Chapter 12 Ornithology

12.1 Introduction

1 This chapter of the Environmental Statement and the accompanying technical report (Appendix 12.1: Ornithology Technical Report) presents the assessment of the impact of the proposed Neart na Gaoithe Offshore Wind Farm on ornithology.

12.2 Guidance and Legislation

2 The assessment has been carried out in accordance with the following guidance and legislation:

- Guidelines for ecological impact assessment in Britain and Ireland: Marine and Coastal (IEEM, 2010);
- Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers (King *et al.,* 2009)*;*
- Scottish Natural Heritage (SNH) Guidance: Survey Methods for Use in Assessing the Impacts of Onshore Windfarms on Bird Communities (SNH, 2005a);
- SNH Guidance: Cumulative Effect of Windfarms (SNH, 2005b);
- SNH Guidance: Assessing the Significance of Impacts from Onshore Windfarms on Birds outside Designated Areas (SNH, 2006);
- SNH Guidance: Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model (SNH, 2010);
- A Review of Assessment Methodologies for Offshore Windfarms (Maclean *et al.,* 2009);
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 and the Marine Works (Environmental Impact Assessment) Regulations 2007 (together the 'EIA Regulations') which transpose European Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (as amended) (the 'EIA Directive') in relation to the offshore works for the proposed Neart na Gaoithe Offshore Wind Farm;
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') and the transposing Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the 'Habitats Regulations');
- Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') which is transposed into UK law by the Habitats Regulations, the Wildlife and Countryside Act 1981 and the Nature Conservation (Scotland) Act 2004;
- The Wildlife and Countryside Act 1981 (as amended);
- The Nature Conservation (Scotland) Act 2004 (as amended); and
- The Wildlife and Natural Environment (Scotland) Act 2011.

12.3 Data Sources

3 The data sources informing this chapter are described in the sections below. They are described in detail in Appendix 12.1: Ornithology Technical Report and include a desk study drawing on existing data sets, boat-based surveys and consultation.

4 In addition to the boat-based data collection survey undertaken by the developer, the following datasets have been considered during the environmental impact assessment (EIA) process:

- SNH SiteLink web pages (online information on designated sites);
- UK Biodiversity Action Plan (UKBAP);
- Birds of Conservation Concern (BoCC) 'Red list' (Eaton *et al.*, 2009);
- SMP online seabird colony database (SMP, 2012);
- JNCC online Special Protection Area (SPA) site information (JNCC, 2012); and
- Seabird data from Regional Seas 1 and 2 from European Seabirds At Sea (ESAS) database.

12.3.1 Desk Study

12.3.1.1 Literature Review

5 The assessment has been informed by a literature review, which sought to place the offshore site into a wider regional ornithological context. Further information on the literature review is provided in Appendix 12.1: Ornithology Technical Report which considers issues including:

- The distribution and abundance of birds at sea in the region;
- The conservation status and population size of relevant species; and
- Bird behaviour and migration routes, including foraging distances.

12.3.2 Survey Methodology

12.3.2.1 Baseline Survey

6 Two years of boat-based seabird and marine mammal surveys were carried out following standard COWRIE approved survey methodology (Camphuysen *et al.,* 2004).

7 A series of transects running in a north-west to south-easterly direction across the study area and spaced 2 km apart were surveyed each month. Birds were counted ahead of the ship and out to one side of the survey vessel in a 90º arc, with a 300 m transect width, using two surveyors, as per Camphuysen *et al.* (2004). Further details on the methodology are provided in Appendix 12.1: Ornithology Technical Report.

8 The study area was comprised of two components; the offshore site and the surrounding buffer area, which extends out to 8 km. These are shown in Figure 12.1.

12.3.3 Data Analysis

9 All data collected during the boat-based surveys were entered onto a Paradox database using the JNCC Seabirds at Sea Team (SAST) data-entry program, then printed and manually checked for any errors before the analysis of the data was conducted.

10 This data formed the basis for estimating population sizes and densities of seabirds in the study area. These estimates were derived by applying distance analysis techniques using Distance 6.0 software. Further details on this technique and associated corrections are discussed in Appendix 12.2: Ornithology Statistics Report.

11 Additional statistical analysis and collision risk modelling (CRM) was also carried out to inform this assessment. Details of this work are presented in Appendix 12.2: Ornithology Statistics Report.

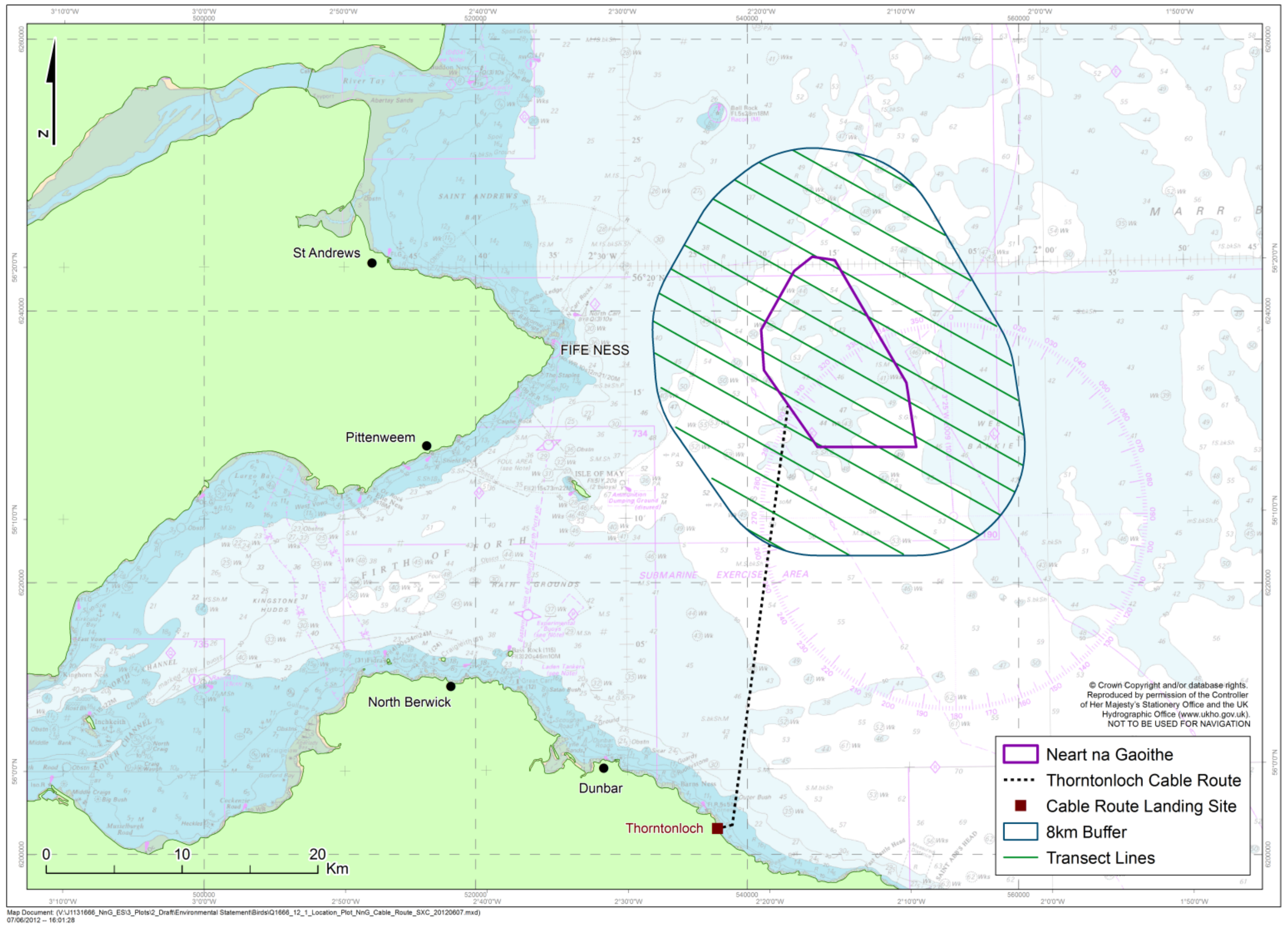

Figure 12.1: Neart na Gaoithe location and study area

12.4 Engagement and Commitments

12.4.1 Strategic and Site Level Requirements

12 A formal scoping request was made in November 2009 from which advice from SNH and Royal Society for the Protection of Birds (RSPB) relevant to the assessment of potential impacts on birds was received and are summarised in Table 12.1.

Source	Comment	Relevance/reference
Scoping Opinion (Marine Scotland)	ES should identify Schedule one birds and European Protected Species (EPS), and any species listed in Schedules 5 or 8 of the Wildlife and Countryside Act 1981, and relevant licenses should be obtained.	Noted.
	ES must take account of Coast Protection Act 1949 section 34, Council Directives on The Conservation of Natural Habitats and of Wild Flora and Fauna, and on The Conservation of Wild Birds (the Habitats and Birds Directives), the Wildlife & Countryside Act 1981, Nature Conservation (Scotland) Act 2004, Protection of Badgers Act 1992, Conservation (Natural Habitats, &c.) Regulations 1994 , Scottish Executive Interim Guidance on European Protected Species (using 3 fundamental tests), Development Sites and the Planning System, Scottish Biodiversity Strategy and associated Implementation Plans.	Noted. Though Section 34 of the Coast Protection Act 1949 has been repealed by the Marine (Scotland) Act 2010.
Scoping Opinion (SNH advice)	Analysis of ornithological issues in the scoping report is excellent.	Noted.
	Clarify 1 km seaward extension of St Abb's Head to Fast Castle SPA and 2 km for Forth Islands SPA.	Extensions to these SPAs are noted.
	Should be some assessment of the potential effects of post-construction Operation & Maintenance, ask if any remote condition monitoring on turbines	Assessment of vessel movements includes maintenance work.
	Request clarity on calculation of bird sensitivity status.	Bird sensitivity is outlined in Methods section
	Collision risk assessment needed for wider range of bird (in particular, SPA qualifiers) in addition to kittiwake and gannet.	Collision risk assessment conducted for all species.
	Request clarification on mitigation and monitoring and methodology for observers to divert boats from bird rafts.	Exact details on mitigation to be developed but may include avoiding areas of relatively high densities or sticking to regular routes.
	Assessment of structures, foundations and scour required with reference to fish species assemblages and indirect impacts as prey.	Included in individual species accounts, where appropriate.
	Recommend the use of sidescan sonar in conjunction with bird surveys to aid understanding/ examine indirect impacts. Methodology should be clear.	Sidescan sonar was not used in conjunction with bird surveys.
	Recommend assessment of specific lighting methods (baffles, coloured filters, strobes) in relation to migrating birds.	Noted.
	Assessment of displacement of energetics needs careful control as it is variable for migratory and breeding birds.	Noted.
	Indirect impact on birds of noise, shockwaves and vibration on prey species (e.g. sandeels) needs assessment.	Included in individual species accounts, where appropriate.
	Indirect impacts of the reef effects caused by structures, scour etc., need assessing, with relationship to species assemblages and prey for birds.	Included in individual species accounts, where appropriate.
	Request clarification of term 'national' (e.g. in reference to Auk populations)	'National' refers to national breeding population, taken from Seabird 2000 (Mitchell *et al.,* 2004).
	Request clarification of term 'small' and recommend estimated population numbers rather than descriptive terms.	Noted. Population numbers used throughout, where possible.
	Recommend assessment of potential attraction of shag to the site.	Full impact assessment conducted for shag.
	Assessment of terrestrial bird impacts recommended (suggested approach - determine how many days/ year that weather conditions bring birds into potentially negative interactions with the turbines, use of Doppler weather radar for overall densities of migrant birds combined with ground counts, use of telemetry tags on migrant geese)	Assessment of terrestrial species recorded included in ES.
	Guidance: Wildfowl and Wetlands Trust (WWT) survey information on migrant geese.	Noted.
	Terrestrial bird impacts - suggest ESAS surveys insufficient to assess impacts but request sight of results.	Numbers of terrestrial bird species recorded on baseline surveys included.
	Highlight issues with possible pseudo replication or systematic bias in survey methodology - needs addressing in ES.	Noted.
	Request consultation on aerial surveys, suggest cross checking with boat surveys for interpretation.	Noted.
	Suggest additional parameters for predictive modelling and distribution maps, including tide, weather, time of day, observer.	Noted.
	Clarify that Distance software has new version, and Percival 2003 is not a citable reference.	Noted.
	Location of onshore infrastructure needs consideration in respect of potential impacts to bird species.	Noted.
	If work involves removal or disturbance of habitat suitable for nesting birds (hedgerows, scrub or trees) an inspection for nests required and mitigation (timing) should be applied.	Not applicable for offshore ES
Scoping Opinion (RSPB)	Welcome proposal to focus on SPA species, but suggest passage species (waders, geese and ducks) also included.	Passage species included in assessment of non-seabirds
	ES should include consideration of Upper Solway Flats and Marshes SPA and Slamannan Plateau SPA.	Noted.
	ES should consider further SPAs relating to qualifying species in offshore site (e.g. in North Sea and UK).	Noted.
	ES should note future marine SPAs and potential impacts (from JNCC).	Noted.
	Note the proposal could indirectly impact birds (SPA qualifiers) through benthic impacts, this should be addressed.	Noted.
	Assume a Habitats Regulations Appraisal (HRA) and subsequent Appropriate Assessment (AA) will be required given proximity to Natura 2000 sites.	Noted.
	ES should examine impacts on SPAs, including context of SPA network and site integrity. ESAS data is limited, suggest telemetry, data logging and modelling approaches.	Noted.
	Buffering methodology limited. Cumulative approach required including data sharing to assess combined and in-combination impacts. Assessment should examine linkages between species and SPAs.	Noted.
	Suggest barrier and collision possibility assessed in ES for migrant birds, including Svalbard barnacle geese, Taiga bean geese and light bellied brent geese (consultation with WWT)	Noted.
	Suggest cumulative surveying approach in Forth and Tay area. Welcome consultation over this.	Noted.
	Impacts on prey species (sandeel, sprat) should be assessed with respect to indirect impacts on birds.	Included in individual species accounts, where appropriate.

Table 12.1: Strategic and site level commitments and requirements

12.4.2 Consultation

14 In addition to the scoping responses outlined above a number of consultations has taken place with SNH and the Joint Nature Conservation Committee (JNCC) together with input from Marine Scotland on associated issues. Consultation has also included non-statutory organisations including the RSPB. Table 12.2 summarises some of the consultations undertaken.

Date	Consultee	Key issues raised	Section of chapter where issue addressed
January 2010	Marine Scotland	Scoping response relevant to birds and HRA.	Throughout
7 April 2011	SNH/JNCC/MS	Forth and Tay Offshore Wind Developers (FTOWDG) collaboration on cumulative impacts and species specific issues.	Throughout
11 April 2011	SNH/JNCC	Cumulative impacts.	Throughout
18 April 2011	SNH	Comments and advice on the year 1 report. Specifically the importance of presenting detailed methods.	Throughout
18 April 2011	SNH/JNCC	General comments on assessment and key species.	Throughout
July 2011	RSPB	FTOWDG meeting. Presented overview of bird impacts.	Throughout
24 April 2012	RSPB	Overview of results and assessments.	Throughout

Table 12.2: Summary of key consultations undertaken on ornithological impacts

12.4.3 The Rochdale Envelope

15 The overall approach to defining the 'Rochdale Envelope' is described Chapter 6: The Approach to Environmental Impact Assessment.

16 The Rochdale Envelope parameters assessed in this chapter take account of the worst (realistic) case scenario for birds. The worst (realistic) case in terms of impacts for birds varies depending on the type and source of impact and individual species' sensitivities. Information on the Rochdale Envelope parameters assessed is provided in Table 12.3 and in Appendix 12.1: Ornithology Technical Report.

Potential effect	Relevant Rochdale Envelope scenario
Construction and decommissioning	
Disturbance/displacement due to increased boat traffic or construction activities	As vessel numbers are not accurately known a range of scenarios and speeds of vessels are considered (refer to Chapter 16: Shipping and Navigation).
Indirect impacts of construction on prey species	Refer to Chapter 12: Marine Mammals for details of scenarios used.
Operation	
Mortality arising from collision with turbine blades	Four turbine sizes modelled ranging from between 64, 7 MW turbines and 128 3.6 MW turbines – refer to appendix 12.1 Ornithology Technical Report for further details.
Barrier effects	Areas considered vary across species and location of the breeding colony. Assumed that whole of the Offshore Site and a surrounding buffer of up to 1 km. Refer to Appendix 12.1 Ornithology Technical Report.
Disturbance/displacement due to presence of turbines / operation and maintenance (O&M) vessel movement	Areas vary depending on species and cause of impact. – see Appendix 12.1 Ornithology Technical Report.
Avoidance / displacement	The proportion of birds displaced varies depending on species. Assumed that whole of the Offshore Site and a surrounding buffer of up to 1 km – refer to Appendix 12.1 Ornithology Technical Report.
Indirect effects arising from changes in habitat and abundance/distribution of prey species	Loss / change of habitat during construction and operation. – Refer to Chapter 14: Benthic Ecology and Chapter 15: Fish and Shellfish Ecology.
Cumulative Impact Scenarios	
Barrier effects during operation	Projects considered: Firth of Forth Round 3 Zone 2 offshore wind farm and Inch Cape offshore wind farm.
Mortality arising from collision with turbine blades	Projects considered: Firth of Forth Round 3 Zone 2 offshore wind farm and Inch Cape offshore wind farm.
Disturbance/displacement due to presence of turbines / operation	Projects considered: Firth of Forth Round 3 Zone 2 offshore wind farm and Inch Cape offshore wind farm.
Avoidance / displacement	Projects considered: Firth of Forth Round 3 Zone 2 offshore wind farm and Inch Cape offshore wind farm.

Table 12.3: Relevant assessment scenarios considered during the impact assessment

12.4.4 The Approach to Impact Assessment

17 It is important to note that the approach to impact assessment and terminology used in this chapter differs from the approach adopted in Chapter 6: The Approach to Environmental Impact Assessment. Sensitivity is adopted rather than vulnerability as this is a recognised and widely used term when discussing ornithological impacts and offshore wind farms. Impacts in this assessment are defined as change in the assemblage of bird species present as a result of the proposed project. Change can occur either during or beyond the life of the proposed project. Where the response of a population has varying degrees of likelihood, the probability of these differing outcomes is considered. Note that impacts can be adverse, neutral or favourable. Further details on the approach to impact assessment are provided in Appendix 12.1: Ornithology Technical Report.

12.4.4.1 Assessing Magnitude

18 Effects are judged in terms of magnitude in space and time (Regini, 2000) (refer to Table 12.4).

Characteristic	Magnitude of effect	Description
Spatial magnitude (severity)	Very high	Total/near total loss of a bird population or productivity due to mortality or displacement or disturbance. Guide: >80% of population affected, >80% change in mortality or productivity rate.
	High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 21-80% of population affected, 21-80% change in mortality or productivity rate.
	Moderate	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 6-20% of population affected, 6-20% change in mortality or productivity rate.
	Low	Small but discernible reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 1-5% of population affected, 1-5% change in mortality or productivity rate
	Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the "no change" situation. Guide: <1% population affected, <1% change in mortality or productivity rate
Temporal magnitude (duration)	Permanent	More than approximately 30 years. Substantially greater than the life span of the longest lived individuals and corresponding to many generation times.
	Long term	Approximately 10 - 30 years. This duration broadly corresponds to the maximum longevity of individual adult seabirds, waders and wildfowl and typically would represent several generation times.
	Medium term	Approximately 3 - 10 years. This duration broadly corresponds to age-of-first-breeding for seabirds, waders and wildfowl and typically would represent approximately one generation time.
	Short term	Up to approximately 3 years. This duration is substantially less than the average generation time for most seabirds, waders and wildfowl.

Table 12.4: Scales of spatial and temporal magnitude

19 The duration of an impact is defined as the time over which the impact is expected to last prior to recovery or replacement of the resource or feature and is defined with respect to ecological characteristics relevant to the species under consideration (IEEM, 2010).

20 The potential nature conservation importance (NCI) of an avian receptor (i.e. a potentially affected bird population) is determined within a defined geographical context (SNH, 2006).

21 In the case of non-designated sites, magnitude is assessed in respect of an appropriate ecological unit. International, national and regional importance are used as frames of reference, following best practice guidance (IEEM, 2010), and adapted to meet local circumstances. Given SNH advice, the top three geographical tiers (international, national and regional) are the most important within the context of the wind farm developments. The classification is hierarchical; therefore, species that would qualify under more than one category are defined according to the highest class.

22 For breeding populations there are generally very good estimates of international and national population sizes (e.g., Mitchell *et al.,* 2004). However, there is no accepted or officially endorsed division of the UK coastal waters into regions for the purpose of defining regional seabird populations.

23 For the purposes of the EIA the regional breeding population of seabird species (with the exception of fulmar) is defined as that comprised by all birds breeding between Peterhead in north-east Scotland to Blyth in Northumberland. This is an area that encompasses the mean maximum foraging ranges for the majority of breeding seabirds present in the proposed Neart na Gaoithe area. For fulmar, a species with an extremely large foraging range, the regional population is defined as including all areas within the mean maximum foraging distance, which encompasses the area between Orkney and Bempton Cliffs.

24 The size and definition of seabird populations outside the breeding season is less straightforward as at these times many species have wide ranging nomadic lives offshore. Following advice from SNH to define seabird reference populations of ecologically meaningful boundaries, the appropriate reference populations for non-breeding seabird populations have been taken to be the whole of the North Sea and subdivisions thereof as appropriate (e.g., one or more of the areas defined in Skov *et al.* (1995).

25 Where the available data allow, the conservation status of each potentially affected species is evaluated for the appropriate 'population'. For these purposes, conservation status is taken to mean the sum of the influences acting on a population that may affect its long term distribution and abundance. Conservation status is considered to be favourable where:

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

12.4.4.2 Assessing Sensitivity

26 The sensitivity of the receptor population to the effect under consideration is taken into consideration during assessments (refer to Table 12.5). Sensitivity may depend on the time of year an effect occurs. For example, a species is likely to be more sensitive to displacement or barrier effects when under high time/energy stress such as when breeding. Seabirds that are flightless whilst undergoing their annual wing moult may be more sensitive to disturbance.

Vulnerability of the receptor	Definition
High	No capacity to accommodate the proposed form of change.
Moderate	Low capacity to accommodate the proposed form of change.
Low	Some capacity to accommodate the proposed form of change.
Negligible	Receptor is likely to have tolerance to accommodate the proposed change.

Table 12.5: Criteria for assessment of sensitivity of bird populations

12.4.4.3 Evaluation of Nature Conservation Importance

27 The NCI of the bird species potentially affected by development is defined according to the highest category of qualification in Table 12.6.

Importance	Definition
Very high	Species regularly present in internationally important numbers (>1% international population).
High	Species listed in Annex I of the Birds Directive. Breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981. Species present in nationally important numbers (>1% national population). Regular occurrence of >1% of an internationally designated population (i.e., from a SPA or Ramsar site).
Moderate	Other species on the Birds of Conservation Concern (BoCC) 'Red' list (Eaton *et al.*, 2009). UK Biodiversity Action Plan species. Species on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species. Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the proposed development Species present in regionally important numbers (>1% regional population).
Low	All other species not covered above.

Table 12.6: Determining factors for nature conservation importance

12.4.4.4 Determining Significance

28 Where there is a potential impact on a bird population that forms part of the qualifying interest of an internationally (i.e., a SPA or Ramsar site) or nationally designated site (i.e., a SSSI) impacts are judged against whether the proposal could significantly affect the site population and its distribution.

29 In the case of a bird population that is not protected by an international or national designation then judgement is made against a more general expectation that the project would not have a significant adverse impact on the overall population, range or distribution; and that it would not interfere significantly with the flight paths of migratory birds. In assessing the impacts, consideration is given to the international or national or regional population of the species as appropriate.

30 The assessment determines the potential impacts of the proposal and the likelihood of their occurrence. In judging whether a potential impact is significant or not, several factors are taken into account:

- The NCI of the species involved;
- Magnitude of the likely impact;
- Duration and reversibility of impact; and
- Sensitivity of the receptor population to the impact.

31 The significance of potential impacts is determined by integrating the assessments of NCI, and magnitude and duration of impacts and the sensitivity of a population in a reasoned way. Inclusion of population sensitivity in the making of professional judgements on significance means that the population status and trend of the potentially affected species is taken into account. If a potential impact is determined to be significant, measures to avoid, reduce or remedy the impact are suggested wherever possible.

The criteria for determining the significance of impacts on birds are provided in Table 12.7. Impacts considered to be major or moderate significance are deemed to be significant in terms of the EIA Regulations.

Significance of impact	Description
Major	Detectable changes in a receptor population that will have severe impacts on its conservation status.
Moderate	Detectable changes in a receptor population that are likely to affect its conservation status.
Minor	Small or barely detectable changes that are unlikely to affect the conservation status of a receptor population.
Not significant	No or non-detectable changes in the conservation status of a receptor population.

Table 12.7: Significance criteria used

33 Detectable changes in international, national or regional populations of high or moderate NCI are considered to be fundamental effects and therefore significant Non-significant effects included all those that were likely to result in non-detectable changes in regionally or nationally important bird populations.

34 Evaluation of effects on Natura 2000 network populations (e.g., SPA populations) also needs to take account of whether or not the conservation status of a species is favourable (in terms of the robustness of its population and the adequacy of its supporting habitats), and whether the proposal would add substantially to the difficulty of taking action to reverse any decline and enable the species to achieve Favourable Conservation Status (FCS).

35 It is recognised that the term 'Favourable Conservation Status', as articulated within the Habitats Directive, is not used in the Birds Directive, but conservation status is favourable where:

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

36 An impact is judged as of concern where it would affect the Favourable Conservation Status of a species, or stop a recovering species from reaching Favourable Conservation Status, at international, national or regional population levels (SNH, 2006).

12.4.4.5 Definition of Assessment Periods

37 For the majority of species, two periods were used; the 'breeding period' and the 'non-breeding period'. In these cases the breeding period was defined as when the majority of breeding adults are strongly in attendance at breeding colonies (based on dates in Cramp and Simmons, 1983) and the non-breeding period the remainder of the year. For guillemot and razorbill a 'chicks-on-sea period' was also used corresponding to the time when adults are no longer attending colonies but males are attending dependent young on the sea; this was defined as the months of July and August (based on Cramp and Simmons (1983), and the dates when dependent young were recorded on surveys). For some species (kittiwake, guillemot, razorbill, puffin) where appropriate, a late summer 'post-breeding period' was also used. This broadly corresponds to the time when adult guillemots and razorbill and kittiwake are undergoing wing moult and when particularly high densities of all four species occurred in the study area. In the case of the three auk species the post-breeding period was defined as the months of September and October. In the case of kittiwake it was defined as August and September.

38 For species that are only present for a small part of the year (e.g., sooty shearwater, Arctic tern, little gull and little auk) the assessment was restricted to the period of the year when they were present.

12.4.4.6 Estimation of Potential Collision Mortality

39 Birds flying through the proposed development could potentially collide with rotating turbine blades and be killed or injured. The collision risk posed by the proposed development was quantified by Collision Rate Modelling (CRM) to predict the annual mortality of each species (Band, 2011, Chamberlain *et al.,* 2006). Data on flying bird density and flying height was derived from the monthly baseline boat-based surveys, and values for typical flight speed and bird size was obtained from published sources (Pennycuick, 1997; Snow & Perrins, 1998; Alerstam *et al.,* 2007; Guilford *et al.* 2008). Full details of the methods used to estimate collisions are presented in Appendix 12.2: Ornithology Statistics Report.

40 CRM calculations were made for four hypothetical development design scenarios encompassing the range of wind farm scales that may be proposed (see Appendix 12.2: Ornithology Statistics Report).

41 Density estimates from Distance analysis were used in two different ways to derive the density of flying birds at turbine height:

- Directly, by excluding all birds outside turbine height before the densities are calculated; and
- Indirectly, by calculating a density estimate for all birds in flight, irrespective of flight height, for each month, and then multiplying this estimate by the estimated proportion of birds at turbine height, calculated on the basis of data across all surveys for the offshore site.

42 For each species, in each month, these combinations yielded four different estimates of flying bird density at turbine height in the proposed wind farm footprint. For the purposes of assessment, the estimate based on the calculated density at turbine height in the offshore site was used. These data were considered to give the most reliable estimates as they were less subject to sampling error caused by inherently variable data. The results of all four analysis scenario are presented in Appendix 12.2: Ornithology Statistics Report .

43 The assessment of the significance of the predicted collision mortality is based on examining the magnitude of the additional mortality against the published estimates of baseline mortality rate for species (as far as is known). For one priority species, little gull, there is no published estimate of adult mortality rate, and in this case an approximation is used based on black-headed gull, which is closely related.

12.4.4.7 Estimation of Potential Displacement

Displacement is the potential for the wind farm and associated human activities to reduce or prevent birds, including flying birds, from using the offshore site and is therefore akin to habitat loss.

44 Displacement is assessed in terms of how potentially important the area under consideration (the offshore site and an appropriate buffer) is to the receptor population. In this case, displacement is assessed in terms of the effective loss or reduction of the food resources the area provides for a receptor population. The importance of a site is indicated by the proportion of the receptor population present at the site, or what proportion of foraging birds are present.

45 Outside the breeding season all individuals of the seabird populations of interest live at sea (with the exception of some gull species, such as herring gull and great black-backed gull). Therefore, the proportion of individuals in the population present in an area to be assessed should give a reasonable and unbiased measure of its importance for foraging. In the non-breeding periods (i.e., when all individuals live at sea), the importance of the offshore site (and an appropriately sized buffer) for foraging was based on the proportion of the receptor population that was present on average during the period under consideration. Populations in the non-breeding periods are the total number of all birds (i.e., adult plus immature birds). For example, if the receptor population size is 10,000 birds, and baseline surveys showed that in the non-breeding part of the year there are on average 500 individuals present in the offshore site, out to 1 km, then it would be estimated that this area is likely to provide approximately 5% of the population's foraging needs at this time of year.

46 To give a reasonable and unbiased measure of the importance of an area for foraging during the colony attendance part of the year, the numbers of birds present are expressed as a proportion of the population that is at sea, i.e., the average number that at any one time are away from the colony foraging. This is based on published estimates of colony attendance rates derived from tagging and colour-ringing.

47 Based on a hypothetical receptor population of 10,000 breeding adults that is known (from studies on the species) to have a mean colony attendance rate of 60% on average, at any one time in the colony attendance period there are 6,000 adults present at the colony and 4,000 away at sea foraging. If baseline surveys observed on average 200 adults in the offshore site buffered to 1 km during the colony attendance period, then it would be estimated that this area is likely to provide approximately 5% (200/4,000) of the population's foraging needs at this time of year.

48 For receptor populations that are populations of breeding seabirds the published population estimates are based on colony counts and therefore do not include non-breeding individuals. However, immature birds may potentially be approximately as numerous as breeding adults. In species where immature birds can, on the basis of plumage, be distinguished from adult birds (e.g., gannet and gull species), it is straightforward to take into account any immature birds seen in analyses. For seabird species in which immature non-breeding birds could not be distinguished from breeding adults during baseline surveys (such as fulmar and auk species) it is assumed that all birds present in the breeding season in adult summer plumage were breeding birds. Although it is likely that some immature birds were present with breeding adults, evidence from ringing studies shows that a high proportion of immature fulmars, guillemots and razorbills spend the spring and early summer away from their natal area (Wernham *et al.,* 2002), suggesting that for these species at least the size of any bias is likely to be small.

12.4.4.8 Estimation of Potential Barrier Effect

Barrier effect is the potential of a development to act as a barrier to the free movement of birds, either flying or swimming, that under normal circumstances would choose to pass through the area occupied by the development.

49 A barrier effect has been observed for many seabird species at operational offshore wind farms, in particular by using radar to track flight routes (Pettersson, 2005, Petersen *et al.,* 2006). A barrier effect causes displacement of birds, and to some extent this issue overlaps with the displacement of foraging birds from the offshore site discussed above. However, a barrier effect can potentially cause impacts further afield and is assessed in terms of the effect it could have on the time and energy budget of foraging birds through causing them to make longer flight paths between breeding colonies and foraging locations.

50 There are two consequences of the barrier effect. First, it could reduce birds' access to areas containing resources they would otherwise exploit, for example to feeding grounds (assessment of this has already covered within displacement). Second, a barrier can cause birds to undertake detours to reach areas that they would otherwise travel directly to and from. Undertaking a detour affects time and energy budgets, and this could have a knock-on effect on their survival and breeding success if it occurs at times when birds are under stress, for example when making provision for young.

51 The scale of the potential barrier that the proposed development would present is examined in terms of its size in relation to and distance from the four closest large seabird breeding colonies, namely Isle of May, Bass Rock, Craigleith and St Abb's Head.

52 The size of the barrier presented to birds at each of these colonies is assumed to be the linear width of the barrier measured at right angles to a flight on a heading towards the centre of the proposed wind farm. The width of the barrier was assumed to be the width of the offshore site with a 1 km buffer either side, this buffer width being considered to be larger than the likely average far-field avoidance distance shown by birds that are affected and therefore likely to lead to cautious estimates. This choice of buffer size was informed by the typical closest approach distances observed for detouring birds from radar studies and experience from observing flying seabirds avoiding other natural and man-made barriers. The proportion of flights potentially affected was estimated from the proportion of the compass sector (spread of directions) potentially available that would be blocked to birds from each colony wishing to undertake foraging trips further than the distance to the wind farm.

53 The additional distance that birds affected by the barrier would need to fly from these colonies in order to access areas at a range of distances away was calculated for each colony. This was evaluated for hypothetical foraging locations immediately beyond the barrier (26 – 42 km depending on the colony) and for locations at 30, 40, 50, 60, 80, 90 and 100 km from each colony. The calculation was based on the 'average detoured flight path', which was taken to be the path taken by a bird that encounters the barrier halfway between one of the ends and the centre of the front edge of barrier. The size of detour is also affected by how close the affected birds approach the wind farm before detouring and thereafter stay away from it; these were both assumed to be 1 km. The lengths of the 'average detoured flight path' were divided by the length of the corresponding direct flight path to give a measure of the detour expressed as a percentage of the direct route. It was assumed that the theoretical detour distance would be the same for both outward and return flights from the colony although it was only calculated for outward flights (although the geometry of the theoretical outward and return detoured flight routes differs slightly, the differences in total length are negligible).

54 In assessing the likely effects of the proposed wind farm acting as a barrier for a particular species, the destination location beyond the barrier was assumed to lie at the mean foraging distance from the colony (Thaxter *et al.,* 2012*)* where this did not correspond to one of the distances evaluated.

55 The theoretical effects of wind farms forming barriers to breeding seabirds has been examined in detail for a range of species, including most of the species considered as priority to the current proposal (Masden *et al.* 2010). This study shows that there is potential for there to be significant effects for species with a high wing loading such as auks, especially puffin.

56 Figure 12.2 illustrates the theoretical situation for guillemots breeding on the Isle of May. Birds on foraging trip headings within the grey cone would be potentially affected by the wind farm acting as a barrier. In the absence of any barrier, the average bird in the northern part of the cone would fly directly from the colony at Point A to feed at Point B, located 38 km away (the mean foraging distance). After the wind farm is constructed, the same average bird is assumed to perceive a barrier at Point C and respond by detouring around the northern perimeter of the wind farm to reach its intended destination at Point B. Similarly, the average bird affected in the southern half of the grey cone would be detoured at Point E around the southern perimeter of the wind farm to reach its intended destination at Point D.

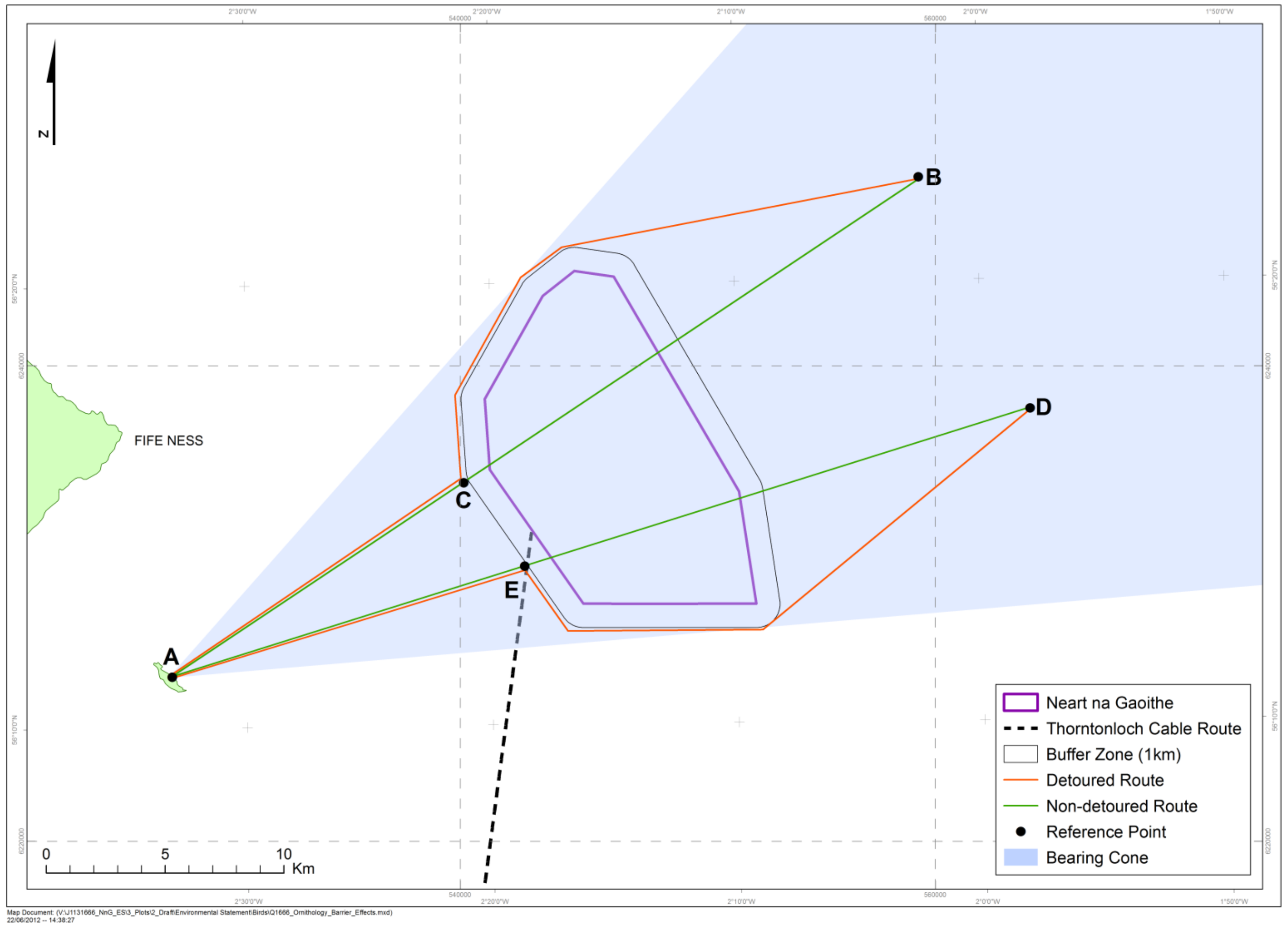

Figure 12.2: Schematic diagram showing how barrier effects were estimated

12.4.4.9 Estimation of Disturbance from Vessels

57 Disturbance from vessels has the potential to cause displacement of seabirds from foraging habitat and cause flying birds to detour their flight routes. Although not limited to the construction and decommissioning phases, vessel disturbance is of particular relevance to these stages because of the relatively large number of vessels proposed to be operating in the offshore site at these times.

58 Displacement of birds from foraging habitat is assessed based on the importance of the area for foraging from which birds are displaced by the vessels.

59 The displacement effects that might be caused by vessel disturbance were examined by simple modelling of a number of hypothetical scenarios. The model outputs are estimates of displacement in terms of foraging habitat loss from the offshore site. Separate models were undertaken for static vessels and vessels in transit and a number of different buffer sizes. All the regularly occurring seabird species that forage in the proposed offshore site are considered to have low susceptibility to disturbance. The amount of displacement predicted by the models is the green line scenarios (150 m disturbance buffer) illustrated in Figure 12.3.

60 The potential amount of displacement that could result at a given time is the sum of the disturbance from static and transiting vessels.

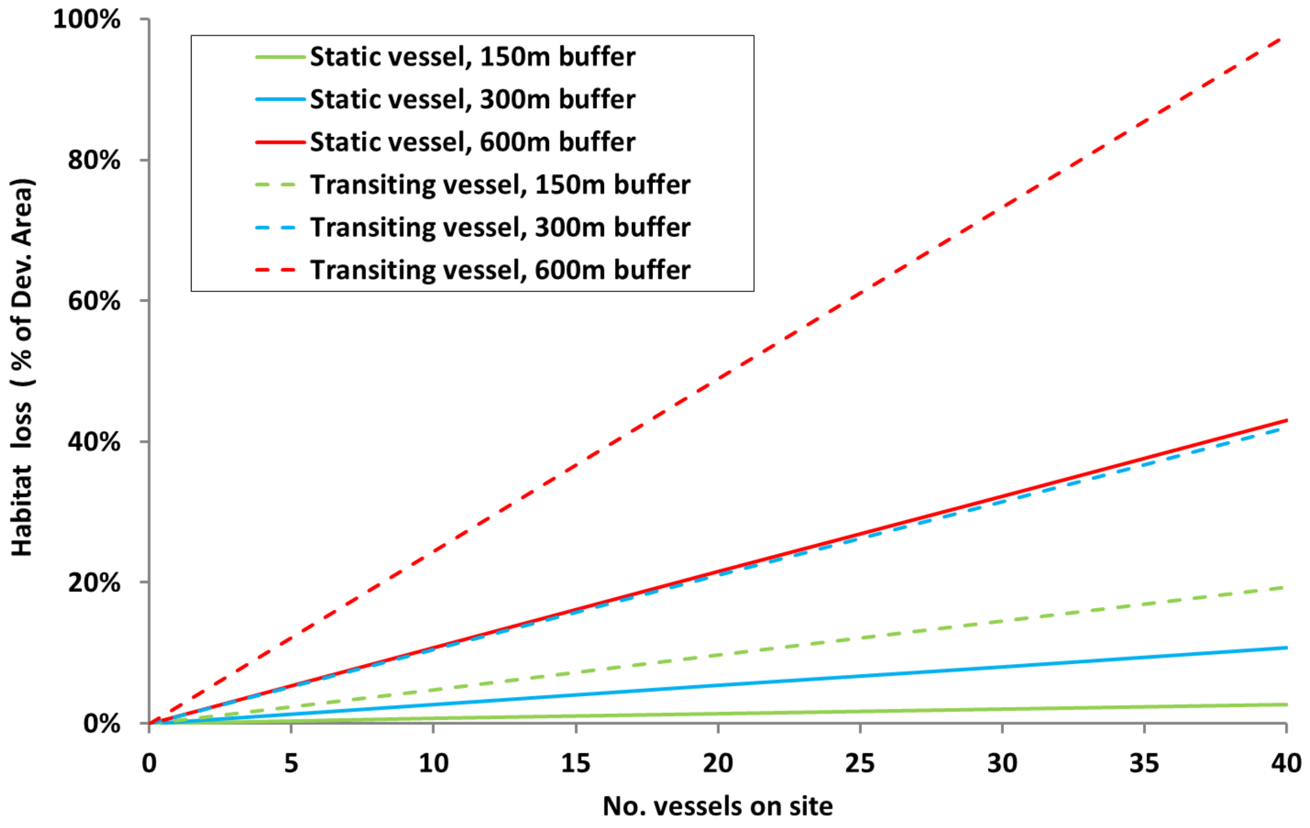

Figure 12.3: The hypothetical loss of seabird foraging habitat from the offshore site caused by disturbance from vessels

61 Estimates are calculated for three sizes of buffer zone drawn around the centre of vessels, from which it is assumed all foraging birds are displaced. Transiting vessels are assumed to travel at 10 knots and disturbed areas remain free of foraging seabirds for five minutes. The estimates assume vessel disturbance zones do not overlap.

62 Vessel disturbance can also disrupt the normal behaviour of foraging seabirds, for example through causing birds to flush and relocate. This dynamic 'active' element to this disturbance is something that is specific to vessel disturbance (and the human activities on board, such as creating loud noises), especially transiting vessels, and is not relevant to the disturbance caused by, for example, wind turbines. The effects of disruption to behaviour could be assessed in terms of impacts to birds' time and energy budgets. However, given the low susceptibility of the seabird species that regularly forage in the offshore site and the very small proportion of the receptor populations that are expected to be affected by vessel disturbance at any one time (see plot above and species accounts), it is clear that the numbers of potentially affected and frequency that individuals would experience such active disturbance are both so low that it is not plausible that it could significantly affect populations.

12.4.4.10 Study Area

63 The area considered in this chapter consists of the following:

- A broad regional study area based on foraging ranges of key species (the "regional study area"); and
- A project specific study area (study area, described above) based on the area covered in the boat-based surveys, incorporating the offshore site and buffer area.

64 The regional study area encompasses the following:

- For all bird species during the breeding season, other than fulmar, the North Sea coast between Peterhead and Blyth; and
- For fulmar the North Sea coast between Orkney and Bempton Cliffs.

65 Details on the selection of these study areas are provided in Appendix 12.1: Ornithology Technical Report.

12.4.5 Cumulative and In-Combination Impact Assessment Approach

66 Two other offshore wind farms are proposed in the region, these are Inch Cape wind farm and the Firth of Forth Round 3 Zone 2 wind farm neither of which have submitted applications and therefore data from these proposed wind farms are limited. However, reports for the first year of survey work are available and these provide information on the numbers of birds seen and make some preliminary assessment of likely impacts. Additional information on the approach to cumulative impact assessment is presented in Appendix 12.1: Ornithology Technical Report.

67 Outside of the Firth of Forth and Firth of Tay area there are two proposed offshore wind farms in the Moray Firth; Beatrice Offshore Wind Farm and Moray Firth Offshore Wind Farm. The offshore wind proposals in the Moray Firth are considered to be in a different region and are not therefore considered in the CIA. In addition, an application has been submitted for the proposed Aberdeen Offshore Wind Farm in Aberdeen Bay, approximately 100 km to the north of Neart na Gaoithe. Based on the scale of the proposed project (11 turbines) and the initial findings in the Environmental Statement, it was concluded that impacts from Aberdeen Offshore Wind Farm would not significantly add to the cumulative effects from Neart na Gaoithe, Inch Cape and the Firth of Forth Round 3 Zone developments. Therefore the Aberdeen Offshore Wind Farm was not considered further in this Cumulative Impact Assessment.

68 Other activities such as shipping, oil and gas, dredging and aggregates are either absent from the potential area of cumulative impact or occur at a low level and are therefore predicted not to have any cumulative or in-combination impacts.

69 The impacts of displacement, collision and barrier effects arising individually from the three proposed wind farms are expected to combine together in an additive way. Therefore, to a large extent CIA simply involves adding the impacts from the developments for each effect for each receptor bird population (King *et al.* 2009).

12.5 Baseline Description

12.5.1 Survey Effort

70 In year 1, surveys were conducted over 32 days between November 2009 and October 2010, with a total of 3,734.6 km surveyed. In year 2, surveys were conducted over 28 days between December 2010 and October 2011, with a total of 3,429.6 km surveyed.

71 Although full coverage was achieved in all months except in November of year 2, there was slight variation in monthly effort, compared to the absolute length of transects, due to slight variations in the vessel trackline.

72 To improve data quality, Camphuysen *et al.* (2004) recommend that seabird data collected in sea states greater than 4 are not used in subsequent analyses. Consequently, surveys were normally suspended when sea state increased above 4. Overall, the majority of all data (98.7%) were collected in sea states 0 to 4, with only 1.3% conducted in sea state 5. This data was excluded from further analyses.

73 Further details of survey effort including survey routes for individual months are presented in Appendix 12.1 Ornithology Technical Report.

12.5.2 Numbers of Birds Seen at Neart na Gaoithe from Boat-Based Surveys

74 A total of 29 seabird species were identified on surveys in the study area in year 1 (November 2009 to October 2010). In year 2, 26 seabird species were recorded in the study area (November 2010 to October 2011) (refer to Table 12.8).

75 Within the Neart na Gaoithe offshore site, 22 species were recorded in year 1**.** The three most frequently recorded species in the offshore site in year 1 were gannet, puffin and guillemot, which together accounted for 62.3% of all birds recorded. In year 2, 16 species were recorded in the offshore site, with gannet, guillemot and puffin again the three most frequently recorded species, although the ranking was slightly different. These three species accounted for 77.1% of all birds recorded (refer to Table 12.8).

76 25 species were recorded in the buffer area in both years 1 and 2. In year 1 gannet, puffin and guillemot accounted for 64.7% of all birds recorded. In year 2, gannet, guillemot and puffin accounted for 71.2% of all birds recorded.

77 Monthly summary tables are presented in Appendix 12.1: Ornithology Technical Report.

12.5.2.1 Non-seabirds

78 A total of 1,209 birds of 19 species of non-seabird were recorded in the study area in year 1. In year 2, 424 birds of 22 species were recorded on surveys (refer to Table 12.9)

79 In year 1, the three most frequently recorded species were barnacle goose, pink-footed goose and meadow pipit, accounting for 95.0% of all non-seabirds recorded. In year 2, pink-footed goose, meadow pipit and golden plover were the three most frequently recorded species, accounting for 92.2% of all non-seabirds recorded.

80 In both years, the majority of non-seabirds were recorded in the buffer area, with 15.4% of all non-seabirds recorded in the offshore site in year 1, and 3.5% recorded in the offshore site in year 2.

Species	Year 1			Year 2		
	Offshore site	Buffer area	Total	Offshore site	Buffer area	Total
Red-throated diver	0	5	5	0	0	0
Fulmar	112	580	692	189	927	1,116
Sooty shearwater	84	143	227	4	175	179
Manx shearwater	16	56	72	27	259	286
Balearic shearwater	1	0	1	0	0	0
Storm petrel	0	1	1	0	0	0
Gannet	1,649	11,372	13,021	3,122	16,294	19,416
Cormorant	0	1	1	0	3	3
Shag	0	11	11	0	6	6
Eider	9	11	20	0	2	2
Common scoter	5	0	5	0	2	2
Red-necked phalarope	0	0	0	0	1	1
Grey phalarope	1	0	1	0	2	2
Pomarine skua	0	6	6	0	0	0
Arctic skua	0	6	6	0	18	18
Great skua	1	23	24	0	16	16
Little gull	32	266	298	6	214	220
Sabine's gull	1	0	1	0	1	1
Black-headed gull	0	27	27	0	11	11
Common gull	6	72	78	12	40	52
Lesser black-backed gull	10	56	66	11	184	195
Herring gull	50	1,673	1,723	58	1,375	1,433
Great black-backed gull	25	503	528	20	414	434
Large gull species	4	158	162	1	347	348
Kittiwake	801	3,154	3,955	719	3,404	4,123
Small gull species	0	0	0	0	1	1
Common tern	3	10	13	13	37	50
Arctic tern	205	672	877	37	292	329
Common/Arctic tern	1	75	76	28	167	195
Unidentified tern species	0	34	34	0	0	0
Guillemot	1,252	6,646	7,898	1,544	10,186	11,730
Razorbill	596	3,384	3,980	350	2,781	3,131
Little auk	26	109	135	16	97	113
Puffin	1,306	9,893	11,199	1,110	5,512	6,622
Puffin/little auk	0	3	3	0	0	0
Guillemot/razorbill	368	2,955	3,323	168	1,364	1,532
Unidentified auk species	155	1,193	1,348	56	771	827
Total numbers	**6,719**	**43,098**	**49,817**	**7,491**	**44,903**	**52,394**

Table 12.8: Comparison of seabird numbers in offshore site and buffer area in years 1 and 2 (raw numbers, all sea states)

Species	Year 1			Year 2		
	Offshore site	Buffer area	Total	Offshore site	Buffer area	Total
Mute swan	0	2	2	0	0	0
Pink-footed goose	0	216	216	0	333	333
Barnacle goose	180	720	900	0	0	0
Wigeon	1	20	21	0	5	5
Shoveler	0	2	2	0	0	0
Tufted duck	0	0	0	0	1	1
Dabbling duck species	0	1	1	0	0	0
Merlin	0	0	0	0	1	1
Oystercatcher	0	2	2	0	2	2
Ringed plover	0	0	0	0	1	1
Golden plover	0	4	4	1	19	20
Sanderling	0	2	2	0	0	0
Purple sandpiper	0	1	1	0	0	0
Little stint	0	0	0	0	1	1
Dunlin	0	3	3	4	1	5
Bar-tailed godwit	0	1	1	0	0	0
Curlew	0	7	7	0	1	1
Redshank	0	2	2	0	2	2
Turnstone	0	0	0	0	2	2
Short-eared owl	0	0	0	0	1	1
Sand martin	0	1	1	0	0	0
Swallow	0	2	2	0	2	2
Skylark	3	0	3	0	0	0
Meadow pipit	1	32	33	8	30	38
Robin	0	0	0	1	1	2
Bluethroat	0	0	0	0	1	1
Wheatear	0	0	0	0	1	1
Song thrush	0	0	0	0	1	1
Blackbird	1	1	2	0	0	0
Fieldfare	0	0	0	0	1	1
Barred warbler	0	0	0	0	1	1
Starling	0	4	4	0	0	0
Carrion crow	0	0	0	1	0	1
Passerine species	0	0	0	0	1	1
Total numbers	**186**	**1,023**	**1,209**	**15**	**409**	**424**

Table 12.9: Comparison of non-seabird numbers in offshore site and buffer area in years 1 and 2 (raw numbers, all sea states)

12.5.3 Flight Heights of Birds Seen at Neart na Gaoithe from Boat-Based Surveys

81 Information on the height of flying birds in years 1 and 2 combined (November 2009 to October 2011) is summarised in Table 12.10. Species where fewer than 20 individuals were recorded are excluded from this, but the information is presented in the individual species accounts. Overall, 94.4% of all flying birds on baseline surveys were recorded flying below 22.5 m in height, i.e. below the wind turbine rotor swept zone. No birds were recorded flying above an estimated height of 120 m on baseline surveys.

82 For fulmar, sooty shearwater, Manx shearwater, guillemot, razorbill and puffin, all or nearly all birds were recorded flying at less than 22.5 m in height (refer to Table 12.10).

83 For other species, a greater proportion of birds were recorded flying above 22.5 m, i.e. in the wind turbine rotor swept zone, for example 6.0% of kittiwakes (n=4,914), 6.5% of gannets (n= 28,828), 19.3% of great black-backed gulls (n=440) and 30.0% of herring gulls (n=1,253) were recorded flying above 22.5 m (refer to Table 12.10).

84 Two species of geese have been recorded to date in the study area, with 42.6% of pink-footed goose recorded flying above 22.5 m (n=549), while 100% of barnacle goose sightings were recorded below 22.5 m (n=900) (refer to Table 12.10).

85 In years 1 and 2, meadow pipit was the only species of land bird for which more than 20 individuals have been recorded, with 1.6% recorded flying above 22.5 m (n=64). The majority of all other passerine species combined (97.2%, n=36) and wader species combined (93.9%, n=33) were recorded flying below 22.5 m in height (refer to Table 12.10).

Species	Height bands in metres					Total in flight	% above 22.5 m
	0 – 7.5	7.5 – 12.5	12.5 –17.5	17.5 – 22.5	Above 22.5		
Fulmar	1,464	23	0	0	2	1,489	0.1
Sooty shearwater	93	0	0	0	0	93	0
Manx shearwater	153	1	0	0	0	154	0
Gannet	22,678	1,651	499	2,132	1,864	28,824	6.5
Pink-footed goose	301	0	0	14	234	549	42.6
Barnacle goose	900	0	0	0	0	900	0
Wigeon	0	0	0	20	1	21	4.8
Eider	12	8	2	0	0	22	0
Golden plover	14	0	0	0	10	24	41.7
Unidentified waders	20	2	2	7	2	33	6.1
Arctic skua	10	3	1	5	1	20	5.0
Great skua	24	7	3	1	1	36	2.8
Little gull	163	21	3	1	83	271	30.6
Black-headed gull	4	13	6	5	10	38	26.3
Common gull	26	19	8	22	29	104	27.9
Lesser black-backed gull	115	33	10	28	30	216	13.9
Herring gull	426	193	76	200	383	1,278	30.0
Great black-backed gull	191	69	23	72	85	440	19.3
Large gull species	2	33	3	13	37	88	42.0
Kittiwake	2,549	1,191	308	571	295	4,914	6.0
Common tern	29	5	1	0	0	35	0
Arctic tern	799	100	17	44	4	964	0.4
Common/Arctic tern	134	62	14	0	0	210	0
Unidentified tern species	34	0	0	0	0	34	0
Guillemot	4,981	72	1	5	2	5,061	< 0.1
Razorbill	1,698	15	6	7	0	1,726	0
Little auk	68	1	0	0	0	69	0
Puffin	5,696	69	7	5	2	5,779	< 0.1
Guillemot/razorbill	1,175	13	1	0	0	1,189	0
Unidentified auk species	151	0	0	0	0	151	0
Meadow pipit	22	25	9	2	1	59	1.7
Unidentified passerines	18	9	8	1	1	37	2.7
Total numbers	**43,950**	**3,638**	**1,008**	**3,155**	**3,077**	**54,828**	**5.6**

Table 12.10: Flight heights of birds in the study area in years 1 and 2 (November 2009 to October 2011)

12.5.4 Relevant Conservation Sites

86 The relevant conservation sites have been considered for all species recorded within the offshore site and 8 km buffer. Details of the sites can be found in Chapter 11: Nature Conservation chapter and Appendix 12.1: Ornithology Technical Report). For the key species detailed in this chapter, the relevant conservation sites are presented in the species accounts.

12.6 Species Baseline Information

87 All species encountered during baseline surveys have been considered for assessment and information on these are presented in Appendix 12.1: Ornithology Technical Report. Whether or not a species is included in the assessment depends on whether there is the likelihood that those individuals using the site form part of the qualifying interest of an SPA and the conservation status of the species. In some cases although a species qualifies for assessment it can be demonstrated through simple analyses and reference to the behavioural ecology of the species that there is no plausible likelihood of significant adverse effects and therefore more detailed examination is not warranted.

88 There is a theoretical collision risk to SPA populations of some land bird species (such as waders and wildfowl species) that potentially migrate over the offshore site. The few (or in some cases total lack of) records of these species from the baseline surveys are not considered to give a representative information on their occurrence as these species either may migrate at night and/or in large flocks that could pass through on days when no survey work took place. Therefore, the potential for collision risk is examined using theoretical worse-case scenario in which 1,000 birds of each species are assumed to pass directly through the wind farm twice per year (once for each migration journey). This approach is highly precautionary.

12.6.1 Information Presented in Species Impact Assessments

89 The information presented here is a summary; for detailed information refer to Appendix 12.1: Ornithology Technical Report.

90 Thirteen species of seabird have been considered to be higher priority on account of the high numbers present at certain times, the likely high connectivity to SPAs (nine species) and their potential sensitivity to potential effects. The higher priority species are: fulmar, sooty shearwater, gannet, little gull, lesser-blacked gull, herring gull, great black-backed gull, kittiwake, Arctic tern, guillemot, razorbill, puffin and little auk. The possible effects of the development on populations of these species are assessed in relative detail in the accounts that follow.

91 All other species have been assessed but as they occurred only sporadically and in low or very low numbers they are considered to be of lower priority. The assessment for these species is less detailed and is presented in Appendix 12.1: Ornithology Technical Report.

12.6.2 Northern Fulmar *Fulmarus glacialis*

12.6.2.1 Status

92 Fulmar numbers and distribution around the UK have increased considerably since the mid-19th century (Pennington *et al.,* 2004). The species is now one of the commonest seabirds in Britain, with an estimated breeding population of 499,081 pairs (Mitchell *et al.,* 2004). The largest breeding colonies are located off the north and west coasts of Scotland. Birds are often present at breeding cliffs outside the breeding season. Fulmars forage at sea, with offal and fish discards from trawlers now a major part of their diet.

93 In year 1, 692 fulmars were recorded on surveys in the study area, with the majority of birds (83.8%) recorded in the buffer area. Numbers of fulmars recorded on surveys in year 2 were higher, with a total of 1,116 birds recorded, the majority of which (83.1%) were in the buffer area (refer to Table 12.8).

94 During the breeding season (March to September), the peak estimated number of fulmars occurred in September of year 1, with an estimated 57 birds in the offshore site, and 295 birds in the buffer area. In year 2, peak estimated numbers of fulmars were also recorded in September, with an estimated 69 birds in the offshore site, and 890 birds in the buffer area (refer to Figure 12.4).

95 In the non-breeding season (October to February), the peak estimated number of fulmars occurred in December of year 1, with an estimated 70 birds in the offshore site, and 185 birds in the buffer area. In year 2, peak estimated numbers of fulmars in the offshore site were recorded in December and January (77 birds), with an estimated 439 birds in the buffer area in January (refer to Figure 12.4).

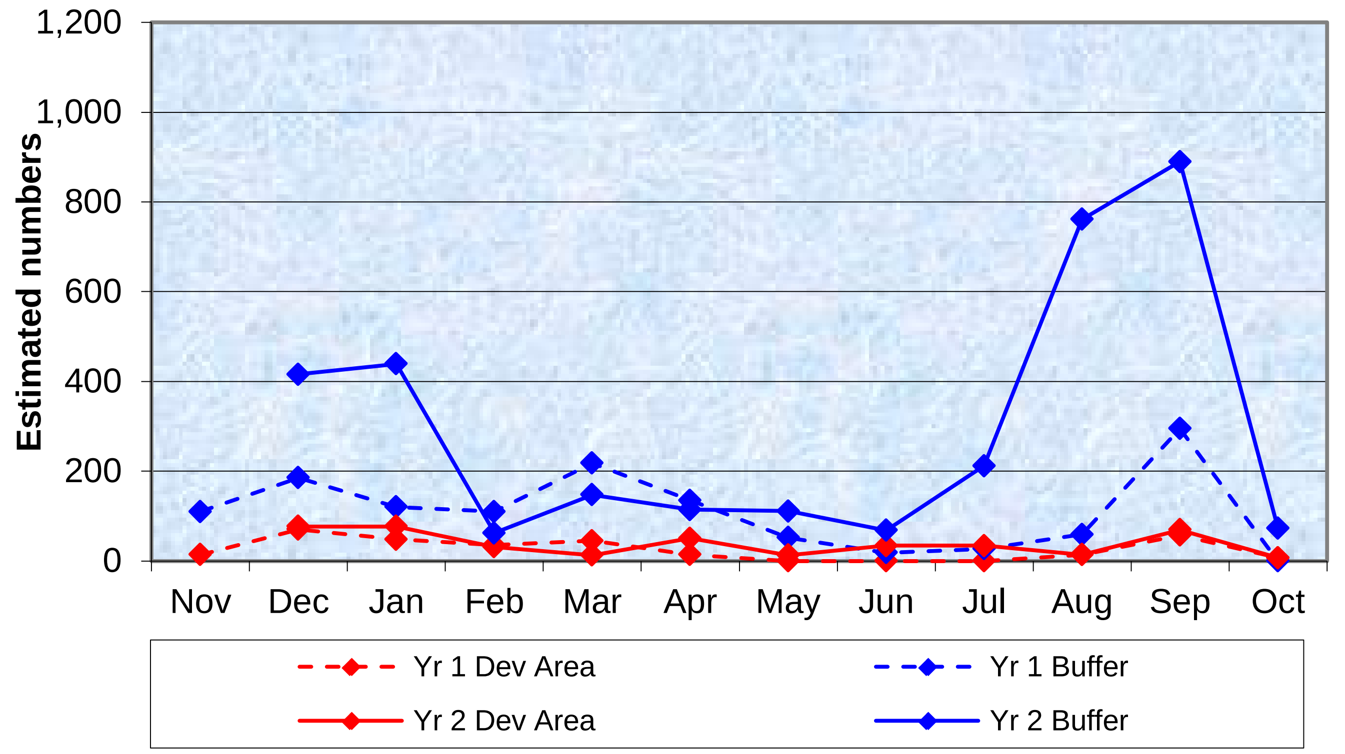

Figure 12.4: Monthly estimated numbers of fulmars in the development & buffer areas in years 1 and 2

96 A total of 1,489 fulmars were recorded in flight in years 1 and 2, with the majority of all birds (98.3%) recorded flying below 7.5 m in height (refer to Table 12.10). Just two birds (0.1%) were recorded flying above 22.5 m, i.e. within the rotor swept zone of the turbines, at an estimated height of 30 m.

97 Flight direction was recorded for 927 fulmars in the breeding season (March to September) with direction recorded for 514 fulmars in the non-breeding season (October to February). An additional 15 birds were recorded as circling.

12.6.2.2 Species Sensitivity

98 Fulmar is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009). A recent assessment rated fulmar as being at moderate risk of habitat loss or changes in prey distribution resulting from offshore wind farms. Risk of collision, displacement and barrier effects were rated as low. Overall, fulmar was assessed as being at low risk from offshore wind developments (Langston, 2010).

99 Fulmar is listed as a qualifying interest species in the breeding season for 17 SPAs on the UK east coast between Hermaness (Shetland) and Spurn (Yorkshire) that could potentially be affected by the development (refer to Table 12.11). These SPAs held 38.0% of the UK breeding population, and greater than 2.4% of the biogeographic population at the time of designation (JNCC, 2012). The distance from the offshore site to 13 of these SPAs is within the mean maximum foraging range of 400 km, while the distance to the remaining four SPAs is within the maximum known foraging range of 580 km (Thaxter *et al*., 2012).

12.6.2.3 Population

100 The regional breeding population size is assumed to be 333,188 birds (i.e. 166,549 pairs). This figure is based on the Seabird 2000 counts for Orkney to Yorkshire (Mitchell *et al.,* 2004).

101 The regional population size in the non-breeding period is assumed to be approximately 400,000 birds. This figure is based on a cautious interpretation of the population estimates for Areas 7, 8, and 9 for November to February given in Skov *et al.* (1995).

12.6.2.4 Nature Conservation Importance

102 The nature conservation importance (NCI) of fulmars using the offshore site is rated at moderate throughout the year. This species merits moderate NCI classification on the basis that a high proportion of birds present in the offshore site are likely to be from SPA colonies, in particular Forth Islands SPA and St Abb's Head to Fast Castle SPA. This species is not subject to special legislative protection, and is not listed on any conservation listings. The mean numbers present are well below 1% of the (at-sea) regional population at all times of year.

12.6.2.5 Offshore Wind Farm Studies of Fulmar

103 Fulmars were uncommon at almost all the operational wind farms that have been studied and therefore there is a paucity of information on how this species responds to offshore wind farms. At Egmond aan Zee, the Netherlands, the results of the single survey with a sufficiently large sample for analysis showed no clear influence of the wind farm on the distribution of fulmar. At Arklow Bank, Ireland, the number of fulmars significantly declined on the survey legs closest to the turbines, however there was no evidence that these declines were associated with proximity to the turbines (Barton *et al.*, 2009). There is limited evidence of the extent to which wind farms present a barrier to fulmars. At Horns Rev, Denmark, a single fulmar approaching the wind farm was observed to change direction to apparently avoid flying through the turbines (Diersche and Garthe, 2006). However, at Blyth Harbour, UK, anecdotal reports of fulmars passing through the wind farm, corroborated by one recorded collision at this site, suggest that any barrier effect to fulmars was at most only partial (Diersche and Garthe, 2006).

12.6.3 Sooty Shearwater *Puffinus griseus*

12.6.3.1 Status

104 Although sooty shearwaters breed in the southern hemisphere on islands off New Zealand, Australia, Chile and the Falkland Islands, the species is regularly recorded on migration off the east coast of Scotland from July to October, but rarely outside this period (Forrester *et al.,* 2007). Sooty shearwater is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

105 In year 1, 227 sooty shearwaters were recorded on surveys in the study area, with the majority of birds (63.0%) recorded in the buffer area in October. In year 2, 179 sooty shearwaters were recorded on surveys, however only four birds were in the offshore site, with 97.8% of birds recorded in the buffer area (refer to Table 12.8). Again, highest numbers were seen in October.

106 In year 1, peak numbers of sooty shearwaters occurred in October, with an estimated 162 sooty shearwaters in the offshore site, and 618 birds in the buffer area (refer to Figure 12.5). In year 2, numbers of sooty shearwaters in the offshore site were low, with a peak of seven birds in September and October (refer to Figure 12.5). In the buffer area, estimated numbers peaked in October, with 892 birds in the buffer area.

107 A total of 93 sooty shearwaters were recorded in flight in years 1 and 2, with all birds flying below 7.5 m in height (refer to Table 12.10).

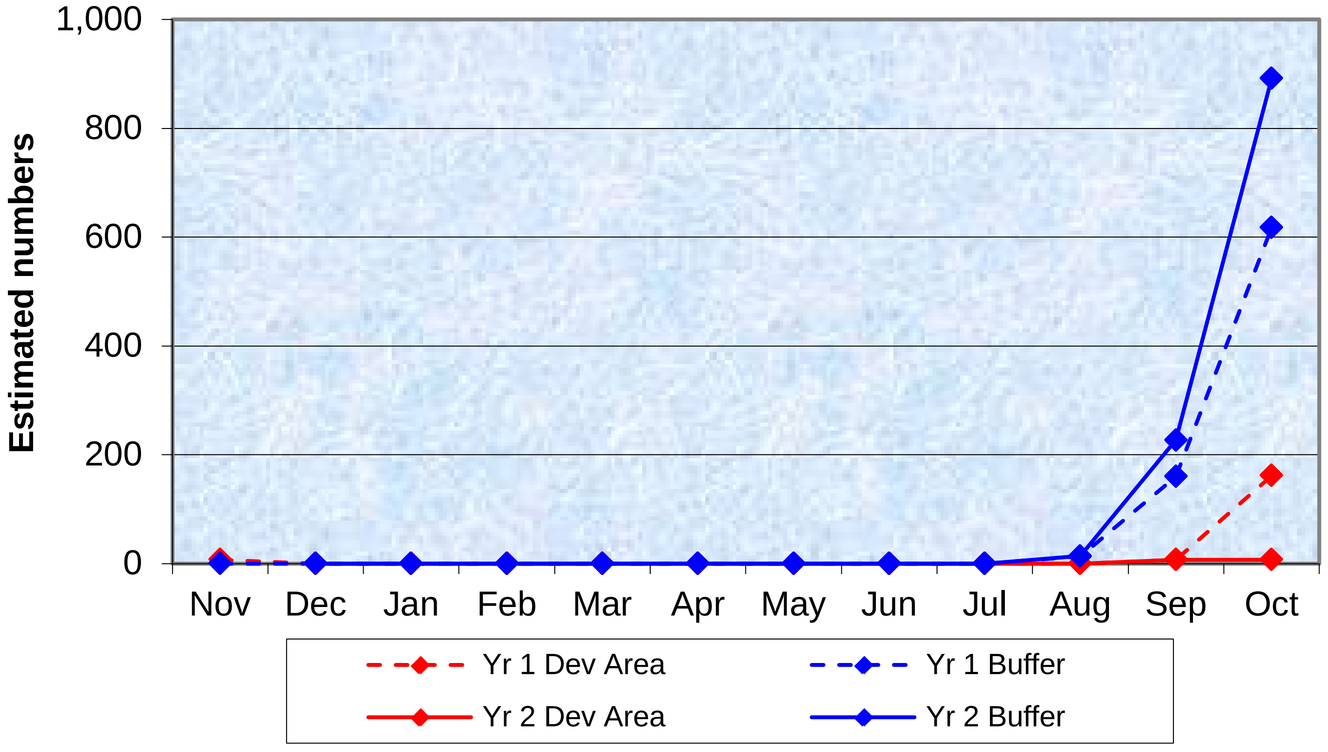

Figure 12.5: Monthly estimated numbers of sooty shearwaters in the development & buffer areas in years 1 and 2

12.6.3.2 Species Sensitivity

108 Langston (2010) assessed sooty shearwater as being at low risk of collision and displacement resulting from offshore wind farms. There are no SPAs designated for sooty shearwater in the breeding or non-breeding seasons in the UK (JNCC, 2012).

12.6.3.3 Population

109 The size of the regional autumn passage population is imprecisely known and is likely to vary year-to-year. The regional population was estimated at being approximately 2,500 birds from the summary ESAS results data presented by Stone *et al.* (1995),

110 There is no evidence to suggest that the baseline survey years were atypical in terms of the numbers present in the offshore site. The species is classed as being uncommon to common on autumn passage off the Fife coast (Dickson, 2002).

12.6.3.4 Nature Conservation Importance

111 The NCI of sooty shearwaters using the site is rated at moderate during the autumn passage period. The species merits this rating as it is classified by IUCN as Near Threatened because, although it has a very large global population (20 million birds), it is thought to have undergone a moderately rapid decline owing to the impact of fisheries, the harvesting of its young and possibly climate change.

12.6.3.5 Offshore Wind Farms Studies of Sooty Shearwater

112 There are very few records and therefore little field-based evidence of the likely effects of operational wind farms on sooty shearwaters. A review of offshore wind farm effects on birds categorised displacement, barrier and collision risk effects as unknown for sooty shearwater (Diersche and Garthe, 2006).

113 In the absence of sooty shearwater data, evidence of the effects of wind farms on other closely related species, in particular Manx shearwater, can give an insight into their likely response to wind farms. At Arklow Bank, analysis of pre and post construction Manx shearwater data reported no significant change in numbers or distribution

following construction of the wind farm (Barton *et al.*, 2009). At Horns Rev and Egmond aan Zee, shearwaters were naturally too scarce to provide information on the likely effects of wind farms on sooty shearwater.

114 Based on the recorded flying heights of sooty shearwaters on baseline surveys it is likely that the risk of sooty shearwaters colliding with turbines is low.

12.6.4 Northern Gannet *Morus bassanus*

12.6.4.1 Status

115 Gannets breed in a few, typically very large, colonies around the UK. The second largest UK colony is at Bass Rock, in the outer Firth of Forth, with an estimated breeding population of 55,482 nests in 2011.

116 Gannet was the commonest seabird recorded on surveys in the study area during the baseline surveys, with 13,021 birds recorded in year 1 and 19,416 birds recorded in year 2. The majority of gannets were recorded in the buffer area. Highest numbers were recorded during the breeding season (March to September) (refer to Table 12.8).

117 During the breeding season (March to September), the peak estimated number of gannets occurred in September of year 1, with an estimated 739 birds in the offshore site, and 3,366 birds in the buffer area (Figure). In year 2, peak estimated numbers of gannets in the offshore site peaked in April (1,634 birds), while estimated numbers in the buffer area peaked in September (5,590 birds) (refer to Figure12.6).

118 In the non-breeding season (October to February), the peak estimated number of gannets occurred in October of year 1, with an estimated 171 birds in the offshore site, and 1,082 birds in the buffer area. In year 2, peak estimated numbers of gannets in the offshore site peaked in February (408 birds), while estimated numbers in the buffer area peaked in October (3,295 birds) (refer to Figure 12.6).

119 Overall, numbers in the Neart na Gaoithe buffer area exceeded 1% of the national breeding population (4,411 birds) (Wanless *et al.* 2005) in June, August and September of year 2 (refer to Figure 12.6).

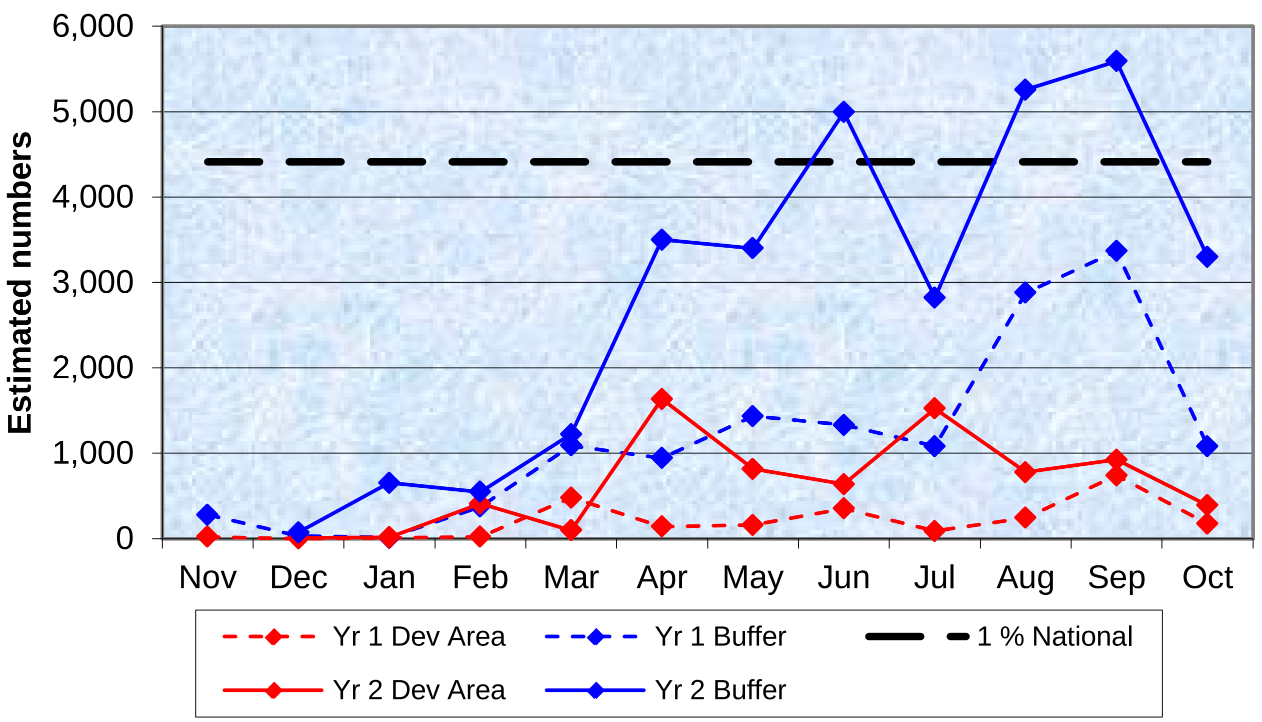

Figure 12.6: Monthly estimated numbers of gannets in the development & buffer areas in years 1 and 2

120 In years 1 and 2, a total of 28,824 gannets were recorded in flight, with 93.5% (26,960 birds) of birds flying below 22.5 m in height i.e. below the turbine swept zone (refer to Table 12.10). A total of 1,864 birds (6.5%) were recorded flying above 22.5 m, i.e. within the rotor swept zone, with the majority of these birds (79.9%) recorded at an estimated 30 m or less. The maximum height estimated was 70 m.

12.6.4.2 Species Sensitivity

121 Gannet is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al*., 2009).

122 Gannet are assessed as being at moderate risk of collision resulting from offshore wind farms. Risk of displacement, barrier effects, habitat loss or changes in prey distribution were rated as low. Overall, gannet was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

123 Gannet is listed as a qualifying interest species in the breeding season for five SPAs on the UK east coast that could potentially be affected by the development (Hermaness, Saxa Vord and Vaila SPA, Fair Isle SPA, Noss SPA, Flamborough Head and Bempton Cliffs SPA and Forth Islands SPA). These SPAs held 28.5% of the UK breeding population, and 21.9% of the biogeographic population at the time of designation (JNCC, 2012). Since designation, the populations at all five SPAs have expanded, with the Bass Rock colony (Forth Islands SPA) being the largest in the region (SMP, 2012).

124 The distance between the offshore site and the Bass Rock colony is within the mean maximum foraging range of 229.4 km, while the distance to the other four SPAs is within the maximum known foraging range of 590 km (Thaxter *et al*., 2012).

12.6.4.3 Population

125 The regional breeding gannet population is defined as all birds breeding less than 229 km from the offshore site, the mean maximum foraging range for breeding gannet (Thaxter *et al.,* 2012). The only colonies within this distance are Bass Rock and Troup Head. Censuses in 2009 estimated 55,482 occupied nests at Bass Rock and 2,787 occupied nests at Troup Head in 2010 (SMP, 2012). On this basis the regional breeding population is assumed to be 116,538 breeding adults (58,269 breeding pairs). The Bass Rock population has shown a long term increase, averaging 4.0% per annum between 1985 and the most recent count in 2009. To prevent this population change causing assessment of effects to be skewed, the most recent count data (SMP, 2012) are used for the assessments of effects, rather than the Seabird 2000 results.

126 The size of the non-breeding-period regional gannet population is assumed to be 31,200 birds based on Skov *et al.* (1995). Although it is likely that many of the birds present in the non-breeding period are from the regional breeding population, birds from further afield, including colonies in Norway, are also likely to be present at this time (Wernham *et al.* 2002).

12.6.4.4 Nature Conservation Importance

127 The NCI of gannets using the site is rated as high throughout the year on account of the regular presence of large numbers of individuals from one or more designated internationally designated population. The mean number present in the breeding season in the offshore site buffered to 1 km exceeds 1% of the regional breeding population, with the majority of birds likely to be from the Bass Rock, a breeding site 27 km away that is internationally important for this species, and a component of the Forth Islands SPA.

12.6.4.5 Offshore Wind Farm Studies of Gannet

128 Post construction monitoring at operational wind farms indicate that gannets are likely to be largely displaced from, and deflected around the footprint of the proposed wind farm (PMSS, 2006, Christensen *et al.*, 2004, Leopold *et al.*, 2011, Diersche and Garthe, 2006). Furthermore, gannets entering the Egmond aan Zee wind farm in the Netherlands always stopped foraging, decreased flight height to <10 m (i.e. to well below rotor height) and cut across its margin suggesting that habitat loss in terms of foraging area is likely to be effectively total within the footprint of the wind farm (Leopold *et al.*, 2011).

129 Results of radar and visual studies indicate that gannets are deflected around or away from wind farms when they approach relatively closely to the perimeter (Petersen *et al.*, 2006, Leopold *et al.*, 2011).

130 No records of gannets colliding with wind turbines were reported by Diersche and Garthe (2006) in a literature review on the effects of offshore wind farms on seabirds. Collision risk will be dependent on the proportion of the at-risk population displaced from the wind farm footprint and the flight behaviour of birds that are not displaced (Leopold *et al.*, 2011).

131 Evidence of gannets flying low through turbine arrays has been suggested as birds habituating to the Egmond aan Zee wind farm (Leopold and Camphuysen, 2008). This would reduce the energy costs associated with birds detouring around wind farms to access foraging areas.

12.6.5 Little Gull *Larus minutus*

12.6.5.1 Status

132 Little gull occurs on passage in Scottish waters, in spring, and more commonly in autumn (Forrester *et al.* 2007). Off the Fife coast, it is considered a passage migrant, mainly in autumn, with small numbers also occurring in winter (Dickson, 2002). There have been one, possibly two, breeding records of little gulls in Scotland in 1988 and 1991, and five unsuccessful breeding attempts in England up to 2007 (Holling *et al.,* 2010).

133 In year 1, 298 little gulls were recorded on surveys in the study area, with the majority of birds (89.3%) recorded in the buffer area, mainly in October. Numbers recorded on surveys in year 2 were slightly lower (220 birds), although the majority of birds (97.3%) were again recorded in the buffer area in September and October (refer to Table 12.8).

134 In year 1, peak numbers of little gulls occurred in October, with an estimated 314 birds in the offshore site, and 1,467 birds in the buffer area. In year 2, estimated numbers of little gulls in the offshore site were lower, with a peak of 41 birds in September. Estimated numbers in the buffer area in year 2 were highest in October, with a peak of 2,923 birds. Outside of September and October, estimated numbers of little gulls in the study area were low (refer to Figure 12.7).

135 Overall, estimated numbers of little gulls in the Neart na Gaoithe buffer area exceeded the 1% threshold for internationally important numbers of little gulls (1,230 birds – Holt *et al.,* 2011) in October of both years 1 and 2 (refer to Figure 12.7).

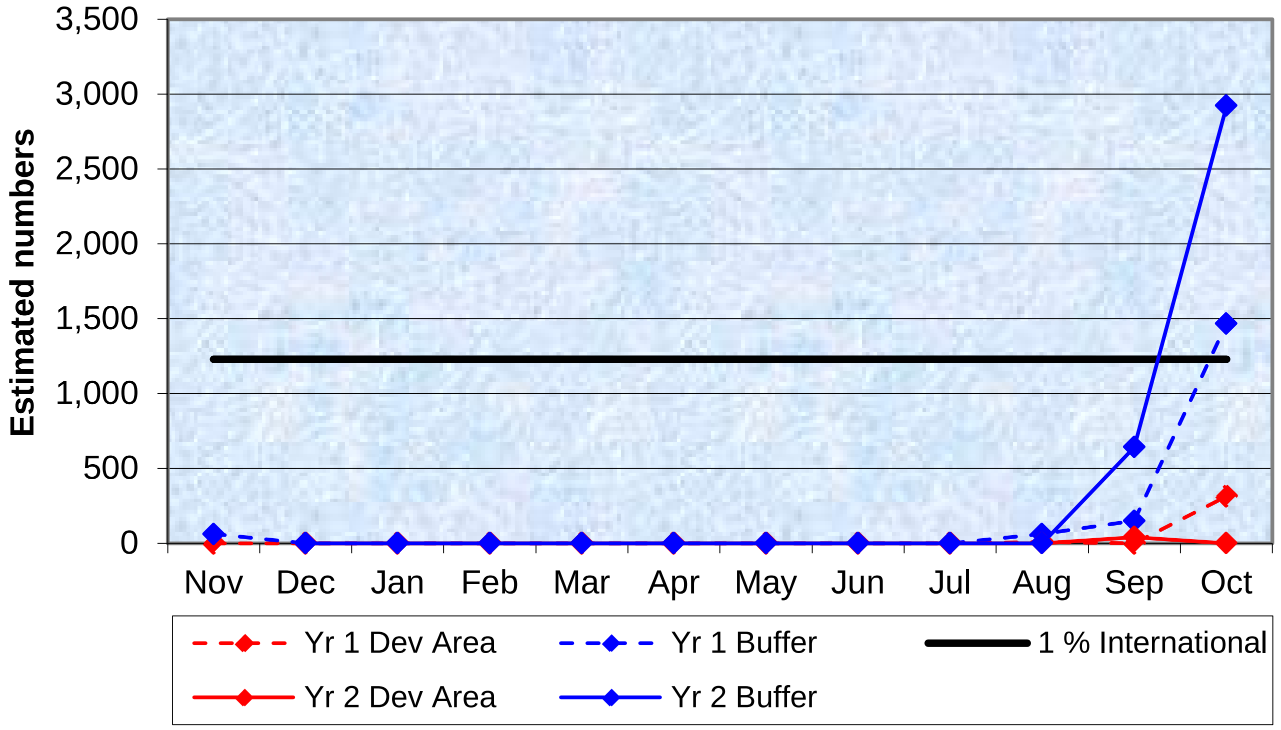

Figure 12.7: Monthly estimated numbers of little gulls in the development & buffer areas in years 1 and 2

12.6.5.2 Species Sensitivity

136 Little gull is listed on Annex I of the Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

137 A recent review assessed little gull as being at low risk of collision with turbines, displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms (Langston, 2010).

12.6.5.3 Population

138 The size of the UK autumn passage population is unknown but it is estimated that the average autumn UK population of little gulls is in the region of 7,500 birds. This figure is used for assessment of effects on the national population. There is also evidence from counts at coastal sites that there are large year-to-year variations in the number of birds that come across the North Sea to Britain (Forrester *et al.,* 2007) and that in some years the total number of individuals greatly exceeds 5,000.

139 For the purposes of assessment, the regional autumn passage population (3,100 birds), is assumed to be the mean of the years 1 and 2 estimates for the study area plus the maximum numbers recorded in the first year of baseline surveys in the Inch Cape survey area (RPS 2012) and Firth of Forth Round 3 Zone survey area (SWEL, 2011), but this is likely to be an underestimate.

140 This species has undergone a recent period of sustained population recovery in Western Europe and is now considered to be in favourable conservation status (BirdLife International, 2012). Therefore, it is likely that the regional autumn passage population has low sensitivity to additional mortality.

12.6.5.4 Nature Conservation Importance

141 The NCI of little gulls using the site is rated as high during the autumn passage period. The species merits this rating because it is listed on Annex I of the Birds Directive and because the numbers present in the offshore site in the autumn period may be of national importance (<1% of the UK population).

12.6.5.5 Offshore Wind Farms Studies of Little Gull

142 Evidence from existing projects regarding the extent to which little gulls are displaced from operational wind farms, and therefore the extent to which this species is likely to be displaced from the proposed development is unclear.

143 Evidence from existing wind farms indicates that there may be little or no barrier effect.

144 The risk of little gulls colliding with wind turbines is likely to be low based on reported flying heights and recorded fatalities from operational wind farms, although the very low probability of detecting seabird fatalities should be recognised.

12.6.6 Lesser Black-Backed Gull *Larus fuscus*

12.6.6.1 Status

145 Lesser black-backed gulls are common and widespread in summer, and breed in colonies in coastal and inland locations. In winter, many birds leave Scotland between November and March, although some remain all year, particularly in the south-west (Forrester *et al.*, 2007). Seabird 2000 recorded 111,835 breeding pairs in Britain (Mitchell *et al.*, 2004). The nearest large colonies to the development are on the islands in the Firth of Forth, and the Isle of May.

146 Lesser black backed gulls take a wide variety of prey and scavenged food, both at sea, and on farmland and refuse sites (Forrester *et al.*, 2007).

147 In year 1, 66 lesser black-backed gulls were recorded on surveys in the study area. Low numbers (10 birds) were recorded in the offshore site, with the majority of birds (84.8%) in the buffer area in the summer months, peaking in June (22 birds). Numbers on surveys in year 2 were higher, with 195 birds recorded, although low numbers (11

birds) were again recorded in the offshore site. The majority of birds (94.4%) were seen in the buffer area in the summer months, peaking in September (120 birds) (refer to Table 12.8).

148 Due to the low sample size of lesser black-backed gulls recorded in years 1 and 2, it was not possible to conduct Distance analysis on the data. Abundance rates (birds/km) were calculated instead.

149 Mean monthly lesser black-backed gull abundance was generally low in the offshore site and the buffer area in years 1 and 2, with a peak of 0.4 birds/km in the buffer area in September of year 2 (refer to Figure 12.8).

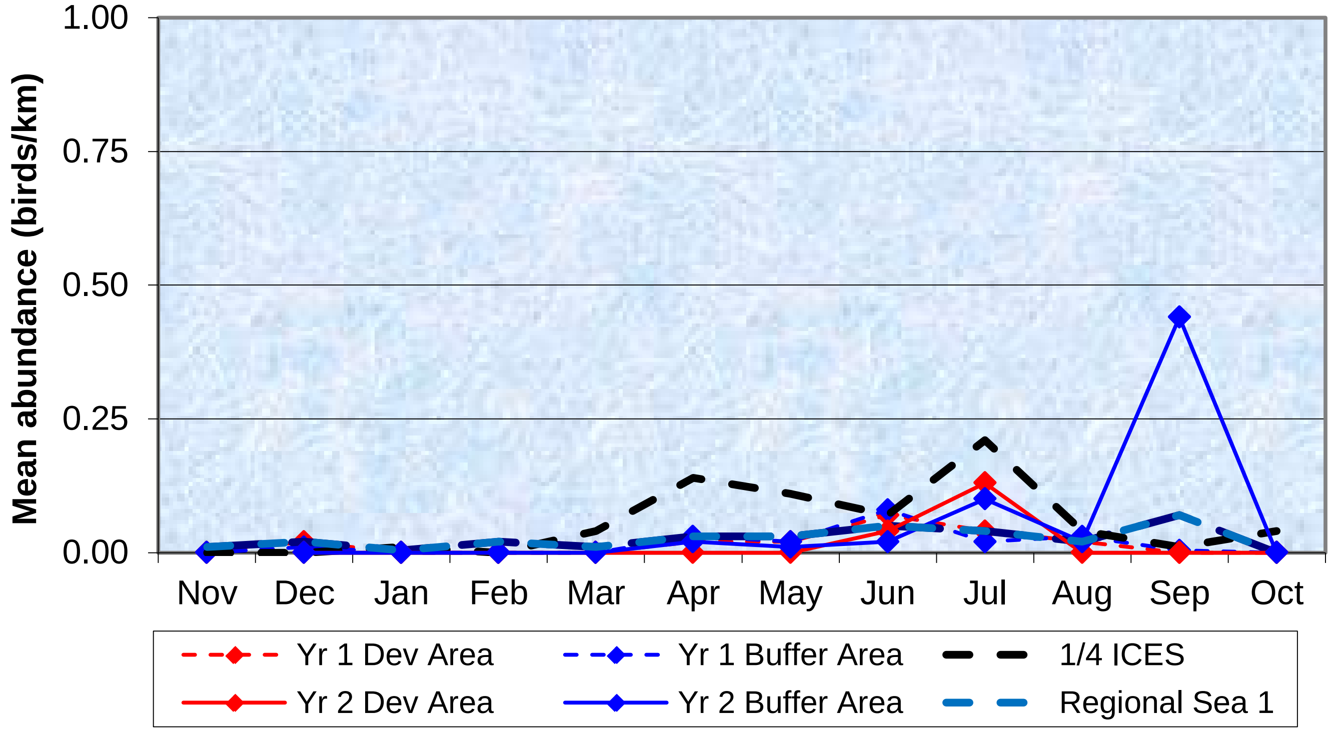

Figure 12.8: Comparison of lesser black-backed gull monthly mean abundance in the development & buffer areas in years 1 and 2, with ESAS data from surrounding ICES rectangles and Regional Sea 1

12.6.6.2 Species Sensitivity

150 Lesser black-backed gull is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

151 A recent review assessed lesser black-backed gull as being at moderate risk of collision. Displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms were rated as low risk. Overall, lesser black-backed gull was assessed as being at high risk from offshore wind developments, when the importance of its UK breeding population was taken into account Langston (2010).

152 Lesser black-backed gull is listed as a qualifying interest species in the breeding season only for the Forth Islands SPA on the UK east coast. This SPA lies between Peterhead and Blyth and could potentially be affected by the development. This SPA held 3.5% of the UK breeding population, and 2.4% of the biogeographic population at the time of designation (JNCC, 2012). Since designation, the breeding population at the SPAs has decreased from 2,920 pairs to 2,061 pairs (SMP, 2012). The distance between the offshore site and the Forth Islands SPA is within the mean maximum foraging range of lesser black-backed gull (132.1 km) (Thaxter *et al*., 2012).

12.6.6.3 Population

153 The regional breeding population size is assumed to be 22,034 adults (i.e. 11,017 pairs). This figure is based on the Seabird 2000 counts for the region (Mitchell *et al.* 2004).

154 The regional population size in the non-breeding period is assumed to be approximately 6,000 birds based on Skov *et al.* (1995).

12.6.6.4 Nature Conservation Importance

155 The NCI of lesser black-backed gulls using the offshore site is rated as moderate during the breeding season. The species is classed as moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA, where this species is a qualifying interest. However, the mean number present in the offshore site buffered to 1 km in the breeding season was well below 1% of the (at-sea) regional population and the species is not subject to any special legislative protection, nor is it on any conservation priority lists.

12.6.6.5 Offshore Wind Farm Studies of Lesser Black-Backed Gull

156 Results from bird monitoring at operational offshore and coastal wind farms indicate that a small proportion of lesser black-backed gulls may be displaced from the footprint of offshore wind farms; however most studies show no significant change in abundance of lesser black-backed gulls between pre-and post-construction surveys.

157 Visual and radar studies suggest that operational wind farms present only a partial barrier to lesser black backed gulls. Studies of wind farms as barriers to migration or regular bird flights, reviewed in Hötker *et al.*(2006), found no studies where wind farms acted as a barrier to lesser black-backed gulls and three studies where they were shown not to act as a barrier.

158 The risk of lesser black-backed gulls colliding with wind turbines is likely to be moderate based on reported flying height and recorded fatalities from operational wind farms. The review of offshore wind farm effects on birds (Diersche and Garthe, 2006) considers lesser black-backed gull collision fatalities at coastal wind farms., Further, there were 45 lesser black-backed gull fatalities reported in a review of the number of collision victims at wind farms in eight European countries (Hötker *et al.*, 2006).

12.6.7 Herring Gull *Larus argentatus*

12.6.7.1 Status

159 Herring gulls are resident, common and widespread, breeding in colonies in coastal and inland locations. There is a general movement southwards in winter months (Forrester *et al.,* 2007). Seabird 2000 recorded 142,942 breeding pairs in Britain (Mitchell *et al.,* 2004). The closest large breeding colonies to the development are on the islands in the Firth of Forth and the Isle of May.

160 Herring gulls exploit a wide range of food sources, including scraps and offal from trawlers, as well as on land at refuse dumps and farm land (Forrester *et al.,* 2007).

161 A total of 1,723 herring gulls were recorded on surveys in the study area in year 1, however only 50 birds were recorded in the offshore site. In year 2, a total of 1,433 birds were recorded on surveys, however only 58 birds were seen in the offshore site (refer to Table 12.8).

162 During the year 1 breeding season (April to August), the peak estimated number of herring gulls in the offshore site occurred in June (14 birds), with an estimated 484 birds in the buffer area in April. In the year 2 breeding season, peak estimated numbers of herring gulls in the offshore site were recorded in July (48 birds), with an estimated 2,015 birds in the buffer area in April (refer to Figure 12.9).

163 In the year 1 non-breeding season (September to March), the peak estimated number of herring gulls in the offshore site occurred in March of year 1 (39 birds) (refer to Figure 12.9). In the buffer area, estimated numbers peaked at 9,061 birds in January. However, this estimate was probably inflated by the presence of fishing vessels in the study area with large numbers of herring gulls associating with them, and should therefore be treated with caution as it may not reflect typical conditions. In year 2, peak estimated numbers of herring gulls also occurred in January although numbers were much lower, with an estimated 41 birds in the offshore site, and 587 birds in the buffer area.

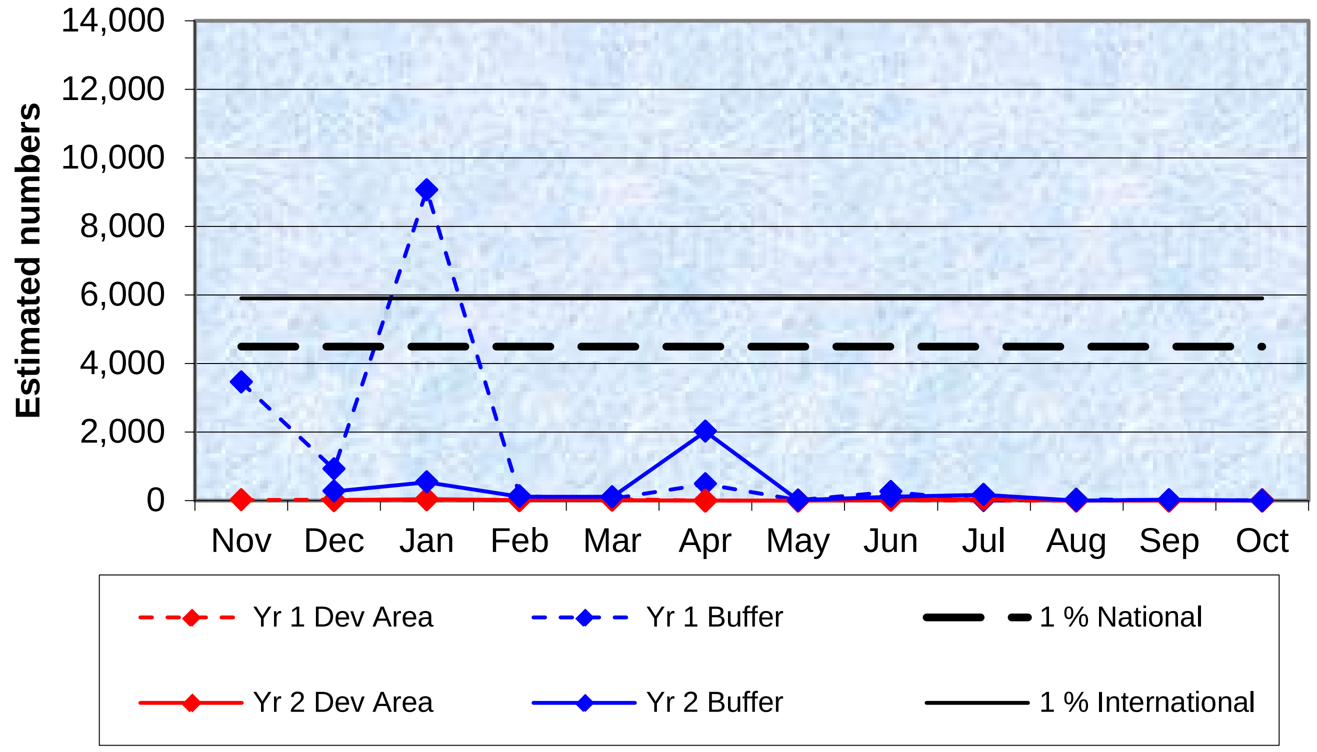

Figure 12.9: Monthly estimated numbers of herring gulls in the development & buffer areas in years 1 and 2

164 In years 1 and 2, a total of 1,284 herring gulls were recorded in flight, with 70.0% of birds flying below 22.5 m. A total of 383 birds (30.0%) were recorded flying above 22.5 m, i.e. within the rotor swept zone, at estimated heights of between 25 m and 60 m.

165 Foraging behaviour was recorded for 953 herring gulls in the study area in years 1 and 2 with scavenging at fishing vessels the most frequently recorded foraging behaviour (92.8%).

12.6.7.2 Species Sensitivity

166 Herring gull is currently red-listed on the UK Birds of Conservation Concern list (Eaton *et al*., 2009).

167 A recent review assessed herring gull as being at moderate risk of collision. Displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms were rated as low risk. Overall, herring gull was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

168 Herring gull is listed as a qualifying interest species in the breeding season for four SPAs on the UK east coast between Peterhead and Blyth that could potentially be affected by the development. These SPAs held 9.5% of the UK breeding population and 1.6% of the biogeographic population at the time of designation (JNCC, 2012). Since designation, the populations at these SPAs have decreased (SMP, 2012). The distance between the offshore site and two SPAs (Forth Islands SPA and St Abb's Head to Fast Castle SPA) is within the mean maximum foraging range (61.1 km), while the distance to Fowlsheugh SPA lies just outside this range, but is within the maximum known foraging range of this species (92 km) (Thaxter *et al*., 2012). Buchan Ness to Collieston Coast SPA is outside the maximum known foraging range.

12.6.7.3 Population

169 The breeding population of herring gulls in Scotland has undergone a prolonged period of decline and recent colony counts indicate that the decline is on-going, though recent declines in the south-east Scotland have been modest. The regional breeding population is assumed to be 43,302 breeding adults (i.e., 21,651 breeding pairs) and the size of the non-breeding-period regional herring gull population is assumed to be 200,000 birds based on Skov *et al.* (1995).

170 A large proportion of the regional breeding population is thought to stay in the region through the non-breeding period but these are joined by many more individuals from other breeding areas.

12.6.7.4 Nature Conservation Importance

171 The NCI of herring gulls using the offshore site is rated as moderate NCI throughout the year. The species merits this classification because it is on the BoCC Red List and is a UK BAP species. It also merits moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA, where this species is a qualifying interest.

12.6.7.5 Offshore Wind Farm Studies of Herring Gull

172 Results from bird monitoring at operational wind farms indicate that a small proportion of herring gulls may be displaced from the footprint of the proposed development. Studies typically show, however, that there is either no significant change or an increase in abundance of herring gulls at operational wind farms compared to pre-construction numbers (i.e. an attraction effect).

173 Visual and radar studies suggest that operational wind farms present only a partial barrier to herring gulls, with birds regularly flying amongst turbines.

174 The risk of herring gull colliding with wind turbines is likely to be low to moderate based on reported flying height and recorded fatalities from operational wind farms.

12.6.8 Great Black-backed Gull *Larus marinus*

12.6.8.1 Status

175 Great black-backed gull is a common resident species, occurring in coastal areas. Largest numbers occur on western coasts, with a British population of 17,394 breeding pairs recorded during Seabird 2000 (Mitchell *et al*., 2004). The Isle of May is the closest colony to the development, with 37 breeding pairs in 2008 (SMP, 2012). Great black-backed gulls are omnivorous, foraging at sea, estuaries and beaches, and less commonly at rubbish dumps (Forrester *et al*., 2007).

176 A total of 528 great black-backed gulls were recorded on surveys in the study area in year 1, however only 25 birds were seen in the offshore site, with the majority of birds (95.3%) in the buffer area. Fewer great black-backed gulls were recorded on surveys in year 2 (434 birds), however numbers in the offshore site (20 birds) were similar to year 1 (refer to Table 12.8).

177 During the year 1 breeding season (April to August), the peak estimated number of great black-backed gulls occurred in April, with zero birds in the offshore site, and an estimated 21 birds in the buffer area (refer to Figure 12.10). In year 2, peak estimated numbers of great black-backed gulls in the offshore site were recorded in June (seven birds), with an estimated 202 birds in the buffer area in April.

178 In the year 1 non-breeding season (September to March) the peak estimated number of great black-backed gulls in the offshore site was 21 birds in December, with an estimated 658 birds in the buffer area in January. In the year 2 non-breeding season, the peak estimated number of great black-backed gulls in the offshore site was seven birds in December and January, with an estimated 542 birds in the buffer area in September (refer to Figure 12.10).

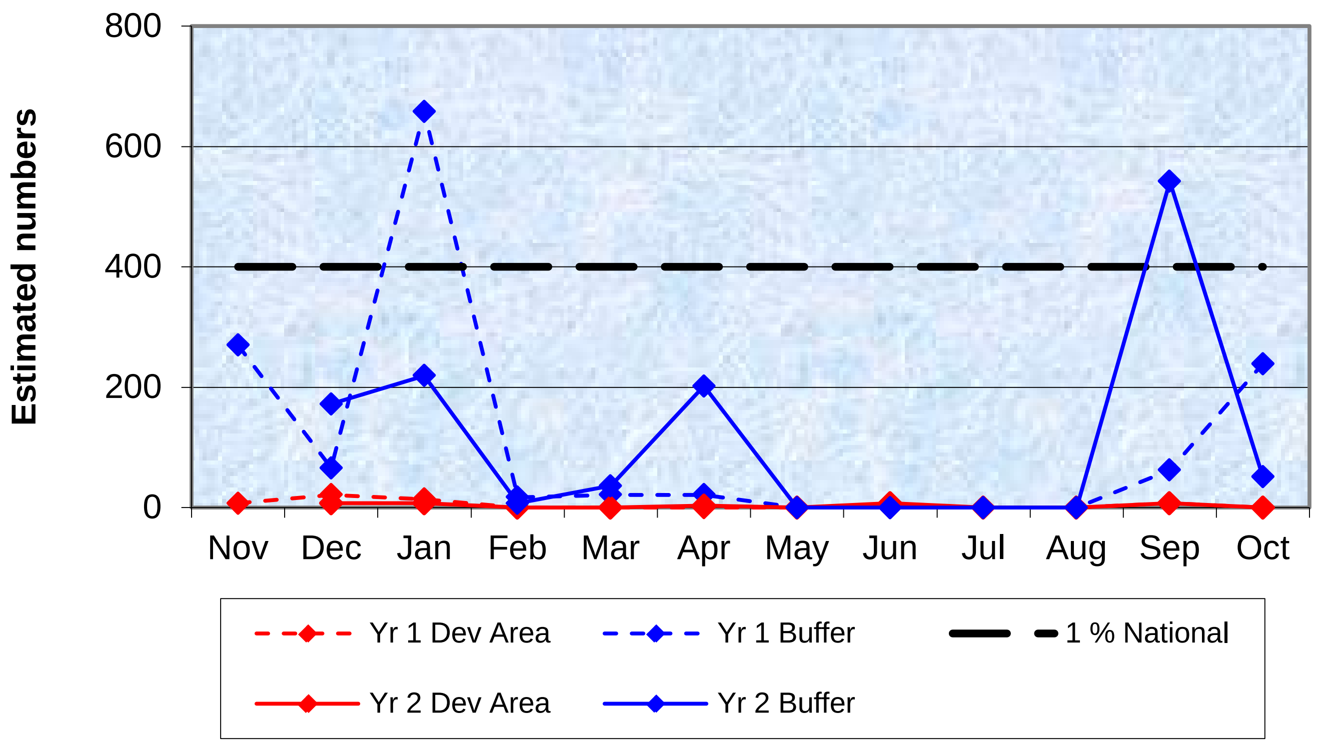

Figure 12.10: Monthly estimated numbers of great black-backed gulls in the development & buffer areas in years 1 and 2

179 In years 1 and 2, 440 great black-backed gulls were recorded in flight, with 80.7% of birds flying below 22.5 m. A total of 85 birds (19.3%) were recorded flying above 22.5 m, i.e. within the rotor swept zone, at estimated heights of between 25 m and 60 m.

180 Foraging behaviour was recorded for 188 great black-backed gulls in the study area in years 1 and 2, with scavenging at fishing vessels the most frequently recorded foraging behaviour (85.6%).

12.6.8.2 Species Sensitivity

181 Great black-backed gull is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al*., 2009).

182 Langston (2010) assessed great black-backed gull as being at moderate risk of collision. Displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms were rated as low risk. Overall, great black-backed gull was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

183 Great black-backed gull is not listed as a qualifying interest species in the breeding season for any SPAs on the UK east coast between Peterhead and Blyth (JNCC, 2012). The nearest SPA for breeding great blacked-gulls is Copinsay SPA, approximately 297 km from the offshore site. The estimated maximum foraging distance for this species is less than 10 km (Roos *et al*., 2010).

12.6.8.3 Population

184 The regional breeding population is assumed to be 226 breeding adults (i.e., 113 breeding pairs) and the size of the non-breeding-period regional great black-backed gull population is assumed to be 21,500 birds based on Skov *et al.* (1995).

185 A large proportion of the regional breeding population is thought to stay in the region through the non-breeding period but these are joined by many more birds from other breeding areas.

12.6.8.4 Nature Conservation Importance

186 The NCI of great black-backed gulls using the offshore site is rated as low NCI throughout the year. The species merits this classification because the mean number present in the offshore site buffered to 1 km in the breeding season is well below 1% of the (at-sea) regional breeding population, and the species is not subject to any special legislative protection.

12.6.8.5 Offshore Wind Farm Studies of Great Black-Backed Gull

187 Available data from other offshore wind farms indicate that great black-backed gulls may be attracted to offshore wind farms and there are not likely to be any displacement or barrier effects (Zucco *et al*., 2006).

188 Great black-backed gulls fly relatively more frequently at rotor height compared to most other seabird species. Studies undertaken to assess flight heights of seabirds indicate that 35% of all flights by great black-backed gull are at rotor height (Cook *et al*. In prep.). Consequently this species is at greater risk of collision than most other seabirds.

12.6.9 Black-Legged Kittiwake *Rissa tridactyla*

12.6.9.1 Status

189 Kittiwakes are one of the commonest seabird species in the UK, breeding in large colonies on suitable coastal cliff habitat. Largest numbers occur on the east coast, and 366,835 breeding pairs were recorded in Britain during Seabird 2000 (Mitchell *et al.,* 2004). The closest large colonies to the development are the Isle of May, St Abb's Head and Fowlsheugh.

190 Kittiwakes mostly prey on small fish species such as lesser sandeels and clupeids, as well as fishery discards (Forrester *et al.,* 2007).

191 Kittiwake was the fourth commonest seabird recorded on surveys in the study area in year 1, with a total of 3,955 birds. The majority of birds (79.7%) were recorded in the buffer area. Birds were recorded in all months, with peak numbers in September and October. In year 2, numbers recorded on survey were similar, with 4,123 birds seen. Numbers in the offshore site peaked in July (220 birds), while in the buffer area peak numbers were recorded in October (1,031 birds) (refer to Table 12.8).

192 During the Year 1 breeding season (April to August), the peak estimated number of kittiwakes in the offshore site occurred in August (159 birds), with an estimated 2,477 birds in the buffer area in April. In the Year 2 breeding season, estimated numbers of kittiwakes peaked in July, with 1,616 in the offshore site and 3,578 in the buffer area (refer to Figure 12.11).

193 In the post-breeding season (September and October), peak estimated numbers of kittiwakes in the offshore site occurred in September of Year 1 (2,195 birds), with 6,070 birds in the buffer area in October. In Year 2, peak estimated numbers of kittiwakes occurred in October, with an estimated 88 birds in the offshore site, and 8,380 birds in the buffer area (refer to Figure 12.11).

194 In the non-breeding season (November to March), peak estimated numbers of kittiwakes in December of Year 1, with 39 birds in the offshore site and 379 birds in the buffer area. In Year 2, peak estimated numbers of kittiwakes in the offshore site occurred in December of Year 1 (808 birds), with a peak of 1,091 birds in the buffer area in January (refer to Figure 12.11).

195 In years 1 and 2, 4,914 kittiwakes were recorded in flight, with the majority of birds (94.0%) recorded flying below 22.5 m in height (refer to Table 12.10). A total of 295 birds (6.0%) were recorded flying above 22.5 m, i.e. within the rotor swept zone, at estimated heights of between 25 m and 70 m, although the majority of higher flying birds (79.7%) were recorded below 35 m.

196 Foraging behaviour was recorded for 1,662 kittiwakes in the study area in years 1 and 2, with the majority of all foraging birds recorded, actively searching (27.2%) and dipping (57.4%).

197 In the breeding season, just over a fifth of all birds recorded were flying south-west (20.1%), with 19.7% of birds flying northeast. In the non-breeding season, 18.7% of birds were recorded flying south-west, with 15.1% flying south. An additional 1,110 birds were recorded as circling.

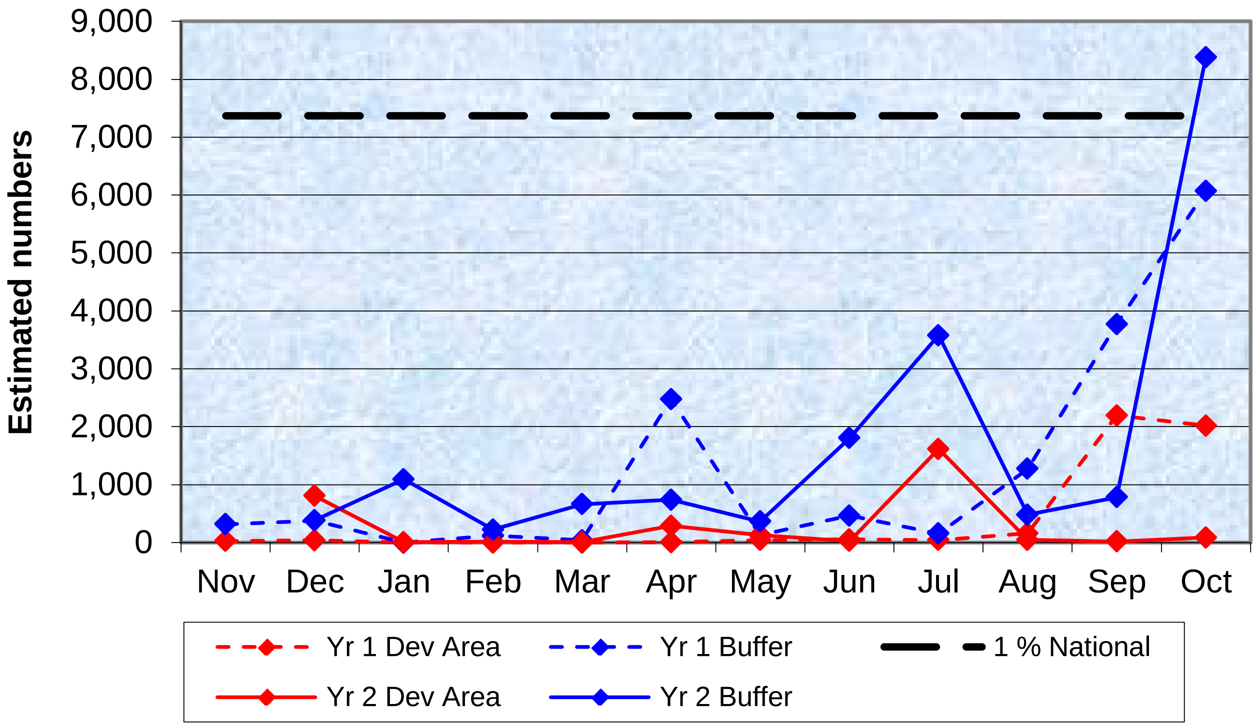

Figure 12.11: Monthly estimated numbers of kittiwakes in the development & buffer areas in years 1 and 2

12.6.9.2 Species Sensitivity

198 Kittiwake is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009). A recent review assessed kittiwake as being at moderate risk of collision. Displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms were rated as low risk. Overall, kittiwake was assessed as being at low risk from offshore wind developments (Langston, 2010).

199 Kittiwake is listed as a qualifying interest species in the breeding season for five SPAs on the UK east coast between Peterhead and Blyth that could potentially be affected by the development. These SPAs held 20.5% of the UK breeding population and 3.2% of the biogeographic population at the time of designation (JNCC, 2012). Since designation, the populations at these SPAs have decreased (SMP, 2012). The distance between the offshore site and two SPAs (Forth Islands SPA and St Abb's Head to Fast Castle SPA) is within the mean maximum foraging range of this species (60 km). The distance to the three other SPAs (Buchan Ness to Collieston Coast SPA, Fowlsheugh SPA and Farne Islands SPA) is within the maximum known foraging range (120 km) (Thaxter *et al.*, 2012).

12.6.9.3 Population

200 Kittiwakes breeding in eastern Scotland are currently experiencing a prolonged period of population decline, and the regional breeding population is assumed to be 121,101 breeding adults (i.e., 60,550 breeding pairs).

201 The size of the post-breeding-period regional kittiwake population is assumed to be the same as the regional breeding population, which is 121,394 adults. The size of the non-breeding-period regional kittiwake population is assumed to be 68,000 birds, based on Skov *et al.* (1995).

12.6.9.4 Nature Conservation Importance

202 The NCI of kittiwakes using the offshore site is rated as moderate during the breeding season. The species is classed as moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA and St Abb's Head to Fast Castle SPA, where this species is a qualifying interest. However, the mean number present in the offshore site, buffered to 1 km in the breeding season, is well below 1% of the (at-sea) regional population. The species is not subject to any special legislative protection, nor is it on any conservation priority lists.

12.6.9.5 Offshore Wind Farm Studies of Kittiwake

203 Results from bird monitoring at operational wind farms indicate that kittiwakes are not likely to be displaced from the footprint of an offshore wind farm. Typically, studies at existing wind farms show either no significant change or small increases in kittiwake numbers compared to pre-construction numbers at these sites.

204 Results of radar and visual studies indicate that flying gulls in general are not deflected around or away from wind farms and kittiwakes are reported as 'commonly flying through wind farms' (Diersche and Garthe, 2006).

205 The risk of kittiwakes colliding with wind turbines is likely to be low to moderate based on reported flying heights and recorded fatalities from operational wind farms.

206 Kittiwakes are considered to have low sensitivity to barrier effects on account of a low wing loading (Maclean *et al.*, 2009).

12.6.10 Arctic Tern *Sterna paradisaea*

12.6.10.1 Status

207 Arctic terns are summer visitors to Britain, breeding in colonies at coastal sites and also inland. Seabird 2000 recorded 56,123 breeding pairs in Britain (Mitchell *et al.,* 2004). The closest large colony to the study area is the Isle of May. Sandeels are the major prey species (Mitchell *et al.,* 2004).

208 In year 1, a total of 857 Arctic terns were recorded on surveys in the study area. Approximately three quarters of all birds (76.6%) were recorded in the buffer area in August. Fewer birds were recorded in year 2 (329 birds), although most birds (88.8%) were again in the buffer area in August and September (refer to Table 12.8). The majority of aged birds were adults (95.7%).

209 Due to the low sample size of Arctic terns recorded in years 1 and 2, it was not possible to conduct distance analysis on the data. Simple abundance rates (birds/km) were calculated instead.

210 Mean monthly Arctic tern abundance was generally low in the offshore site and the buffer area in years 1 and 2, apart from in August (refer to Figure 12.12). Highest mean abundance was recorded in August of year 1, with a peak of 4.3 birds/km in the offshore site, compared to 2.7 birds/km in the buffer area. Peak mean abundance in August of year 2 was lower. ESAS abundance data from the surrounding ICES rectangles and across Regional Sea 1 was very low.

211 A total of 964 Arctic terns were recorded in flight in Years 1 and 2, with almost all birds (99.6%) flying below 22.5 m in height (refer to Table 12.10). A total of four birds (0.4%) were recorded flying above 22.5 m, at estimated heights of 25 and 30 m. In addition, a further 210 unidentified common/Arctic terns and 34 unidentified tern species were recorded in flight in Years 1 and 2. All birds were recorded flying below 22.5 m.

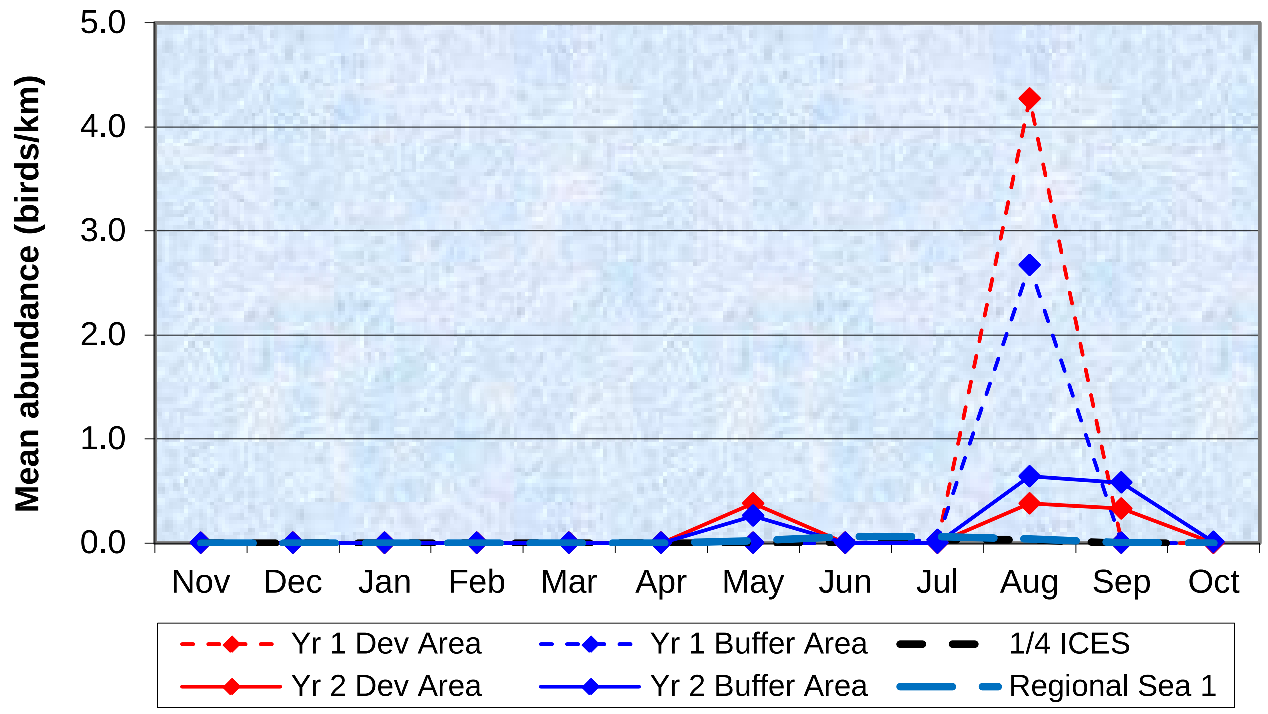

Figure 12.12: Comparison of Arctic tern monthly mean abundance in the development & buffer areas in years 1 and 2, with ESAS data from surrounding ICES rectangles and Regional Sea 1

12.6.10.2 Species Sensitivity

212 Arctic tern is listed on Annex I of the Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

213 A recent review assessed Arctic tern as being at moderate risk of collision and habitat loss or changes in prey distribution resulting from offshore wind farms. Displacement and barrier effects were rated as low risk. Overall, Arctic tern was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

214 Arctic tern is listed as a qualifying interest species in the breeding season for three SPAs on the UK east coast between Peterhead and Blyth (Coquet Island SPA, Farne Islands SPA and Forth Islands SPA) that could potentially be affected by the development. These SPAs held 9.3% of the UK breeding population and > 0.4% of the biogeographic population at the time of designation (JNCC, 2012). The distance between the offshore site and the Forth Islands SPA is within the mean maximum foraging range of Arctic tern (24.2 km) (Thaxter *et al.*, 2012).

12.6.10.3 Nature Conservation Importance

215 The NCI of Arctic terns using the offshore site is rated as high. The species merits high NCI because it is on Annex I of the Birds Directive. It is also likely that a high proportion of individuals present are from SPA designated breeding sites where this species is a qualifying interest, including the Forth Islands SPA. The mean number present in the autumn passage period (but not in other periods) in the offshore site buffered to 1 km exceeds 1% of the assumed regional breeding population.

12.6.10.4 Population

216 The regional breeding population of Arctic terns is assumed to be 10,056 birds, or 5,028 pairs. However, there is no published estimate of the size of regional autumn passage population of Arctic tern. The birds present at this time of year are likely to comprise a mix of birds breeding within the region and further north in Scotland, and also possibly from Scandinavian breeding grounds. The size of the population may therefore, be much greater than the regional breeding population. A more appropriate population to base the EIA assessment on is the number breeding in eastern Scotland and north-east England; approximately 98,052 adults based on the Seabird 2000 census (Mitchell *et al.*, 2004)

217

12.6.10.5 Offshore Wind Farm Studies of Arctic Tern

218 Results from bird monitoring at operational wind farms indicate that Arctic/common terns are not likely to be displaced from the footprint of an offshore wind farm (Diersche and Garthe, 2006).

219 Most studies of Arctic/common tern flying behaviour suggest that wind turbines are unlikely to present a barrier. The review by Hötker *et al.* (2006) of these studies of wind farms as barriers to birds identified three studies where wind farms were concluded to act as barriers to common terns, and one where they were not.

220 The number of Arctic terns colliding with wind turbines is likely to be low based on collision risk studies and reported flying heights from operational wind farms.

12.6.11 Guillemot *Uria aalge*

12.6.11.1 Status

221 Guillemots are one of the commonest seabird species in Britain, breeding in large colonies on suitable coastal cliff habitat. There are several large colonies on the east coast, and Seabird 2000 recorded 1,322,830 individuals at breeding colonies in Britain (Mitchell *et al.,* 2004). The closest large colonies to the study area are the Isle of May, St Abb's Head and Fowlsheugh. Guillemots mostly prey on small fish species such as lesser sandeels, sprat and gadoid fish (Mitchell *et al.,* 2004).

222 Guillemot was the third most frequently recorded seabird recorded on surveys in year 1, with a total of 7,898 birds. Overall, the majority of guillemots (84.1%) were recorded in the buffer area. Peak numbers were recorded in the offshore site (705 birds) and the buffer area (1,833 birds) in October. A further 3,323 unidentified guillemot/razorbills, and 1,348 unidentified auks were also seen on surveys in year 1 (refer to Table 12.8).

223 In year 2, guillemot was the second most frequently recorded species on surveys in the study area (11,730 birds). The majority of birds (86.8%) were again recorded in the buffer area. Numbers of guillemots in the offshore site were slightly higher than in year 1, with a peak of 427 birds in April. Numbers recorded in the buffer area peaked in September (2,242 birds). A further 1,532 unidentified guillemots/razorbills and 827 unidentified auks were also seen on the year 2 surveys (refer to Table 12.8).

224 During the breeding period (April to June), the peak estimated number of guillemots in year 1 occurred in June, with 354 birds in the offshore site and 4,474 birds in the buffer area. In year 2, estimated numbers of guillemots in the offshore site peaked in April (3,272 birds), with 6,650 in the buffer area in May (refer to Figure 12.13).

225 During the chick period (July and August), the peak estimated number of guillemots in the offshore site in year 1 occurred in July (130 birds), with 1,551 birds in the buffer area in August. In year 2, estimated numbers of guillemots peaked in July, with 1,186 birds in the offshore site, and 6,724 birds in the buffer area (refer to Figure 12.13).

226 In the post-breeding season (September and October), peak estimated numbers of guillemots occurred in October of year 1, with 8,315 birds in the offshore site, and 20,136 birds in the buffer area. In year 2, peak estimated numbers of guillemots occurred in September, with an estimated 2,439 birds in the offshore site, and 21,760 birds in the buffer area (refer to Figure 12.13).

227 In the non-breeding season (November to March), peak estimated numbers of guillemots in the offshore site occurred in November of year 1 (1,039 birds), with 3,785 birds in the buffer area in March. In year 2, peak estimated numbers of guillemots in the offshore site occurred in December and March, with 726 and 725 birds respectively. Estimated numbers in the buffer area were highest in March (8,410 birds) of year 2 (refer to Figure 12.13).

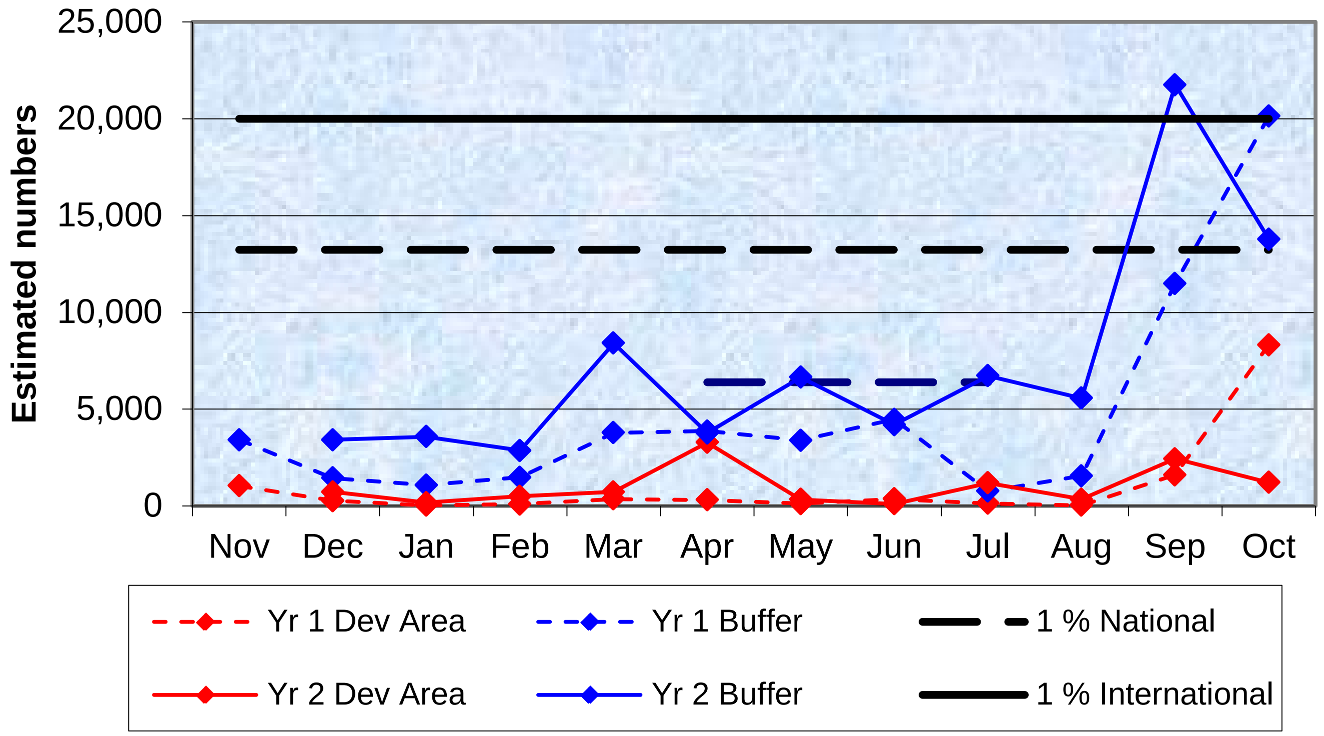

Figure 12.13: Monthly estimated numbers of guillemots in the development & buffer areas in years 1 and 2

228 Foraging behaviour was recorded for 197 guillemots in the study area in years 1 and 2. The majority of all foraging birds were recorded holding fish (51.8%) and pursuit diving (38.6%). Prey was identified for 21 prey items, with 20 sandeels and one herring/sprat recorded.

229 In years 1 and 2, 5,061 guillemots were recorded in flight, with almost all birds recorded flying below 22.5 m in height (refer to Table 12.10). The majority of birds (98.4%) were recorded flying below 7.5 m in height. Two birds (0.04%) were recorded flying above 22.5 m i.e. within the likely rotor-swept zone, at estimated heights of 25 m to 30 m.

230 Flight direction was recorded for 2,875 guillemots in the breeding season (April to June), with direction recorded for 2,193 guillemots in the post-breeding and non-breeding seasons combined (July to March). In the breeding season, just under a third of all birds recorded were flying east (30.2%), with 23.0% of birds flying north-east. In the post-breeding and non-breeding seasons, approximately one third of birds were recorded flying north east (32.1%), with 17.2% flying east.

12.6.11.2 Species Sensitivity

231 Guillemot is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

232 Guillemot is listed as a qualifying interest species in the breeding season for five SPAs on the UK east coast between Peterhead and Blyth that could potentially be affected by the development. These SPAs held 65.2% of the UK breeding population and 20.4% of the biogeographic population at the time of designation (JNCC, 2012). The distance between the offshore site and four SPAs (Farne Islands SPA, Firth of Forth Islands SPA, Fowlsheugh SPA and St Abb's Head to Fast Castle SPA) is within the mean maximum foraging range of guillemot (84.2 km). The distance to the remaining SPA (Buchan Ness to Collieston Coast SPA) is within the maximum known foraging range (135 km) (Thaxter *et al*., 2012).

12.6.11.3 Population

233 Guillemot is the commonest seabird species breeding in the region. The breeding population of guillemots in Scotland has undergone a prolonged period of decline and recent colony counts indicate that the decline is on-going. The regional breeding population is assumed to be 312,151 breeding adults.

234 The size of the post-breeding-period regional guillemot population is assumed to be 274,050 adults based on Skov *et al.* (1995).

235 The size of the non-breeding-period regional guillemot population is assumed to be 521,000 birds based on Skov *et al.* (1995). An unknown proportion of the regional breeding population may remain in the region through the non-breeding period but these are joined by many more birds from other breeding areas.

12.6.11.4 Nature Conservation Importance

236 The NCI of guillemots using the offshore site is categorised as moderate during the breeding season. The species is classed as moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA and St Abb's Head to Fast Castle SPA, where this species is a qualifying interest. The mean numbers present in the offshore site, buffered to 1 km, are approximately 1% of the (at-sea) regional population during the colony attendance part of the breeding season and in the post-breeding season, but are well below 1% at other times of year. This species is not subject to any special legislative protection, nor is it on any conservation priority lists.

12.6.11.5 Offshore Wind Farm Studies of Guillemot

237 The extent to which guillemots are displaced from operational wind farms differs between studies. Monitoring studies at offshore wind farms in Denmark and the Netherlands indicate conflicting evidence on the extent that guillemot are displaced. However, it is presumed that low statistical power as a consequence of low bird densities, clumped distributions or between year variation in bird numbers may explain some of the apparent differences in these results. It is likely that guillemots will be partly displaced from the wind farm footprint and the proportion of birds displaced may be sensitive to spacing distance between turbines.

238 There is limited evidence of guillemot flights deflecting around or away from wind farms although guillemots are reported as having a strong deflection/avoidance response at German wind farms (Diersche and Garthe, 2006).

239 The risk of guillemots colliding with wind turbine rotors is likely to be very low, based on reported flying heights at operational wind farms.

12.6.12 Razorbill *Alca torde*

12.6.12.1 Status

240 Razorbills are one of the commonest seabird species in Britain, breeding in large colonies of other seabirds on suitable coastal cliff habitat. There are several large colonies on the east coast, and Seabird 2000 recorded 164,557 individuals breeding in Britain (Mitchell *et al.,* 2004). The closest large colonies to the study area are at the Isle of May, St Abb's Head and Fowlsheugh.

241 Razorbills prey on sandeels and other small fish species (Snow and Perrins 1998). A study in the Netherlands concluded that razorbills are probably more dependent on a specialised diet of small schooling fish such as herring, sprat or sandeels than guillemots, which have a much broader diet (Ouwehand *et al.* 2004).

242 Razorbill was the fifth most frequently recorded seabird recorded on surveys in the study area in year 1, with a total of 3,980 birds. Overall, the majority of razorbills (85%) were in the buffer area. Peak numbers were recorded in the offshore site (283 birds) and the buffer area (2,043 birds) in October. A further 3,323 unidentified guillemot/razorbills, and 1,348 unidentified auks were also seen in year 1) (refer to Table 12.8).

243 In year 2, razorbill was the fifth most frequently recorded species on surveys in the study area (3,131 birds). The majority of birds (87.4%) were again recorded in the buffer area. Numbers of razorbills in the offshore site peaked at 135 birds in September. Numbers recorded in the buffer area peaked at 1,681 birds in September. A

further 1,532 unidentified guillemots/razorbills and 827 unidentified auks were also seen on the year 2 surveys (refer to Table 12.8).

244 During the breeding period (April to June), the peak estimated number of razorbills in the offshore site in year 1 occurred in June (48 birds), with 465 birds in the buffer area in April (refer to Figure 12.14). In year 2, estimated numbers of razorbills occurred in May, with 346 birds in the offshore site, and 1,048 birds in the buffer area.

245 During the chick period (July and August), the peak estimated number of razorbills occurred in August of year 1, with 1,500 birds in the offshore site, and 4,359 birds in the buffer area. In year 2, estimated numbers of razorbills peaked in July, with 376 birds in the offshore site, and 1,687 birds in the buffer area (refer to Figure 12.14).

246 In the post-breeding season (September and October), peak estimated numbers of razorbills occurred in October, with 3,054 birds in the offshore site, and 19,892 birds in the buffer area in year 1. In year 2, peak estimated numbers of razorbills also occurred in October, with an estimated 877 birds in the offshore site, and 14,165 birds in the buffer area (refer to Figure 12.14).

247 In the non-breeding season (November to March), peak estimated numbers of razorbills in the offshore site occurred in November of year 1 (264 birds), with 986 birds in the buffer area in March. In year 2, peak estimated numbers of razorbills in the offshore site occurred in December (303 birds), with 997 birds in the buffer area in February (refer to Figure 12.14).

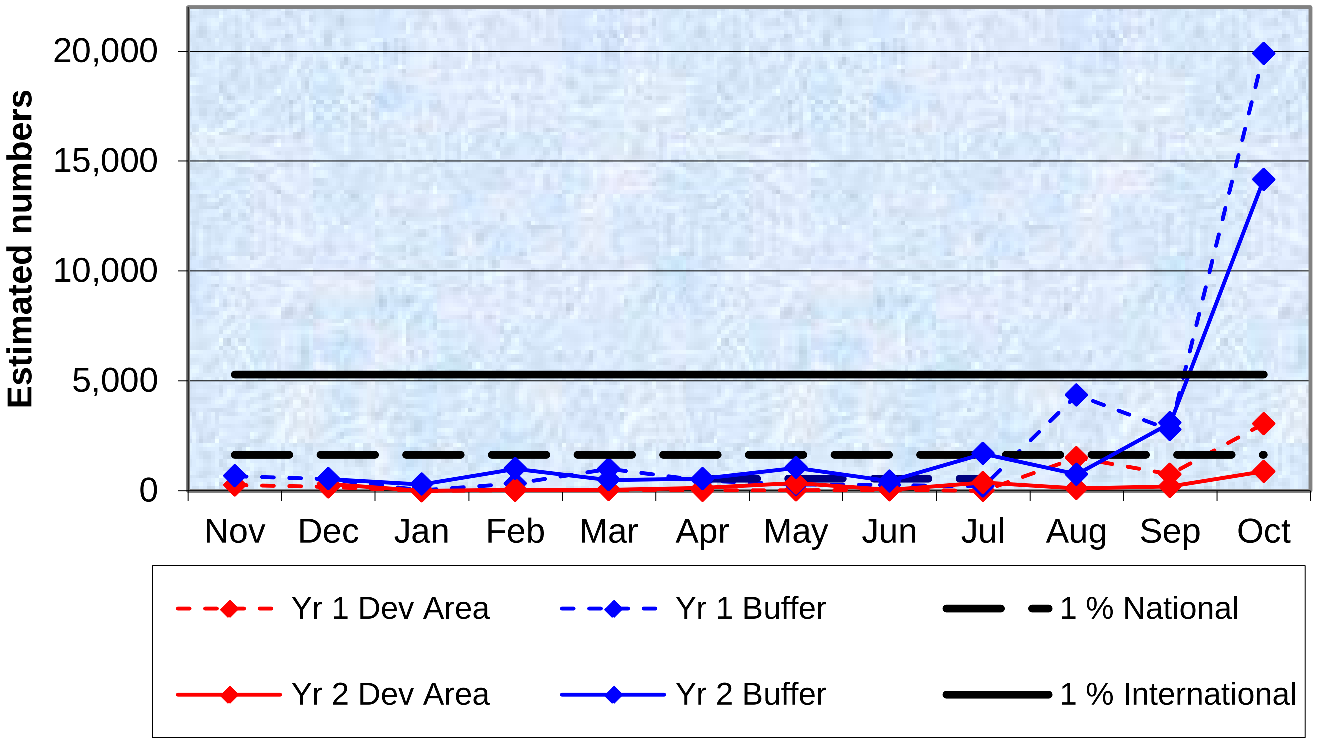

Figure 12.14: Monthly estimated numbers of razorbills in the development & buffer areas in years 1 and 2

248 In years 1 and 2, 1,726 razorbills were recorded in flight, with all birds recorded flying below 22.5 m in height. The majority (98.4%) were recorded flying below 7.5 m in height (refer to Table 12.10).

249 Flight direction was recorded for 544 razorbills in the breeding season (April to July), with direction recorded for 1,181 razorbills in the post-breeding and non-breeding seasons (August to March).

250 In the breeding season, just over a fifth of all birds recorded were flying south-west (22.8%), or north-east (21.9%), with slightly lower numbers flying east/west. In the non-breeding season, just over a fifth of all birds recorded were flying north-east (21.7%) with lower numbers flying north (15.8%).

12.6.12.2 *Species Sensitivity*

251 Razorbill is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

252 A recent review assessed razorbill as being at moderate risk of displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms, while collision risk was rated as low risk. Overall, razorbill was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

253 Razorbill is listed as a qualifying interest species in the breeding season for three SPAs on the UK east coast between Peterhead and Blyth that could potentially be affected by the development. These SPAs held 8.7% of the UK breeding population and 1.5% of the biogeographic population at the time of designation (JNCC, 2012). The distance between the offshore site and two of these SPAs (Forth Islands SPA and St Abb's Head to Fast Castle SPA) is within the mean maximum foraging range of razorbill (48.5 km). The distance to Fowlsheugh SPA is within the maximum known foraging range (95 km) (Thaxter *et al.*, 2012).

12.6.12.3 *Population*

254 The breeding population of razorbills in Scotland has undergone a prolonged period of decline and recent colony counts indicate that the decline is on-going. The regional breeding population is assumed to be 26,737 breeding adults.

255 The regional population estimate for the chicks-at-sea period is 52,429 birds. The size of the post-breeding-period regional razorbill population is assumed to be 75,600 birds, based on Skov *et al.* (1995). The size of the non-breeding-period regional razorbill population is assumed to be 14,400 birds based on Skov *et al.* (1995).

12.6.12.4 *Nature Conservation Importance*

256 The NCI of razorbills using the offshore site is categorised as moderate during the breeding season. The species is classed as moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA and St Abb's Head to Fast Castle SPA, where this species is a qualifying interest. The mean numbers present in the offshore site buffered to 1 km exceed 1% of the (at-sea) regional population during the colony attendance part of the breeding season and the winter period, and exceed 5% of the regional population during the post-breeding season. This species is not subject to any special legislative protection, nor is it on any conservation priority lists.

12.6.12.5 *Offshore Wind Farm Studies of Razorbill*

257 In general, the evidence of the displacement, barrier and collision effects of existing wind farms on razorbills appears to be similar as those for guillemot, a closely related species.

258 Razorbills may be totally displaced only when turbine density exceeds a particular point (Leopold *et al.*, 2011). The authors of this study concluded that the magnitude of the displacement effect for razorbills was less than 50%.

259 There is limited evidence in post-construction monitoring reports of razorbill flights deflecting around or away from wind farms although they are reported as having a strong deflection/avoidance response (Diersche and Garthe, 2006).

260 Nearly all razorbills monitored at operational wind farms were recorded outside the breeding season and so there is some uncertainty how actively breeding razorbills, which are likely to form the bulk of the at-risk population at Neart na Gaoithe will respond.

261 The risk of razorbills colliding with wind turbines is likely to be very low based on reported flying heights from existing wind farm studies.

12.6.13 Atlantic Puffin *Fratercula arctica*

12.6.13.1 Status

262 Puffins are one of the commonest seabird species in Britain, breeding in coastal colonies. There are several large colonies on the east coast of Scotland, and Seabird 2000 recorded 579,500 breeding pairs in Britain (Mitchell *et al.* 2004). The closest large colony to the study area is the Isle of May, with a population of 56,867 pairs in 2009 (SMP, 2012). Lesser sandeel is the commonest prey item for puffins, but they also eat sprat, herring and a wide range of young gadoid fish (Harris, 1984).

263 Puffin was the second commonest seabird recorded on surveys in year 1, with a total of 11,199 birds seen on surveys. The majority of birds (88.3%) were in the buffer area. Peak numbers of puffins were recorded in the offshore site (574 birds) and the buffer area (5,862 birds) in August. Three unidentified puffin/little auks were also seen in year 1 (refer to Table 12.8).

264 In year 2, puffin was the third most frequently recorded species on surveys in the study area, with 6,622 birds seen, just over half of the year 1 total. The majority of birds (83.2%) were again recorded in the buffer area. Numbers of puffins in the offshore site peaked at 298 birds in July. Numbers recorded in the buffer area peaked at 1,198 birds in September. Both peaks were lower than the peaks recorded in year 1 (refer to Table 12.8).

265 During the breeding period (April to August), the peak estimated number of puffins occurred in August, with 2,461 birds in the offshore site, and 23,728 birds in the buffer area. In year 2, estimated numbers of puffins in the offshore site were highest in July (2,480 birds), with 7,127 birds in the buffer area in May (refer to Figure 12.15).

266 In the post-breeding season (September and October), peak estimated numbers of puffins occurred in October, with 2,174 birds in the offshore site, and 11,893 birds in the buffer area in year 1. In year 2, an estimated 1,776 birds were in the offshore site, with 14,892 birds in the buffer area (refer to Figure 12.15).

267 Estimated numbers of puffins during the non-breeding season (November to March) were lower, with a peak in March in year 1, when 288 birds were in the offshore site, with 1,062 birds in the buffer area. In year 2, peak estimated numbers of puffins in the offshore site occurred in February (54 birds), with 349 birds in the buffer area in March (refer to Figure 12.15).

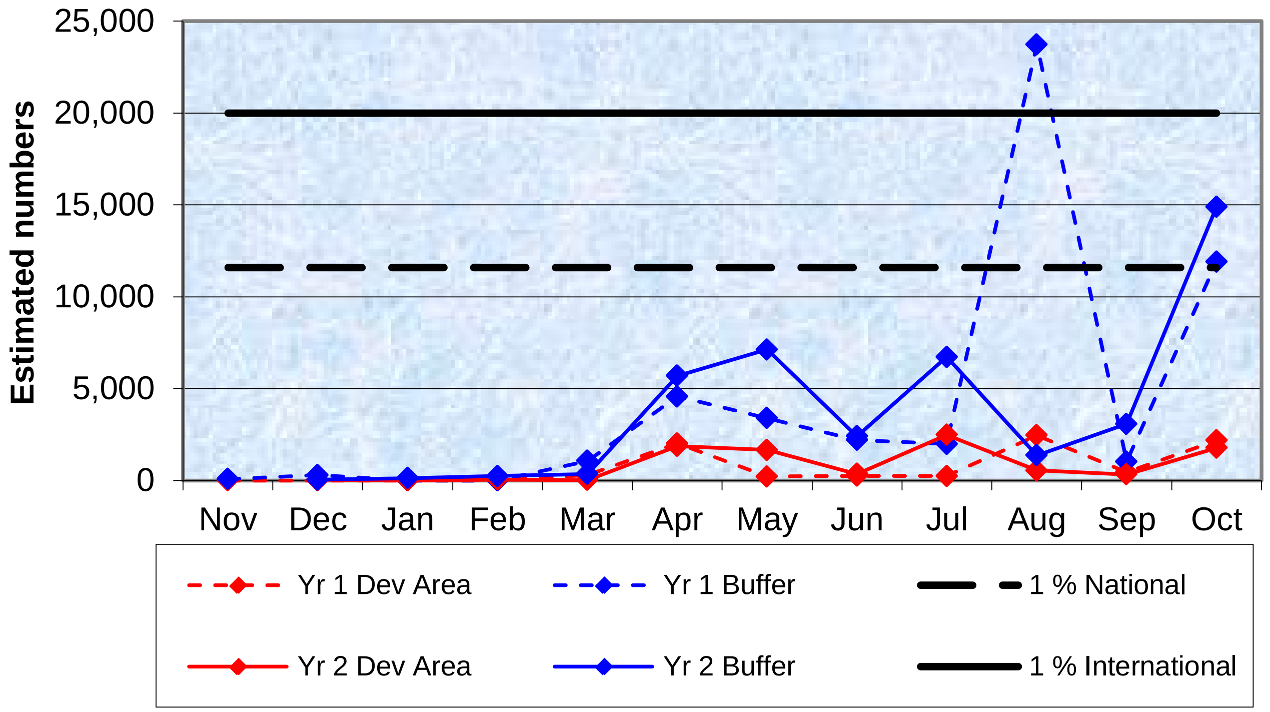

Figure 12.15: Monthly estimated numbers of puffins in the development & buffer areas in years 1 and 2

268 Foraging behaviour was recorded for 115 puffins in the study area in years 1 and 2. The majority of all foraging birds were recorded holding fish (67.8%). Prey identification was only recorded in four instances (all sandeels), with the remaining sightings being "unidentified fish".

269 In years 1 and 2, 5,779 puffins were recorded in flight, with almost all birds recorded flying below 22.5 m in height, and 98.5% of birds recorded flying below 7.5 m in height (refer to Table 12.8). Two birds (0.1%) were recorded flying above 22.5 m, i.e. within the rotor swept zone, at an estimated height of 25 m.

270 Flight direction was recorded for 5,305 puffins in the breeding season (April to August), and for 110 puffins in the non-breeding season (September to March).

271 In the breeding season, just over half of all birds recorded were flying north-east (30.3%) or east (23.4%), with just over one third of birds flying south-west (19.5%), and west (14.8%). In the non-breeding season, one quarter of all birds recorded were flying north-east (25.5%), with just less than a fifth of birds flying south-west (19.1%).

12.6.13.2 Species Sensitivity

272 Puffin is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al.*, 2009).

273 A recent review assessed puffin as being at moderate risk of displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms, while collision risk was rated as low risk. Overall, puffin was assessed as being at moderate risk from offshore wind developments (Langston, 2010).

274 Puffin is listed as a qualifying interest species in the breeding season for three SPAs on the UK east coast between Peterhead and Blyth that could potentially be affected by the development. These SPAs held 14.9% of the UK breeding population and 7.5% of the biogeographic population at the time of designation (JNCC, 2012). The distance between the offshore site and two SPAs (Farne Islands SPA and Forth Islands SPA) is within the mean maximum foraging range of puffin (105.4 km). The distance to Coquet Island SPA is within the maximum known foraging range of 200 km (Thaxter *et al.*, 2012).

12.6.13.3 Population

275 Puffin is the second commonest seabird species breeding in the region. The breeding population of puffins in south-east Scotland and north-east England has undergone recent declines. The regional breeding population is assumed to be 258,543 breeding adults.

276 There is uncertainty over the size of the post-breeding-period regional puffin population but for the purposes of assessment it is assumed to be 167,790 birds.

277 The size of the non-breeding-period regional puffin population is assumed to be 37,500 birds. This is derived from the October to January and February to March estimates given in Skov *et al.* (1995).

12.6.13.4 Nature Conservation Importance

278 The NCI of puffins using the offshore site is rated as moderate during the breeding season and post-breeding period. The species is merits moderate NCI because a high proportion of birds using the offshore site are likely to be from the breeding colonies within the Forth Islands SPA, where this species is a qualifying interest. The mean number present in the offshore site buffered to 1 km in the breeding season is approximately 1% of the (at-sea) regional population. This species is not subject to any special legislative protection, nor is it on any conservation priority list.

12.6.13.5 Offshore Wind Farm Studies of Puffin

279 There is little field-based evidence on the effects on puffins from operational wind farms. This is because existing offshore wind farms for which published results are available are located in areas where puffins are naturally scarce.

280 The review of offshore wind farm effects on birds categorises displacement, barrier and collision risk effects all as unknown for puffin (Diersche and Garthe, 2006).

12.6.14 Little Auk *Alle alle*

12.6.14.1 Status

281 Little auks breed in the high Arctic in large numbers, and occur in UK waters in late autumn and winter months. Large "wrecks" of birds can occur following winter gales, with birds sometimes found inland on lochs or reservoirs.

282 Little auks feed on *Calanus finmarchius*, a planktonic copepod, which is also a major food for sandeels and other fish (Forrester *et al.,* 2007).

283 Little auks were only recorded in the study area in the winter months. Between November and February of year 1, 135 little auks were recorded in the study area, with the majority of birds (80.7%) in the buffer area. Numbers recorded on surveys between December and February of year 2 were similar (113 birds), with 85.8% of birds seen in the buffer area (refer to Table 12.8).

284 In the non-breeding season (November to February), peak estimated numbers of little auks occurred in November of year 1, with 536 birds in the offshore site, and 1,222 birds in the buffer area (refer to Figure 12.16). Estimated numbers in the buffer area in February of year 1 were similar (1,191 birds). In year 2, peak estimated numbers of little auks occurred in December, with 95 birds in the offshore site, and 529 birds in the buffer area (refer to Figure 12.16).

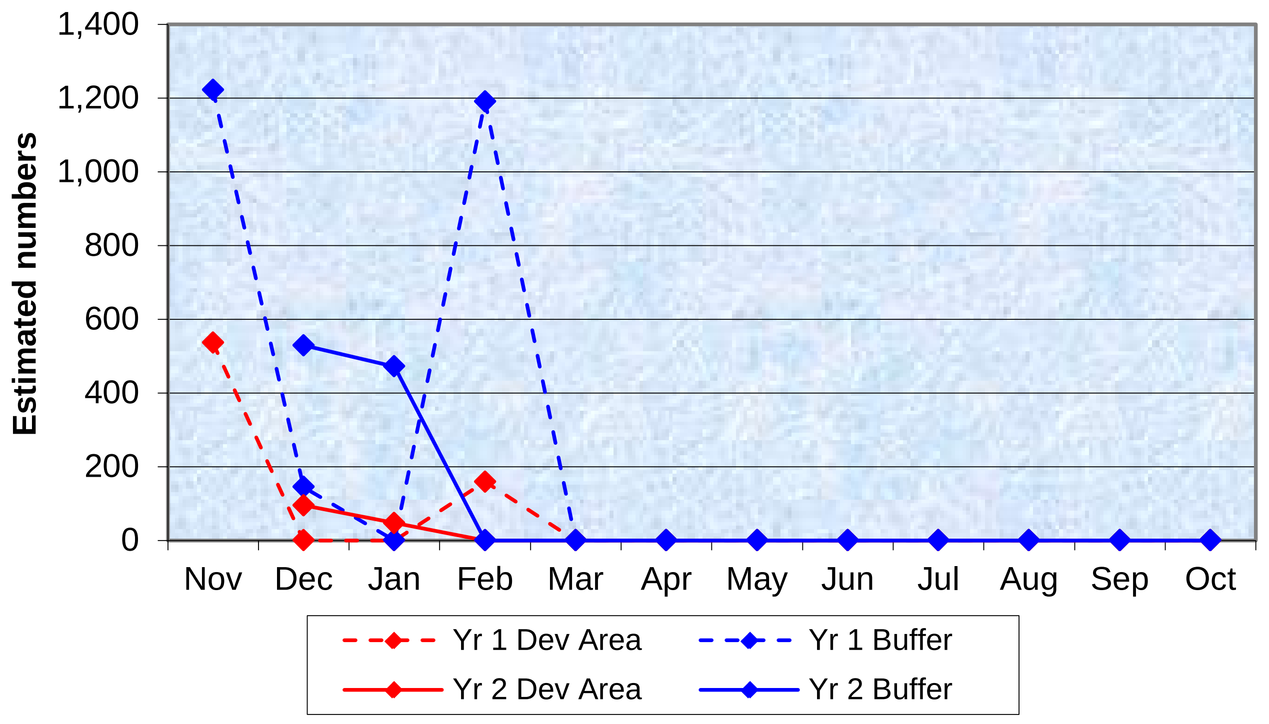

Figure 12.16: Monthly estimated numbers of little auks in the development & buffer areas in years 1 and 2

12.6.14.2 Species Sensitivity

285 A recent review assessed little auk as being at moderate risk of displacement, barrier effects, habitat loss or changes in prey distribution resulting from offshore wind farms, while collision risk was rated as low risk. Overall, little auk was assessed as being at possibly moderate risk from offshore wind developments (Langston, 2010).

12.6.14.3 Population

286 Little auks are a winter visitor to the seas around the UK from Arctic breeding grounds. The origin of the birds wintering off eastern Scotland is unknown but is likely to be breeding grounds in Iceland, Norway and Russia.

287 Analysis of ESAS data by Skov *et al.* (1995) identifies a relatively discrete wintering concentration in the outer Firth of Forth/Devils's Hole part of the North Sea, estimated at approximately 2,300 birds. However, there are likely to be large year-to-year fluctuations in numbers present..

288 The peak winter counts from the three proposed wind farm survey areas in the outer Forth suggests a minimum regional population of 4,242 birds. However, these surveys did not cover all areas of the outer Forth area. For the purposes of assessment a regional winter population of 5,000 birds is assumed.

289 Large declines have recently been reported in the numbers breeding at some colonies in Iceland and Norway. Climate change has been hypothesised to be the ultimate cause of these declines.

12.6.14.4 Nature Conservation Importance

290 For EIA assessment purposes, the NCI of little auks using the offshore site is rated as moderate during the non-breeding season. This classification is merited because the Outer Forth area, including the Neart na Gaoithe offshore site, host a wintering population that likely exceeds 1% of the national population, although this is poorly defined and quantified. This species is not subject to any special legislative protection, nor is it on any conservation priority lists.

12.6.14.5 Offshore Wind Farm Studies of Little Auk

291 There are very few records and therefore little field-based evidence of the likely effects of operational wind farms on little auk. This is because all existing offshore wind farms for which published results are available are located in areas where little auks are naturally scarce. The review of offshore wind farm effects on birds categorises displacement, barrier and collision risk effects all as unknown for little auk (Diersche and Garthe, 2006)

12.7 Species Impact Assessment - Potential Impacts

292 The potential significant impacts associated with the development are:

- Displacement due to the physical presence of the turbines and associated vessels during the construction, operation and decommissioning phases of the development. Displacement may also be caused by changes in habitats or prey availability, including impacts of construction on prey species;
- Barrier effects due to birds avoiding flying through the proposed development and consequently either flying around or over the turbines; and
- Collision impacts caused by birds flying into the rotor blades of the turbines.

293 These impacts are likely to be intermittent and temporary, arising only when construction activities are undertaken.

294 Detail of the potential impacts on each of the species recorded, are presented in Appendix 12.1: Ornithology Technical Report.

12.7.1 Fulmar

12.7.1.1 Displacement

295 For estimating the potential for displacement to affect foraging birds, the assessment was made on all birds (on the sea and in flight) recorded during baseline surveys. The value of the offshore site, buffered to 1 km, as a foraging site to breeding fulmars was estimated for each of the receptor populations in terms of the average proportion of at-sea adults (i.e. not attending a colony) that were present in the offshore site during the breeding season. Given the paucity of information on the likely displacement response of fulmar to the wind farm, for the purposes of assessment it is assumed that fulmars will show complete displacement from the wind farm area buffered to 1 km. The results are summarised in Table 12.11.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding period (Seabird 2000)	993,333	496,667	27	<0.1%	49	<0.1%
North Sea, non-breeding period (Skov *et al.* 1995)	1,872,000	1,872,000	37	<0.1%	48	<0.1%
Regional, breeding period (Seabird 2000)	333,188	166,594	27	<0.1%	49	<0.1%
Regional, non-breeding (Skov *et al.* 1995)	400,000	400,000	37	<0.1%	48	<0.1%

Table 12.11: The mean estimated number of fulmar present during the breeding period and non-breeding periods, and this value as a percentage of the (at-sea) receptor population potentially at risk of displacement

296 On this basis, it is estimated that the offshore site buffered to 1 km provides 0.06% of the foraging resources of the regional breeding population; i.e. at any one time in the breeding season, it is estimated that 0.06% of the breeding birds in the regional population that are at sea occur in the offshore site and therefore are potentially at risk of being displaced by the wind farm. Outside the breeding season the proportion of foraging resources reduced by the proposed development is even lower at 0.01%

297 The likely impact of displacement from foraging areas in the breeding period on the regional breeding and non-breeding fulmar population is an effect of negligible magnitude, temporally long term and reversible. It is concluded that this effect is not significant

12.7.1.2 Barrier Effects

298 There is the potential for the wind farm to act as a barrier to the foraging flights of breeding fulmar and cause them to detour around the wind farm. The mean destination distance of fulmar foraging flights is 48 km (Thaxter *et al.,* 2012). Acknowledging there is uncertainty in how far on average the destination distance of affected flights are from the colony, for the purpose of assessment, a cautious value of 50 km is assumed.

299 Assuming the destinations of affected flights are on average 50 km from the colonies, the mean increase in the length of barrier-affected flights is estimated at 7.1% for birds nesting on the Isle of May, 4.8% for birds breeding on Bass Rock and 4.4% for birds from St Abb's Head.

300 The potential effect the barrier would have on flight distances and times depends on how far the destination areas lie behind the barrier. The results from tagging studies on fulmars show that they forage over vast areas and commonly travel distances in excess of 300 km, and sometimes over twice this distance (Thaxter *et al.,* 2012). It is therefore reasonable to assume that likely destinations of fulmar foraging trips affected by the wind farm acting as a barrier would be at a wide range of distances beyond the offshore site, and commonly many tens of kilometres beyond.

301 The size of detours that fulmar experiencing a barrier effect would be required to make is small and only a small proportion (the affected colonies represent approximately 1.5% of the regional total) of the breeding fulmars in the region would potentially be affected. The effect on fulmars of the wind farm forming a barrier is categorised as negligible magnitude temporally long term and reversible. Bearing in mind that fulmars are considered to have low sensitivity to barrier effects (Langston, 2010), it is concluded that the impact of the wind farm acting as a barrier during foraging trips of the regional breeding fulmar population is ***not significant***.

12.7.1.3 Disturbance by Vessels

302 Fulmars are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of fulmars in the breeding and non-breeding periods is ***not significant***

12.7.1.4 Collision Mortality

303 Collision risk modelling was not undertaken for fulmar because 99.9% of all birds seen in flight during the baseline surveys were below the proposed minimum rotor swept height of turbines. Therefore, it is not plausible that this species will experience significant mortality from collision with turbine rotors.

304 The potential effect of the collision mortality of fulmars on the baseline mortality rate is rated as negligible in magnitude (<1%), temporally long term and reversible. It is concluded that the impact of collision mortality on fulmars is ***not significant***.

12.7.1.5 Summary of Impacts Combined for Fulmar

305 All effects are adverse and reversible (refer to Table 12.12). This species is categorised as having moderate NCI.

306 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the regional population is negligible. Furthermore the regional population has low sensitivity to all effects. It is concluded that the overall impact on the regional population in the breeding and non-breeding periods is ***not significant.***

Effect	Spatial magnitude (severity)	Temporal magnitude (duration)	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Barrier effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Negligible	Long term	Low	Not significant

Table 12.12: Summary of impacts on the regional breeding population of fulmar

12.7.2 Sooty Shearwater

12.7.2.1 Displacement

307 The value of the offshore site buffered to 1 km as a foraging site to sooty shearwaters in the autumn passage period was estimated from the mean proportion of assumed regional population present from August to October. On this basis, it is inferred that the offshore site, buffered to 1 km, provides foraging resources for up to approximately 2.1% of the regional population during the autumn passage period.

308 Were 50% of sooty shearwaters to be displaced from the offshore site buffered to 1 km, the impact of this would be the effective loss of up to 1.1% of the foraging habitat used by the regional autumn passage population (refer to Table 12.13). This is considered to be of low magnitude, and temporally long term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impact of displacement from foraging areas on the regional autumn passage populations of sooty shearwaters is ***not significant***

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at Risk	%	Mean no. at Risk	%
North Sea, autumn passage (derived from Stone *et al.* 1995)	15,000	15,000	30	0.2%	53	0.4%
Regional, autumn passage (derived from Stone *et al.* 1995)	2,500	2,500	30	1.2%	53	2.1%

Table 12.13: The mean estimated number and percentage of the sooty shearwater population potentially at risk of displacement from marine areas during the autumn passage period (August to October)

12.7.2.2 Barrier Effect

309 As the nearest breeding colonies are in the South Atlantic and sooty shearwaters undertake migrations of many thousands of kilometres there is predicted to be no barrier effect on sooty shearwaters.

12.7.2.3 Disturbance by Vessels

310 Sooty shearwaters are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional population of sooty shearwaters in the autumn passage period is ***not significant***

12.7.2.4 Collision Mortality

311 Collision risk modelling was not undertaken for sooty shearwaters because all birds seen in flight during the baseline surveys were below the proposed minimum rotor swept height of turbines. Therefore, it is not plausible that this species will experience significant mortality from collision with turbine rotors.

312 The potential effect of the collision mortality of sooty shearwaters on the baseline mortality rate is rated as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of collision mortality on sooty shearwaters is ***not significant***.

12.7.2.5 Summary of Impacts Combined for Sooty Shearwater

313 All effects are adverse and reversible (refer to Table 12.14). This species is categorised as having moderate NCI.

314 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the regional population is low. However, because the population has low sensitivity to all effects, it is concluded that the overall impact on the regional population in the autumn passage period is ***not significant*.**

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational Phase				
Displacement from foraging habitat	Low	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Low	Not significant

Table 12.14: Summary of impacts on the regional autumn passage population of sooty shearwaters

12.7.3 Gannet

12.7.3.1 Displacement

315 The results from potential displacement effects on gannets are presented in Table 12.15.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding period (Seabird 2000)	440,963	251,349	627	0.2%	870	0.3%
North Sea, non-breeding period (Skov *et al.* 1995)	157,800	157,800	121	0.1%	164	0.1%
Regional, breeding period	116,538	66,427	627	0.9%	870	1.3%
Regional, non-breeding (Skov *et al.* 1995)	31,200	31,200	121	0.4%	164	0.5%

Table 12.15: The mean estimated number of gannet receptor populations present (on the sea and flying)

316 Based on the studies reported, for the purpose of assessment of displacement it is assumed that there will be complete displacement of gannets from the proposed development and a surrounding buffer of 1 km. This is likely to be a cautious assumption as some gannets are likely to continue to forage in the 1 km buffer.

317 It is estimated that on average during the breeding season 1.3% (870 adults) of the at-sea regional breeding population were present in the offshore site, buffered to 1 km, and that, on the basis of their behaviour recorded during the baseline surveys, approximately 35% (305 adults) of these were potentially foraging and not merely flying over). These birds are potentially at risk of being displaced from foraging in this area by the proposed wind farm. In the same way, it is estimated that 0.5% (164) of the regional wintering population are on average present in the offshore site buffered to 1 km.

318 For the purposes of assessment of displacement it is assumed that there will be complete displacement of gannets from the offshore site buffered to 1 km. Research on foraging ranges indicates that Bass Rock gannets have a high capacity to use additional potential feeding areas by flying further from the breeding colony (Hamer *et al.,* 2007). Therefore, it is likely that gannets can compensate for a moderate amount of displacement by choosing to forage elsewhere. On this basis, the regional breeding gannet population is considered to have low sensitivity to displacement effects and it is therefore unlikely that the predicted displacement will result in any discernible population effects on the regional breeding population.

319 If all gannets were to be displaced during the breeding season from the offshore site, buffered to 1 km, the impact of this would be the effective loss of up to around 0.5% of the foraging habitat of the regional population in the breeding season. This impact is categorised as negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding gannet population are ***not significant.***

320 If all gannets were to be displaced during the non-breeding period from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.20% of the foraging habitat of the regional population in the non-breeding period. This impact is categorised as negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding gannet population are ***not significant.***

12.7.3.2 Barrier Effect

321 There are two gannet colonies that are within the mean maximum foraging range; Troup Head and Bass Rock. Birds from Troup Head are predicted to occur mainly around that colony in the outer Moray Firth and therefore, during the breeding season nearly all the gannets in the study area originate from the Bass Rock (Hamer *et al*., 2011).

322 The proposed development, buffered to 1 km, would potentially form a barrier of 17.8 km wide 27 km north-east of the Bass Rock colony. This barrier would potentially block approximately 27% of the possible flight directions available to gannets flying out to distances in excess of 27 km from the colony. For the purposes of assessment it is assumed that 27% of foraging flights by breeding gannets would be affected by the proposed development acting as a barrier.

323 The potential effect the barrier would have on flight distances and times depends on how far the destination areas lie beyond the barrier. The results from tagging studies on gannets breeding at Bass Rock show that they forage over a vast area of the northern North Sea; commonly travelling distances in excess of 150 km and sometimes up to three times this distance (Hamer *et al.,* 2000).

324 The mean destination distance of gannet foraging flights is 93 km (Thaxter *et al.,* 2012). Acknowledging there is uncertainty in how far on average the destination distance of affected flights are from the colony, for the purpose of assessment, a cautious value of 90 km is assumed. This would mean that the flight routes of birds affected by a barrier effect would be increased by approximately 2.2%.

325 This potential adverse effect is rated as low in magnitude and temporally long term and reversible.

326 Studies on foraging gannets have shown that they are capable of extending foraging distances in response to distribution of prey, suggesting that the species would easily absorb the minor increases in flight distances that a barrier could cause (Hamer *et al.,* 2007). On this basis, they appear to have a low sensitivity to barrier effects. This species is also rated as low for sensitivity to barrier effects by Maclean *et al.* (2009) and Langston (2010). Therefore, it is concluded that any adverse effects on the regional breeding gannet population caused by the proposed wind farm acting as a barrier is ***not significant***.

12.7.3.3 Disturbance by Vessels

327 Gannets are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impacts of displacement during construction operations on the regional populations of gannets in the breeding and non-breeding periods is ***not significant.***

12.7.3.4 Collision Mortality

328 The results of CRM for the regional breeding population of gannet are summarised in Table 12.16. The CRM predictions presented are the number of gannets potentially killed each year for different overall avoidance rates, for the most adverse (128 x 3.6 MW turbines) and least adverse (64 x 7 MW turbines) wind farm designs evaluated and for three values of overall avoidance rate (OAR)

Wind farm design	% birds present assumed to be regional breeders	98.0% OAR		99.5% OAR		99.8% OAR	
Period of year		CRM deaths	Change AMR	CRM deaths	Change AMR	CRM deaths	Change AMR
Design 1, 64 x 7 MW turbines							
Breeding period (Mar - Sep)	100%	587	6.0	147	1.5	59	0.6
Non-breeding period (Oct - Feb)	50%	35	0.4%	9	0.1%	3	0.04%
Whole year	Varies	621	6.3%	155	1.6%	62	0.6%
Design 4, 128 x 3.6 MW turbines							
Breeding period (Mar - Sep)	100%	902	9.2%	225	2.3%	90	0.9%
Non-breeding period (Oct - Feb)	50%	53	0.5%	13	0.1%	5	0.1%
Whole year	Varies	955	9.8%	238	2.4%	95	0.97%

Table 12.16: The effect of collision risk modelling predicted collision mortality on the adult mortality rate (AMR) of the regional breeding gannet population

329 For the purposes of assessing collision mortality it is assumed, on the basis of evidence from existing offshore wind farms present above, that 90% of flying gannets will be displaced outside the wind farm, and therefore the at-risk flight activity by gannets during the operational phase is assumed to be 10% of that recorded during the baseline surveys. This is considered to lead to strongly cautious assumptions regarding collision because the actual proportion displaced outside the wind farm is likely to exceed 90% and the few birds that do fly through the proposed wind farm are likely to lower their flight height to well below the rotor heights.

330 COWRIE guidance (Maclean *et al.,* 2009) advises using a default avoidance rate of 99.5% for seabirds. There is no specific SNH guidance on avoidance rates for seabirds, and therefore their default value of 98.0% is applicable. However, both these values are likely to underestimate the true avoidance rate due to the very high (>90%) far far-field avoidance shown by this species (Leopold *et al.*, 2011). In light of this, an overall avoidance rate of 99.8% is likely to be more appropriate and more closely reflect the true risks whilst still remaining cautious. An overall avoidance rate of 99.8% is ten times higher than 98.0% and is chosen to reflect the assumption that flight activity within the wind farm by gannets will on average be one tenth of that observed in the baseline surveys.

331 The highest potential collision rates are for wind farm design 4 (128 x 3.6 MW turbines). Under this design and for a 99.8% overall avoidance rate it is estimated that the average number of adult gannets killed annually would be 100 and of these, 95 are estimated to be from birds belonging to the regional breeding population (the

remaining five birds are attributed to birds overwintering from breeding sites outside the breeding region). If the avoidance rate was 98.0% these figures would be ten times greater.

332 The baseline annual average mortality of adult birds in the regional breeding population is estimated at 9,789 birds based on an adult annual mortality rate of 8.40% (BTO, 2012). Therefore, additional loss of 95 adults each year from the regional breeding population predicted for wind farm design 4 would represent an increase in the adult mortality rate of 0.97%. If a 98.0% avoidance rate is used the change in the adult mortality rate would be 9.7%.

333 The predicted collision deaths caused by wind farm design 1 (the least adverse) are 62 deaths per year for a 99.8% avoidance rate, i.e., approximately two thirds of those predicted for wind farm design 4. This number of additional deaths would cause the baseline adult mortality rate to increase by 0.6%.

334 Taking into consideration that 99.8% is likely to be much closer to the true avoidance rate than 98.0%, yet still remain cautious, it is concluded that for wind farm design 4 (the most adverse design, 128 x 3.6 MW) collision mortality of gannet is an effect of low magnitude, temporally long term and reversible.

335 It is further concluded that that for wind farm design 1 (the least adverse design, 64 x 7 MW) collision mortality of gannet is an effect of negligible magnitude, temporally long term and reversible. However, should the avoidance rate be lower than this, then there is an increasing risk of an adverse effect occurring.

12.7.3.5 EIA Summary of Impacts Combined for Gannets

336 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the population is low. However, because the population has low sensitivity to all effects, it is judged that the overall impact on the regional population in the breeding and non-breeding periods is ***not significant*** under the EIA regulations (refer to Table 12.17 and Table 12.18).

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Low	Long term	Low	Not significant
Barrier effect	Low	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible or low	Long term	Low	Not significant
All effects combined	Low	Long term	Low	Not significant

Table 12.17: Summary of impacts on the regional population of gannets in the breeding season

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Negligible	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible or Low	Long term	Low	Not significant
All effects combined	Low	Long term	Low	Not significant

Table 12.18: Summary of impacts on the regional population of gannets in the non-breeding season

12.7.3.6 Cumulative Impact Assessment for Gannet

337 The results of the potential collision mortality and displacement effects are presented in Table 12.19. The level of significance depends on the level of avoidance that may occur.

Effect Assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement	100%	235	582	1,017 – 3,678	1,834 - 5,512
Collision (most adverse design	98%	955	4,004	3,264	8,224
	99.5%	239	1,001	816	2,056
	99.8%	96	400	326	822

Table 12.19: Summary of cumulative impacts for the three proposed offshore wind farms in south-east Scotland on the regional population of breeding gannet based on most adverse turbine arrays.

338 The predicted potential increase in baseline mortality rates are of up to 80%, based on worst-case scenario, and are rated as moderate in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional population of breeding gannet is assessed as being of ***moderate significance.***

339 The potential impact of collision mortality on the baseline mortality rate of 8% based on a 99.8% avoidance rate is rated as low in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of breeding gannet is assessed as being of ***minor significance***.

12.7.4 Little Gull

12.7.4.1 Displacement

340 Table 12.20 presents a summary of the displacement assessment for national, North Sea and regional population estimates.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, autumn period (Skov *et al.* 1995, Stone *et al.* 1995)	7,500	7,500	58	0.8%	74	1.0%
North Sea, autumn period (Skov *et al.* 1995)	9,000	9,000	58	0.6%	74	0.8%
Regional, autumn period (Skov *et al.* 1995)	3,100	3,100	58	1.9%	74	2.4%

Table 12.20: The mean estimated number and percentage of the at-sea little gull population potentially at risk of displacement from marine areas during the post-breeding/passage (August to October)

341 The value of the offshore site buffered to 1 km as a foraging site for little gulls in the autumn passage period was estimated from the mean proportion of assumed North Sea, national and regional populations present from August to October.

342 On this basis, it is inferred that the offshore site buffered to 1 km provides foraging resources for up to approximately 0.6% of the regional population (25% of the figure in Table 12.25) during the autumn passage period. It is concluded that the offshore site is likely to be of national importance (>1% of population present) and is of regional importance for this species at this time of year.

343 For the purposes of assessment, it is assumed that 25% of the potential displacement would be realised, a figure that is likely to be cautious. It is unknown whether displaced birds would be disadvantaged or whether they would merely move to alternative foraging areas with capacity to hold more birds. The species undertakes large movements and therefore displaced birds are likely to move elsewhere to seek out alternative foraging sites. Nevertheless, the species is also concentrated into relatively small favoured areas (see Skov *et al.* 1995) and the extent to which these are used to capacity is unknown. Recognising this uncertainty but also taking a cautionary approach, it is considered that the regional autumn passage population of little gull potentially has moderate sensitivity to displacement from foraging areas.

344 If 25% of little gulls were displaced from the offshore site, buffered to 1 km, the impact of this would be the effective loss of up to around 0.6% of the foraging habitat of the regional autumn passage population. This impact is categorised as negligible magnitude, and temporally long term and reversible.

345 Taking into consideration the above assessment and the high NCI of this species it is concluded the impact of displacement from foraging areas on the regional autumn passage population of little gulls is ***not significant***

12.7.4.2 Collision Mortality

The results of CRM for little gull are summarised in Table 12.21 (see Appendix 12.1: Ornithology Technical Report) for full details on CRM). There is uncertainty over the size of the little gull populations. There is also uncertainty over the baseline mortality rate as there is no published estimate. A baseline mortality rate of 10.0% per annum is assumed, which is the rate for black-headed gull, a closely related species.

Wind farm design	Receptor population size	98.0% OAR		99.5% OAR	
Receptor population		CRM deaths	Change AMR	CRM deaths	Change AMR
Design 1, 64 x 7 MW turbines					
North Sea	9,000	12	1.3%	3	0.3%
National, all year	7,500	12	1.6%	3	0.4%
Regional, all year	3,100	12	3.9%	3	1.0%
Design 4, 128 x 3.6 MW turbines					
North Sea	9,000	17	1.9%	4	0.5%
National, all year	7,500	17	2.3%	4	0.6%
Regional, all year	3,100	17	5.5%	4	1.4%

Table 12.21: The indicative effect of CRM predicted collision mortality on the adult mortality rate (AMR) of little gull populations. Results are presented for most adverse (128 x 3.6 MW turbines) and the least adverse (64 x 7 MW turbines) wind farm designs evaluated, and for two values of overall avoidance rate (OAR)

346 For the purposes of assessment it is assumed that there will be no far-field avoidance of the proposed wind farm by little gulls.

347 COWRIE guidance (Maclean *et al.,* 2009) advises using a default avoidance rate of 99.5% for seabirds. There is no specific SNH guidance on avoidance rates for seabirds, and therefore their default value of 98% is applicable.

348 The highest potential collision predicted by the modelling is of 17 birds if the avoidance rate was 98.0%, and 4.3 birds if it was 99.5%.

349 Using an avoidance rate of 98.0% the impact of the additional mortality would cause an increase in the assumed annual adult mortality rate of between 1.6% and 2.3% of the national population and between 3.9% and 5.5% of the regional population.

350 Assessed for 98.0% avoidance rate, the potential impact of the predicted collision mortality on both the national (and regional) little gull population is an effect of low magnitude (1-5%) and temporally long term and reversible. Given that this species is categorised as high NCI, it is concluded that the impact of collision mortality on the regional autumn passage population is of ***moderate significance***. It should be noted that this conclusion is potentially sensitive to the size of the regional and national population used for comparison, about which there is some uncertainty. Using an avoidance rate of 99.5%, the impact of additional mortality caused by collision would be to cause an increase in the assumed annual adult mortality rate of the regional population of between 1.0% and 1.4%.

351 Assessed for 99.5% avoidance rate, the potential impact of the predicted collision mortality on the regional little gull population is an effect of low magnitude and temporally long term and reversible. It is concluded that the impact of collision mortality on the national autumn passage population is of ***minor significance***.

12.7.4.3 Summary of Impacts Combined for Little Gull

352 All effects are adverse and reversible (refer to Table 12.22). This species is categorised as having high NCI.

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Moderate	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality for 98.0% AR	Moderate	Long term	Moderate	Moderate significance
Collision mortality for 99.5% AR	Low	Long term	Moderate	Minor significance
All effects combined (Collision 98.0% AR)	Moderate	Long term	Moderate	Moderate significance
All effects combined (Collision 99.5% AR)	Low	Long term	Moderate	Minor significance

Table 12.22: Summary of impacts on the regional autumn passage population of little gull

353 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the effects on the regional population is low. The regional population is categorised as having moderate sensitivity to collision and displacement effects and is categorised as having high NCI.

354 Conclusions on the overall impact of the proposed development are sensitive to the level of avoidance assumed for predictions of collision deaths. If a 98.0% avoidance rate is assumed it is concluded that the overall impact of the proposed development on the regional population in the autumn passage period is an effect of ***moderate significance*** under the EIA regulations.

355 If a 99.5% avoidance rate is assumed it is concluded that the overall impact of the proposed development on the regional population in the autumn passage period is an effect of ***minor significance*** under the EIA regulations.

12.7.4.4 Cumulative Impact Assessment for Little Gull

356 Adding the predicted individual impacts for the three proposed offshore wind farms suggests that the overall impacts on the regional autumn passage population of little gull will be as shown in Table 12.23.

Predicted displacement causing the potential effective loss of up to 1.7% of the foraging habitat of the regional autumn passage population of little gull is rated as an effect of low magnitude, temporally long term and reversible. Bearing in mind that little gull is rated as high NCI, it is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional autumn passage population of little gull is of ***minor significance***.

Effect Assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement Autumn passage	25%	0.6%	0.2%	0.9%	1.7%, Low
Collision (most adverse design)	98%	5.5%, moderate	no data, assumed moderate	No data, assumed moderate	High
	99.5%	1.4%, low	no data, assumed low	No data, assumed low	Moderate

Table 12.23: Summary of CIA for the three proposed offshore wind farms in south-east Scotland on the regional autumn passage population of little gull

359 Conclusion on the cumulative impact of collision mortality on the regional autumn passage population of little gull is sensitive to the wind farm designs evaluated and the level of avoidance rate used for predictive calculations of the number of collision strikes (refer to Appendix 12.2: Ornithology Statistics Report). There is also uncertainty over the cumulative impact of collision mortality on little gulls because of the lack of modelling results for this species for the Inch Cape and Firth of Forth Round 3 Zone 2 developments, and because of the uncertainty over the baseline mortality rate for this species.

360 Using an avoidance rate of 99.5% the cumulative impact of the three wind farms in terms of the predicted increase to the annual adult mortality rate is provisionally estimated to be an effect of moderate magnitude, temporally long term and reversible. On this basis it is concluded that, when assessed using a 99.5% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms and on the regional autumn passage population of little gull is of ***moderate significance***.

361 Using an avoidance rate of 98.0% the cumulative impact of the three wind farms in terms of the predicted increase to the annual adult mortality rate is provisionally estimated to be an effect of high magnitude, temporally long term and reversible.

362 On this basis it is concluded that, when assessed using a 98.0% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms and on the regional autumn passage population of little gull is of potentially ***major significance***.

363 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the effects on the population is low. The population is categorised as having moderate sensitivity to collision and displacement effects and is categorised as having high NCI. It is concluded that the overall impact of the proposed development on the population is of ***minor significance***.

12.7.5 Lesser Black Backed Gull

12.7.5.1 Displacement

364 For the purpose of assessing displacement it is assumed that 50% of lesser black-backed gulls will be displaced from the proposed wind farm footprint and a surrounding buffer of 1 km. Based on the modelled evidence from Egmond aan Zee and observations from Horns Rev this is likely to be a cautious conclusion as these studies suggest hardly any effect of wind farms on lesser black backed gull distribution.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding period (Seabird 2000)	176,646	88,323	11	<0.1%	14	<0.1%
Regional, breeding period (Seabird 2000 and SMT database)	22,034	11,017	11	<0.1%	14	<0.1%

Table 12.24: The mean estimated number of lesser black-backed gull present (on the sea and flying) during the breeding period (attending colonies, April to August), and this value as a percentage of the (at-sea) receptor population potentially at risk of displacement

365 The value of the offshore site, buffered to 1 km, as a foraging site to lesser black-backed gulls in the breeding season was estimated from the proportion of the adults likely to be at sea (not attending a colony) that were on average present. On this basis, it is estimated that the offshore site, buffered to 1 km, provides 0.06% (<0.1%) of the foraging resources of the regional breeding population (refer to Table 12.24).

366 Studies at operational wind farms show that lesser black-backed gulls exhibit only low levels of displacement. Therefore, it is likely that little if any of the potential displacement would be realised.

367 If 25% of lesser black-backed gulls were to be displaced from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.03% of the foraging habitat of the regional breeding population. This impact is negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding lesser black-backed gull population is ***not significant***

12.7.5.2 Barrier Effect

368 Lesser black-backed gulls are considered to have low sensitivity to barrier effects on account of a low wing loading (Maclean *et al.*, 2009). The potential effects on lesser black-backed gull of the proposed wind farm acting as a barrier are assessed for the part of the breeding season when birds are attending colonies only.

369 The only breeding colonies in the region where lesser black-backed gulls are potentially affected by the proposed development acting as a barrier are the Isle of May and Craigleith. For the Isle of May colony, the proposed wind farm would present a barrier 17.9 km wide and located 16 km to the north-east. This barrier would potentially block approximately 33% of the possible flight directions available to lesser black-backed gulls flying out to distances in excess of 16 km from the Isle of May. However, observations from operational offshore wind farms show no evidence that wind farms pose a barrier to lesser black-backed gulls. It is therefore likely that a much smaller percentage of foraging trips by this species of birds would be affected, if any. On the assumption that the destinations of affected flights lies on average 70 km from the breeding colony (the mean foraging distance is 72 km, Thaxter *et al.* 2012), the mean increase in the length of barrier-affected flights is estimated at 4.7%. Similarly for birds from the Craigleith colony, the mean increase in the length of barrier-affected flights is estimated at 3.7%.

370 The potential impact of the wind farm to act as a barrier and increase the length and duration of foraging trips for birds of the regional population in the breeding season is an effect that is negligible in magnitude and temporally long term and reversible. It is concluded that the impact of any barrier effect on the regional lesser black-backed gull population in the breeding season is ***not significant***.

12.7.5.3 Disturbance by Vessels

371 Lesser black-backed gulls are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impacts of displacement during construction operations on the regional population of lesser black-backed gulls in the breeding season is ***not significant***

12.7.5.4 Collision Mortality

372 The results of CRM for lesser black-backed gull are summarised in Table 12.25 (see Appendix 12.2: Ornithology Statistics Report, for full details on CRM).

373 For the purposes of assessment it is assumed that there will be no far-field avoidance of the proposed wind farm by lesser black-backed gulls. The results from the modelling are presented for the most adverse (128 x 3.6 MW turbines) and the least adverse (64 x 7 MW turbines) wind farm designs evaluated, and for two values of overall avoidance rate (OAR) (refer to Table 12.25).

Wind farm design	Receptor population size	98.0% OAR		99.5% OAR	
Period of year		CRM deaths	Change AMR	CRM deaths	Change AMR
Design 1, 64 x 7 MW turbines					
Whole year	19,148	4	0.02%	1	<0.01%
Design 4, 128 x 3.6 MW turbines					
Whole year	19,148	6	0.03%	1	<0.01%

Table 12.25: The effect of CRM predicted collision mortality on the adult mortality rate (AMR) of the regional breeding lesser black-backed gull population

374 Using avoidance rates of 98.0% and 99.5%, the increase in the adult mortality rate of the regional population would be <0.1%. In both cases the changes are well below potential for adverse impacts on a population.

375 The potential impact of the predicted collision mortality on the regional population is an effect of negligible magnitude (<1%) and temporally long term and reversible. It is concluded that the impact of collision mortality on the regional lesser black-backed gull breeding population is ***not significant***.

12.7.5.5 Summary of Impacts Combined for Lesser Black-Backed Gull

376 All effects are adverse and reversible (refer to Table 12.26). This species is categorised as having moderate NCI.

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Barrier effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Negligible	Long term	Low	Not significant

Table 12.26: Summary of impacts on the regional population of lesser black-backed gulls in the breeding season

377 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude on the regional population is negligible. Furthermore, the population has low sensitivity. It is concluded that the overall impact on the regional population in the breeding and non-breeding periods is ***not significant.***

12.7.5.6 Cumulative Impact Assessment for Lesser Black-backed Gull

378 Adding the predicted individual impacts for the three proposed offshore wind farms suggests that the overall impacts on the regional autumn passage population of lesser black-backed gull is as detailed in Table 12.27.

Effect assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative impact
Displacement Breeding season	25%	<0.1%, negligible	<0.1%, negligible	0.8%, negligible	<1.0%, Negligible
Collision (most adverse design)	98%	0.03%, negligible	43.9% major	Approx. 0.6% negligible (based on NNG scaled by abundance)	44.5% moderate
	99.5%	<0.01%, negligible	11.0% moderate	Approx. 0.6% negligible (based on NNG scaled by abundance)	11.6% moderate

Table 12.27: Summary of CIA for the three proposed offshore wind farms in south-east Scotland on the regional population of breeding lesser black-backed gull

379 It is estimated that about 5% of foraging flights of breeding birds from the Isle of May and Craigleith (about 4% of the regional total) would be affected by the three wind farms acting as barriers. Affected flights would undergo detours that would, on average, amount to an increase in length of approximately 20%, compared to direct flights to the same destination beyond the wind farm. This estimate assumes, on the basis of observations at operational wind farms that only 25% of birds reaching the barrier will respond by detouring around the wind farms. The cumulative barrier effect is rated as low magnitude, temporally long term and reversible. It is concluded that the cumulative impact of a barrier effect caused by the three proposed offshore wind farms on the regional population of lesser black-backed gulls in the breeding season is of ***minor significance***.

380 The cumulative assessment of barrier effects above assumes that all areas of the wind farm lease sites will be developed. In the case of the Firth of Forth Round 3 Zone there will be large areas without turbines and the eventual design may therefore effectively present birds several smaller barriers with gaps between through which birds can pass, rather than the single large barrier assumed above. Were this to be the case, the magnitude of the cumulative barrier effect could be substantially less than suggested above.

381 Using an avoidance rate of 98.0% the cumulative effect of the three wind farms is to increase the annual adult mortality rate by 3.1% for the least adverse wind farm designs and by 44.5% for the most adverse designs. Increasing the avoidance rate reduces the annual mortality rate to between 1.1% and 11.6%, depending on turbine designs. It is concluded that, when assessed using a 98.0% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of lesser black-backed gull in the breeding season is of ***moderate to minor significance***.

12.7.6 Herring Gull

12.7.6.1 Displacement

382 It is assumed that 50% of herring gulls will be displaced from the proposed wind farm footprint and a surrounding buffer of 1 km. Based on the evidence from existing wind farms this is likely to be a cautious assumption because reported declines in herring gull abundance at existing wind farm are below 50% (e.g. Nysted, Denmark), indeed, some sites showed no significant change, while increased numbers were recorded at other sites during the operational phase (e.g. Horns Rev, Egmond aan Zee).

383 The value of the offshore site as a foraging site for breeding herring gulls was estimated for each seasonal populations from the proportion of the birds likely to be at sea that were on average present in the offshore site during the each season and on the basis of a potential displacement from the offshore site out to 1 km. The results are presented in Table 12.28.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding period (Seabird 2000)	282,613	141,307	10	<0.1%	10	<0.1%
North Sea, non-breeding period (Skov *et al.* 1995)	971,700	971,700	18	<0.1%	240	<0.1%
Regional, breeding period (Seabird 2000 x 6% decline)	43,302	21,651	10	<0.1%	10	<0.1%
Regional, non-breeding (Skov *et al.* 1995)	200,000	200,000	18	<0.1%	240	0.1%

Table 12.28: The mean estimated number of herring gull present during the breeding period and the non-breeding period, and the value as a percentage of the (at-sea) receptor population potentially at risk of displacement

384 Studies of herring gulls show that this species exhibits little, if any, displacement behaviour in response to operational wind farms.

385 If 25% of herring gulls were displaced during the breeding season from the offshore site, buffered to 1 km, the impact of this would be the effective loss of up to around <0.1% of the foraging habitat of the regional breeding population. During the non-breeding season up to <0.1% of the foraging habitat may be effectively lost. The impact is considered as negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding herring gull population is ***not significant***

12.7.6.2 Disturbance by Vessels

386 Herring gulls are not considered susceptible to disturbance and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of herring gulls in the breeding and non-breeding periods is ***not significant***

12.7.6.3 Barrier Effect

387 Herring gulls breeding at nearby colonies to the proposed wind farm could be affected by the wind farm acting as a barrier. The greatest potential for such impacts is to birds from the Isle of May and Craigleith colonies.

388 For birds breeding on the Isle of May colony, if the wind farm acts as a barrier, it would block approximately 33% of the possible flight directions and, assuming a mean destination distance of 30 km, the mean increase in the length of barrier-affected flights is estimated at 17.7%. Similarly, for birds breeding on Craigleith colony, the wind farm acting as a barrier would potentially block approximately 28% of the possible flight directions and assuming a mean destination distance of 45 km, the mean increase in the length of barrier-affected flights is estimated at 5.3%.

389 However, observations from operational offshore wind farms shows no evidence that wind farms pose a barrier to herring gulls. It is therefore likely that a much smaller percentage of foraging trips by this species birds would be affected, if any.

390 The potential impact of the wind farm to act as a barrier and increase the length and duration of foraging trips for birds of the regional population in the breeding season is an effect that is negligible in magnitude (<1%) and temporally long term and reversible. It is concluded that any barrier effect on the regional breeding herring gull population is ***not significant***.

12.7.6.4 Collision Mortality

391 The results of CRM for herring gull are summarised in Table 12.29 (refer to Appendix 12.2: Ornithology Statistics Report, for full details on CRM). Results are presented for the most adverse (128 x 3.6 MW turbines) and the least adverse (64 x 7 MW turbines) wind farm designs evaluated, and for two values of overall avoidance rate (OAR). The most recent information indicates that the regional breeding population is 50,033 adults. Approximately 6,004 adults die each year as a consequence of baseline mortality, assumed to be 12.0% per annum

Wind farm design	% birds present assumed to be regional breeders	98.0% OAR		99.5% OAR	
Period of year		CRM deaths	Change AMR	CRM deaths	Change AMR
Design 1, 64 x 7 MW turbines					
Breeding period (April - August)	100%	12	0.2%	3	0.1%
Non-breeding period (Sept. - March)	25%	12	0.2%	3	<0.1%
Whole year	varies	24	0.4%	6	0.1%
Design 4, 128 x 3.6 MW turbines					
Breeding period (April - August)	100%	18	0.3%	55	0.1%
Non-breeding period (Sept. - March)	25%	17	0.3%	43	0.1%
Whole year	varies	35	0.6%	99	0.2%

Table 12.29: The effect of CRM predicted collision mortality on the adult mortality rate (AMR) of the regional breeding herring gull population

392 In the non-breeding season the regional population comprises a mixture of birds originating from regional breeding colonies and colonies further afield. Therefore, to estimate the effect of year-round collision mortality on the regional breeding population, the proportion of collision deaths that occur in the non-breeding period involving birds from the regional breeding population needs to be estimated. Ringing and colour marking studies show that large numbers of herring gulls from the breeding region (Peterhead to Blyth) overwinter outside the region (Wernham *et al.,* 2002). They also show that large numbers of birds from northern Scotland and Scandinavian breeding grounds overwinter in the region (Wernham *et al.,* 2002). The winter population estimate for the region (approximately 200,000 birds, Skov *et al.,* 1995) also indicates that there is a large net influx of herring gull into the region in the winter, with around twice as many birds present in winter compared to the breeding season. Based on this evidence, for the purposes of assessment it is assumed that 25% of the adult collision deaths during the non-breeding period involve adults from the regional breeding population. The effect of year-round collision mortality on the annual adult mortality rate for the regional breeding population is calculated by summing the breeding season mortality and the non-breeding period mortality attributed to breeding birds from the region.

393 Using an avoidance rate of 99.5% as recommended by COWRIE for gull species, the increase in the adult annual mortality rate of the regional population would be between 0.1% and 0.2% depending on wind farm design (Maclean *et al.,* 2009). Using an avoidance rate of 98.0% the increase is between 0.4% and 0.6%. For both avoidance rates the changes in mortality rate are in all cases below the default guidance threshold of 1%, which is considered the minimum likely to have potential for adverse impacts on a population (King *et al*., 2009).

394 The potential impact of the predicted collision mortality on the regional breeding population is an effect of negligible magnitude (<1%) and temporally long term and reversible. It is concluded that the impacts of collision mortality on the regional herring gull population in the breeding season are ***not significant***.

12.7.6.5 Summary of Impacts Combined for Herring Gull

395 All effects are adverse and reversible (refer to Table 12.30).

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Barrier effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Moderate	Not significant
All effects combined	Negligible	Long term	Low -Moderate	Not significant

Table 12.30: Summary of impacts on the regional breeding population of herring gull

396 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the regional population is negligible. Furthermore, the population has low sensitivity to all effects except collision risk. It is concluded that the overall impact on the regional population in both the breeding and non-breeding periods is ***not significant***.

12.7.6.6 Cumulative Impact Assessment for Herring Gull

397 The results of the potential collision mortality and displacement effects are presented in Table 12.31.

Effect Assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement	25%	<0.1	<0.1	<0.1	≤0.3
Collision	98%	29 - 39	16 - 139	41 – 63	86 - 241
	99.5%	7 - 10	4 – 34	10 - 16	21 - 60

Table 12.31: Summary of cumulative impacts for the three proposed offshore wind farms in south-east Scotland on the regional population of breeding herring gull

398 The predicted potential effective loss of <0.3% of the foraging habitat of the regional population of herring gulls in the breeding season is rated as an effect of negligible magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional population of herring gulls in the breeding season is ***not significant***.

399 The mean foraging distance of herring gull is 10.5 km and the mean maximum distance is 61.1 km (Thaxter *et al*., 2012). This means that almost no flights will be to areas beyond the barrier formed by the three proposed wind farms. As a result any barrier effect will be negligible. The cumulative barrier effect is rated as negligible magnitude, temporally long term and reversible. Bearing in mind the low sensitivity of herring gull to barrier effects it is concluded that the cumulative impact of a barrier effect caused by the three proposed offshore wind farms on the regional population of herring gulls in the breeding season is ***not significant***.

400 Using an avoidance rate of 98.0% the cumulative effect of the three wind farms is to increase the annual adult mortality rate by 1.3% for the least adverse wind farm designs and by 3.5% for the most adverse designs. The potential cumulative impact of this additional mortality on the regional population of herring gulls in the breeding season is rated as low magnitude, temporally long term and reversible. It is concluded that, when assessed using a 98.0% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of herring gull in the breeding season is of ***minor significance***.

401 Using an avoidance rate of 99.5% the cumulative effect of the three wind farms is to increase the annual adult mortality rate by 0.4% for the least adverse wind farm designs, and by 0.9% for the most adverse designs. The potential cumulative impact of this additional mortality on the regional population of herring gulls in the breeding season is rated as negligible magnitude (<1%), temporally long term and reversible. It is concluded that, when assessed using a 99.5% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of herring gulls in the breeding season is ***not significant***.

12.7.7 Great Black-Backed Gull

12.7.7.1 Displacement

402 For the purpose of assessing displacement it is assumed that 25% of great black-backed gulls will be displaced from the proposed wind farm footprint and a surrounding buffer of 1 km. Based on evidence from existing wind farms this is likely to be a cautious assumption because reported declines in great black-backed gull abundance at existing wind farms are below 25%, indeed, some sites showed no significant change, while increased numbers were recorded at other sites during the operational phase.

403 The value of the offshore site as a foraging site for breeding great black-backed gulls was estimated for each seasonal population from the proportion of the birds likely to be at sea that were on average present in the offshore site during each season and on the basis of a potential displacement from the offshore site out to 1 km. The results are presented in Table 12.32.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding period (Seabird 2000)	39,382	19,691	0.4	<0.1%	0.6	<0.1
North Sea, non-breeding period (Skov *et al.* 1995)	299,900	299,900	5.2	<0.1%	36.4	<0.1%
Regional, breeding period (Seabird 2000)	226	113	0.4	0.3%	0.6	0.5%
Regional, non-breeding (Skov *et al.* 1995)	21,500	21,500	5.2	<0.1%	36.4	<0.2%

Table 12.32: The mean estimated number of great black-backed gulls present during the breeding period and the non-breeding period, and the value as a percentage of the (at-sea) receptor population potentially at risk of displacement

404 Great black-backed gulls show little, if any, displacement behaviour in response to operational wind farms. The effective loss of around 0.1% or less of the foraging habitat of the regional breeding population is negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional great black-backed gull population in the breeding and non-breeding periods are ***not significant.***

12.7.7.2 Barrier Effect

405 Great black-backed gulls breeding at nearby colonies to the proposed wind farm could be affected by the wind farm acting as a barrier. The greatest potential for such impacts is for birds from the Isle of May.

406 Observations from operational offshore wind farms show no evidence that wind farms pose a barrier to great black-backed gulls. This, together with the limited maximum known foraging range (< 10 km) (Roos *et al.,* 2010) indicates that there will be no barrier effect on great black-backed gull arising from the offshore site in the breeding season. It is concluded that the impact of a barrier effect on the regional population of great black-backed gull in the breeding season is ***not significant***.

12.7.7.3 Disturbance by Vessels

407 Great black-backed gulls are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impact of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of great black-backed gull is ***not significant.***

12.7.7.4 Collision Mortality

408 For the purposes of assessment it is assumed that there is no far-field avoidance of the proposed wind farm by great black-backed gulls.

409 The results of CRM for great black-backed gull are summarised in Table 12.33 (refer to Appendix 12.2: Ornithology Statistics Report, for full details of CRM). Results are presented for the most adverse (128 x 3.6 MW turbines) and the least adverse (64 x 7 MW turbines) wind farm designs evaluated, and for two values of OAR. The most recent information indicates that the regional breeding population is 226 adults (Mitchell *et al.,* 2004). Approximately 27 adults die each year as a consequence of baseline mortality, assuming an adult survival rate of 0.88 per annum (BTO, 2012).

Wind farm design	% birds present assumed to be regional breeders	98.0% OAR		99.5% OAR	
Period of year		CRM deaths	Change AMR	CRM deaths	Change AMR
Design 1, 64 x 7 MW turbines					
Breeding period (April - August)	100%	0.9	3.2%	0.2	0.8%
Non-breeding period (Sept. - March)	10%	1.0	3.5%	0.2	0.9%
Whole year	varies	1.8	6.8%	0.5	1.7%
Design 4, 128 x 3.6 MW turbines					
Breeding period (April - August)	100%	1.3	4.9%	0.3	1.2%
Non-breeding period (Sept. - March)	10%	1.5	5.4%	0.4	1.3%
Whole year	varies	2.8	10.3%	0.7	2.6%

Table 12.33: The effect of CRM predicted collision mortality on the adult mortality rate (AMR) of the regional breeding great black-backed gull population

410 Using an avoidance rate of 99.5%, the increase in the assumed adult annual mortality rate of the regional population would be between 1.7% and 2.6% depending on wind farm design. Using an avoidance rate of 98.0%, the increase is between 6.8% and 10.3%.

411 The potential impact of the predicted collision mortality based on a 99.5% avoidance rate on the regional breeding population is an effect of low magnitude (1-5%) and temporally long term and reversible. Bearing in mind also that the regional breeding population of great black-backed gull is categorised as having low NCI, it is concluded that the impact of collision mortality on the regional population of great black-backed gulls in the breeding and non-breeding periods is an effect of ***minor significance***.

412 The potential impact of the predicted collision mortality based on a 98.0% avoidance rate on the regional breeding population is an effect of moderate magnitude (5-20%) and temporally long term and reversible. Considering the low NCI for this species, it is concluded that the impact of collision mortality on the regional population of great black-backed gulls in the breeding and non-breeding periods is assessed being of ***moderate significance***.

12.7.7.5 Summary of Impacts Combined for Great Black-Backed Gull

413 A summary of impacts in the breeding season is presented in Table 12.34.

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Barrier effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality using 98.0% AR	Moderate	Long term	Moderate	Moderate significance
Collision mortality using 99.5% AR	Low	Long term	Moderate	Minor significance
All effects combined (98.0% AR for collision risk)	Moderate	Long term	Low – moderate	Moderate significance
All effects combined (99.5% AR for collision risk)	Low	Long term	Low -Moderate	Minor significance

Table 12.34: Summary of impacts on the regional breeding population of great black-backed gull

414 The three effects assessed will act on the regional breeding population in a broadly additive manner. In combination it is judged that the magnitude of the three effects is low. Using a 99.5% avoidance rate the overall impact on the regional breeding population is judged of ***minor significance.*** With a lower avoidance rate of 98% it is judged to be of ***moderate significance.***

415 During the non-breeding period it is judged that the magnitude of the three effects is negligible using a 99.5% avoidance rate, and the overall impact on the regional non-breeding-period population is judged ***not significant.*** However, using a 98.0% avoidance rate the magnitude of the effects combined increase to low. Under this assessment scenario the overall impact on the regional population in the non-breeding-period is judged of ***minor significance.***

12.7.7.6 Cumulative Impact Assessment for Great Black-backed Gull

416 The results of the potential collision mortality and displacement effects are presented in Table 12.35.

Effect assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement Breeding season	25%	0.1%, Negligible	<0.1%, negligible	Negligible	<0.2% (+), Negligible
Collision (most adverse design)	98%	10.3% (2.8 adult collisions) High	60.9% (16.5 adult collisions) very high	no data available, likely high	71.2% (+), likely very high
	99.5%	2.6% (0.7 adult collisions) Low	15.2% (4.1 adult collisions) moderate	no data available, likely moderate	17.8% (+), likely high

Table 12.35: Summary of cumulative impacts for the three proposed offshore wind farms in south-east Scotland on the regional population of breeding great black-backed gull across the whole year

417 The cumulative impact of barrier effects on great black-backed gull during the breeding season is categorised as negligible in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of barrier effects caused by the three proposed offshore wind farms on the regional great black-backed gull population in the breeding season is ***not significant***.

418 Using an avoidance rate of 99.5% the cumulative effect of the Inch Cape and Neart na Gaoithe offshore wind farms is to increase the assumed annual adult mortality rate by 3.8% for the least adverse wind farm designs, and by 17.8% for the most adverse designs. Additional deaths from the Firth of Forth Round 3 Zone development are likely to substantially increase the number of collision strikes annually, possibly increasing the impact on the population to ***moderate significance***.

419 Using an avoidance rate of 98.0% the cumulative effect of the Inch Cape and Neart na Gaoithe offshore wind farms is to increase the assumed annual adult mortality rate by 15.4% for the least adverse wind farm designs and by 71.2% for the most adverse designs. Additional collisions from the Firth of Forth Round 3 Zone are likely to substantially increase the cumulative number of collision strikes annually, possibly increasing the impact on the population to ***major significance***.

12.7.8 Black-Legged Kittiwake

12.7.8.1 Displacement

420 For the purpose of assessing displacement it is assumed that 25% of kittiwakes will be displaced from the proposed wind farm footprint and a surrounding buffer of 1 km. This is likely to be a cautious assumption as although it is likely that some kittiwakes will be displaced during the construction phase, it is also likely that those displaced will reduce to negligible levels once construction is completed.

421 The value of the offshore site as a foraging site for breeding kittiwakes was estimated for each seasonal population from the proportion of the birds likely to be at sea that were on average present in the offshore site during each season and on the basis of a potential displacement from the offshore site out to 1 km. The results are presented in Table 12.36.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, colony-attend period (Seabird 2000)	734,550	462,766	246	0.1%	342	<0.1%
National, post-breeding period (Seabird 2000)	734,550	734,550	1,043	0.1%	1,250	0.2%
North Sea, winter period (Skov *et al.* 1995)	1,032,690	1,032,690	100	<0.1%	115	<0.1%
Regional, colony-attend period (Seabird 2000 and SMT database)	121,101	76,293	246	0.2%	342	0.4%
Regional, post-breeding period (Seabird 2000 and SMT database)	121,101	121,101	1,043	0.7%	1,250	1.0%
Regional, winter period (Skov *et al.* 1995)	68,000	68,000	100	0.1%	115	0.2%

Table 12.36: The mean estimated number of kittiwake present (on the sea and flying)

422 Kittiwakes show low levels of displacement from offshore wind farms and therefore it is very unlikely that the potential displacement effects quantified above will be fully realised. The impact from displacement is categorised as negligible magnitude, and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding kittiwake population are ***not significant.***

12.7.8.2 Barrier Effect

423 The potential effects on kittiwake of the proposed wind farm acting as a barrier were assessed for the breeding season only. During this period birds undertake commuting flights to and from feeding grounds and it is the potential for the wind farm to act as a barrier and disrupt these flights that is the primary concern arising from barrier effects.

424 The proposed wind farm would potentially form a barrier to commuting birds from all breeding colonies that lie within the typical foraging distance of kittiwake. The main kittiwake colonies in the region potentially affected are Isle of May and St Abb's Head. Although in theory the flights of kittiwakes from more distant colonies could also be affected, the distance away and alignment of the proposed wind farm from these colonies make it implausible that barrier effects on birds from these colonies could have more than a negligible effect. Therefore, no attempt is made to quantify it.

425 For the purposes of assessment the width of the barrier is assumed to extend 1 km in both directions beyond the maximum width of the proposed wind farm.

426 For the Isle of May colony (part of the Forth Islands SPA), the proposed wind farm would present a barrier 17.9 km wide, 16 km to the north-east. This barrier would potentially block approximately 33% of the possible flight directions available to kittiwakes flying out to distances in excess of 16 km from the Isle of May. Assuming mean destination distance from the colony of barrier-affected flights is 30 km (the mean foraging distance is 24.8 km, Thaxter *et al.* 2012) the mean increase in the length of barrier-affected flights is estimated at 17.7%.

427 For the St Abb's Head colony, the proposed wind farm would present a barrier 11.6 km wide located 33 km to the north. This barrier would potentially block approximately 9% of the possible flight directions available to kittiwakes flying out to distances in excess of 33 km from the St Abb's Head colony. Assuming mean destination distance from the colony of barrier-affected flights is 45 km (the closest distance beyond the barrier possible) the mean increase in the length of barrier-affected flights is estimated at 5.3%.

428 Observations from operational offshore wind farms shows no evidence that wind farms pose a barrier to kittiwakes. It is therefore likely that a much smaller percentage of foraging trips by this species of birds would be affected, if any.

429 Given that the Isle of May and St Abb's Head colonies between them have less than half the kittiwakes breeding in the region, it is clear that the impacts of any barrier effect on the regional breeding population would be negligible in magnitude, temporally long term and reversible. It is concluded that any barrier effect on the regional breeding kittiwake population is ***not significant***.

12.7.8.3 Disturbance by Vessels

430 Kittiwakes are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible and given the expected low sensitivity of the population to displacement it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of kittiwakes in the breeding, post-breeding and non-breeding periods is ***not significant.***

12.7.8.4 Collision Mortality

431 The results of CRM for kittiwake are summarised in Table 12.37 (see Appendix 12.2: Ornithology Statistics Report, for full details of CRM). Results are presented for the most adverse (128 x 3.6 MW turbines) and the least adverse (64 x 7 MW turbines) wind farm designs evaluated, and for two values of OAR. The most recent information indicates that the regional breeding population is 157,762 adults. Approximately 4,844 adults die each year as a consequence of baseline mortality, assumed to be 4% per annum.

Wind farm design	% birds present assumed to be regional breeders	98.0% OAR		99.5% OAR	
Period of year		**CRM deaths**	**Change AMR**	**CRM deaths**	**Change AMR**
Design 1, 64 x 7 MW turbines					
Breeding period (April - August)	100%	38	0.5%	10	0.1%
Non-breeding period (Sept - March)	50%	22	0.3%	6	0.1%
Whole year	varies	60	0.8%	15	0.2%
Design 4, 128 x 3.6 MW turbines					
Breeding period (April - August)	100%	57	0.8%	14	0.2%
Non-breeding period (Sept - March)	50%	33	0.5%	8	0.1%
Whole year	varies	90	1.3%	23	0.3%

Table 12.37: The effect of CRM predicted collision mortality on the adult mortality rate (AMR) of the regional breeding kittiwake population

432 For the purposes of assessment it is assumed that there is no far-field avoidance of the proposed wind farm by kittiwakes. Therefore, the mortality that is considered likely to occur for wind farm designs and assumed avoidance rate scenarios illustrated is that presented in the table above.

433 Given the large and continuing decline of the regional kittiwake population (by approximately 4% per year (SMP, 2012), equivalent to approximately 4,200 less breeding adults every year), this population is considered to have high sensitivity to any additional adult mortality.

434 Using an avoidance rate of 99.5%, the increase in the adult mortality rate of the regional breeding population would be between 0.2% and 0.3% depending on the wind farm design (refer to Table 12.337. Using an avoidance rate of 98.0% the increase is between 0.8% and 1.3% (refer to Table 12.37). Thus for a 99.5% avoidance rate the changes in mortality rate are in all cases well below the default guidance threshold of 1%, which is considered the minimum likely to have potential for adverse impacts on a population (King *et al.*, 2009). However, for a 98% avoidance rate the predicted change in mortality rate exceeds the guidance threshold of 1%, and therefore could

potentially lead to adverse impacts on a population, especially one that has a declining status. The 99.5% avoidance rate is likely to more closely reflect the actual behaviour of kittiwake.

435 Using the more likely avoidance rate of 99.5%, the potential impact of the predicted collision mortality on the regional breeding population is an effect of negligible magnitude (<1%) and temporally long term and reversible. It is concluded that the impact of collision mortality on the regional kittiwake breeding population are ***not significant***.

436 When assessed using a 98.0% avoidance rate, the potential impact of the predicted collision mortality on the regional breeding population is an effect of low magnitude (<1%) and temporally long term and reversible. It is concluded that the impact of collision mortality assessed at 98.0% avoidance on the regional kittiwake breeding population is of ***minor significance***.

12.7.8.5 Summary of Impacts Combined for Kittiwake

437 Table 12.38 summarises the impacts for the breeding season.

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Barrier effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality*	Negligible	Long term	Moderate	Not significant
All effects combined	Negligible	Long term	Low/Moderate	Not significant
***The collision mortality summary is for predictions based on a 99.5% avoidance rate.**				

Table 12.38: Summary of impacts on the regional breeding population of kittiwake

438 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the population is negligible. Furthermore, the population has low sensitivity to all effects except collision risk. It is concluded that the overall impact on the regional kittiwake population in the breeding and non-breeding period is ***not significant.***

12.7.8.6 Cumulative Impact Assessment for Kittiwake

439 The results of the potential collision mortality and displacement effects are presented in Table 12.39.

Effect assessed	Assumption	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative impact
Displacement Breeding season	25%	0.1%	0.6%	1.0%	≤1.7%
Collision	98%	90 - 134	9 – 997	1,076 – 1,737	1,175 – 2,868
	99.5%	23 - 34	24 - 250	270 – 435	317 - 719

Table 12.39: Summary of cumulative impacts for the three proposed offshore wind farm in south-east on the regional population of breeding kittiwake

440 The predicted potential effective loss of up to 1.7% of the foraging habitat is rated as low in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional population of breeding kittiwake is assessed as being not significant.

441 The mean foraging distance from the colony for kittiwakes is 24.8 km and the mean maximum foraging distance is 60.0 km (Thaxter *et al*., 2012). This means that almost no foraging flights by kittiwake will be to areas beyond the barrier formed by the three proposed wind farms. As a result, any barrier effect will be negligible. The cumulative barrier effect is rated as negligible magnitude, temporally long term and bearing in mind the low sensitivity of kittiwake to barrier effects, it is concluded that the cumulative impact of a barrier effect caused by the three proposed offshore wind farms on the regional population of kittiwakes in the breeding season is ***not significant***.

442 Using an avoidance rate of 98.0% the cumulative effect of the three wind farms is to increase the annual adult mortality rate by 11.5% for the least adverse wind farm designs and by 36.3% for the most adverse designs. Assuming that the least adverse designs are chosen, the potential cumulative impact of this additional mortality on the regional kittiwake population in the breeding season is rated as moderate magnitude, temporally long term and reversible. It is concluded that, using a 98.0% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of kittiwakes in the breeding season is of ***moderate significance***.

443 Using a 99.5% avoidance rate, an increase in the annual adult mortality rate of 2.8% for the least adverse wind farm designs, and of 8.9% for the most adverse designs may occur. Assuming that the least adverse designs are chosen, the potential cumulative impact of this additional mortality on the regional kittiwake population in the breeding season is rated as low magnitude (1-5%), temporally long term and reversible. It is concluded that, when assessed using a 99.5% avoidance rate, the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of kittiwakes in the breeding season is of ***minor significance***.

12.7.9 Arctic Tern

12.7.9.1 Displacement

444 For the purpose of assessing displacement it is assumed that 25% of Arctic terns will be displaced from the proposed wind farm footprint and a surrounding buffer of 1 km. The results of the assessment are summarised in Table 12.40.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, breeding (Seabird 2000)	105,159	105,159	363	0.3%	425	0.4%
UK east coast, breed (Shetland to Blyth) (Seabird 2000)	98,052	98,052	363	0.4%	425	0.4%
Regional, breeding (Seabird 2000)	10,056	10,056	363	3.6%	425	4.2%

Table 12.40: The mean estimated number and percentage of the Arctic tern population potentially at risk of displacement from marine areas during the autumn passage period (August - September)

445 The value of the offshore site buffered to 1 km as a foraging site to Arctic terns in the autumn passage period was estimated from the mean proportion of regional breeding population present in the autumn passage period.

446 On this basis, the offshore site might provide up to approximately 4.2% of the regional autumn passage period foraging resources. However, for the reasons discussed earlier, it is considered more likely that birds in the autumn passage period originate from colonies across eastern Scotland and north-east England (and possibly further afield) in which case it would then be inferred that the offshore site buffered to 1 km might provide up to approximately 0.4% of the autumn passage period foraging resources.

447 Were 25% of Arctic terns to be displaced from the offshore site buffered to 1 km, this would represent a loss of up to approximately 1.1% of the regional autumn passage period foraging resources (25% of the regional breeding population value in Table 12.40). This is likely to be an overestimate of the importance of the area for foraging because as discussed earlier, the size of the autumn passage population is likely to be larger than the regional breeding population. If the autumn passage population comprised birds from breeding grounds across eastern Scotland and north-east England, which is considered more likely, the equivalent loss of foraging resources figure reduces to 0.1% (25% of UK east coast breeding population value in Table 12.40). The loss of 0.1% of the autumn passage population's foraging resources would be an effect of negligible magnitude (<1%) and temporally long term and reversible. It is concluded that the impact of displacement on the regional Arctic tern population in the autumn passage period is ***not significant.***

448 The numbers of Arctic tern present in the spring passage period in the offshore site buffered to 1 km were much lower than in the autumn passage period. Therefore, it follows that any loss of foraging habitat caused by displacement in this period is also ***not significant***.

12.7.9.2 Barrier Effect

449 Based on evidence from other wind farm studies summarised above, and the absence of Arctic terns in the offshore site in June and July on baseline surveys, it is concluded that the development will not present a barrier to foraging Arctic terns in the breeding season.

12.7.9.3 Disturbance by Vessels

450 Arctic terns are not considered susceptible to disturbance impacts and were assessed as being at low risk of displacement resulting from offshore wind farms (Langston, 2010). Any such impact is therefore categorised as negligible (<1%) magnitude, and temporally short term and reversible. Given the expected low sensitivity of the population to displacement it is concluded that the impact of disturbance by vessels during the construction, operation and decommissioning phases on the regional autumn passage populations of Arctic terns is ***not significant.***

12.7.9.4 Collision Mortality

451 Collision risk modelling was undertaken for Arctic tern based on an assumed population of 1,000 birds passing through the offshore site twice per year, once in spring and once in autumn, with 23% of birds at rotor height (Cook *et al* 2012). This resulted in a total of 0.9 collisions predicted per year, based on an avoidance rate of 98.0%, or 0.2 collisions predicted per year, based on an avoidance rate of 99.5%.

452 Scaling this up to the size of the Arctic tern population of 98,052 adults that might pass through would give a worst case scenario of 88.2 and 22.1 collisions per annum for 98.0% and 99.5% avoidance rates respectively. Nevertheless the effect of this on the population's adult mortality rate remains the same as shown above.

453 The results are unrealistically precautionary as only a very small proportion of Arctic tern flight activity would be at rotor height, indeed, 99.6% of 964 flying Arctic terns recorded in baseline surveys were below the proposed rotor height. Also, Arctic terns migrate on a relatively broad front that is wider than the offshore site. Therefore, only a relatively small proportion (say, <25%) of the population would be expected to pass through the offshore site. It is likely therefore that the actual effects of collision mortality on migrating Arctic terns is considerably lower than the worst case scenario figures presented above.

454 The potential effect of the collision mortality of Arctic terns on the baseline mortality rate is categorised as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of collision mortality on Arctic terns is ***not significant***.

12.7.9.5 Summary of Impacts Combined for Arctic Tern

455 All effects are adverse and reversible (refer to Table 12.41). This species is categorised as having high NCI.

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Negligible	Long term	Low	Not significant

Table 12.41: Summary of impacts on the regional autumn passage population of Arctic terns

456 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the regional population is negligible. It is concluded that the overall impact on the regional population of Arctic tern in the autumn passage period is ***not significant.***

12.7.9.6 Cumulative Impact Assessment

457 Predicted displacement causing the potential effective loss of up to 0.8% of the foraging habitat of the autumn passage population of Arctic tern is rated as negligible magnitude (<1%), temporally long term and reversible (refer to Table 12.42). It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional population of Arctic terns in the autumn passage period is ***not significant***.

Effect Assessed	Assumed amount of potential displacement realised	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement: effective loss of foraging habitat during the autumn passage period (%)	25%	0.1%, negligible	<0.1%, negligible	0.6%, negligible	0.8%, Negligible
Collision: % increase in assumed annual adult mortality rate. All designs.	0%	No change, Negligible	No change, Negligible	No change, Negligible	No change, Negligible

Table 12.42: Summary of CIA for the three proposed offshore wind farms in south-east Scotland on the regional autumn passage population of Arctic tern

458 The potential cumulative impact of collision mortality on the baseline mortality rate of the regional Arctic tern population in the autumn passage period is rated as negligible magnitude, temporally long term and reversible. It is concluded that the cumulative impact of collision mortality caused by the three proposed offshore wind farms on the regional population of Arctic tern in the autumn passage period is ***not significant***.

12.7.10 Guillemot

12.7.10.1 Displacement

459 For the purposes of assessment it is assumed that 50% of guillemots would be displaced from the proposed development and a surrounding buffer of 1 km. The results of the assessment are presented in Table 12.43.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, colony-attend period (Seabird 2000)	2,208,812	883,525	737	<0.1%	930	0.1%
National, chicks-on-sea period (Seabird 2000)	2,208,812	2,208,812	311	<0.1%	499	<0.1%
North Sea, post-breeding period (Skov *et al.* 1995)	1,426,100	1,426,100	3,588	0.3%	5,111	0.4%
North Sea, winter period (Skov *et al.* 1995)	1,562,400	1,562,400	665	<0.1%	879	0.1%
Regional, colony-attend period ((Seabird 2000 and SMT database)	312,151	124,860	737	0.6%	930	0.7%
Regional, chicks-on-sea period (Seabird 2000 and SMT database)	312,151	312,151	311	<0.1%	499	0.2%
Regional, post-breeding period (Skov *et al.* 1995)	274,050	274,050	3,588	1.3%	5,111	1.9%
Regional, winter period (Skov *et al.* 1995)	521,000	521,000	665	0.1%	879	0.2%

Table 12.43: The mean number of guillemot present in the offshore site and 1 km buffer in each period of the year and this figure expressed as the percentage of the (at-sea) receptor population. (The periods are defined as follows: colony attendance, April to June; chicks-on-sea, July and August; post-breeding, September and October; and winter, November to March)

460 The value of the offshore site buffered to 1 km as a foraging site for breeding guillemots was estimated for the regional breeding population from the proportion of the adults likely to be at sea (not attending a colony) that were on average present and on the sea. This is likely to overestimate the importance for feeding as it is likely that some individuals that were present were not feeding.

461 On this basis, the proportion of the foraging resources provided by the offshore site buffered to 1 km during the different periods of the year is as follows:

- 0.7% during the colony attendance part of the breeding season;
- 0.2% during the chicks-on-sea part of the breeding season;
- 1.9% during the post-breeding period; and
- 0.2% during the winter period.

462 Studies show that not all guillemots are displaced from within operational wind farms, indeed there is strong evidence from several studies that this species is little affected by displacement. For the purposes of assessment it is cautiously assumed that 50% of guillemots that would otherwise forage in the offshore site buffered to 1 km would be displaced elsewhere.

463 If 50% of guillemots were to be displaced during the breeding season from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.4% of the foraging habitat of the regional breeding population. During the post-breeding season the effective loss is up to around 0.1% and during the non-breeding season around 0.1% of the foraging habitat.

464 The sensitivity of the population to displacement may vary across the year depending on the need to attend colonies and provision young or whether they are undergoing wing moult. However, in all instances magnitude of the impact is considered negligible or low and temporally long term and reversible. It is concluded that the impact of displacement on the regional breeding guillemot population are ***not significant.***

12.7.10.2 Barrier Effect

465 The potential effects on guillemot of the proposed wind farm acting as a barrier were assessed only for the part of the breeding season when birds are attending colonies. During this period birds undertake commuting flights to and from feeding grounds and it is the potential for the wind farm to act as a barrier and disrupt these flights that gives cause for concern and the possibility of adverse effects on a population.

466 The proposed wind farm would potentially form a barrier to commuting birds from all breeding colonies that are closer to the offshore site than typical foraging distance of guillemot during the period of colony attendance. The main guillemot colonies potentially affected are Isle of May, Craigleith, and St Abb's Head. Although in theory the birds from more distant colonies could also be affected the distance away and alignment of the proposed wind farm from these colonies make it implausible that barrier effects on birds from these colonies could have more than a negligible effect. Therefore, no attempt is made to quantify it.

467 For the purposes of assessment the width of the barrier is assumed to extend 1 km in both directions beyond the maximum width of the proposed wind farm (i.e. the offshore site and a 1 km buffer).

468 For the Isle of May colony (part of the Forth Islands SPA), the proposed wind farm would present a barrier 17.9 km wide, 16.2 km to the north east. This barrier would potentially block approximately 33% of the possible flight directions available to guillemots flying out to distances in excess of 16.2 km from the Isle of May. Assuming the destinations of affected flights are on average 35 km, the mean increase in the length of affected flights is estimated at 12.6%.

469 For the Craigleith colony (part of the Forth Islands SPA), the mean increase in the length of affected flights is estimated at 28% and could increase the average length of foraging journeys for guillemots breeding at the Craigleith colony by up to approximately 12.1%.

470 For the St Abb's Head colony, the proposed wind farm would present a barrier 11.6 km wide 33.4 km to the north. This barrier would potentially block approximately 9% of the possible flight directions available to guillemots flying out to distances in excess of 33.4 km from the St Abb's Head colony and cause a mean increase in the length of affected flights caused by the barrier effect by an estimated 17.1% and the average length of foraging journeys for guillemots breeding at the St Abb's Head colony by up to approximately 5.3%.

471 Of the large nearby colonies examined above for sensitivity to barrier effects in the colony attendance period, only the Isle of May colony could plausibly be adversely affected by more than a negligible amount, and even here the magnitude of this effect is very small. Given that the Isle of May supports only approximately 10% of the regional breeding population, the effect of the proposed wind farm acting as a barrier is categorised as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of the proposed wind farm acting as a barrier on regional breeding guillemot population is ***not significant***.

12.7.10.3 Disturbance by Vessels

472 The presence of vessels and their activities may cause disturbance and consequently displacement to species that avoid them, e.g. divers and scoter. The extent that birds may be displaced by vessels varies depending on the type and speed of the vessel and possibly the time of year. Guillemots are not thought to be particularly sensitive to vessel movements but birds disturbed by vessels will either swim or fly away to an alternative location until the vessels have passed, after which they may return to the area. Consequently, there may be a localised, short term effect.

473 Based on this, possible displacement impacts were categorised as being of low (1-5%) magnitude, and being temporally short term and reversible. Overall, it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of guillemots in the breeding, post-breeding and non-breeding periods is ***not significant.***

12.7.10.4 Collision Mortality

474 Collision risk modelling was not undertaken for guillemot as almost all birds (99.96%) seen in flight during the baseline surveys were below the proposed minimum rotor swept height of turbines. Therefore, it is not plausible that this species will experience mortality from collision with turbine rotors.

475 The likely effect of the collision mortality on the baseline mortality rate on the regional guillemot population in the breeding season is rated as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of collision mortality on guillemots is not significant.

12.7.10.5 Summary of Impacts Combined for Guillemot

476 The impacts of the effects assessed will act in a broadly additive manner on the receptor population. In combination it is judged that the magnitude of the effects on the regional population of guillemots in the breeding season is low (refer to Table 12.44). It is concluded that the overall impact on the regional population of guillemots in the breeding season is ***not significant*.**

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Low	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Moderate	Not significant
Barrier Effect	Negligible	Long term	Low	Not significant
Vessel disturbance	Low	Long term	Moderate	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Low - Moderate	Not significant

Table 12.44: Summary of impacts on the regional population of guillemots in the breeding season

477 In combination it is judged that the magnitude of the effects on the regional population of guillemots in the post-breeding and non-breeding-periods is negligible to low (refer to Table 12.45). It is concluded that the overall impact on the regional population of guillemots in the post-breeding and non-breeding-period is ***not significant.***

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Low	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat, post-breeding period	Low	Long term	Low	Not significant
Displacement from foraging habitat, non-breeding period	Negligible	Long term	Negligible	Not significant
Vessel disturbance	Low	Long term	Moderate	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Low - Moderate	Not significant

Table 12.45: Summary of impacts on the regional population of guillemots in the post-breeding and non-breeding periods

12.7.10.6 Cumulative Impact Assessment for Guillemot

478 Very few guillemots have been recorded flying at rotor height across all three developments and therefore there is predicted to be no significant cumulative impact on guillemots from collision mortality.

479 For potential barrier effects it is predicted that guillemots from any of the major colonies will, at most, only be affected by one development during each foraging trip to and from the colony. There will not be any cumulative impacts where guillemots are affected by more than one development during a single foraging trip.

480 The predicted effective loss of up to 5.4% of the foraging habitat of the regional guillemot population during the breeding season (refer to Table 12.46) is rated as an effect of moderate magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional guillemot population during the breeding season is of ***moderate significance***.

Effect Assessed	Assumed amount of potential displacement realised	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement: effective loss of foraging habitat during breeding period (%)	50%	0.4%, Negligible	1.4%, Low	3.6%, Low	5.4%, Moderate
Displacement: effective loss of foraging habitat during post-breeding period (%)	50%	0.9%, Negligible	0.2, Negligible	0.2, Negligible	≤1.3, Minor
Barrier Effect	100%	Foraging trips of <10% of Forth Islands and St Abb's Head birds potentially increase on average by 6%. Negligible	Foraging trips of <10% of Fowlsheugh and Forth Islands birds potentially increase on average by ca. 5%. Negligible	No barrier effect as no flights likely to go beyond the development area, Negligible	No barrier effect as no flights likely to go beyond the development area. Negligible
Collision: % increase in assumed annual adult mortality rate. All designs.	0%	No change, Negligible	No change, Negligible	No change, Negligible	No change, Negligible

Table 12.46: Summary of CIA for the three proposed offshore wind farms in south-east Scotland on the regional population of breeding guillemot

481 The predicted effective displacement of between 0.8% and 0.9% of the regional breeding guillemot population during the breeding season is rated as low in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional guillemot population during the breeding season is not significant.

12.7.11 Razorbill

12.7.11.1 Displacement

482 For the purposes of assessment it is assumed that 50% of razorbills would be displaced from the offshore site and a surrounding buffer of 1 km. The results from the assessment of potential displacement on razorbill are presented in Table 12.47.

Receptor population	Population size (adults) (colony count 1.538)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, colony-attend period (Seabird 2000)	253,418	88,696	101	0.1%	124	0.1%
National, chicks-on-sea period (Seabird 2000)	253,418	253,418	215	0.1%	301	0.1%
North Sea, post-breeding period (Skov *et al.* 1995)	218,620	218,620	1,429	0.7%	2,055	0.9%
North Sea, winter period (Skov *et al.* 1995)	324,000	324,000	116	<0.1%	190	0.1%
Regional, colony-attend period (Seabird 2000 x 14% decline)	26,737	9,358	101	1.1%	124	1.3%
Regional, chicks-on-sea (with 14% decline). Hybrid estimate, see text.	52,429	52,429	215	0.4%	301	0.6%
Regional, post-breeding period (Skov *et al.* 1995)	75,600	75,600	1,429	1.9%	2,055	2.7%
Regional, winter period (Skov *et al.* 1995)	14,400	14,400	116	0.8%	190	1.3%

Table 12.47: The mean number of razorbill present in the offshore site and 1 km buffer in each period of the year and this figure expressed as the percentage of the (at-sea) receptor population

483 The value of the offshore site buffered to 1 km as a foraging site to breeding razorbills was estimated for the regional breeding population from the proportion of the adults likely to be at sea (not attending a colony) that were on average present on the sea.

484 On this basis, the foraging resources provided by the offshore site buffered to 1 km during the different periods of the year was as follows:

- 1.3% during the colony attendance part of the breeding season;
- 0.6% during the chicks-on-sea part of the breeding season;
- 2.7% during the post-breeding period;
- 1.3% during the winter period.

485 Studies show that not all razorbills are displaced from within operational wind farms, several studies indicate that this species is little affected by displacement. For the purposes of assessment it is cautiously assumed that 50% of razorbills that would otherwise forage in the offshore site buffered to 1 km would be displaced elsewhere.

486 If 50% of razorbills were to be displaced from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.7% of the foraging habitat of the regional breeding population during the colony attendance period. Similarly during the period when chicks are on the sea 0.28% of the foraging habitat available to the regional population may be lost. During the post-breeding period there is the greatest potential for loss of foraging habitat with an estimated 1.4% of the habitat becoming unavailable. Before decreasing to 0.74% during the non-breeding period. For all periods the magnitude of the effect is assessed as being either low or negligible and temporally long term and reversible. The impacts are considered to be not significant for all periods except during the post-breeding period when they are they are considered to be of ***minor significance***.

12.7.11.2 Barrier Effect

487 The potential effects on razorbill of the proposed wind farm acting as a barrier were assessed only for the part of the breeding season when birds are attending colonies. During this period birds undertake commuting flights to and from feeding grounds and it is the potential for the wind farm to act as a barrier and disrupt these flights that gives cause for concern and the possibility of adverse effects on a population.

488 The proposed wind farm would potentially form a barrier to commuting birds from all breeding colonies that are closer to the offshore site than typical foraging distance of razorbill during the period of colony attendance. The main razorbill colonies potentially affected are at the Isle of May and St Abb's Head. Although in theory birds from other and more distant colonies could also be affected.

489 For the Isle of May colony, the proposed wind farm would present a barrier 17.9 km wide, 16.2 km to the north-east. This barrier would potentially block approximately 33% of the possible flight directions available to razorbills flying out to distances in excess of 16.2 km from the Isle of May. Assuming the destinations of affected flights are on average 25.6 km from the colony, i.e. immediately beyond the wind farm, the mean increase in the length of affected flights is estimated at 28.4%.

490 For the St Abb's Head colony, the proposed wind farm would present a barrier 11.6 km wide, 33.4 km to the north. This barrier would potentially block approximately 9% of the possible flight directions available to razorbills flying out to distances in excess of 33.4 km from the St Abb's Head colony. However the mean foraging distance of razorbill is 23.7 km (Thaxter *et al.* 2012), and therefore relatively few foraging trips are likely to be affected. Assuming the destination distance of affected flights that are affected is 45 km from the breeding colony on average, i.e., immediately beyond the proposed wind farm, the mean increase in the length of affected flights is estimated at 5.3%

491 Of the two large nearby colonies examined above for potential impacts to barrier effects in the colony attendance period, only the Isle of May colony could plausibly be adversely affected by more than a negligible amount. Given that the Isle of May supports approximately 22% of the regional breeding population, and that approximately 17% of flights there may be affected, this suggests that approximately 4% of foraging trips made by birds in the regional breeding population could be affected by the wind farm acting as a barrier. It is concluded that the wind farm acting as a barrier should be categorised as an effect of moderate magnitude, temporally long term and reversible. It is concluded that the predicted impact of the proposed wind farm acting as a barrier on the regional breeding razorbill population is of ***moderate significance***.

12.7.11.3 Disturbance by Vessels

492 The presence of these vessels and their activities may cause disturbance and consequently displacement to species that avoid them, e.g. divers and scoter. The extent that birds may be displaced by vessels varies depending on the type and speed of the vessel and possibly the time of year. Razorbills are not thought to be particularly sensitive to vessel movements but birds disturbed by vessels will either swim or fly away to an alternative location until the vessels have passed, after which they may return to the area. Consequently, there may be a localised, short term effect.

493 Based on this, possible displacement impacts were categorised as being of low (1-5%) magnitude, and being temporally short term and reversible. Overall, it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of razorbills in the breeding, post-breeding and non-breeding periods is ***not significant.***

12.7.11.4 Collision Mortality

494 Collision risk modelling was not undertaken for razorbill because all birds seen in flight during the baseline surveys were below the proposed minimum rotor swept height of turbines. Therefore, it is not plausible that this species will experience mortality from collision with turbine rotors.

495 The likely effect of the collision mortality on the baseline mortality rate of the regional breeding razorbill population is rated as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of collision mortality on razorbills is not significant.

12.7.11.5 Summary of Impacts Combined for Razorbill

496 The impacts of the effects assessed will act in a broadly additive manner on the receptor population. In combination it is judged that the magnitude of the effects on the regional razorbill population in the breeding season is low (refer to Table 12.48). It is concluded that the overall impact on the regional population of razorbills in the breeding season is of ***minor significance.***

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Low	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat, colony attendance period	Negligible	Long term	Moderate	Not significant
Displacement from foraging habitat, chick-on-sea period	Negligible	Long term	Moderate	Not significant
Barrier effect, colony attendance period	Low	Long term	Moderate	Minor significance
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Moderate	Minor significance

Table 12.48: Summary of impacts on the regional breeding population of razorbill

497 In combination it is judged that the magnitude of the effects on the regional razorbill population in the post-breeding and non-breeding-period is low (refer to Table 12.49). It is concluded that the overall impact on the regional population of razorbills in the post-breeding and non-breeding-periods is of ***minor significance.***

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Low	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat, post-breeding period	Low	Long term	Moderate	Minor significance
Displacement from foraging habitat, non-breeding period	Negligible	Long term	Negligible	Not significant
Vessel disturbance	Negligible	Long term	Minor	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Low	Minor significance

Table 12.49: Summary of impacts on the regional post-breeding and non-breeding period populations of razorbill

12.7.11.6 Cumulative Impact Assessment for Razorbill

498 Very few razorbills have been recorded flying at rotor height across all three developments and therefore there is predicted to be no significant cumulative impact on razorbills from collision mortality.

499 For potential barrier effects it is predicted that razorbills from any of the major colonies will, at most, only be affected by one development during each foraging trip to and from the colony. There will not be any cumulative impacts where razorbills are affected by more than one development during a single foraging trip.

500 The main potential for a cumulative impact on razorbill may arise from displacement effects. The results from the assessment undertaken by the Forth Tay developers to assess cumulative impacts during the breeding period are presented in Table 12.50. Data are not available for assessing potential displacement outwith the breeding season.

Effect	Assumed amount of potential displacement realised	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement in breeding season	50%	0.7% Negligible	1.7% Low	3.6% Low	6.0% Moderate
Displacement in non-breeding season	50%	1.4% Low	0.9% Negligible	2.0% Low	4.3% Low

Table 12.50: Summary of CIA for the three proposed offshore wind farms in southeast Scotland on the regional population of breeding razorbill

501 The predicted effective displacement of up to 6.0% of the regional breeding razorbill population during the breeding season is rated as moderate in magnitude, temporally long term and reversible.

502 The impacts of displacement on razorbills are uncertain. It is most likely that displaced birds will relocate to other areas although this may cause intraspecific competition and consequently have an energetic cost on the individuals displaced.

12.7.12 Puffin

12.7.12.1 Displacement

503 As with guillemots and razorbills, for the purposes of assessment it is assumed that 50% of puffins would be displaced from the proposed development and a surrounding buffer of 1 km. The results from the impact assessment on displacement are summarised in Table 12.51.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
National, colony-attend period (Seabird 2000)	1,159,447	753,640	1,305	0.2%	1,877	0.2%
North Sea, post-breeding period (Skov *et al.* 1995)	1,159,447	1,159,447	857	0.1%	1,348	0.1%
North Sea, winter period (Skov *et al.* 1995)	50,000	50,000	25	0.1%	33	0.1%
Regional, colony-attend period (Seabird 2000 and SMT database)	258,543	168,053	1,305	0.8%	1,877	1.1%
Regional, post-breeding period (Skov *et al.* 1995)	167,790	167,790	857	0.5%	1,348	0.8%
Regional, winter period (Skov *et al.* 1995)	37,500	37,500	25	0.1%	33	0.1%

Table 12.51: The mean number of puffin present in the offshore site and 1 km buffer in each period of the year and this figure expressed as the percentage of the (at-sea) receptor population. (The periods are defined as follows: colony attendance, April to August; post-breeding, September and October; and winter, November to March.)

504 The value of the offshore site buffered to 1 km as a foraging site to puffins was estimated for the regional population for the three periods of the year from the proportion of the adults likely to be at sea (not attending a colony) that were on average present.

505 On this basis, it is inferred that the proportion of the foraging resources provided by the offshore site buffered to 1 km during the different periods of the year was as follows:

- 1.1% during the colony attendance part of the breeding season;
- 0.8% during the post-breeding period;
- 0.1% during the winter period.

506 If 50% of puffins were to be displaced from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.6% of the foraging habitat of the regional breeding population during the colony attendance period. During the post-breeding period this decreases to 0.4% and to 0.1% during the non-breeding period.

507 For all periods it is concluded that the magnitude of the impacts are negligible, temporally long term and reversible. However, due to the differing sensitivities to the population across the year, the effects on the puffin population may vary and is considered to be potentially significant during the post-breeding period, as many adults undergo wing moult and so they have increased food requirements and reduced mobility when they are flightless. Furthermore, the extent of favoured feeding habitat at this time of year is apparently relatively restricted with birds congregating in favoured areas such as the Firth of Forth and Moray Firth (Skov *et al.* 1995). Overall it is concluded that the impact of displacement on the regional puffin population in the breeding season is ***not significant.***

12.7.12.2 Barrier Effect

508 The potential effects on puffin of the proposed wind farm acting as a barrier were assessed only for the part of the breeding season when birds are attending colonies. During this period birds undertake commuting flights to and from feeding grounds and it is the potential for the wind farm to act as a barrier and disrupt these flights that gives cause for concern and the possibility of adverse effects on a population.

509 The proposed wind farm could potentially form a barrier to commuting birds from all breeding colonies that are closer to the offshore site than typical foraging distance of puffin during the period of colony attendance. The main puffin colonies potentially affected are the Isle of May, and Craigleith, both in the Forth Islands SPA.

510 For the purposes of assessment the width of the barrier is assumed to extend 1 km in both directions beyond the maximum width of the proposed wind farm (i.e. the offshore site and a 1 km buffer).

511 For the Isle of May colony, the proposed wind farm would present a barrier 17.9 km wide, 16.2 km to the north-east. This barrier would potentially affect approximately 33% of the possible flight directions available to puffins flying out to distances in excess of 16.2 km from the Isle of May. Tagging studies of puffins on the Isle of May in 2010 showed that the maximum distance from the colony exceeded 16.2 km for 93% of the 15 foraging trips logged, and that the mean maximum distance of the trips that exceeded 16.2 km was at least 43.1 km from the colony. Assuming that the average destination of barrier-affected flights lies on average 45 km from the colony, the mean increase in the length of affected flights is estimated at 8.1% (approximately 3.7 km).

512 For Craigleith, the proposed wind farm would present a barrier that would potentially affect approximately 28% of the possible flight directions available to puffins flying out to distances in excess of 31.5 km from the Craigleith colony. Assuming that the average destination of barrier-affected flights from Craigleith lies on average 50 km from the colony, the mean increase in the length of affected flights is estimated at 6.4%, (approximately 3.2 km).

513 The likely impact of the proposed wind farm acting as a barrier to breeding puffins is categorised as negligible in magnitude, temporally long term and reversible. It is concluded that the effect of the proposed wind farm acting as a barrier on regional breeding puffin population is of ***minor significance***.

12.7.12.3 Disturbance by Vessels

514 Puffins are not thought to be particularly sensitive to vessel movements but birds disturbed by vessels will either swim or fly away to an alternative location until the vessels have passed, after which they may return to the area. Consequently, there may be a localised, short term effect. Based on this, possible displacement impacts were categorised as being of low (1-5%) magnitude, and being temporally short term and reversible. Overall, it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional populations of puffins in the breeding, post-breeding and non-breeding periods is ***not significant.***

12.7.12.4 Collision Mortality

515 Collision risk modelling was not undertaken for puffin because almost all birds seen in flight (99.97%) during the baseline surveys were below the proposed minimum rotor swept height of turbines. Therefore, it is not plausible that this species will experience significant mortality from collision with turbine rotors.

516 The likely effect of the collision mortality on the baseline mortality rate on the regional breeding puffin population is rated as negligible in magnitude temporally long term and reversible. It is concluded that the impact of collision mortality on puffins is ***not significant***.

12.7.12.5 Summary of Impacts Combined for Puffin

517 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the effects on the regional puffin population during the breeding and post-breeding period is low. It is concluded that the overall impact on the regional population of puffins in the breeding and post-breeding periods is of ***minor significance*** (refer to Table 12.52).

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Moderate	Not significant
Operational phase				
Displacement from foraging habitat, colony attendance period	Negligible	Long term	Low	Not significant
Displacement from foraging habitat, post-breeding period	Negligible	Long term	Low	Not significant
Barrier effect	Low	Long term	Moderate	Minor significance
Vessel disturbance	Negligible	Long term	Moderate	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Low	Long term	Low - Moderate	Not significant

Table 12.52: Summary of impacts on the regional population of puffins in the breeding and post-breeding periods

518 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the effects on the population is low. It is concluded that the overall impact on both the breeding and non-breeding populations is ***not significant***.

12.7.12.6 Cumulative Impact Assessment for Puffin

519 Very few puffins have been recorded flying at rotor height across all three developments and therefore there is predicted to be no significant cumulative impact on puffins from collision mortality.

520 For potential barrier effects it is predicted that puffins from any of the major colonies will, at most, only be affected by one development during each foraging trip to and from the colony. There will not be many cumulative impacts where puffins are affected by more than one development during a single foraging trip.

The main potential for a cumulative impact on puffin may arise from displacement effects. The results from the assessment undertaken by the Forth Tay developers to assess cumulative impacts during the breeding period are presented in Table 12.53. Data are not available for assessing potential displacement outwith the breeding season.

Effect Assessed	Assumed amount of potential displacement realised	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement in breeding season	50%	0.6% Negligible	0.5% Negligible	1.3% Negligible	2.4% Low
Displacement in non-breeding season	50%	0.4% Negligible	0.8% Negligible	1.7% Low	2.9% Low
Barrier Effect	100%	Up to ca.16% of foraging flights in the region (all by Forth Islands birds) increase in length by up to 8%. Low	Up to ca. 10% of foraging flights in the region (all by Forth Islands birds) increase in length by up to 6%. Negligible	Negligible barrier effect as very few flights are likely to go beyond the development area. Negligible	Negligible barrier effect as very few flights are likely to go beyond the development area. Negligible

Table 12.53: Summary of cumulative displacement effects on the regional puffin population

522 The predicted effective displacement of between 0.6% and 1.8% of the regional puffin population during the breeding season is rated as low in magnitude, temporally long term and reversible. It is concluded that the cumulative impact of displacement caused by the three proposed offshore wind farms on the regional puffin population during the breeding season is assessed as being ***not significant***.

12.7.13 Little Auk

12.7.13.1 Displacement

523 As with the other auk species, for the purposes of assessment it is assumed that 50% of little auks would be displaced from the proposed development and a surrounding buffer of 1 km. The results from the assessment from potential displacement are presented in Table 12.54. Recent survey work suggests that the regional population size estimated by Skov *et al.* (1995) and used in the table is considerably smaller than the current population size. If this is true, the estimated percentage of the regional population that would be at a risk of displacement would be lower than shown in Table 12.54.

Receptor population	Population size (adults)	No. assumed at sea	Offshore site		Offshore site + 1 km	
			Mean no. at risk	%	Mean no. at risk	%
North Sea, non-breeding period (Skov *et al.*, 1995)	852,690	852,690	54	<0.1%	88	<0.1%
Regional, non-breeding period (Recent surveys)	5,000	5,000	54	1.1%	88	1.8%

Table 12.54: The mean estimated number and percentage of little auk populations potentially at risk of displacement from marine areas during the non-breeding period (November to February)

524 The value of the offshore site buffered to 1 km as a foraging site to little auks in the non-breeding period was estimated from the mean proportion of assumed regional non-breeding season population present from November to February. On this basis, the offshore site buffered to 1 km provides up to approximately 7.8% of the foraging resources of the regional non-breeding period population.

525 If 50% of little auks were to be displaced from the offshore site buffered to 1 km the impact of this would be the effective loss of up to around 0.90% of the foraging habitat of the regional non-breeding population during the non-breeding-period. This impact is categorised as low magnitude, and temporally long term and reversible. The sensitivity of the population at this time of year to displacement is unknown, but is likely to be negligible to low. It is concluded that the impact of displacement on the regional breeding little auk population is ***not significant.***

12.7.13.2 Disturbance by Vessels

526 Little auks are not thought to be particularly sensitive to vessel movements but birds disturbed by vessels will either swim or fly away to an alternative location until the vessels have passed, after which they may return to the area. Little auks only occur in the offshore site in the winter months, so will not be present for much of the year. Consequently, there may be a localised, short term effect in winter. Based on this, possible displacement impacts were categorised as being of negligible (<1%) magnitude, and being temporally short term and reversible. Overall, it is concluded that the impacts of disturbance by vessels during the construction, operation and decommissioning phases on the regional population of little auks in the non-breeding periods is ***not significant.***

12.7.13.3 Collision Mortality

527 The results of CRM using an avoidance rate value of 98% predict that no little auks would be killed by the proposed wind farm. The potential effect of the predicted collision mortality of little auks on the baseline mortality rate is rated as negligible in magnitude, temporally long term and reversible.

528 It is concluded that the impact of collision mortality is ***not significant***.

12.7.13.4 Summary of Impacts Combined for Little Auk

529 The adverse impacts of the effects assessed will act in a broadly additive manner. In combination it is judged that the magnitude of the three effects on the regional population is low. It is concluded that the overall impact on the regional population of little auks in the non-breeding (winter) period is ***not significant*** (refer to Table 12.55).

Effect	Spatial magnitude	Temporal magnitude	Sensitivity	Significance
Construction and decommissioning phases				
Vessel disturbance	Negligible	Short term	Low	Not significant
Operational phase				
Displacement from foraging habitat	Negligible	Long term	Low	Not significant
Vessel disturbance	Negligible	Long term	Low	Not significant
Collision mortality	Negligible	Long term	Low	Not significant
All effects combined	Negligible	Long term	Low	Not significant

Table 12.55: Summary of impacts on the regional wintering population of little auk

12.7.13.5 Cumulative Impact Assessment for Little Auk

530 The predicted effective loss of up to 5.6% of the foraging habitat of the regional little auk population in the non-breeding period is rated as moderate magnitude, temporally long term and reversible (refer to Table 12.56). Bearing in mind the low sensitivity of overwintering little auks to displacement effects, it is concluded that the cumulative impact of displacement caused by the proposed offshore wind farms on the regional little auk population in the non-breeding period is an effect of ***minor significance***.

Effect Assessed	Assumed amount of potential displacement realised	Predicted impact from Neart na Gaoithe	Predicted impact from Inch Cape	Predicted impact from Firth of Forth Round 3 Zone 2	Cumulative Impact
Displacement: effective loss of foraging habitat during the non-breeding period (%)	50%	0.9%, Negligible	0.5, Negligible	4.2, Low	5.6, Moderate
Collision: % increase in assumed annual adult mortality rate. All designs.	0%	No change, Negligible	No change, Negligible	No change, Negligible	No change, Negligible

Table 12.56: Summary of CIA for the three proposed offshore wind farms in south-east Scotland on the regional population of little auks in the non-breeding (winter) period

12.7.14 Non-seabirds

531 The majority of the non-seabird species recorded on baseline surveys in the Neart na Gaoithe Survey Area were only recorded in low numbers, with greatest variety of species occurring in the autumn passage period and to a lesser extent the spring passage period (refer to Table 12.9).

12.7.14.1 Displacement

532 As wildfowl and waders are not seabirds, they are very unlikely to regularly use the offshore site for foraging or resting, although it is possible that geese and ducks could land on the sea to rest during migration. However, there are no species of wildfowl and wader likely to forage regularly in the offshore site. As such, it is concluded that the impact of displacement on non-seabirds such as wildfowl and waders is ***not significant***.

12.7.14.2 Barrier Effect

533 The assessment of displacement of flying birds transiting around the offshore site instead of through it is considered under barrier effects. As species of wildfowl and waders do not regularly forage at sea, the only possible barrier effect can occur during migration periods in spring and autumn, when birds are moving to or from breeding grounds to wintering areas. If birds avoided the wind farm area and flew around it instead of through it, then there could potentially be an impact on these birds as a result of the increased length of their journey.

534 However, the magnitude of any such barrier effect is likely to be negligible for species of wildfowl and waders on migration, as the migration journeys that they undertake are typically hundreds or thousands of kilometres long. Therefore, the potential incremental increase in distance as a result of having to fly around the wind farm rather than through it will be negligible compared to the overall distance flown during migration. Overall, it is concluded that the impact of barrier effect on non-seabirds such as wildfowl and waders is ***not significant***.

12.7.14.3 Collision Mortality

535 Collision risk modelling was undertaken for 15 species of geese and waders based on an assumed population of 1,000 birds of each species passing through the offshore site twice per year, on spring and autumn passage, with all birds flying at rotor height. The predicted number of collisions per year, based on a selection of avoidance rates are shown in Table 12.57. Further details are presented in Appendix 12.1: Ornithology Technical Report and Appendix 12.2: Ornithology Statistics Report .

Species	Annual no of collisions at different avoidance rates				
	No avoidance	95% avoidance	98% avoidance	99% avoidance	99.5% avoidance
Bean goose [1]	423	21	8	4	2
Pink-footed goose	410	20	8	4	2
Barnacle goose	390	19	8	4	2
Bar-tailed godit	321	16	6	3	2
Black-tailed godwit [1]	323	16	6	3	2
Knot [1]	297	15	6	3	1
Curlew	360	18	7	4	2
Dunlin	288	14	6	3	1
Sanderling	293	15	6	3	1
Grey plover [1]	307	15	6	3	2
Lapwing [1]	325	16	6	3	2
Ringed plover	286	14	6	3	1
Redshank	333	17	7	3	2
Turnstone	299	15	6	3	1
Oystercatcher	348	17	7	3	2

1 Species not recorded in Neart na Gaoithe Survey Area on baseline surveys

Table 12.57: Predicted number of collisions per year for 15 species of geese and waders

536 Using a 98% avoidance rate, and an assumed population of 1,000 birds passing through the wind farm twice a year at rotor height gives a peak predicted number of eight collisions per year for the three species of geese, which is equivalent to 0.8% of the assumed population (1,000 birds). Using the same parameters for the 12 species of waders gives a peak predicted number of seven collisions per year, which is equivalent to 0.7% of the assumed population (1,000 birds).

537 Overall, the potential effect of the collision mortality of these 15 species of geese and waders on the baseline mortality rate is rated as negligible in magnitude, temporally long term and reversible. It is concluded that the impact of collision mortality on these 15 species of geese and waders is therefore ***not significant***.

12.7.14.4 Cumulative Impact Assessment for non-seabirds

538 Cumulative Impact Assessment has not been undertaken for non-seabirds such as wildfowl and waders because the predicted effects of Neart na Gaoithe offshore wind farm for these species were very close to no effect based on unrealistic precautionary assessments. Therefore, it is not plausible that the Development could contribute to a significant cumulative impact for these species.

12.8 Mitigation and Residual Impacts

539 Effective and practical mitigation measures to reduce impacts on birds are limited but may include:

- Changes to turbine layout. By avoiding placing turbines in areas of relatively higher concentrations of birds the risk of an impact occurring is reduced accordingly. However, site-specific data collected at Neart na Gaoithe has not identified any particular areas within the site where reducing the number of turbines would reduce the potential impacts. Species densities were largely similar across the offshore site and therefore no obvious practical benefits have been identified by changing the turbine locations;
- Evidence from some wind farms suggest that by placing turbines further apart it may reduce the level of displacement that could occur. The evidence suggesting this is speculative and it may be other factors that are causing the differences in the level of displacement across developments;
- Increasing the turbine height has the potential to greatly reduce the risk of collision for a number of seabirds, many of which rarely fly above about 25 m but occur regularly at around 20 m. Therefore an increase in turbine height can cause a reduction in the number of predicted collisions;
- By reducing the rotor swept area the number of collisions will automatically be reduced. In particular the blade width and the radius of the rotor may make most differences in the number of predicted collisions; and
- The use of soft-start during construction will be undertaken as routine mitigation measure. By doing so, this might reduce the impacts on prey species upon which seabirds rely.

12.9 References

Alerstam, T., M. Rosén, J. Bäckman, P.G.P. Ericson, and O. Hellgren, 2007. Flight speeds among bird species: Allometric and phylogenetic effects. *PLoS Biol* 5(8), e197. doi:10.1371/journal.pbio.0050197.

Band, W. 2011. *Using a Collision Risk Model to Assess Bird Collisions Risks for Offshore Windfarms*. Final September 2011.

Barton, C., Pollock, C., and Harding, N., 2009. *Arklow Bank seabird and marine mammal monitoring programme*. Year 8. A report to Airtricity.

Birdlife International, 2012. *Birdlife Seabird Foraging Database* [Online]. Birdlife International. Available online at: http://seabird.wikispaces.com [Accessed on 20 Oct 2011].

BTO (British Trust for Ornithology), 2012. *BTO Birdfacts*. Available online at: http://blx1.bto.org/birdfacts/ [Accessed on 27 Jun 2012].

Camphuysen, C.J., Fox, T., Leopold, M.F., and Petersen, I.K., 2004. *Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the UK*. A report for COWRIE.

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

Christensen, T.K., Hounisen, J.P. Clausager, I., and Petersen, I.K., 2004. *Visual and radar observations of birds in relation to collision risk at the Horns Rev offshore wind farm*. Department of Wildlife Ecology and Biodiversity, National Environmental Research Institute commissioned by Elsam Engineering A/S 2003.

Cook, A,S,C.P, Johnstone, A., Wright, L.J., and Burton, N.H.K., 2012. *A review of methods to estimate the risk of bird collisions with offshore wind farms.* Strategic Ornithological Support Services. Project SOSS-02. BTO Report for The Crown Estate. December 2011.

Cramp, S. and Simmons, K.E.L., 1983. *Birds of the Western Palearctic. Vol 3*. Oxford University Press, Oxford.

Dickson, D. 2002. *Fife Bird Report 2001*. Fife Bird Club.

Diersche, V., and Garthe, S., 2006. Literature review of offshore wind farms with regard to seabirds. *In:* Zucco, C., Wende, W., Merck, T., Kochling, I. and Kopper, J. (eds.) *Ecological research of offshore wind farms: international exchange of experiences (Project No. 804 46 001), Part B: Literature review of the ecological impacts of offshore wind farms.* Bonn, Germany: BfN-Skripten.

Eaton M.A., Brown A.F., Noble D.G., Musgrove A.J., Hearn R., Aebischer N.J., Gibbons D.W., Evans A., and Gregory R.D., 2009. Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. *British Birds*, 102, 296-341. Available online at: http://www.rspb.org.uk/Images/BoCC_tcm9-217852.pdf [Accessed 27 Jun 2012].

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

Guilford, T.C., Meade, J., Freeman, R., Biro, D., Evans, T., Bonadonna, F., Boyle, D., Roberts, S., and Perrins, C.M., 2008. GPS tracking of the foraging movements of Manx Shearwaters (*Puffinus puffinus*) breeding on Skomer Island, Wales. *Ibis*, 150 (3), 462-473.

Hamer, K.C., Humphreys, E.M., Garthe, S., Hennicke, J., Peters, G., Grémillet, D., Phillips, R.A., Harris, M.P., and Wanless, S., 2007. Annual variation in diets, feeding locations and foraging behaviour of Gannets in the North Sea: flexibility, consistency and constraint. *Marine Ecology Progress Series*, 338, 295-305.

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

Harris, M.P., 1984. *The Puffin*. T & A.D. Poyser, Calton.

Holling, M., and Rare Breeding Birds Panel, 2010. Rare breeding birds in the United Kingdom in 2007. *British Birds*, Vol 103, pp 2-52. Available online at: http://www.rbbp.org.uk/downloads/rbbp-report-2007.pdf [Accessed on 27 Jun 2012].

Holt, C., Austin, G., Calbrade, N., Mellan, H., Mitchell, C., Stroud, D., Wotton, S., and Musgrove, A., 2011. *Waterbirds in the UK 2009/10: The Wetland Bird Survey*. BTO, WWT, RSPB & JNCC. Available online at: http://www.bto.org/volunteer-surveys/webs/publications/wituk-200910 [Accessed on 27 Jun 2012].

Hötker, H., Thomsen, K.-M., and Jeromin, H., 2006. *Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation*. Bergenhusen: Michael-Otto-INstitut im NABU.

IEEM (Institute of Ecology and Environmental Management), 2010. *Guidelines for ecological impact assessment in Britain and Ireland: Marine and Coastal.*

JNCC (Joint Nature Conservation Committee), 2012. *Online species accounts for SPA species*. Available online at: http://www.jncc.gov.uk/page-1419 [Accessed on 27 Jun 2012].

King, S., Maclean, I.M.D., Norman, T., and Prior, A., 2009. *Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers*. COWRIE.

Langston, R.H.W., 2010. *Offshore wind farms and birds: Round 3 zones, extensions to Round 1 & 2 sites & Scottish Territorial Waters*. RSPB Research Report No. 39.

Leopold, M.F., and Camphuysen, C.J., 2008. *Local birds in and around the offshore wind park Egmond aan Zee (OWEZ) (T1)*. Texel, The Netherlands: Wageningen IMARES.

Leopold, M.F., Dukman, E.M., and Teal, L., 2011. *Local Birds in and around the Offshore Wind Farm Egmond aan Zee (OWEZ) (T-0 & T-1, 2002-2010).* Texel, The Netherlands: Wageningen IMARES

Maclean, I.M.D., Wright, L.J., Showler, D.A., and Rehfisch, M.M., 2009. *A review of assessment methodologies for offshore wind farms*. British Trust for Ornithology commissioned by Cowrie Ltd.

Masden, E.A. Haydon, D.T., Fox, A.D., and Furness, R.W., 2010. Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. *Marine Pollution Bulletin,* 60**,** 1085-1091.

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

Ouwehand J., Leopold M.F. , and Camphuysen C.J., 2004. A comparative study of the diet of Guillemots *Uria aalge* and Razorbills *Alca torda* killed during the Tricolor oil incident in the south-eastern North Sea in January 2003. *Atlantic Seabirds (special issue,)* 6, 147-166.

Pennington, M., Osborn, K., Harvey, P., Riddington, R., Okill, D., Ellis, P., and Heubeck, M., 2004. *Birds of Shetland.* Christopher Helm.

Pennycuick, C.J., 1997. Actual and "optimum" flight speeds: field data reassessed. *Journal of Exerimental. Biology*, 200, 2355-2361.

Petersen, I.K., Christensen, T.K., Kalhert, J., Desholm, M., and Fox, A.D., 2006. *Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. National Environmental Research Institute*. Report to DONG energy and Vattenfall A/S.

Pettersson, J., 2005. *The impact of offshore wind farms on bird life in Southern Kalmar Sound, Sweden: a final report based on studies 1999-2003*. Department of Animal Ecology, Lund University, Sweden.

PMSS (Project Management Support Services), 2006. *North Hoyle Offshore Wind Farm: FEPA monitoring post construction (04-05).*

Regini, K., 2000. *Guidelines for ecological evaluation and impact assessment*. In Practice. Bulletin of the Institute of Ecology and Environmental Management, 29, 2-7. Webb, D.A., Parnell, J., and Doogue, D., 1996. An Irish Flora. (7th Edn.)

Roos, S., Humphreys, L., Wernham, C. and Burton, N., 2010. *Informing Appropriate Assessment of the Pentland Firth Strategic Area leasing Round.* Ornithological scoping Report. BTO. Thetford.

Skov, H., Durinck, J., Leopold, M.F., and Tasker, M.L., 1995. *Important bird areas for seabirds in the North Sea, including the Channel and Kattegat*. BirdLife International, Cambridge.

SMP (Seabird Monitoring Programme), 2012. Online Database. Available online at: http://www.jncc.gov.uk/smp/ [Accessed on 27 Jun 2012].

SNH (Scottish Natural Heritage), 2005a. *Scottish Natural Heritage Guidance: Survey Methods for Use in Assessing the Impacts of Onshore Windfarms on Bird Communities.* SNH Guidance, November 2005.

SNH, 2005b. *SNH Guidance: Cumulative Effect of Windfarms*. SNH Guidance, Version 2. Revised 13.04.2005.

SNH, 2006. *SNH Guidance: Assessing the Significance of Impacts from Onshore Windfarms on Birds outwith Designated Areas*. SNH Guidance Document. July 2006.

SNH, 2010. *Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model*. SNH Avoidance Rate Information and Guidance Note.

Snow, D.W., and Perrins, C.M. (Eds), 1998. *The Birds of the Western Palearctic*. Volume 1. Concise Edition. Oxford University Press.

Stone, C.J. Webb, A., and Tasker, M.L., 1995. The distribution of auks and Procellariiformes in north-west European waters in relation to the depth of the sea. *Bird Study,* 42**,** 50-56.

Thaxter, C.B., Lascelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langton, R.H.W., and Burton, N.H.K., 2012. *Seabird foraging ranges as a tool for identifying candidate marine protected areas.*

UKBAP, 2012, http://jncc.defra.gov.uk/page-5155 [Accessed Jun 2012].

Wanless, S., Murray, S. and Harris, M.P., 2005. The status of Northern Gannet in Britain & Ireland in 2003/04. *British Birds,* 98, 280-294.

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark J.A., Siriwardena, G.M., and Baille, S.R. (eds.) 2002. *The migration atlas: movements of the birds of Britain and Ireland.*

Zucco, C., Wende, W., Merck, T., Köchling, I., and Köppel, J., 2006. *Ecological Research on Offshore Wind Farms: International Exchange of Experiences. PART B: Literature Review of Ecological Impacts*. BfN-Skripten 186.

Appendices

Appendix 12.1: Ornithology Technical Report

Appendix 12.2: Ornithology Statistics Report