Appendix D - Hornsea Two – Written Representations for The Royal Society for the Protection of Birds

The Royal Society for the Protection of Birds

1 April 2019

Planning Act 2008 (as amended)

In the matter of:

Application by Ørsted Hornsea Project Three (UK) Ltd for an Order Granting Development Consent for the

Hornsea Project Three Offshore Wind Farm

Planning Inspectorate Ref: EN010080
Registration Identification Ref: 20010702

rspb giving nature a home

Written Representations
for the
Royal Society for the Protection of Birds

15 July 2015

Planning Act 2008 (as amended)

In the matter of:

Application by SMartWind for an Order granting Development Consent for the Hornsea Offshore Wind Farm – Project Two located 89 km east of the East Riding of Yorkshire Coast

Planning Inspectorate Ref: EN010053
Registration Identification Ref: 10031166

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1. Introduction

1.1 These representations have been prepared with Dr McCluskie, whose qualifications and experience are provided in Annex 1.

The RSPB

1.2 The Royal Society for the Protection of Birds (the RSPB) was set up in 1889. It is a registered charity incorporated by Royal Charter and is Europe's largest wildlife conservation organisation, with a membership of more than 1.1 million[1]. The principal objective of the RSPB is the conservation of wild birds and their habitats. The RSPB therefore attaches great importance to all international, EU and national law, policy and guidance that assist in the attainment of this objective. It campaigns throughout the UK and in international fora for the development, strengthening and enforcement of such law and policy. In so doing, it also plays an active role in the domestic processes by which development plans and proposals are scrutinised and considered, offering ornithological and other wider environmental expertise. This includes making representations to, and appearing at, public inquiries and hearings during the examination of applications for development consents.

1.3 The RSPB considers that climate change is the most pressing threat to the UK's wildlife and that wind energy has an important role to play in countering this threat. However, the RSPB will continue to oppose wind farms in inappropriate locations that risk significant damage to protected species and sites, in just the same way that we do for other developments. At the same time, we work with applicants to find ways to minimise the risk of such damage. Early engagement helps this process, by identifying information requirements and anticipated problems at the earliest stage, so that ways forward can be found and accommodated without unnecessary delay.

The RSPB's interest in offshore wind development

1.4 Faced with the threats of climate change to the natural world the RSPB considers that a low-carbon energy revolution is essential to safeguard biodiversity. However, inappropriately designed and/or sited developments can also cause serious and irreparable harm to biodiversity, and damage the public acceptability of the necessary low-carbon energy transition technologies.

[1] *RSPB Annual Review 2013-2014* at page 45, http://www.rspb.org.uk/Images/annualreview20132014_tcm9-384063.pdf.

1.5 The UK is of outstanding international importance for its breeding seabirds, most notably northern gannet, great skua, lesser black-backed gull and Manx shearwater, for which it supports over 50% of their respective biogeographical populations. As a consequence, the UK has particular responsibility under the Birds Directive[2] to secure the conservation of these important seabird populations.

1.6 The available evidence suggests that the main risks of offshore wind farms for birds are collision, disturbance/displacement, barriers to movement e.g. migrating birds, or disruption of access to such as between the breeding areas and feeding areas, habitat change particularly with associated changes in food availability and the in-combination effects of these across multiple wind farms.

1.7 Such impacts are avoidable, and the RSPB has spent considerable time working with stakeholders in the UK offshore wind industry to ensure that decisions about deployment of renewable energy infrastructure take account of environmental constraints and seek to avoid or minimise impacts wherever possible. The RSPB therefore strongly advocates the use of rigorous, participative environmental assessments to inform the development of projects.

The RSPB's interest in this case and summary of its position

1.8 The RSPB engaged with the pre-submission consultation process, as reported by the Applicant.[3] However, matters of serious concern to the RSPB have not been resolved.

1.9 The primary concerns of the RSPB are due to the wind farm footprint and surrounding area lying within the foraging range of the Flamborough Head and Bempton Cliffs Special Protection Area (the SPA) and the Flamborough and Filey Coast potential SPA (the pSPA) and their designation species. These include northern gannets, in respect of which the area is the only breeding colony in England, black legged kittiwakes (kittiwakes) particularly in light of its reduction from the 83,370 breeding pairs in 1993 to an average of 44,520 breeding pairs between 2008 and 2011, common guillemot, razorbill and Atlantic puffin. In addition the RSPB has concerns over both great black and lesser black backed gulls, which NE defines as EIA species (RR, para 3.3).

[2] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version) (the Birds Directive).

[3] In the Applicant's Consultation Report (PINS Document Ref 2.1).

1.10 The RSPB is concerned about the robustness of the assessment of the applications' offshore impacts and how these are addressed. These concerns can be broadly summarised as follows:

1.10.1 The assessment of the collision risk to gannet, kittiwakes, greater and lesser black backed gulls (both migratory, breeding and non breeding birds), including the use of the extended Band Model for collision risk modelling (CRM) and avoidance rates adopted;

1.10.2 The assessment of disturbance and displacement for some seabird species namely guillemot, razorbill and puffin, including the extent of buffer zones adopted; and

1.10.3 The continued use of Potential Biological Removal (PBR) as a means of assessing the overall impact of the Project on bird species and the associated inadequate reliance on proper Population Viability Analysis (PVA) to assess impact.

1.11 The RSPB is concerned that due to deficiencies and uncertainties in the methodological information on the likely effects of the applications on the SPA/pSPA and their species, it cannot be concluded with certainty that the applications, alone or in combination with other plans/projects, will not have an adverse effect on the integrity of the SPA and pSPA and their species.

1.12 The RSPB is also concerned with some of the possible onshore impacts on the Humber Estuary SPA (and Ramsar site) and its designation species. These concerns are all in relation to the intertidal area beyond Horseshoe Point and the laying of cables, in particular the timing of these works.

1.13 These concerns are set out in more detail below, following a brief summary of the SPA and pSPA and two of their key species, so far as is material to these representations, and of relevant legislation and guidance.

2. Protected Sites and Species

The Flamborough Head and Bempton Cliffs SPA and Flamborough and Filey Coast pSPA

2.1 The Flamborough Head and Bempton Cliffs SPA was designated under Article 4(2) of the Birds Directive as an SPA in 1993 due to the presence of 83,370 pairs of black-legged kittiwake (*Rissa tridactyla*), representing 4% of the Eastern Atlantic breeding population. In 2001 the UK SPA Review found that it also qualified under Article 4(2) as a site regularly supporting at least 20,000 seabirds. At the time of designation, the site regularly supported 305,784 individual seabirds including: puffin (*Fratercula arctica*), razorbill (*Alca torda*), guillemot (*Uria aalge*), herring Gull (*Larus argentatus*), Gannet (*Morus bassanus*), and Kittiwake. Kittiwake and the seabird assemblage are therefore the qualifying features of the SPA. Further information on those species is set out in Annex III.

2.2 On 29 May 2012, Natural England published revised Conservation Objectives for the SPA, and subsequently revised them on 30 June 2014[4]. These are:

> *With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified ("the Qualifying Features" listed below), and subject to natural change;*
> ***Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:***
> - *The extent and distribution of the habitats of the qualifying features*
> - *The structure and function of the habitats of the qualifying features*
> - *The supporting processes on which the habitats of the qualifying features rely*
> - *The populations of the qualifying features, and,*
> - *The distribution of the qualifying features within the site.*
>
> *This document should be read in conjunction with the accompanying Supplementary Advice document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.*
> ***Qualifying Features:***
> *A188* Rissa *tridactyla; Black-legged kittiwake (Breeding)*

2.3 In January 2014, Natural England opened a formal consultation on proposals to extend the SPA and rename it as the Flamborough and Filey Coast SPA. The proposals comprise changes to the designated site boundary and changes to the qualifying species.

[4] Available here: http://publications.naturalengland.org.uk/publication/5400434877399040 (accessed 12 July 2015).

2.4 Natural England has also conducted a review of the seabird populations using contemporary data. A summary of Natural England's review of the ornithological interest of the pSPA is as follows with the key species set out in more detail in Table 2.1 below[5]:

> The application of SPA selection guidelines (JNCC 1999) to current data for this site confirm that it qualifies by regularly supporting internationally important numbers of breeding black-legged kittiwakes, northern gannet, common guillemot and razorbill and an assemblage of European importance of over 20,000 breeding seabirds. Black-legged kittiwake, northern gannet, common guillemot and razorbill are all main components of the assemblage and present in internationally important numbers. However, northern fulmar is also present in sufficient numbers to warrant being listed as main component species of the assemblage, since numbers exceed 2,000 individuals (10% of the minimum qualifying assemblage of 20,000 individuals). In addition, Atlantic puffin, herring gull, European shag *Phalacrocorax aristotelis* and great cormorant *Phalacrocorax carbo* are also part of the breeding seabird assemblage.

Table 2.1: Summary of Ornithological Interest of the pSPA

Species	**Count (period)**	**% of subspecies or population (pairs)**	**Interest Type**
Original classification			
Black-legged kittiwake *Rissa tridactyla*	83,700 pairs (1987)	4% Western Europe	Migratory
Revised proposal			
Black legged kittiwake *Rissa tridactyla*	44,520 pairs 89,041 breeding adults (2008-2011)	2% North Atlantic	Migratory
Northern gannet *Morus bassanus*	8,469 pairs 16,938 breeding adults (2008-2012)	2.6% North Atlantic	Migratory
Common guillemot *Uria aalge*	41,607 pairs 83,214 breeding adults (2008-2011)	15.6% (*Uria aalge albionis*)	Migratory
Razorbill *Alca torda*	10,570 pairs 21,140 breeding adults (2008-2011)	2.3% (*Alca torda islandica*)	Migratory
	Count period	**Average number of individuals**	
Seabird assemblage	2008-2012	215,750	

2.5 Since this site achieved SPA status, the national populations of both kittiwake and some assemblage species have suffered substantial declines. For example the UK breeding kittiwake population has reduced by 72%[6] (between 1986 and 2013). Within the SPA there has been a reduction from the 83,370 breeding pairs of kittiwakes (at time of designation, 1993) to an average of 44,520 breeding pairs between 2008 and 2011.

[5] *Proposed extension to Flamborough Head and Bempton Cliffs Special Protection Area and renaming as Flamborough and Filey Coast potential Special Protection Area,* Departmental Brief. Natural England, January 2014 at page 4.

[6] *State of the UK's Birds 2014*, http://www.rspb.org.uk/Images/state-of-the-uks-birds_tcm9-383971.pdf.

2.6 Due to these steep national declines for both kittiwake and species of the assemblage feature, consideration of contemporary data alone is inappropriate. The RSPB considers that historic population levels should also be taken into account due to the SPA's conservation objectives as set out above – *by maintaining or restoring ... the populations of the qualifying features.*

2.7 Attached to this written representation at Annex II is a more detailed description of both the SPA and the pSPA. Information on two of the relevant species is set out below.

Gannet

2.8 The RSPB's concern over the possible impacts to gannets is in part due to the SPA being the only gannetry (breeding colony) in England and in 2015 it supported 12,494 occupied nests[7] (HRA Report Part 2 (ref 12.6), paragraph H.22), concentrated in an approximately 5 km stretch of cliff[8]. Within this area is the RSPB's Bempton Cliffs Reserve. This SPA population accounts for approximately 3.3% of the North Atlantic biogeographic population[9].

2.9 Gannets (and other seabirds) are central-place foragers during the breeding season, i.e. they have to return to their nest regularly. This results in frequent foraging trips. These breeding adults therefore may be more at risk to a collision hazard than for example migrating birds on passage. Conversely, if the wind farm is located within a preferred foraging area and the birds display a high degree of avoidance of wind turbines when making their frequent foraging trips during the breeding season, there is still a concern that gannets may be effectively displaced from suitable foraging areas. Whilst gannets have greater foraging flexibility than many other seabirds, there are potential implications for breeding productivity if their foraging areas are constrained. The SPA has had high levels of breeding productivity in recent years but, as described above, is the only gannet colony in England.

2.10 In recent tracking studies from the RSPB's Bempton Cliffs Reserve, adult gannets, during the breeding season, were fitted with transmitters.

[7] Apparently Occupied Nests (AON) is a standard census unit used to estimate the number of pairs of colonially nesting bird species, which includes most seabirds. AON is one way to estimate the number of breeding parts.

[8] There were also approximately 2,500 non-breeders on potential nest sites.

[9] A biogeographic population is defined by JNCC as a group of birds which breed in a particular location (or group of locations), breed freely within the group and rarely breed or exchange individuals with other groups.

2.11 The tracked birds from the SPA showed considerable use of the Hornsea Zone, including the proposal area for Project Two, both for foraging and flying through to reach other foraging areas, during the chick-rearing season. Of the 42 individuals tracked 24 were recorded within the Hornsea Project Two area. The area of active use identified showed marked similarity over the three years, although in 2012 the core area used extended further into the proposed Hornsea Project Two. Although densities diminish with increased distance offshore foraging flights and feeding behaviours were still recorded[10].

2.12 Tracking continued after the breeding season. In 2010 post-breeding locations were obtained for 18 of the tracked gannets, including use of the marine environment in and around the Hornsea Zone. The results from 2011 and 2012 also indicated an overlap with the Hornsea Zone, including this project, but showed dispersal to other parts of the North Sea before the individuals' winter migration[10].

2.13 There is therefore a need to distinguish between breeding, non-breeding/winter seasons in assessing the possible impacts to gannets. For example from October especially, there is considerable overlap of gannets from different breeding colonies[11]. Due to the diverse pattern of migration there is an increased potential for interaction with this and other proposed or constructed wind farms. There are indications of a high degree of flight avoidance by migratory gannets around the Egmond aan Zee[12] and Horns Rev[13] offshore wind farms, although in the case of Horns Rev, no gannets were recorded in the wind farm area prior to or post-construction. The well designed and executed studies from which this information is drawn relate to inshore wind farms and the results may not be applicable to breeding gannets.

[10] Langston, R., Teuten, E. & Butler, A., 2013. *Foraging ranges of northern gannets Morus bassanus in relation to proposed offshore wind farms in the North Sea: 2010-2012.* RSPB Report to DECC, December 2013.

[11] Fort, J., Pettex, E., Tremblay, Y., Lorentsen, S.-H., Garthe, S., Votier, S., Baptiste Pons, J., Siorat, F., Furness, R. W.,Grecian, W. J., Bearhop, S., Montevecchi, W. A. & Gremillet, D. 2012. *Meta-population evidence of oriented chain migration in northern gannets (Morus bassanus)*. Frontiers in Ecology and the Environment 10:237-242.

[12] Krijgsveld, K. L., Fijn, R. C., Japink, M., van Horssen, P. W., Heunks, C., Collier, M., Poot, M. J. M., Beuker, D. & Dirksen, S. 2011. *Effect studies offshore wind farm Egmond aan Zee: Final report on fluxes, flight altitudes, and behaviour of flying birds.* NoordzeeWind report nr WEZ_R_231_T1_20111114_flux&flight. Bureau Waardenburg report nr 10-219 to Nordzeewind, Culemborg, The Netherlands. Final report November 2011. http://www.noordzeewind.nl/wpcontent/uploads/2012/03/OWEZ_R_231_T1_20111114_2_fluxflight.pdf, last accessed 25 June 2012.

[13] Petersen, I. K., Christensen, T. K., Kahlert, J., Desholm, M. & Fox, A. D. 2006. *Final results of bird studies at the offshore wind farms of Nysted and Horns Rev, Denmark*. NERI report commissioned by DONG energy and Vattenfall A/S. National Environmental Research Institute, Ministry of the Environment, Denmark.

2.14 In addition available evidence shows that all the adult gannets, and most of the immature gannets (age 3-4 years), were recorded in the Hornsea Project Two area during the breeding season come from the SPA.

Black-legged Kittiwake

2.15 The SPA is the only English SPA supporting black-legged kittiwake in numbers of international importance. Between 2008 and 2011 the SPA, including the proposed extension, supported an average of 44,520 pairs of black-legged kittiwakes, which represents 2% of the North Atlantic biogeographic population[14], but is also a substantial decline on historical population levels. At the time of designation of the SPA, the population estimate was 83,370 pairs.

2.16 When not at the nest kittiwakes loaf on the sea below the cliffs and forage up to 120 km offshore[15] (ES Vol 2, Ch 5, paragraph 5.5.120, p5-41), although the FAME data indicate kittiwakes regularly forage considerably further, up to 231 km.

2.17 The RSPB has carried out tracking of kittiwakes from the SPA. The GPS data collected in 2010-2014, show the kittiwakes making foraging trips across the Hornsea zone, including the proposal area for Hornsea Project Two (please see attached Annex IV, Figure 4). There was considerable overlap in areas used in different years by kittiwakes from the SPA. Birds tracked from Filey north-west of the SPA and proposed as part of the pSPA, in 2013, covered a larger area of sea than was recorded for the kittiwakes from the SPA in 2010-2012. The sinuous sections of tracks from the GPS data collected indicate foraging behaviour being conducted on these longer journeys

2.18 The available evidence supports the precautionary allocation of all adult kittiwakes recorded in Hornsea Project Two area during the breeding season to the SPA. But the Applicant's HRA Report has taken a substantially lower figure of 19.34% (HRA Report part 1, paragraph 5.8.178).

[14] AEWA, 2012. *African-Eurasian Waterbird Agreement 2012: Report on the Conservation Status of Migratory Waterbirds in the Agreement Area*. Fifth Edition. AEWA, Bonn

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

3. Legislation and Policy Background

Introduction

3.1 Section 104 of the Planning Act 2008 provides that an application for development consent for energy infrastructure must be decided in accordance with the relevant National Policy Statement (NPS) except where in doing so it would lead to the UK being in breach of its international obligations; be in breach of any statutory duty that applies to the Secretary of State; be unlawful; result in adverse impacts which would outweigh the benefits; or be contrary to regulations about how decisions are to be taken. The suite of Energy NPSs set out the Government's approach to ensuring the security of energy supplies and the policy framework within which new energy infrastructure proposals are to be considered. The presumption in favour of granting consent, as identified in NPS EN-1, *Overarching National Policy Statement for Energy*, is subject to the tests set out in section 104 of the Planning Act (see paragraphs 4.1.2 and 1.1.2).

3.2 The international obligations and statutory duties to which the 2008 Act refers include legislation designed to protect nature conservation interests. EN-1 recognises the need to comply with the Conservation of Habitats and Species Regulations 2010 (the Habitats Regulations)(paragraph 4.3.1) within a wider objective of protecting the most important biodiversity conservation interests (see section 5.3 generally). It records that the Habitats Regulations provide statutory protection for important sites identified through international conventions and European Directives, including Ramsar sites, listed under the Ramsar Convention[16], SPAs designated under the Birds Directive and Special Areas of Conservation (SACs) designated under the Habitats Directive[17].

3.3 NPS EN-1 also confirms that for the purposes of considering development proposals affecting them, as a matter of policy the Government wishes potential SPAs (pSPAs) to be considered in the same way as if they had already been classified. Listed Ramsar sites should also, as a matter of policy, receive the same protection (paragraph 5.3.9).

3.4 NPS EN-3, *National Policy Statement for Renewable Energy Infrastructure*, specifically identifies birds as a biodiversity concern to be taken into account (paragraph 2.6.59 and 2.6.68). Whilst it is stated that the designation of an area as a protected European site does

[16] The Convention on Wetlands of International Importance 1971.
[17] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

not necessarily restrict the construction or operation of offshore wind farms (paragraph 2.6.69), the legislative requirements identified above are still to be met. The protection afforded by legislation, to which the 2008 Act and the NPSs refer, are addressed briefly below.

The Birds and Habitats Directives

3.5 The Birds Directive requires the conservation of all species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies. It applies to birds, their eggs, nests and habitats (Article 1).

3.6 The Directive imposes a requirement on Member States to maintain all wild bird populations at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or if necessary to restore the population of these species to that level (Article 2). They are required to take the requisite measures to preserve, maintain or re-establish a sufficient diversity and area of habitats for all wild bird species, including the creation of protected areas (Article 3). The requirement to establish a system of protection for all wild bird species, includes prohibiting certain activities such as deliberate killing or disturbance (Article 5).

3.7 Article 4 provides particular protection for species listed in Annex I to the Directive. These species are to be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Member States must classify in particular the most suitable territories in number and size as SPAs. Similar measures are to be taken for regularly occurring migratory species not listed in Annex I due to the need for coherent protection in both their wintering and breeding areas to ensure their survival.

3.8 Article 7 of the Habitats Directive replaced the first sentence of Article 4 of the Birds Directive by applying the obligations in Articles 6(2)-(4) of the Habitats Directive to SPAs established under the Birds Directive. Those obligations require that:

> "2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.

> 3. Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.
>
> 4. If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted."

3.9 Once designated SPAs and their species benefit from the requirement for plans and projects to be assessed in accordance with the above requirements.

3.10 The Natura 2000 Network is intended to be a coherent European ecological network including both SACs and SPAs that enables the natural habitat types and the species habitats concerned to be maintained or, where appropriate, restored, at a favourable conservation status in their natural range (Article 3(1) of the Habitats Directive).

3.11 The second sentence of Article 4(4) of the Birds Directive continues to provide that outside SPAs, Member States must strive to avoid pollution or deterioration of habitats. Article 13 further provides that application of measures taken pursuant to the Directive may not lead to deterioration in the present situation as regards the conservation of the wild bird species.

The Conservation of Habitats and Species Regulations 2010 and Offshore Habitat Regulations 2007

3.12 SACs and SPAs are protected as "European sites" in inshore waters (up to 12 nautical miles from the baselines) by the Conservation of Habitats and Species Regulations 2010 (as amended); and in offshore waters (i.e. from 12-200 nautical miles) by the Offshore Marine Conservation (Natural Habitats etc) Regulations (as amended)(Offshore Regulations). In each case the regulations transpose in a similar form Article 6 of the Habitats Directive, through regulations 61, 62 and 66 of the Habitats Regulations and regulations 25, 26 and 30 of the Offshore Regulations respectively.

3.13 The Habitats Regulations thus set out the sequence of steps to be taken by the competent authority (here the Secretary of State) when considering authorisation for a project that may have an impact on a European site before deciding to authorise that project. These are as follows:

a. Step 1: Under regulation 61(1)(b), consider whether the project is directly connected with or necessary to the management of the SPA. If not –
b. Step 2: Under regulation 61(1)(a) consider, on a precautionary basis, whether the project is likely to have a significant effect on the SPA, either alone or in combination with other plans or projects (the Likely Significance Test).
c. Step 3: Under regulation 61(1), make an appropriate assessment of the implications for the SPA in view of its conservation objectives. Regulation 61(2) empowers the competent authority to require an applicant to provide information for the purposes of the appropriate assessment. There is no requirement or ability at this stage to consider extraneous (non-conservation e.g. economics, renewable targets, public safety etc) matters in the appropriate assessment.
d. Step 4: Pursuant to regulation 61(5) and (6), consider whether it can be ascertained that the project will not, alone or in combination with other plans or projects, adversely affect the integrity of the SPA, having regard to the manner in which it is proposed to be carried out, and any conditions or restrictions subject to which that authorisation might be given (the Integrity Test).
e. Step 5: In light of the conclusions of the assessment and in accordance with regulation 61(5) and (6), the competent authority shall agree to the project only after having ascertained that it will not adversely affect the integrity of the SPA, alone or in combination with other plans or projects.
f. Step 6: as required by regulation 62(1), only **i**f the competent authority is *satisfied that, there being no alternative solutions, the plan or project must be carried out for imperative reasons of overriding public interest* (which, subject to [regulation 62(2)], *may be of a social or economic nature), they may agree to the plan or project notwithstanding a negative assessment of the implications for the European site*. Or put another way whether the need satisfies the high hurdle of "*imperative reasons of overriding public interest*" must be tested against the internationally and nationally important nature conservation designations that are affected by the project.

g. Step 7: and finally regulation 66 of the Habitats Regulations, requires that in the event of the imperative reasons of overriding public interest and alternative solutions tests being satisfied, the Secretary of State must *secure that any necessary compensatory measures are taken to ensure that the overall coherence of Natura 2000 is protected.* The essential steps in fulfilling this duty are to ascertain precisely the ecological function and resource which is lost and how that function and resource can be permanently secured elsewhere.

3.14 In relation to both inshore area and the offshore marine area, any competent authority must exercise its functions so as to secure compliance with the requirements of the Habitats Directive and the Birds Directive; and to take such steps as it considers appropriate to secure the preservation, maintenance and re-establishment of a sufficient diversity and area of habitat for wild birds, having regard to the requirements of Article 2 of the Birds Directive.[18]

Alternative Solutions

3.15 Section 9 below considers the scope of possible alternative solutions, along with relevant Government Policy and the Planning Inspectorate's guidance on alternative solutions. We consider what alternative solutions, in our view, could be considered in determining this application and the Environmental Impact Assessment and Habitats Regulations requirements.

3.16 It is the RSPB's view that the Secretary of State must consider **all** renewable energy proposals that are in the public domain as at the date of the present Proposal as possible alternative solutions. Thus ensuring that consideration is given to those alternative solutions at the same time as considering the Hornsea Project Two proposal.

3.17 The concept of an alternative solution clearly includes variations to the project promoted, whether in form, size, layout, location or otherwise (as required by the EIA Regulations). But in addition all potential alternative solutions to meet the public interest objectives need to be assessed by the Secretary of State against their relative impact upon European sites and their species.

[18] See regulation 9 of the Habitats Regulations and regulation 6 of the Offshore Regulations.

3.18 Alternative solutions to be preferred are those which satisfy the imperative reasons of overriding public interest test, as identified by the competent authority, but which also better respect the integrity of the European sites and their species (see Managing Natura 2000 (MN2000)[19] paragraph 5.3.1) and the value of the Natura 2000 Network as a whole. This means that a competent authority must consider the comparative ecological impacts on European sites and species arising from alternatives in order to identify alternative solutions.

3.19 Ecological, not economic, considerations are the reference parameters for the identification of alternative solutions. Economic considerations cannot, as a matter of law, be determinative in the assessment of alternative solutions (see e.g. MN2000 paragraph 5.3.1).

3.20 It is for the Secretary of State, as the competent authority, to be satisfied that no alternative solutions exist. If she cannot be so satisfied, e.g. because there are potential alternative solutions but they have not been properly evaluated, she must reject the project.

3.21 It will therefore be necessary for the Secretary of State to rank the competing alternative solutions against the Hornsea Project Two scheme in terms of their ecological impact.

3.22 It is fundamental to do so because unless such an exercise is undertaken, the Secretary of State cannot rationally form the view that there is no alternative solution. Nor can she form the view that the Hornsea Project Two proposal must be carried out for imperative reasons of overriding public interest unless she is satisfied that the "*need*" said to justify the harm will not be or cannot be appropriately met elsewhere.

3.23 Ranking of the alternative solutions will require a thorough analysis of all relevant and available information.

3.24 The need to consider alternative solutions is not limited to other schemes within that area as confirmed in the Secretary of State's Dibden Bay Port Proposal Decision Letter, para 51:

> "51. The Secretary of State notes, however, that the consideration of alternatives for projects which would have a significant impact upon a site designated in accordance with the Habitats Regulations must necessarily range more widely. The Secretary of State agrees with the Inspector's conclusion that the Applicant's proposal would have a significant effect upon the integrity of designated sites. It follows that consideration of alternatives must

[19] EC (2000) *Managing Natura 2000 sites – the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.*

concern alternative ways of avoiding impacts on the designated sites. The Secretary of State considers that such alternatives would not be confined to alternative local sites for the project. He draws attention to the European Commission's methodological guidance on the Assessment of Plans and Projects significantly affecting Natura 2000 sites, which interprets article 6 (4) of the Habitats Directive. The guidance states that a competent authority should not limit consideration of alternative solutions to those suggested by a project's proponents and that alternative solutions could be located even in different regions or countries."

Principles of appropriate assessment

3.25 The Habitats Directive and Regulations are to be applied in accordance with the precautionary principle[20] such that a project is to be made subject to an appropriate assessment if it cannot be excluded, on the basis of objective information, that it will have a significant effect on that site: the Waddenzee case.[21] Where a project is likely, applying this precautionary approach, to undermine the site's conservation objectives, it must be considered likely to have a significant effect on that site.[22]

3.26 If likely significant effects cannot be excluded at this screening stage, a plan or project may only be approved if the competent authority is convinced that it will not affect the integrity of the European site(s) concerned. Waddenzee confirmed that where doubt remains as to the absence of adverse effects on the integrity of the site, approval should be refused[23] (subject to the considerations of alternative solutions, imperative reasons of overriding public interest and the provision of compensatory measures). Thus an appropriate assessment implies that all aspects of the project which can affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field.[24] The competent authority, "taking account of the conclusions of the appropriate assessment of the implications…for the site concerned, in the light of the conservation objectives, are to authorise such activity only if they have made certain that it will not adversely affect the integrity of the site. That is the case where no reasonable scientific doubt remains as to the absence of such effects"[25] (emphasis added).

3.27 *Sweetman v. An Bord Pleanala*,[26] concerned a candidate SAC, in which a road scheme would involve the permanent loss of 1.47 ha of limestone pavement, from a distinct sub-area of a

[20] See Article 191 of the Treaty on the Functioning of the European Union ("TFEU").
[21] CJEU Case-127/02; [2004] ECR-7405 at [45].
[22] [49].
[23] [56]-[57].
[24] [61].
[25] [59].
[26] CJEU CaseC-258/11; [2013] ECR-000.

priority habitat containing 85 ha of limestone pavement, which itself formed part of a total of 270 ha of such limestone pavement in the entire area. It was held that when considering the effect of a project on the integrity of a site:

> a. "The competent national authorities cannot therefore authorise interventions where there is a risk of lasting harm to the ecological characteristics of sites which host priority natural habitat types. That would particularly be so where there is a risk that an intervention of a particular kind will bring about the disappearance or the partial and irreparable destruction of a priority natural habitat type present on the site concerned";[27]
> b. an appropriate assessment cannot "have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned";[28]
> c. if "that plan or project will lead to the lasting and irreparable loss of the whole or part of a priority natural habitat type whose conservation was the objective that justified the designation of the site concerned as an SCI, the view should be taken that such a plan or project will adversely affect the integrity of that site"[29] (emphasis added).

3.28 The Opinion of the Advocate General identified, in the context of the case involving a cSAC, the provisions of the Habitats Directive which refer to the maintenance and restoration of habitats at a favourable conservation status including sites within the Natura 2000 network (which would also include SPAs); and the requirement under Article 6(2) for steps to be taken to avoid the deterioration of the habitats concerned.[30] The purpose of these provisions was to pre-empt damage being done to the site,[31] having regard to its conservation objectives, and to avoid those objectives being prejudiced.[32]

3.29 European Commission guidance "Managing Natura 2000" advises[33] that "as regards the connotation or meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. The 'integrity of the site' has been usefully defined as 'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified'.[34] A site can

[27] [43].
[28] [44]. The need for reliable data was emphasised, in relation to birds, in Case C-43/10 *Nomarchiaki Aftodioikisi Aitoloakarnanias and Others v Ypourgos Perivallontos, Chorotaxias kai Dimosion ergon and Others* (judgment 11 September 2012).
[29] [46].
[30] Paragraphs 39-41 of the Opinion.
[31] Paragraph 43.
[32] Paragraph 44.
[33] Paragraph 4.6.3.
[34] See ODPM Circular 6/2005 para. 20.

be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required. When looking at the 'integrity of the site', it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term".[35]

3.30 Commission guidance on "Assessment of plans and projects significantly affecting Natura 2000 sites" includes an "integrity of site checklist"[36] which asks whether the project has the potential to cause delays towards achieving the conservation objectives of the site; interrupt progress towards achieving the conservation objectives of the site; disrupt the factors that help to maintain the conservation objectives of the site; and interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site.

3.31 As is clear from Article 6(3) of the Directive (as transposed into e.g. regulation 25(1) of the Offshore Regulations), this assessment of integrity is to be considered by reference to the impact of the project alone and in combination with other plans and projects. As clearly set out in *Waddenzee*, para 61:

> **61** In view of the foregoing, the answer to the fourth question must be that, under Article 6(3) of the Habitats Directive, **an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field**. The competent national authorities, taking account of the appropriate assessment of the implications of mechanical cockle fishing for the site concerned in the light of the site's conservation objectives, are to authorise such an activity only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects. (emphasis added)

Ramsar Sites

3.32 The UK is a party to the Convention on Wetlands of International Importance 1971, which is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

[35] See too the European Commission Guidance; Wind Energy Developments and Natura 2000, 2011, page 82-83, paragraph 5.5.3.
[36] P. 28 paragraph 3.2.4.

Sites listed under the Convention are known as "Ramsar Sites".[37] The Government designates Ramsar sites in accordance with criteria set out in the Convention, so as to recognise the importance of these sites as a wetland wildlife habitat.

3.33 As with pSPAs, Government policy is that such sites are to be made subject to the same requirements as those described above which apply to European sites.[38]

Environmental Impact Assessment

3.34 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (as amended) transposed Council Directive 85/337/EC on the assessment of certain public and private projects on the environment (as amended). That Directive and its amendments have been codified by Council Directive 2011/92/EU, which was itself amended by Directive 2014/52/EU. Development consent cannot be granted for EIA development unless the decision-maker has taken into account environmental information including an environmental statement which describes the likely significant effects, including cumulative effects, of the development on the environment. This will include effects on wild bird species regardless of any designation of a site as a SPA.

3.35 NPS EN-3 acknowledges that offshore wind farms have the potential to impact on birds through collision with rotating blades, direct habitat loss, disturbance from construction activities, displacement during the operational phase (resulting in loss of foraging/roosting area) and impact on bird flight lines (i.e. barrier effect) and associated increased energy use by birds for commuting flights between roosting and foraging areas.[39] These potential impacts have been taken into account by the RSPB and its remaining concerns with the applications are set out below, in the context of the legislative provisions summarised above, in particular those relating to appropriate assessment.

[37] See Article 4.

[38] See NPS EN-1 para. 5.3.9; Circular 6/2005 para 5.

[39] Paragraph 2.6.101; see paragraphs 2.6.100-110 and 2.6.58-71 generally. Effects on foraging areas outside an SPA are to be taken into account when assessing the effects on bird populations of the SPA: see *Hargreaves v Secretary of State for Communities and Local Government* [2011] EWHC 1999 (Admin), which concerned effects on pink-footed geese which commuted inland from their roosting sites in the SPA to feed on grain and winter cereal crops on fields adjacent to the proposed development site.

4. Offshore Ornithology Concerns

4.1 The main focus of this written representation is the qualifying interest species of both the SPA and the pSPA, comprising northern gannet, black-legged kittiwake, common guillemot, razorbill and Atlantic puffin. We identify below the concerns which cover more than one species before placing them in the context of the individual species that are relevant to the SPA and pSPA. As stated above, these concerns relate to collision risk modelling; displacement; and PBR, which are addressed in turn below. We are also concerned as to the potential collision impacts on great black-backed gull and lesser black-backed gull, until a more rigorous assessment of population scale impacts is carried out.

5. Collision Risk Modelling

Introduction

5.1 A method of quantifying the risk of bird collisions with the turbines of wind farms, known as the Band model, was formalised in 2007[40], and has become the standard method for collision risk assessments. It combines a series of parameters describing the turbine design and operation with estimates of a birds size and behaviour, to generate a predicted number of birds that would collide with a turbine over a given time period.

5.2 The model was subsequently refined to account for differences in survey methodology for offshore wind farms in 2012[41], and this also included an "extended" Band model. Supporting guidance recommended that the extended model be used, and presented alongside the basic model, if the data were suitably robust, (Band, 2012 Page 7, para 13).

5.3 The difference between these models is addressed below, but in essence the Band model now has two versions, the basic and extended, and 4 options. These are differentiated by the assumption of a uniform or heterogeneous flight distribution, and by how site specific and generic flight height data are incorporated into the model (see box). The key distinction is between the basic and the extended Band models, the other subdivisions are related to the source of input data.

[40] Band, W., Madders, M. And Whitfield, D.P. (2007). Developing field and analytical methods to assess avain collision risk at wind farms. Pp. 259-275 In: de Lucas, M., Janss, G.F.E. and Ferrer, M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation. Quercus, Madrid.

[41] Band, W. 2012. Using a Collision Risk Model to assess bird collision risks for offshore wind farms. Final report on Project SOSS-01, March 2012, to The Crown Estate, London.

5.4 The extended Band model relies on flight height distribution curves. In most cases, these are those derived from a review of flight heights and Avoidance Rates (see below)(Cook et al 2012)[42] that included "generic" flight height distributions. These distributions, which were incorporated into the Band model, were subsequently refined in Johnston at al., (2014 with corrigendum[43]). They use coarse banded survey data from surveys of proposed off shore wind farms to generate species-specific distributions of the proportions of birds that would occupy 1m height bands above the water surface, along with confidence intervals around the distributions. In the original source data, heights were allocated to broad bands during survey, and as these were delineated differently at different sites, so there was an overall spread of height bands when these data were pooled. The medians of the height bands[44] were then plotted and a distribution function fitted to the best fit, with associated confidence intervals.

5.5 These confidence intervals presented alongside the height distribution curves give an indication of the variability in flight height. The guidance accompanying the Band model recommends that these are used in the model to generate a measure of the uncertainty associated with such variability.

5.6 It should be noted that the Band 2012 Guidance also notes that due to simplifications in the model and potential sources of under- and over-estimation that the outputs should be considered to have a 20% margin of error (page 19, para 50).

5.7 The Band Collision Risk Model (CRM) has been used by the Applicant to determine whether there will be an impact on a number of bird species due to collision with turbines. For the Hornsea Project Two application the extended version of the Band CRM has been used. This is in the form of "Option 4" which utilises data collected on site, but assigned to 1m height bandwidths[45,] (see box below summarising CRM options). Below these representations explain the difficulties with the use of the Band model in this case, and how the application has incorrectly taken into account the latest recommendations from the BTO in its Avoidance Rate Review and the SNCBs AR Guidance.

[42] Cook et al., 2012
[43] Johnston *et al* 2014
[44] Or for Johnston et al 2014, the "maximum likelihood estimate", analogous to the median.

Summary explanation of collision risk options for the "Band" model

Summary explanation of collision risk options for the "Band" model[41]

Basic model
The basic model assumes a uniform distribution of bird flight heights between the lowest and highest blade sweep. This means that collision risk is the same no matter what position the bird is in the rotor swept area.

Option 1 – the original "Band" model utilises data on bird movements collected on site, usually from boat-based bird surveys. Observers most commonly assign flight height into bands; such as below rotor, within rotor swept height or above the rotor, often also using fixed structures to delineate bands.

Option 2 – this Option is mathematically identical to Option 1 but derives numbers of birds at collision height from the overall density (from the site-specific counts), combined with the proportion of these at potential collision height (determined by generic flight height distributions). This version of the model permits subsequent changes in rotor hub height to be incorporated, and examine how these changes influence bird collision mortality. Option 1 is restricted to the rotor dimensions specified during survey.

Extended model
The extended model differs from the basic model in that it allows for a heterogeneous distribution of birds in the rotor swept area. For the basic model, average collision risk is calculated across the whole rotor swept area, but the extended model includes variability in bird flux (from height distribution) and collision risk (from distance from rotor hub).

Option 3 – uses the generic bird flight height data, as described under Option 2, allocated to 1m bandwidths, alongside data on bird density derived from site surveys. As the generic distributions of bird flight height are skewed toward the lower end of the potential collision window, this therefore predicts a reduced risk of collision the greater the distance from the turbine.

Option 4 – the extended model, as for Option 3, but using site-specific bird survey data allocated to 1m bandwidths. Hornsea Project One was the first project to apply this modified version of the model (but the DECC Secretary of State's decision, on 10 December 2014, did not rely on this Option and instead determined that Option 2 was the more appropriate). Hornsea Project Two is the second project to apply this modified version of the model.

5.8 After the publication of the extended Band model, Marine Scotland Science[46] commissioned the BTO[47] to carry out a review of one aspect of collision risk modelling, the application of a correction factor known as "Avoidance Rate", and this review has now been completed[48]. In

[46] Marine Scotland Science undertakes research and provides scientific and technical advice on a number of marine and fisheries issues including aquaculture and fish health, freshwater fisheries, sea fisheries and the marine ecosystem, to the Scottish Government.

[47] The British Trust for Ornithology is an independent charitable research institute combining professional and citizen science aimed at using evidence of change in wildlife populations, particularly birds, to inform the public, opinion-formers and environmental policy- and decision-makers.

[48] Cook, A.S.C.P., Humphries, E.M., Masden, E.A., and Burton, N.H.K. 2014. The avoidance rates of collision between birds and offshore turbines. BTO research Report No 656 to Marine Scotland Science.] Report of work carried out by the British Trust for Ornithology in collaboration with the Environmental Research Institute on behalf of the Marine Scotland Science – "The Avoidance Rates of Collision Between Birds and Offshore Turbines", BTO 2014 (officially dated

response to this review, the Statutory Nature Conservation Bodies (SNCBs)[49] have published new guidance to the use of Avoidance Rates with the basic and extended model (the SNCBs AR Guidance)[50].

5.9 This Report and the SNCBs review of it was not available at the time of Examination into Hornsea Project One. However, the BTO Review was concluded before the completion of the Secretary of State's determination and was taken into account by the Secretary of State in the Hornsea Project One Appropriate Assessment, where its importance was acknowledged, as explained further below.

5.10 It is the RSPB's view that the CRM carried out by the applicant has not been done correctly and the RSPB does not think the application of the extended Band model is appropriate and hence the collision risk estimates for gannet, kittiwake, great and lesser black-backed gulls, at Hornsea Project Two are not reliable. In particular we are very concerned that advice as to the use of the extended model, included in the Band (2012) model guidance itself, in the BTO Avoidance Rate Review, in the SNCB AR Guidance and the Hornsea Project One Appropriate Assessment, has been disregarded. Therefore, the manner in which the Band model has been used by the Applicant cannot provide the necessary reassurance that there will not be an impact on the gannet and kittiwake SPA populations due to collision, either alone or in combination with other wind farms.

5.11 It is the RSPB's view that the Applicant's CRM assessment is incorrect for four reasons:

5.11.1 The manner in which data on birds in flight, in particular flight height, were collected during survey, and subsequently manipulated for analysis, exacerbates potential errors in collision risk modelling;

5.11.2 The extended Band model has been used in the absence of suitable data and contrary to the guidance in the BTO review and SNCB response;

5.11.3 There is an inappropriate use of an elevated correction factor (Avoidance Rate) which is applied to the final outputs, against the BTO AR Review and the SNCBs AR Guidance;

3.12.14 but circulated to stakeholders as final version in September 2014)

[49] These are the UK Governments' advisers and include Natural England, Scottish Natural Heritage, Joint Nature Conservancy Council (JNCC), Marine Scotland Science and Natural Resources Wales.

[50] Joint Nature Conservation Committee (JNCC), Natural England (NE), Natural Resource Wales (NRW), Northern Ireland Environment Agency (NIEA), Scottish Natural Heritage (SNH). (2014). Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review. 25th November 2014.

5.11.4 No account is given for uncertainty and variability in the model outputs, contrary to the Band model guidance and the SNCB AR Guidance.

5.12 The results of collision risk modelling have been presented by the Applicant in summary in Table 5.46, 5.46, 5.48 and 5.49 of Volume 2 Chapter 5 of the Environmental Statement, and in full in Appendix C of the Chapter 5.5.1 Ornithology Technical Report. The concerns of the RSPB with this information are set out below, taking the above reasons in turn.

Survey data

5.13 The methods for obtaining bird densities for input into collision risk modelling from boat surveys are detailed in sections C.2 and C.3 of Appendix C of Annex 5.5.1

5.14 However, the method for deriving the density of birds in flight is poorly explained (C.23), neither is the justification of this approach provided, although it appears to differ from standard methodologies, as described in the Band model guidance (page 11, para 22). The RSPB agrees with Natural England as set out in its Relevant Representations (paras 2-9) that a fully worked example of how the snap shot surveys have been converted into density estimates must be provided, along with an explanation of how these values have been used for collision risk modelling. Without such an explanation, the values presented seem unexpectedly low. Furthermore complete presentation of the density values for each month as entered into the model should be provided.

5.15 The RSPB also agrees with Natural England that there has been an inadequate survey effort undertaken at Hornsea Project Two, and so it is impossible to currently make a complete assessment.

5.16 A requirement of the basic Band model is that a value of the proportion of birds at Potential Collision Height (PCH) is inputted. As described above, for Option 1, this is obtained from site specific data, for Option 2 from the generic data (most recently Johnston *et al*., 2014). For the extended Band model, rather than a simple PCH, flight height distributions are used. Option 3, the conventional use of extended Band model, relies on the flight height distribution curves also presented in Johnston et al. 2014.

5.17 Johnston *et al.* 2014 used available survey data from proposed off shore wind farms to generate species specific distributions of the proportions of birds that would occupy 1m height bands above the water surface, along with confidence intervals around the distributions. While the RSPB is satisfied with the mathematical procedures used to generate these curves, we have concerns about the assumptions implicit in these models, which are largely acknowledged in the Band (2012) report (page 28, para 86) and Johnston *et al*., paper (page 39 para 5-8). In particular, the extended model assumes that birds are correctly assigned to the appropriate height category. This assumption is not validated, and initial indications, including from offshore post-construction monitoring, are that it may not be a valid assumption[51].

5.18 Flight height estimation to the nearest five metres intervals, as undertaken for Hornsea Project Two, is likely to provide a large degree of error, as it can be considered extremely unlikely that observers in a moving vessel, even with experience and training, are able to make such estimation with any degree of accuracy. Such an approach differs from the usual survey method, whereby flight height is allocated to broad bands, often defined by fixed structures such as mast height as reference points, as well as the upper and lower swept heights of the proposed turbine blades. The subsequent analytical approach taken for Hornsea Project Two is also novel, for both the calculation of PCH (for the basic Band model, and for the calculation of height distribution curves (for the extended model).

5.19 For the calculation of PCH, the Applicant allocates all height estimations between 22.5 and 32.5 meters into a 10m band, and from this calculates a proportion above the stated minimum rotor height of 28.04 m above mean sea level. The RSPB agrees with Natural England (as set out in its Relevant Representation (RR), para 27) that it is unclear why this novel method was used, and that it is inconsistent with methods used elsewhere. Furthermore it is entirely unnecessary for the following reason. Turbine dimensions are usually expressed in relation to sea level at Highest Astronomical Height (HAT), for reason of navigational clearance requirements (see for example Band 2012, page 52, para 3). However, the Applicant describes turbine height in relation to Mean Sea Level (MSL). If the minimum rotor height used was expressed as distance from HAT rather than MSL, as is more conventional, it would be 21.93m, meaning there is only 57cm difference between it and the 22.5m height band. Variability between sea level at survey, (assumed to be MSL) and turbine

[51] Furness, R. W., Wade, H. M., & Masden, E. A. 2013. *Assessing vulnerability of marine bird populations to offshore wind farms.* Journal of Environmental Management, 119, 56-66.

height as HAT is then corrected for by the Tidal Correction stage in the Band model (Annex 7 of Band 2012, page 52), taking account of tidal variation). The RSPB agrees with Natural England (RR para 28) that this approach highlights the spurious accuracy of the Applicant's methods for estimating flight height.

5.20 The Applicant's derivation of flight height for use in the extended Band model differs significantly from that used to derive conventional flight height distribution curves. In Johnston *et al.,* the key source for flight height data, complex statistical models are used, pooling data from a large number of surveys where heights have been allocated to bands, often with reference to fixed structures. For Hornsea Project Two the height estimates carried out during survey were allocated to 5m bands *post hoc*, which are then subdivided into 1m bands by simple averaging. This manipulation of data that are likely to be inaccurate in the first place and their subsequent use in a mathematically sophisticated model is likely to compound the fundamental error in height estimation from boats, whereas the methods used by Johnston *et al.* 2014 are designed to minimise such error.

5.21 The Band CRM recommends that the collision risk assessment should determine whether site specific data are compatible with generic data from multiple wind farms reviewed on behalf of SOSS[52]. This generic review assumed that year-round data from 40 surveys at 32 existing or proposed offshore wind farms in UK waters would capture the range of variability in seabird flight height, and used these data to model flight height distribution curves. This paper has been updated and peer-reviewed as Johnston *et* al, 2014. For most key species, the proportion of flights estimated to be at collision height (percentage at collision height), at Hornsea Project Two, is substantially lower, compared with those in Johnston *et al.,*. For kittiwake, lesser and great black-backed gulls this proportion was lower than the lowest 95% confidence intervals for the generic data. (ES Vol. 2, Ch. 5, Figure 5.2, pg5-66) These species are incorrectly referred to in the text (Appendix 5.5.1., page 5-65, para 5.6.76) as kittiwake, Arctic skua and common tern, although correctly labelled in Figure 5.2. (Appendix 5.5.1 page 5-66)

5.22 As described below, the Johnston *et al*., data are presented with confidence intervals, which allow for the expression of uncertainty associated with variability in flight height. The

[52] Strategic Ornithological Support Services.

method used for Hornsea Project Two to generate flight height distributions does not allow for this, and, aside from the issues of inaccuracy, is a major drawback of the approach.

5.23 This disparity leads to concern that assessment based on site-specific data presented by Hornsea Project Two may lead to underestimation of the risk of collision, notably for kittiwake, the PCH for which is substantially lower than in Johnston *et al.*. These figures for flight height of kittiwake at Hornsea Project Two are also considerably lower than those obtained from elsewhere by different means (e.g. Krijgsveld *et al*., 2011[53] and Mendel *et al*., 2014[54].)

5.24 Whilst site-based data are likely to be most relevant to the site-specific conditions prevailing during data collection, the magnitude of the observed difference merits critical examination. Such a critical examination has not been presented for Hornsea Project Two; rather there is the statement that standard methods were used by experienced surveyors. While we would not question the experience of the surveyors, the method used to determine flight height for Hornsea 2 was the *estimation* of height to the nearest 5m metres, (HRA, Annex 5.5.1, para 2.1.7 pg 4: "*in addition, the estimated height of flying birds was also recorded, to the nearest 5m*"). This is contrary to standard practise which is that birds are *apportioned* to height bands, often with reference to fixed structures (see discussion above). This methodological difference is the most likely explanation for the discrepancy in flight heights.

5.25 Bird flight height is dependent on bird species, wind/weather conditions, "topography" (at sea, this is influenced by waves), behaviour, and the interactions between these factors. Consequently, recorded flight height will vary within and between individual surveys and sites, as well as between bird species. Any assessment of collision risk needs to take account of different bird activity, for each species, across the site or between seasons in order to identify any site-specific factors that might help to explain the difference in the proportion of flights at collision height recorded at the Hornsea Project Two area compared with Johnston *et al*.

[53] Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beuker, D. & Dirksen, S. 2011. Effect Studies Offshore Wind Farm Egmond aan Zee. Final report on fluxes, flight altitudes and behaviour of flying birds. Bureau Waardenburg report 10-219, NZW-ReportR_231_T1_flu&flight. Bureau Waardenburg, Culemborg, Netherlands.

[54] Mendel, B., Kotzerka, J., Sommerfeld, J., Schwemmer, H., Sonntag, N. & Garthe, S. (2014) Chapter 11. Effects of the alpha ventus offshore test site on distribution patterns, behaviour and flight heights of seabirds. In Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Eds.) Ecological Research at the Offshore Windfarm alpha ventus, Federal Maritime and Hydrographic Agency. DOI 10.1007/978-3-658-02462-8_11, © Springer Fachmedien Wiesbaden 2014.

5.26 Given the outstanding questions with the approach taken to assessing flight height at Hornsea 2, the collision risk figures presented that rely only on site specific data (Options 1 and 4) cannot be relied upon in isolation. Those model options that use the generic data, Options 2 and 3, should also be considered, and in the absence of any reasoning why there are consistently lower flight heights recorded at this site compared with other studies, such results should be considered a more accurate reflection of collision risk (subject however to the further issue with the extended model as set out below).

Incorrect Model Version

5.27 As described below, the BTO, under commission of Marine Scotland Science, carried out a Review of Avoidance Rates for Collision Risk Modelling (BTO AR Review). Notwithstanding the further discussion of recommended Avoidance Rates below, one conclusion of the BTO AR Review was that the data that exist for kittiwake and gannet were inadequate to calculate an avoidance rate for use with the extended Band model for these species. This meant that the BTO recommended that only a no-avoidance collision estimate should be presented when using the extended model for gannet and kittiwake, until better data were available.

5.28 Consequently, the SNCBs issued AR Guidance (in response to the BTO Review), in which they were clear that: "*it is not appropriate to use the Extended Band model in predicting collision figures for* [gannet and kittiwake] *at the current time"*. Pg 4, para 3.2.

5.29 The Secretary of State's decision, on 10 December 2014 for Hornsea Project One did not consider the use of the extended Band model appropriate and relied on the basic Band model, Option 1 outputs within the Appropriate Assessment for both gannets and kittiwakes.

5.30 As such the RSPB does not believe that the extended Band model should be used for either gannet nor kittiwake to predict collision risk (assuming avoidance behaviour) and that only the basic model should be considered. This position is in alignment with that of Natural England (RR para 82).Therefore, those figures presented for Hornsea Project Two for these species which use the extended model, are unreliable.

Avoidance Rates

5.31 The extended Band CRM has been the subject of considerable debate across the SNCBs and offshore wind stakeholders. Concerns have partly focused on the correction factor (Avoidance Rate) to the output from the CRM, notably because of the paucity of empirical data to determine appropriate rates for seabirds. This correction factor encompasses a range of factors[55] that influence the CRM predictions, not just avoidance per se, although avoidance is a key factor[56]. The theoretical derivation of this correction factor has been based entirely on the original, basic version of the Band CRM (Options 1 and 2), and includes modelling error and uncertainty specific to that version.

5.32 Uncertainty applies to all versions of the Band CRM options and the related outputs, notably because of the lack of validation through pre- and post-construction monitoring of offshore wind farms that use the CRM predicatively, starting with pre-construction survey data and then follow up with post-construction data collection for comparison with the pre-construction predictions. Therefore, as explicitly acknowledged by the Band CRM, the Avoidance Rate for the basic model should not be directly applied to the extended model. As mentioned above, Marine Scotland Science (MSS), commissioned a review of Avoidance Rates and aspects of the Band CRM, which examined these issues – the BTO AR Review and the SNCBs AR Guidance responding to that BTO review.

5.33 Avoidance Rate is the inverse of the ratio of number of actual collisions to number of predicted collisions. As such "Avoidance Rate" is a misnomer; it is a catch all term for the inconsistency between predicted and actual mortalities, an inconsistency that can be derived from a variety of sources, including avoidance behaviour, observer bias and model error. Developing this argument further, because Avoidance Rate encompasses model error it is inappropriate to use the same Avoidance Rate for what are essentially different models, the basic and extended versions of the Band CRM.

5.34 Other sources of error in the extended Band model include incorrect estimation of height, decreased detection of higher flying birds, natural variability in numbers detected, and many

[55] Whitfield, D.P. & Urquhart, B. 2013. *Avoidance Rates in Offshore Collision Risk Modelling: a Synthesis.* Report from Natural Research Projects (NRP) to Marine Scotland. NRP, Banchory.

[56] Chamberlain, D.E., Rehfisch, M.R., Fox, A.D., Desholm, M. & Anthony, S.J. 2006. *The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models.* Ibis 148 (Suppl. 1), 198-202.

others. This means that until full validation of the extended Band model has been done, the assumption that the model needs no further correction is not valid.

5.35 Previous Scottish Natural Heritage guidance (SNH 2010) gives a default Avoidance Rate of 98% for seabird species. However this predated the extended Band CRM, and therefore could only be considered applicable to the basic model. In addition that Guidance was focused on terrestrial wind farms.

5.36 The BTO AR Review was overseen by a steering group of expert stakeholders, and provides a comprehensive review. In particular it took a qualitative approach to the available evidence, and its applicability to offshore developments. The key objective of the project was to calculate avoidance rates for five priority species of seabird; gannet, kittiwake, lesser black-backed, herring and great black-backed gulls by reviewing all the available data.

5.37 The review was unable to calculate species-specific avoidance rates for gannet, kittiwake, lesser black-backed and great black-backed gulls using either the basic or extended model. Where possible the review made recommendations based on the species groups: “all gulls”, “large gulls” and “small gulls”. The review makes clear that these recommendations are not applicable for other species.

5.38 For the basic Band model, recommendations for kittiwake were based on the small gulls group, for gannet, the all gulls group, and for lesser and great black-backed gulls the large gulls group. There was sufficient evidence to calculate a species specific avoidance rate for herring gull. These avoidance rates are shown in Table 5.1, below.

5.39 For the extended Band model, it was impossible to make any recommendation for gannet and kittiwake. As such the extended model is functionally useless for these species (see above) although the BTO Review says that a “no-avoidance” calculation can be carried out using the extended model. As shown below it was possible for some species, e.g. lesser and great black-backed gulls, to recommend a “large-gulls” avoidance rate In addition there was sufficient evidence to calculate a species specific avoidance rate for herring gull. That this was the only species where it was possible to calculate a species-specific avoidance rate for use with the basic model demonstrates that there remains very little quantitative evidence

on which to base the calculations of avoidance rate at offshore wind farms.[57]. These avoidance rates are shown in Table 5.1.

Table 5.1. BTO recommended avoidance rates for priority species.

Species	Basic model	Extended model
Gannet	98.9%[a]	n/a
Kittiwake	99.2%[b]	n/a
Lesser black backed gull	99.5%[c]	98.9%[c]
Herring gull	99.5%	99.0%
Great black-backed gull	99.5%[c]	98.9%[c]

[a]Based on "all gulls" group
[b]Based on "small gulls" group
[c]Based on "large gulls" group

5.40 The SNCBs AR Guidance is broadly in agreement with the BTO Review recommendations, except with regard to kittiwake, for which they advocate the more precautionary avoidance rate derived for "all-gulls", and applied also to gannet, in the absence of empirical data specific to these species. The SNCBs recommended avoidance rates are shown in Table 5.2. Their response makes the important point, *"a key finding of the report is the absence of studies of collision mortality and avoidance rates at offshore wind farms"* (page 1, second para) and this is particularly pertinent.

Table 5.2. SNCB recommended avoidance rates for priority species.

Species	Basic model	Extended model
Gannet	98.9%	n/a
Kittiwake	98.9%	n/a
Lesser black backed gull	99.5%	98.9%
Herring gull	99.5%	99.0%
Great black-backed gull	99.5%	98.9%

5.41 As we have mentioned, the SNCB AR Guidance makes clear that, as the BTO Review was unable to *present* an avoidance rate for either kittiwake or gannet, *"...it is not appropriate to use the extended model for these species at this time"*.

5.42 The RSPB are broadly in agreement with the recommendations of the SNCBs Guidance. This is an interim position, guided by the review of limited information, with the expectation of further data to permit a modified and, hopefully, better-informed position in due course,

[57] There were however quite large difference between site specific and generic flight height data for this species, which could arguably invalidate this.

notably for kittiwake and gannet. However, there remains the concern that little information relates to breeding seabirds which have different constraints compared with non-breeding seabirds. Consequently, site-specific cases require the inclusion of the basic model with 98% AR, notably for breeding gannets from colonies close to proposed offshore wind farms, as well as for species not included in the review.

5.43 The use of Avoidance Rates in the Hornsea Project Two assessment claims to follow those presented in the BTO Review (Annex 5.5.1 Part 2, Appendix C, C.42). However, as Avoidance Rates for the extended model are used, this represents a fundamental mis-reading of the BTO report, and also contradicts the advice of the SNCBs.

5.44 In particular, the Applicant misinterprets the BTO Review for gannet and kittiwake, stating that the BTO made no recommendation for the avoidance rate for these species, (ES Appendix 5.5.1, Appendix C, C.38). The BTO made it clear that based on the current evidence it was impossible to calculate an avoidance rate for gannet and kittiwake. The Applicant has provided no new evidence to support its suggested avoidance rates.

5.45 Notwithstanding the problems associated with the use of the extended model for gannet and kittiwake described in the previous sections, in the absence of an appropriate Avoidance Rate, the extended Band model cannot be used to make an assessment for gannet and kittiwake, and the basic Band model must be relied upon for these species. This position is in agreement with that of Natural England (RR para 82). We would further recommend that the avoidance rates recommended by the SNCBs are used, alongside 98% for breeding gannet.

Expression of uncertainty

5.46 As illustrated by the BTO Review, there are scant data to validate all Collision Risk Models for most seabirds, notably in a UK context and for breeding seabirds, whatever version of the Collision Risk Model is used. This means that outputs from the Collision Risk Model can provide only a relative estimate of collision risk for most bird species. The single figure output from the Collision Risk Model that is usually presented for each bird species, presents a misleading impression of accuracy when in fact the model output is an approximation that may or may not be close to the actual collision risk.

5.47 The flight height distribution curves by Johnston *et al* 2014, have confidence intervals alongside the curves, and the guidance accompanying the Band model recommends that these are used in the model to generate a measure of the uncertainty associated with variability in flight height.

5.48 This expression of uncertainty is only part of the recommendations in the Band (2012) guidance. As a Stage F of the calculation, he recommends consideration of the following: general variability in survey data, data unavailability out with favourable survey conditions, natural variability in bird populations, observer bias in flight height information, the simplified geometry of the Collision Risk Model, potential collision with turbine towers, variability in bird parameters (length, wingspan, flight speed), insufficient empirical data on bird displacement avoidance and attraction.

5.49 The Band model guidance also recommends the use and presentation of a range of Avoidance Rates and model options, with justification for the model option and Avoidance Rate considered most likely to characterise the collision risk at the site. Over-reliance on single figure outputs from CRM gives an erroneous impression of precision in the collision risk estimates. As described, an attempt should be made to convey the uncertainty in the estimates, aiming to express this in terms of 95% confidence intervals as set out in the Band CRM report[41]. In addition, comparison of outputs from all the different Band CRM options, contributes to a critical examination of the pronounced differences in recorded flight heights at collision risk height described above. Currently, the Applicant presents only the Band Options 1 and 4 in its HRA Report, and EIA Chapter 5, although the other options are presented in tables C5 to C 12 in Appendix C of Annex 5.5.1 of the ES. This approach does not allow for the examination of error in flight height estimation and other potential reasons for the discrepancy between site-specific and generic data. Notwithstanding the value of the presentation of a range of options in understanding uncertainty, until the outstanding questions surrounding flight height accuracy and Avoidance Rates are answered, any assessment of whether harm will be avoided should be based on the outputs of the basic model.

5.50 The BTO review makes clear that model error was previously considered as a component of avoidance rate, and therefore the derived rates presented include this component to lesser extent. As such, following the recommendations in the Band model and the BTO Review, the

SNCB response to the BTO Review details the need to take into account uncertainty, and provides the means to do this. These include the use of confidence intervals presented in Johnston *et al.,* 2014. As such only the options of the Band model that use this generic data (Options 2 and 3) can express uncertainty, and the Applicant has presented no other means of expressing variability and uncertainty in flight, these Options should be preferred (though see caveats above to the use of the extended model).

5.51 Despite these specific acknowledgements of the need to incorporate uncertainty into collision risk modelling the Applicant has made no consideration of it in their assessment of Hornsea 2, and without this crucial contextual information, such assessment cannot be considered reliable. This position is in agreement with that of Natural England (RR para 81).

The RSPB's Conclusions on Hornsea Project Two CRM

5.52 The RSPB does not consider that the collision risk modelling undertaken for Hornsea Project 2 is reliable or appropriate, for the following reasons:

5.52.1 The means by which the survey data are inputted into the model, in terms of survey effort, calculation of density and flight height are not adequately explained or justified. In particular the novel method for deriving flight heights is unreliable, and consequently only options that use generic data should be considered, provided the other issues with survey data can be resolved.

5.52.2 An incorrect option of the Band model is preferred, despite the recommendations of the BTO, the SNCBs and the Secretary of State in the Hornsea Project 1 decision. The model version used in the assessment of kittiwake and gannet should be the basic model.

5.52.3 The avoidance rates preferred are contrary to the advice of the BTO and SNCBs for the extended model.

5.52.4 There has been expression of uncertainty or variability in the expression of collision risk, contrary to the advice of the SNCBs.

5.53 Provided the issues around survey data can be resolved, the RSPB would accept the results of analysis using Option 2 of the Band model, with the associated 95% confidence intervals presented. This position is in alignment with that of Natural England with whose representations on CRM the RSPB essentially agrees. In the Secretary of State's decision for

Hornsea Project 1, the preferred Band model version was the basic model option was Option 1. The RSPB therefore remain in agreement that the basic model should be used, but differ in our preference for Option 2. The reason for this preferred option are firstly that the survey data for Hornsea Project 2 are not suitably reliable to calculate a crucial input parameter for Option 1, the PCH, and secondly that Option 2 allows for the presentation of confidence intervals that expressed some of the variability and uncertainty in collision risk estimation. This later reason has only become apparent in response to the BTO review, which was not available at the time of the Hornsea Project 1 inquiry, although the importance of it was acknowledged by the Secretary of State.

5.54 Due to the inadequacy of the model outputs presented, it is impossible at this stage to come to a conclusion with regard to the assessment of in-combination collision risk.

6. Displacement

Summary

6.1 The RSPB concerns in summary are:

6.1.1 The population estimates derived from survey data appear unrealistic and cannot be relied upon for assessment; and

6.1.2 Uncertainty as to the extent of mortality as a consequence of displacement has been inadequately expressed.

6.2 Therefore a risk of harm in respect of effects on populations of guillemot, razorbill and puffin, due to displacement, cannot be ruled out, either alone or in-combination. This position is in alignment with that of Natural England with whose representations on displacement the RSPB essentially agrees.

Introduction

6.3 Displacement arises when there is a significant reduction in the density of birds within the wind farm footprint and the surrounding area (the buffer zones), which may be partial or total displacement, compared with the baseline situation. Displacement is equivalent to habitat loss and may be temporary or permanent, depending on whether or not there is habituation, i.e. adjustment to the presence of the wind farm and a resumption of use of the

area. It may be triggered during construction[58], or during operation, depending on the direct cause.

6.4 Assessment of displacement is carried out by the Applicant in both the Environmental Statement and the Habitats Regulations Assessment, mainly in:

6.5 The ES Volume 2, Chapter 5 (Ornithology) paragraphs 5.5.3-7 (survey methodology), 5.6.41-60 (assessment methodology), 5.6.96-140 (construction effects) and 6.6.225-345 (operational effects), 5.7.223-38, 5.7.181-296 (cumulative impacts).

6.6 The Habitats Regulations Assessment paragraphs 5.8.56-77 then within individual SPA and species accounts 5.8.98-350.

6.7 The buffer of at least 2km as presented in Appendix A to the ES (Volume 5, Chapter 5.5.1 Ornithology Technical Report) and in the HRA (5.8.64) is appropriate for the assessment of displacement.

6.8 The concerns of the RSPB with this information fall under the following headings.

Population estimates

6.9 As described in the Natural England Relevant Representation, there are inconsistencies in the manner that the boat survey data have been analysed to produce population estimates, such that these estimates are much lower than would be expected, for the survey data and from the population estimates from Hornsea Project One. Because of this, unless the Applicant can provide a fully worked example to confirm that the estimation has been carried out correctly, the data put forward for analysis of displacement effects cannot be relied upon. As such it is impossible to rule out adverse impacts on common guillemot, puffin and razorbill due to displacement effects.

Displacement magnitude

6.10 In its HRA Report, the Applicant has a preferred value of 30% as the magnitude of displacement for guillemot (Tables 5.50 & 5.51 pg 136 & 137) and 40% for razorbill (Tables

[58] Pearce-Higgins, J. W., L. Stephen, A. Douse, and R. H. W. Langston. 2012. *Greater impacts of wind projects on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis.* Journal of Applied Ecology 49:386–394.

5.53 & 5.54, pgs. 142 & 143) and puffin (Tables 5.58 & 5.59, pg150 & 151), although these figures are presented in a matrix, and the values preferred by Natural England are discussed. This presentation of a range of values is welcomed as the available evidence indicates considerable variation in the observed magnitude of displacement for these species. It is important to note that this evidence has variable study methods which are not always clearly documented, so studies may not be directly comparable. Furthermore, study design is critical to the statistical power to detect change[59],[60]. The observed variability in the studies that do exist warrants further consideration and impact assessment for a range of magnitude of displacement.

Displacement and mortality

6.11 The selected displacement mortality values taken forward in the HRA Report for Hornsea Project Two do not exceed 10%, e.g. 10% and 1% respectively for guillemots during breeding, non-breeding seasons and 10% and 2% for razorbills during breeding, non-breeding seasons, and 2%, 1% and 1% respectively for gannet during breeding, post-breeding pre-breeding. Inadequate justification is given for which of these values have been chosen. We do not know the consequences for mortality of the effects of displacement and therefore cannot determine whether or not these values are precautionary, as indicated, or if they are underestimates. While we welcome the matrix approach to setting out the mortality values, further justification for the preferred values is needed

6.12 In the Hornsea Project Two assessment of displacement, a higher mortality rate has been allocated to breeding rather than non-breeding seasons. The proximate effect of displacement of breeding seabirds is likely to be a reduction in breeding productivity, especially for those species, such as guillemots, that have to make frequent food deliveries to chicks. Long-lived breeding adult seabirds are thought to be more likely to abandon a breeding attempt in any one year than risk their own survival[61],[62]. However, this theory is not always borne out in practice and several studies indicate that seabirds may compromise

[59] Maclean, I. M. D., Skov, H., & Rehfisch, M. M. & Thaxter, C. B. 2013. *Evaluating the statistical power of detecting changes in the abundance of seabirds at sea.* Ibis 155: 113-126.

[60] Krijgsveld, K. L., Fijn, R. C., Japink, M., van Horssen, P. W., Heunks, C., Collier, M., Poot, M. J. M., Beuker, D. & Dirksen, S. 2011. *Effect studies offshore wind farm Egmond aan Zee: Final report on fluxes, flight altitudes, and behaviour of flying birds.* NoordzeeWind report nr WEZ_R_231_T1_20111114_flux&flight. Bureau Waardenburg report nr 10-219 to Nordzeewind, Culemborg, The Netherlands. Final report November 2011. http://www.noordzeewind.nl/wpcontent/uploads/2012/03/OWEZ_R_231_T1_20111114_2_fluxflight.pdf, last accessed 25 June 2012.

[61] Oro, D. & Furness, R. W. 2002. *Influences of food availability and predation on survival of kittiwakes.* Ecology 83(9): 2516-2528.

[62] Monaghan et el. 1992. *Ardea* 80: 71-81.

their future survival prospects by persisting with a breeding attempt in unfavourable conditions, as found for e.g. kittiwake. In other words, the increased energetic demands of displacement on breeding seabirds, making repeat return foraging trips during the breeding season may lead to increased mortality. Such mortality may not occur immediately, but may act later, during the non-breeding season, due to loss of condition during the breeding season. Other species may adopt a strategy in between these extremes, with effects on both chick production and adult survival, e.g. Arctic skua[63], Arctic tern[64].Therefore the Applicant's approach, of apportioning a higher mortality rate to breeding than non-breeding seasons may not be appropriate for all species.

The RSPB's conclusions on the Hornsea Project Two displacement assessment

6.13 Due to outstanding concerns with the methodology used to derive population estimates, it is impossible to assess whether there will be impact due to displacement.

6.14 There are also concerns with the values used to represent displacement mortality.

6.15 As such, the information presented in the ES and the HRA Report cannot provide the necessary reassurance that there is not a risk of harm in respect of effects on populations of guillemot, razorbill and puffin, due to displacement, either alone or in combination with other wind farms.

7. Population Level Effects/Thresholds

7.1 The RSPB is very conscious that the Examining Authority is well aware of its strong objection and serious concerns about the use of Potential Biological Removal when considering possible impacts arising from Hornsea Project Two to the SPAs and their species. These are detailed in Annex 5.

7.2 However in light of the following:

7.2.1 the Examining Authority's recommendations for Hornsea Project One;

7.2.2 the Secretary of State's Appropriate Assessment for Hornsea Project One;

[63] Davis, S. E. Nager, R. G., & Furness, R. W. 2005. *Food availability affects adult survival as well as breeding success of parasitic jaegers [Arctic skua].* Ecology 86(4): 1047-1056.

[64] Monaghan, P., Uttley, J. D., Burns, M. D., Thaine, C., & Blackwood, J. 1989. *The relationship between food supply, reproductive effort and breeding success in Arctic terns Sterna paradisaea.* Journal of Animal Ecology 58: 261-274.

7.2.3 other offshore wind farm decisions;

7.2.4 recent SNCB Advice on the use of PBR; and

7.2.5 the Applicant continuing to partially rely on this method in the information provided for the Habitats Regulations Appropriate Assessment.

The RSPB does feel it is necessary to repeat our serious concerns as set out in our submissions to the Hornsea Project One Examination as well as expanding those views in light of the above.

The Examining Authority's Report for Hornsea Project One

7.3 In the Examining Authority's Report of Findings and Conclusions and Recommendation to the Secretary of State for Energy and Climate Change dated 10 September 2014 (the ExA Report), Section 5, population level effects are discussed.

7.4 At paragraph 5.64 PBR is described:

> *5.64 PBR calculations provide a means of estimating the number of additional bird mortalities that a given population can sustain. It can be used to identify sustainable harvest rates that would maintain populations at, or above, maximum net productivity level (MNPL) or maximum sustained yield.*

7.5 Just considering the language used (before taking account of our serious concerns about the way it has been used) it is clear that conservation species within a protected area is not compatible with calculating a *productivity level* and maximum *sustainable harvest rates* to ensure there is sufficient for next year's yield.

7.6 The ExA recognised the importance of PVA at para 5.71:

> *5.71 Overall the work by the various parties on PBR and PVA provided a further sensitivity analysis dimension for the ExA to the ornithological assessment of the impacts of the project.*

7.7 However for possible displacement effects PVA was not considered in the Appropriate Assessment for Hornsea Project One.

7.8 As set out in para 5.105:

> *5.105 The applicant further states that the PVA analysis also demonstrates that this scale of additional mortality is sustainable [REP-378], and NE accepted that the PVA analysis was broadly in line with the PBR analysis.....*

7.9 It is possible that due to NE's conclusion that the PVA and PBR analyses were broadly in line the ExA was not required to consider in detail the RSPB's serious concerns. Once again the RSPB wishes the language to be noted – *additional mortality is sustainable* and wishes to remind the ExA that the Conservation Objectives for all SPAs clearly state the need to maintain or if necessary restore their qualifying species' population levels.

The Secretary of State's Appropriate Assessment for Hornsea Project One

7.10 The Secretary of State's Appropriate Assessment dated 27 November 2014 for Hornsea Project One (the AA), having set out the SPA Conservation Objectives (para 6.5) namely:

> *Avoid the deterioration of the habitats of the qualifying features, and the significant disturbance of the qualifying features, ensuring the integrity of the site is maintained and the site makes a full contribution to achieving the aims of the Birds Directive.*
>
> *Subject to natural change, to maintain or restore:*
> - *The extent and distribution of habitats of the qualifying features*
> - *The structure and function of the habitats of the qualifying features*
> - *The supporting processes on which the habitats of the qualifying features rely*
> - *The distribution of the qualifying features within the site*

7.11 Goes on to recognises, at paragraph 6.18, that PBR analysis is used to determine additional mortality *without resulting in a long term population decline.*

7.12 Again supporting our view that, for reasons which have been explained by the RSPB, the concept of PBR involves the setting of thresholds which relate to the extinction of a population, or its reduction to low levels. It is not to be equated with a simple decline in population, and in particular its thresholds do not necessarily relate to a decline in population which has an adverse effect on the integrity of the SPA and therefore the use of PBR is not consistent with the SPA's Conservation Objective of e.g. *maintain*.

Other Offshore Windfarm Decisions

7.13 Reference was made during the Hornsea Project One Examination and within the Decision documents to the Firth of Forth offshore Windfarm applications – Neart na Gaoithe, Inch Cape and Seagreen Alpha and Bravo. The Scottish Ministers determined on 10 October 2014

(after the Hornsea Project One Examination had been concluded) to grant consent for all four applications.

7.14 During the Scottish Ministers' consideration of the applications they received advice from Scottish Natural Heritage, JNCC and Marine Scotland Science – all ultimately advising against the sole use of PBR as follows.

SNH and JNCC

7.15 In their 7 March and 6 June 2014 advice to Marine Scotland although PBR was recommended as an appropriate method for considering possible impacts, this was along side thresholds from proxy species, was only for consideration of impacts to one species, namely puffin as a result of displacement within and around the windfarms footprints and due to the *low confidence in the reliability of the PVA outputs due to large uncertainties in the model. Puffins, as burrow nesters, are difficult to count and the Forth Islands population has only been counted sporadically since 1980.* (page 22).

7.16 And on the basis of several caveats about the use of thresholds generally, namely (page 3):

7.16.1 These thresholds are only indicative as there is considerable uncertainty in the modelling steps.

7.16.2 The population models for each species incorporate year round natural mortality but only address one form of anthropogenic mortality (wind farm impacts) and only during the breeding season.

7.16.3 These thresholds have been set without considering the status of the population; whether it is increasing or declining (see Appendix 4). Consequently, thresholds for declining species, such as kittiwakes, should be treated with caution.

7.16.4 **Consequently, allowing impacts on seabirds that are predicted to be very close to thresholds is a high risk approach and we strongly recommend that limits to additional impacts are not set close to thresholds, especially for declining species.**

7.17 And (page 22) clearly stating that *"the inability of more sophisticated population models to predict future population sizes for puffin, means that we can assign only relatively low confidence to these PBR thresholds."*

MSS

10 April advice to Scottish Ministers

7.18 Confirms that "*For puffin the SNCBs have used PBR and the ruABC thresholds for guillemot and razorbill as proxy species. This is due to the lack of a ... PVA and the lack of suitable outputs from the* [Inchcape] *PVA."*

7.19 MSS go on to criticise SNH and JNCCs' PBR advice for puffins, preferring their own PBR calculations.

Puffin PVA

7.20 MSS went on to commission a puffin PVA and this was used instead of reliance on PBR calculations (as explained below).

7.21 Marine Scotland Licensing Operations Team – confirmed these positions in its letter to the RSPB on 1 August 2014 discussing the RSPB's concerns with the FoF applications:

> "RSPB Scotland consider that PBR is a wholly inappropriate tool for use in these assessments and ABC is not sufficiently precautionary. Marine Scotland have not relied on PBR in the Forth and Tay AA."

7.22 The Scottish Ministers carried out a joint Appropriate Assessment for all four applications and concluded within that Assessment the PBR was not appropriate.

7.23 The FoF AA page 24 explains that there are several methods for calculating acceptable levels of change to SPA species' population levels:

> 2.) Setting a precautionary level of acceptable change
> Several methods have been used to set and sense-check thresholds of acceptable change and these are discussed below:
> - Population Modelling;
> - Interpreting population model outputs using Acceptable Biological Change ("ABC");
> - Interpreting population model outputs using reduced uncertainty Acceptable Biological Change ("ruABC");
> - Interpreting gannet population model using the probability of population decline at the end of the 25 year period of effect being lower than the starting population;
> - Interpreting puffin population model using the probability of population decline in any year of the 25 year period of effect;
> - Potential Biological Removal ("PBR");
> - Ratios of median change to populations with and without the acceptable effects.

7.24 And then on page 27-28 the SMs conclude that although:

> PBR was used by the SNCBs to inform the puffin thresholds. The PBR equation is based on a simple form of population modelling, which was first formulated for marine mammals (Wade 1998) to estimate allowable by-catch. PBR requires the setting of a recovery factor (f), the value of which is a conservation management decision. Rationales in support of choice of f values rely upon criteria that are open to debate. PBR calculates the number of additional mortalities that can be sustained annually by a population, accepting the assumptions and goals of the method. **However there are concerns relating to the realism of PBR's assumptions about population dynamics. MSS recommend that reliance upon PBR should be limited to those scenarios where it constitutes the best available evidence, and this is unlikely to include scenarios where bespoke population models are available.** Although not used by MSS or MS-LOT in reaching conclusions, the PBR f values are presented in table 5 below. (emphasis added)

7.25 The AA relied upon the MSS advice and the PVA work carried out to information that assessment and did not rely on PBR in reaching its overall conclusions. For example at page 40:

> "Having considered the advice provided by the SNCBs and MSS regarding the different assessment methods for puffin, MS-LOT acknowledge the issues advised by CEH over the use of their model of puffin and the limitations advised by MSS of reliance upon use of proxy species and PBR for setting thresholds. MS-LOT consider that the justification provided by MSS on the use of the common currency for estimating effects and the MacArthur Green model for looking at the population consequences use the best available evidence and the most suitable techniques....."

7.26 Despite the RSPB having serious concerns with many aspects of the SMs' FoF Appropriate Assessment it welcomed the rejection of PBR as an acceptable method for use within such assessments as confirmed on page 69 *"Marine Scotland have not relied on PBR for reaching any conclusions on site integrity in this AA."* Going on to support the use of PVAs where possible "*MSS are of the view that, where available, PVAs provide the best available evidence for informing thresholds."...*

7.27 The AA also acknowledged several areas where more research, data and consideration was required, including "Further exploration and assessment of methods for setting thresholds" (FoF, AA, Appendix 5, Page 80).

Natural England's Hornsea Project Two Relevant Representations

7.28 NE have always been clear (as set out above) that at the very least PVA was useful as a sensitivity check of the conclusions on impacts to species' populations. In its RR for Hornsea

Project Two paragraph 5.1.1.1 (page 17) NE states that where possible PVA should be used *rather than PBR to investigate the population level impacts of the predicted additional mortality arising from the construction and operation of the project, and in combination with other projects*. And this position includes the consideration of displacement effects as set out on page 60 of its RR:

> **Population modelling approaches and demographic parameters.**
> 104. The Applicant has used a combination of Potential Biological Removal (PBR) and Population Viability Analysis (PVA) modelling outputs and metrics to assess the significance of the predicted mortality impacts from collision and displacement on the feature populations of FFC pSPA. However, for the EIA assessments against a wider population scale, the Applicant has relied only on PBR as a method of assessing the significance of predicted mortality levels. Natural England advises that where possible PVA modelling should be used rather than PBR to investigate the population level impacts of the predicted additional mortality arising from the construction and operation of the project and in combination with other projects. Therefore, Natural England would welcome further discussion with the Applicant regarding population modelling options for assessing EIA impacts for relevant species as well as appropriate metrics for assessing impacts from PVA model outputs.
>
> 105. JNCC have recently commissioned a review of seabird demographic rates which gives age specific survival and productivity rates for a range of seabird species in the UK1 2(Horswill & Robinson 2015). Natural England would welcome discussion with the Applicant regarding the potential use of these demographic rates in the population modelling as some of the suggested rates and standard errors around these differ from those used by the Applicant in their population models (as documented in Table G-1 of Appendix G of the HRA report).

7.29 The RSPB welcomes and supports NE's position on the use of PVA, in particular the recognition that PVA should be used "rather" than PBR appears to acknowledge the concerns expressed by the RSPB regarding the use of PBR.

The Applicant continuing to partially rely on this method in the information provided for the Habitats Regulations Appropriate Assessment

7.30 Despite these helpful criticisms of PBR the Applicant has continued to partially rely on it in the information provided for the Habitats Regulations Appropriate Assessment. Although the RSPB does welcome the PVAs provided, the Applicant has not carried out an in-combination PVA for gannet collision mortality.

7.31 In light of our concerns with the survey methods and calculations for bird densities and flight height and the use of the extended Band Model Option 4, we are not able to comment in detail on those PVAs but would welcome a discussion with the Applicant to understand more

about the calculation undertaken due to the *workings* not being included within the technical information accompanying its Application for Hornsea Project Two. If it is possible to see those *workings* we can at least comment on how the PVA was carried out even if our concerns over the information put into it, remain.

7.32 The RSPB's welcomes the constructive dialogue it has already had with the Applicant including Statement of Common Ground discussions and as part of progressing with that statement can discuss the PVA once further information is provided. In addition to assist the Examination Authority it may be possible for the RSPB to carry out some further calculations before the next submission deadline.

7.33 The RSPB's serious concerns about the use of PBR are summarised below and are in full in the attached Annex V.

7.34 The attached Annex V evaluates the methods used in the HRA Report and associated documents to assess the effects of additional mortality caused by collisions and displacement. The Annex assesses the applicability of these methods to the HRA Report, the pitfalls involved in their interpretation and the way in which the calculations are performed. The text below sets out the conclusions of that Annex. In short, it concludes that the use of Potential Biological Removal as a mean of assessing the impact of the Project on bird populations is flawed, for reasons which are summarised below.

7.35 It is generally accepted that an informative assessment of the impact of an intervention, such as a built development, harvesting or pollution, upon an animal population should involve the evaluation of a counterfactual: a comparison of the expected outcome for the population of interest with and without the intervention. The two principal methods available for this are (1) simulation modelling of population processes and population size (often known as Population Viability Analysis (**PVA**)) and (2) comparison of additional numbers killed because of the intervention with the Potential Biological Removal (**PBR**).

PVA and PBR

7.36 A PVA population simulation model was conducted for the HRA of all the species considered, with the exception of in-combination collision mortality of gannet, but was not used specifically for evaluation of the likely effects of the Project on this or any other species. PBR

was used in preference. For the EIA assessments against a wider population scale, the Applicant relied solely on PBR.

7.37 PVA analysis is appropriate for assessing the expected outcomes for the populations of interest with and without the anticipated additional mortality caused by the Project. The RSPB agrees with Natural England that PVA modelling should be used in preference to PBR (Natural England Relevant Representation, Appendix 1, page 30, para 104). The PVA output metric presented in the HRA is reduction in population growth rate due to this additional mortality. A more informative, and robust metric, would be the percentage difference between the population with or without additional mortality, at the end of the lifetime of the wind farm. This metric is known as the Counterfactual of Population Size(CPS).

7.38 Additional mortality as a consequence of the wind farm is inputted into the PBR and PVA as either via collision or displacement. It would be more informative to model the two effects together.

7.39 PVA are reliant on the input of demographic rates, such as age at first breeding and average clutch size. Since the PVAs set out in the HRA were carried out for the Hornsea Project One Appropriate Assessment (Applicant's Appendix X in Response to Deadline IV), there has been a review of seabird demographic rates carried out under commission of JNCC (Horswill & Robinson 2015). The RSPB agree with Natural England (Relevant Representation Appendix 1, page30, para 105)that this would be a more appropriate source of demographic rates for use in the PVA models.

7.40 The RSPB agree with Natural England (Relevant Representation Appendix 1, page 13 para 31) that there are serious inadequacies in the Applicants' approach to apportioning the birds recorded in the Hornsea Project Two survey area to SPA colony. Until these adequacies are resolved it is impossible to correctly carry out the PVA, as they are dependent on correct apportioning.

7.41 Inadequate use of the PVA approach is a serious flaw in the HRA.

7.42 PBR is presented preferentially to PVA. PBR calculations are designed to identify levels of additional mortality caused by a project or intervention that would almost certainly result in

the decline of the population of interest to extinction or, at best to low levels. Avoidance of extinction or reduction to low levels of populations of species of interest do not constitute the sole conservation objectives for the Flamborough Head & Bempton Cliffs SPA. Rather, the objectives include the maintenance or restoration of populations. An adequate test of the effects of the Project requires that the expected population size of species of interest is projected with and without the anticipated effects of the Project. PBR does not, and is not designed to do that and it is therefore inadequate for the purpose of the assessment.

7.43 The PBR approach is intended to identify levels of additional mortality that are almost certainly not sustainable by the population of interest because they exceed the levels the population could sustain, even if conditions were such that it could otherwise increase at the maximum possible rate. In the HRA, PBR results are incorrectly used in an attempt to identify the levels of additional mortality that are sustainable by the populations of interest.

7.44 The PBR calculations do not include all sources of additional mortality, so the possibility remains that the increment in additional mortality caused by the Project might be sufficient to increase the total of all additional deaths so that it exceeds the PBR.

7.45 The HRA relies upon the PBR method which requires the use of a recovery factor f which is set based upon opinion rather than being determined by theoretical or empirical constraints.

7.46 The HRA relies upon the PBR method which has not been subjected to empirical validation tests for birds or mammals.

7.47 In conclusion while the RSPB welcomes the inclusion of PVA into the HRA, we are in agreement with Natural England that it should be presented in preference to PBR for the reasons given above, and that further analysis is required, including the use of more up to date demographic rates, the modelling of displacement and collision mortality together, correct apportioning to SPA, and the use of the Counterfactual of Population Size as an output metric.

8. In Combination Considerations

8.1 We note Natural England's position in relation to in - combination, as set out in its Relevant Representations (in particular paras 37, 132-3 and 137-144). The RSPB agrees with Natural England that at this stage due to for example the projects included (only Tiers One and Two are included within the assessment) and the failure to allow for full capacity build out, specific issues concerning population estimates, displacement figures, failure to consider impacts across annual cycles it is not possible to draw any conclusions on the in-combination assessment.

8.2 The RSPB is therefore concerned that the information provided will not enable the Examining Authority (and subsequently the Secretary of State) a carry out a comprehensive in-combination assessment.

8.3 As the Examining Authority is aware, one of the main reasons for the in-combination requirement is to ensure that European sites and their species do not suffer what the EU Commission terms death by a thousand cuts[1] i.e. European Sites would be irreversibly harmed by a series of plans or projects affecting part of the site only proceeding because it would be possible to say in relation to each plan or project that it would not adversely affect the integrity of the site.

8.4 If the combined effects from other projects are excluded, changed or confidence in them questioned, a true in-combination assessment cannot be carried out and the full impacts of these applications not recorded. In addition a fair apportionment of responsibility needs to be placed on relevant developers before determining whether their projects are allowed to proceed and what mitigation or compensatory measures may be required.

9. Alternative solutions

Introduction

9.1 In paragraph 2.2.14 of its Planning Statement, the Applicant advances the following contention:

[1] CJEU Case C-258/11, Advocate General Opinion, para 76.

> "In the case of renewables, applications should not be rejected simply because fewer adverse impacts would result from developing similar infrastructure on another suitable site. This is because it is possible that all suitable sites for renewable energy infrastructure may be needed for future proposals (NPS EN-1, paragraph 4.4.3)."

9.2 The Applicant develops upon this in paragraphs 3.2.2 and 3.2.4 citing DECC's Annual Energy Statement 2012 which suggests that electricity demand is likely to increase by 30% to 50% by 2050, and DECC's Energy Security Strategy (in 2012) which suggests that capacity will need to grow by between 30 and 100% by 2050.

9.3 In essence the Applicant is arguing that future electricity demands are such that this scheme must be consented. The RSPB consider that this position is incorrect on a number of grounds, which we detail below.

9.4 The RSPB has concerns about the Applicant's position and raised the issue of alternative solutions in its Relevant Representation of 22 April 2015[65]. This section develops those concerns further.

9.5 These concerns are due to the information set out in preceding sections in our view demonstrating that it is not possible, with the required degree of certainty, to conclude that Hornsea Project Two will not have an adverse effect upon the integrity of the Flamborough Head and Bempton Cliffs SPA or the Flamborough Head and Filey Coast pSPA either on its own or in combination with other offshore wind farm schemes. Consequently, it is important to consider the next decision-making steps set out in the Habitats Regulations.[66]

9.6 Avoiding damage to the species and habitats of European Sites is a key requirement of the Birds and Habitats Directives and damage should only be justified in exceptional circumstances. As set out above, the Habitats Regulations require a step by step approach to considering plans and projects likely to affect European Sites. If damage cannot be avoided further tests apply, namely the consideration of alternative solutions and IROPI arguments – they are intended to make sure damage permitted to European Sites is both unavoidable,

[65] http://infrastructure.planningportal.gov.uk/projects/yorkshire-and-the-humber/hornsea-offshore-wind-farm-zone-4-project-two/?ipcsection=relreps&relrep=30. The RSPB asked how the issue would be dealt with within the Examination by letter of 1 June 2015 to the Planning Inspectorate - http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/EN010053/2.%20Post-Submission/Representations/Additional%20Representations/The%20Royal%20Society%20for%20the%20Protection%20of%20Birds.pdf, and the Planning Inspectorate replied by email of 2 June 2015, advising the RSPB to make these points in its written representations. This the RSPB has duly done.

[66] Throughout this section the term "Habitats Regulations" should be read as including references to both The Conservation of Habitats and Species Regulations 2010 (as amended) and The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended).

necessary, imperative and that there is a genuine overriding public interest in the plan or project proceeding and ecological compensation is provided to ensure the overall coherence of the Natura 2000 network is maintained.

9.7 Therefore, the alternative solutions and IROPI tests should be about deciding, in the interests of wider society, where the balance lies between the public interest of conserving Europe's biodiversity and the public interest(s) provided by the plan or project but only in the absence of less damaging alternative solutions to the application.

9.8 In this context the aim of the alternative solutions test is to determine whether there are other ways the public need to be met by the plan or project can be delivered without damaging European Sites.

9.9 European Commission guidance states that the primary assessment criteria for considering alternative solutions are the conservation and maintenance of SPA and SAC integrity: economic criteria cannot be seen as overruling ecological criteria.[67] At page 42, para 5.3.1, the Commission Guidance states:

> "It should be stressed that the reference parameters for such comparisons deal with aspects concerning the conservation and the maintenance of the integrity of the site and of its ecological functions. In this phase, therefore, other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria.
>
> **It rests with the competent national authorities to assess alternative solutions. This assessment should be made against the site's conservation objectives.**"

Identifying alternative solutions

9.10 We consider four basic steps are necessary to ensure the alternative solutions test is applied rigorously and fairly:

9.10.1 **Identify the needs for (or benefits of) the plan or project and decide which are genuine public needs**. These should be objective and not restricted to the need or benefits claimed by the proponent;

9.10.2 **Identify all potential and feasible alternative solutions to meet the public needs.**

[67] *Managing Natura 2000 Sites – The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC* (European Commission, 2000) http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf.

9.10.3 **Assess the impacts of these alternative solutions on Natura 2000 sites and their species/habitats.** This assessment will need to be undertaken by the competent authority. The RSPB recommends the use of a "common currency" approach as advocated by Natural England to ensure that the comparative impacts of the various possible alternative solutions are properly understood.

9.10.4 **Decide whether there are less damaging alternative solutions to the plan or project.**

9.11 The Habitats Directive requires a very wide range of options to be taken into consideration by the competent authority before a conclusion that there are no alternative solutions to a plan or project can be reached. In considering the needs or benefits relevant to the Hornsea Project Two the RSPB has reviewed the Government's legal and policy framework on energy.

9.12 This section then considers the scope of alternative solutions that are permitted within Government Policy and by the Planning Inspectorate's guidance on alternative solutions and what in our view should be considered in determining this application[68]. This section details how the RSPB has approached the issue of alternative solutions, including the schemes that have been considered, its initial conclusions on the issue, and the RSPB's recommended further steps that may need to be taken by the Examining Authority and the Secretary of State before determining the Hornsea Project Two application.

9.13 Finally, the influence of Government funding decisions is also taken into account because even if the Application is consented it is likely that without Government funding support Hornsea Project Two may not actually be built.

9.14 Overall, on the basis of publicly available information, the RSPB considers that there are less damaging, alternative solutions to the Hornsea Project Two available, and these need to be considered by the Examining Authority in making its recommendations, and the Secretary of State in reaching a final decision on the Hornsea Two Project.

9.15 We set out below our detailed comments on these points. However, it needs to be noted that the RSPB has approached this on the basis of our conclusions that it is not possible to conclude that Hornsea Project Two will not have an adverse effect on the integrity of the SPA/pSPA and their bird species. If the Examining Authority and the Secretary of State agree

[68] Both in terms of "alternatives" as required for Environmental Impact Assessment and "alternative solutions" as required under the Habitats Directive.

that consideration of alternative solutions needs to be had then of course they will need to consider all relevant European Sites and their features (see also paras 9.64 to 9.67 below).

The context for considering alternative solutions

The project context

9.16 Hornsea Project Two is a proposal for a 1.8 GW offshore wind farm, which the Applicant indicates is expected to be generating energy by the end of 2022.[69] In addition to the private interest, commercial objectives and benefits, the project is clearly intended to contribute to meeting public interest objectives set out in the Government's legal and policy framework. These public interest objectives are considered in more detail below.

9.17 The timescale for delivery of the project sets a clear framework for the consideration of the environmental impacts of this scheme, and alternative and potentially less damaging schemes, within the Government's 2025 planning horizon set out in National Policy Statement EN-1, *Overarching National Policy Statement for Energy* ("EN-1") (see below).

Government legal and policy framework on energy

9.18 Under the EU Renewable Energy Directive (2009)[70] the UK is required to source 15% of its energy consumption from renewable sources by 2020, including electricity, heat and transport[71]. Alongside the National Policy Statements, there are a number of Government plans which outline the UK's delivery of renewable energy capacity against this 15% target. These include the National Renewable Energy Action Plan (NREAP), the UK Renewable Energy Roadmap and the Electricity Market Reform (EMR) Delivery Plan.

9.19 Beyond 2020, there is an EU wide target for at least 27% of the EU's energy consumption to be produced from renewable sources by 2030[72]: however there is currently little clarity on what the UK's contribution towards this target will be. This will be planned out in the UK's 5th Carbon Budget, which will cover the period from 2028-2032. The Committee on Climate

[69] Figure 14 – Indicative Programme for Project Two, *Round 3 Hornsea Zone Offshore Wind Farm – Development Update* (SMartWind, June 2014, issue 5).

[70] Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[71] Article 3(1) and Annex I, *National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020*.

[72] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, A policy framework for climate and energy in the period from 2020 to 2030* COM/2014/015 Final.

Change[73] will publish its advice to Government on this in December 2015 with the Government proposing draft legislation for the fifth budget in 2016.[74] The UK's overall greenhouse gas emission reduction target is an 80% reduction (based on 1990 levels) by 2050, as stipulated in the Climate Change Act (2008)[75].

9.20 It is the 15% target from the Renewable Energy Directive 2009 that forms the basis for current published Government policy for securing future renewable energy supplies. This is set out in EN-1 and provides the policy framework within which Hornsea Project Two should be considered. It is important to note at the outset that in our consideration of alternative solutions the RSPB is not challenging Government policy, instead using it as a framework within which to structure its approach.

9.21 EN-1 sets out the Government's main priorities for energy: a secure and affordable supply, which it expects to be provided via market-based schemes[76]. It also sets out a clear picture of what the Government considers must be delivered by 2025. EN-1 anticipates an increase in demand from 85 GW of electricity in 2011 to 113 GW by 2025. The key element relevant to this project is that EN-1 anticipated that around 33 GW would come from renewable sources.[77] EN-1 goes onto list possible renewable energy sources including on and offshore wind farms, biomass, energy from waste and wave and tidal[78] and it is important to note that EN-1 expresses no views on the relative amounts of energy that these different renewable energy sources should provide. For convenience we set out the key excerpts from EN-1:

> 3.3.22 If we assume, as is prudent, that total electricity demand is unlikely to remain at approximately current levels (and may have increased) in 2025[33] and that a larger amount of generating capacity will be required to serve even the same level of demand[34] then, based on the UEP high fossil fuel and carbon price scenario, the UK would need at least 113 GW of total electricity generating capacity[35] (compared to around 85 GW now), of which at least 59 GW would be new build. A further breakdown

[73] The Committee on Climate Change is an independent, statutory body established under Part 2 of the Climate Change Act 2008. Its purpose is to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

[74] See The Committee on Climate Change http://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/carbon-budgets-and-targets/. Accessed 10 July 2015.

[75] Section 1(1) of the Act:"It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline."

[76] EN-1, paragraph 2.2.19.

[77] EN-1, paragraph 3.3.22 states "around 33GW of the new capacity by 2025 would need to come from renewable sources to meet renewable energy commitments as set out in Section 3.4".

[78] EN-1 pages 26-27, paragraph 3.4.3

of this figure to illustrate the scale of the challenge facing us in terms of new electricity generating infrastructure provision by technology type would be as follows:

● around 33 GW of the new capacity by 2025 would need to come from renewable sources to meet renewable energy commitments as set out in Section 3.4;
● it would be for industry to determine the exact mix of the remaining 26 GW of required new electricity capacity, acting within the strategic framework set by the Government;
● of these figures of 33 GW and 26 GW respectively, around 2 GW of renewables and 8 GW of non-renewable technologies are already under construction[36]. This leaves a balance of 18 GW to come from new non-renewable capacity; and
● the Government would like a significant proportion of this balance to be filled by new low carbon generation and believes that, in principle, new nuclear power should be free to contribute as much as possible towards meeting the need for around 18 GW of new non-renewable capacity by 2025.

[33] See paragraph 3.3.14 on likely increases in electricity demand.
[34] See paragraph 3.3.11 on intermittency of renewable electricity generation.
[35] Annex J to the UEP shows total generation capacity.
[36] UEP 40 using National Grid figures April 2010. The Government is aware that there are also a number of energy projects (approximately 9 GW in total as of April 2010) that have obtained planning permission, but have not as yet started to be built. As we cannot be certain that these projects will become operational, the Government considers that it would not be prudent to consider these numbers for the purposes of determining the planning policy in this NPS. Such numbers evolve over time and are regularly updated by National Grid in their Seven Year Statement.

3.3.26 Reducing demand for electricity is a key element of the Government's strategy for meeting its energy and climate change objectives. The 2050 Pathways Analysis shows that total UK energy demand from all sectors (heating, transport, agriculture, industry and electricity demand) will need to fall significantly per head of population by 2050 and in the most extreme scenarios, total energy demand could be almost 50% lower than 2007 levels by 2050. The analysis highlights the importance of energy efficiency and the potential that this can have to help achieve our carbon emission reduction targets.

3.4.1 The UK has committed to sourcing 15% of its total energy (across the sectors of transport, electricity and heat) from renewable sources by 2020[40] and new projects need to continue to come forward urgently to ensure that we meet this target. Projections[41] suggest that by 2020 about 30% or more of our electricity generation – both centralised and small-scale – could come from renewable sources, compared to 6.7% in 2009[42]. The Committee on Climate Change in Phase 1 of its advice to Government in September 2010 agreed that the UK 2020 target was appropriate, and should not be increased. Phase 2 was published in May 2011 and provided recommendations on the post 2020 ambition for renewables in the UK, and possible pathways to maximise their contribution to the 2050 carbon reduction targets.

[40] DECC (2009): The UK Renewable Energy Strategy (p.30). (The original URL in the footnote no longer works.)
[41] It is important to recognise that we may reach our renewable energy goals in different ways, depending on how the drivers to investment, supply chain and non-financial barriers evolve. As a result, the lead scenario presented in the Renewable Energy Strategy should not be seen as a sector or technology target.
[42] DUKES 2010 (p.184)

9.22 In light of the 15% target and Government policy, nine Round 3 offshore wind farm zones, including Hornsea, were released by the Crown Estate in 2010, with a capacity of up to

32GW. This followed the UK Offshore Energy Strategic Environmental Assessment in 2009 (the SEA). [79]

9.23 Due to the need for new energy capacity (52% of 2025 power supply is expected to come from newly constructed sources) national policy has a presumption in favour of consenting energy NSIPs, which applies unless more specific and relevant policies in the NPSs clearly indicate that consent should be refused[80]. Of course these must be in compliance with any relevant legal requirements such as the Habitats Directive. As the Government acknowledges within EN-1, project-level HRA may result in the refusal of consent for particular applications[81] and due to insufficient offshore data being available when the SEA for Round 3 was being carried out many important marine bird (and other wildlife) areas are only being identified once applicants are carrying out their marine surveys for their environmental impact and Habitat Regulations assessments.

9.24 Therefore, the key public interest objectives emerging from the Government's legal and policy framework are:

9.24.1 **EU:** source 15% of UK energy consumption from renewable sources by 2020, under the EU Renewable Energy Directive (2009)[82];

9.24.2 **EU**: target of at least 27% of the EU's energy consumption to be produced from renewable sources by 2030[83] – UK contribution to be set by Government in 2016 through the 5th Carbon Budget;

9.24.3 **UK:** 80% greenhouse gas emission target under CC Act 2008[84].

9.24.4 **UK:** Government 2025 target of 33GW of renewable energy capacity [85].

Alternative solutions in National Policy Statements

9.25 As mentioned above, the other future large scale renewable energy technologies within the scope of EN-1 are onshore windfarms, biomass and waste[86]. Wave, tidal and solar are also

[79] See http://www.thecrownestate.co.uk/energy-and-infrastructure/offshore-wind-energy/working-with-us/leasing-rounds/round-3/. Accessed 11 July 2015.
[80] EN-1, paragraph 4.1.2.
[81] EN-1, paragraph 1.7.13.
[82] Article 3(1) and Annex I, *National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020*.
[83] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A policy framework for climate and energy in the period from 2020 to 2030* COM/2014/015 Final.
[84] Section 1(1), Climate Change Act 2008 (as amended).
[85] EN-1, paragraph 3.3.22.

mentioned but at the time of drafting (2011) these sources were seen to be intermittent and incapable of being relied upon to meet demand[87]. In preparing the NPSs only a very narrow range of technology-agnostic alternative approaches were considered (EN-1's alternatives were securing low cost energy, reducing greenhouse gas emissions, and reducing other environmental impacts of schemes[88]). Although the Government acknowledges that energy efficiency improvements will be vital it does not consider them as an alternative means of helping to meet the anticipated increase in demand by 2025.

9.26 EN-1 makes it clear that development should aim to avoid significant harm to biodiversity, including through the consideration of reasonable alternatives. It sets out a number of principles for dealing with alternatives[89]:

9.26.1 The consideration of alternatives should be carried out in a proportionate manner;

9.26.2 The Examiners should be guided by whether there is a realistic prospect of the alternative delivering the same infrastructure capacity in the same timescale as the proposed development;

9.26.3 Where legislation imposes a specific target the Examiners should not reject an application on one site simply because fewer adverse impacts would result from developing similar infrastructure on another site, and the examiners are required to consider whether all the sites may be needed for future proposals (the RSPB consider this point in detail below);

9.26.4 Alternatives not among the main alternatives studied by the applicant (as reflected in the ES) should only be considered to the extent that the Examiners consider they are both important and relevant to the decision;

9.26.5 If a hypothetical alternative proposal would not accord with the policies in the relevant NPS that alternative proposal is unlikely to be important and relevant to the IPC's decision;

9.26.6 Alternative proposals which are not commercially viable, or proposals for an unsuitable site can be excluded on the basis that they are not important and relevant to the IPC's decision; and

9.26.7 Alternative proposals which are vague or inchoate can be excluded on the grounds that they are not important and relevant to the IPC's decision.

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[86] EN-1, paragraph 1.4.5. EN-3 only considers these sources (EN-3, paragraph 1.8.1).
[87] EN-1, page 19, paragraph 3.3.11.
[88] EN-1, paragraph 1.7.5.
[89] EN-1, paragraph 4.4.2.

9.27 Before moving on, it should be noted that the tests above are a statement of national policy and appear to be focused on EIA requirements and do not specifically cover the alternative solutions test as set out in reg. 62 of the Habitat Regulations. This is important: the RSPB respectfully suggests that if there is a choice for the Examiners between approving a scheme for which an adverse effect upon the integrity of a European site ***cannot*** be excluded in the knowledge that there are relevant schemes for which an adverse effect ***can*** be excluded they must reject the damaging scheme. In addition, the fact that a site may be needed at a subsequent time is an issue which can be returned to by decision makers at that future stage when the imperative *need* for damaging the site can be more clearly established.

The Planning Inspectorate's Guidance for dealing with alternative solutions

9.28 The Planning Inspectorate's advice on this issue is set out in Advice Note 10: *Habitat Regulations Assessment relevant to nationally significant infrastructure projects* (version 6, June 2015). This brief section is repeated verbatim for ease of reference:

> **Stage 3: Assessment of alternatives**
> 4.33 The applicant's assessment should identify and assess alternatives that have been considered. Details should be provided in the applicant's HRA Report.
> 4.34 Alternative solutions can include a proposal of a different scale, a different location, and an option of not having the scheme at all – the 'do nothing' approach.

9.29 We consider the first of these two requirements below. We return to the second set of requirements under the heading "The RSPB's approach to alternative solutions to the Hornsea Project Two" below.

The alternative solutions considered by the Applicant

9.30 Despite, as set out above, arguing in its Planning Statement that future electricity demands are such that this scheme must be consented, the Applicant has confined its consideration of alternatives to those required by the EIA legislation i.e. project-level alternatives available to it as the applicant and not considered the broader requirements of the Habitat Regulations' alternative solutions test.

9.31 In addition, the Applicant's Environmental Statement has limited the consideration of alternatives to two different turbine sizes, with two different layouts per turbine size within the same overall scheme footprint, delivering the same 1.8 GW in total[90]. With the exception

[90] Set out in Figure 3.5 and Table 3.3, ES Volume 1, Chapter 4 *Site Selection and Consideration of Alternatives* (January

of paragraph 2.2.14 of its Planning Statement (see para 9.1 above), the Applicant has not considered the Habitat Regulations' alternative solutions test in detail. It is thought this is due to its HRA conclusion that there will be no adverse effects on the integrity of the European sites and their species due to Hornsea Project Two (HRA, Part 1, paragraph 5.8.350, page 167), either on its own or in combination with other schemes, even though paragraph 2.2.14 of its Planning Statement clearly anticipates the potential need for consideration of the alternative solutions and IROPI tests.

The RSPB's approach to alternative solutions to Hornsea Project Two

9.32 In accordance with EN-1 the RSPB has attempted to assess possible alternative solutions in a proportionate manner, focussing on schemes where there is a realistic prospect of delivering similar capacity in a similar timescale to meet Government targets and policy objectives and have concentrated on those that are relevant to the Government's overarching renewable energy targets for 2025. At this stage, we have excluded schemes where their promoters have concluded they are currently commercially unviable (for example Atlantic Array[91], Celtic Array Round 3[92] or Islay[93] offshore wind farm schemes). All the projects that we consider have sufficiently detailed information already prepared, or are sufficiently far advanced in pre-planning, to justify consideration as alternative solutions and therefore can be included as part of the alternative solutions assessment.

Installed renewable energy capacity since 2011

9.33 When it was published in 2011 EN-1 set a clear target of 33 GW for new renewable energy capacity, to be delivered by 2025. In order to identify post-2011 contributions to renewable energy sources the RSPB has identified changes in renewable energy capacity reported by DECC since the first quarter of 2011, as set out in Table 9.1 below. Given the lead-in times on preparing the NPS all 2011 contributions are included. The figures are up-to-date to the end of the first quarter of 2015. In this time the following additional capacity has been added.

2015).

[91] Potentially 1.2 GW.

[92] Potentially 2.2 GW.

[93] Potentially 0.69 GW.

Table 9.1: Changes in installed renewable energy capacity between 2011 and March 2015

Sources: First Quarter (Q1) of 2011 data from: DECC (2012) *Energy Trends* (June 2012); Q1 2015 data from: DECC (2015) *Energy Trends* (June 2015))

	Q1 2011 figure[94] (GW)	Q1 2015 figure (GW)[95]	Increase Q1 2011 to Q1 2015 (GW)
DECC's Total	9.563[96]	26.448	16.885
Onshore Wind	4.142	8.580	4.438
Offshore Wind	1.427	4.749	3.322
Solar	0.137	6.823	6.686
Plant Biomass	0.327	2.270	1.943
Other[97]	3.532	4.026	0.494

9.34 Therefore, as of the first quarter of 2015, DECC's figures show that since the first quarter of 2011, there has been an increase of 16.885 GW of installed renewable energy capacity, or over half the 33GW target. Since the 2015 offshore wind figures were compiled, several other offshore wind schemes (Gwynt y Mor[98], Humber Gateway[99] and Westermost Rough[100]) have come fully on stream. This would increase the offshore wind contribution from 4.749 GW to 5.120 GW, an additional 0.371 GW.

9.35 Adding in this extra capacity means that since the first quarter of 2011, 17.256 GW of new renewable energy capacity has come on stream. This leaves 15.744 GW of new renewable energy to be delivered in order to meet the 33 GW target for 2025 set out in EN-1.

9.36 In considering PINS' guidance on alternatives (Advice Note 10, paragraph 4.34, page 11) we have included schemes of different scales and different locations, but due to the ready availability of information for offshore renewable NSIPs have focused on these. As set out

[94] Taken from DECC's *Energy Trends* (June 2012), Table 6.1 *Renewable electricity capacity and generation*, column headed "2011 1st quarter" (p47) and rows under the heading "Cumulative Installed Capacity".

[95] Taken from DECC's *Energy Trends* (June 2015), Table 6.1 *Renewable electricity capacity and generation*, column headed "2015 1st quarter" (p47) and rows under the heading "Cumulative Installed Capacity". It should be noted that these are provisional figures.

[96] This figure is taken directly from DECC's *Energy Trends* (June 2012), Table 6.1 *Renewable electricity capacity and generation*, column headed "2011 1st quarter" and row "Total" under "Cumulative Installed Capacity". If the figures in the rows below are added this actually comes to 9,565 MW. As there is no explanation for the difference, the total figure given in the table has been kept: this feeds through in to the figure for the total increase 2011 to 2015 which is 2MW higher than indicated by the different sectors. The total figure for 2015 does match the sum of the different sectors.

[97] This includes shoreline wave/tidal, small and large scale hydro, landfill gas, sewage sludge digestion, energy from waste, animal biomass (non-anaerobic digestion), and anaerobic digestion.

[98] Officially opened in June 2015: http://www.bbc.co.uk/news/uk-wales-33168638; also mentioned by the Secretary of State in a speech: https://www.gov.uk/government/speeches/address-to-the-renewablesuk-offshore-wind-conference.

[99] http://www.grimsbytelegraph.co.uk/power-hit-Humber-Gateway/story-26656844-detail/story.html (9 June 2015).

[100] Officially inaugurated on 1 July 2015: http://renews.biz/91063/westermost-rough-has-lift-off/ Also mentioned by the Secretary of State in a speech: https://www.gov.uk/government/speeches/address-to-the-renewablesuk-offshore-wind-conference.

above in Section 3 all other types of renewable energy capable of contributing within similar timescales are relevant to the consideration of alternative solutions. Updated data on renewable energy capacity and the energy supply pipeline from these other sources should be available to the Secretary of State at the time of her consideration of the alternative solutions question. This will enable the Secretary of State to update the figures that we present below. We return to the implications of this at paragraph 9.49 below.

9.37 Due to the renewable energy target for 2025 set by the Government we have not considered a 'do nothing' approach as required by the EIA requirements, but instead have considered the prospects of meeting the 2025 target of 33 GW of new renewable energy if the Hornsea Two scheme is not consented. We have later considered the influence of available levels of Government funding on the contribution of offshore wind to meeting the 2025 target.

Table9. 2: Capacity of offshore wind farms, operational, under construction or consented and funded

Main source: The Crown Estate (2015) *UK offshore wind – key facts 2015-16* (April 2015). See Annex 6 for a fuller version including sources for each wind farm.

Scheme categories	**Capacity (GW)**
Operational	5.120
Under construction	0.710
Consented and funded	5.105
TOTAL	**10.935**

Note: Data is taken from *UK offshore wind – key facts 2015-16* (The Crown Estate, April 2015) *table: UK offshore wind project pipeline – April 2015* (The Crown Estate, 2015), and the *Digest of UK Energy Statistics, Table 5.10 Power Stations in the United Kingdom* (DECC, 2014). This information under the *operational* heading has been updated to reflect schemes that have come fully online since April 2015.

9.38 Including the schemes that are under construction (0.71 GW) reduces the amount of renewable energy required by 2025 to 15.034 GW. It is important to note that there is another 5.105 GW worth of consented and funded schemes that have yet to start construction. In the absence of evidence to the contrary, it is reasonable to assume that all of those schemes will go ahead[101]. Taking these schemes into account reduces the amount of renewable energy to be secured by 2025 to 9.929 GW. It is worth repeating at this point that this target is to be met from ***all*** renewable sources, not just offshore wind.

[101] Recent information about these schemes is presented in Annex 6.

9.39 The RSPB notes that in the Committee on Climate Change's 2015 Report to Parliament, *Meeting Carbon Budgets – Progress in reducing the UK's emissions*, it is suggested that there are a further 2 GW of onshore wind, 2.1 GW of biomass and 0.8 GW of solar power "in the pipeline".[102] No details are provided on the individual schemes, but this could represent a further 4.9 GW of capacity which is likely to be delivered. This would reduce the remaining figure to be supplied by 2025 to 5.029 GW.

9.40 A summary is provided in Table 9.3Table 9.3 below.

Table 9.3: Summary of progress towards installation of 33 GW renewable energy capacity by 2025

Sources: for detailed references, please see paras 9.34, 9.35, 9.38 and Table 9.2 above.

	Contribution to 2025 renewable energy target (GW)	**Amount of capacity still required to meet 2025 renewable energy target of 33 GW**
Renewable energy capacity installed between Q1 2011 and Q1 2015	16.885	16.115
Offshore wind schemes on-stream since Q1 2015	0.371	15.744
Offshore wind schemes under construction	0.710	15.034
Offshore wind schemes consented and funded	5.105	9.929
Climate Change Committee "pipeline" renewable energy schemes (onshore wind, solar, biomass)	4.900	5.029

Alternative solutions to Hornsea Project Two

9.41 Based on the analysis above, the amount of energy capacity required to be installed from all renewable sources to meet the Government's 2025 target of 33 GW is 9.929 GW if consented and funded schemes are included. If the Committee on Climate Change "pipeline" figures are also included, then this reduces further to 5.029 GW. It is against the backdrop of these two figures that we consider the issue of alternative solutions to Hornsea Project Two in meeting the public interest objectives described above (see para 9.24).

9.42 The RSPB has considered additional alternative schemes under a number of headings, set out in Table 9.4 below). The headings are as follows:

[102] *Meeting Carbon Budgets – Progress in reducing the UK's emissions, 2015 Report to Parliament,* (Committee on Climate Change, June 2015), Table 1.1 Overview of renewable deployment in 2014. The pipeline schemes are ones which have been awarded a CFD or are under construction (p53).

I. *Consented but unfunded offshore wind farms;*
Those wind farm schemes which have received consent, but which have not yet secured funding via a Contract for Difference (CFD)[103]. The total capacity of these schemes is 7.402 GW.[104]

II. *Offshore wind farm schemes that are currently going through the planning process.*
There are four schemes which are currently being considered. The total capacity of these schemes (as applied for) is 3.40 GW.[105]

III. *Offshore wind farm schemes expected to be submitted in the next 12 months*
Schemes listed on the Planning Inspectorate's website. The total capacity of these schemes (as listed on the Planning Inspectorate's website) is 4.8 GW.[106]

IV. *Alternative offshore renewable energy sources*
Although there are others the only alternative energy solution we have included is the recently consented Swansea Tidal Lagoon (0.320 GW). This offers 1/6th of the energy proposed for Hornsea 2 and should be taken into consideration.

V. *Energy efficiency measures*
The RSPB has not attempted to quantify any levels of energy efficiency that it considers should be achieved. However, we note that since the adoption of EN-1 which forecast an energy rise from 85 to 113 GW in 2025, the actual energy consumption rates in the UK have actually fallen by 4% (13 TWh) to 304 TWh[107]. The Committee for Climate Change noted "Relatively high temperature drove a quarter of this fall and there is evidence to suggest improved energy efficiency (and/or changes in consumer behaviour) and changes in industrial energy use accounted for most of the remainder, with a small contribution from increased embedded generation (i.e. rooftop solar)."

9.43 Before deciding to consent the Hornsea Project Two the Secretary of State would need to satisfy herself that there is no scope for further energy efficiency improvements to offset the need for this scheme.

9.44 We have excluded 0.3 GW of the Rampion Southern Array, which the developer has announced that they will not be proceeding with.

9.45 On this basis, we have set out the energy capacity of potential alternative solutions in categories I-IV in Table 9.4 below, as explained above, focusing on offshore renewable energy NSIPs due to this information being more easily available.

[103] See "The Government's funding decisions and delivery of Government policy" below for more details on CFDs.
[104] See Annex 6 for full details.
[105] **See** Table 9.4 below for details. Navitus Bay is listed at the 0.970 GW as applied for, although an alternative scheme would bring this down to 0.630 GW and the overall total down to 3.03 GW.
[106] **See** Table 9.4 below for details.
[107] Committee on Climate Change, *Meeting Carbon Budgets – Progress in reducing the UK's emissions, 2015 Report to Parliament* (June 2015), Chapter 1: *Progress decarbonising the power sector*, page 47. Final consumption of electricity has fallen from 318.009 TWh in 2011 (*Digest of UK Energy Statistics 2012* (DECC, 2012), Table 5.2 *Electricity supply and consumption,* page 136), to a provisional figure for 2014 of 304.921 TWh (*Energy Trends* (DECC, June 2015), Table 5.2 *Supply and consumption of electricity*, page 42).

Table 9.4: Energy capacity of alternative solutions from the offshore marine renewable sector

Source: The Crown Estate (2015) *Energy and infrastructure key facts 2015-16, table: UK offshore wind project pipeline – April 2015.*

Scheme categories	**Capacity (GW)**
I - Consented but unfunded	
Aberdeen Demonstration	0.066
Dogger Creyke Beck A	1.200
Dogger Creyke Beck B	1.200
East Anglia One (unfunded part)	0.486
Inch Cape*	0.784
MacColl (Moray Firth)	0.372
Seagreen Alpha (Firth of Forth)*	0.525
Seagreen Bravo (Firth of Forth)*	0.525
Stevenson (Moray Firth)	0.372
Telford (Moray Firth)	0.372
Triton Knoll	1.200
Subtotal	*7.102*
II – Currently going through the planning process	
Hywind 2 (Buchan Deep)	0.030
Navitus Bay	0.970
Dogger Teesside A	1.200
Dogger Teesside B	1.200
Subtotal	*3.400*
III – Expected to be submitted within the next 12 months[108]	
2-B Demo[109]	0.014
Dogger Teesside C (expected Q1 2016)	1.200
Dogger Teesside D (expected Q1 2016)	1.200
East Anglia Three (expected Q3 2015)	1.200
East Anglia Four (expected Q2 2016)	1.200
Subtotal	*4.814*
IV - Alternative offshore renewable energy sources	
Swansea Tidal Lagoon[110]	0.320
Subtotal	*0.320*
Total	***15.636***

9.46 The RSPB wishes to highlight that the decision to grant consent for the schemes marked with an asterisk "*" has been judicially reviewed by the RSPB. However as the ExA is aware judicial review is focused on the process undertaken by the decision maker and rarely considers the merits of applications. Therefore, even if the RSPB were successful in its

[108] Information for Dogger Teesside C&D and East Anglia Three and Four was taken from the National Infrastructure Planning website on 7 July 2015.

[109] A lease for the two experimental twin-blade turbines was signed with The Crown Estate on 19 August 2014, with deployment anticipated in 2016 (http://renews.biz/72614/2-b-offshore-demo-wins-crown-lease/).

[110] The RSPB is aware that this is funded from a different CFD pot to offshore wind, but considers that as this is an entirely domestic funding issue and therefore the funding pot should be overlooked when considering the requirements of the Habitats Regulations.

judicial review the recourse is for the applications to be re-determined. This may be possible with the timescale being considered and therefore we have included these schemes within the above table. However we do set out below the possible capacity figures without these schemes.

9.47 Taken at face value, this suggests that there is up to 15.636 GW of alternative offshore renewable energy supply available to meet the current shortfall in meeting the 2025 target of between 5.029 GW and to 9.929 GW (see para 9.41 above).

9.48 Given the stage in the planning process, Category I provides greatest certainty in being capable of delivering capacity in a similar timescale to Hornsea Project Two. Category I can deliver up to 7.102 GW. Category II schemes are in the planning process with decisions due shortly on the NSIP schemes: Category II provides up to 3.4 GW. The total of 10.502 GW exceeds the maximum shortfall of 9.929 GW and comfortably exceeds the shortfall if the Committee on Climate Change's "pipeline" projects are taken in to account.

9.49 If Category III and IV projects are factored in, as we believe they should be, then the available offshore renewable energy alternative solutions could comfortably exceed the 2025 target of 33 GW and make a significant contribution to requirements beyond 2025. This strongly suggests to the RSPB that there is a wide range of alternative solutions available for consideration by the Secretary of State just from within the offshore renewables sector and that Hornsea Project Two does not need to be consented now to meet the 2025 renewable energy target of 33 GW.

9.50 It is important to note that other than the "pipeline" figures referred to by the Committee on Climate Change (set out in Table 9.3 above), the RSPB's calculations do not include any contribution from onshore renewables, beyond those included in Table 9.1 above, which only counts those sources generating electricity at the end of Q1 2015. Our calculations proceed on the extremely unlikely premise that the 4.9 GW of "pipeline" schemes represents the entire remaining contribution towards onshore renewables until 2025.[111] The reality is that significantly more capacity is likely to be available: in the four years since the

[111] The Committee on Climate Change notes that for onshore wind alone there are a further 5.2 GW of onshore wind schemes with planning permission and a further 7.3 GW seeking approval. *Meeting Carbon Budgets – Progress in reducing the UK's emissions* (June 2015), Chapter 1: *Progress decarbonising the power sector*, page 53.

adoption of EN-1 more than half the capacity required to meet the 33 GW target for 2025 has been installed.

Implications of the RSPB's judicial reviews

9.51 As mentioned above the RSPB has taken judicial review proceedings against the Scottish Ministers' decision to grant consent for the four Firth of Forth offshore wind farms. Only one of these projects is funded and their capacities are as follows:

- Neart na Gaoithe (0.448 GW - funded)
- Inch Cape (0.784 GW - unfunded)
- Seagreen Alpha (0.525 GW - unfunded); and
- Seagreen Bravo (0.525 GW - unfunded)

9.52 However even if these projects are excluded completely from the relevant categories the total impact would be a maximum reduction of 2.282 GW. The revised figures and the amount of the changes are set out in Table 9.5 and Table 9.6 below.

Table 9.5: Summary of alternative solutions from the offshore marine renewable sector without the Firth of Forth schemes

Note: Only category I is affected by the judicial reviews.

Scheme categories	**Capacity (GW)**
I - Consented but unfunded	5.268 *(was 7.102)*
II – Currently going through the planning process	3.400
III – Expected to be submitted within the next 12 months[112]	4.814
IV - Alternative offshore renewable energy sources	0.320
Total	***13.802***

Note: Category I excludes Inch Cape (0.784 GW), Seagreen Alpha (0.525 GW) and Seagreen Bravo (0.525 GW), unfunded schemes totalling 1.834 GW.

9.53 Based on this, in Table 9.6, we have produced an adjusted summary of progress towards installation of the 2025 target of 33 GW of renewable energy capacity.

Table 9.6: Revised summary of progress towards installation of 33 GW renewable energy capacity by 2025

Sources: for detailed references, please see paras 9.34, 9.35, 9.38, 9.50 and Table 9.2 above.

[112] Information for Dogger Teesside C&D and East Anglia Three and Four was taken from the National Infrastructure Planning website on 7 July 2015.

	Contribution to 2025 renewable energy target (GW)	Amount of capacity still required to meet 2025 renewable energy target of 33 GW
Renewable energy capacity installed between Q1 2011 and Q1 2015	16.885	16.115
Offshore wind schemes on-stream since Q1 2015	0.371	15.744
Offshore wind schemes under construction	0.710	15.034
Offshore wind schemes consented and funded	4.657 *(was 5.105)*	10.377 *(was 9.929)*
Climate Change Committee "pipeline" renewable energy schemes (onshore wind, solar, biomass)	4.900	5.477 *(was 5.029)*

Note: The "Consented and funded" category now excludes Neart na Gaoithe (0.448 GW) on the basis of a successful judicial review and the scheme not being re-determined.

9.54 As the table above shows revisiting the figures set out in paragraphs 9.34, 9.35, 9.38 and Table 9.2 above, without the Firth of Forth schemes (if the applicant decided not to get the schemes re-determined), would be as follows: There would be up to 13.802 GW of alternative offshore renewable energy supply available to meet a shortfall in meeting the 2025 target of between 5.477 GW and 10.377 GW (see Tables 5 and 6 above).

9.55 Category I (Table 9.5) can deliver up to 5.268 GW while Category II still delivers up to 3.4 GW. The total of 8.668 GW is 1.709 GW short of meeting the maximum shortfall of 10.377 GW, but still comfortably exceeds the shortfall if the Committee on Climate Change's "pipeline" projects are taken into account.

9.56 Inclusion of Category III and IV schemes still means that the 2025 target of 33 GW could be comfortably exceeded.

The Government's funding decisions and delivery of Government policy

9.57 Granting consent for an offshore wind farm is not the last way in which the Government influences whether that scheme will be built. The funding that the Government offers to support the delivery of energy infrastructure which is not currently economically viable at current electricity market prices is key: without this support a scheme will not go ahead despite being granted consent. Through this price support the Government determines and controls the source and amount of new renewable energy supply that will be built.

9.58 In the context of the offshore wind sector, this has historically been through a combination of funding mechanisms including the Renewables Obligation Certificate (ROC) and the Final

Investment Decision Enabling for Renewables (FIDER process) which took place in 2014. FIDER funded five offshore wind projects, including Hornsea Project 1[113]. The Renewables Obligation will close to all new projects on 31 March 2017.[114]

9.59 From 2014 onwards, offshore wind is funded through the Contracts for Difference (CFD) mechanism. This is a competitive process in which renewable energy generators bid for 15 year contracts in an auction process, which guarantees the generator a fixed price for the energy produced known as the 'strike price'. If the wholesale cost of electricity is less than the agreed strike price, the Government pays the generator the difference; if it is higher, the generator pays the difference back to the Government. The rationale behind this process is that when bidding, the generators will submit the lowest possible strike price that they are willing to accept, therefore pushing down costs. By doing this the Government aims to bring competition into the low carbon energy market, and deliver the maximum amount of energy using a limited pot of money. The mechanism is funded through the Levy Control Framework (LCF) which levies an additional cost onto consumers' energy bills.

9.60 There are different 'pots' of money within the LCF; offshore wind is funded through Pot 2 (less established technologies). Projects must have received planning consent to qualify for entry in to the CFD auction process.

9.61 So far there has been one allocation 'round' for CFDs for projects commissioning from 2016/17 onwards. This was announced on 26 February 2015[115]. While there will have been several consented schemes bidding in this confidential auction process, only two offshore wind projects totalling 1.162 GW gained funding: EA1 in East Anglia (0.714 GW) and Neart na Gaoithe in the outer Firth of Forth (0.448 GW). It is worth noting that the limited funding available meant EA1 only received sufficient funding for part of its 1.2 GW scheme. It is the RSPB's understanding that the next CFD round is currently expected to commence in October 2015, with a formal notification of the start of the process expected in July[116].

[113] The offshore wind funded via the FIDER mechanism were Beatrice (0.664 GW), Burbo Bank Extension (0.258 GW), Dudgeon (0.402 GW), Hornsea 1 (1.200 GW) and Walney (0.660 GW), a total of 3.184 GW. FIDER also funded 3 biomass-based schemes, Drax Unit #1 conversion (0.645 GW), Lynemouth (0.420 GW) and Teesside (0.299 GW), a total of 1.364 GW. In total 4.548 GW was funded, 70.01% offshore wind, 29.99% biomass.

[114] Note that Clause 60 of the Energy Bill which received its first reading in the House of Lords on 9 July 2015, proposes to close the Renewables Obligation for onshore wind on 31 March 2016. See: http://www.publications.parliament.uk/pa/bills/lbill/2015-2016/0056/16056.pdf, accessed 11 July 2015.

[115] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407059/Contracts_for_Difference_-_Auction_Results_-_Official_Statistics.pdf.

[116] https://lowcarboncontracts.uk/system/files/round_2_operational_plan_v2.pdf.

Unless the rules are changed Hornsea Project Two will not be in a position to bid in the second round (expected to invite applications this autumn) as it will not have its consent in place.

9.62 It is therefore clear that the availability of Government funding is acting as a major and real constraint for the delivery of offshore wind farm schemes: there is a surplus of consented and planned offshore wind projects in the supply pipeline in comparison to the amount of Government funding that appears to be available (as shown above in Table 9.4). The Committee on Climate Change recently recommended that the Government should set out the intention to contract 1-2 GW per year of offshore wind, which provides a clear indication of the amount of capacity funding which is needed on an annual basis[117].The Category I schemes would therefore represent approximately 3-7 years of delivery, the Category II schemes a further 2-3 years, and the Category III schemes a further 2-5 years, taking delivery beyond the 2025 target.[118]

9.63 The RSPB continues to be supportive of the overall Government policy objective in respect of large scale offshore wind but it is clear that the pot of money available for offshore wind is de facto constraining that policy to a more limited objective. Therefore, any consideration of the public interest objectives for offshore wind needs to take account of the practical influence on that policy of Government funding decisions. This properly rests with the Secretary of State who oversees all relevant elements. If Government funding decisions act to constrain the contribution of the offshore wind sector to meeting stated Government renewable energy supply targets (both for 2025 and beyond), then it is clear that there will be a significant number of alternative solutions competing for the pot of money the Government has chosen to allocate offshore wind to meet its contribution to the UK's renewable energy requirements.

Other Natura 2000 features (marine mammals, habitats)

9.64 As set out previously (para 9.10), where it is not possible to rule out an adverse effect on the integrity of an SPA or SAC and their species, the competent authority can go on to consider

[117] Committee on Climate Change, *Meeting Carbon Budgets – Progress in reducing the UK's emissions*, *2015 Report to Parliament* (June 2015), *Overview, Table 6, Summary of recommendations – central Government*, recommendation 4 (page 40).

[118] The larger range for the first figure reflects the range from 5.268 to 7.102 GW depending on the outcome of the judicial reviews.

whether there are less damaging alternative solutions that meet the public interest objectives of the plan or project.

9.65 The purpose of the alternative solutions section above is explicitly to demonstrate that there are other schemes that could produce the energy proposed to be supplied by Hornsea Project Two which would need to be considered to determine if they have less harmful effects upon the ornithological features of affected SPAs. It explicitly does not address the implications of Hornsea Project Two for SAC features, nor does it address the implications for SAC features of those schemes the RSPB has identified as potential less damaging alternative solutions as these matters are outside the RSPB's area of expertise. The RSPB also does not comment upon the risk of harm to European Protected Species (e.g. harbour porpoise)[119]. These are matters for other parties to the Examination, as well as the Examining Authority and the Secretary of State.

9.66 However, the RSPB is aware from discussions with the Wildlife Trusts that some of those schemes that the RSPB has identified as potential alternative solutions to Hornsea Project Two may not be acceptable due to their impacts upon marine mammals, either as SAC features or as European Protected Species, during the construction or operational phases for example, the Dogger Bank SAC. The RSPB also notes the implications of the current consideration being given to the designation of one or more SACs to protect Harbour Porpoise.[120] As such, the potential alternative solutions that we identify will also need to be evaluated for their impacts upon these candidate SACs and their features by the Secretary of State.

9.67 The RSPB understands from the Wildlife Trusts that by a careful choice of construction methods and choice of turbine foundations it may be possible to reduce the impacts of those other schemes upon marine mammals and upon the habitat of the Dogger Bank SAC. The Wildlife Trusts are far better placed to advise on these matters and the RSPB defers to them on this issue. However, it is our view, following discussion with the Wildlife Trusts that appropriate safeguards could be put in place to make the potential alternative solutions we identify above acceptable in terms of their impacts on SAC features and European Protected Species. We would urge the Examining Authority and the Secretary of State to consider these safeguards alongside our proposed alternative solutions.

[119] Listed in Schedule 2 of The Conservation of Habitats and Species Regulations 2010 (as amended).
[120] Set out in Natural England's Relevant Representation (paragraphs 4.2.2 and 4.2.3).

10. Onshore – Ecology and Nature Conservation

Intertidal Ornithology

10.1 As detailed in the HRA, Part 1, paragraph 2.2.13 (page 6), the proposed cable landfall site lies within the Humber Estuary Special Protection Area (the Humber SPA), Special Area of Conservation (SAC) and Ramsar site[121]. The RSPB stated in its relevant representation that it had concerns over the impacts of the Project, both alone and in combination with other projects, on the Humber Estuary SPA and its designation species.

10.2 Having established that the proposed cabling works will involve no permanent land-take from the Humber Estuary and its associated nature conservation designations (HRA, Part 1, Table 5.1), the RSPB's principal concern in relation to the Humber Estuary SPA and its species is the potential disturbance and displacement impacts resulting from the construction phase for the cabling. The RSPB also agrees with Natural England's concerns over potential operational phase impacts set out in paragraphs 5.5.2.1 and 5.5.2.2 of its Relevant Representation.

10.3 As recorded in the HRA, Part 1, Table 5.1, a construction window of April to September inclusive was identified by the Applicant from an early stage as appropriate to mitigate for potential impacts on Humber Estuary SPA birds to avoid an impact on wintering birds (ES Vol. 3, Chapter 4, Table 4.1, pg 4-2). In considering this proposal, the RSPB is concerned with this period due to the potential impact on migratory and wintering SPA species. We note (HRA, Part 1, Table 5.1, page 28) that the intertidal works to install the cables could involve up to four phases over a 6 year period for the Hornsea 2 project alone. We consider this to be far from a transient impact and are concerned with the potential longer term impacts of such ongoing disturbance. The RSPB question why this needs to take up to six years when the Hornsea 1 construction work (for four ducts and cables rather than Hornsea 2's eight) is expected to last only two years. We question why twice the work for Hornsea 2 cannot be completed in a maximum of four years instead of the six proposed. We return to this issue under the consideration of in-combination impacts below.

In-combination Impacts

10.4 Following clarification during the Hornsea 1 examination, the RSPB agreed that the proposed cable landfall construction works associated with Project 1 alone will lead to some

[121] Listed under the Convention on wetlands of international importance, Ramsar 1971.

disturbance but that the effects of this alone will not be unacceptable and therefore do not constitute an adverse effect on the integrity of the Humber Estuary SPA. However, as noted in paragraph 0 above, we are concerned about the cumulative impacts on the intertidal area of the cable work for the Hornsea 1 and Hornsea 2 schemes. This is particularly important as the owners of the Hornsea 1 scheme made it clear in their relevant representation that they are now entirely separate from the Hornsea 2 promoters, and that this has profound implications for the ability to work cooperatively to minimise the environmental impacts.[122] The only substantial high tide wader roosts in this part of the estuary are in the vicinity of the cable landfall. Disturbance in this area may cause temporary disturbance f this roost, but there is concern that disturbance over several years may cause abandonment of these roosts and the associated feeding areas.

10.5 The HRA and ES have considered three possible scenarios for cable laying:

- Scenario One – Project 1 constructed before Project 2.
- Scenario Two – Project 2 constructed before Project 1.
- Scenario Three – Project 1 and Project 2 constructed at the same time.

The HRA states that cable laying for Project 1 is anticipated to be undertaken in two phases in successive years (HRA, Part 1, paragraph 5.9.123), and notes that when taken together with Project 2 that the construction works could take up to 7 years (HRA, Part 1, paragraph 5.9.127) in total.

10.6 In Scenario Three the cabling work for Projects 1 and 2 will take place at the same time (HRA, Part 1, paragraph 5.9.126). The RSPB notes that there is a "staggered" approach where the drilling of cable ducts for one scheme can be undertaken at the same time as cable laying for the other scheme. The RSPB requests that the Hornsea 2 developer liaises closely with the Hornsea 1 developer to identify whether this is the least disturbing permutation for Scenario Three, and if so, to ensure that this approach is adopted in preference to Scenarios One or Two.

10.7 The RSPB notes that the potential impacts from cable works arising from Hornsea Project 3 have not been assessed (HRA, Part 1, paragraph 5.9.119). Given the potential duration of works on the intertidal zone already highlighted above, further extensions of the disturbance

[122] Representation No. 18, Julian Boswell on behalf of Heron Wind Limited, Njord Limited and Vi Aura Limited.

due to cable laying works for Projects 3 and 4 should be considered now. Failure to do so will represent a missed opportunity to minimise the harm of the total quantum of cable laying and will increase the risks that Projects 3 and 4 may encounter difficulties due to disturbance caused during the laying of the cables for Projects 1 and 2.

10.8 The RSPB ask that detailed monitoring of the cable laying impacts of Projects 1 and 2 is undertaken and that lessons learnt from that are used to make any necessary changes to the cable laying regime for Project Three in order to reduce its impacts on the intertidal area.

Development Consent Order and Deemed Marine Licence

10.9 Further comments on the draft Development Consent Order and deemed Marine Licence are set out below, however it is convenient to set out here particular points which arise in relation to onshore concerns. The RSPB considers it necessary for such details to be added to the Ecological Management Plan required under Schedule A, Part 3, Paragraph 7 of the draft DCO, to be approved by the Local Planning Authority in consultation with Natural England.

10.10 The RSPB considers it necessary to amend Part 2 Paragraph 10(2)(b) of the Deemed Marine Licences A2 and B2 (set out in Schedules I and K to the draft DCO) so that it either incorporates the detailed construction methods and timing, as set out in the intertidal clarification note referenced above, or as such details are added to the Ecological Management Plan and it forms part of the Marine Licence requirements.

10.11 The RSPB are concerned about the reference to a 7.7m tide at Grimsby that is used to control operations over the intertidal zone. This is set out in section 20(4) of the Deemed Licence under the Marine and Coastal Access Act 2009 – Deemed Marine Licences A2 "Transmission Assets" and B2 "Transmission Assets" (in Schedules I and K to the draft DCO).

10.12 The provision currently limits works "within one kilometre seaward of the seawall during the period of time commencing two hours before a high tide greater than 7.7 metres (as measured at Grimsby) between 1 April and 31 May (inclusive) and 1 August to 30 September (inclusive)". The RSPB is concerned about tides that are greater than 6.5m when measured against Ordnance Datum at Tetney. Grimsby has a 1.2m sill, and if it is not included in the 7.7m measurement at Grimsby we are concerned that there will be few, if any, high tides at Tetney at which works associated with cable laying would stop. We ask that the text of the

DCO is amended to read either “as measured at Grimsby including the 1.2m outer sill”, or by changing the measurement to a 6.5m high tide (above Ordnance Datum). This amendment would ensure that work at Tetney would stop when the tide reached 6.5m at that location, and would address our concerns on this point.

11. Draft Development Consent Order (DCO) and Deemed Marine Licence (DML), Version 2

11.1 As with Hornsea Project One the RSPB is likely to only have limited comments in relation to the draft DCO and DML. Unfortunately due to only recently spotting that a second version of the DCO and DML has been submitted by the Applicant, the RSPB was unable to review in detail prior to the submission deadline for these Written Representations.

11.2 However, the RSPB will ensure that it reviews that second version as soon as possible and passes on issues of concern or suggested redrafting to the Applicant.

Annex I – Qualifications and Experience of the RSPB's Experts

Dr. Aly McCluskie

Dr. Aly McCluskie is a Conservation Scientist with the RSPB, based at the RSPB's Scottish Headquarters in Edinburgh. He holds a BSC(Hons) and a PhD in otter marine ecology both from the University of Glasgow. He has worked in consultancy (Natural Research Ltd, 5 years) and for the RSPB (7 years) as well as working freelance, largely examining the potential ornithological impacts of renewable energy developments. His main role within the RSPB is providing scientific support to caseworkers, with particular regard to the impacts of marine developments. He holds an honorary lectureship at the University of Glasgow, has sat on several scientific steering groups, including the current avoidance rate review, has presented papers to a variety of international conferences, and has co-authored peer-reviewed scientific papers and reports.

Annex II – The Flamborough and Bempton Cliffs SPA and the Flamborough and Filey Coast potential SPA

1. Flamborough and Bempton Cliffs SPA

Designation

1.1 Flamborough Head projects into the North Sea from the Yorkshire Coast rising to 135m on the Bempton Cliffs. It was designated under Article 4(2) of the Birds Directive as an SPA in 1993 due to the presence of 83,370 pairs of black-legged kittiwake (*Rissa tridactyla*), representing 4% of the Eastern Atlantic breeding population at the time of survey (1987).

1.2 In 2001, the UK SPA Review found the site also qualified under Article 4(2) as a site regularly supporting at least 20,000 seabirds. At the time of designation, the site regularly supported 305,784 individual seabirds including: puffin (*Fratercula arctica*), razorbill (*Alca torda*), guillemot (*Uria aalge*), herring Gull (*Larus argentatus*), Gannet (*Morus bassanus*), and Kittiwake.

Conservation Objectives

1.3 On 29 May 2012, Natural England published revised Conservation Objectives for the SPA, and subsequently revised them on 30 June 2014[123]. These are:

> *With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified ("the Qualifying Features" listed below), and subject to natural change;*
> ***Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:***
> - *The extent and distribution of the habitats of the qualifying features*
> - *The structure and function of the habitats of the qualifying features*
> - *The supporting processes on which the habitats of the qualifying features rely*
> - *The populations of the qualifying features, and,*
> - *The distribution of the qualifying features within the site.*
>
> *This document should be read in conjunction with the accompanying Supplementary Advice document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.*
> ***Qualifying Features:***
> *A188 Rissa tridactyla; Black-legged kittiwake (Breeding)*

2. Flamborough and Filey Coast pSPA

2.1 In January 2014, Natural England opened a formal consultation on proposals to extend the existing SPA and rename it as the Flamborough and Filey Coast SPA. The proposals comprise changes to the designation boundary and review of the qualifying species. Further details are provided in the following sections.

Designation Proposals

2.2 The pSPA proposals comprise three key boundary changes:

[123] Available here: http://publications.naturalengland.org.uk/publication/5400434877399040 (accessed 12 July 2015).

2.2.1 A proposed terrestrial extension running from the cliffs at Filey Brigg north-west to Cunstone Nab, which is being considered to incorporate important breeding areas for seabird that currently fall outside the existing SPA.

2.2.2 Marine extensions out to 2km from the seabird colonies which are proposed, due to the importance of these waters to breeding seabirds.

2.2.3 Modification of the landward boundary to ensure that the features of the pSPA remain protected into the future.

2.3 Natural England has also conducted a review of the seabird populations using contemporary data. This concluded that the pSPA, including the proposed seaward and landward extensions qualifies under Article 4(2) of the Birds Directive because:

2.3.1 The site regularly supports more than 1% of the biogeographical population of four regularly occurring migratory species (black-legged kittiwake *Rissa tridactyla*, northern gannet *Morus bassanus*, common guillemot *Uria aalge* and razorbill *Alca torda*). Therefore the site qualifies for SPA designation in accordance to the SPA selection guidelines.

2.3.2 The site regularly supports an assemblage of more than 20,000 breeding seabirds. Therefore the site qualifies for SPA designation in accordance to the SPA selection guidelines.

2.3.3 Several species components of the pSPA assemblage qualify for a generic seaward extension of the SPA (northern fulmar *Fulmarus glacialis* and northern gannet *Morus bassanus* for a generic 2km seaward extension; common guillemot *Uria aalge* and razorbill *Alca torda* for a generic 1 km seaward extension).

2.4 Natural England's summary of the ornithological interest of the pSPA is therefore as follows with the key species are set out in more detail in Table 1 below[124].

2.5 The application of SPA selection guidelines (JNCC 1999) to current data for this site confirm that it qualifies by regularly supporting internationally important numbers of breeding black-legged kittiwakes, northern gannet, common guillemot and razorbill and an assemblage of European importance of over 20,000 breeding seabirds. Black-legged kittiwake, northern gannet, common guillemot and razorbill are all main components of the assemblage and present in internationally important numbers. However, northern fulmar is also present in sufficient numbers to warrant being listed as main component species of the assemblage, since numbers exceed 2,000 individuals (10% of the minimum qualifying assemblage of 20,000 individuals). In addition, Atlantic puffin, herring gull, European shag *Phalacrocorax aristotelis* and great cormorant *Phalacrocorax carbo* are also part of the breeding seabird assemblage.

Table 1: Summary of Ornithological Interest of the Flamborough and Filey Coast pSPA

Species	Count (period)	% of subspecies or population (pairs)	Interest Type
Original classification			
Black-legged kittiwake *Rissa tricactyla*	83,700 pairs (1987)	4% Western Europe	Migratory
Revised proposal			
Black legged kittiwake *Rissa tridactyla*	44,520 pairs 89,041 breeding adults (2008-2011)	2% North Atlantic	Migratory

[124] Natural England's *Proposed extension to Flamborough Head and Bempton Cliffs Special Protection Area and renaming as Flamborough and Filey Coast Special Protection Area*, Departmental Brief, January 2014 at page 4.

Northern gannet *Morus bassanus*	8,469 pairs 16,938 breeding adults (2008-2012)	2.6% North Atlantic	Migratory
Common guillemot *Uria aalge*	41,607 pairs 83,214 breeding adults (2008-2011)	15.6% (*Uria aalge albionis*)	Migratory
Razorbill *Alca torda*	10,570 pairs 21,140 breeding adults (2008-2011)	2.3% (*Alca torda islandica)*)	Migratory
	Count period	**Average number of individuals**	
Seabird assemblage	2008-2012	215,750	

Black-legged Kittiwake Population Declines

2.6 Since this site achieved SPA status, the UK kittiwake population has experienced severe declines and has fallen by 55%[125] (between 1986 and 2011). This has been reflected within the SPA with a reduction in numbers from the 83,370 breeding pairs upon which classification of the site was based in 1993 (supported by counts of 80,180 pairs in 1979 and 85, 395 pairs in 1987) to an average of 44,520 breeding pairs between 2008 and 2011, a fact that is not mentioned in Natural England's Relevant Representation.

2.7 In 2001, the UK SPA Review's site account for the SPA reiterated the 83,370 breeding pairs of kittiwake, and also identified an assemblage feature comprising 305,784 individual seabirds including: puffin *Fratercula arctica*, razorbill *Alca torda*, guillemot *Uria aalge*, herring gull *Larus argentatus*, gannet *Morus bassanus*, kittiwake *Rissa tridactyla*. Since that time, the numbers of some of the species included within the assemblage features have also declined (e.g. herring gull fell by 24% and recordings of puffin at the SPA indicate reductions in that population: Seabird Colony Register 1987 recorded 7,000 puffins whereas Seabird Colony Register 2000 recorded only 2,615 puffins).

2.8 In the context of such steep and national declines, and the requirements of the Birds and Habitats Directives (as summarised below), the RSPB has expressed concern about the consideration of contemporary data alone in relation to both kittiwake and the assemblage feature, for it would lead to the designation of a site at population levels that have declined from previous levels. This decline must also be taken into account when considering the effect of this Project, for it emphasises the sensitivity of the SPA and pSPA to adverse impacts from development outside these areas. The data above clearly illustrate the ongoing population declines currently being experienced by kittiwake in particular, and the implications of these for not only nature conservation site designation, but also impact assessment for plans and projects.

[125] *State of the UK's Birds 2012*, http://www.rspb.org.uk/Images/SUKB_2012_tcm9-328339.pdf.

Annex III – The SPA Species of Concern

1. Gannet

Population and distribution

The Gannet breeds on both sides of the Atlantic Ocean between approximately Norway in the north and the equator in the south[126]. Most recent estimates of the European population range between 300,000 and 310,000 breeding pairs[127], with European colonies accounting for 75 –94% of the species' range[126]. The most recent estimate of the breeding population of gannets in Britain was 218,546 nesting pairs[128] representing 59% of the world population[129].

Breeding on the Flamborough and Filey Coast

The SPA is the only gannetry in England and in 2015 supported 12,494 occupied nests[130] (HRA, Part 2, paragraph H.22, page 356), concentrated in approximately 5km stretch of cliff[131]. Within this area is the RSPB's Bempton Cliffs Reserve. This SPA population accounts for approximately 3.3% of the North Atlantic biogeographic population[132]. These latest data reflect the ongoing increases in the gannet breeding population at the SPA and the welcome proposals to designate the Flamborough and Filey Coast SPA in part for breeding gannet.

The steady rate of increase in this area, since its colonisation in the 1960s, has become more rapid since 2000. The potential for further growth is considerable in view of the large number of non-breeding immature birds associated with the colony; 1,470 in 2009, and 798 in 2012[133]. This contrasts with the situation across Britain and Ireland as a whole, where the rate of population growth dropped to 1.33% per year during 1995-2005, from the previously recorded 2% per year, consistent with the expectation that the rate of increase would plateau[134].

2010 to 2012 were good breeding seasons at the SPA, with breeding productivity per active occupied nest of 0.82 in 2010, 0.83 in 2011, and 0.85 in 2012, compared with 0.86 in 2009[133].

Hornsea Project Two defined the breeding season for gannets as April to August (ES, Chapter 5, Table 5.17, *Seasons for species taken forward to displacement impact assessment*, p5-63). Taking the example of the SPA, adult gannets return to the colony from January onwards, with the majority of adults back by March. The earliest egg laying date is at the end of March, most egg laying occurring in April. The fledging peak is in August, decreasing through September.

Defining the breeding season is not an exact science as there is overlap, with some birds returning to the colony whilst others remain on wintering grounds. The period from the start of April until the

[126] BirdLife International, 2014. *IUCN Red List for birds*. Downloaded from http://www.birdlife.org on 4 February 2014

[127] Bufield, I. & Van Bommel, F. 2004. *Birds in Europe: Population Estimates, Trends and Conservation Status.* BirdLife International, Cambridge, UK.

[128] Baker, H., Stroud, D., Aebischer, N.J., Cranswick, P.A., Gregory, R.D, McSorley, C.A., Noble, D.G., Rehfisch, M.M. 2006. *Population estimates of birds in Great Britain and the United Kingdom.* British Birds 99:25-44.

[129] Mitchell, P.I., Newton, S.F., Ratcliffe, N., Dunn, T.E., 2004. *Seabird Populations of Britain and Ireland.* Poyser, London

[130] Apparently Occupied Nests (AON) is a standard census unit used to estimate the number of pairs of colonially nesting bird species, which includes most seabirds. AON is one way to estimate the number of breeding pairs.

[131] There were also approximately 2,500 non-breeders on potential nest sites.

[132] A biogeographic population is defined by JNCC as a group of birds which breed in a particular location (or group of locations), breed freely within the group and rarely breed or exchange individuals with other groups.

[133] Langston, R., Teuten, E. & Butler, A., 2013. *Foraging ranges of northern gannets Morus bassanus in relation to proposed offshore wind farms in the North Sea: 2010-2012.* RSPB Report to DECC, December 2013.

[134] WWT Consulting, 2012. SOSS-04 *Gannet Population Viability Analysis. Demographic data, population model and outputs.* Wildfowl and Wetlands Trust (consulting) Ltd, Slimbridge.

end of September coincides with the main breeding activity of egg-laying, incubation, and chick-rearing. Prior to that time, birds commute between feeding and nesting sites on a more irregular basis, whilst defending their nest location.

Migration and non-breeding season

The British gannet population is partially migratory, with significant variation in migratory strategy depending on age and breeding colony. Migration is particularly strong among first year birds, but there is substantial variation in migratory patterns with birds of all plumage states (ages) occurring in all parts of the range throughout the year, showing a degree of dispersive movement away from breeding colonies[135]. Most adults depart the breeding colony at the SPA in late September/early October. A period of dispersal within the North Sea follows before onward migration to wintering grounds, ultimately to the south of the UK.

Ringing data show that juveniles mostly winter in areas from the Bay of Biscay to the subtropical and tropical waters off West Africa[134,135,136]. It was previously believed that distance travelled from the breeding colony reduced with age so that, by adulthood (5 years and older), most birds from East coast colonies remained in the North Sea[134,135]. However, the recent tracking studies from Bempton Cliffs have shown a more complicated picture.

Adult gannets, at FHBC SPA, were fitted with battery-powered, Platform Terminal Transmitters (PTTs), which transmit data via the Argos satellite, at FHBC in 2010 (n=14 birds), 2011 (n=13) and 2012 (n=15).

Breeding gannets are central place foragers[137]. Consequently, their foraging ranges are likely to be most constrained when provisioning growing chicks, although they can still cover large distances during this period[133] (HRA Part 1, paragraph 5.8.58, p107). As central-place foragers during the breeding season, gannets (and other seabirds) have to return to their nest – the central place – regularly and so interception of frequent foraging trips by offshore wind turbines may present more of a collision hazard than for migrating birds on passage, especially if the turbines coincide with foraging areas where plunge-diving gannets will occur at rotor-swept height. Conversely, if the birds display a high degree of avoidance of wind turbines when making frequent foraging trips during the breeding season, there is a concern that gannets may be effectively displaced from suitable foraging areas. Whilst gannets have greater foraging flexibility than many other seabirds, there are potential implications for breeding productivity if their feeding areas are constrained. FHBC has had high levels of breeding productivity in recent years and, as described above, is the only gannet colony in England. The UK has a special responsibility for gannets as it hosts over 50% of the world's breeding northern gannets.

The adult gannets fitted with PTTs at FHBC SPA showed considerable use of the Hornsea Round 3 zone, including the proposal area for Project Two (Annex IV, Figure 1), both for foraging and flying through to reach other foraging areas, during the chick-rearing season[133] (ES, Chapter 5, paragraph 5.6.250, page 5-84).

Satellite tags were used because of the logistical difficulties associated with the Bempton colony, thereby enabling data capture without need for further entry into the gannet colony. Data from

[135] Wernham, C., Toms, M., Marchant, J., Clark., J. Siriwardena, G. and Baillie, S. [Eds], 2002. *The Migration Atlas: Movements of the Birds of Britain and Ireland.* T & AD Poyser, London.

[136] Snow, D.W., and Perrins, C.M., 1998. *The Birds of the Western Palearctic, Concise Edition.* Oxford University Press, Oxford.

[137] Gremillet, D., Pichegru, L., Siorat, F., & Georges, J.-Y. 2006. *Conservation implications of the apparent mismatch between population dynamics and foraging effort in French northern gannets from the English Channel*. Marine Ecological Progress Series 319: 15-25.

satellite tags do not readily permit the distinction of foraging from other behaviours. However, trip endpoints represent a conservative but standardised indication of foraging locations, and were distributed throughout the area of active use. All tagged birds were recorded in the Hornsea Round 3 zone. One tag failed or was lost within a few days of deployment in 2012, and there were intermittency problems with the five GPS tags fitted, leading to exclusion of these data from analysis. Of the 36 individuals fitted with continuously recording tags, or tags set to record at longer time intervals (in an attempt to extend the recording period by preserving battery life), 24 were recorded within the Hornsea Project Two area.

These tracking data cannot be used to prove a negative, i.e. that birds do not use certain locations, but they do provide an indication of areas they definitely do use. The area of active use identified showed marked similarity over the three years, although in 2012 the core area, represented by the 50% density contour (relating to satellite tracking locations of gannets, (Annex IV, Figure 2), extended further into the proposed Hornsea Project Two. Distance to colony was the over-riding factor influencing the distribution of gannet locations, with the highest density closest to the colony, where outgoing and returning birds mix with those active around colony. Activity closer to the colony includes "maintenance" behaviours such as bathing, preening, resting, and communicating, as well as some feeding. Densities diminish with increased distance offshore, but include foraging flights and feeding behaviour. Plunge-diving to feed is one of the behaviours that increases collision risk, especially where there are feeding aggregations.

During the breeding season, the main colony from which gannets were found to interact with the Hornsea Round 3 zone was Flamborough Head and Bempton Cliffs SPA. However, Hornsea Project Two lies within the documented maximum foraging range for gannets[138], from the Forth Islands SPA (ES, Chapter 5, paragraph 5.7.62, page 5-133), so it cannot be ruled out that gannets from Bass Rock could occur within the Hornsea Project One area, but this seems unlikely for actively breeding birds. It is also important to consider that, as the Bempton colony grows in size, it might be expected that foraging ranges will increase, owing to increased intraspecific competition at the colony[133],[150].

Immature birds associate with the breeding colonies during the breeding season increasingly after their first year, particularly at age 3-4yrs. Although not as tied to the colony as adult birds, they are still central place foragers, returning regularly[139]. Recent studies also indicate sexual segregation in foraging behaviour at sea by breeding adult gannets. There are observed consistent differences in their isotopic signatures indicating dietary segregation, including a likely higher proportion of fishery discards (thus boat following) in the diets of breeding males, which also foraged closer inshore than females[140]. Further studies have confirmed the greater association with fisheries vessels by males than females[141]. There are different implications of accounting for boat following than assumption of equivalent effect across all birds irrespective of sex (or age etc). No such sexual segregation was apparent during the non-breeding season, nor among non-breeding, immature (2-4yrs) gannets.

[138] Thaxter, C. B., B. Lascelles, K. Sugar, A. S. C. P. Cook, S. Roos, M. Bolton, R. H. W. Langston, and N. H. K. Burton. 2012. *Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas*. Biological Conservation156: 53–61.

[139] Votier, S. C., Grecian, W. J., Patrick, S., & Newton, J. 2010. *Inter-colony movements, at sea behaviour and foraging in an immature seabird: results from GPS-PTT tracking, radio-tracking and stable isotope analysis.* Mar Biol DOI 10.1007/s00227-010-1563-9.

[140] Stauss, C., S. Bearhop, T. W. Bodey, S. Garthe, C. Gunn, W. J. Grecian, R. Inger, M. E. Knight, J. Newton, S. C. Patrick, R. A. Phillips, J. J. Waggitt, & S. C. Votier. 2012. *Sex-specific foraging behavior in northern gannets Morus bassanus: incidence and implications.* Mar Ecol Prog Ser 457: 151-162.

[141] Votier, S. C., Bicknell, A., Cox, S. L., Scales, K. L. & Patrick, S. C. 2013. *A bird's eye view of discard reforms: bird-borne cameras reveal seabird/fishery interactions.* PLoS ONE 8(3) e57376, DOI: 10.1371/journal.pone.0057376.

The available evidence supports the allocation of all adult gannets, and most immature gannets (age 3-4yrs), recorded in the Hornsea Project Two area during the breeding season, to FHBC, which raises considerable concern for this colony if Hornsea Project Two is consented.

Post-breeding locations were obtained for 18 of the satellite tracked gannets from the SPA[133], albeit only very limited data were obtained from four birds in 2010. The results from 2011 and 2012 still indicated overlap with the Hornsea Round 3 zone, including Project Two, but showed dispersal to other parts of the North Sea before migration, as far south as west Africa (Annex IV, Figure 3 presents results for 2011) supporting previous studies of gannet movements from colonies at Bass Rock[134],[142], or cessation of recording. All adult gannets had left the SPA by early October, including satellite tracked individuals, and the latest date for which data were received from any tag was 24 November 2012, for a bird that migrated to Western Sahara. It has been suggested that these shifts in migratory patterns reflect changes in North Sea fishing practices, including reduced discards, while fishing fleets off West Africa have grown with discards remaining high[134].

While tracking data described above show a general southerly movement for British breeding gannets, numbers of wintering adult gannets in the North Sea remain comparable to those nesting on the British East coast[134] due to inward movements from more Northerly colonies. However, the origins of these birds is variable, with ringing data demonstrating the presence of Norwegian breeding gannets in the North Sea during winter[135] and tracking of Icelandic birds showing Autumn passage through the North Sea on route to African waters[134].

There is therefore a need to distinguish breeding season versus non-breeding/ winter season in assessing the potential cumulative effects of multiple offshore wind farms, in UK waters and beyond. From October especially, there is considerable overlap of gannets from different breeding colonies[143]. Post-breeding, dispersal of gannets from the Bass Rock (Forth Islands SPA), was recorded to the north and south, from gannets fitted with geolocation data loggers in 2002 and 2003. Of 20 tracked birds that wintered south of the UK, eight travelled north from the Bass Rock, around the north of Scotland and south down the west coast of Britain and Ireland, whilst 12 headed south and through the English Channel[142]. A further geolocation study in 2008 resulted in seven of the 21 recovered loggers indicating this northward migration route and 14 took the southward route[134],[144], along the east coast of the UK. Just one of the satellite tracked post-breeding gannets from FHBC was recorded taking the northerly route via the north of Scotland (Annex IV, Figure 3) before heading south via the west of Britain[145]. On the northward migration in spring, results from the same Bass Rock studies[142] [144] [146], indicated that three of the 20 geolocators fitted in 2002 and 2003 returned via the English Channel and six via the west coast and around the north of Scotland[142], compared with five and 16 of the 21 geolocation loggers fitted in 2008[144] [146], respectively. This diverse pattern of migration increases the potential for interaction with multiple wind farms.

Arguably, potential impacts on migratory gannets may be of lesser concern than risk to breeding gannets because the birds are no longer constrained by central place foraging (see below for further explanation), and so generally more widely dispersed at lower density. There are also indications of

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

[143] Fort, J., Pettex, E., Tremblay, Y., Lorentsen, S.-H., Garthe, S., Votier, S., Baptiste Pons, J., Siorat, F., Furness, R. W., Grecian, W. J., Bearhop, S., Montevecchi, W. A. & Gremillet, D. 2012. *Meta-population evidence of oriented chain migration in northern gannets (Morus bassanus).* Frontiers in Ecology and the Environment 10:237-242.

[144] Garthe, S., Kubetzki, U., Furness, R.W., Huppop, O., Fifield, D., Montevecchi, W.A. & Votier, S.C. 2010. *Zugstrategien und Winterokologie von Basstolpeln im Nord-Atlantik. Vogelwarte* 48:367. Cited in WWT Consulting et al. 2012

[145] Langston, R. H. W. & Teuten, E. 2012. *Foraging ranges of northern gannets Morus bassanus in relation to proposed offshore wind farms in the North Sea*: 2011. RSPB report to DECC, DECC URN: 12D/315, London.

[146] Meraz Hernando, J.F., 2011. *Seabird ecology in relation to fisheries.* PhD thesis, University of Glasgow.

a high degree of flight avoidance by migratory gannets around the Egmond aan Zee[147] and Horns Rev[148] offshore wind farms, although in the case of Horns Rev, no gannets were recorded in the wind farm area prior to or post-construction. These well designed and executed studies relate to inshore wind farms and the results may not be applicable to breeding gannets.

Foraging

Gannets range widely over continental shelf areas (ES, Chapter 5, paragraph 5.6.150, page 5-73), taking chiefly fish between 2.5 and 30.5cm[136], but with foraging concentrated over areas of high marine productivity[135]. It is known that gannets fly and plunge dive from between 10 and 50m, or even higher: elevations within the rotor swept height of offshore turbines[147], [149]. Gannets' gregarious breeding habits are reflected in their foraging, where plunge-diving birds exhibit a marked attraction to others[136]. However, tracking studies of gannets at multiple breeding colonies around the UK in 2010-2011 indicate strong spatial segregation of foraging areas with little if any overlap between areas used by adjacent colonies[150].

2. Kittiwake

Population and distribution

The black-legged kittiwake is a widespread breeding species, nesting through the northern Pacific and Atlantic Oceans[126]. It is a colonial breeding seabird and occurs discontinuously along the shores of north-west Europe, from the coasts of Portugal and Galicia (north-west Spain) in the south, through Brittany (France), Ireland and Britain, Iceland and along Scandinavian coasts to the Kola Peninsula. It is predominantly a coastal species, but with some inland and island colonies. In the UK, Kittiwakes occur on most coasts, although there are few colonies on the south and east coasts of England.

The European breeding population is estimated to be over 2.1 million pairs[127]. With the breeding population in Great Britain estimated to be 366,832 pairs[128], representing on its own about 17% of the North Atlantic biogeographic population[151]. The number of black-legged kittiwakes breeding in England is estimated to be 76,281 pairs[129].

Breeding on the Flamborough and Filey Coast

This SPA represents the only English SPA supporting black-legged kittiwake numbers of international importance, but is a typical breeding colony in terms of its habitat of sheer cliffs[152].

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147 Krijgsveld, K. L., Fijn, R. C., Japink, M., van Horssen, P. W., Heunks, C., Collier, M., Poot, M. J. M., Beuker, D. & Dirksen, S. 2011. Effect studies offshore wind farm Egmond aan Zee: Final report on fluxes, flight altitudes, and behaviour of flying birds. NoordzeeWind report nr WEZ_R_231_T1_20111114_flux&flight. Bureau Waardenburg report nr 10-219 to Nordzeewind, Culemborg, The Netherlands. Final report November 2011. http://www.noordzeewind.nl/wpcontent/uploads/2012/03/OWEZ_R_231_T1_20111114_2_fluxflight.pdf, last accessed 25 June 2012.

148 Petersen, I. K., Christensen, T. K., Kahlert, J., Desholm, M. & Fox, A. D. 2006. *Final results of bird studies at the offshore wind farms of Nysted and Horns Rev, Denmark.* NERI report commissioned by DONG energy and Vattenfall A/S. National Environmental Research Institute, Ministry of the Environment, Denmark.

149 Nelson, J. B. 1978. *The Gannet.* T & A D Poyser, Berkhamsted.

150 Wakefield, E. D., Bodey, T. W., Bearhop, S., Blackburn, J., Colhoun, K., Davies, R., Dwyer, R. G., Green, J., Gremillet, D., Jackson, A. L., Jessopp, M. J., Kane, A., Langston, R. H. W., Lescroel, A., Murray, S., Le Nuz, M., Patrick, S. C., Peron, C., Soanes, L., Wanless, S., Votier, S. C., Hamer K. C. 2013. *Space Partitioning Without Territoriality in Gannets.* Science 341: 68-70.

151 AEWA, 2012. *African-Eurasian Waterbird Agreement 2012: Report on the Conservation Status of Migratory Waterbirds in the Agreement Area*. Fifth Edition. AEWA, Bonn.

152 Natural England, 2014. *Proposed extension to Flamborough Head and Bempton Cliffs Special Protection Area and renaming as Flamborough and Filey Coast potential Special Protection Area (pSPA).* Departmental Brief. Natural England, January 2014.

Between 2008 and 2011 the SPA, including the proposed extension, supported an average of 44,520 pairs of black-legged kittiwakes, which represents 2% of the North Atlantic biogeographic population[151], but also a substantial decline from historical population levels. At the time of designation the SPA's kittiwake population was 83,370 pairs. Black-legged kittiwakes nest throughout the extended area that the pSPA covers, with the main concentrations around Bempton Cliffs and Breil Newk. The intertidal chalk platforms are also used as roosting sites at low water by juvenile kittiwakes in particular.

Hornsea Project Two defines the breeding season for kittiwake as May to July (ES, Chapter 5, Ornithological Technical Report Part 1, para 6.1.263, p82), in contrast with NE's definition (RR, paragraph 55) of March to August. There is considerable overlap between seasons, especially bearing in mind that failed breeders may be joining non-breeders any time during the months that successful breeders are still based at the colony. Most adult kittiwakes are back at the colony by March, with the first birds returning in February, so February is both breeding and non-breeding season, depending on individuals. Most chicks have fledged by mid to late July.

Migration and non-breeding season

The kittiwake is sometimes reported as a non-migratory species or one that disperses as opposed to migrating. However, during the wintering season birds of the Atlantic subspecies *tridactyla* vacate the breeding grounds and become truly oceanic[135] but, as gannets do, initially post-breeding adults disperse from the colony before embarking on long-distance migration.

There is extensive sharing of wintering areas among Atlantic populations, with the majority of adults from all parts of the European breeding range (except the western British Isles) migrating across the Atlantic. Ringing and geolocation studies have shown that shelf areas in Western Europe and around the Labrador Sea are important for wintering adult kittiwakes but that a very large part of the Atlantic population winters in offshore areas west of the Mid-Atlantic Ridge [135], [153], [154], [155], [156], [157].

Foraging

When not attending the nesting platform, kittiwakes loaf on the sea below the cliffs and forage up to 120 km offshore (ES Vol 2, Ch 5, paragraph 5.5.120, p5-41) (mean foraging range of 24.8 ± 12.1 km, with highest confidence of assessment)[158], although the FAME data indicate kittiwakes regularly forage considerably further, up to 231km (Annex IV, Figure 4)[159]. They generally feed on small shoaling fish, particularly sand eels, but also herrings and sprats. During the breeding season

[153] Frederiksen, M., Moe, B., Daunt, F., Phillips, R.A., Barrett, R.T., Bogdanova, M.I., Boulinier, T., Chardine, J.W., Chastel, O., Chivers, L,S., Christensen-Dalsgaard, S., Clement-Chastel, C., Colhoun, K., Freeman, R., Gaston, A.J., Gonzalez-Solis, J., Goutte, A., Gremillet, D., Guilford, T., Jensen, G.H., Krasnov, Y., Lorentsen, S.-H.R.A., Mallory, M.L., Newell, M., Olsen, B., Shaw, D., Steen, H., Strom, H., Systad, G.H., Thorarinsson, T.L., Anker-Nilssen, T., 2012. *Multicolony tracking reveals the winter distribution of a pelagic seabird on an ocean basin scale.* Diversity and Distributions 18: 530-542.

[154] Bogdanova, M.I., Daunt, F., Newell, M., Phillips, R.A., Harris, M.P. & Wanless, S., 2011. *Seasonal interactions in the blacklegged kittiwake, Rissa tridactyla: links between breeding performance and winter distribution.* Proceedings of the Royal Society B: Biological Sciences, 278, 2412–2418.

[155] Gonza´lez-Solı's, J., Croxall, J.P., Oro, D. & Ruiz, X., 2007. *Trans-equatorial migration and mixing in the wintering areas of a pelagic seabird.* Frontiers in Ecology and the Environment, 5, 297–301.

[156] Bonlokke, J., Madsen, J.J., Thorup, K., Pedersen, K.T., Bjerrum, M. & Rahbek, C., 2006. *Dansk trækfugleatlas (The Danish Bird Migration Atlas)*, Rhodos, Humlebak, Denmark.

[157] Bakken, V., Runde, O. & Tjorve, E., 2003. *Norsk ringmerkingsatlas (Norwegian Bird Ringing Atlas), Vol. 1.* Stavanger Museum, Stavanger, Norway.

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

[159] Future of the Atlantic Marine Environment (FAME), a collaborative project involving the RSPB, http://www.rspb.org.uk/ourwork/projects/details/255106-future-of-the-atlantic-marine-environment-fame-, www.fameproject.eu/en/.

kittiwakes can also forage on intertidal crustaceans and molluscs. They are regarded as mainly surface feeders, but can also plunge-dive to approximately 1 m[160].

High densities can be present in areas of high productivity, such as cold water upwellings, fronts between water masses and sandbanks (e.g. Flamborough Front). Foraging birds are often associated with flocks of common guillemot and razorbill, which when pursuing prey underwater can drive fish to the surface where kittiwakes can access them.

Tracks from GPS data loggers deployed, by the RSPB, on kittiwake at the SPA in 2010-2014, illustrate foraging trips across the Hornsea Zone, including the proposal area for Hornsea Project Two (Annex IV, Figure 4). There was considerable overlap in areas used in different years by kittiwakes from the SPA. Birds tracked from Filey (within the pSPA), in 2014, covered a larger area of sea than was recorded for the kittiwakes from the SPA in 2010-2012. It is not known whether this difference persists in other years. These tracking data cannot be used to prove a negative, i.e. that birds do not use certain locations, but they provide an indication of areas they definitely do use. The sinuous sections of tracks from the GPS data collected indicate foraging behaviour being conducted on these longer journeys.

The available evidence supports the precautionary allocation of all adult kittiwakes recorded in Hornsea Project Two area during the breeding season to the SPA/ pSPA. But the Applicant's HRA Report considers allocating just 19.34% of the SPA/pSPA population (HRA Report, Part 1, para 5.8.178, page 129).

3. Guillemot

Population and distribution

The Common Guillemot has a circumpolar distribution, occurring in the low-arctic and boreal waters of the north Atlantic and north Pacific[126]. It is a widespread but patchily distributed breeder in coastal areas of western and northern Europe, which accounts for less than half of its global breeding range. Nesting is confined to areas safe from mammalian predators such as sheer cliffs and offshore islands. Its European breeding population is very large, with estimates between 2 million and 2.7 million pairs[127].

The breeding population of common guillemots in Great Britain is estimated to be 1,322,354 individuals[128], representing about 31% of the North Atlantic population[129]. Breeding colonies are distributed widely around the coast of Britain, with the exception of the southeast from Sussex to Lincolnshire.

Breeding on the Flamborough and Filey Coast

Between 2008 and 2011 the Flamborough and Filey Coast pSPA supported an average of 62,100 common guillemots (counted as "individuals on land") representing around 41,607 pairs (correction factor 0.67[161]) equating to 83,214 breeding adults. This constitutes 15.6% of biogeographic population of the southern subspecies *Uria aalge albionis*[151]. Nesting birds are distributed throughout the pSPA with the exception of the coastal cliffs south of Flamborough Head.

[160] Hatch, S.A., Robertson, G.J. & Baird, P.H., 2009. *Black-legged Kittiwake (Rissa tridactyla).The Birds of North America Online.* Cornell Lab of Ornithology, Ithaca, NY. Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/092doi:10.2173/bna.92. Accessed 17 February 2014.

[161] Harris, M.P., 1989. *Variation in the correction factor used for converting counts of individual guillemots into breeding pairs.* Ibis, Vol.131, 85-93.

Migration and non-breeding season

Guillemots undergo post-breeding dispersal with chicks and so is not a truly migratory species, with many adults remaining in the seas surrounding their breeding colonies through the year[135]. As a result, outside the breeding season, Guillemots occur widely in the seas off northwest Europe. Small numbers of guillemots from Scandinavian and Faeroese colonies also reach northern Britain and the North Sea, reflecting a general southward movement of most northerly breeding birds[162].

Foraging

Common guillemot feeds on a variety of small marine fish, especially sandeels and sprats (ES Vol 2, Ch 5, 5.6.165) using pursuit diving, primarily during the day. It has been recorded diving to maximum depths of 170 to 230m. During the breeding season, surveys recorded the highest densities of birds in the 51 to 100 m depth zone, although birds were still abundant in water less than 50 m and 101 - 200 m deep[163]. The maximum reported foraging range for guillemot during the breeding period is 135 km (ES Vol 2, Ch 5, 5.5.155), with a mean of 37.8km[164]; however, FAME data indicate that guillemots can regularly forage further than this although further analysis of these data is required (RSPB, unpublished data)[159].

4. Razorbill

Population and distribution

Razorbills and common guillemots frequently nest together, and therefore share very similar breeding distributions. Nesting is confined to sheer cliffs and offshore islands on northern Atlantic coasts, in eastern North America as far south as Maine (USA), and in western Europe from northwestern Russia to northern France[126], with the latter accounting for >75% of its global range[127]. Estimates of the European breeding population range widely, between 430,000 pairs and 770,000 pairs[127]. The breeding population of razorbills in Great Britain is estimated to be 164,492 individuals[128], representing about 21% of the NW Europe population[129].

Breeding on the Flamborough and Filey Coast

During 2008 and 2011 the Flamborough and Filey Coast pSPA supported an average of 15,776 razorbills (counted as "individuals on land") representing around 10,570 pairs (correction factor 0.67[161]) equating to 21,140 breeding adults. This constitutes 2.3% of the biogeographic population of the subspecies *Alca torda islandica*[151]. Numbers have increased greatly since 1969 when 1,724 individuals were present at Flamborough Head.

Migration and non-breeding season

After the breeding season and post-breeding moult, Razorbills disperse away from breeding colonies with their chicks. In western Atlantic populations, there is an apparent tendency to move south and west towards warmer waters, but the relevance of this trend on North Sea populations is unclear.

There are no clearly defined migration routes for razorbill and movements may vary with annual weather conditions and food supplies. Birds from Faeroese colonies have been recorded moving into the North Sea, where the highest densities occur off North West Scotland.

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[162] Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J. & Pienkowski, M.W., 1995. *An atlas of seabird distribution in north-west European waters.* Joint Nature Conservation Committee, Peterborough, UK.

[163] Wanless, S., Harris, M.P. and Morris, J.A. ,1990*. A comparison of feeding areas used by individual common murres (Uria aalge) razorbills (Alca torda) and an Atlantic puffin (Fratercula arctica) during the breeding season.* Colonial Waterbirds 13: 16-24.

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

Foraging

Razorbills forage in marine, coastal and continental-shelf waters, where sea-surface temperatures are less than 15°C. In the North Sea, Razorbills feed in shallow waters on dense schools of fish concentrated at a hydrographic front between thermally mixed coastal waters and thermally stratified offshore waters. Razorbills appear particularly selective in choice of feeding habitat compared to other Auks. The maximum reported foraging range for razorbill during the breeding period is 95 km (ES Vol 2, Ch 5, 5.5.163), and the mean foraging range 23.7 km[164]. However, as with guillemot, recent tracking studies of razorbills from several breeding colonies, using GPS data loggers as part of the FAME programme[159], have found that razorbills regularly travel considerably greater distances than previously documented. This research provides further support for FHBC as the most likely origin of razorbills observed at Hornsea Project Two during the breeding season.

Razorbills catch their prey, mainly sandeels, mostly by surface-diving; a bird dips its head into the water sometimes several times, while swimming around, apparently to spot prey before diving. Razorbills will also land in fish shoals and dive immediately. Razorbills rarely form dense flocks and forage in a more dispersed pattern than some other auks such as Common Guillemots. Like many species of seabirds, Razorbills also participate in small, short-lived, multi-species foraging assemblages. Typically, small social feeding flocks of auks (mainly guillemots or razorbills) drive a dense ball of fish towards the surface in a concerted effort and exploit this resource from below.

Annex IV

Figure 1: Highlighted flight end points providing a conservative sample of foraging destinations of adult gannets from Bempton Cliffs during chick-rearing in, from left, 2010, 2011, 2012. Different colours signify different individual birds (Langston *et al.* 2013).

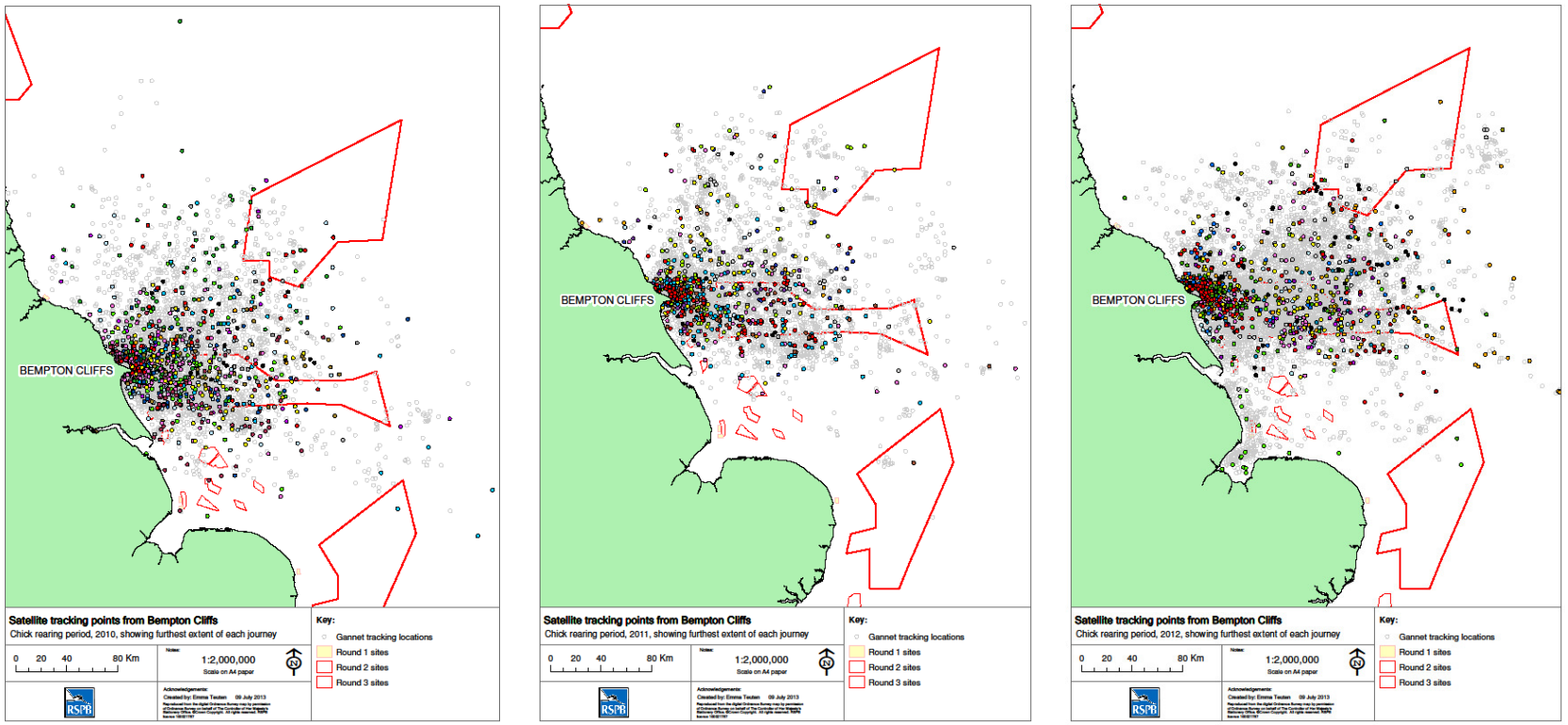


Figure 2: Kernel Density Estimation (kernel density tool, ArcGIS Desktop 10) for adult gannets during chick-rearing in, from left: 2010, 2011, and 2012, showing the 50%, 75% and 95% density contours.

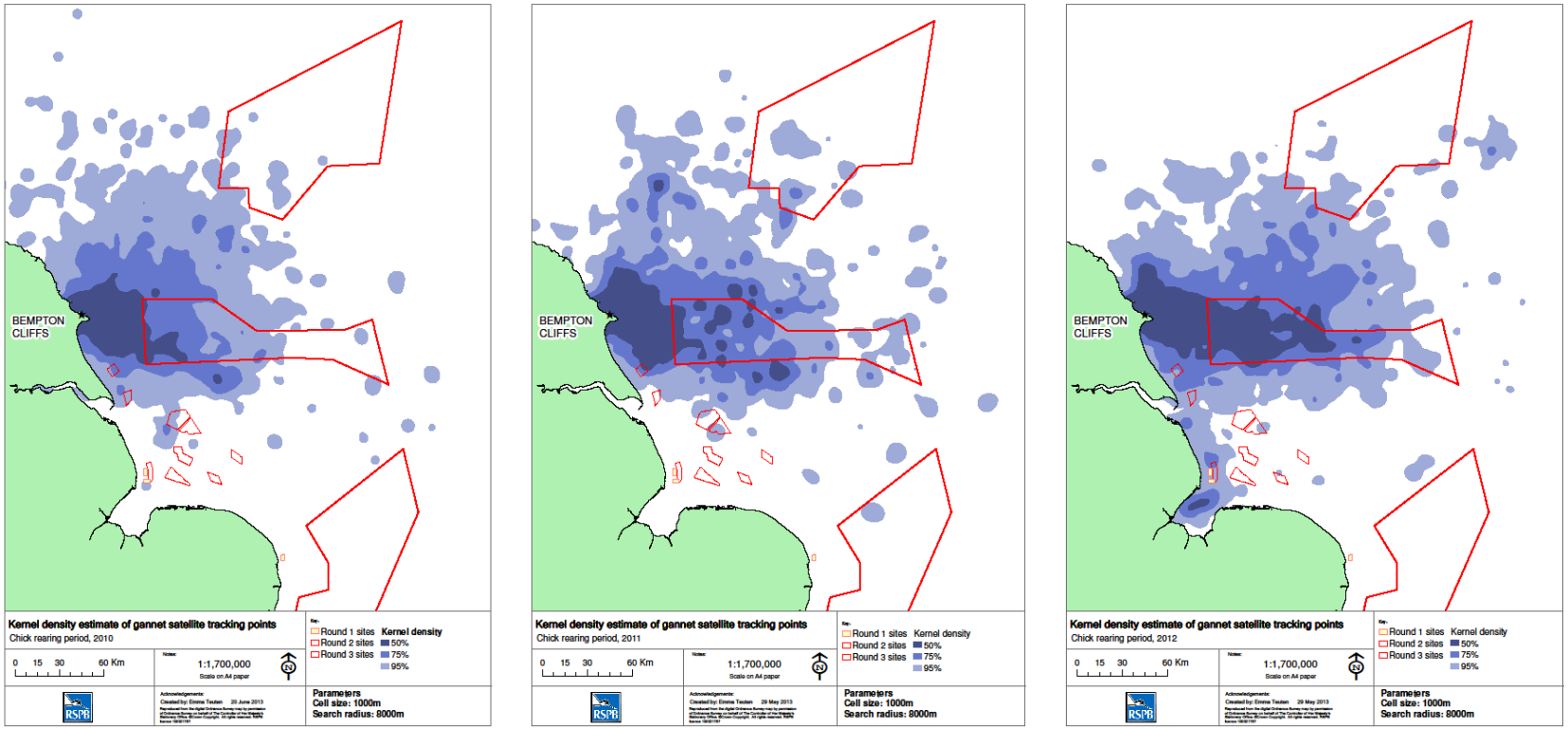
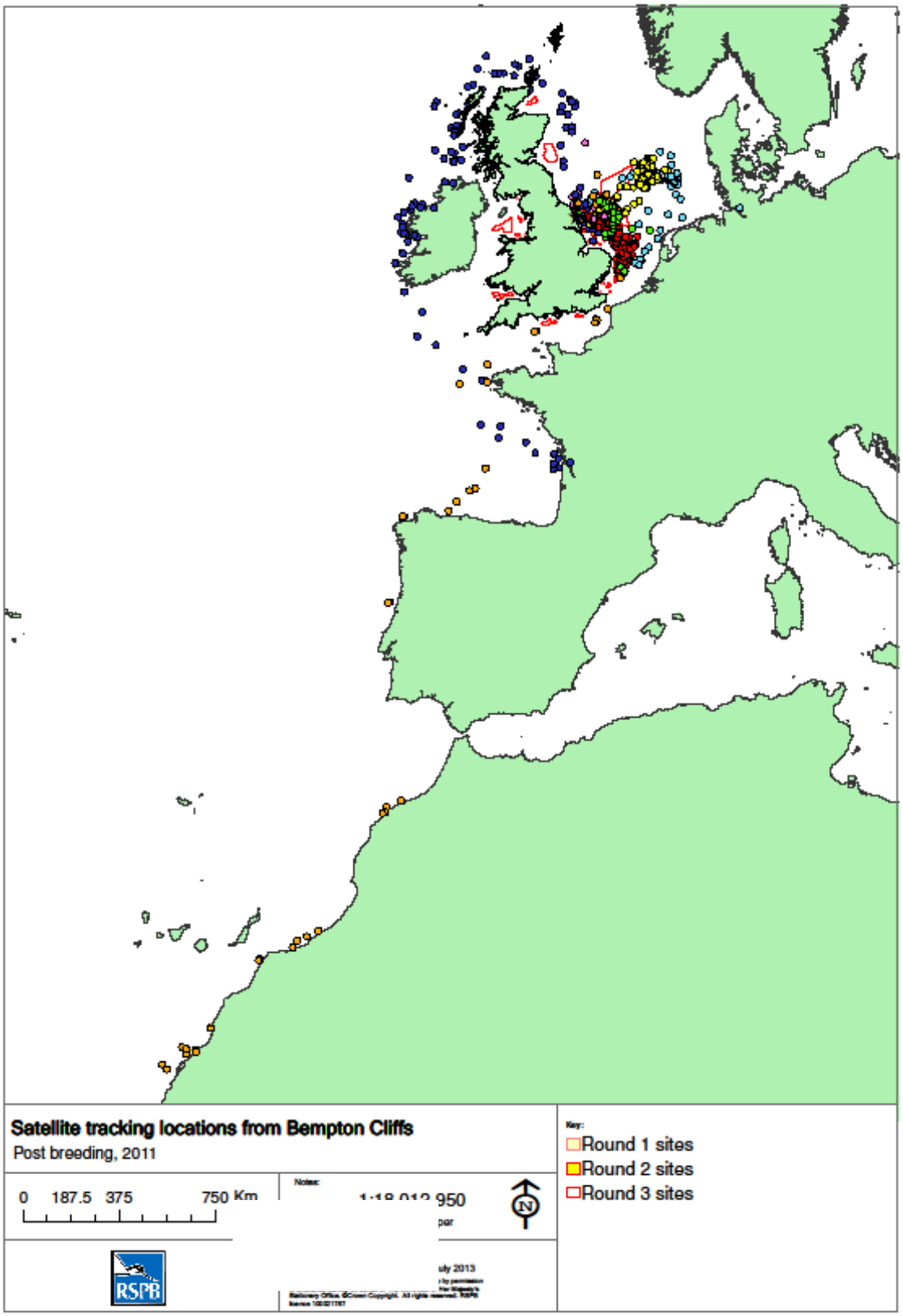
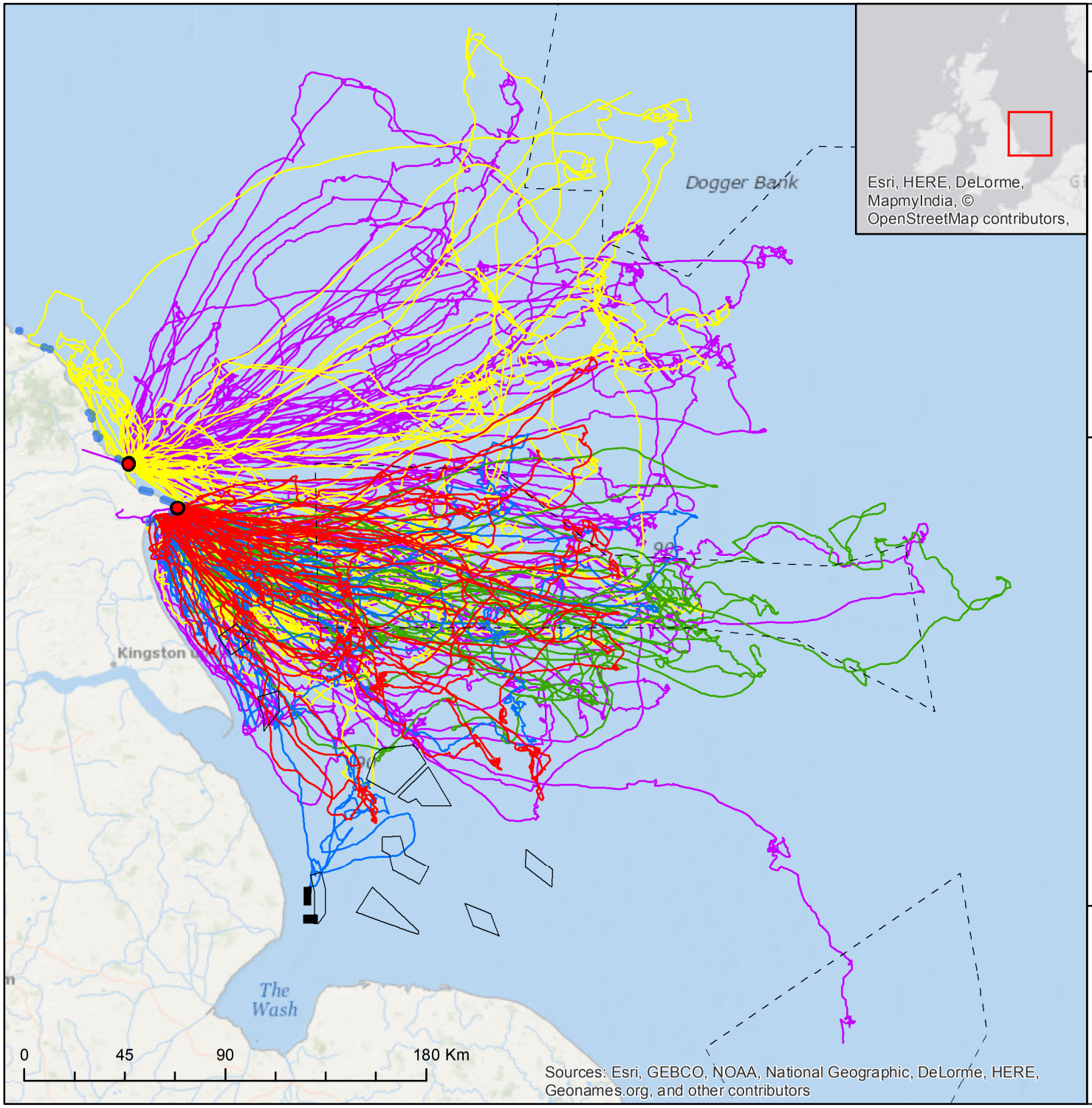


Figure 3: Post-breeding locations in 2011 of seven individually tagged gannets from FHBC





Foraging Tracks - Kittiwake

East Yorkshire - 2010 - 2014

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2010 tracking data
- 2011 tracking data
- 2012 tracking data
- 2013 tracking data
- 2014 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Filey (n=36 birds,2013-14) & Flamborough Head (n=108 birds,2010-14)

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

Drs Ellie Owen and Mark Bolton March 2015

Acknowledgements:

Field workers: David Aitken, Guy Anderson, Mark Bolton, Liz Mackley, Alice Macmillan & Ellie Owen

Map created by: Tessa Cole, 14/07/2015

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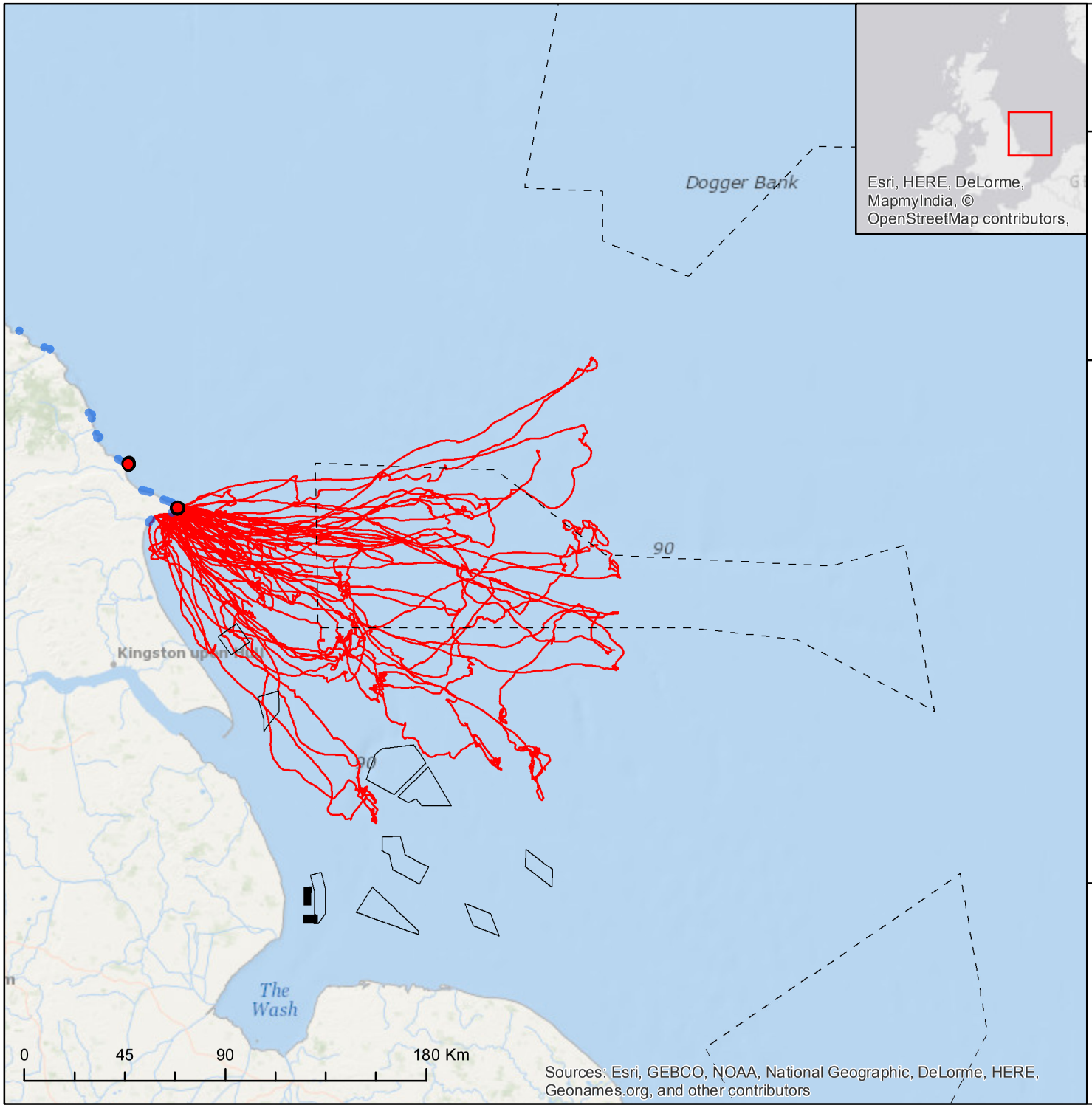

Foraging Tracks - Kittiwake

East Yorkshire - 2010

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2010 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Flamborough Head (n=25 birds) during 2010.

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

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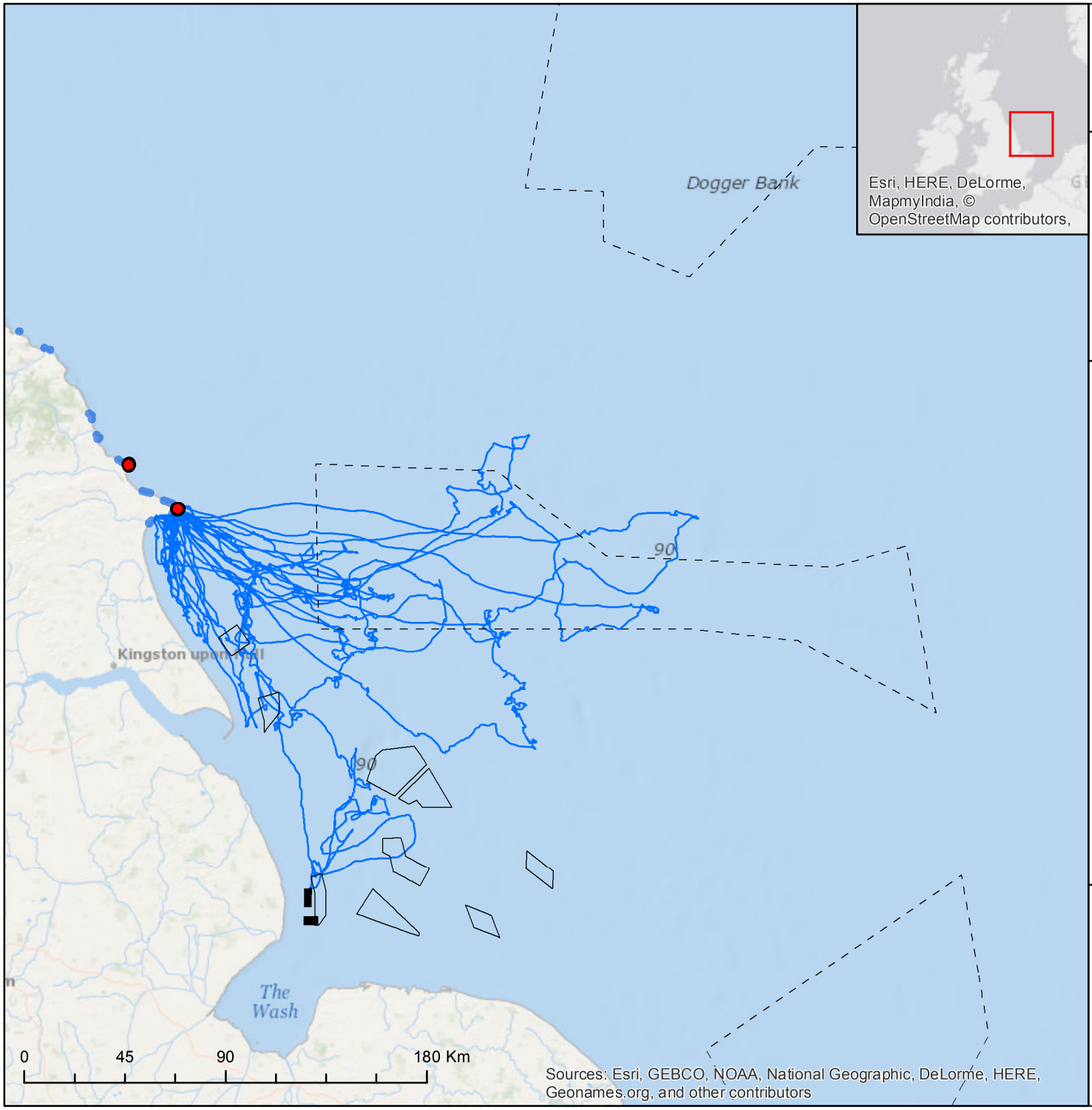

Foraging Tracks - Kittiwake

East Yorkshire - 2011

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2011 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Flamborough Head (n=17 birds) during 2011.

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

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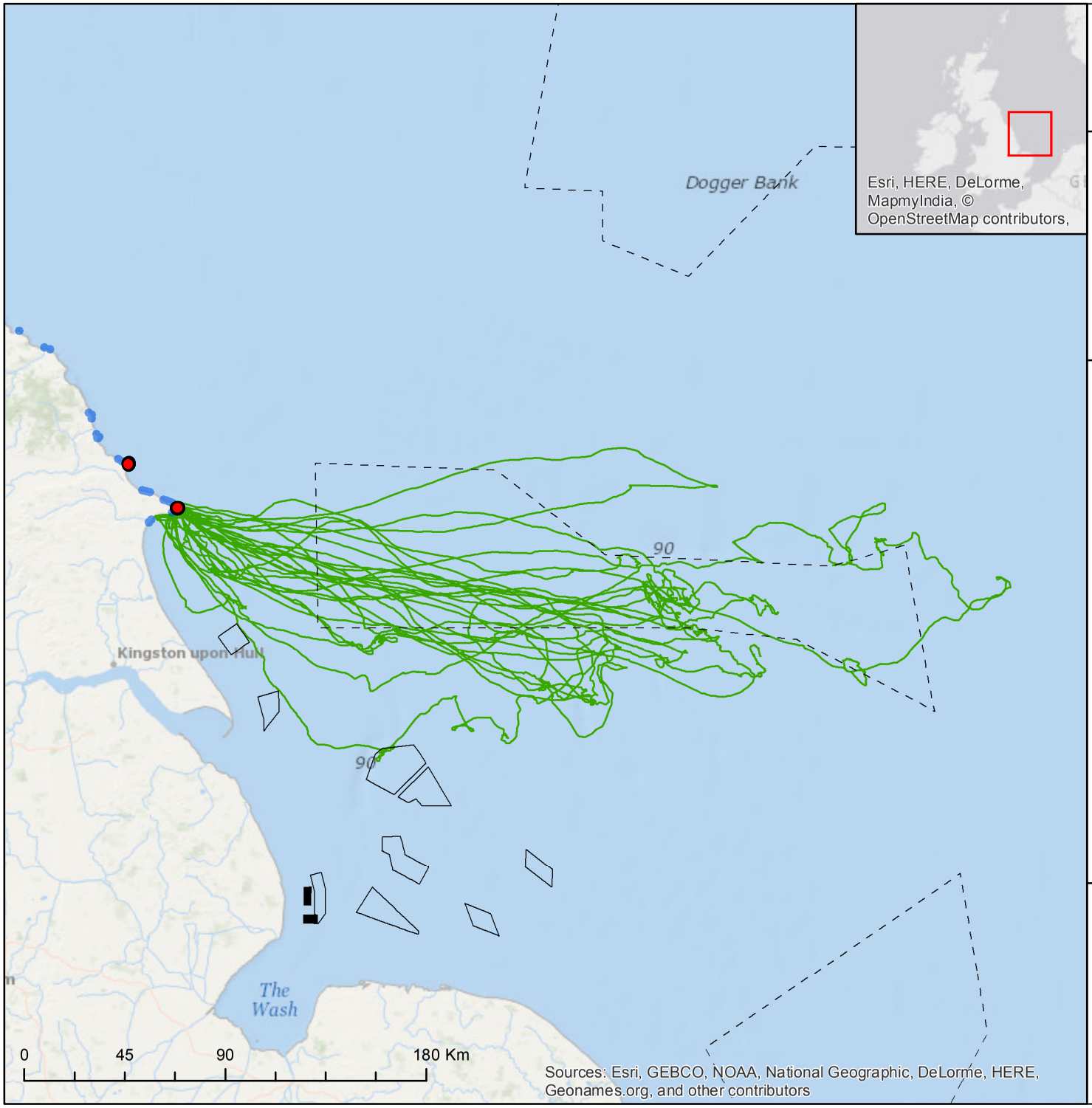

Foraging Tracks - Kittiwake

East Yorkshire - 2012

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2012 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Flamborough Head (n=9 birds) during 2012.

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

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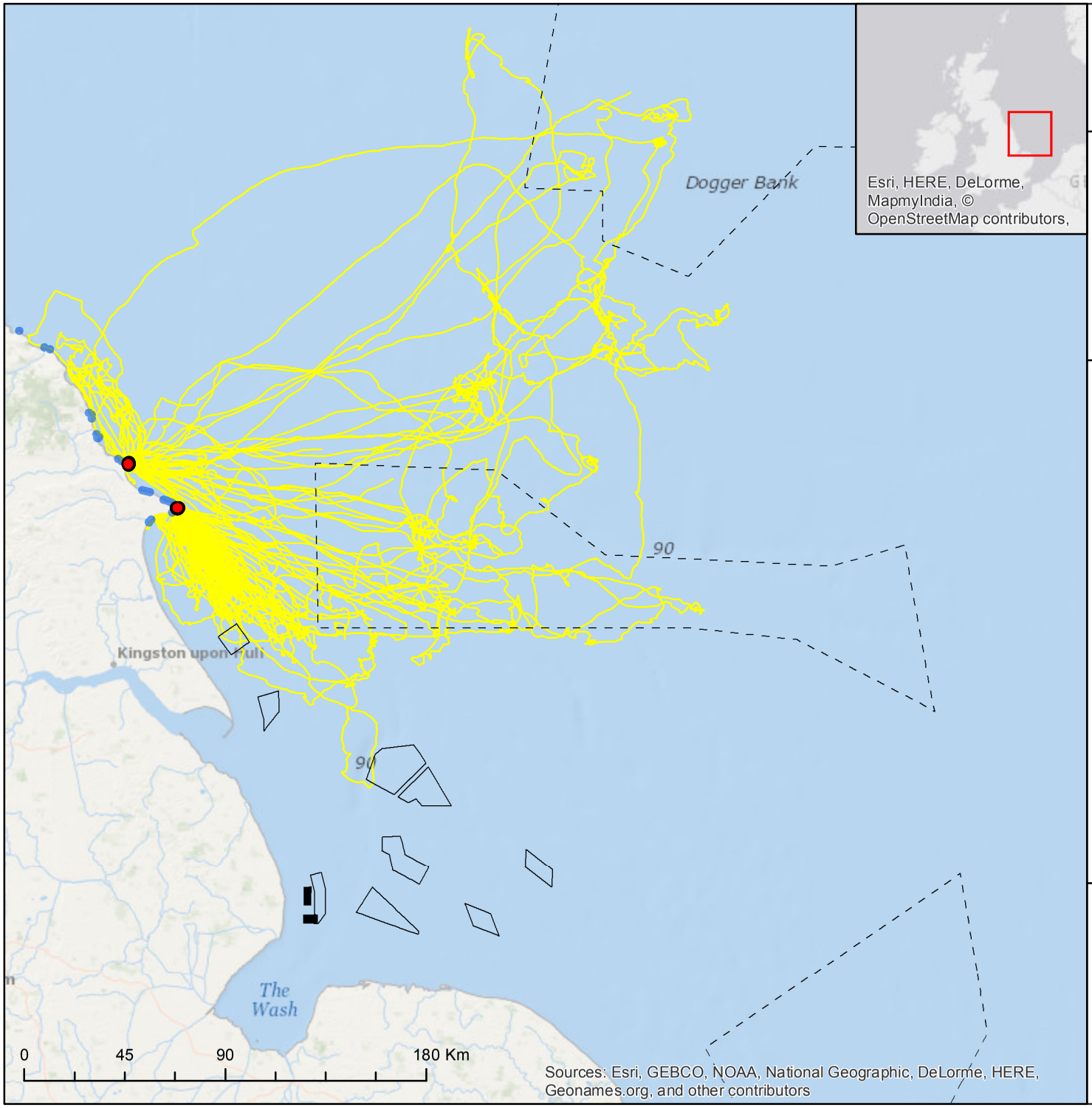

Foraging Tracks - Kittiwake

East Yorkshire - 2013

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2013 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Filey (n=20 birds) and Flamborough Head (n=21 birds) during 2013.

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

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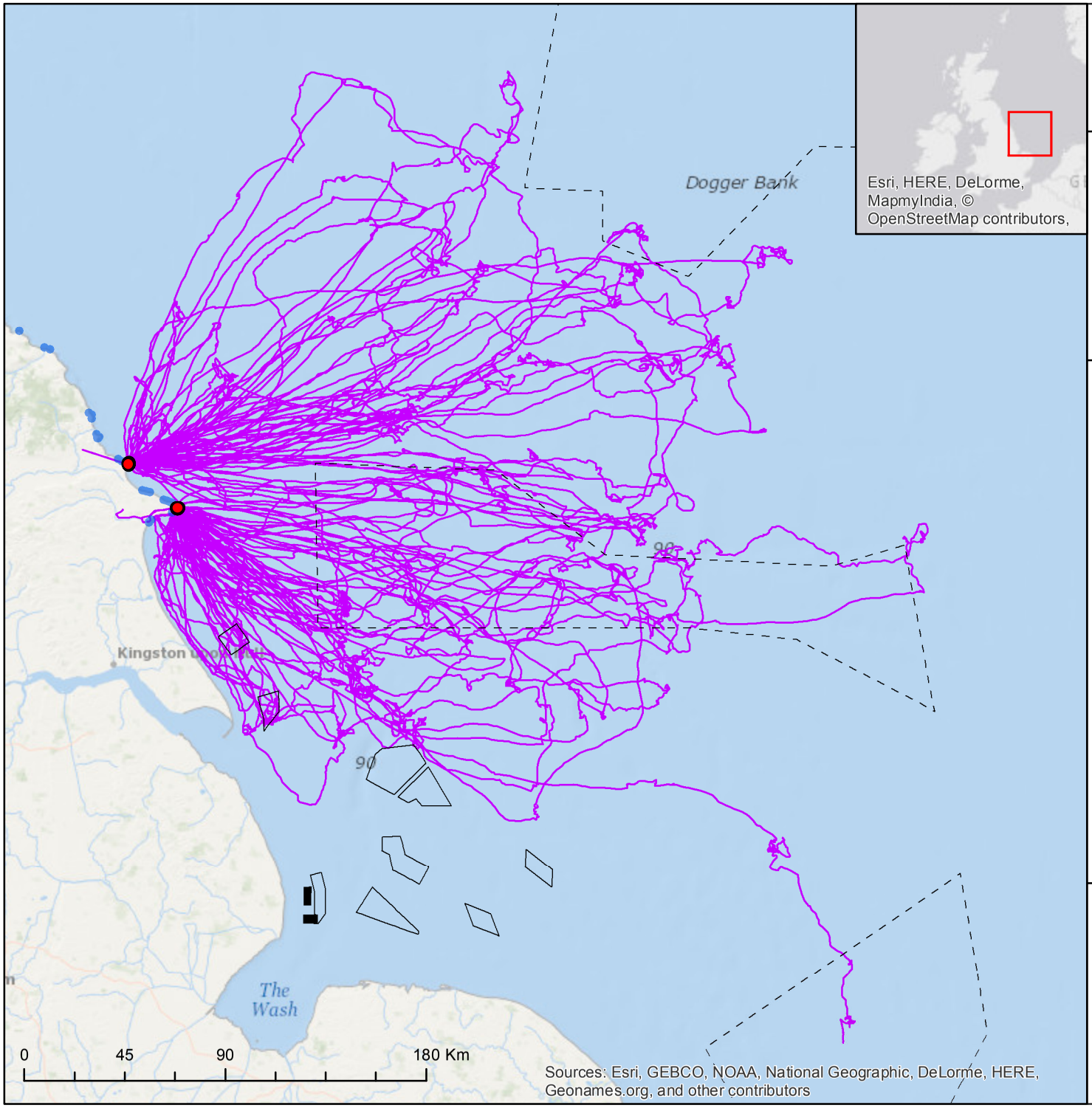

Foraging Tracks - Kittiwake

East Yorkshire - 2014

- location of breeding site of tracked birds
- Kittiwake colonies
- Round 1 windfarms
- Round 2 windfarms
- Round 3 windfarms
- 2014 tracking data

Notes:

High resolution GPS tags were deployed on kittiwakes breeding at Filey (n=16 birds) and Flamborough Head (n=17 birds) during 2014.

The map shows all the trips recorded from all birds tracked in that year. Some individual birds make more than one trip away from the nest during the time that they are tracked.

These maps represent some of the best information currently available on the marine areas used by seabirds during the breeding season, and the connectivity between marine area usage and the location of breeding colonies. However, it is important to emphasise the limitations of the information represented here. Tracking tags were typically deployed for a few days on each bird, and the duration of the tracking period was generally just 3-4 weeks, and so the map illustrates the movement of a small number of birds, for short periods of time. The limits of the area accessed are therefore likely to under-estimate the extent of the area used by the colony as a whole during the course of the entire breeding season. The extent of this under-estimation is unknown. Furthermore, the data were collected from a limited number of years and do not indicate how widely foraging areas might differ over longer time scales. Note that the map does not indicate the area where birds foraged. The locations of further colonies are illustrated with coloured symbols. Birds from these colonies may use entirely different areas for foraging.

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Annex V

From the RSPB's Hornsea Project One Written Representations - A critique of the methods used to assess the effect of additional mortality on bird population size in the Hornsea Two Habitats Regulation Assessment (HRA) Report and associated documents

Scope of this critique

This annex evaluates the methods used in the HRA (PINS Document 12.6) and associated documents to assess the effects of additional mortality caused by collisions and displacement. It does not address the accuracy of the estimates made in the HRA of the numbers or proportions of birds expected to be killed as a result of the proposed development. That is an important issue which is dealt with elsewhere in these Written Representations.

It is generally accepted that an informative assessment of the impact of an intervention, such as a built development, harvesting or pollution, upon an animal population should involve the evaluation of a counterfactual: a comparison of the expected outcome for the population of interest with and without the intervention. The two principal methods available for this are (1) simulation modelling of population processes and population size (often known as Population Viability Analysis (PVA)) and (2) comparison of additional numbers killed because of the intervention with the Potential Biological Removal (PBR). This critique will assess the applicability of these methods to the HRA Report, pitfalls involved in their interpretation and the way in which the calculations are performed.

Population Viability Analysis

Principles of PVA

Simulation models of populations

PVA includes a wide variety of population modelling and estimation methods. In the context of the HRA Report, the relevant methods require simulating the size and age structure of an animal population at annual intervals by means of a demographic model.

The demographic model requires initial numbers of animals in a starting year in each of several age classes, estimates of the probability that an individual of a given age will survive and remain within the population from one year to the next, and estimates of age-specific fecundity (the average number of young produced per individual of a given age). Age-specific fecundity is the product of two components: (1) the probability that an individual of a given age will attempt to breed, and (2) given that breeding is attempted, the mean number of young surviving to independence per breeding individual. The survival and fecundity rates are referred to as demographic rates. Demographic rates may vary among individuals of a given age class or show trends or fluctuations from year to year. These changes in demographic rates over time may be influenced by external variables, such as weather, or by the size of the population.

The influence of population size on demographic rates is referred to as density dependence. Density dependence may be negative if the effect tends to make the rate of population growth more negative than it would otherwise be when population size is large. Examples of mechanisms of negative density dependence are competition for limited resources, such as food, shelter or nest sites, and increased death rates when predation or disease is more prevalent at high than low population size. Density dependence can also be positive, for example animals may be less able to find mates when population size is low or the rate of predation may be increased at low population size because there are more predators per prey animal or because the prey animals are more vulnerable because they are less likely to be able to form large aggregations to deter or swamp predators. These effects tend to make population growth rate more positive at high than at low population size.

A useful analogy is with the calculations involved in making projections of the future size of a bank balance (representing the population size) based upon estimates of income (representing additions to the population through reproduction) and expenditure (representing death). Tax allowances whereby no taxes are levied when the balance is small, but they are levied when a threshold is exceeded, or instances where rates of tax on income increase progressively as the balance increases are analogous to negative density dependence.

Comparison of the effects of interventions on population size and trend with and without density dependence

It is easy to see intuitively that if demographic rates stay the same over time then the annual rate of change of the population as a proportional increase or decrease per year will settle down to a constant value after initial changes because of the age structure in the starting year. If the demographic rates are initially constant and such that the population is stable (no change in numbers from year to year) then additional deaths or an imposed reduction in prevailing per capita fecundity rates later on will cause the population to decline at a constant proportional rate until extinction occurs. Adopting the financial analogy, if books used to balance perfectly but annual expenditure is increased without any change in income, the balance will, perhaps quite soon, reduce to zero.

In practice, decline as far as extinction of a real animal population might not occur because of negative density dependence. As the population declines, competition for resources might become less fierce or disease less prevalent leading to increases in survival or age-specific fecundity. Fecundity could increase either because breeding animals are more successful or because those that would otherwise not find a vacant nest site or breeding territory are able to do so and can therefore join the breeding population at a younger age than would otherwise be the case. As population size decreases and demographic rates improve, the average rate of population growth might return to 1 (that is, no year on year change). The population size would then stabilise at a new, lower level. However, if the strength of density dependence (the slope of a graph relating a demographic rate to population size) is insufficient then the effect of density dependence might not be enough to prevent extinction. In that case, the rate of decline would be slow, but the population would still eventually go extinct.

Relevance to the HRA

The relevance of this hypothetical discussion to the HRA is that PVA population simulations have the potential to be used to estimate population size and population trend at some future time, given estimates of starting conditions, initial demographic rates and how they will change in relation to intervention, population size and other factors. This is exactly what is needed to evaluate the impact of an intervention on the conservation status of an animal population at a designated site because the counterfactual – what would happen with and without the intervention - can be estimated. The discussion above also reveals that an animal population that is initially stable will inevitably go extinct if an intervention reduces survival or fecundity, even by a small amount, unless there is sufficiently large a compensatory improvement in one or more demographic rates because of density dependence. For this reason, the strength of density dependence assumed in PVA models is a key determinant of whether the model projects extinction or reduction of population size to a new lower stable equilibrium size in response to an intervention. The stronger the density dependence, the less likely the population is to be driven to extinction by the intervention and, if the outcome is a new lower stable level, the smaller the reduction in that level relative to the initial population.

Does PVA predict that additional mortality always reduces population size?
Even though density dependence can permit a population to persist despite an intervention that has negative effects on demographic rates, the resulting population size will usually be lower, and potentially much lower, than the initial population size. It is not impossible that additional mortality could occur and the population size not decline. For example, imagine that a stable animal population exists in which there is no harvesting by hunting during the breeding season, but such harvesting occurs at the beginning of the non-breeding season. If density dependence of survival rates late in the non-breeding season is sufficiently strong then the additional losses caused by hunting might be completely compensated for by improved survival late in the non-breeding season - perhaps because of reduced competition for food. As a result, survival over the whole non-breeding season could be the same as it would have been if hunting had not occurred and the size of the breeding population therefore remains constant from year to year. This perfect or complete density dependence can occur, but the density dependence must be strong for it to do so.

PVA population simulations in practice
The foregoing sections established that projections from a well-conducted PVA population simulation could provide the type of quantitative information on future population size and trend required for an informative Appropriate Assessment of the effects of an intervention.

There might be difficulties in gathering all the information required to perform an accurate and realistic simulation. The method requires estimates of starting values of population size, age distribution and demographic rates. However, these may be available for the population involved from recent studies. Although less satisfactory, it is possible to use estimates of some model parameters from other studies of the same species done elsewhere.

The relationship between demographic rates in animal populations and population size can be difficult to measure accurately for a range of technical reasons. There are two principal methods available: (1) measure demographic rates on the same population over many years or for different populations over a shorter period and obtain mathematical functions relating demographic rates to population size or density per unit area using statistical methods; or (2) build a detailed simulation model of the process by which population size influences a demographic rate by detailed observations of individual animals. For the comparative demography approach (method 1) studies of long duration are required in which many things other than population size might change and obscure or spuriously enhance the effect of population size on demographic rates. Similarly, if multiple populations are compared, although the problem of poorly understood changes over time might be reduced, there may be unmeasured differences among study areas in factors which influence demographic rates. Method 2 is also demanding in terms of the amount of information needed to obtain reliable and generalisable results. Both methods have the potential drawback that the circumstances that apply in the future might be outside the range of those observed when building the models of density dependence. For example, future population size might decline below levels that have been observed in the field studies. This will make estimates of how demographic rates will respond to further changes in population size suspect. Despite these difficulties, accurate quantitative descriptions of the density dependence of demographic rates have been obtained for some animal populations, including seabirds.

Even though it may not be feasible to measure density dependence for a particular population of interest, it may still be informative to conduct PVA modelling. This can be done by making informed assumptions about density dependence. Ecological knowledge derived from other studies of the demographic rates of the same or similar species can be used to identify the demographic rates most likely to be density dependent, the strength of the density dependence and its form (that is, the shape of the function relating the rate to population size). It would be unwise to adopt a single

one of these surrogates in making population projections, but it is informative to use a range of scenarios based upon observations of surrogate populations to produce a set of projections under a range of assumptions about density dependence. This could be done using results from published studies of density dependence in the same or other species by adopting values for the strength of density dependence in the low, middle and high ends of range of variation seen in the published studies. This set of projections should include a scenario with no density dependence. This procedure cannot provide a definitive prediction of how the population will respond to the intervention, but it provides the worst case (no density dependence) and a series of other projections whose plausibility can be debated. As with any tool to assess future population levels of any bird species, PVA is not perfect. However it remains a useful method to assess how the population may change over time as a result of an intervention such as the proposed Project and it ought to be used to inform any decision on whether the Project should be allowed the proceed.

PVA population simulations in the HRA

PVA population simulation models were conducted for the HRA for the Flamborough and Filey Coast pSPA populations of gannet, kittiwake, guillemot, razorbill and puffin (Appendix G of HRA). These models used initial estimates of mean annual survival of a number of age classes. These survival rates were not derived wholly from the population of interest, but the values used were appropriate and the population model was run retrospectively to "tune" the values used to give a good fit to recent population changes. Age specific fecundity was derived by assuming a fixed age of first breeding obtained from another population and per capita production of young measured at the SPA for various time periods. Density independent and density dependent formulations were included in the models. The population models were run with and without additional mortality caused by the project and with various levels of additional mortality and fecundity. The models indicated a range of outcomes, depending upon the assumptions made.

While the inclusion of these models in the HRA is welcome, they have not been used to inform the assessment, rather to provide background context to PBR. PBR is consistently presented preferentially to PVA.

Potential Biological Removal

Principles of PBR

The Demographic Invariants Method

PBR is an application of the Demographic Invariants Method (DIM) to the detection of overharvesting of exploited animal populations and unsustainable additional mortality of other kinds. PBR identifies levels of additional death in a population which, if exceeded, would be almost certain to cause it to decline to extinction. It is important to understand the basic purpose of the PBR method. It attempts to identify the level of additional mortality that will lead to the extinction or substantial reduction of the population, but it does not explicitly estimate how population size will change over a period of time as a result of an intervention. This is explained further below. PBR can be valuable when applied to animal conservation because it can be performed using very few data. The required data are the minimum current population size, mean age at first breeding and mean annual adult survival. Values for all of these parameters should be those observed under optimal environmental conditions when population size is increasing at the maximum possible rate (Niel & Lebreton 2005). PBR calculations use mean age at first breeding and mean adult survival to calculate the maximum annual growth rate of the population λ_{max}. This is done by solving the equation

$$\lambda_{max} = \exp(1/(\alpha + (s/(\lambda_{max} - s))))$$

for λ_{max}, where α is mean age at first breeding in years and s is mean annual adult survival (Niel & Lebreton 2005). The maximum annual growth rate of the population λ_{max} is a number that exceeds 1

because the population is, by definition, increasing under optimal conditions. The realised rate of population growth would be 1 if the population was stable. Populations usually do not achieve the maximum annual growth rate because they are usually not experiencing optimal conditions. Implicit in the use of PBR is that demographic rates are enhanced when population size is reduced by additional mortality. This reduction in population size allows the population growth rate to increase towards the maximum rate because of density dependence (see PVA section).

Intuitively it can be seen that $\lambda_{max} - 1$ provides an upper limit to maximum per capita rate at which young individuals could join the population and hence the largest per capita death rate, in excess of that which would normally apply, that a population could sustain without declining to extinction, or at best to a low level. For example, if the maximum annual growth rate of the population λ_{max} was 1.2 (i.e. 20% increase in population per year) then it might be feasible for the population to incur a maximum additional mortality rate of $\lambda_{max} - 1 = 0.2$ (20% additional death rate per year).

Wade (1998) and Niel and Lebreton (2005) proposed that overharvesting or unsustainable additional mortality could be detected by comparing the number of animals killed by an additional source of mortality with the potential excess growth *P* where

$$P = N \beta (\lambda_{max} - 1),$$

N is the estimated population size and β is a factor required to account for the effect of density on population size (i.e. density dependence, as described in the preceding section on PVA) and several other reasons listed by Niel & Lebreton (2005; p. 832). If the actual level of additional mortality continues to exceed *P*, then the population is likely to decline to extinction. In practice, the maximum value of β considered acceptable is β = 0.5 (Wade 1998; Niel & Lebreton 2005). In most cases where the DIM procedure has been applied to additional mortality caused by renewable energy projects, an alternative expression, based upon Dillingham & Fletcher (2008),

$$PBR = 0.5\, N_{min}\, f\, (\lambda_{max} - 1)$$

in which PBR is equivalent to the potential excess growth, N_{min} is a value of estimated population size lower than the most probable value and *f* is the recovery factor. Note that this expression is the same as that for *P*, except for the use of N_{min} instead of *N* and the substitution of $f = 2\beta$. N_{min} is a lower confidence bound of the estimated population size, adopted for precautionary reasons when population size is not known precisely. Wade (1998) proposed the use of the lower bound of the 60% confidence interval.

The appropriate use of PBR in practical applications

The PBR method is intended to identify levels of additional mortality that are almost certainly not sustainable by the population of interest. It is important to understand what the term sustainable means in this context. The management goal set by the US Marine Mammal Protection Act, that underpins the original PBR calculations, is to prevent populations from 'depletion', in which a population is considered depleted if it falls below its maximum net productivity level (Wade 1998). Hence, a population incurring additional mortality caused by an intervention such as a wind energy project which is below the level defined by an appropriately calculated PBR could still decline substantially below the population size that would have occurred without the project. PBR calculations do not provide an estimate of how large the difference between the population with and without the intervention is expected to be. In practice, a level of additional mortality above that indicated by an appropriately calculated PBR suggests that the population is likely to decline to extinction, or at best to a low level, unless the mortality rate is reduced.

The use of PBR calculations in the HRA

PBR calculations have been carried out for gannet and kittiwake (collision and displacement), guillemot, razorbill and puffin (displacement), in relation to Hornsea Project Two in the HRA. It is concluded in the HRA that additional mortality expected to be caused by the project is less than the calculated PBR values and that the effect of the project on the populations of interest will therefore be acceptable.

The use of PBR is incorrect in principle for two reasons

The first reason

As described above, appropriately conducted PBR calculations provide a means to identify levels of additional mortality caused by an intervention that would almost certainly result in the decline of the population of interest to extinction or, at best to low levels. By contrast, the objectives of SPA protection of a site usually require the maintenance of populations of those species for which the site was designated close to the population levels at designation, or in some cases to restore populations.

In the case of the Flamborough Head & Bempton Cliffs SPA, the site conservation objective most pertinent to the qualifying bird species, in the context of Hornsea Project Two, is "by monitoring or restoring ... the populations of the qualifying features". This is a very different objective to that implicit in the use of PBR, which is to reduce the risk of extinction or population reduction to a low level. The avoidance of extinction or population reduction to a low level are not sufficient as objectives for sites specially selected and designated to protect the populations they hold. Hence, the use of PBR as a test of the expected impact of the Project on the integrity of the SPA is inappropriate. An adequate test requires that the expected population size of species of interest is projected with and without the anticipated effects of the Project. PBR does not, and is not designed to, specify the expected difference between the size of the population of the species of interest with and without the project. This principle is not recognised in the HRA, where the effect of additional mortality less than the PBR level is frequently assessed as "sustainable" without definition or specification of what "sustainable" means. The intended implication in the HRA is that the PBR indicates a level of additional mortality that can be sustained without any appreciable reduction in the population of interest, but this is not the case. Hence, its use in this HRA is incorrect.

It is highly likely that additional mortality considerably lower than the PBR level would result in a reduction in the size of the population of interest compared with what it would have been without the mortality. Within certain limits, this reduction would take place so that population size in the presence of a fixed per capita level of additional mortality would reach a stable equilibrium size lower than that without the additional mortality. How much lower this new population level would be is determined by the level of the additional mortality and features of the density dependence of demographic rates. At higher levels of additional mortality, density dependent compensation is inadequate to allow population size to attain a lower equilibrium level and the population declines to extinction. The level of additional mortality at which this more severe outcome occurs is also determined by features of the density dependence of demographic rates. The relevant features of density dependence for both outcomes are the particular demographic rates and age classes upon which it operates and its strength and form. Such features are only well-known for the most intensively studied bird populations. They are certainly not adequately known for any of the populations under consideration in the HRA assessment. Population extinction is unlikely to occur with levels of mortality lower than those indicated by an appropriately conducted PBR, but a reduction in population size is highly likely and it is not possible to predict how large that reduction will be with the type of data usually available or available in this case.

The second reason

The application of the PBR method in this HRA is incorrect in principle because it fails to recognise an important asymmetry in the logic underlying PBR. The PBR approach is intended to identify levels of additional mortality that are almost certainly not sustainable by the population of interest because they exceed the levels the population could sustain, *even if conditions were such that it could otherwise increase at the maximum possible rate*. In the HRA, it is suggested PBR can be used to identify levels of additional mortality that are almost certainly sustainable by the population of interest. This is the exact opposite of what PBR is designed for and logically capable of doing. The reason for the asymmetry in logic is that it cannot be known, with the limited information available, whether or not the conditions affecting the population currently or in future are such that it would increase at the maximum possible rate, given that the additional mortality was absent. Neither is it possible using PBR to assess the degree to which conditions that apply currently or in future approach those that would allow the population to *increase at the maximum possible rate*. This last problem makes the use of low values of the recovery factor *f* as a safety measure unsatisfactory because they are based upon guesswork.

The HRA and other assessments that rely upon PBR to identify "sustainable" levels of additional mortality fail to recognise this asymmetry in the applicability of the PBR approach, even though it is clearly stated in the authoritative study of the Demographic Invariants Method by Niel and Lebreton (2005). Niel and Lebreton (2005; p. 833) write "Because DIM considers maximum rates, its use must be limited to the detection of overharvested populations. It could be applied to predict whether an additional source of mortality is unsustainable, but it cannot be used the other way around (i.e. to predict that it is sustainable)." Rarely have scientists delivered a cautionary message about their method as clearly as this. However, the need for caution has not been recognised in the approach adopted by the applicant.

PBR is incorrectly implemented in the HRA

The PBR calculations do not include all sources of additional mortality

The PBR approach evaluates whether the effects of all sources of additional mortality in combination exceed the levels the population could sustain, even if conditions were such that it could otherwise increase at the maximum possible rate. Although the HRA assesses the in-combination effects of additional mortality caused by renewable energy projects other than Hornsea Two, it does not properly evaluate whether there are other sources of additional mortality. The capacity of seabird populations to compensate for additional mortality caused by wind energy developments is likely to be compromised by other frequent sources of additional mortality, such as drowning in fishing gear, overexploitation of fish stocks and anthropogenic climate change affecting food supplies. In other applications of the PBR approach to the assessment of the impact of additional mortality, it has been emphasized that it is essential to have accurate estimates of all sources of additional mortality affecting the whole population under consideration if comparison of additional losses with PBR is to be valid (Zydelis et al. 2009). Whilst these additional losses may be difficult to measure precisely, without estimates the possibility remains that the increment in additional mortality caused by the Hornsea Two project might be sufficient to increase the total of all additional deaths so that it exceeds the PBR. Hence, even if the arguments presented above that the PBR approach is not appropriate for the purposes of the HRA are rejected, the approach is likely to overestimate the margin of safety between the expected levels of additional mortality and the levels estimated from PBR as preventing the populations from being "sustainable". This further illustrates why it is inappropriate to rely upon the use of PBR in this case.

The PBR calculations do not recognise the lack of adequate empirical support for the selection of the recovery factor

PBR requires the use of a recovery factor *f* which is set based upon opinion rather than being determined by theoretical or empirical constraints. Whilst suggestions have been put forward for suitable recovery factors for populations of different status (Dillingham & Fletcher 2008), and a maximum default recovery rate of 0.5 has been recommended these values are simply matters of opinion and appropriate recovery factors are really unknown. A higher value of the recovery factor increases the PBR. High values of recovery factor are claimed to be justified based on the premise that the capacity for increased recruitment to offset any additional mortality incurred is likely to be greater in populations that are increasing in size than in those where numbers are stable or declining. According to Wade (1998), the recovery factor should not be higher than 0.1-0.2 if the aim is to maintain the population at 90-95% of the starting population size (i.e. a decline no greater than 5-10%), or in the case of a declining population, the recovery factor should be no higher than 0.1-0.3 if to avoid delaying the recovery time by more than 10-20%. The results from Wade's simulations are dependent on features of the assumptions about the form and strength of density dependence which are unknown for the seabirds under consideration in this case. It is necessary to understand that the PBR values are dependent upon a factor which is based simply upon opinion and simulation results that are sensitive to untested assumptions.

PBR has not been adequately validated by empirical studies

The PBR method has not been validated for birds or mammals. Proper validation would require that comparisons of reliably measured trends in population size with PBR calculations indicated that populations subject to additional mortality less than the PBR were not declining whereas those with additional mortality were declining. In practice, because any PBR calculation involves an uncertain choice of the recovery factor (see above) such an analysis would indicate which values of the recovery factor produce the most robust results. Such a validation test has not been done. When used for setting marine mammal bycatch or hunting bag limits, PBR is predicated on a feedback loop to modify "harvesting" rates iteratively, if necessary. This offers opportunities to validate the initial PBR calculation and, if it fails the test, to modify the recovery factor as part of adaptive management. This opportunity is not present for wind energy developments. Once wind turbines are erected, there will be limited scope for modifying take if it is found not to be sustainable.

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Annex 6: Wind farms operational, under construction or consented and funded

Scheme categories	Capacity (GW)
A – Operational	
Barrow	0.090
Beatrice*	0.010
Blyth	0.004
Burbo Bank I	0.090
Greater Gabbard	0.504
Gunfleet Sands Demonstration	0.012
Gunfleet Sands 1	0.108
Gunfleet Sands 2	0.065
Gunfleet Sands 3*	0.065
Gwynt y Mor[165]	0.576
Humber Gateway[166]	0.219
Inner Dowsing	0.097
Kentish Flats	0.090
Lincs	0.270
London Array 1	0.630
Lynn	0.097
Methil Demonstration (Fife Energy Park)	0.007
North Hoyle	0.060
Ormonde	0.150
Rhyl Flats	0.090
Robin Rigg (East & West)	0.180
Scroby Sands	0.060
Sheringham Shoal	0.317
Teesside	0.062
Thanet	0.300
Walney 1	0.184
Walney 2	0.184
West of Duddon Sands	0.389
Westermost Rough[167]	0.210
Subtotal	*5.120*

[165] Officially opened in June 2015: http://www.bbc.co.uk/news/uk-wales-33168638; also mentioned by the Secretary of State in a speech: https://www.gov.uk/government/speeches/address-to-the-renewablesuk-offshore-wind-conference

[166] http://www.grimsbytelegraph.co.uk/power-hit-Humber-Gateway/story-26656844-detail/story.html (9 June 2015)

[167] Officially inaugurated on 1 July 2015: http://renews.biz/91063/westermost-rough-has-lift-off/ Also mentioned by the Secretary of State in a speech: https://www.gov.uk/government/speeches/address-to-the-renewablesuk-offshore-wind-conference.

B – Under construction	
Burbo Bank Extension	0.258
Dudgeon	0.402
Kentish Flats Extension	0.050
Subtotal	*0.710*
C – Consented and funded	
Beatrice[168]	0.664
Blyth Demonstration[169]	0.099
EA 1[170]	0.714
Galloper[171]	0.340
Hornsea 1 (Heron wind + Njord)[172]	1.200
Neart na Gaoithe[173,174]	0.448
Race Bank[175]	0.580
Rampion (Southern Array)[176]	0.400
Walney Extension[177]	0.660
Subtotal	*5.105*
Total	**10.935**

Sources:

Unless stated otherwise, the source for the information above is *UK offshore wind – key facts 2015-16* (The Crown Estate, April 2015).

* Listed in Table 5.10 Power Stations in the United Kingdom, *Digest of United Kingdom Energy Statistics 2014* (DECC, 2014)

[168] Hi Def Surveying won a contract from SSE Renewables to provide survey work in 2015 (http://renews.biz/90182/hidef-woos-beatrice/ (15 June 2015))
[169] EDF Energy Renewables was scheduled to carry out site investigation works in June 2015. (http://www.newspostleader.co.uk/news/local/work-continues-on-350m-wind-farm-1-7313366)(17 June 2015)
[170] Iderdrola has selected Siemens to supply turbines for EA1: http://renews.biz/89668/siemens-lands-east-anglia-giant/ (5 June 2015)
[171] RWE Innogy UK "is continuing to make significant progress with a revised business case and design for the scheme: http://www.galloperwindfarm.com/ (June 2015)
[172] Hornsea 1 has awarded the contract to construct turbine blades to Siemens' Green Port Hull scheme: http://www.hulldailymail.co.uk/Siemens-Hull-factory-wins-UK-s-biggest-wind-farm/story-26642010-detail/story.html (5 June 2015)
[173] As mentioned above Neart na Gaoithe is one of the Scottish windfarms decisions that is currently subject to a Judicial Review by the RSPB.
[174] Neart na Gaoithe placed an order for Siemens' new offshore transmission module (http://www.rechargenews.com/wind/1396924/neart-na-gaoithe-offshore-wind-debut-for-siemens-otm) (13 April 2015)
[175] Siemens have one the contract to supply turbines for this scheme: http://www.power-technology.com/news/newssiemens-wins-turbine-supply-contract-for-race-bank-offshore-wind-project-in-uk-4616040# (6 July 2015)
[176] Babcock International has won a contract to build an offshore substation for the Rampion scheme (http://renews.biz/89907/babcock-scotland-win-at-rampion/)(9 June 2015)
[177] Siemens have been chosen as preferred supplier for the Walney scheme: http://www.4coffshore.com/windfarms/siemens-7mw-turbine-favored-for-walney-ext-nid1513.html (12 March 2015)