



Rampion Offshore Wind Farm



ES Section 11 – Marine Ornithology

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11 MARINE ORNITHOLOGY

11.1 Introduction

11.1.1 This section of the Environmental Statement (ES) provides details of the marine ornithological interest for the Rampion Offshore Wind Farm (the Project) and its surroundings and describes the potential impacts and any proposed mitigation on ornithology which may arise as a result of the Offshore elements of the Project. Details of the terrestrial ornithological interests for the Project are provided in Section 24 – Ecology.

11.1.2 The ornithological assessment's specific objectives are to:

- Present the results of the baseline bird surveys of the Offshore Project site and its surroundings to determine the numbers and distributions of birds present;
- Collate appropriate additional information on the Offshore Project site's ornithological interests, including a review of the literature;
- To establish the relative importance of the area for birds, for breeding, migratory and wintering populations;
- Evaluate the ornithological conservation importance of the site;
- Predict the potential ornithological impacts of the construction, operation and de-commissioning of the Offshore Project and predict the significance of the impacts;
- Develop mitigation measures to reduce potential ornithological impacts;
- Assess the significance of the residual impacts following mitigation;
- Provide a baseline for monitoring of the impacts of the development, if consent is granted.

11.2 Legislation and Policy Context

Legislation

11.2.1 The following legislation is relevant to the assessment:

- National Policy Statement (NPS) EN-1 (Overarching National Policy Statement for Energy) and NPS EN-3 (National Policy Statement for Renewable Energy Infrastructure)
- EU Council Directive 79/409/EEC on the conservation of wild birds (the 'Birds Directive');

- EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (the 'Habitats Directive');
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 which implement the Habitats Directive and the Birds Directive in relation to marine areas where the UK has jurisdiction beyond territorial waters (broadly 12 nautical miles to 200 nautical miles).
- The Conservation of Habitats and Species Regulations 2010 which implement the Habitats Directive and the Birds Directive in relation to England and Wales as far as the limit of territorial waters (usually 12 nautical miles).
- The Wildlife and Countryside Act 1981 (as amended);
- The UK Biodiversity Action Plan; and
- The National Planning Policy Framework (NPPF).

National Policy Statements

11.2.2 The National Policy Statement for Renewable Energy Infrastructure (EN-3) contains policy which is of relevance to ornithology.

11.2.3 Paragraph 2.6.100 states that:

"Offshore wind farms have the potential for the following effects on ornithology:

- *Collisions with rotating blades*
- *Direct habitat loss*
- *Disturbance from construction activities such as movement of construction/decommissioning vessels and piling;*
- *Displacement during the operational phase, resulting in loss of foraging/roosting area; and*
- *Impacts on bird flight lines (i.e. barrier effect) and associated energetic expenditure for commuting flights between roosting and foraging areas."*

11.2.4 Paragraph 2.6.101 states that:

"The scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor."

11.2.5 Paragraph 2.6.102 states that:

"Relevant data from operational offshore wind farms should be referred to in the applicant's assessment."

11.2.6 Paragraph 2.6.103 states that:

“It may be appropriate for assessment to include collision risk modelling for certain species of birds. Where necessary, the assessments carried out by the applicants should assess collision risk using survey data collected from the site at the pre-application EIA stage. The IPC [now Secretary of State] will want to be satisfied that the collision risk assessment has been conducted to a satisfactory standard having had regard to the advice from the relevant statutory advisor.”

11.2.7 With regard to Mitigation, Paragraph 2.6.106 states that:

“Aviation and navigation lighting should be minimised to avoid attracting birds taking into account impacts on safety.”

11.2.8 Paragraph 2.6.107 states that:

“Subject to other constraints, wind turbines should be laid out within a site to minimise collision risk, where the collision risk assessment shows there is a significant risk of collision.”

11.2.9 Paragraph 2.6.108 states that:

“Construction vessels associated with offshore wind farms should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods.”

11.2.10 Paragraph 2.6.109 states that:

“The exact timing of peak migration events is inherently uncertain. Therefore, shutting down turbines within migration routes during estimated peak migration periods is unlikely to offer suitable mitigation.”

11.2.11 The legislation relating to the specific protection of bird species is summarised below:

11.2.12 **Directive 2009/147/EC on the conservation of wild birds (The Birds Directive), translated into UK law in the Habitats Regulations:** Provides protection for all species of naturally occurring birds in the wild state in Europe. Applies to birds, their eggs, nests and habitats. The Directive provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. It sets broad objectives for a wide range of activities, although the precise legal mechanisms for their achievement are at the discretion of each Member State.

11.2.13 **The Wildlife and Countryside Act 1981:** All wild birds, their nests and eggs are protected in the UK under this Act (a wild bird is defined as any bird of a species that is resident in or is a visitor to the European Territory of any member state in a wild state). Offences under the Act include the intentional killing, injury or taking of any wild bird; intentionally taking or damaging the nest of any wild bird

whilst it is in use or being built; intentionally taking or destroying the egg of any wild bird and intentionally or recklessly disturbing any wild bird listed on Schedule 1 while it is nest building, or at a nest containing eggs or young.

11.2.14 **Natural Environment and Rural Communities Act 2006:** Public bodies have to have due regard to the conservation of biodiversity in general. Makes provision regarding environmental bodies, wildlife, SSSIs, National Parks and the Broads; and rights of way.

11.2.15 **The UK Biodiversity Action Plan (UK BAP):** The UK BAP does not afford specific legal protection for species and habitats but it does highlight many species of conservation concern. The UK BAP resulted from the UK's commitment to the Convention on Biological Diversity 1992, which came out of the Rio Earth Summit.

Guidance

11.2.16 The following guidance documents have been used to inform the ornithological impact assessment:

- King *et al.* (2009) COWRIE guidance on ornithological cumulative impact assessment for offshore wind farms;
- Camphuysen *et al.* (2004) COWRIE guidance on seabird survey techniques;
- Maclean *et al.* (2009) COWRIE review of assessment methodologies for offshore wind farms;
- Guidance on the Assessment of Effects on the Environment and Cultural Heritage from Marine Renewable Developments. Produced by: The Marine Management Organisation (MMO), Joint Nature Conservation Council (JNCC), Natural England, the Countryside Council for Wales (CCW) and Centre for Environment, Fisheries & Aquaculture Science (Cefas) (December 2010);
- RSPB research report on offshore wind farms and birds (Langston, 2010);
- Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal (Institute for Ecology and Environmental Management (IEEM) (2010);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects. Draft for consultation. Cefas. Report reference: ME5403 – Module 15. Issue date: 10 March 2011;
- Nature conservation guidance on offshore wind farm development. A Guidance Note on the Implications of the EC Wild Birds and Habitats Directives for Developers Undertaking Offshore Wind farm Developments (Defra, 2005); and

- Managing Natura 2000 Sites (Anon, 2000), which gives guidance on the implementation of the Birds and Habitats Directives.

11.3 Scoping and Consultation

Scoping

11.3.1 Initial consultation on the Project was carried out via the Rampion Offshore Wind Farm Scoping Document (E.ON/RSK, 2010), as well as further consultation exercises in 2011. A Scoping Opinion (IPC, October 2010) was received from the IPC in October 2010 incorporating comments from a wide range of consultees. A copy of the Scoping Report and the Scoping Opinion itself are provided in Appendix 5.1 and 5.2 respectively. The information and advice received during the scoping process with regard to ornithological issues are summarised in Table 11.1.

Table 11.1: Scoping and consultation responses

Date	Consultee	Summary of issues	Sections where addressed
29/10/10	RSPB	Advised that the site development area should remain flexible so as not to reduce the scope for environmental mitigation – not narrowed at an early stage.	The site design has taken into account a large range of constraints, particularly water depth, and distance from navigation and shipping lanes, which has resulted in a reduced potential development area from 270 to 138km ²
		Significant effects on internationally designated sites cannot be ruled out at this stage. Impact of collision and displacement from foraging areas should be subject to survey.	The assessment is being informed primarily by the baseline survey data.
		RSPB welcomes consultation and meetings to discuss the bird survey results	Noted
		Collision risk for birds using the site needs to be considered, including Mediterranean Gull, Sandwich Tern and Kittiwake.	Collision risk modelling has been carried out for all species at risk
		RSPB has potentially useful information available from its Balanced Seas project	Information from the Balanced Seas project has been noted
		The reference to Habitats Regulations in section 3.2 should say "Conservation of Habitats and Species Regulations 2010".	Noted and updated

Date	Consultee	Summary of issues	Sections where addressed
		Section 4.5.2: The RSPB does not consider that NPS statements are relevant as assessment criteria in defining significance of impacts.	Noted – these have not been used as definitive assessment criteria.
		Table 4.2: In terms of compensation it would be helpful to mention the Habitats Regulations. If impacts on SPAs cannot be reduced or avoided, tests in the regulations have to be met before compensation can be considered.	Noted and updated.
		Section 4.7: other offshore wind farms should be mentioned in cumulative, even just to say there will be no cumulative impacts. Also, The COWRIE report (2009) <i>Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers</i> should be referred to.	Cumulative assessment includes full list of offshore wind farms that could contribute to in-combination effects. King <i>et al.</i> (2009) COWRIE report has been used.
		Section 5.7.1 Adur Estuary SSSI should be added to the list of designated sites on p.56 and table 5.3	Added to list
		P58. RSPB agree some species may require specific surveys	Noted
		P60. certain species of wader are mentioned in this list but the RSPB recommends that individual species are not focus upon at this stage.	Assessment does address all wader species recorded
		Section 5.7.2: Potential effects should include collision mortality	Potential effects do include collision mortality
		Section 5.7.3.1: More detail of the survey methodology inc. duration, transect spacing and resolution of digital photography should be included.	Aerial survey methodology provided in Appendix 11.1
	Marine Management Organisation (MMO)	Langston (2010) Offshore wind farms and birds: Round 3 zones, extensions to Round 1 and Round 2 sites and Scottish Territorial Waters RSPB research report no 39. should be reviewed.	Noted and added to guidance document list

Date	Consultee	Summary of issues	Sections where addressed
10/11/10	Natural England	Most of the seabird species listed in table 5.4 and 5.5 which are not Annex 1 are considered to be regularly occurring migrants. Article 4 of the Birds Directive requires Member States to adopt similar special conservation measures for such species as for those species listed on Annex 1. As such, these seabird species should be given the same consideration as species listed on Annex 1.	Noted
		Little gulls are not a breeding species in this region.	Noted and updated - typographical error.
		All wader species should be given consideration in the ES	Assessment addresses all wader species recorded
		There should be more consideration given to the possible impact on migrating land birds crossing the channel in spring and autumn. Impacts due to collisions with this wind farm in combination with other wind farm developments might have potential impacts on such populations. There needs to be some consideration given to surveys that will assess the level of risk e.g. a programme of land-based diurnal migration watches in spring and autumn and/or radar/nocturnal studies at appropriate times of year.	Assessment includes specific section on migrating land birds. Collision modelling of species recorded during baseline surveys has been undertaken. Cumulative assessment has been carried out.
		Page 60. The list of bird species identified as being of "principal potential concern" should not be viewed as being definitive in advance of the baseline survey work.	Noted – assessment has been made on basis of all data from baseline surveys.
		Natural England suggested (Feb 2010) the need for night-time migration monitoring. There is no mention of such monitoring in this scoping report.	During further discussions with Natural England it was agreed that such work would be unlikely to add to the understanding of the baseline and hence has not been undertaken.

Date	Consultee	Summary of issues	Sections where addressed
		Diurnal migration activity monitoring - boat-based and aerial surveys conducted once a month are not designed to record rapid movements of birds on passage across an area of sea. As such, the planned survey methodology is highly likely to underestimate such bird activity. To parallel nocturnal migration activity monitoring, a programme of land-based, visual observations of bird passage offshore during daylight should be considered, possibly in parallel with a shore-based radar monitoring programme.	A dedicated migration observer was used on the survey vessel during migration periods, as agreed with Natural England.
		Section 5.7.3.3 Potential Cumulative and in combination impacts - The statement that discussions with Natural England led to an agreement that there are unlikely to be cumulative impacts due to the distance between the Rampion site and the West of Wight zone is incorrect. NE were of the view that West of Wight needed to be included in any cumulative impact assessment and that there was a need to consider how much further afield it would be appropriate to search for possible cumulative and in-combination assessments.	Noted.
		Section 5.7.2 This list of potential effects needs to include additional collision mortality during the operational phase.	Noted.
		5.7.3.1 The second objective of the ornithological surveys is very unclear	Noted and clarified.

Date	Consultee	Summary of issues	Sections where addressed
		Section 4.5.2 Assessment Criteria. It is likely that the process of assessing the significance of potential environmental impacts will follow standard procedures. However, in this, as in other Round 3 development zones, particular attention needs to be given to the robustness of such generic approaches. For example the appropriateness of the threshold levels of impact magnitude used to discriminate between e.g. major and moderate level impacts requires careful consideration. Also, for example, the way in which peak numbers of birds seen on passage during snapshot boat-based surveys are compared with regional or national population sizes in order to assess magnitude of impacts needs careful consideration. So too does the population level-scale with which any increased collision induced mortality is compared in order to establish its significance.	Generic approach used for guidance only, with final assessments being made using professional judgement, as per Maclean <i>et al.</i> 2009.
		P61, Natural England has not (as far as I am aware) agreed the specifications of all of these surveys.	This was agreed at subsequent meetings.
		While the extent of the boat-based surveys for ornithological monitoring is sufficient, the extent of the aerial surveys, being effectively the same, does not seem particularly large.	Both the boat-based and aerial surveys cover very extensive areas around the wind farm site as well as the site itself (see Figures 11.1 and 11.2)
		Section 5.7.3.1 The proposed boat based survey plan appears satisfactory	Noted

Date	Consultee	Summary of issues	Sections where addressed
		Natural England did recommend (in Feb 2010) the need for monthly aerial surveys over the first 12 months with a review at that stage to consider the need for further aerial survey work. Other than that Natural England has had no further discussions regarding the specification of these aerial surveys. It is not possible from the content of the scoping report to assess the suitability of the proposed aerial survey monitoring programme.	The survey programme was agreed at meetings following the scoping process.

11.3.2 Following the scoping process, regular meetings have taken place between the developer and Natural England, on the following dates: 12/6/09, 4/8/10, 16/11/10, 4/3/11, 29/11/11, 20/3/12 and 23/10/12, and detailed comments have been received from Natural England on a draft of this section.

11.3.3 The main potential offshore ornithological effects arising from the Offshore Project that require further assessment were identified through the scoping process and comprise the following:

- Displacement of birds from the Offshore Project site and its surrounds as a result of disturbance to feeding, roosting and moulting sites during construction, operation and maintenance;
- Collision risk to birds using and over-flying the Offshore Project site;
- Disruption of bird flight routes;
- Habitat loss through construction of the wind turbine foundations;
- Changes to the sediment (including potential erosion and deposition effects) resulting in habitat alteration; and
- Cumulative effects on seabirds, in combination with the proposed Navitus Bay Offshore wind farm, to the West of the Isle of Wight.

11.3.4 The scope of the assessment was modified accordingly to take account of the above consultee responses and the opinions of the IPC, the findings of which were reported in a Draft ES and subject to stakeholder consultation.

11.3.5 Key consultees (i.e. with regard to ornithology; Natural England, RSPB, and the Sussex Ornithological Society) provided responses to the draft ES on ornithology. These responses, and the modifications subsequently made to the final ES, including the following updates to the chapter:

- Further detail of the numbers of migrant flights through the wind farm site included in the collision risk assessment;
- Use of post-construction monitoring data from Thanet and other post-construction monitoring surveys in predicting the likely displacement of seabirds around the wind farm;
- Assessment of the collision risk against national and biogeographic populations as well as regional populations;
- Use of Thaxter *et al.* (2012) seabird range data in determining which seabird may be linked to SPAs and determining their likely provenance;
- Consideration of Cook *et al.* (2012) flight heights particularly for species seen infrequently at Rampion;
- Inclusion of 'out of transect' data in the population estimates and evaluation;
- Completion of cumulative assessment to include wider area consideration of more wide-ranging species;
- Consideration of data from Stone *et al.* (1995) in relation to providing a wider context for the seabird densities observed at Rampion;
- Clarification of data used in collision risk modelling (boat/aerial/wider survey area);
- Additional information provided on % change to baseline mortality for a range of avoidance rates;
- Inclusions of assessment of possible collision risk to migrant nightjars in relation to the regional SPA populations;
- Further consideration of the potential piling noise impacts on seabird prey species (fish);
- Clarification of the treatment of 'unidentified' species, particularly common/arctic tern and razorbill/guillemot and details of how these have been incorporated into the assessment;

11.4 Assessment Methodology

Establishment of Baseline Environment

Desk Study Methods

11.4.1 A desk study was undertaken to collate relevant information available on the ornithological interests in and around the Offshore Project Site. The main sources of information used for the desk study were:

- Natural England website - statutory designated site boundaries, including Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI) and SSSI citation details;
- Joint Nature Conservation Committee website (www.jncc.gov.uk) – SPA citation information;
- Aerial Surveys of waterbirds in UK inshore areas (Dean *et al.*, 2003; DTI, 2006; Söhle *et al.*, 2006; Lewis *et al.*, 2008);
- The Migration Atlas Movements of the Birds of Britain and Ireland (Wernham *et al.*, (eds). 2002);
- ESAS – European Seabirds at Sea Database JNCC (Stone *et al.*, 1995) to provide contextual data on seabird densities in the region;
- County Bird Reports (Hampshire 2005, Sussex 2005, Kent 2005 & Isle of Wight 2006);
- Various offshore wind farm Environmental Statements (including London Array, Thanet, Kentish Flats, Greater Gabbard);
- National Biodiversity Network (NBN) web site (www.nbn.org.uk): records include data from the Seabird 2000 national seabird census project (Mitchell *et al.*, 2004); and
- Wetland Bird Survey Data: Britain's important waterfowl sites are counted monthly through the year as part of the national Wetlands Birds Survey (WeBS). Data have been obtained from the British Trust for Ornithology (BTO) to provide further information on the longer-term populations trends of the key species.

Study Areas

11.4.2 The surveys include the area that could potentially be affected by the Offshore Project and a wider area around this. Data from a wider area have been used to assess the importance of the proposed Offshore Project site in relation to other feeding, roosting and moulting areas in the vicinity. The offshore boat surveys therefore covered the offshore wind farm site itself, plus a buffer around that,

which included an area extending to at least 5km outside the Offshore Project site. The extent of the boat survey areas and the survey transects are shown in Figure 11.1 and cover a total area of 1,076km². The 5km+ buffer enabled a wider context of the wind turbine locations to be determined and will also enable post-construction monitoring to use these data to undertake gradient analysis to determine distances at which birds were affected by the wind turbines.

- 11.4.3 The aerial survey area covered a wider area around the boat survey area, to provide additional information on the regional distribution of seabirds. It covered a total of 1,100 km². The extent of this survey area is shown in Figure 11.2.

Field Survey Methods: Offshore Boat Surveys

- 11.4.4 Boat-based bird surveys have been ongoing in the relevant survey area since March 2010 and a full two years' surveys have been undertaken to provide the baseline for the ES assessment.
- 11.4.5 The methodologies outlined in the 'Manual for Aeroplane and Ship Surveys of Waterfowl and Seabirds' (Komdeur *et al.*, 1992) and updated by Camphuysen *et al.* (2004) and Maclean *et al.* (2009) for COWRIE have been followed throughout the surveys. Given that there is year-round bird interest in the relevant survey area and seabird numbers may be variable between years, it was essential to ensure that two full years' survey data were collected for the EIA.

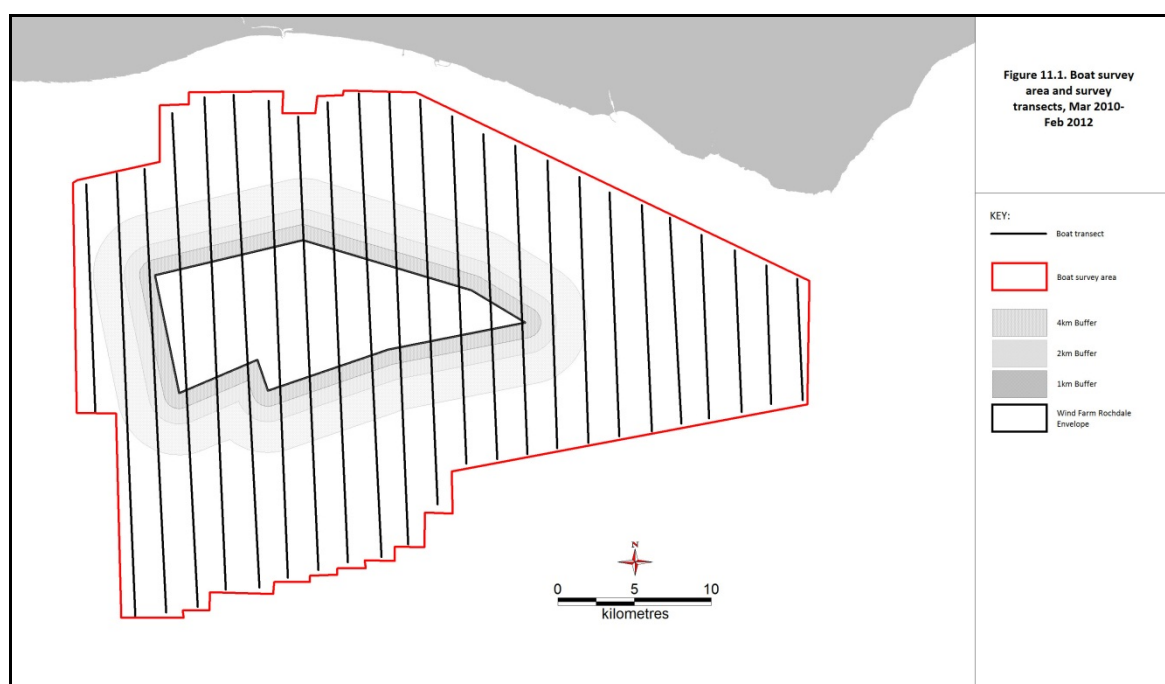


Figure 11.1: Boat survey area showing transects, March 2010 – February 2012



Figure 11.2: Aerial survey area showing transects, August 2010 – August 2011

- 11.4.6 The vessel used for the boat-based surveys provided a stable viewing platform at 5.5m viewing height (above sea level) and surveyed at a speed of about 12 knots, to give full compliance with the COWRIE (2004) guidance.
- 11.4.7 Surveys were carried out to cover the whole survey area once per month. A survey route was designed to provide a 2 km interval between transects. This was sufficient to provide an adequate sample from the study area, whilst minimising the potential for displacing birds into adjacent transects. A GPS record of the precise route was recorded, so that the location at all times was known. The transects followed an approximate north-south direction perpendicular to the shore to comply with COWRIE guidance. The locations are shown in Figure 11.1.
- 11.4.8 The observation team included a surveyor and recorder, with additional back-up to ensure that observers could be rested in rotation. All surveyors were experienced ornithologists, able to identify all the species encountered accurately, and all were ESAS¹ accredited. An additional bird observer was used during the main bird migration periods (Mar-May and Sep-Nov) to search at greater distances from the survey vessel to increase detection of migrating birds. The frequency of surveys during this period was also increased to twice per month in 2011.
- 11.4.9 All birds encountered, their behaviour, flight height and approximate distance and direction from the boat were recorded. A range-finder was used to estimate distances of the birds from the vessel. Following the COWRIE (Camphuysen *et al.*, 2004) recommendations, birds were recorded in five distance bands (0-50m, 50-100m, 100-200m, 200-300m and 300+m). Flight heights were summarised to

¹ ESAS – European Seabirds at Sea (a qualification recognised by the JNCC for offshore bird survey experience)

height classes following COWRIE guidance (0-2m, 2-10m, 10-25m, 25-50m, 50-100m, 100-200m, >200m; Camphuysen *et al.* (2004), Lensink *et al.* (2002).

- 11.4.10 The snapshot survey technique recorded data in 1-minute blocks, to maximise the spatial resolution of the data collected, making analysis of the factors affecting the birds' distribution more precise. The time of each observation has been linked to the GPS data to give the precise location of each bird/flock encountered.
- 11.4.11 As well as bird species, number of individuals present, flight height, behaviour, distance from the vessel, in transect or not in transect, plumage, age, sex, moult, flight direction, notes on whether the bird was oiled and associations between or within species was recorded, together with the vessel's position its speed, course and whether there were any other vessels present.
- 11.4.12 The boat survey data have been subject to correction to take into account declining detectability with distance from the survey vessel and survey coverage (Buckland *et al.*, 2001; Thomas *et al.*, 2009).
- 11.4.13 The boat surveys were carried out on the following dates, at approximately monthly intervals. In most months it took three days to cover the survey area, and these were usually done on consecutive days. Data from the first 22 surveys have been included in this report (with two remaining, one in January 2012 and the final one in February 2012 – to be added at the final ES stage):
- March 2010 - 9/3/10, 12/3/10, 13/3/10, 14/3/10 and 23/3/10;
 - April 2010 – 17/4/10, 18/4/10 and 19/4/10;
 - May 2010 – 13/5/10, 14/5/10 and 15/5/10;
 - June 2010 – 22/6/10, 23/6/10 and 24/6/10;
 - July 2010 – 6/7/10, 7/7/10 and 8/7/10;
 - August 2010 – 3/8/10, 4/8/10 and 5/8/10;
 - September 2010 – 8/9/10, 9/9/10 and 10/9/10;
 - October 2010 – 4/10/10, 5/10/10 and 7/10/10;
 - November 2010 – 19/11/10, 20/11/10 and 21/11/10;
 - December 2010 – 7/12/10, 9/12/10 and 10/12/10;
 - January 2011 – 21/1/11, 22/1/11, 23/1/11 and 24/1/11;
 - February 2011 – 9/2/11, 10/2/11 and 11/2/11;
 - March 2011 – 15/3/11, 16/3/11, 17/3/11, 21/3/11, 22/3/11 and 23/3/11;

- April 2011 – 4/4/11, 6/4/11, 7/4/11, 20/4/11, 21/4/11 and 22/4/11;
- May 2011 – 9/5/11, 10/5/11, 11/5/11, 17/5/11, 19/5/11 and 25/5/11;
- June 2011 – 7/6/11, 9/6/11 and 10/6/11;
- July 2011 – 11/7/11, 12/7/11 and 13/7/11;
- August 2011 – 15/8/11, 16/8/11 and 17/8/11;
- September 2011 – 15/9/11, 16/9/11, 25/9/11, 26/9/11, 27/9/11 and 28/9/11;
- October 2011 – 12/10/11, 13/10/11, 14/10/11, 19/10/11, 20/10/11 and 21/10/11;
- November 2011 – 9/11/11, 10/11/11, 11/11/11, 17/11/11, 19/11/11 and 20/11/11;
- December 2011 – 21/12/11, 22/12/11 and 8/1/12;
- January 2012 – 9/1/12, 10/1/12 and 11/1/12; and
- February 2012 – 4/2/12, 6/2/12 and 7/2/12.

Field Survey Methods: Offshore Aerial Surveys

11.4.14 The methods employed for the aerial surveys followed those developed by National Environmental Research Institute [NERI] in Denmark in recent years, which were designed specifically around the requirement to provide accurate spatial data for seaducks and associated species, and particularly scoter (Kahlert *et al.*, 2000). As for the boat transect surveys, the survey methods were based on distance sampling protocols. The aerial survey area covered an area of 1,102km² around the wind farm site, to provide additional information on the regional distribution of seabirds. This area and the transects used for the aerial survey are shown in Figure 11.2. Full details of the aerial survey method are given in Appendix 11.1.

11.4.15 The aerial surveys were carried out on the following dates:

- August 2010 – 12/8/10;
- September 2010 – 18/9/10;
- October 2010 – 12/10/10;
- November 2010 – 19/11/10;
- December 2010 – 12/12/10;

- February 2011 – 18/2/11;
- March 2011 – 11/3/11;
- May 2011 – 20/5/11;
- June 2011 - 28/6/11 (only the eastern half of the survey area was covered on this date. The remainder was covered on an additional survey on 20/7/11);
- July 2011 – 21/7/11; and
- August 2011 – 2/8/11.

Data analysis and presentation

11.4.16 The first step in the analysis was to determine the distance correction factors (see Appendix 11.5). These were calculated in the same way as for the boat transect surveys (see above). The correction factors were applied to each raw data record, to give the distance-adjusted count. These data were used to calculate the overall bird density, and hence to estimate the populations in the whole study area (multiplying the bird density by the total area). Data from the two bands closest to the survey plane were used (bands A and B), as the detectability of birds in the further band (C) was too low to give a reliable population estimate.

11.4.17 This was repeated for the proposed wind farm site and for the surrounding buffers, but using the correction factors for the whole study area (to provide a larger sample), to estimate the bird density and total numbers.

Identification and Assessment of Impacts and Mitigation Measures

11.4.18 The evaluation of conservation importance has been carried out using the methodology published in Percival (2007), which has been adapted from the methodology developed by Scottish Natural Heritage (SNH) and the British Wind Energy Association (now Renewable UK) and following Maclean *et al.* (2009). This methodology first identifies the sensitivity (conservation importance; as defined in Table 11.2) of the receptors present in the study area and then determines the magnitude of the possible effect on those receptors (Table 11.3).

11.4.19 The conservation importance in numeric terms has been assessed by reference to Table 11.2 and by using the standard 1% criterion method (Holt *et al.*, 2011); (>1% national population = nationally important, >1% international population = internationally important). The national baseline populations have been taken from Baker *et al.* (2006) and citation populations from the respective SPAs. A further category of 'local importance' has been used for species that are not considered to be of regional importance, but were still of some ecological value. This included all species on the red or amber lists of the RSPB publication 'Birds of Conservation Concern' (Eaton *et al.*, 2009). In assessing the importance of each population, consideration was given to any unidentified groups that may

have included each species (specifically whether unidentified birds may have increased the numbers above any threshold level of importance), whether populations may have been underestimated through birds' behavior (e.g. diving and hence out of surveyors' view), and for migrants the total number of flights that might occur through the survey area during migration.

Table 11.2: Sensitivity (Conservation Importance) of Bird Species

Sensitivity	Definitions
Very High	Species for which at site is designated (Special Protection Areas (SPAs) / Special Areas of Conservation (SACs)) or notified (Sites of Special Scientific Interest (SSSIs)). A local population of more than 1% of the international population of a species.
High	Other species that contribute to the integrity of an SPA or SSSI. A local population of more than 1% of the national population of a species. Any ecologically sensitive species, e.g. large birds of prey or rare birds (<300 breeding pairs in the UK). EU Birds Directive Annex 1, EU Habitats Directive priority habitat/species and/or Wildlife and Countryside Act 1981 (as amended) Schedule 1 species (if not covered above). Other specially protected species.
Medium	Regionally important population of a species, either because of population size or distributional context. UK Biodiversity Action Plan (BAP) priority species (if not covered above).
Low	Any other species of conservation interest, e.g. species listed on the Birds of Conservation Concern not covered above.

Table 11.3: Definition of Terms Relating to the Magnitude of Ecological Effects

Magnitude	Definition
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: >80% of population/habitat lost
High	Major alteration to key elements/ features of the baseline (conditions such that post development character/composition/attributes will be fundamentally changed). Guide: 20-80% of population/habitat lost
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/ composition/ attributes of baseline will be partially changed. Guide: 5-20% of population/habitat lost

Magnitude	Definition
Low	Minor shift away from baseline conditions. Change arising from the loss/ alteration will be discernible but underlying character/ composition/ attributes of baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/habitat lost
Negligible	Very slight or no change from baseline condition. Change barely distinguishable, approximating to the “no change” situation. Guide: <1% of population/habitat lost

Significance Criteria

11.4.20 The combined assessment of the magnitude of an effect and the sensitivity of the receptor has been used to determine whether or not an effect is significant. These two criteria have been cross-tabulated to assess the overall significance of that effect (Table 11.4).

Table 11.4: Matrix of Magnitude of Effect and Sensitivity used to quantify the Significance of Effects

Magnitude	Sensitivity			
	Very High	High	Medium	Low
Very High	Very high	Very high	High	Medium
High	Very high	Very high	Medium	Low
Medium	Very high	High	Low	Very low
Low	Medium	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low

11.4.21 The significance category of each combination is shown in each cell. Red and orange cells indicate potentially significant effects.

11.4.22 The interpretation of these significance categories is as follows, though as recommended in Maclean *et al.* (2009) expert judgement has also been used in the interpretation of the results of the assessment:

- very low and low are not normally of concern, though normal design care should be exercised to minimise adverse effects;
- very high and high represent negative effects on bird populations which are regarded as significant in terms of the EIA Regulations; and
- medium represents a potentially significant negative effect which, in comparison with very high and high negative effects, may be reduced below the level of significance (in terms of the EIA Regulations) by mitigation measures.

- 11.4.23 An assessment has also been made of the significance of residual impacts, i.e. those remaining after mitigation.
- 11.4.24 The guidance threshold values given in the Table 11.4 have been used widely in the assessment process but are arbitrary, and expert judgment still needs to be applied in the process, particularly where effects may be potentially significant and where the magnitude of effects is close to a threshold value (following the recommendation of Maclean *et al.*, 2009).
- 11.4.25 All species recorded within the survey area have been considered in the assessment, not just those that were found in the potential impact zone of the Offshore Project site.
- 11.4.26 As it is possible that birds associated with several SPAs could potentially be affected by the Offshore Project, a specific Habitats Regulations Assessment (HRA) has been undertaken to address whether there would be a likely significant effect on any SPA. That report (Document 5.3) has concluded that there would not be any likely significant effect under the Habitats Regulations resulting from the project in relation to ornithology, and therefore that the Competent Authority (in this case the Secretary of State) would not be required to undertake an Appropriate Assessment under those Regulations.

Uncertainty and Technical Difficulties Encountered

- 11.4.27 No significant information gaps have been identified. Inevitably with any ecological survey it cannot be guaranteed to detect all target species/individuals and surveys cannot be fully representative of all conditions (e.g. severely reduced visibility). However, in this case the baseline surveys provide a robust data set on which to carry out the assessment. No survey limitations/constraints are considered likely to have significantly affected the conclusions of this assessment.

11.5 Environmental Baseline

- 11.5.1 This section describes the ornithological interests of the Project site and its surroundings.

Desk Study

Nature Conservation Designations

- 11.5.2 The nature conservation designations relating to offshore ornithology considered in this assessment are as follows. This includes all statutory designated sites that have any ornithological interest feature that could use the ecological resources within/around the Offshore Project site and/or over-fly the Offshore Project site (and hence be at risk of collision mortality), within an initial search area of 100km from the Offshore Project site. Further consideration is then given for more

distant sites where there could possibly be a clear ecological link between birds using the Project site and a Special Protection area (SPA):

- Chichester and Langstone Harbours (West Sussex) designated as a Ramsar site, SPA and Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) (as part of the Solent Maritime SAC);
- Portsmouth Harbour (Hampshire) Ramsar site, SPA and SSSI;
- Solent and Southampton Water (Hampshire) SPA incorporating several SSSIs. North Solent is a National Nature Reserve (NNR);
- Pagham Harbour (West Sussex) Ramsar site, SPA and SSSI;
- Dungeness to Pett Level (Kent to East Sussex), which incorporates a proposed Ramsar site, SPA, SAC and SSSI (Dungeness, Romney Marsh and Rye Bay). Dungeness is also a NNR;
- Rye Harbour (East Sussex) SSSI;
- Adur Estuary SSSI;
- Bracklesham Bay (West Sussex) SSSI;
- Hastings Cliffs to Pett Beach (East Sussex) SSSI;
- Selsey, East Beach (West Sussex) SSSI;
- Climping Beach (West Sussex) SSSI;
- Bognor Reef (West Sussex) SSSI;
- Seaford to Beachy Head (East Sussex) SSSI;
- Brighton to Newhaven Cliffs SSSI – though primarily a geological site, this also holds small breeding populations of fulmar, kittiwake and herring gull (as per the SSSI citation), though the Seabird 2000 (Mitchell *et al.*, 2004) survey reports only a single species, fulmar, of which there were 18 pairs recorded;
- Pevensey Levels (East Sussex) SSSI and NNR (this site is mostly inland but extends to the coast);
- Newtown Harbour (Isle of Wight) NNR; and
- Titchfield Haven (Hampshire) NNR.

11.5.3 Table 11.5 gives the population sizes for each of the SPA seabird breeding colonies. All of the qualifying and assemblage species for each SPA are summarised in Table 11.6.

Table 11.5: Population sizes for each of the SPA seabird breeding colonies

SPA	Species	Population (number of breeding pairs - SPA Review)	Distance from wind farm site	Thaxter et al (2012) max foraging range	Notes
Solent and Southampton Water	Mediterranean Gull	2	49km	20km	
	Sandwich Tern	231		54km	On fringe of max foraging range
	Common Tern	267		30km	
	Roseate Tern	2		30km	No longer breeding in this SPA (Holling <i>et al.</i> 2012)
	Little Tern	49		11km	
Chichester and Langston Harbour	Sandwich Tern	158	35km	54km	On fringe of max foraging range
	Little Tern	100		11km	
Pagham Harbour	Little Tern	12	28km	11km	
Dungeness to Pett Levels	Mediterranean Gull	2	57km	20km	
	Common Tern	266		30km	
	Little Tern	35		11km	

11.5.4 The Rampion Project site lies within the maximum foraging range of only one of these species, Sandwich tern, from two SPAs, Solent and Southampton Water and Chichester and Langston Harbour. For all other of these SPA breeding seabirds, the Project site lies outside the maximum recorded foraging range, so would be very unlikely to be used by breeding birds from these populations (except possibly on migration to/from the SPAs).

11.5.5 Further details of the locations (including maps) for the statutory protected nature conservation sites are presented in Section 9 - Nature Conservation).

Table 11.6: SPA species and their exposure to risk of any effect from the Project. Q = qualifying species, A = assemblage species (as listed in SPA Review, jncc.defra.gov.uk)

Species	SPA:					Present in wind farm or wider survey area ²	
	Chichester and Langstone Harbour	Portsmouth Harbour	Solent and Southampton Water	Pagham Harbour	Dungeness to Pett Levels	Disturbance zone	Collision zone at rotor height
Bewick's Swan					Q		
Brent Goose	Q	Q	Q			(✓)	✓
Shelduck	A		A				
Wigeon	A		A			(SA)	
Teal	A		Q			(SA)	
Gadwall			A				
Pintail	A		A	Q			
Shoveler	A		A		Q		
Red-breasted Merganser	A		A			SA	
Great Crested Grebe			A				
Little Grebe	A		A				
Cormorant	A		A			SA	
Little Egret	Q						
Oystercatcher	A						
Ringed Plover	Q		Q				
Lapwing	A		A				

² ✓ = within wind farm potential impact zone, SA denotes that the species is seen but only in wider survey area outside potential impact zone, () indicates birds only seen overflying the area on migration, not making use of its ecological resources.

Species	SPA:					Present in wind farm or wider survey area ²	
	Chichester and Langstone Harbour	Portsmouth Harbour	Solent and Southampton Water	Pagham Harbour	Dungeness to Pett Levels	Disturbance zone	Collision zone at rotor height
Grey Plover	Q		A				
Dunlin	Q		A			(SA)	
Knot	A						
Sanderling	A						
Bar-tailed Godwit	Q					(✓)	SA
Black-tailed Godwit	Q		Q				
Ruff				Q			
Redshank	Q		A				
Curlew	A		A			(SA)	SA
Whimbrel	A						
Mediterranean Gull			Q		Q	✓	✓
Sandwich Tern	Q		Q			SA	(SA)
Common Tern			Q		Q	✓	Present but all flights below rotor ht
Roseate Tern			Q				
Little Tern	Q		Q	Q	Q	SA	
Aquatic Warbler				Q	Q		

Ecological Links to more distant SPAs

11.5.6 It is possible that several of the bird species using the survey area could be ecologically linked to more distant SPA populations. While SPAs up to 100km from the Project site that could be affected have been identified in the previous section, foraging ranges of some seabird species can exceed this distance so those more far-ranging species are considered further in this section (Table 11.7). Foraging distances from breeding colonies are taken from a recent review by Thaxter *et al.* (2012). Thaxter *et al.* give three measures of foraging range in their review and all of those are given here for each of the species with ranges exceeding 100km that occurred within the survey area; (a) the maximum range, defined as the maximum foraging range from all studies reviewed, (b) the mean maximum, the maximum range reported in each study averaged across studies, and (c) the global mean, the mean foraging range reported for each colony averaged across all colonies. Distances have been measures as the closest distance across the sea. A worst case approach has been adopted in the assessment, such that all SPAs designated for these species within their maximum foraging range have been considered, though Natural England has advised that the primary consideration should be of sites within the mean maximum range.

Table 11.7: Species exceeding 100km foraging range and occurring within the survey area:

Species	Thaxter <i>et al.</i> max range (km)	Thaxter <i>et al.</i> mean max range (km)	Thaxter <i>et al.</i> global mean range (km)	SPAs within max range
Fulmar	580	400	48	None
Manx shearwater	>330	>330	2.3	None
Gannet	590	229	93	Alderney West Coast and the Burhou Islands Ramsar site (180km), Archipel des Sept-Iles SPA (300km), Flamborough Head and Bempton Cliffs SPA (490km)
Great skua	219	86	-	None
Lesser black-backed gull	181	141	72	Baie de Seine Occidentale (Iles de Saint Marcouf) SPA (130km)
Kittiwake	120	60	25	None
Guillemot	135	84	38	None
Puffin	200	105	4	None

11.5.7 As shown in Table 11.7, there are only two species for which the Rampion Offshore Wind Farm site lies within the maximum foraging range of any additional SPA colonies; gannet and lesser black-backed gull. For both of these species the wind farm site lies on the edge of the foraging range, well outside the global mean distances recorded. Given the distances from these SPA/Ramsar sites, it is considered very unlikely that the site would be regularly used by either species' SPA/Ramsar populations and it can therefore be confidently concluded

that no Likely Significant Effect would occur on any of either species' SPA/Ramsar populations.

Field Studies

Boat Survey Data

- 11.5.8 The bird populations estimated from the baseline boat surveys for the survey area covered by those surveys are summarised in Appendix 11.3. This Appendix gives the total population estimates (taking into account coverage and declining bird detectability with distance from the survey vessel) for each survey, using the 'in-transect' data from the zone within 300m of the survey vessel. In order to ensure full consideration of all species that could be affected by the Offshore Project, the out of transect data have also been included in this Appendix where the raw counts were higher than the 'in-transect' based population estimates.
- 11.5.9 Bird numbers in proximity to the Offshore Project site are summarised in Table 11.8, which gives the mean density (birds per km²) and peak population estimate for the Offshore Project site plus buffers of 1km, 2km and 4km (all based on the 'in-transect' data). Table 11.8 also gives the densities from the survey area as a whole for comparison.
- 11.5.10 The intention had been to present a wider regional context to the data collected from the Rampion survey area using other published data, particularly from Stone *et al.* (1995). However, the data from Stone *et al.* (1995) were found to exhibit some major differences to the Rampion data and it is not clear how such differences have occurred, so making meaningful comparisons is difficult. Fulmar, gannet and great skua were all recorded at about double the Stone *et al.* 'English Channel and Bristol Channel' area mean density at Rampion (0.8, 0.3 and 0.02 per km² compared with Stone *et al.*'s 0.4, 0.15, and 0.01 per km² for each species respectively). Kittiwakes were observed in similar densities (0.45 per km² compared with 0.45 per km² in Stone *et al.*). Herring gull, great black-backed gull, guillemot and razorbill were all recorded in much higher densities in the Rampion surveys (2.4, 1.1, 4.2 and 0.8 per km² respectively compared with the equivalent values of 0.5, 0.2, 0.2 and 0.05 per km² from Stone *et al.*).

Table 11.8 Boat-based survey mean population densities (birds / km²) and peak population estimate for the proposed wind farm site, its buffer zones and the whole survey area

Species	Mean density					Peak population estimate				
	WF	WF+1km	WF+2km	WF+4km	Whole survey area	WF	WF+1km	WF+2km	WF+4km	Whole survey area
Brent Goose	0.002	0.010	0.008	0.010	0.005	7	53	53	60	87
Common Scoter	0	0	0	0.001	0.007	0	0	0	7	73
Red-throated Diver	0	0	0	0.002	0.003	0	0	0	13	91
Fulmar	0.216	0.297	0.251	0.244	0.299	273	667	693	733	1774
Manx Shearwater	0.005	0.008	0.006	0.007	0.004	13	33	33	33	67
Balearic Shearwater	0	0.001	0.001	0.001	0.001	0	7	7	7	27
European Storm-petrel	0	0	0	0.003	0.002	0	0	0	27	27
Gannet	0.678	0.709	0.667	0.570	0.768	1087	1647	2047	2153	6524
Cormorant	0	0	0.001	0.001	0.0002	0	0	7	7	7
Coot	0	0.001	0.001	0.001	0.0004	0	7	7	13	13
Bar-tailed Godwit	0	0	0	0.015	0.007	0	0	0	187	187
Pomarine Skua	0.003	0.009	0.007	0.004	0.002	13	53	53	53	53
Arctic Skua	0.002	0.001	0.001	0.001	0.001	7	7	7	7	10
Great Skua	0.008	0.007	0.009	0.007	0.018	20	20	20	20	148
Mediterranean Gull	0.002	0.001	0.001	0.001	0.001	7	7	7	7	7
Common Gull	0.032	0.054	0.059	0.135	0.192	33	80	107	960	2510
Lesser Black-backed Gull	0.032	0.035	0.043	0.042	0.053	40	40	60	80	319
Yellow-legged Gull	0.002	0.001	0.001	0.001	0.000	7	7	7	13	13
Herring Gull	0.729	3.403	2.714	2.050	1.586	433	16180	16260	16567	17820
Great Black-backed Gull	0.625	0.484	0.464	0.405	0.513	980	1000	1000	1013	3365
Little Gull	0.003	0.010	0.013	0.019	0.015	13	53	53	107	168

Species	Mean density					Peak population estimate				
	WF	WF+1km	WF+2km	WF+4km	Whole survey area	WF	WF+1km	WF+2km	WF+4km	Whole survey area
Kittiwake	0.298	0.334	0.385	0.439	0.419	173	393	527	827	1329
Common Gull/Kittiwake	0.003	0.002	0.002	0.002	0.001	13	13	13	27	27
Herring/Lesser Black-backed Gull	0.002	0.002	0.002	0.002	0.001	7	7	7	13	20
Large gull sp	0.841	0.791	0.642	0.571	1.150	3107	3113	3113	3113	8065
Lesser/Great Black-backed Gull	0	0.152	0.114	0.072	0.028	0	907	907	907	908
Sandwich Tern	0	0.001	0.002	0.002	0.005	0	7	13	13	40
Common Tern	0.011	0.010	0.008	0.017	0.010	40	40	40	147	172
Arctic Tern	0.032	0.022	0.017	0.011	0.006	133	133	133	140	180
Common/Arctic Tern	0.156	0.224	0.254	0.165	0.074	627	1293	1980	1980	2287
Guillemot	4.612	4.310	4.121	3.816	3.212	3540	4820	6080	8720	18496
Razorbill	0.403	0.395	0.389	0.412	0.495	227	367	453	673	3883
Guillemot/Razorbill	1.192	0.972	1.019	0.839	0.888	1580	1920	3033	3773	10675
Puffin	0.002	0.001	0.001	0.002	0.002	7	7	7	13	27
Auk sp	0.013	0.009	0.014	0.027	0.237	20	20	73	153	3782
Feral Pigeon	0	0	0	0.001	0.0002	0	0	0	7	7
Swift	0	0	0	0.001	0.001	0	0	0	13	13
Sand Martin	0.002	0.001	0.001	0.001	0.001	7	7	7	7	27
Swallow	0.006	0.035	0.048	0.035	0.056	20	147	227	247	927
House Martin	0.010	0.011	0.008	0.005	0.002	27	53	53	53	53
Meadow Pipit	0.045	0.037	0.028	0.023	0.022	180	200	200	240	447
Pied Wagtail	0.002	0.002	0.002	0.001	0.002	7	7	7	7	33
Wren	0	0	0	0.001	0.0002	0	0	0	7	7
Blackbird	0.003	0.002	0.003	0.002	0.001	13	13	13	13	13

Species	Mean density					Peak population estimate				
	WF	WF+1km	WF+2km	WF+4km	Whole survey area	WF	WF+1km	WF+2km	WF+4km	Whole survey area
Fieldfare	0.003	0.002	0.002	0.001	0.0004	13	13	13	13	13
Song Thrush	0.071	0.049	0.037	0.023	0.009	293	293	293	293	293
Starling	0.002	0.001	0.002	0.001	0.002	7	7	7	7	60
Finch sp	0	0.003	0.003	0.002	0.001	0	20	20	20	20
Passerine sp	0.003	0.002	0.002	0.001	0.007	13	13	13	13	220

11.5.11 The bird flight activity within the collision risk zone (taken as the extent of the Offshore Project site – see Figure 11.1) is summarised in Table 11.9. This gives the mean count within this zone, the percentage of birds flying (the number of birds recorded as flying during the boat surveys divided by the total number observed during those surveys), the percentage of those observed at rotor height (again derived from the boat survey data), which are combined to give the estimated mean numbers flying at rotor height. The latter is calculated as a mean value for each species for each month for input into the collision risk modelling – see below). The mean density flying at rotor height over the survey area as a whole is also given for comparison. Species for which this exceeds the flight density at rotor height within the Offshore Project site are shown in red (and therefore for which these wider area values were used in the collision risk assessment).

11.5.12 Table 11.9 also shows flight heights published by Cook *et al.* (2012) in a review of data from 40 wind farm sites. For most species for which estimates were available from Cook *et al.* (2012) the values were similar to those obtained from the local Rampion surveys. The percentage of flights at rotor height for common scoter, gannet, great skua and Sandwich tern were all higher in the local data set, whilst those for arctic skua, common gull, little gull, and common and arctic terns were higher in the Cook *et al.* review. The local data have been used in preference in the collision modelling where a reasonable sample size has been obtained (>30 flocks measured), but the Cook *et al.* data have been used for common scoter, arctic skua, little gull, Sandwich tern and arctic tern. Though the sample size for common terns was small (14 flocks), the Cook *et al.* value was not used in the modeling as it was considered that this substantially over-estimated the actual proportion of tern flights at rotor height (possibly due to a large proportion of the data coming from sites nearer to breeding colonies, and also the recording of height to coarse bands which may lead to overestimation as a result of a large number of flights around the lower rotor height threshold).

Table 11.9: Bird numbers and flight behaviour within the Offshore Project site from the boat survey data, and the number flying at risk height.

Species	Mean count flying in wind farm [A]	Mean density flying in wind farm [B]=[A]/Area of wind farm	% of flying birds at rotor height [C]	Sample size	Cook <i>et al.</i> 2012 % flights at rotor height	Mean density flying at collision height in wind farm = B x C	Mean density flying at collision height in whole survey area
Brent Goose	0.22	0.0016	43%	7	-	0.0007	0.0024
Common Scoter	0	0	13%	8	1%	0	0.0009
Fulmar	5.1	0.037	0%	677	0.2%	0	0
Manx Shearwater	0	0	0%	11	0.04%	0	0
Gannet	25.3	0.184	13%	1554	9.6%	0.0239	0.0466
Kestrel	0	0	100%	1	-	0	0.0002

Species	Mean count flying in wind farm [A]	Mean density flying in wind farm [B]=[A]/Area of wind farm	% of flying birds at rotor height [C]	Sample size	Cook <i>et al.</i> 2012 % flights at rotor height	Mean density flying at collision height in wind farm = B x C	Mean density flying at collision height in whole survey area
Falcon sp	0	0	100%	1	-	0	0.0002
Bar-tailed Godwit	0	0	33%	3	-	0	0.0025
Curlew	0	0	100%	1	-	0	0.0002
Pomarine Skua	0.44	0.0032	0%	2	-	0	0
Arctic Skua	0	0	0%	3	3.8%	0	0
Great Skua	0.44	0.0032	16%	61	4.3%	0.0005	0.0013
Mediterranean Gull	0.22	0.0016	50%	3	-	0.0008	0.0002
Common Gull	2.44	0.0177	15%	317	22.9%	0.0027	0.0113
Lesser Black-backed Gull	2.67	0.0193	25%	160	25.2	0.0048	0.0101
Yellow-legged Gull	0.22	0.0016	0%	2	-	0	0
Herring Gull	78.9	0.572	26%	1451	28.4%	0.1487	0.3251
Great Black-backed Gull	10.0	0.0725	36%	748	33.1%	0.0261	0.0894
Little Gull	0.44	0.0032	0%	25	5.5%	0.0002	0.0003
Large gull sp	11.3	0.0821	51%	108	-	0.0419	0.2544
Kittiwake	24.4	0.177	14%	1008	15.7%	0.0248	0.0407
Sandwich Tern	0	0	8%	13	3.6%	0	0.0003
Common Tern	1.56	0.0113	0%	14	12.7%	0.0003	0.0001
Arctic Tern	4.44	0.0322	0%	4	2.8%	0.0009	0.0001
Common/Arctic Tern	20.89	0.151	0%	23	-	0.0042	0.0017
Guillemot	10.0	0.0725	1%	3517	0.01%	0.0007	0.0015
Razorbill	3.11	0.0225	0%	436	0.4%	0	0
Guillemot/Razor bill	2.44	0.0177	0%	305	-	0	0
Auk sp	0.67	0.0048	0%	61	-	0	0
Sand Martin	0.22	0.0016			-	0	
Swallow	0.89	0.0064	5%	64	-	0.0003	0.0025
House Martin	1.33	0.0097	0%	1	-	0	0
Meadow Pipit	6.22	0.0451	9%	23	-	0.0041	0.0017
Pied Wagtail	0.22	0.0016	14%	7	-	0.0002	0.0003
Blackbird	0.44	0.0032	0%	2	-	0	0
Fieldfare	0.44	0.0032	0%	1	-	0	0
Song Thrush	9.78	0.0709	0%	1	-	0	0
Starling	0.22	0.0016	0%	4	-	0	0
Passerine sp	0.44	0.0032	0%	4	-	0	0

11.5.13 Species at risk of collision (i.e. those observed flying through the Project site at rotor height) were; Brent goose, Gannet, Great skua, Mediterranean gull, Common gull, Lesser black-backed gull, Herring gull, Great Black-backed gull, Kittiwake, Little gull, Common and Arctic terns, Guillemot, Swallow, Meadow Pipit and Pied Wagtail. Collision risk modelling was therefore undertaken for all of these species and is presented in the assessment section below.

11.5.14 In addition collision modelling has also been undertaken for other species that were recorded flying at rotor height in the boat survey area though not within the Project site: Common scoter, Bar-tailed godwit, Curlew and Sandwich tern.

Aerial Survey Data

11.5.15 The bird populations estimated from the baseline aerial surveys for the survey area covered by those surveys are summarised in Appendix 11.4. That Appendix gives the total population estimates (taking into account coverage and declining bird detectability with distance from the survey aircraft) for each survey, using the data from the two survey bands closest to the aircraft (i.e. 49-174m (band A) and 175-459m (band B)). Detectability in the third and most distant band, C, was too low to provide any useful population estimates.

11.5.16 Bird numbers from the aerial surveys in proximity to the proposed Offshore Project site are summarised in Table 11.10, which gives the mean density (birds per km²) and peak population estimate for the Project site and buffers around that of 1km, 2km and 4km, as provided above for the boat-based surveys. Table 11.10 also gives the densities across the whole survey area for comparison.

11.5.17 The bird flight activity within the collision risk zone (taken as the extent of the Offshore Project site) is summarised in Table 11.11. This gives the mean count within this zone, the percentage of birds flying, the percentage of those observed at rotor height (taken from the boat survey data as it was not possible to obtain data on this from the aerial surveys), which are combined to give the estimated mean numbers flying at rotor height (for input into the collision risk modelling – see below). Table 11.11 also gives the mean densities in the whole study area for comparison.

Table 11.10: Aerial survey mean densities and population estimate peaks for wind farm sites and buffer zones

Species	Mean density					Peak population estimate				
	WF	WF+1km	WF+2km	WF+4km	Whole survey area	WF	WF+1km	WF+2km	WF+4km	Whole survey area
Common Scoter	0	0	0	0	0.034	0	0	0	0	210
Red-breasted Merganser	0	0	0	0	0.008	0	0	0	0	57
duck sp.	0	0	0	0	0.001	0	0	0	0	14
Red-throated Diver	0	0	0	0	0.001	0	0	0	0	7
diver sp.	0	0	0	0.001	0.001	0	0	0	5	8
Fulmar	0.033	0.035	0.035	0.032	0.060	23	37	60	89	262
British Storm-petrel	0	0	0	0	0.001	0	0	0	0	10
Gannet	0.380	0.531	0.536	0.466	0.523	255	538	579	735	2,020
Cormorant	0	0	0	0	0.003	0	0	0	0	16
Kestrel	0	0	0	0	0.001	0	0	0	0	2
skua sp.	0	0	0	0	0.002	0	0	0	0	10
Great Skua	0.005	0.004	0.004	0.003	0.005	10	10	13	15	17
Common Gull	0.002	0.002	0.001	0.010	0.028	5	5	5	39	132
Lesser black-backed Gull	0.016	0.012	0.015	0.016	0.042	13	13	15	27	163
grey gull spp (Herring or Common)	0.004	0.005	0.009	0.021	0.126	2	9	18	42	756
Herring Gull	0.140	0.216	0.283	0.250	0.632	151	365	423	499	3,449
black-backed gull spp	0.025	0.025	0.031	0.027	0.089	23	37	39	39	581
Great Black-backed Gull	0.001	0.002	0.001	0.014	0.033	2	2	2	61	239
gull sp.	1.028	0.748	0.603	0.476	0.510	1,921	1,921	1,921	1,921	2,005
large gull sp.	0.125	0.149	0.134	0.099	0.306	162	175	179	184	1,614
Black-headed Gull	0	0	0	0	0.002	0	0	0	0	21
Kittiwake	0.635	0.574	0.503	0.517	0.773	463	546	600	680	2,183
small gull sp.	0.017	0.035	0.046	0.055	0.126	26	42	42	138	611

Species	Mean density					Peak population estimate				
	WF	WF+1km	WF+2km	WF+4km	Whole survey area	WF	WF+1km	WF+2km	WF+4km	Whole survey area
Sandwich Tern	0	0	0	0	0.001	0	0	0	0	2
tern sp.	0	0.004	0.003	0.002	0.004	0	10	10	10	23
Arctic/Common Tern	0.016	0.032	0.025	0.018	0.025	31	34	34	34	188
auk sp.	0.830	1.052	1.030	0.992	0.910	564	1,018	1,459	2,308	4,430
Guillemot	0.001	0.002	0.001	0.001	0.001	2	2	2	2	9
Razorbill	0	0	0.003	0.002	0.001	0	0	9	9	9
Feral Pigeon	0	0	0	0	0.002	0	0	0	0	25
Swallow	0	0	0.001	0	0.001	0	0	2	2	2
passerine sp.	0	0	0	0.001	0.002	0	0	0	5	16

Table 11.11: Bird numbers and flight behaviour within the Offshore Project site from the aerial survey data, and the number flying at risk height.

Species	Mean count in wind farm [A]	Mean density in wind farm [B] = [A]/Area of wind farm	Mean density in survey area [C]	% birds flying [D]	% of flying birds at rotor height [E] ³	Mean density flying at collision height in wind farm = [B] x [D] x [E]	Mean density flying at collision height in survey area = [C] x [D] x [E]
Common Scoter	0	0	0.034	86%	1%	0	0.0003
Red-breasted Merganser	0	0	0.008	33%	1%	0	0.00003
duck sp.	0	0	0.001	0%	1%	0	0
Red-throated Diver	0	0	0.001	25%	0%	0	0
diver sp.	0	0	0.001	0%	0%	0	0
Fulmar	6	0.033	0.060	62%	0%	0	0
European Storm-petrel	0	0	0.001	100%	0%	0	0
Gannet	66	0.380	0.523	60%	13%	0.0303	0.0418
Cormorant	0	0	0.003	43%	0%	0	0
Kestrel	0	0	0.000	100%	100%	0	0.0002
skua sp.	0	0	0.002	67%	4%	0	0.00005
Great Skua	1	0.005	0.005	100%	16%	0.0009	0.0008
Common Gull	0	0.002	0.028	93%	15%	0.0003	0.0039
Lesser black-backed Gull	3	0.016	0.042	58%	25%	0.0023	0.0061
grey gull spp (Herring or Common)	1	0.004	0.126	55%	26%	0.0005	0.0178
Herring Gull	24	0.140	0.632	78%	26%	0.0282	0.1273
black-backed gull spp	4	0.025	0.089	23%	36%	0.0021	0.0073
Great Black-backed Gull	0	0.001	0.033	40%	36%	0.0002	0.0047
gull sp.	180	1.028	0.510	48%	26%	0.1272	0.0632
large gull sp.	22	0.125	0.306	51%	26%	0.0162	0.0397
Black-headed Gull	0	0	0.002	50%	0%	0	0
Kittiwake	111	0.635	0.773	85%	14%	0.0774	0.0943
small gull sp.	3	0.017	0.126	29%	14%	0.0007	0.0052
Sandwich Tern	0	0	0.001	100%	4%	0	0.00002
tern sp.	0	0	0.004	67%	8%	0	0.0002

³ Derived from survey data, apart from common scoter, skua sp, Sandwich tern and arctic/common tern where data from Cook et al (2012) used, as discussed above.

Species	Mean count in wind farm [A]	Mean density in wind farm [B] = [A]/Area of wind farm	Mean density in survey area [C]	% birds flying [D]	% of flying birds at rotor height [E] ³	Mean density flying at collision height in wind farm = [B]x[D]x[E]	Mean density flying at collision height in survey area = [C]x[D]x[E]
Arctic/Common Tern	3	0.016	0.025	100%	3%	0	0.0008
auk sp.	145	0.830	0.910	7%	1%	0.0006	0.0007
Guillemot	0	0.001	0.001	0%	1%	0	0
Razorbill	0	0	0.001	0%	0%	0	0
Feral Pigeon	0	0	0.002	100%	0%	0	0
Swallow	0	0	0.000	100%	5%	0	0.00001
passerine sp.	0	0	0.002	100%	5%	0	0.00007

11.5.18 Generally bird numbers in flight recorded during the aerial surveys were similar or lower than those from the boat-based surveys. No additional species were observed flying through the collision risk zone during the aerial surveys. Numbers of herring gull and great black-backed gull were particularly low from the aerial survey data, mainly as a result of lower numbers counted in the Project site (the percentage of birds flying was similar between the two survey methods). For the purposes of the collision modelling a worst-case approach has been adopted, using the higher value of bird activity within the collision risk zone. This in practice meant using the boat-based data for all except three species, gannet, great skua and kittiwake, for which the aerial survey numbers at risk were slightly higher.

Evaluation of Conservation Importance

Importance of Bird Populations using the Offshore Project site and its surrounds

11.5.19 The evaluation of the conservation value of the bird populations observed within 4km of the Offshore Project site has been summarised in Table 11.12, though consideration has also been given to other species only observed in the wider survey area. This included:

- very high sensitivity (SPA species) – brent goose, gannet, bar-tailed godwit, lesser black-backed gull, Sandwich tern and common tern;
- high sensitivity species (EU Birds Directive Annex 1 species) – red-throated diver, Balearic shearwater, little gull and arctic tern;
- medium sensitivity species (species present in regionally important numbers and/or UK BAP priority species) – common scoter, fulmar, Pomarine skua, arctic skua, great skua, common gull, yellow-legged gull, herring gull, great

black-backed gull, kittiwake, guillemot, razorbill, song thrush and starling. Whilst some of these species may originate from more distant SPAs, the lack of any direct and clear ecological link to any specific 'home' SPA has meant that they have not been classed as very high sensitivity (though further consideration of possible SPA links is included in the assessment, particularly in relation to cumulative ornithological issues); and

- low sensitivity species – Manx shearwater, European storm-petrel, sand martin, swift, sand martin, swallow, house martin, meadow pipit, black redstart and fieldfare.

Table 11.12: Evaluation of the conservation importance of the bird populations using the Project site and its surrounds

Species	Peak Count:				SPA sp ⁴	Population Importance ⁵	EU Birds Directive Annex 1	Red [R]/ Amber [A] List	UK BAP Priority Species	Sensitivity () = not seen <4km from wind farm
	Wind Farm	WF+1 km	WF+2 km	WF+4 km						
Brent Goose	7	53	53	60	✓	Local		A	✓	Very high
Teal	0	0	0	0	✓			A		(Very high)
Eider	0	0	0	0				A		(Low)
Velvet Scoter	0	0	0	0				A		(Low)
Common Scoter	0	0	0	7		Regional		R	✓	Medium
Red-breasted Merganser	0	0	0	0	✓					(Very high)
Red-throated Diver	0	0	0	13		Regional	✓	A		High
Black-throated Diver	0	0	0	0			✓	A	✓	(High)
Great Crested Grebe	0	0	0	0	✓					(Very high)
Slavonian Grebe	0	0	0	0			✓	A		(High)
Fulmar	273	667	693	733		Regional		A		Medium
Manx Shearwater	13	33	33	33		Local		A		Low
Balearic Shearwater	0	7	7	7		Regional	✓	R	✓	High
European Storm-petrel	0	0	0	27		Local		A		Low
Gannet	1087	1647	2047	2153	✓	Regional		A		Very high
Cormorant	0	0	7	7	✓	Local				(Very high)
Grey Heron	0	0	0	0						Nil

⁴ Q = SPA qualifying species, A = SPA assemblage species

⁵ On the basis of peak numbers and the 1% threshold (Holt *et al.*, 2011): I = International, N = National, R = Regional, L = Local. Within 4km of wind farm. Separate consideration given to migrant numbers and turnover in text for key species.

Species	Peak Count:				SPA sp ⁴	Population Importance ⁵	EU Birds Directive Annex 1	Red [R]/ Amber [A] List	UK BAP Priority Species	Sensitivity () = not seen <4km from wind farm)
Kestrel	0	0	0	0				A		(Low)
Peregrine	0	0	0	0			✓			(High)
Coot	0	7	7	13						Nil
Grey Plover	0	0	0	0	✓			A		(Very high)
Dunlin	0	0	0	0	✓		✓	R		(Very high)
Bar-tailed Godwit	0	0	0	187	✓	Regional	✓	A		Very high
Whimbrel	0	0	0	0	✓			R		(Very high)
Curlew	0	0	0	0	✓			A	✓	(Very high)
Turnstone	0	0	0	0	✓			A		(Very high)
Pomarine Skua	13	53	53	53		Regional				Medium
Arctic Skua	7	7	7	7		Local		R	✓	Medium
Great Skua	20	20	20	20		Regional		A		Medium
Mediterranean Gull	7	7	7	7	✓	Local	✓	A		Very high
Common Gull	33	80	107	960		Regional		A		Medium
Lesser Black-backed Gull	40	40	60	80	✓	Local		A		Very high
Yellow-legged Gull	7	7	7	13		Regional				Medium
Herring Gull	433	16180	16260	16567		National		R	✓	High
Great Black-backed Gull	980	1000	1000	1013		National		A		High
Little Gull	13	53	53	107		National	✓	A		High
Black-headed Gull	0	0	0	0				A		(Low)
Kittiwake	173	393	527	827		Regional		A		Medium
Large gull sp	3107	3113	3113	3113						n/a
Little Tern	0	0	0	0	✓		✓	A		(Very high)
Black Tern	0	0	0	0			✓	A		(High)
Sandwich Tern	0	7	13	13	✓	Local	✓	A		Very high
Common Tern	40	40	40	147	✓	National	✓	A		Very high
Arctic Tern	133	133	133	140		National	✓	A		High
Common/ Arctic Tern	627	1293	1980	1980						n/a
Guillemot	3540	4820	6080	8720		Regional		A		Medium
Razorbill	227	367	453	673		Regional		A		Medium
Guillemot/ Razorbill	1580	1920	3033	3773						n/a
Puffin	7	7	7	13		Local		A		
Feral Pigeon	0	0	0	7						Nil

Species	Peak Count:				SPA sp ⁴	Population Importance ⁵	EU Birds Directive Annex 1	Red [R]/ Amber [A] List	UK BAP Priority Species	Sensitivity () = not seen <4km from wind farm)
Swift	0	0	0	13		Local		A		Low
Sand Martin	7	7	7	7		Local		A		Low
Swallow	20	147	227	247		Local		A		Low
House Martin	27	53	53	53		Local		A		Low
Meadow Pipit	180	200	200	240		Local		A		Low
Yellow Wagtail	0	0	0	0				R	✓	(Medium)
Pied Wagtail	7	7	7	7						Nil
Wren	0	0	0	7						Nil
Robin	0	0	0	7						Nil
Black Redstart	0	0	0	0				A		Low
Blackbird	13	13	13	13						Nil
Fieldfare	13	13	13	13		Local		R		Low
Song Thrush	293	293	293	293		Local		R	✓	Medium
Whitethroat	0	0	0	0				A		(Low)
Willow Warbler	0	0	0	0				A		(Low)
Carrion Crow	0	0	0	0						Nil
Starling	7	7	7	7		Local		R	✓	Medium
Chaffinch	0	0	0	0						Nil
Linnet	0	0	0	0				R	✓	(Medium)

11.5.20 Maps of the distributions of the very high, high and medium sensitivity species are shown in Figure 11.3 - Figure 11.14, aggregated across the whole survey period to show the overall use of the survey area by each species. The Figures also show the seasonal pattern of use of each species, giving the peak population estimate recorded for each in each month.

- Fulmar (Figure 11.3) – widely distributed across the survey area, though more abundant in the southern part in the deeper waters further from the shore. The species was recorded mainly during the spring and summer (Mar-July);
- Gannet (Figure 11.4) – a widespread species though with most of the larger flocks observed in the deeper waters of the southern part of the survey area, further from shore. It was recorded through the year, with higher numbers peaking in winter (October and January);
- Great Skua (Figure 11.5) – widely scattered but most frequently encountered in the southern part of the survey area in the deeper waters further from the shore. It was seen mainly during spring and autumn;

- Common Gull (Figure 11.6) – strongly concentrated in the shallower waters in the more inshore parts of the survey area. Most records were from the spring (Mar-Apr);
- Lesser Black-backed Gull (Figure 11.7) – widely scattered across the survey area, with no notable concentrations recorded. Peak numbers were observed in spring and autumn, with few during the main winter period;
- Herring Gull (Figure 11.8) – another species widespread across the whole survey area, with concentrations noted in both the northern and southern parts. This species was seen year-round but with highest numbers in July;
- Great Black-backed Gull (Figure 11.9) – a widespread and evenly distributed species, though with one larger concentration in the eastern part of the survey area. This was primarily a wintering species, with peak numbers recorded in January;
- Little Gull (Figure 11.10) – most recorded in the more inshore parts of the survey area and in the eastern part. This species was primarily a spring migrant, with most records in April;
- Kittiwake (Figure 11.11) – a widespread species abundant across the whole of the survey area. This species was present year round, with no clear seasonal pattern of occurrence;
- Common and Arctic Terns (Figure 11.12) – recorded widely through the central part of the survey area. Most records come from a single survey in May 2010 when a higher number of migrants passing through the survey area were observed;
- Guillemot (Figure 11.13) – another widespread and abundant species, with larger concentrations found mainly in the inshore waters. It was seen in highest numbers in winter/early spring (Jan-Apr); and
- Razorbill (Figure 11.14) – a widespread species but with higher numbers in the shallower inshore waters. Its seasonal pattern of occurrence was similar to that of the previous species, with highest numbers in winter and early spring.

11.5.21 Other species of very high, high and medium sensitivity were only recorded in very low numbers (<10 records) so have not been mapped. These comprise Brent goose, Balearic shearwater, Bar-tailed godwit, Sandwich tern, Common scoter, Pomarine skua, Arctic skua, Yellow-legged gull, Song Thrush and Starling.

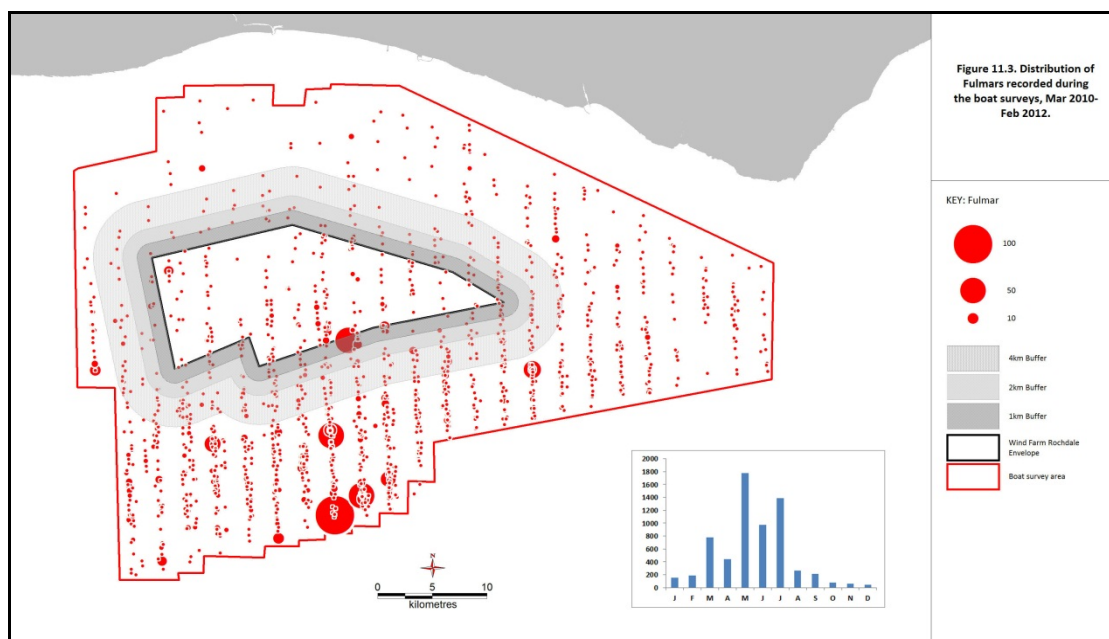


Figure 11.3: Distribution of Fulmars recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

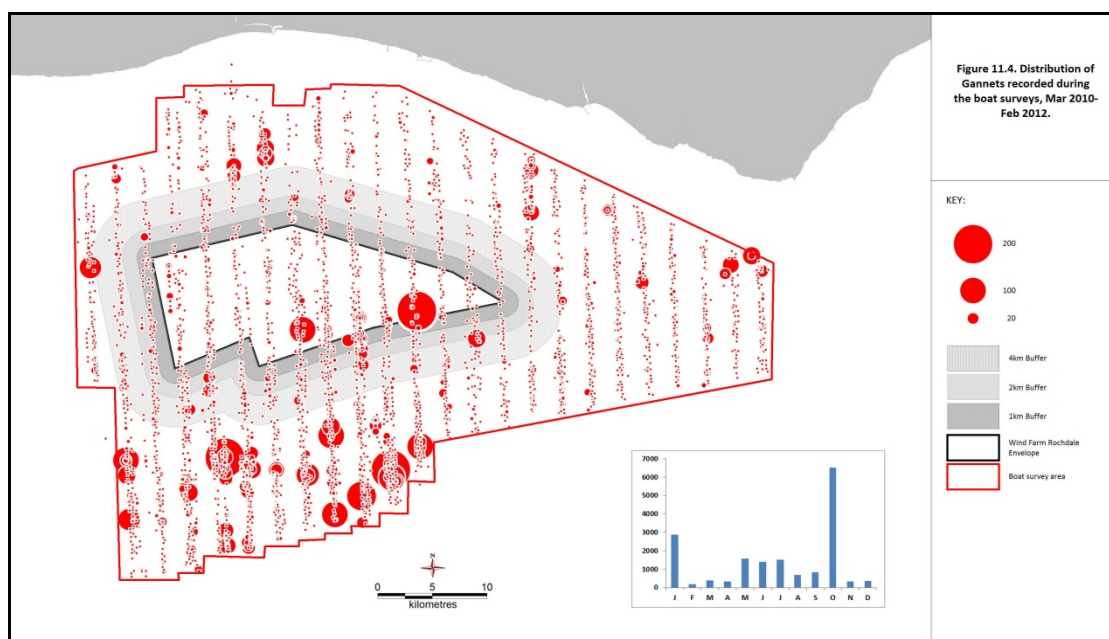


Figure 11.4: Distribution of Gannets recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

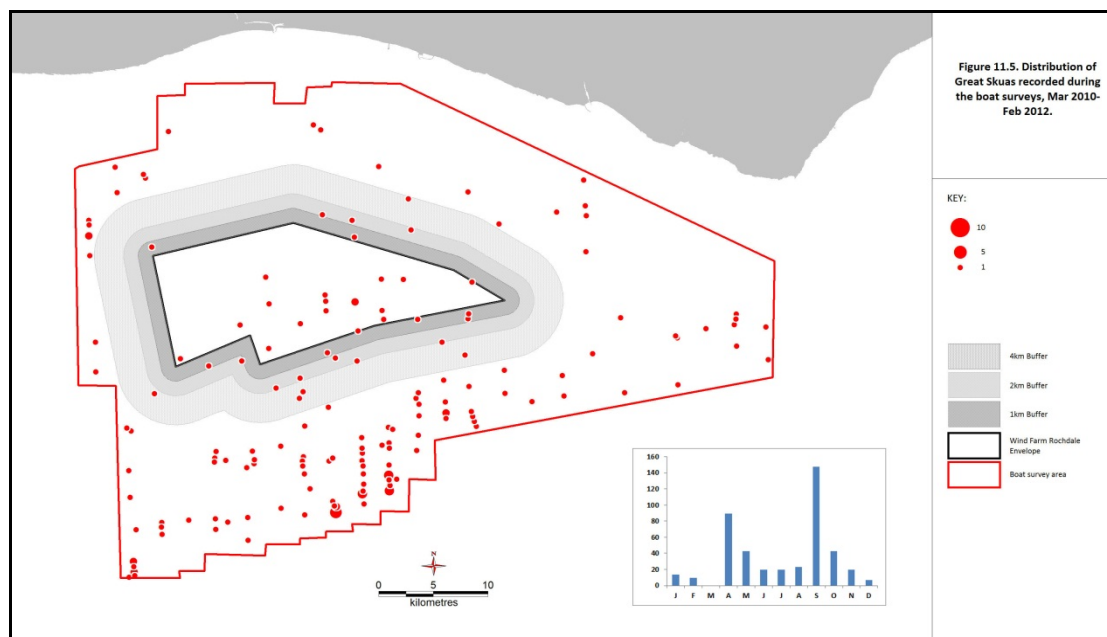


Figure 11.5: Distribution of Great Skuas recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

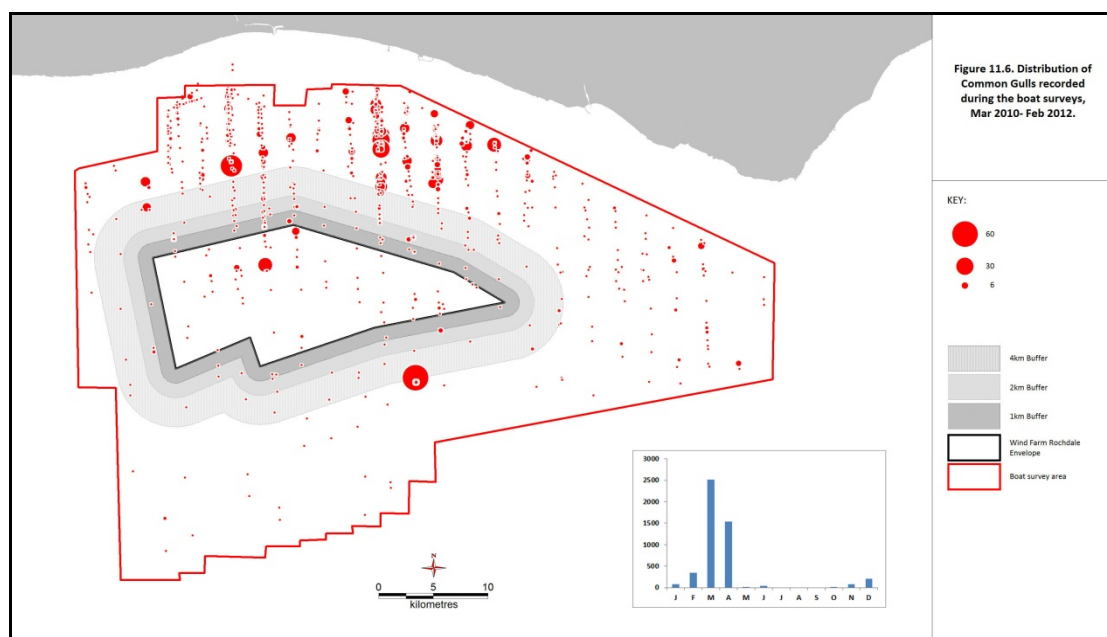


Figure 11.6: Distribution of Common Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

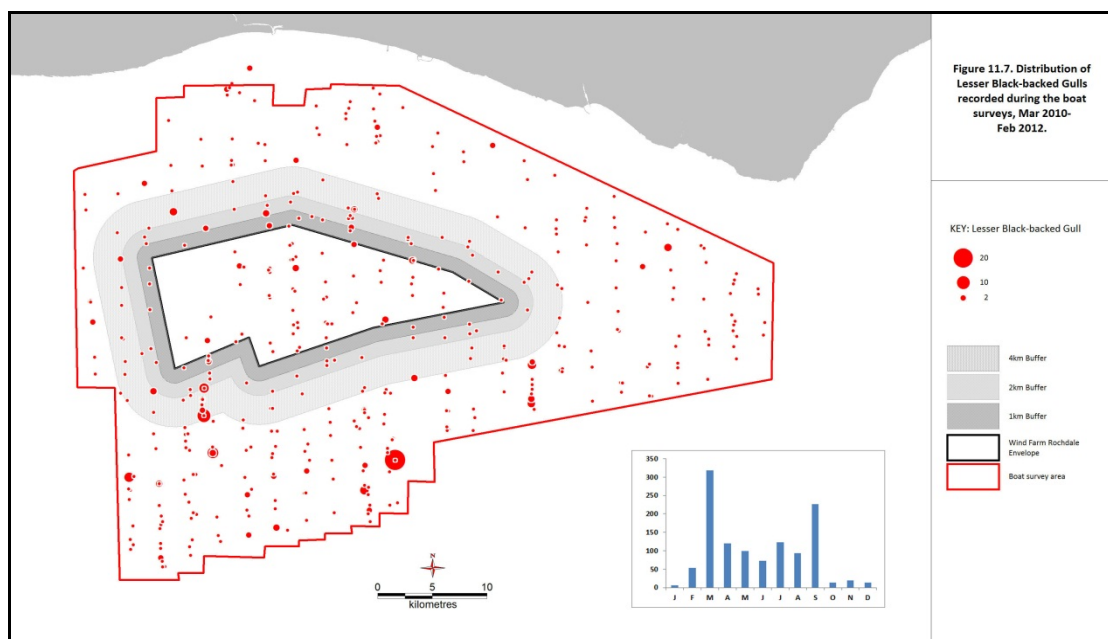


Figure 11.7: Distribution of Lesser Black-backed Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

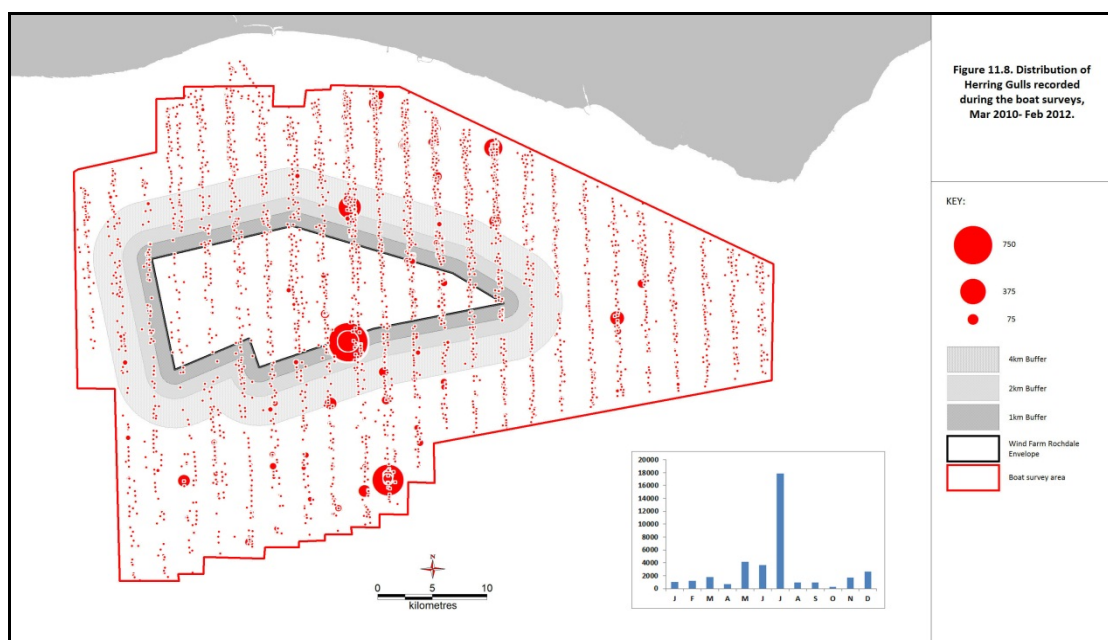


Figure 11.8: Distribution of Herring Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

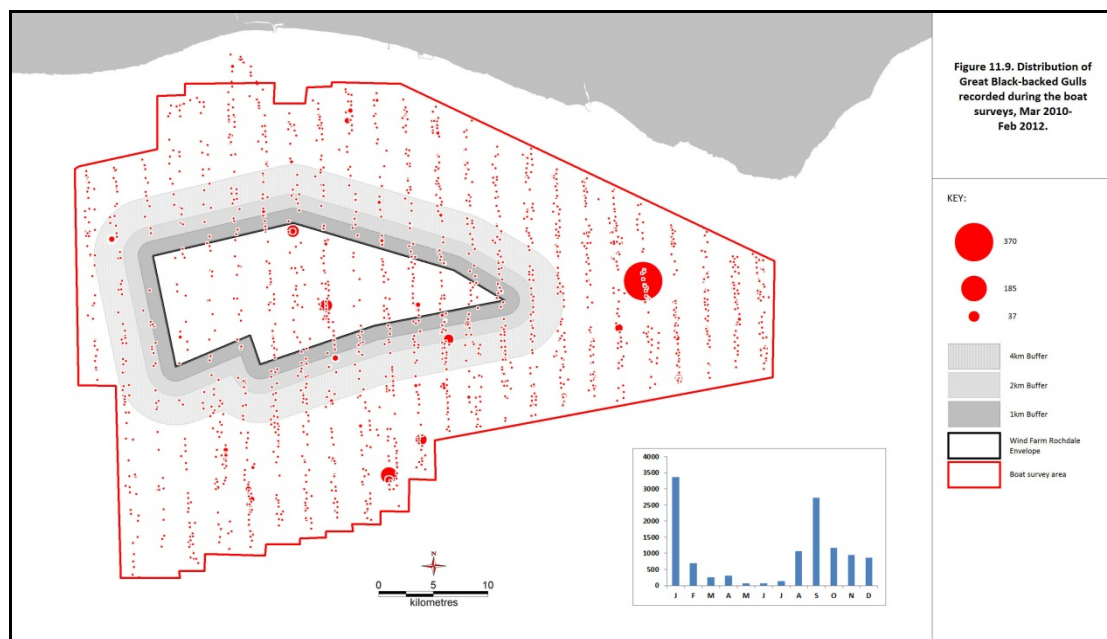


Figure 11.9: Distribution of Great Black-backed Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

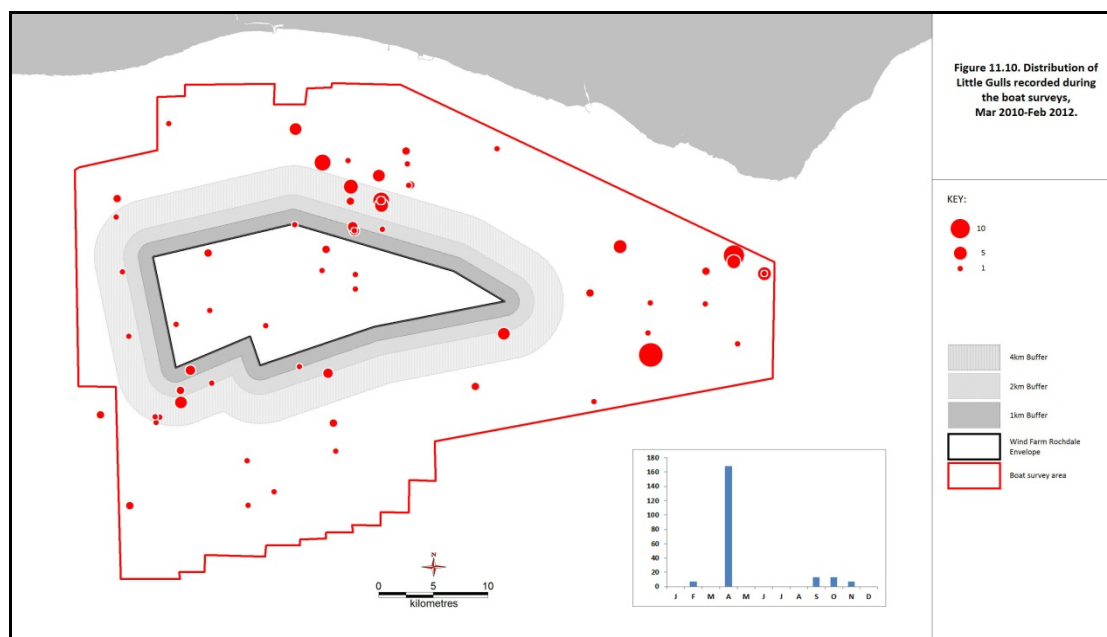


Figure 11.10: Distribution of Little Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

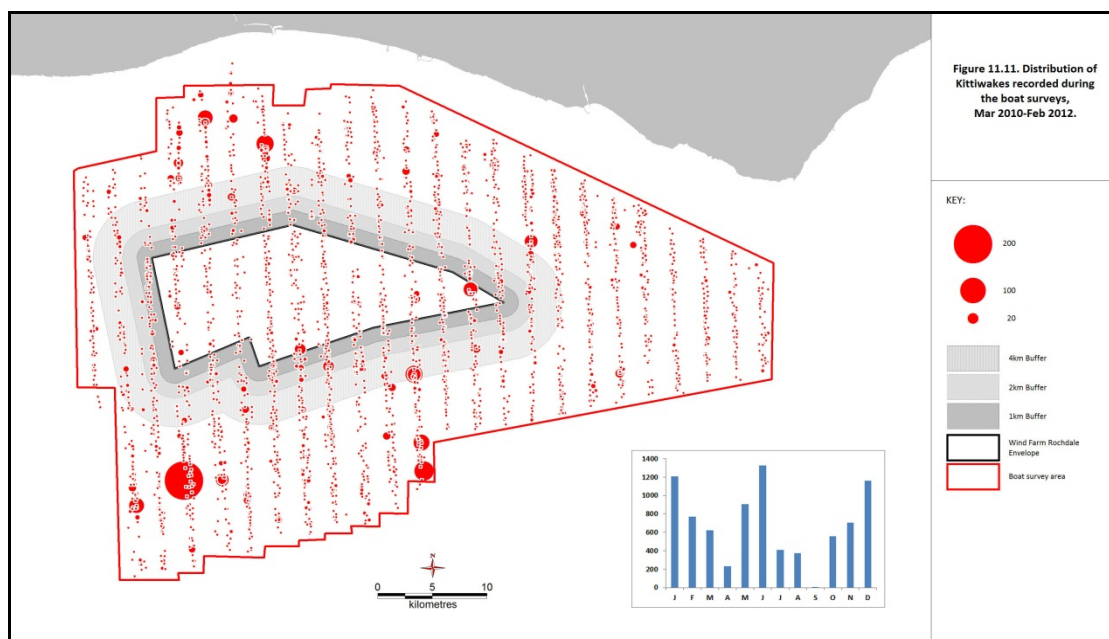


Figure 11.11: Distribution of Kittiwakes recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

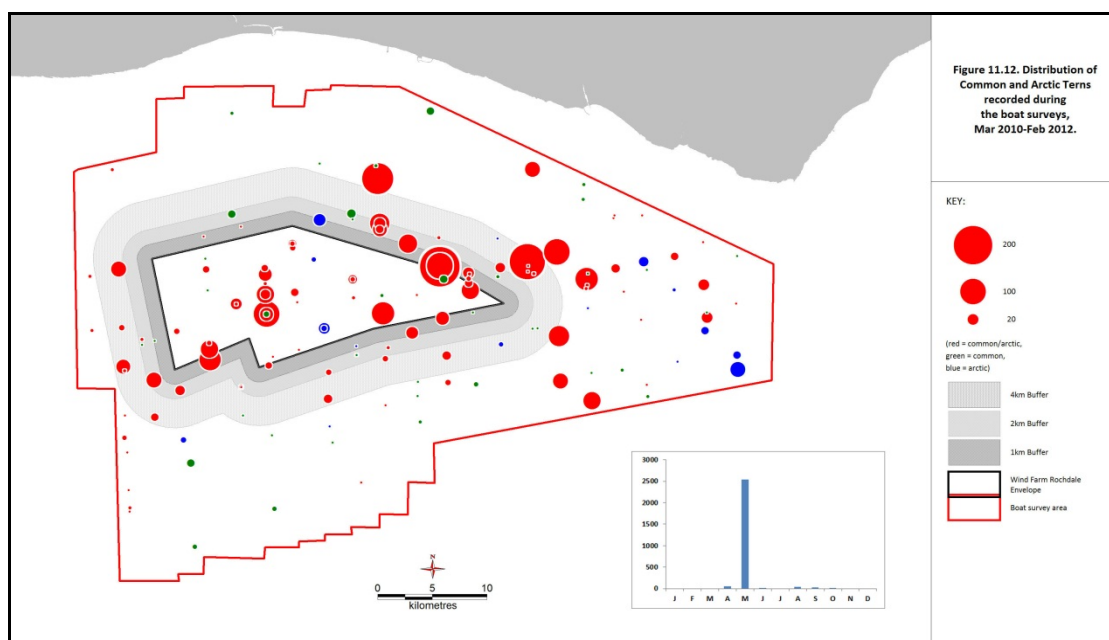


Figure 11.12: Distribution of Common/Arctic Terns recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

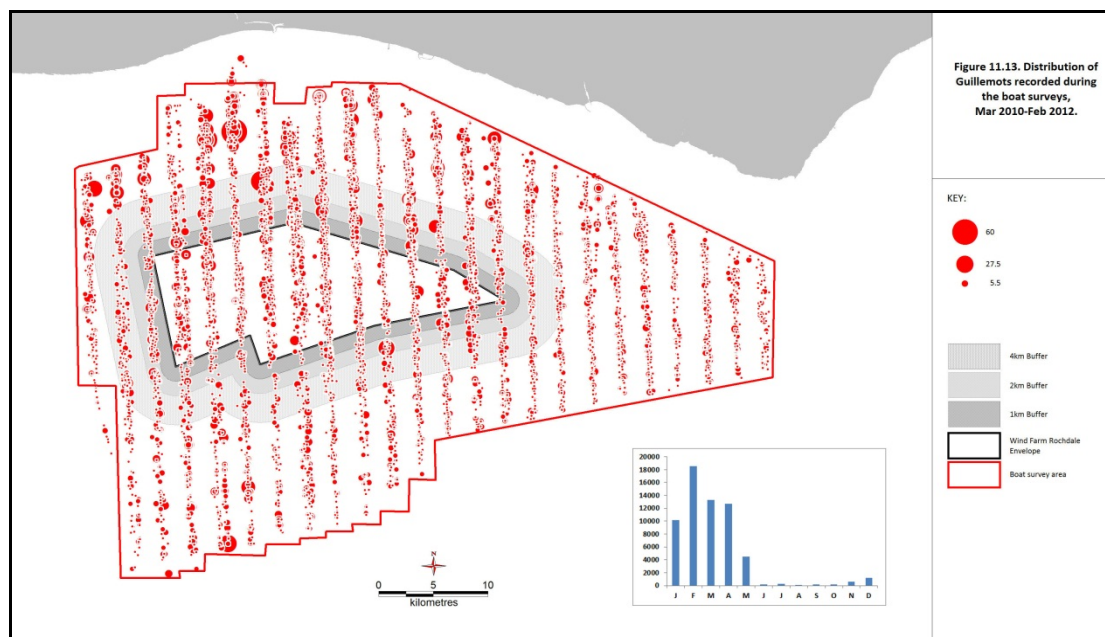


Figure 11.13: Distribution of Guillemots recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

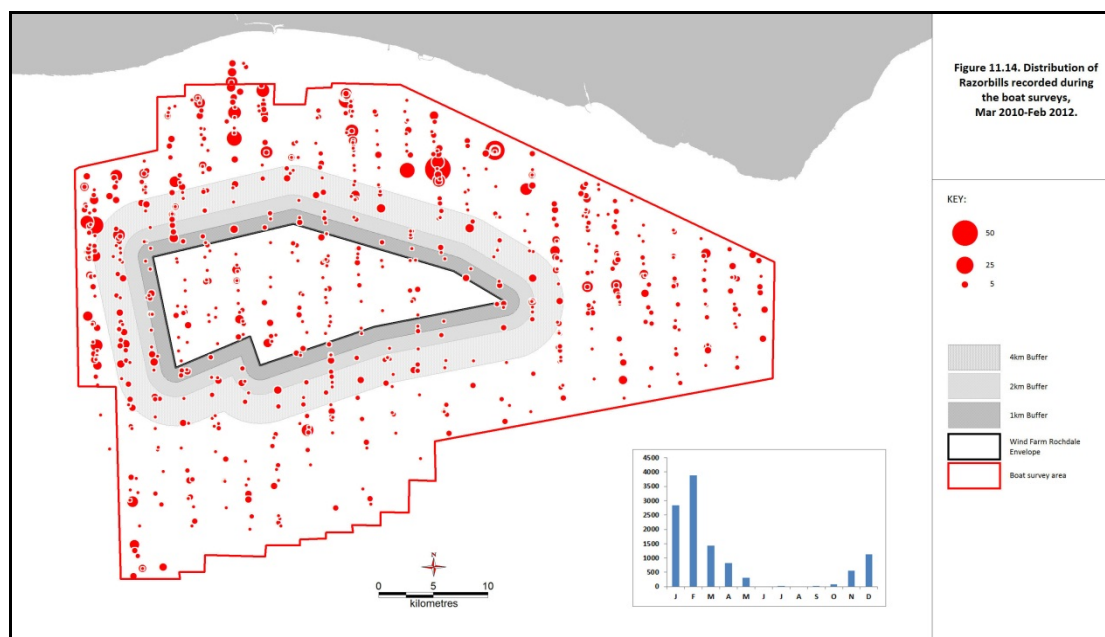


Figure 11.14: Distribution of Razorbills recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.

11.6 Assessment of Potential Impacts

11.6.1 The ornithological impact assessment presented here has been undertaken on a worst-case scenario basis to account for any uncertainties in the Project design, to ensure that the magnitude of all impacts is not under-estimated. Table 11.13

lists the components of the design of the marine part of the project that could influence the magnitude of impacts.

Table 11.13: Wind farm design features and their influence on the Rochdale envelope for Ornithology

Design feature	Design options
Wind Farm Site Layouts	Turbines are located throughout the site creating the widest potential for barrier effects and greatest footprint for displacement of birds.
Wind Turbines	Many small turbines is the worst case in terms of potential for collision risk.
Foundations	High piling noise could affect fish spawning sites, with potential for reduction in supply of prey for foraging birds.
Construction and Installation	Longer installation period will be a worst case for disturbance to birds potentially present on the wind farm site.
Decommissioning	Assumed as installation (though noise effects on prey species will not be as prominent) longer period is a worst case.

11.6.2 In line with the use of the “Rochdale Envelope” (see Section 5), the assessment in this chapter has been based on a development scenario that is considered to be the worst case in terms of impacts to birds. More information on the realistic worst-case scenario in terms of number of turbines, seabed take, turbine diameters and source noise levels is presented in Section 2 Project Description. This includes the maximum number of turbines being considered (175) over the maximum possible extent (the whole of the Rochdale envelope) and hence the maximum footprint. Appendix 11.2 presents the parameters used in the collision risk modeling, those parameters used represent the worst-case scenario.

11.6.3 The ornithological impact assessment presented here has been undertaken on a worst-case scenario basis to account for any uncertainties, to ensure that the magnitudes of all impacts are not under-estimated. The main potential ornithological impacts are disturbance and displacement of birds from the wind farm site and its surrounds, mortality through collision with the wind turbines, a barrier effect such that bird flight routes are diverted around the wind farm site and changes to the birds’ habitat/food supply (Drewitt and Langston, 2006). The worst-case assumptions can be summarised as follows:

- Wind turbines will be located across all of the Rampion Offshore Wind Farm site;
- Disturbance of birds could occur up to 4km from the wind turbines during the construction and operational phases;
- A barrier effect could cause birds to divert around the entire wind farm;
- Collision risk predictions have been made using a precautionary range of avoidance rates.

- 11.6.4 For all of the assessment presented below, records of birds that were not identified to species level have been allocated according to proportion of identified records of each species group.

Construction

Disturbance and displacement

- 11.6.5 Construction activities (e.g. piling and an increase in boat traffic) at the Offshore Project site will result in noise and vibration. The noise associated with the construction activities has the potential to disturb and displace bird species from the Project site for the duration of installation activities (NERI, 2004). The presence of plant and personnel on site may also cause localised disturbance throughout construction. In all cases, such disturbance impacts are likely to be temporary and exist only when vessels are on site and / or particular construction activities are being undertaken. Therefore, birds may readily re-distribute in periods of less intense or no activity during the construction period.
- 11.6.6 An important consideration when assessing the potential impacts of the construction phase of the Offshore Project is the spatial extent of construction activity at any one time. Construction would not take place simultaneously over the whole site and therefore impacts would not be expected to occur over the whole of the Offshore Project site over the whole of the construction period. Rather they would be more restricted to smaller areas of activity at any particular time.

Displacement from Feeding Habitat and Changes to Prey Supply

- 11.6.7 All species within the potential impact zone of the Offshore Project have been considered in this part of the assessment, with key species identified as discussed above.
- 11.6.8 The 'potential impact zone' of the proposed wind farm with regard to disturbance was defined as the zone from which displacement may occur. Disturbance effects on birds during the construction phase of offshore wind farms have been little studied. One study that has been published on this topic was carried out on the Danish wind farm at Horns Rev (Christensen *et al.*, 2004) found no significant impacts. However it should be noted that bird numbers at this site were generally low, so this result should be treated with caution. A precautionary approach has been adopted here, assuming that birds up to 4km from the Project site could be temporarily displaced during the construction period (though individual species susceptibility to such disturbance is considered in the following paragraphs).
- 11.6.9 There is also an additional potential construction phase impact that could have another effect - through piling impacts on seabird prey populations, specifically on fish populations. Fish may be susceptible to injury or mortality as a result of piling of wind turbine foundations during construction.

- 11.6.10 This issue has been fully assessed in Section 8 - Fish and Shellfish Ecology in which it is acknowledged that there would be an area around the Project site over which there was potential for fish to be affected by piling, particularly through disturbance. Potentially significant disturbance effects were identified for herring, though these would be mitigated through restrictions on timing of piling activities. This would include restrictions on piling during the peak spawning season, limiting work to the installation of smaller piles in the western part of the Project Array, which (as detailed in the Section 8) would reduce the impact to medium magnitude.
- 11.6.11 Natural England and RSPB have raised particular concerns on this issue in relation to possible adverse effects on fish stocks used for feeding by terns from the Dungeness-Pett Levels SPA (Common terns and Little terns). The possible overlap of the piling noise impact zone and the foraging range of these species from this SPA have been examined. With regard to Little terns, their maximum foraging range (11km, Thaxter *et al.* 2012) would not overlap at all with the potential impact zone. The closest that the predicted 75dBht zone (in which there could be significant displacement of particularly sensitive fish species, notably herring; see Section 8 Figure 8.5) comes to the nearest tern colony within the Dungeness to Pett Levels SPA is 25km (to the Rye Harbour colony; the second main colony at Burrowes Pit is 28km from that zone). There would be a small overlap between the maximum Common tern foraging range (30km) and this zone, but given that it lies well outside the mean maximum range for this species of 15km (Thaxter *et al.* 2012) and that only a small part of that foraging range would overlap with that zone, any effects on this SPA population would be of negligible magnitude and not significant. There could additionally be indirect effects on herring spawning outside this foraging range and on recruitment to the wider herring population, but as explained in the previous paragraph this would be mitigated by restrictions to piling activity.
- 11.6.12 **Gannet:** this species has a potential ecological link to the Alderney West Coast and the Burhou Islands Ramsar site (where there is a breeding colony of 5,950 pairs) and possibly the Archipel des Sept-Iles SPA; its population there is 13,500 pairs). Though the Project site is over 180km from the first of these and 300km from the second, this species is very wide-ranging throughout the year (Hamer *et al.*, 2000), so a link (albeit a distant one) is possible. At these distances the importance of the potential Project impact zone for gannets breeding on these SPA/Ramsar sites is likely to be very low. Even taking the whole Project site plus a 4km buffer would occupy only 0.5% of the feeding range from the Alderney Ramsar site but lies outside the range of the Archipel de Sept Iles SPA (using the mean maximum feeding range data from Thaxter *et al.* (2012)). The potential impact zone relating to construction disturbance (the wind turbine locations plus up to a 4km buffer) held densities slightly lower than the study area as a whole, with no indication that any part of that zone was of particular importance to this species (Table 11.10 and Figure 11.4). Given this and that it has such a wide foraging range the temporary loss of a very small part of that range would be of

negligible magnitude and not significant, even if there were displacement over a zone of up to 4km during construction.

- 11.6.13 **Sandwich Tern:** this is a qualifying species of the Solent Marshes and Southampton Water SPA and the Chichester and Langston Harbours SPA. The proposed Project site lies beyond the usual foraging range from both of these sites (Perrow *et al.*, 2010) though within the maximum foraging distance given by Thaxter *et al.* (2012), so it is possible that there could be some use of the survey area by the SPA populations. However, recorded use of the potential impact zone relating to construction disturbance during the baseline surveys was very low indeed. As a result any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.14 **Common Tern:** this is a qualifying species of the Solent Marshes and Southampton Water SPA and the Dungeness to Pett Levels SPA. The Project site lies outside the usual foraging range of these sites (Perrow *et al.*, 2010), but for Sandwich tern it is possible that there could be some use of the survey area by the SPA populations. Small numbers of this species were recorded within the potential impact zone, but the total numbers involved were small with no evidence of this area (or indeed any within the survey area) being of particular importance to this species), so any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.15 **Lesser black-backed gull:** this is a qualifying species of the Baie de Seine Occidentale (Iles de Saint Marcouf) SPA, which is 130km from the Project site. At this distance it may be on the fringe of the SPA foraging range (Thaxter *et al.* 2012 reported a mean maximum foraging range of 141km for this species) but would be very unlikely to be an important part of that foraging range. The whole Project site plus a 4km buffer would occupy only 0.2% of the feeding range from the SPA (using the mean maximum feeding range data from Thaxter *et al.*, 2012). Use of the potential disturbance zone around the Project site as a whole was generally similar to that of the wider survey area (Table 11.10). As a result, any disturbance effect during construction would be of negligible magnitude and not significant, particularly given this species' low vulnerability to disturbance (Garthe and Huppopp, 2004).
- 11.6.16 **Kittiwake:** this species was present in the survey area in regionally important numbers. The potential impact zone relating to construction disturbance (the wind turbine locations plus up to a 4km buffer) held densities slightly higher than the study area as a whole (Table 11.10 and Figure 11.11). Given that it has such a wide foraging range the temporary loss of a small part of that range would be of negligible magnitude and not significant, even if there were displacement over a zone of up to 4km of any construction activity.
- 11.6.17 **Guillemot:** this species was present in the survey area in nationally important numbers but is not clearly linked to any specific SPA. Peak numbers were recorded during late winter/spring with fewer during the summer and autumn. The potential impact zone relating to construction disturbance (the wind turbine

locations plus up to a 4km buffer) held densities slightly higher than the wider study area, with no indication that any part of that zone was of particular importance to this species (Table 11.10 and Figure 11.13). Given this and considering that it has a wide foraging range the temporary loss of a very small part of that range would be of negligible magnitude and not significant, even if there were displacement over a 2km zone during construction.

- 11.6.18 **Razorbill:** this species was present in the survey area in regionally important numbers. The potential impact zone relating to construction disturbance (the wind turbine locations plus up to a 4km buffer) held densities typical of the study area as a whole, with no indication that any part of that zone was of particular importance to this species (Table 11.10 and Figure 11.14). Given this and considering that it has a wide foraging range the temporary loss of a very small part of that range would be of negligible magnitude and not significant, even if there were displacement up to a 4km zone around any construction activity.
- 11.6.19 **Little Gull:** mostly a spring migrant through the survey area, with peak counts in April each year. The peak count (168) was sufficient to be classed as regionally important, and this species is listed on Annex 1 of the EU Birds Directive. Most individuals were recorded in the more inshore parts of the survey area and in the eastern part – the wind farm site held densities generally typical of the survey area. Any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.20 **Arctic Tern:** most records of this Annex 1 species were from a single survey in May 2010 when a higher number of migrants passing through the survey area were observed (sufficient to be considered regionally important). Apart from this however, use of the survey area by this species was very low. Any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.21 **Red-throated Diver:** there were no records of this Annex 1 species within 2km of the wind farm site and a peak of only 13 within 4km (Table 11.8). Given such low numbers and infrequent occurrence (Table 11.10), any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.22 **Great Skua:** this species was recorded in regionally important numbers and was widely scattered across most of the survey area, though with more records in the southern part of the survey area in the deeper waters further from the shore (Figure 11.5). Densities within the potential disturbance zone around the Project site were generally lower than in the wider survey area (Table 11.10). Any disturbance effect during construction would be of negligible magnitude and not significant.
- 11.6.23 **Great Black-backed Gull:** the peak number of this species recorded in the survey area (4,473) was sufficient to be classed as nationally important. It was widespread across all of the survey area, and the potential disturbance zone held densities typical of the wider survey area (Table 11.10). Five other survey totals exceeded the threshold for national importance, 760; Holt *et al.*, 2011). Given

that it has such a wide foraging range the temporary loss of a small part of that range would be of negligible magnitude and not significant, even if there were displacement in a zone of up to 4km around any construction activity.

11.6.24 **Common scoter:** this species was recorded in regionally important numbers within the survey area, mainly during spring. None were seen within 2km of the Project site and only very low densities within 4km (Table 11.10). As a result any disturbance effect on this species during construction would be of negligible magnitude and not significant.

11.6.25 **Fulmar:** this species was widespread across all of the survey area, and was recorded in regionally important numbers. Densities were similar across the potential disturbance zone and the wider area (Table 11.10), though numbers were higher in the deeper water to the south of the Project site (Figure 11.3). Any disturbance effect during construction would be of negligible magnitude and not significant.

11.6.26 **Balearic Shearwater:** this species was only recorded during two surveys in small numbers (peak population estimate in survey area 27). It is however an EU Birds Directive Annex 1 species, giving it high sensitivity (and is also a UK BAP priority species). Given the very low number recorded and low frequency of occurrence, and the lack of any particular importance of the potential disturbance zone, any disturbance effect during construction would be of negligible magnitude and not significant.

11.6.27 **Common gull:** this was another species found in regionally important numbers but individuals were recorded more frequently in the inshore waters away from the Project site (Figure 11.6). The potential disturbance zone did not hold notably high densities of this species (Table 11.10 and Figure 11.6). Any disturbance effect during construction would be of negligible magnitude and not significant.

11.6.28 **Herring gull:** this was an abundant species across all of the survey area, with concentrations noted in both the northern and southern parts (Figure 11.8) Peak numbers were sufficient to be considered of national importance (17,280) though this threshold was only exceeded on a single count (July 2011). Use of the potential disturbance zone around the Project site as a whole was generally similar to that of the wider survey area (Table 11.10). As a result, any disturbance effect during construction would be of at most low magnitude and not significant, particularly given this species' low vulnerability to disturbance (Garthe and Huppop, 2004).

Operation

Barrier effect

11.6.29 During operation, birds may change their flight path to avoid crossing through a wind farm, with the wind farm effectively acting as a barrier to free movement resulting in increased energetic costs of daily movements and migration (DECC,

2009; Masden *et al.*, 2010). It has been suggested in several studies that wind farms may act as a barrier to bird flight lines, with birds preferring to fly around wind farms rather than between turbines, particularly where they are located close to each other. In a study at Tunø Knob, for example (Tulp *et al.*, 1999), eider ducks avoided flying between turbines at 200m separation. It is possible that the wind farm may act as a barrier to movements of some bird species through this area (though the wide separation may be sufficient to avoid this effect). Gulls and terns have been shown to regularly fly through lines of smaller wind turbines with much smaller distances between turbines without any such barrier being apparent (e.g. Painter *et al.* (1999) in a study at Blyth Harbour with a line of 9 turbines, and Everaert (2003) at Zeebrugge Harbour with 23 turbines in two lines along the harbour walls). Possible barrier effects on other seabirds are largely unknown, so for the purposes of this assessment it has been assumed that they could be potentially affected. It is also likely that migrant waterfowl will to at least some extent be diverted around the wind farm, as has occurred at several other offshore wind farm sites (e.g. Nysted, Kahlert *et al.*, 2004, and Utgrunden, Petterson, 2004).

- 11.6.30 The extent of a barrier effect is likely to be partly dependent on the spacing of the wind turbines, and whether passage is facilitated by the presence of open corridors between them. This will depend on the typical angle of flight lines taken by any given species, as well as meteorological conditions and other factors. The impact of any barrier effect is also likely to be dependent on the size of wind farm in relation to the flight path taken by birds as a whole. In a worst case birds may be diverted around the whole of the wind farm, and the assessment here has been made on that basis.
- 11.6.31 For a barrier effect to be potentially significant it would need to result in either reduced utilisation of an ecological resource (through birds no longer being able to reach it through the barrier) or significantly increased energy expenditure by the birds in flying around the barrier. Given the extent of the Offshore Project and its orientation in relation to the main seabird migration route up/down the English Channel it is unlikely that this would give rise to any significant effect on any bird species. In its wider dimension it would present more of a barrier to terrestrial migrants crossing the English Channel, though given the broad geographical range from over which such migration would take place and the high altitude at which most of these migrants usually fly (well above rotor height) (Alerstam, 1990), this is not considered to be any more than a negligible effect that would not be significant for any species.

Disturbance and displacement:

- 11.6.32 Similar to the situation during construction, certain species are likely to be more sensitive to the disturbance effects of operational wind farms and, therefore, may avoid and be displaced from an area of former use. A high level assessment of the relative risk of disturbance from offshore wind farms to a range of seabird species was published by Garthe and Huppop (2004), and the assessment here draws from that paper.

- 11.6.33 As for the assessment of the potential disturbance effects during construction, all species within the potential impact zone (up to 4km from the wind farm) of the Offshore Project are considered in this part of the assessment. Particular consideration has again been given to species present that could be ecologically linked to any SPA populations and to any others present in nationally or regionally important numbers.
- 11.6.34 The 'potential impact zone' during the operation phase is likely to be smaller (as a result of a reduced range/magnitude of potentially disturbing activities, particularly vessel activity and the level of noise – which would be greater during construction piling than any possible operational noise) than during the construction phase (where displacement up to 4km was used as a precautionary worst case), though consideration has still been made of the bird populations within 4km of the Project site. The other major differences from the construction phase are the longer-term nature of the effect in this phase (i.e. for the lifetime of the Project) and the fact that these effects will potentially impact on the whole of the potential disturbance zone (rather than just the parts in which construction is taking place).
- 11.6.35 As for the assessment of the construction phase disturbance, the magnitude of the worst-case disturbance effects during operation, the size and importance of each population that would be displaced, and the ecological consequences of such displacement were considered (the latter particularly focussing on the relative importance of the potential disturbance zone in comparison with the surrounding area).
- 11.6.36 In determining the magnitude of the worst-case disturbance effects during construction, the size and importance of each population that would be displaced, and the ecological consequences of such displacement were considered.
- 11.6.37 The assessment of the potential operational disturbance effects of the Project on seabirds has been refined through the use of results from post-construction studies of seabird displacement at existing wind farms. Though the number of such studies currently available is still low, they do enable a more evidence-based approach to the assessment to be taken (rather than overly precautionary worst-case assumptions).
- 11.6.38 Of the species potentially linked to SPAs using the potential disturbance zone around the Offshore Project site, most have been identified by Garthe and Huppopp (2004) as being species that would not be likely to be vulnerable to disturbance; Kittiwake, other gull species, Sandwich tern and Common Tern. This conclusion has also generally been supported by studies from existing wind farms, including at Blyth Harbour (Percival, 2007) and Zeebrugge Harbour (Everaert and Stienen, 2007). Given this and the discussion presented above for each species in relation to possible construction disturbance, any operational disturbance effects on these species would be likely to be of negligible magnitude and not significant.

- 11.6.39 The main species groups that would be more likely to be affected by operational disturbance are Gannet and auks (particularly Guillemot and Razorbill). All of these species have very wide foraging ranges, the potential impact zone did not support particularly high numbers or any particularly important habitat (it held densities generally typical of the study area as a whole) and their main use of the survey area was outside the breeding season, when birds would be ranging over a larger area than during breeding. As a result any disturbance of these species during operation would be of negligible magnitude and not significant. There is also empirical evidence that the actual zone over which displacement might occur for these species is rather less than the 4km buffer used in the precautionary assessment. There have been reductions in Gannet numbers within wind farms post-construction reported in several studies including Petersen *et al.* (2006), Krijgsveld *et al.* (2010) and Percival *et al.* (2012), with displacement within wind farms (though not in any buffer zone around them) exceeding 90% in some cases. Therefore applying a displacement model for this species that assumes full displacement within the wind farm, but not extending into any of surrounding area would seem a more reasonable approach. In that case peak of 1,087 Gannets would be predicted to be displaced at Rampion, an effect of negligible magnitude that would not be significant.
- 11.6.40 No marked avoidance of wind farms by Guillemots and Razorbills was noted by Lindeboom *et al.* (2011) at an offshore wind farm in the Netherlands, though Petersen *et al.* (2006) did observe a degree of displacement of these species. At the Thanet offshore wind farm (Percival *et al.*, 2012), initial results from the first two years of post-construction monitoring indicated a 69% reduction in density within the wind farm during construction and a 48% reduction in the 0-1km buffer within that period, and a 26% reduction within the wind farm post-construction, in comparison with the pre-construction baseline, but no reduction apparent beyond those zones. The only disturbance effect on razorbills apparent at Thanet was during the construction phase, when a decrease in density of 96% was recorded within the wind farm and 67% in the 0-1km zone, though no reduction was apparent outside that zone (Percival *et al.*, 2012). Applying a displacement model assuming a 30% reduction within the wind farm would seem therefore to be a reasonable approach for these species that would capture any likely disturbance impacts. This would result in a displacement of 1,130 Guillemots and 86 Razorbills, an effect of negligible magnitude that would not be significant.
- 11.6.41 Further consideration of the ecological consequences of such disturbance effects adds further support to the conclusion that any operational phase disturbance to these species would not be significant. The loss of feeding range for all three of these species would be negligible (<0.1%) in the context of their very extensive non-breeding foraging ranges, and the Project site is not located within the core feeding range of any important seabird breeding colonies.
- 11.6.42 All of the other Annex 1 species recorded within the potential disturbance zone around the Project site, red-throated diver, little gull and arctic tern, made only low and infrequent use of the potential disturbance zone around the wind

turbines. As a result any disturbance effect during operation would be of negligible magnitude and not significant.

11.6.43 **Great Black-backed Gull:** as discussed above in the assessment of construction phase disturbance, this species was widespread across all of the survey area, with no evidence of any particular preference of the potential disturbance zone. It is also a species that Garthe and Huppopp (2004) assessed as not being vulnerable to disturbance. Any disturbance effect during operation would be of negligible magnitude and not significant.

11.6.44 **Herring Gull:** as discussed above in the assessment of construction phase disturbance, this species was widespread across all of the survey area, with no evidence of any particular preference of the potential disturbance zone. It is also a species that Garthe and Huppopp (2004) assessed as not being vulnerable to disturbance. Any disturbance effect during operation would be of negligible magnitude and not significant.

11.6.45 Of the other species present within the survey area in regionally important numbers, those discussed above in the construction impact assessment section as being potentially vulnerable to disturbance then could be potentially affected by operational disturbance as well, though as noted above this would be likely to be of lower magnitude but over a longer timescale and a wider geographic area. There was no evidence that the potential disturbance zone held particularly important numbers of any of these species. Any disturbance effect on them during operation would be of negligible magnitude and not significant.

Collision risk

11.6.46 Collision risk modelling has been undertaken for all of the very high, high and medium sensitivity species that have been recorded flying through the collision risk zone at rotor height.

11.6.47 The collision risk model used in this assessment is the one developed by SNH and BWEA (Percival *et al.*, 1999; Band, 2001, Band *et al.*, 2007), recently updated for specific use for offshore wind farm assessments (Band, 2011). Details of the model are given in these publications. The model runs as a two-stage process. Firstly the risk is calculated making the assumption that flight patterns are unaffected by the presence of the wind turbines, i.e. that no avoidance action is taken. This is essentially a mechanistic calculation, with the collision risk calculated as the product of (i) the probability of a bird flying through the rotor swept area, and (ii) the probability of a bird colliding if it does so. This probability is then multiplied by the estimated numbers of bird movements through the wind farm rotors at the risk height (i.e. the height of the rotating rotor blades) in order to estimate the theoretical numbers at risk of collision if they take no avoiding action.

11.6.48 The second stage then incorporates the probability that the birds, rather than flying blindly into the turbines, will actually take a degree of avoiding action, as

has been shown to occur in all studies of birds at existing wind farms. SNH has recommended a precautionary approach, using a value of 98% as an avoidance rate for all of the species modelled here (Urquhart, 2010). Maclean *et al.* (2009) however recommended the use of more realistic rates (99%-99.9%) in their review for COWRIE. Results for a range of avoidance rates are presented here, as recommended by Band (2011). The main part of the assessment has drawn primarily on the application of the avoidance rates recommended by Maclean *et al.* (2009) but consideration has also been given to lower more precautionary rates as well. These rates relate to avoidance exhibited by birds once they are in proximity to the wind turbines, as they have been primarily derived from studies that have only been carried out post-construction, avoidance typically termed 'micro-avoidance'. Avoidance of the wind farm site altogether through displacement, or 'macro-avoidance' would therefore act in addition to these micro- rates for species that exhibited such behavior.

- 11.6.49 With very high, high and medium sensitivity populations involved, anything more than a negligible, low and medium magnitude effect would respectively be potentially significant (Table 11.4). In this context the magnitude of the effect has been determined as a percentage increase in the existing baseline mortality (to put the potential wind farm mortality into the ecological context of the birds' population dynamics). Following King *et al.* (2009) all non-negligible collision risks for all species (i.e. all risks exceeding 1% of the existing baseline mortality) modelled have been considered further in the assessment in the context of each species' demographic characteristics and potential vulnerability to additional mortality.
- 11.6.50 The collision model requires data on bird body size and flight speed. Body sizes and baseline mortality rates were taken from Robinson (2005), and flight speeds from Campbell and Lack (1985).
- 11.6.51 Details of the model input data are provided in Appendix 11.2, together with a worked example of the Band (2011) model for one species, and a table of all the key input parameters for all other species to enable validation to be carried out. This includes all of the data used in the model and therefore allows a full replication of the model to be undertaken. Electronic versions of the collision modelling are also available on request.
- 11.6.52 Table 11.14 gives the background annual mortality rate (Robinson *et al.*, 2005), the estimated baseline population size and the estimated existing annual background mortality. The main baseline region used for this assessment was defined as the area from Durlston Head (Poole Harbour) in west to Dover in the east, to 35km offshore (i.e. the same as furthest extent of the survey area). This covered a total area of 7,300km² and it was assumed that the densities recorded in the survey area were representative of that area (with the regional population estimate based on the peak density recorded across the Rampion survey area). For terrestrial SPA and other species, data were also used from WeBS counts (Holt *et al.*, 2012) for sites within this region, and other data sources included

Baker *et al.* (2006) for national UK populations, and Tucker *et al.* (2004) for international populations.

11.6.53 An initial assessment is presented below of the predicted collision mortality in the context of the regional population, as a preliminary worst case. For species for which this regional impact could be potentially significant then each is also considered at the national and international (biogeographic) population levels.

11.6.54 As noted above, a worst-case approach has been adopted for the bird flight activity data for the collision modelling, using the higher value of bird activity within the collision zone from either the boat-based or aerial surveys. This in practice meant using the boat-based data for all except three species, Gannet, Great skua and Kittiwake, for which the aerial survey numbers at risk were slightly higher.

Table 11.14: Collision risk model input data for the proposed Rampion offshore wind farm.

Species	Background annual mortality rate	Estimated baseline population size			Estimated number of flights per year through wind farm ⁶
		Regional	UK	Int	
Brent Goose	10%	20,000	91,000	240,000	66,576
Common Scoter	22%	1,000	100,000	550,000	98,112
Gannet	8%	45,000	440,000	610,000	1,096,402
Bar-tailed Godwit	28%	1,500	38,000	120,000	72,270
Curlew	26%	5,000	140,000	840,000	2,190
Great Skua	11%	1,000	19,000	32,000	32,631
Mediterranean Gull	20%	840	1,800	77,000	1,898
Common Gull	20%	30,000	700,000	1,640,000	153,738
Lesser Black-Backed Gull	7%	5,000	120,000	550,000	120,435
Herring Gull	7%	120,000	730,000	1,020,000	1,997,083
Great Black-backed Gull	7%	30,000	76,000	420,000	448,074
Kittiwake	19%	10,000	370,000	>2,000,000	952,475
Little Gull	15%	1,100	10,000	110,000	30,602
Common Tern	10%	6,700	20,000	180,000	130,000
Arctic Tern	10%	8,800	106,000	2,000,000	170,000
Sandwich Tern	10%	1,000	21,000	170,000	16,863
Guillemot	5%	125,000	1,300,000	4,700,000	582,817
Swallow	63%	100,000	2,800,000	52,000,000	176,733
Meadow Pipit	46%	100,000	6,400,000	23,000,000	189,216

⁶ Assuming all flights are straight through wind farm – primarily applicable to migrant species.

11.6.55 Table 11.15 summarises the collision risk analysis for each of the key species for the 175-turbine option. The Table gives the number of collisions predicted per year based on a range of avoidance rates (from the collision risk model), the percentage increase that each avoidance rate would represent over the baseline mortality, the magnitude of that effect and whether such an effect would be significant.

Table 11.15: Collision risk modelling predictions for the Rampion Offshore wind farm: 175 x 4MW turbine worst-case option

Species	Predicted number of collisions per year applying the following avoidance rates:			Percentage increase in baseline mortality applying the following avoidance rates:			Magnitude of effect	Likely significant effect?
	98%	99%	99.5%	98%	99%	99.5%		
Brent Goose	5.7	2.9	1.4	0.3%	0.1%	0.1%	Negligible	No
Common Scoter (wider boat)	0.6	0.3	0.1	0.3%	0.1%	<0.1%	Negligible	No
Gannet (aerial)	184.8	92.4	46.2	5.1%	2.6%	1.3%	Medium/low	Possible
Bar-tailed Godwit (wider boat)	14.2	7.1	3.5	3.4%	1.7%	0.8%	Low/negligible	Possible
Curlew (wider boat)	2.0	1.0	0.5	0.2%	0.1%	<0.1%	Negligible	No
Great Skua (aerial)	2.4	1.2	0.6	2.2%	1.1%	0.5%	Low/negligible	Possible
Mediterranean Gull	1.7	0.9	0.4	1.0%	0.5%	0.2%	Low/negligible	Possible
Common Gull	7.6	3.8	1.9	0.1%	0.1%	<0.1%	Negligible	No
Lesser Black-backed Gull	31.4	15.7	7.9	9.0%	4.5%	2.3%	Medium/low	Possible
Herring Gull	620.2	310.2	155.1	7.4%	3.7%	1.8%	Medium/low	Possible
Great Black-backed Gull	103.9	51.9	26.0	4.9%	2.5%	1.2%	Low	Possible
Kittiwake (aerial)	220.9	110.5	55.3	11.6%	5.8%	2.9%	Medium/low	Possible
Little Gull	0.5	0.2	0.1	0.3%	0.1%	0.1%	Negligible	No
Sandwich Tern (wider boat)	0.5	0.3	0.1	0.5%	0.3%	0.1%	Negligible	No
Common Tern	7.4	3.7	1.8	1.1%	0.6%	0.3%	Low/negligible	Possible

Species	Predicted number of collisions per year applying the following avoidance rates:			Percentage increase in baseline mortality applying the following avoidance rates:			Magnitude of effect	Likely significant effect?
	98%	99%	99.5%	98%	99%	99.5%		
Arctic Tern	9.8	4.9	2.5	1.1%	0.6%	0.3%	Low/negligible	Possible
Guillemot	4.1	2	1	0.1%	<0.1%	<0.1%	Negligible	No
Swallow	0.6	0.3	0.1	<0.1%	<0.1%	<0.1%	Negligible	No
Meadow Pipit	9.2	4.6	2.3	<0.1%	<0.1%	<0.1%	Negligible	No

Bold indicates primary avoidance rate used in the further assessment.

It was agreed with NE that a 95% avoidance rate was not a realistic value to use in assessment, though that value can be calculated as the 98% value multiplied by 2.5.

Common/ arctic tern risk has been divided according to % of each record identified to that species (43% common, 57% arctic).

11.6.56 The collision risk exceeded a 1% (negligible magnitude) increase over the baseline mortality in ten species (assuming a precautionary 98% avoidance rate), all of which are considered further here; Gannet, Bar-tailed Godwit, Great Skua, Mediterranean gull, Lesser Black-backed gull, Herring gull, Great Black-backed gull, Kittiwake, Common Tern and Arctic Tern.

11.6.57 **Gannet:** the collision risk to gannet was assessed as medium magnitude applying a 98% avoidance rate and low magnitude applying 99-99.5% rates. As this species has been classed as very high sensitivity this would be an effect that would be considered potentially significant. Assessing against the national population would reduce this magnitude to a negligible level, which would not be significant. As a result it can be concluded with a high degree of confidence (given the worst case assumptions adopted) that there would not be any significant effect on gannet at the national level. Maclean *et al.* (2009), in their review of assessment methodologies for COWRIE, recommended use of a 99.5% avoidance rate for Gannet, which would give only a low magnitude effect at the regional level. The behaviour of gannets at existing wind farms, exhibiting a high degree of macro-avoidance of the wind farm (Petersen *et al.*, 2006, Krijgsveld *et al.*, 2010 and Percival *et al.*, 2012), would further reduce the actual collision risk and add further support to the conclusion of a lack of a significant collision risk to this species. In addition to that population viability analysis for gannets (WWT Consulting, 2012) has shown the population to be robust to additional mortality and hence it would be unlikely that even the highly precautionary level of additional mortality would have any significant population consequences.

11.6.58 **Bar-tailed Godwit:** the collision risk to bar-tailed godwits was assessed as low/negligible magnitude, which, for a very high sensitivity species (bar-tailed godwit is a qualifying species for the Chichester and Langston Harbour SPA), would be of medium significance (and could be potentially significant). However, as shorebirds are recognised by RSPB/BirdLife as a group that is not particularly vulnerable to collision (Langston and Pullan, 2003), it is not considered that the collision risk would be significant and that the actual collision risk would be rather lower than the precautionary value presented in Table 11.14. Assessing

against the national population, the predicted collision risk would be negligible (constituting only a 0.1% increase over the baseline mortality, even applying a 98% avoidance rate) and would not be significant.

- 11.6.59 **Mediterranean Gull:** the collision risk to this very high sensitivity species (it is a qualifying feature of the Solent and Southampton Water and Dungeness to Pett Levels SPAs) would be numerically low (1.7 per year applying a 98% avoidance rate) but this would still be borderline significant at this rate (representing a 1.0% increase over the baseline mortality – Table 11.14). However given the evidence from existing wind farms (Hotker *et al.*, 2004) that have reported generally low numbers of gull collisions and the recommendation of Maclean *et al.* (2009) to adopt a 99.5% avoidance rate for gulls, the collision risk to this species would be of negligible magnitude and not significant.
- 11.6.60 **Great Skua:** the collision risk to this species (it is present in the survey area in regionally important numbers) would be numerically low (2.4 per year applying a 98% avoidance rate), but equivalent to 2.2% increase over the baseline mortality (a low magnitude effect). A low magnitude effect on a medium sensitivity species would be of low significance and not significant.
- 11.6.61 **Other Gull species (lesser black-backed gull, herring gull, great black-backed gull and kittiwake):** the collision risk for all of these four species was assessed as being of low magnitude in the context of their background mortalities. One of these species, great black-backed gull, was present in the survey area in nationally important numbers, so was classed as high sensitivity. A low magnitude effect on this high sensitivity species would be of low significance and not significant (Table 11.4). The other three species were all classed as medium sensitivity, so low magnitude effects on these species would be of low significance and not significant (Table 11.4). Additionally, in their reviews of collision risks of wind farms to birds Hotker *et al.* (2004) and more recently Illner (2011) reported only small numbers of gull collisions in relation to other bird groups, and Garthe and Huppopp (2004) did not identify gulls as a group at particular risk of collision impacts. This adds further support to the conclusion that there would not be any significant collision risk to any of these gull species resulting from the Project.
- 11.6.62 **Common and Arctic tern:** though neither of these species was observed flying at rotor height during the baseline surveys, a precautionary collision risk assessment was undertaken using flight data data from Cook *et al.* (2012). The collision risk for both species just exceeded a 1% over the existing baseline mortality applying a 98% avoidance rate. Given this precautionary assessment and recommendations by Maclean *et al.* (2009) of the use of an avoidance rate of 99% for terns, only a negligible magnitude collision risk is predicted for both species, which would not be significant.
- 11.6.63 **Other shorebird migrants:** records of other shorebird species were largely closer inshore than the areas in which the wind turbines would be located, with only very small numbers of migrants recorded flying in proximity to the Project site

and none through the collision risk zone at rotor height. It was therefore concluded that the proposed development would not result in any significant collision risk to any other shorebird species.

11.6.64 **Landbird migrants:** these birds fly over the sea during long-distance migration, and it is likely that the Project site will be over-flown by birds moving across the English Channel in spring and autumn, though given the distance from the shore it is unlikely that these would be in any major concentration. Studies at onshore coastal wind farms (Winkelman 1992a and 1992b) have reported collision rates of 0.01-0.02% of birds passing through the wind farm, equivalent to 1 in 5-10,000 individuals. At such a low rate of collision it would be very unlikely that any collision risk to any landbird species would be significant at the Offshore Project site. Specific collision risk modelling for the two landbird migrants observed flying through the site at rotor height during the baseline surveys (swallow and meadow pipit) was undertaken (Table 11.14), though for both the risk was of negligible magnitude and not significant.

11.6.65 Natural England and RSPB both raised collision risk to migrating nightjars as a specific concern relating to landbird migrants. Both were concerned that mortality on migration might affect the Nightjar populations from the SPAs in the region; Ashdown Forest SPA (35 breeding pairs noted in the SPA Review), Thames Basin Heaths SPA (103 pairs) and Wealden Heaths Phases I and II (264 pairs).

11.6.66 Worst case collision modelling was undertaken to address this concern and to determine if there could possibly be a likely significant effect on the SPA nightjar population. This assumed an absolute worst case that all of the nightjars from these SPAs passed through the wind farm corridor on spring and autumn migration and that all were flying at rotor height. With a total combined SPA population of 402 pairs this would involve 804 flights through the wind farm in spring, and the same in autumn plus the year's production of young (0.7 chicks per pair fledged, giving $402 \times 0.7 = 281$ juveniles), based on a nightjar baseline survival rate of 69% (Robinson, 2005).

11.6.67 The collision modelling gave a predicted collision risk of 1.3 per year, applying a precautionary 98% avoidance rate, which would be equivalent to a 0.4% increase over the baseline mortality. As a result given that this worst case would result in only a negligible magnitude effect, it can be confidently concluded that there would not be any significant collision risk to this species.

11.6.68 Collision risk to all other bird species would be of negligible magnitude and not significant.

Changes in habitat or prey supply

11.6.69 The Offshore Project has the potential to result in a number of effects on foraging birds during its operation; these will include impacts associated with the displacement of certain sensitive species from within the wind farm and as such,

loss of foraging habitat, as discussed under disturbance and displacement. The Project will also result in the direct loss of a small area of sub-tidal habitat, although this loss is likely to be minimal in relation to the regional resource. Whilst construction noise, for example from piling operations, might temporarily displace fish from the Offshore Project site, conversely reduced fishing intensity in the wind farm area (see Section 8 -. Fish and Shellfish) has the potential to increase prey availability in the long term. Therefore, in the longer term certain species such as gulls and cormorants, which are not prone to displacement, may feed within the Project site preferentially. Increases in gulls and cormorants have been recorded during monitoring at the Horns Rev offshore wind farm (NERI, 2005) and at the Robin Rigg wind farm in the Solway Firth (Percival *et al.*, 2010), possibly at least partly as a result of an increased availability of fish on which to feed.

- 11.6.70 Fish surveys carried out at Kentish Flats during the operational phase of that wind farm have not indicated any adverse effects on fish populations within the area that could be attributed to the construction of the wind farm (OES, 2009⁷). Similarly, benthic and seabed monitoring have not shown any gross changes to the benthic habitats within the existing project area and surrounds, apart from the loss of a small area to the foundations themselves and associated small areas of scour around the structures. As a result changes in habitat/prey supply would not be likely to result in any more than a negligible magnitude effect on any bird species, which would not be significant even for the very high sensitivity species.

Decommissioning

- 11.6.71 The main potential offshore impacts arising from the Offshore Project during the decommissioning phase are disturbance from decommissioning activities such as movement of construction/decommissioning vessels.
- 11.6.72 Impacts during the decommissioning phase would be likely to be similar to and no greater than those during construction, and no significant impacts would be predicted to occur at this time. Section 2 - Project Description provides information on the options for decommissioning the wind farm and its associated structures. Though details of the decommissioning would be dependent on the processes outlined in Section 2 to inform the best methodology at the time, it is likely that it will involve boat activity at a similar level to construction, lifting/removal of turbines and foundations, and some disturbance to the seabed, but the magnitude of those effects would be likely less than during the construction phase (and not significant).

⁷ OES (Offshore Environmental Solutions) (2009). Kentish Flats Offshore Wind Farm FEPA Monitoring Summary Report.

11.7 Mitigation Measures

- 11.7.1 No mitigation measures are considered to be required in relation to marine ornithology, though the design will minimise the footprint of the turbines and scour protection where possible.

11.8 Residual Impacts

- 11.8.1 Overall, there are not likely to be any significant residual impacts on marine ornithology as a result of the Offshore Project. No effects are predicted that would result in any breach of the Habitats Regulations. Table 11.17 presents a summary of residual impacts resulting from the various Offshore Project phases.

11.9 Cumulative Impacts

- 11.9.1 This cumulative ornithological assessment follows the recommendations and assessment methodology recommended by the King *et al.* (2009) COWRIE study. This includes compiling of a 'long list' of species to undergo cumulative assessment and refining this with reference to the King *et al.* list of species potentially at risk of cumulative impacts (in Appendix 7 of that publication).

- 11.9.2 All of the species recorded during the Offshore Project baseline surveys, together with an evaluation of their conservation status, are given above in Table 11.12. This table constitutes the 'long list' for the Project site and includes all local SPA, Ramsar and SSSI species, as well as the other species recorded. This list has then been refined to include:

(a) all species of very high, high and medium sensitivity recorded flying through the collision risk zone and at rotor height – and hence at risk of collision - together with other migrants that could be at risk; and

(b) species that occurred within the potential impact zone of the development using that area's ecological resource – not just over-flying on migration - and therefore could possibly be subject to a significant disturbance impact.

- 11.9.3 This included the following:

(a) Key species at risk of collision

- Gannet
- Great Skua
- Lesser black-backed Gull
- Herring Gull
- Great black-backed gull

- Kittiwake
- Common and Arctic terns

(b) Key species at risk of disturbance

- Gannet
- Guillemot
- Razorbill

11.9.4 Additional consideration has also been given to other species potentially linked to an SPA (Sandwich tern, common tern, bar-tailed godwit), and to other Annex 1 species (including red-throated diver, arctic tern and little gull).

11.9.5 As recommended by King *et al.* (2009) quantitative data on number and density for all species at a project site have been included in this draft ES to enable quantitative CIA to be undertaken for the final ES. Following King *et al.* (2009) the cumulative assessment includes:

- Projects that have been consented but which are yet to be constructed;
- Projects for which application has been made;
- Projects that are reasonably foreseeable;
- Relevant non-wind farm projects subject to EIA; and
- Existing projects which have yet to exert a predicted effect (i.e. an effect that is not covered in the baseline).

11.9.6 The main focus of the cumulative ornithological assessment related to the wind farm proposals within the eastern English Channel, though consideration has also been given to other schemes in a wider area relevant to specific wider-ranging bird species (adopting the same approach as used for the Galloper wind farm cumulative ornithological assessment, Royal Haskoning, 2011). The main sites included in the CIA were:

- West of Wight (Navitus Bay) Offshore Wind Farm; and
- Fécamp Offshore Wind Farm in France.

11.9.7 Applications have not yet been submitted for either of these sites, so only a very preliminary cumulative ornithological assessment can be made of their effects. The Navitus Bay proposal is likely to involve a similar scale of proposal to the Rampion site and is located in an area that is likely to support similar bird populations to those at Rampion, so the effects of the two schemes are likely to be similar. At this stage therefore the only assessment that can be made of

Navitus Bay is that it would effectively introduce a second wind farm into the region that would be likely to have a similar ornithological impact to the Rampion scheme.

11.9.8 The Fécamp wind farm is currently being proposed as an 83 x 6MW turbine site located 13km from the French coast, covering an area of 65km² (EDF, 2012). It is scheduled to commence operation in 2018. No information is currently available about its bird populations nor its ornithological impacts, though two years of baseline surveys are being undertaken.

11.9.9 Projects in a wider area were also considered in the cumulative ornithological impact assessment, which are within the foraging range and migratory route for gannet, and also along the migratory flyway for other species such as skuas. Cumulative assessment of these sites focused mainly on collision risk. These projects included:

- Projects within Thames Strategic Area;
- East Anglia ONE: available data is limited to the scoping report, though did include preliminary collision risk assessment for lesser black-backed gulls;
- Projects within the Greater Wash Strategic Area and east coast of Britain.

Cumulative Impacts during Construction

11.9.10 Cumulative construction impacts would only occur if construction were to take place at same time at sites with overlapping potential impact zones. The only potential for such an effect at Rampion would be indirect cumulative effects on prey species (fish) if piling at Rampion and Navitus Bay were carried out at the same time, but it is understood that this would not occur given the current proposed timetables for the two sites.

Cumulative Impacts during Operation

11.9.11 The main cumulative ornithological concern raised previously in relation to most of the other sites being considered in the wider cumulative assessment, as identified in the Galloper wind farm ES (Royal Haskoning 2011), has been red-throated diver. That ES described this species as the only one of principle concern likely to encounter potentially significant levels of cumulative impact due to disturbance. Rampion (and by association Navitus Bay) would not add anything more than a trivial increase to the overall cumulative effect on this species and both are located well outside any SPA (particularly the Greater Thames SPA which is particularly important for this species).

- 11.9.12 The Galloper cumulative ornithological impact assessment did not identify any other cumulative impact due to construction disturbance for any other species of principle conservation concern. The Rampion and Navitus Bay wind farms would not add any additional cumulative disturbance issues either.
- 11.9.13 The cumulative collision risk assessment for a regional assessment would include Navitus Bay, though there is no ornithological information currently available for that site. It was agreed with Natural England that for the purposes of the Rampion cumulative assessment that it would be reasonable, in the absence of any data or assessment for Navitus Bay, to assume that its collision impact would be approximately the same risk as for the Rampion site.
- 11.9.14 Further analysis has been carried out for wider ranging migratory species, as undertaken for the Galloper wind farm cumulative ornithological assessment. This has focused on two key species, gannet and great skua, again following the strategy adopted at Galloper. The cumulative collision risks are presented in Table 11.16. This Table shows the collision risk for each wind farm for which data are currently available for a range of avoidance rates (98%-99.5% as presented for the assessment of Rampion alone above).

Table 11.16: Cumulative collision risk for gannet and great skua⁸.

Wind Farm	Number of turbines	Gannet (98% avoidance)	Great skua (98% avoidance)
Galloper	>140	112	27
Greater Gabbard	140	na	80
Gunfleet Sands 1-3	50	na	na
London Array 1-2	341	185	na
Kentish Flats and extension	47	6	na
Thanet	100	2	na
Westermest Rough	80	1	na
Scroby Sands	30		na
Humber Gateway	83	8	na
Lincs	75	9	na
Lynn and Inner Dowsing	54	1	na
Sheringham Shoal	88	31	na
Teeside	27	12	na
Race Bank	88	198	na
Triton Knoll	333	271	na
Dudgeon	168	145	na
Docking Shoal	83-177	75	na
Beatrice Demonstrator	2	4	na
Rampion	175	185	2
Navitus Bay (assuming same as Rampion)	c.175	185	2

⁸ na = data not available

Wind Farm	Number of turbines	Gannet (98% avoidance)	Great skua (98% avoidance)
Total at 98% avoidance		1430	111
Total at 99% avoidance		715	56
Total at 99.5% avoidance		358	28
% increase over UK baseline mortality at 98% avoidance		2.8%	5.3%
% increase over UK baseline mortality at 99% avoidance		1.4%	2.7%
% increase over UK baseline mortality at 99.5% avoidance		0.7%	1.3%
% increase over international baseline mortality at 98% avoidance		2.0%	3.2%
% increase over international baseline mortality at 99% avoidance		1.0%	1.6%
% increase over international baseline mortality at 99.5% avoidance		0.5%	0.8%

11.9.15 The cumulative collision risk to Gannet would be of negligible magnitude and not significant for gannet at the UK and international scales, for the same reasons as put forward for the assessment of collision risk for the Rampion site alone, i.e (a) Maclean *et al.* (2009) recommended use of a 99.5% avoidance rate for gannet, which would give a negligible magnitude effect even at the regional level, (b) the behaviour of gannets at existing wind farms, exhibiting a high degree of macro-avoidance of the wind farm, would further reduce the actual collision risk and (c) population viability analysis for gannets (WWT Consulting, 2012) has shown the population to be robust to additional mortality.

11.9.16 The cumulative collision risk to Great skua would also not be significant at the national or international level, as the actual avoidance rate would be likely to be at least 99.5%. The Rampion site would also add only a very small amount to the cumulative risk at both the national and international level, both numerically (only 2 collisions per year even with a 98% avoidance rate) and proportionately, with a very high proportion of the risk to the UK/international populations deriving from the Greater Gabbard wind farm.

11.10 Conclusions

11.10.1 Overall, there are not likely to be any significant impacts on offshore ornithology as a result of the Rampion Project. No effects are predicted that would result in any breach of the Habitats Regulations.

Table 11.17: Summary of Residual Effects and Mitigation Measures – Ornithology

Aspect	Effect	Proposed Mitigation Measures	Sensitivity	Potential magnitude	Residual Effect ⁹
Construction Phase					
Installation of turbine foundations, turbines and associated ancillary works	Direct loss of habitat.	Design will minimise the footprint of turbines and scour protection where possible.	Up to very high	Negligible	Negligible
	Indirect effects on bird food availability		Up to very high	Negligible	Negligible
	Displacement of birds through disturbance		Up to very high	Negligible	Negligible
Operational Phase					
Operation/presence of wind turbines	Risk of mortality through collision with turbines to:				
	Gannet		Very high	Medium/low	Negligible
	Common Scoter		Medium	Negligible	Negligible
	Bar-tailed Godwit		Very High	Low/negligible	Negligible
	Great black-backed gull		High	Low	Negligible
	Lesser black-backed Gull		Very high	Medium/low	Negligible
	Herring Gull		High	Medium/low	Negligible
	Kittiwake		Medium	Medium/low	Negligible
	Other bird species		Up to very high	Low/negligible	Negligible
	Displacement of birds through disturbance		Up to very high	Negligible	Negligible
	Barrier effect disrupting bird flight paths		Up to very high	Negligible	Negligible

⁹ After applying assessment methodology and professional judgement to the outcome of that assessment.

Aspect	Effect	Proposed Mitigation Measures	Sensitivity	Potential magnitude	Residual Effect ⁹
	Changes in habitat and/or food supply		Up to very high	Negligible	Negligible
Decommissioning Phase					
Removal of turbines and associated structures	Displacement of birds through disturbance		Up to very high	Negligible	Negligible

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