# Rampion Offshore Wind Farm

# ES Section 11 – Marine Ornithology

**RSK Environmental Ltd** | **Document 6.1.11**

**December 2012** | **APFP Regulation 5(2)(a)**

**Revision A**

**E.ON Climate & Renewables UK Rampion Offshore Wind Limited**

## CONTENTS



**Tables**

**Figures**

# 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) *Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers* should be referred to. | Cumulative assessment includes full list of offshore wind farms that could contribute to in-combination effects. King *et al*. (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 *et al*. 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 an 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 1,076km$^2$. 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 km$^2$. 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.

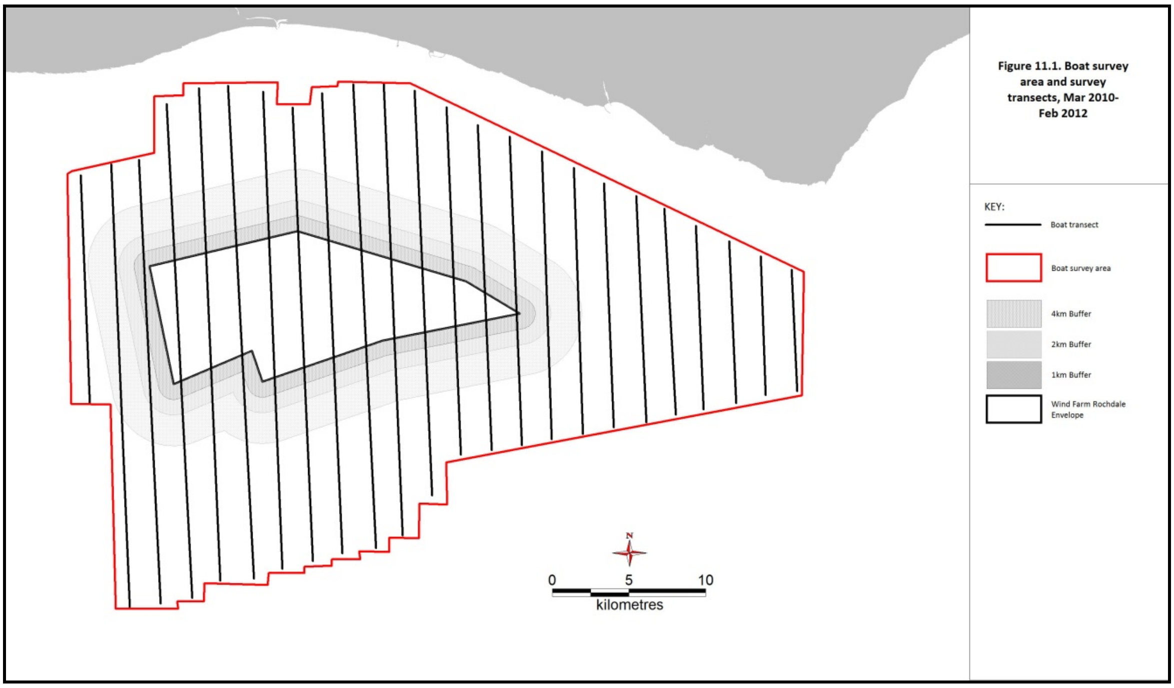


**Figure 11.1: Boat survey area showing transects, March 2010 – February 2012**

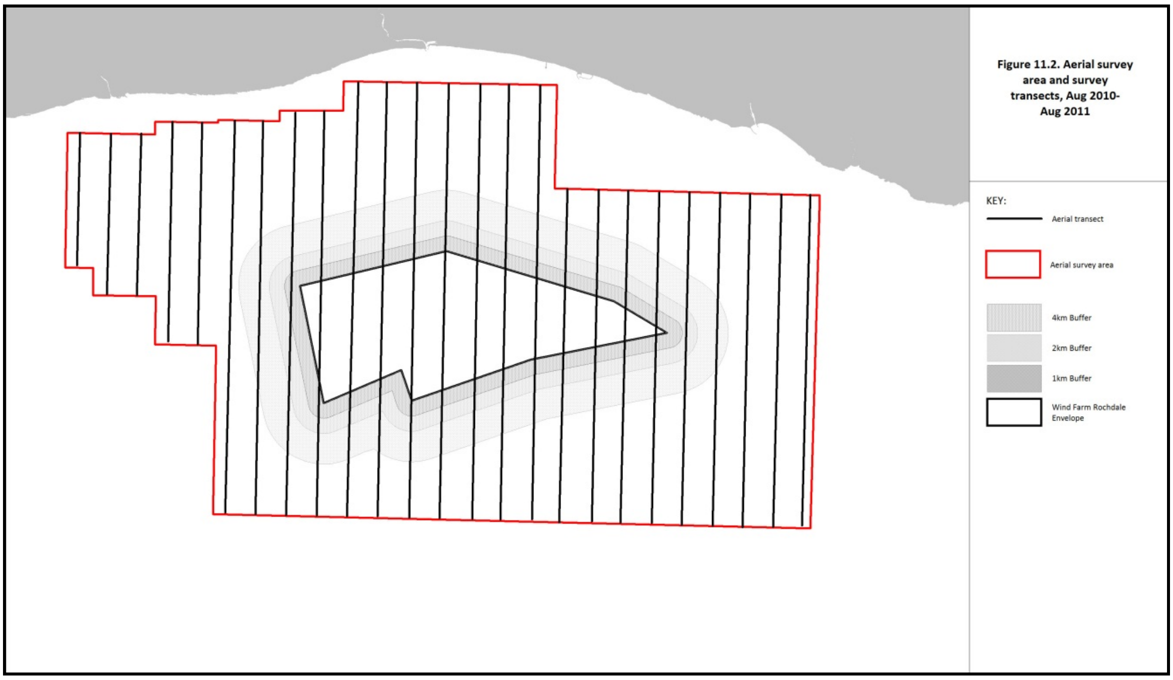


**Figure 11.2: Aerial survey area showing transects, August 2010 – August 2011**

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 ESAS[1] 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 1,102km$^2$ 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)).<br>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.<br>Any ecologically sensitive species, e.g. large birds of prey or rare birds (<300 breeding pairs in the UK).<br>EU Birds Directive Annex 1, EU Habitats Directive priority habitat/species and/or Wildlife and Countryside Act 1981 (as amended)<br>Schedule 1 species (if not covered above).<br>Other specially protected species. |
| Medium | Regionally important population of a species, either because of population size or distributional context.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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 *et al*. 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 *et al*. max range (km)** | **Thaxter *et al*. mean max range (km)** | **Thaxter *et al*. 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 $km^2$) 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 $km^2$ compared with Stone *et al*.'s 0.4 0.15, and 0.01 per $km^2$ for each species respectively). Kittiwakes were observed in similar densities (0.45 per $km^2$ compared with 0.45 per $km^2$ 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 $km^2$ respectively compared with the equivalent values of 0.5, 0.2, 0.2 and 0.05 per $km^2$ from Stone *et al*.).

**Table 11.8 Boat-based survey mean population densities (birds / km$^2$) 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 *et al*. 2012 % flights at rotor height | Mean density flying at collision height in wind farm = B x C | Mean density flying at collision ht 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 *et al*. 2012 % flights at rotor height | Mean density flying at collision height in wind farm = B x C | Mean density flying at collision ht 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/Razorbill | 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 $km^2$) 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 ht 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 ht 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.

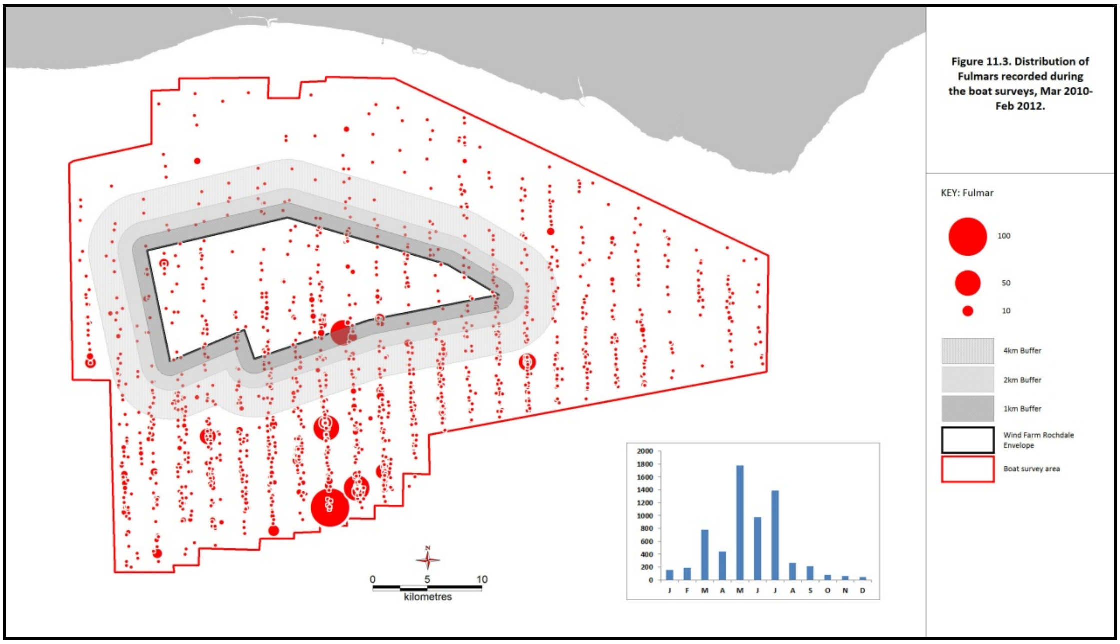


**Figure 11.3: Distribution of Fulmars recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

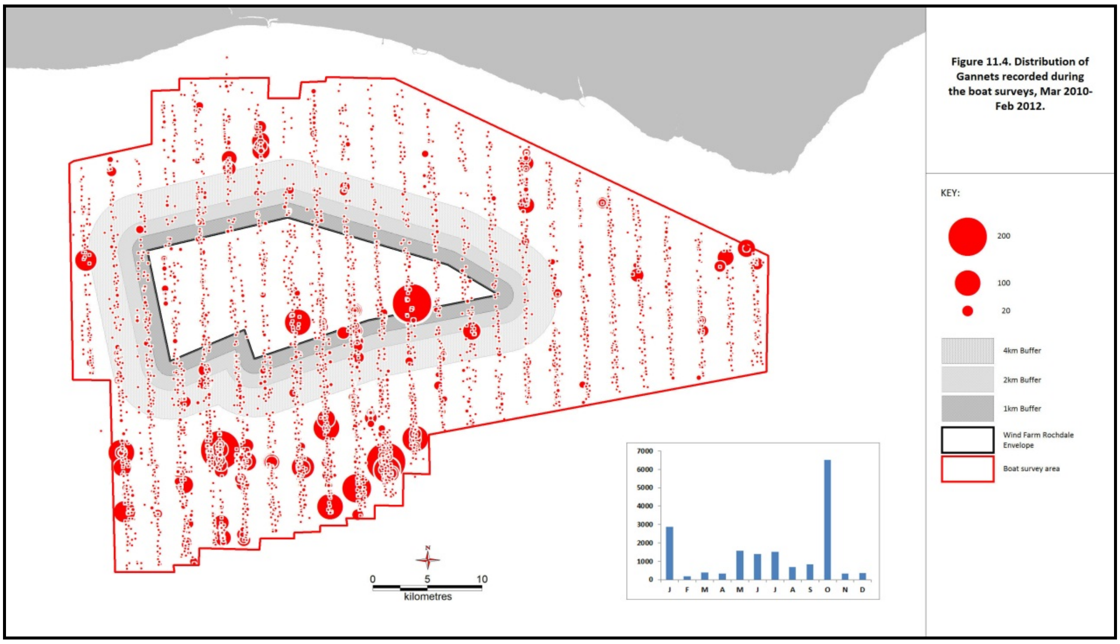


**Figure 11.4: Distribution of Gannets recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

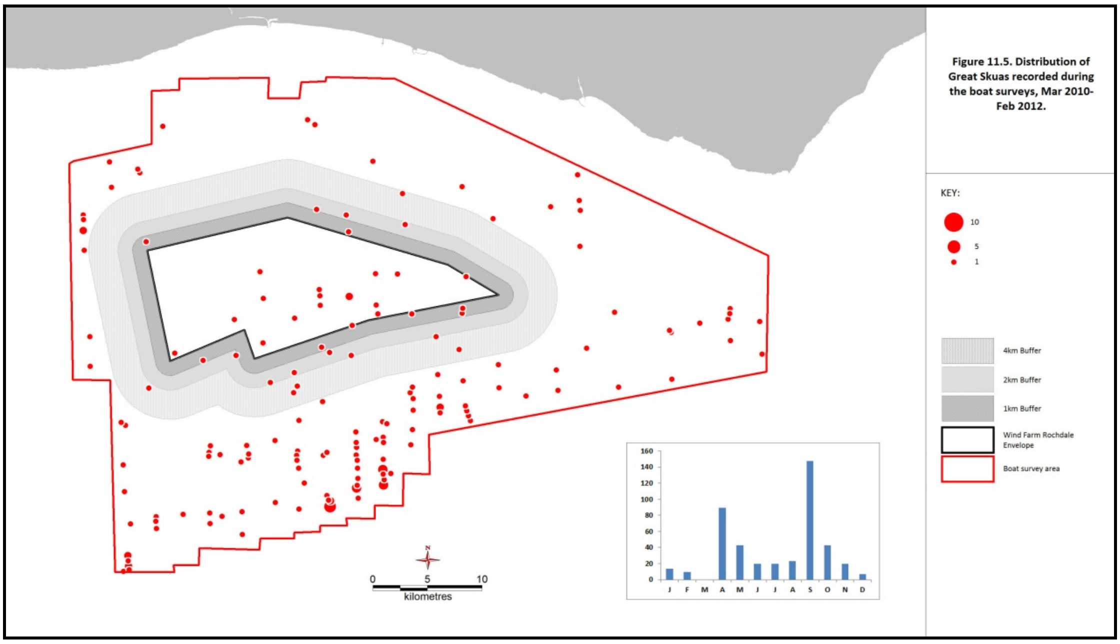


**Figure 11.5: Distribution of Great Skuas recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

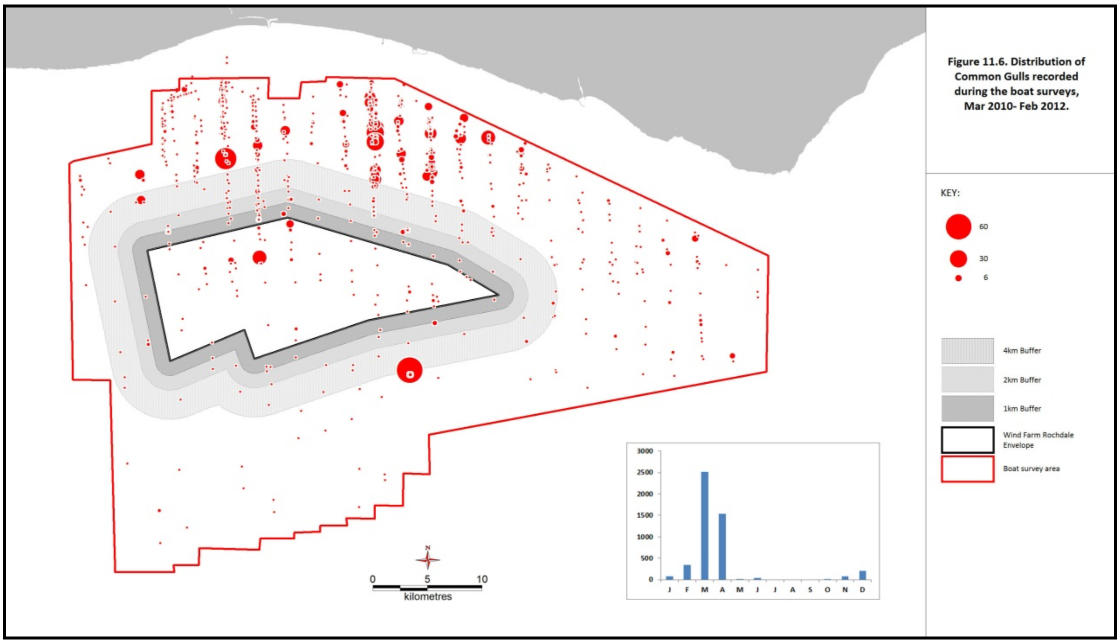


**Figure 11.6: Distribution of Common Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

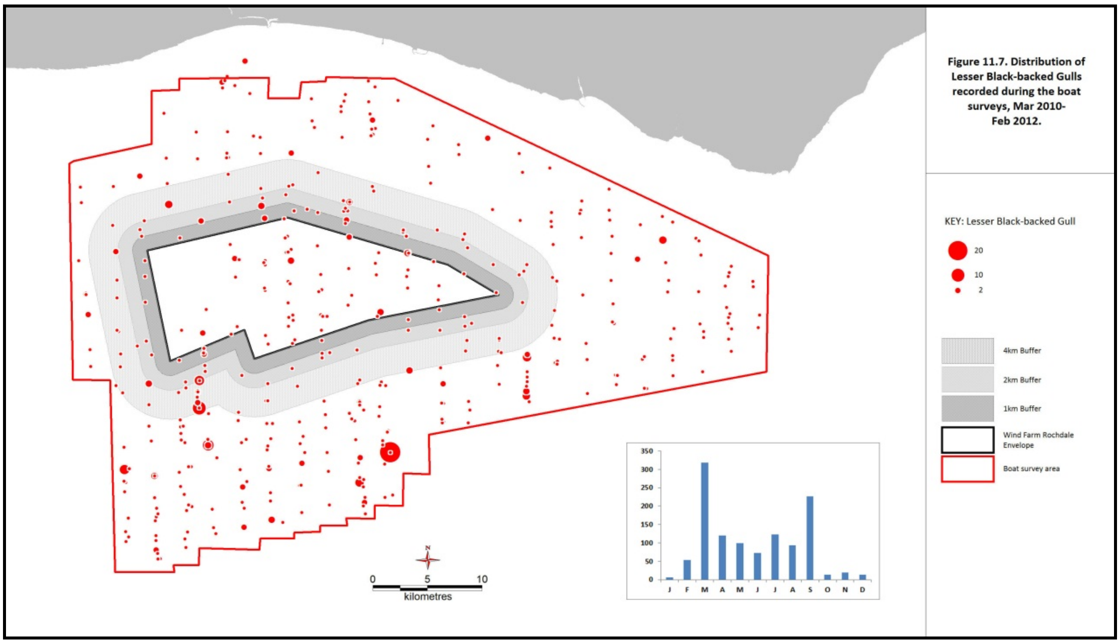


**Figure 11.7: Distribution of Lesser Black-backed Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

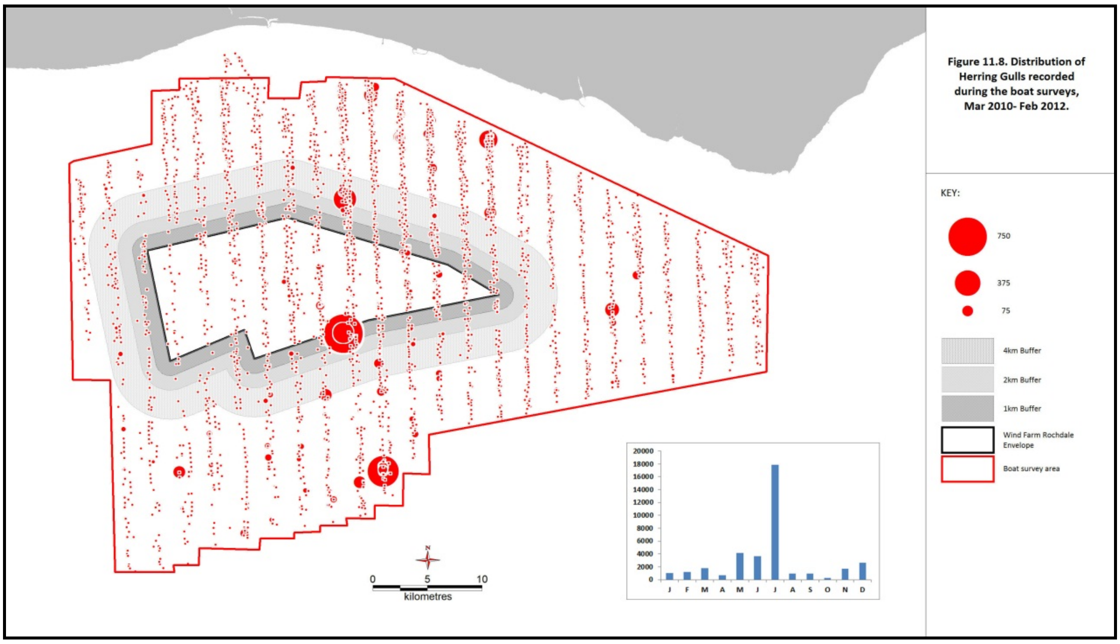


**Figure 11.8: Distribution of Herring Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

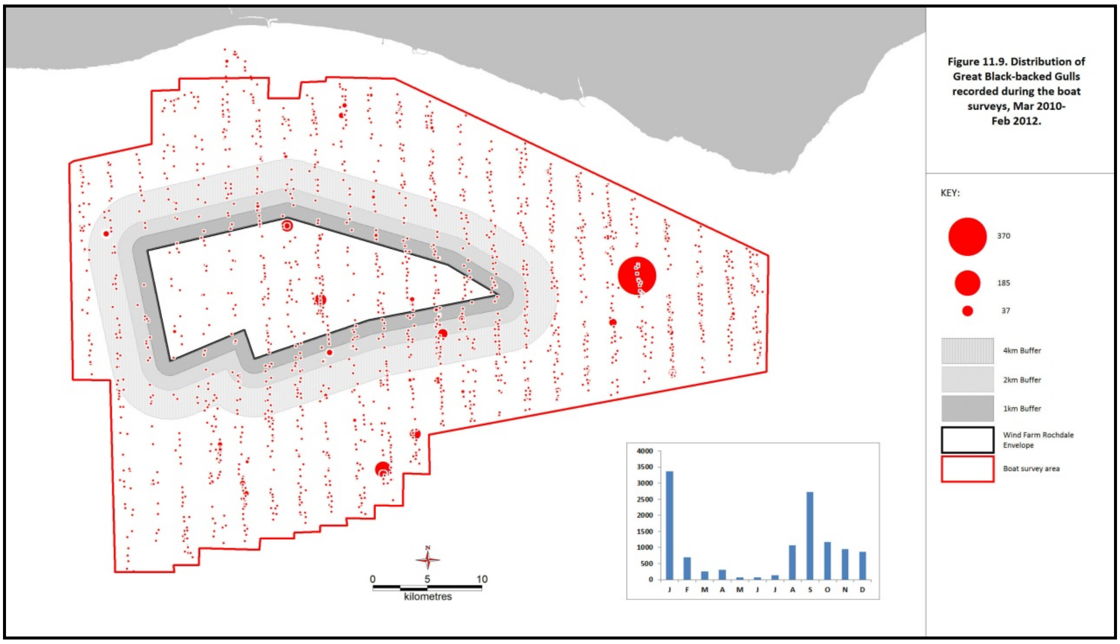


**Figure 11.9: Distribution of Great Black-backed Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

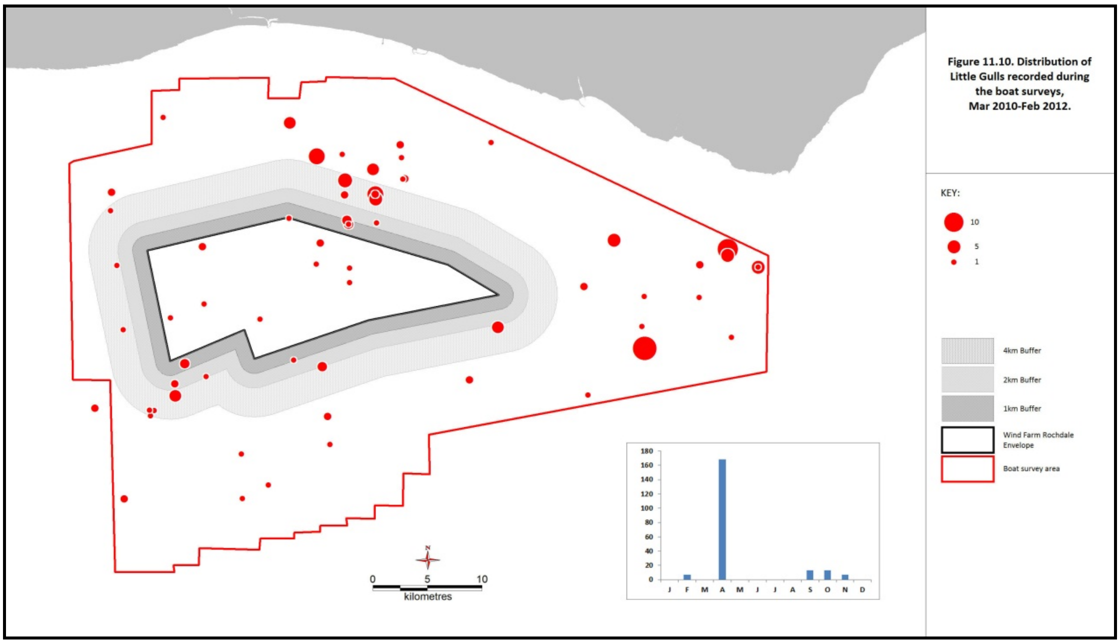


**Figure 11.10: Distribution of Little Gulls recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

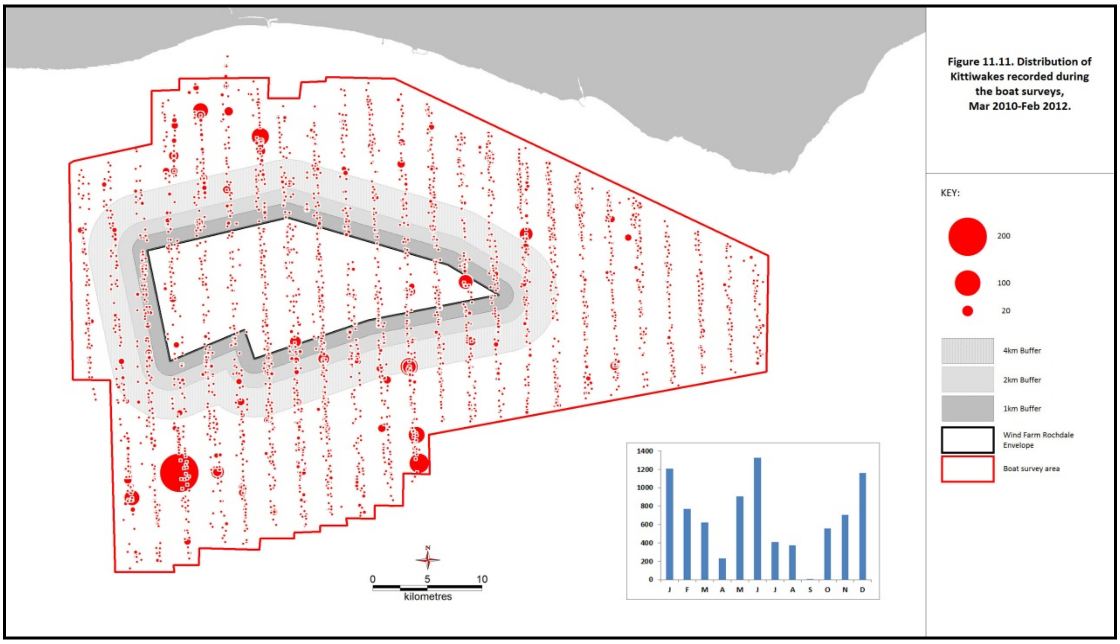


**Figure 11.11: Distribution of Kittiwakes recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

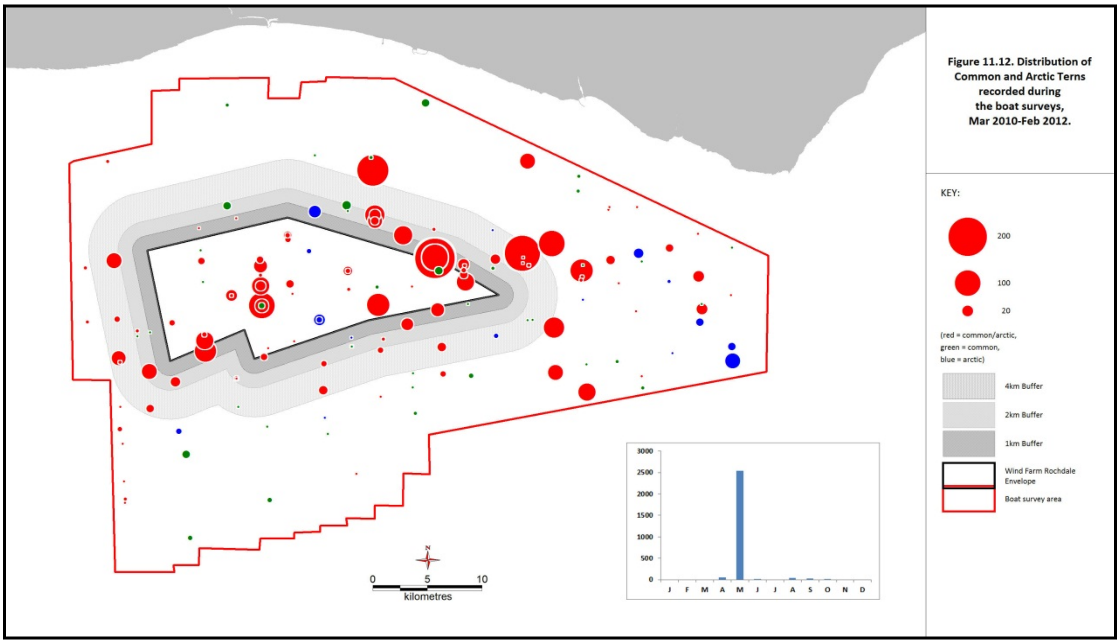


**Figure 11.12: Distribution of Common/Arctic Terns recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

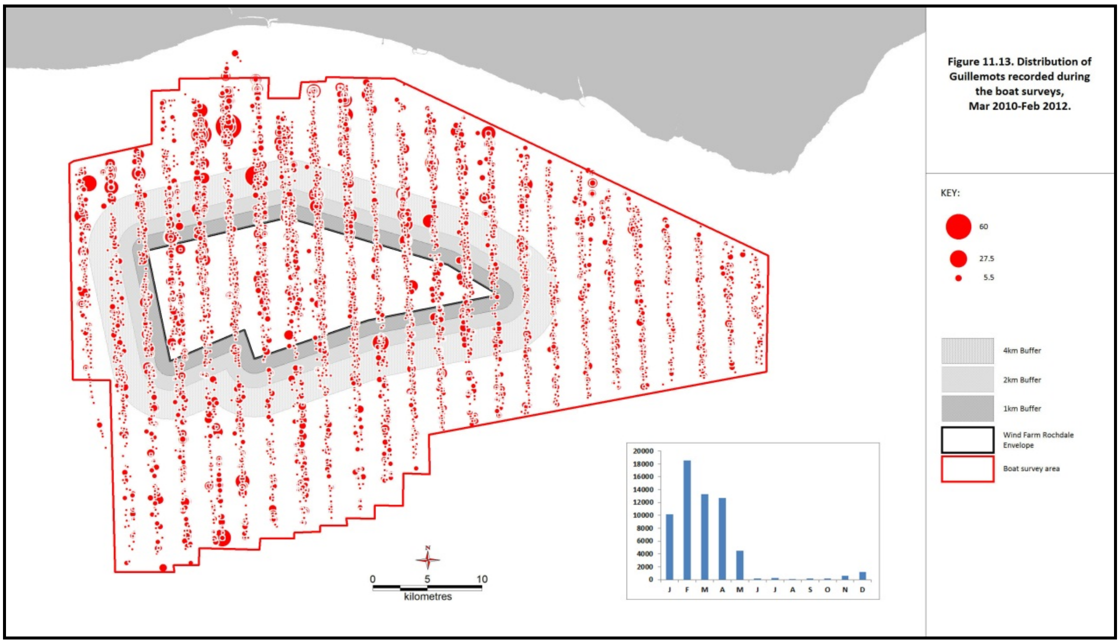


**Figure 11.13: Distribution of Guillemots recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

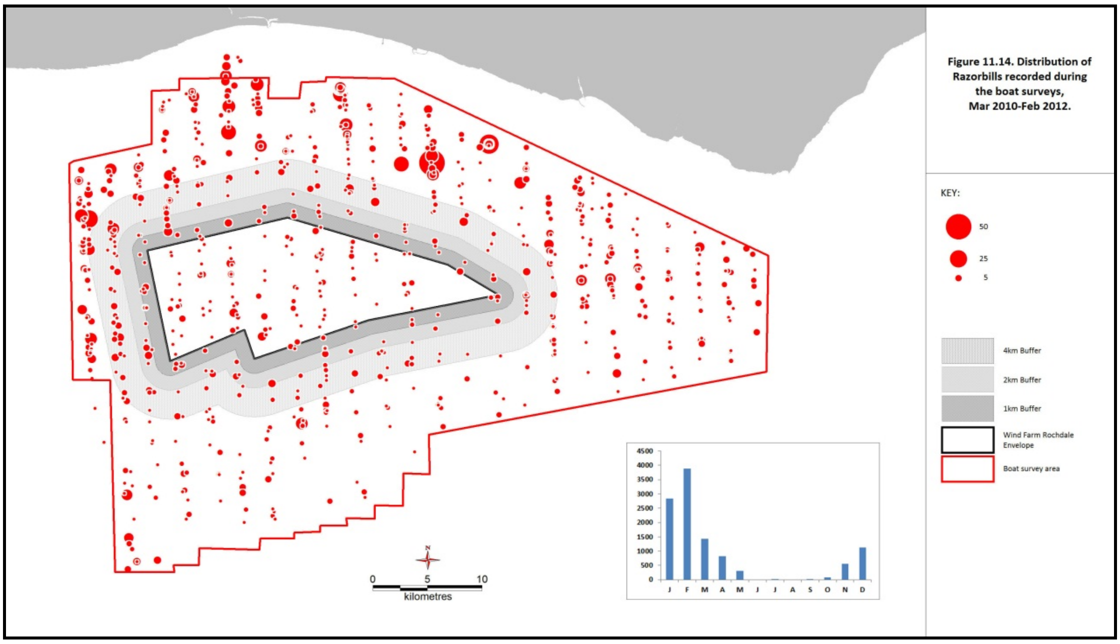


**Figure 11.14: Distribution of Razorbills recorded during boat surveys March 2010 – February 2012, and monthly peak population estimates.**

## 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 effecgts 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 Huppop, 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 Huppop (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 that 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 Huppop (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 Huppop (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 7,300km$^2$ 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 avoidances 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 Huppop (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 x 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, 2009[7]). 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 65km$^2$ (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 skua[8].**

| 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 |
| Westermost 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 |

## 11.11 References

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# Rampion Offshore Wind Farm

# ES Section 11 – Marine Ornithology - Appendix 11.1 – 11.5

**RSK Environment Ltd** | **Document 6.3.11**

**December 2012** | **APFP Regulation 5(2)(a)**

**Revision A**

**E.ON Climate & Renewables UK Rampion Offshore Wind Limited**

# *Appendix 11.1: Aerial Survey Methodology*

### Transect positioning

A11.1.1 The sampling design comprised a grid of systematically spaced line transects, running north-south across the study area. To provide as high resolution as possible, but to avoid double-counting as a result of birds disturbed by the aircraft moving into the search area for adjacent transects (aerial survey in Denmark has suggested that scoter rarely fly more than 1km when disturbed), transects were flown at 2km separation.

### Aircraft, survey height and speed

A11.1.2 A high-winged, twin-engined plane is essential to conform to legal requirements and provide optimal viewing. A Partenavia PN68 was used. Following test flights in the Kattegat, Denmark, in August 1999 using this type of plane, flight altitude during surveys was standardised at 78m (250 feet) at a cruising speed approximately 185 km (100 knots, Kahlert et al., 2000). This enables rapid approach to birds sitting on the sea, causing minimal disturbance. Identification of most species on the sea surface can be made from this height. The flight speed is sufficiently slow to allow a reasonable time to identify and count birds, but sufficiently fast that, for any species prone to disturbance by the plane, the point at which any displaced birds are first detected will not be greatly different from the location from which they were displaced.

### Navigation

A11.1.3 A navigator sat alongside the pilot and guided the pilot along the intended transect route, advising the observers of the points at which to begin and stop counting along each transect (it is not possible to count during turns between transects due to the angle of tilt of the plane).

A11.1.4 Navigation was achieved using a hand-held GPS. The navigator advised the pilot of any notable deviation from the transect route (the plane can normally be kept within 50m of the intended route unless, for example, ships or oil rigs dictate temporary detours) and ensured the pilot kept to the intended survey altitude. The precise location was downloaded from the GPS onto a laptop computer every 5 seconds as an accurate record of the precise flight path taken.

A11.1.5 On a small number of occasions satellite coverage by the handheld GPS was lost preventing an accurate positional fix. The backup system employed was to navigate between the end points of the transects using the plane's onboard GPS (which was always functional, although it operated using latitude/longitude co-ordinates and data were not downloadable). The navigator identified, using the GPS, the point at which the start and end points of the transect were crossed and these times were recorded by the observers. Thus, the flight path could still be interpolated but with a lesser degree of accuracy than provided by 5 second intervals.

**Recording protocol**

A11.1.6 Two observers were used, each covering one side of the aircraft. All observations were recorded onto a dictaphone. The general objective was to obtain as accurate position for all birds encountered as possible under the circumstances. The position of each record was determined in two ways:

A11.1.7 Firstly, the perpendicular distance of the bird or group of birds from the line of the transect was determined. Because birds are encountered so rapidly, it is simply not possible to estimate and record the precise distance for each record. Consequently, records were assigned to distance classes for simplicity (a minimum of three distance categories are required to meet the requirements of distance sampling techniques). In studies carried out by NERI in Denmark, where very high densities of common scoter are encountered, this technique is used based on three standardised distance intervals out from the track-line taken by the aircraft: 49-174m (band A), 175-459m (band B) and 460m-1km (band C). Observers cannot observe a band of width 49 m on either side of the flight track since this is obscured by the body of the plane. The limits of each band were determined using a clinometer which enabled the measurement of predetermined angles below the horizontal measured abeam (at 85m altitude, the 49m cut-off is an angle of 60o from the horizontal, 174m is 25o and 459m represents 10o declination, angles that can be confirmed with relative ease by use of the clinometer).

A11.1.8 Secondly, the position along the transect was recorded by noting the precise time (to the nearest second) at which the bird or flock of birds is perpendicular to the observer using watches synchronised with the GPS. The time at which each observation along the transect was made can be converted into a position by interpolating the data from the GPS and placing observations into a predetermined distance from the track-line according to the band in which the bird was recorded.

A11.1.9 For each observation, the following information was recorded:

**Species**:

A11.1.10 As far as possible, all waterbird species were recorded. In cases where identification to species was not possible they were recorded to the best level of identification, e.g. auk species, cormorant species, gull species. All cetaceans and seals were also recorded. In addition, all human activities, both mobile and static, were also recorded, e.g. boats, gas platforms, gill net markers. Species on the shore close to the high water mark were omitted since these are best monitored by other methods.

**Number**:

A11.1.11 The count (usually estimated for larger flocks) was recorded. Where groups of birds straddle two or more transect bands, the number in each was recorded separately.

**Behaviour**:

A11.1.12 The behaviour of individual birds has a considerable effect on the detectability of the individual. Since distance sampling makes the assumption that birds are recorded undisturbed at the point at which they are first detected, it is important that if the need arises, it is possible to carry out analysis on data that exclude, for example, birds flushing or flying. Consequently, four different behaviours were recognised and recorded: sitting; diving; flushing; and flying. In addition, two additional categories were used for the surveys: sat on a buoy, and sat on a sand bank, in so far as these features are likely to affect the distribution of birds (to separate, for example, groups of feeding Cormorants from those loafing on a buoy). For marine mammals and mobile human activities, the direction of travel was recorded under behaviour.

**Transect band**:

A11.1.13 The distance from the plane to the bird, mammal or human activity was recorded, assigned to one of the three distance bands A, B or C (see above).

**Time**:

A11.1.14 Time was read from the watch, attached to the window of the plane in an appropriate position to allow the observer unhindered access to read the time whenever necessary. Time was recorded to the nearest second as the observation is perpendicular to the plane. Where birds were detected either in front of or behind the plane, an allowance was made when recording the time on the dictaphone.

**Additional information**:

A11.1.15 Where possible, the age of the bird, i.e. juvenile, immature, near adult and adult, and sex (the precise information recorded being dependent on the plumage characteristics of the individual species) was recorded, although this information was only recorded where time permitted and did not compromise the collection of priority data outlined above.

**Observation conditions**:

A11.1.16 Sea state conditions, cloud cover and the viewing conditions were recorded at regular intervals and whenever conditions changed, along with the time of the observation. Sea state conditions denoted the swell and number of whitecaps to the waves (worsening conditions are likely to affect the ability to detect birds) using a standard scoring system, cloud cover was also recorded using a standard scoring system, and viewing conditions (affected by any combination of glare, haze, rain and reflection on the water) were recorded using a subjective assessment of good, poor or bad with the transect bands affected.

**Data transcription and validation**

A11.1.17 Data were transcribed from the dictaphone tapes either direct into an Excel spreadsheet or onto paper and then into the spreadsheet. The speed of dictation allowed species, number, behaviour, age (juveniles, immatures or adults) and transect band to be transcribed on a first play of the tape. A second play allowed both visual validation of these data and time to be input. Data were input using alphanumeric codes (which, having meaning, reduced the likelihood of transcription error and simplify the identification of errors). Date, observer initials and the observer's position in the plane were also input. Start and end times of counting, crossing of transect way points, crossing over any areas of exposed sand were input on a separate worksheet, and codified information for sea state and visibility onto another.

A11.1.18 Data were visually inspected to ensure only valid codes had been used, and that all necessary information had been input for each observation. Times were checked by sorting the data according to time and then checking the sequence of a numerical ID field corresponding to the order in which observations were input (any anomalies in the ID field sequence, which corresponded to an incorrect time entry, were readily identified). Data were converted to numeric codes using look-up tables, thereby also providing a further means of validation that all data matched valid codes.

**Assigning locations to observations**

A11.1.19 The NERI system uses a combination of GIS and bespoke software to add a position to each record of observation data. Using the observation file and the track file, every record in the observation file can have a position calculated, with time as the link field. Records were distributed to either side of the track line, according to the observer and the transect band in question.

**Position accuracy of observations**

A11.1.20 Using the methods defined above, the NERI experience has been that the majority of observations can be considered to be accurate to within 4 seconds. That is to say, an observation and all the spoken information relating to the visual encounter generally coincide to within that time period. In situations where high densities of birds have been encountered, multiple observations may have necessitated amalgamation, such that discrete observations were all recorded with a common time reference. Such grouping of observations (by virtue of extremely high bird densities) very rarely extended over a period of more than 10 seconds. Hence, overall, it should be anticipated that the positional accuracy along the axis of the transect should, in most cases, fall within less than 206 m (4 seconds travelling at a speed of 51.4m s-1) of the true position, but in the case of grouped observations, this could extend to 515m accuracy. As noted above, however, such amalgamation of data was very rarely required.

# *Appendix 11.2: Collision Risk Modelling*

# EXAMPLE BAND 2011 INPUT SPREADSHEET (KITTIWAKE):

**COLLISION RISK ASSESSMENT**
**Sheet 1 - Input data**

- used in overall collision risk sheet
- used in migrant collision risk sheet
- used in single transit collision risk sheet or extended model
- used in available hours sheet
- used in large array correction sheet
- not used in calculation but stated for reference

| | Units | Value | Data sources | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bird data** | | | | | | | | | | | | | | |
| Species name | | **Kittiwake** | | | | | | | | | | | | |
| Bird length | m | 0.39 | | | | | | | | | | | | |
| Wingspan | m | 1.08 | | | | | | | | | | | | |
| Flight speed | m/sec | 13.1 | | | | | | | | | | | | |
| Nocturnal activity factor (1-5) | | 1 | | | | | | | | | | | | |
| Flight type, flapping or gliding | | flapping | | | | | | | | | | | | |
| | | | **Data sources** | | | | | | | | | | | |
| **Bird survey data** | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Daytime bird density | birds/sq km | | 0.5302 | 0.57204 | 0.10954 | 0.06314 | 0.01674 | 2.2121 | 0.10041 | 0.48456 | 0.01674 | 0.40469 | 0.20995 | 0.48837 |
| Proportion at rotor height | % | 14.0% | AERIAL SURVEY | | | | | | | | | | | |
| Proportion of flights upwind | % | 50.0% | | | | | | | | | | | | |
| | | | **Data sources** | | | | | | | | | | | |
| **Birds on migration data** | | | | | | | | | | | | | | |
| Migration passages | birds | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Width of migration corridor | km | 8 | | | | | | | | | | | | |
| Proportion at rotor height | % | 0% | | | | | | | | | | | | |
| Proportion of flights upwind | % | 50.0% | | | | | | | | | | | | |
| | **Units** | **Value** | **Data sources** | | | | | | | | | | | |
| **Windfarm data** | | | | | | | | | | | | | | |
| Name of windfarm site | | **Rampion** | | | | | | | | | | | | |
| Latitude | degrees | 50.65 | | | | | | | | | | | | |
| Number of turbines | | 175 | | | | | | | | | | | | |
| Width of windfarm | km | 16 | | | | | | | | | | | | |
| Tidal offset | m | 0 | | | | | | | | | | | | |
| | **Units** | **Value** | **Data sources** | | | | | | | | | | | |
| **Turbine data** | | | | | | | | | | | | | | |
| Turbine model | | **4MW turbine** | | | | | | | | | | | | |
| No of blades | | 3 | | | | | | | | | | | | |
| Rotation speed | rpm | 10 | | | | | | | | | | | | |
| Rotor radius | m | 65 | | | | | | | | | | | | |
| Hub height | m | 100 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Monthly proportion of time operational | % | | 90% | 84% | 87% | 88% | 85% | 80% | 79% | 77% | 83% | 81% | 90% | 82% |
| Max blade width | m | 4.0 | | | | | | | | | | | | |
| Pitch | degrees | 15 | | | | | | | | | | | | |

| Avoidance rates used in presenting results | Predicted Collisions: |
|---|---|
| 98.00% | **220.9** |
| 99.00% | **110.5** |
| 99.50% | **55.3** |

## SPECIES MODEL INPUT DATA:

| **Monthly flight densities:** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **Boat data for wind farm:** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| Brent Goose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0161 | 0 | 0 |
| Mediterranean Gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0161 | 0 |
| Common Gull | 0.04831 | 0 | 0.11272 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02415 |
| Herring Gull | 0.62802 | 0.12077 | 0.32206 | 0.16103 | 0.17713 | 1.13527 | 0.82126 | 1.2637 | 0.41695 | 0.19324 | 2.24129 | 0.17253 |
| Lesser Black-backed Gull | 0 | 0 | 0 | 0 | 0.0161 | 0 | 0.04831 | 0.26806 | 0 | 0 | 0.03586 | 0 |
| Great Black-backed Gull | 0.24155 | 0 | 0.03221 | 0 | 0.03221 | 0.02415 | 0.02415 | 0.03829 | 0.05003 | 0.19324 | 0.25102 | 0.06901 |
| Little Gull | 0 | 0 | 0 | 0.032206 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Common/Arctic Tern | 0 | 0 | 0 | 0 | 1.932367 | 0 | 0 | 0 | 0 | 0.016103 | 0 | 0 |
| Guillemot | 0.27476 | 0.36232 | 0.06039 | 0 | 0.03221 | 0 | 0.02415 | 0 | 0 | 0.02415 | 0.1503 | 0.54897 |
| Swallow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0161 | 0.04831 | 0 | 0 |
| Meadow Pipit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.43478 | 0 | 0.0161 | 0 |
| | | | | | | | | | | | | |
| **Aerial data for wind farm:** | | | | | | | | | | | | |
| Gannet | 0.02202 | 0 | 0 | 0.1079 | 0.2158 | 0.32061 | 0.24927 | 0.25147 | 1.7255 | 0.266 | 0.01674 | 0.04404 |
| Kittiwake | 0.5302 | 0.57204 | 0.10954 | 0.06314 | 0.01674 | 2.2121 | 0.10041 | 0.48456 | 0.01674 | 0.40469 | 0.20995 | 0.48837 |
| Great Skua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.03803 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | |
| **Boat data for whole survey area:** | | | | | | | | | | | | |
| Common Scoter | 0 | 0 | 0.01239 | 0.02272 | 0.02272 | 0 | 0 | 0 | 0 | 0 | 0.00826 | 0 |
| Bar-tailed Godwit | 0 | 0 | 0 | 0 | 0.0682 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Curlew | 0 | 0 | 0 | 0 | 0 | 0.0031 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sandwich Tern | 0 | 0 | 0 | 0.00207 | 0.0062 | 0.01549 | 0 | 0 | 0.02685 | 0 | 0 | 0 |

Nightjar – migrant flights only, modelled on worst case of all regional SPA population (total 402 pairs) flying through wind farm corridor – 804 individuals in spring, 1085 in autumn

| Other Species Input Data: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Species** | **Length (m)** | **Wingspan (m)** | **Flight speed (m/s)** | **Nocturnal** | **Flight type** | **Rotor Ht %** | **Rotor Ht % source** | **Flight density source** |
| Brent Goose | 0.58 | 1.15 | 19 | 5 | flapping | 43% | Boat survey | Boat survey |
| Mediterranean Gull | 0.37 | 0.96 | 13.1 | 1 | flapping | 50% | Boat survey | Boat survey |
| Common Gull | 0.41 | 1.2 | 13.1 | 1 | flapping | 15% | Boat survey | Boat survey |
| Herring Gull | 0.6 | 1.44 | 11.3 | 1 | flapping | 26% | Boat survey | Boat survey |
| Lesser Black-backed Gull | 0.58 | 1.42 | 11.3 | 1 | flapping | 25% | Boat survey | Boat survey |
| Great Black-backed Gull | 0.71 | 1.58 | 12.4 | 1 | flapping | 36% | Boat survey | Boat survey |
| Little Gull | 0.26 | 0.78 | 13.1 | 1 | flapping | 5.5% | Cook et al | Boat survey |
| Common/Arctic Tern | 0.33 | 0.88 | 10.5 | 1 | flapping | 2.8% | Cook et al | Boat survey |
| Guillemot | 0.4 | 0.67 | 19.1 | 1 | flapping | 1% | Boat survey | Boat survey |
| Swallow | 0.18 | 0.34 | 9 | 1 | flapping | 5% | Boat survey | Boat survey |
| Meadow Pipit | 0.14 | 0.24 | 12 | 5 | flapping | 9% | Boat survey | Boat survey |
| | | | | | | | | |
| Gannet | 0.94 | 1.72 | 14.9 | 1 | gliding | 13% | Boat survey | Aerial survey |
| Kittiwake | 0.39 | 1.08 | 13.1 | 1 | flapping | 14% | Boat survey | Aerial survey |
| Great Skua | 0.56 | 1.36 | 14.9 | 1 | flapping | 16% | Boat survey | Aerial survey |
| | | | | | | | | |
| Common Scoter | 0.49 | 0.84 | 21 | 5 | flapping | 1% | Cook et al | Boat (wider survey area) |
| Bar-tailed Godwit | 0.38 | 0.75 | 15 | 5 | flapping | 33% | Boat survey | Boat (wider survey area) |
| Curlew | 0.55 | 0.9 | 15 | 5 | flapping | 100% | Boat survey | Boat (wider survey area) |
| Sandwich Tern | 0.38 | 1 | 10.5 | 1 | flapping | 3.8% | Cook et al. | Boat (wider survey area) |
| | | | | | | | | |
| Nightjar | 0.27 | 0.60 | 10.0 | 5 | flapping | 100% | Worst case | Regional SPA populations |

# *Appendix 11.3: Boat-based survey area population estimates for each monthly/twice-monthly survey, March 2010 – February 2012*

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mute Swan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 |
| Brent Goose | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67 | 87 | 0 | 0 | 0 | 0 | 0 | 87 |
| Goose sp | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Wigeon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Teal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Eider | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Common Scoter | 40 | 27 | 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 73 |
| Velvet Scoter | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Red-breasted Merganser | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| Duck sp | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Red-throated Diver | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 91 |
| Black-throated Diver | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Red/Black-throated Diver | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| Diver sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Great Crested Grebe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| Slavonian Grebe | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Fulmar | 123 | 216 | 380 | 972 | 550 | 212 | 216 | 0 | 7 | 33 | 153 | 13 | 80 | 778 | 445 | 362 | 1774 | 458 | 617 | 1387 | 265 | 7 | 20 | 13 | 80 | 45 | 60 | 47 | 136 | 189 | 1774 |
| Manx Shearwater | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 67 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67 |
| Balearic Shearwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| European Storm-petrel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 7 | 7 | 0 | 0 | 27 |
| Gannet | 28 | 100 | 250 | 1392 | 553 | 263 | 395 | 274 | 182 | 61 | 2861 | 150 | 385 | 107 | 229 | 334 | 1559 | 1361 | 1303 | 1502 | 670 | 199 | 828 | 1468 | 6524 | 324 | 190 | 372 | 744 | 181 | 6524 |
| Cormorant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 7 |
| Shag/Cormorant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Grey Heron | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Marsh Harrier | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Kestrel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Merlin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Peregrine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Falcon sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Coot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Grey Plover | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| Dunlin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Bar-tailed Godwit | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 187 |
| Whimbrel | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Curlew | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Curlew/Whimbrel | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Turnstone | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Large wader sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Medium wader sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Grey Phalarope | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Small wader | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| Wader sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pomarine Skua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| Arctic Skua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Long-tailed Skua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Great Skua | 0 | 27 | 13 | 13 | 0 | 10 | 27 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 90 | 7 | 43 | 13 | 20 | 20 | 23 | 0 | 148 | 43 | 20 | 20 | 0 | 7 | 13 | 10 | 148 |
| Arctic/Pomarine Skua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Skua sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Mediterranean Gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 7 |
| Common Gull | 528 | 1534 | 0 | 0 | 0 | 0 | 0 | 0 | 79 | 200 | 27 | 251 | 192 | 2510 | 246 | 30 | 13 | 0 | 33 | 0 | 0 | 0 | 0 | 13 | 20 | 13 | 67 | 13 | 76 | 343 | 2510 |
| Lesser Black-backed Gull | 79 | 30 | 13 | 73 | 113 | 60 | 10 | 0 | 13 | 0 | 0 | 53 | 319 | 76 | 20 | 120 | 99 | 33 | 66 | 123 | 93 | 30 | 227 | 0 | 13 | 20 | 0 | 13 | 7 | 0 | 319 |
| Yellow-legged Gull | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Herring Gull | 1769 | 659 | 90 | 2524 | 1623 | 914 | 90 | 7 | 1133 | 2144 | 995 | 919 | 1108 | 729 | 404 | 230 | 4170 | 1717 | 3682 | 17820 | 253 | 253 | 926 | 80 | 251 | 840 | 1713 | 2640 | 336 | 1182 | 17820 |
| Great Black-backed Gull | 253 | 23 | 13 | 0 | 13 | 73 | 450 | 742 | 210 | 311 | 3365 | 425 | 226 | 128 | 121 | 302 | 62 | 40 | 76 | 136 | 1068 | 238 | 2724 | 339 | 1173 | 591 | 948 | 867 | 945 | 689 | 3365 |
| Little Gull | 0 | 168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 157 | 100 | 0 | 0 | 0 | 0 | 0 | 13 | 7 | 0 | 13 | 7 | 0 | 0 | 0 | 0 | 168 |
| Little Gull/Tern sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black-headed Gull | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Kittiwake | 106 | 139 | 359 | 790 | 367 | 371 | 0 | 7 | 374 | 1100 | 1207 | 146 | 624 | 612 | 150 | 232 | 909 | 277 | 1329 | 410 | 7 | 7 | 0 | 100 | 560 | 703 | 260 | 1162 | 456 | 772 | 1329 |
| Common Gull/Kittiwake | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Great/Lesser Black-backed Gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Gull sp | 10 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 1 | 6 | 5 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 |
| Herring/Common Gull | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 |
| Herring/Lesser Black-backed Gull | 13 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Kittiwake/Fulmar | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| Large gull sp | 7 | 200 | 1007 | 1252 | 160 | 160 | 0 | 0 | 173 | 0 | 2307 | 23 | 400 | 1927 | 7 | 300 | 173 | 0 | 0 | 7 | 900 | 7 | 8065 | 1073 | 6288 | 120 | 111 | 6040 | 1676 | 4733 | 8065 |
| Lesser/Great Black-backed Gull | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 908 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 908 |
| Medium gull sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Small gull sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 |
| Little Tern | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Black Tern | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandwich Tern | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 20 | 0 | 33 | 0 | 0 | 27 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| Common Tern | 0 | 0 | 67 | 0 | 0 | 27 | 33 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 172 | 0 | 20 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 172 |
| Arctic Tern | 0 | 0 | 180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 |
| Common/Arctic Tern | 0 | 13 | 2287 | 10 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 27 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2287 |
| Tern sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| Guillemot | 765 | 7792 | 2501 | 129 | 13 | 0 | 0 | 0 | 622 | 1102 | 10143 | 2515 | 13326 | 13109 | 8900 | 12682 | 4470 | 628 | 146 | 222 | 46 | 191 | 20 | 143 | 106 | 410 | 115 | 1210 | 3875 | 18496 | 18496 |
| Razorbill | 184 | 340 | 309 | 0 | 7 | 0 | 0 | 20 | 552 | 929 | 2843 | 617 | 1253 | 1433 | 571 | 814 | 171 | 0 | 0 | 0 | 0 | 0 | 14 | 13 | 81 | 87 | 247 | 1123 | 474 | 3883 | 3883 |
| Guillemot/Razorbill | 470 | 1210 | 46 | 0 | 0 | 0 | 0 | 0 | 364 | 121 | 7877 | 1494 | 390 | 1395 | 213 | 1535 | 1157 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 243 | 120 | 58 | 372 | 892 | 10675 | 10675 |
| Puffin | 0 | 20 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Auk sp | 0 | 0 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 426 | 3333 | 20 | 3782 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 7 | 0 | 27 | 3782 |
| Owl sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Feral Pigeon | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Swift | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Skylark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 10 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sand Martin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 27 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Swallow | 0 | 40 | 140 | 0 | 0 | 0 | 260 | 167 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 7 | 0 | 0 | 0 | 0 | 233 | 927 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 927 |
| House Martin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| Hirundine sp | 0 | 12 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| Meadow Pipit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 40 | 20 | 13 | 0 | 0 | 0 | 0 | 0 | 167 | 447 | 0 | 13 | 7 | 0 | 0 | 0 | 0 | 447 |
| Meadow/Tree Pipit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Pipit sp | 13 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Yellow Wagtail | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Pied Wagtail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 33 | 7 | 0 | 0 | 0 | 0 | 0 | 33 |
| Wren | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 7 |
| Robin | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Black Redstart | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 7 |
| Blackbird | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 13 |
| Fieldfare | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Song Thrush | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 293 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 293 |
| Thrush sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| Whitethroat | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Chiffchaff | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Willow Warbler | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Willow Warbler/Chiffchaff | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Warbler sp | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Carrion Crow | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Starling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 60 |
| Chaffinch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 87 | 0 | 0 | 0 | 0 | 0 | 0 | 87 |
| Goldfinch | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Siskin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| Linnet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Finch sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 20 |

| SPECIES | 201003 | 201004 | 201005 | 201006 | 201007 | 201008 | 201009 | 201010 | 201011 | 201012 | 201101 | 201102 | 201103a | 201103b | 201104a | 201104b | 201105a | 201105b | 201106 | 201107 | 201108 | 201109a | 201109b | 201110a | 201110b | 201111a | 201111b | 201112 | 201201 | 201202 | PEAK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Passerine sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 | 0 | 0 | 0 | 0 | 0 | 0 | 220 |
| Small passerine sp | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |

# *Appendix 11.1: Aerial survey area population estimates for each survey, August 2010 – August 2011.*

| **Species** | **12/8/10** | **18/9/10** | **21/10/10** | **19/11/10** | **21/12/10** | **18/2/11** | **11/3/11** | **20/5/11** | **28/6/11 & 20/7/11** | **21/7/11** | **2/8/11** | **Peak** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Common Scoter | 0 | 5 | 0 | 196 | 0 | 0 | 210 | 0 | 0 | 0 | 0 | **210** |
| Red-breasted Merganser | 0 | 0 | 0 | 0 | 0 | 35 | 57 | 0 | 0 | 0 | 0 | **57** |
| duck sp. | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | **14** |
| Red-throated Diver | 0 | 0 | 0 | 5 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | **7** |
| diver sp. | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | **8** |
| Fulmar | 183 | 0 | 10 | 95 | 10 | 35 | 23 | 22 | 60 | 20 | 262 | **262** |
| British Storm-petrel | 0 | 0 | 0 | 0 | 10 | 0 | 2 | 0 | 0 | 0 | 0 | **10** |
| Gannet | 476 | 847 | 2,020 | 62 | 44 | 31 | 69 | 190 | 670 | 923 | 1,013 | **2,020** |
| Cormorant | 0 | 0 | 0 | 5 | 0 | 10 | 0 | 2 | 0 | 0 | 16 | **16** |
| Kestrel | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| skua sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | **10** |
| Great Skua | 13 | 0 | 10 | 7 | 0 | 0 | 0 | 0 | 10 | 0 | 17 | **17** |
| Common Gull | 0 | 0 | 2 | 132 | 69 | 79 | 52 | 2 | 2 | 0 | 0 | **132** |
| Lesser black-backed Gull | 0 | 24 | 37 | 67 | 57 | 69 | 2 | 10 | 12 | 163 | 64 | **163** |
| grey gull spp (Herring or Common) | 0 | 22 | 7 | 756 | 509 | 114 | 33 | 0 | 83 | 0 | 9 | **756** |
| Herring Gull | 29 | 15 | 71 | 360 | 343 | 393 | 174 | 316 | 2,241 | 3,449 | 270 | **3,449** |
| black-backed gull spp | 5 | 65 | 14 | 581 | 83 | 129 | 26 | 15 | 2 | 2 | 157 | **581** |
| Great Black-backed Gull | 5 | 2 | 2 | 239 | 88 | 42 | 0 | 2 | 2 | 0 | 17 | **239** |
| gull sp. | 51 | 84 | 761 | 1,150 | 777 | 282 | 126 | 2,005 | 120 | 248 | 582 | **2,005** |
| large gull sp. | 0 | 191 | 27 | 242 | 437 | 26 | 332 | 22 | 50 | 1,614 | 768 | **1,614** |
| Black-headed Gull | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **21** |
| Kittiwake | 57 | 208 | 2,183 | 2,170 | 875 | 876 | 781 | 225 | 923 | 269 | 806 | **2,183** |
| small gull sp. | 0 | 97 | 155 | 83 | 611 | 126 | 20 | 36 | 63 | 2 | 331 | **611** |

| Species | 12/8/10 | 18/9/10 | 21/10/10 | 19/11/10 | 21/12/10 | 18/2/11 | 11/3/11 | 20/5/11 | 28/6/11 & 20/7/11 | 21/7/11 | 2/8/11 | Peak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandwich Tern | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | **2** |
| tern sp. | 2 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 0 | 0 | **23** |
| Arctic/Common Tern | 5 | 34 | 34 | 0 | 0 | 0 | 0 | 188 | 0 | 2 | 45 | **188** |
| auk sp. | 19 | 31 | 225 | 686 | 3,260 | 2,122 | 4,430 | 113 | 81 | 2 | 60 | **4,430** |
| Guillemot | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 9 | 2 | 0 | **9** |
| Razorbill | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | **9** |
| Feral Pigeon | 0 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **25** |
| Swallow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | **2** |
| passerine sp. | 0 | 0 | 16 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | **210** |

# *APPENDIX 11.5. Distance correction factors for the Rampion Offshore Wind Farm boat-based surveys.*

A11.5.1 As noted in the main ES, the raw count data from both the boat-based and the aerial surveys need to be adjusted to take into account the fact that the likelihood of a bird being seen declines with distance from the observer (i.e. detectability is a function of distance from the transect line). Put simply, the chance of seeing a bird close to the observer would be higher than if it were at greater distance. The relationship between detectability and distance can be modelled using software packages such as Distance (Buckland et al. 2001), but for the purposes of this assessment a simpler approach was adopted (mainly because the limited number of distance bands makes modelling of the distance function difficult for many of the species encountered in this study). The approach used here is similar to that used by JNCC in their Seabirds at Sea surveys (e.g. Stone et al. 1995), but correction factors have been calculated for each major species group (auks/seaduck, gannet, and gulls/terns) specifically using the data collected from each of the two survey methods (boat and aerial). Species were assigned to these groups on their similarly of likely detectability and pooled to give a robust sample size for each group. Group compositions are given in Table A11.1. The same process was used to correct both the aerial and the boat data, though as detectability differed between these methods separate correction factors were calculated for each.

**Table A11.1. Species groups used in calculation of distance correction factors**

| Species Group | Species |
|---|---|
| Auks and seaduck | Guillemot, Razorbill, Puffin, Little Auk, Eider, Common Scoter and other seaduck |
| Gannet | Gannet |
| Gulls and terns | Gulls, skuas, terns, shearwaters |

A11.5.2 The process in calculating those correction factors was as follows:

- The total numbers of birds of each species group were calculated for each distance band over all of the surveys.
- Differences in the width of the distance bands were taken into account by dividing the total number by the band width, to give a standardised total (density index).
- It was assumed that bird detectability in the closest transect to the observer was 100% (a standard assumption of the Distance sampling methodology).
- As detectability of birds on the sea and flying were different from the boat survey data separate correction factors were used for each of these. In fact detectability of flying birds was so high that no correction factors were necessary for these birds – effectively all of these birds were detected within the main transect.
- For each of the other bands, the percentage difference between that band's standardised total and the closest band to the observer were calculated.
- These differences were then applied as the correction factors, dividing each count by the appropriate factor. For example, auks in band C were divided

by 49%. Hence a count of 100 in that band would be corrected to 204 (=100/0.49).

**Table A3.2. Distance correction factors used for the boat survey data**

| Species group | A [0-50m] | B [50-100m] | C [100-200m] | D [200-300m] |
|---|---|---|---|---|
| Auks/seaduck | 100% | 89% | 49% | 27% |
| Gannet | 100% | 100% | 86% | 86% |
| Gulls/terns | 100% | 100% | 69% | 50% |

*Note: Data for band E (>300m from the survey vessel, out of transect) were not used in the density calculations or main population estimates but are included in Appendix 11.3.*

**Table A3.3. Distance correction factors used for the aerial survey data**

| Species group | A [49-174m] | B [175-459m] | C [460m-1km] |
|---|---|---|---|
| Auks/seaduck | 100% | 17% | 0.4% |
| Gannet | 100% | 36% | 12% |
| Gulls/terns | 100% | 22% | 2.8% |

*Note: values are given in the Table for band C but these were not used in the density calculations or population estimates as detectability in this band was considered too low to provide a reliable population estimate.*