THE CROWN ESTATE

Pentland Firth and Orkney Waters Enabling Actions Report

Ornithological Cumulative Impact Assessment Framework

Published by The Crown Estate.

This report is available on The Crown Estate website at: www.thecrownestate.co.uk

ORNITHOLOGICAL CUMULATIVE IMPACT ASSESSMENT FRAMEWORK
PENTLAND FIRTH AND ORKNEY WATERS WAVE & TIDAL PROJECTS

This report has been published by The Crown Estate as part of our enabling work to support development of the Pentland Firth and Orkney waters wave and tidal projects. This work aims to accelerate and de-risk the development process, looking at a range of key issues. Work is selected, commissioned and steered by The Crown Estate in close discussion with the project developers.

For more information on The Crown Estate's work in wave and tidal energy, see www.thecrownestate.co.uk/energy/wave-and-tidal/
or contact waveandtidal@thecrownestate.co.uk.

The Ornithological CIA framework and supporting information has been developed to assist the wave and tidal current industry in the production of ornithological cumulative impact assessments with the intention of reducing delays in the consenting process. However, this does not constitute statutory guidance and developers are under no obligation to follow the steps as presented here.

Marine Scotland and SNH, as part of the Project Steering Group, have reviewed the documents and have indicated their broad support of the approach adopted in the framework and worked example.

MacArthur Green was commissioned by The Crown Estate to produce a methodological framework for the assessment of ornithological cumulative and in combination impacts of the Pentland Firth and Orkney Waters (PFOW) wave and tidal projects. This work is part of The Crown Estate's Enabling Actions work to accelerate and de-risk the development of the PFOW wave and tidal projects.

This report details the Ornithological CIA Framework and is divided into four sections:

- Pentland Firth and Orkney Waters Wave and Tidal Projects Ornithological Cumulative Impact Assessment Framework. This report provides the background to CIA for wave and tidal current developments in the Pentland Firth and Orkney Region and presents detailed guidance on the steps involved.
- Appendix 1 - Supporting Information. This contains detailed information in support of the CIA Framework and a Strategic Review of potential seabird impacts.
- Appendix 2 – CIA Worked Example Scoping Report. This report provides a worked example of a scoping report for a hypothetical wave site in Scapa Flow.
- Appendix 3 – CIA Worked Example. This report provides a worked example of an Ornithological CIA for a hypothetical wave site in Scapa Flow.

This guidance has been developed through detailed consultation with the Project Steering Group and wider consultation with various organisations through a workshop held on 11 October 2012. The Project Steering Group comprised representatives from The Crown Estate, from the regulators and their advisors (Marine Scotland Science, Marine Scotland Licencing, Scottish Natural Heritage and Joint Nature Conservation Committee) and the renewables industry (Niras Consulting [as adviser to The Crown Estate for this project], ScottishPower Renewables, Aquamarine Power and SSE Renewables). MacArthur Green and The Crown Estate wish to thank the Project Steering Group and the various attendees of the workshop who have contributed valuable input to the development of this guidance. We also wish to thank JNCC for their helpful advice and previews of reports in preparation.

This report should be cited as:
MacArthur Green (2013). Ornithological Cumulative Impact Assessment Framework: Pentland Firth and Orkney Waters Wave and Tidal Projects. Report commissioned by The Crown Estate.

MacArthur Green

ORNITHOLOGICAL CUMULATIVE IMPACT ASSESSMENT FRAMEWORK

PENTLAND FIRTH AND ORKNEY WATERS WAVE & TIDAL PROJECTS

ORNITHOLOGICAL CIA FRAMEWORK

Prepared by:
David MacArthur, Professor Bob Furness, Dr Mark Trinder & Kirsty MacArthur

Date: 30th May 2013

Tel: 0141 342 5404
Web: www.macarthurgreen.com
Office: 95 South Woodside Road |Glasgow | G20 6NT

CONTENTS

LIST OF TABLES & FIGURES - FRAMEWORK

Figures

Tables:

ACRONYMS

CIA	Cumulative Impact Assessment
CFD	Cumulative Frequency Distribution
EC	European Commission
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
ES	Environmental Statement
EU	European Union
HRA	Habitats Regulations Appraisal
JNCC	Joint Nature Conservation Committee
MS	Marine Scotland
NCI	Nature Conservation Importance
PFOW	Pentland Firth and Orkney Waters strategic development area
PFSA	Pentland Firth Strategic Area
SAC	Special Area for Conservation
SNCBs	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TBP	Target Bird Populations

EXECUTIVE SUMMARY

MacArthur Green has been commissioned by The Crown Estate to produce a methodological framework for the assessment of ornithological cumulative and in combination impacts of the Pentland Firth and Orkney Waters (PFOW) wave and tidal projects. This work is part of The Crown Estate's Enabling Actions work to accelerate and de-risk the development of the PFOW wave and tidal projects.

This report details the Ornithological CIA Framework and is supported by the following three appendices:

- Appendix 1: Ornithological Cumulative Impact Assessment Framework. Pentland Firth and Orkney Waters Wave and Tidal Projects; Supporting Information. This report contains all associated appendices and the Strategic Review completed as part of this project.

- Appendix 2: Ornithological Cumulative Impact Assessment Framework. Pentland Firth and Orkney Waters Wave and Tidal Projects; Worked Example Scoping Report. This report provides a scoping report for a hypothetical wave site.

- Appendix 3: Ornithological Cumulative Impact Assessment Framework. Pentland Firth and Orkney Waters Wave and Tidal Projects; Worked Example. This report provides a worked example of an Ornithological CIA for a hypothetical wave site.

The conclusion of the Strategic Review included in Appendix 1 is that wave and tidal current developments will have a relatively low impact on PFOW seabird populations, particularly in comparison to other factors affecting seabird populations.

This guidance has been developed through detailed consultation with the Project Steering Group and wider consultation with various organisations through a workshop held on 11 October 2012. The Project Steering Group comprised representatives from The Crown Estate, from the regulators and their advisors (Marine Scotland Science, Marine Scotland Licencing and Scottish Natural Heritage) and the renewables industry (Niras Consulting [as adviser to The Crown Estate for this project], ScottishPower Renewables, Aquamarine Power and SSE Renewables). MacArthur Green and The Crown Estate wish to thank the Project Steering Group and the various attendees of the workshop who have contributed valuable input to the development of this guidance. We also wish to thank JNCC for their helpful advice and previews of reports in preparation.

Marine Scotland and SNH, as part of the Project Steering Group, have reviewed the documents and have indicated their broad support of the approach adopted in the framework and worked example.

The Environmental Impact Assessment (EIA) Regulations and Habitats Regulations both require the full consideration of cumulative impacts. Although the Habitats Regulations refer to 'in combination' impacts instead of cumulative impacts, this report refers to these as 'Ornithological Cumulative Impact Assessment' (Ornithological CIA).

Ornithological CIA has proven to be challenging. In the context of Ornithological CIA for offshore wind farm developments, King et al. (2009) found that the approach lacked a systematic, standardised method and data. The approach was often qualitative rather than quantitative. This created uncertainty over conclusions, and ultimately caused delays in the consenting process. Causes of these issues were:

1. Inadequate scoping;

2. Lack of understanding of which species/populations were involved;
3. Lack of understanding of which projects should be included;
4. Lack of systematic assessment methodology;
5. Tendency for CIA to be left to the end of the consenting process as an 'add-on' rather than being approached in the same strategic way as EIA.

The reason that this Ornithological CIA method has been prepared is to provide guidance to avoid similar issues arising for wave and tidal developments in the PFOW. This will help developers to submit comprehensive and proportional Ornithological CIA as part of their Environmental Statement (ES), and will ultimately help to speed up the consenting process by ensuring regulators and their advisors receive sufficient information on which to make consenting decisions in a timely fashion.

The invitation to tender from The Crown Estate detailed the aim of this Project:

'*The aim of the Project is to produce a methodological framework to help guide, in an agreed and consistent manner and in the potential absence of information on other projects and/or species abundance, PFOW developer Cumulative Impact Assessments (CIA) in the identification and analysis of ornithological cumulative and in-combination impacts at the project level.*'

The aim is achieved by the following objectives:

(Objective 1) Define the Ornithological CIA Framework and detail clearly the stages involved within it.

(Objective 2) For each relevant stage of the Ornithological CIA Framework, provide guidance on the recommended approach and methods to address areas of uncertainty.

(Objective 3) Make recommendations as to the need for, and benefits of, further strategic work regarding Ornithological CIA and the consenting of wave and tidal projects in the PFOW.

(Objective 4) Complete a high level strategic review of the factors influencing the dynamics of seabird populations, putting potential cumulative impacts of wave and tidal current projects into the wider context of changing background numbers of seabirds (Appendix 1, Section 5).

The following Ornithological CIA Framework and associated stages are identified under Objective 2 and recommendations provided for each of these stages where relevant.

Stage	**Description**
1.	Scoping
2.	Define the Target Bird Populations and designated sites to include in the Ornithological CIA
3.	Defining the plans and projects to include in the Ornithological CIA
4.	Identifying relevant Cumulative Impacts to consider in the Ornithological CIA
5.	Define Vulnerability of Target Bird Populations to development
6.	Establish Conservation Status of Target Bird Populations and their respective baselines for the assessment
7.	Detail relevant data collection methods
8.	Data acquisition from other developments
9.	Detail relevant data analysis methods, compatibility and presentation
10.	Determine the significance of Cumulative Impacts
11.	Mitigation Measures
12.	Residual Effects

Ornithological CIA should be fully integrated into the EIA and Habitats Regulations Appraisal (HRA) processes. It is important to emphasise here that it should **<u>not</u>** be seen as a separate process; the intention of the EIA Regulations and the Habitats Regulations is that cumulative / in combination impacts are an integral part of the assessment and should therefore be considered from the very beginning of the assessment process. It is essential therefore that the Ornithological CIA should be clearly integrated into these **established processes** and related methodologies. The intention is that this Framework serves to help with this and serves to create a more consistent, proportionate and certain process for all.

Recommendations are given for further strategic work for Ornithological CIA under Objective 3. It is recommended that it would be beneficial to undertake further strategic work on the following issues:

- Identifying Target Bird Populations and projects relevant to each PFOW wave and tidal project;
- Data acquisition;
- Assessment of existing data that could inform on impacts on seabirds;
- Determination of thresholds for acceptable population change; and,
- Updated data on SPA populations.

A strategic review is completed under Objective 4 as noted above (Framework Section 6). This review concludes that wave and tidal current energy developments will have a relatively low impact on PFOW seabird populations when compared with other impacts. These include food abundance, fisheries, mammal predation and climate change. Against this backdrop of large scale effects on seabird populations, any impacts from wave and tidal current energy projects may be too low to detect, even when considering changes to the most vulnerable seabird populations. In light of this conclusion, it is our view that Ornithological CIA for wave and tidal current energy developments and statutory authorities should take into consideration the relatively minor nature of the predicted ornithological impacts.

Finally, it is important to note that information on bird sensitivities, population vulnerability, population sizes and conservation status will continue to be updated, and information presented in this report will need to be revised regularly to take account of new information, rather than being considered a static resource. Post-construction monitoring at developed sites will play an important role in refining our understanding of the potential (cumulative) impacts and also, therefore, this guidance.

The Ornithological CIA Framework and supporting information has been developed through a workshop and detailed engagement with key stakeholders. However, it is important to stress that it is not statutory guidance and is not intended to detail a specific process/approach which developers are required to follow.

Developers will of course take their own approach to ornithological CIA, and that approach will no doubt need to reflect relevant issues on a site-specific basis. The aim of the framework and supporting information is to assist those involved in consenting and ornithological CIA and promote a more consistent, proportional and practical approach to ornithological CIA.

1. INTRODUCTION

The Environmental Impact Assessment (EIA) Regulations and the Habitats Regulations both require the full consideration of cumulative impacts (as detailed in Section 3 below). Although the Habitats Regulations refer to 'in combination' impacts instead of cumulative impacts, there is no basis for any difference between the two terms in the legislation. Thus, while EIA legislation uses one term and the Habitats Regulations use another, the requirement to take account of the effects of other projects which may add to or act with the effects of the proposed development on a particular receptor is the same in both cases. This report therefore refers to and includes both of 'in combination' and 'cumulative' in the term 'Cumulative Impact Assessment' (CIA). In 2008, The Crown Estate announced the first leasing round for wave and tidal projects in the PFOW Strategic Area (Figure 1). Following a competitive leasing round, The Crown Estate entered into agreements for lease for 11 projects with a potential capacity of up to 1,600 MW in PFOW. More recently (2012), Scotrenewables was awarded an Agreement for Lease for a 30MW commercial demonstration project in Lashy Sound (Orkney).

Experience of operating wave and tidal current array projects is limited and unprecedented at the scale planned in the PFOW, so environmental impacts cannot simply be inferred from studies elsewhere at existing sites of the same type. The projects also represent a challenge in that the area is important for many species of seabirds, which is reflected by the number of Special Protection Areas (SPAs) within the PFOW[1]. However, it is important to bear in mind that ultimately, wave and tidal energy developments will have a relatively low impact on PFOW seabird populations when compared to other impacts. These include food abundance, fisheries, mammal predation and climate change. Any impacts from wave and tidal current energy projects may be too low to detect, even when considering changes to the most vulnerable seabird populations. This conclusion is explained within the high level strategic review of the factors influencing the dynamics of seabird populations within the Supporting Information (Appendix 1 Section 5). In light of this conclusion, it is our view that Ornithological CIA for wave and tidal current energy developments and statutory authorities should take into consideration the relatively minor nature of the predicted ornithological impacts.

[1] 14 SPAs and 1 Ramsar Site (ABPmer, 2010. P.24)

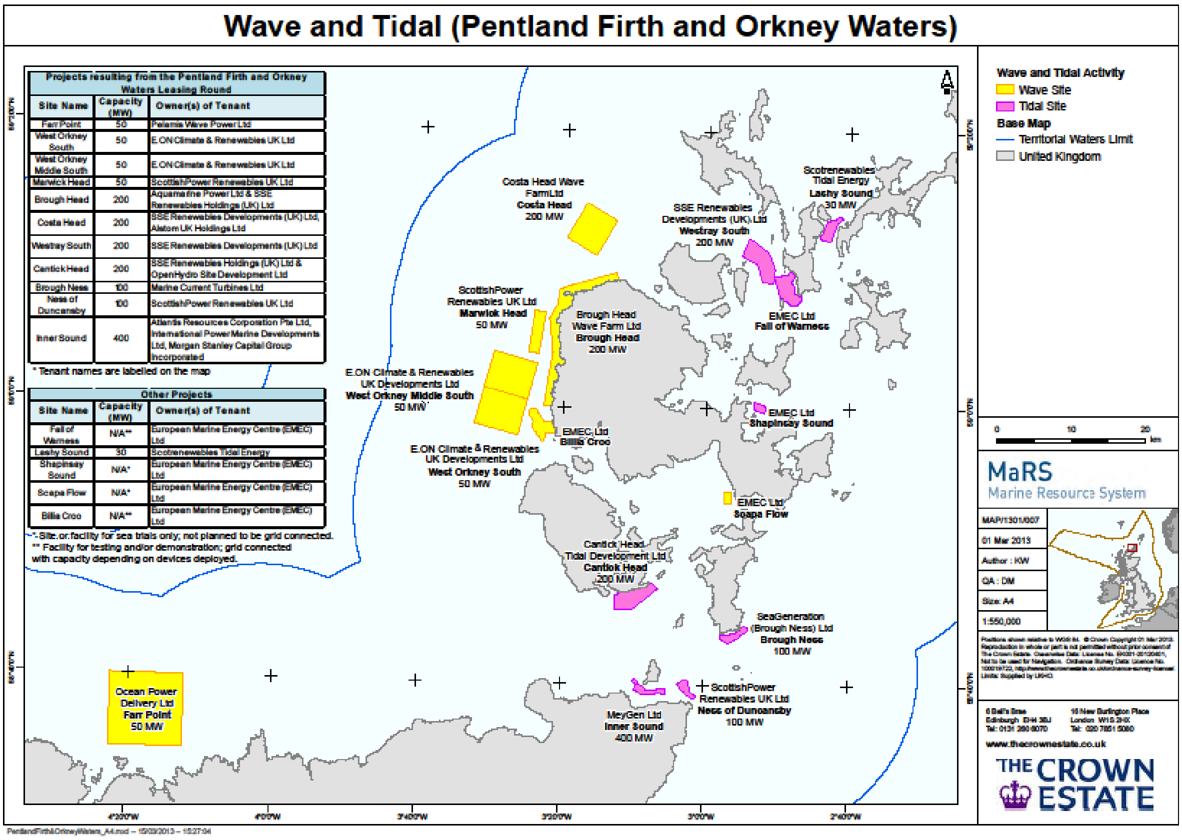


Figure 1. Pentland Firth & Orkney Waters Wave and Tidal Projects.

Ornithological CIA has proven to be challenging in other industries. In the context of Ornithological CIA for offshore wind farm developments, King et al. (2009) found that the approach lacked a systematic, standardised method and data. This created uncertainty over conclusions, and ultimately caused delays in the consenting process. Causes of these issues were:

1. Inadequate scoping;
2. Lack of understanding of which species/populations were involved;
3. Lack of understanding of which projects should be included;
4. Lack of systematic assessment methodology;
5. Tendency for CIA to be left to the end of the consenting process as an 'add-on' rather than being approached in the same strategic way as EIA.

The reason that this Ornithological CIA framework has been prepared is to provide guidance to avoid similar issues arising for wave and tidal current developments in the PFOW. This will help developers to submit comprehensive Ornithological CIA as part of their Environmental Statement (ES), and will ultimately help to speed up the consenting process by ensuring regulators and their advisors receive sufficient information on which to make consenting decisions in a timely fashion.

Currently eight of the PFOW wave and tidal projects have undertaken scoping. This report will provide guidance to inform Ornithological CIA for these projects and potential future PFOW projects, which includes approaches to scoping.

Of the 11 PFOW commercial lease sites and one commercial demonstration site in PFOW, only one (Inner Sound, MeyGen) has submitted an application (July 2012) for phase one of its development. The remaining projects are at various stages, between pre-scoping and baseline surveying. **It is recommended that these projects, for which the ES has not been completed, should review their**

proposed approach to Ornithological CIA based on this Framework, and, at the appropriate time, discuss their approach with SNH and Marine Scotland.

Several key documents help to outline a potential approach to Ornithological CIA for the PFOW projects. These include:

- the analogous guidance for development of Ornithological CIA for offshore wind farms (King et al. 2009);
- a report to inform Appropriate Assessment for the Pentland Firth strategic area (PFSA) first leasing round (ABPmer 2010) which considered Appropriate Assessment for the PFOW Wave and Tidal leasing programme;
- a discussion document on the identification of cumulative and in-combination effects associated with wave and tidal development in the Pentland Firth and Orkney Waters (Royal Haskoning 2011);
- The Crown Estate's PFOW CIA project (AMEC 2013)
- an unpublished report to Scottish Natural Heritage (SNH) on Assessment methodology for determining cumulative impacts of wave and tidal marine renewable energy devices on marine birds (RPS 2010); and
- reports to Marine Scotland on vulnerability of Scottish seabird populations to adverse effects from offshore wind farms (Furness and Wade 2012; Furness et al. 2013) and to SNH on vulnerability of Scottish seabird populations to adverse effects from wave and tidal current energy developments, published in the ICES Journal of Marine Science (Furness et al. 2012).

In addition to these existing documents, there are several reports that are currently in development which provide important information and guidance. These include:

- a draft paper by JNCC (Sophy Allen and Finlay Bennet) written with inputs from Natural England, Countryside Council for Wales and SNH 'Assigning predicted effects of marine renewable energy projects to seabird populations in the context of complying with the Habitats Regulations';
- guidance being developed by SNH on the application of data on seabird foraging ranges to assess connectivity between seabird SPA breeding sites and developments; and
- a draft Cumulative Impact Assessment Methods report by West Coast Developers' Group (King 2012) which sets out the key issues for the CIA for seabirds of the SSER (Islay) and SPR (Argyll Array) offshore wind farms.

Further work, which is not expected to be available in final form until later in 2013, is also being carried out by SNH on apportioning impacts between SPA populations. However, a draft of the work is available (SNH & JNCC, 2012) and its approach has been used in the worked example (Appendix 3).

This report draws on these key documents, other relevant literature and expertise, and a variety of sources of data. Detailed information and data used in this report are presented in Appendices and referred to where relevant.

Experience is drawn from the previous work on CIA for offshore wind farms in this report as there are a number of lessons to be learned from this work with regards to the efficiency of the CIA process and achieving consistently high quality and comparable Ornithological CIAs.

It is important to note that information on bird sensitivities, population vulnerability, population sizes and conservation status will all change over time, and information presented in this report will need to be updated regularly, rather than being considered a static resource. Post-construction monitoring at developed sites will also play an important role in refining our understanding of the potential (cumulative) impacts and therefore this guidance too.

2. AIMS AND OBJECTIVES

The aim of this project is defined by The Crown Estate's invitation to tender. This is detailed below:

'The aim of the Project is to produce a methodological framework to help guide, in an agreed and consistent manner and in the potential absence of information on other projects and/or species abundance, PFOW developer Cumulative Impact Assessments (CIA) in the identification and analysis of ornithological cumulative and in-combination impacts at the project level.'[2]

The aim is achieved by the following objectives:

(Objective 1) Define the Ornithological CIA Framework and detail clearly the stages involved within it (Section 4.1).

(Objective 2) For each relevant stage of the Ornithological CIA Framework, provide guidance on the recommended approach and methods to address areas of uncertainty (Section 4.2).

(Objective 3) Make recommendations as to the need for, and benefits of, further strategic work regarding Ornithological CIA and the consenting of wave and tidal projects in the PFOW (Section 5).

(Objective 4) Complete a high level strategic review of the factors influencing the dynamics of seabird populations, putting potential cumulative impacts of wave and tidal current into the wider context of changing background numbers of seabirds (Section 6).

3. LEGISLATION AND POLICY FRAMEWORK

The legislation and policy framework relevant to Ornithological CIA is summarised below.

Guidance on the EIA and Habitats Regulations Appraisal (HRA) for wave and tidal current developments in Scotland is provided in Section 6 of Marine Scotland's draft Licensing and Consents Manual, covering wave, tidal current and offshore wind energy developments (ABP Marine Environmental Research Ltd October 2012) and SNH (2009).

The two areas of legislation requiring consideration in relation to Ornithological CIA are: (1) those affecting designated sites (particularly 'European Sites') and; (2) those affecting non-designated areas ('wider-countryside').

Plans or projects with the potential to affect Special Protection Areas ('SPAs') and Special Areas of Conservation ('SACs'), referred to as 'European Sites' (SNH, 2009), will require an HRA under the Habitats Regulations. The only European Sites that are relevant to this guidance are SPAs as these are designated for their ornithological interest. The competent authority (usually the authority which grants consent) undertakes both the HRA and the Appropriate Assessment which forms part of the HRA (Appendix 1, Section 1 details stages involved in a HRA). The developer is required to provide the relevant information to inform the HRA and the AA should this be required.

European Sites are designated under the Habitats Directive 92/43/EEC and Wild Birds Directive (2009/147/EC). These have been transposed into Scottish legislation by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (SI 1994/2716) ('The Habitats Regulations'), the

[2] (The Crown Estate's Invitation to Tender, April 2012)

Conservation of Habitats & Species Regulations 2010 in relation to reserved matters (SI 2010/490) and The Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended).

The Habitats Regulations require the consideration of cumulative impacts – termed 'in combination' impacts in the Habitats Regulations. Regulation 48 paragraph 1 of the Habitats Regulations is detailed below for ease of reference:

'(1) A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which –

(a) Is likely to have a significant effect on a European site[3] in Great Britain (either alone or ***in combination*** *with other plans or projects), and*
(b) Is not directly connected with or necessary to the management of the site,

shall make an Appropriate Assessment of the implications for the site in view of that site's conservation objectives.'

Ramsar sites are designated under the Ramsar Convention on Wetlands of International Importance (1976). The convention's particular focus is the protection of waterfowl habitat. Scottish Office Circular 6/1995 (updated June 2000) explains that, '*The Convention requires contracting parties to designate suitable wetlands ("Ramsar sites") for inclusion in a list of wetlands of international importance and to formulate and implement their planning so as to promote the conservation of the wetlands included in the list, and as far as possible the wise use of wetlands in their territory.'* Given that most Ramsar sites are designated for internationally important numbers of birds, they are also often designated as an SPA. Where a Ramsar site is not designated as an SPA, it is afforded the same level of protection as an SPA as a matter of policy[4]. A full list of Ramsar sites within Scotland is provided on the JNCC website[5].

Where plans or projects do not impact an SPA, but do impact upon the wider-countryside and/or a Site of Special Scientific Interest ('SSSI') (and any Marine Protected Area (MPA); see below), they need to consider the relevant EIA Regulations (provided the plan or project is classified as requiring an EIA). These Regulations differ for onshore and marine developments; onshore developments: The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (SI 2011/139); Marine developments: The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (SI 2000/320) and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2007 (as amended) (SI 2007/1518). All these sets of Regulations are referred to here as the 'EIA Regulations'. Developments affecting SSSIs should also consider provisions detailed within the Nature Conservation (Scotland) Act 2004 (as amended) and Wildlife and Countryside Act 1981 (as amended). EIA Regulations require cumulative impacts to be considered within the Environment Statement[6].

It is likely that in the near future, certain sites within the PFOW will be designated as Marine Protected Areas (MPAs). MPAs will be designated under The Marine (Scotland) Act 2010. The Marine (Scotland) Act 2010 (Section 83) requires the consideration impacts of plans and projects on

[3] European Site in terms of the Habitats Regulations is defined in Regulation 10 as being special sites of conservation, SPAs (as defined in Article 4(1) of the Wild Birds Directive (Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the codified version)), sites of Community Importance designated by the European Commission under the Habitats Directive, and potential SACs awaiting designation.

[4] 'For those sites which qualify for designation only under the Ramsar Convention (and not as SAC or SPA) the Scottish Executive has chosen as a matter of policy to apply the same considerations to their protection as if they were classified as SPAs. SNH will be able to advise planning authorities on the conservation of Ramsar sites'. Scottish Office Circular 6/1995 (updated 2000)

[5] http://jncc.defra.gov.uk/page-1391

[6] See Schedule 4, Paragraph 3 and 4 of the EIA Regulations & Para. 48 of PAN 58 & P.20 EMEC and Xodus Group, April 2010.

MPAs. Although cumulative or in combination impacts are not mentioned explicitly within the Act, it is likely that the assessment of cumulative impacts will have to be considered within the assessment procedure detailed within Section 83(4a).

Assessment of impacts on European Sites, MPAs, SSSIs and the wider countryside can all fall under the EIA Regulations where a development may have an impact on protected interests.[7,8] All assessments should be included within an ES for the proposed development.[9]

Therefore in summary, the EIA Regulations are the relevant Regulations that determine the decision making process for SSSIs and wider countryside developments (assuming they are classified as EIA developments). The Marine (Scotland) Act details the decision making framework relevant to MPAs and the Habitats Regulations set out the appropriate decision making framework for European Sites. The HRA is entirely independent of the EIA Regulations.[10] Nonetheless, an ES is required to meet the requirements of the HRA as well as EIA Regulations[11].

4. ORNITHOLOGICAL CIA FRAMEWORK (OBJECTIVES 1 – 2)

Section 4.1 below addresses Objective 1 ('Define the Ornithological CIA Framework and detail clearly the stages involved within this').

Section 4.2 below addresses Objective 2 ('For each relevant stage of the CIA Framework, provide guidance on the recommended approach and methods to address areas of uncertainty').

4.1 Defining the Ornithological CIA Framework (Objective 1)

Ornithological CIA should be fully integrated into the EIA and HRA processes (Norman et al. 2007; SNH, 2009). It is important to emphasise here that it should **not** be seen as a separate process; the intention of the EIA Regulations and the Habitats Regulations is that cumulative / in combination impacts are an integral part of the assessment and should therefore be considered from the very beginning of the assessment process.

It is recommended that the Ornithological CIA Framework (also referred to as 'the Framework' within this report) developed here is clearly integrated into these established processes and related methodologies. To inform this, the relevant EIA and HRA processes, Ornithological Impact Assessment methods and recommendations from King et al (2009) were reviewed and are summarised in Appendix 1, Section 1.

It is important to emphasise that Ornithological CIA is a component of CIA, as currently required under EIA Regulations, and not an additional requirement. Therefore, this Framework provides guidance on how the existing requirement of Ornithological CIA may be undertaken. The Ornithological CIA method detailed within this Framework also shares a similar approach to CIA for other disciplines – scoping, assessment and submission of the ES (Figure 2).

---

[7] EU 2010 Guidance (defined in Annex A), page 24, para. 2.5.3.
[8] SNH, 2009. P227
[9] Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'), June 2000 Revised Guidance updating Scottish Circular No. 6/1995, Annex E, Appendix A: Consideration of Development Proposals Affecting SPAs and SACs.
[10] EU 2010 Guidance (defined below), page 24, para. 2.5.3.
[11] Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('The Habitats and Birds Directives'), June 2000 Revised Guidance updating Scottish Circular No. 6/1995, para. 12.

Table 1 below details the Ornithological CIA Framework that has been produced from this review. Figure 2 is adapted from ABPmer (2012) and illustrates how the Framework fits into these established processes. It is important to emphasise the following points on the Framework:

- It should be clear to any EIA practitioner, particularly those who undertake Ornithological Impact Assessments, that the Framework follows the standard process and method employed for assessing impacts on bird populations. This is because a new process is not being proposed here; rather the focus is on providing guidance on how the various elements of Ornithological CIA could be undertaken as part of the established EIA and HRA processes in order to improve the quality of Ornithological CIA and the consistency across projects.

- The Framework identifies 12 Stages. These stages are broadly in chronological order (e.g. Scoping is usually undertaken at the beginning of the EIA process and consideration of residual effects towards the end) however many of the identified steps may run in tandem and overlap.

- Scoping refers to the general EIA scoping report that is submitted by developers to Marine Scotland and statutory consultees for comment. It is identified as a distinct stage in the Framework as it is considered that guidance is required on the type of information that should be included at the scoping stage to inform the ornithological assessment (which includes the CIA). Scoping will however involve detailing information that is noted within other Stages of the Framework.

- The Framework has to consider the requirements of the EIA and HRA processes. Even though these are independent processes it is possible to combine them within the Framework as they have similar attributes. It is however important to be aware of the differences between the two and these are detailed within Table 1.

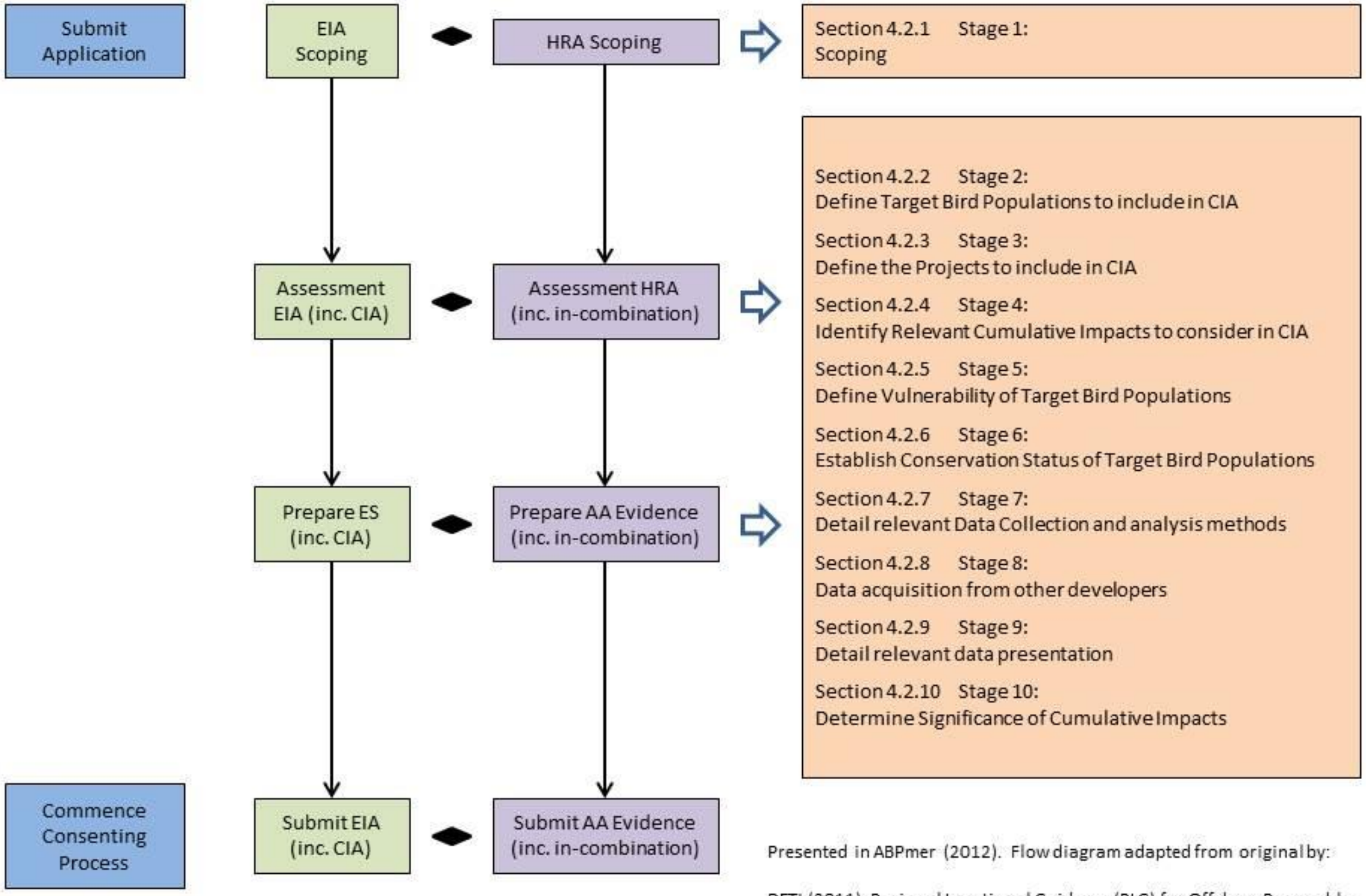
Table 1. Ornithological CIA Framework for PFOW Wave and Tidal Projects

Stage	Description	Consideration of Differences Between EIA and HRA
1	**Scoping**	This can apply to both processes. However, this stage may also deal with the Screening/Likely Significant Effect (LSE) stage of the HRA process, detailing mitigation measures where appropriate, and (assuming that the LSE test is positive) provide details on the proposed approach to assessing the impact of the project on the integrity of the SPA in light of the SPA's conservation objectives.
2	**Refine the Target Bird Populations and designated sites to include in the Ornithological CIA**	This applies to both processes although the relevant Target Bird Populations may differ.
3	**Refining the projects to include in the Ornithological CIA**	This applies to both processes, however, the relevant plans or projects may differ between EIA and HRA due to differences in the foraging ranges of the relevant Target Bird Populations.
4	**Identifying relevant Cumulative Impacts to consider in the Ornithological CIA**	These are likely to be the same for both processes. Although consideration will need to be given to the conservation objectives affected by the various impacts within the HRA.
5	**Define vulnerability of Target Bird Populations to development**	This applies to both processes.
6	**Establish Conservation Status of Target Bird Populationsand their respective baselines for the assessment.**	This applies to both processes although the Target Bird Population for an SPA will be the SPA's population, whereas the Target Bird Population for EIA will be either the regional population, flyway population or subspecies population.

Stage	Description	Consideration of Differences Between EIA and HRA
7	**Detail relevant data collection methods**	This applies to both processes. However, data collection methods may vary between EIA and HRA due to differences in information requirements (e.g. information has to be collected to assess impacts on an SPA's conservation objectives).
8	**Data acquisition from other developments**	This applies to both processes although the relevant projects may vary between EIA and HRA depending on the Target Bird Population under consideration.
9	**Detail relevant data analysis methods, compatibility and presentation**	This applies to both processes although they are likely to vary due to the differing assessment requirements for an SPA.
10	**Determine the significance of Cumulative Impacts**	Significance should be established through considering the above factors (Nature Conservation Importance, Conservation Status, Impacts, Vulnerability and Magnitude of Impact). For the purpose of this report, assessing the magnitude of impact falls within this stage. Spatial and Temporal magnitude will have to be established for both EIA and HRA and these are likely to differ depending on the Target Bird Populations under consideration. The significance test will differ between EIA and HRA processes. The HRA requires that the focus of the assessment should be on objectively demonstrating, with supporting evidence, that there will be no adverse effects on the integrity of the Natura 2000 site, in light of its conservation objectives.

Stage	Description	Consideration of Differences Between EIA and HRA
11	Mitigation Measures	Both EIA and HRA should consider mitigation measures. Although this is noted as stage 11 within this table, mitigation should be considered at an early stage (screening) in both processes where significant effects are identified. An AA or EIA will not be required where mitigation measures provide sufficient certainty that significant effects will not occur (Para. B4.42. SNH, 2009). Appendix 1 Section 2 provides detail on the definitions of mitigation and compensation relevant to the HRA and how these differ from EIA. In summary, HRA mitigation measures cannot include habitat management within an SPA as this falls under compensation measures and can only be considered under Regulation 53 if the development is allowed to proceed under Regulation 49. EIA mitigation measures (for e.g. SSSIs/wider countryside species) can include habitat management.
12	Residual Effects	Both processes should consider residual affects after mitigation, compensation and enhancement measures are taken into account.

Figure 2. Ornithological CIA Framework. The stages listed in the right-hand boxes identify the stage in this Framework (see relevant sections for further details).



Presented in ABPmer (2012). Flow diagram adapted from original by:

DETI (2011). Regional Locational Guidance (RLG) for Offshore Renewable Energy Development in NI Waters. Published September 2011 by The Department of Enterprise, Trade and Investment: http://www.detini.gov.uk/rlg_final_version_sept_2011.pdf

4.2 Guidance on the Ornithological CIA Framework (Objective 2)

This section provides guidance on the stages of the Ornithological CIA Framework as identified in section 4.1 (Table 1) of this report. The beginning of each of the following sections provides a brief summary of the background to the issues within each stage to clearly establish the specific areas to address.

This report gives guidance on what developers should consider at each stage, however Stage 2 provides specific details on which Target Bird Populations to consider (and which ones may be scoped out) within the ornithological impact assessment and associated CIA. Stage 5 (Vulnerability of Target Bird Populations) and Stage 6 (Conservation Status of Target Bird Populations) also provide full details which developers can easily include within their ornithological assessment and associated Ornithological CIA.

4.2.1 Stage 1: Scoping

Background

In their review of CIA for offshore wind developments, King et al. (2009) reported on the discussions from a workshop where aspects relating to scoping were discussed. Amongst the issues raised and comments made, were;

- A lack of consistency, particularly in the level of detail provided, on Ornithological CIA in EIA scoping reports produced for offshore wind farms;
- Inconsistency in the level of detail in the responses provided by the Statutory Nature Conservation Bodies (SNCBs);
- Scoping was often considered to be too superficial in nature, particularly with regards to potential cumulative issues;
- It was also felt that scoping often did not take place at a sufficiently early stage in the development process; and,
- It was recommended that communication should be ongoing and not simply stop after submission of the scoping report and receipt of responses.

Scoping has been submitted for 8 of the 11 PFOW developments (August 2012). A review of these documents revealed that limited attention was given to potential cumulative impacts (Appendix 1 Section 4). Lists of potential impacts, species and projects to include in Ornithological CIA were mostly absent. In the responses from Marine Scotland and SNH, requests were made for more details on proposed assessment methods, including the determination of which projects and species to include. There were also requests for early engagement with SNH with regards to potential cumulative impacts. Given the low level of detail provided and the requests for more from Marine Scotland and SNH, there would seem to be a clear need for more explicit guidance, which is provided below.

Recommendations

The recommendations made by King et al. (2009) with regards to Ornithological CIA for offshore wind farm developments apply equally to the wave and tidal PFOW proposals. These were:

- Early engagement by developers with all stakeholders to inform scoping;
- Use of standard templates to list ‘key features’ relevant to the Ornithological CIA (this included species, SPAs, relevant populations, species vulnerability, impacts, projects, survey and analysis methods);
- Provision of as much information as possible by SNCBs; and,

- Ongoing and frequent communication between all involved parties with regards to Ornithological CIA. This is regarded as the most critical step in improving provision of Ornithological CIA and reducing delays in consenting.

To further support the detail of scoping reports and agreement of ‘key features’ at an early stage, PFOW developer’s EIA scoping reports could use the headings and suggested content provided in Table 2 with respect to their consideration of ornithological CIA. This should not include detailed descriptions at this stage, but rather brief descriptions of topics of aspects requiring further consideration.

Table 2. Proposed headings and content to include within the ornithological CIA sections of the EIA Scoping report[12]. For many of the items, tabulation is likely to be a useful means of presenting the information.

Proposed Heading	Suggested Content and Notes
Target Bird Populations & Designated Sites (Stage 2)	1) Defining relevant Target Bird Populations and designated sites is an iterative process which should commence at the EIA Scoping report stage. 2) A list of designated sites with potential connectivity to the development. 3) A list of Target Bird Populations that have the potential to be affected by the development should be prepared. This can be taken from the list presented in Appendix 1, Section 3. This may include SPA, Ramsar, SSSI, MPA and wider-countryside populations. 4) The list of Target Bird Populations will determine the spatial scale of the Ornithological CIA. Thus, if the populations on the list change the spatial scale will also change. 5) At the scoping stage, it is unlikely that any site specific surveys will have been completed. Therefore the initial Target Bird Population list should be inclusive to ensure sensitive populations are not scoped out inadvertently. It is likely that the initial Target Bird Population list will be similar, if not the same as, that detailed within Stage 2 (section 4.2.2 below). 6) As site specific surveys commence and data on the species present are gathered, the Target Bird Population list should be reviewed and amended as necessary. 7) Once surveys have been completed, the Target Bird Population list and the relevant designated sites to be considered within the assessments can be finalised.

[12] If available, it is recommended that the information noted in the following table be provided at the scoping report stage. However, it is recognised that some information may not be available at an early stage and it may be necessary in some cases to consider the information when it becomes available at a later stage in the EIA process.

Proposed Heading	Suggested Content and Notes
Projects to Include in Ornithological CIA (Stage 3)	1) Defining relevant Projects to include with the Ornithological CIA is an iterative process which should commence at the EIA Scoping report stage (this will necessarily be high level at the Scoping stage and is likely to encompass more/different projects than may eventually be included in the assessment) 2) Because the list of Target Bird Populations will ultimately determine the spatial scale of the Ornithological CIA for each project, this in turn will determine the list of relevant projects. 3) The method detailed within Stage 3 (section 4.2.3 below) could be followed to identify a list of relevant projects that may be included within the Ornithological CIA. 4) Once surveys have been completed, the spatial area can be fixed and the list of relevant projects finalised.
Identify Relevant Ornithological Impacts (Stage 4)	1) All potential impacts should be listed. These should be categorised by development stage (construction, operation, decommissioning)
Define Vulnerability of Target Species Populations (Stage 5)	1) The vulnerability of the relevant Target Bird Populations to be used in the ornithological impact assessment should be confirmed. This could follow the criteria as detailed within Stage 5 (section 4.2.5) below.
Detail Conservation Status of Target Bird Populations (Stage 6)	1) The conservation status of the relevant Target Bird Populations to be used in the ornithological impact assessment should be outlined. This could follow the conservation status values as detailed within Stage 6 (section 4.2.6) below. 2) It is likely that conservation status of Target Bird Populations may change as new information becomes available. Any updated new information should be taken account of in the scoping report.
Data Collection & Analysis Methods (Stage 7)	1) Details of survey methods should be provided within the scoping report (or as soon as they have been determined). 2) If possible, details of proposed data analysis methods should be provided within the scoping (or as soon as they have been determined).
Data Acquisition from other Developments (Stage 8)	1) For each relevant project indicate if data are/will be available for inclusion in the Ornithological CIA (N.B. the data does not need to be provided at this stage).
Data Presentation (Stage 9)	1) Intentions as to data presentation could be briefly outlined (see recommendations as detailed in Stage 9 (section 4.2.9)).

Proposed Heading	Suggested Content and Notes
Significance Test (Stage 10)	1) The relevant methods for determining significance should be detailed. See recommendations as detailed in Stage 10 (section 4.2.10).
Mitigation Measures (Stage 11)	1) If appropriate, a list of potential mitigation measures could be detailed within the scoping report. These should be reviewed throughout the EIA and HRA processes and the relevant ones applied to the development as required.

The following sections detail Stages 2 to 10 of the Framework. These stages relate principally to the assessment stage of the EIA and HRA processes (Figure 2) but can also help to usefully inform initial considerations at the scoping stage (as above).

4.2.2 Stage 2: Define the Target Bird Populations to Include in the Ornithological CIA

Background

For the purposes of this guidance, Target Bird Population is defined as follows:

The population of a species considered to be at potential risk of impact due to a proposed wave or tidal current energy development. The size of the population reflects the time of year under consideration (e.g. breeding season, migration period, etc.) and therefore for any given species may vary depending on the impact being considered and the time of year during which the impact may be of importance.

There is a need to ensure that Target Bird Populations are consistently identified in order that Ornithological CIA can be conducted in a consistent and standardised way using the same reference bird populations (King et al. 2009). In addition, it is important to identify which populations of each species may be using the area, since some of these populations may be of High Nature Conservation Importance (NCI) while others may not. For example, from the HRA perspective, northern gannets from Scottish SPAs will be defined as High NCI, whereas northern gannets from the Norwegian or Icelandic population that may visit PFOW in autumn and winter are of Low NCI since there are no SPAs in Norway or Iceland. In contrast, from the broader perspective of EIA, these distinctions do not appear, and all gannets are of equivalent importance, regardless of their origin.

Target Bird Populations are those of greatest perceived risk of impact from wave and tidal current projects. Although Target Bird Populations at Scoping should be the same for all wave projects in PFOW and the same for all tidal projects in PFOW (but not necessarily the same for both development types) survey data can be used to determine site-specific lists.

Appendix 1 Section 5 presents a high level review of the bird populations in the PFOW which can be used by prospective developers to refine identification of project specific Target Bird Populations. The following sections describe the process adopted for the high level review.

NCI is defined as either 'High', 'Moderate' or 'Low'. The criteria for each category are detailed in Table 4 below. This report identifies Target Bird Populations as those of either 'High' or 'Moderate' NCI. Bird populations of Low NCI should be scoped out of the ornithological assessment and associated CIA. Once survey data become available, these are likely to further reduce the list of species under consideration.

Target Bird Populations have been identified by this report based on a preliminary list of species provided by SNH for consideration, and based on the status of these species and their populations as identified from relevant literature (especially Forrester et al. 2007).

Details of the process of identifying Target Bird Populations are presented in Appendix 1 Section 3, and are summarised in Table 4 below. The process requires knowledge of the distribution of protected areas and of the connectivity of the populations in these protected areas (based on breeding season foraging ranges). For HRA, protected areas will be limited to SPAs, however for EIA consideration of bird populations which are features of SSSIs will also need to be considered. Although in many cases these will be features of SPAs, this is not always the case. SNH is compiling a list of SSSIs and their notified features (C. Eastham, SNH, pers. comm.) which should be consulted once this becomes available. These topics are detailed in Appendix 1 Section 3. In particular, data on foraging ranges of Target Bird Populations are given in Table A1.3.5, and data on breeding population sizes of Target Bird Populations in Orkney and Caithness in Table A1.3.6.

One species considered in Table 4 was found not to qualify as a Target Bird (great-crested grebe) but is included in the Table for completeness and because its consideration had been suggested originally by SNH.

Initially all bird species recorded in Orkney and Caithness were included for consideration. However, some of these Target Bird Populations could be scoped out at an early stage. Terrestrial birds will not be affected by wave or tidal current projects at sea, except where these developments require associated terrestrial infrastructure such as access roads, harbours, cables, transformer stations and other structures on land. Such on-shore development is likely to be predominantly along the coastal fringe and so will not affect inland terrestrial bird populations. So the focus of Ornithological CIA is likely to be on seabirds in their marine environments, relevant SPA species, and birds of the coastal fringe that may be sensitive to habitat alteration and disturbance.

Where on-shore infrastructure is likely to have a significant effect on shorebirds, geese or terrestrial birds that are qualifying features of an SPA, it would be appropriate for the Ornithological CIA to include these protected bird populations. Where on-shore infrastructure would be outside of boundaries of statutory designated sites for shorebirds, geese or terrestrial birds, Ornithological CIA for these bird types may not be required, since the proportion of the coastal fringes of Orkney and Caithness affected would be negligible and hence habitat loss and disturbance would be limited to negligible proportions of the available habitat, and so impacts on populations of shorebirds, geese and terrestrial birds would be negligible. This can readily be assessed by comparing numbers of birds found in developments' zone of impact with the regional (Caithness and Orkney) populations of these species, and establishing any potential connectivity between the proposal and the qualifying features of an SPA.

Species of shorebird such as turnstone and purple sandpiper that are features of East Sanday Coast SPA are well known to be highly site-faithful in winter (Metcalfe and Furness 1985; Burton and Evans 1997; Dierschke 1998; Mittelhauser et al. 2012), inhabiting the same small home range in successive winters, so will not be affected by developments elsewhere in PFOW away from their home range. The same is true of many other shorebirds, though it is more difficult to demonstrate this with species on muddy shores rather than on rocky shores because of the higher numbers and densities of birds in that habitat (Burton 2000; Rehfisch et al. 2003; Conklin and Colwell 2007). Disturbance can affect shorebird distribution, as can loss of a safe roost site, although shorebirds can adapt to newly created opportunities such as presented by newly constructed islands where roosting may develop (Burton et al. 1996). Barnacle geese in winter tend to feed within 2 km of their roost site, and predominantly remain within protected areas close to the roost when these are available (Black et al. 1991; Si et al. 2011). Si et al. (2011) found that the barnacle geese they studied remained within a protected area 80% of the time during the overwinter period, and rarely ventured more than 2 km from this to graze. Bird species with such site-faithful habits that are protected by SPAs are very unlikely to be affected by developments on the coast outside their SPA sites. However, there are species which may forage at times outwith an SPA, such as golden plover and hen harrier, and which may be adversely affected by the onshore part of a proposal even when the proposal is some distance from the SPA.

Another point to consider is that although this Framework is relevant for the lease areas within the current PFOW leasing round, it may also be used for future leasing rounds within PFOW and also perhaps other areas outwith PFOW. In which case, cumulative impacts on shorebirds, geese and terrestrial birds may be more (or indeed less) of an issue. Considering the above, the CIA should assess whether the proposal is likely to have a significant effect on the qualifying features in-combination with other projects, even when the proposal is outwith the SPA. For shorebirds, geese, and terrestrial birds, and especially for the current PFOW leasing round, the CIA for each proposal would be able to quickly scope out these features if no likely significant effect is identified.

Recommendations

- Developers can use Table 5 (below) and the high level review (Appendix 1 Section 5) to identify Target Bird Populations for their site.
- Where developments do not involve onshore structures being deployed within statutory designated sites for terrestrial birds (including shorebirds and geese), we consider that after a brief consideration of any likely significant effects, terrestrial birds are unlikely to need to be included in Ornithological CIA. Any development proposing to place infrastructure within or in close proximity to an SPA for terrestrial birds (including shorebirds and geese) may need to carry out Ornithological CIA in relation to a HRA.
- Although initially all seabird species of high and moderate NCI should be considered as potential Target Bird Populations, for tidal current projects we recommend scoping out seabirds whose populations are considered to be at low or very low vulnerability from tidal current developments. SNH has however indicated that they consider that exceptions to this include situations where the number of a species present at the proposed development site, despite being a species classed as low or very low vulnerability, represent a high proportion of the regional population (by convention, a figure of >1% is often taken to define this threshold) of a local SPA population. It is also possible that some low or very low vulnerability species may form part of the qualifying feature of an SPA and they may therefore require consideration under a HRA. In such circumstances the connectivity to SPAs needs to be considered (see Section 4.2.3). It should be noted that, while including low and very low vulnerability species for these reasons will increase the number of species assessed, the level of detail required for their impact assessments is unlikely to be high, since low vulnerable species remain at low risk of impact even in high numbers.
- Although initially all seabird species of high and moderate NCI should be considered as potential Target Bird Populations, for wave projects we recommend scoping out seabirds whose populations are considered to be at low or very low risk from wave projects (with the above noted exception regarding high proportions of the regional population or connectivity with an SPA population).
- The list of Target Bird Populations should be kept under review and potentially refined in light of survey data.

Table 3. Definition of Nature Conservation Importance categories.

Importance	Definition
High	Populations receiving protection by a SPA, proposed SPA, Ramsar Site, SSSI, MPA or which would otherwise qualify under selection guidelines.
Moderate	The presence of species listed in Appendix 1 of the Birds Directive (but population does not meet the designation criteria under selection guidelines). The presence of breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The presence of species noted on the latest Birds of Conservation Concern (BoCC) 'Red' list (Eaton et al. 2009). Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the proposed development. Species present in regionally important numbers (>1% regional breeding population) at some particular season of the year (breeding, migration, or winter).
Low	All other species' populations not covered by the above categories.

Table 4. Target Bird Populations for Ornithological CIA in PFOW. Populations with NCI defined as 'Low' should be scoped out of CIA (for further details of population sizes and migration routes see Appendix 1 Section 3).

Target Bird	Population	NCI (High, Moderate, Low)	Reason
Greater scaup	Breeding	Low	No significant breeding population
	Migration	Moderate	Migrants to winter area likely to be a significant proportion of Scottish population of this red listed species
	Wintering	Moderate	10% of Scottish Scaup winter in Orkney and the species is red listed
Common eider	Breeding	Moderate	Breeding numbers represent ca.15% of the Scottish total
	Migration	Moderate	The population is predominantly resident so numbers are much as in the breeding season
	Wintering	Moderate, possibly high in future	Numbers represent ca.12% of the Scottish wintering total, and a major part of the population may become a designated feature of an SPA likely to be designated for wintering seaducks and divers
Long-tailed duck	Breeding	Low	None breed in the area
	Migration	Moderate	Although numbers migrating through the area are not well known, given the high proportion of the Scottish wintering population in the area it is likely to be similarly important for migrating birds
	Wintering	Moderate	Numbers wintering in Orkney and Caithness represent around 17% of the Scottish total
Common scoter	Breeding	Moderate	Breeding numbers in Caithness represent ca.38% of the Scottish total and this species is red listed
	Migration	Moderate	Red listed species
	Wintering	Moderate	Red listed species, although wintering numbers in the area are low
Velvet scoter	Breeding	Low	None breed in the area
	Migration	Low	Numbers in the area are thought to be relatively low
	Wintering	Moderate	Numbers in the area are relatively low (ca. 150 birds) although this represents ca. 5% of the Scottish total
Common goldeneye	Breeding	Low	None breed in the area
	Migration	Low	Numbers in the area are thought to be relatively low
	Wintering	Moderate	Numbers wintering in Orkney and Caithness represent ca. 7% of the Scottish total
Red-throated diver	Breeding	High	Birds Directive - Annex 1 species. High connectivity with SPA population
	Migration	High	Birds Directive - Annex 1 species. Some of the migrants may come from SPA populations, and total numbers are likely to represent a high proportion of the Scottish population

Target Bird	Population	NCI (High, Moderate, Low)	Reason
	Wintering	High	Birds Directive - Annex 1 species. This species is likely to be cited in a wintering population SPA in/adjacent to PFOW, and numbers in winter in Orkney and Caithness represent ca. 9% of the Scottish population
Black-throated diver	Breeding	High	Birds Directive - Annex 1 species. Probable connectivity with SPA population
	Migration	High	Birds Directive - Annex 1 species. Some of the migrants may come from SPA populations, and total numbers are likely to represent a high proportion of the Scottish population
	Wintering	High	Birds Directive - Annex 1 species. This species is likely to be cited in a wintering population SPA in/adjacent to PFOW, and numbers in winter in Orkney and Caithness represent ca. 9% of the Scottish population
Great northern diver	Breeding	Moderate	Birds Directive - Annex 1 species. Not a local breeding species, but a few birds may summer as immatures/nonbreeders
	Migration	High	Birds Directive - Annex 1 species. Present in regionally important numbers; in the near future there may be an SPA designated for the wintering population of this species within or close to PFOW.
	Wintering	High	Birds Directive - Annex 1 species. Present in regionally important numbers; in the near future there may be an SPA designated for the wintering population of this species within or close to PFOW.
Great-crested grebe	Breeding	Low	None breed in the area
	Migration	Low	No significant migration of this species occurs in the area
	Wintering	Low	Few, if any, overwinter in the area
Slavonian grebe	Breeding	Low	Birds Directive - Annex 1 species. However, none breed in the area
	Migration	Moderate	Birds Directive - Annex 1 species. Only very small numbers are recorded
	Wintering	Moderate	Birds Directive - Annex 1 species. Although numbers are small, they represent ca. 19% of the Scottish wintering total
Northern fulmar	Breeding	High	SPA populations have high connectivity
	Migration	High	Many migrants are likely to be from SPA populations
	Wintering	High	A high proportion of winter birds are likely to be from Scottish SPA populations
Sooty shearwater	Breeding	Low	None breed
	Migration	Moderate	A high ca. 44% of the Scottish total passes through this area in autumn
	Wintering	Low	None normally present in winter

Target Bird	Population	NCI (High, Moderate, Low)	Reason
Manx shearwater	Breeding	Moderate	Low connectivity to SPA populations and small numbers present in summer
	Migration	Moderate	Small numbers migrate through area
	Wintering	Low	None normally present in winter
European storm-petrel	Breeding	High	Birds Directive - Annex 1 species. SPA populations have high connectivity
	Migration	High	Birds Directive - Annex 1 species. SPA populations probably migrate through area
	Wintering	Low	None normally present in winter
Leach's storm-petrel	Breeding	High	Apparently locally extinct as a breeding species, but there is an SPA for this species in the area where it previously bred and so NCI is by definition 'High'. Connectivity with SPA populations elsewhere appears to be negligible
	Migration	Moderate	Very few of this Birds Directive - Annex 1 species migrate through the area
	Wintering	Low	None normally present in winter
Northern gannet	Breeding	High	SPA populations have high connectivity
	Migration	High	Several SPA populations probably migrate through the area
	Wintering	Moderate	Few winter in the area and those birds are probably mostly from Norwegian colonies
Great cormorant	Breeding	High	SPA populations may show connectivity
	Migration	Moderate	Some birds from SPA populations are likely to be included within the population migrating through the area
	Wintering	Moderate	Some birds from SPA populations are likely to be included in the wintering population of the area
European shag	Breeding	High	Some SPA populations show connectivity and local numbers represent ca. 14% of Scottish total
	Migration	High	Local birds (some from SPA populations) are most likely to be involved in the limited migration shown by this species
	Wintering	High	Wintering birds represent ca. 7% of the Scottish total and will include birds from local SPA populations
White-tailed eagle	Breeding	Low, but potentially High in future	None breed in the area at present though it is likely that the species will recolonize the area at some point, and the species is on Birds Directive - Annex 1 of the Birds Directive
	Migration	Low, but potentially High in future	No significant migration of this species occurs through Orkney and Caithness

Target Bird	Population	NCI (High, Moderate, Low)	Reason
	Wintering	Moderate, and potentially High in future	Very small numbers of this Birds Directive - Annex 1 species have visited Orkney and Caithness in winter since reintroduction of the species to Scotland. Numbers are likely to increase as the Scottish population grows in size and expands its geographical range
Arctic skua	Breeding	High	SPA populations show high connectivity
	Migration	Moderate	Red listed
	Wintering	Low	None normally present in winter
Great skua	Breeding	High	SPA populations show high connectivity
	Migration	High	Many migrants are likely to be from SPA populations
	Wintering	Low	Very few, if any, are present in winter
Black-headed gull	Breeding	Moderate	Numbers breeding in Orkney and Caithness represent ca. 8% of the Scottish total
	Migration	Moderate	Numbers (especially in spring) probably represent ca. 10% of the total in Scotland
	Wintering	Low	Few winter in the area (only ca. 0.6% of the Scottish total)
Common gull	Breeding	Moderate	Breeding numbers in Orkney and Caithness represent ca. 24% of the Scottish total
	Migration	Moderate?	Although numbers migrating through the area are not well known, they are likely to represent a significant percentage of the Scottish total
	Wintering	Low	Numbers in winter are relatively low, and the populations are unlikely to be from areas with conservation designations
Lesser black-backed gull	Breeding	Moderate	No SPA populations have connectivity but local breeders represent ca. 4% of Scottish population
	Migration	Moderate	Migrants are likely to be from populations without SPAs
	Wintering	Low	Very few, if any, are present in winter
Herring gull	Breeding	High	SPA populations show high connectivity
	Migration	Moderate	Some birds from SPAs may migrate through the area. Species is red listed
	Wintering	Moderate	Some birds from SPA populations may winter in the area. Winter numbers represent ca. 6% of the Scottish total. Species is red listed
Great black-backed gull	Breeding	High	SPA populations show high connectivity
	Migration	Moderate	Some birds from SPAs may migrate through the area but many migrants derive from Arctic Norway and Russia
	Wintering	Moderate	Some birds from SPAs may winter in the area but many derive from Arctic Norway and Russia
Black-legged kittiwake	Breeding	High	SPA populations have high connectivity
	Migration	High	SPA populations probably migrate through area

Target Bird	Population	NCI (High, Moderate, Low)	Reason
	Wintering	Moderate	Although many birds present in winter probably come from populations without SPAs, the area holds ca. 8% of the Scottish total in winter and some probably come from SPA populations
Little tern	Breeding	Moderate	Birds Directive - Annex 1 listed, though no SPA populations show connectivity
	Migration	Moderate	Birds Directive - Annex 1 listed, although this species is not regularly seen on migration in the area
	Wintering	Low	None normally present in winter
Sandwich tern	Breeding	Moderate	Birds Directive - Annex 1 listed, though no SPA populations show connectivity
	Migration	Moderate	Birds Directive - Annex 1 listed
	Wintering	Low	None normally present in winter
Common tern	Breeding	Moderate	Birds Directive - Annex 1 listed, though no SPA populations show connectivity
	Migration	Moderate	Birds Directive - Annex 1 listed
	Wintering	Low	None normally present in winter
Roseate tern	Breeding	Moderate	Birds Directive - Annex 1 listed, though no SPA populations show connectivity
	Migration	Moderate	Birds Directive - Annex 1 listed
	Wintering	Low	None normally present in winter
Arctic tern	Breeding	High	SPA populations have high connectivity
	Migration	High	SPA populations probably migrate through area
	Wintering	Low	None normally present in winter
Common guillemot	Breeding	High	SPA populations have high connectivity
	Migration	High	SPA populations probably migrate through area
	Wintering	Moderate	Birds present in winter represent a small proportion of the Scottish total and probably include only a small proportion of birds that are from SPA populations
Razorbill	Breeding	High	SPA populations have high connectivity
	Migration	High	SPA populations probably migrate through area
	Wintering	Moderate	Some birds present in winter may be from SPA populations although many probably originate from populations where there are no SPAs. Numbers in winter represent ca. 4% of the Scottish total.
Black guillemot	Breeding	Moderate	Orkney and Caithness hold ca. 19% of the Scottish breeding total. Some of these are in areas likely to be designated in near future as MPAs with black guillemot as a feature.
	Migration	Moderate	The population is resident so the same birds will be present as in the breeding season
	Wintering	Moderate, possibly High in the future	The numbers present in winter represent ca.19% of the Scottish total. It is likely that the species will be a notified feature of future MPAs in the area
Little auk	Breeding	Low	None breed in the area

Target Bird	Population	NCI (High, Moderate, Low)	Reason
	Migration	Moderate	Although numbers migrating through the area are not well known, given the importance of the area for this species in winter it is likely that a high proportion of migrants occur in this area too
	Wintering	Moderate	Orkney and Caithness hold ca. 30% of the Scottish total in winter
Atlantic puffin	Breeding	High	SPA populations have moderate connectivity
	Migration	Moderate	Migrants may include some birds from SPA populations but also some from areas without SPAs
	Wintering	Low	Numbers wintering in the area are low, and probably mainly originate from Norwegian colonies

4.2.3 Stage 3: Define the Projects to include in the Ornithological CIA

Background

There are three elements which require consideration when determining which projects to include in a CIA:

1) The temporal scale: At what stage in the planning process should projects be included or excluded from Ornithological CIA?
2) The spatial scale: What is the relevant spatial scale when considering which projects to include in Ornithological CIA?
3) Which types of project should be included?

<u>The Temporal Scale</u>

In terms of the stage in the planning process that projects should be considered, King et al. (2009) divided projects to be included into those:

- Which have been consented but are yet to be constructed;
- For which an application has been submitted; and,
- Which are 'reasonably foreseeable'.

Based on a review of the relevant legislation and guidance by MacArthur Green, which includes the recent DEFRA guidance[13] (see Appendix 1, Section 6), it is considered that the projects to be included for consideration within an CIA for EIA and HRA are those which:

- are existing (granted planning permission but not yet operational);
- have been submitted into the planning process (the planning application and associated ES has been submitted, and therefore information regarding the project is available to the public).

However, although not necessarily accepted by all the PFOW developers as the 'industry standard', Marine Scotland has advised (pers. comm.) that "reasonably foreseeable" projects may also need to be considered in CIA (on a qualitative basis) where appropriate and have referred to the approach detailed within recent CIA guidance for offshore wind farms (RUK 2013). Essentially this states that

[13] The Habitats and Wild Birds Directives in England and its seas. Core guidance for developers, regulators & land/marine managers (December 2012)'

reasonably foreseeable projects should be considered where 'sufficient relevant information exists' and that a qualitative assessment should be considered 'even when information and data may be missing or sparse, or when it is difficult to analyse the impacts of future actions'.

Assessing the potential cumulative impacts on projects which are undefined and lack detailed information (i.e. projects which have not submitted an application) is clearly very difficult and can only be done on a qualitative basis. For projects which have not yet submitted scoping there will be even less detail available, making any (even qualitative) assessment impracticable.

With regards to operational projects, consideration needs to be given to which projects should be excluded from a CIA on the basis of their inclusion in the baseline. Whether they form part of the baseline or not will be dependent on the date that the project started construction and the date of the most recent population census of each Target Bird Population. For example, projects constructed before the most recent population census can be considered as forming part of that figure. In contrast, impacts from projects constructed after the most recent population census will not be reflected in that figure. The figure (from the last population census) will of course also not reflect potential changes in the population to the present date (e.g. at the point of a consent application). Indeed, since comprehensive seabird censuses have historically been separated by up to 15 years, such changes are very likely to have occurred.

To allow for this, if the most recent population estimates (which may be several years old) are not considered to reflect the current population status, they may be updated to the current year on the basis of observed trends. This will result in a prediction of the current population size (which will include impacts from operational projects) for use as the 'baseline' for the assessment (SNH & JNCC, 2012). The challenge with this approach is determining the appropriate trend to employ, which will need to be done in discussion with the relevant statutory agencies. The need for agreement on the most appropriate method of updating population estimates, and the discussion this may generate, highlights that consideration of this aspect should be made at an early stage to avoid the risk of subsequent delays. Once an up-to-date figure for the relevant population has been established, the impacts from existing operational developments will effectively be incorporated into the baseline. Therefore, only new proposed projects (which are not operational and/or were not operational prior to the agreed updated population figure which will be the impact assessment's baseline) need to be included in the CIA.

<u>The Spatial Scale</u>

King et al. (2009) considered that the default spatial scale for CIA should be the strategic development area (i.e. Round 2 strategic areas or Round 3 zones), although it was noted that these were not always ecologically appropriate. Early discussion with SNCBs to define the area for assessment was recommended.

The approach recommended here to define the relevant Ornithological CIA spatial scale for each PFOW project is based on the final list of identified Target Bird Populations required to be included in the ornithological assessment. Initially, for each species, the breeding colonies located within foraging range (Table A1.3.5) from the focal project are identified. In this context, the appropriate foraging range to use to define connectivity (as high, moderate, low or zero) is based on both the mean and the maximum foraging range. Following recommendations from SNH, connectivity is assessed as high where the proposed site is within the mean foraging range, the mean maximum plus 1 standard deviation (SD) and/or the 95% cumulative frequency distribution (CFD).

Connectivity can be assessed as moderate where the Site is within the maximum foraging range and either the mean maximum + 1 SD or 95% CFD (or close to these). Connectivity can be assessed as low where the proposed site is within the maximum but out with the mean maximum or mean range. Connectivity can be assessed as zero where the proposed site is outwith the maximum foraging range from an SPA.

This is likely to identify multiple colonies for each Target Bird Population. However, the relative contribution of each one to the total on-site population is unlikely to be equal, with factors such as distance and colony breeding size influencing the relative share originating from each colony. SNH is developing a method for apportioning birds among the candidate colonies (see Section 4.2.7 for further details). Application of this method will permit exclusion of those colonies which contribute a smaller percentage to the on-site population than an agreed threshold level.

The final step in determining the spatial scale is to identify the other projects located within the foraging range of the species/colony combinations which have been retained.

At the scoping stage the final Target Bird Population list will not be known so a provisional one will need to be estimated, based on knowledge of the seabird colonies within the PFOW region and other available data (e.g. from nearby projects, EMEC data, etc.). This list can then be used as described above to generate a provisional list of other projects. For wave energy projects, the Target Bird Populations are likely to be red-throated diver, black-throated diver and/or great northern diver (see Section 4.3.5), the only species categorised as having moderate or high vulnerability to wave energy developments. The foraging ranges of these species are approximately 9-11 km (mean) and approximately 50 km (maximum) although foraging ranges of divers in winter are not well known. So a precautionary approach would be to include projects within 50 km in CIA. For tidal current devices the species categorised as moderate or high vulnerability include divers, shag, cormorant, and auks (see Section 4.3.5). Foraging ranges vary between species (data in Table A1.3.5), so the spatial scale appropriate for a particular development will depend on which of these species is present.

<u>Which types of Project should be included?</u>

Marine Scotland's Draft Licensing Manual states that the following types of development (over and above other offshore renewable developments) should be included for consideration within CIA[14]:

- Port development;
- Oil and gas;
- Aquaculture;
- Dredging; and,
- Coastal developments.

In addition to these, there may be other on-shore developments which may have a cumulative impact with the on-shore part of a wave or tidal current project and therefore may need considering.

Only those developments which lie within the foraging ranges of species present within the colonies identified above need to be considered (as described above). Further exclusion can be made on the basis of the particular impact being considered for the focal development (see Stage 4) and the ecology of the species in question (e.g. the collision risk assessment for tidal current turbines will only need to consider developments which can potentially have a collision impact on deeper diving species). Full justification for such exclusions will need to be provided. In practice, a brief scan of the ES from developments of the above types within the appropriate foraging range should be adequate

[14] The draft Licensing Manual also lists fishing in the list of examples. However, we have removed it from this list because, in terms of the regulations, fishing is an on-going activity which is not subject to licensing/consent. As such, impacts from fishing activity should form part of the baseline for CIA rather than forming a plan/project for inclusion in the CIA

to establish which projects need to be considered further for birds, since in many cases the ES is likely to scope out the key species of concern with regard to wave and tidal current developments, so that no contribution to cumulative impacts will arise from those developments. Where the ES does identify an impact on the key species, the magnitude of the impact should be taken directly from the relevant ES, without the need for recalculation based on extracting relevant data from the ES (i.e. the impacts assessed in each ES should be taken at face value if SNH and MS have approved them). Further guidance on this is provided within Appendix 1, Section 7.

Recommendations

The Temporal Scale

- Those projects that have been submitted into planning (and for which an ES is therefore available) and have received planning consent but are not yet operational should be included within Ornithological CIA where relevant (i.e. with respect to spatial scales and type of project).
- Operational projects may be referred to for reference/information. However, it is important to ensure that these are not included in the actual CIA as this could lead to double counting since use of up-to-date/updated population figures (which have been agreed with the statutory advisor) will mean that projects (and any on-going impacts they may be having) which were operational prior to the date of the agreed (updated) population figure will form part of the baseline[15].
- Although not a legal requirement and not necessarily accepted as the industry standard by all PFOW developers, MSLOT have indicated that reasonably foreseeable projects may need to be included where sufficient information exists. However, where information on a project is limited (e.g. projects which have only scoped and have not yet submitted an application), the assessment may be qualitative rather than quantitative.

The Spatial Scale

- The following method is recommended for defining the spatial extent of the Ornithological CIA area:
  1. At the scoping stage, the identified Target Bird Population list (Table 5) relevant to the project (Stage 2) could be used to identify relevant species. This should be refined when site specific survey data become available;
  2. Identify the breeding colonies, and hence the Target Bird Populations (SPA, other designated sites and non-designated breeding colonies) within foraging range of the project (Table A1.3.5). This will need to be conducted on a species by species basis;
  3. If necessary, apportion the on-site bird population among potential candidate colonies using the SNH method (i.e. for species which could originate from more than one colony). Exclude those colonies whose contribution is below a pre-defined threshold (agreed with SNH);
  4. Each relevant Target Bird Population's foraging range (from the identified colonies) sets the spatial limit of the Ornithological CIA area;
  5. Relevant projects within this area should be considered for inclusion within Ornithological CIA, taking information on impacts directly from the relevant ES where possible.

Type of Projects

[15] Nb. projects which have become operational after the updated population figure (e.g. those which have only just become operational) may need to be included as projects within the CIA. This will need to be discussed and agreed with the regulator and statutory advisor.

- A list of projects which have the potential to contribute to cumulative ornithological impacts should be produced. These should include those which fall under the definitions provided in Marine Scotland's Draft Licensing Manual (listed above), and relevant on-shore projects, and for which there is the potential for cumulative impacts.
- There will be scope for refinement of this list based on more detailed consideration of the species in question (e.g. numbers and activity observed on the focal site, apportioning of Target Bird Populations among projects; see Stage 7).
- Projects may be removed from the list on the basis that their ESs do not contain impacts for seabirds, so no cumulative impacts can be identified from those development types. This applies to dredging for example, and preliminary examination of aquaculture ESs suggests that disturbance and entanglement risks for seabirds are generally not considered in their impact assessment. Justification should be provided on why projects should be removed. This list can then form the basis of discussions and subsequent agreement between Marine Scotland, SNH and the Local Authorities.
- Once the final list of Ornithological CIA projects is agreed, the availability of data and approach for analysis can be determined (Stage 7) and approaches to data acquisition (Stage 8) determined.

4.2.4 Stage 4: Identify Relevant Cumulative Impacts to Consider in Ornithological CIA

Background

The cumulative impacts for consideration within the Ornithological CIA for each development will be the same as those assessed for the single site impacts. In the Appropriate Assessment for the PFOW leasing round, ABPmer (2010) listed the following potential impacts in relation to wave and tidal current devices:

- Physical damage to habitats or species from collision risk;
- Physical loss/gain of habitat from direct physical disturbance;
- Physical damage to habitats or species from indirect disturbance and exclusion from habitats;
- Non-physical disturbance from marine noise;
- Toxic contamination from turbidity and disturbance of sediments; and,
- Biological disturbance from predation mortality.

Offshore wind farm impacts were detailed in King et al. (2009), and fall under the same broad categories listed above; collision risk, disturbance, displacement, barrier effects and indirect effects (i.e. via effects on prey species such as fish), with each impact to be considered within the key phases of development; construction, operation and decommissioning.

Furthermore, for the purposes of HRA, effects on the integrity of an SPA with respect to its conservation objectives need to be assessed. The conservation objectives for the seabird breeding SPAs in the PFOW region are:

'To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

…to ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site;
- Distribution of the species within site;

- Distribution and extent of habitats supporting the species;
- Structure, function and supporting processes of habitats supporting the species; and,
- No significant disturbance of the species.'

Of these conservation objectives, the focus for wave and tidal current developments will be primarily on the first bullet point; maintenance of populations as viable components of their SPAs. However, given the seaward extensions of many seabird breeding SPAs to safeguard areas of sea used for supporting activities (e.g. loafing, foraging, etc.), there is potential for the other conservation objectives to be affected by PFOW projects.

The onshore infrastructure and undersea cables which will be required for wave and tidal current installations will also require consideration, during both construction and operation, with effects potentially including disturbance, displacement and loss of habitat.

Once the Target Bird Populations are determined (initially done at the scoping stage, using Table 4 to assist with this, and then refined through data from baseline surveys), it is likely that the list of potential impacts can be reduced, since in many cases the impacts due to wave and tidal current installations will be species specific. For wave energy developments, collision mortality risk, disturbance, and displacement from habitat, should be considered for diver species if these are present at the site. For tidal current developments, collision mortality risk, disturbance, and displacement from habitat, should be considered for divers, auks, shag and cormorant if these are present at the site. Barrier effects appear to be trivial and therefore do not require EIA, HRA or CIA. Indirect effects (e.g. impacts of devices on sediments and therefore potentially on seabird food such as sandeels) are extremely difficult to predict, but appear to be unlikely to occur over a large enough spatial scale to affect seabirds at the population level.

A preliminary assessment of projects and related impacts that should be considered for Ornithological CIA is summarised in Appendix 1 Section 7.

Recommendations

- The scoping report should include a list of predicted impacts at each stage of the development (as is currently the case for all EIA scoping reports). These should consider impacts affecting wider-countryside Target Bird Populations and the conservation objectives of SPAs.
- Once the initial project list is identified, relevant impacts from other projects which should be considered within Ornithological CIA can be determined (projects or project related impacts may be scoped out where necessary).
- Impacts assessed as non-significant for EIA should still be considered for Ornithological CIA due to the potential for accumulation of impacts (unless individual impacts are assessed as negligible).
- The primary focus for determining which impacts need to be assessed will be on the potential for effects on seabird populations. However, the close proximity to shore of many PFOW developments means that direct impacts on the habitats within seabird breeding SPAs due to the installed devices may need to be assessed.
- Onshore impacts resulting from the development of supporting infrastructure will have the potential to impact on seabird habitats directly, as well as on terrestrial species. However, unless the site for proposed onshore development is likely to have a significant effect on the qualifying features of an SPA, such impacts should be scoped out of Ornithological CIA at an early stage (see discussions in Stage 2 and Stage 5).

4.2.5 Stage 5: Define Vulnerability of Target Bird Populations to Development

Background

To inform the assessment of significance (EIA) or adverse effect on integrity (HRA), it is necessary to define the vulnerability of the Target Bird Populations to impacts that may arise from wave and tidal current projects. The vulnerability of a certain bird to a specific impact will influence the overall magnitude of impact predicted. From an Ornithological CIA perspective, it is important that the vulnerability of a Target Bird Population is considered in a standard way to allow the assessment to be completed more easily and consistently across projects. This section provides an assessment of the vulnerability of the various Target Bird Populations.

The vulnerability of Scottish seabird populations to tidal current and wave energy devices was assessed by Furness et al. (2012). This assessment reviewed evidence for likely impacts on seabirds, and constructed indices assessing the relative vulnerability of seabird species' populations to impacts of tidal current turbines and of wave energy devices, predominantly considering the operational phase but not excluding construction and decommissioning. The work obtained consensus opinions from a large number of seabird ecologists with expertise in marine renewables. It was reported to SNH, and subsequent to peer review has been published in the ICES Journal of Marine Science (Furness et al. 2012). The key results from this analysis are the identification of the species of seabird populations most likely to show adverse impacts from wave and tidal current projects, and the fact that most seabird populations in Scotland are unlikely to be adversely affected by these developments (details of scores and classifications are in Tables 5 and 6 below).

Details of the computation of the vulnerability indices are given in Furness et al. (2012). In summary, the vulnerability index is based on scores allocated to each species on the basis of best available scientific evidence from the literature, in some cases moderated by expert opinion from a panel of experts. For Table 5 (vulnerability to impacts of tidal turbines), the criteria combined in the index were the conservation importance of the species, use of high tidal flow areas for foraging, diving depth, drowning risk, extent of benthic foraging, feeding range, habitat specialisation and disturbance by ship traffic. The last five factors were given lower weightings than use of high tidal flow areas for foraging, and diving depth, and the computed index was then categorised into five descriptors from very high vulnerability to very low vulnerability at the population level. For Table 6 (vulnerability to wave energy devices), the criteria combined in the index were the conservation importance of the species, risk of collision mortality due to structures, exclusion from foraging habitat due to behavioural constraints, benefit from roost platform, benefit from fish attraction device effect or biofouling, disturbance by structures, disturbance by ship traffic, and habitat specialisation. The computed index (which is on a different numerical scale from that for tidal turbines) was then categorised into the same five descriptors, from very high vulnerability to very low vulnerability at the population level. A similar assessment, for offshore wind farm impacts on seabird populations, was carried out (Furness and Wade 2012). This assessment may be useful in CIA when considering offshore wind farm impacts and indicate that the species at highest risk are rather different for offshore wind, tidal and wave. The scores on which the index is based should be reviewed as the industry develops to incorporate wave and tidal device specific responses as data become available.

Recommendations

It is recommended that seabird species classified as 'very low vulnerability' or 'low vulnerability' can be scoped out for Ornithological CIA. However, SNH has indicated that they consider exceptions to this rule would be the inclusion of low or very low vulnerability species if they are present in high numbers (representing a high proportion of the regional population, by convention, a figure of >1%

is often taken to define this threshold). This clearly highlights the need for site characterisation surveys in order to establish the species composition and relative abundances. It is also possible that some low or very low vulnerability species may form part of the qualifying feature of an SPA and they may therefore require consideration under a HRA. In such circumstances the connectivity to SPAs needs to be considered. Data on regional population sizes are given in Table A1.3.3 for breeding populations, Table A1.3.4 for nonbreeding populations; foraging ranges used to establish connectivity are given in Table A1.3.5, and SPA seabird population sizes are listed in Table A1.3.6. All species classified as 'very high vulnerability', 'high vulnerability' or 'moderate vulnerability' should be scoped in. The inclusion for Ornithological CIA of populations classified as 'moderate vulnerability' recognises that there is at present a lack of detailed understanding of the impacts of wave and tidal developments on these seabirds, and it is likely that once initial projects have been established and post-construction data collected (due to the novel nature of the proposed developments post-construction monitoring is expected to be required for the first round of developments) and evaluated, it may then be possible to remove some or many of these species from the list requiring CIA.

Table 5. Species vulnerability index for tidal turbine impacts on seabirds.

Species	Vulnerability index	Descriptor on 5-score scale
Black guillemot	9.9	4: high vulnerability
Razorbill	9.6	4: high vulnerability
Shag	9.6	4: high vulnerability
Common guillemot	9	4: high vulnerability
Great cormorant	7	4: high vulnerability
Great northern diver	4.1	3: moderate vulnerability
Red-throated diver	3.8	3: moderate vulnerability
Atlantic puffin	3.8	3: moderate vulnerability
Black-throated diver	3.6	3: moderate vulnerability
Little auk	2.2	3: moderate vulnerability
Slavonian grebe	2	2: low vulnerability
Arctic tern	1.9	2: low vulnerability
Common eider	1.5	2: low vulnerability
Common scoter	1.5	2: low vulnerability
Manx shearwater	1.5	2: low vulnerability
Velvet scoter	1.4	2: low vulnerability
Northern gannet	1.4	2: low vulnerability
Common goldeneye	1.1	2: low vulnerability
Great-crested grebe	1.1	2: low vulnerability
Sooty shearwater	1.1	2: low vulnerability
Sandwich tern	1.1	2: low vulnerability
Greater scaup	1	1: very low vulnerability
Long-tailed duck	1	1: very low vulnerability
Great black-backed gull	1	1: very low vulnerability

Species	Vulnerability index	Descriptor on 5-score scale
Roseate tern	1	1: very low vulnerability
Black-legged kittiwake	0.9	1: very low vulnerability
Herring gull	0.8	1: very low vulnerability
Great skua	0.7	1: very low vulnerability
Common gull	0.7	1: very low vulnerability
Lesser black-backed gull	0.7	1: very low vulnerability
Little tern	0.7	1: very low vulnerability
White-tailed eagle	0.6	1: very low vulnerability
Arctic skua	0.6	1: very low vulnerability
Common tern	0.6	1: very low vulnerability
Black-headed gull	0.6	1: very low vulnerability
Northern fulmar	0.5	1: very low vulnerability
European storm-petrel	0.5	1: very low vulnerability
Leach's storm-petrel	0.5	1: very low vulnerability

Table 6. Species vulnerability index for wave energy device impacts on seabirds.

Species	Score	Descriptor on 5-score scale
Red-throated diver	288	3: moderate vulnerability
Black-throated diver	288	3: moderate vulnerability
Great northern diver	270	3: moderate vulnerability
Razorbill	192	2: low vulnerability
Common scoter	180	2: low vulnerability
Common guillemot	176	2: low vulnerability
Black guillemot	169	2: low vulnerability
Slavonian grebe	169	2: low vulnerability
Shag	165	2: low vulnerability
Atlantic puffin	160	2: low vulnerability
Little tern	156	2: low vulnerability
Greater scaup	154	2: low vulnerability
Velvet scoter	154	2: low vulnerability
Arctic tern	153	2: low vulnerability
Common goldeneye	144	2: low vulnerability

Species	Score	Descriptor on 5-score scale
Northern gannet	136	2: low vulnerability
Roseate tern	135	2: low vulnerability
Common eider	130	2: low vulnerability
Common tern	126	2: low vulnerability
Sandwich tern	125	2: low vulnerability
Great cormorant	110	2: low vulnerability
Manx shearwater	102	2: low vulnerability
Black-legged kittiwake	98	1: very low vulnerability
Long-tailed duck	96	1: very low vulnerability
Great skua	96	1: very low vulnerability
Great-crested grebe	91	1: very low vulnerability
Arctic skua	84	1: very low vulnerability
Little auk	81	1: very low vulnerability
Northern fulmar	80	1: very low vulnerability
Great black-backed gull	75	1: very low vulnerability
Sooty shearwater	72	1: very low vulnerability
White-tailed eagle	72	1: very low vulnerability
European storm-petrel	68	1: very low vulnerability
Common gull	65	1: very low vulnerability
Lesser black-backed gull	64	1: very low vulnerability
Leach's storm-petrel	64	1: very low vulnerability
Black-headed gull	60	1: very low vulnerability
Herring gull	48	1: very low vulnerability

4.2.6 Stage 6: Establish Conservation Status of Target Bird Populations

Background

To inform the assessment of significance (EIA) or adverse effect on integrity (HRA), it is necessary to define the Conservation Status of the Target Bird Populations. From an Ornithological CIA perspective, it is important that the Conservation Status of a Target Bird Population is considered in a standard way to allow CIA to be completed more easily and consistently across projects. This section provides details of the Conservation Status of the relevant Target Bird Populations at the time of writing this report (Table 7).

As defined by SNH (2006), the Conservation Status of a species is, '*the sum of the influences acting on it which may affect its long-term distribution and abundance, within the geographical area of interest (which for the purposes of the Birds Directive is the EU)*'. Conservation Status is considered favourable under the following circumstances (SNH, 2006; Para.15):

- 'Population dynamics indicate that the species is maintaining itself on a long term basis as a viable component of its habitats; and
- The natural range of the species is not being reduced, nor is likely to be reduced for the foreseeable future; and
- There is (and probably will continue to be) a sufficiently large habitat to maintain its population on a long term basis'.

SNH state that, 'A*n impact should be judged as of concern where it would adversely affect the favourable conservation status of a species, or stop a recovering species from reaching favourable conservation status, at international or national level or regionally*' (SNH, 2006; Para. 17).

Recommendations

It is recommended that the following Target Bird Populations' Conservation Status (Table 7) are used in Ornithological CIA for the PFOW wave and tidal projects.

Table 7. Conservation Status of Target Bird Populations (data predominantly from Forrester et al. 2007, updated by Eaton et al. 2009). 'Unfavourable conservation status' is defined as moderate or strong evidence of a substantial population decline (probably exceeding 25%) over the last few years or decades, in Orkney and Caithness, or where local data are limited, in Scotland as a whole. Populations with unfavourable conservation status are highlighted in bold text.

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Greater scaup	Schedule 1 Red list		Breeding: sporadic, trivial numbers, a few nonbreeders summer in Orkney Migration: little information on numbers Wintering: In 1975-2005 there were 4000-8000 in Scotland, no clear trend since large decline before mid-1970s
Common eider	Amber list		**Breeding: increased in past but currently declining in much of Scotland** Migration: Scottish populations are largely resident **Wintering: numbers now declining in many areas of Scotland**
Long-tailed duck	Schedule 1 Amber list		Breeding: none in Scotland Migration: little information on numbers **Wintering: Suspected that numbers have declined in Shetland and Orkney since 1970s but data quality poor**

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Common scoter	Schedule 1 Red list		**Breeding: scarce breeder in Scotland, and apparently in decline** Migration: little information on numbers Wintering: uncertain if any trend, as numbers fluctuate and are not well known
Velvet scoter	Schedule 1 Amber list		Breeding: none in Scotland Migration: little information on numbers **Wintering: large decline in numbers wintering in Orkney, and possibly declining elsewhere, though numbers also fluctuate depending on winter weather in the Baltic Sea**
Common goldeneye	Schedule 1 Amber list		Breeding: very scarce breeder in Scotland, with increases from early 1970s to 2000 but little trend since then Migration: little information on numbers Wintering: sharp decline in 1970s but apparently roughly stable numbers since the 1980s
Red-throated diver	Annex 1 SPA cited Schedule 1 Amber list	Favourable 2 No data 1	Breeding: apparently approximately stable numbers breeding in Orkney, and in Scotland as a whole Migration: little information on numbers Wintering: a suggestion of some decline in Wintering numbers but a lack of data
Black-throated diver	Annex 1 SPA cited Schedule 1 Amber list	Favourable 1	Breeding: numbers approximately stable since 1970s Migration: little information on numbers Wintering: little information on numbers and no clear trend evident
Great northern diver	Annex 1 Schedule 1 Amber list		Breeding: normally none in Scotland Migration: little information on numbers Wintering: individuals are thought to be highly site-faithful in winter, but trends in numbers are not known
Great-crested grebe	Green list		Breeding: Scottish breeding numbers increased in 1970s but are now approximately stable Migration: little information on numbers Wintering: numbers in Scotland apparently stable
Slavonian grebe	Annex 1 SPA cited Schedule 1 Amber list		Breeding: Scottish breeding numbers increased in 1970s, decreased in 1990s but recovered after 2000 Migration: little information on numbers Wintering: no trend in wintering numbers has been identified (and none is suspected)

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Northern fulmar	SPA cited Amber list	Favourable 6 Unfavourable 4	Breeding: numbers in Scotland were increasing from 1900 to 1990 but since 1990 have declined slightly Migration: little information on numbers Wintering: no trend in winter numbers has been identified
Sooty shearwater	IUCN near threatened		Breeding: none breed in Scotland Migration: possibly slightly increasing in numbers but trend is uncertain as it is probably at least in part due to increased observer effort Wintering: none winter in Scottish waters
Manx shearwater	SPA cited Amber list		**Breeding: declines have been recorded at many smaller colonies but trend at the large colony on Rum is unclear due to difficulty of counting birds in the terrain there, though there are indications of a decline there too** Migration: little information on numbers Wintering: none winter in Scottish waters
European storm-petrel	Annex 1 SPA Cited Amber list	Favourable 2	Breeding: trends are unknown as census methods are not yet adequate for this species Migration: little information on numbers Wintering: none winter in Scottish waters
Leach's storm-petrel	Annex 1 SPA cited Amber list	Favourable 1	**Breeding: possibly declining, as some smaller colonies have disappeared and numbers on Dun, St Kilda which is the largest UK colony have apparently fallen by 48% since 1999** Migration: little information on numbers Wintering: none winter in Scottish waters
Northern gannet	SPA cited Amber list	Favourable 2	Breeding: increasing, though at a rate that is now slowing compared to increases from 1939 to 1989 Migration: numbers are probably increasing along with increases in breeding numbers in Scotland, Norway and Iceland Wintering: few winter in Scottish waters. Numbers at sea in Scottish waters in winter seem from ESAS database to have remained fairly constant despite large increases in breeding numbers

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Great cormorant	SPA cited Amber list	Favourable 1 Unfavourable 1	Breeding: Overall a slight increase in breeding numbers in Scotland since the 1960s, but with evidence of a local decline in Shetland, Orkney, Caithness and Sutherland between 1969 and 2000, thought to be due to persecution at salmon farms and at salmon rivers Migration: little information on numbers Wintering: no trend evident
European shag	SPA Cited Amber list	Favourable 1 Unfavourable 2	**Breeding: a widespread decline in Scotland after 1985, but with some recovery in some areas since 2000 and continued declines in other areas** Migration: Scottish populations are predominantly resident and there is negligible long-distance migration to/from Scotland **Wintering: trends as for breeding numbers**
White-tailed eagle	Annex 1 Schedule 1 Red list		Breeding: increasing since re-introduction in 1970s Migration: no significant migration occurs Wintering: numbers reflect changes in breeding numbers (increasing)
Arctic skua	SPA cited Red list	Favourable 3 Unfavourable 2	**Breeding: large decline, by more than 50%, in recent years which took this species directly from green list before 2009 to red list now** Migration: no evidence of a trend in numbers passing on migration Wintering: none winter in Scottish waters
Great skua	SPA cited Amber list	Favourable 3	Breeding: numbers increased at 7% p.a. from 1900 to 1980, but have decreased at the largest colonies since then, although many small colonies have continued to grow so the overall trend is probably a slight decline in the last two decades Migration: no evidence of a trend in numbers passing on migration Wintering: normally none winter in Scottish waters
Black-headed gull	Amber list		**Breeding: there is evidence of a recent decline in breeding numbers although the evidence base is weak for inland colonies** Migration: little information available Wintering: slight decline in wintering numbers

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Common gull	Amber list		Breeding: strong evidence of changes in distribution, but the total numbers in Scotland may have remained at a fairly consistent level Migration: little information available **Wintering: numbers in Scotland in winter appear to have declined considerably since the 1980s**
Lesser black-backed gull	SPA Cited Amber list		**Breeding: numbers increased considerably from 1950s to 2000, but have decreased in many areas since 2000 and in some areas, such as Orkney and Shetland, this decrease started well before 2000.** Migration: little information available Wintering: numbers over wintering in Scotland have increased since the 1950s; these are birds from local colonies that no longer migrate to southern Europe in autumn
Herring gull	SPA cited Red list	Unfavourable 1	**Breeding: numbers increased considerably from 1900 to 1969, but started to decline in the 1970s (coinciding with large scale culling of breeding adults at several major colonies but that was not the main cause of the decline). The decline has continued, with breeding numbers in Scotland reduced in 2000 to about half the numbers present in 1969.** **Migration: numbers migrating through Scotland are not well known (but include birds from Arctic Norway and Russia as well as Scottish birds); numbers involved have probably decreased since the 1970s** **Wintering: numbers of wintering birds have shown a similar decline to that observed with the breeding population**

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Great black-backed gull	SPA cited Amber list	Favourable 1 Unfavourable 3	Breeding: numbers in Scotland as a whole have shown only a slight decrease from 1969 to 2000, but there have been pronounced declines at some colonies, especially formerly large colonies such as on Hoy Migration: the species is largely resident in Scotland although numbers are supplemented by migrants arriving from Arctic Norway and Russia in autumn. Since numbers wintering in the North Sea have declined, the number of migrants arriving has almost certainly decreased **Wintering: numbers wintering in Scotland have declined, as have numbers at sea in the North Sea in winter**
Black-legged kittiwake	SPA cited Amber list	Favourable 2 Unfavourable 9	**Breeding: after many decades of population growth from 1900 to about 1980, there has been a large decrease in breeding numbers between 1985 and 2000, which has continued since 2000. This decline has been especially pronounced in Orkney and Shetland.** Migration: little data on numbers migrating through the area Wintering: little data on any trend in wintering numbers in Scottish waters; most kittiwakes leave Scottish waters in winter
Little tern	Annex 1 SPA cited Schedule 1 Amber list		Breeding: numbers have fluctuated considerably, but indicate a small decline since 1985 (much smaller than the decline that has occurred over the same period in England, Wales and Ireland) Migration: little data available as this species is rarely reported on migration in Scotland Wintering: none winter in Scottish waters
Sandwich tern	Annex 1 SPA cited Amber list		**Breeding: numbers in Scotland have declined by about 50% since 1970, and the breeding range has contracted considerably** Migration: little data available Wintering: normally fewer than 5 birds remain in Scottish waters in winter
Common tern	Annex 1 SPA cited Amber list		**Breeding: numbers have declined considerably since 1985, especially in Shetland** Migration: little data available Wintering: none winter in Scotland

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Roseate tern	Annex 1 SPA cited Schedule 1 Red list		**Breeding: numbers have decreased very considerably since the 1960s from around 500 pairs to 4 in 2004 and similar extremely low numbers since then** Migration: rarely seen on migration Wintering: none winter in Scotland
Arctic tern	SPA cited Annex 1 Amber list	Favourable 2 Unfavourable 4	**Breeding: numbers have decreased considerably since 1985, especially in Orkney and Shetland** Migration: little data available Wintering: none winter in Scotland
Common guillemot	SPA cited Amber list	Favourable 7 Unfavourable 5	Breeding: numbers increased between 1969 and 1985, and increased slightly between 1985 and 2000, but have decreased since 2000 in Orkney and Shetland and in NW Scotland Migration: patterns have changed somewhat, with movements apparently responding to changes in fish stocks so that birds from the northern isles may remain in Scottish waters when local sandeel abundance is high or may migrate to Danish waters when sandeels are scarce but sprats and young herring are available in the eastern North Sea Wintering: numbers at sea in Scottish waters in winter probably reflect changes in breeding numbers in Scotland but may vary according to abundance of food fish such as sandeels and sprats
Razorbill	SPA cited Amber list	Favourable 5 Unfavourable 1	Breeding: numbers increased by 25% between 1969 and 2000, although numbers in Shetland decreased during this period and hardly changed in Orkney or in Caithness. Numbers declined considerably in eastern Scotland after 2000, but showed little change in western Scotland Migration: little data available Wintering: most leave Scottish waters and winter further south, numbers remaining in Scottish waters in winter are not known to have changed
Black guillemot	Amber list		Breeding: numbers seem to have increased from 1969 to 1985, although survey methods in 1969 were not ideal. Numbers in 2000 were almost identical to those in 1985 Migration: this species does not migrate Wintering: numbers in winter have remained much the same since 1985

Target Bird	Conservation categories	SPA Sites Condition summary for sites <80 km from PFOW	Population conservation status: trends in numbers (unfavourable conservation status highlighted in bold)
Little auk	Green list		Breeding: none breed in Scotland Migration: little data available, Wintering: numbers wintering in Scottish waters are thought to have increased since the 1970s, but represent a very small fraction of the population of this species
Atlantic puffin	SPA cited Amber list	Favourable 3 Unfavourable 3	Breeding: there is thought to have been a decline in numbers in the late 19th and during the early 20th century, but numbers increased slightly in Scotland as a whole from 1969 to 2000, except in Caithness where numbers declined considerably Migration: little data as this species is difficult to detect at sea and counts from seawatching are not very informative Wintering: relatively few remain in Scottish waters in winter and no trend has been detected

4.2.7 Stage 7: Detail Relevant Data Collection and Analysis Methods

Background

The data required for Ornithological CIA is likely to be the same as that collected for EIA, but the requirement for any additional CIA specific data collection should be agreed during scoping (King et al. 2009). The key information required to inform an ornithological impact assessment is identification of the species present within the area of potential impact, the seasonal densities of each species (e.g. by month) for periods of one to two years, dependent primarily on the scale of the proposed development and the sensitivity of the location[16] and the range of activities/behaviours observed. These data are then used to estimate the number of individuals at risk of impacts.

The results of the impact assessment for each project included in the CIA can be combined to estimate the total number predicted to be affected (e.g. the combined sum of birds estimated to be displaced or at risk of collision). When undertaking this process it is important that any potential biases associated with different survey methods are considered. The following sections summarise some of the issues to be considered when combining seabird data across projects.

Survey methods

It is beyond the scope of this document to specify survey methods, however the regulator and SNH will need to be satisfied that, whichever methods are employed, the outputs are fit for the purpose of impact assessment. With regards to the PFOW projects, a review of the scoping reports (Appendix 1 Section 4) has revealed that a wide range of approaches to obtaining site specific seabird data have been proposed, including surveys by boat, from the shore and the use of existing survey data (e.g. APEM aerial surveys, JNCC boat surveys). While use of standardised methods for

[16] Marine Scotland Survey, deploy and Monitor Policy. Draft. *www.scotland.gov.uk/Resource/Doc/295194/0119338.doc*

survey and analysis will simplify the combination of results across different projects, and may therefore be preferred, the varied nature of the different proposed developments in the PFOW area means a flexible approach to survey methods is required (for a discussion of recommended common survey methods for offshore developments see Jackson and Whitfield 2011). Consequently, for any given focal development, Ornithological CIA will require combining outputs generated using a variety of methods. It is not possible here to specify precise methods for all potential combinations, since individual circumstances will vary, however the following section summarises aspects for consideration.

Assessment methods

There are currently no standardised modelling methods for impact assessment for wave and tidal current projects and it is therefore not possible to recommend any particular analytical approaches here. Differences in methods notwithstanding, so long as the approach taken by each developer is regarded as robust and fit for purpose, the outputs (as confirmed by MSLOT) should be compatible. For example, tidal turbine collision risk models will generate an estimate for each species considered at risk. These estimates can be combined across projects to obtain a cumulative total, although this will be considerably simplified if results are presented in comparable forms (e.g. annual or monthly, see Stage 9).

Another aspect in need of guidance is the determination of connectivity between project sites and seabird colonies. This is of particular importance for the PFOW area due to the numerous seabird breeding colonies (both SPA and non-SPA) present, and the consequent likelihood that birds seen on any given development site could be drawn from one of several colonies. An agreed means to apportion birds among colonies is a prerequisite for EIA, CIA and HRA; such methodology is currently being developed by SNH in consultation with JNCC and others (this is currently in draft and has been used in the worked example which accompanies this report). It involves simple allocation in relation to distances of SPAs from a focal development site and numbers of pairs or individuals of the seabird species at each of these SPAs. Allied to this is the need for agreed reference population sizes for each colony; it is currently far from clear what population sizes to use and how to account for recent trends, however JNCC and SNH are currently developing guidance on these issues. This is discussed further in Appendix 1 Section 3.

The ultimate measure of impact is on the status of one or more populations. Therefore, while the means to determine the number of individuals affected and the magnitude of the effect will necessarily vary depending on the technologies in question, interpretation of the effects is a matter of population dynamics. Small impacts (e.g. sub-lethal impacts on small numbers of individuals of lower sensitivity species) can be assessed in relation to average demographic. Larger impacts, or those which affect more sensitive species, may need to be explored in greater detail, for example using population modelling. The level of detail required will need to be agreed in consultation with the regulators and statutory advisors.

Recommendations

- Methods for combining impact assessment results obtained using different methods and across different time frames (i.e. different years) need to be developed, potentially at a strategic level.
- Variations in technology mean that development of single approaches for estimating impacts (e.g. collision risk modelling) may not be possible. However, presentation of standardised outputs (e.g. monthly collision risk numbers or changes in the density of birds foraging) would greatly simplify combination of such impacts across sites and is strongly encouraged.

- There is an urgent need for an agreed means to apportion seabirds seen on a focal site amongst multiple breeding colonies. SNH is in the process of finalising development of such a method for dissemination to developers.

4.2.8 Stage 8: Data Acquisition from other Developers

Background

King et al. (2009) explain that commercial sensitivities are likely to limit data sharing prior to submission of applications. This being the case, it is likely that data for other developments will only be available for those projects when the planning application is submitted. This restriction on data availability pre-planning application should not be an issue for Ornithological CIA as, at a minimum, only projects that have a submitted planning application should be considered, at least on a quantitative basis (as explained in Stage 3 (above) and Appendix 1, Section 6).

To avoid delays in conducting Ornithological CIA it is important that the ES, Technical Appendices and associated data are made easily available to other developers (note that raw survey data are not required).

Recommendations

- To avoid developers incurring delays in completing their Ornithological CIA, it is recommended that each developer sends an electronic copy of their ES, Technical Appendices and associated data (see Stage 9 below for details of what data this should include) to the other developers who have agreements for lease with The Crown Estate in the PFOW area.

4.2.9 Stage 9: Detail Relevant Data Presentation

Background

King et al. (2009) recommended that a standardised system for reporting results in ESs should be developed to improve compatibility of results but that until this was in place, raw data and density and population estimates (with methods for their generation) should be presented. Clarity in reporting of methods was also considered to be of importance.

The primary measures of interest for impact assessment are bird density and population estimates on the development site. Estimates need to reflect temporal variations (particularly seasonal) and potentially variations linked to tide state and time of day. Results of impact assessments which have been generated using methods accepted by the regulator should be treated as compatible for the purposes of CIA. Therefore the key aspect is that these results are straightforward to combine.

Recommendations

- The most critical consideration with regards to combining data across projects for the purpose of Ornithological CIA is that the outputs should be compatible. To ensure consistency across projects, the following data for all species assessed should be presented in tables in the ES or its supporting Technical Appendices:
  - Bird density estimates by month (including variances);
  - Survey dates;
  - If appropriate, collision mortality estimates by month (including variances if estimated);

- If appropriate, estimates of displacement by month (including variances if estimated);
- Reference populations used in the assessment (stage 2);
- Standard bird metrics used in assessments (e.g. foraging ranges, swimming speeds, diving depths, breeding seasons, etc.). The source for these values should be included; and
- Results of impact assessments which have been accepted by the regulator should be treated as compatible for the purposes of CIA.

4.2.10 Stage 10: Determine Significance of Cumulative Impacts

The following approach to determining the significance of effect is recommended.

The assessment of significance (including the CIA) should follow the methods detailed in The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (SI 2011/139) and The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (SI 2000/320). Guidance on the implementation of the Birds and Habitats Directive (SERAD, 2000) is considered for Natura sites.

The information provided by the assessment method should provide adequate information to allow the competent authority to undertake an Appropriate Assessment should this be required (in line with the Habitats Directive). This will involve establishing whether the project (either alone or in combination with other plans or projects) is likely to have an adverse effect on the integrity of the relevant SPA(s).

The method for assessing the significance of an effect on the integrity of an SPA is different from that employed for wider-countryside ornithological interests. The Habitats Directive is transposed into domestic legislation by the Habitats Regulations. Regulation 48 indicates a number of steps to be taken by the competent authority before granting planning permission (these are referred to here as a 'Habitats Regulation Appraisal'). In order of application, the first three are:

Step 1: Consider whether the proposal is directly connected to or necessary for the management of the site (Regulation 48 (1b)). If not,

Step 2: Consider whether the proposal, alone or in combination, is likely to have a significant effect ("LSE") on the site with regards its Conservation Objectives (Regulation 48 (1a)). If so,

Step 3: Consider whether it can be ascertained that the proposal will not adversely affect the integrity of the site ("Integrity Test") having regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which they propose that the consent, permission or other authorization should be given (Regulation 48 (5 & 6). The information provided within this assessment will be sufficient to inform an Appropriate Assessment should this be required as part of the Habitat Regulations Appraisal.

Where an SPA population is below the levels for which it has been designated, there is further consideration to be made with regards how a development may affect the population's ability to recover to its size at designation. It will therefore have to be shown that the development as proposed will not be detrimental to the full recovery of the site. It is important that such an assessment considers the potential effects of the development *over and above* any underlying influences so as not to over-state the potential impacts.

Finally, the EIA methodology for assessing the significance of wider-countryside effects detailed below can also be employed as part of the HRA to aid in the appraisal process.

The evaluation of wider-countryside interests (interests unrelated to an SPA) involves the following process:

- Identification of the potential effects of the Development;
- Consideration of the likelihood of occurrence of potential effects where appropriate;
- Defining the Nature Conservation Importance of the bird populations present;
- Defining the Vulnerability of the bird populations present;
- Establishing the population's Conservation Status;
- Establishing the Magnitude of the Likely Effect (both spatial and temporal);
- Based on the above information, a judgement is made as to whether or not the identified
- Effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- Opportunities for enhancement are considered; and
- Residual effects after mitigation, compensation or enhancement are considered.

5. RECOMMENDATIONS FOR STRATEGIC WORK (OBJECTIVE 3)

5.1 Need for, and benefits of, further strategic work regarding Ornithological CIA and consenting of wave and tidal projects in the PFOW

Three potential approaches may be taken to conducting Ornithological CIA:

1. **Decentralised Approach**: This is where guidance for completing Ornithological CIA is prepared at a strategic level and developers prepare their project specific Ornithological CIA independently.
2. **Semi-Centralised Approach**: This is where guidance for completing Ornithological CIA AND key elements of Ornithological CIA stages are provided at a strategic level but the Ornithological CIA is delivered independently by the developer.
3. **Centralised Approach**: This is where the Ornithological CIA is prepared at a strategic level by an appointed organisation.

<u>Decentralised & Semi-Centralised Approaches</u>

The approach being adopted presently (by this report) generally falls under the 'Decentralised Approach' with elements of the 'Semi-centralised Approach'. For example, this report generally gives guidance on what developers should consider at each stage, however Stage 2 provides further details on which Target Bird Populations to consider (and which ones may be scoped out) within the ornithological impact assessment and associated CIA. Stage 5 (Vulnerability of Target Bird Populations) and Stage 6 (Conservation Status of Target Bird Populations) also provide full details which developers can easily include within their ornithological assessment and associated Ornithological CIA.

However, there are a number of areas where a strategic (i.e. semi-centralised) approach may be beneficial to ensuring the production of high quality and consistent Ornithological CIA, which in turn will benefit the marine renewables industry via reduced consenting times. Recommendations for strategic work which would fall within the 'Semi-centralised Approach' are detailed below.

Identifying Target Bird Populations and Projects Relevant to each PFOW Wave and Tidal Project

To unify the task of determining Target Bird Populations, SPAs and projects to include in Ornithological CIA for each individual project, a high level GIS based assessment could be undertaken. This would use agreed foraging ranges to identify which SPAs and projects should be included at the outset of an Ornithological CIA, based on the overlap of projects and Target Bird Population foraging ranges. The resulting outputs would make initial SPA and project selection straightforward. Subsequent collection of site specific survey data could then be used to refine the starting list, on the basis of species observed on site, while tagging data could provide empirical estimation of connectivity between project sites and SPAs.

Data Acquisition

It is recommended that the collation of relevant data from the various projects and activities (other than wave and tidal current) to inform Ornithological CIA could be done at a strategic level. This would avoid individual developers receiving multiple data requests, reduce the overall transaction costs and would avoid separate developers undertaking a similar (potentially quite extensive) exercise which could just be done once and then updated/amended by individual developers as necessary.

Updated Data on SPA Populations

In many cases, there are no up to date estimates of seabird breeding numbers at SPAs and at other colonies in the area, the most recent complete survey having been completed in 1998-2002. Determining current conservation status for important populations where recent data are lacking would improve Ornithological CIA. Important populations where trends and numbers are particularly uncertain include common guillemots at North Caithness Cliffs SPA (last counted 2000), at East Caithness Cliffs SPA (1999) at Sule Skerry and Sule Stack (1998), red-throated divers at Caithness and Sutherland Peatlands SPA (1980s), razorbills at North Caithness Cliffs SPA (2000) and East Caithness Cliffs SPA (1999), Atlantic puffins at Sule Skerry and Sule Stack SPA (1998), and shags at East Caithness Cliffs SPA (1999).

Assessment of existing data that could inform on impacts on seabirds

The recent history of testing of devices at EMEC could potentially inform on the scale of impacts on seabirds. Although only single devices are deployed at EMEC, whereas wave & tidal projects in the PFOW will consist of arrays, this may still generate some useful information on impacts. There would be two possible approaches:

Firstly, seabird counts at the EMEC test sites could be analysed in relation to deployment of devices at these sites. Such an analysis may indicate the extent of displacement (or lack of displacement) of seabirds when devices are in the water or are functioning. This analysis has not yet been carried out owing to the confidential nature of device deployment at EMEC. Although detailed monitoring of seabird numbers at the test sites (Fall of Warness and Billia Croo) have been completed, and the data have been reviewed (Reports to SNH by Alex Robbins), information on the periods during which devices were present or were operating has not yet been made available.

Secondly, there are 'beached bird survey' data collected by RSPB in Orkney each month since 1976. These beached bird surveys provide an index of seabird mortality, but the data need to be examined with great care because numbers of seabirds found on beaches vary considerably according to a variety of environmental conditions. However, the beaches surveyed each month include the shoreline at Billia Croo, and there are some data from Sanday (though not shorelines of Eday or Stronsay). With careful consideration of the use of appropriate control stretches of coastline, it may be possible to assess whether there has been any change in numbers of dead birds on beaches downstream from EMEC test sites during periods of deployment of devices at EMEC. Such an analysis may not provide a powerful test of the hypotheses that devices increase, or do not increase, seabird mortality rates, but the data are available from RSPB and it would seem sensible to investigate whether they provide any useful information in this context.

Centralised Approach

The 'Centralised Approach' might involve an appointed organisation completing an initial Ornithological CIA (referred to here as the 'Centralised CIA') for the PFOW wave and tidal projects. Because wave and tidal projects, and other relevant projects, will submit their planning application at different points in time, it would be necessary to update the Centralised CIA as new projects submit their planning applications. Any such Centralised CIA would effectively be akin to a regional Ornithological CIA and initially would predominantly contain a modelling/qualitative approach to assessment due to the lack of baseline data – this is explained further below.

The centralised Ornithological CIA could also include projects which are reasonably foreseeable. Although this is not a regulatory requirement of EIA or HRA (see Appendix 1 Section 6), there are benefits to the industry and regulators of including reasonably foreseeable projects in a Centralised Ornithological CIA: it would allow developers and their consultants to update the Centralised

Ornithological CIA with greater ease (replacing modelled/qualitative parameters with actual assessment data); it would allow the industry and regulators greater insight to particular future significant cumulative effects which can inform the development of mitigation measures at a project and strategic level – this in turn would enable future development constraints to be addressed well in advance and help to avoid delays in the planning process as a consequence of these issues.

Determination of thresholds of acceptable population change

An important consideration for developments which may affect wildlife population sizes is determining the extent of change (e.g. decline) in population size which is considered acceptable. This is a matter which needs to be addressed by the regulator and their statutory advisors. Aspects which need to be considered in estimating thresholds of acceptability will include how to allow for underlying trends, how uncertainty in population sizes, trends and impacts are handled and the frequency with which thresholds are reviewed.

6. STRATEGIC REVIEW OF FACTORS AFFECTING DYNAMICS OF SEABIRD POPULATIONS (OBJECTIVE 4)

There are many factors in the marine environment which can impact upon seabird populations, and of these, the ones that have affected PFOW seabird populations most in the past are human exploitation and persecution, mammal predation, food abundance and fisheries. Those most likely to affect PFOW seabird populations at present are food abundance, fisheries, mammal predation and climate change, and those most likely to affect PFOW seabird populations in the future are also likely to be food abundance, fisheries, mammal predation and climate change (see Appendix 1, Section 5). There is the potential for offshore wind farms to result in cumulative impacts on some seabirds, although these impacts may be difficult to quantify in the context of changing baselines for these species caused by climate change, food abundance and fisheries. These issues are reviewed in detail in Appendix 1, Section 5.

Wave and tidal current projects can be predicted to have a relatively low impact on PFOW seabird populations (Furness et al. 2012), which even in the most vulnerable seabird populations may be too low to detect in the face of changes to seabird baseline populations driven by food abundance, fisheries, mammal predation and climate change (see details in Appendix 1, Section 5). The impact of wave and tidal current projects on vulnerable seabirds may be greater for populations that are already stressed by other factors, and so impacts may increase for declining populations, but even so, the cumulative impacts of these technologies are likely to be much less than impacts from food abundance, fisheries, mammal predation and climate change so will still be difficult to detect with existing seabird survey methodologies that can generally only measure population changes of tens of percent from baseline (Mitchell et al. 2004; Topping and Petersen 2011). The exception to this may be where developments are proposed within or close to SPAs. It is thought that diving birds will encounter a risk of entanglement, collision with subsurface components or blade strike (Boehlert and Gill 2010); this risk being higher for tidal current turbines as wave energy device structures will be situated mostly above the sea surface so represent a lower hazard. Seabirds such as auks, divers, shags and cormorants dive deep below the sea surface to catch their prey hence any novel construction underwater has the potential to act as a barrier to their movements and a collision hazard. There is speculation that with rotating blades under the sea surface, there is potential for seabirds to collide with rotating blades as with onshore wind turbines. However, Faber Maunsell and Metoc (2007) believe that underwater, birds' moderately fast burst speed would enable escape from the path of tidal turbine blades. It is also worth noting that the tip speed of current tidal turbine models is only 20-30% that of wind turbines.

There is also concern for seabirds during the installation and maintenance of turbines and wave energy devices, that boat traffic and disturbance will increase. Increase in boat traffic during the installation and maintenance of devices could flush auk species from hundreds of metres away (Langton et al. 2011). Divers have been reported to be especially sensitive to boat movements and therefore could be negatively impacted by an increase in boat traffic in the PFOW area during construction and maintenance of tidal current and wave turbines. Divers also tend to show strong avoidance to structures such as offshore wind farms. For seabirds along the Oregon coastline, it has been predicted that stormy conditions such as high winds or poor visibility could increase collision rates with wave energy converters and that continuous lighting present on any devices could increase collision risk at night when birds could be attracted to the lights. Scientists there are also concerned about the potential risk for oil leakage from wave energy structures and the impacts that this could have on seabird waterproofing and thermoregulation if feathers become fouled (Boehlert et al. 2008). Alongside these potential negative impacts of wave and tidal current arrays, they also carry potential positive impacts to the local seabird colonies: modifications to water movements and turbulence could alter vertical movements of marine organisms and result in prey and predator aggregations (Boehlert and Gill, 2010). Langton et al. (2011) have also reported that fish move closer to structures after disturbance events and suggest that once tidal current or wave energy devices are installed, this could increase the success of seabirds foraging around the structures.

It will be impossible to know the full extent of these device instalments upon seabird populations until they have been installed and the local area and seabird colonies surveyed. However, the likely effects of wave energy and tidal current turbine arrays have been assessed by McCluskie et al. (2012) and by Furness et al. (2012). These two reviews reach broadly similar conclusions. Impacts of wave energy devices are likely to be substantially less than impacts of tidal current arrays, and both technologies are likely to have less impact on seabirds than some other developments. For example, displacement of seabirds by tidal current turbine arrays or wave energy devices is likely to be substantially less than from offshore wind farms because wave and tidal current developments occupy much smaller areas than taken up by offshore wind farms (McCluskie et al. 2012). Seabirds most likely to be adversely affected can be identified based on knowledge of seabird ecology. For wave energy devices, the main hazards to seabirds are possible displacement of sensitive species from foraging habitat and possible injury through collision with structures either above or below water. While in the past there has been a tendency to assume that displacement equals death, this approach is no longer considered appropriate, and the effects of displacement are more appropriately assessed through a model linking behaviour to demography (McDonald et al. 2012). More speculative impacts include the possibility that such devices may provide ‘stepping stones’ permitting alien mammal predators such as mink to extend their range, and the possibility that pollutants may enter the marine environment by leakage from these devices (McCluskie et al. 2012). Seabirds most vulnerable to impacts of wave energy devices appear to be divers (all species), as these birds are particularly sensitive to disturbance.

In the analysis by Furness et al. (2012), for wave energy devices, no seabird species fell into the categories ‘very high vulnerability’ or ‘high vulnerability’. Red-throated divers, black-throated divers and great northern divers were classified as ‘moderate vulnerability’. A total of 19 species fell into the category of ‘low vulnerability’ and 16 into the category ‘very low vulnerability’. Details of these scores are presented in Table 6. Therefore the focus of Ornithological CIA for wave energy devices in PFOW should be on possible displacement impacts on diver populations in PFOW.

For tidal current arrays, no species fell into the ‘very high vulnerability’ category. Five species fell into the ‘high vulnerability’ category (black guillemot, razorbill, European shag, common guillemot and great cormorant). Five species fell into the ‘moderate vulnerability’ category (great northern diver, red-throated diver, Atlantic puffin, black-throated diver and little auk). The remaining 28 species fell into categories ‘low vulnerability’ or ‘very low vulnerability’, suggesting that their populations are unlikely to be affected by tidal current turbines. Details of these scores are presented in Table 5. Therefore the focus of Ornithological CIA for tidal current arrays in PFOW should be on collision risks and displacement impacts on these seabird populations categorised as high or moderate vulnerability.

Many breeding seabird populations in Orkney and Caithness represent high proportions of the Scottish total for the species (great black-backed gull 39%, Arctic skua 38%, common scoter 38%, black-legged kittiwake 38%, common guillemot 35%, Arctic tern 30%, northern fulmar 25%, common gull 24%, great skua 23%, razorbill 22%, black guillemot 19%, Sandwich tern 16%, common eider 15%, shag 14%, great cormorant 14%, Atlantic puffin 13%, red-throated diver 9%, herring gull 8%, black-headed gull 8%, European storm-petrel 6%, black-throated diver 6%, little tern 6%). In addition, within 80 km of PFOW there are SPAs designated for common guillemot (12 sites), black-legged kittiwake (11 sites), northern fulmar (10 sites), Atlantic puffin (6 sites), razorbill (6 sites), Arctic tern (6 sites), Arctic skua (5 sites), great black-backed gull (4 sites), red-throated diver (3 sites), great skua (3 sites), shag (3 sites), northern gannet (2 sites), European storm-petrel (2 sites), great cormorant (2 sites), black-throated diver (1 site), Leach’s storm-petrel (1 site), and herring gull (1 site). Connectivity between SPAs and development sites is assessed on the basis of estimated mean and maximum foraging ranges of breeding seabirds of the focal species, using a methodology developed by SNH. Many of these SPA seabird populations have connectivity with PFOW development sites, based on the breeding season mean and maximum foraging ranges of these species from their colonies (Foraging range data are presented in Appendix 1 Table A1.3.5).

However, based on a proportionate response to the anticipated very low impact of phase 1 tidal current and wave energy developments in PFOW, many of these seabird species and SPA populations can be scoped out due to low or very low vulnerability to wave and tidal current devices. For more details of the appraisal of impacts of unregulated and regulated factors on seabird populations in PFOW and at a wider scale, see Appendix 1, Section 5.

For wave energy devices, divers are the species considered to be at risk of significant displacement, and both red-throated divers and black-throated divers breed in SPAs that have connectivity with parts of PFOW. For tidal current arrays, of those species considered to be at high or moderate risk of impacts at the population level, several breed in SPAs that have connectivity with parts of PFOW. These are razorbill, shag, common guillemot, great cormorant, red-throated diver, Atlantic puffin and black-throated diver. Given the likely locations of MPAs with black guillemot as a feature, these may not have connectivity with PFOW sites, although the population of this species in PFOW represents a significant proportion of the total Scottish population of this species, as do the populations of all of the other species considered to be at high or moderate vulnerability.

Conclusion

Seabird populations are subject to impacts of many factors, the most important of which at the present time in PFOW are likely to be food abundance, fisheries, mammal predation and climate change. Many seabird populations are currently declining as a consequence of reductions in sandeel stocks in the NW North Sea, reductions in fishery discarding, and impacts of climate change on the marine food web. Impacts of offshore wind are likely to be small, and impacts of tidal current arrays and wave energy devices are likely to be very small by comparison with these major effects. Detecting any impacts of marine renewables on seabird populations will be difficult in the context of large changes caused by food abundance, fisheries, predators and climate change. Among seabird populations in PFOW, only diver species are likely to be sensitive to wave energy devices, primarily through disturbance and displacement. A larger number of underwater piscivorous pursuit-diving seabirds are likely to be sensitive to tidal current arrays (auks, divers, shag, and cormorant). Most of these sensitive species are present in Orkney and Caithness in nationally or internationally important numbers, and several are designated features of SPAs with connectivity to PFOW development Sites. These species should be the main focus of ornithological CIA. Seabird species with low sensitivity to wave and tidal current devices should be scoped out of Ornithological CIA except (as advised by SNH) in cases where numbers occurring at development sites represent a high proportion of the regional population, or when the species is a SPA qualifying feature and the conservation objectives are not met. In the context of HRA, connectivity between development sites and SPAs should be assessed from foraging range data using a classification developed by SNH.

REFERENCES

ABP Marine Environmental Research Ltd. October 2012 Marine Scotland's Licensing and Consents Manual, covering Marine Renewables and Offshore Wind Energy Development. Marine Scotland. Report R.1957.

Albores-Barajas, Y.V., Soldatini, C. and Furness, R.W., 2009, Are burrow nesting seabird chicks affected by human disturbance? Waterbirds, 32: 572-578.

Allen, S. and Bennet, F. 2012. Assigning predicted effects of marine renewable energy projects to seabird populations in the context of complying with the Habitats Regulations. Paper to Chief Scientists Group.

Almaraz, P. and Oro, D. 2011. Size-mediated non-trophic interactions and stochastic predation drive assembly and dynamics in a seabird community. Ecology 92: 1948-1958.

AMEC 2013. Cumulative Impact Assessment in Pentland Firth and Orkney Waters. Commissioned report for The Crown Estate.

Anon 2010. Wind energy developments and Natura 2000. Natura 2000 Guidance Document. European Commission.
http://ec.europa.eu/environment/nature/natura2000/management/docs/Wind_farms.pdf

APEM 2011. Investigation of the utilisation of sea space by sea birds in the Pentland Firth & Orkney area. Annual Report Final , January 2012. APEM Ref: 411122.

APEM 2012. Pentland Firth and Orkney Waters aerial bird survey 2010/11 additional image analysis. APEM Scientific Report 412052. Report to The Crown Estate, 180pp.

Barbraud, C., Rolland, V., Jenouvrier, S., Nevoux, M., Delord, K. and Weimerskirch, H. 2012. Effects of climate change and fisheries bycatch on Southern Ocean seabirds: a review. Marine Ecology Progress Series 454: 285-307.

Barrett, R.T., Nilsen, E.B. and Anker-Nilssen, T. 2012. Long-term decline in egg size of Atlantic puffin *Fratercula arctica* is related to changes in forage fish stocks and climate conditions. Marine Ecology Progress Series 457: 1-10.

Beale, C.M. and Monaghan, P. 2004, Human Disturbance: People as Predation-free Predators? Journal of Applied Ecology 41: 335-343.

Beale, C.M. and Monaghan, P. 2005, Modelling the effects of limiting the number of visitors on failure rates of seabird nests. Conservation Biology 19: 2015-2019.

Bellefleur, D., Lee, P., Ronconi, R.A. 2009. The impact of recreational boat traffic on marbled murrelets (*Brachyramphus marmoratus*). Journal of Environmental Management 90, 531-538.

Black, J.M., Deerenberg, C. and Owen, M. 1991. Foraging behaviour and site selection of barnacle geese *Branta leucopsis* in a traditional and newly colonized spring staging habitat. Ardea 79: 349-358.

Boehlert, G.W., McMurray, G.R., Tortorici, C.E. eds. 2008, Ecological Effects of Wave Energy Development in the Pacific Northwest: A Scientific Workshop, October 11-12, 2007. NOAA Technical Memorandum NMFS-F/SPO-92

Boehlert, G.W. and Gill, A.B., 2010, Environmental and Ecological Effects of Ocean Renewable Energy Development. Oceanography 23: 68-81.

Boulinier, T. and Danchin, E. 2005. Population trends in kittiwake *Rissa tridactyla* colonies in relation to tick infestation. Ibis 138: 326-334.

Boulinier, T. and Riffaut, L. 2008. What is the impact of oil pollution on seabirds? Oceanis 30: 577-598.

Bright, J.A., Langston, R.H.W., Bullman, R., Evans, R.J., Gardner, S., Pearce-Higgins, J. and Wilson, E. 2006. Bird sensitivity map to provide locational guidance for onshore wind farms in Scotland. RSPB Research Report No. 20.

Buckland, S.T., Anderson, D., Burnham, K., Laake, J., Borchers, D. and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford.

Burthe, S., Daunt, F., Butler, A., Elston, D.A., Frederiksen, M., Johns, D., Newell, M., Thackeray, S.J. and Wanless, S. 2012. Phenological trends and trophic mismatch across multiple levels of a North Sea pelagic food web. Marine Ecology Progress Series 454: 119-133.

Burton, N.H.K. 2000. Winter site-fidelity and survival of redshank *Tringa totanus* at Cardiff, south Wales. Bird Study 47: 102-112.

Burton, N.H.K., Evans, P.R. and Robinson, M.A. 1996. Effects on shorebird numbers of disturbance, the loss of a roost site and its replacement by an artificial island at Hartlepool, Cleveland. Biological Conservation 77: 193-201.

Burton, N.H.K. and Evans, P.R. 1997. Survival and winter site-fidelity of turnstones *Arenaria interpres* and purple sandpipers *Calidris maritima* in northeast England. Bird Study 44: 35-44.

Burton, N.H.K., Banks, A.N., Calladine, J.R. and Austin, G.E. 2013. The importance of the United Kingdom for wintering gulls: population estimates and conservation requirements. Bird Study 60: 87-101.

Busch, M., Kannen, A., Garthe, S. and Jessopp, M. 2013. Consequences of a cumulative perspective on marine environmental impacts: offshore wind farming and seabirds at North Sea scale in context of the EU Marine Strategy Framework Directive. Ocean and Coastal Management, in press.

Camphuysen, C.J. 2011. Seabirds and chronic oil pollution: self-cleaning properties of gulls, Laridae, as revealed from colour ring sightings. Marine Pollution Bulletin 62: 514-519.

Camphuysen, C.J. and van der Meer, J. 2005. Wintering seabirds in West Africa: foraging hotspots off Western Sahara and Mauritania driven by upwelling and fisheries. African Journal of Marine Science 27: 427-437.

Camphuysen K.C.J. Fox T.A.D. Leopold M.M.F & Petersen IBK (April 2004) Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. A comparison of ship and aerial sampling methods for marine birds, and their applicability to Offshore wind farm assessments. Commissioned by COWRIE.

Carney, K.M., Sydeman, W.J. 1999. A review of human disturbance effects on nesting colonial seabirds. Waterbirds, 22: 68-79.

Chivers, L.S. 2012. Foraging ecology and reproductive success of the black-legged kittiwake *Rissa tridactyla*, common guillemot *Uria aalge* and razorbill *Alca torda*. PhD thesis, Queen's University Belfast.

Chivers, L.S., Lundy, M.G., Colhoun, K., Newton, S.F., Houghton, J.D.R. and Reid, N. 2012. Foraging trip time-activity budgets and reproductive success in the black-legged kittiwake. Marine Ecology Progress Series 456: 269-277.

Colabuono F.I. Taniguchi S., Montone R.C., Polychlorinated biphenyls and organochlorine pesticides in plastics ingested by seabirds. Marine Pollution Bulletin 60: 630-634.

Conklin, J.R. and Colwell, M.A. 2007. Diurnal and nocturnal roost site fidelity of dunlin (*Calidris alpina pacifica*) at Humboldt Bay, California. Auk 124: 677-689.

Coulson, J.C., Monaghan, P., Butterfield, J.E.L., Duncan, N., Ensor, K., Shedden, C. and Thomas, C. 1984a. Scandinavian herring gulls wintering in Britain. Ornis Scandinavica 15: 79-88.

Coulson, J.C., Butterfield, J.E.L., Duncan, N., Kearsey, S., Monaghan, P. and Thomas, C. 1984b. Origin and behaviour of great black-backed gulls wintering in northeast England. British Birds 77: 1-11.

Crawford, R.J.M. 2009. A recent increase of swift terns *Thalasseus bergii* off South Africa – The possible influence of an altered abundance and distribution of prey. Progress in Oceanography 83: 398-403.

Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J-P., Shannon, L. and Sydeman, W.J. 2011. Global seabird response to forage fish depletion – one-third for the birds. Science 334: 1703-1706.

Davis, S.E., Nager, R.G. and Furness, R.W. 2005. Food availability affects adult survival as well as breeding success of parasitic jaegers. Ecology 86: 1047-1056.

Dawson, N., Söhle, I., Wilson, L.J., Dean, B.J., Webb, A. and Reid, J.B. 2009. The numbers of inshore waterbirds using Scapa Flow, Orkney, during the winter season; an assessment of the area's potential for qualification as a marine SPA. JNCC Report No. 407.

Desholm, M. and Kahlert, J. 2005, Avian collision risk at an offshore wind farm. Biology Letters 1: 296-298.

Dierschke, V. 1998. Site fidelity and survival of purple sandpipers *Calidris maritima* at Helgoland (North Sea). Ringing & Migration 19: 41-47.

Dillon, I.A., Smith, T.D., Williams, S.J., Haysom, S., Eaton, M.A. 2009. Status of red-throated diver *Gavia stellata* in Britain in 2006. Bird Study 56: 147-157.

Dorresteijn, I., Kitaysky, A.S., Barger, C., Benowitz-Fredericks, Z.M., Byrd, G.V., Shulz, M. and Young, R. 2012. Climate affects food availability to planktivorous least auklets *Aethia pusilla* through physical processes in the southeastern Bering Sea. Marine Ecology Progress Series 454: 207-220.

Dunn, E. K. and Steel, C. 2001. The impact of long-line fishing on seabirds in the north-east Atlantic: recommendations for reducing mortality. Royal Society for the Protection of Birds/ Joint Nature Conservation Committee, Sandy.

Dunnet, G.M. and Ollason, J.C. 1982. The feeding dispersal of fulmars *Fulmarus glacialis* in the breeding season. Ibis 124: 359-361.

Eaton, M.A., Brown, A.F., Noble, D.G., Musgrove, A.J., Hearn, R.D., Aebischer, N.J., Gibbons, D.W., Evans, A., Gregory, R.D. 2009. Birds of conservation concern 3. The population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 102, 296-341.

European Commission (1999) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions.

European Commission (2000) Managing Natura 2000 Sites. The Provision of Article 6 of the 'Habitats' Directive 92/43/EEC. European Commission, Brussels.

European Commission (2001) Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. European Commission, Brussels.

European Commission (27 October 2010) Natura 2000 Guidance Document 'Wind Energy Developments and Natura 2000'. European Commission, Brussels.

Exo, K.-M., Huppop, O. & Garthe, S. 2003. Birds and offshore wind farms: a hot topic in marine ecology. Wader Study Group Bulletin 100: 50-53.

Faber Maunsell and Metoc, 2007. Scottish Marine SEA: Environmental Report Section C Chapter C8: Marine Birds.

Fauchald, P., Skov, H., Skern-Mauritzen, M., Johns, D. and Tveraa, T. 2011. Wasp waist interactions in the North Sea ecosystem. PLoS ONE 6(7): e22729.

Ewins, P.J. 1988. An analysis of ringing recoveries of black guillemots *Cepphus grylle* in Britain and Ireland. Ringing and Migration 9: 95-102.

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. and Grundy, D.S. 2007. The Birds of Scotland. Scottish Ornithologists' Club, Aberlady.

Fowler, J.A. and Hounsome, M.V. 1998. Migration and arrival of immature storm petrels Hydrobates pelagicus in Shetland. Ringing and Migration 19: 91-94.

Fontaine, R., Gimenez, O. and Bried, J. 2011. The impact of introduced predators, light-induced mortality of fledglings and poaching on the dynamics of the Cory's shearwater (*Calonectris diomedea*) population from the Azores, northeastern subtropical Atlantic. Biological Conservation 144: 1998-2011.

Forrester, R.W., Andrews, I.J., McInerny, C.J., Murray, R.D., McGowan, R.Y., Zonfrillo, B., Betts, M.W., Jardine, D.C. and Grundy, D.S. 2007. The Birds of Scotland. Scottish Ornithologists' Club, Aberlady.

Fort, J., Pettex, E., Tremblay, Y., Lorentsen, S-H., Garthe, S., Votier, S., Pons, J.B., Siorat, F., Furness, R.W., Grecian, W.J., Bearhop, S., Montevecchi, W.A. and Gremillet, D. 2012. Meta-population evidence of oriented chain migration in northern gannets (*Morus bassanus*). Frontiers in Ecology and the Environment DOI http://dx.doi.org/10.1890/110194

Frederiksen, M. 2006. Causes of seabird declines are complex: Kittiwakes, climate and fisheries in the North Sea. Journal of Ornithology 147: 15-16.

Frederiksen, M., Wanless, S., Harris, M.P., Rothery, P. and Wilson, L.J. 2004. The role of industrial fisheries and oceanographic change in the decline of North Sea black-legged kittiwakes. Journal of Applied Ecology 41: 1129-1139.

Frederiksen, M., Harris, M.P., Daunt, F., Rothery, P. and Wanless, S. 2004. Scale-dependent climate signals drive breeding phenology of three seabird species. Global Change Biology 10: 1214-1221.

Frederiksen, M., Wright, P.J., Harris, M.P., Mavor, R.A., Heubeck, M. and Wanless, S. 2005. Regional patterns of kittiwake Rissa tridactyla breeding success are related to variability in sandeel recruitment. Marine Ecology Progress Series 300: 201-211.

Frederiksen, M., Edwards, M., Richardson, A.J., Halliday, N.C. and Wanless, S. 2006. From plankton to top predators: bottom-up control of a marine food web across four trophic levels. Journal of Animal Ecology 75: 1259-1268.

Frederiksen, M., Furness, R.W. and Wanless, S. 2007. Regional variation in the role of bottom-up and top-down processes in controlling sandeel abundance in the North Sea. Marine Ecology Progress Series 337: 279-286.

Frederiksen, M., Edwards, M., Mavor, R.A. and Wanless, S. 2007. Regional and annual variation in black-legged kittiwake breeding productivity is related to sea surface temperature. Marine Ecology Progress Series 350: 137-143.

Frederiksen, M., Jensen, H., Daunt, F., Mavor, R.A. and Wanless, S. 2008. Differential effects of a local industrial sand lance fishery on seabird breeding performance. Ecological Applications 18: 701-710.

Frederiksen, M., Moe, B., Daunt, F., Phillips, R.A. et al. 2012. Multicolony tracking reveals the winter distribution of a pelagic seabird on an ocean basin scale. Diversity and Distributions 18: 530-542.

Furness, R.W. 2002. Management implications of interactions between fisheries and sandeel-dependent seabirds and seals in the North Sea. ICES Journal of Marine Science 59: 261-269.

Furness, R.W. 2003. Impacts of fisheries on seabird communities. Scientia Marina 67 (Suppl. 2): 33-45.

Furness, R.W. 2007. Responses of seabirds to depletion of food fish stocks. Journal of Ornithology 148: S247-252.

Furness, R.W. and Todd, C.M. 1984. Diet and feeding of fulmars *Fulmarus glacialis* during the breeding season: a comparison between St Kilda and Shetland colonies. Ibis 126: 379-387.

Furness, R.W., Edwards, A.E., Oro, D. 2007. Influences of management practices and of scavenging seabirds on the availability of fisheries discards to benthic scavengers. Marine Ecology Progress Series 350: 235-244.

Furness, R.W. and Wade, H. 2012. Vulnerability of Scottish seabirds to offshore wind turbines. Report to Marine Scotland.

Furness, R.W., Wade, H.M., Robbins, A.M.C. and Masden, E.A. 2012. Assessing the sensitivity of seabird populations to adverse effects from tidal stream turbines and wave energy devices. ICES Journal of Marine Science 69: 1466-1479.

Furness, R.W., Wade, H. and Masden, E.A. 2013. Assessing vulnerability of seabird populations to offshore wind farms. Journal of Environmental Management. In press.

Garthe, S. and Hüppop, O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41, 724-734.

Garthe, S., Ludynia, K., Hüppop, O., Kubetzki, U., Meraz, J.F. and Furness, R.W. 2012. Energy budgets reveal equal benefits of varied migration strategies in northern gannets. Marine Biology 159: 1907-1915.

Gaston, A.J. and Descamps, S. 2011. Population change in a marine bird colony is driven by changes in recruitment. Avian Conservation and Ecology 6:2:5 DOI: 10.5751/ACE-00482-060205

Gjøsæter, H., Bogstad, B. and Tjelmeland, S. 2009. Ecosystem effects of the three capelin stock collapses in the Barents Sea. Marine Biological Research 5: 40-53.

Grecian, J.W. et al. 2010. Potential impacts of wave-powered marine renewable energy installations on marine birds. Ibis 152: 683-697.

Gremillet, D., Welcker, J., Karnovsky, N.J., Walkusz, W., Hall, M.E., Fort, J., Brown, Z.W., Speakman, J.R. and Harding, A.M.A. 2012. Little auks buffer the impact of current Arctic climate change. Marine Ecology Progress Series 454: 197-206.

Hamer, K.C., Phillips, R.A., Wanless, S., Harris, M.P. and Wood, A.G. 2000. Foraging ranges, diets and feeding locations of gannets *Morus bassanus* in the North Sea: evidence from satellite telemetry. Marine Ecology Progress Series 200: 257-264.

Hamer, K., Langston, R.H.W. and Wakefield, E.D. 2011. Gannets and offshore wind farms – Towards a tracking-based approach to the assessment of impacts. The Seabird Group, Plymouth.

Hass, T., Hyman, J. and Semmens, B.X. 2012. Climate change, heightened hurricane activity, and extinction risk for an endangered tropical seabird, the black-capped petrel *Pterodroma hasitata*. Marine Ecology Progress Series 454: 251-261.

Heath, M., Edwards, M., Furness, R., Pinnegar, J. and Wanless, S. 2009. A view from above: changing seas, seabirds and food sources. In Marine Climate Change Ecosystem Linkages Report Card 2009 (Eds. Baxter, J.M., Buckley, P.J. and Frost, M.T.). Online Science Reviews, 24pp. www.mccip.org.uk/elr/view

Heubeck, M. et al. 2003. Assessing the impact of major oil spills on seabird populations. Marine Pollution Bulletin 46: 900-902.

Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., Treweek, J. 1997. Bird disturbance: improving the quality and utility of disturbance research. Journal of Applied Ecology, 34: 275-288.

Hilton, G.M. and Cuthbert, R.J. 2010. The catastrophic impact of invasive mammalian predators on birds of the UK Overseas Territories: a review and synthesis. Ibis 152: 443-458.

Jackson, D., and Whitfield, P. 2011. Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Volume 4. Birds. Unpublished draft report to Scottish Natural Heritage and Marine Scotland.

Jennings, G., McGlashan, D.J. and Furness, R.W. 2012. Responses to changes in sprat abundance of common tern breeding numbers at twelve colonies in the Firth of Forth, east Scotland. ICES Journal of Marine Science 69: 572-577.

King, S. 2012. West Coast Developers' Group Islay and Argyll Array Offshore Wind Farms, Cumulative Approach Update, Ornithology, April 2012. Document Reference ISL-REP-ORN-SSE-038.

Knudsen, L.B., Borga, K., Jorgensen, E.H., van Bavel, B., Schlabach, M., Verreault, J. and Gabrielsen, G.W. 2007. Halogenated organic contaminants and mercury in northern fulmars (*Fulmarus glacialis*): levels, relationships to dietary descriptors and blood to liver comparison. Environmental Pollution 146: 25-33.

Kubetzki, U., Garthe, S., Fifield, D., Mendel, B. and Furness, R.W. 2009. Individual migratory schedules and wintering areas of northern gannets. Marine Ecology Progress Series 391: 257-265.

Langton, R. Davies, I.M. and Scott, B.E. 2011. Seabird conservation and tidal stream and wave power generation: Information needs for predicting and managing potential impacts. Marine Policy 35: 623-630.

Leon, A. De, Mínguez, E., Harvey, P., Meek E., Crane, J.E. and Furness, R.W. 2006. Factors affecting breeding distribution of Storm-petrels *Hydrobates pelagicus* in Orkney and Shetland. Bird Study 53: 64-72.

Lewis, S., Sherratt, T.N., Hamer, K.C. and Wanless, S. 2001. Evidence of intra-specific competition for food in a pelagic seabird. Nature 412: 816-819.

Lewis, M., Lye, G., Pendlebury, C. and Walls, R. 2012. Population sizes of seabirds breeding in Scottish SPAs. Natural Power Consultants, Report to Marine Scotland.

Lewison, R., Oro, D., Godley, B.J. et al. 2012. Research priorities for seabirds: improving conservation and management in the 21st century. Endangered Species Research 17: 93-121.

Maclean, I M D, Wright, L J, Showler, D A and Rehfisch, M M. (2009) A Review of Assessment Methodologies for Offshore Wind farms. British Trust for Ornithology Report Commissioned by Cowrie Ltd. (COWRIE METH-08-08) ISBN: 978-0-9557501-6-8.

Magnusdottir, E., Leat, E.H.K., Bourgeon, S., Strøm, H., Petersen, A., Phillips, R.A., Hanssen, S.A., Bustnes, J.O., Hersteinsson, P. and Furness, R.W. 2012. Wintering areas of great skuas *Stercorarius skua* breeding in Scotland, Iceland and Norway. Bird Study 59: 1-9.

Manchester, S.J. and Bullock, J.M. 2000, The impacts of non-native species on UK biodiversity and the effectiveness of control. Journal of Applied Ecology, 37: 845-864.

Mavor, R.A., et al. 2006. Seabird numbers and breeding success in Britain and Ireland, 2005. JNCC. Peterborough.

McCluskie, A.E., Langston, R.H.W. and Wilkinson, N.I. 2012. Birds and wave & tidal stream energy: as ecological review. RSPB Research Report No. 42. RSPB, Sandy. 120pp.

McDonald, C., Searle, K., Wanless, S. and Daunt, F. 2012. Effects of displacement from marine renewable developments on seabirds breeding at SPAs: a proof of concept model of common guillemots breeding on the Isle of May. Report to Marine Scotland Science. CEH, Edinburgh. 48pp.

Meek, E.R., Bolton, M., Fox, D., Remp, J. 2011. Breeding skuas in Orkney: a 2010 census indicates density-dependent population change driven by both food supply and predation. Seabird 24: 1-10.

Metcalfe, N.B. and Furness, R.W. 1985. Survival, winter population stability and site fidelity in the turnstone *Arenaria interpres*. Bird Study 32: 207-214.

Mitchell, P.I., Newton, S.F., Ratcliffe, N., Dunn, T.E. 2004. Seabird Populations of Britain and Ireland. T & AD Poyser, London.

Mitchell, I. and F. Daunt (2010) Seabirds *in* MCCIP Annual Report Card 2010-11, MCCIP Science Review, 12pp.

Mittelhauser, G.H., Tudor, L. and Connery, B. 2012. Within-year movements and site fidelity of purple sandpipers during the nonbreeding season. Journal of Field Ornithology 83: 32-40.

Mullers, R.H.E., Navarro, R.A., Crawford, R.J.M. and Underhill, L.G. 2009. The importance of lipid-rich fish prey for Cape gannet chick growth: are fishery discards an alternative? ICES Journal of Marine Science 66: 2244-2252.

Muzaffar, S.B. and Jones, I.L. 2004. Parasites and diseases of the auks (Alcidae) of the world and their ecology- a review. Marine Ornithology 32: 121-146.

Navarro, J., Louzao, M., Igual, J.M., Oro, D., Delgado, A., Arcos, J.M., Genovart, M., Hobson, K.A. and Forero, M.G. 2009. Seasonal changes in the diet of a critically endangered seabird and the importance of trawling discards. Marine Biology 156: 2571-2578.

Nordstad, T., Moe, B., Bustnes, J.O., Bech, C., Chastel, O., Goutte, A., Sagerup, K., Trouve, C., Herzke, D. and Gabrielsen, G.W. 2012. Relationships between POPs and baseline corticosterone levels in black-legged kittiwakes (*Rissa tridactyla*) across their breeding cycle. Environmental Pollution 164: 219-226.

Norman, T., Buisson, R. and Askew, N. (2007) COWRIE workshop on the cumulative impact of offshore windfarms on birds. COWRIE CIBIRD-01-2007

Okes, N.C., Hockey, P.A.R., Pichegru, L., van der Lingen, C.D., Crawford, R.J.M. and Gremillet, D. 2009. Competition for shifting resources in the southern Benguela upwelling: Seabirds versus purse-seine fisheries. Biological Conservation 142: 2361-2368.

Oppel, S., Raine, A.F., Borg, J.J., Raine, H., Bonnaud, E., Bourgeois, K. and Breton, A.R. 2011. Is the Yelkouan shearwater *Puffinus yelkouan* threatened by low adult survival probabilities? Biological Conservation 144: 2255-2263.

Orkney Bird Report Committee, 2010. Orkney Bird Report 2009. The Orcadian, Orkney.

Oro, D. and Furness, R.W. 2002. Influences of food availability and predation on survival of kittiwakes. Ecology 83: 2516-2528.

Oswald, S., Bearhop, S., Furness, R.W., Huntley, B. and Hamer, K.C. 2008. Heat stress in a high-latitude seabird: effects of temperature and food supply on bathing and nest attendance of great skuas *Catharacta skua*. Journal of Avian Biology 39: 163-169.

Österblom, H., Olsson, O., Blenckner, T. & Furness, R.W. 2008. Junk food in marine ecosystems. Oikos 117: 1075-1085.

Pennington, M.G., Osborn, K., Harvey, P.V., Riddington, R., Okill, J.D., Ellis, P.M. and Heubeck, M. 2004. The Birds of Shetland. Christopher Helm, London.

Perez, C., Munilla, I., Lopez-Alonso, M. and Velando, A. 2010. Sublethal effects on seabirds after the Prestige oil-spill are mirrored in sexual signals. Biology Letters 6: 33-35.

Phillips, R.A. 2010. Eradications of invasive mammals from islands: why, where, how and what next? Emu 110: i-vii.

Pichegru, L., Gremillet, D., Crawford, R.J.M. and Ryan, P.G. 2010b. Marine no-take zone rapidly benefits endangered penguin. Biology Letters 6: 498-501.

Pichegru, L., Ryan, P.G., Crawford, R.J.M., van der Lingen, C.D. and Gremillet, D. 2010a. Behavioural inertia places a top marine predator at risk from environmental change in the Benguela upwelling system. Marine Biology 157: 537-544.

Pollock, C.M., Mavor, R., Weir, C.R., Reid, A., White, R.W., Tasker, M.L., Webb, A. and Reid, J.B. 2000. The Distribution of Seabirds and Marine Mammals in the Atlantic Frontier, North and West of Scotland. Joint Nature Conservation Committee, Aberdeen.

Quillfeldt, P., Schenk, I., Mcgill, R.A.R., Strange, I.J., Masello, J.F., Gladbach, A., Roesch, V. and Furness, R.W. 2008. Introduced mammals coexist with seabirds at New Island, Falkland Islands: abundance, habitat preferences, and stable isotope analysis of diet. Polar Biology 31: 333-349.

Regular, P.M., Robertson, G.J., Montevecchi, W.A., Shuhood, F., Power, T., Ballam, D. and Piatt, J.F. 2010. Relative importance of human activities and climate driving common murre population trends in the Northwest Atlantic. Polar Biology 33: 1215-1226.

Rehfisch, M.M., Insley, H. and Swann, B. 2003. Fidelity of overwintering shorebirds to roosts on the Moray Basin, Scotland: Implications for predicting impacts of habitat loss. Ardea 91: 53-70.

Reynolds, T.J., Harris, M.P., King, R., Swann, R.L., Jardine, D.C., Frederiksen, M. and Wanless, S. 2011. Among-colony synchrony in the survival of common guillemots *Uria aalge* reflects shared wintering areas. Ibis 153: 818-831.

Richerson, K., Levin, P.S. and Mangel, M. 2010. Accounting for indirect effects and non-commensurate values in ecosystem based fishery management (EBFM). Marine Policy 34: 114-119.

Riffaut, L. et al, 2005. Population genetics of the common guillemot *Uria aalge* in the North Atlantic: geographic impact of oil spills. Marine Ecology Progress Series 291: 263-273.

Rojek, N.A., Parker, M.W., Carter, H.R., McChesney, G.J. 2007. Aircraft and vessel disturbances to common murres *Uria aalge* at breeding colonies in central California, 1997-1999. Marine Ornithology, 35: 61-69.

Ronconi, R.A., St. Clair, C.C.S. 2002. Management options to reduce boat disturbance on foraging black guillemots (*Cepphus grylle*) in the Bay of Fundy. Biological Conservation 108, 265-271.

Ruddock, M. and Whitfield, D.P. 2007. A review of disturbance distances in selected bird species. Natural Research report to SNH.

Sagerup, K., Larsen, H.J.S., Skaare, J.U., Johansen, G.M. and Gabrielsen, G.W. 2009. The toxic effects of multiple persistent organic pollutant exposures on the post-hatch immunity maturation of glaucous gulls. Journal of Toxicology and Environmental Health A 72: 870-883.

Sakshaug, E., Johnsen, G. and Kovacs, K. 2009. Ecosystem Barents Sea. Tapir Academic Press, Trondheim.

Sandvik, H., Erikstad, K.E. and Sæther, B-E. 2012. Climate affects seabird population dynamics both via reproduction and adult survival. Marine Ecology Progress Series 454: 273-284.

Satterthwaite, W.H., Kitaysky, A.S. and Mangel, M. 2012. Linking climate variability, productivity and stress to demography in a long-lived seabird. Marine Ecology Progress Series 454: 221-235.

Schwemmer, P., Mendel, B., Sonntag, N., Dierschke, V., Garthe, S. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21, 1851–1860.

Scott, B.E., Sharples, J., Wanless, S., Ross, O.N., Frederiksen, M. and Daunt, F. 2006. The use of biologically meaningful indices to separate the effects of climate and fisheries on seabird breeding success. Pp. 46-62 In Boyd, I.L., Wanless, S. and Camphuysen, C.J. (Eds.) Top Predators in Marine Ecosystems: Their Role in Monitoring and Management.

Scottish Office Circular 6/1995 (updated June 2000)

Si, Y.L., Skidmore, A.K. et al. 2011. Distribution of barnacle geese *Branta leucopsis* in relation to food resources, distance to roosts, and the location of refuges. Ardea 99: 217-226.

Smith, P.A. and Gaston, A.J. 2012. Environmental variation and the demography and diet of thick-billed murres. Marine Ecology Progress Series 454: 237-249.

SNH 2009. A handbook on environmental impact assessment; Guidance for Competent Authorities Consultees and others involved in the Environmental Impact Assessment Process in Scotland, 3rd Ed. Edinburgh: David Tyldesly and Associates.

Scottish Natural Heritage 2006 *Assessing significance of impacts from onshore Windfarms on birds outwith designated areas.*

Scottish Natural Heritage 2010 *Survey Methods for Use in Assessing the Impacts of Onshore Windfarms on Bird Communities.*

Scottish Natural Heritage and Joint Nature Conservation Committee 2012 Approaches to apportioning impacts on breeding seabirds among Special Protection Areas arising from marine renewable developments. SNH & JNCC discussion paper.

Stapp, P. 2002. Stable isotopes reveal evidence of predation by ship rats on seabirds on the Shiant Islands, Scotland. Journal of Applied Ecology 39: 831-840.

Stienen, E.W.M, Waeyenberge V., Kuijken, E., Seys, J. , 2007. Trapped within the corridor of the southern North Sea: The potential impact of offshore wind farms on seabirds. Chapter 3.

Sydeman, W.J., Thompson, S.A. and Kitaysky, A. 2012. Introduction Seabirds and climate change: roadmap for the future. Marine Ecology Progress Series 454: 107-117.

Tasker ML, Jones PH, Dixon T, Blake BF. 1984. Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. Auk 101: 567–577.

Tasker, M.L., Camphuysen, C.J., Cooper, J., Garthe, S., Montevecchi, W.A. and Blaber, S.J.M. 2000. The impacts of fishing on marine birds. ICES Journal of Marine Science 57: 531-547.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langston, R.H.W. & Burton, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Biological Conservation 156: 53-61.

Thayer, J.A., Sydeman, W.J., Fairman, N.P., Allen, S.G. 1999. Attendance and effects of disturbance on coastal common murre colonies at Point Reyes, California. Waterbirds, 22: 130-139.

Thompson, S.A., Sydeman, W.J., Santora, J.A., Morgan, K.H., Crawford, W. and Burrows, M.T. 2012. Phenology of pelagic seabird abundance relative to marine climate change in the Alaska Gyre. Marine Ecology Progress Series 454: 159-170.

Topping, C. and Petersen, I.K. 2011. Report on a red-throated diver agent-based model to assess the cumulative impact from offshore wind farms. Report commissioned by the Environmental Group. Aarhus University DCE – Danish Centre for Environment and Energy. 44pp.

Towns, D.R., Byrd, G.V., Jones, H.P., Rauzon, M.J., Russell, J.C. and Wilcox, C. 2011. Impacts of introduced predators on seabirds. pp56-90 in Mulder, C.P.H., Anderson, W.B., Towns, D.R. and Bellingham, P.J. (eds) Seabird islands: ecology, invasion and restoration. Oxford University Press, Oxford.

Votier, S.C., Bearhop, S., Fyfe, R. and Furness, R.W. 2008. Temporal and spatial variation in the diet of a marine top predator – links with commercial fisheries. Marine Ecology Progress Series 367: 223-232.

Votier, S.C., Heubeck, M. and Furness, R.W. 2008. Using inter-colony variation in demographic parameters to assess the impact of skua predation on seabird populations. Ibis 150: (Supplement 1) 45-53.

Votier, S.C., Bearhop, S., Crane, J.E., Arcos, J.M. and Furness, R.W. 2007. Seabird predation by great skuas *Stercorarius skua* – intra-specific competition for food? Journal of Avian Biology 38: 234-246.

Votier, S.C., Furness, R.W., Bearhop, S., Crane, J.E., Caldow, R.W.G., Catry, P., Ensor, K., Hamer, K.C., Hudson, A.V., Kalmbach, E., Klomp, N.I., Pfeiffer, S., Phillips, R.A., Prieto, I., and Thompson, D.R. 2004. Changes in fisheries discard rates and seabird communities. Nature 427: 727-730.

Votier, S.C., Hatchwell, B.J., Beckermann, A., McCleery, R.H., Hunter, F.M., Pellatt, J., Trinder, M. and Birkhead, T.R. 2005. Oil pollution and climate have wide-scale impacts on seabird demographics. Ecology Letters 8: 1157-1164.

Wagner, E.L. and Boersma, P.D. 2011. Effects of fisheries on seabird community ecology. Reviews in Fisheries Science 19: 157-167.

Wanless, S., Harris, M.P. and Morris, J.A. 1991. Foraging range and feeding locations of shags Phalacrocorax aristotelis during chick rearing. Ibis 133: 30-36.

Wanless, S. 2012. ARGOS tracks northern gannets breeding on St Kilda. ARGOS Forum 74: 14

Wanless, S., Frederiksen, M., Daunt, F., Scott, B.E. and Harris, M.P. 2007. Black-legged kittiwakes as indicators of environmental change in the North Sea: Evidence from long-term studies. Progress in Oceanography 72: 30-38.

Wanless, S., Frederiksen, M., Walton, J. and Harris, M.P. 2009. Long-term changes in breeding phenology at two seabird colonies in the western North Sea. Ibis 151: 274-285.

Watanuki, Y. and Ito, M. 2012. Climate effects on breeding seabirds of the northern Japan Sea. Marine Ecology Progress Series 454: 183-196.

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A., Siriwardena, G.M. and Baillie, S.R. 2002. The Migration Atlas: Movements of the Birds of Britain and Ireland. T. & A.D. Poyser, London.

Wiese, F.K. and Robertson, G.J. 2004. Assessing seabird mortality from chronic oil discharges at sea. Journal of Wildlife Management 68: 627-638.

Wiese, F.K., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W., Linke, J. 2001. Seabirds at risk around offshore oil platforms in the North-West Atlantic. Marine Pollution Bulletin 42: 1285-1290.

Williams, E.J. 2001. Wintering seafowl survey in Scapa Flow Orkney 2000/2001. RSPB Report.

Williams, E.J. 2007. Wintering seafowl in Scapa Flow 1974-2007. Orkney Bird Report 2007 pp100-106.

Xodus Group 2010. Cava (South Site) Post ES Support Hoy SPA supporting documentation. A-30191-S02-REPT-01-R02.

Yamashita, R., Takada, H., Fukuwaka, M.A. and Watanuki, Y. 2011. Physical and chemical effects of ingested plastic debris on short-tailed shearwaters, *Puffinus tenuirostris*, in the North Pacific Ocean. Marine Pollution Bulletin 62: 2845-2849.

APPENDIX 1: ORNITHOLOGICAL CUMULATIVE IMPACT ASSESSMENT FRAMEWORK PENTLAND FIRTH AND ORKNEY WATERS WAVE & TIDAL PROJECTS – SUPPORTING INFORMATION

CONTENTS

LIST OF FIGURES AND TABLES – APPENDIX 1

Figures

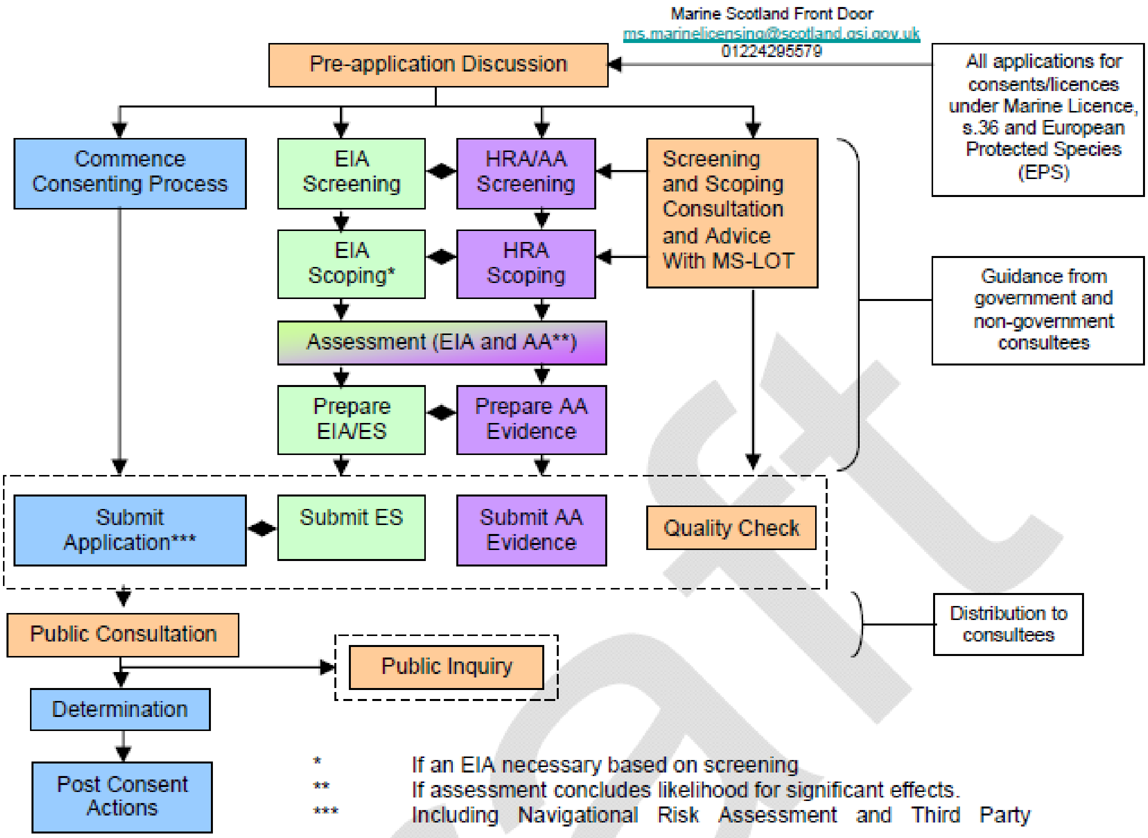
Tables

SECTION 1: REVIEW OF ESTABLISHED PROCESSES

Environmental Impact Assessment Method

The overall purpose of EIA is to draw '*together, in a systematic way, an assessment of a project's likely significant environmental effects. This helps to ensure that the importance of the predicted effects, and the scope for reducing any adverse effects, are properly understood by the public and the competent authority before it makes its decision*' (Circular 3, 2011, page 2). Section 6 of Marine Scotland's draft licensing and consents manual (ABP Marine Environmental Research, October 2012) provides guidance on the relevant EIA and HRA process for Marine Renewable Energy Developments. This takes account of the SNH, 'Environmental Impact Assessment Handbook, Guidance for all partners in the EIA process'[17].

This guidance identifies the following EIA and HRA process:



Flow diagram adapted from original by:
DETI (2011). Regional Locational Guidance (RLG) for Offshore Renewable Energy Development in NI Waters. Published September 2011 by The Department of Enterprise, Trade and Investment: http://www.detini.gov.uk/rlg_final_version_sept_2011.pdf

Figure A1.1, P.14 of ABP Marine Environmental Research (draft, October 2012)

[17] (Updated and extended in 2009), Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland. (2011) http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=454.

Planning Advice Note 58 on Environmental Impact Assessment, 1999 ('PAN 58')[18] provides detailed advice on the decision making framework that operates in relation to applications for developments such as marine renewable energy devices. PAN 58, outlines the EIA process, this is detailed below for ease of reference[19]:

- **Project Initiation** – Design with the environment;
- **Screening** – Determining whether EIA is required;
- **Scoping**: The developer may request the competent authority to advise what should be covered by the EIA information to be provided by the developer;
- **EIA Report Preparation**: The developer must provide information on the environmental impact of the proposed development/preparation of the Environmental Statement ('ES')';
- **Submission of Planning Application with ES**;
- **Review**: Review of ES by planning authority and consultees (possible request for further information);
- **Decision-Making**: The competent authority decides, taking into consideration the results of the consultations, whether to refuse or grant consent (with or without conditions); and
- **Implementation and Monitoring.**

Habitats Regulations Appraisal Method

In addition to the EIA process, the Ornithological CIA Framework also has to consider the requirements of the HRA, which are detailed below. It is likely that most, if not all, wave and tidal projects in the PFOW will have connectivity with an SPA and will therefore have to undertake such an appraisal (Section 3 Table A1.3.6).

The Nature Conservation Update Guidance[20] details the relevant method for assessing the impacts of plans or projects on European Sites. Annex E Appendix B of that guidance details the process involved in the carrying out a HRA for plans and projects in general. Section 6 of Marine Scotland's Licensing and Consents Manual (ABP Marine Environmental Research October 2012) presents an overview of the HRA process as applied to wave and tidal current projects. This is illustrated in Figure A1.1 as copied above for ease of reference. The competent authority (usually the authority which grants consent) undertakes both the HRA and the Appropriate Assessment which forms part of the HRA. The developer is required to provide the relevant information to inform the HRA and the AA should this be required.

Interpretation of the requirements of the Habitats Regulations can vary. The EU 2010 Guidance[21] is intended to assist with the application of the Habitats and Wild Birds Directives, and the Habitats Regulations, in the UK.

The EU 2010 Guidance describes three broad stages in the decision making framework (the Habitats Regulations Appraisal):

- Stage one: Screening/ The Likely Significant Effect test;
- Stage two: Appropriate Assessment, and;
- Stage three: Derogation.[22]

[18] The Scottish Government intend to update PAN 58 in due course, and the 2011 Regulations and Circular 3, 2011 take precedence over the advice in PAN 58. (Circular 3, 2011, page 1)
[19] PAN 58, para 24.
[20] *Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds ('the Habitats and Birds Directives'). June2000 revised guidance updating Scottish Office Circular no. 6/1995 ('Nature Conservation Update Guidance'*
[21] Wind Energy Developments and Natura 2000
[22] EU 2010 Guidance, page 66.

Stages 1 and 2 are considered below. The implications of stage 3, (Regulation 49 (the derogation stage)) are not addressed here. This stage reflects Article 6(4) of the Habitats Directive, and applies only where there are imperative reasons of overriding public interest, which may be social or economic.

Stage One: Screening/The Likely Significant Effect Test

Provided that the proposed development is not directly connected with, or necessary to, the management of the site, the 'Likely Significant Effect' test is the first to consider.

The EU 2010 Guidance states that the *'… 'likelihood' of potentially significant effects should be considered in the light of the conservation objectives, the characteristics and the specific environmental conditions of the site. Plans or projects likely to undermine the site's conservation objectives must be considered likely to have a significant effect on that site.'*[23]

The purpose of the Likely Significant Effect test is to determine whether a plan or project has to undergo an Appropriate Assessment. If significant negative effects associated with the proposed development cannot be excluded on the basis of objective information, the EU 2010 Guidance requires that an Appropriate Assessment should be undertaken.[24] Where there is any doubt over the likelihood of significance of the effects, then an Appropriate Assessment must be undertaken to ensure that these potential effects can be studied in full[25].

The competent authority must consider the project inclusive of any mitigation measures that form part of the development proposal[26]. An Appropriate Assessment is still required where the efficacy of the mitigation proposed is in doubt, '… *if it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 site, even after the introduction of mitigation measures, then the plan or project cannot be approved'*.[27]

Stage Two: Appropriate Assessment

An Appropriate Assessment must be undertaken, *'If it cannot be excluded, on the basis of objective information, that there will be significant negative effects upon a Natura 2000 site'.*[28]

This stage requires that, *'detailed information should be gathered on the site's ecological features and conservation objectives, and on the potential impacts of the plan or project on these conservation objectives'*[29] to enable an, *'assessment to be carried out on whether the plan or project, alone, or in combination with other plans or projects, will have an adverse impact on the integrity of the Natura 2000 site.'*[30]

According to the EU 2010 Guidance, *'…the focus of the assessment should be on objectively demonstrating, with supporting evidence, that there will be no adverse effects on the integrity of the Natura 2000 site, in light of its conservation objectives.'*[31] There has to be sufficient certainty as to

---

[23] EU 2010 Guidance, page 69, para. 5.3.2.
[24] EU 2010 Guidance, page 65.
[25] Case C-127/02, Landelijke Vereniging tot Behoud Van De Waddenzee And Nederlandse Verneging To Bescherming Van Vogels V Staatssecretaris Van Landbouw[25] (The 'Waddenzee Case')
[26] R (On The Application Of Hart District Council) V Secretary Of State For Communities And Local Government [2008] 2 P & Cr 16 (The 'Dilly Lane Case')
[27] EU 2010 Guidance, page 71, para. 5.4
[28] EU 2010 Guidance, Page 65, para. 5.2
[29] EU 2010 Guidance, page 65, para. 5.2
[30] EU 2010 Guidance, page 65, para. 5.2
[31] EU 2010 Guidance, page 82, para. 5.5.3 (Emphasis as per EU 2010 Guidance).

the absence of effects, *'The burden of proof is on demonstrating that there will be no adverse effects on the integrity of the site'*[32]. Furthermore, the competent authority is only to authorise a plan or project if they are, *'sure that there is no reasonable scientific doubt'*[33].

The Nature Conservation Update Guidance defines the integrity of the site as, '*the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified.'*[34]

Relationship of the HRA Process & to the EIA Process

The EU 2010 Guidance confirms that the EIA process is quite distinct from the Appropriate Assessment process: *'…EIA cannot replace, or be a substitute for an Appropriate Assessment as neither procedure overrides the other. They may of course run alongside each other or the Appropriate Assessment may form part of the EIA…'*[35].

The SNH EIA Handbook confirms that, '*the respective assessments may share some procedural steps, such as information gathering, scoping and consultation but the Competent Authority must clearly and distinctly follow the procedures of the respective assessment processes, which are different in many respects*' (SNH, 2009. paragraph B8.9).

Ornithological Impact Assessment Method

Guidance on the process for Ornithological Impact Assessment is given by the Institute of Ecologist and Environmental Management (IEEM, Guidelines for Ecological Impact Assessment in the Britain and Ireland, Marine and Coastal, 2010).

In addition to this, other relevant guidance on ornithological impact assessment methods includes SNH (July 2006) 'Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Areas'. Although this has been written specifically for onshore wind farms it provides useful guidance on the approach to ornithological impact assessment in the wider countryside.

Based on the above guidance, and the authors' experience of the standard approach to ornithological assessment, the steps involved in conducting an Ornithological Impact Assessment within an ES are summarised below.

[32] EU 2010 Guidance, page 65
[33] EU 2010 Guidance, page 82, para. 5.5.3.
[34] *'If the planning authority concludes that a proposed development unconnected with site management is likely significantly to affect a European site, it must then carry out an Appropriate Assessment of its implications in view of the site's conservation objectives (i.e. the reasons for which the site was classified), so as to ascertain whether or not it will adversely affect the integrity of the site'.* Nature Conservation Update Guidance, Annex E, Appendix A: Consideration of Development Proposals Affecting SPAs and SACs
[35] EU 2010 Guidance, page 24 para. 2.5.3

Table A1.1.1 Ornithological Impact Assessment Method.

Step	Title	Description
1	**Identify Target Bird Populations**	The relevant Target Bird Populations for the Impact Assessment are identified. These are identified at the desk study stage and during survey work.
2	**Define Nature Conservation Importance**	Define whether the Target Bird Populations are of High, Moderate or Low Nature Conservation Importance. This is usually dictated by their geographic importance as determined by their degree of policy/legal protection.
3	**Determine Conservation Status**	Define Conservation Stats (e.g. Favourable Stable, Unfavourable, Declining, etc.; SNH 2006)
4	**Identify Potential Impacts & their likelihood**	The potential impacts occurring at each stage of the development (construction, operation, decommissioning) should be identified along with their likelihoods of occurrence where relevant.
5	**Species Sensitivity**	Define each identified Target Bird Population's potential sensitivity to each impact.
6	**Magnitude of Specific Impact**	Quantify the likely spatial and temporal magnitude of Impact on each relevant Target Species.
7	**Significance of Effect**	The significance of effect, both alone and in combination with other impacts, on each species of High or Moderate Nature Conservation Importance will be established through considering the above factors (NCI, Conservation Status, Impacts, Sensitivity and Magnitude of Impact.
8	**Mitigation Measures**	Appropriate measures to mitigate significant effects are proposed.
9	**Enhancement Measures**	Enhancement measures are proposed where reasonably practicable.
10	**Residual Effects**	The residual effects are detailed.

Guidance on Ornithological CIA Process from King et al. (2009)

COWRIE commissioned the report 'Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers' (King et al. 2009). This report developed recommendations, via extensive consultation with the renewables industry, on the methods and techniques to be utilised for Ornithological CIA and offshore wind farms. Although written specifically for offshore wind, this report provides helpful guidance on key elements of Ornithological CIA which are also relevant to wave and tidal current projects. The report does not provide detailed guidance on the full process involved in Ornithological CIA but focuses instead on the areas of the CIA process and ornithological assessment method where guidance was required. These areas are listed below.

- Scoping;
- Identifying a 'Long List' of species to be assessed;
- Identifying local SPA and SSSI species together with predicted impacts;
- Detailing the quantitative data to be included in ES;
- Appraisal of baseline conditions;
- Define projects to be included in the CIA;
- Define reference populations for SPA species;
- Define reference populations for non-SPA species;
- Define default boundary of CIA area;
- Consideration of different populations at different times of year;
- Data collection;
- Data presentation;
- Data compatibility;
- Cumulative collision effects; and
- Cumulative disturbance effects.

SECTION 2: MITIGATION, COMPENSATION AND ENHANCEMENT

Mitigation

Mitigation involves, *'…introducing measures into the plan or project to eliminate …potential negative effects or reduce them to a level where they are no longer significant'*. [36] Mitigation measures, *'must be directly linked to the likely impacts and based on a sound understanding of the species/ habitats concerned'*. [37]

Examples in the case of wave and tidal current projects include changes to the location of the development away from SPAs, modifications to the size, design and layout of the site.[38]

The competent authority must consider the project inclusive of any mitigation measures that form part of the development proposal. An Appropriate Assessment is still required where the efficacy of the mitigation proposed is in doubt, *'… if it cannot be ascertained that there will be no adverse effects on the integrity of the Natura 2000 site, even after the introduction of mitigation measures, then the plan or project cannot be approved'*.[39]

The Dilly Lane Case confirms that that mitigation proposals included in the design of a proposed development can be taken into account when considering whether it would be likely to have a significant effect on a designated site. Successful (i.e. those with sufficient scientific certainty) mitigation measures may preclude the need for the development to be considered for Appropriate Assessment.

'Mitigation is defined … as 'measures aimed at minimising or even cancelling the negative impact of a plan or project, during or after its completion'. [40]

Compensation

The EU 2010 Guidance confirms the role of compensation as follows:

'Compensatory measures, as described in Article 6(4) of the Habitats Directive, constitute the "last resort" and are used only when the decision has been taken to proceed with a plan or project having an adverse effect on the integrity of the Natura 2000 site because no alternative solutions exist and the project has been judged to be of overriding public interest under the conditions described above.

The compensatory measures constitute measures specific to the unavoidable adverse effects of a project or plan. They aim to ensure that the overall coherence of Natura 2000 is protected, and should provide compensation corresponding precisely to the negative effects on the species or habitat concerned.'[41]

Compensatory measures are not the same as mitigation measures. The two terms are often confused in considerations of Habitats Regulations Appraisals, but only mitigation measures can be considered within a Habitats Regulations Appraisal (at the Screening and Appropriate Assessment stages): compensatory measures are considered only under Regulation 53 if the development is allowed to proceed under Regulation 49.

[36] EU 2010 Guidance, page 31, para. 3.3. Further examples of mitigation can be seen at Chapter 5.5.4 of EU 2010 Guidance.
[37] EU 2010 Guidance, page 31, para. 3.3. Further examples of mitigation can be seen at Chapter 5.5.4 of EU 2010 Guidance.
[38] EU 2010 Guidance, page 31, para. 3.3. Further examples of mitigation can be seen at Chapter 5.5.4 of EU 2010 Guidance.
[39] EU 2010 Guidance, page 71, para. 5.4
[40] Assessment of Plans and Projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, European Commission (November 2001), page 14.
[41] EU 2010 Guidance 2010 - 5.6.4

European Guidance on compensatory measures and mitigation states that: *'The term 'compensatory measures' is not defined in the Habitats Directive. Experience would suggest the following distinction:*

- *Mitigation measures in the broader sense, are those measures which aim to minimise, or even cancel, the negative impacts on a site that are likely to arise as a result of the implementation of a plan or project. These measures are an integral part of the specifications of a plan or project…, and*
- *Compensatory measures sensu stricto: are independent of the project (including any associated mitigation measures). They are intended to offset the negative effects of the plan or project so that the overall ecological coherence of the Natura 2000 Network is maintained.'*[42]

The EU 2010 Guidance refers to *this European guidance*[43] when it gives examples of compensatory measures under Article 6(4):
- Restoration or enhancement within existing Natura 2000 sites: restoring the habitat to ensure the maintenance of its conservation value and compliance with the conservation objectives of the site or improving the remaining habitat in proportion to the loss due to the plan or project on a Natura 2000 site;
- Habitat Recreation: recreating a habitat on a new or enlarged site, to be incorporated into Natura 2000;
- Designation of new sites under the Birds and Habitats Directive, in association with other works, as described above. As regards compensatory measures for designated sites under the Birds Directive (SPA), any new habitat created as compensation for damage to an SPA should be designated as an SPA once it meets its objectives in order to maintain the overall coherence of the network.'[44]

Enhancement: IEEM

Enhancement is defined by IEEM guidance as, *'A new benefit to biodiversity, unrelated to any negative impact'*.[45]As such, it is distinct from mitigation and compensation.

A developer is encouraged to seek opportunities for ecological enhancements as early as possible in the initial project design at the outset of the project.[46] Enhancement opportunities should also be identified throughout the evolution of project design and mitigation.[47]

[42] Guidance document on article 6(4) of the 'Habitats Directive'92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission, January 2007, section 1.4.1.
[43] Guidance document on article 6(4) of the 'Habitats Directive'92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission, January 2007; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf
[44] EU 2010 Guidance, page 91, para. 5.6.4, referring to Guidance document on article 6(4) of the 'Habitats Directive'92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission; http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf
[45] IEEM, Guidelines for Environmental Impact Assessment in the United Kingdom, 26 June 2006, Page 55
[46] IEEM, Guidelines for Environmental Impact Assessment in the United Kingdom, 26 June 2006, Page 9
[47] IEEM, Guidelines for Environmental Impact Assessment in the United Kingdom, 26 June 2006, Page 10

SECTION 3: SELECTION OF TARGET BIRD POPULATIONS

This Section describes the methods for identifying Target Bird Populations and presents a high level review which can be used by PFOW developers to begin the process of selecting Target Bird Populations to include in Ornithological CIA. This expands on the summary provided in Section 4.2.2 of the main report.

Initially all marine bird species recorded in Orkney and Caithness are included for consideration. However, some of these species and their populations can be scoped out at an early stage. Terrestrial birds will not be affected by wave or tidal stream energy developments at sea, except where these developments require associated development of terrestrial infrastructure such as access roads, harbours, cables, transformer stations and other structures on land. Such on-shore development is likely to be predominantly along the coastal fringe and so will not affect inland terrestrial bird populations. So the focus of CIA is likely to be on seabirds in their marine environments, SPA species, and birds of the coastal fringe that may be sensitive to habitat alteration and disturbance. Where on-shore infrastructure is likely to have a significant effect on an SPA for shorebirds, geese or terrestrial birds, it would be appropriate to carry out CIA for these protected bird populations. Where on-shore infrastructure would be outside of boundaries of SPAs for shorebirds, geese or terrestrial birds, CIA for these bird types may not be required, since the proportion of the coastal fringes of Orkney and Caithness affected would be negligible and hence habitat loss and disturbance would be limited to negligible proportions of the available habitat, and so impacts on populations of shorebirds, geese and terrestrial birds would be negligible.

Based on their high adult survival rates and anticipated vulnerability to developments in the marine and coastal environment such as in PFOW, SNH provided advice on which species of birds to consider in the context of potential impacts of wave and tidal current developments The list of species included 38 species of birds, comprising one bird of prey (white-tailed sea eagle), two species of grebe (Slavonian grebe, great-crested grebe), six species of sea ducks (common eider, common scoter, velvet scoter, long-tailed duck, greater scaup, common goldeneye), three species of diver (great northern diver, red-throated diver, black-throated diver), and 26 species of true seabird (northern fulmar, Manx shearwater, sooty shearwater, European storm-petrel, Leach's storm-petrel, northern gannet, great cormorant, shag, great skua, Arctic skua, common gull, black-headed gull, herring gull, lesser black-backed gull, great black-backed gull, black-legged kittiwake, Sandwich tern, little tern, common tern, Arctic tern, roseate tern, common guillemot, razorbill, little auk, Atlantic puffin and black guillemot). These species were therefore also chosen to be the main focus of this report, but we consider other possible receptor bird species, especially those dependent on the coastal fringe (such as shorebirds and red-breasted mergansers), and those species representing notified features of SPAs in the region (not only seabirds, but also shorebirds, birds of prey, and geese), which also need to be evaluated for scoping in or scoping out

Seabird populations of concern include not only the locally breeding seabirds, but also migrant populations of the same and other species that may pass through the PFOW region during spring and/or autumn migration periods, and populations from other regions that spend the winter in PFOW. A comprehensive assessment of the distinct populations of each species of seabirds involved is summarised in Table A1.3.1

Table A1.3.1. Seasonal movements of seabird populations into and out of the PFOW area. Data predominantly from Wernham et al. (2002) and Forrester et al. (2007) except where attributed to another authority. Species ranked in order of Scottish conservation importance score (see Table A1.3.2) with highest importance listed first.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Great northern diver	None.	Some passage and staging in spring and autumn. Most arrivals in Scotland are in October and November, with spring departure in late April and early May.	Birds arrive from various Arctic regions, predominantly in the Nearctic. Birds wintering in Scotland are thought to come mainly from Iceland, Greenland, and possibly Canada (where the breeding population is 250,000 to 500,000 individuals).
Northern gannet	Most breeders are present around colonies from February to October. Colonies are vacant from late November to early January.	Birds from Shetland pass south in autumn (September-October), return migration in spring (February-March) is more often up west coast and North Sea breeders migrate through PFOW in early season (Feb-Mar) (Kubetzki et al. 2009, Fort et al. 2012).	Few in winter, these being probably mostly from Norway as this species shows 'chain migration' (Fort et al. 2012), but may include some birds from Shetland colonies and elsewhere.
Manx shearwater	Very few in PFOW during breeding season.	There is very little migration of shearwaters through PFOW.	None.
European storm-petrel	Few breed in Orkney (mostly at Auskerry) and none in Caithness, but wandering nonbreeders from all areas may pass through PFOW during summer (mainly in July-August). Fowler and Hounsome (1998) estimated that some 60,000 wandering nonbreeders visit Shetland waters in summer, and numbers visiting PFOW may be similar to this total.	Spring migration to colonies occurs in late April and early May. Chicks fledge in September-October and adults and young migrate to wintering grounds in the southern hemisphere at about that time. Birds breeding in Iceland, Faeroes and Norway probably migrate through Scottish waters in spring and autumn.	None.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Arctic tern	Adults arrive at colony sites in May and are present until no later than mid-August. When breeding conditions are poor, colonies may be abandoned much earlier in the summer.	Spring migration occurs mainly in May and autumn migration in July-August. Migrant Arctic terns in PFOW are likely to include birds from breeding areas in Iceland, Faeroes, and Scandinavia, as well as birds from Shetland, and may include birds from high Arctic colonies in western Siberia, although these more distant migrants probably pass through PFOW relatively fast.	None.
Lesser black-backed gull	Breeders return to colony areas in February-April, and are present until July-October.	Local birds migrate back to colonies in PFOW in February-April, but spring migration may also involve birds returning to colonies further north passing through PFOW towards Iceland, Faeroes and Shetland. Norwegian birds (which are of a different sub-species *intermedius*), apparently do not normally pass through PFOW. In autumn, Icelandic and Faeroese lesser black-backed gulls pass south through Scottish waters, but Norwegian birds apparently move from Norway to east England and probably do not appear in PFOW.	Very few in PFOW.
Great skua	Breeders return to colony areas in March-May and disperse southwards in July-October.	Migrants in February-May and in July-October include birds from Shetland and probably also from Iceland, Norway and Faeroes (Magnusdottir et al. 2012).	Very few in PFOW.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Black-throated diver	Adults increase in numbers at sea near to breeding areas in March-April, and after breeding disperse southwards in September-October.	Numbers at sea in March-April and in September-October are roughly double the number wintering in Scotland, indicating a clear passage of birds in spring and autumn. These birds probably are mostly Scottish breeders and immatures, with few continental migrants apparently reaching PFOW and the majority of Fennoscandian breeders wintering in the Baltic, Black Sea and eastern Mediterranean (Forrester et al. 2007).	Scapa Flow (Orkney) and Sinclair's Bay (Caithness) are important wintering areas, thought to be used mainly by local breeding birds.
Red-throated diver	Adults start to reoccupy nesting sites from March, and depart after breeding from early August to late September.	Spring migration peaks in April-May, and presumably includes birds heading towards Iceland, Greenland or Fennoscandia, as Scottish breeders tend to be on territory by then. Autumn migration peaks in September-October in Orkney (but in October-November further south in Scotland), and involves larger numbers of birds than seen in spring (Forrester et al. 2007). Presumably many of these autumn migrants are from Iceland, Greenland and Fennoscandia.	Wintering birds are thought to be a mixture of local breeders and birds from more northerly areas (presumably Greenland, Iceland, Scandinavia, as well as Shetland). Relative numbers present in winter from different populations are unknown, but many PFOW breeding red-throated divers are thought to winter as far south as France as indicated by ring recoveries (Wernham et al. 2002).

Species	Movements		
	Breeding season	Migration periods	Wintering
Razorbill	Adults arrive at colonies in March, and depart in July (males accompany chicks to sea early in July and females leave later). Immatures attend colonies for a shorter period than adults, with peak numbers in June.	PFOW breeders mostly migrate south in autumn (from July to October) towards wintering areas from the southern North Sea to Iberia. Return migration in spring starts from late February, with most back at colonies by late March. A few PFOW breeders probably remain in PFOW waters all year round. In autumn, many of the local birds are replaced by birds from further north, including Shetland but also Faeroes, Iceland, Russia and Norway.	Wintering razorbills in PFOW will include some local breeders, but this species seems to show 'chain migration' with birds from further north moving into areas largely vacated by birds moving further south. So razorbills in PFOW from November to February are probably mostly from Iceland, Faeroes, Norway and Russia.
Atlantic puffin	Breeders tend to aggregate at sea near to colonies in early March before coming ashore. Breeders disperse from colonies in August. Immatures tend to visit colonies for a shorter season, with numbers peaking at colonies in June-July.	Many ringed puffins from Iceland and Norway have been recovered in winter off eastern Canada, so their migrations probably do not bring these birds to PFOW. However, there are several recoveries of ringed puffins from Norway in Orkney and Shetland, so clearly some of the Norwegian population do pass through PFOW on migration.	Only very small numbers of puffins winter in Scottish waters (JNCC surveys reported less than one puffin per 20 km^2 Pollock et al. 2000), and there are likely to be very few in PFOW from September to February; those few are probably birds from the Norwegian population rather than the Scottish population (Forrester et al. 2007).

Species	Movements		
	Breeding season	Migration periods	Wintering
Northern fulmar	Adults occupy breeding sites almost all year round; (intermittently) from November-December onwards, and depart at the end of the breeding season in late August or September. Attendance in October occurs occasionally. Immatures also attend colonies throughout most of the year, especially from February to June, but dispersing to moult while breeding adults are rearing chicks.	There is no clear migration period, but fulmars disperse in September and return to breeding areas in November-December.	Most Scottish fulmars remain in Scottish waters throughout the year, but some disperse across the Atlantic into Canadian waters, or off Greenland, or into the Barents Sea. Ringed fulmars from Iceland, the Faeroes, Denmark, and Norway have been recovered around the British Isles, but the relative proportion of fulmars in PFOW in winter originating from these overseas populations is unclear. Forrester et al. (2007) suggest that around 1 million Scottish fulmars are in Scottish waters in winter, joined by perhaps ‘many thousands’ from more northern populations.
Common guillemot	Date of return to breeding colonies varies according to local environmental conditions. In PFOW birds return to colonies from January. Chicks fledge in July and are accompanied to sea by the male. Females remain ashore until early August. Nonbreeders are present for a shorter period, with peak numbers in June.	Common guillemots are dispersive rather than migratory. Birds from Shetland, Norway and the Faeroes, may pass through PFOW in autumn (August) and spring (January). Moult occurs in August-September, when birds tend to concentrate in sheltered areas with reliable food supplies, such as the Moray Firth.	Birds from PFOW mainly winter offshore outside Scottish waters (distributed from Norway to Iberia) but some may remain in PFOW all year. Other wintering birds in PFOW are likely to originate from populations in Norway, the Faeroes, Ireland and from other parts of Britain. At sea density of common guillemots in winter in PFOW is relatively low compared to higher densities present off the east coast of Scotland at that time of year (Forrester et al. 2007).

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Herring gull	Some birds, particularly adult males, remain close to the breeding site all year round. Numbers at colonies increase from February to April. Some adults disperse at the end of the breeding season in August-September. Immatures spend less time at colonies, peaking in numbers in June.	Local birds may disperse southwards as far as southern England, but many travel only short distances southwards. Immatures travel further south than adults, and adult females travel further than adult males. Birds from Fennoscandia and Russia (subspecies *argentatus*) arrive in late October and November and remain until January-March.	Winter populations include some local breeders, but also birds from further north in Scotland, and birds from north Norway and Russia (which are classified as a different subspecies), Coulson et al. (1984a). According to Pennington et al. (2004) up to 90% of herring gulls at Shetland in winter are the northern subspecies rather than Scottish birds, and a similarly high proportion of PFOW herring gulls in winter probably originate from Russia and Fennoscandia.
Leach's storm-petrel	Apparently locally extinct as breeding species.	Very few in PFOW.	None.
Shag	Some adults remain at or close to the colony all year round. Those that disperse return to the colony in January-February. A small proportion of adults show dispersal at the end of breeding, from July to October.	Some shags from Shetland colonies disperse to Orkney or east Scotland and a very few cross the North Sea to Norway, but the wettable plumage of shags constrains their movement across long distances of sea. It is unlikely that any shags migrate to PFOW from any further away than Shetland, and the majority of Shetland shags remain their throughout the year (Pennington et al. 2004).	Winter populations are likely to consist predominantly of local shags, with a small component of birds from Shetland. The latter may comprise predominantly juveniles and immatures.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Great black-backed gull	Adults return to colonies in February-March. Chicks fledge in July, and fledglings and adults disperse from colonies in July-August.	Scottish great black-backed gulls show limited dispersal from breeding areas, with ringed immatures moving a median distance of 115 km from the colony, while most breeders remain within 50 km (Wernham et al. 2002). Great black-backed gulls from Norway and Russia arrive in PFOW (and other parts of north and east Scotland) in July to October, and depart in February (Coulson et al. 1984b).	Winter populations include some local breeders, but also birds from further north in Scotland, and birds from north Norway and Russia (Coulson et al. 1984b). These northern birds probably outnumber local birds from September to February (Wernham et al. 2002).
Sandwich tern	Adults return to colonies in April-May and depart in July-August. Nonbreeders arrive later and leave earlier than breeders.	In PFOW, spring migration occurs mainly in April and May, and into June and July. Autumn migration lasts from August to early October, but is not pronounced in PFOW (Forrester et al. 2007).	None.
Roseate tern	None since 1976.	Fewer than one bird per year has been seen passing through PFOW (Forrester et al. 2007).	None.
Common tern	Adults arrive at colonies in late May and early June. Colonies are normally vacated by early August, but can sometimes be occupied by late breeders into September.	Spring, and perhaps especially autumn migration in August to October, may include some birds from the continent as well as local birds from Shetland and Orkney.	None.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Arctic skua	Adults arrive at colonies in May, and depart in July or early August. Nonbreeders arrive later and depart earlier.	Spring migration in late April to June involves birds returning to breed in the Arctic which tend to move north later than local breeders, but most spring migration takes place offshore, outside PFOW. Autumn migration involves not only local birds and birds from Shetland, the Faeroes and Iceland and the Baltic region, but also birds from the Arctic which tend to pass PFOW and other parts of Scotland in September-October.	None.
Black-legged kittiwake	Kittiwakes return to colonies in March. Colonies are deserted by late August in years of good food supply, and earlier in poor years.	Migrations of kittiwakes are not strongly seasonally synchronised, but involve prolonged dispersal although this can be rapid by individual birds.	Few local kittiwakes are likely to be in PFOW in winter, as they disperse widely across the North Atlantic. Ringed birds from NE England, East Scotland, Iceland, Norway and Russia have been recovered in Orkney in winter.
Black guillemot	Remains close to breeding areas all year round. The median distance moved by recovered ringed birds is only 10 km.	No evidence of migration by this species into Scottish waters from any overseas populations.	In winter, black guillemots move from exposed to sheltered coasts, but mostly only over very short distances. However some black guillemots from Foula, Shetland, move to Shetland mainland to winter in more sheltered areas, and many black guillemots from Fair Isle move to winter in the sheltered waters of Orkney and Caithness (Ewins 1988).

Species	Movements		
	Breeding season	Migration periods	Wintering
Common eider	Resident throughout the year.	Scottish eiders do not migrate. There is little or no migration of Icelandic, Faeroese, or Scandinavian eiders (which are different subspecies from that in PFOW) into Scotland.	Very occasional vagrant 'northern' eiders have been reported from the northern isles in winter, but represent a negligible addition to the resident population. Although it has been suggested that eiders may move between Shetland and Orkney, recent evidence suggests that this very rarely happens (Pennington et al. 2004).
Common gull	Adults return to colonies between February and April. Colonies are abandoned as soon as chicks fledge, in July.	Most locally breeding common gulls in PFOW migrate to southern Scotland, England and Ireland, in July-August. At the same time, common gulls from Iceland and Fennoscandia arrive in Scotland. Spring migration of those birds out of Scotland occurs in March and April.	Wintering common gulls in PFOW will include a small proportion of local birds, but mainly birds from Fennoscandia. There is some evidence for birds from more northern parts of Fennoscandia wintering further north, so PFOW wintering birds are likely to come predominantly from Norway and Russia rather than the Baltic states.
Little tern	Adults arrive at colonies from mid-April, and depart in July-September.	There is very little evidence of migrations of little terns as they are rarely seen much in Scotland away from breeding sites. Orkney as at the northern edge of breeding distribution for this species, so migration through PFOW to other breeding areas is unlikely.	None.

Species	Movements		
	Breeding season	Migration periods	Wintering
Slavonian grebe	None.	Autumn migration apparently occurs around October, and spring migration in April-May, but given the small numbers of birds involved these timings are not well defined.	Biometrics suggest that Slavonian grebes wintering in Orkney and Caithness originate from Iceland, Scotland and/or north Norway and not from further east where bill size is smaller (Fjeldså 1973). Given the small size of the Scottish breeding population and the fact that at least some birds from that population winter on the sea off Inverness-shire, it seems likely that birds wintering in PFOW are predominantly from north Norway or Iceland.
Sooty shearwater	None.	Sooty shearwaters are seen in Orkney in late July-early November, with peak passage in late September. These birds originate from colonies in the southern hemisphere, such as Falkland Islands, Tristan da Cunha, and islands off Australia and New Zealand.	None.
Common scoter	Return to breeding areas in late April. Males depart for the nearby coast in June, followed by females after chick-rearing in August.	Autumn migration occurs from September to December, with return migration in spring in March-May.	The wintering area of the small breeding population in Scotland remains unknown, but it is likely that birds may winter fairly close to their Scottish breeding sites. Most wintering birds come to Scotland from further north, either from Fennoscandia, northern Russia, or Iceland. Given that the Fennoscandian population is the largest, it is likely that most wintering birds come from that region.

Species	Movements		
	Breeding season	Migration periods	Wintering
Common goldeneye	None.	Autumn arrivals occur in late October or November. Spring departures occur from February to April.	Wintering goldeneyes in Orkney occur both on the sea and on freshwater. These birds are thought to originate mainly from breeding populations in Sweden, Finland and Norway.
Black-headed gull	Adults arrive at breeding sites in late March and April. They leave in late July and August.	Spring migration peaks in April-May in Orkney, and autumn migration is rather indistinct. Spring migrants may involve a mixture of local birds arriving back plus birds passing through on the way to Scandinavia and/or Iceland.	Few winter in Orkney or Caithness. Those few birds may include some local breeders and some birds from Iceland, and/or Scandinavia.
White-tailed eagle	None at present, but this species used to nest widely across Orkney and Caithness before it was exterminated in the 19th century. It seems likely to return to the area eventually.	No significant migration of this species through Orkney and Caithness.	In Scotland, wintering birds tend to stay close to their breeding site, but juveniles and immatures range more widely, and some from the re-introduced population in west Scotland have been seen in Orkney and Caithness.
Greater scaup	None since 1979.	Most autumn arrivals appear in September-October. Spring passage and departure from the area occur in March-April.	Most scaup wintering in Scotland probably originate from Iceland, but some may come from Denmark, Finland or Russia.
Velvet scoter	None.	Moult-migrants arrive from mid-June. Post-moult, numbers increase into September and October which are the main autumn migration months in Orkney. Spring departures and migration occur in March to mid-May.	Wintering velvet scoters are thought to come mainly from breeding populations in Fennoscandia, and probably from the western edge of that breeding area as Scotland represents the western edge of the winter range which is predominantly in the Baltic Sea.

Species	Movements		
	Breeding season	**Migration periods**	**Wintering**
Great cormorant	Adults typically attend the colony from mid-February to August, although the timing of breeding can vary a lot from year to year depending on local environmental conditions.	Most Scottish populations disperse after breeding, in August-September. Cormorants from Caithness colonies mostly migrated southwards down the east coast of Scotland. 40% of recoveries were within 100 km of the colony, but a few birds travelled as far as France. Although some continental cormorants move to Britain in autumn, it seems that few of these come into Scotland, and those that do tend to arrive on the east coast of Scotland; more continental cormorants arrive in east England, possibly entering the British Isles across the Channel rather than across the North Sea.	Winter populations in PFOW are likely to be of local breeding birds, possibly with some birds from Shetland also overwintering in PFOW.
Little auk	None.	Little auks start to migrate south from Arctic breeding grounds in August-September onwards, with peak numbers observed at North Ronaldsay in October and early November.	Little auks migrating through, or wintering in, Orkney and Caithness probably come from the Svalbard breeding colonies (Forrester et al. 2007).
Long-tailed duck	None.	Autumn migration occurs in late October through to December, with return migration in spring in March-April.	Breeding origins of long-tailed ducks wintering in Scotland are uncertain. They may come mainly from western Fennoscandia, but possibly also from Iceland, and possibly even from Greenland.
Great-crested grebe	None.	No significant migration of this species through PFOW.	Very few, if any, occur in PFOW in winter.

Conservation importance of the key bird species identified by SNH as of particular concern in relation to deployments of tidal current turbines and wave energy devices in Scottish waters are listed in Table A1.3.2, where species are ranked in the table according to their total score. The total score, calculated as the sum of the component scores, varies between theoretical limits of four and 20. Only three species in the list (great crested grebe, long-tailed duck and little auk) fall below a score of ten, indicating that almost all of the listed species are of high conservation importance. The highest score is 18, for great northern diver, a species where a high proportion of the birds present in Europe in winter are in the seas off north and west Scotland, the species has a high adult survival rate so is particularly susceptible to any factors that cause increased mortality, it has a high UK threat status score, and is on Annex 1 of the Birds Directive. Northern Gannet, Manx shearwater, European storm-petrel and Arctic tern each achieve a total score of 17, but for slightly different reasons. Particularly high proportions of the world population of Northern gannets and Manx shearwaters breed in the UK, including in Scotland, and these species score highly on all the other factors. European storm-petrel and Arctic tern are on Annex 1 of the Birds Directive, and score highly on all the other factors. Ten species achieve scores of 16; lesser black-backed gull, great skua, black-throated diver, red-throated diver, razorbill, Atlantic puffin, northern fulmar, common guillemot, herring gull and Leach's storm-petrel. Four species achieve a score of 15; shag, great black-backed gull, Sandwich tern, and roseate tern. Sixteen species achieve scores from 11 to 14 (Table A1.3.2).

Table A1.3.2 Seabird species rankings based on conservation importance score (data from Furness et al. 2012).

Species	Scientific name	Score				
		Percent of biogeographic population	Adult survival	UK threat status	Birds Directive	Total Importance
Great northern diver	*Gavia immer*	5	4	4	5	18
Northern gannet	*Morus bassanus*	5	5	4	3	17
Manx shearwater	*Puffinus puffinus*	5	5	4	3	17
European storm-petrel	*Hydrobates pelagicus*	3	5	4	5	17
Arctic tern	*Sterna paradisaea*	4	4	4	5	17
Lesser black-backed gull	*Larus fuscus*	4	5	4	3	16
Great skua	*Stercorarius skua*	5	4	4	3	16
Black-throated diver	*Gavia arctica*	3	4	4	5	16
Red-throated diver	*Gavia stellata*	4	3	4	5	16
Razorbill	*Alca torda*	4	5	4	3	16
Atlantic puffin	*Fratercula arctica*	4	5	4	3	16
Northern fulmar	*Fulmarus glacialis*	4	5	4	3	16

Species	Scientific name	Score				
		Percent of biogeographic population	Adult survival	UK threat status	Birds Directive	Total Importance
Common guillemot	*Uria aalge*	5	4	4	3	16
Herring gull	*Larus argentatus*	3	5	5	3	16
Leach's storm-petrel	*Oceanodroma leucorhoa*	2	5	4	5	16
Shag	*Phalacrocorax aristotelis*	5	3	4	3	15
Great black-backed gull	*Larus marinus*	4	5	3	3	15
Sandwich tern	*Sterna sandvicensis*	2	4	4	5	15
Roseate tern	*Sterna dougallii*	1	4	5	5	15
Common tern	*Sterna hirundo*	2	4	3	5	14
Arctic skua	*Stercorarius parasiticus*	3	3	5	3	14
Black-legged kittiwake	*Rissa tridactyla*	4	3	4	3	14
Black guillemot	*Cepphus grylle*	4	4	4	1	13
Common eider	*Somateria mollissima*	2	4	4	3	13
Common gull	*Larus canus*	3	3	4	3	13
Little tern	*Sternula albifrons*	2	2	4	5	13
Slavonian grebe	*Podiceps auritus*	3	1	4	5	13
Sooty shearwater	*Puffinus griseus*	1	5	3	3	12
Common scoter	*Melanitta nigra*	2	2	5	3	12
Common goldeneye	*Bucephala clangula*	2	3	4	3	12
Black-headed gull	*Chroicocephalus ridibundus*	2	3	4	3	12
White-tailed eagle	*Haliaetus albicilla*	1	1	5	5	12
Greater scaup	*Aythya marila*	2	1	5	3	11
Velvet scoter	*Melanitta fusca*	2	2	4	3	11
Great cormorant	*Phalacrocorax carbo*	3	3	2	3	11

Species	**Scientific name**	**Score**				
		Percent of biogeographic population	**Adult survival**	**UK threat status**	**Birds Directive**	**Total Importance**
Little auk	*Alle alle*	1	4	1	3	9
Long-tailed duck	*Clangula hyemalis*	2	1	2	3	8
Great-crested grebe	*Podiceps cristatus*	2	1	1	3	7

However, not all of the species in Table A1.3.2 are present in large numbers in PFOW, or in Orkney and Caithness. Table A1.3.3 lists breeding seabird species, ranked by conservation importance score, showing their breeding numbers in Scotland, in Orkney and in Caithness, and presenting the percentage of the total Scottish breeding population that breeds in Orkney and Caithness combined. From Table A1.3.3 it can be seen that two of the species with the highest total scores in terms of national conservation importance, northern gannet and Manx shearwater, are not well represented in Orkney and Caithness; Orkney and Caithness hold only 2.6% of Scotland's breeding northern gannets, and 0% of Scotland's breeding Manx shearwaters. However, Orkney and Caithness hold 39% of the Scottish breeding population of great black-backed gulls, 38% of black-legged kittiwakes, 38% of common scoters, 35% of common guillemots, 30% of Arctic terns, 25% of northern fulmars, 24% of common gulls, 23% of great skuas, 22% of razorbills, and 19% of black guillemots. These data are based on the most recent population estimates which date mostly from 1998-2002 (the national breeding seabirds census), though in a few cases from surveys carried out more recently. For example, skuas in Orkney were counted in 2010 (Meek et al. 2011) and gannets in the UK and Ireland in 2004 (Wanless et al. 2005).

Table A1.3.3. Seabird species' populations in Orkney and Caithness in relation to totals for Scotland (data extracted from 'Birds of Scotland' based on most recent census data (mostly for 1998-2002, but from 2004 for the national gannet census (Wanless et al. 2005) and 2010 for the Orkney skua census (Meek et al.2011)) for each species and expressed as 'pairs'; conversion factors for common guillemot and razorbill 1.5 individuals on ledges = 1 pair, black guillemot 2 individuals in spring count = 1 pair).

Species	**National Conservation Importance Score**	**Breeding population in Scotland (pairs)**	**Breeding population in Orkney (pairs)**	**Breeding population in Caithness (pairs)**	**Total local breeding population (pairs)**	**Local numbers as % of Scottish population**
Northern gannet	17	182,511	4,689	0	4,689	2.6
Manx shearwater	17	126,545	0	0	0	0.0
European storm petrel	17	31,570	1,870	0	1,870	5.9
Arctic tern	17	47,300	13,476	594	14,070	29.7
Lesser black-backed gull	16	25,000	1,045	2	1,057	4.2
Great skua	16	9,650	2,209	5	2,214	22.9
Black-throated	16	200	0	12	12	6.0

Species	National Conservation Importance Score	Breeding population in Scotland (pairs)	Breeding population in Orkney (pairs)	Breeding population in Caithness (pairs)	Total local breeding population (pairs)	Local numbers as % of Scottish population
diver						
Red-throated diver	16	1,200	105	5	110	9.2
Razorbill	16	93,300	6,796	13,555	20,351	21.8
Atlantic puffin	16	493,000	61,758	1,278	63,036	12.8
Northern fulmar	16	486,000	90,846	29,957	120,803	24.9
Common guillemot	16	780,000	120,684	150,836	271,520	34.8
Herring gull	16	72,100	1,933	3,743	5,676	7.9
Leach's storm petrel	16	48,047	0	0	0	0.0
Shag	15	21,500	1,872	1,136	3,008	14.0
Great black-backed gull	15	14,800	5,505	211	5,716	38.6
Sandwich tern	15	1,100	173	0	173	15.7
Roseate tern	15	4	0	0	0	0.0
Common tern	14	4,800	125	44	169	3.5
Arctic skua	14	2,100	720	71	791	37.7
Black-legged kittiwake	14	282,200	57,668	49,533	107,201	38.0
Black guillemot	13	18,750	2,910	624	3,534	18.8
Common eider	13	20,000	2,000	1,000	3,000	15.0
Common gull	13	48,100	11,141	559	11,700	24.3
Little tern	13	331	4	15	19	5.7
Slavonian grebe	13	55	0	0	0	0.0
Common scoter	12	95	0	36	36	37.9
Common goldeneye	12	150	0	0	0	0.0
Black-headed gull	12	43,200	2,854	535	3,389	7.8
White-tailed eagle	12	32	0	0	0	0.0
Great cormorant	11	3,600	412	107	519	14.4
Great-crested grebe	7	300	0	0	0	0.0

Similarly, the proportions of the Scottish populations of wintering or passage seabirds that occur in Orkney and Caithness vary considerably among species (Table A1.3.4). Great northern divers in Orkney and Caithness represent 30% of the Scottish wintering total. The area also holds 30% of Scotland's wintering little auks, 19% of wintering black guillemots, 19% of wintering Slavonian grebes, 17% of wintering long-tailed ducks, and 16% of wintering great black-backed gulls. In the migration periods, Orkney and Caithness holds 44% of Scotland's migrant numbers of sooty shearwaters in autumn, and about 20 to 25% of migrant great skuas and European storm-petrels.

Table A1.3.4. Estimated seabird species' populations in Orkney and Caithness in winter or on migration, in relation to totals for Scotland (data extracted from 'Birds of Scotland' based on most recent census data and estimates for each species). These data mainly relate to surveys carried out around 1995-2005. Details for each species can be found in Forrester et al. (2007) under individual species' texts in that book. Note that there are new data appearing in the literature all the time so this table will require updating (see for example Burton et al. 2013 for new data on gull numbers wintering in the UK).

Species	National Conservation Importance Score	Estimated Winter (w) or migrant passage (p) numbers in Scotland	Estimated Winter or migrant population in Orkney	Estimated Winter or migrant population in Caithness	Local numbers as % of Scottish total
Great northern diver	18	2,000 w	500	100	30.0
Northern gannet	17	5,000 w	100	100	4.0
Manx shearwater	17	50,000 p	0	0	0.0
European storm-petrel	17	10,000 p	1,000	1,000	20.0
Arctic tern	17	100,000 p	5,000	1,000	6.0
Lesser black-backed gull	16	400 w	0	0	0.0
Great skua	16	6,000 p	1,000	500	25.0
Black-throated diver	16	750 w	60	10	9.3
Red-throated diver	16	2,500 w	200	20	8.8
Razorbill	16	100,000 w	2,000	2,000	4.0
Atlantic puffin	16	20,000 w	500	200	3.5
Northern fulmar	16	1,000,000 w	35,000	25,000	6.0
Common guillemot	16	750,000 w	30,000	50,000	10.7
Herring gull	16	91,000 w	2,000	3,000	5.5
Leach's storm-petrel	16	150,000 p	1,000	1,000	1.3
Shag	15	70,000 w	3,000	2,000	7.1
Great black-backed gull	15	9,000 w	1,000	400	15.6
Sandwich tern	15	3,000 p	100	10	3.7
Roseate tern	15	10 p	0	0	0.0
Common tern	14	10,000 p	100	50	1.5
Arctic skua	14	6,000 p	500	50	9.2
Black-legged kittiwake	14	10,000 w	250	500	7.5
Black guillemot	13	45,000 w	7,000	1,500	18.9
Common eider	13	64,500 w	6,000	2,000	12.4
Common gull	13	79,700 w	2,000	1,000	3.8

Species	National Conservation Importance Score	Estimated Winter (w) or migrant passage (p) numbers in Scotland	Estimated Winter or migrant population in Orkney	Estimated Winter or migrant population in Caithness	Local numbers as % of Scottish total
Little tern	13	100 p	0	0	0.0
Slavonian grebe	13	400 w	70	5	18.8
Sooty shearwater	12	8,000 p	3,000	500	43.8
Common scoter	12	27,500 w	50	200	0.9
Common goldeneye	12	11,000 w	581	191	7.0
Black-headed gull	12	155,500 w	500	400	0.6
White-tailed eagle	12	250 w	2	2	1.6
Greater scaup	11	6,000 w	600	0	10.0
Velvet scoter	11	3,000 w	100	50	5.0
Great cormorant	11	10,000 w	400	200	0.6
Little auk	9	10,000 w	2,000	1,000	30.0
Long-tailed duck	8	15,000 w	2,000	500	16.7
Great-crested grebe	7	1,000 w	0	0	0.0

When considering cumulative impacts in terms of HRA, the presence of SPAs with connectivity to PFOW developments is a key issue. Connectivity of breeding seabirds from SPAs depends on their foraging range from the colony during the breeding season. Foraging ranges have been studied for most seabirds, but often only in a few years at a single colony and for small numbers of breeding birds. Furthermore, there is evidence that foraging ranges may vary considerably among years (being longer when food supply is restricted) and among colonies (being longer at larger colonies). The way in which foraging ranges have been described is also variable, with many studies reporting maximum range values, but fewer reporting mean values. There are also discrepancies in how mean values are presented. In some cases 'mean foraging ranges' represent the true mean distance of foraging birds from the colony, as reported by Wanless et al. (1991) for shags, where data are for individual birds foraging at specific locations. Other studies report foraging tracks of individuals where the 'mean' foraging range cited is often the maximum range achieved by each individual bird during a foraging trip. Such data represent mean maximum distances rather than true mean distances. For example, in the northern gannet Hamer et al. (2000) reported that the 'mean distance to the furthest point from the colony on any one trip was 232 km'. However, the same paper reported that the mean distance of foraging birds from the colony was 164 km (excluding locations at the nest). Several reviews report the 232 km statistic as mean foraging range for this study, although the true mean should be reported as 164 km. Data on mean and maximum foraging ranges of seabirds are presented in Table A1.3.5.

Table A1.3.5. Reported foraging ranges of seabirds.

Species	Mean foraging range (km)	Maximum foraging range (km)	Reference
Greater scaup	3.52 ±1.06		Herring and Collazo 2005 (lesser scaup)
Common eider	9	100	Langston 2010
	2.4	80	Thaxter et al. 2012

Species	Mean foraging range (km)	Maximum foraging range (km)	Reference
Long-tailed duck	NA		
Common scoter	2	200	Langston 2010
Velvet scoter	7	20	Langston 2010
Common goldeneye	NA		
Red-throated diver	11	50	Langston 2010
	4.5	9	Thaxter et al. 2012
Black-throated diver	inshore		
Great northern diver	inshore		
Great-crested grebe	Close to shore		
Slavonian grebe	Close to shore		
Northern fulmar	69	664	Langston 2010
	48	580	Thaxter et al. 2012
Sooty shearwater		>1500	Weimerskirch 1998 (N.Zealand)
	1.5-2		Fenwick 1978 (N.Zealand)
	c. 80		Camphuysen 1995 (North Sea)
Manx shearwater	172	400	Langston 2010
	2.3	32	Thaxter et al. 2012
European storm-petrel	100	>100	Ratcliffe et al. 2000 in Langston 2010
		>65	Thaxter et al. 2012
Leach's storm-petrel	100	>100	Ratcliffe et al. 2000 in Langston 2010
		<120	Thaxter et al. 2012
Northern gannet	232	540	Hamer et al. 2000 (Bass Rock)
	90	240	Hamer et al. 2001 (Great Saltee)
	140	640	Langston 2010
	92.5	590	Thaxter et al. 2012
Great cormorant	10	50	Forrester et al. 2007
	8	50	Langston 2010
	5.2	35	Thaxter et al. 2012
Shag	7	17	Wanless et al. 1991b
		17	Pearson 1968
	7	20	Langston 2010

Species	Mean foraging range (km)	Maximum foraging range (km)	Reference
		12.7	Wanless et al. 1998
	5.9	17	Thaxter et al. 2012
White-tailed eagle		14	Oehme 1975 in Krone et al. 2009
Arctic skua	28	100	Langston 2010
	6.4	75	Thaxter et al. 2012
Great skua	36	100	Langston 2010
		13 or 219	Thaxter et al. 2012
Black-headed gull	<15		Ratcliffe et al. 2000 in Langston 2010
	11.4	40	Thaxter et al. 2012
Common gull	<15		Ratcliffe et al. 2000 in Langston 2010
	25	50	Thaxter et al. 2012
Lesser black-backed gull	<40		Ratcliffe et al. 2000 in Langston 2010
		80	Shamoun-Baranes et al. 2011
		>100	Schwemmer and Garthe 2005 – found in offshore areas >100km from coast
			Camphuysen 1995
		>100	Thaxter et al. 2012
	72	181	
Herring gull	<40		Ratcliffe et al. 2000 in Langston 2010
	10.5	92	Thaxter et al. 2012
Great black-backed gull	<40		Ratcliffe et al. 2000 in Langston 2010
Black-legged kittiwake		55	Pearson 1968
		40-60	Suryan et al. 2000
		73	Daunt et al. 2002
	<5km, 1991		Hamer et al. 1993
	>40km, 1990		Hamer et al. 1993
	25	200	Langston 2010
	26	59	Kotzerka et al. 2010
	25	120	Thaxter et al. 2012
	ca.10	47	Chivers 2012, Chivers et al. 2012
Little tern	2.2 in 2003	9 in 2003	Perrow et al. 2006
	5.6 in 2004	27 in 2004 by failed breeders	Perrow et al. 2006
		11	
		11	
	4		Langston 2010

Species	Mean foraging range (km)	Maximum foraging range (km)	Reference
	2.1		Thaxter et al. 2012
Sandwich tern		25	Pearson 1968
	15	70	Langston 2010
	11.5	54	Thaxter et al. 2012
		54	Perrow et al. 2011
Common tern		22	Pearson 1968
	9	37	Langston 2010
	4.5	30	Thaxter et al. 2012
		9	Perrow et al. 2011
Roseate tern	12	30	Langston 2010
	12.2	30	Thaxter et al. 2012
	7	24	Rock et al. 2007 (Nova Scotia)
Arctic tern		20	Pearson 1968
	12	21	Langston 2010
	7.1	30	Thaxter et al. 2012
		29	Perrow et al. 2011
Common guillemot	6-8	100	Bradstreet and Brown 1985
	24	200	Langston 2010
	38	135	Thaxter et al. 2012
Razorbill	10	51	Langston 2010
		35	Benvenuti et al. 2001
	24	95	Thaxter et al. 2012
Black guillemot	0-4	7	Bradstreet and Brown 1985
	5	55	Langston 2010
Little auk		Considerable distances in pelagic habitat	Bradstreet and Brown 1985
Atlantic puffin		140	Pearson 1968
	3-5	100	Bradstreet and Brown 1985
	30	200	Langston 2010
	4	200	Thaxter et al. 2012

Only five species have mean foraging ranges exceeding 40 km; Manx shearwater (mean 172 km), Leach's storm-petrel (mean 100 km), European storm-petrel (mean 100 km), northern gannet (mean 90 to 230 km), and northern fulmar (mean 60 km). All other species have considerably shorter foraging ranges, varying from a few km (terns, black guillemots, common eiders, shags) to about 40 km (herring gull, lesser black-backed gull, great black-backed gull, black-legged kittiwake). All of those species may have connectivity between development sites in PFOW and some SPAs within 80 km from PFOW (Table A1.3.6). Only Manx shearwater, Leach's storm-petrel, European storm-petrel, northern gannet, and northern fulmar might show connectivity with SPAs more than 80 km from PFOW development sites.

In the case of Manx shearwater, this species is rarely seen in PFOW waters except in small numbers and is predominantly seen in August-September which is assumed to represent autumn passage rather than foraging trips by breeders (Orkney Bird Reports). The largest Manx shearwater colony in Scotland (holding about 90-95% of the Scottish breeding population of this species) is on Rum, in the Inner Hebrides. This colony is extremely difficult to census and numbers there are rather uncertain, but there may be around 61,000 pairs according to SNH Sitelink Rum SPA citation, or 120,000 AOS (=pairs) in 2001 according to Forrester et al. (2007) based on data from the Seabird 2000 survey (Mitchell et al. 2004). The shortest sea route between Rum and the nearest corner of PFOW is around 275 km, so PFOW lies 100 km beyond the mean foraging range of breeding Manx shearwaters. This would support the suggestion in the Orkney Bird Reports that Manx shearwaters in PFOW are predominantly migrants rather than commuting breeders from Rum. The only other large colony of Manx shearwaters in Scotland is on St Kilda, which is also an SPA. Manx shearwaters contribute to the qualification of Rum SPA under Article 4.2 (in excess of 20,000 seabirds) as there are around 5,000 pairs of Manx shearwaters on St Kilda according to SNH Sitelink St Kilda SPA citation and according to Forrester et al. (2007). This colony, although further west than Rum, is not as far south and the distance to PFOW is almost the same for St Kilda as for Rum. It is also unlikely, therefore, that breeding Manx shearwaters from St Kilda regularly commute as far as PFOW to feed.

In the case of Leach's storm-petrel, there are few records from PFOW. The species is classified as an 'uncommon summer visitor and passage migrant' by Orkney Bird Report. In 2009, 15 Leach's storm-petrels were trapped at North Ronaldsay bird observatory using tape recordings to lure birds into mist nets (Orkney Bird Report). Seawatching produced only 15 records of this species in 2009, mostly in September-October. Leach's storm-petrel is considered to feed predominantly close to the continental shelf edge, west of the Outer Hebrides (Forrester et al. 2007). While PFOW falls within the foraging range of Leach's storm-petrels breeding at North Rona SPA, Sula Sgeir SPA, and possibly within the range of birds breeding at the Flannan Isles SPA and St Kilda SPA (the last holding by far the largest colony of this species in the UK), the continental shelf-edge habitat used by Leach's petrel is not present in PFOW. Birds from those colonies are considered to forage west of their colonies and not significantly to the east of the colonies (Forrester et al. 2007).

In the case of European storm-petrel, there are two SPAs within 80 km from PFOW where European storm-petrel is a designated species; one is Auskerry SPA which held 3,600 pairs of European storm-petrel at designation but only 857 pairs in 2005, and the other is Sule Stack and Sule Skerry SPA which held 1,000 pairs at designation (Table A1.3.6). In addition to those closest sites, there were 1,000 pairs at designation on North Rona and Sula Sgeir SPA (125 km distant from PFOW), 2,200 pairs at Priest Island SPA (125 km distant from PFOW), 6,760 pairs at Mousa SPA (125 km distant from PFOW), and 850 pairs at St Kilda SPA (275 km distant from PFOW). Birds from North Rona and Sula Sgeir, Priest Island and Mousa could all reach PFOW during foraging trips from the colony, whereas birds from St Kilda would be unlikely to travel that far. There are also smaller colonies of this species in Orkney and Shetland and along the north coast of Scotland on sites where they are not designated species within SPAs.

In the case of northern gannet, there are two SPAs close to PFOW where the species is listed in the citation; Sule Skerry and Sule Stack SPA holds around 5,000 pairs of gannets (Table A1.3.6), and Fair Isle SPA held 1,166 pairs at citation and this colony has increased to 4,085 pairs in 2011 (Table A1.3.6). In view of the large foraging range of this species, which varies considerably from year to year and in relation to colony size (Table A1.3.5), there may be connectivity between PFOW development sites and all gannet colonies in Scotland except perhaps Ailsa Craig and Scar Rocks. Shortest sea distances between the PFOW region and gannet colonies are: Westray (not an SPA, 14 pairs in 2003-04; 0 km), Fair Isle (SPA, 4,085 pairs in 2011; 25 km), Sule Skerry and Sule Stack (SPA, around 5,000 pairs; 50 km), Foula (gannet is not a listed species in the citation although Foula is an SPA, 919 pairs in 2003-04; 75 km), Troup Head (not an SPA, 1,547 pairs in 2003-04; 125 km), Sula Sgeir (SPA, 9,225 pairs in 2003-04; 125 km), Noss (SPA, 8,652 pairs in 2003-04; 140 km), Hermaness (SPA, 15,633 pairs in 2003-04, 175 km), Flannans (gannet is not a listed species in the SPA citation, 2,760 pairs in 2003-04; 220 km), St Kilda (SPA, 59,622 pairs in 2003-04; 275 km), Bass Rock (SPA, 48,065 pairs in 2003-04; 310 km). However, tracking studies with breeding gannets at a number of UK colonies have shown a very strong tendency for adults from adjacent colonies not to forage within sea areas closer to their neighbour than to their own colony (Hamer et al. 2011, Bearhop, Votier et al. unpublished data). This would suggest that breeding adult gannets foraging in PFOW would most likely originate from Westray, Sule Skerry and Sule Stack, Troup Head, and Fair Isle, and probably not from more distant sites. Nevertheless, there are some examples of northern gannets from further afield visiting PFOW while breeding. Breeding adults (a sample of 22 birds) equipped with satellite transmitters at nests on St Kilda were found to forage over a huge sea area extending from Mull to north of the Faeroe islands, from the continental shelf edge west of Scotland to east of Orkney (Wanless 2012), although only a very small proportion of their foraging (<1%) was in PFOW waters and most was close to the Western Isles.

In the case of northern fulmar, all Scottish fulmar colonies fall well within the recorded maximum foraging range of breeding northern fulmars (up to 664 km; Table A1.3.5), and one famous fulmar breeding at Eynhallow, Orkney, was caught on a trawler over 400 km away in the North Sea (Dunnet and Ollason 1982). Large numbers breed throughout Orkney, the coasts of Caithness, Shetland, and the northwest of Scotland and most of these fall within twice the mean foraging range of this species (mean around 50-70 km, Table A1.3.5). Fulmars potentially have connectivity to PFOW sites from throughout Caithness, Orkney, Shetland and the northwest of Scotland, but it is possible that, as seen in gannets, birds from particular colonies tend to stay closer to their breeding area than to colonies nearby. If so, fulmars at PFOW may originate primarily from Orkney and Caithness, and not from Shetland or NW Scotland. Studies of fulmar diet at St Kilda and Shetland showed such great differences in prey species between breeding birds sampled at those two areas, that it is clear that there was little overlap in the feeding ranges of fulmars from those sites (Furness and Todd 1984).

Table A1.3.6. Designated seabird population sizes at SPAs within 80 km (this range chosen to include the mean foraging ranges of target species of seabirds) of PFOW development sites.

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
Northern gannet	17	4,689	Sule Skerry and Sule Stack (**4,890 pairs in 1994 (SNH citation), 5,900 pairs in 1985-88 (JNCC citation);** 5,137 in 1999, 4,675 in 2004; *4,018 in 1969-70, 5,900 in 1984-85, 4,888 in 1994-95, 5,137 in 1998-00*)	08/07/2004- favourable maintained
			Fair Isle (**1,166,** 1162 in 2000, 1,406 in 2001, 1,585 in 2002, 1,866 in 2003, 1,875 in 2004, 1,817 in 2005, 1,957 in 2007, 2,488 in 2008, 3,582 in 2009, 3,968 in 2010, 4,085 in 2011). **SUM OF SPAs 6,166. Latest estimate for SPAs 8,760.**	15/06/2001- favourable maintained
European storm-petrel	17	1,870	Auskerry (**3,600 pairs in 1995**; 994 in 2001, 978 in 2003, 857 in 2005; *150 in 1969-70, 994 in 1999-02*)	14/07/2005- favourable recovered
			Sule Skerry and Sule Stack (**1,000 pairs in 1986 (SNH citation), >500 pairs in 1985-88 (JNCC citation);** 309 in 2001; *1,000-10,000 in 1984-85, 309 in 1999-02*). **SUM OF SPAs 4,600. Latest estimate for SPAs 1,200.**	06/07/2001- favourable maintained
Arctic tern	17	14,070 'declining' – Orkney Bird Report 2009	Papa Westray (**1,950 pairs in 1997 in JNCC citation (SNH say 1,700);** 955 in 2000, 1,726 in 2002, 813 in 2005, 556 in 2006, 800 in 2007, 667 in 2009, 356 in 2010; *881 in 1998-02*)	15/08/2006- unfavourable declining
			West Westray (**1,140 pairs in 1985-88;** over 1,000 adults in colony in 2009 - Orkney Bird Report**)**	20/06/2007- unfavourable declining

[48] (pairs except common guillemot and razorbill individuals) (Data from Birds of Scotland)

[49] Distances of SPAs from nearest PFOW development site: Auskerry, Calf of Eday, Copinsay, Hoy, Marwick Head, North Caithness Cliffs, Orkney Mainland Moors, Papa Westray, Pentland Firth Islands, Rousay, West Westray < 10 km, Caithness and Sutherland Peatland 10 to 60 km, East Caithness Cliffs 25 to 75 km, Cape Wrath 50 km, Sule Stack and Sule Skerry 60 km, Fair Isle 75 km, Handa 80 km. More distant SPAs not included: Sumburgh 100 km, Foula 120 km, North Rona and Sula Sgeir 120 km, Mousa 130 km, Noss 150 km, Papa Stour 150 km.

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
			Auskerry (**780 pairs average 1992-95 (SNH) 1991-95 (JNCC)**; 627 in 1996, 1,553 in 1998, 1,000 in 1999, 20 in 2001, 560 in 2003, 0 in 2004, 0 in 2005, 667 in 2007, 0 in 2011)	29/06/2007- favourable maintained
			Rousay (**790 pairs average 1991-95**)	08/07/2000- favourable maintained
			Pentland Firth Islands (**>1,200 pairs in 1992-95 in JNCC citation, 1,000 pairs in 1995 in SNH citation;** 327 in 2004, 1,400 in 2005, 0 in 2007)	30/06/2007- unfavourable declining
			Fair Isle (**1,100 5 year mean 1993-97,** 2,836 in 2001, 115 in 2002, 80 in 2003, 11 in 2004, 47 in 2005, 818 in 2006, 208 in 2007, 0 in 2008, 283 in 2009, 9 in 2011). **SUM OF SPAs 6,960. Latest estimate for SPAs ca. 909.**	01/06/2009- unfavourable declining
Lesser black-backed gull	16	1,047	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Great skua	16	2,214	Hoy (**1,900 pairs in 1992;** 1,973 in 2000, 1,346 in 2010; *1,573 in 1982, 1,900 in 1992, 1,973 in 1998-02*)	15/05/2000- favourable maintained
			Fair Isle (**110,** 143 in 2001, 189 in 2006, 224 in 2007, 294 in 2008, 277 in 2009, 280 in 2010, 227 in 2011)	01/06/2009- favourable maintained
			Handa (**66,** 165 in 1998, 195 in 2000, 212 in 2005, 202 in 2006, 190 in 2007, 272 in 2008, 266 in 2009, 241 in 2010). **SUM OF SPAs 2,076. Latest estimate for SPAs 1,814.**	07/06/2000- favourable maintained
Leach's storm-petrel	16	5	Sule Skerry and Sule Stack (**5 pairs in 1985-88;** *1 in 1933, >5 in 1984-85, 0 in 1999-02*). **SUM OF SPAs 5. Latest estimate for SPAs 0.**	06/07/2001- favourable maintained
Black-throated diver	16	12	Caithness & Sutherland Peatland (**26 pairs**). **SUM OF SPAs 26. Latest estimate for SPAs unknown.**	31/07/2004- favourable maintained

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
Red-throated diver	16	110	Caithness & Sutherland Peatland (**89 pairs**)	Data not available
			Hoy (**58 pairs;** 62 in 2009 – Orkney Bird Report)	30/08/2007- favourable maintained
			Orkney Mainland Moors (**18 pairs**). **SUM OF SPAs 165. Latest estimate for SPAs unknown.**	15/08/2003- favourable maintained
Razorbill	16	30,527i 5 to 34% declines since 2006 at monitoring sites in Orkney – Orkney Bird Report 2009	West Westray (**1,946 individuals in 1985-88**; 2,412 in 1999, 813 in 2007)	14/06/2007- favourable maintained
			North Caithness Cliffs (**4,000 individuals in 1985-88;** 2,466 in 2000)	15/06/2000- unfavourable declining
			East Caithness Cliffs (**15,800 individuals in 1985-88;** 17,869 in 1999)	02/07/1999- favourable maintained
			Cape Wrath (**1,800,** 2,992 in 2000)	09/06/2000- favourable maintained
			Fair Isle (**3,400,** 3,205 in 1993, 3,296 in 1998, 3,599 in 2000, 3,421 in 2005, 1,365 in 2010)	01/06/2005- favourable maintained
			Handa (**16,394,** 15,573 in 1997, 16,991 in 2001, 12,925 in 2006, 7,709 in 2010). **SUM OF SPAs 43,340. Latest estimate for SPAs 33,214.**	30/06/2006- favourable declining
Atlantic puffin	16	63,036	Sule Skerry and Sule Stack (**46,900 pairs in 1993 (JNCC citation)**; 43,384 in 1993, 59,471 in 1998)	23/06/1998- favourable maintained
			Hoy (**3,500 pairs**)	29/06/2004- unfavourable declining
			North Caithness Cliffs (**1,750 pairs in 1985-88;** *2,076 in 1985-88, 781 in 1998-02*)	15/06/2000- favourable maintained
			East Caithness Cliffs (**1,750 pairs in 1985-88;** 274 in 1999; *599 in 1985-88, 497 in 1998-02*)	02/07/1999- favourable maintained
			Cape Wrath (**5,900**)	27/06/2000- unfavourable declining
			Fair Isle (**23,000 individuals,** 80,000 in 2000, 54,000 in 2001, 16,700 in 2007, 7,278 in 2009). **SUM OF SPAs 82,800. Latest estimate for SPAs uncertain but apparently much reduced.**	01/05/2009- unfavourable declining

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
Northern fulmar	16	120,803	West Westray (**1,400 pairs in 1985-88;** 4,270 in 2000, 677 in 2007)	14/06/2007- unfavourable declining
			Calf of Eday (**1,955 pairs in 1985-88**; 1,842 pairs in 2002)	06/06/2002- favourable maintained
			Rousay (**1,240 pairs in 1985-88;** 1,030 in 2009)	02/06/1999- unfavourable declining
			Copinsay (**1,615 pairs in 1985-88;** 2,054 in 1999, 1630 in 2008)	07/06/2008- favourable recovered
			Hoy (**35,000 pairs;** 19,586 in 2007; *37,465 in 1985-88, 35,858 in 1998-02*)	11/06/2007- unfavourable declining
			North Caithness Cliffs (**14,700 pairs in 1985-88;** 13,950 in 2000)	15/06/2000- favourable maintained
			East Caithness Cliffs (**15,000 pairs in 1985-88;** 14,202 in 1999)	02/07/1999- favourable maintained
			Cape Wrath (**2,300,** 2,115 in 2000)	09/06/2000- favourable maintained
			Fair Isle (**35,210,** 43,317 in 1996, 20,424 in 2000, 27,896 in 2006, 29,649 in 2011)	30/06/2000- favourable maintained
			Handa (**3,500,** 4,323 in 1996, 3,550 in 2000, 2,119 in 2004, 1,915 in 2008). **SUM OF SPAs 111,920. Latest estimate for SPAs 86,596.**	30/06/2008- unfavourable declining
Common guillemot	16	407,280i Declining since 2000 at all monitoring plots in Orkney – Orkney Bird Report 2009	Sule Skerry and Sule Stack (**6,298 individuals in 1985-88**; 14,357 in 1993, 11,393 in 1998)	23/06/1998- favourable maintained
			West Westray (**42,150 individuals in 1985-88;** 50,613 in 2007)	14/06/2007- favourable maintained
			Calf of Eday (**12,645 individuals in 1985-88;** 2,560 in 2002, 9,012 in 2006)	07/06/2006- unfavourable no change
			Rousay (**10,600 individuals in 1985-88;** 8,822 in 2009)	17/06/1999- unfavourable declining
			Copinsay (**29,450 individuals in 1986;** 18,675 in 1999, 13,680 in 2008)	07/06/2008- unfavourable declining
			Marwick Head (**37,700 individuals in 1991;** 10,476 in 2004, 16,817 in 2006)	22/06/1999- favourable maintained
			Hoy (**13,400 individuals;** 20,514 in 1999, 9,020 in 2007)	11/06/2007- unfavourable declining

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
			North Caithness Cliffs (**38,300 individuals in 1985-88;** 70,154 in 2000)	15/06/2000- favourable maintained
			East Caithness Cliffs (**106,700 individuals in 1985-88;** 158,895 in 1999)	02/07/1999- favourable maintained
			Cape Wrath (**13,700,** 40,835 in 2000)	09/06/2000- favourable maintained
			Fair Isle (**32,300,** 32,321 in 1989, 37,563 in 1994, 39,257 in 1999, 27,320 in 2005, 19,501 in 2010)	15/06/1999- favourable maintained
			Handa (**98,686,** 112,676 in 1998, 90,105 in 2003, 45,597 in 2007, 56,706 in 2011). **SUM OF SPAs 441,929. Latest estimate for SPAs 465,448.**	02/07/2007- unfavourable declining
Herring gull	16	5,676	East Caithness Cliffs (**9,400 pairs in 1986,** 3,393 in 1999). **SUM OF SPAs 9,400. Latest estimate for SPAs 3,393.**	02/07/1999- unfavourable declining
Shag	15	3,008	Sule Skerry and Sule Stack (**874 pairs in 1985-88**; 701 in 1993, 724 in 1998, 200 in 2011)	23/06/1998- favourable maintained
			East Caithness Cliffs (**2,300 pairs in 1986,** 1,056 in 1999)	02/07/1999- unfavourable declining
			Fair Isle (**1,100,** 946 in 1993, 567 in 1998, 663 in 2001, 732 in 2003, 235 in 2008). **SUM OF SPAs 4,274. Latest estimate for SPAs 1,491.**	01/06/2008- unfavourable declining
Great black-backed gull	15	5,716	Calf of Eday (**938 pairs in 1985-88;** 100 in 2004, 281 in 2006; *800 in 1985-88, 675 in 1998-02*)	08/06/2006- unfavourable declining
			Copinsay (**490 pairs in 1985-88;** 288 in 2005, 324 in 2008; *618 in 1985-88, 1189 in 1998-02*)	07/06/2008- unfavourable declining
			Hoy (**570 pairs;** 432 in 2000; *>1068 in 1985-88, >383 in 1998-02*)	04/07/2000- favourable maintained
			East Caithness Cliffs (**800 pairs in 1986;** 175 in 1999). **SUM OF SPAs 2,798. Latest estimate for SPAs 1,212.**	02/07/1999- unfavourable declining
Sandwich	15	173	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0**	

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
tern				
Common tern	14	169	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Arctic skua	14	791 'Declining' – Orkney Bird Report 2009	West Westray (**78 pairs in 1985-88;** 38 in 2007; *45 in 1982, 98 in 1992, 88 in 1998-02*)	20/06/2007- unfavourable declining
			Papa Westray (**150 pairs**; 64 in 2000, 47 in 2007, 35 in 2008, 66 in 2009, 44 in 2010, 25 in 2011; *96 in 1982, 151 in 1992, 64 in 1998-02*)	07/07/2000- unfavourable declining
			Rousay (**130 pairs in 1985-88;** 114 in 2000, 46 in 2007; *96 in 1982, 137 in 1992, 115 in 1998-02*)	08/07/2000- favourable maintained
			Hoy (**59 pairs;** 72 in 2000, 12 in 2010; *406 in 1982, 211 in 1992, 72 in 1998-02*)	15/05/2000- favourable maintained
			Fair Isle (**110,** 105 in 2006, 68 in 2007, 37 in 2008, 65 in 2009, 70 in 2010, 29 in 2011). **SUM OF SPAs 527. Latest estimate for SPAs 150**	01/06/2009- favourable maintained
Black-legged kittiwake	14	107,201 'Decline of this species continues almost unabated' – Orkney Bird Report 2009	West Westray (**23,900 pairs in 1985-88;** 33,281 in 1999, 12,055 in 2007; *31,085 in 1985-88, 34,864 in 1998-02*)	14/06/2007- unfavourable declining
			Calf of Eday (**1,717 pairs in 1985-88;** 765 in 2002, 747 in 2006),	07/06/2006- unfavourable no change
			Rousay (**4,900 pairs in 1985-88;** 2,713 in 1999, 1,764 in 2009)	17/06/1999- unfavourable declining
			Copinsay (**9,550 pairs in 1986;** 4,256 in 1999, 3,552 in 2008; *9,550 in 1985-88, 4,364 in 1998-02*)	07/06/2008- unfavourable declining
			Marwick Head (**7,700 pairs in 1991;** 4,543 in 1997, 5,573 in 1999, 3,860 in 2003, 2,185 in 2006, 2,018 in 2009; *5,509 in 1985-88, 5,573 in 1998-02*)	30/06/2006- unfavourable declining
			Hoy (**3,000 pairs;** 781 in 1999, 397 in 2007)	11/06/2007- unfavourable declining

Species	Conservation Score	Breeding population in Orkney and Caithness[48]	Breeding pairs in SPAs (citation counts taken from SNH Sitelink in bold; counts from Lewis et al. 2012 in plain text, counts from Mitchell et al. 2004 in italics)[49]	Date of Assessment and Condition (taken from SNH Sitelink)
			North Caithness Cliffs (**13,100 pairs in 1985-88;** 9,960 in 2000)	15/06/2000- unfavourable declining
			East Caithness Cliffs (**32,500 pairs in 1986;** 40,410 in 1999)	02/07/1999- favourable maintained
			Cape Wrath (**9,700,** 10,344 in 2000)	09/06/2000- favourable maintained
			Fair Isle (**18,160,** 19,340 in 1988, 18,159 in 1992, 11,650 in 1997, 8,175 in 2000, 8,204 in 2001, 5,399 in 2005, 1,438 in 2011),	01/06/2008- unfavourable declining
			Handa (**10,732,** 7,418 in 1995, 7,013 in 1999, 5,985 in 2005, 4,466 in 2009). **SUM OF SPAs 125,409. Latest estimate for SPAs 87,151 but weighted by East Caithness Cliffs last count being 1999.**	05/07/1999- unfavourable declining
Black guillemot	13	7,067	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Common eider	13	3,000	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Common gull	13	11,700	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Little tern	13	19	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Common scoter	12	36	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Black-headed gull	12	3,389	None classified. **SUM OF SPAs 0. Latest estimate for SPAs 0.**	
Great cormorant	11	519	Calf of Eday (**223 pairs in 1985-88;** 138 in 2000, 195 in 2003, 204 in 2006; *223 in 1985-88, 138 in 1999-02*)	07/06/2006- favourable maintained
			East Caithness Cliffs (**230 pairs in 1985-88;** 96 in 2003, 101 in 2004, 77 in 2005, 83 in 2006, 60 in 2007, 67 in 2008, 53 in 2009, 81 in 2010). **SUM OF SPAs 453. Latest estimate for SPAs 285.**	02/07/1999- unfavourable declining

SNH has been developing guidance by using the breeding seabird foraging ranges taken from the Birdlife online database, and plotting these from SPAs. The idea is to see where the foraging ranges overlap with wave and tidal lease areas, thus indicating a potential for connectivity between the proposal and the qualifying feature from the SPA. SNH are currently using the mean, maximum, mean maximum, and if available the 95% cumulative frequency plots. The aim of this work is to provide developers with a long list of qualifying features and SPAs at the scoping stage, which can then be refined using knowledge of bird behaviour, device type, and site characterisation survey results. Connectivity between qualifying features from SPAs and the proposed development site is judged according to the definitions described in Table A1.3.7 below. This is then used to assess whether the proposed development is likely to have a significant effect on the qualifying feature. A similar approach has recently been used for the West Coast Developers Group (Islay and Argyll Array off-shore wind) CIA for birds (King 2012).

Table A1.3.7. SNH's definition of connectivity between qualifying features from SPAs and proposed development sites.

Connectivity	Definition	Potential for Likely Significant Effect
High	Site within the mean foraging range, the mean maximum plus 1 SD and/or the 95% CFD	Yes
Moderate	Site within the maximum foraging range and either the mean maximum + 1 SD or 95% CFD (or close to these)	Yes
Low	Site within the maximum but out with the mean maximum or mean range	Yes
No connectivity	Site further than the maximum foraging range	No
Unknown	No data available	?

SNH is currently reviewing this work, and hope to include data from Thaxter et al. (2012) and the FAME project in the next version.

Determination of appropriate temporal and spatial scale

Allen and Bennet (2012) consider the difficult question of how to assess impacts of renewables developments on seabirds at the appropriate spatial and temporal scales to comply with the Habitats Regulations. They suggest assigning effects during the breeding season to seabird populations within specific SPAs based on estimates of connectivity indicated by foraging range data. However, for the non-breeding season such assignments are difficult, or impossible, given the limited information on movements outside the breeding season of birds from specific SPAs. They suggest three possible approaches for the non-breeding season:

1. To not attempt to undertake such an assessment;
2. To assess against geographically defined populations;
3. To apportion effects in the non-breeding season to breeding colony SPAs.

They propose a workshop with an objective of reaching consensus regarding the appropriate options (both in the breeding and non-breeding seasons). There is, therefore, no clear consensus at present on how this issue should be approached for non-breeding season impacts.

Data for seabird numbers of designated species in SPAs within 80 km of PFOW are presented in Table A1.3.6. Although numbers at citation as an SPA are crucial data, it is clear that in many of these SPAs the population sizes have changed since citation. In most cases, numbers are now lower than when SPAs were established (Table A1.3.8). While gannet numbers have clearly increased, and common guillemot numbers have changed rather inconsistently at different sites, numbers of almost all other species have decreased. The largest decreases are in numbers of Arctic terns (-87%), European storm-petrels (-74%), Arctic skuas (-72%), shags (-65%), herring gulls (-64%) and great black-backed gulls (-57%). There is no simple connection between all these declining species; Arctic terns, Arctic skuas and shags feed almost entirely on sandeels, but herring gulls and great black-backed gulls have varied diets including fishery discards, small seabirds, and various marine organisms as well as some sandeels. Auks and kittiwakes, which also feed mainly on sandeels, have apparently declined somewhat, although not as much as the species listed above, and the timing and extent of declines of auk and kittiwake colonies seems to have been inconsistent (some examples are in Table A1.3.6). These rather large, and apparently continuing changes, make it difficult to set a clear baseline against which to assess potential impacts of tidal current and wave energy developments.

The main option here appears to be use either the JNCC seabird monitoring data to adjust from the last census to likely current population sizes based on Scottish (national) or if available regional trend statistics, or the percentage change data listed in Table A1.3.8 for this purpose. That has the advantage of updating population figures to a more up-to-date 'baseline' for use in impact assessment but has the drawback that applying national trend data to regional populations may not be entirely appropriate, and/or trends may not be very accurately measured, and for some species are simply not available. There is also the risk of disagreement as to which change rate is appropriate to use and therefore disagreement as to the likely current sizes of Target Bird Populations. This issue therefore needs to be discussed and agreed with the Regulator and statutory advisor at an early stage.

Table A1.3.8a. Changes in seabird population sizes indicated by JNCC monitoring data (data from JNCC web site http://jncc.defra.gov.uk/page-3201 and by recent surveys of skuas and red-throated divers (Meek, E.R., Bolton, M., Fox, D., Remp, J. 2011. Breeding skuas in Orkney: a 2010 census indicates density-dependent population change driven by both food supply and predation. Seabird 24: 1-10. and Dillon, I.A., Smith, T.D., Williams, S.J., Haysom, S., Eaton, M.A. 2009. Status of red-throated diver *Gavia stellata* in Britain in 2006. Bird Study 56: 147-157.).

Species	Index in 1998-2002	Index in 2011	% change 1998-2002 to 2011 (Scotland)	% change 2000 to 2010 (Orkney)	% change in Scotland 1994-2006
Fulmar	111.2	92.6	-16.7		
Shag	73.98	52.6	-28.9		
Great skua				-23	
Arctic skua	64.6	26.4	-59.1	-47	
Kittiwake	72.4	33.99	-53.1		
Common gull	163	101.25	-37.9		
Herring gull	83.25	42.4	-49.1		
Great black-backed gull	101.27	46.56	-54		
Sandwich tern	70.6	494.3	600		
Common tern	93.1	57	-38.8		
Arctic tern	134.3	27.6	-79.4		
Common guillemot	124.5	75.6	-39.3		
Razorbill	170.3	131.7	-22.7		
Black guillemot	51.7	59.56	15.2		
Red-throated diver					34

Table A1.3.8b. Changes in designated seabird population sizes at SPAs within 80 km of Pentland Firth Orkney Waters wave and tidal development sites.

Species	Conservation Score	Breeding population in Orkney and Caithness (pairs, except common guillemot and razorbill; individuals). Data from Forrester et al. (2007)	Breeding numbers at citation in SPAs <80 km	Latest estimate of breeding numbers in SPAs <80 km	% change
Northern gannet	17	4,689	6,166	8,760	+42
European storm-petrel	17	1,870	4,600	1,200	-74
Arctic tern	17	14,070 'declining' – Orkney Bird Report 2009	6,960	909	-87
Lesser black-backed gull	16	1,047	0	0	.
Great skua	16	2,214	2,076	1,814	-13
Leach's storm-petrel	16	5	5	0	-100
Black-throated diver	16	12	26	?	?
Red-throated diver	16	110	165	?	?
Razorbill	16	30,527i 5 to 34% declines since 2006 at monitoring sites in Orkney – Orkney Bird Report 2009	43,340	33,214	-23
Atlantic puffin	16	63,036	82,800	reduced	-?
Northern fulmar	16	120,803	111,920	86,596	-23
Common guillemot	16	407,280i Declining since 2000 at all monitoring plots in Orkney – Orkney Bird Report 2009	441,929	465,448	+5
Herring gull	16	5,676	9,400	3,393	-64
Shag	15	3,008	4,274	1,491	-65
Great black-backed gull	15	5,716	2,798	1,212	-57
Sandwich tern	15	173	0	0	.

Species	Conservation Score	Breeding population in Orkney and Caithness (pairs, except common guillemot and razorbill; individuals). Data from Forrester et al. (2007)	Breeding numbers at citation in SPAs <80 km	Latest estimate of breeding numbers in SPAs <80 km	% change
Common tern	14	169	0	0	.
Arctic skua	14	791 'Declining' – Orkney Bird Report 2009	527	150	-72
Black-legged kittiwake	14	107,201 'Decline of this species continues almost unabated' – Orkney Bird Report 2009	125,409	87,151	-31
Black guillemot	13	3,534	0	0	.
Common eider	13	3,000	0	0	.
Common gull	13	11,700	0	0	.
Little tern	13	19	0	0	.
Common scoter	12	36	0	0	.
Black-headed gull	12	3,389	0	0	.
Great cormorant	11	519	453	285	-37

For convenience we have also listed (in Table A1.3.9) notified bird populations that are not seabirds in SPAs in the region, although these populations are very unlikely to be affected by PFOW wave and tidal developments because they are in areas where developments associated with wave and tidal projects are most unlikely to occur, birds from these SPAs do not range widely outside their designated SPAs, and are unlikely to occur within development areas. It would be prudent, however, to include these species in bird surveys of development areas to check that they are not occurring there.

Table A1.3.9. Non-seabird avian populations designated in SPAs (data from SPA citation documents on SNH and JNCC web sites).

SPA	Designated species	Numbers at designation
Caithness and Sutherland Peatlands SPA	Hen harrier	14 females
	Golden eagle	5 pairs
	Merlin	54 pairs
	Golden plover	1,064 pairs
	Wood sandpiper	1-5 pairs
	Short-eared owl	30 pairs
	Dunlin	1,860 pairs
East Caithness Cliffs SPA	Peregrine	6 pairs
East Sanday Coast SPA	Purple sandpiper	830 birds (SNH) 840 birds (JNCC)
	Turnstone	1,400 birds
Fair Isle SPA	Fair Isle wren	33 territories
Hoy SPA	Peregrine	6 pairs
North Caithness Cliffs SPA	Peregrine	6 pairs
North Sutherland Coastal Islands SPA	Barnacle goose	631 birds
Orkney Mainland Moors SPA	Hen harrier	28 females
	Short-eared owl	19 pairs
Switha SPA	Barnacle goose	1,120 birds

SECTION 4: REVIEW OF PFOW WAVE AND TIDAL PROJECTS SCOPING REPORTS

The following table provides a summary of the proposed ornithological cumulative assessments discussed within submitted scoping reports for the PFOW, and where provided, comments from respondents.

Table A1.4.1 Cumulative aspects provided in scoping reports and relevant responses, where available at time of reporting.

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
Costa Head Wave Farm	'It is recognised that there is the potential for cumulative effects to arise from development, maintenance and operation of the development, adding to existing activities such as fishing and tourism. Inevitably the assessment of these 'future projects' is dependent upon the level of information available on those projects at the time of undertaking the cumulative assessment. Due to the fact it is expected different levels of detail will be available for different projects, the cumulative impact assessment is proposed to be undertaken qualitatively. Sufficient data is unlikely to be available in the public domain to allow a fully quantified cumulative impact assessment. Table 8* provides a list of the projects CHWFL proposes to consider from a cumulative and in-combination impact assessment perspective.' [*Table 8 includes all current PFOW tidal and wave sites (the sites in this table), the wave energy test site at Billia Croo and the tidal energy test site at Fall of Warness, the intermediate wave energy test site at St	Site specific marine wildlife surveys to establish the use of the area and behaviour of bird species. APEM aerial survey data. Published literature on the behaviour of species. Previously collected data from protected site specific monitoring e.g. SNH, JNCC.	SNH: We would remind the applicant that cumulative and in combination impacts will need to be carefully assessed for both offshore (i.e. other marine renewable energy sites) and onshore elements (i.e. the Orkney to Caithness 132kV cable / HVDC link and Brough Head wave development). The developer also needs to consider the major works taking place at the various piers / harbours (e.g. Coplands Dock) that are planned over the same timeframe. Not only will these have their own impacts but they may have implications for harbour space and vessel availability during installation. Also note that during their own consultation, included in the preliminary hazard analysis, OIC Marine Services highlighted the ongoing developments at Stromness, Lyness and Haston. We recommend a collaborative approach between this development and with other developers of other lease areas in close proximity, notably those on to the west of Orkney mainland. This would be much more efficient in terms of time and costs, and would provide more useful data. We would welcome ongoing

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
	Mary's Bay and the intermediate tidal energy test site at Head of Holland. The table also refers to 7 operational salmon farms in vicinity of Costa Head. It is proposed that all of these projects are assessed for potential cumulative effects, but it is not stated if these would be ornithological impacts.]		engagement with the applicant, MS and The Crown Estate on cumulative and in-combination impacts during the EIA and HRA, and would strongly encourage engagement with other developers within the Pentland Firth and Orkney Waters Developers Group forum.
Westray South Tidal Array	Potential cumulative and in-combination impacts for the proposed development identified as being of greatest significance (either positive or negative) are identified as follows: Impacts to ornithology, through habitat loss, modification to migratory routes, collision risk and disruption to habitat function. Impacts that will be considered in this EIA relate to impacts due to the Project and: • Other wave and tidal energy projects (including Phase 2 of the Project) in the Pentland Firth and Orkney Waters leasing round and other projects in the scoping process or beyond; • Other sea and seabed users e.g., commercial fishing, shipping, wind farms, marine aggregate extraction, oil and gas; and • Other onshore infrastructure, including wind farms and other energy project's grid connection infrastructure.	Information on baseline conditions regarding birds sufficient to inform HRA and EIA will be assembled from a combination of existing data sources and commissioned survey work. APEM data aerial survey data will be used to provide regional context for at-sea seabird densities. These data were collected in 2010 and cover alternate 2x2km blocks of sea around Orkney and the Pentland Firth. SSER plan to begin boat-based baseline surveys using ESAS methods (Camphuysen et.al, 2004) in November 2011. It is intended that the site will be surveyed nine times during Year 1. Surveys will be undertaken at approximately monthly intervals during the bird breeding season (April - August) and at approximately bi-monthly intervals over the rest of the year. The survey site will consist of the development area and a buffer area extending up to 4km (in some parts 4km will not be possible due to	SNH: We advise that cumulative impact assessment will require to be discussed in sufficient detail. Early discussion with SNH will be important to establishing the sources of cumulative and in-combination impacts for discussion. We recommend providing a methodology for assessing which projects may have connectivity with the same populations that may be impacted by the proposed Westray South development. SNH can then provide comments on the methodology, without having to consider each potential cumulative impact individually. This should be informed by knowledge of foraging ranges during the breeding season, post-breeding dispersal patterns, known or estimated migration routes and known or estimated wintering areas.

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
	Consultation will take place with Marine Scotland and The Crown Estate regarding potential studies they may conduct in the Pentland Firth and Orkney Waters regarding cumulative and in-combination effects. Consideration will be given to The Crown Estate's document identifying cumulative and in combination effects associated with wave and tidal development in the Pentland Firth and Orkney Waters (Royal Haskoning, in prep).	land). The present intention is for the survey to consist of traversing the area with a series of parallel transect lines 2km apart.	
Brough Head Wave Farm	On-going consultation and collation of additional site-specific data will inform the significance of potential project effects and cumulative/in-combination effects.	Field study using video footage and/or still camera footage (methodology and scope not yet defined). Shore-based marine wildlife monitoring survey currently ongoing across the entire Brough Head Wave Farm site to characterise the whole site and aid site selection. Site-specific field survey monitoring the use of a chosen site by marine mammals, birds and basking sharks	Marine Scotland: Marine Scotland are concerned that very little information is given on the seabirds present in the area and little attention is given to the potential effects of the development. More detail is required on the project and the monitoring proposals in order for the scoping process to be of benefit to the developer. Consideration should be given to the cumulative effects on birds. SNH: We are aware that wildlife monitoring is already underway at the broad scale of the whole lease area, with the intention being for subsequent surveys to focus in on smaller areas once options for development locations have been refined. SNH would appreciate the opportunity to comment on the proposed methodology for these more focussed surveys. We recommend a minimum of 2 years baseline survey data are collected in order to

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
			accurately characterise the use of the site by natural heritage features. This allows some level of inter-annual variation to be assessed at the site and the collection of sufficient data to estimate the season population size with a suitable level of accuracy. Once a development location is identified we should be in a more informed position from which to provide further advice in respect of duration of site focussed baseline surveys from which to inform EIA and HRA. We recommend that in addition to the broad scale monitoring currently underway, the APEM digital aerial survey data should be used to provide contextual data for the EIA / HRA.
Marwick Head Wave Farm	As there are several designated sites in the vicinity of the proposed development and there are also other proposed developments along the west coast of the Orkney Mainland then there is the potential possibility for cumulative effects. This potential will be fully assessed during the EIA process.	Terrestrial survey: A dedicated survey, including breeding birds, will cover the area of all possible proposed cable landfall and substation locations. Boat survey: Dedicated monthly boat survey (for 1 year of data, with possible extension by a further year) using methodology recommended in Camphuysen et al (2004). Surveys to be conducted in transect pattern by boat based visual observers. Survey covering wave farm lease boundary area and an appropriate buffer zone (to be agreed with SNH).	Scoping responses not available at time of reporting.

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
West Orkney South Wave Energy Site	Other impacts may include disturbance to birds during maintenance and decommissioning, collision with or entanglement by cables/mooring lines, and cumulative and in-combination impacts with other tidal and wave energy developments in the Pentland Firth and Orkney waters. For cumulative and in-combination impacts, E.ON will engage with SNH and Marine Scotland during the EIA process to agree an approach to these sections of the ES. It is understood that The Crown Estate will fund a cumulative impact assessment for those developments in the Pentland Firth and Orkney waters. The results will be used to inform the cumulative assessment section of the WOS EIA. For the offshore elements of the project, this will include consideration of the following activities: other renewable energy projects, commercial fisheries activity, subsea cables and pipelines, commercial and recreational navigation, port/harbour development. While there is limited potential for cumulative impacts from onshore elements of Phase 1, they will still be thoroughly investigated. The unknown nature of the landfall and substation location for Phase 2 dictates that the potential	A programme of aerial surveys of seabirds commenced in October 2010 and continued through to September 2011 (eight surveys were carried out within this period), and were funded by CEEAF. These surveys covered the whole of the Pentland Firth and Orkney waters Round 1 wave and tidal power area, including WOS and its surroundings. The surveys flew transects that were spaced 2km apart and used high-resolution camera technology to capture digital still images of birds for identification. Where the detail in the images was not sufficient to determine the species, the birds were identified to broad groupings (e.g. auks, gulls). These data were then fully analysed post hoc. Photos were taken at 2km intervals on each of the transects.	SNH: We are content with the description of potential impacts to bird species as described in section 5.5.2 and 5.2.2 but would remind the applicant that cumulative impacts will need to be carefully assessed for both offshore (i.e. other marine renewable energy sites such as EMEC, WOMS, etc) and onshore elements (i.e. the Orkney to Caithness 132kV cable / HVDC link and Brough Head wave development). We would welcome ongoing engagement with the applicant and MS on cumulative and in-combination impacts during the EIA and HRA, and would strongly encourage engagement with other developers within the Pentland Firth and Orkney Waters Developers Group forum.

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
	for cumulative effects for that stage cannot be estimated at the current stage of the project.		
MeyGen Tidal Energy Project	The assessment of cumulative impacts has been dependant on the public availability of information on other projects in the planning process. It is generally acknowledged that there are difficulties in assessing cumulative impacts via a single-project EIA. Where appropriate and if available within the timeframe of the EIA, MeyGen Ltd. will reference guidance on the assessment of cumulative impacts being developed by The Crown Estate. Other tidal energy developments have the potential to cause very similar impacts to those created by the Project. This means that the potential for cumulative impacts to occur is where sites are adjacent to one another.	1. Ornithological desk study. 2. Stroma Sound – Inner Pentland Firth Site specific bird surveys to be carried out over a 2 year period. The survey methodology has been agreed with SNH. Visual observations supplemented by bird tagging. 3. Site specific collision risk analysis 4. Acoustic monitoring and collision event analysis from monitoring of tidal turbines at EMEC. 5. Ornithological impact assessment The assessment of impacts on seabirds will consider the species that occur in the study area and the importance of any concentrations, their feeding behaviour, and prey species. This will determine whether Inner Sound is likely to constitute a regionally important area and whether the project is likely to have an impact on seabirds.	SNH: We recommend that further consideration is given to site characterisation of the entire lease area and not just this first phase of development. Such an appraisal would assist in helping define future phases as well as providing further contextual data as part of the assessment process for phases both individually and cumulatively. Data and analysis from the Pentland Firth Orkney Waters aerial survey work being carried out by APEM on behalf of the PFOW Developers Group, is likely to be of assistance in this work. We would be pleased to advise further on this aspect of work.
Ness of Duncansby Tidal Array	As there are several designated sites in the vicinity of the proposed development and there are also other proposed developments within the Pentland Firth area then there is the potential possibility for cumulative effects. This potential will be fully assessed during the EIA process, following recommended best practice methodologies currently being developed by The Crown Estate for	Terrestrial survey: A dedicated survey, including breeding birds, will cover the area of all possible proposed cable landfall and substation locations. Boat survey: Dedicated monthly boat survey (for 1 year of data, with possible extension by a further year) using methodology recommended in Camphuysen et al (2004).	Not available at time of reporting

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
	developments in the PFOW area. SPR will also endeavour to work alongside developers to share data on impacts to inform cumulative assessments.	Surveys to be conducted in transect pattern by boat based visual observers. Survey covering tidal array lease boundary area and an appropriate buffer zone (to be agreed with SNH).	
Farr Point Wave Farm	There are a number of other projects and plans which may be relevant to the Farr Point project in relation to the consideration of cumulative and in-combination effects under the Conservation of Habitats and Species Regulations 2010. In particular, there will be interest in the more mobile qualifying interests such as grey seal, common seal, salmon, sea lamprey and seabirds. For such species, activities such as breeding, migration and foraging behavior could potentially be affected by multiple developments in different locations. Given the high number of unregulated activities that take place in the sea today it is quite possible that impact vectors that from an objective assessment level would appear to be significant, yet they are deemed actively to be acceptable, or passively to be tolerable in terms of sea use management. This creates a difficulty when addressing the acceptability of otherwise of possible cumulative effects. The assessment will therefore identify where there is a potential for cumulativeness and will indicate the acceptability of possible impacts	During the pre-scoping process, PWP collated a substantial metadata catalogue which detailed all known available data and information sources with regards to the relevant environmental sensitivities within the proposed receiving area. (Including data on seabirds).	The list of bird receptors provided in the scoping report contains species only from SPAs within a fixed distance from the proposed development. Please see Appendix D for further discussion of SPA qualifying interests and our advice in this regard. No consideration has been given to species outwith the SPAs listed. Identification of potential impacts – this is considered in the table in section 6. However, the level of detail and assumptions made are inadequate. It is simply stated that issues will be considered in the ES. It is important and necessary to discuss at the scoping stage what the impacts may be and how these will be determined. Details / plan for studies – there are no details or plan for undertaking any surveys (other than mention of “short breeding season surveys”). Detailed methods for undertaking surveys in order to establish baseline conditions will be required. Without these data it will not be possible to conduct an EIA or HRA. We recommend that survey methodologies, covering at least two whole years, are submitted to MS and SNH for comment.

Project	Discussion of CIA with relevance to ornithology	Bird survey methods	Response relevant to ornithology CIA
	through benchmarking with existing activities. It is important to note that within the contexts of the Habitats Regulations Assessment for this project a different threshold level of acceptability is currently required and may differ from the conclusions drawn in this broader assessment of all cumulative effects		
Cantick Head Wave Project	Not available at time of reporting		Not available at time of reporting
West Orkney Middle South Wave Farm	Not available at time of reporting		Not available at time of reporting
Brough Ness Tidal Array	Not available at time of reporting		Not available at time of reporting

SECTION 5: REVIEW OF FACTORS AFFECTING THE POPULATIONS OF SEABIRDS

This review has been conducted with particular reference to the PFOW area, including climate change, fisheries, food availability, human disturbance, offshore wind farms, parasites, predation (mammalian and great skuas) and wave and tidal current turbine developments.

5.1 Introduction

Studies of seabirds have identified a large number of factors that affect seabird demography, and hence influence population trends, in the British Isles. These were listed by Mitchell et al. (2007) as: historic exploitation and persecution in the British Isles, current exploitation and persecution in the British Isles, exploitation and persecution of British and Irish seabirds while they are abroad, bycatch in nets, bycatch on longlines, collision with wind turbines, mammalian predation, avian predation, avian diseases and natural toxins (including botulism, puffinosis, ticks, red tides), food availability, effects of fisheries on food availability (through depletion of fish stocks, increases of non-target fish stocks and through provision of offal and discards), effects of offshore development on food availability, effects of refuse management on food availability, effects of farming on food availability, loss of nesting habitat, provision of new nesting habitat, oil pollution, persistent organic pollutants, heavy metal pollution, plastic pollution, global climate change, large-scale atmospheric and oceanographic events (e.g. El Niño, North Atlantic Oscillation) and short-term weather events (e.g. storms).

While a few of these effects are due to regulated development, and so are included in Cumulative Impact Assessment as relevant projects, most of these impacts are due to human activities that are not subject to planning regulation, and a few impacts are natural. Impacts not included in CIA (i.e. activities which are not regulated development/not subject to consenting) must be treated as impacts affecting the baseline numbers of seabirds. The aim of this review is to identify the likely scale of the impacts of such factors on baseline numbers of seabirds, especially with regard to populations in PFOW, and to put into a wider environmental context the likely impacts of regulated developments such as those caused by wave and tidal arrays.

Compared to most other kinds of birds, adult seabirds are exceptionally long-lived, with low reproductive output and late maturity (many species do not start to breed until three to eight years old, and many lay only a single egg which has a relatively low probability of survival to adult status). These demographic features of seabirds lead to a low ability to increase in numbers, and to particularly low resilience to additional mortality factors that reduce adult survival rate. Compared to other types of birds, seabirds can be expected to have populations that remain relatively stable over periods of years or decades. Nevertheless, many seabird populations in Britain and Ireland have changed in numbers very considerably over the past 100 years, with a general trend for most species to have increased from 1900 to about 1990 to 2000, but in many cases to have declined since reaching a peak in breeding numbers late in the 20th Century (Mitchell et al. 2004, Forrester et al. 2007, Mitchell and Daunt 2010). Identifying causes of population increase or decrease is difficult, as the response time of seabirds tends to be slow. Any factor reducing breeding success, for example, could not be evident in terms of breeding numbers for several years, and may be delayed further by the buffering effect of a pool of non-breeders waiting to recruit into the breeding population and processes of emigration and immigration that can also buffer local or even regional scale impacts on seabird demography. To compound this problem, counts of breeding numbers of seabirds at individual colonies do not necessarily reflect changes in numbers in the region as a whole as birds may move between colonies for various reasons such as local impacts of predators (Jennings et al. 2012). Since national surveys of breeding seabird numbers tend to be made only every 10 to 15 years, and include a considerable inaccuracy in survey data, changes in breeding numbers may not become evident until several decades after the factor causing the change had its effect. Thus in most cases, changes in population size (normally defined as numbers of breeding pairs) are inferred on the basis of measured changes in particular demographic parameters rather than from changes in breeding numbers.

Mitchell et al. (2004) suggested that the factors that affected seabird populations in Britain and Ireland most in the past were historic exploitation and persecution, exploitation of British and Irish seabirds abroad (i.e. outside the breeding season when the birds migrate), mammalian predation (especially involving introduced alien mammals), food availability, and fisheries. They also suggested that current population trends were most likely to be influenced by food availability, fisheries and climate change. Seabird researchers across nine nations identified 20 top priority global research questions regarding recent seabird declines and grouped them into six categories: population dynamics, spatial ecology, tropho-dynamics, fisheries interactions, response to global climate change, and management of anthropogenic impacts (Lewison et al. 2012). These six categories are all consistent with, or at least related to, the factors affecting seabirds covered in this review.

Here we review the evidence presented for each of the main factors affecting seabird populations, with particular reference to PFOW populations but taking global examples when these are informative and particularly clear examples.

5.2 Exploitation and persecution

Mitchell et al. (2004) suggest that historic persecution and exploitation of seabirds during the 19th Century is '*likely to be at least partially responsible for the increases in most seabirds species observed between the 1930s and the mid-1980s in Britain*'. The same authors also suggest that current levels of persecution and exploitation in Britain can affect rates of population change of some species; culling of large gulls, shooting of great cormorants *Phalacrocorax carbo* under licence to protect freshwater fisheries, illegal shooting of skuas in some parts of Scotland, and the traditional harvest of northern gannet *Morus bassanus* chicks on Sula Sgeir may all have reduced population growth rates or increased declines of particular populations, but these effects appear to be less influential and also much more local than the effects of factors such as changes in food supply or climate change. Exploitation of British breeding seabirds in winter when they are in their wintering areas, or during migration, may influence breeding numbers of roseate terns *Sterna dougalii* in Britain (Mitchell et al. 2004). Although large numbers of auks have been shot on the coast of Norway and these include birds from Scottish colonies, there is no evidence to indicate that this harvesting has affected numbers at Scottish colonies (Mitchell et al. 2004). Overall, exploitation and persecution seem unlikely to be significant factors affecting current seabird numbers in PFOW or in SPAs with connectivity to PFOW.

5.3 Food supply

Mitchell et al. (2004) conclude that seabird demography in Britain and Ireland is '*strongly affected by the availability of food*'. Many breeding seabirds feed primarily on small schooling pelagic fish. These fish are important food because they tend to be abundant, available in the upper layers of the sea, have a high energy density, and are relatively small so are easy for seabirds to catch and swallow. In many different parts of the world and for many different kinds of seabirds, breeding success shows a strong sigmoidal correlation with the abundance of their preferred prey fish (Cury et al. 2011). Cury et al. (2011) identified a threshold of one third of the long-term maximum prey biomass of forage fish abundance, below which stock biomass many seabird species suffer from reduced and more variable productivity. Such a reduction in breeding success is likely to lead to population decline if sustained. Food availability of preferred prey species varies across the oceans. Flight time data from geolocation loggers on northern gannets wintering off Western Africa and wintering further north (Bay of Biscay, Celtic sea) suggested that food availability for wintering gannets is much more varied in the north but more consistent off Western Africa (Garthe et al. 2012).

Several species' breeding success in Shetland, including that of the black-legged kittiwake *Rissa tridactyla* (Votier et al. 2008), Arctic tern *Sterna paradisaea* and Arctic skua *Stercorarius parasiticus,* shows strong correlation with sandeel *Ammodytes marinus* stock biomass (Furness, 2002). A potential B_{lim} has been put forward for seabirds (specifically kittiwakes and Arctic skuas) as a total stock biomass of 30,000 tonnes of sandeels in the Shetland stock (Furness, 2007). Below this, sandeel-dependant seabirds would be predicted to suffer from reduced breeding success, and hence potentially from population declines. One such example from the North Sea caused breeding failures for a variety of seabirds in 2004, after sandeel landings (reflecting stock biomass) decreased by over 50% between 2003 and 2006 (Frederiksen et al. 2006). In 2005 at North Sutor, N. Scotland, black-legged kittiwakes suffered from complete breeding failure; along with other species' low levels of breeding success, this decline was suspected to be linked to a shortage in sandeel abundance at the time (Mavor et al. 2005). On the Isle of May, there was a positive correlation between seabird breeding productivity and the size or biomass of sandeel prey (for Atlantic puffins *Fratercula arctica*, shags *Phalacrocorax aristotelis*, common guillemots *Uria aalge*, razorbills *Alca torda* and kittiwakes), (Frederiksen et al. 2006). Another study on the Isle of May kittiwake colony in relation to the opening and closure of the local sandeel fishery showed that breeding productivity was significantly reduced while the fishery was active, reducing the availability of the kittwake's preferred prey (Frederiksen et al. 2008). Overall it is evident that particular species of seabirds in northern Scotland, namely black-legged kittiwakes, Arctic terns, Arctic skuas and Atlantic puffins have a strong prey preference for sandeels and hence are vulnerable to changes in their abundance. A few species of seabirds on the other hand appear unaffected by sandeel stock biomass: gannet breeding success in northern Scotland shows no correlation with the availability of sandeels : although they will feed on sandeels when these are available, when sandeel abundance is low gannets can switch to alternative prey such as adult herring *Clupea harengus* or mackerel *Scomber scombrus*, fish that are too large for most other seabird species to swallow.

Arctic skua breeding success in Shetland has shown a strong correlation with the biomass of the Shetland sandeel stock, but in addition the breeding numbers in Shetland have declined substantially over the last 20 years. A study was carried out to find out the source of this population decline and it was found that breeding pairs supplemented with food had a higher nest attendance rate than those without supplement. Not only did food availability have a strong impact on breeding success, but it also affected adult survival. Birds given supplementary food were more likely to return to breed the next year than were unfed controls (Davis et al. 2005). The impact of food availability on adult survival is potentially more influential on population trend than the impact on breeding success. Similar relationships between food supply and seabird population size have been reported further afield. For example, off South African's Western Cape, swift tern *Sterna bergii* population numbers track the abundance of their prey anchovy *Engraulis capensis* and sardines *Sardinops sagax* (Crawford 2009). In Japan, the availability of anchovy *Engraulis japonicus* and sandeel *Ammodytes personatus* prey was recorded to affect seabird chick diet, growth rate and breeding success of the rhinoceros auklet *Cerorhinca monocerata*, Japanese cormorant *Phalacrocorax filamentous* and black-tailed gull *Larus crassirostris* (Watanuki et al. 2012). In the Firth of Forth, common tern *Sterna hirundo* breeding numbers at individual colonies show rather different trends over recent decades, but the regional population size correlates with the abundance of sprats *Sprattus sprattus* (their main breeding season food) in the area (Jennings et al. 2012). The variable dynamics of individual colonies seems to be driven by predation impacts and presence of gulls, with terns moving between colonies in response. Overall breeding numbers in the region varied much less than numbers at individual colonies. On the east coast of England and Scotland, large kittiwake colony "clusters" were associated with aggregations of sandeels whereas on the west coast, these predator-prey dynamics were not as apparent. The study showed that regional variation in prey abundance has a stronger impact on kittiwake populations than local prey depletion (Frederiksen et al. 2005, Fauchald et al. 2011).

Not only are seabird populations affected by the amount of prey available, some can be vulnerable to changes in the prey age-class structure. This highlights how specific some seabird's reliance can be upon a relatively unpredictable food source. An unproductive breeding season for Atlantic puffins at St Kilda in 2006 was correlated with a low availability of the appropriate age class of sandeel (Mavor et al. 2006). The breeding success of common guillemots, razorbills and shags in the North Sea has also shown a positive correlation to sandeel growth rates (Burthe et al. 2012). In Shetland and on the Isle of May, a positive correlation between 0-group sandeel abundance and adult survival of kittiwakes is apparent (Oro and Furness, 2002, Wanless et al. 2007). Food abundance can affect a wide range of demographic parameters and even such biometrics as egg size. Decreases in puffin egg size at colonies in Norway and Scotland have been related to effects of reduced food fish abundance (Barrett et al. 2012).

Food availability can affect the foraging ranges of seabirds; with decreased levels of food increasing the distance that birds will travel to feed (this can also be linked to nest desertion which will be discussed later). A study of breeding northern gannet colonies around the UK concluded that there was a positive correlation between population size and mean foraging trip duration (Lewis et al. 2001). Larger populations of seabirds increase competition for food and hence at larger colonies, birds will have to travel further to obtain food, depleting energy stores and potentially leaving nests unattended during the breeding season. Great skua *Stercorarius skua* migratory routes were studied to identify changes over time and the Scottish skuas were recorded to winter much further south than previously thought to occur: off northwest Africa. It was suggested that this migration further south could be linked to an increase in fishery discards and increasing pelagic fish stocks in the area (Magnusdottir et al. 2012). The survival of Scottish adult common guillemots has been correlated for colonies which share wintering areas, suggesting that some environmental factor present at these shared wintering sites is affecting adult guillemot survival (Reynolds et al. 2011), referring to Magnusdottir's study cited above, perhaps the most likely common factor affecting adult survival is food availability.

There is a broad consensus that seabird breeding numbers are particularly affected by food abundance, and that this factor (in some cases modulated by fisheries or by climate change) is the single most important influence on seabird population sizes at a regional level. Small, surface-feeding seabirds with short foraging ranges and a lack of alternative foods are especially vulnerable to such impacts (Furness and Tasker 2000). Changes in breeding numbers of seabirds resulting from changes in fish abundance can be dramatic. For example, common tern breeding numbers in the Firth of Forth were reduced to about half when sprat abundance fell (Jennings et al. 2012), Arctic tern and Arctic skua breeding numbers in Shetland fell by at least 50% after the decline of the Shetland sandeel stock (Forrester et al. 2007), common guillemot breeding numbers in the Barents Sea fell by over 90% when the capelin *Mallotus villosus* stock collapsed (Sakshaug et al. 2009). In contrast, swift tern and African penguin *Spheniscus demersus* numbers increased in part of the Benguela ecosystem when the sardine stock redistributed from one part to another (Cury et al. 2011).

5.4 Fisheries

Fisheries can affect seabird populations in several ways. Fisheries for the small pelagic fish that seabirds tend to target as preferred food can reduce food availability and so can cause breeding failures of seabirds (Wagner and Boersma 2011). However, fisheries for predatory fish may alter food web structure such that small pelagic fish stocks increase, and so trawl fisheries reducing predatory fish biomass can benefit seabird populations. Fisheries can also alter food availability to seabirds through the provision of offal (fish guts) and discards (whole fish rejected as beyond quota or too small or not worth taking to market and thrown back at sea). Most discards tend to come from bottom trawl fisheries. This supply of food that would otherwise be inaccessible to seabirds (because the fish involved are generally much too big for seabirds that can dive to the sea floor to swallow) can increase numbers of scavenging seabirds. However, reductions in the amounts of offal or discards can then lead to diet switching by large scavenging seabirds such as great skuas, great black-backed gulls *Larus marinus*, herring gulls *L. argentatus*, lesser black-backed gulls *L. fuscus*, adding a novel predatory impact onto small seabird populations in their vicinity (Votier et al. 2004).

Seabird mortality through bycatch from fisheries can have a strong impact on seabird populations in certain parts of the world. In the UK, long-line fishing has been a cause of bycatch mortality in auks and northern fulmars *Fulmarus glacialis* (Dunn and Steel, 2001). However, according to Mitchell et al. (2004) changes in food availability may be involved in declines in fulmar numbers in Shetland, and the role of longline mortality is unclear. Fisheries bycatch was also a named potential factor causing the decline in adult survival of Yelkouan shearwaters *Puffinus yelkouan* between 1969 and 1994 in Malta (Oppel et al. 2011). The decline of common guillemots recorded during the 1980s at a Low Arctic colony in Newfoundland was considered to be associated with bycatch drowning from gillnets which overwhelmed any impact from climate change (Regular et al. 2010). The by-catch of albatrosses and petrels in the North Pacific and Southern Ocean is currently a major problem caused by long-line fisheries (Tasker et al. 2000). Bycatch mortality of seabirds due to fisheries can be an important issue in some parts of the world but is apparently only a minor influence for seabird populations breeding in northern Scotland. According to Mitchell et al. (2004) '*studies of bycatch mortality in Britain showed that large numbers of auks may be caught and drowned in these nets but the rates were insufficient to cause local population declines*' and '*mortality in nets outside British waters during winter was insufficient to cause population declines of auks in Britain and Ireland*'.

5.5 Fishing on pelagic prey fish stocks

Although there are many examples of seabird breeding success relating to pelagic fish abundance, there is often dispute as to how much the abundance of pelagic fish is determined by fishing and how much variation is due to natural factors. The presence of sandeel fishing on the Wee Bankie, E Scotland, has been clearly correlated with low and variable kittiwake breeding success, whereas before the fishery opened (in 1990), breeding success at the Isle of May colony was much higher (Frederiksen et al. 2004, Scott et al. 2006). However, this relationship was complicated as there was also an influence of sea temperature (i.e. global climate change impact) in addition to the influence of presence or absence of a sandeel fishery. In Shetland, although the relationships between sandeel stock biomass and seabird breeding success are clear, it is uncertain whether the decline in sandeel abundance in the late 1980s and since 2000 is due to fishing impacts or whether it is due to natural factors or to climate change. There is, for example, some evidence to suggest that the declines in sandeel abundance in the Shetland stock may have been influenced by top down predation impacts due to recovery of adult herring biomass in the area in the late 1980s and after 2000 (Frederiksen et al. 2007). Examples where impacts of the fishery on pelagic fish can be more clearly seen include the collapse of seabird populations in Namibia and parts of South Africa following depletion of sardine and anchovy stocks by overexploitation (Pichegru et al. 2010a, Cury et al. 2011) and the mass mortality of seabirds in Peru following depletion of the anchoveta *Engraulis ringens* stock by fishing (Wagner and Boersma 2011). The fact that closing areas around African penguin colonies can lead to rapid recovery of breeding success and numbers (Pichegru et al. 2010b) also provides clear evidence of a fishery impact on seabird prey abundance in that ecosystem. Changes in breeding numbers of seabirds resulting from changes in fish abundance driven by fisheries can be dramatic. For example, African penguin numbers fell by over 90% when sardines were overfished in Namibia (Cury et al. 2011), Atlantic puffin breeding numbers at Røst, Norway, fell by 50% after the herring stock was depleted by fishing (Gjøsæter et al. 2009, Cury et al. 2011). Richerson et al. (2010) showed by modelling seabird-fishery interactions that a 20% reduction in sandeel harvest from Shetland could potentially effect a doubling in breeding success of Arctic terns *Sterna paradisaea* in Shetland, by allowing sandeel stock biomass to recover from the depletion caused by a fishery operating at Maximum Sustainable Yield (MSY).

5.6 Discards and offal

Although there are efforts currently in place to reduce the amount of fish being discarded from vessels at sea, scavenging seabirds still consume large quantities of discarded fish, and offal (60-80% of roundfish discards and 70-95% of offal discards) (Furness et al. 2007). Great skua colonies of the northern North Sea have seen rapid population growth from early in the 20th Century up to the end of the century, and this has been correlated to increases in fishery discards from the 1940s to the 1980s (Votier et al. 2004). From a study on great skua populations around Shetland is was clear that those skuas rely heavily on fishery discards as a large component of their diet (Votier et al. 2008). Similar dependence on fishery discards is apparent in large colonies of great black-backed gulls and possibly in several other gull species (Mitchell et al. 2004). As reducing fishery discards remains a top priority for FAO's policy for Responsible Fisheries (Furness 2003), it seems reasonable to predict that unless these seabird species can switch to alternative diets, their future breeding success is unlikely to be sustained. Wintering seabirds off the Western coast of Africa (Sahara and Mauritania) have also been reported to have a close association with fishing trawlers, feeding on the discards. However, hydrography (specifically cold water upwelling) there has perhaps an equally important role to play in seabird success (Camphuysen and Van der Meer, 2005). During a study to investigate the winter migration patterns of northern gannets, it was revealed that they often stay in areas of elevated discard availability. Off western Africa, 88.8% of wintering gannets were found to be associating with fishing vessels (Kubetzki et al. 2009). As gannets are adapted for diving and catching live fish prey, it isn't surprising that they are switching to discards as a food source when availability of wild fish is low. It has been discovered, however, that fishery discards are a poor substitute for higher energy anchovy and sardine, which gannets would preferably feed on in favourable conditions. Between 1986 and 2006, anchovy and sardine availability off the west coast of South Africa have decreased from <84% to <35%, correlated with a decline in growth rate of cape gannet *Morus capensis* chicks, (Mullers et al*. 2009)*. This decline in anchovy and sardine availability can be linked to the activities of a purse-seine fishery, which in 2007 took 41% of the food needed for the Malgas Island cape gannet colony (72,000 birds) (Okes et al. 2009). A study of Balearic shearwater *Puffinus mauretanicus* diet pre-incubation and during the breeding period showed an interesting link to the energy differences in prey species. During the pre-incubation period, breeding adults were recorded to feed mainly on demersal (discarded) fish, whereas during incubation, had a tendency to switch their foraging effort to higher energy fish such as anchovies and pilchards *Sardina pilchardus*, (this was particularly prevalent in the female adults), (Navarro et al. 2009). This prey-switching behaviour in the shearwaters could be linked to natural (seasonal) or unnatural (caused by fisheries) variations in the availability of their preferred prey. However, the increased switching amongst females would suggest that this move away from discard feeding was linked to feeding their young since discards are lower in energy (Mullers et al. 2009). Österblom et al. (2008) put forward the "junk-food hypothesis" affecting marine top predators such as seabirds. This hypothesis suggests that also the quality, not just the quantity of food can affect population survival rates of seabirds. Given that the EU Common Fisheries Policy is currently being rewritten and that it is highly likely that the EU will introduce a 'no discards' policy, scavenging seabirds in Scotland are very likely to face a drastic decrease in food availability. This will probably result in reduced breeding success and declines in breeding numbers of great skuas, great black-backed gulls, herring gulls, lesser black-backed gulls and possibly of northern fulmars and northern gannets.

5.7 Climate change

Although impacts on seabirds from climate change are mostly indirect, such as increased sea surface temperature (SST) altering the marine food web from plankton upwards, they can still have strong impacts on the breeding success of seabirds. According to Sydeman et al. (2012), seabirds are responding to climate change across the globe and as a result, can be used as indicator species when studying the effects of climate change on the marine environment. When predicting climate change impacts on seabirds it is apparent that no single factor acts alone on populations, all factors (such as food availability, warming oceans or nest desertion rates) are interconnected (Heath et al. 2009). Climate change models have predicted that by the end of this century, great skua and Arctic skua *Stercorarius parasiticus*: two widespread seabirds in North Scotland including PFOW will no longer breed in the UK (Mitchell and Daunt 2010). Measurements using the NAO index have estimated that 29 species of North Atlantic seabirds are significantly affected by climate (Sandvik 2012). One such example is the kittiwakes of Orkney which have suffered breeding success declines with increasing Sea Surface Temperature (SST), as warming oceans are also correlated with a decrease in large *Calanus* copepod abundance (Frederiksen et al. 2007). Kittiwakes in the West Atlantic are also thought to be sensitive to deteriorating environmental conditions, leading to population declines, (Frederiksen et al. 2012); these deteriorating environmental conditions can only become more exaggerated with climate change. Kittwakes of the Bering shelf region however may experience short-term demographic benefits from ocean warming effects (Satterthwaite, 2012). On a larger scale however, long term, it is unlikely that the longevity of these birds will be enough to cushion their populations from continued low reproductive rates (Satterthwaite, 2012). In Nunavut, Canada, although the reproductive success of thick-billed murres (Brunnich's guillemots) *Uria lomvia* has not yet been reduced by an increasing SST and declining ice cover, a declining rate of energy supply to chicks suggests that reproductive success could be affected in the foreseeable future (Smith and Gaston, 2012). Auks of the North Sea (common guillemots, razorbills and Atlantic puffins) have been recorded to be breeding later as a response to climate change (Wanless et al. 2008), probably because of an effect of reduced prey availability during the laying and incubation period. One of the more indirect effects of warming oceans due to climate change is the effect upon the marine food web and most importantly at the bottom of the web, plankton. With a decrease in large *Calanus* copepods correlated to increasing SST, many small fish (such as sandeel) will have a limited food source, which as discussed above, can have seriously detrimental impacts on seabird's breeding success. It is not only kittiwakes that are affected by climate change; there is evidence of effects on many other species, but not all effects are negative. In the Alaska Gyre, the abundance of 15 species of seabirds were tested against seasonal oceanic trends to predict the potential effects of climate change in the future. Overall, they found an increase in seabird abundance (9 out of 15 species), which they believed was a result of an increase in forage nekton and a lengthening of the growing season (Thompson et al. 2012). The effects of climate change can affect seabirds to different extents across the globe. Great skuas have experienced heat stress above certain temperatures causing increased rates of nest desertion. Above 16°C, 10% of great skua territories were deserted by both parents leaving chicks vulnerable to predation and/or starvation (Oswald et al. 2008) at a study site in Foula, Shetland. At this same site, heat stress was recorded to have a "critical" effect on chick survival above 14°C. During a seabird review throughout the UK conducted by MCCIP, climate change along with prey availability was found to correlate with the breeding success and survival rate of kittiwake, shag, Arctic skua, Arctic tern, common guillemot and Atlantic puffin *,* with infanticide being recorded in guillemot colonies as a critical impact *(*Mitchell and Daunt, 2010). As for climate change affecting migration routes with changing temperatures, Fort et al. (2012) have found that winter hotspots for northern gannets could in fact be dictated by the origin of the bird (suggesting genetic control of migration pathways) and hence may not be as much affected by climate change as previously thought. Little auks *Alle alle* of the North Atlantic also have the ability to offset potential climate change impacts (i.e. ocean warming) through plasticity of their foraging behaviour (Grémillet et al. 2012). Kittiwakes of the North Sea on the other hand have been reported to correlate their laying dates with NAO and SST in the prebreeding period, whereas common guillemots made only minor adjustments to their breeding schedule even with large-scale climate changes (Frederiksen et al. 2004).Rising sea levels linked to climate change are another concern for seabird colonies on lowlying islands or exposed coastlines, with the potential for the nest habitats of ground-nesting birds such as Manx shearwater (*Puffinus puffinus)* and Arctic terns to be washed away (Mitchell and Daunt, 2010). Anticipated climate warming in the 'Green Belt' of the south-eastern Bering Sea is predicted to reduce availability of prey for planktivorous predators (in this case least auklets *Aethia pusilla* (Dorresteijn et al. 2012). Another predicted effect of climate change is an increased frequency of hurricanes and storms. Along the US Atlantic Ocean seaboard, it has been modelled that the rise in numbers of hurricanes has the potential to put an already endangered seabird: black-capped petrel *Pterodroma hasitata* at an elevated risk of extinction (Hass et al. 2012). The impacts observed from these studies are relatively strong, affecting seabirds at a population level and the effects are long-term with predictions for even stronger effects in the future. Climate change is therefore a relatively important factor affecting seabird populations. In contrast to the effects of fisheries however, climate fluctuation mainly affected "low elasticity demographic traits" (such as fecundity, productivity), contrary to bycatch (and mammal predation and offshore wind farm collision) which mainly affects "high elasticity traits" (i.e. survival) (Barbraud et al. 2012).

5.8 Predation

Predation in general, when at a natural occurring level, has no dominant impact on seabird breeding success or survival. Predation from introduced mammals, however, can have extremely serious unsustainable impacts on seabird populations, especially on smaller seabirds as mammals tend to only attack seabirds that are smaller in size than they are (Towns et al. 2011). For example, the presence or absence of brown rats *Rattus norvegicus* in Orkney and Shetland is the "*single most important influence*" on storm-petrel breeding distribution (de Leon et al. 2006). Evidence of this comes from a survey reporting that European storm petrels *Hydrobates pelagicus* were restricted to rat-free and low-disturbance islands (de Leon et al. 2006). It is estimated that 75% of threatened island birds are at risk from introduced species (Phillips 2010). Since European expansion in the 16th century, invasive mammalian predators have spread through UK Overseas Territories (e.g. Bermuda, Gibraltar, Falklands, Cyprus). These invasions have caused seabird extinctions and population declines which are ongoing across the islands (Hilton and Cuthbert 2010). Similar devastating impacts have frequently been seen throughout the world where alien mammals have been introduced onto islands with seabird colonies (Towns et al. 2011). However, there are a few examples of cases where very large seabird populations have coexisted with rats for many decades without obvious impacts (Quillfeldt et al. 2008), possibly because rat numbers in these cases are simply too low relative to the huge numbers of seabirds in the colonies. Brown rat and American mink *Neovison vison* are two introduced predatory species that have caused whole colony extinctions of terns, gulls, storm petrels, Manx shearwater *Puffinus puffinus* and Atlantic puffin at many sites in the British Isles (Mitchell and Daunt 2010). The Shiant Islands of the Outer Hebrides experienced declines in nesting seabirds in the early 1990s which was correlated to the introduction of ship (black) rats *Rattus rattus* in 1990 (Stapp, 2002). Now the predatory impacts of invasive mammals are known, regulations are in place regarding the release of such animals, to reduce the chances of them reaching currently "safe" islands (Manchester and Bullock 2000). However, with the introduction of wave and tidal structures in the Pentland Firth and Orkney Waters, there is concern that devices with surface structures (e.g. wave devices) could provide a substitute for islet chains and increase the risk of mink accessing offshore islands in Orkney (Faber Maunsell and Metoc 2007). Otters *Lutra lutra*, an endemic mammalian predator resident to Scottish coastlines, were the cause of a very low breeding success rate of Arctic terns in NE Scotland in 2005 (Mavor et al. 2006). In the Azores, the introduction of mammalian predators led to the disappearance of Procellariform seabirds from the main islands, all except the Cory's shearwater *Calonectris diomedea,* the largest abundant seabird of that archipelago (Fonataine et al. 2011). In combination with low natal philopatry, high predation pressure on the East Limestone Island colony of ancient murrelets *Synthliboramphus antiquus* in British Columbia has the potential to eradicate this seabird species from the island (Gaston and Descamps, 2011). Mammalian predators generally have a much greater impact on seabird populations than other predators, such as eagles, skuas and great black-backed gulls.

Mammals are obviously not the only predators of seabirds. Skuas feed on other seabirds; Arctic skuas mainly on young chicks but great skuas can take larger seabirds too. Their predominant prey is sandeels but in response to declines in sandeel availability and in the face of reduced rates of fishery discarding, skuas have resorted to feeding more on other seabirds (Votier et al., 2007). To emphasise the extent of predation from skuas on other seabirds: it was recorded in 2005 that only 2 out of >300 pairs of Arctic terns fledged as a result of great skua predation and bad weather in North Ronaldsay (Mavor et al. 2006). Common terns are also strongly influenced by local predation (Jennings et al. 2012). Great skuas fed less on other seabirds at larger colonies than at small colonies (Votier et al 2007). An interpretation of this finding was that at larger colonies, competition for other seabirds as prey was so intense that most of the skuas would feed on fish instead, even though foraging range would be wider. In the Mediterranean Basin, empirical evidence has proven that the local extinction of two seabird species during a study period was prompted by interspecific competition in the colonies and further population changes were a result of carnivorous predators (Amaraz and Oro, 2011). As discussed above, following climate change, increasing temperatures, and hence a projected decline in sandeel stocks, seabird predation by skuas may well be subject to increase in the future. However, on a scale of factors affecting seabird populations, avian predators are a natural source of predation that tends to be sustainable, and alone (without the cumulative effect of climate change and fisheries management affecting skua predation), have a relatively weak impact on seabird populations.

5.9 Disturbance

Human disturbance of wild animals is often a concern. As for seabirds, most are cliff or ground-nesting which is obviously of greater disturbance potential than tree-nesting terrestrial birds. As k-selected species, seabirds are particularly sensitive to human impacts which affect adult survival, (Stienen et al. 2007). At Alness Point, N. Scotland, a long term decline in common gull *Larus canus* numbers has been recorded, with human disturbance being the main factor reducing gull success: all nests failed in 2005 (Mavor et al. 2006). Kittiwakes and common guillemots at St. Abb's Head, East Scotland have shown reduced nesting success and even nest failure linked to human disturbance, (specifically people load and distance from nest), (Beale and Monaghan, 2004, 2005). In Orkney and Shetland, the presence of human visitors also appears to affect the distribution of storm petrels (de Leon et al. 2006). It is important to note here that at St. Abb's Head, there is a visitor's centre in place encouraging people to come and see the nesting birds. This obviously has an impact on the number of people that are included in the "human disturbance" figures. A study of Cassin's auklets (*Ptycoramphus aleuticus*-a ground-nesting seabird*)* off the coast of Mexico on West San Benito Island, has recorded human disturbance effects from a seabird colony less habituated to visitors. At this site, disturbed auklet chicks showed a lower mean peak mass than the control group of chicks left undisturbed. This showed that under strict experimental conditions, the growth rate (measured in mean peak mass) decreases with increasing disturbance. This considered, human disturbance is a relatively low impact factor on seabird populations. Although disturbance in studies cited above shows a negative correlation with both nesting success and chick growth rate, the effect of disturbance at a population level was weak compared to other factors affecting seabird success.

5.10 Parasites and disease

Botulism is thought to have caused reductions in breeding numbers of large gulls where these birds regularly scavenge on refuse tips where botulism can develop (Mitchell et al. 2004). Puffinosis can cause death of large numbers of Manx shearwater chicks, with up to 4% dying in some years from this disease. However, the scale of mortality is thought not to affect breeding population trends (Mitchell et al. 2004). According to Mitchell and Daunt (2010), the detrimental impact of parasites on seabirds is increasing. However, a lack of research on parasitology of seabirds makes it difficult to gauge the importance of parasitic impact on seabird populations. The colonial nature of seabird breeding however represents an ideal niche for tick infestations. Tick infections have been recorded to reduce nestling condition, growth rates and survival of seabirds (Muzaffar and Jones 2004). Ticks as parasites will rarely kill their hosts, but can have a detrimental impact on their seabird hosts (especially when carrying viruses) which could impact the population dynamics long-term. Desertion of portions of kittiwake colonies during their breeding season has been associated with abnormally high levels of ectoparasite infestations (Boulinier and Danchin, 1996). These impacts, however, mostly are not substantial enough to cause large-scale population changes among seabird colonies, although in some cases they might influence local population trends (Mitchell et al. 2004). Therefore parasites can be considered a relatively low-impact factor of seabird population change.

5.11 Oil Pollution

Whether from offshore oil platform leakages, oil spills at sea or general waste disposal, oil pollution remains a factor that affects seabirds and can kill large numbers of seabirds, especially auks. However, Mitchell et al. (2004) concluded that '*effects of large oil spills are relatively short-term and localised, with no evidence of wide-scale, long-term effects on auk population trends*'. Seabirds are described by Boulinier and Riffaut (2008) as the '*emblematic victims*' of oil pollution. It is thought that after an oil spill, when it affects adult seabird survival, population declines will occur the following year but that after the decline, populations generally recover again (Piatt and Roseneau, 1999). Off the Dutch coast, quick post-spill recoveries have been recorded in gulls. All birds in the study managed to clean their plumage within a few weeks of the spill, in enough time to establish territories and breed that season (Camphuysen, 2011). However, a study on the effect of oil spills on adult common guillemots showed that major oil pollution incidences doubled their winter mortality rate (Votier at al. 2005).The Exxon Valdez oil spill of 1989 in Alaska caused population declines in affected common guillemot colonies and delayed breeding phenology leading to low reproductive success (Piatt and Roseneau, 1999). The Prestige oil spill, NW Spain, caused a delayed but sublethal impact on local seabirds, e.g. damage to kidneys and liver (Perez et al. 2010). In December of 1999, the Erika oil tanker spill in the Bay of Biscay resulted in the wreck of 80,000 seabirds being washed ashore, with 80% of these birds recorded as common guillemots (Riffaut et al. 2005). These oil spills obviously had a large impact on local seabirds, particularly on common guillemots, but as the spills were rare events, alongside evidence for self-cleaning properties of some seabird species, populations had future opportunity to recover. Oil spills around the Scottish coastline are especially rare, however oil spills around the Northern Isles between December 1978 and March 1979 caused the death of 7, 735 birds which were found oiled and dead on Orkney and Shetland islands (Richardson et al. 1982). Although the rarity of oil spills around Scotland presents a case for that factor to be of relatively low importance on seabird populations, it also means that the coastline is unprepared to deal with potential spills and clean up procedures, which could aggravate already serious impacts (Heubeck et al. 2003). Mortality peaks have also been recorded for foraging seabirds around offshore oil platforms as a result of ingested oil or damaged feathers (Wiese et al. 2001). As for oil discharges from ships, along the coast of Newfoundland, Canada, illegal oil discharges were the cause of 315,000 ± 65,000 common guillemot deaths each year (Wiese et al. 2004). This emphasises the impact that oil can have on seabirds in areas where oil pollution is much more common than around Scotland. Although the impact upon seabird populations from various forms of oil pollution can be severe and often lethal, impacts vary greatly between species (Boulinier and Riffaut 2008) and they are usually centred around certain hotspots where commercial shipping is intense and frequent. In Scotland therefore, the relative importance of oil pollution as a factor affecting seabird populations, is relatively low because pollution events are relatively infrequent. Worldwide, oil pollution represents a more important impact upon seabirds, but despite this is generally considered not to have a significant long term impact on breeding seabird numbers.

5.12 Persistent Organic Pollutants and heavy metals

Persistent Organic Pollutants (POPs) include pesticides such as DDT, and industrial chemicals such as PCBs and flame retardants. Some of these POPs have oestrogenic effects on birds, or are carcinogenic, and most are toxic although toxicity varies considerably among compounds (Knudsen et al. 2007). POPs tend to accumulate in body fat and increase in concentration up the food chain, so reach highest concentrations in top predators such as skuas and large gulls (Sagerup et al. 2009). Increased POP levels can show a positive correlation with corticosterone levels in seabirds, as shown in black-legged kittiwakes in Svalbard. This is an important environmental finding as corticosterone stress hormone levels predict the level of response from seabirds to changing environmental conditions (e.g. SST, food availability, parental effort) (Nordstad et al. 2012). Another POP study on seabirds in the Arctic researched the effects of POPs on the immune system of glaucous gull *Larus hyperboreus* chicks. The findings revealed that multiple POP exposures on the chicks had a negative effect on their immune system (Sagerup et al. 2009). Again, in the face of changing environmental conditions, a weakening of the immune system represents a negative impact on the survival rate of gull chicks. However, very few studies have found harmful effects of POPs on seabirds on a scale that would be likely to affect seabird population size, except in a very few cases such as the impact of a massive pesticide spillage in the southern North Sea in 1967 which killed large numbers of gulls, terns and cormorants (Mitchell et al. 2004). In the highly polluted Great Lakes, POPs caused embryo mortality and population decline in cormorants, gulls and terns, but levels of these compounds in Scottish seabirds are far below the levels reported in seabirds in the Great Lakes. Heavy metals, especially mercury and cadmium, are also considered to be a hazard for seabirds, but as with POPs, there is very little evidence that these metals influence seabird demography in any detectable way in the British Isles, and impacts elsewhere seem generally to be difficult to detect and probably only very local in exceptional circumstances.

5.13 Plastics

Plastics have been distributed around the oceans in increasing amounts over the past 40 years (Yamashita et al. 2011), acting as a source of pollution and a cause of potential harm to marine animals that may ingest plastic or become entangled. A group of short-tailed shearwaters *Puffinus tenuirostris* accidentally caught in the North Pacific Ocean in 2003 were studied for the potential effects of ingested plastics. Each bird's stomach contained a mean mass of 0.23g plastic. The mass of ingested plastic in the birds was found to correlate with concentrations of lower-chlorinated congeners found in the birds' tissues (Yamashita et al. 2011). Ingestion of plastics can be toxic to seabirds and could become more of an issue with an increase in the numbers of vessels using our oceans and amounts of plastic being used throughout the world. In a study along the coastline of Rio Grande do Sul, southern Brazil, stomach contents were studied from several species of dead seabirds, looking for plastics. Seabird species included shearwaters, albatrosses and petrels. Pieces of nylon line (from fishing boats) accounted for 17% of the plastics found in the seabird's stomach contents (Colabuono et al. 2010) while most was industrial raw plastic pellets or broken fragments of user plastic. Large accumulations of plastic fragments in the gizzard could reduce hunger or food assimilation. According to Colabuono et al. (2010), plastics could be an additional source (alongside transfer up the food chain) of POP exposure to seabirds, as well as a hazard blocking the intestine and filling the gizzard with indigestible material. However, attempts to measure harmful effects of ingested plastics in seabirds have been largely unsuccessful, suggesting that plastics are unlikely at present to have any detectable effect on seabird demography.

5.14 Offshore wind farms

Offshore wind farm developments will be localized and therefore not as widespread as the impacts that climate change or fisheries and food availability would have on seabirds. However, seabirds are at risk of collision mortality at offshore wind farms, and may also be affected by displacement (habitat loss) and barrier effects (increasing flight times and so energy costs) (Furness and Wade 2012). Alongside this, seabird populations are more sensitive to impacts of increased mortality rates than are terrestrial bird populations, so marine wind farms are likely to have a relatively larger impact on seabirds than onshore wind farms have on terrestrial birds (Exo et al 2003). Conversely, there are fewer records of offshore collisions than onshore collisions (Boehlert and Gill 2010) and seabirds, wildfowl, and waders have been noted to avoid collisions with offshore turbines by altering their flight paths up to a few hundred metres around wind farms to avoid collisions (Exo et al. 2003), even at night time. In fact, out of all the ducks and geese recorded off Nysted wind farm, less than 1% flew close enough to the turbines during migration to be at any risk of a collision (Desholm and Kahlert, 2005). While the impact of offshore wind farms on seabird populations remains to be seen, some seabirds such as northern gannets and gulls, tend to fly at heights that make them relatively vulnerable to collisions with turbines (Furness and Wade 2012; Furness et al. 2013).

5.15 Wave and tidal current arrays

Impacts of wave and tidal current arrays on bird populations remain to be seen, but are considered likely to be small and confined to a relatively small number of seabird species and populations (Furness et al. 2012). It is thought that diving birds will encounter a risk of entanglement, collision or blade strike with subsurface components (Boehlert and Gill 2010); subsurface components specifically of tidal turbines, as wave energy device structures will be situated mostly above the sea surface. Seabirds such as auks, divers, shags and cormorants dive deep below the sea surface to catch their prey hence any novel construction underwater has the potential to act as a barrier to their movements and a collision hazard. There is also concern for seabirds during the construction and maintenance of new devices at sea, that boat traffic and disturbance will increase. Increase in boat traffic during the construction, decommissioning and maintenance of devices could flush auk species from hundreds of metres away (Langton et al. 2011). Divers have been reported to be especially sensitive to boat movements and therefore could be negatively impacted by an increase in boat traffic in the PFOW area during construction and maintenance of tidal stream and wave devices. For seabirds along the Oregon coastline, it has been predicted that stormy conditions such as high winds or poor visibility could increase collision rate with wave devices and that continuous lighting present on any wave devices could increase collision risk at night when birds could be attracted to the lights. Scientists there are also worried about the potential risk for oil leakage from wave devices and the impacts that this could have on seabird waterproofing and thermoregulation if feathers become fouled (Boehlert et al. 2008). Alongside these potential negative impacts of the pending wave and tidal arrays, they also carry potential positive impacts to the local seabird colonies: modifications to water movements and turbulence could alter vertical movements of marine organisms and result in prey and predator aggregations (Boehlert and Gill, 2010). Langton et al. (2011) have also reported that fish move closer to structures after disturbance events and suggest that once tidal stream and wave energy devices are installed, this could increase the success of seabirds foraging around the new device structures. Another noteworthy point, from Grecian et al. (2010) was that wave devices minimize noise impacts experienced by seabirds; (noise impacts from pile driving have the potential to cause auditory damage to local wildlife). So negating the need for pile driving during installations would be beneficial for seabirds in the area, causing less disturbance. There is speculation that with rotating blades under the sea surface, there is potential for seabirds to collide with rotating blades as with onshore wind turbines. However, Faber Maunsell and Metoc (2007) believe that underwater, birds' moderately fast burst speed would enable escape from the path of tidal turbine blades. There still remains the risk of collision for diving birds underwater with newly installed turbines though, especially for those that actively forage underwater. It is important to emphasise here the novelty of these marine energy devices and hence the scarcity of available literature assessing their potential impacts.

It will be impossible to know the full extent of these device instalments upon seabird populations until they have been installed and the local area and seabird colonies surveyed. However, the likely effects of wave energy and tidal stream turbine arrays have been assessed by McCluskie et al. (2012) and by Furness et al. (2012). These two reviews reach broadly similar conclusions. Impacts of wave energy devices are likely to be substantially less than impacts of tidal stream arrays, and both technologies are likely to have less impact on seabirds than development of offshore wind farms. For example, displacement of seabirds by tidal stream turbine arrays or wave energy devices is likely to be substantially less than from offshore wind farms because wave and tidal developments occupy much smaller areas than taken up by offshore wind farms (McCluskie et al. 2012). Seabirds most likely to be adversely affected can be identified based on knowledge of seabird ecology. For wave energy devices, the main hazards to seabirds are possible displacement of sensitive species from foraging habitat and possible injury through collision with structures either above or below water. While in the past there has been a tendency to assume that displacement equals death, this approach is no longer considered appropriate, and the effects of displacement are more appropriately assessed through a model linking behaviour to demography (McDonald et al. 2012). More speculative impacts include the possibility that such devices may provide 'stepping stones' permitting alien mammal predators such as mink to extend their range, and the possibility that pollutants may enter the marine environment by leakage from these devices (McCluskie et al. 2012). Seabirds most vulnerable to impacts of wave energy devices appear to be divers (all species), as these birds are particularly sensitive to disturbance.

In the analysis by Furness et al. (2012), for wave energy devices, no seabird species fell into the categories 'very high vulnerability' or 'high vulnerability'. Red-throated divers, black-throated divers and great northern divers were classified as 'moderate vulnerability'. A total of 19 species fell into the category of 'low vulnerability' and 16 into the category 'very low vulnerability'. Details of these scores are presented in Table 6 (of main report).

For tidal stream arrays, no species fell into the 'very high vulnerability' category. Five species fell into the 'high vulnerability' category (black guillemot, razorbill, European shag, common guillemot and great cormorant). Five species fell into the 'moderate vulnerability' category (great northern diver, red-throated diver, Atlantic puffin, black-throated diver and little auk). The remaining 28 species fell into categories 'low vulnerability' or 'very low vulnerability', suggesting that their populations are unlikely to be affected by tidal stream turbines. Details of these scores are presented in Table 5 (of Framework).

Many breeding seabird populations in Orkney and Caithness represent high proportions of the Scottish total for the species (most recent data mostly coming from the national seabird survey 1998-2002, but percentages have probably not changed much since then as declines that have occurred have mostly been Scotland-wide) (great black-backed gull 39%, Arctic skua 38%, common scoter 38%, black-legged kittiwake 38%, common guillemot 35%, Arctic tern 30%, northern fulmar 25%, common gull 24%, great skua 23%, razorbill 22%, black guillemot 19%, Sandwich tern 16%, common eider 15%, shag 14%, great cormorant 14%, Atlantic puffin 13%, red-throated diver 9%, herring gull 8%, black-headed gull 8%, European storm-petrel 6%, black-throated diver 6%, little tern 6%). In addition, within 80 km of PFOW there are SPAs designated (as at January 2013) for common guillemot (12 sites), black-legged kittiwake (11 sites), northern fulmar (10 sites), Atlantic puffin (6 sites), razorbill (6 sites), Arctic tern (6 sites), Arctic skua (5 sites), great black-backed gull (4 sites), red-throated diver (3 sites), great skua (3 sites), shag (3 sites), northern gannet (2 sites), European storm-petrel (2 sites), great cormorant (2 sites), black-throated diver (1 site), Leach's storm-petrel (1 site), and herring gull (1 site). Many of these SPA seabird populations have connectivity with PFOW development sites, based on the breeding season mean and maximum foraging ranges of these species from their colonies.

However, based on a proportionate response to the anticipated very low impact of phase 1 tidal stream and wave energy developments in PFOW, many of these seabird species and SPA populations can be scoped out due to low or very low vulnerability to wave and tidal developments.

For wave energy devices, divers are the species considered to be at risk of significant displacement, and both red-throated divers and black-throated divers breed in SPAs that have connectivity with parts of PFOW. For tidal stream arrays, of those species considered to be at high or moderate risk of impacts at the population level, several breed in SPAs that have connectivity with parts of PFOW. These are razorbill, shag, common guillemot, great cormorant, red-throated diver, Atlantic puffin and black-throated diver. Given the likely locations of MPAs with black guillemot as a feature, these may not have connectivity with PFOW sites, although the population of this species in PFOW represents a significant proportion of the total Scottish population of this species, as do the populations of all of the other species considered to be at high or moderate vulnerability.

5.17 Conclusions

To conclude, there are a range of factors in the marine environment which can impact upon seabird populations, and of these, the ones that have affected PFOW seabird populations most in the past are human exploitation and persecution, mammal predation, food abundance, and fisheries. Those most likely to affect PFOW seabird populations at present are food abundance, fisheries, mammal predation and climate change, and those most likely to affect PFOW seabird populations in the future are also likely to be food abundance, fisheries, mammal predation and climate change. There is the potential for offshore wind farms to result in cumulative impacts on some seabirds, although these impacts may be difficult to quantify in the context of changing baselines for these species caused by climate change, food abundance and fisheries. Wave and tidal turbines can be predicted to have a relatively low impact on PFOW seabird populations, which even in the most vulnerable seabird populations may be too low to detect in the face of changes to seabird baseline populations driven by food abundance, fisheries, mammal predation and climate change.

SECTION 6: PROJECTS TO INCLUDE IN CIA

6.1 Introduction

1. Marine Scotland requested MacArthur Green prepare this note at the Project Steering Group meeting for The Crown Estate's project, '*Assessment of ornithological cumulative and in-combination impacts of Pentland Firth and Orkney waters wave and tidal projects*'. MacArthur Green has been awarded the contract to deliver this project.

2. The aim of this note is to seek clarification from Marine Scotland and SNH on the following question:

   A developer looking to obtain planning permission for a wave or tidal energy development must prepare an ES which will include a Cumulative Impact Assessment (CIA) and Habitats Regulations Appraisal (HRA). This CIA and HRA has to consider the cumulative impacts of the proposed development along with other projects, however it is not clear at what stage in the planning process do other projects need to be considered as part of CIA.

   At what stage in the planning process do other projects have to be considered by a developer as part of a CIA or HRA?

3. A summary of the reqirements of relevant leglisation and guidance is provided below.

4. MacArthur Green has considered these requirements and conclude that only projects that:

   (a) are existing (approved by planning but not operational); or

   (b) have been submitted into the planning process (the planning application and associated ES has been submitted, and therefore information regarding the project is available to the public),

   should be included for consideration within an ES's and/or HRA's CIA.

6.2 Summary of the requirements of relevant legislation and guidance

EIA Regulations & Guidance

5. The relevant EIA Regulations for wave and tidal energy projects are noted below:

   a) The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations (SI 2011/139).

   b) Marine developments: The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (SI 2000/320).

6. Both these regulations state that cumulative impacts should be considered within the Environmental Impact Assessment process, however, no details are given as to the point in the planning process when projects become relevant for consideration within a CIA.

7. The SNH EIA Handbook (2009, P.39. Para B.4.24) advises that only '*exisiting or approved development*' should be considered: '*In judging whether the effects of a proposal are likely to be significant, Competent Authorities should always have regard to the possible **cumulative effects with any existing or approved development**. There are occasions where the existence of other development may be particularly relevant in determining whether significant effects are likely. Similarly, there may be cases where applications for development should be considered jointly to determine whether or not EIA is required, see*

further advice on cumulative effects in para 50, Circular 8/2007, SPP Part 3 and PAN 45' (emphasiss added). This suggests that only projects that are approved, in planning or built are relevant for consideration within a CIA.

8. Circular 8/2007 para 50 states that, '*In determining whether significant effects are likely, planning authorities should have regard to the cumulative effects of the project under consideration together with any effects from* ***existing or approved development****. Generally, it would not be feasible to consider the cumulative effects with other* ***applications which have not yet been determined****, since there can be no certainty that they will receive planning permission. However, there could be* ***circumstances where 2 or more applications for development should be considered together****. Such circumstances are likely to be where the applications in question are not directly in competition with one another so that both or all of them might be approved, and where the overall combined environmental impact of the proposals might be greater or have different effects than the sum of the separate parts. The consideration of cumulative effects is different in principle from the issue of multiple applications which need to be considered together*'.

9. Thus, SNH guidance advises that existing or approved developments should be considered by CIA. Circular 8/2007 appears to extend this to projects which have been submitted into planning but not approved. Neither of these guidance notes, nor the EIA Regulations, advise that projects which have not be submitted into planning (e.g. projects which have only produced a scoping report, or less) should be considered within CIA.

10. Marine Scotland's draft Licencing & Consents Manual -P.73 - (currently subject to consultation with the renewables industry) states the following: '*To identify which developments should be included in the in-combination effects assessment consultation with MS-LOT is required. They should include other offshore renewable developments as well as:*

- *Ports and shipping;*
- *Oil and gas;*
- *Fishing and aquaculture;*
- *Dredging; and*
- *Coastal Developments.*

Projects will include those that are:

- *Under construction;*
- *Permitted application(s) but not yet implemented*
- *Submitted application(s) not yet determined; and*
- ***Plans or projects which are "reasonably foreseeable " i.e. developments that are being planned including other offshore windfarms which have a Crown Estate agreement for lease***' (emphasis added).

11. Thus, the draft Licencing Manual, if approved in its current state, would extend the scope for CIA to projects that are "reasonable foreseeable". This would appear to be at odds with existing EIA planning guidance as noted above. The draft Licensing Manual states that this requirement is associated with 'EIA Regulations' however no reference can be found to this within the relevant Regulations. There are significant practical implications here, for example, how would information regarding such projects be ascertained in order to be considered?

12. The document by RUK/NERC 'GUIDING PRINCIPLES FOR CUMULATIVE IMPACT ASSESSMENT IN OFFSHORE WIND FARMS' currently recommends that, '*Developers are only able to assess*

quantitatively those projects with a sufficient level of data i.e. number of turbines, hub height, blade tip length, clearance above sea level, separation distances between turbines, cable route, landfall, scoping report. Projects without this level of detail cannot be assessed as comprehensively and where information is lacking or sparse developers' consideration of cumulative impacts will be necessarily at a lower resolution. It may not always be easy for developers to assess potential impacts fully due to lack of available information. In such circumstances, developer should take a pragmatic approach when determining what is feasible and reasonable[50]*"*. It is difficult to see how sufficient information will be available to complete a CIA if the developer(s) of the other project(s) in question have not completed their surveys and/or associated ornithological impact assessment.

13. European Commission Guidance 'Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions' (1999) states that '*Impacts that result from incremental changes caused by other past, present or* ***reasonably foreseeable*** *actions together with the project'* (P.7). This guidance also states, ***'The time-scale which is to be considered for the past and reasonably foreseeable impacts is often limited by a shortage of data****. Furthermore there is an inherent uncertainty associated with activities outside the control of the project being assessed. Boundaries should be treated as useful tools in rationalising the scope of the assessment but they should also be flexible if possible*' (P.89. Section 7.6.1).

14. The term "reasonably foreseeable" used within the above draft documents may have been taken from the EC 1999 guidance (ibid); this appears to be the only source of this term in official guidance. Indeed, EC 1999 is referenced within Marine Scoltand's draft Licencing Manual (P. 72. Section 6.4.9). Within the draft documents "reasonably foreseeable" is assumed to apply to projects that have not submitted a planning application whereas the EC 1999 does not use this definition. For example, "reasonably foreseeable" may apply to projects that have submitted a planning application but have not yet been determined. Given that EC 1999 recognises that '*The time-scale which is to be considered for the past and reasonably foreseeable impacts is often limited by a shortage of data',* a reasonable interpretation of this may be that "reasonably foreseeable" applies to projects that have submitted a planning application and sufficient data are therefore available.

Habitats Regulations & Guidance

15. Regulation 48 (1) of the Habitats Regulations requires that in combination effects are considered. However no details are given on at which point in the planning process should projects have to be considered within an HRA.

'(1) A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which –

(a) Is likely to have a significant effect on a European site in Great Britain (either alone or in combination with other plans or projects), and

(b) Is not directly connected with or necessary to the management of the site, shall make an Appropriate Assessment of the implications for the site in view of that site's conservation objectives'.

16. The guidance 'Managing Natura 2000 Sites' provides further details on projects that should be included within CIA. P.23 of this guidance states:

[50] DCLG Planning Act 2008. Guidance on the pre-application process. January 2013

- '*Plans and projects which have been approved in the past and which have not be implemented or completed should be included in the combination provision.*
- *On grounds of legal certainty, it would seem appropriate to restrict the combination provision to other plans or projects which have been* ***actually proposed.*** *At the same time, it must be evident that, in considering a proposed plan or project, Member States do not create a presumption in favour of other as yet unproposed plans or projects in the future*'.

17. The guidance 'Wind Energy Developments and Natura 2000' provides additional guidance on projects that should be included within HRA. P. 70 (section 5.3.3) of the guidance states:

- '*Other plans or projects to be considered in this case include those that have already been completed, those that are approved by the planning authorities, or those that are currently undergoing planning approval*'.

18. Draft guidance by DEFRA, 'The Habitats and Wild Birds Directives in England and its seas. Core guidance for developers, regulators & land/marine managers (December 2012)' provides guidance on the assessment of in combination effects. With regard specifically to projects to include, the guidance states:

- '*The competent authority should take account of all current and proposed plans or projects of which it is aware (and the applicant is responsible for making the authority aware of such plans or projects). This would include proposals where planning permission (or a similar regulatory consent) has been applied for or granted*'
- '*It is not necessary to take account of plans or projects for which there have been no formal applications under an approvals process*'.

19. Thus, based on existing guidance, it appears that the minimum legislative requirement (for CIA in both EIA and HRA) is that only projects that have been completed, approved by planning authorities or are undergoing planning approval should be considered within a CIA.

SECTION 7. PROJECT IMPACTS TO INCLUDE/EXCLUDE

An assessment of projects with the potential to act cumulatively that should be considered for Ornithological CIA is summarised below.

7.1 Wave energy developments

Only three species are considered to be of moderate vulnerability to wave energy developments, red-throated diver, black-throated diver and great northern diver (see section 4.2.5; no species are considered to have any higher vulnerability to wave device impacts). For collision mortality risk, disturbance risk and displacement from foraging habitat, Ornithological CIA should consider those project types indicated in the relevant table with a 'X'.

Table A1.7.1. Wave project to include on basis of potential collision mortality.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Red-throated diver	X	X	X	X	X		
Black-throated diver	X	X	X	X	X		
Great northern diver	X	X	X	X	X		

Table A1.7.2. Wave project to include on basis of potential disturbance.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Red-throated diver	X	X	X	X	X	X	X
Black-throated diver	X	X	X	X	X	X	X
Great northern diver	X	X	X	X	X	X	X

Table A1.7.3 Wave project to include on basis of potential displacement from foraging habitat.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Red-throated diver	X	X	X	X	X	X	X
Black-throated diver	X	X	X	X	X	X	X
Great northern diver	X	X	X	X	X	X	X

7.2 Tidal stream developments

Ten species are considered to be of high or moderate vulnerability to tidal stream energy developments, in ranked order being black guillemot, razorbill, shag, common guillemot, great cormorant, great northern diver, red-throated diver, Atlantic puffin, black-throated diver and little auk (see section 4.2.5). For collision mortality risk, disturbance risk and displacement from foraging habitat, CIA should consider those project types indicated in the relevant table with a 'X'.

A1.7.4. Tidal stream projects to include on basis of potential collision mortality risk.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Black guillemot		X	X	X			
Razorbill		X	X	X			
Shag		X	X	X			
Common guillemot		X	X	X			
Great cormorant		X	X	X			
Great northern diver	X	X	X	X	X		
Red-throated diver	X	X	X	X	X		
Atlantic puffin		X	X	X			
Black-throated diver	X	X	X	X	X		
Little auk		X	X	X			

Table A1.7.5. Tidal stream projects to include on basis of potential collision disturbance.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Black guillemot		X	X	X	X	X	X
Razorbill		X	X	X	X	X	
Shag		X	X	X	X	X	X
Common guillemot		X	X	X	X	X	
Great cormorant		X	X	X	X	X	X
Great northern diver	X	X	X	X	X	X	X
Red-throated diver	X	X	X	X	X	X	X
Atlantic puffin		X	X	X	X	X	
Black-throated diver	X	X	X	X	X	X	X
Little auk		X	X	X	X	X	

A1.7.6. Tidal stream projects to include on basis of potential displacement from foraging habitat.

Species	Wave	Tidal	Offshore wind	Aquaculture	Oil & Gas	Ports and shipping	Coastal development
Black guillemot		X	X				
Razorbill		X	X				
Shag		X	X				
Common guillemot		X	X				
Great cormorant		X	X				
Great northern diver	X	X	X	X	X	X	X
Red-throated diver	X	X	X	X	X	X	X
Atlantic puffin		X	X				
Black-throated diver	X	X	X	X	X	X	X
Little auk			X				

It is highly likely that many of the boxes marked X under Aquaculture, Oil & Gas, Ports & Shipping and Coastal Development may be scoped out after brief examination of ESs under those headings, as it appears that their Ornithological CIAs rarely, if ever, determine/identify the cumulative impacts listed above to be significant for those development types.

SECTION 8. SOUTH CAVA SALMON CAGES PLANNING APPLICATION 2010/2011

This Section is included here to indicate the similarity in scale and impact of a relatively typical aquaculture site to that of a wave energy site, and the fact that these sites may in some circumstances share similar likely impacts on particularly sensitive marine birds (in this case, red-throated divers).

Planning application initially submitted June 2010. Objection from SNH stating that AA is required due to likely impact on Hoy SPA red-throated divers. According to Xodus Group (2010) SNH stated that in regard to this development concern lies only with the red-throated diver, and that '*this assessment should in particular be based on an appraisal of the risk of entanglement of red-throated divers'*

A Post ES Support document (Xodus Group 2010) stated:

> '*A number of potential risks to a qualifying interest of the Hoy SPA (red-throated divers) have been identified resulting from the Northern Isles Salmon Cava development:*
> *• Entanglement in predator nets*
> *• Increased boat traffic*
> *• Use of barge lighting and subsea lights'*
> *'Red-throated divers are known to feed in Scapa Flow and the vicinity of Cava favouring inshore areas and shallow bays for foraging. The steps taken to mitigate the risk of potential entanglement such as avoiding the use of predator nets as far as possible, together with mesh size selection and net visibility will further ensure that the likelihood of entanglement is minimal. With the commitment to monitoring of the entanglement issue also, it is therefore concluded that the integrity of the Hoy SPA will not be adversely impacted through potential entanglement of red-throated divers at the Northern Isles Salmon Cava site.'*
>
> '*The potential impact on red-throated divers caused by boats is considered to be negligible, as the highest number of boat trips will be experienced during winter when the numbers of red-throated divers are lowest. The average number of boat trips during production will average up to two return boat trips per day from Lyness to Cava for daily maintenance with up to three additional trips per fortnight to fill the feed barge. This is a low frequency against the background of other vessels operating nearby in Scapa Flow, such as ferries. In addition Northern Isles Salmon will brief site operators and boat skippers to make a considerable effort to reduce the number of boat trips taken*
> *along the south west and west coats of Cava. It is therefore concluded that the integrity of the Hoy SPA will not be adversely impacted upon as a result of increased boat traffic*.'
>
> '*The potential impact on red-throated divers caused by lighting on the barge and cage lighting is minimal as at the time of year when lighting may be used red-throated diver numbers will be at their lowest. It is therefore concluded that the integrity of the Hoy SPA will not be adversely impacted upon due to cage lighting at the Cava Site*.'

In the context of CIA, Xodus Group (2010) stated:

> '*The small cage net mesh size used (14 mm smolt nets and 24 mm grower nets) was concluded not to pose an entanglement risk to the red-throated divers (Section 4.2.1). As a result the cumulative risk of entanglement in tensioned cages nets is considered to be negligible. Sea users in the vicinity of the development include numerous dive boats, ferries and small fishing vessels. The JNCC boat based survey undertaken in 2005 (unpublished data) observed red-throated divers in the stretch of water between the east coast of Hoy and the west coasts of Fara and Flotta. This area of water is frequently used by a number of vessels*

including divers, larger boats such as the inter-island ro-ro ferry and, in adverse weather conditions, the passenger ferry operating between Stromness and Scrabster on the Scottish mainland. The increased boat activity that would arise as a result of the proposed development through routine site maintenance and feed supply includes up to two return journeys per day for general maintenance and up to three additional trips per fortnight when the feed barge is filled. Dillon et al. (2006) reported that the breeding population of the redthroated diver has remained stable since 1994 and the Orkney Bird report (2010) reported that 2009 was a successful year for this species, which indicates that they are not significantly disturbed by the current level of marine traffic. Considering the use of the sea along the east coast of Hoy between Cava and its surrounding area it is not considered that the number of boat trips arising from the proposed development would significantly add to the level of sea use currently experienced in the area. Additionally the size of the vessels that will be used by Northern Isles Salmon (Section 2.4.2) will be much smaller than the inter-island ro-ro ferry and comparable to small fishing vessels operating in the area. The potential for cumulative impacts as a result of increased boat traffic are therefore considered to be negligible. At the time of writing, and as identified in the ES, only one other site in Scapa Flow operated by Scottish Seafarms uses subsea cage lighting, and this is more than 4.5 km from the proposed development at Cava. It is therefore concluded that there will be no cumulative impact to the red-throated divers as a result of subsea cage lighting and the integrity of the Hoy SPA will not be affected. On assessing the potential for cumulative impacts on the red-throated divers and consequently the integrity of the Hoy SPA, it was identified that the most significant cumulative impact is likely to be a minimal impact caused by entanglement in external subsea predator nets if deployed across all Northern Isles Salmon sites in the future. Presently the cumulative impacts are assessed as negligible. Northern Isles Salmon will continue to operate using the mitigation measures outlined and it is therefore concluded the likelihood of entanglement of red-throated divers adversely affecting the integrity of the Hoy SPA is minimal'.

A letter from SNH to OIC dated 9 March 2011 stated:

'*Disturbance and consequent displacement from feeding grounds is possible, and it is important to note that red-throated divers are particularly sensitive to boat based disturbance. However likely loss of feeding habitat at the South Cava site in isolation will be small and unlikely to have an adverse effect on site integrity. We also remain concerned about the potential cumulative effects of operation of the Cava South site in combination with the existing West Fara and Chalmers Hope sites. This should be addressed as part of the Appropriate Assessment*.'

'*the proposed changes to the predator management strategy for Cava South should be sufficient to enable Appropriate Assessment to conclude no adverse effect on site integrity with respect to Hoy SPA'*

Orkney Islands Council (2011) concluded:

'*based on the nature of the proposed fish farm operation it is considered that the Cava site has the potential to have an impact on the qualifying interest of the Hoy SPA from both entanglement risk and disturbance' and 'the development as proposed with the agreed mitigation strategy and predatory management strategy would not adversely affect the integrity of the Hoy Special Protection Area'*

Planning application was approved on 24 August 2011.

APPENDIX 2: ORNITHOLOGICAL CUMULATIVE IMPACT ASSESSMENT FRAMEWORK PENTLAND FIRTH AND ORKNEY WATERS WAVE & TIDAL PROJECTS – HYPOTHETICAL SCOPING REPORT FOR SCAPA FLOW WAVE SITE ORNITHOLOGICAL ASPECTS

CONTENTS

LIST OF TABLES & FIGURES – APPENDIX 2

Figures

Tables

EXECUTIVE SUMMARY

MacArthur Green has been commissioned by The Crown Estate to produce a Worked Example of the Ornithological aspects of a Cumulative Impact Assessment (CIA) for a hypothetical wave energy site in the Pentland Firth and Orkney Waters (PFOW) area. Part of this work involves the production of the ornithological aspects of a scoping report (hereafter referred to as the ornithological scoping report) to underpin the Worked Example. This ornithological scoping report follows the recommendations within Section 4.2.1 of the Ornithological CIA Framework and therefore provides an example of the form and content of the ornithological aspects of a scoping report. While this hypothetical ornithological scoping report is obviously focussed on bird aspects, there is a need to include more general contextual information, hence this report is longer than would usually be required in practice to detail the ornithological features and potential impacts.

In delivering the Ornithological CIA Framework, it became apparent from discussions with the attendees at the workshop and members of the Project Steering Group (PSG) that it would be beneficial to demonstrate application of the Ornithological CIA Framework by producing a Worked Example of an Ornithological CIA. Therefore, the aim of this project is to produce a Worked Example of an Ornithological CIA for a fictional wave project in PFOW. This will help demonstrate the process and stages involved and provide an example of the approach to, and level and type of data that may be necessary in, PFOW developer applications. This scoping report provides the background detail required to inform the Worked Example (Appendix 3).

It is anticipated that utilising the Ornithological CIA Framework and Worked Example will aid PFOW developers in ensuring they provide sufficient, proportionate and consistent Ornithological CIA information in their consent applications. This will ultimately help regulators and their advisors in the decision making process and therefore progress timely consenting decisions.

The hypothetical 'Scapa Flow Wave Farm' development has been chosen for this Worked Example as it is very unlikely that a wave site will ever be developed here for obvious reasons. Therefore any confusion with current or future wave and tidal sites in the same area is not likely to occur.

This report forms part of a suite of 4 reports:

1. Ornithological CIA Framework for the PFOW (the first section of this report);
2. Ornithological CIA Framework – Supporting Information (Appendix 1);
3. **Worked Example Ornithological Scoping Report (Appendix 2)**; and
4. Worked Example Ornithological CIA of Scapa Flow Wave Project (Appendix 3).

This hypothetical example has been developed through detailed consultation with the Project Steering Group and wider consultation with the PFOW developers. The PSG comprised representatives from The Crown Estate, from the regulators and their advisors (Marine Scotland Science, Marine Scotland Licencing, Scottish Natural Heritage and Joint Nature Conservation Committee) and the renewables industry (Niras Consulting – as adviser to The Crown Estate for this project), ScottishPower Renewables, Aquamarine Power, SSE Renewables. MacArthur Green and The Crown Estate wish to thank the PSG and the various attendees of the workshop who have contributed valuable input to the development of the project.

1. INTRODUCTION

The hypothetical 'Scapa Flow Wave Farm' development (from hereafter referred to as 'the Development') has been chosen for this Worked Example as it is very unlikely that a wave site will ever be developed here for obvious reasons. Therefore any confusion with current/future wave sites in the same area is not likely to occur.

This scoping report, focused on only the ornithological aspects, follows the recommendations within Section 4.2.1 of the Ornithological CIA Framework. This report (hereafter referred to as the ornithological scoping report) therefore provides an example of the form and content that an ornithological scoping report may take.

This ornithological scoping report contains the following sections:

Section 2: Site Description
Section 3: Target Bird Populations & Designated Sites
Section 4: Projects to Include in Ornithological CIA
Section 5: Ornithological Impacts
Section 6: Sensitivity of Target Bird Populations
Section 7: Conservation status of Target Bird Populations
Section 8: Proposed Data Collection and Analysis Methods
Section 9: Data Acquisition from other Projects to be Included in Ornithological CIA
Section 10: Data Presentation
Section 11: Methods for Determining Significance
Section 12: Mitigation Measures

The overall aim of an ornithological scoping report is to agree at an early stage in the Environmental Impact Assessment (EIA) process the proposed approach to, and scope of, the ornithological impact assessment with the relevant stakeholders (which includes Ornithological CIA). This involves identifying Target Bird Populations that may be adversely affected by the Development, and to outline the approach to assessing bird use of the Site and its vicinity and evaluating the magnitude of impacts and significance of effects.

2. SITE AND PROJECT DESCRIPTION

The proposed development Site covers a 4 km^2 area and is located ca. 1.5 km south of mainland Orkney within Scapa Flow (Figure A2.1).

The Development will comprise a total of 15 floating wave energy devices (with a total power generating capacity of 10 MW), with a submarine cable connecting the wave energy devices to a grid connection somewhere onshore at mainland Orkney to the north-west of the Site.

For bird surveys, a survey area of 4 km^2 plus a buffer of 1 km extending beyond the survey area, will be used for site characterisation. The total survey area is thus approximately 16km^2 (Figure A2.1).

The Development Site is located 5.1km south of Orkney Mainland Moors SPA (red-throated diver is the qualifying feature relevant to the Development) and 5.7km east of Hoy SPA (red-throated diver and various sea bird species). There are numerous other SPAs with bird populations that have the potential for connectivity to the Development.

The onshore infrastructure is not included in this example scoping report, which focusses on the offshore elements. However, onshore aspects would normally be included in the discussion of potential cumulative impacts and survey methods to establish the baseline situation considered.

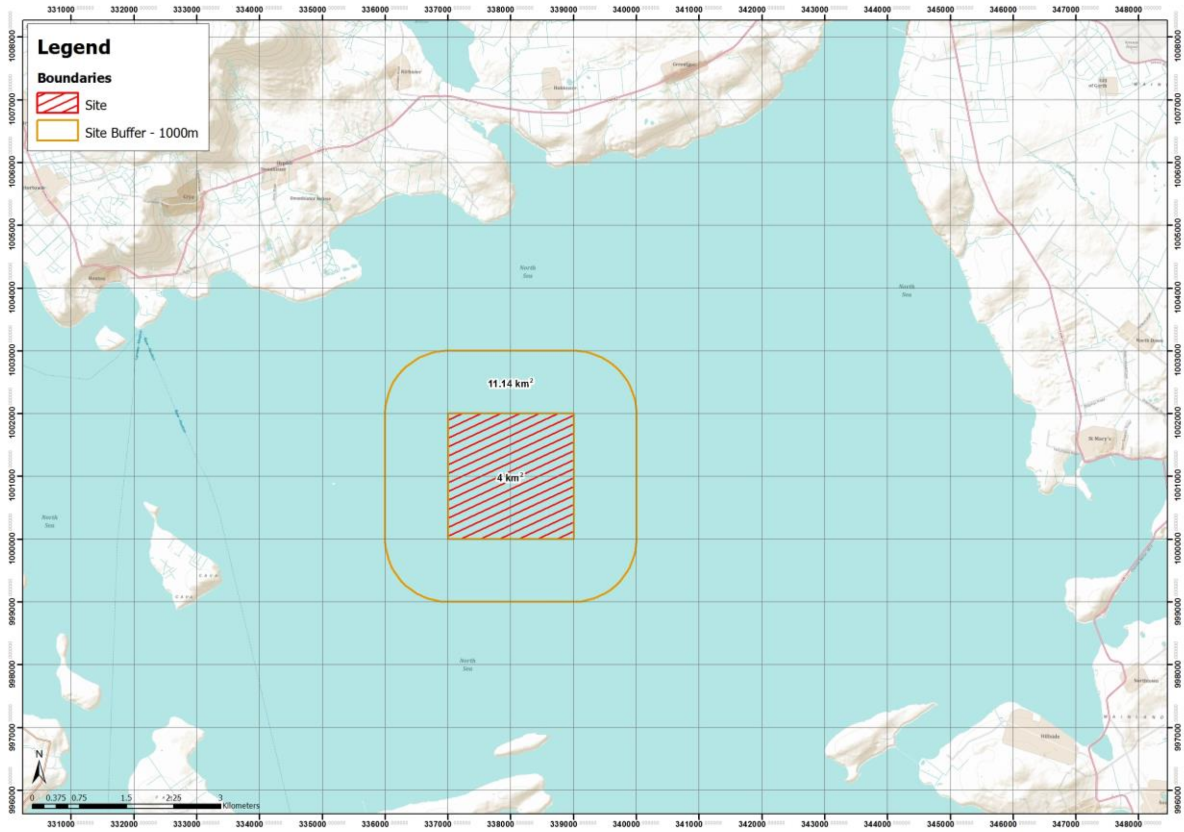


Figure A2.1. Location of proposed Scapa Flow Wave Farm (4 km^2 within hatched red area). The bird survey area includes a buffer of 1 km, and covers a total area of approximately 16 km^2 (buffer survey area limits are indicated with the brown line).

3. TARGET BIRD POPULATIONS & DESIGNATED SITES

The purpose of this section is to detail the Target Bird Populations that are likely to be present within or in the vicinity of the Site and any likely connectivity with designated sites (Framework Section 4.2.2).

Relevant Target Bird Populations can be defined by considering guidance in the Framework. No species in Scottish waters are considered to be Highly Vulnerable to impacts from wave energy developments (Furness et al. 2012). Only divers are considered to be Moderately Vulnerable to impacts of wave energy developments (see Table 6 in Framework), and so only these species (red-throated diver, black-throated diver and great northern diver) have been identified as Target Bird Populations at the Scoping stage. Consideration of existing survey data that include the site and surroundings suggest that no other seabird or sea duck species occur at especially high densities in the site plus buffer (APEM 2011, 2012, JNCC Seaduck Surveys: http://jncc.defra.gov.uk/page-4566). However, if any species categorised as Low Vulnerability or Very Low Vulnerability are found by ornithological surveys to be present in particularly high numbers and are likely to be from SPAs with connectivity to the Development, then SNH have advised that those populations should also be considered as Target Bird Populations (Framework Section 4.2.5). Therefore, the possibility that further species may need to be added to the list of Target Bird Populations once survey data become available needs to be borne in mind. Appendix 1 Section 3 of this report provides further consideration of Low and Very Low Vulnerability species which may be scoped into the assessment if recorded in particular high numbers within the Site. Appendix 1 (ibid) provides further details of potential connectivity of all relevant SPAs to the Site.

Table A2.1. Target Bird Populations of Conservation Importance (Data predominantly from SNH Sitelink http://gateway.snh.gov.uk/sitelink/, Forrester et al. 2007 (Birds of Scotland), and annual Orkney Bird Reports).

Species	Population / Designated Site
Red-throated diver	Caithness and Sutherland Peatlands SPA 89 pairs; Hoy SPA 58 pairs; Orkney Mainland Moors SPA 18 pairs; 110 pairs breed in Orkney & Caithness (9% of Scottish total); 220 individuals in Orkney & Caithness in winter (9% of Scottish total)
Black-throated diver	Caithness and Sutherland Peatlands SPA 26 pairs; 12 pairs breed in Orkney & Caithness (6% of Scottish total) but occur only on freshwater sites during breeding season; 70 individuals in Orkney & Caithness in winter (9% of Scottish total)
Great northern diver	600 individuals in Orkney & Caithness in winter (30% of Scottish winter total), but none breed in the region.

The Target Bird Populations determine the spatial scale of the Ornithological CIA. In practice, once surveys have been completed, the Target Bird Population list, relevant designated sites to be considered within the assessments, and spatial scale for each Target Bird Population can be finalised.

A list of designated sites with Target Bird populations showing likely connectivity to the Development is detailed in Table A2.2 below. These are illustrated in Figure 2 below.

Table A2.2 Designated sites with potential connectivity to the Development site.

Designated Site	Minimum distance to Site (km)	Qualifying Feature	Number in SPA citation	Connectivity (Mean maximum foraging range km)*
Orkney Mainland Moors SPA	4	Red-throated diver (breeding)	18 prs	9 km - YES
Hoy SPA	5	Red-throated diver (breeding)	58 prs (1994)	9 km - YES
Caithness and Sutherland Peatlands SPA	30	Red-throated diver (breeding)	89 prs (1993-94)	9 km - NO

*Mean maximum foraging range data taken from Thaxter et al. (2012) as recommended by SNH. Note however that other estimates have been published, such as in Langston (2010) which suggests that red-throated divers may range up to 50 km, although this estimate appears inconsistent with other literature and is not supported by cited data.

There is a possibility that further SPAs may be designated in the near future to protect wintering populations of divers, especially great northern divers, and these may include areas in Orkney. If such designations occur, there will be a need to consider wintering populations, as well as breeding populations. At present, the ornithological impact assessment (including the CIA) needs to consider breeding populations of red-throated divers on SPAs, and wintering populations of all three diver species at the wider countryside level. Breeding populations of black-throated divers on SPAs do not require assessment here since those birds only feed in freshwater habitat while breeding, whereas red-throated divers feed in the sea near to their freshwater nesting sites and carry marine fish back to their nesting site.

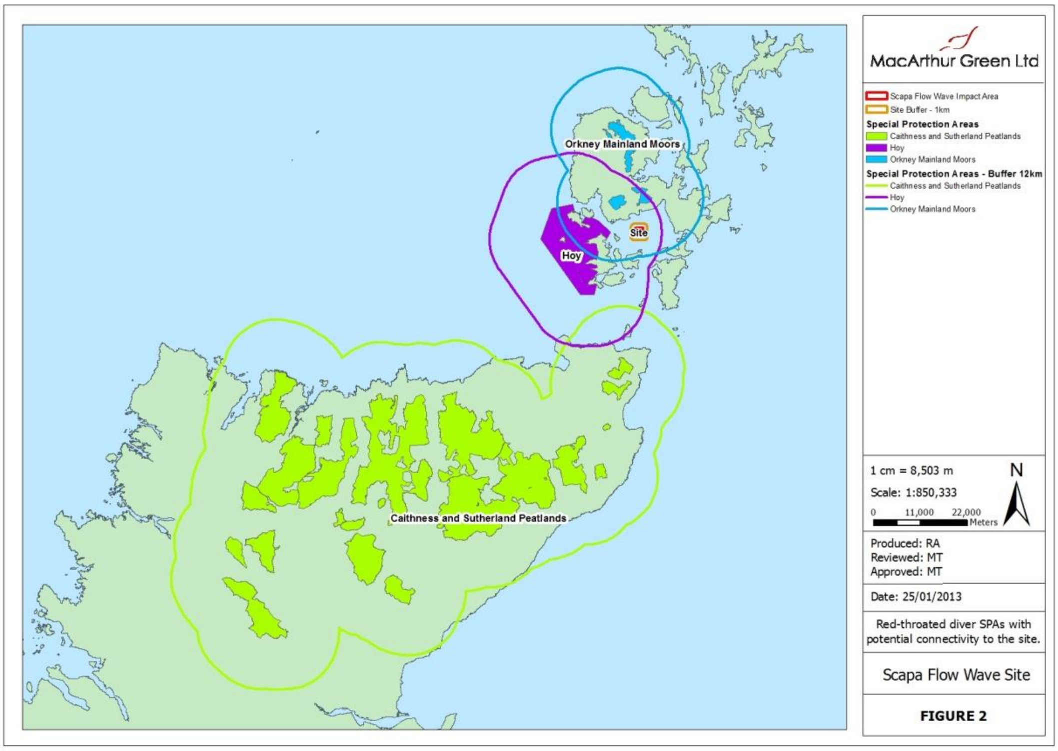


Figure A2.2. Diver SPAs with potential connectivity to the Scapa Flow Wave Site.

4. PROJECTS TO INCLUDE IN ORNITHOLOGICAL CIA

The purpose of this section is to define which projects may need to be included within the Ornithological aspects of the CIA. The type of projects to be considered and how to determine the relevant temporal and spatial scales are detailed within section 4.2.3 of the Framework.

Figure A2.2 details the relevant spatial scales for the Target Bird Populations identified (these are defined by the Target Bird Population's foraging range). The following projects have been identified within the relevant Target Bird Population's foraging ranges for initial consideration within the Ornithological CIA (Table A2.3). At this stage the list is preliminary, and will be refined (likely resulting in a reduction in projects) during the assessment period to reflect site specific ornithological features identified during the survey period (e.g. SPAs for any other sensitive seabird species identified during the surveys and species found in high numbers). In summary, currently there are: 9 projects at pre-scoping; 7 at scoping; 6 projects have submitted an ES into planning; and 9 are operational.

The distance from the development site over which projects should be considered for inclusion in CIA is determined by the foraging range of Target Bird Species. If red-throated divers were the only Target Bird Species then a 9 km range would be appropriate, but in case other seabirds with larger foraging ranges occur in high numbers at the development site so need to be scoped in, a longer range may be appropriate in the first instance. Foraging ranges of many seabirds may be up to 100 km, and a few (e.g. gannet, fulmar) can be considerably greater than that. In the first instance, all known projects that are listed in planning document web sites (e.g. Orkney Islands Council planning department web pages) for which ESs may exist and that are within 100 km of the Development are detailed in Table A2.3. It is worth pointing out that even with this very conservative range, the number of projects is not very large. Some of these sites may be too far from the Development to be considered further (but that will depend on the final list of Target Bird Populations and the connectivity of those particular populations). Some projects may also fall out for temporal considerations. The earliest time in the time window over which projects need to be included is determined by the date of baseline data which will be updated for the relevant Target Bird Populations in consultation with SNH and Marine Scotland using an agreed population projection (Framework Section 4.2.7; SNH & JNCC, 2012). Updating the baseline allows the 9 operational projects to be scoped out of the Ornithological CIA (since the impacts from those projects therefore forms part of the baseline figures used in the assessment). These scoped out projects are detailed in Annex 1 of this scoping report for completeness.

For this project, baseline data is available from around 1998-2002, when the last national seabird census 'Seabird 2000' was carried out (if a revised seabird census is conducted sufficiently soon then the results from this will be used instead). For red-throated divers some survey results are available for more recent years, and a skua survey was carried out in Orkney in 2010, but for common guillemots and most other seabirds there are few data for most colonies since Seabird 2000. For some, but not all, seabird species JNCC seabird monitoring data for Scotland might be used to project Seabird 2000 counts to a more recent year, but data are not available for all species and are not available specifically for Orkney and Caithness.

Based on this initial consideration, the maximum scope of the ornithological CIA in terms of the number of projects to include will be 18. At present, adopting MSLOT's approach of including scoped projects in the CIA where relevant, 14 of these would be subject to a qualitative assessment as they are at the pre-scoping/scoping stage and 4 would be subject to a quantitative assessment. Furthermore, based on the Target Bird Populations identified (red-throated divers) and their known foraging range (up to 9 km), only 4 projects appear likely to need inclusion in the ornithological CIA (Cava South salmon cage site, Cantick Head Tidal Energy Project, West Fara salmon cage site, and West Orkney South Wave Energy Project). As noted above, this list may change as new projects are proposed (and/or others are delayed/drop out) and if the spatial and temporal extent changes due to, for example, a change (identified during/following site characterisation surveys) in the final Target Bird Populations for inclusion in the CIA. Discussions with SNH and MS may also refine this list.

Table A2.3. Potential Projects to Include in identified Target Bird Populations Ornithological CIA.

Project title	Location	Project Status (Pre-scoping, Scoping, ES Submitted, Consented)	Distance from Scapa Flow Wave Farm (km)	Within Target Bird Population's Range and therefore likely inclusion in CIA
MeyGen Tidal Energy Project Phase 1, MeyGen Ltd	Sound of Stroma	ES Submitted	28	
MORL Offshore Wind Farm, Moray Offshore Renewables Ltd	Moray Firth	ES Submitted	64	
Beatrice Offshore Wind Farm, BOWL	Moray Firth	ES Submitted	61	
Stroupster Wind Farm, RWE npower renewables	Between John O'Groats and Wick, Caithness	ES Submitted	37	
Lashy Sound Demonstrator Project, Scotrenewables Tidal Power Ltd.	Between Eday and Sanday	Pre-Scoping	38.6	
Brough Ness Tidal Energy Project, Sea Generation (Brough Ness) Ltd	Brough Ness, south of South Ronaldsay, Orkney	Pre-Scoping	22.5	
Cantick Head Tidal Energy Project, Cantick Head Tidal Development Ltd	Cantick Head, SE corner of Hoy	Pre-Scoping	13.5	Hoy RTD
West Orkney Middle South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	West of Mainland, Orkney	Pre-Scoping	20	
West Fara salmon cage site, Northern Isles Salmon	East of Hoy in Scapa Flow, west of Fara Island	Pre-Scoping	10	Hoy RTD

Project title	Location	Project Status (Pre-scoping, Scoping, ES Submitted, Consented)	Distance from Scapa Flow Wave Farm (km)	Within Target Bird Population's Range and therefore likely inclusion in CIA
SHETL, HVDC cable (offshore Moray Firth)		Pre-Scoping		
SHETL, HVDC cable (onshore to substation near Keith, Moray)		Pre-Scoping		
Ness of Duncansby Tidal Energy Project, ScottishPower Renewables UK Ltd	Ness of Duncansby, by Duncansby Head, Caithness	Scoping	28	
Farr Point Wave Energy Project, Pelamis Wave Power	North Coast of Caithness	Scoping	62	
Brough Head Wave Energy Project, Brough Head Wave Farm Ltd	Brough Head, NW Mainland Orkney	Scoping	29	
West Orkney South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	West of Mainland, Orkney	Scoping	17	OMM RTD
Marwick Head Wave Energy Project, ScottishPower Renewables UK Ltd	NW Mainland Orkney	Scoping	26.5	
Westray South Tidal Energy Project, SSE Renewables Developments (UK) Ltd	South of Westray, Orkney	Scoping	37	
Costa Head Wave Energy Project, SSE Renewables Developments (UK) Ltd	Costa Head, N Mainland Orkney	Scoping	27	

5. ORNITHOLOGICAL IMPACTS

The purpose of this section is to detail and agree at an early stage the impacts that are likely to arise from the Development that will require assessment (Framework Section 4.2.4). Impacts may affect Target Bird Populations that form part of a designated (such as an SPA) as well as wider-countryside populations. Both of these are considered below.

Possible adverse impacts on Target Bird Populations by the Development are identified as collision mortality, disturbance, displacement from foraging habitat and cumulative impacts with other relevant project and activities, although the predicted magnitude of impacts from wave and tidal current devices are expected to be negligible in the context of other activities (Framework Section 6, Furness et al. 2012). Possible beneficial impacts include mitigation of climate change due to increasing levels of carbon dioxide, use of structures as resting perches by marine birds, and the possible functioning of devices as fish attracting devices (FADs) that may cause local enhancement of feeding opportunities for marine birds but the beneficial effects of each individual development are considered to be very slight at the population level (Furness et al. 2012). Each impact will be considered within the key phases of construction, operation and decommissioning.

As detailed within Table A2.2 above, the Site falls within the foraging range of breeding red-throated divers which form part of Orkney Mainland Moors SPA and Hoy SPA. The Site therefore has the potential for connectivity with these SPAs and the Development could be considered likely to have a significant effect on these SPAs should a connection be established. A HRA will therefore be required for these SPAs. For the purposes of HRA, effects on the integrity of an SPA with respect to its conservation objectives will be assessed. The conservation objectives for the seabird breeding SPAs in the PFOW region are numbered below for ease of future reference within the assessment:

1. 'To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

2. to ensure for the qualifying species that the following are maintained in the long term:
   a. Population of the species as a viable component of the site;
   b. Distribution of the species within site;
   c. Distribution and extent of habitats supporting the species;
   d. Structure, function and supporting processes of habitats supporting the species; and,
   e. No significant disturbance of the species.'

Because the Development is out-with the boundaries of these SPAs, the relevant conservation objectives to be considered within the HRA will be 1, 2a and 2e.

The various impacts and their relevance to HRA (and EIA for non-SPA target populations) are discussed in turn below.

Collision mortality

Albeit unlikely, collision mortality may have an adverse effect on the integrity of the SPAs through an impact on conservation objectives 1 and 2a.

Some seabirds may be at risk of injury or death from colliding with wave energy devices, either in flight or while swimming or diving. Risks of collision mortality will be similar during construction, operation and decommissioning. Risks will be higher for species with large body size, high travel speed, low manoeuvrability, a tendency to fly close to water level, or to dive in search of prey.

Disturbance and Displacement

Disturbance may have an adverse effect the integrity of the SPAs through an impact on conservation objectives 1, 2a and 2e.

Over the medium term, marine birds need to balance their daily energy budget, and disturbance can affect this by reducing time available for energy intake and by increasing energy expenditure to avoid causes of disturbance. Marine bird species differ in their tolerance of human activity and artificial structures, so disturbance impacts will differ among species. Vessel movements associated with the wave farm are likely to disturb marine birds more than the presence of the devices in the water. Risks of disturbance impacts arise at all stages of the project (construction, operation and decommissioning) but are higher during construction and decommissioning due to increased human activity levels during those stages. The most serious consequence of disturbance is displacement from an area.

Displacement may have an adverse effect the integrity of the SPAs through an impact on conservation objectives 1, 2a and 2e.

Wave energy devices and associated vessel traffic and human activity might prevent some seabirds from foraging in important habitat if they cause displacement resulting in birds having to move to other areas away from the Development. This may be because the birds are unable to land or take off readily where devices are present in the water, because other birds have been attracted into the area and affect their foraging, or because they need to spend time avoiding the devices rather than searching for food. Species that use a wide range of habitats or forage over large areas may not be constrained by reduced availability of a small area around a wave device. In contrast, seabirds that have highly specialized and restricted foraging habitat in small areas where wave devices may be deployed could be prevented from using key habitat for foraging. The impact may be trivial for seabirds which have long foraging ranges and a wide diversity of habitats in which they can feed but may be higher for seabirds that feed in a limited habitat in which wave arrays are to be placed. Some marine birds, such as divers, need open water for landing and taking off, and may be unable to land in areas where devices block a descent flight onto the water. Displacement has been identified as an impact of offshore wind farms, moving and parked shipping vessels, aquaculture cages and coastal developments.

Beneficial Impacts

One of the primary influences on Scottish seabird population trends is thought to be climate change. Warming seas have led to northward shifts of large copepods which are key to the functioning of the marine food chain. Some fish species have also shown northward shifts in distribution. Sandeels, a major prey for Scottish seabirds during the breeding season, produce fewer young in warmer years, and recent collapses of sandeel stocks in the North Sea have been attributed to climate change impacts as well as to high take by the industrial fishing fleet. Development of renewable energy mitigates climate change effects and so contributes to conservation of marine ecosystems, including seabirds.

Wave energy devices are occasionally used as resting platforms by some seabirds. The opportunity to come out of the water onto wave energy devices to dry plumage and to preen may allow birds to avoid risks of predation and disturbance that would be likely to arise onshore, and may allow birds to save energy and time by avoiding the need to travel to the shore. Such benefits seem particularly to apply to cormorants, given their wettable plumage so greater need to exit from the water at regular intervals. Being able to do so on wave energy devices may extend the potential range offshore that cormorants can forage.

Wave energy devices are likely to attract fish. Small fish tend to aggregate underneath floating objects. Fish-eating seabirds may benefit from the opportunity to forage on aggregations of small fish. Benthic-feeding seabirds may benefit from the opportunity to forage on grounds that are no longer subject to trawling; such areas may develop increased stocks of molluscs in particular.

Overall, however, these beneficial impacts are thought (like any negative impacts) likely to be small at individual wave energy sites in the context of seabird populations.

Cumulative Impacts

Although individual developments may have no more than minor impacts on marine bird populations that individually are of no concern at the population level, the sum of impacts of numerous developments (the cumulative impact) could in theory add up to a total that could be significant. Cumulative impacts of collision mortality, disturbance or displacement need to be considered for all wave energy developments and for other projects having similar effects on marine birds.

Finally, it is necessary to consider which of the above impacts should be considered with regard to other projects to be included within Ornithological CIA. Appendix 1, Section 7 provides further consideration of other relevant project related impacts.

6. VULNERABILITY OF TARGET BIRD POPULATIONS

The purpose of this section is to assess which marine bird species need to be considered as Target Species due to their species-specific vulnerability to impacts. Differences in the ecology of different seabird species affect how likely they are to be adversely affected by wave energy devices, while the demography of the species and the conservation importance and conservation status of populations influence their population-vulnerability (Framework Section 4.2.5).

Vulnerability of marine bird populations to impacts of wave energy devices has been assessed by Furness et al. (2012). These published assessments form the basis of selecting Target Species of marine birds in the context of the Development. Three species of marine bird have been identified as having populations with Moderate Vulnerability (Table A2.4). Species with low and very low vulnerability have been scoped out of consideration at this stage, although if survey data subsequently show that there are high numbers on Site of a species that is an SPA feature and which shows connectivity to the Development, then such species will (to accord with SNH's position) be added to the list of Target Bird Populations for assessment of cumulative impacts.

Table A2.4 Species vulnerability index for wave energy device impacts on seabirds (From Furness et al. 2012).

Species	Vulnerability score and classification
Red-throated diver	288 'moderate vulnerability'
Black-throated diver	288 'moderate vulnerability'
Great northern diver	270 'moderate vulnerability'
Razorbill	192 'low vulnerability'
Common scoter	180 'low vulnerability'
Common guillemot	176 'low vulnerability'
Black guillemot	169 'low vulnerability'
Slavonian grebe	169 'low vulnerability'
Shag	165 'low vulnerability'
Atlantic puffin	160 'low vulnerability'

Species	Vulnerability score and classification
Little tern	156 'low vulnerability'
Greater scaup	154 'low vulnerability'
Velvet scoter	154 'low vulnerability'
Arctic tern	153 'low vulnerability'
Common goldeneye	144 'low vulnerability'
Northern gannet	136 'low vulnerability'
Roseate tern	135 'low vulnerability'
Common eider	130 'low vulnerability'
Common tern	126 'low vulnerability'
Sandwich tern	125 'low vulnerability'
Great cormorant	110 'low vulnerability'
Manx shearwater	102 'low vulnerability'
Other species (black-legged kittiwake, long-tailed duck, great skua, great crested grebe, Arctic skua, little auk, northern fulmar, great black-backed gull, sooty shearwater, white-tailed eagle, European storm-petrel, common gull, lesser black-backed gull, Leach's storm-petrel, black-headed gull, herring gull)	Scores below 100 'very low vulnerability'

7. CONSERVATION STATUS OF TARGET BIRD POPULATIONS

The purpose of this section is to identify the conservation status of Target Bird Populations to be used in the impact assessment (including CIA; Framework Section 4.2.6).

The conservation status of the relevant Target Bird Populations to be used in the ornithological impact assessment and associated cumulative impact assessment CIA are defined in Table A2.5. These follow the conservation status values as detailed within Stage 6 (Framework Section 4.2.6) and additional SPA information.

Table A2.5 Species conservation status.

Species	Conservation Status
Red-throated diver	Connectivity with two SPA breeding populations: Orkney Mainland Moors SPA (SPA designation based on presence of **18 pairs**) site condition monitoring on 15/08/2003 classified this feature as 'favourable maintained' (SNH Sitelink). Hoy SPA (SPA designation based on presence of **58 pairs;** 62 in 2009 – Orkney Bird Report) site condition monitoring on 30/08/2007 classified this feature as 'favourable maintained' (SNH Sitelink). No SPAs exist at present for wintering populations. Wider countryside population is 1,200 breeding pairs in Scotland, 105 pairs in Orkney, 5 pairs in Caithness; 110 pairs in Orkney & Caithness represent 9.2% of Scottish breeding population. Numbers roughly stable over recent decades (Forrester et al. 2007). There are 2,500 in Scotland in winter, with 200 in Orkney and 20 in Caithness. The 220 birds wintering in Orkney & Caithness represent 8.8% of

Species	Conservation Status
	the Scottish wintering population. Numbers roughly stable over recent decades (Forrester et al. 2007). Dawson et al. (2009) reported a mean peak winter count of about 23 red-throated divers in Scapa Flow. Red-throated diver is Annex 1 Birds Directive, Schedule 1, and Amber-listed. Adults start to reoccupy nesting sites (small freshwater lochs near to foraging habitat in shallow marine areas) from March, and depart to marine coastal habitat after breeding from early August to late September. While breeding, adults commute between nest sites and adjacent marine feeding areas, within a foraging range of up to about 9 km. Spring migration peaks in April-May, and presumably includes birds heading towards Iceland, Greenland or Fennoscandia, as Scottish breeders tend to be on territory by then. Autumn migration peaks in September-October in Orkney (but in October-November further south in Scotland), and involves larger numbers of birds than seen in spring (Forrester et al. 2007). Presumably many of these autumn migrants are from Iceland, Greenland and Fennoscandia. Wintering birds are thought to be a mixture of local breeders and birds from more northerly areas (presumably Greenland, Iceland, Scandinavia, as well as Shetland). Relative numbers present in winter from different populations are unknown, but many PFOW breeding red-throated divers are thought to winter as far south as France as indicated by ring recoveries (Wernham et al. 2002).
Black-throated diver	No connectivity with SPA breeding populations as this species feeds on freshwater lochs during the breeding season. No SPAs exist at present for wintering populations. However, Dawson et al. (2009) reported a mean peak winter count of 57 black-throated divers in Scapa Flow, making this site exceed the Stage 1 threshold for designation. Wider countryside population is 750 birds in Scotland in winter, with 60 of these in Orkney and 10 in Caithness. The 70 birds wintering in Orkney & Caithness represent 9.3% of the Scottish wintering population. Numbers roughly stable over recent decades (Forrester et al. 2007). Black-throated diver is Annex 1 Birds Directive, Schedule 1, and Amber-listed. Black-throated divers breed on large freshwater lochs and while breeding they feed on freshwater fish. Adults increase in numbers at sea near to breeding areas in March-April, and after breeding disperse southwards in September-October. Numbers at sea in March-April and in September-October are roughly double the number wintering in Scotland, indicating a clear passage of birds in spring and autumn. These birds probably are mostly Scottish breeders and immatures, with few continental migrants apparently reaching PFOW and the majority of Fennoscandian breeders wintering in the Baltic, Black Sea and eastern Mediterranean (Forrester et al. 2007). Scapa Flow (Orkney) and Sinclair's Bay (Caithness) are important wintering areas, thought to be used mainly by local breeding birds.
Great northern diver	No connectivity with SPA breeding populations as this species does not normally breed in Scotland. No SPAs exist at present for wintering populations. However, Dawson et al. (2009) reported a mean peak count of 229 birds in Scapa Flow, making this

Species	Conservation Status
	site exceed the Stage 1 qualification threshold. Wider countryside population is 2,000 birds in Scotland in winter, with 500 of these in Orkney and 100 in Caithness. The 600 birds wintering in Orkney & Caithness represent 30% of the Scottish wintering population. Numbers roughly stable over recent decades (Forrester et al. 2007). Great northern diver is Annex 1 Birds Directive, Schedule 1, and Amber-listed. Some passage and staging in spring and autumn. Most arrivals in Scotland are in October and November, with spring departure in late April and early May. Birds arrive from various Arctic regions, predominantly in the Nearctic. Birds wintering in Scotland are thought to come mainly from Iceland, Greenland, and possibly Canada (where the breeding population is 250,000 to 500,000 individuals).

8. PROPOSED DATA COLLECTION AND ANALYSIS METHODS

The purpose of this section is to describe the proposed survey and analysis methods in order to demonstrate to the regulator and their advisors that standard methods will be employed. This will ensure the results generated are compatible with those reported for other developments. The methods will follow those described in the Framework Section 4.2.7. It is also worth noting that there may be useful sources of existing survey data (from e.g. APEM, JNCC), and these will be used wherever appropriate.

Bird distribution and abundance estimates will be obtained using standard boat based survey methods (Camphuysen et al. 2004). These will comprise monthly visits to the survey area for a minimum of one year, with experienced seabird surveyors (ESAS trained) collecting data using line transect methods. Data will be analysed using Distance methods to account for detection rates. These data will be used to estimate bird densities and seasonal patterns of site use. Additional bird behaviour observations will be made, to establish the activities of birds present on site (e.g. foraging, loafing, etc.). Since Scapa Flow is known for the presence of divers (Dawson et al. 2009) and these species can be susceptible to flushing at comparatively large distances, dedicated diver surveyors will be included within the team of surveyors. These diver surveyors will primarily scan ahead of the survey vessel, observing over a considerably greater distance than the 300m survey window used for the line transect in order to minimise the risk of under recording divers. Further development of the survey methods will be conducted in discussion with SNH and Marine Scotland prior to commencement.

9. DATA ACQUISITION FROM OTHER PROJECTS TO BE INCLUDED IN ORNITHOLOGICAL CIA

The purpose of this section is to indicate for each relevant project if data are/will be available for inclusion in the Ornithological CIA (Framework Section 4.2.8).

Operational projects have been scoped out of Ornithological CIA as they will form part of the baseline. Table A2.6 includes all projects within 100 km that could possibly need to be considered, although several of these could be scoped out if Target Bird Species do not include species with large foraging ranges.

Table A2.6. Data Availability.

Project title	Project Status (Pre-scoping, Scoping, ES Submitted, Consented, Operational)	Data Availability / Assessment type
MeyGen Tidal Energy Project Phase 1, MeyGen Ltd	ES Submitted	Yes - Quantitative
MORL Offshore Wind Farm, Moray Offshore Renewables Ltd	ES Submitted	Yes - Quantitative
Beatrice Offshore Wind Farm, BOWL	ES Submitted	Yes - Quantitative
Stroupster Wind Farm, RWE npower renewables	ES Submitted	Yes - Quantitative
Lashy Sound Demonstrator Project, Scotrenewables Tidal Power Ltd.	Pre-Scoping	No - Qualitative
Brough Ness Tidal Energy Project, Sea Generation (Brough Ness) Ltd	Pre-Scoping	No - Qualitative
Cantick Head Tidal Energy Project, Cantick Head Tidal Development Ltd	Pre-Scoping	No - Qualitative
West Orkney Middle South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	Pre-Scoping	No - Qualitative
West Fara salmon cage site, Northern Isles Salmon	Pre-Scoping	No - Qualitative
SHETL, HVDC cable (offshore Moray Firth)	Pre-Scoping	No - Qualitative
SHETL, HVDC cable (onshore to substation near Keith, Moray)	Pre-Scoping	No - Qualitative
Ness of Duncansby Tidal Energy Project, ScottishPower Renewables UK Ltd	Scoping	No - Qualitative
Farr Point Wave Energy Project, Pelamis Wave Power	Scoping	No - Qualitative
Brough Head Wave Energy Project, Brough Head Wave Farm Ltd	Scoping	No - Qualitative
West Orkney South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	Scoping	No - Qualitative
Marwick Head Wave Energy Project, ScottishPower Renewables UK Ltd	Scoping	No - Qualitative

Project title	Project Status (Pre-scoping, Scoping, ES Submitted, Consented, Operational)	Data Availability / Assessment type
Westray South Tidal Energy Project, SSE Renewables Developments (UK) Ltd	Scoping	No - Qualitative
Costa Head Wave Energy Project, SSE Renewables Developments (UK) Ltd	Scoping	No - Qualitative

10. DATA PRESENTATION

The purpose of this section is to describe the proposed data presentation methods in order to demonstrate to the regulator and their advisors that standard methods will be employed. This will ensure the results are presented in a manner which will make combination with other developments straightforward. The methods will follow those described in Framework Section 4.2.9.

Following collation of data from the other projects identified for inclusion within the Ornithological CIA, tables for each data type (e.g. peak breeding season abundance estimates) will be presented. This will permit straightforward assessment of the cumulative totals (e.g. in terms of numbers of individuals at risk of impact).

11. METHODS FOR DETERMING SIGNIFICANCE

The assessment will follow the methods detailed in The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (SI 2011/139) and The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (SI 2000/320). Guidance on the implementation of the Birds and Habitats Directive (SERAD, 2000) is considered for Natura sites.

The information provided by the assessment method will provide adequate information to allow the competent authority to undertake an Appropriate Assessment should this be required (in line with the Habitats Directive). This will involve establishing whether the Development (either alone or in combination with other plans or projects) is likely to have an adverse effect on the integrity of the relevant SPA(s). The SPAs likely to be relevant to the Development Orkney Mainland Moors SPA and Hoy SPA.

The method for assessing the significance of an effect on the integrity of an SPA is different from that employed for wider-countryside ornithological interests. The Habitats Directive is transposed into domestic legislation by The Habitats Regulations. Regulation 48 indicates a number of steps to be taken by the competent authority before granting planning permission (these are referred to here as a 'Habitats Regulation Appraisal'). In order of application, the first four are:

Step 1: Consider whether the proposal is directly connected to or necessary for the management of the site (Regulation 48 (1b)). If not,

Step 2: Consider whether the proposal, alone or in combination, is likely to have a significant effect ("LSE") on the site (Regulation 48 (1a)). If so,

Step 3: Make an Appropriate Assessment of the implications for the site in view of that site's conservation objectives (Regulation 48 (1)). It is possible for the risk of significant adverse effects on the integrity of the relevant SPAs to be excluded on the basis of objective information.

Step 4: Consider whether it can be ascertained that the proposal will not adversely affect the integrity of the site ("Integrity Test") having regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which they propose that the consent, permission or other authorization should be given (Regulation 48 (5 & 6). The information provided within this assessment will be sufficient to inform an Appropriate Assessment should this be required as part of the Habitat Regulations Appraisal.

Where an SPA population is below the levels for which it has been designated, there is further consideration to be made with regards how a development may affect the population's ability to recover to its size at designation. It will therefore have to be shown that 'the development as proposed will not be detrimental to the full recovery of the site' (SNH 2011). It is important to make it clear that only the potential effects of the proposed Development on a population's ability to recover *over and above* that which may be expected to occur in the absence of the Development which will be considered when making this assessment.

Finally, the EIA methodology for assessing wider-countryside effects detailed below will be employed as part of the HRA to aid in the appraisal process.

The evaluation of wider-countryside interests (interests unrelated to an SPA) involves the following process:

- Identification of the potential effects of the Development;
- Consideration of the likelihood of occurrence of potential effects where appropriate;
- Defining the Nature Conservation Importance of the bird populations present;
- Defining the Vulnerability of the bird populations present;
- Establishing the population's Conservation Status;
- Establishing the Magnitude of the Likely Effect (both spatial and temporal);
- Based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- Opportunities for enhancement are considered; and,
- Residual effects after mitigation, compensation or enhancement are considered

12. MITIGATION MEASURES

The purpose of this section is to describe any industry standard impact mitigation options which may be appropriate for any impacts identified. The options follow the guidelines provided in the Framework Guidance (Table 1).

At the scoping stage it is obviously neither feasible nor necessary to identify specific impacts which may be minimised through mitigation. However, given the expected presence of species sensitive to wave developments (divers) on the Site, measures to minimise impacts on their populations will be considered during discussions with the regulator and their advisors throughout the assessment phase.

Mitigation measures may include: the design of the Development, timing of construction works and timing of operational activities.

Annex 1 - Operational projects scoped out

Table A2.A1 Projects Excluded from Ornithological CIA.

Project title	Location	Project Status	Distance from Scapa Flow Wave Farm (km)	Within Target Bird Population's Range
Billia Croo, EMEC Wave Energy test site, Mainland Orkney	West of Mainland, Orkney	Operational	15	Hoy RTD, OMM RTD
Fall of Warness, Eday, EMEC Tidal Energy test site,	Eday, Orkney	Operational	37	
St Mary's Bay, Orkney, EMEC Preliminary test site for wave energy,	St Mary's – Burray, Scapa Flow	Operational	8.5	Hoy RTD
Head of Holland, Orkney, EMEC Preliminary test site for tidal energy,	Between Orkney Mainland near Kirkwall and Shapinsay	Operational	15	OMM RTD
Chalmers Hope salmon cage site, Northern Isles Salmon		Operational		
Pegal Bay salmon cage site, Northern Isles Salmon		Operational	6.9	
Lyrawa salmon cage site, Northern Isles Salmon	East of Hoy, in Scapa Flow, near mouth of Lyrawa Burn, Hoy	Operational	9	Hoy RTD
Toyness salmon cage site, Scottish Sea Farms		Operational	2.3	
Cava South salmon cage site , Northern Isles Salmon	East of Hoy, in Scapa Flow adjacent to Cava Island	Operational	7	Hoy RTD
Beatrice Offshore Wind Farm Demonstration Project, SSE and Talisman	Moray Firth	Operational	80	
Bring Head salmon cage site, Scottish Sea Farms	Bring Head, NW coast of Rousay, Orkney	Operational	30	

APPENDIX 3: ORNITHOLOGICAL CUMULATIVE IMPACT ASSESSMENT FRAMEWORK PENTLAND FIRTH AND ORKNEY WATERS WAVE & TIDAL PROJECTS – HYPOTHETICAL SCAPA FLOW WAVE SITE CIA - WORKED EXAMPLE

CONTENTS

LIST OF TABLES & FIGURES – APPENDIX 3

Figures

Tables

EXECUTIVE SUMMARY

In delivering the Ornithological CIA Framework, it became apparent from discussions with the attendees at the workshop and members of the Project Steering Group (PSG) that it would be beneficial to demonstrate application of the Ornithological CIA Framework by producing a Worked Example of an Ornithological CIA. Therefore, MacArthur Green was commissioned by The Crown Estate to produce a Worked Example of the Ornithological aspects of a Cumulative Impact Assessment (CIA) for a hypothetical wave energy site in the Pentland Firth and Orkney Waters (PFOW) area. This ornithological CIA follows the recommendations within Sections 4.2.2 to 4.2.10 of the Ornithological CIA Framework and therefore provides an example of the form and content of the ornithological aspects of a CIA. While this hypothetical ornithological CIA is obviously focussed on bird aspects, there is a need to include more general contextual information, hence this CIA is longer than would usually be required in practice to detail the ornithological features and potential impacts.

It is anticipated that utilising the Ornithological CIA Framework and Worked Example will aid PFOW developers in ensuring they provide sufficient, proportionate and consistent Ornithological CIA information in their consent applications. This will ultimately help regulators and their advisors in the decision making process and therefore progress timely consenting decisions.

The hypothetical 'Scapa Flow Wave Farm' development has been chosen for this Worked Example as it is very unlikely that a wave site will ever be developed here for obvious reasons. Therefore any confusion with current or future wave and tidal sites in the same area is not likely to occur.

This report forms part of a suite of 4 reports:

1. Ornithological CIA Framework for the PFOW (the first section of this report);
2. Ornithological CIA Framework – Supporting Information (Appendix 1);
3. Worked Example Ornithological Scoping Report (Appendix 2); and
4. **Worked Example Ornithological CIA of Scapa Flow Wave Project (Appendix 3).**

This hypothetical example has been developed through detailed consultation with the Project Steering Group and wider consultation with the PFOW developers. The PSG comprised representatives from The Crown Estate, from the regulators and their advisors (Marine Scotland Science, Marine Scotland Licencing, Scottish Natural Heritage and Joint Nature Conservation Committee) and the renewables industry (Niras Consulting – as adviser to The Crown Estate for this project), ScottishPower Renewables, Aquamarine Power, SSE Renewables. MacArthur Green and The Crown Estate wish to thank the PSG and the various attendees of the workshop who have contributed valuable input to the development of the project.

1. INTRODUCTION

The hypothetical 'Scapa Flow Wave Farm' development (hereafter referred to as 'the Development') was chosen for this Worked Example as it is very unlikely that a wave site will ever be developed here for obvious reasons. Therefore any confusion with current or future wave sites in the same area is not likely to occur.

This Ornithological Cumulative Impact Assessment (CIA) follows the recommendations within the Ornithological Cumulative Impact Assessment Framework. This report therefore provides an example of the form and content that an Ornithological CIA should take.

This hypothetical Ornithological CIA contains the following sections:

Section 2: Site and Project Description
Section 3: Survey results for the hypothetical Scapa Flow Site
Section 4: Ornithological Impact Assessment Method
Section 5: Summary results of Ornithological Impact Assessment Method
Section 6: Cumulative Impact Assessment (following stages 2 to 10 of the Framework)

2. SITE AND PROJECT DESCRIPTION

The proposed Development Site covers a 4 km^2 area and is located ca. 1.5 km south of mainland Orkney within Scapa Flow (Figure A3.1).

The Development comprises a total of 15 floating wave energy devices (with a total power generating capacity of 10 MW), with a submarine cable connecting the wave energy devices to a grid connection onshore at mainland Orkney immediately north-west of the Site.

For bird surveys, a survey area of 4 km^2 plus a buffer of 1 km extending beyond the survey area, will be used for site characterisation. The total survey area is thus around 16 km^2 (Figure A3.1).

The Development is located 5.1 km south of Orkney Mainland Moors SPA (red-throated diver is the qualifying feature relevant to the Development) and 5.7 km east of Hoy SPA (red-throated diver and various sea bird species). There are numerous other SPAs with bird populations that have the potential for connectivity to the Development.

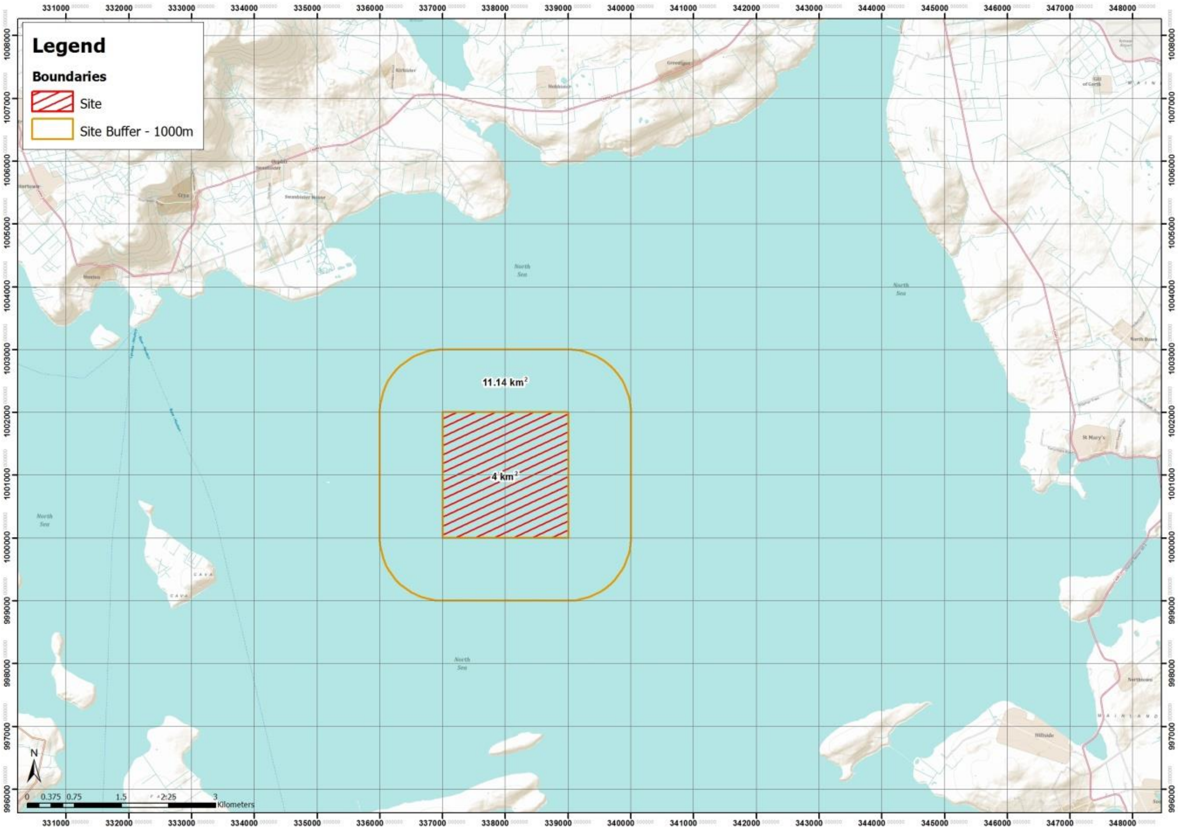


Figure A3.1. Location of the Development (4 km^2 within hatched red area). The bird survey area includes a buffer of 1 km, and covers a total area of slightly under 16 km^2 (buffer survey area limits are indicated with the brown line).

3. SURVEY RESULTS FOR SCAPA FLOW WAVE SITE

At Scoping (Appendix 2) the Target Bird Populations were identified as red-throated diver (breeding and non-breeding), black-throated diver (non-breeding), and great northern diver (non-breeding). However, during the site specific bird surveys a high density of great skuas and common guillemots were also found. SNH advised that these represented potentially significant proportions of the local SPA populations of these species (Table A3.1). Therefore, in-line with SNH advice, these two species were added to the Target Bird Population list for ornithological impact assessment (including CIA). Therefore, information on population status and foraging ranges from SPAs for these species becomes relevant (Table A3.1).

Table A3.1. Bird Survey Results for Scapa Flow Wave Site & Target Bird Populations.

Species	Target Bird Population (season)	On site peak abundance (this is the maximum number estimated to be present on the Development site on the basis of survey data)
Red-throated diver	Breeding season (foraging range 12 km): Orkney Mainland Moors SPA (4 km from the Development) 18 pairs. Hoy SPA (5 km from the Development) 58 pairs at designation, 62 pairs in 2009 (Williams 2010). Orkney & Caithness 110 pairs. UK 1,143-1,255 breeding pairs. JNCC survey in summer 2005 found 106 in the sea around Hoy and Scapa Flow.	6
Red-throated diver	Non-breeding season: Orkney & Caithness 220 birds. Winter peak count of 82 in Scapa Flow (Williams 2001, 2007) but only maximum of 56 in 2006-07 (Dawson et al. 2009).	8
Black-throated diver	Non-breeding season: Orkney & Caithness 70 birds.	1
Great northern diver	Non-breeding season: Orkney & Caithness 600 birds.	10
Great skua	Breeding season (foraging range 42 km): Hoy SPA (5 km) 1,900 pairs. Orkney & Caithness 2,214 pairs.	5
Common guillemot	Breeding season (foraging range 60 km): Hoy SPA (5 km) 13,400 birds. Copinsay SPA (20 km) 29,450 birds. Rousay SPA (24 km) 10,600 birds. N Caithness Cliffs SPA (26 km) 38,300 birds. Calf of Eday SPA (40 km) 12,645 birds. Marwick Head SPA (40 km) 37,700 birds. West Westray SPA (45 km) 42,150 birds. E Caithness Cliffs SPA (55 km) 106,700 birds.	60

4. ORNITHOLOGICAL IMPACT ASSESSMENT METHOD

The method for undertaking the ornithological impact assessment would normally be detailed at the beginning of the Environmental Statement (ES) chapter. However, an example assessment methodology for wider-countryside interests and Special Protection Area (SPA) qualifying species is provided here as this is also relevant to the Ornithological CIA.

The assessment will follow the methods detailed in The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (SI 2011/139) and The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 (SI 2000/320). Guidance on the implementation of the Birds and Habitats Directive (SERAD, 2000) is considered for Natura sites.

The information provided by the assessment method will provide adequate information to allow the competent authority to undertake an Appropriate Assessment should this be required (under the Habitats Directive). This will involve establishing whether the Development (either alone or in combination with other plans or projects) is likely to have an adverse effect on the integrity of the relevant SPA(s).

The SPAs relevant to the Development are dependent on the Target Bird Populations; for red-throated diver these are Orkney Mainland Moors SPA and Hoy SPA, for guillemot they are Calf of Eday SPA, Copinsay SPA, East Caithness Cliffs SPA, Hoy SPA, Marwick Head SPA, North Caithness Cliffs SPA, Rousay SPA and West Westray SPA and for great skua Hoy SPA.

The method for assessing the significance of an effect on the integrity of an SPA is different from that employed for wider-countryside ornithological interests. The Habitats Directive is transposed into domestic legislation by The Habitats Regulations. Regulation 48 indicates a number of steps to be taken by the competent authority before granting planning permission (these are referred to here as a 'Habitats Regulation Appraisal'). In order of application, the first four are:

Step 1: Consider whether the proposal is directly connected to or necessary for the management of the site (Regulation 48 (1b)). If not,

Step 2: Consider whether the proposal, alone or in combination, is likely to have a significant effect ("LSE") on the site with regards its Conservation Objectives (Regulation 48 (1a)). If so,

Step 3: Consider whether it can be ascertained that the proposal will not adversely affect the integrity of the site ("Integrity Test") having regard to the manner in which it is proposed to be carried out or to any conditions or restrictions subject to which they propose that the consent, permission or other authorization should be given (Regulation 48 (5 & 6). The information provided within this assessment will be sufficient to inform an Appropriate Assessment should this be required as part of the Habitat Regulations Appraisal.

Where an SPA population is below the levels for which it has been designated, there is further consideration to be made with regards how a development may affect the population's ability to recover to its size at designation. It will therefore have to be shown that the Development as proposed will not be detrimental to the full recovery of the site (note however that this is a consideration of the potential effects of the Development over and above any other factors affecting the population's ability to recover).

Finally, the EIA methodology for assessing wider-countryside effects detailed below will be employed as part of the HRA to aid in the appraisal process.

The evaluation of wider-countryside interests (interests unrelated to an SPA) involves the following process:

- Identification of the potential effects of the Development;
- Consideration of the likelihood of occurrence of potential effects where appropriate;
- Defining the Nature Conservation Importance of the bird populations present;
- Defining the Vulnerability of the bird populations present;
- Establishing the population's Conservation Status;
- Establishing the Magnitude of the Likely Effect (both spatial and temporal);
- Based on the above information, a judgement is made as to whether or not the identified effect is significant with respect to the EIA Regulations;
- If a potential effect is determined to be significant, measures to mitigate or compensate the effect are suggested where required;
- Opportunities for enhancement are considered; and,
- Residual effects after mitigation, compensation or enhancement are considered

For clarity, the following sections further define the methods used to evaluate Conservation Status, Magnitude of Likely Effects and Nature Conservation Importance as used for the CIA (and EIA).

4.1 Method Used to Evaluate Conservation Status of Bird Populations

As defined by SNH, the Conservation Status of a species is, '*the sum of the influences acting on it which may affect its long-term distribution and abundance, within the geographical area of interest (which for the purposes of the Birds Directive is the EU)*' (SNH, 2006).

Conservation Status is considered favourable under the following circumstances (SNH, 2006, Para.15):

- '*Population dynamics indicate that the species is maintaining itself on a long term basis as a viable component of its habitats; and*
- *The natural range of the species is not being reduced, nor is likely to be reduced for the foreseeable future; and*
- *There is (and probably will continue to be) a sufficiently large habitat to maintain its population on a long term basis*'.

SNH states that, '*An impact should be judged as of concern where it would adversely affect the favourable conservation status of a species, or stop a recovering species from reaching favourable conservation status, at international or national level or regionally*' (SNH, 2010, Para. 17).

For breeding seabirds the populations of each species considered to be at potential risk of impact were defined on the basis of estimates of foraging range (Thaxter et al. 2012). For wintering or migratory species the national population is often considered to be the relevant scale for determining effects on the conservation status (SNH, 2010, Para. 20 & 21) and this approach is used here.

4.2 Method Used to Evaluate the Magnitude of Likely Effects

An effect is defined as a change to the abundance and distribution of a population as a result of the Development. Effects can be adverse, neutral or favourable.

There can often be varying degrees of uncertainty over effects as a result of limited information. A precautionary approach is adopted where the response of a population to an effect is uncertain.

In determining the magnitude of effects, the resilience of a population to recover from temporary adverse conditions is considered in respect of each potentially affected population.

The vulnerability of individual species to disturbance during relevant behaviours is considered when determining spatial and temporal magnitude of effect and will be assessed using guidance described for birds in general by Bright et al. (2006), Hill et al. (1997) and Ruddock and Whitfield (2007), and specifically for marine birds by Garthe and Hüppop (2004), Schwemmer et al. (2011) and Furness et al. (2012, 2013).

In the case of non-designated sites, magnitude is assessed in respect of an appropriate ecological unit. Routinely, the appropriate unit for breeding species is taken to be the Natural Heritage Zone (in this case NHZ 2 Pentland and Orkney) as defined by SNH (2006). In the case of seabirds however, foraging ranges may for many species exceed the spatial scale of NHZs and so it may be appropriate to consider wider countryside populations in a larger area than the local NHZ. In this case we consider the local countryside population of Orkney and Caithness as a more appropriate countryside population than that in NHZ2 alone. For some populations insufficient information on the NHZ population may exist. In these circumstances the national population estimate is used.

For the current assessment, effects have been judged in terms of magnitude in space and time (note that this approach is intended as guidance only and that alternative approaches may be more suitable for other developments). There are five levels of spatial effects and four levels of temporal effects as detailed in Tables A3.2 and A3.3 below respectively. The definitions in Tables A3.2 and A3.3 are presented and used here to help categorise the magnitude of an impact, however assessments of significance are also based on other aspects including Nature Conservation Interest, Conservation status, vulnerability and likelihood of an effect.

Table A3.2. Spatial Effect Magnitude.

Spatial Magnitude	Definition
Very high	Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of productivity in a bird population due to disturbance. Guide: >80% of population lost through additive mortality.
High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 21-80% of population lost through additive mortality.
Moderate	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 6-20% of population lost through additive mortality.
Low	Small but discernible reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 1-5% of population lost through additive mortality.
Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the “no change” situation. Guide: < 1% population lost through additive mortality.

Table A3.3. Temporal Effect Magnitude.

Temporal Magnitude	Definition
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25 years), except where there is likely to be substantial improvement after this period. Where this is the case, Long Term may be more appropriate.
Long term	Approximately 15 - 25 years or longer (see above).
Medium term	Approximately 5 – 15 years.
Short term	Up to approximately 5 years.
Negligible	Very minor (<6 months) or no temporal effect.

4.3 Method Used to Evaluate the Nature Conservation Importance of Bird Populations

There are three levels of Nature Conservation Importance as detailed below in Table A3.4.

Table A3.4. Nature Conservation Importance.

Importance	Definition
High	Populations receiving protection by a SPA, proposed SPA, Ramsar Site, SSSI, MPA or which would otherwise qualify under selection guidelines.
Moderate	The presence of species listed in Annex 1 of the Birds Directive (but population does not meet the designation criteria under selection guidelines). The presence of breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The presence of species noted on the latest Birds of Conservation Concern (BoCC) 'Red' list (Eaton et al. 2009). Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the Development. Species present in regionally important numbers (>1% regional breeding population) at some particular season of the year (breeding, migration, or winter).
Low	All other species' populations not covered by the above categories.

'Target species' were taken to be those species of High and Moderate NCI (Table A3.4)

4.4 Significance of Effect

The predicted significance of the effect has been determined through a standard method of assessment based on professional judgement, considering both vulnerability and magnitude of change. The significance criteria used in this assessment are listed below in Table A3.5.

Table A3.5. Effect Significance.

Significance of Effect	Description
Major	The effect is likely to result in a long-term significant adverse effect on the integrity of a receptor.
Moderate	The effect is likely to result in a medium-term or partially significant adverse effect on the integrity of a receptor.
Minor	The effect is likely to adversely affect a receptor at an insignificant level by virtue of its limitations in terms of duration or extent, but there will probably be no effect on its integrity.
Negligible	No effect.

'Major' and 'Moderate' effects are considered to be **Significant** in accordance with the EIA Regulations.

'Minor' and 'Negligible' effects are considered to be **Not Significant** in accordance with the EIA Regulations.

Effects on the integrity of an SPA are considered as either significant or not significant.

5. SUMMARY RESULTS OF ORNITHOLOGICAL IMPACT ASSESSMENT

Results of the Ornithological Impact Assessment (Table A3.6) and Habitats Regulations Appraisal (for the Development on its own) are provided here for reference so that they can be used in the Ornithological CIA.

Table A3.6. Results of the Ornithological Impact Assessment.

Predicted Effects	Receptor	Significance	Proposed Mitigation	Residual Effects
Construction – Displacement	Red-throated diver (SPA populations)	Not Significant	NA	Not Significant
	Red-throated diver (non-breeding)	Negligible	NA	Negligible
	Black-throated diver (non-breeding)	Negligible	NA	Negligible
	Great northern diver (non-breeding)	Negligible	NA	Negligible
	Guillemot (SPA populations)	Not Significant	NA	Not Significant
	Great skua (SPA population)	Not Significant	NA	Not Significant
Operation – Displacement & collision risk	Red-throated diver (SPA populations)	Not Significant	NA	Not Significant
	Black-throated diver (non-breeding)	Negligible	NA	Negligible
	Great northern diver (non-breeding)	Negligible	NA	Negligible

Predicted Effects	Receptor	Significance	Proposed Mitigation	Residual Effects
	Guillemot (SPA populations)	Not Significant	NA	Not Significant
	Great skua (SPA population	Not Significant	NA	Not Significant
Decommissioning – Displacement (same as construction)				

Onshore surveys conducted for the cable land fall and onshore infrastructure found no sensitive ornithological receptors. Therefore no cumulative assessment or HRA was required for these aspects.

6. CUMULATIVE IMPACT ASSESSMENT

6.1 Target Bird Populations

The Target Bird Populations for Ornithological CIA were those identified as at risk of impacts during the EIA (Table A3.6). These populations are assessed for cumulative impacts due either to their comparatively high population abundances on the Site (the relevant SPA populations of guillemot and great skua) or their relatively high predicted vulnerability to wave farm developments combined with the presence of breeding individuals (the relevant SPA populations of red-throated diver). Although JNCC reported relatively high numbers of great northern divers present in March 1999 (Dawson et al. 2008), very few were seen during surveys conducted for the current development, a conclusion supported by the recently collected APEM data on seabird distributions in the area (APEM 2011, 2012). Black-throated divers were also only observed occasionally and in very low numbers during site specific surveys. Therefore both these species are scoped out of the Ornithological CIA as the Development is considered to have a negligible impact on them due to only low numbers observed using the Site.

6.2 Projects to Include in Ornithological CIA

<u>Spatial Extent</u>

The identified Target Bird Population's foraging range defines the specific spatial extent of the CIA for that population. These are detailed in Figures A3.2, A3.3 and A3.4 below.

<u>Temporal Extent</u>

The baseline for the Ornithological CIA is defined as the most recent robust population census for each Target Bird Population. For red-throated diver a census was conducted in 2009 (Orkney Bird Report Committee 2010), for great skua a census was conducted in 2010 (Meek et al. 2011) while for common guillemot this was conducted in 2000 (Mitchell et al. 2004). For the first two the census dates are considered to be sufficiently recent and we are not aware of any significant known/expected population changes since then to indicate that these figures cannot provide a reasonable baseline for the assessment. For guillemot, the current population was estimated through projection of the 2000 census to 2010 to be consistent with data for red-throated diver and great skua, and because the population trend monitored by JNCC is only known up to a year or two before present (2010 being most recent data published online). This was derived using the upper and lower trend estimates for this population (for such assessments the trend will need to be agreed with the regulator and their advisors). [Note: there are *no* recent count data for guillemot in the Orkney region on which to base these trend estimates, therefore a hypothetical range of +/-10% was adopted for the purpose of this example. This should not be treated as a guide to how the actual populations may have actually changed]. Projects constructed prior to these dates are considered to form part of the baseline conditions and any influences they exert are therefore incorporated into the results of the site surveys and population figures [note that in practice reference populations should be agreed with the regulator and statutory advisor]. Examples of projects which are not included in this Ornithological CIA due to construction prior to the population baseline were those fish farms in Scapa Flow installed prior to 1999. The only fish farm in this region constructed after this time (the Cava South Salmon Cage Site; initial ES submitted June 2010, planning application approved August 2011, constructed 2012/13) is included in the assessment. All projects constructed after these dates are included in the Ornithological CIA for each Target Bird Population.

Projects for which an ES has been submitted or for which consent has been granted but the project is not yet under construction, are considered. In total, there are 3 of these projects (Table A3.7).

Projects which are at the pre-scoping and scoping stages (reasonably foreseeable projects) have also been included in the assessment as required by Marine Scotland. However, as there are no specific quantitative data available for these projects, assessment can only be conducted in a qualitative manner. In total, there are 9 of these projects (Table A3.7).

On the basis of the Target Bird Populations identified during surveys of the Site (Table A3.1), the following projects (Table A3.7) have been identified for inclusion in the assessment of cumulative impacts. The list includes all those projects which have the potential to generate cumulative impacts for any of the Target Bird Populations, and those projects relevant to each Target Bird Population are indicated. Project inclusion was determined using species specific foraging ranges (Thaxter et al. 2012); projects located within the range of Target Bird Population breeding sites are included. Some projects originally listed at Scoping are now dropped from further consideration. These include Farr Point, Stroupster Wind Farm, Lashy Sound, and the SHETL cable projects which have no overlap in Target Bird Species with the Scapa Flow Wave Farm development.

Table A3.7. Projects to Include in Ornithological CIA.

Project title	Location	Distance from Scapa Flow Wave Farm (km)	Included in species assessment	Project status and data availability
MORL Offshore Wind Farm, Moray Offshore Renewables Ltd	Moray Firth	64	Common guillemot	ES submitted - quantitative data available
Beatrice Offshore Wind Farm, BOWL	Moray Firth	61	Common guillemot	ES submitted - quantitative data available
MeyGen Tidal Energy Project Phase 1, MeyGen Ltd	Sound of Stroma	28	Red-throated diver, Great skua, Common guillemot	ES Submitted – quantitative data available

Project title	Location	Distance from Scapa Flow Wave Farm (km)	Included in species assessment	Project status and data availability
Cantick Head Tidal Energy Project, Cantick Head Tidal Development Ltd	Cantick Head, SE corner of Hoy	13.5	Red-throated diver, Great skua, Common guillemot	Pre-scoping – no data
West Orkney Middle South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	West of Mainland, Orkney	20	Red-throated diver, Great skua, Common guillemot	Pre-scoping – no data
Ness of Duncansby Tidal Energy Project, ScottishPower Renewables UK Ltd	Ness of Duncansby, by Duncansby Head, Caithness	28	Great skua, Common guillemot	Scoping – no data available
Brough Ness Tidal Energy Project, Sea Generation (Brough Ness) Ltd	Brough Ness, south of South Ronaldsay, Orkney	22.5	Great skua, Common guillemot	Scoping – no data available
Brough Head Wave Energy Project, Brough Head Wave Farm Ltd	Brough Head, NW Mainland Orkney	29	Red-throated diver, Great skua, Common guillemot	Scoping – no data available
Costa Head Wave Energy Project, SSE Renewables Developments (UK) Ltd	Costa Head, N Mainland Orkney	27	Red-throated diver, Great skua, Common guillemot	Scoping – no data available

Project title	Location	Distance from Scapa Flow Wave Farm (km)	Included in species assessment	Project status and data availability
West Orkney South Wave Energy Project, EON Climate & Renewables UK Developments Ltd	West of Mainland, Orkney	17	Red-throated diver, Great skua, Common guillemot	Scoping – no data available
Marwick Head Wave Energy Project, ScottishPower Renewables UK Ltd	NW Mainland Orkney	26.5	Red-throated diver, Great skua, Common guillemot	Scoping – no data available
Westray South Tidal Energy Project, SSE Renewables Developments (UK) Ltd	South of Westray, Orkney	37	Great skua, Common guillemot	Scoping – no data available

6.3 Relevant Ornithological Impacts

Table A3.8 identifies the combinations of impacts and development stages for which cumulative assessment for each Target Bird Population will be presented. Collision risks are considered to only be of relevance during operation. The presence of the devices in isolation is not considered likely to cause disturbance or displacement impacts for either guillemot or great skua (Furness et al. 2012). This conclusion was based on the fact that great skuas show little or no disturbance reaction to the presence of human activity at sea (Garthe and Hüppop 2004), while common guillemots show moderate avoidance but only at relatively close range (Carney and Sydeman 1999; Thayer et al. 1999; Garthe and Hüppop 2004; Rojek et al. 2007; Ronconi and Clair 2002; Bellefleur et al. 2009), hence operational impacts were confined to red-throated diver. While the above was derived on the basis of guillemots response to boats, not wave devices, the proposed technology for deployment at this site is considered to represent, at most, a similar level of disturbance potential.

Table A3.8. Cumulative Impacts assessed for each Target Bird Population.

Development Stage	Disturbance	Displacement	Collision
Construction	Red-throated diver, Great skua, Common guillemot	Red-throated diver, Common guillemot	-
Operation	Red-throated diver	Red-throated diver	Red-throated diver
Decommissioning	Red-throated diver, Great skua, Common guillemot	Red-throated diver, Common guillemot	-

Collision mortality

Some seabirds may be at risk of injury or death from colliding with wave energy devices, either in flight or while swimming or diving. Risks will be higher for species with large body size, high travel speed, low manoeuvrability, a tendency to fly close to water level, or to dive in search of prey.

Disturbance

Over the medium term, marine birds need to balance their daily energy budget, and disturbance can affect this by reducing time available for energy intake and by increasing energy expenditure to avoid causes of disturbance. Marine bird species differ in their tolerance of human activity and artificial structures, so disturbance impacts will differ among species. Vessel movements associated with the wave farm are likely to disturb marine birds more than the presence of the devices in the water. Risks of disturbance impacts arise at all stages of the project (construction, operation and decommissioning) but are higher during construction and decommissioning due to increased human activity levels during those stages.

Displacement

Wave energy devices and associated vessel traffic and human activity might prevent some seabirds from foraging in important habitat if they cause displacement resulting in birds having to move to other areas away from the Development. This may be because the birds are unable to land or take off readily where devices are present in the water, because other birds have been attracted into the area and affect their foraging, or because they need to spend time avoiding the devices rather than searching for food. Species that use a wide range of habitats or forage over large areas may not be constrained by reduced availability of a small area around a wave device. In contrast, seabirds that have highly specialized and restricted foraging habitat in small areas where wave devices may be deployed could be prevented from using key habitat for foraging. The impact may be trivial for seabirds which have long foraging ranges and a wide diversity of habitats in which they can feed but may be higher for seabirds that feed in a limited habitat in which wave arrays are to be placed. Some marine birds, such as divers, need open water for landing and taking off, and may be unable to land in areas where devices block a descent flight onto the water. Displacement has been identified as an impact of offshore wind farms, moving and parked shipping vessels, aquaculture cages and coastal developments.

6.4 Target Bird Population Vulnerability & Nature Conservation Importance

The Vulnerability and Nature Conservation Importance of each Target Bird Population to wave device impacts are provided in Table A3.9.

Table A3.9. Target Bird Population vulnerability scores for wave energy device impacts on seabirds (From Furness et al. 2012), and Nature Conservation Importance (High where an SPA population shows connectivity to the site, Moderate for Annex 1/Schedule 1/Red listed species with no SPA connectivity, Low for other populations).

Species	Vulnerability score and classification	Nature Conservation Importance
Red-throated diver	288 ‘moderate vulnerability’	High
Common guillemot	176 ‘low vulnerability’	High
Great skua	96 ‘very low vulnerability’	High

6.5 Conservation Status of Target Bird Populations

Table A3.10. Conservation Status of Target Bird Population.

Species	Conservation Status
Red-throated diver	Connectivity with two SPA breeding populations: Orkney Mainland Moors SPA (SPA designation based on presence of 18 pairs) site condition monitoring on 15/08/2003 classified this feature as 'favourable maintained' (SNH Sitelink). Hoy SPA (SPA designation based on presence of 58 pairs; 62 in 2009 – Orkney Bird Report) site condition monitoring on 30/08/2007 classified this feature as 'favourable maintained' (SNH Sitelink). No SPAs exist at present for wintering populations. Wider-countryside population is 1,200 breeding pairs in Scotland, 105 pairs in Orkney, 5 pairs in Caithness; 110 pairs in Orkney & Caithness represent 9.2% of Scottish breeding population. Numbers roughly stable over recent decades (Forrester et al. 2007). There are 2,500 in Scotland in winter, with 200 in Orkney and 20 in Caithness. The 220 birds wintering in Orkney & Caithness represent 8.8% of the Scottish wintering population. Numbers roughly stable over recent decades (Forrester et al. 2007). Red-throated diver is Annex 1 Birds Directive, Schedule 1, and Amber-listed. Adults start to reoccupy nesting sites (small freshwater lochs near to foraging habitat in shallow marine areas) from March, and depart to marine coastal habitat after breeding from early August to late September. While breeding, adults commute between nest sites and adjacent marine feeding areas, within a foraging range of up to about 12 km. Spring migration peaks in April-May, and presumably includes birds heading towards Iceland, Greenland or Fennoscandia, as Scottish breeders tend to be on territory by then. Autumn migration peaks in September-October in Orkney (but in October-November further south in Scotland), and involves larger numbers of birds than seen in spring (Forrester et al. 2007). Presumably many of these autumn migrants are from Iceland, Greenland and Fennoscandia. Wintering birds are thought to be a mixture of local breeders and birds from more northerly areas (presumably Greenland, Iceland, Scandinavia, as well as Shetland). Relative numbers present in winter from different populations are unknown, but many PFOW breeding red-throated divers are thought to winter as far south as France as indicated by ring recoveries (Wernham et al. 2002).
Common guillemot	Connectivity with eight SPA populations: Hoy SPA (5 km) SPA designation based on presence of 13,400 birds (described as 13,400 pairs in Citation document) Conservation status defined as 'Unfavourable, Declining' on 11/6/2007. Copinsay SPA (20 km) 29,450 birds in citation, designation on 29/3/1994. Conservation status defined as 'Unfavourable, Declining' on 7/6/2008 Rousay SPA (24 km) 10,600 birds in citation, designation on 2/2/2000.

Species	Conservation Status
	Conservation status defined as 'Favourable, Recovered' on 13/6/2009. N Caithness Cliffs SPA (26 km) 38,300 birds in citation, designation on 16/8/1996. Conservation status defined as 'Favourable Maintained' on 15/6/2000. Calf of Eday SPA (40 km) 12,645 birds in citation, designation on 29/6/1998. Conservation status defined as 'Unfavourable, No change' on 7/6/2006. Marwick Head SPA (40 km) 37,700 birds in citation, designation on 16/12/1994. Conservation status defined as 'Favourable, Maintained' on 22/6/1999. West Westray SPA (45 km) 42,150 birds in citation, designation on 16/8/1996. Conservation status defined as 'Favourable, Maintained' on 14/6/2007. E Caithness Cliffs SPA (55 km) 106,700 birds in citation, designation on 27/3/1996. Conservation status defined as 'Favourable, Maintained' on 2/7/1999. No SPAs exist at present for non-breeding populations Wider countryside population 271,520 pairs estimated to breed in Orkney and Caithness (34.8% of Scottish total).
Great skua	Connectivity with one SPA breeding population: Hoy SPA (5 km) 1,900 pairs at designation. Conservation status described as 'Favourable, Maintained on 15 May 2000. However, the population was estimated at 1,346 pairs in 2010 (Meek et al. 2011). No SPAs exist for non-breeding populations. Wider countryside population There were 9,600 pairs in Scotland in 1998-2002. The Orkney & Caithness population was estimated at 2,214 pairs in 1998-2002, but numbers in Orkney declined from 2,209 pairs in 1998-2002 to 1,710 pairs in 2010 (Meek et al. 2011).

6.6 Data - Collection and Analysis Methods and Presentation

Quantitative assessment of cumulative impacts on Target Bird Populations require estimates of the number of individuals predicted to be at risk of an effect at each project included. Such data were only available for the MeyGen Inner Sound project, the Cava South Salmon Cage Site, the Beatrice Offshore Wind Farm and the Moray Firth R3 Offshore Wind Farm. For each of these projects the predicted impacts on breeding season peak populations was obtained.

Data for each of these projects, and the Development, are presented in the assessment section. This includes the period over which the survey data were obtained in order to clarify extent of temporal overlap.

For all other projects included in the Ornithological CIA (i.e. those for which no survey results are available), a qualitative assessment was conducted in-line with MS-LOT's advice.

6.7 Ornithological Cumulative Impact Assessment

6.7.1 Construction

Red-throated diver

The potential effects of disturbance and displacement during construction activity are detailed above. There are two SPAs for breeding red-throated divers which lie within the 9 km foraging range of this species (Figure A3.2).

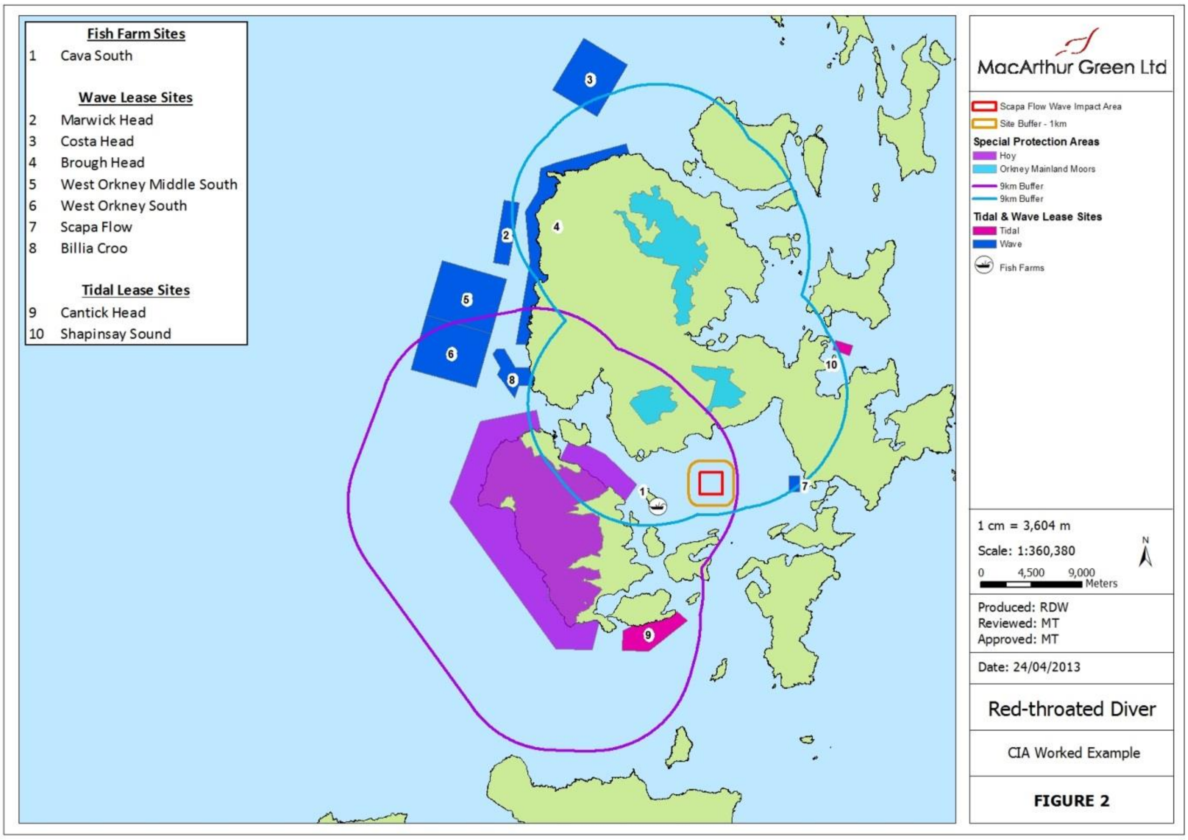


Figure A3.2. SPAs designated for breeding red-throated divers within 9km of the Development and other developments identified with potential for cumulative impacts.

With regards to the HRA detailed in section 4, as previously stated, the proposal is not directly connected to, or necessary for the management of, the SPAs (Step 1). The Development is considered not likely to have a significant effect in isolation (see section 5 above), however this cumulative assessment considers whether it could have a significant effect on the integrity of the SPAs when considered in combination with other projects (Step 3).

To establish the impact of the Development on the integrity of the SPAs, it is necessary to consider the relevant conservation objectives which may be affected. The conservation objectives for these SPAs are:

1. 'To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

2. to ensure for the qualifying species that the following are maintained in the long term:
    a. Population of the species as a viable component of the site;
    b. Distribution of the species within site;

c. Distribution and extent of habitats supporting the species;
d. Structure, function and supporting processes of habitats supporting the species; and,
e. No significant disturbance of the species.'

Only the following conservation objectives are relevant because the Development is out with the SPAs:

(1) To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
(2) To ensure for the qualifying species that the following are maintained in the long term:
    (a) Population of the species as a viable component of the SPA;
    (e) No significant disturbance of the species.

Nature Conservation Importance, Conservation Status and Vulnerability

As an SPA species red-throated diver are of High Nature Conservation Importance. The most recent Site Condition Monitoring assessments (snh.gov.uk/sitelink) for the SPAs with potential connectivity with the Development are both Favourable, maintained. Red-throated diver is considered to be of moderate vulnerability to impacts from wave devices.

Magnitude of Effect

The number of individuals recorded at those projects for which data are available is provided in Table A3.11. No other projects have been included in this assessment since they are either beyond this species' foraging range or have no records of red-throated diver presence.

Table A3.11. Red-throated diver: Target Bird Population Numbers Recorded on Relevant Projects.

Project / Activity	Peak number observed during breeding season
Scapa Flow Wave Site	6
Cava South Salmon Cage Site	5
Total	11

Thus a peak breeding season total of 11 individuals was assessed as being at risk of displacement during installation of the Scapa Flow Wave site in combination with other projects.

The anticipated period for construction of the Development is summer 2014 (i.e. construction impacts will be confined to the breeding season). All the other projects included in this CIA are at less advanced stages of development, therefore there is not considered to be any potential for combined impacts during construction.

Disturbance from increased boat traffic during construction could affect divers in a number of ways, including (at a worst case) complete avoidance of construction areas. This could lead to birds, on limited occasions (i.e. whilst construction is taking place) being forced to forage in areas of lower prey availability, or increase competition for resources at other locations. Aside from underlying vessel movements within Scapa Flow, the only vessel traffic associated with other named projects which could contribute to a cumulative impact is that for the South Cava Fish Farm. In their responses to this fish farm application (in relation to the Hoy SPA population), SNH stated that:

'…likely loss of feeding habitat at the South Cava site in isolation will be small and unlikely to have an adverse effect on site integrity.'

With two SPAs from which red-throated divers could originate, the relative contribution to the onsite population from each was estimated using an apportioning method (Framework Stage 7, SNH & JNCC 2012). Table A3.12 presents the calculations and the relative proportions from each SPA.

Table A3.12. Relative contributions from red-throated diver SPAs to the onsite population.

Site name	Population	Distance to site	Proportion of sea within foraging range	Weight	SPA Proportion	Proportion of SPA population at risk of effect
Orkney Mainland Moors	36	4	0.41	5.51	0.45	0.074
Hoy	124	5	0.72	6.86	0.55	0.026
			Sum	12.38		

Weight = population/(distance^2 × sea proportion)
SPA Proportion = SPA weight / ∑SPA weights
Proportion of SPA population at risk = SPA Proportion × peak population on site / SPA population

With a foraging range of up to 9km from their nesting site, red-throated divers may have a foraging area of up to about 250km^2. However, in practice part of this potential foraging range will consist of land; in the case of the birds nesting in the Hoy SPA or Orkney Mainland Moors SPA the total proportions of sea around each SPA are 72% and 41% respectively, which equate to areas of sea of 720km^2 and 360km^2 (note that due to the large areas of the SPAs these are larger than the range for any individual bird). The potential maximum loss of an area of 16km^2 (the Site) and 4km^2 (Cava cages) represents 3% and 5% respectively, however since displacement effects would not occur simultaneously throughout the Site plus buffer during construction the maximum area affected at any given time would be much smaller and which will only be for a limited time (i.e. whilst construction is taking place).

With regards to projects which are currently in scoping or pre-scoping there is not considered to be any potential for a cumulative construction impact since these projects will not be installed during the same time frame as the Development.

Thus, for breeding red-throated diver, the small amount of potential disturbance and displacement associated with the installation of the Development in combination with other vessel traffic in the vicinity is considered likely to generate an impact magnitude of **Negligible Spatial and Temporal**.

Effect Significance

There are no Likely Significant Effects (alone or in combination with other projects) predicted on the red-throated diver qualifying interest of Orkney Mainland Moors or Hoy SPAs under the Habitats Regulations.

Considering the wider countryside population, given the lack of any significant effect on the two SPA populations (with a total of 80 pairs), impact on the slightly larger wider countryside population (110 pairs in Orkney and Caithness) must by definition also be not significant under the EIA Regulations.

Common guillemot

The potential effects of displacement during construction activity are detailed above. There are eight SPAs for breeding common guillemot which lie within the 60 km foraging range of this species (Figure A3.3).

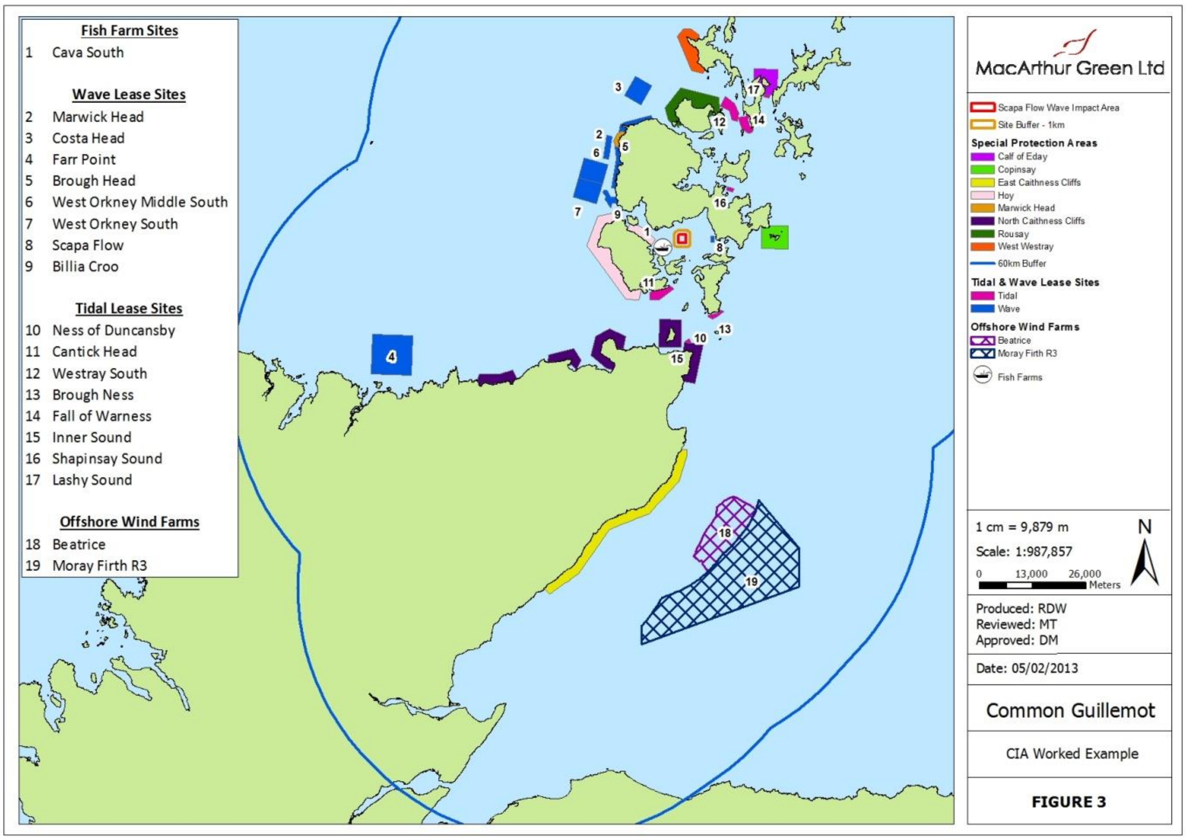


Figure A3.3. SPAs designated for breeding common guillemot within 60 km of the Development and other projects identified with potential for cumulative impacts.

The same considerations with respect to the Habitats Regulations apply to guillemot as detailed for red-throated diver above. Only the following conservation objectives are relevant because the Development is out with the SPAs:

(1) To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

(2) To ensure for the qualifying species that the following are maintained in the long term:
  - (a) Population of the species as a viable component of the SPA;
  - (e) No significant disturbance of the species.

Nature Conservation Importance, Conservation Status and Vulnerability

As an SPA species guillemot are of High Nature Conservation Importance. The most recent Site Condition Monitoring assessments (snh.gov.uk/sitelink) for the SPAs with potential connectivity with the Development are provided in Table A3.13. Guillemot is considered to be of low vulnerability to impacts from wave devices.

Table A3.13. Common guillemot SPA population status from Site Condition Monitoring.

SPA	Status	Year
Calf of Eday	Unfavourable, no change	2006
Copinsay	Unfavourable, declining	2008
East Caithness Cliffs	Favourable, maintained	1999
Hoy	Unfavourable, declining	2007
Marwick Head	Favourable, maintained	1999
North Caithness Cliffs	Favourable, maintained	2000
Rousay	Favourable, recovered	2009
West Westray	Favourable, maintained	2007

Magnitude of Effect

The other projects for which site specific guillemot abundance are available are the MeyGen Tidal Energy Project, the Beatrice Offshore Wind Farm and the Moray Firth Round 3 Offshore Wind Farm (Table A3.14). The two wind farm sites have recorded peak abundances two orders of magnitude higher than those of the other sites. No other projects have been included in this assessment since they are either beyond this species' foraging range or have no records of guillemot presence.

Table A3.14. Common guillemot: Target Bird Population Numbers Recorded on Relevant Projects.

Project / Activity	Peak abundance recorded during breeding season
Scapa Flow Wave Site	60
MeyGen Tidal Energy Project Phase 1	27
Beatrice Offshore Wind Farm	6,812
MORL R3	15,705
Total	22,096

Thus a peak breeding season total of 22,000 individuals is assessed as being at risk of displacement during installation of the Development in combination with other projects. Of this, the Development contributes only 0.3%.

With eight SPAs from which guillemot could originate, the relative contribution to the onsite population from each was estimated using an apportioning method (Framework Stage 7, SNH & JNCC 2012). Table A3.15 presents the calculations and the relative proportions predicted for each SPA. This apportioning used the citation populations rather than an updated one projected forward since the same trend would be applied to all populations and hence the same proportions would be generated. To update the proportion of each SPA population at risk of effect to account for population trends (left-hand column in Table A3.15) the estimates can simply be divided by the current relative population size (e.g. if current population is estimated to be 90% of last census, divide SPA proportion by 0.9).

Table A3.15. Relative contributions from guillemot SPAs to the onsite population.

Site name	Population at citation	Distance to site	Proportion of sea within foraging range	Weight	SPA Proportion	Proportion of SPA population at risk of effect
Calf of Eday	8,241	40	0.91	5.66	0.0042	0.00003
Copinsay	29,450	20	0.86	85.61	0.0630	0.00013
East Caithness Cliffs	106,700	55	0.813	43.39	0.0319	0.00002
Hoy	13,400	4	0.78	1073.72	0.7897	0.00354
Marwick Head	37,700	40	0.88	26.78	0.0197	0.00003
North Caithness Cliffs	38,300	26	0.68	83.32	0.0613	0.00010
Rousay	10,600	25	0.91	18.64	0.0137	0.00008
West Westray	42,150	45	0.92	22.62	0.0166	0.00002
			Sum	1359.73		

Weight = population/(distance^2 × sea proportion)
SPA Proportion = SPA weight / ∑SPA weights
Proportion of SPA population at risk = SPA Proportion × peak population on site / SPA population

As can be seen in Table A3.15, Hoy SPA is predicted to be the source of the majority of guillemot seen on the site (79%). However, even from this SPA the proportion of its total population seen on site is predicted to be only 0.35%. Taking the hypothetical worst case population trend (a 10% decline) this percentage increases to 0.39%. This is not surprising given the large foraging range for this species (60 km) and the large area of sea this encompasses around each SPA (not less than 10,000km^2 for any of these SPAs). Thus the 'loss' (in the worst case scenario) of a maximum of 16 km^2 (on a temporary basis during construction) is considered to be negligible.

Hoy SPA is the closest breeding colony to the proposed development and as such is predicted to be the main source of guillemots seen on the Site. The estimated foraging range for guillemot is at least 60 km (seabird.wikispaces) therefore the potential foraging area from all the SPAs in Table A3.13 will be at least 10,000km^2. The potential temporary exclusion of guillemots from a maximum area of 16km^2 during construction of the Scapa Flow wave site is therefore not considered to be significant.

The anticipated period for construction of the Development is summer 2014 (i.e. construction impacts will be confined to the breeding season). The only other project expected to be under construction at this time will be the MeyGen Tidal Energy Project Phase 1. This is located 25 km away and consequently the potential for combined construction impacts is considered to be very small and not significant.

Disturbance from increased boat traffic during construction could affect guillemot in a number of ways, including complete avoidance of construction areas. This could lead to birds being forced to forage in areas of lower prey availability, or increase competition for resources at other locations. However, guillemots are generally quite robust to the presence of vessels (Furness et al. 2012).

With regards to projects which are currently in scoping or pre-scoping there is not considered to be any potential for a cumulative construction impact since these projects will not be installed during the same time frame as the Development.

Thus, for breeding guillemot, the small amount of potential disturbance associated with the installation of the Development in combination with the construction of other developments in the vicinity is considered likely to generate an impact magnitude of **Negligible Spatial and Temporal**.

Effect Significance

There are no Likely Significant Effects predicted (alone or in combination with other projects) on the common guillemot qualifying interest of Hoy, Copinsay, Rousay, N. Caithness Cliffs, Calf of Eday, Marwick Head, West of Westray, E. Caithness Cliffs SPAs under the Habitats Regulations.

Given that the wider countryside population of common guillemots (271,520 pairs in Orkney and Caithness) is at least an order of magnitude larger than that of the Hoy SPA (13,400 birds), since there is no likely significant effect on the SPA populations, then by definition there must be no significant effect on the wider countryside population under the EIA Regulations.

Great skua

The potential effects of disturbance during construction activity are detailed above. There is a single SPA for breeding great skua (with a baseline population of 1,342 pairs) within the 42 km foraging range of this species (Figure A3.4).

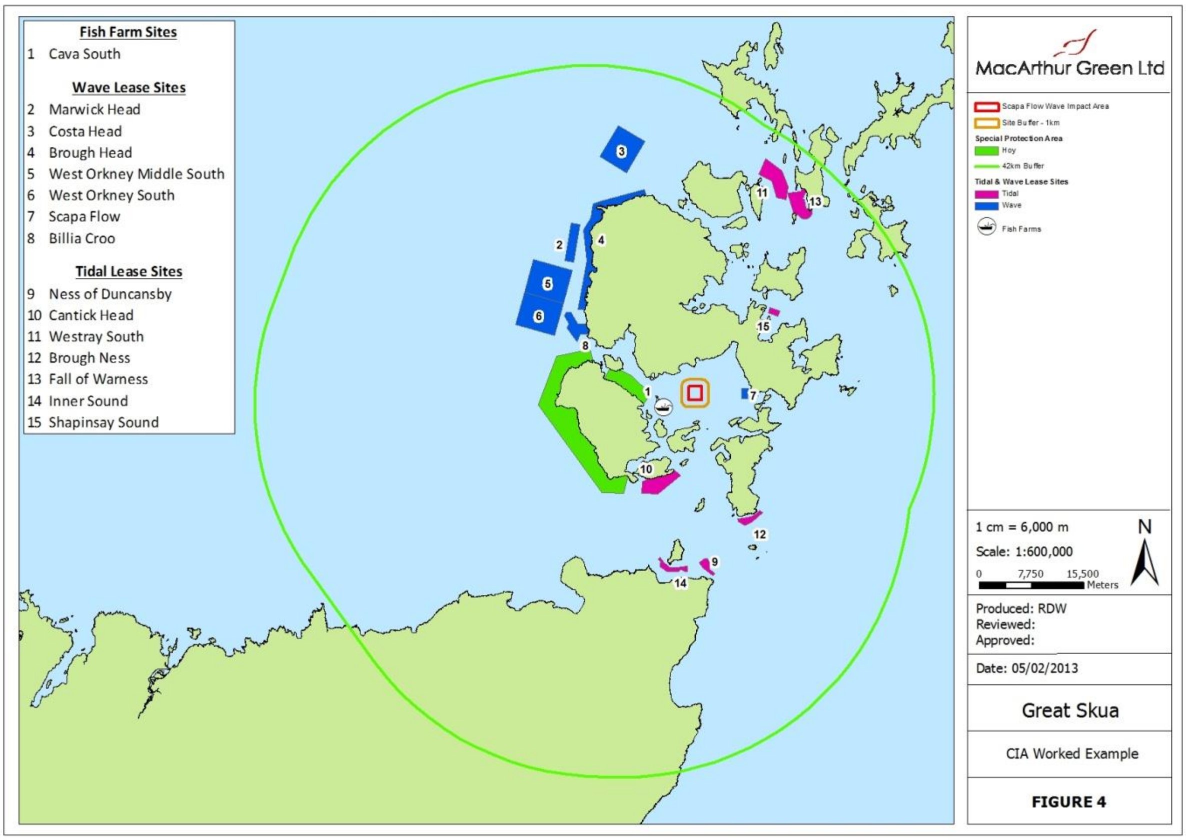


Figure A3.4. SPAs designated for breeding great skua within 42 km of the Development and other projects identified with potential for cumulative impacts.

The same considerations with respect to the Habitats Regulations apply to great skua as detailed for red-throated diver above. Only the following conservation objectives are relevant because the Development is out with the SPAs:

(1) To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

(2) To ensure for the qualifying species that the following are maintained in the long term:

(a) Population of the species as a viable component of the SPA;

(e) No significant disturbance of the species.

Nature Conservation Importance, Conservation Status and Vulnerability

As an SPA species great skua are of High Nature Conservation Importance. The most recent Site Condition Monitoring assessments (snh.gov.uk/sitelink) for the only SPA with potential connectivity with the Development is Favourable, maintained. Great skuas are considered to be of very low vulnerability to impacts from wave devices.

Magnitude of Effect

The only other project for which site specific great skua abundance is available is the MeyGen Tidal Energy Project, for which a peak count of 1 individual was recorded during the breeding season (Table A3.16). No other projects have been included in this assessment since they are either beyond this species' foraging range or have no records of great skua presence.

Table A3.16. Target Bird Population Numbers Recorded on Relevant Projects.

Project / Activity	Peak abundance recorded during breeding season
Scapa Flow Wave Site	5
MeyGen Tidal Energy Project Phase 1	1
Total	6

Thus a peak breeding season total of 6 individuals were assessed as being at risk of disturbance during installation of the Scapa Flow Wave site in combination with other projects.

With regards to projects which are currently in scoping or pre-scoping there is not considered to be any potential for a cumulative construction impact since these projects will not be installed during the same time frame as the Development.

Great skuas are considered to be very insensitive to disturbance by vessel traffic (Garthe and Hüppop 2004). Thus, for breeding great skua, the low numbers at risk, significantly higher numbers at the SPA and the small (and temporally limited) amount of potential disturbance associated with the installation of the Development in combination with other vessel traffic in the vicinity is considered likely to generate an impact magnitude of **Negligible Spatial and Temporal**.

Effect Significance

There are no Likely Significant Effects (either alone or in combination with other projects) predicted on the great skua qualifying interest of Hoy SPA under the Habitats Regulations.

Considering the wider countryside population, given the lack of any significant impact on the Hoy SPA population (with a total of 1,346 pairs), impacts on the slightly larger wider countryside population in Orkney and Caithness must by definition also be not significant under the EIA Regulations.

6.7.2 Operation

Red-throated diver

The potential effects of disturbance and displacement during operation of the Wave site will be similar to those detailed during construction, albeit at a lower intensity (and with the potential for some habituation). During operation there may also be potential for seabirds to collide with the wave devices.

With regards to the HRA detailed in section 4, as previously stated, the proposal is not directly connected to, or necessary for the management of, the SPAs (Step 1). The Development is considered not likely to have a significant effect in isolation (see section 5 above). However, this cumulative assessment considers whether it could have a significant effect on the integrity of the SPAs when considered in combination with other projects (Step 2). Step 3 requires an Appropriate Assessment to be undertaken of the implications for the SPA in view of that SPA's conservation objectives. This assessment provides information to inform the Appropriate Assessment should this be required.

To establish the impact of the Development on the integrity of the SPAs, it is necessary to consider the relevant conservation objectives which may be affected. Only the following conservation objectives are relevant because the Development is out with the SPAs:

(1) To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
(2) To ensure for the qualifying species that the following are maintained in the long term:
  (a) Population of the species as a viable component of the SPA;
  (e) No significant disturbance of the species.

Nature Conservation Importance, Conservation Status and Vulnerability

High, Favourable maintained and Moderate.

Magnitude of Effect

The number of individuals recorded at those projects for which data are available is provided in Table A3.17. No other projects have been included in this assessment since they are either beyond this species' foraging range or have no records of red-throated diver presence.

Table A3.17. Target Bird Population Numbers Recorded on Relevant Projects.

Project / Activity	Peak number observed during breeding season
Scapa Flow Wave Site	6
Cava South Salmon Cage Site	5
Total	11

Thus a peak breeding season total of 11 individuals was assessed as being at risk of displacement during operation of the Scapa Flow Wave site in combination with other projects.

Disturbance and Displacement

The predicted level of disturbance and displacement to red-throated divers resulting from the presence of the wave energy devices themselves is considered to be minor; the devices are small in size and their spacing will probably not impede divers landing or taking off from the sea surface. In general, red-throated divers prefer to feed close to the coast, so their preferred habitat may overlap with the distribution of wave energy devices, but the tendency of red-throated divers to feed in sheltered bays differs from the areas most suitable for wave energy devices.

Increased boat traffic within Scapa Flow during operation in relation to maintenance and other activities could lead to disturbance effects. The frequency of vessel movements during operation of the Development will be lower than that during construction. Visits to the Development will also be of shorter duration during operation.

In relation to the Cava Fish Farm development, SNH considered that the impact of vessel traffic (involving several vessel movements to and from the site each day) and cage structures on red-throated divers was negligible, and would not affect the integrity of the Hoy SPA. Given that the Development is used by a similar number of birds, and that routine boat traffic would be expected to be low on the wave site, this conclusion also applies to the Scapa Flow Wave site, where vessel traffic is expected to be less than at a typical fish farm.

With a foraging range of up to 9 km from their nesting site, red-throated divers may have a foraging area of up to about 250 km^2. However, in practice part of this potential foraging range will consist of land; in the case of the birds nesting in the Hoy SPA or Orkney Mainland Moors SPA the total proportions of sea around each SPA are 74% and 49% respectively, which equate to areas of sea of 720km^2 and 360km^2. The potential maximum loss of an area of 16km^2 represents 2% and 4% respectively. However, disturbance due to operation of the wave site would not be expected to extend far beyond the devices themselves. This, combined with the low numbers observed within the proposed development site itself, suggests that a maximum area of disturbance area of 4km^2 seems more reasonable (this equates to potential habitat loss of 0.5% and 1.1% respectively for Hoy SPA and Orkney Mainland Moors SPA). The potential loss of this amount of foraging area in combination with that lost due to the South Cava Fish Farm is not considered to be of importance for these breeding populations.

With regards to projects which are currently in scoping or pre-scoping, these are located along exposed coasts in water depths considered to be less favourable areas for diver foraging. On this basis, and in the absence of site specific survey data, it is therefore considered that the likelihood for cumulative displacement during operation of these projects is minor.

Thus, for breeding red-throated diver, the small amount of potential disturbance and displacement associated with the operation of the Development in combination with other vessel traffic in the vicinity is considered likely to generate an impact magnitude of **Negligible Spatial and Temporal**.

Collision

Prior to device installation, and owing to the comparative infancy of the proposed technologies, it is not possible to quantify the potential for seabird collisions. Nonetheless, the characteristics of the proposed devices suggest the risks for collision impacts will be minimal. The devices are relatively small in size, will be well spaced to minimise interference with one another and do not extend far above the sea surface. The devices move passively with the passage of waves and have no external moving parts beyond those which permit articulation to conform to the waves. Thus the collision risk posed can be expected to be of a similar magnitude to that presented by other large passively moving structures such as navigation buoys. Furthermore, the low height and rounded cross-section of the proposed devices will minimise both the likelihood of a collision and the severity should any occur. Therefore, in operation it is considered that the devices will present a very small collision risk and certainly no more than that from the above surface component of fish farm enclosures, for example. In addition, the potential disturbance and/or displacement effects would be likely to further reduce the small risk of collision.

Of the other sites considered for potential cumulative collision effects, on site abundance estimates are available only for the MeyGen Tidal Project and the South Cava Salmon Cage Site. Neither of these is predicted to contribute to cumulative collision impacts, since no red-throated divers were recorded on the MeyGen site and the South Cava Cage was not assessed as presenting a collision risk. The remaining projects which could contribute to a cumulative collision impact (Figure 2) are at the scoping or pre-scoping stage and hence there are no data available. However, the technologies currently proposed for these sites are either very similar to that to be used for the Development, or are predicted to present similarly low collision risks. In acknowledgment of the uncertainties regarding the devices to be used, the spatial extent of future developments and the seabird usage of the sites, a cumulative collision risk for breeding red-throated diver of **Negligible Spatial and Temporal** is assessed.

Effect Significance

There are no Likely Significant Effects (either alone or in combination with other projects) predicted on the red-throated diver qualifying interest of Hoy or Orkney Mainland Moors SPAs under the Habitats Regulations.

Given the low numbers observed on the site, and the absence of either a collision risk (South Cava Cage) or birds of this species (MeyGen) at the other sites for which quantitative assessment is possible, the impact on the wider countryside population (110 pairs in Orkney and Caithness) was assessed as not significant under the EIA Regulations.

6.7.3 Decommissioning

Decommissioning effects are considered to be similar to construction effects.

6.7.4 Summary of Ornithological CIA

Table A3.18. Summary of Effects.

Predicted effects	Receptor	Significance	Proposed mitigation	Residual effects
Construction - Displacement (Cumulative)	Red-throated diver (SPA populations)	Not Significant	NA	Not Significant
	Guillemot (SPA Populations)	Not Significant	NA	Not Significant
	Great skua (SPA Population)	Not Significant	NA	Not Significant
Operation – Collision (Cumulative)	Red-throated diver (SPA population)	Not Significant	NA	Not Significant
Operation – Displacement (Cumulative)	Red-throated diver (SPA population)	Not Significant	NA	Not Significant
Decommissioning - Displacement (Cumulative)	Red-throated diver (SPA populations)	Not Significant	NA	Not Significant
	Guillemot (SPA Populations)	Not Significant	NA	Not Significant
	Great skua (SPA Population)	Not Significant	NA	Not Significant

6.7.5 Statement of Significance

The Development will have no significant cumulative effects under the terms of the EIA Regulations.

The Development is not likely to have a significant effect (either alone or in combination with other projects) on the integrity of SPAs.

THE CROWN ESTATE

16 New Burlington Place
London
W1S 2HX
Tel: 020 7851 5080

6 Bell's Brae
Edinburgh
EH4 3BJ
Tel: 0131 260 6070

www.thecrownestate.co.uk