i>)
Priority evidence needs	Understanding the impact of introduced hard substrate (turbines, mattresses, rock dump) on the biological and ecological structure and functioning of designated sediment habitats in Marine Protected Areas (MPAs)
	Removal of introduced hard structure on the biological and ecological structure and functioning of designated sediment habitats in MPAs
	Understanding the magnitude of the biological and ecological impacts of introduced hard substrate into wider North Sea ecosystems
Marine mammals	
Priority species	Most of the research needs apply to marine mammal species as a whole but harbour porpoise is a priority
Priority evidence needs	Improved understanding of behavioural disturbance responses of key marine mammal species to offshore wind farm installation noise
	The development and evaluation of effective mitigation measures
	Characterisation of marine mammal species' distribution, abundance and habitat use
Ornithology	
Priority species ¹	Atlantic puffin, black-legged kittiwake, common guillemot, great black-backed gull, lesser black-backed gull, razorbill, red-throated diver. In May 2020, as part of the OWSMRF process, SNCBs, Marine Scotland Science and Royal Society for the Protection of Birds (RSPB) identified kittiwake as the bird species posing greatest consent risk to offshore wind development

¹ Those species likely to trigger an adverse effect on a site's integrity in the near future.

Priority evidence needs	Understanding the energetic and demographic consequences of displacement
	Understanding how bird behaviour changes in the vicinity of turbines
	Understanding the consequences of offshore wind development for prey distributions and knock-on effects to marine birds
	Obtaining an improved understanding of population dynamics and drivers of population change

More detail on high priority species and evidence needs for each receptor is provided in the following report.

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1 Glossary

List of all acronyms used in this report

AA	Appropriate Assessment
AEoI	Adverse Effect on Integrity
BEIS	Department for Business, Energy & Industrial Strategy
BEIS OE SEA research programme	BEIS Offshore Energy Strategic Environmental Assessment research programme
CES	Crown Estate Scotland
CRM	Collision risk models
DEFRA	Department for Environment, Food & Rural Affairs
EOWDC	European Offshore Wind Deployment Centre
HRA	Habitats Regulations Assessment
INSITE	INfluence of man-made Structures In The Ecosystem
JNCC	Joint Nature Conservation Committee
MDE	Marine Data Exchange
MEEB	Measures of Equivalent Environmental Benefit
MIG	Marine Industry Group
MPA	Marine Protected Area
MROG	Marine Renewables Ornithology Group
MSS	Marine Scotland Science
NE	Natural England
NRW	Natural Resources Wales
NS	NatureScot
ORJIP - OSW	Offshore Renewables Joint Industry Programme for Offshore Wind
OWSMRF	Offshore Wind Strategic Monitoring and Research Forum
PAG	Project Advisory Group
PSG	Programme Steering Group

PTS	Permanent Threshold Shift
RSPB	Royal Society for the Protection of Birds
ScotMER	Scottish Marine Energy Research
SMMR	UK Sustainable Management of Marine Resources
SNCB	Statutory Nature Conservation Body
SNSOWF	Southern North Sea Offshore Wind Forum
SPA	Special Protection Area
TCE	The Crown Estate
TTS	Temporary Threshold Shift

2 Background

2.1 The Offshore Wind Evidence and Change Programme

The Crown Estate and UK Government (BEIS and Defra) have launched a new partnership to protect and restore the UK's marine environment, called the Offshore Wind Evidence and Change Programme. The partnership, led by The Crown Estate, has committed to a five-year £25 million programme of strategic research and data projects. These will help better understand and address environmental considerations, ensuring the offshore wind sector can deliver at pace while protecting the natural environment.

2.1.1 Programme Purpose

The Offshore Wind Evidence and Change Programme's purpose is to facilitate the sustainable and coordinated expansion of offshore wind to help meet the UK's commitments to low carbon energy transition whilst supporting clean, healthy, productive and biologically diverse seas.

2.1.2 Programme Objectives

In support of this purpose, the Offshore Wind Evidence and Change Programme has the following objectives:

1. To guide and deliver research to address gaps in evidence and knowledge of the cumulative environmental impacts and benefits of offshore wind deployment and other commercial activities in the marine and onshore environments in order to reduce impacts and allow recovery of the environment.
2. To convene all relevant actors to develop a common understanding of, and take action relating to, the strategic deployment of offshore wind and interactions in the sea space and onshore.
3. To facilitate proactive, open and collective collaboration between organisations key to the future offshore wind deployment, an effective planning system and the evolution of relevant policy and decision-making.

2.1.3 Core themes

Following engagement with key stakeholders in 2019/20, four core themes emerged as priorities for the Programme (as part of the Needs Case for the programme):

1. Spatial co-ordination and co-location. To increase strategic coordination of different activities and interests in the sea space and onshore, opening-up new opportunities for offshore wind through co-location and innovation allowing multi-use of space.
2. To improve the understanding of environmental impacts and benefits. Strategic research, evidence gathering and data sharing projects to: reduce impacts, uncertainty and risk, foster innovation, enabling more offshore wind to be deployed with confidence that impacts will not impede recovery of the environment and preservation of our cultural heritage.
3. To investigate the derogation process to unlock further offshore wind deployment. To investigate the availability and use of the Habitats Regulations Assessment (HRA) derogation process and Measures of Equivalent Environmental Benefit (MEEB) to help the consenting of offshore wind whilst maintaining the integrity of Marine Protected Areas – including alternatives and compensatory measures.
4. Delivery of net environmental gains. To investigate the delivery of net environmental gains to evidence and secure the benefits of deployment of offshore wind.

2.1.4 The Offshore Wind Evidence and Change Programme Projects Criteria for Evaluation

The Offshore Wind Evidence and Change Programme will support a range of strategic research, evidence-gathering, data-sharing and enabling activities with a defined timeframe and output. To be considered for Crown Estate funding and support, projects and activities will need to demonstrate that they make a significant contribution in helping to deliver the Offshore Wind Evidence and Change Programme's Purpose and Objectives, and are in line with one or more of the Core Themes, as described above.

In addition, projects will need to demonstrate the following criteria:

1. That they do not replicate, but rather build on, support and add value to other evidence-gathering projects, studies and gap analysis activity, such as those being pursued by the Offshore Renewables Joint Industry Programme for Offshore Wind (ORJIP), The Offshore Wind Strategic Monitoring Forum (OWSMRF), BEIS Strategic Environmental Assessment (SEA) Programme, The Pathways to Growth Group and other Sector Deal activity, the Scottish Marine Energy Research (ScotMER) programme, as well as academic research activity in the UK and overseas, such as the UK Sustainable Management of Marine Resources (SMMR) Programme.
2. That they are supported by a project advisory group (PAG) or other appropriately qualified group, with recognised subject matter experts and contain robust proposals for project management, quality control and validation of findings.
3. That they have defined deliverables and include a timeframe for these.
4. That they are collaborative, with involvement and support from different sectors – including, for example: industry, non-governmental organisations, regulator, government and academia.
5. That matched funding opportunities have been investigated, and included, where relevant, in the event that there are other project beneficiaries and areas of mutual interest.
6. That any additional funding from the Offshore Wind Evidence and Change Programme does not simply displace existing funding streams but adds genuine value.
7. That projects / activities have the aim of generating learning for the benefit of the UK offshore wind industry and community as a whole and in the long-term, rather than being niche/project-specific, although it is accepted that some regional or project-specific learning may be able to be applied more generally.
8. That they are focussed on receptors and topics that pose greatest risk in terms of future offshore wind farm consents and deployment – need to know vs nice to know. Attempts should be made to quantify this risk, if possible. What happens if we don't do this project/activity?
9. Key outputs must be made available and in a form that can be shared with the Offshore Wind Evidence and Change Programme Steering Group, on TCE's or the Marine Data Exchange (MDE) websites and the wider offshore wind community for mutual benefit, although it is recognised that there may be some elements of sensitivity regarding releasing raw data and draft reports to wider audiences that will need to be managed appropriately.
10. There is a narrative or roadmap to demonstrate how the findings will be communicated to the relevant audiences; and how they could inform future policy, practice and decision-making to deliver the Programme's mission.

3 Need for information in support of project evaluation

In January 2021, The Crown Estate and its programme partners BEIS and Defra launched a call for research project proposals to members of its programme steering group. These proposals will be evaluated against ten criteria (see The Offshore Wind Evidence and Change Programme Projects Criteria for Evaluation above). They require certain information to support the assessment of the extent to which a project proposal meets each criterion. In particular:

Criterion 1: That they do not replicate, but rather build on, support and add value to other evidence-gathering projects, studies and gap analysis activity, such as those being pursued by the Offshore Renewables Joint Industry Programme for Offshore Wind (ORJIP), The Offshore Wind Strategic Monitoring Forum (OWSMRF), BEIS Strategic Environmental Assessment (SEA) Programme, The Barriers (Pathways) to Growth Group and other Sector Deal activity, the Scottish Marine Energy Research (ScotMER) programme, as well as academic research activity in the UK and overseas, such as the UK Sustainable Management of Marine Resources (SMMR) Programme;

and,

Criterion 8: That they are focussed on receptors and topics that pose greatest risk in terms of future offshore wind farm consents and deployment – need to know vs nice to know. Attempts should be made to quantify this risk, if possible. What happens if we don't do this project/activity?

The Offshore Wind Evidence and Change Programme therefore requires information on those receptors and issues posing the greatest consent risk for offshore wind development across the UK, and a list of offshore wind related evidence-gathering projects currently being undertaken.

3.1 The task of JNCC

TCE asked JNCC to provide an impartial collation and review of high priority evidence needs and current research underway for the Offshore Wind Evidence and Change Programme. JNCC focussed on areas of its core expertise, defined as ornithology, marine mammals, benthic, marine protected areas, cumulative effects, compensation and net gain (Figure 1).

JNCC is the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation, as well as providing a forum through which the statutory nature conservation bodies (SNCBs) in England, Scotland, Wales and Northern Ireland discharge their statutory responsibilities across the UK and internationally. Given JNCC's statutory nature conservation role in relation to UK offshore waters, JNCC works closely with marine industries including the offshore wind sector, providing environmental advice on benthic, marine mammal and ornithological receptors. JNCC's UK-wide perspective and impartial, scientific, evidence-based approach mean JNCC is well-placed to identify key environmental evidence priorities for the Offshore Wind Evidence and Change Programme.

This report builds on the outputs of the Offshore Wind Evidence and Change Programme workshop on 4/12/2019 (Needs Case: <https://www.marinedataexchange.co.uk/ItemDetails.aspx?id=11430>) and understanding of the cumulative impacts of offshore wind deployment, consenting risks for offshore wind, and

knowledge of research and studies that are already underway, and remaining evidence gaps.

Figure 1: The four Core Themes of the Offshore Wind Evidence and Change Programme showing thematic focus of this report on environmental impacts and benefits. Whilst not addressing the Net Gain theme directly some of the priorities identified for key receptors will be relevant to that theme.



TCE asked JNCC to theme the priorities and provide an indicative scale of investment to help understand how the ideas fit to the main call for project proposals, at the start of the year, versus the mid-year intermediate call, and against other initiatives.

Key tasks were to:

1. Work with TCE to identify key priority areas for environmental research and studies to inform decisions on project funding by the Offshore Wind Evidence and Change Programme, noting the scale of the projects being considered and the timing of the project calls.
2. Produce a draft summary report of key priority areas and headline areas of focus for potential projects in the Offshore Wind Evidence and Change Programme Project calls.

This report aims to address key task 2, i.e. to assist the Programme Steering Group (including TCE, Defra and BEIS) and others with an interest in offshore wind and strategic research evidence in the marine environment across the UK, with understanding the current offshore wind environmental strategic research landscape. In particular, this report aims to identify the evidence needs which in JNCC's view need filling most urgently, to help the Programme Steering Group identify programme project proposals that will have greatest impact and be most effective in reducing consenting risk. Additionally, the supporting spreadsheets list research currently underway to assist in reducing the chance of duplicative funding.

Timescales for delivery of this report were very short, with the work being commissioned on 7th December 2020 for delivery of a draft report by 12th January 2021 and a final report by 31st January 2021. Due to the scale and complexity of the task, it was not possible to indicate scale of investment required to deliver projects. JNCC received comments from TCE, Marine Scotland, RenewableUK, NatureScot, Defra Offshore Wind Enabling Actions Programme, Crown Estate Scotland and The Wildlife Trusts on a draft version of this report; all these comments have been addressed as far as possible in this final report and in the supporting spreadsheets.

4 Methods used to gather information

During December 2020, JNCC collated information on priority areas for environmental research and research studies currently/imminently underway. This was focussed on areas of JNCC expertise and does not cover all environmental topics. Research already underway was limited to environmental research and did not include other issues related to environmental impacts and consent risk. For example, the Scottish Offshore Wind Energy Council's Barriers to Deployment Group has recently commissioned a project to obtain a legal opinion on aspects of HRA definitions and an example of an 'Alternatives' argument for an offshore wind project in Scotland. Since this commission is directly about environmental research, this project was deemed out of scope for this review and so was not listed in the 'current research underway' spreadsheets.

Information for benthic, marine mammal and ornithological receptors was gathered; for each receptor, this was done in a slightly different way (see below). Additional information on priority evidence needs and current research underway provided by Programme Steering Group Member Organisations (see Appendix for list of all PSG Member Organisations) was also included in this report.

4.1 Benthic

A list of evidence needs and current research underway for benthic receptors was derived by appending information from the following sources:

- The streamlined ScotMER evidence plan² (<https://www.gov.scot/publications/streamlined-scotmer-evidence-map/>, updated 3 Dec 2020)
- INSITE phase 1 and 2 projects (<https://www.insitenorthsea.org/>; updated with awarding of phase 2 project in Sept-Oct 2020)
- The Third Offshore Energy Strategic Environmental Assessment's funded projects list: (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/836329/Offshore_Energy_SEA_Recent_Research_Summary_September_2019.pdf)
- Research agendas agreed within SNCB Marine Industry Benthic and Decommissioning Groups (unpublished – internal, December 2020)
- Natural England internally funded / TCE funded research projects
- Marine Scotland funded projects

These sources were appended together without modification and were coded by benthic receptor. JNCC is unaware of any other available accessible lists that would cover offshore wind related research, however, there are likely to be internal unpublished research lists held by various agencies, consultancies, and government.

² This new version hasn't yet been fully consulted upon; this will happen in 2021. The older version of the ScotMER evidence map for benthic receptors can be found here: <https://www.gov.scot/publications/benthic-species-specialist-receptor-group/>

4.2 Marine mammals

Marine mammal related evidence needs were compiled from the following lists of research/evidence needs:

- SNCBs Marine Industries Group (MIG) – Marine Mammals list of evidence needs (unpublished – internal, December 2020)
- ScotMER evidence maps (<https://www.gov.scot/publications/marine-mammals-specialist-receptor-group/>, October 2018)
- Year 1 [ORJIP](#) Forum Results
- The Wildlife Trusts offshore wind evidence needs (sent by email via Steering Group)

The lists were all filtered to ensure that evidence needs that were not related to offshore wind farms and marine mammals were removed. There was no further filtering attempted, for example no filtering out of evidence needs that may be judged by JNCC to be of lower importance. Many of the evidence gaps relate to work areas that are of broader relevance than just to offshore wind. Both the ScotMER and the ORJIP lists have some form of prioritisation included, but not the Marine Industry Group Marine Mammal (MIG Mammals) SNCB list, nor the list from The Wildlife Trusts.

Relevant ongoing or completed projects are also included in the marine mammal spreadsheet that accompanies this report; it is possible that other relevant projects are underway but are not listed in easily accessible resources.

4.3 Ornithology

Unlike for marine mammals and benthic receptors, JNCC is unaware of any single overarching spreadsheet of UK-wide research and evidence needs for marine birds with respect to offshore wind development. Consequently, JNCC took two approaches to providing information on evidence needs for marine birds. Firstly, we created a high-level table identifying species likely to pose a consenting risk from the Round 4 and ScotWind leasing rounds. Secondly, we collated and reviewed research priority lists created by other fora, e.g. ScotMER, ORJIP, OWSMRF, etc., indicating the extent to which these might be of use to the Offshore Wind Evidence and Change Programme.

To obtain a list of current ornithology research projects underway, JNCC emailed more than 50 stakeholders from across the sector who are involved with offshore wind ornithology research and asked them to provide details of any current research projects they were involved with.

5 Priority evidence needs and current research

Prioritising evidence needs is difficult as additional evidence on all stages of an impact assessment is needed, for many receptors. Evidence needs can be prioritised, to some extent, by their ability to reduce consent risk, but many other factors besides environmental evidence also influence consent risk. A more effective criterion for prioritising research needs is to select research projects that have the highest likelihood of reducing scientific uncertainty around understanding predicted impacts. This has the dual benefit of potentially decreasing the extent of precaution in assessments thereby reducing consent risk and, in some cases, offering increased headroom for further offshore wind development. There are several fora and organisations who have collated lists of evidence needs and current research for all receptors. These sources have been used in this report to generate lists of high priority evidence needs and current research that is underway.

5.1 Sources of information

5.1.1 High priority evidence needs across all receptors

Table 2 below lists sources that have reviewed evidence needs for all receptors. Each source is described in more detail below the table. Cells coloured green indicate this source is useful whereas amber implies some likely limitation, e.g. it does not have full UK coverage, it is somewhat out of date or it does not cover all receptors. Whilst JNCC attempted to identify all sources listing priority evidence needs and research gaps, there may be additional evidence needs lists available that are not listed here.

These sources provide lists of evidence that are viewed as high priority by those producing them, with the result that priorities may differ across lists. From these, JNCC has made generic recommendations on research that in our view is of highest priority, i.e. will bring about the greatest reductions in areas with currently high consenting risk.

Table 2: Sources that review offshore wind-related evidence needs with information about scope, when it was produced and whether any prioritisation of research needs was undertaken.

Research list name	Organisation producing list	Geographic coverage	Receptors included	Date list drawn up	Prioritisation of evidence needs?
ScotMER Evidence Map	Marine Scotland	Scotland but also refers to evidence gaps of relevance to whole UK	All receptors	March 2017 – MSS in the process of updating the list	Yes
MIG evidence needs lists	SNCB Marine Industry Groups	UK	Marine mammal and benthic	Dec 2020 review for marine mammal receptors; recent update for benthic receptors	No
ORJIP Project catalogue	ORJIP	UK	All receptors	Dec 2019	Partially (ranking of project proposals undertaken by Advisory Network)
BEIS Offshore Energy Strategic Environmental Assessment Research Programme	Hartley Anderson Ltd.	UK	All receptors	2019	Partially (there is no complete list of evidence needs, only a list of research underway which is deemed high priority)
OWSMRF Research Opportunities	OWSMRF	UK	Ornithology only	2019/20	Yes

ScotMER Evidence Maps

Marine Scotland has worked with industry, environmental NGOs, Statutory Nature Conservation Bodies, academics and other interested stakeholders to map out the gaps in knowledge when assessing the environmental and socio-economic impacts of offshore renewable developments. The ScotMER Evidence Maps (<https://www.gov.scot/publications/streamlined-scotmer-evidence-map/>) cover all receptors. As well as identifying evidence needs, the evidence maps also list research underway to fill these gaps (<https://www.gov.scot/policies/marine-renewable-energy/science-and-research/>), although this is currently being updated by Marine Scotland. Information from the ScotMER evidence maps was used to inform the benthic and marine mammal priority evidence needs lists presented below and in the attached spreadsheets.

SNCB Marine Industry Groups and Marine Renewables Ornithology Group

Statutory Nature Conservation Body specialists meet regularly to discuss technical issues of relevance to marine industry. Separate Marine Industry Groups (MIG) cover each group of receptors: MIG General covers benthic receptors, MIG Mammals covers marine mammals and MIG Birds covers ornithology. Additionally, the Marine Renewables Ornithology Group (MROG), comprising the SNCBs, RSPB and Marine Scotland Science, focusses solely on offshore wind issues. The MIG groups have produced a comprehensive list of high priority evidence needs for benthic and marine mammal receptors, which are presented below and in the attached spreadsheets. MIG Birds have not collated such a list due to the complexity of species and issues. MROG did produce a list of high priority evidence needs but this has not been updated since 2014.

ORJIP Project Catalogue

ORJIP's project catalogue comprises a long list of all project proposals that The Carbon Trust received following their call for proposals in 2019. It is a useful list of potential research projects that could meet key evidence needs, with an indication of resources required to deliver each research project. Project proposals are grouped under thematic headings (e.g. 'Cumulative Impact Assessment Considerations'). In December 2019, a large group of stakeholders (the Advisory Network) were invited to rank projects; this information was used subsequently by the ORJIP OSW Steering Group to select a few projects to fund during 2020. The marine mammal priority evidence list presented below, and in the spreadsheet accompanying this report, draws on this ORJIP project list. The ORJIP Project Catalogue is available on request from The Carbon Trust (Liam.Leahy@carbontrust.com).

BEIS Offshore Energy Strategic Environmental Assessment Research Programme

BEIS funds a programme of research to fill key evidence gaps in relation to offshore energy. The programme, delivered by Hartley Anderson Ltd., covers all receptors. Whilst there is no overarching list of evidence needs, key information needs are outlined in SEA Recommendations: <https://www.gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process#offshore-energy-sea-research-programme>).

OWSMRF

The Offshore Wind Strategic Monitoring and Research Forum (<https://jncc.gov.uk/our-work/owsmrf/>) recently produced a detailed review of the current evidence base and high priority research to fill key evidence needs for black-legged kittiwake. This species was identified by SNCBs, MSS and RSPB as the bird species posing greatest consent risk to offshore wind development. Whilst OWSMRF will consider evidence needs for other marine bird species in future, it will not cover benthic and marine mammal receptors.

5.1.2 Current research underway

As well as producing lists of high priority evidence needs, the fora or organisations that are currently undertaking strategic UK research have published lists of projects and research that are underway or recently completed:

- ScotMER: <https://www.gov.scot/policies/marine-renewable-energy/science-and-research/>

- ORJIP: <https://www.carbontrust.com/our-projects/offshore-renewables-joint-industry-programme-orjip-for-offshore-wind>
- BEIS OE SEA research programme: <https://www.gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process#offshore-energy-sea-research-programme>
- The Crown Estate: <http://marinedataexchange.co.uk/search?q=#fq=fq%3DProject%253Amd1r4nl8676>

Additionally, the Offshore Wind Industry Council's Pathways to Growth workstream recently commissioned GoBe Consultants to compile a comprehensive database of current and recent studies and research related to offshore wind³. This work mapped out the current offshore wind studies and existing strategic projects that are being completed or that are planned / proposed in order to determine the key strategic areas in which work is being undertaken.

Information from these sources on current research underway were included in the receptor-specific spreadsheets that accompany this report. This was then supplemented with additional information from PSG Members on current research.

5.2 Benthic receptor high priority evidence needs and research underway

Benthic research themes are currently relatively high-level compared to marine mammals or ornithology. While higher-level priorities have been identified through research programmes such as ScotMER and INSITE, as well as by agencies through the complexities of dealing with wind farm applications, only recently has there been enough understanding to start delving into these themes at a more detailed level.

From the collation of evidence priorities for benthic receptors, the high-level area of greatest priority is that of understanding biodiversity change in MPAs associated with installation and decommissioning of turbines, cable protection and scour protection. These activities are likely to have a long-term or permanent impact on the sediments on which the wind farm is installed.

Research is also needed to inform how introduced infrastructure / scour protection may introduce or alter ecosystem connectivity across the North Sea and will input into the wider scale agendas around the relative importance of climate change and biodiversity loss. Also seen as a priority is the need for a cross-industry database to provide fully comparable access to survey evidence (e.g. baseline surveys, monitoring surveys) for research for full understanding of the whole range of benthic impacts, alone and cumulatively. The final priority highlighted in the list is the need for increased research on floating wind impacts.

Natural England currently has two relevant projects aiming to inform further research questions and agendas around introduction of hard substrates; the first of these was completed in December 2020 (decommissioning), and the second is ongoing and due for publication in March 2021 (soft sediment impacts workshop). Outputs from these will significantly aid in prioritising more detailed areas of research around the impacts on soft sediments and the impacts of decommissioning.

³ GoBe Consultants (2020) Mapping the existing strategic work in environmental consents and licensing. Final report to the Offshore Wind Industry Council, Offshore Wind Sector Deal - Barriers to Growth Workstream.

The '**OWEC-Benthic-EvidenceGaps-20210129**' spreadsheet lists high priority evidence needs and current research being undertaken to address those needs in a single worksheet.

5.2.1 JNCC's advice on benthic priority evidence needs

This report comprises an impartial collation and review of high priority evidence needs and current research underway that is addressing those needs. However, TCE also asked for JNCC's opinion on which evidence needs are of highest priority. JNCC has provided this below; note this is JNCC's view and this advice does not incorporate consultation with any other key stakeholders who may well have a different view on highest priority evidence needs.

For benthic receptors, JNCC consider the main priority evidence needs are:

- Understanding the impact of introduced hard substrate (turbines, mattresses, rock dump) on the biological and ecological structure and functioning of designated sediment habitats in MPAs. This will provide a better understanding of whether long-term or permanent habitat loss could lead to significant change to soft sediment habitats and physical processes, and could involve research into whether there is a 'halo' of impact beyond any introduction of hard substrates, understanding of whether hard substrate can host soft sediment communities (both epifauna and infauna) and whether hard substrate faunas vary significantly between introduced and natural hard substrates.
- Removal of introduced hard structure on the biological and ecological structure and functioning of designated sediment habitats in MPAs. This will also provide a better understanding of whether long-term or permanent habitat loss could lead to significant change to soft sediment habitats and physical processes, as well as providing evidence around recovery possibilities and recovery rates of soft sediment communities.
- Understanding the magnitude of the biological and ecological impacts of introduced hard substrate into wider North Sea ecosystems, including understanding how these substrates impact connectivity across ecosystems. This is one aspect of the 'rigs to reef' effect, where both the positive and negative impacts of introduced hard substrate is considered across wider ecosystems.

5.3 Marine mammal receptor high priority evidence needs and research underway

5.3.1 High priority species

For marine mammal receptors, most of the research needs apply to cetacean and pinniped species as a whole. Nevertheless, some species or taxonomic groups have been highlighted as having specific research needs; for example, a greater understanding is needed of habitat use by harbour porpoise and any changes caused by noise from piling, in particular in marine protected areas.

5.3.2 High priority evidence needs

Priority evidence needs from the SNCBs' MIG Mammals, ORJIP, The Wildlife Trusts and ScotMER are presented as separate worksheets in the spreadsheet '**OWEC-Mammals-EvidenceGaps-20210129**', which accompanies this report. Whereas no attempt was made to further prioritise the lists of evidence needs, there were some clear common evidence themes:

- I. Improved understanding of behavioural disturbance responses of key marine mammal species to installation noise. This includes understanding behavioural responses to different sources of noise, quantifying noise dose-response for disturbance, and understanding the consequences of behavioural disturbance to animals' vital rates. Tagging technology and novel survey methods should be employed. Given the cost of field data collection, multi-partner funding, collaboration and coordination will be crucial.
- II. Improved understanding of hearing damage from loud noise, including incidence and consequences of PTS (Permanent Threshold Shift) onset. This includes assessing a baseline incidence of TTS/PTS (Temporary Threshold Shift/PTS) in marine mammals and better understanding the consequences of TTS/PTS (both to individuals and at population level). A more accurate method of estimating cumulative exposure to individuals would improve predictions of PTS onset.
- III. The development of frameworks to allow assessment of population-level effects from cumulative impacts. This includes the further refinement of population models, reducing assumptions by collecting field data on species movements, energy budgets and responses to noise. In addition, standardising and improving framework datasets would increase robustness of assessments.
- IV. The development and evaluation of effective mitigation measures, for example, improving understanding of how hydrographic conditions impact the effectiveness of noise abatement devices. Previously identified constraints to the safe and cost-effective deployment of mitigation measures should be assessed. An increased understanding of the effectiveness of mitigation measures in reducing disturbance to marine mammals is needed.
- V. Characterisation of marine mammal species' distribution, abundance and habitat use, prioritising locations with planned offshore wind developments. Fundamental to environmental impact assessments is an understanding of species movements, distribution, habitat use and population dynamics. Marine mammals, cetaceans in particular, are challenging to study; novel survey and tagging methods should be deployed and long-term sustainable monitoring programmes put in place.

5.3.3 JNCC's advice on priority evidence needs

This report comprises an impartial collation and review of high priority evidence needs and current research underway that is addressing those needs. However, TCE also asked for JNCC's opinion on which evidence needs are of highest priority. JNCC has provided this below; note this is JNCC's view and this advice does not incorporate consultation with any other key stakeholders who may well have a different view on highest priority evidence needs.

Of the above, I, IV and V are the three topics considered by JNCC as priorities. There is clear evidence that noise from the installation of offshore wind farms affects the behaviour, local abundance and distribution of marine mammal species, in particular the harbour porpoise. Whereas observable effects are temporary and may last only for the duration of the noise itself, the unprecedented scale of planned offshore wind installation in certain hotspot areas of cetacean abundance will result in many years of intermittent loud noise unless mitigation measures are put in place. The longer-term consequences to the health of individuals and populations will be uncertain for years to come given the challenges in studying these species and the evidence so far justifies the continued efforts from industry and governments to avoid and reduce underwater noise. Noise management spatio-temporal measures, less noisy alternatives to piling turbine foundations and noise abatement technology should be further developed. In JNCC's view, this would probably be the single most effective way to reduce consenting risks in relation to this receptor group.

Regrettably, much of the environmental impact assessments of the effects of offshore wind installation on marine mammals are filled with uncertainties, many caused by the challenging nature of marine mammal field research. Developing monitoring that is sustainable in the long term and will increase our understanding of species movements, behaviour and distribution will go a long way to help better predict responses to pressures including noise. In the short to medium term, it is important we observe species responses to noise disturbance and investigate influencing factors. This will make impact assessments more realistic and help target noise management measures, providing more certainty to industry and regulators.

5.3.4 Current marine mammal research underway

Current ongoing research projects or initiatives in various stages of completion are outlined in detail in the spreadsheet in the “Ongoing projects” tab, alongside recently completed projects in the “Completed projects tab”. These are summarised below. These are mainly projects funded or carried out in the UK. There are several other relevant projects in European countries like the Netherlands and Germany, and also in the USA, but these were not compiled here.

Some of these projects provide the foundation on which to develop further scopes of work to address the high priority evidence gaps identified. For example, there have been a couple of reviews and a workshop looking at alternative foundations and noise abatement techniques for piling and unexploded ordnance clearance. The findings and recommendations from these reports should help move forward the development and implementation of such noise reducing techniques.

The work carried out in the Moray Firth, the Wash, Southern North Sea SAC (ongoing) and in European countries, on behavioural responses of seals and harbour porpoise to pile-driving noise can inform the further work needed to better understand the effects on behaviour and energetic budgets of affected species.

List of work topics with currently ongoing or completed research projects or initiatives of relevance to offshore wind and marine mammals:

- Underwater noise risk assessment
- Population consequences
- Underwater noise mitigation
- Species abundance and distribution
- Seal behaviour, distribution and movements
- Cetacean prey distribution
- Underwater noise measurement standards
- Risk of entanglement
- Underwater noise characterisation
- Underwater noise monitoring

5.4 Ornithology receptor high priority evidence needs and research underway

5.4.1 Priority species

There are many species of marine bird for which impacts of offshore wind development have been considered but many of these species do not represent a high risk to future consenting of offshore wind projects. Those species for which an Adverse Effect on Integrity (AEoI) has

already been advised by the Statutory Nature Conservation Bodies (SNCBs), but not necessarily determined by decision makers, are likely to trigger a future AEol, and derogation may be required to enable further development in areas used by these interest features. Other species have potential to cause a future consent risk. The SNCBs have raised concerns⁴ about the overlap of SPAs (Special Protection Areas) and Round 4 bidding areas, identifying interest features for which an AEol could potentially be triggered by further offshore wind development. For Scotland, offshore wind development in certain Plan Options may be limited by certain species posing an 'ornithological constraint'. These species were listed in the Sectoral Marine Plan Appropriate Assessment⁵. Table 3 lists species which might pose a consenting risk for future UK-wide offshore wind development, given existing information on the areas of sea currently being considered for future development and past assessments. However, additional species, such as great skua and Arctic skua, may yet be identified by the SNCBs as posing a consenting risk for future offshore wind development. Whilst Natural England, NatureScot and Natural Resources Wales have all inputted to developing Table 3, SNCBs have not had an opportunity to fully consider and advise on which species are of highest priority; further consultation with the SNCBs, RSPB and Marine Scotland is essential.

Table 3: DRAFT list of species for which further evidence on impacts of OW development is a priority. Species include those identified as possible consent risk in Round 4 Bidding Regions and those presenting an ornithological constraint to development in ScotWind, in the Scottish Sectoral Marine Plan. AEol: Adverse Effect on Integrity of a site; NS: NatureScot; NE: Natural England; SNCB: Statutory Nature Conservation Body; AA: Appropriate Assessment.

Species	AEol previously advised by SNCBs	Species flagged as possible consent risk by SNCBs in R4 bidding areas	Species identified as an ornithological constraint in final Sectoral Marine Plan AA ⁶	Impact pathway
Atlantic puffin	Y (by NS)	Y (Wales)	Y	displacement
Black-legged kittiwake	Y (by NS and NE)	Y (England + Wales)	Y	collision (and displacement in Scotland)
Common guillemot	N	Y (England + Wales)	Y	displacement
Common scoter	N	Y (Wales)	N	displacement
Great black-backed gull	Y (by NS)	N	Y	collision
Lesser black-backed gull	Y (by NE)	Y (England + Wales)	N	collision
Manx shearwater	N	Y (Wales)	N	Collision and/or displacement and/or damage to supporting prey resources
Northern gannet	N	Y (Wales)	Y	collision
Razorbill	N	Y (England + Wales)	Y	displacement

⁴ JNCC, NE and NRW (2020): Letter to TCE; Boundaries to Offshore Wind Leasing Round 4 Bidding Areas.

⁵ <https://www.gov.scot/publications/sectoral-marine-plan-appropriate-assessment/>

⁶ <https://www.gov.scot/publications/sectoral-marine-plan-appropriate-assessment/>

Red-throated diver	Y (by NE)	Y (England + Wales)	N	displacement
Sandwich tern	Y (by NE)	Y (England)	N	collision

5.4.2 Priority evidence needs

For each marine bird species listed in Table 3 there are various evidence needs to reduce uncertainty in assessments of likely impacts of offshore wind. For example, for a species such as black-legged kittiwake which suffers collision mortality, there are many evidence needs relating to better modelling of collision risk, improving understanding of connectivity between an offshore wind farm area and an SPA population and improving modelling of population responses to predicted impacts. Furthermore, there is a need to understand efficacy of potential compensatory measures for kittiwake populations and other species. Key evidence needs for kittiwakes were described in detail by OWSMRF in three reports (<https://jncc.gov.uk/our-work/owsmrf/>). When all evidence needs for all species are considered along with other needs around assessing cumulative effects, the list of potential research projects becomes very long (e.g. the ScotMER ornithology evidence map lists almost 100 evidence needs and most of these apply to multiple bird species and does not include species of importance in England/Wales only).

As there is no single UK-wide list of all evidence needs for marine birds; JNCC has reviewed all the existing evidence need lists that we are aware of, highlighting the benefits of each – see Table 2, above. Whilst JNCC is aware of other lists of ornithological evidence needs, these have not been listed here as they were deemed to be less useful, e.g. a list from MROG (Marine Renewables Ornithology Group comprising SNCBs, RSPB and MSS) is not presented here because it has not been updated since October 2014. Similarly, work by MacArthur Green and SPR in 2016 on behalf of the Southern North Sea Offshore Wind Forum (SNSOWF) to develop prioritised lists of evidence needs has subsequently been superseded.

Defra’s Offshore Wind Enabling Actions Programme, with Natural England, Cefas, The Wildlife Trusts and others, have recently identified evidence needs that they see as high priority. These include:

- I. Addressing areas of uncertainty around modelling of impacts on seabirds (including Cumulative Effects Assessment)
- II. Identify and validate methods for measuring actual bird collisions to improve prediction modelling
- III. Collision mitigation for seabirds – A feasibility study/exploration of novel mitigation measures based on expert understanding of bird behaviour and particularly focusing on measures that incorporate technology that will enable the measurement of collision rates. Data on real-time collisions is a key evidence gap at the moment and having a better handle on this will reduce uncertainty in consenting.
- IV. Review and identify best practice for baseline characterisation surveys for birds
- V. Identify the most important geographical areas for seabirds and overlap with areas in current/future demand for offshore wind - this has already been done for some seabird species, but has tended to be carried out once development areas are known rather than to inform the location of new areas. It’s particularly needed to inform the siting of future floating wind installations.
- VI. Increase understanding of the impacts of floating wind developments on seabirds
- VII. Feasibility study of network of receivers to detect bird movements around offshore wind farms - A feasibility study for a network of receivers which could detect bird (and bat?) movements around offshore wind farms, of the type already up and running in

some terrestrial locations. The technology would help answer questions about connectivity between wind farms and seabird colonies, but a feasibility study would be needed as a first step.

The ScotMER evidence maps provide the most comprehensive overview of high priority evidence needs for marine birds. However, since this Scottish-focussed list might overlook species of high priority in English or Welsh waters (e.g. red-throated diver), the ScotMER list should be supplemented by other sources listed in Table 2 (but note that the ScotMER evidence maps do include evidence needs of UK-wide relevance too). The OWSMRF reports provide a comprehensive list of scientifically robust evidence needs for kittiwakes but does not yet cover other high priority species. Neither MIG Birds nor MROG have a list of high priority evidence needs, due primarily to the huge scale of the task of identifying and prioritising evidence needs and keeping the list up to date. The ORJIP catalogue provides a long list of potential research projects but there are many ornithology projects and identifying those which are high priority is not straightforward. The BEIS OE SEA research programme commissions high priority research but does not publish an overarching list of evidence needs. A report published in 2016 by MacArthur Green⁷, commissioned by the Southern North Sea Offshore Wind Forum, reviews in detail the evidence base for seven marine bird species of potential consent risk in the southern North Sea. That report also attempted to prioritise research needs, but this was undertaken by a single consultant several years ago so JNCC would not recommend relying on this prioritisation alone.

JNCC therefore recommends using the ScotMER evidence map to identify evidence needs in Scottish waters and the Defra Offshore Wind Enabling Actions Programme list for English and Welsh waters, plus OWSMRF reports for UK-wide evidence needs relating to kittiwakes.

5.4.3 JNCC's advice on priority evidence needs

This report comprises an impartial collation and review of high priority evidence needs and current research underway that is addressing those needs. However, TCE also asked for JNCC's opinion on which evidence needs are of highest priority. JNCC has provided this below; note this is JNCC's view and this advice does not incorporate consultation with any other key stakeholders who may well have a different view on highest priority evidence needs.

JNCC ornithologists have identified four high priority evidence needs. These are listed in order of priority with the most important evidence gap first.

1. Understanding the energetic and demographic consequences of displacement.
Priority species: red-throated diver, auks.

We view this as probably the most important gap in our understanding of the impacts of offshore wind development on marine birds. Currently, we have no idea how displacement causes energetic changes in individuals, potentially leading to reduced survival and/or productivity and ultimately demographic consequences, such as population decline. This means we don't know how important even small amounts of displacement are on SPA site integrity. This leads to high uncertainty in the resulting survival or productivity impacts, and a broad range of scenarios need to be considered as part of the impact assessment, to reflect this uncertainty. A better understanding of the demographic consequences of displacement will reduce the breadth of scenarios required and could potentially result in reduced precaution in assessments (which would create headroom for future developments). This

⁷ MacArthur Green (2016) Research priorities for seabirds in UK southern North Sea waters to reduce offshore wind farm consenting risk.

evidence would also enable improved spatial management of causes of disturbance (e.g. vessels) to reduce impacts.

However, obtaining relevant information on energetics and demographic consequences of displacement for marine birds (and marine mammals too) is extremely challenging and is probably why there have been few attempts to tackle this evidence need to date (but see the Red-throated Diver Energetics Project⁸ and SeabORD⁹).

2. Understanding how bird behaviour changes in the vicinity of turbines. Priority species: kittiwake, gannet, large gulls. Possibly additional species at risk with Round 4 and ScotWind areas, but less certainty on priority of this evidence need for other species.

Work under this evidence need would include three areas of investigation:

- obtaining better data with which to parameterise collision risk models, e.g. avoidance rates, flight heights, etc.
- obtaining a broader understanding of how bird behaviour changes around turbines, beyond parameterising CRM models (Collision risk models), e.g. how do birds using an area of sea change the way they behave before and after a wind farm is constructed?
- Direct empirical measures of collision mortality, e.g. deploying cameras on turbines to record incidences of collision (to both validate CRM model predictions and as a direct assessment of mortality caused by an operational wind farm).

Obtaining improved estimates of collision mortality helps reduce precaution in assessments, potentially creating more headroom for further development. This evidence gap in our understanding of bird behaviour around turbines is receiving more attention and research than other evidence gaps but this is due to it being a high priority. One previous study, the ORJIP Bird Collision Avoidance Study¹⁰, obtained information on bird avoidance behaviour near a wind farm, turbines and individual turbine blades. Additionally, a further study at Aberdeen Bay EOWDC¹¹ is investigating bird behaviour around turbines and another study in the Firth of Forth is currently being developed. Despite this, there is still important research needed to reduce uncertainty around collision mortality, complementing existing efforts. Defra's Offshore Wind Enabling Actions Programme identified work in this area as a high priority (see above). This is also possibly the easiest win in terms of releasing headroom from the current position with cumulative effects. Addressing this evidence gap could be an effective investment of Offshore Wind Evidence and Change funding on an agreed key priority with 'known' ways of getting data and reducing uncertainty, and clear 'path to releasing headroom'.

3. Understanding the consequences of offshore wind development for prey distributions and knock-on effects to marine birds. Priority species: Manx shearwater, red-throated diver, common scoter, terns. Likely of some relevance to most species.

Ecosystem and trophic effects of offshore wind development on marine birds is a poorly understood area and will become a high priority evidence gap during Round 4. Wind farm development could significantly alter prey availability through time and space, resulting in redistribution of birds and changes in their population dynamics. This could either be through

⁸ <https://jncc.gov.uk/our-work/rtde-project/>

⁹ <https://data.marine.gov.scot/dataset/finding-out-fate-displaced-birds>

¹⁰ <https://www.carbontrust.com/resources/bird-collision-avoidance-study>

¹¹ <https://group.vattenfall.com/uk/newsroom/pressreleases/2019/ornithology-embraces-the-digital-age-as-radars-to-be-deployed-on-ground-breaking-offshore-wind-research>

development in marine SPAs or development elsewhere that affects prey of interest features at terrestrial colonies. One example of this is Irish Sea Front SPA designated for Manx shearwater, and which has a conservation objective relating to prey availability within the site.

4. Obtaining an improved understanding of population dynamics and drivers of population change. Priority species: kittiwake, lesser black-backed gull, guillemot, razorbill and others.

We currently have a poor understanding of what maintains population size of marine bird SPA interest features. For example, is population size of kittiwakes breeding at the Flamborough and Filey Coast SPA maintained by birds fledged from that colony recruiting into the breeding population or is it supplemented by birds from other colonies? Is Flamborough and Filey Coast supporting colonies elsewhere by exporting young birds? How do changes to prey availability caused by commercial fisheries and climate change, influence survival and productivity of interest feature populations?

Without a good understanding of immigration and emigration in a meta-population dynamics context, and other drivers of change in demographic rates, we cannot reliably assess how populations will respond to additional anthropogenic mortality from offshore wind development and other pressures. This information is also of key importance when looking to implement compensation measures to augment the number of young kittiwakes recruiting into the breeding population. Improving understanding of drivers of population change and how populations are currently maintained will increase confidence in likely efficacy of proposed compensatory measures.

Information on immigration and emigration could be acquired through a strategic tracking system, such as colour ringing or automated resighting of marked birds such as MOTUS¹², as highlighted by Defra's Offshore Wind Enabling Actions Programme (see above). This would help both with understanding meta population dynamics to address questions outlined above and also provide more information on connectivity between offshore wind farm footprints and SPA colonies, i.e. are the birds using a wind farm area from a protected population?

5.4.4 Current research imminently or currently underway

Table 2 includes several published lists of evidence needs across ornithological receptors covering England, Wales and Scotland. Some of these evidence needs are being addressed by recent or ongoing research projects. For example, the ScotMER evidence map also lists research underway to address evidence needs listed, although the evidence maps are in the process of being updated at present.

The spreadsheet '**Ornithology-research-20210129**' that accompanies this report lists research projects currently underway and recently completed that address ornithology evidence needs in relation to offshore wind development. This includes projects where stakeholders responded to an email request by JNCC, but it is not a comprehensive list of all research currently underway. The list includes research currently underway by ORJIP and Marine Scotland.

No attempt has been made at this stage to match evidence needs identified by other fora to ongoing research in the accompanying spreadsheet. Doing so may be a useful next step, along with work towards producing a single centralised list of ornithology evidence needs

¹² <https://motus.org/>

Review of priority evidence needs around the impact of offshore wind development on key receptors and research underway

with indications of priority; this would require meaningful input from key stakeholders (including all SNCBs across the UK, RSPB, and others) if it were to be of value. Note that the accompanying spreadsheet is not comprehensive as not all those who were contacted for information were able to reply in the timeframe given, but it gives a reasonable representation of ornithology offshore wind research that is currently underway.

6 Future work and recommendations

This report and supporting spreadsheets provide a brief review of evidence needed to fill gaps in our understanding of the impacts of offshore wind development on benthic, marine mammal and ornithological receptors. The spreadsheets also list current and recently completed research projects of relevance to these evidence gaps. This information will be used by the Offshore Wind Evidence and Change Programme Steering Group, including TCE, Defra and BEIS, to select research to fund that will have the greatest impact in reducing consenting risk, helping to facilitate rapid deployment of offshore wind. However, this report and spreadsheets have been compiled quickly and with very little consultation and input from other key stakeholders involved with evaluating environmental impacts of offshore wind development marine mammal, ornithological and benthic receptors. Recognising plans to build on this project (see Section 5.1 below), we conclude with some recommendations for future work that would help develop review of environmental evidence needs and current research.

6.1 Recommendations

The following recommendations flow from our experience in collating the evidence priorities in this report and are also informed by comments from the Offshore Wind Evidence and Change Programme Steering Group Members, for which we are grateful. Additional work to develop the resources in the report might benefit from these observations.

6.1.1 Review of all lists of evidence needs

Whilst JNCC attempted to obtain all lists of evidence needs drawn up by different organisations, it is likely that we have overlooked some. For example, the Offshore Wind Industry Council may have a list that would be useful to consult and the Sectoral Marine Plan Post Adoption Statement lists research gaps / requirements in the sustainability appraisal¹³.

6.1.2 Synthesise and prioritise evidence needs

Compiling the multiple lists of evidence needs results in a very long list of evidence needs that cannot possibly all be addressed. The many differing evidence needs also illustrate the fact that there is no single shortlist of evidence needs, but rather evidence needs reflect each organisation's priorities and perspective. Therefore, to create a shortlist of high priority evidence needs, it is important to consider (a) which stakeholders should inform the prioritisation and (b) against which principles or criteria should prioritisation be made. In this report, JNCC has provided our own recommendations on high priority evidence needs, but that is only a single perspective from one stakeholder. It is essential that all key stakeholders are given the opportunity to contribute to identifying and agreeing high priority evidence needs. The approach developed by OWSMRF provides one model for how to effectively achieve a shared view on evidence prioritisation, whilst ORJIP is an alternative one and other initiatives might also provide valuable insights.

6.1.3 Produce an ornithology high priority evidence need list

This report presents lists of high priority evidence needs for marine mammals and benthic receptors, informed by the SNCBs (through the Marine Industry Groups), ORJIP, ScotMER and other sources. However, no such list currently exists for ornithological receptors, other than the ScotMER evidence map. Work is needed to identify and review high priority species

¹³ <https://www.gov.scot/publications/sectoral-marine-plan-post-adoption-statement/pages/12/>

and evidence needs for offshore wind development in English and Welsh waters, of particular relevance to Round 4. Some of the ScotMER evidence needs apply at a UK scale so duplication with ScotMER should be avoided. When developing a UK-wide list for ornithological receptors, it will be essential to consult key stakeholders. A useful starting point for this could be the Offshore Wind Enabling Actions Programme evidence list, presented in this report.

6.1.4 Developing a cross-receptor evidence need list

It may be helpful to create a single prioritised list of all evidence needs across all receptors with the same prioritisation process applied across all receptors. Whilst this would help greatly with evaluating project proposals submitted to the Offshore Wind Evidence and Change Programme, it will be difficult to do in a meaningful way. For example, whether a particular benthic evidence need is higher priority than an ornithological evidence need will be very hard to judge. In many cases, it will only be possible to rank evidence needs as high, medium or low priority, with many high priority evidence needs all requiring further research to reduce consenting risk.

6.1.5 Breaking down evidence needs into research questions

Evidence needs describe an area of work where we need more information. Research questions describe the research needed to obtain the right information in the right format to fill the evidence need; most evidence needs are informed by multiple research questions. It is important to bring relevant stakeholders together to identify questions that meet specific needs; there are differing levels of progress in doing this for different receptor groups and further development of research questions would be beneficial for some.

There are several ways to develop research questions, including effective methods for answering them, and these could be reviewed to identify the most effective approach. For example, OWSMRF stakeholders identified kittiwake collision risk as a high priority evidence need (or Knowledge Gap). During a workshop, technical experts identified multiple research questions (or Research Opportunities) that would help fill this evidence need (see report¹⁴ for more information). These high priority research questions could be used by researchers and experts in the field to shape their proposals for programme funding. The ORJIP approach was to invite submission of short research specifications, which were prioritised initially by a consideration at a diverse stakeholder forum (Advisory Network), with the final high priority projects being selected by the ORJIP SG members. The questions and specifications for those selected as high priority were then refined by expert panels, comprising representatives from the SNCBs, NGOs and industry.

6.1.6 Technological and modelling advances

Both technology and modelling/statistical approaches are advancing rapidly. For example, tags suitable for attachment to birds are becoming smaller and smaller, enabling tags to be deployed on smaller birds and for longer periods, resulting in more and better empirical data. New modelling approaches and better computing power are also creating new opportunities for interrogating existing data. These advances in themselves do not represent an evidence need but offer novel and innovative means of tackling research to address evidence gaps.

¹⁴ <https://hub.jncc.gov.uk/assets/bbe5e9fa-0ef2-4cb7-a34a-a9c87960bb75>

6.1.7 Collate current research into a single database

The receptor-specific spreadsheets that support this report each have a different structure and present different information. This makes it difficult to easily draw out information required. These spreadsheets would be better presented as a single database that can be easily searched, updated and maintained. Useful fields to include in the database are: receptor, knowledge gap, impact on consenting, recommended research, has it been scoped, current research underway, expected completion date, implementation steps (e.g. decision making or policy or modelling), and prioritisation scale. The ScotMER evidence maps provide much of this information in a clear accessible format and could be a useful model to follow.

6.1.8 Broaden the scope of current research to include work outside the UK

The spreadsheets of current research provided alongside this report consider only UK-based research. However, there is a lot of relevant and transferable research underway, particularly elsewhere in Europe, addressing the same evidence needs for the same or similar species. In some cases, the same individuals of migratory bird and mammal species are subject to offshore wind impacts in both the UK and Europe. Therefore, we recommend adding current research that is underway in Europe on species that cause consent risk in the UK.

6.1.9 Cross-reference evidence needs and current research

The purpose of the list of current research projects is to assist with reviewing whether a project proposal to the Offshore Wind Evidence and Change Programme is novel research or whether work under that evidence need is already underway. However, the spreadsheets do not currently explicitly link current research to a particular evidence gap. Mapping very recent and ongoing research to evidence priorities would be a useful process to enable easier identification of possible duplication.

6.1.10 Review the evidence base

It may be helpful to commission a series of short reviews for high priority evidence gaps to understand the evidence base and identify gaps in current evidence. Whilst lists of current research identify work that is currently underway, obtaining a review of what is already known and what is not known may be more helpful. The OWSMRF reports¹⁵ each have a comprehensive detailed evidence base review at the start of the report which serves the dual purpose of providing a single accessible point of reference for current state of knowledge on a particular evidence need and identifying gaps in our knowledge that require further research.

¹⁵ <https://jncc.gov.uk/our-work/owsmrf/>

Version Control

Version	Changes	Action
15.12.20, v1.0	First draft by SO, with input from BH and SC	Sent to JB, LR, SM and KH for QA
18.12.20, v1.1	Comments incorporated from JNCC staff QA plus limited SNCB input	Sent to HB and KH for final comment
04.01.21, v1.2	Final draft edit by HB and comments	Sent to SO for final additions
05.01.21, v1.3	Final draft additions incorporated	Sent to HB and KH
08.01.21, v1.4	Approved for submission to TCE by HB	Sent to TCE
28.01.21, v2.0	Incorporation of PSG and TCE comments by SO, BH, SM, SC and LM	Sent to KH and HB for final review
29.01.21, Final draft	Approval by KH and HB	Sent to TCE for final comments
22.02.21, Final	Incorporation of additional final comments from TCE by SO, BH and SM; approval by HB	Final version sent to TCE

Evidence Quality Assurance Process

JNCC's Evidence Quality Assurance standards (<https://data.incc.gov.uk/data/5f7aa652-69b5-48ab-8239-dbccc5333d09/jncc-evidence-quality-assurance-2019-A.pdf>) were met through the following processes.

The benthic receptor evidence needs and research underway spreadsheet was collated by Becky Hitchin with input by Tetrienne Kerswell-Box, Thomas Fey. It was subsequently reviewed by Karen Hall.

The marine mammal receptor evidence needs and research underway spreadsheet was collated by Sarah Canning and subsequently reviewed by Sonia Mendes.

The marine mammal receptor evidence needs and research underway information was collated by Sue O'Brien with input by Danni Thompson and Orea Anderson. It was subsequently reviewed by Julie Black and Lise Ruffino.

Helen Baker and Karen Hall provided comment on various drafts of this report.

Additional comments on a draft version of this report (13th January 2021) were received from Mandy King (TCE), Ed Salter (TCE), Rosie Kelly (TCE), Alicia Green (RUK), Annie Breaden (CES), Erica Knott (NS), Janelle Braithwaite (MS), Tania Davey (TWT) and Amy Stubbles (Defra). All these comments were addressed as far as possible in this final report.

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7 Appendix: Programme Steering Group Member Organisations

List of Offshore Wind Evidence and Change Programme Steering Group Member Organisations (as at Feb 2021)

Centre for Environment, Fisheries and Aquaculture Science

Crown Estate Scotland

Department for Business, Energy and Industrial Strategy - Programme Partner

Department for the Economy, Northern Ireland

Department for Environment, Food and Rural Affairs - Programme Partner

Department of Agriculture, Environment and Rural Affairs, Northern Ireland

Historic England

Maritime and Coastguard Agency

Joint Nature Conservation Committee – authors of this report

Marine Management Organisation

National Grid Electricity System Operator

National Grid Transmission Owner

Natural England

Natural Resources Wales

NatureScot

Offshore Wind Industry Council / Pathways to Growth

Office of Gas and Electricity Markets

The Planning Inspectorate

RenewableUK

Royal Society for the Protection of Birds

Scottish Government (Marine Scotland)

Seabed User and Developer Group

The Crown Estate - Programme Lead

The Wildlife Trusts

Trinity House

Welsh Government