Seabirds and marine mammals technical report

Statoil ASA

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Hywind Scotland Pilot Park

Seabirds and Marine Mammals

Technical Report

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SUMMARY

- This Technical Report is concerned with the environmental studies undertaken to inform the EIA and HRA of seabirds and marine mammals for the proposed Hywind Scotland Pilot Park Project, a demonstration floating offshore windfarm being progressed by Hywind Scotland Limited (HSL). The report presents results for the one-year programme of boat-based baseline European Seabirds at Sea (ESAS) surveys together with relevant context information on regularly occurring species.

- The Survey Area covers 170.5 km^2 and comprises the original Exclusivity Area buffered to 3 km. This area is covered by 23 parallel transects spaced 0.75 km apart and with a total length of 228 km. Surveys of all 23 transects took two days to complete, with alternate transects surveyed on one day and the other set of alternates on the other day. This regime meant that on each survey day the whole Survey Area was covered.

- The surveys were conducted following the ESAS method. This involves a team of two accredited surveyors on board a survey vessel collecting data on all birds and marine mammals seen in a 300 m wider survey corridor in a format that is suitable for distance sampling analysis.

- Two survey days of effort (i.e. surveying each transect once) were scheduled at monthly intervals from June 2013 to May 2014. A total of 20 surveys (days) were undertaken over the year. Eight additional surveys were undertaken between July and September 2014 using the same survey design and methods. These surveys are reported separately (Caloo 2014c (Annex 3 to Technical Report) however the results are used as additional evidence to characterise the ornithology of the Survey Area.

- Persistent unfavourable sea conditions prevented some scheduled surveys visits in the autumn and winter months. No surveys were possible in October 2013 or January 2014, and only one survey day was possible in December 2013 and March 2014. When conditions allowed (one day in November 2013 and another in April 2014) additional surveys were undertaken to compensate for missed surveys in the previous month.

- Survey results are presented as ‘raw’ numbers of seabird and marine mammal species recorded. For common seabird species, those with sufficient records, Distance Sampling statistical analysis has been undertaken to provide abundance estimates with confidence limits for the Survey Area (the Exclusivity Area buffered to 3 km) and the Exclusivity Area buffered to 1 km.

- A total of 13 seabird species were regularly recorded and the results for each of these are considered in detail. Nine other species of seabird and several migrant non-seabird bird species were recorded in very small numbers occasionally.

- Five species of marine mammal were recorded during the surveys; these were the harbour porpoise, white-beaked dolphin, minke whale, grey seal and harbour seal.

- Distance sampling was used to estimate of the number and density of birds in the Survey Area and within 1km of the proposed wind turbine locations (WT+1km) on each survey and each season of the year. These estimates are put into context by comparison with regional population sizes. Additional context information covering likely connectivity to designated sites, conservation status, flight height, migration behaviour and vulnerability to wind farm impacts is also presented for each regularly occurring species. Information gaps relevant to the EIA of the Project are also identified.

- Seabird species are categorised as high, moderate or low priority for the Project’s EIA. Prioritisation was based on a combination of the importance of the vicinity of the windfarm as a foraging site to a species and a species vulnerability to the impacts of offshore windfarms. The purpose of these categories is to identify and draw attention to the species whose populations are most likely to be affected by the Project, and those for which adverse population effects appear to be unlikely.

- Razorbill is rated as high priority on account of the potential for the windfarm to disturb and displace large numbers of birds (in the context of regional population size) in July and August, a time when this species

has heightened vulnerability due to having dependent chick on the sea and adults being temporarily flightless as they undergo wing moult.

- Guillemot is rated as moderate priority on account of the potential for the windfarm to disturb and displace moderate numbers of birds (in the context of regional population size) in July and August, a time when this species has heightened vulnerability due to having dependent chick on the sea and adults being temporarily flightless as they undergo wing moult.

- Gannet, great black-backed gull, herring gull, kittiwake and Arctic tern are all rated as moderate priority on account of the potential for collision and declining populations (with the exception of gannet). Nevertheless, for all these species the numbers using the Project area are very low in the context of regional populations.

- All other seabird species were rated as low priority.

Statistical analyses of the seabird data were undertaken by Caloo Ecological Services. These analyses are provided as Annexes to this Technical Report:

- Annex 1 - Caloo 2014a. Distance sampling analyses of year 1 ESAS survey results for the Hywind Scotland Pilot Park;
- Annex 2 - Caloo 2014b. Collision risk modelling with respect to seabirds for the Hywind Scotland Pilot Park;
- Annex 3 - Caloo 2014c. Distance sampling analyses of additional (July – September 2014) ESAS survey results for the Hywind Scotland Pilot Park.

In addition to the analyses presented in the above reports, Marine Scotland, SNH and JNCC requested some alternative analyses of the survey data based on the breeding seasons specified by SNH / JNCC. These analyses have been reported in the following standalone report:

- Caloo 2014d. Alternative density, abundance and collision risk mortality estimates based upon breeding seasons as specified by SNH/JNCC for seabirds using the waters of the Buchan Deep off the Aberdeenshire coast for the period June 2013 to May 2014 in support of the Hywind Scotland Pilot Park project.

Substantial detail on data analysis and results is provided in these four reports, the essence of which is presented throughout the EIA. Where relevant, cross-references to tables have been used to aid the reader's interpretation of the assessment and underlying analytical output.

INTRODUCTION

1. This Technical Report presents the results of visual boat-based European Seabird at Sea (ESAS) surveys in the Buchan Deep area, 25 km east of Peterhead undertaken over a one year period from June 2013 to May 2014. The surveys are part of the environmental studies to inform the EIA of seabirds and marine mammals for the proposed Hywind Scotland Pilot Park Project, a demonstration floating offshore windfarm being progressed by Hywind Scotland Limited (HSL). The results of the one year of ESAS surveys and supporting contextual information reported form the baseline characterisation of the ornithological and marine mammal interest to support the Marine Licence application for the Project.

2. The proposed Project is described in detail in the Environmental Statement. The ESAS survey design and methods are fully described in the Seabird Discussion Document (Xodus 2013b). In summary, the Project is to install and operate five floating Hywind Wind Turbine Generator (WTG) Units with a total maximum capacity of 30 MW in an area within the Buchan Deep. The WTG Units will then be connected via a single export cable into the electricity grid at Peterhead.

3. The ESAS survey programme was undertaken by Natural Research (Projects) Ltd (NRP) and is designed to provide both baseline characterisation data on seabirds and marine mammals occurring in the Hywind Scotland Pilot Park Project Exclusivity Area[1] and a surrounding 3km buffer, a total area of 170.5 km^2; this area is known as the Survey Area. This information will help inform the assessment of potential impacts of the Project on seabirds and marine mammals that will be presented in the Environmental Statement (ES) and Habitat Regulation Appraisal (HRA) Report for the Project. The same survey data will provide pre-installation monitoring information to compare with later operational monitoring data (Seabird Discussion Report (Xodus, 2013b)). Survey work consists of visual boat-based seabird surveys undertaken at approximately monthly intervals.

4. Due to the lack of potential for significant impact mechanisms on marine mammals from the proposed Project, it was agreed with Marine Scotland and their advisors that no dedicated marine mammal survey was required. However, all marine mammals seen during the ESAS surveys were recorded and these results are presented in this report.

5. The aims of the report are as follows:

   - To provide an overview of the survey programme and its context;
   - To summarise the survey design and methods;
   - To summarise the survey effort each month;
   - To summarise the sea conditions at the time of surveys;
   - To present the survey results for each species in terms of density, abundance, distribution and behaviour (where data allow);
   - To summarise for regularly occurring species context information relevant to the assessment of impacts such as population size, conservation status, flight behaviour and geographical movements and Vulnerability to windfarm impacts;
   - To evaluate the importance of the Survey Area and Project area (the wind turbines buffered to 1 km) to each regularly occurring species and indicate the relevance to the Project;
   - To describe any problems encountered;
   - Identify any important information gaps; and
   - To draw comparisons with results from additional ESAS surveys undertaken in summer 2014 (Caloo 2014c Annex 3 to Technical Report).

1.

[1] The surveys commenced prior to the award of the Agreement for Lease (AfL) by the Crown Estate and the decision on where the wind turbines would be located, therefore the Survey Area comprised the previously awarded Exclusivity Area with a buffer of 3 km.

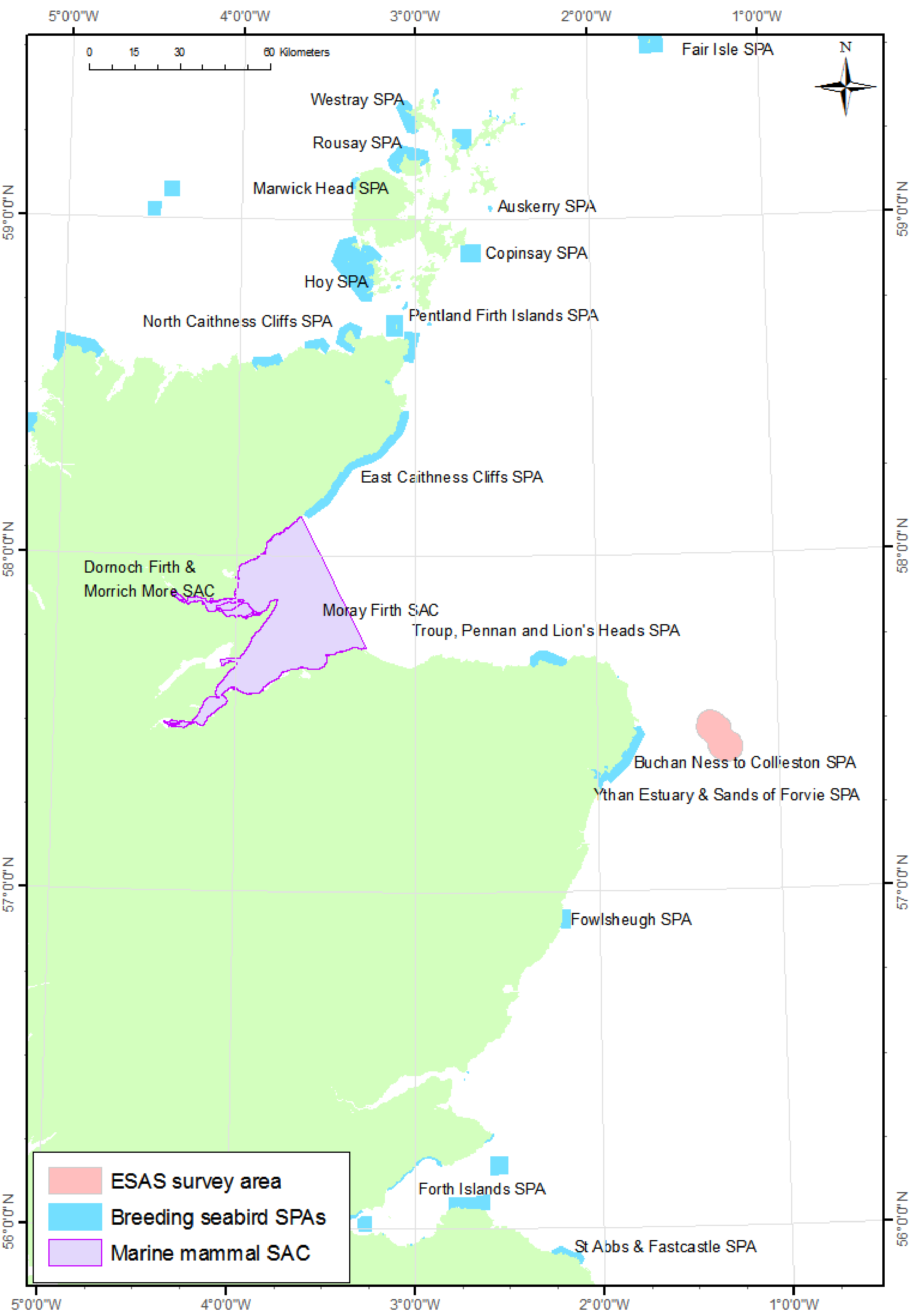
Designated sites

6. The Survey Area does not overlap any designated sites but is likely to be used for foraging and transiting through by several seabird and marine mammal species that are qualifying features of designated sites in eastern Scotland and in some cases further afield (Fig. 1). The HRA Report (Xodus, 2015) outlined the designated site interests that could potentially be affected by the proposed Project. This document should be referred to for further information on this aspect. The sites listed below are believed at this stage to be of the highest relevance primarily due to their proximity and qualifying features, though as shown in the EIA Scoping Report there are other sites that will also need to be considered.

   - Buchan Ness to Collieston SPA;
   - Troup, Pennan and Lion's Heads SPA;
   - Fowlsheugh SPA;
   - Forth Islands SPA (on account of gannets breeding on Bass Rock).
   - East Caithness Cliffs SPA (although further away than the Mean Maximum Foraging Range (MMFR) distance for most species, this SPA is potentially a source colony for guillemots and razorbill in the chicks-on-sea part of their breeding season and of three gull species during the post-breeding period).

7. The Survey Area is not coincident with any designated sites for marine mammals, but the Survey Area and wider north-east Scotland sea area may be used as feeding grounds and transit routes by marine mammal species for which protected sites are designated (e.g. bottlenose dolphins from the Moray Firth Special Area of Conservation (SAC), harbour seals from Dornoch Firth and Morrich More SAC). In addition, the proposed cable route passes through the southern part of the Southern Trench Marine Protected Area (MPA) search location, which has been identified for, amongst other features, minke whales and white-beaked dolphins.

Figure 1. Location of the Hywind ESAS Survey Area and breeding seabird SPAs and marine mammal SACs.



Aim of the Survey

8. The primary aim of the ESAS survey is to provide data that establish the distribution, abundance and behaviour of birds, within the defined Survey Area and how these change seasonally. The survey was designed so that the bird data would be suitable for Distance Sampling statistical analysis (Thomas *et al., 2*010), and thereby allow absolute measures of abundance with confidence limits to be estimated for all common seabird species present. A further aim of the surveys was to collect data on flying seabirds suitable for Collision Rate Modelling analyses. This was achieved by recording the estimated height of flying seabirds in addition to the range of standard data metrics collected by the ESAS method.

9. The marine mammal observations recorded during the ESAS surveys are used to confirm the understanding of the status of marine mammals in the area from existing baseline data. The collection of marine mammal survey data under the ESAS methodology, rather than through dedicated marine mammal observers, is aimed at providing site characterisation in terms of what species were occurring and at what times of year to support regional marine mammal data sets. Unlike the seabird data, the marine mammal data are not suitable for estimating measures of absolute abundance.

Abbreviations

- The following abbreviations are used in this report:
- AIF - Anticipated Impact Footprint
- AfL - Agreement for Lease
- AOB - Apparently occupied burrow
- AON – Apparently occupied nest
- BDMPS - Biologically defined minimum population size
- CRM – Collision Risk Modelling
- ESAS – European Seabirds at Sea
- FAME - Future of the Atlantic Marine Environment
- JNCC - Joint Nature Conservation Committee
- MMFR - Mean Maximum Foraging Range
- MMO - Marine Mammal Observer
- MPA – Marine Protection Area
- MS - Marine Scotland
- NRP – Natural Research (Projects) Ltd
- RP – Regional population
- SAC - Special Area for Conservation
- SPA - Special Protection Area
- SNCB - Statutory Nature Conservation Body (e.g. SNH and JNCC)
- SNH - Scottish Natural Heritage

- SMP – Seabird Monitoring Programme
- UKCS - United Kingdom Continental Shelf
- UCL - Upper confidence limit
- WT+1km –The wind turbines buffered to 1km
- WT+2km – The wind turbines buffered to 1km

METHODS

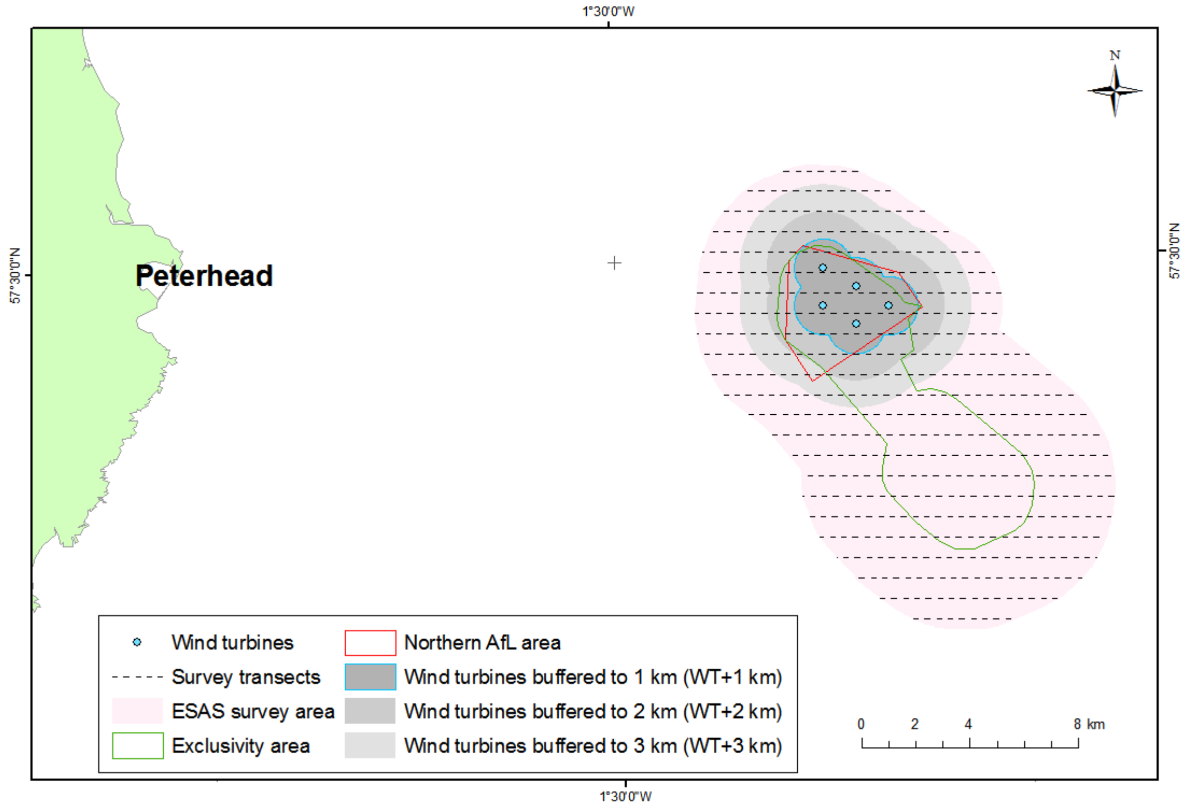
Survey Design and Methods

10. The survey design and survey method is described in detail in the Seabird Discussion Document (Xodus 2013b). This document, which was approved by JNCC, SNH and MS in September 2013, describes in detail the layout of the survey design and the reasoning behind it. It also briefly describes the survey methods. The design has been driven by the theoretical requirements of Distance Sampling (Buckland *et al., 2*001) and mediated by practical consideration of safe operation of the survey vessel and the desire to reduce potential disturbance of birds and marine mammals. The survey design and method are also informed by the COWRIE guidance for offshore windfarms (Camphuysen, 2003) and the draft SNH survey guidance for 'wet renewables' (Jackson and Whitfield, 2011). The guidance recommends the European Seabirds At Sea (ESAS) survey method (Camphuysen *et al*., 2004) to inform for offshore windfarm projects and thus this was the survey method chosen.

11. The Survey Area was defined as the Exclusivity Area buffered to 3 km (Figs. 1 and 2). As the surveys commenced prior to the award of the Agreement for Lease (AfL) by the Crown Estate and the decision on where the wind turbines would be located, the Survey Area comprised the previously awarded Exclusivity Area with an buffer of 3 km. The AfL awarded to HSL comprises two areas either side of the BP Forties pipeline system. The final proposed turbine deployment area occupies most of the northern part of the AfL area (Fig 2).

12. The Survey Area has high exposure to wind and swell and these present a significant constraint to safely undertaking boat-based surveys. ESAS surveys must be undertaken in conditions of Sea State 4 or below, and marine mammal surveys ideally require conditions to be below Sea State 3. For this reason flexibility was built into the timing of visits.

Figure 2. The location of the ESAS Survey Area, survey transects and the Hywind Pilot Park wind turbines.



ESAS method

13. The salient points of the survey design and method are:

- A single Survey Area (the Survey Area) of 170.5 km^2 comprising the original Exclusivity Area of 45.3 km^2 and a surrounding 3 km buffer (Fig. 2).
- 23 parallel transect lines spaced 0.75 km apart that give even coverage across the Survey Area (Fig. 2). Transects numbered 1 to 23 sequentially from north to south. The total transect length is 228 km. Transects orientated along a west – east direction.
- At the target boat speed of 10 knots it took 14 to 15 hours to survey all 23 transects. Complete coverage of all transects was spread over a two-day period. The odd-numbered transects were surveyed on one day and the even-numbered transects on another day with suitable conditions for survey. This regime meant that on each survey day the whole Survey Area was covered.
- Two survey visits (2 days) at approximately monthly intervals through the year subject to sea conditions suitable for undertaking ESAS surveys.
- Surveying was undertaken by a team of three accredited and highly experienced ESAS surveyors. A rotation system was used such that at any one time two surveyors were surveying and the other is on a rest period.
- Recording was undertaken from one side of the vessel only, whichever side presents the best conditions for detecting birds at the time.
- Surveyors had a ranging stick to facilitate accurate determination of distance bands, and an angle board to determine bearings (only required for marine mammal records).
- All birds, marine mammals and basking shark seen were recorded. The species, number, plumage, activity, flight direction and distance from the boat were recorded, together with information on environmental conditions at the time of each sighting in terms of sea state, swell, wind force and

direction and sun glare. Distance of birds sitting on the sea was recorded as one of five distance bands (0-50 m, 50-100 m, 100-200, 200-300 m, >300 m) (full details in Camphuysen 2004).

- In cases where an animal could not be identified to species level it was assigned to a higher taxonomic level appropriate to the level of certainty for example this might be an species pair where two similar species could not be distinguished (e.g., guillemot/razorbill) or a taxonomic family if there are several potential candidate species (e.g. 'auk species' and 'dolphin species').
- Flying birds were recorded that passed through the survey corridor and assigned as being in-transect or not-in-transect according to whether they were inside a 300 m x 300 m box at the time snapshots were taken. This was done at regular intervals (full details in Camphuysen 2004) and the snapshot interval was the time taken for the vessel to travel 300 m, at 10 knots the interval is one minute. The height above sea level of flying birds is also recorded, estimated using 5-metre height bands (e.g., 0-5 m, 5-10 m, 10-15 m, etc. above sea level).
- All survey work was conducted from the MV Eileen May. This vessel was chosen because it complies with ESAS recommendations regarding vessel type, size and height of survey platforms.

Additional summer 2014 surveys

14. Through consultation with MS, SNH and JNCC over the ESAS survey results for the breeding season and autumn of 2013 (first half of Year 1), these organisations requested that additional survey work was undertaken in July, August and September of 2014 (Year 2). This request was made on account of the very high densities guillemots and razorbills present in August 2013 and the desire to better understand the importance of the Survey Area for these species. Therefore, additional to the original survey programme described above, eight additional surveys (days) were undertaken in July to September 2014. The methods used for these surveys were the same as for the Year 1 surveys. The results of these surveys are presented separately (Caloo 2014c Annex 3 to Technical Report).

Photo of MV Eileen May

Analyses - Seabirds

15. Statistical analyses of the seabird data were undertaken by Caloo Ecological Services. These analyses are provided as Annexes to this Technical Report:

- Annex 1 - Caloo 2014a. Hywind Scotland Pilot Park distance sampling analysis of Year 1 (June 2013 to May 2014) ESAS surveys;
- Annex 2 - Caloo 2014b. Hywind Scotland Pilot Park seabird collision risk modelling;

- Annex 3 - Caloo 2014c. Hywind Scotland Pilot Park distance sampling analysis of Year 2 summer (July 2014 to September 2014) ESAS surveys.

16. In addition to the analyses presented in the above reports, Marine Scotland, SNH and JNCC requested some alternative analyses of the survey data based on the breeding seasons specified by SNH / JNCC. These analysis have been reported in the following standalone report:

- Caloo 2014d. Alternative density, abundance and collision risk mortality estimates for breeding seasons specified by SNH/JNCC for the Hywind Scotland Pilot Park

Distance sampling

17. The first of the reports (Caloo 2014a) presents distance sampling analyses of the seabird data collected during ESAS surveys on 20 survey dates between June 2013 and May 2014. In response to a request by Marine Scotland for results to be presented for the windfarm site buffered to a range of distances this report provides density and abundance estimates for the wind turbines buffered to 1 km, 2 km and 3 km and also for the whole ESAS survey area (Table 1).

Table 1. The extent of the Survey Area and sub-areas used to report the results.

Description	Label (used in text)	Area (km^2)
The ESAS Survey Area	Survey Area	170.5
Wind turbines buffered to 1 km	WT+1 km	13.0
Wind turbines buffered to 2 km	WT+2 km	30.2
Wind turbines buffered to 3 km	WT+3 km	53.4

18. Density estimates are provided for both individual surveys and for seasons specific to each species. For a particular species, density estimates varied greatly between survey dates within a month. Therefore monthly estimates of abundance based upon one or two surveys would poorly reflect the true average abundance of birds present during that month, and thus provide an unreliable basis for impact assessment. Therefore, the approach adopted was to base characterisation of the survey area and sub-areas on seasonal rather than monthly abundance estimates. This avoids having to assume that surveys on different dates within a month are sampling the same statistical population. Also, as seasons usually encompass several months seasonal estimates are usually based upon more surveys than are the corresponding monthly estimates. This means that the resulting estimates should be more reliable, and less prone to sampling error.

19. The report (Caloo 2014a, including figures in Appendix G) also explicitly considers the appropriate spatial scale at which to estimate density when abundance for the turbine deployment area and surrounding buffers. With one exception, these analyses suggested that density estimates based upon survey effort across the whole survey area provide the most accurate and least biased estimates of density for turbine deployment area and surrounding buffers within the survey area.

20. The one exception is for the three species of locally breeding auk (guillemot, razorbill and puffin) during the colony-attendance period, when the density estimates derived for effort in the northern half of the survey area appears to be significantly higher than for the whole survey area (Caloo 2013a Appendix G, Figs G.23, G.29 and G.36). This is consistent with breeding auks during their colony-attendance period being more concentrated in the northern half of the survey area, perhaps because the northern half is closer to the closest breeding colonies. Therefore, when calculating density and abundance estimates for these three species during the colony-attendance period, the survey effort across the northern half of the survey area is used. In all cases, these auk density and abundance estimates based on the northern half of the survey area are in fact higher than estimates based on the whole survey area and therefore are more precautious for impact assessment.

21. For birds on the water, the probability of detection was estimated using detection function modelling (Buckland *et al.* 2001, 2004) and using of all observations of in-transect birds on the water across all surveys from June 2013 to May 2014 inclusive. To estimate the probability of detection for common species (those with 30 or more sightings) a single detection function was fitted across all species and surveys. Variation in the probability of detection between species is captured by including species as a covariate in the model, with sightings for all species with less than 30 observations combined into a single 'other species' category. The shape of the detection function is modelled as a half normal key function with no adjustment terms (Buckland *et al.* 2001). Cluster size, survey, sea state, wind force, swell height and observer were then considered as additional covariates and the best fitting model was used to estimate the probability of detection.

22. For species with less than 30 sightings, the standard approach (Maclean *et al*. 2009) to estimate the probability of detection is to use JNCC correction factors such as those provided in Stone *et al*. (1995). However an alternative approach was used that aims to provide more accurate estimates. As the starting point a detection function model with the same covariates as the model used to estimate the probability of detection for common species was used, and also the same underlying dataset of all sightings of birds on the water across all species and surveys. However to capture the variation between species in detectability the species covariate was replaced with a quantitative covariate, body length[2] and a two-level factorial covariate describing behaviour ('surface/aerial feeder' or 'surface diver'). The underlying assumption of this approach is that a rare species will have similar probabilities of detection to a common species with similar traits, thus allowing the probability of detection for rare as well as common species to be estimated. For the common species with 30 or more sightings the rare species model provides very similar estimates of the probability of detection as the common species model, increasing confidence in its predictions for rarer species. For these rarer species, the probability of detection based upon the rare species detection function model, which is site-specific and takes into account the effect of other covariates is likely to provide a more accurate estimate of the actual probability of detection than using generic JNCC correction factors.

23. For birds in flight, density estimates are based on snapshot counts, for which no distance data is recorded, and so it was assumed all flying birds within the snapshot box were detected.

24. For all our abundance and density estimates, 95% one sided (90% double sided) confidence limits are provided. For birds on the water, these confidence limits take into account uncertainty in both the estimated probability of detection and in the encounter rate. For birds in flight, where it is assumed that all birds are detected, the confidence limits only take into account uncertainty in the encounter rate. Caloo (2014a) also describes the methods used to take into account observations not positively identified to species, in particular a minority of observations of auk species.

Collision risk modelling

25. The methods and results used to predict the potential risk of collision of seabirds with the turbines and associated uncertainty are presented in Caloo 2014b and 2014d - the latter incorporating adjusted seasonality in line with SNH/JNCC advice (letter, dated 06 February 2015). The approach adopted follows the guidance provided by Band (2012) which at the time of writing of these documents was the most up to date guidance for offshore wind farms. Further advice received from SNH/JNCC indicated the need for incorporation of newly published CRM recommendations from the SNCBs (Joint Guidance, 25 November 2014), in turn based on Cook *et al.* (2014).

26. On the basis of their potential vulnerability to collision impacts (Furness *et al*., 2013) eight seabird species that regularly occur in the turbine deployment area were selected for collision risk modelling: gannet, Arctic skua, great skua, herring gull, great black-backed gull, kittiwake, common tern and Arctic tern.

27. The original 'basic' model used to assess collision risk for onshore wind farms and earlier offshore wind farms assumes birds are evenly distributed over rotor swept heights. As well as implementing this basic model in the offshore environment, Band (2012) also implements an 'extended' model, that allows the proportion of birds passing through the rotors at different heights to vary. As flight height distributions for seabirds tend to be heavily skewed towards low altitudes, the assumption that birds are evenly distributed

over rotor swept heights is unrealistic. Therefore, the extended model is likely to yield more accurate estimates of collision risk than the basic model. However, SNCBs currently consider there to be too much uncertainty with respect to the validity of the Extended model as very few empirical studies into bird collisions at offshore wind farms exist. In particular there is concern about the sensitivity to flight height distribution data, and the uncertainty this component introduces to variation in estimates of collision. Current guidance therefore recommendations requires the use of Options 1 and 2 of the basic model, restrict the use of Extended model Option 3 to large gulls only (if data allows) and discourages the use of Option 4 altogether.

28. Flight height distribution data are required to estimate the probability of the proportion of birds at rotor swept height for both the basic and extended models and to model the distribution of birds across the rotor swept height for the extended model. Such flight height distributions can potentially be derived from data collected on site. However, where site specific data is inadequate, Band (2012) recommends that generic flight height distributions predicted by models constructed under the auspices of the SOSS project (Cook *et al.* 2012, Johnston *et al.* 2014a,2014b) should be used to furnish these data.

29. Combining the two types of collision risk model (i.e. basic and extended) with the two potential sources of height distribution (i.e. site-specific and generic) Band (2012) identifies four potential options for estimating collision risk mortality:

    1. The basic model using site-specific flight height data.
    2. The basic model using generic flight height data.
    3. The extended model using generic flight height data.
    4. The extended model using site-specific flight height data.

30. Band 2012 recommends that a collision risk assessment for a specific site should not be based solely on the use of generic height and that if sufficient site-specific height data are available the results of option 4 should also be reported.

31. For four of the species selected (gannet, herring gull, great black-backed gull and kittiwake) there was adequate site-specific data to allow modelling of flight height distribution. For these four species Caloo (2014b, 2014d – with adjusted seasonal definitions to reflect SNH/JNCC advice) presents estimates of collision risk mortality based upon all four modelling options. For the reasons explained in Caloo (2014b), the collision predictions for option 4 are considered to be most likely to most closely reflect the actual collision risk and therefore the most appropriate for assessment purposes. For these four species, simulation modelling was used to bootstrap 95% one-sided confidence limits for the annual and seasonal collision risk mortality estimates based upon option 4. These confidence limits take into account sampling uncertainty in both the flight height data and the seasonal density estimates, and estimate the relative contribution of these two potential sources of uncertainty to the overall uncertainty. An assessment of the bias that could potentially arise in collision risk mortality if observers underestimated flight heights is also provided. However, given current guidance the Extended model results presented in Caloo (2014 b and d) are not used for assessment purposes, but have been retained in the reports for context purposes.

32. For the four other species (Arctic skua, great skua, common tern and Arctic tern), there is insufficient site-specific data to fit flight height distribution. Therefore it was only possible to undertake modelling for the basic and extended models based upon the generic flight height data (i.e., model options 2 and 3). The predictions for option 3 are considered likely to more closely reflect the actual collision risk because this takes into account the actual flight behaviour of birds.

33. In all cases the model options, avoidance rates and associated uncertainty (two standard deviations) presented in the Technical Report are in line with the SNCB Joint Advice letter of 6 February 2015.

Additional surveys

34. Prior to field work commencing JNCC and SNH agreed with Statoil that "*we support the case for undertaking a single year of data collection prior to determination of the project, with the need for a potential further year pre-construction to be examined based on the results gathered during the first year,*

and the impacts predicted through the EIA" (JNCC and SNH advice on Bird Survey Strategy Document, 31 October 2011).

35. During the single year of surveys (Year 1) unexpectedly high numbers of guillemots and razorbills were recorded in August 2013. In response to this, in their scoping opinion MS-LOT, requested the developer to carry out further ESAS surveys in July, August and September 2014 to provide additional information on the importance of the survey area to auk species in these months. Caloo (2014c) reports the distance sampling analysis of data collected during eight additional surveys conducted in July to August 2014 to meet this request.

36. These additional Year 2 surveys are considered in species accounts for auk species, gannet and Arctic tern and contribute to the determination of the importance of the Survey Area and Anticipated Impact Footprint where relevant.

The size of Anticipated Impact Footprint (AIF)

37. Impact footprint is a term used to define the area over which a species may experience an impact arising from a project. An Anticipated Impact Footprint (AIF) is the predicted area, based on the best information available and where necessary expert judgement, within which a species is considered likely experience an impact from a project, and is a concept used in assessing ecological effects of a proposed project. The way impacts act on species vary and the distance from a project at which individuals of a species may experience an impact can also vary depending on it vulnerability. Thus the geographical extent of the AIF will vary between impacts and between species.

38. JNCC and SNH jointly advised that a 1km buffer around the wind turbines is appropriate for informing the assessment of displacement and disturbance impacts for the range of seabird species that occur in the proximity of the wind turbines, unless there is evidence to support a different sized AIF. This is referred to as the WT +1 km area.

Tables of seabird abundance

39. The 'raw' numbers of birds and marine mammals seen from transects on survey day are presented in Tables A1.2 to A1.11. Additional records of birds and marine mammals seen 'off effort' e.g., between transects are presented in Table A1.12.

40. Tables showing the estimated density and abundance of each regularly occurring seabird species for each survey month is summarised for each commonly occurring species for the whole Survey Area and for the WT+1 km, WT+2 km and WT+3 km in the individual species accounts.

41. 'Off-effort' records are summarised in Table A1.12. These refer to any records that were not recorded from a transect line or were on the opposite side of the boat to that being recorded; they do not contribute to the estimated abundance. They mostly comprise records made incidentally by surveyors whist the boat was sailing the 'tails' between transects. During these periods surveyors took a short break but may have remained on deck or been looking out from a window and if they happened to see what they considered to be a 'notable' species or aggregations this was noted as an off-effort record. These records represent incidental data as there is no measure of the effort associated with them and although they may add to the understanding of the wildlife importance of the Survey Area they cannot be used for statistical estimates of population abundance.

Species distribution maps

42. The results maps (Figs. 5 to 16) show the locations of species recorded 'in transect', either on water or flying, as dots. The dots are scaled in size according to the number of birds recorded. Birds that were sitting on the water (orange dots) are distinguished from birds that were in flight (blue dots). The transect lines indicated on the maps are the designed survey layout. The WT+1 km area is also shown on the maps to give an indication of the areas that might be affected by the Project.

43. The purpose of the maps is to illustrate the distribution pattern of a species across the Survey Area in each season. The amount of survey effort (i.e., number of survey visits) varies between the defined seasons for a species. For this reason between-season differences in the number of dots shown on the maps for a species should not be interpreted as a reliable indication of abundance differences between seasons.

44. The position of records for plotting on maps was calculated from the GPS position of the vessel at the time of the record and the distance and direction of the animal from the vessel. The accuracy of determining an animal's position is approximately plus or minus 100 m based on the size of recording bands, vessel speed and GPS accuracy.

Seabird seasons

45. Estimates of abundance and density for individual months were averaged for periods corresponding to each species' annual main phenology stages, referred to here as periods (Table 2). The definition and appropriate labelling of these periods differs between species reflecting the differences in the timing of breeding, moulting and migration and other differences in their ecology (Table 2). Such divisions are useful for summarising the value of the area surveyed and drawing comparisons to context information. However, it should be realised that often the change from one period to the next is gradual and therefore where best to place divisions is a matter of judgement and partly arbitrary.

46. The choice of months for each species' periods used in this report (Tables 2 and 3) was informed by information on the timing of breeding and migration (Cramp and Simmons, 1977; Cramp and Simmons, 1982; Cramp, 1985; Forrester *et al*. 2007; Wanless *et al.,* 2007; Wernham *et al.*, 2002).

47. For all species that breed in the region a colony attendance period is defined that corresponds to the breeding season and when breeding adults are geographically constrained the need to stay within foraging of their colony. In the case of common guillemot and razorbill a 'chicks-on-sea period' is also defined. This is the part of their breeding season that occurs after the colony-attendance period when male adults may have dependent young with them on the sea. In this period these species are no longer geographically constrained by having to be within foraging range of their colony. For several species a post-breeding period is also identified, corresponding roughly to the time between the colony-attendance period and departing the region for wintering areas. The term 'summering' is used for species that occur in the Survey Area during the breeding season but do not breed in the region. An autumn passage period is identified for species that pass through the region on their migration. The winter period is used to cover the remaining parts of the year when a species is present and in many cases includes the autumn as well as the winter months.

48. In their written advice of 6 February 2015, SNH and JNCC recommend the use of standardised seasonality for five seabird species (herring gull, great black-backed gull, kittiwake, Arctic tern and puffin) in order to maximise compatibility with the assessments undertaken for the Forth and Tay offshore wind developments (referred to as 'common currency'). With the exception of Arctic tern these recommendations have been incorporated in the underlying technical report, the EIA chapter and the HRA document. The rationale for the original seasonal definitions has been retained in order to safeguard scientific rigour (Table 3).

Table 2: Species-specific seasons used to summarise ESAS survey results of regularly occurring seabird species

<table>
<tr><th>Species</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr>
<tr><td>Fulmar</td><td colspan="4">Winter</td><td colspan="5">Colony attendance</td><td colspan="3">Winter</td></tr>
<tr><td>Manx shearwater</td><td colspan="4">Absent</td><td colspan="6">Summering/ autumn passage</td><td colspan="2">Absent</td></tr>
<tr><td>Sooty Shearwater</td><td colspan="6">Absent</td><td colspan="5">Autumn passage</td><td>Absent</td></tr>
<tr><td>Balearic Shearwater</td><td colspan="6">Absent</td><td colspan="5">Autumn passage</td><td>Absent</td></tr>
<tr><td>Storm petrel</td><td colspan="4">Winter</td><td colspan="6">Summering/ autumn passage</td><td colspan="2">Winter</td></tr>
<tr><td>Gannet</td><td colspan="3">Winter</td><td colspan="6">Colony attendance</td><td colspan="3">Winter</td></tr>
<tr><td>Pomarine Skua</td><td colspan="7">Absent</td><td colspan="4">Autumn passage</td><td>Absent</td></tr>
<tr><td>Arctic Skua</td><td colspan="5">Absent</td><td colspan="6">Autumn passage</td><td>Absent</td></tr>
<tr><td>Great Skua</td><td colspan="6">Absent</td><td colspan="5">Autumn passage</td><td>Absent</td></tr>
<tr><td>Common Gull</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td colspan="4">Winter</td></tr>
<tr><td>Lesser Black-backed gull</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td colspan="4">Winter</td></tr>
<tr><td>Herring Gull</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td colspan="4">Winter</td></tr>
<tr><td>Great black-backed gull</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td colspan="4">Winter</td></tr>
<tr><td>Kittiwake</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td colspan="4">Winter</td></tr>
<tr><td>Common tern</td><td colspan="4">Absent</td><td colspan="4">Colony attendance</td><td colspan="4">Absent</td></tr>
<tr><td>Arctic tern</td><td colspan="4">Absent</td><td colspan="3">Colony attendance</td><td>Post-breeding</td><td colspan="4">Absent</td></tr>
</table>

<table>
<tr><th>Species</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr>
<tr><td>Guillemot</td><td colspan="3">Winter</td><td colspan="4">Colony attendance</td><td>Chicks on sea</td><td colspan="4">Winter</td></tr>
<tr><td>Razorbill</td><td colspan="3">Winter</td><td colspan="4">Colony attendance</td><td>Chicks on sea</td><td colspan="4">Winter</td></tr>
<tr><td>Little auk</td><td colspan="3">Winter</td><td colspan="7">Absent</td><td colspan="2">Winter</td></tr>
<tr><td>Puffin</td><td colspan="3">Winter</td><td colspan="5">Colony attendance</td><td>Post-breeding</td><td colspan="3">Winter</td></tr>
</table>

Table 3. Reasons and supporting evidence for the definition of species-specific seabird seasons

Species	**Hywind defined season**	**JNCC draft recommendation**	**Reason and supporting evidence**
Fulmar	Breeding - May to Sept. Non-breeding - Oct. to April	Same	Follows SNH/JNCC draft recommendations.
Manx shearwater	Summer/passage - May to Oct.		Recorded at Hywind only during June to August, and then in very small numbers only. Extremely rare breeding bird in region, and so all birds seen most likely to be either non-breeding summering birds or birds on autumn passage. Autumn passage period based on Forester *et al.* (2007). Not recorded during spring passage period (April).
Sooty Shearwater	Autumn passage - July to Nov.		Recorded at Hywind only in August when present in very small numbers. No locally breeding birds and it is assumed all birds seen were birds on autumn passage. Autumn passage period based on Forester *et al.* (2007).
Balearic Shearwater	Autumn passage - July to Nov.		Recorded at Hywind only in August when a single bird seen. No locally breeding birds and it is assumed all birds seen were on autumn passage. Autumn passage period based on Forester *et al.* (2007).
Storm petrel	Summer/passage - May to Oct.		Recorded at Hywind only during June to September, and then in very small numbers only. No locally breeding birds and so it is assumed that all birds seen were either non-breeding summering birds or birds on autumn passage. Autumn passage period based on Forester *et al.* (2007).
Gannet	Breeding - April to Sept. Non-breeding - Oct. to March	Same	Follows SNH/JNCC draft recommendations.
Pomarine Skua	Autumn passage - August to Nov.		Recorded at Hywind only in August when a single autumn passage bird seen. Based on seasonal occurrence of birds at Hound Point, Firth of Forth (Lothian) as presented in Forester *et al.* (2007).
Arctic Skua	Summer/passage - June to Nov.		Recorded at Hywind only during June to August, and then in very small numbers only. No locally breeding birds and so it is assumed all birds seen were non-breeding summering birds or birds on autumn passage. Autumn passage follows the eastern Scottish coast whereas birds on spring passage follow the Atlantic coast, and thus spring passage not expected. Occurrence of birds at Hound Point, Firth of Forth (Lothian) as presented in Forester *et al.* (2007) indicates autumn passage lasts from July to November. The single record in June was likely to be a non-breeding immature bird summering away from breeding grounds.
Great Skua	Autumn passage - July to Nov.		No locally breeding birds and it is assumed all birds seen were non-breeding summering birds or birds on autumn passage. Autumn passage, mainly follows the eastern Scottish coast whereas bon spring passage follow the Atlantic coast, and thus were not expected to be recorded. Occurrence of birds at Hound Point, Firth of Forth (Lothian) as presented in Forester *et al.* (2007) indicates autumn passage

Species	Hywind defined season	JNCC draft recommendation	Reason and supporting evidence
			lasts from July to November. which is also consistent with this species occurrence in the Hywind survey area.
Common Gull	Breeding – April to August	Same	Follows SNH/JNCC draft recommendations
Lesser Black-backed gull	Breeding – April to August	Same	Follows SNH/JNCC draft recommendations
Herring Gull	Breeding (colony-attendance) – April to August Non-breeding – Sep. to March	Breeding - April to August	SNH/JNCC recommendations were followed to implement different seasonal definitions: breeding (April to August) and, by implication, non-breeding (September to March). The originally defined seasons for Hywind were: breeding and post-breeding – April to September and non-breeding – October to March. NRP considers the latter definitions to be more ecologically appropriate in relation to the Survey Area and therefore the original seasonal rationale has been retained below: Most herring gulls depart their breeding colony when chicks fledge around the end of July and early August. Through August and into September Scottish herring gull typically remain close to breeding colonies and juveniles may continue to be fed by parents, therefore these months are considered to form a post-breeding period. The numbers of herring gulls present in the Hywind survey area on surveys dates between April and September were consistently very low (or absent). Therefore the colony-attendance period (April to July) and post-breeding period (August and September) are pooled into a single summer season (April to September). A relatively high proportion (32%) of birds using the Hywind survey area during summer months were immatures suggesting that many of the birds were not actively breeding. The numbers of herring gull in the survey area from November to March (there are no October survey results) were consistently relatively high (typically at least ten times greater compared to the summer period) and this corresponds to the expected influx of wintering birds from northern Scotland and Scandinavia (Wernham *et al* 2002; Forrester and Andrews, 2007) in these month.
Great black-backed gull	Breeding (colony-attendance) – April to August Non-breeding – Sep. to March	Breeding - April to August	SNH/JNCC recommendations were followed to implement different seasonal definitions: breeding (April to August) and, by implication, non-breeding (September to March). The originally defined seasons for Hywind were: breeding and post-breeding – April to September and non-breeding – October to March. NRP considers the latter definitions to be more ecologically appropriate in relation to the Survey Area and therefore the original seasonal rationale has been retained below: Most great black-backed gulls depart their breeding colony when chicks fledge around late July. Through August and into September Scottish birds typically remain in the breeding area, therefore these months are considered to form a post-breeding period. The numbers of great black-backed gulls present in the Hywind survey area on surveys dates between April and September were consistently very low (or absent). Therefore the colony-attendance period (April to July) and post-breeding period (August and September) are pooled into a single summer season (April to September). A very high proportion (91%) of birds using the Hywind survey area during the summer months were immatures suggesting that many of the birds

Species	Hywind defined season	JNCC draft recommendation	Reason and supporting evidence
			were not actively breeding. The numbers of great black-backed gulls in the survey area from November to March (there are no October survey results) were consistently relatively high (typically at least ten times greater compared to the summer period) and this corresponds to the expected influx of wintering birds from northern Scotland and Scandinavia (Wernham *et al*., 2002; Forrester and Andrews, 2007)
Kittiwake	Breeding (colony-attendance) - April to August Non-breeding (passage and overwintering) – Sept. to March	Breeding - April to August	SNH/JNCC recommendations were followed to implement different seasonal definitions: breeding (April to August) and, by implication, non-breeding (September to March). The originally defined seasons for Hywind were: breeding (April to July), post-breeding (August) and non-breeding (September to March). NRP considers the latter definitions to be more ecologically appropriate in relation to the Survey Area and therefore the original seasonal rationale has been retained below: The Hywind surveys show that approximately consistent numbers of kittiwake were present through April to July and much larger numbers (approximately ten times greater) were present in August. April to July corresponds to the period of colony-attendance. August is categorized as a the post-breeding period because by the time of the surveys this month (these took place towards the end of the first week of August) the majority of breeding kittiwakes would have already departed their breeding colony either because they had failed to breed successfully (kittiwakes experienced high rates of breeding failure on the Isle of May in 2013, http://www.ceh.ac.uk/sci_programmes/2013-seabird-breeding-isleofmay.html) or because their chicks had fledged (on the Isle of May fledging typically occurs in late July and early August[1]). Following colony departure kittiwakes disperse rapidly and very widely, for example many adults and juveniles from North Sea colonies are known to be on foraging grounds off Newfoundland by the end of August (Wernham *et al*., 2002). It is thus likely that the birds using the survey area in August include birds from further afield than colonies within the maximum-foraging-range distance of colony-attending birds.
Common tern	Breeding (colony-attendance) - May to August		Follows SNH/JNCC draft recommendations. Only sightings in Hywind survey area were 3 birds in June.
Arctic tern	Breeding (colony-attendance) - May to July Post-breeding/autumn passage -	Breeding - May-August	SNH/JNCC recommendations to implement different seasonal definitions: breeding (May to August) and, by implication, non-breeding (September to April) was not implemented. The originally defined seasons for Hywind were: breeding (April to July) and post-breeding / autumn passage (August). NRP considers the latter definitions to be absolutely more ecologically appropriate in relation to the Survey Area and therefore the original seasonal rationale has been used as part of the assessment. Surveys results show that during May to July (the colony-attendance period) this species is either absent or

Species	Hywind defined season	JNCC draft recommendation	Reason and supporting evidence
	August.		present in the Hywind survey area in very small numbers only, however they were present in highly variable and much larger numbers during (early) August. This pattern is consistent with birds passing through the site in August during post-breeding dispersal and autumn passage. The August birds are mostly likely to be predominantly birds from the numerous colonies in northern Scotland (rather than local colonies), especially those in Orkney and Shetland, areas known to be vacated by terns by mid-August (Forrester *et al.,* 2007).
Guillemot	Breeding part 1 (colony-attendance) - April to July Breeding part 2 (chicks-on-sea and moulting) - August Non-breeding - Sept. to March	Breeding - April to July	Definition of colony attendance period is consistent with SNH/JNCC draft recommendation of April-July breeding period. Nevertheless it is recognized that most adults arrive back at colonies March and so the birds present in March are likely to be mainly from local breeding colonies. It is also recognized that adults and chicks typically depart colonies in the first half of July. Surveys (in 2013) were conducted in early July and are thus considered to best represent the colony-attendance period even though some chicks were seen in the survey area during July surveys. By August guillemots have departed colonies but chicks remain dependent on their father for food for several more weeks and thus August is still part of the breeding season. It is also the time when adults undergo wing moult and become temporarily flightless, which increases their vulnerability to disturbance. For these reasons August merits categorization as a season in its own right. Numbers present in the survey area in September were broadly similar to numbers during later winter months and by this time chicks will be fully independent. Therefore September is pooled with winter months. Nevertheless at least some adults will still be flightless for much of the month whilst they complete their moult
Razorbill	Breeding part 1 (colony-attendance) - April to July Breeding part 2 (chicks-on-sea and moulting) - August Non-breeding - Sept. to March	Breeding - April to July	Definition of colony attendance period is consistent with SNH/JNCC draft recommendation of April-July breeding period. It is recognized that adults and chicks typically depart colonies in the first half of July. Surveys (in 2013) were conducted in early July and are thus considered to best represent the colony-attendance period even though some chicks were seen in the survey area during July surveys. By August razorbills have departed colonies but chicks remain dependent on their father for food for several more weeks and thus August is still part of the breeding season. It is also the time when adults undergo wing moult and become temporarily flightless, which increases their vulnerability to disturbance. For these reasons August merits categorization as a season in its own right. Numbers present in the survey area in September were broadly similar to numbers during later winter months and by this time chicks will be fully independent. Therefore September is pooled with winter

Species	**Hywind defined season**	**JNCC draft recommendation**	**Reason and supporting evidence**
			months. Nevertheless at least some adults will still be flightless for much of the month whilst they complete their moult
Little auk	Non-breeding (wintering) – Nov. to March		Following Forrester *et al.* (2007) and Stone *et al.* (1995) would suggest November to February as season when likely to be recorded. However, single bird recorded on March 26 2014 survey. So, season extended to include March.
Puffin	Breeding (attending colony) - April to August Post-breeding - Sept. Non-breeding (passage and overwintering) - Sept. to March	Breeding - April to August	SNH/JNCC recommendations were followed to implement different seasonal definitions: breeding (April to August). As a result post-breeding is defined as September and non-breeding as September to March (note the overlap in the latter two seasons to maximise compatibility with other projects). The originally defined seasons for Hywind were: breeding (April to July), post-breeding (August-September) and non-breeding (October to March). NRP considers the latter definitions to be more ecologically appropriate in relation to the Survey Area and therefore the original seasonal rationale has been retained below: SNH/JNCC draft recommendations suggest April-August as breeding period. However, in east Scotland young puffins typically fledge (by when they are fully independent) in mid to late July (median fledging date on Isle of May is approximately 24 July[1]), with adults leaving a few days earlier. Thus August is not a breeding season month in eastern Scotland. (Note, puffin breeding phenology in western Scotland is reported to be approximately 2-3 weeks later (Forrester *et al*., 2007)). It is recognized that adult puffins arrive back at colonies in March (Forrester *et al*., 2007), well before breeding starts, and so the (very few) birds present in March were also likely to be mainly from breeding colonies in the region. August and September are categorized as the post-breeding period. During this period puffins continued to be present in relatively large numbers. The recognition of August and September as a distinct post- breeding period for North Sea puffins follows the seasons defined by Stone *et al.* (1995) and Skov *et al*. (1995) breeding season. October to March is defined as the winter period; during this time the numbers using the Hywind survey area were consistently very low.

[1] derived from median hatching date (Wanless *et al*., 2007; Burthe, 2011) and mean fledging period in (Cramp and Simmons, 1982)

Literature Review - Seabirds

Regional population geographical limits

49. EIA requires that assessment is based on considering potential effects at appropriate spatial scales. For seabirds this is usually interpreted as a scale ranging from international, national, regional and district level (IEEM, 2010). Of these, it will be the regional level that has most relevance to the Hywind Scotland Pilot Park Project EIA.

50. There is no agreed or officially endorsed definition of regional populations for seabirds around the UK. For most species there are no or few range discontinuities or major barriers that make for natural regional divisions. Furthermore, it is clear from tagging studies that individuals of most species range widely and intermix with individuals from other areas. Thus the notion of a regional population for most seabirds is to a large extent a construct for convenience and cannot fully represent the actual degree of spatial independence between areas. As a consequence of these factors, any division into regions will inevitably be arbitrary to some extent and the defined populations are unlikely to be self-contained, rather there will inevitably be significant mixing of individuals between adjacent regions. This does not mean that that the concept of a regional population is not useful for EIA, but it is important to recognise the limitations of what is meant by such a regional population and its largely artificial basis.

51. It is also important to bear in mind that the conclusions drawn from EIA are potentially sensitive to how a regional receptor population is defined. For example, other things being equal, the larger a region's geographic extent the more individuals of a species the defined population is likely to contain. This may have the effect of diluting the assessed magnitude of an impact from a project on the population being considered. Sensitivity to what may effectively be a semi-arbitrary decision (the boundary chosen) is clearly unsatisfactory and could lead to poor decision making.

52. The matter of where boundaries might be drawn for marine policy in general including nature conservation was the subject of a Marine Scotland consultation report (Marine Scotland, 2010). This presents a number of alternative regional divisions that have been and are being used for various aspects of marine policy. Information on seabird breeding season foraging ranges (Thaxter *et al.*, 2012) also provides useful information on the minimum geographic scale appropriate for defining breeding regions for a species.

53. There is a high degree of concordance between several of the alternative regional division suggested in the Marine Scotland consultation report (Marine Scotland, 2010). Indeed, to a large extent there are only minor differences in the boundaries to the main regional divisions between those used by JNCC in their Marine Nature Conservation Review (MNCR) (these are referred to as marine sectors and are illustrated in Fig. 3 in the consultation report (Marine Scotland, 2010)) and the regional divisions being used by the Scottish Government in preparing material to meet its obligations under OSPAR and the State of Scotland's Seas Atlas (these divisions are referred as Scottish sea areas and are illustrated in Fig 4 in the Marine Scotland consultation report). In both cases these identify a large region named East Coast extending south from the Buchan coast to either Fife (MNCR sector) or the English Border (Scottish Government sea area). The Scottish Government East Coast sea area together with the much smaller Forth sea area is broadly the same as the boundaries used for two of the Inshore Fisheries Groups (IFG) regional divisions. Thus there is considerable precedent for defining a Scottish east coast region that extends from the south-east corner of the Moray Firth south to the border and seawards for up to about 100 km. For most species this area also broadly fits with breeding regions based on foraging distance and recognises the large natural gap in the distribution of colonies corresponding to the inner Moray Firth.

54. Following advice from SNH/JNCC (letter, dated 5 February 2015) the original approach to defining regional breeding populations through using regions was changed to a foraging range-driven definition instead. In line with recommendations regional breeding populations were thus defined according to the likely connectivity of the Survey Area, in turn based on species-specific foraging ranges. Although it is accepted that such regions do not necessarily represent closed ecological systems, and therefore potential

development impacts could exceed beyond them, it is considered that the approach taken here is sufficiently focussed to both determine regional importance levels as well potential development impacts on a scale ecologically relevant to each receptor species.

55. Seabird foraging ranges are strongly linked to food resource availability. In the marine environment such resources tend to be patchily distributed, with often marked inter-annual variation in distribution. Thus, for the purpose of this assessment using mean or maximum ranges would likely substantially under- or overestimate average site-colony connectivity.

56. Instead spatial connectivity between the Survey Area and seabird colonies was calculated - for most seabird species - by using the mean maximum foraging range (Thaxter *et al.*, 2012) plus a 10% margin. This is considered to be a reasonably robust indicator of connectivity for the key breeding seabird species involved.

57. Colonies within each species-specific foraging range from the Hywind Survey Area (WT+3 km edge to edge) were selected for inclusion. For skuas, gulls and terns direct (over land) distances were used, with by-sea distances used for all other species (adjusting for non-direct flight lines to reflect the presence of mainland features such as Duncansby Head). Colonies which fell just outside a foraging range were considered for inclusion on a case by case basis. For example, for herring gull an approximate range of 70 km (MMFR of 61 km plus a 10% margin) would just exclude the large colony at Fowlsheugh by 8 km. However, given its location relative to the Survey Area, with the potential of a direct line of flight and the species capacity to forage over reasonably long distances, connectivity was assumed.

58. Due to a lack of available foraging range information for great black-backed gull (not included in Thaxter *et al.* 2012) a maximum range of 40 km was assumed based on estimates in Ratcliffe *et al.* (2000).

59. The above definition is inappropriate for the latter part of the breeding season of guillemot and razorbill (chicks-on-sea). There is strong evidence that the regional population increases in the period shortly following colony departure (in particular August) due to an influx of birds from colonies further north. The question of how best to define the size of the regional context populations of guillemot and razorbill for this time of year is important as it potentially effects the conclusions of EIA, and is therefore discussed in some detail. Although razorbill and guillemot typically vacate their breeding colonies in early to mid-July their breeding season continues for several more weeks, whilst dependent young are reared at sea. Thus the period between colony-departure to the end of August is part of these species' breeding season; it is also the period when adults undergo primary moult and are thus temporarily flightless. During the chicks-on-sea part of the breeding season, despite most individuals being flightless, birds may nevertheless travel relatively large distances (100s of km) by swimming (Wernham *et al.*, 2002), and by August the numbers off the east Scottish mainland south of the Moray Firth have increased markedly compared to numbers during the colony-attendance period (Skov *et al*., 1995). This increase coincides with a corresponding decrease in the numbers in the waters around Orkney and Shetland. Indeed, there appears to be a gradual southerly movement of these species along the east coast culminating in very large concentrations, especially of razorbill, in the outer Firth of Forth region in the autumn months (though smaller concentrations remain in the Moray Firth). Although the general pattern of late summer east Scotland guillemot and razorbill redistribution is approximately understood there remains considerable uncertainty about the detail of the movement patterns and the year-to-year consistency. It is concluded from the above discussion that the birds using the Project area in August may originate from colonies anywhere in eastern mainland Scotland and Orkney, and possibly Shetland also, and therefore that the appropriate biologically defined regional population for this period has to be substantially larger than during the colony-attendance part of the breeding season when only birds from colonies over a much more restricted area (i.e., within foraging range) will be present. It is also concluded that because the post-colony departure dispersal is mainly by swimming, and thus relatively slow compared to flying, that the birds using the Project area in August are likely to mainly comprise birds from the relatively close colonies of the east coast mainland, and that Orkney birds, and even more so Shetland birds, are likely to be relatively scarce. Thus balancing the desire for the regional context populations to be based on ecological reality yet factor in due caution to account for uncertainty it is considered that for EIA purposes the appropriate definition for regional populations of razorbill and guillemot in the chick-on-sea part of the breeding season (defined as August) is the sum of birds breeding in east mainland Scotland (Caithness to

Berwickshire). This is likely to underestimate the population size, and therefore is a precautionary approach for assessment, as it excludes birds form Orkney and Shetland.

60. Biologically defined minimum population size (BDMPS) populations for the periods of the year when seabirds are not breeding have recently been defined through a process of extensive literature review by Furness (2014). This review concludes that relatively few ‘regions’ are appropriate for most species (typically two or three) and even then considerable movement between these regions is likely for some species. The definition of the ‘regions’ varies between species, the BDMPS non-breeding population for a species that includes the waters off eastern Scotland (the North Sea area) is considered to be appropriate for definition of the non-breeding season regional population for EIA purposes.

Regional population sizes

61. The number of adults breeding in the east coast region is well quantified through the periodic national census of breeding colonies coordinated by JNCC and additional *ad hoc* counts undertaken at many colonies in the years in between (e.g. Mitchell *et al., 2*004; JNCC Seabird Monitoring Programme (SMP) database). The regional breeding population was determined by summing the number of adults breeding in the region based on the JNCC SMP data. Where counts are expressed as pairs, apparently occupied nests etc. this was doubled to give the number of breeding adults. In the case of guillemot and razorbill JNCC colony counts are given as the number of birds present at the colony. This was converted to an estimated number of breeding adults using the x1.34 correction factor given by Mitchell *et al.* (2004).

62. Since the Seabird 2000 census, monitoring counts from a sample of breeding seabird colonies has shown there have been recent population changes. For most species the change in numbers since Seabird 2000 is either small or variable (SNH, 2012; reviewed in Furness, 2014) and thus the Seabird 2000 results provide a reasonable estimate of the current breeding population size. However for two species, kittiwake and Arctic tern, the recent monitoring shows that the number of breeding birds has undergone large and widespread decline since the Seabird 2000 census, so much so that the Seabird 2000 results no longer give a reasonable estimate of the population size. Therefore for these two species the assumed breeding population size is estimated by multiplying the average decline observed at monitored colonies since the Seabird 2000 census by the Seabird 2000 estimate (SNH, 2012).

63. As a consequence of delayed maturity, most seabird species have substantial numbers of non-breeding immature birds in their population and these individuals may be intermixed with and in many cases indistinguishable from actively breeding adults in the breeding season. Therefore, the total numbers of a species present in the region during the breeding season may be substantially greater than the sum of breeding adult birds.

64. The size of regional non-breeding BDMPS estimated by Furness (2014) is used in the evaluation of importance of the evaluation of the Survey Area and WT+1km area. In cases where Furness splits the non-breeding season into more than one period the smallest of the population sizes given is chosen as this provides the most cautious basis for evaluating importance.

Impacts of offshore windfarms on seabirds

There is a considerable amount of empirical evidence on how offshore windfarms affect seabirds. This subject was subject to a literature review the results of which are presented in Annex 1 at the end the report. There have also been several studies that have also assessed the vulnerability of seabird species to the impacts of offshore windfarms and wet renewable developments (Garthe and Hüppop, 2004; Furness *et al*., 2012; Furness *et al*., 2013) and the results of this are summarised in Table 4.

Table 4. Species vulnerability to disturbance by vessels (Furness *et al*., 2012), displacement by structures (Furness *et al*., 2012) and collision risk with offshore wind turbines (Furness *et al.*, 2013).

Species	Vulnerability to disturbance by vessels Score out of 5 [1]	Vulnerability to displacement by structures Score out of 5 [1]	Vulnerability to collision risk Risk score
Fulmar	1	1	48
Manx shearwater	1	1	0
Storm-petrel	1	1	91
Gannet	2	2	725
Herring gull	2	1	1306
Great black-backed gull	2	1	1225
Kittiwake	2	1	523
Great skua	1	1	320
Artic skua	1	1	327
Arctic tern	2	2	198
Razorbill	3	2	32
Common guillemot	3	1	37
Puffin	2	2	27

[1] Score 1 is lowest vulnerability and score 5 highest.

[2] Score ranges from 0 (no risk) to 1306 (highest risk) and is derived from species-specific information on flight altitude, flight agility, percentage of time flying and nocturnal flight activity.

Seabird Species Priority

65. The relevance of each seabird species to the Project's EIA is categorised as high, moderate or low priority on the basis of abundance in the WT+1km relative to regional population size and vulnerability to the impacts of offshore windfarms. The purpose of these categories is to identify and draw attention to the species whose populations are most likely to be affected by the Project, and those for which adverse population effects appear to be unlikely.

66. The importance to regional receptor populations of the Project area and adjacent waters, in particular the turbine deployment area buffered to 1 km (WT+1 km), is evaluated by comparing seasonal estimates of mean abundance and the 95% UCL with regional receptor population sizes. The importance of the WT+1 km to a receptor population was defined on the basis on the mean percentage of a population present, as follows:

- High importance, >5% of the population;
- Medium importance, 1 - 5% of the population;

- Low importance, 0.1 - 1% of the population; and,
- Negligible, <0.1% of the population.

67. Species that have low vulnerability and low abundance or density are rated as low priority. Species which have at least moderate vulnerability to one or more potential impacts and occurred in low abundance or density in the context of their regional population size are rated having moderate importance. Species which have at least moderate vulnerability to one or more potential effects and occurred in moderate or high abundance or density in the context of their regional population size are rated having high importance.

Analyses - Marine Mammals

68. The marine mammal component of the surveys was designed to provide site characterisation data to determine what species are present and at what times of the year. The appropriate analysis of such data is:

- Presentation of the numbers of marine mammals recorded from each site visit;
- A breakdown of sightings by behaviour of sighted animals;
- Presentation of average and maximum group sizes by species;
- Sightings rate by species (animals per km); and
- Mapping showing the locations of marine mammal species recorded during the ESAS surveys.

69. Since both on-effort (within transect survey corridors when seen) and off-effort (outside transect corridor when seen but within Survey Area) records provide information on the species sighted, the number of animals sighted and the behaviour of those animals, the summary tables show combined on-effort and off-effort sightings. However, when measures of abundance are compared to effort and when distribution maps are presented both show 'on-effort' sightings only (since off-effort sightings are not, by definition, accompanied by effort data and since 'off-effort' sightings are not assigned positions on the water). For marine mammal maps, the points are scaled in size according to the number of animals recorded for each species.

70. Regarding marine mammals, no attempt has been made to correct for under recording (i.e. where animals are not available for recording, due to being below the sea surface) and the values for marine mammals presented herein give a relative measure only of abundance. The type and detail of analysis presented in this report is considered adequate to inform the EIA.

RESULTS

Survey Effort and Sea Conditions

72. A total of 20 surveys visits (days) were undertaken between June 2013 and May 2014 (Table 5).

73. On the great majority of survey dates over the year conditions were good or very good for survey work and well within ESAS guidelines for seabird surveys (up to sea state 4) (Table 5). However on two of the winter survey visits conditions of sea state 5 were temporally experienced. Full details of sea state, wind direction, swell and survey times for each transect are presented in Appendix 1 (Table A1.1).

74. Eleven survey visits were made during the months April to August, with at least two visits in each month. This is one visit more than was planned for at the start of the survey programme. All transects were surveyed in these months and sea conditions at the time of surveys were generally very good (predominantly seas state 1 to 3) except on the July visits which had good conditions (predominantly sea states 3 and 4, but never exceeding sea state 4). These months cover the breeding season for most seabird species.

75. Five autumn survey visits were made in the months September to November, 83% of the planned survey effort for this period. Although unsuitable sea conditions prevented any survey visits in October this was compensated for by an additional survey visit in November. All transects were surveyed at least twice in this period and sea conditions at the times of surveys were very good (predominantly seas state 1 to 3) on all visits except the 25th November visit, which had good conditions (predominantly sea states 3 and 4, but never exceeding sea state 4)

76. Five winter survey visits were made in the months December to March, 63% of the planned survey effort for this period. The winter of 2013/14 was the stormiest in the UK for over forty years and this caused sea conditions in the Survey Area to be persistently unfavourable for surveys. As a consequence of this there were no opportunities to survey during January, and only single visits could be made in December and March. Furthermore, on two of the winter visits (7th February and 26th March) deteriorating weather meant that sea conditions for part of the visit were poor (sea state 4 and occasionally sea state 5) and eventually conditions became unsuitable and the survey was ended for the day with either one (26 March) or two (7th February) of the planned transects not surveyed. Conditions on the other three winter surveys were either good or very good.

77. Despite the weather related problems, the winter survey visits were approximately evenly spread through the period (longest period between visits was 40 days) and 90% of the winter survey effort was conducted in sea conditions that complied with ESAS guidance.

78. The results presented in the next section show that the numbers and diversity of seabirds using the Survey Area in the winter months was consistently low and in line with expectations based on results from previous winter surveys off NE Scotland (Kober *et al., 2*010). For these reasons it is considered that despite the lower than planned for winter survey effort, the survey results for the winter months nevertheless give adequate baseline data for the impact assessment.

Table 5. Survey visit summary June 2013 to May 2014 (full details of sea conditions are presented in Appendix 1, Table A1.1).

Survey date	Sea state (Douglas scale)	Transects T completed	Incomplete transects
08/06/2013	2	T1-23	None
09/06/2013	0-2		
08/07/2013	3-4	T1-23	None
09/07/2013	0-4		
05/08/2013	2	T1-23	None
06/08/2013	2-4		
09/09/2013	1-3	T1-23	None
19/09/2013	2-3		
05/11/2013	2-4	T1-23	None
09/11/2013	2-3		
25/11/2013	2-4	T1-23	None
29/12/2013	2-4		
07/02/2014	3-5	T1, T3, T6-23	T2, T4
19/02/2014	2-3		
26/03/2014	2-5	T1-20, T22	T21, T23
02/04/2014	2-3		
20/04/2014	2-3	T1-23	None
28/04/2014	1-3		
02/05/2014	2	T1-23	None
03/05/2014	1-4		

Table 6. Summary of the importance of windfarm area (the wind turbines buffered to 1km, WT+1km) to regional receptor populations of seabirds. The mean number of birds in WT+1km area and 95% upper confidence limit (UCL) are calculated by distance analysis of the Year 1 baseline survey results. Note, the population sizes shown are expressed to the same precision as given in the source data.

Species	Season	Regional population (RP)		Source	Estimated mean in WT+1 km area		95% UCL of est. mean in WT+1 km area		Importance of WT+1 km to RP
		Number	Units		Number (all ages)	% of RP	Number (all ages)	% of RP	
Fulmar	Breeding season (Apr - Sep)	767,160	adults	Seabird 2000	30	<0.01%	40	<0.01%	Negligible
	Winter (Oct - Mar)	568,736	birds	Furness, 2014	20	<0.01%	25	<0.01%	Negligible
Manx shearwater	Summer (non-breed) and migration (May - Sep)	8,507	birds	Furness, 2014	0.7	<0.01%	1.3	0.02%	Negligible
European storm-petrel	Migration (May - Oct)	*ca.* 10,000	birds	Stone *et al.*, 1995	0.6	<0.01%	1.1	0.01%	Negligible
Gannet	Breeding season (Apr - Sep)	124,386	adults	Seabird 2000	10	<0.01%	13	0.01%	Negligible
	Winter (Oct - Mar)	248,385	birds	Furness, 2014	4	<0.01%	5	<0.01%	Negligible
Arctic skua	Summer (non-breed) and autumn migration (Jun - Nov)	6,427	birds	Furness, 2014	0.1	<0.01%	0.4	0.01%	Negligible
Great skua	Autumn migration (Jul - Nov)	19,556	birds	Furness, 2014	0.5	<0.01%	0.9	<0.01%	Negligible
Herring gull	Breeding season (Apr - Aug)	25,474	adults	Seabird 2000	1	<0.01%	1	<0.01%	Negligible
	Winter (Sep- Mar)	466,511	birds	Furness, 2014	12	<0.01%	17	<0.01%	Negligible
Great black-backed gull	Breeding season (Apr - Aug)	140	adults	Seabird 2000	<1	0.05%	1	0.05%	Negligible
	Winter (Sep- Mar)	91,399	birds	Furness, 2014	11	0.01%	13	0.01%	Negligible
Kittiwake	Breeding season (Apr - Aug)	73,440	adults	Seabird 2000 & SMP database	81	0.1%	112	0.2%	Low
	Winter (Sep - Mar)	627,816	birds	Furness, 2014	3	<0.01%	4	<0.01%	Negligible
Arctic tern	Breeding season (May - July)	276	adults	Seabird 2000	0 (counted 3 birds out with WT+1km	1%	n/a	n/a	Negligible
	Migration seasons (Aug)	163,930	birds	Furness, 2014	50	0.03%	128	0.08%	Negligible
Common guillemot	Colony attendance (Apr - July)	200,851	adults	Seabird 2000	249	0.10%	295	0.14%	Low

Species	Season	Regional population (RP)		Source	Estimated mean in WT+1 km area		95% UCL of est. mean in WT+1 km area		Importance of WT+1 km to RP
		Number	Units		Number (all ages)	% of RP	Number (all ages)	% of RP	
	Chicks on sea (August)	576,185	adults	Seabird 2000	2,136	0.4%	3,169	0.6%	Low
	Winter (Sep - Mar)	1,617,306	birds	Furness, 2014	40 / 78	<0.01%	52 / 409 (peak)	<0.01% / 0.03%	Negligible
Razorbill	Colony attendance (April - July)	11,312	adults	Seabird 2000	30	0.3%	40	0.4%	Low
	Chicks on sea (August)	62,058	adults	Seabird 2000	719	1.2%	1,085	1.7%	Medium
	Winter (Sep - Mar)	218,622	birds	Furness, 2014	10	<0.01%	16	<0.01%	Negligible
Puffin	Colony attendance (Apr - Aug)	89,906	adults	Seabird 2000	119	0.1%	138	0.2%	Low
	Post-breeding (Sep)	89,906	adults	Seabird 2000	85	0.09%	104	0.12%	Low
	Winter (Sep - Mar)	231,957	birds	Furness, 2014	21	<0.01%	26	0.01%	Negligible
Note: for guillemot two values are provided in the winter season, reflecting the incorporation of Year 2 September surveys with significantly higher densities.									

Seabird Results

Overview

79. The species accounts below present and discuss the results for the 13 regularly (more than five records) encountered seabird species. These are the species considered to have relevance to the Project. A summary of the abundance estimates and importance of the Survey Area and WT+1km in each season for these species is presented in Table 6. Maps showing the distributions of records across the Survey Area for these species are also presented (Figs. 5-16).

80. In addition to the 13 species considered in detail below, nine other seabird species and 12 non-seabird species were encountered on less than six occasions and in small numbers only during the year of surveys (Table 7, Appendix 1 Tables A1.2 to A1.6). With the exception of wintering little auk and glaucous gull all these species were migrants. It is clear that the Survey Area has very low importance for these species at all times of the year and therefore they are not discussed further.

81. Small numbers of migrant non-seabird species were recorded flying through the Survey Area (Table 8, Appendix 1 Tables A1.2 to A1.6). It is clear that the Survey Area has very low importance for these species at all times of year and therefore they are also not discussed further.

82. The four survey visits made between 9th September and 9th November 2013 and the six visits between 26th March and 3rd May 2014, fall within the main periods for autumn and spring migration respectively for shorebird and wildfowl species. The fact that such low numbers of shorebird and wildfowl were seen passing over during these visits suggests that the Survey Area does not lie on an important migration path for species in these groups.

83. Although not recorded during surveys, SNH/JNCC requested that the potential collision risk to migrating Svalbard barnacle geese should be considered. Results of simple collision rate modelling assuming a broad front migration and based on generic parameters and methods described by WWT Consulting (2014) and are presented in Appendix 3.

84. In the species accounts below information on the likely breeding site origins of birds using the Survey Area is presented. Owing to the fact that all the species that regularly use the Survey Area range widely and that birds from different breeding sites may, to a greater or lesser extent, share foraging areas there is inevitably some uncertainty about the exact breeding site origins of the individuals present. During the breeding season information on typical foraging distances from a colony based on tagging studies (Thaxter *et al*., 2012) is used to give an indication of the likely geographic spread of source colonies. Where available, results from tagging birds at colonies in east Scotland may demonstrate direct connectivity between a colony and the wind farm area. Outside the breeding there is typically greater uncertainty about the origin of the birds present due to fewer studies at this time of year. Nevertheless for all species that use the area there is increasing evidence of widespread and often long-distance movement outside the breeding season typically with considerable mixing of populations from different breeding areas (Furness, 2014).

Table 7. Summary of seabird species seen on less than six occasions during the year of surveys.

Species	Date	Observation
Red-throated diver	25 November 2013	1 flying S, not in transect
Sooty shearwater	5 August 2013	5 on sea and 1 flying off effort
	6 August 2013	1 flying off effort
Balearic shearwater	5 August 2013	1 on sea
Common gull	2 April 2014	2 flying, not in transect
Lesser black-backed gull	8 June 2013,	1 flying and 1 off effort
	8 July 2013	1 flying, not in transect
	2 April 2013	1 flying
Glaucous gull	25 November 2013	1 flying off effort
'white-winged' gull sp.	9 November 2013	1 flying, not in transect
Common tern	8 June	3 flying
Pomarine skua	5 August 2013	1 on sea
Little auk	5 November 2013	1 on sea and 4 flying not in transect
	25 November 2013	1 on sea
	26 March 2014	1 on sea
	2 April 2014	2 flying, not in transect
	5 November 2013	1 on sea and 4 flying not in transect

Table 8. Summary of non-seabird migrant species seen during the year of surveys.

Species	Date	Observation
Greylag goose	5 November 2013	2 flying, not in transect
Common scoter	9 Sept 2013	7 flying, not in transect
	29 December 2013	1 flying off effort
Dunlin	5 August	2 flying, not in transect
Curlew	8 July 2013	1 flying, not in transect
Purple sandpiper	8 July 2013	1 flying, not in transect
Kestrel	19 September 2013	1 flying, not in transect
Meadow pipit	19 Sept 2013	39 flying, not in transect
Black redstart	2 April 2014	1 flying, not in transect
Robin	20 April 2014	1 flying, not in transect
Starling	9 June 2013	1 flying, not in transect
Swallow	9 July 2013	1 flying off effort
Swift	9 July 2013	2 flying not in transect and 1 off effort

Fulmar

Overview

85. Fulmars were common in the Survey Area throughout the year, with a high proportion of birds seen in flight (Table 9). Fulmars range very widely away from breeding colonies, to forage when they are breeding (MMFR 400 km) and at other times of year when they make more extensive movement. The birds seen in the Survey Area are likely to be mainly from breeding areas across northern and eastern Scotland. This species habitually flies well below the proposed rotor height and has low sensitivity to human disturbance.

Table 9. Fulmar average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1 km												
Colony attendance	13	439	866	2.27	17%	22	30	40	29%	14.92	195	334
Winter	7	233	320	1.53	14%	16	20	25	69%	3.31	43	78
Turbines + 2 km												
Colony attendance	13	439	866	2.27	17%	51	68	91	29%	14.92	450	772
Winter	7	233	320	1.53	14%	36	46	59	69%	3.31	100	181
Turbines + 3 km												
Colony attendance	13	439	866	2.27	17%	90	121	162	29%	14.92	796	1,366
Winter	7	233	320	1.53	14%	64	82	104	69%	3.31	176	321
Survey Area												
Colony attendance	13	439	866	2.27	17%	289	386	517	29%	14.92	2,543	4,364
Winter	7	233	320	1.53	14%	206	261	331	69%	3.31	564	1,024
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Colony-attendance period

86. The colony-attendance period for fulmar is defined as the months of May to September as this covers the period from nest establishment through to young fledging for the great majority of breeding birds. At other times of year some individuals may be present at colonies, but they are unlikely to be engaged in breeding activities.

87. Based on the MMFR (plus approximately 10%) the breeding population in the defined breeding region is 767,160 adults based on the Seabird 2000 census results (Mitchell *et al.,* 2004). The actual number of fulmars present in the region during the breeding season is likely to be substantially greater than this figure because of the presence of immature birds.

88. The mean estimated number of fulmars present in the Survey Area during the colony-attendance period was 386 birds and the peak estimated number was 2,543 (Table 9). These estimates represent 0.1% and 0.3% respectively of the assumed regional breeding population.

89. Based on the density in the Survey Area, the estimated mean number of fulmars in the WT+1km and 95% upper confidence limit (UCL) of this mean was 30 individuals and 40 individuals respectively. These

numbers represent <0.01% of the regional breeding population respectively and thus the WT+1km area is considered to have negligible importance as a foraging area for the population.

Winter period

90. The mean estimated number of fulmars present in the Survey Area during the winter period (October to April) was 261 birds (Table 9). This represents <0.1% of the estimated minimum non-breeding period population of 568,736 birds for the North Sea BDMPS region (Furness, 2014).

91. Based on the density in the Survey Area in the winter period, the estimated mean number of fulmars in the WT+1km and 95%UCL of this mean was 20 individuals and 25 individuals respectively. These estimates represent <0.01% and <0.01% respectively of the assumed regional winter period population and thus the WT+1km area is considered to have negligible importance as a foraging area for the population.

Behaviour

92. The maps showing the distribution of fulmar records show that birds are approximately evenly spread over the Survey Area (Fig. 3a and b). The statistical analysis examines variation in estimated density between sub-divisions of the Survey Area and shows that the density differences are small and likely to reflect sampling variation rather than genuine differences (Caloo, 2014a).

93. On average, 29% of fulmars present in the Survey Area during the breeding season were in flight, rising to 69% in the winter period.

94. Almost all (99.9%) of the flying fulmars recorded were estimated to be at or below 20 m above the sea, suggesting that this species would be at negligible risk of collision with turbine rotors.

Likely origins

95. During the breeding season, fulmars in the Survey Area could potentially originate from colonies anywhere along the north and east coast of Scotland, Orkney and Shetland. The closest breeding fulmar colonies are on the coast of Buchan and Aberdeenshire, but these are small in size compared to colonies further north, especially in Orkney. Using the MMFR plus 10% leads to a regional population which stretches as far west as the Western Isles and Skye, as far north as Shetland and as far south as Flamborough Head.

96. Outside the breeding season fulmars range widely. The birds seen in the Survey Area in the autumn and winter are likely to originate mainly from any of the colonies in eastern and northern Scotland. They are also likely to include birds from colonies in Scandinavia and the Arctic. The sighting of a 'blue' phase fulmar in the Survey Area in November confirms that some individuals are from arctic breeding grounds.

Status and protection

97. The Scottish population has a favourable conservation status and has undergone long term increase in numbers (Mitchell *et al., 2*004).

98. Fulmar is a qualifying species of Buchan Ness to Collieston SPA, Troup, Pennan and Lion's Heads SPA, Fowlsheugh SPA, East Caithness Cliffs, North Caithness Cliffs SPA, Forth Islands SPA, Calf of Eday SPA, Copinsay SPA, Hoy SPA, Rousay SPA, West Westray SPA, Fair Isle SPA and five SPAs in Shetland.

Vulnerability to windfarm impacts

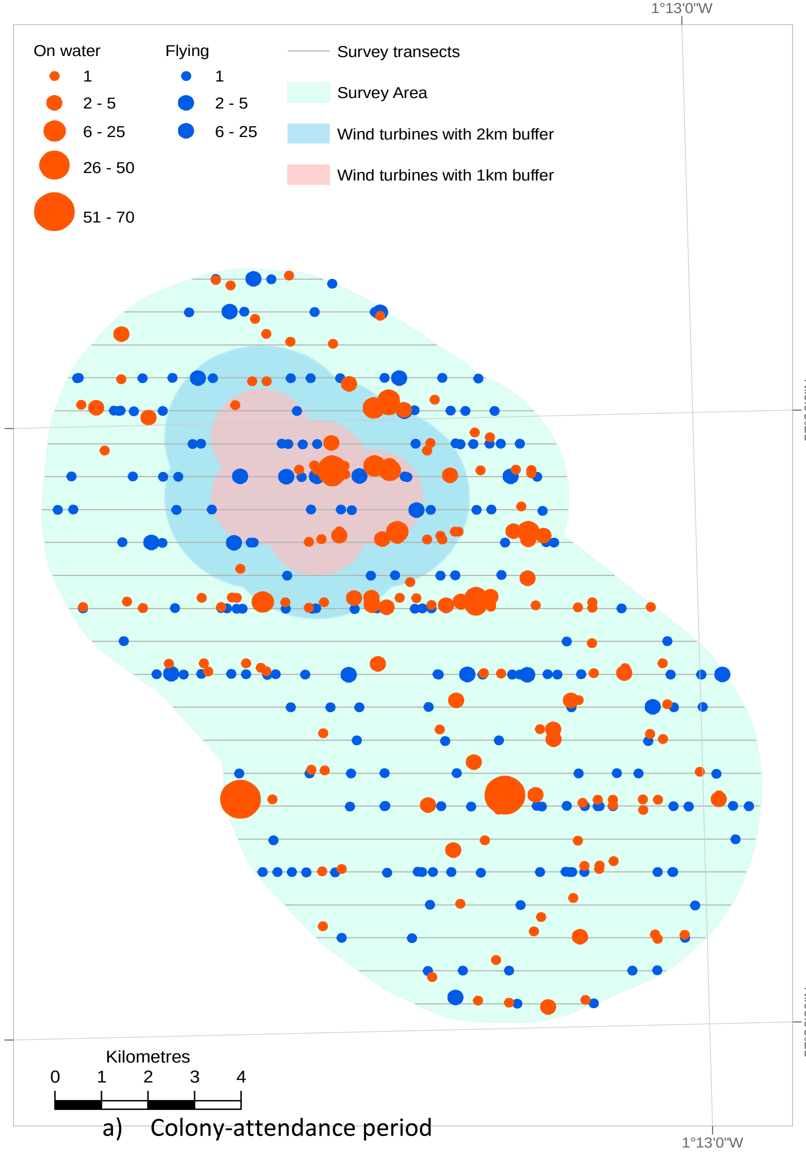
99. Fulmars are considered to have very low vulnerability to vessel disturbance, displacement by structures and offshore wind turbine collision risk (Table 3).

Relevance to Project

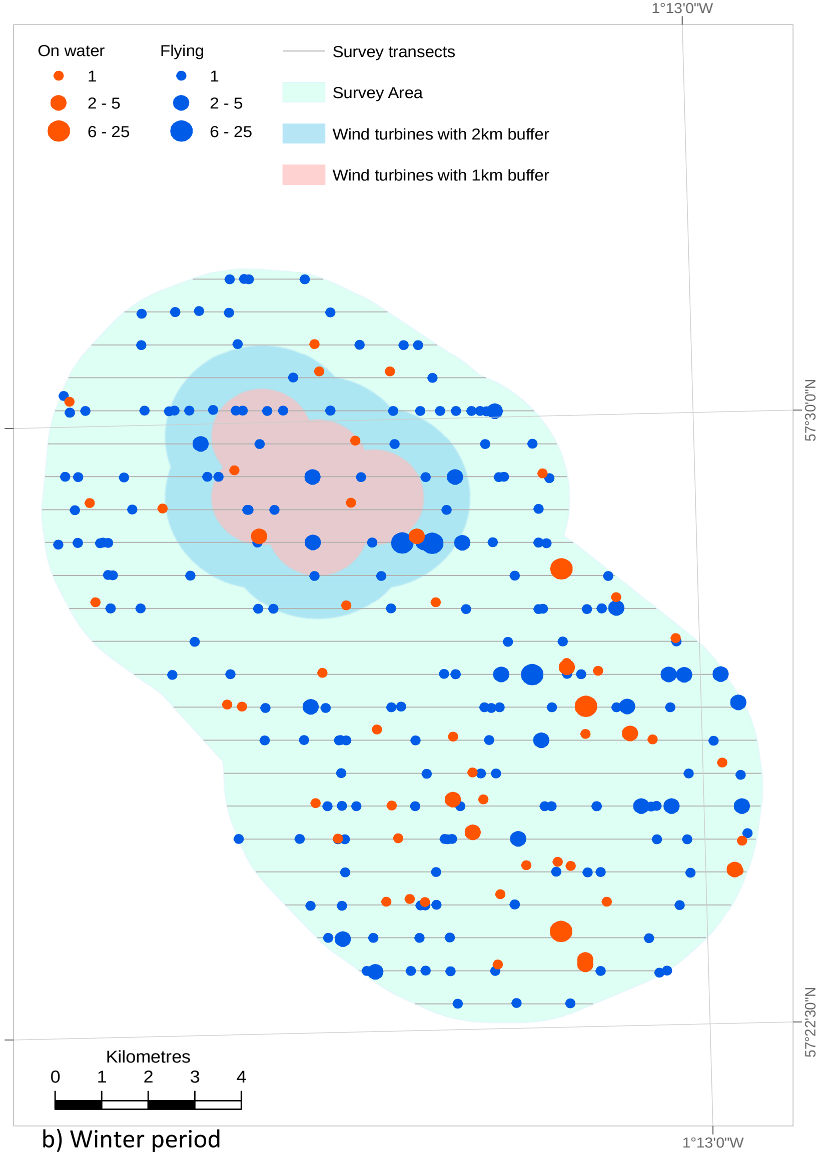
100. Concerns likely to be low as this species is relatively tolerant of disturbance and habitually flies well below the height of offshore wind turbine rotors.

101. Rated as low priority.

Fig. 3. Distribution and abundance of fulmars recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (10 survey days), and b) the winter period (10 survey days).



a) Colony-attendance period



b) Winter period

Information gaps

102. None of importance.

Manx shearwater

Overview

103. Manx shearwaters are a summer visitor to eastern Scotland and were occasionally recorded in low numbers in the Survey Area in the summer months (Table 10). The birds seen were likely to be non-breeding immatures and passage birds. This species habitually flies well below the proposed rotor height and has low sensitivity to human disturbance.

Table 10. Manx shearwater average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Colony attendance	10	7	14	0.06	34%	0.4	0.7	1.3	41%	0.35	4.5	9.8
Turbines + 2 km												
Colony attendance	10	7	14	0.06	34%	1.0	1.7	3.0	41%	0.35	10.5	22.7
Turbines + 3 km												
Colony attendance	10	7	14	0.06	34%	1.7	3.0	5.3	41%	0.35	18.6	40.2
Survey Area												
Colony attendance	10	7	14	0.06	34%	5.5	9.7	17.0	41%	0.35	59.3	128.5
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Summer / autumn passage period

104. It is unlikely that the small numbers of Manx shearwater seen in the Survey Area during the summer were actively breeding individuals because the Survey Area is further than the MMFR from the closest large breeding colonies. It is considered more likely that the birds seen in the Survey Area were wandering immature birds and autumn passage birds. Manx shearwater does not regularly breed in the region but presumed non-breeding birds are present at low densities (Kober *et al.,* 2010) in the summer.

105. The estimated mean number of Manx shearwaters present in the Survey Area during the colony-attendance period was 10 birds and the peak estimated number was 59 (Table 10). These estimates represent 0.1% and 0.7% respectively of the BDMPS migration population of 8,507 birds for the North Sea area (Furness, 2014).

106. Based on the estimated density in the Survey Area, the estimated mean number present in the WT+1km area was just 0.7 birds and upper 95% confidence limit of this was 1.3 birds. These numbers represent <0.01% and 0.02% of the BDMPS migration population of 8,507 birds for the North Sea area (Furness,

2014) and therefore the WT+1km area is considered to have negligible importance as a foraging area for the population.

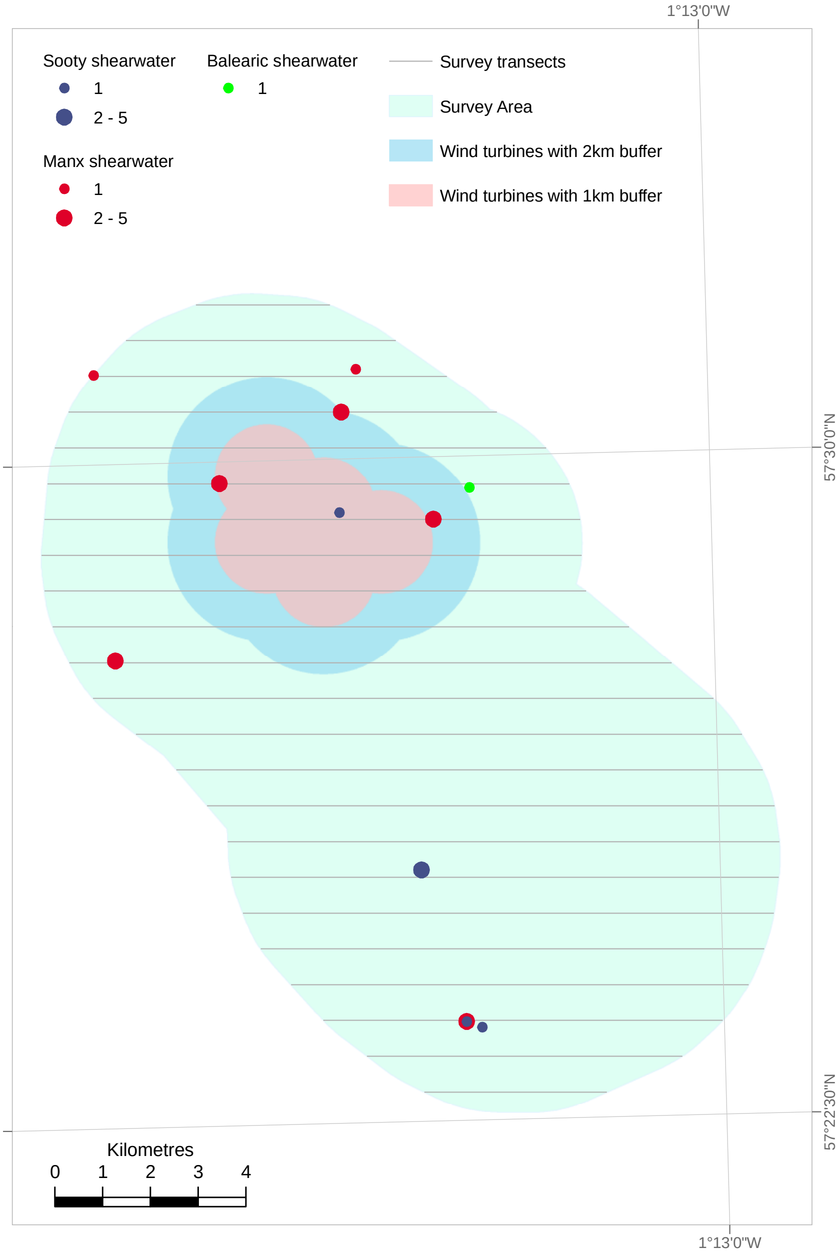
Behaviour

107. The map of the distribution of Manx shearwater records shows that birds are approximately evenly spread over the Survey Area (Fig. 4).

108. On average, 41% of Manx shearwaters estimated to be present were in flight, the remainder were sitting on the sea.

109. All flying Manx shearwaters recorded were estimated to be at or below 5 m above the sea, suggesting that this species would be at no risk of collision with wind turbine rotors.

Fig. 4. Distribution and abundance of shearwater species recorded during ESAS surveys between June 2013 and May 2014 (20 survey days).



Likely origins

110. Non-breeding and migrant Manx shearwaters wander very extensively from breeding areas (Wernham *et al., 2*003). The birds present off the east coast of Scotland are most likely to originate from the large breeding colonies in north-west Scotland, in particular Rum and St Kilda, and the more moderate sized colonies in Iceland and Faeroe Islands. They also breed in very small numbers in Orkney and Shetland (<10 pairs, (Forrester *et al*., 2007) and a handful of pairs has recently established on the Isle of May in the Firth of Forth (Thorne *et al*., 2014). There are also small populations in Norway.

Status and protection

111. The Scottish population has a favourable conservation status and has undergone long term increase in numbers (Mitchell *et al*., 2004).

112. Qualifying species of Rum SPA and St Kilda SPA.

Vulnerability to windfarm impacts

113. Manx shearwaters are considered to have very low vulnerability to vessel disturbance, displacement by structures and offshore wind turbine collision risk (Table 3).

Relevance to Project

114. Concerns are likely to be low as this species is scarce, relatively tolerant of disturbance and flies well below the rotor height of offshore windfarms.

115. Rated as low priority.

Information gaps

116. None of importance.

Storm petrel

Overview

117. European storm-petrels (hereafter just 'storm-petrels') are a summer and passage visitor to eastern Scotland and were occasionally recorded in very low numbers in the Survey Area in the summer months (Table 11). The birds seen were likely to be non-breeding immatures and passage birds. This species habitually flies well below the proposed rotor height and has low sensitivity to human disturbance.

Summer/colony attendance period

118. Storm petrels do not breed in the region but immature birds are present at low densities and breeding birds pass through on migration. It is likely that the small numbers of storm petrel seen in the Survey Area during the colony attendance period were non-breeding immature individuals because the Survey Area is further from the closest breeding colonies in Orkney than the species' maximum foraging distance (120 km, Thaxter *et al.,* 2012).

119. The number of birds present in the region during the summer is poorly quantified. Based on the densities in Stone *et al*. (1995), the western North Sea summer/autumn population (May to October) is very approximately 10,000 birds.

120. The mean estimated number of storm petrels present in the Survey Area during the summer was 8.5 birds and the peak estimated number was 35 (Table 11). This represents approximately 0.08% and 0.3% respectively of the assumed regional summer/migration population.

121. Based on the estimated density in the Survey Area, the mean number present in the WT+1km area was just 0.6 birds. The 95% UCL of this mean is 1.1 birds. These numbers represent approximately 0.01% of the North Sea summer/autumn population and thus the WT+1km area is considered to have negligible importance as a foraging area for the population.

Table 11. Storm-petrel average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1 km Colony attendance	10	15	17	0.05	31%	0.4	0.6	1.1	100%	0.20	3	7
Turbines + 2 km Colony attendance	10	15	17	0.05	31%	0.9	1.5	2.5	100%	0.20	6	15
Turbines + 3 km Colony attendance	10	15	17	0.05	31%	1.6	2.6	4.4	100%	0.20	11	27
Survey Area Colony attendance	10	15	17	0.05	31%	5.0	8.5	14.2	100%	0.20	35	86
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Behaviour

122. The records of storm petrel were approximately evenly distributed over the Survey Area (Fig. 5).

123. All storm petrels recorded were estimated to be at or below 5 m above the sea, suggesting that this species would be at no risk of collision with turbine rotors.

Likely origins

124. Non-breeding and migrant storm petrel wander very extensively from breeding areas (Wernham *et al.,* 2003). The birds present off the east coast of Scotland are likely to originate from breeding colonies around Scotland especially the closest colonies which are in Orkney and Shetland.

Status and protection

125. The Scottish population has a favourable conservation status and has undergone a long term increase in numbers (Mitchell *et al*., 2004).

126. Qualifying species of Auskerry SPA, Fair Isle SPA, Mousa SPA and North Rona and Sule Sgeir SPA.

Vulnerability to windfarm impacts

127. Storm-petrels are considered to have very low vulnerability to vessel disturbance, displacement by structures and offshore wind turbine collision risk (Table 3).

Relevance to Project

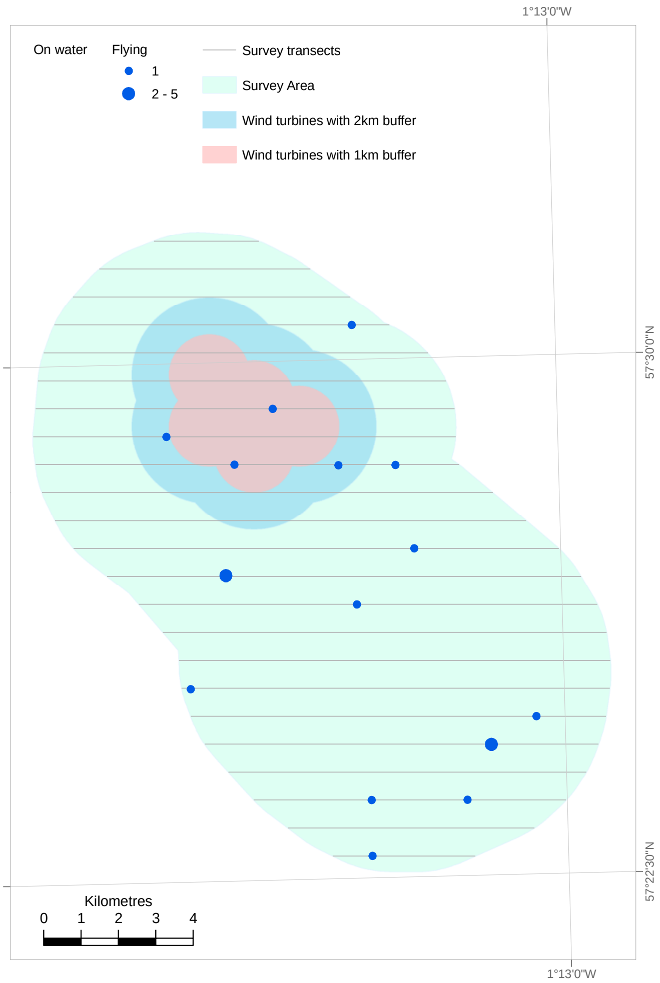
128. Concerns are likely to be low as this species is scarce, relatively tolerant of disturbance and always flies well below rotor height of offshore windfarms.

129. Rated as low priority.

Information gaps

130. None of importance.

Fig. 5. Distribution and abundance of storm petrels recorded ESAS surveys between June 2013 and May 2014 (20 survey days).



Gannet

Overview

131. Gannets were commonly present in the Survey Area throughout the year, with a high proportion of birds seen in flight (Table 12). Gannets range very widely away from breeding colonies both to forage during the breeding season and during their extensive movements at other times of year. This species regularly flies at the height of wind turbine rotors and are therefore considered to have moderate sensitivity to offshore windfarms.

Colony-attendance period

132. Based on MMFR the regional breeding population of gannets was taken to be the sum of birds breeding at Bass Rock, Fair Isle and Troup Head. The numbers breeding at these colonies has changed since the Seabird 2000 census, therefore more recent count data from the SMP database are used. The regional breeding population is assumed to be 124,386 adults (derived from a 2010 count of 2,787 Apparently Occupied Nests (AONs) for Troup Head, a 2009 count of 55,482 AONs for Bass Rock and a 2013 count of 3,924 AONs for Fair Isle).

Table 12. Gannet average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Colony attendance	13	207	343	0.78	13%	8	10	13	80%	2.18	28	50
Winter	7	68	74	0.33	15%	3	4	5	72%	1.05	14	20
Turbines + 2 km												
Colony attendance	13	207	343	0.78	13%	19	24	29	80%	2.18	66	115
Winter	7	68	74	0.33	15%	8	10	13	72%	1.05	32	47
Turbines + 3 km												
Colony attendance	13	207	343	0.78	13%	34	42	52	80%	2.18	116	204
Winter	7	68	74	0.33	15%	14	17	22	72%	1.05	56	83
Survey Area												
Colony attendance	13	207	343	0.78	13%	108	134	166	80%	2.18	371	653
Winter	7	68	74	0.33	15%	44	56	71	72%	1.05	179	265
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Table 13. Gannet, age frequency

Season	% of aged birds			Sample size	% of on-effort birds not aged
	Adult	Juvenile	Immature		
Colony-attendance period (Apr-Sep)	91.4	0.4	8.2	1133	6.4
Winter period (Oct-Mar)	87.4	4.9	7.6	223	4.3

133. The estimated mean and peak number of gannets present in the Survey Area during the colony-attendance period was 134 and 371 respectively (Table 12). These represent approximately 0.1% and 0.3% of the assumed regional breeding population of 124,386 adults.

134. Based on the density in the Survey Area, the estimated mean number of gannets in the WT+1km and 95%UCL of this mean was 10 individuals and 13 individuals respectively. These numbers represent <0.01%

and 0.01% respectively of the regional breeding population and therefore the WT+1km area is considered to have negligible importance as a foraging area for the population.

135. A total of 91% of gannets that were aged during the colony-attendance period were adults and the rest were immatures (Table 13). No attempt has been made to correct for the presence of immatures in the evaluation of the site's importance to breeding birds above.

Winter period

136. The mean estimated number of gannets present in the Survey Area during the winter period was 56 birds (Table 12). This represents <0.1% of the estimated minimum non-breeding period population of 248,385 birds for the North Sea and Channel BDMPS region (Furness, 2014).

137. Based on the density in the Survey Area in the winter period, the estimated mean number of gannets in the WT+1km and 95%UCL of this mean was 4 individuals and 5 individuals respectively. These estimates both represent <0.01% of the assumed regional winter period population and therefore the WT+1km area is considered to have negligible importance as a foraging area for the population.

Behaviour

138. The maps showing the distribution of records show that birds were approximately evenly spread over the Survey Area (Fig. 6a and b).

139. On average, approximately 76% of gannets estimated to be present were in flight, the remainder were sitting on the sea (Table 13).

140. Approximately 20% of flying gannets recorded were estimated to be above 15 m above the sea level (Caloo 2014b), suggesting that a moderate proportion of birds flying in the windfarm would be at risk of collision with turbine rotors.

141. During the colony-attendance period there was a strong tendency for gannet flights to be along a N/NE – S/SW orientation (Fig. 7). This probably indicates strong connectivity to the Bass Rock colony, by far the largest colony within foraging range and lying approximately 169 km to the southwest of the Survey Area. Perhaps surprisingly, there were extremely few colony-attendance-period flights with a NW – SE orientation, the orientation that would be expected for birds from Troup Head colony; this lies approximately 60 km to the north-west of the Survey Area.

Fig. 7. Gannet flight directions (%) recorded during ESAS surveys between June 2013 and May 2014. (n = number of records).

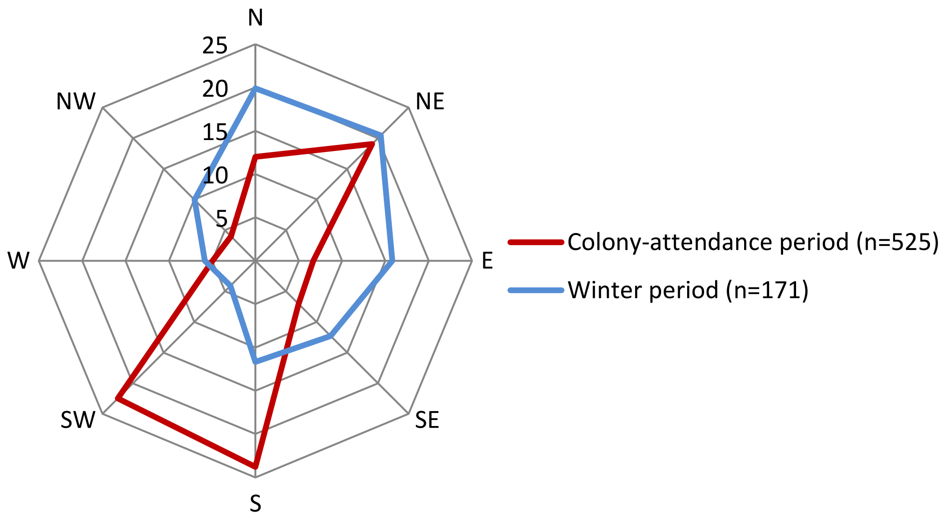
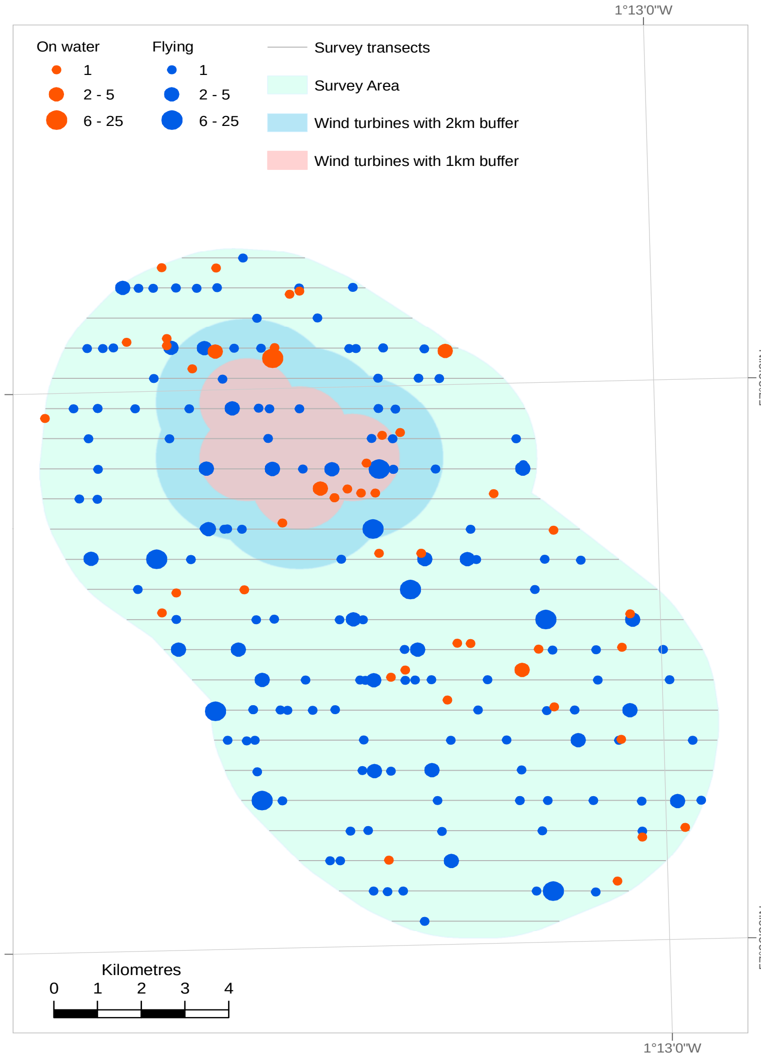
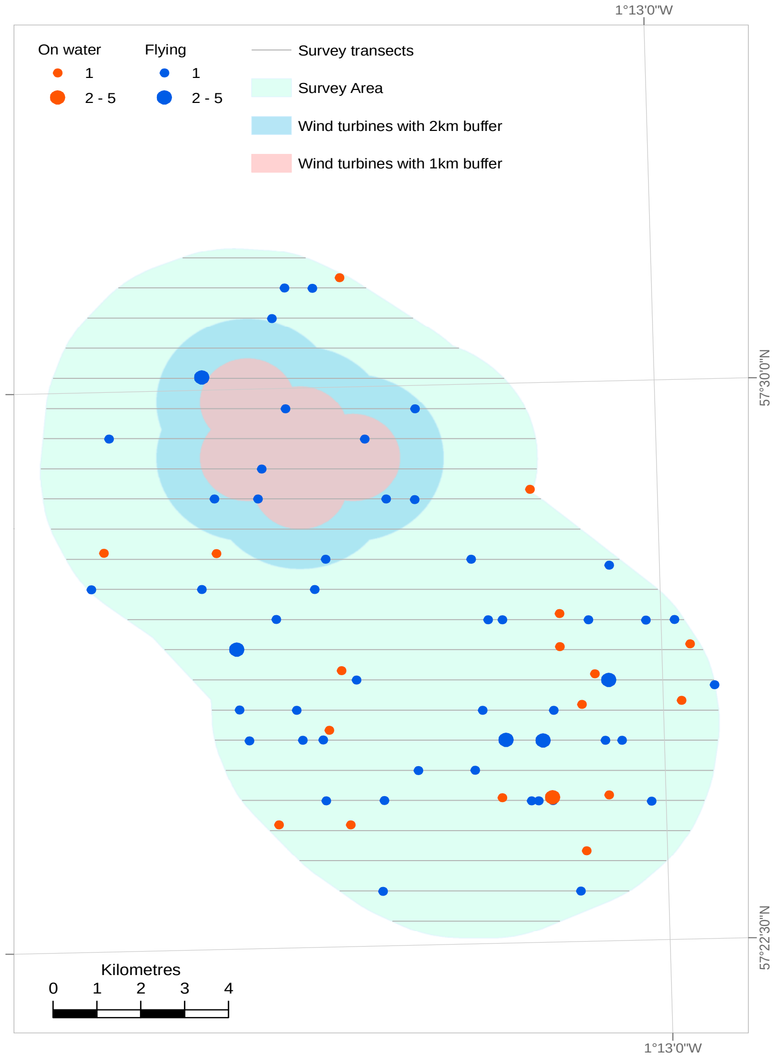


Fig. 6. Distribution and abundance of gannets recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (12 survey days), and b) the winter period (8 survey days).



a) Colony-attendance period



b) Winter period

Likely origins

142.Breeding gannets range long distances to forage; the mean foraging distance is 93 km and the MMFR is 229 km (Thaxter *et al., 2*013). The closest gannetry is the relatively small colony at Troup Head (2,787 AONs in 2013), approx. 60 km from the Project area and the only gannetry within the mean foraging distance. The next closest colony is the large gannetry at Bass Rock (55,482 AONs), 169 km away. GPS tracking tags fitted to gannets on the Bass Rock show that the Survey Area is in the peripheral part of the large area regularly used for foraging by this colony (Hamer *et al., 2*007). The gannetry on Fair Isle (3,924 AONs, 2013 count) is 228 km to the north, lies at the MMFR and therefore breeding birds from this colony may also potentially forage in the Survey Area.

143.Outside the breeding season gannets range widely and tend to move south. The birds seen in the Survey Area from September onwards are likely to originate from any of the colonies in eastern and northern Scotland, including colonies in Shetland.

Status and protection

144.The Scottish population has a favourable conservation status and has undergone a long term increase in numbers (Mitchell *et al*., 2004).

145.Qualifying species of Forth Islands SPA (Bass Rock) Fair Isle SPA, Noss SPA, Hermaness, Saxa Vord and Valla Field SPA and Sule Skerry and Sule Stack SPA. Since designation, gannets have established a colony at Troup, Pennan and Lion’s Head SPA though this species is not cited as a qualifying feature of this SPA.

Vulnerability to windfarm impacts

146.Gannets are considered to have low vulnerability to vessel disturbance and displacement by structures (Table 3.). However, gannets are considered to have a relatively high vulnerability to collision risk because they commonly fly at the height of offshore wind turbines (Table 3) and therefore collision rate modelling has been undertaken for this species (Caloo 2014b Annex 2 to Technical Report).

Relevance to Project

147.Although the numbers of gannet using the WT+1km area are very low in the context of the regional population size, this species is rated as moderate priority because of the potential for collision strikes with offshore wind turbines.

Information gaps

148.None of importance.

Comparison with additional 2014 summer surveys

149.Density and abundance estimates for gannet in July to September 2014 are similar to those for the same months in the previous year (Tables 3a and 6a in Caloo 2013c Annex 3 to Technical Report).

Arctic skua

Overview

150.Arctic skuas are a non-breeding summer visitor and passage migrant to eastern mainland Scotland. They were occasionally recorded in very low numbers in the Survey Area in the summer and autumn months (Table 14). The birds seen were likely to be non-breeding immatures and passage birds. This species typically flies below the proposed rotor height and has low sensitivity to human disturbance.

Table 14. Arctic skua average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Autumn passage	11	2	2	0.01	78%	003	0.1	0.4	31%	0.06	0.8	3.8
Turbines + 2 km												
Autumn passage	11	2	2	0.01	78%	0.1	0.3	0.9	31%	0.06	1.9	8.9
Turbines + 3 km												
Autumn passage	11	2	2	0.01	78%	0.1	0.4	1.5	31%	0.06	3.4	15.7
Survey Area												
Autumn passage	11	2	2	0.01	78%	0.4	1.4	4.8	31%	0.06	11	50
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Summer/Autumn passage period

151. The estimated mean number of Arctic skuas present in the Survey Area during the summer/autumn passage period was just 1.4 birds (Table 14). The 95% upper confidence limit of this mean is 4.8 birds. These numbers represent approximately 0.02% and 0.08% respectively of the regional BDMPS non-breeding migration population of 6,427 birds (Furness, 2014). Due to the very low numbers of encounters with this species the confidence limits on this estimate are relatively wide.

152. Based on the estimated density in the Survey Area, the mean number present in the WT+1km area during the summer and autumn passage period (June to November) was just 0.1 birds. The 95% upper confidence limit of this mean is 0.4 birds. These numbers represent approximately <0.01% of the BDMPS migration season population of 6,427 birds for the North Sea and Channel area (Furness, 2014) and thus the WT+1km area is considered to have negligible importance as a foraging area for this species.

Behaviour

153. The map showing the distribution of records shows that birds were approximately evenly spread over the Survey Area (Fig. 8).

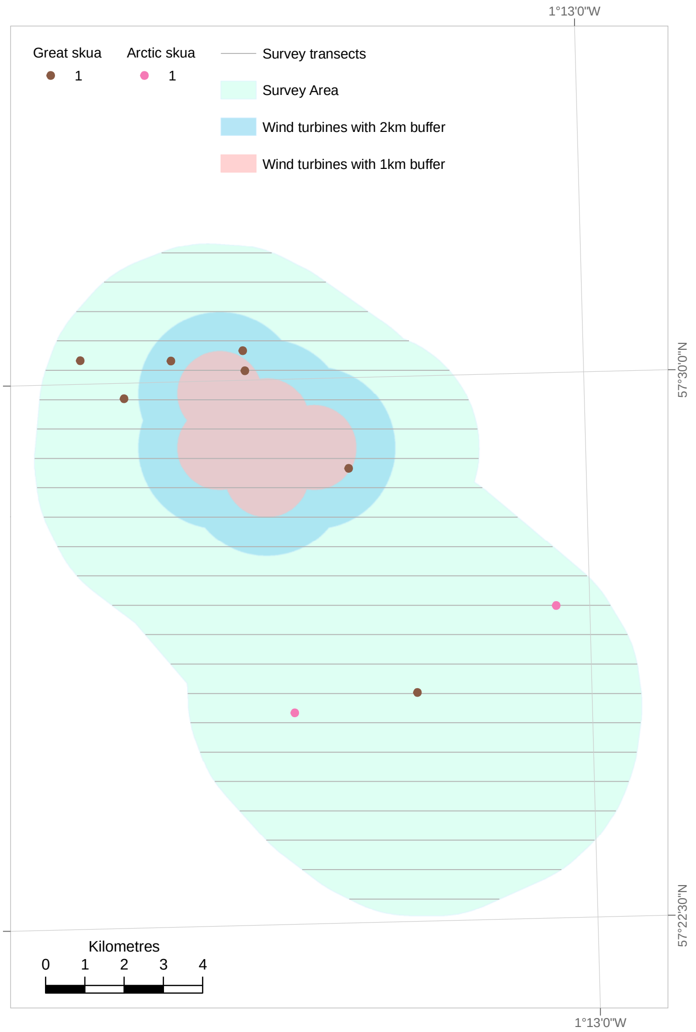
154. On average, 31% of Arctic skuas estimated to be present were in flight, the remainder were sitting on the sea (Table 14).

155. All flying Arctic skuas recorded in flight were estimated to be at or below 20 m above the sea, however the sample size was small (n=5). A review of seabird flight heights (Cook *et al*., 2013) estimated that approximately only 3.8% of flight activity is likely to be at heights with potential for collision with offshore wind turbines, suggesting that birds flying in the windfarm would be at low risk of collision.

Likely origins

156. Tracking studies estimate that the maximum foraging range of breeding Arctic skua is 75 km, and the MMFR is 63 km (Thaxter *et al., 2*013). The closest breeding colonies are on the Caithness Flows and Orkney, at least 160 km to the north-west. Therefore, it is very unlikely that the birds seen in the Survey Area in the breeding season are foraging breeding adults.

Fig. 8. Distribution and abundance of skua species recorded during ESAS surveys between June 2013 and May 2014 (20 survey days).



157.It is likely that the birds in the Survey Area in the summer (June to August) mainly comprise non-breeding immature birds from the Orkney and Shetland populations summering away from the breeding grounds. It is also possible they include late spring passage breeding birds in June and immature birds from Scandinavia and Arctic breeding grounds (Wernham *et al*., 2002).

158.The birds seen in the Survey Area in September and November are likely to be autumn passage birds from Orkney and Shetland (Wernham *et al., 2*003). It is also possible that Arctic and Scandinavian birds occur at this time though there is little direct evidence from ringing studies (Wernham *et al.,* 2002).

Status and protection

159.The Scottish population has an unfavourable conservation status. It has undergone a long term decline in numbers, amounting to a 74% reduction since 1986 (Mitchell *et al., 2*004, SNH 2012). The Scottish breeding population now numbers approximately 500 pairs only based on SNH 2012 review. This represents approximately 6 to 14% of the NE Atlantic population (Mitchell *et al., 2*004).

160.Qualifying species at seven SPAs in Orkney and Shetland.

Vulnerability to windfarm impacts

161. Arctic skuas are considered to have very low vulnerability to vessel disturbance and displacement by structures and moderate vulnerability to offshore wind turbine collision risk (Table 3) and therefore collision rate modelling has been undertaken for this species (Caloo 2014b Annex 2 to Technical Report).

162. The combination of this species' poor conservation status, small population size and relatively low background mortality rate will mean that the population is expected to be relatively sensitive to additional mortality. However, the Project is unlikely to result in collision mortality because the species was very scarce in the WT+1 km area and only a small proportion of flight activity is likely to may be at the height of turbine rotors (Johnston *et al*., 2014).

163. Rated as low priority.

Information gaps

164. There is uncertainty about whether the birds present in summer are part of the Scottish population as speculated earlier, or whether they are from Scandinavian or Arctic populations, or a combination of these. This information gap is does not limit the undertaking a robust impact assessment.

Great skua

Overview

165. Great skuas are a non-breeding summer visitor and passage migrant to eastern mainland Scotland. They were recorded in low numbers in the Survey Area in the summer and autumn months (Table 15). The birds seen were likely to be non-breeding immatures and passage birds. This species typically flies below the proposed rotor height and has low sensitivity to human disturbance.

Table 15. Great skua average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Autumn passage	9	8	8	0.03	41%	0.2	0.5	0.9	9%	0.08	1.1	4.8
Turbines + 2 km												
Autumn passage	9	8	8	0.03	41%	0.5	1.1	2.0	9%	0.08	2.5	11
Turbines + 3 km												
Autumn passage	9	8	8	0.03	41%	1.0	1.9	3.6	9%	0.08	4.4	20
Survey Area												
Autumn passage	9	8	8	0.03	41%	3.1	5.9	11.5	9%	0.08	14	62
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a, c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Summer/autumn passage period

166. The mean estimated number of great skuas present in the Survey Area during the summer/autumn passage period was 6 birds (Table 15). This represents approximately <0.1% of the assumed regional BDMPS non-breeding population of 19,556 birds during the autumn migration (Furness, 2014).

167. Based on the density in the Survey Area, the 95%UCL of the estimated mean number of great skuas in the WT+1km area was just 0.9 birds. This number represents <0.01% of the regional BDMPS autumn migration population and thus the WT+1km area is considered to have negligible importance as a foraging area for this population.

Behaviour

168. The maps showing the distribution of records shows that great skua were approximately evenly spread over the Survey Area (Fig. 8).

169. On average, 9% of great skuas estimated to be present were in flight, the remainder were sitting on the sea.

170. A total of 11% (n=9) of great skuas recorded in flight were estimated to be more than 20 m above the sea, suggesting that a only a small proportion of birds flying in the Project area would be at potential risk of collision with turbine rotors.

Likely origins

171. Tracking studies show that the maximum foraging range of breeding great skua is 219 km, and the MMFR is 86 km (Thaxter *et al.,* 2012). The closest breeding colonies are on Orkney, approximately 180 km to the north-west. Therefore it is possible that some of the birds seen in the Survey Area in the summer were foraging breeding adults from colonies in southern Orkney, in particular Hoy. However, it is considered more likely that most of the birds in the Survey Area in the summer are non-breeding immature birds originally from Orkney and Shetland but summering away from the breeding grounds.

172. The birds seen in the Survey Area in September and November are likely to be wandering autumn birds from colonies in Orkney and Shetland before they depart the region for their winter quarters (Wernham *et al.,* 2002).

Status and protection

173. The Scottish population has a favourable conservation status and has undergone a long term increase in numbers (Mitchell *et al*., 2004). Great skua has a relatively small global population size. The Scottish breeding population numbers approximately 9,600 pairs and represents around 60% of the global population (Mitchell *et al., 2*004).

174. Qualifying species of Hoy SPA Orkney and five SPAs in Shetland.

Vulnerability to windfarm impacts

175. Great skuas are considered to have very low vulnerability to vessel disturbance and displacement by structures and moderate vulnerability to offshore wind turbine collision risk (Table 3) and therefore collision rate modelling has been undertaken for this species (Caloo 2014b Annex 2 to Technical Report).

Relevance to Project

176. Concerns are likely to be low as this species is scarce in the WT+1km area. This species is relatively tolerant of disturbance but has a small potential for collision mortality as some flight activity may be at the same height as turbine rotors. Although the species has a favourable conservation status, its small population size and low background mortality rate will increase its sensitivity to additional mortality.

177. Rated as low priority.

Information gaps

178.It would be desirable to know the breeding status of birds using the Survey Area in the breeding season. However, this information gap does not limit the undertaking of a robust impact assessment.

Herring gull

Overview

179.Herring gulls were regularly present in the Survey Area in small numbers in the summer and moderate numbers in the winter. A high proportion of birds seen were in flight (Table 16) and some were associating with fishing vessels. This species regularly flies at the height of wind turbine rotors and is therefore considered to have moderate sensitivity to offshore windfarms. There are large breeding and wintering populations in the region.

Colony-attendance/summer period

180.Based on the MMFR (plus approximately 10%) and the Seabird 2000 census results (Mitchell *et al.,* 2004) the regional population consists of 25,474 adults (based on Apparently Occupied Nests multiplied by 2). The actual number of herring gulls present in this defined region during the breeding season is likely to be substantially greater than this figure because of the presence of immature birds.

181.Approximately 73% of the herring gull that were aged during the colony-attendance/summer period were adults and the rest were immatures or juveniles (Table 17).

182.The mean estimated number of herring gulls present in the Survey Area during the colony-attendance/summer period was 9 birds and the peak estimated number was 65 (Table 16). After accounting for the proportion of immature (non-breeding) birds these estimates represent approximately 0.03% and 0.2% of the assumed regional adult breeding population.

183.Based on the density in the Survey Area, the estimated mean number and 95% UCL of herring gulls in the WT+1km was 1 bird and 1 bird respectively. These numbers represent well below 0.01% of the regional breeding population and thus the WT+1km area is considered to have negligible importance as a foraging area for this population.

Table 16. Herring gull average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Breeding	11	12	19	0.05	41%	0	1	1	100%	0.38	5	13
Winter	9	148	237	0.94	20%	9	12	17	78%	3.14	41	86
Turbines + 2 km												
Breeding	11	12	19	0.05	41%	1	2	3	100%	0.38	11	29
Winter	9	148	237	0.94	20%	20	28	40	78%	3.14	95	198
Turbines + 3 km												
Breeding	11	12	19	0.05	41%	1	3	5	100%	0.38	20	52
Winter	9	148	237	0.94	20%	36	50	70	78%	3.14	168	351
Survey Area												
Breeding	11	12	19	0.05	41%	4	9	17	100%	0.38	65	165
Winter	9	148	237	0.94	20%	114	160	224	78%	3.14	536	1,120
Refer to Caloo 2014d for: sample size, average and maximum density, CV, % flying (Tables 2a-c), average and maximum abundance and CLs for four different areas (Tables 4a-c, 5a-c, 6a-c and 7a-c).												

Table 17. Herring gull, age frequency

Season	% of aged birds			Sample size	% of on-effort birds not aged
	Adult	Juvenile	Immature		
Summer period (Apr-Aug)	72.9	8.3	18.8	48	33.8
Winter period (Sep-Mar)	64.9	10.3	24.8	536	15.7

Winter period

184. The mean number of herring gulls present in the Survey Area during the winter period was 160 birds (Table 16). This represents <0.1% of the estimated minimum non-breeding period population of 466,511 birds for the North Sea and Channel BDMPS region (Furness, 2014).

185. Based on the density in the Survey Area in the winter period, the estimated mean number of herring gulls in the WT+1km and 95%UCL of this mean was 12 individuals and 17 individuals respectively. These estimates both represent <0.01% of the assumed regional winter period population and thus the WT+1km area is considered to have negligible importance as a foraging area for this population.

186. Approximately 65% of the herring gulls that were aged in the winter period were adults and the remainder were immatures or juveniles (Table 17).

Behaviour

187. The maps showing the distribution of herring gull records shows that birds were approximately evenly spread over the Survey Area (Fig. 9).

188. All herring gulls seen in the summer period together with 78% of those present in the winter period were in flight, the remainder were sitting on the sea.

189. Approximately 64% of flying herring gulls were estimated to be above 15 m above the sea (Caloo 2014b), suggesting that a high proportion of birds flying in the WT+1 km area would be at relatively high risk of collision with turbine rotors.

Likely origins

190. Breeding herring gulls range moderate distances to forage; the MMFR is 61 km (Thaxter *et al., 2*013). The closest colonies are at those along the Buchan Ness to Collieston coast 22 km at closest and roof top colonies in Peterhead 20 km at closest. Using the MMFR plus 10% the regional breeding population stretches west to colonies at Banff and south to Fowlsheugh. Although the latter lies slightly out with the foraging range definition used (by about 10 km) it is considered likely that birds from this relatively large colony occur in the Survey Area.

191. Outside the breeding season herring gull from east Scotland breeding colonies show a mixture of sedentary behaviour and short to moderate distance southwards movements (Wernham *et al., 2*003). The birds seen in the Survey Area from August onwards are likely to originate from colonies throughout eastern and northern Scotland. From November onwards these will be joined by birds from northern Scandinavia (Wernham *et al.,* 2002).

Status and protection

192. The Scottish population has an unfavourable conservation status on account of a long term decline. It is has declined by 58% over the past 25 years, equating to an average decline rate of 3.4% per annum (SNH, 2012; Mitchell *et al*., 2004). This decline is linked to food supply and changes in human activities, such as fishing and refuse management (Mitchell *et al*., 2004). Herring gull is on the BOCC Red List (Eaton, 2009) and is a UK BAP species.

193. Qualifying species of Buchan Ness to Collieston SPA, Troup, Pennan and Lion's Head, Fowlsheugh SPA and East Caithness Cliffs SPA.

Vulnerability to windfarm impacts

194. Herring gulls are considered to have very low vulnerability to vessel disturbance and displacement by structures (Table 3). However, herring gull are considered to have a relatively high vulnerability to collision risk because they commonly fly at the height of offshore wind turbines (Furness, Wade, & Masden, 2013) and therefore collision rate modelling has been undertaken for this species (Caloo 2014b Annex 2 to Technical Report).

Relevance to Project

195. Rated moderate priority because this species has potential for collision risk and has a poor conservation status, although the numbers using the WT+1km area are very low in the context of regional populations.

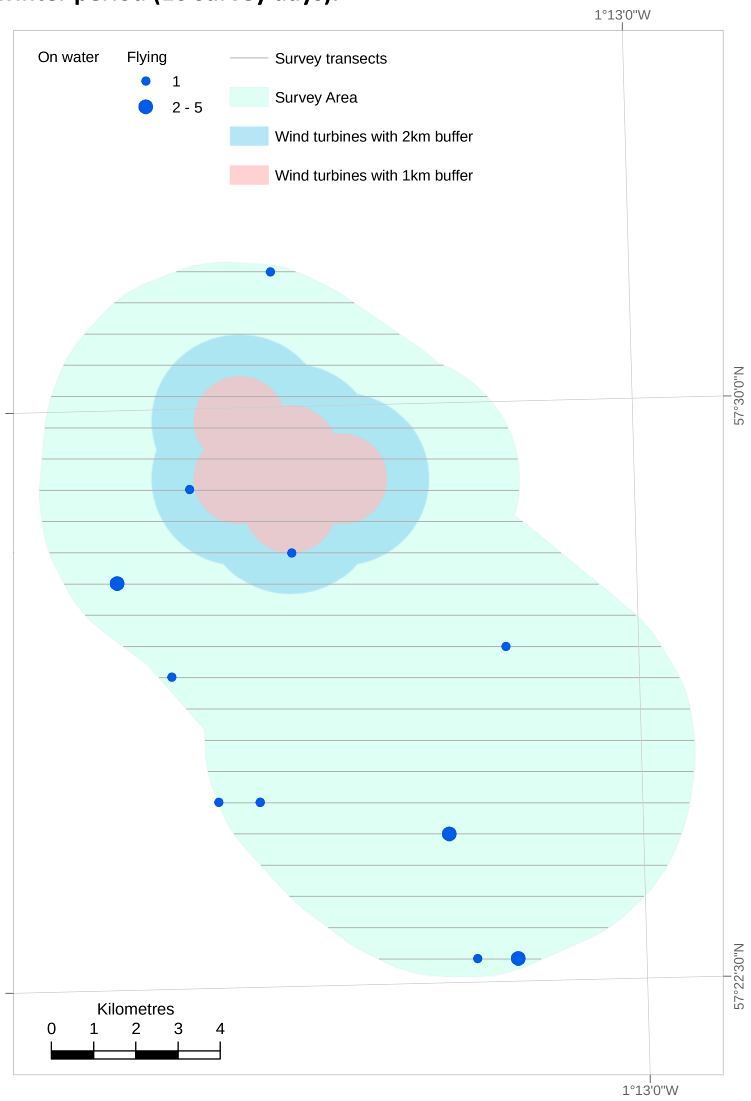
Information gaps

196. None of importance.

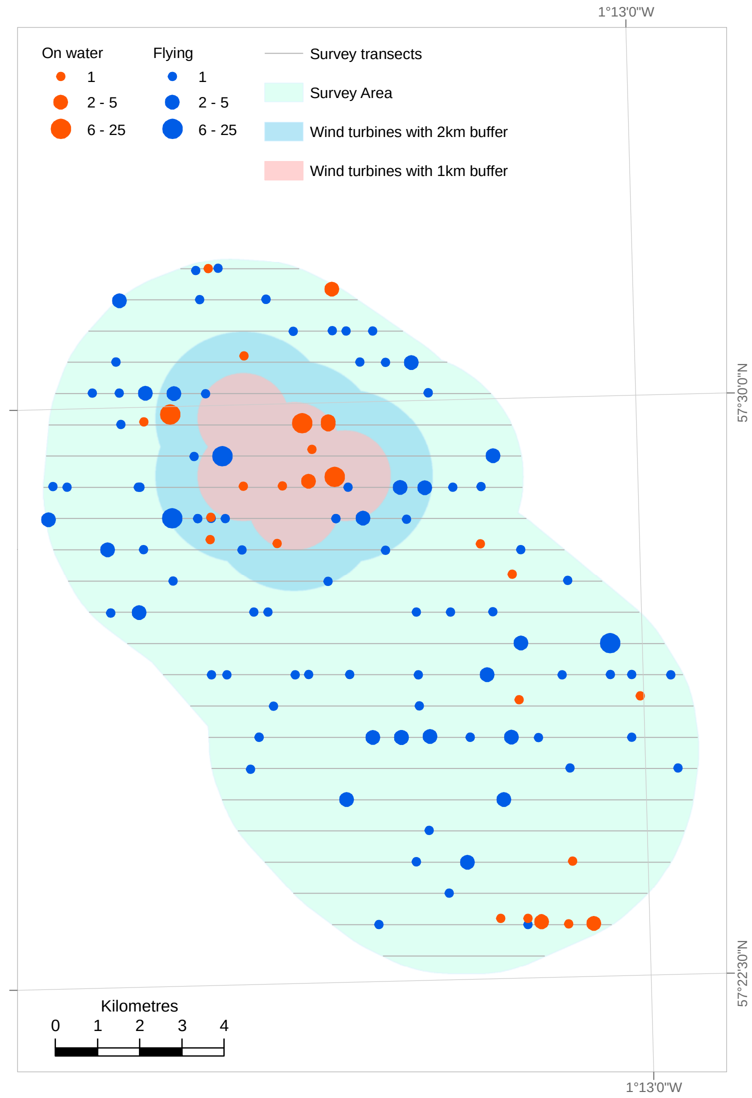
Comparison with additional 2014 summer surveys

197. Very low densities of herring gull were recorded during July to September in both years (Tables 3b and 6b in Caloo 2013c Annex 3 to Technical Report). No birds were recorded during the August surveys in either year. During the four September surveys across the two years, never more than one bird was recorded. One to four records during the three July 2014 surveys compared to the 0 to 2 records during the two July 2013 surveys.

Fig. 9. Distribution and abundance of herring gulls recorded during ESAS surveys between June 2013 and May 2014 for a) the breeding season (10 survey days, and b) the winter period (10 survey days).



a) Colony-attendance season



b) Winter period

Great black-backed gull

Overview

198.Great black-backed gulls were regularly present in the Survey Area, with small numbers of mainly immature non-breeding birds present in the summer months and moderate numbers of all age classes in the winter. A high proportion of birds seen were in flight (Table 18) and some were associating with fishing vessels. This species regularly flies at the height of wind turbine rotors and are therefore considered to have moderate sensitivity to offshore windfarms. Great blacked-backed gull breed in only small numbers in the region but much larger numbers occur in winter.

Table 18. Great black-backed gull average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Breeding	11	8	11	0.03	59%	0	0	1	100%	0.26	3	11
Winter	9	173	195	0.82	10%	9	11	13	50%	2.45	32	43
Turbines + 2 km												
Breeding	11	8	11	0.03	59%	0	1	2	100%	0.26	8	25
Winter	9	173	195	0.82	10%	21	25	29	50%	2.45	74	99
Turbines + 3 km												
Breeding	11	8	11	0.03	59%	1	2	4	100%	0.26	14	44
Winter	9	173	195	0.82	10%	37	44	52	50%	2.45	131	176
Survey Area												
Breeding	11	8	11	0.03	59%	2	5	13	100%	0.26	45	141
Winter	9	173	195	0.82	10%	118	140	165	50%	2.45	418	562
Refer to Caloo 2014d for: sample size, average and maximum density, CV, % flying (Tables 2a- c), average and maximum abundance and CLs for four different areas (Tables 4a-c, 5a-c, 6a-c and 7a-c).												

Table 19. Great black-backed gull age frequency.

Season	% of aged birds			Sample size	% of on-effort birds not aged
	Adult	Juvenile	Immature		
Breeding season (Apr-Aug)	8	0	92	50	36.4
Winter period (Sep-Mar)	59.4	18.3	22.2	387	3.5

Colony-attendance/summer period

199.The defined regional breeding population based on the Seabird 2000 census results (Mitchell *et al.,* 2004) is 140 adults (based on Apparently Occupied Nests multiplied by 2). The actual number of great black-backed gulls present in this defined region during the breeding season is likely to be substantially greater than this figure because of the presence of immature birds.

200.Only 8% of the great-black backed gulls present between April and September were adults and the rest were immatures (Table 19).

201.The mean estimated number of great black-backed gulls present in the Survey Area during the colony-attendance/summer period was 5 birds and the peak estimated number was 45 (Table 18). After accounting for the proportion of immature (non-breeding) birds these estimates represent 0.3% and 2.6% of the assumed regional adult breeding population.

202.Based on the density in the Survey Area, the estimated mean number of great black-backed gulls in the WT+1km area during the breeding season was <1 bird (all age classes). The 95% upper confidence limit of this mean is 1.0. After adjusting for the proportion of presumed immatures (i.e., birds not in adult plumage), the estimated mean number of adults present at these times of year was 0.05% of the regional breeding population of 140 adults (Mitchell *et al.,* 2004) and thus the WT+1km area is considered to have negligible importance as a foraging area for the regional breeding population.

Winter period

203.The mean number of great black-backed gulls present in the Survey Area during the winter period was 140 birds (Table 18). This represents 0.15% of the estimated minimum non-breeding period population of 91,399 birds for the North Sea BDMPS region (Furness, 2014).

204.Based on the density in the Survey Area in the winter period, the estimated mean number of great black-backed gulls in the WT+1km area was 11 birds. The 95%UCL of this mean was 13 birds. These estimates both represent 0.01% of the assumed regional winter period population thus the WT+1km area is considered to have negligible importance as a foraging area for the population.

205.Approximately 60% of the great black-backed gulls that were aged in the winter period were adults and the remainder were immatures or juveniles (Table 19).

Behaviour

206.The maps of the distribution maps of great black-backed gull records show that birds were approximately evenly spread over the Survey Area (Fig. 10).

207.On average, 65% of great black-backed gulls estimated to be present were in flight, the remainder were sitting on the sea.

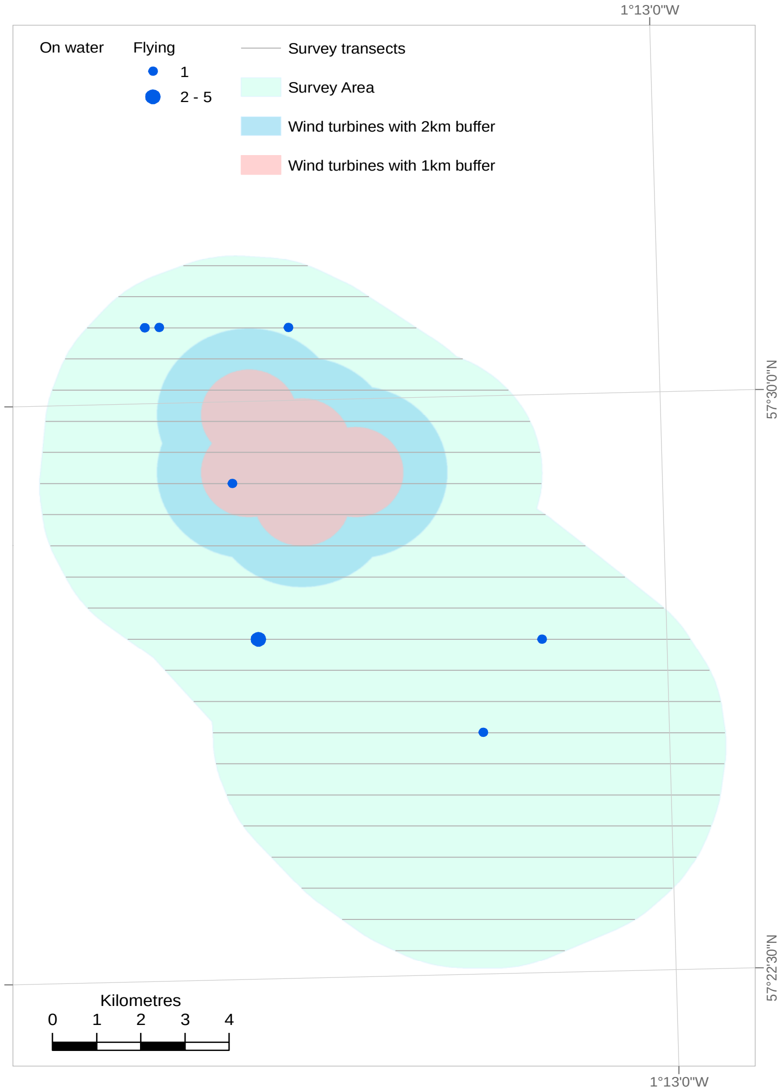
208.Approximately 56% of flying great black-backed gulls were estimated to be above 15 m above the sea (Caloo 2014b), suggesting that a high proportion of birds flying in the WT+1 km area would be at relatively high risk of collision with turbine rotors.

Likely origins

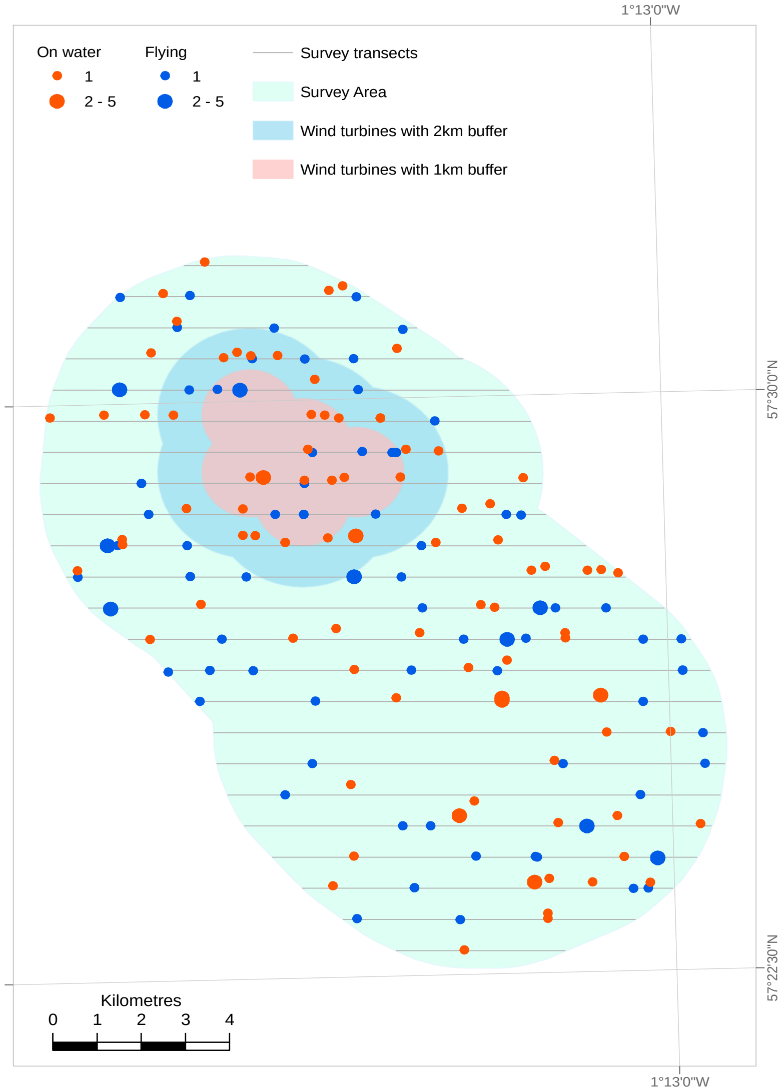
209.Breeding great-black backed gulls range over relatively small distances (up to 40 km) to forage, though this is based on only a small sample size of tracked birds (Ratcliffe *et al*., 2000). Based on this distance the regional population is defined as the small numbers breeding on the Buchan coast within the Buchan Ness to Collieston SPA.

210.A total of 87.5% of the birds seen in the Survey Area in the breeding season were immature birds based on plumage (Table 19) and these may originate from colonies outside the region, particularly those further north in Scotland where this species is much more numerous. For example, there are around 17,000 breeding adults in Caithness, Orkney and Shetland (Mitchell *et al*., 2004)

Fig. 10. Distribution and abundance of great black-backed gulls recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (10 survey days), and b) the winter period (10 survey days).



a) Colony attendance period



b) Winter period

211.Outside the breeding season great-black backed gulls from east Scotland breeding colonies show a mixture of sedentary behaviour and short to moderate distance southwards movements (Wernham *et al.,* 2002). The birds seen in the Survey Area from August onwards are likely to originate from colonies throughout eastern and northern Scotland. From November onwards these will be joined by birds from northern Scandinavia (Wernham *et al.,* 2002).

Status and protection

212.The Scottish population has an unfavourable conservation status on account of a long term decline. It is has declined by 53% over the past 25 years, equating to an average decline rate of 3.0% per annum (SNH 2012, Mitchell *et al*., 2004) The decline has been linked to food supply and changes in human activities -

213.Qualifying species of East Caithness Cliffs, Calf of Eday SPA, Copinsay SPA, Hoy SPA and North Rona and Sule Sgeir SPA.

Vulnerability to windfarm impacts

214.Great black-backed gulls are considered to have very low vulnerability to vessel disturbance and displacement by structures (Table 3). However, they are considered to have a relatively high vulnerability to collision risk because they commonly fly at the height of offshore wind turbines (Furness, Wade, & Masden, 2013) and therefore collision rate modelling has been undertaken for this species (Caloo, 2014b Annex 2 to Technical Report).

Relevance to Project

215.Although the numbers of great black-backed gull using the WT+1km area are low in the context of the regional population size, this species is rated as moderate priority because of the potential for collision strikes with offshore wind turbines and the species' poor conservation status.

Information gaps

216.It would be desirable to know -what proportion of the birds that are that are present in the breeding season and have adult breeding plumage are actively breeding, however this information gap is not needed to undertake a robust impact assessment.

Comparison with additional 2014 summer surveys

217.Very low densities of great black-backed gull were recorded during July to September in both years (Table 3c and 6c in Caloo 2014c Annex 3 to Technical Report).

Kittiwake

Overview

218.Kittiwakes were regularly present in the Survey Area in moderate numbers in the summer and smaller numbers in the winter. A high proportion of birds seen were in flight (Table 20). This species regularly flies at the height of wind turbine rotors and are therefore considered to have moderate sensitivity to offshore windfarms. Large numbers of kittiwakes breed in eastern Scotland but they are undergoing rapid decline.

Colony-attendance period

219.Kittiwakes breeding in Scotland are undergoing rapid decline, at an average rate of -4.2% per annum (derived from SNH, 2012). Thus in the 14-year period since the Seabird 2000 census numbers will have declined by approximately 45%. Therefore the current regional breeding population is assumed to be the number estimated by Seabird 2000 census (133,528 adults) multiplied by 0.55, which is 73,440 adults. The actual number of kittiwakes present in this defined region during the breeding season is likely to be greater than this figure because of the presence of immature birds. However, poor breeding success in recent years (a feature of the decline) means that relatively few immatures are to be expected, as transpired in survey results.

Table 20. Kittiwake average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Breeding	11	371	2165	6.19	19%	58	81	112	33%	43.55	568	922
Winter	9	44	54	0.21	20%	2	3	4	83%	1.10	14	24
Turbines + 2 km												
Breeding	11	371	2165	6.19	19%	135	187	258	33%	43.55	1,314	2,131
Winter	9	44	54	0.21	20%	4	6	9	83%	1.10	33	56
Turbines + 3 km												
Breeding	11	371	2165	6.19	19%	239	331	457	33%	43.55	2,324	3,770
Winter	9	44	54	0.21	20%	8	11	16	83%	1.10	59	99
Survey Area												
Breeding	11	371	2165	6.19	19%	764	1,056	1,460	33%	43.55	7,425	12,044
Winter	9		54	0.21	20%	25	35	50	83%	1.10	188	315
Refer to Caloo 2014d for: sample size, average and maximum density, CV, % flying (Tables 2a-c), average and maximum abundance and CLs for four different areas (Tables 4a-c, 5a-c, 6a-c and 7a-c).												

Table 21. Kittiwake, age frequency

Season	% of aged birds			Sample size	
	Adult	Juvenile	Immature		
Colony attendance (April to August)	98	0.1	0.9	2112	
Winter (Sept. to March)	95.3	4.1	0.6	172	

220. A total of 98% of the kittiwakes that were aged during the colony-attendance period were adults and the rest were immatures (Table 21). No attempt has been made to correct for the presence of immatures in the evaluation of the site's importance to breeding birds above.

221. The estimated mean number of kittiwakes present in the Survey Area during the colony-attendance period (April to August) was 1,056 birds and the peak estimated number was 7,425. (Table 20). These estimates represent 1.4% and 10% respectively of the assumed regional breeding population of 73,440 adults.

222. Based on the density in the Survey Area, the estimated mean number of kittiwakes during the breeding season (April to August) in the WT+1km area was 81 individuals (all age classes). The 95% upper confidence limit of this mean is 112 individuals. These numbers represent 0.1% and 0.2% respectively of the regional breeding population of 73,440 adults and thus the WT+1km area is considered to have low importance as a foraging area for the regional breeding population.

Winter period

223.The mean number of kittiwakes present in the Survey Area during the winter period (September to March) was 35 and the peak estimated number was 188 birds (Table 20). These estimates both represent <0.1% of the estimated minimum non-breeding period population of 627,816 birds for the North Sea BDMPS region (Furness, 2014).

224.Based on the density in the Survey Area in the autumn and winter period (September to March), the estimated mean number of kittiwakes in the WT+1km area was 3 individuals. The 95% upper confidence limit of this mean is 4 individuals. These numbers represent <0.01% winter/spring migration BDMPS population of 627,816 birds for the North Sea region (Furness, 2014) and thus the WT+1km area is considered to have negligible importance as a foraging area for the BDMPS North Sea region autumn and winter population.

Behaviour

225.The maps showing the distribution of records shows that birds were approximately evenly spread over the Survey Area (Fig. 11a, b and c).

226.Between 33% and 83%, depending on season, of kittiwakes in the Survey Area were in flight, the remainder were sitting on the sea (Table 20).

227.Approximately 31% of flying kittiwakes were estimated to be above 15 m above the sea (Caloo 2013b), suggesting that a moderate proportion of birds flying in the WT+1 km area would be at risk of collision with turbine rotors.

228.During the colony-attendance period there was a strong tendency for kittiwake flights to be orientated along a roughly W – E orientations (Fig. 12). This possibly indicates strong connectivity to the Bullars of Buchan and nearby colonies, the closest by far to the Survey Area.

Fig. 12. Kittiwake flight directions (%) recorded during ESAS surveys between June 2013 and May 2014. (n = number of records).

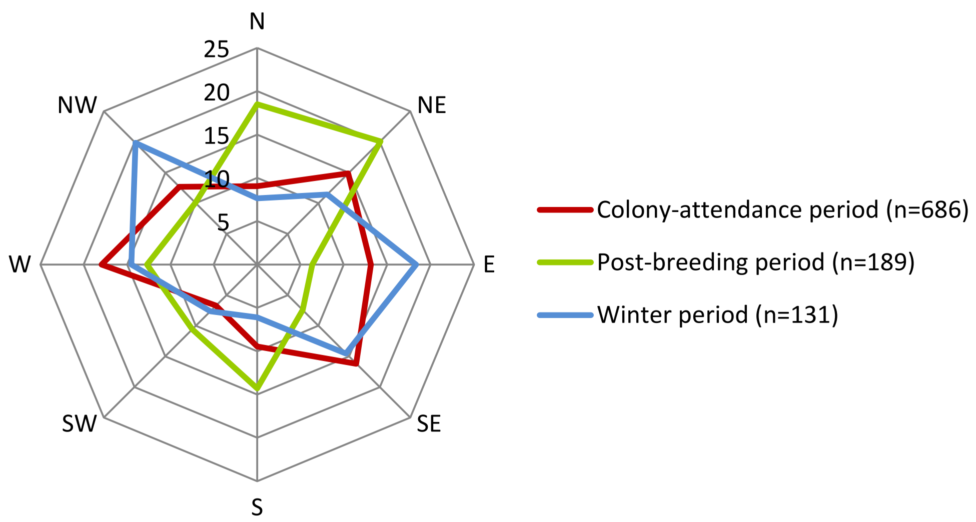
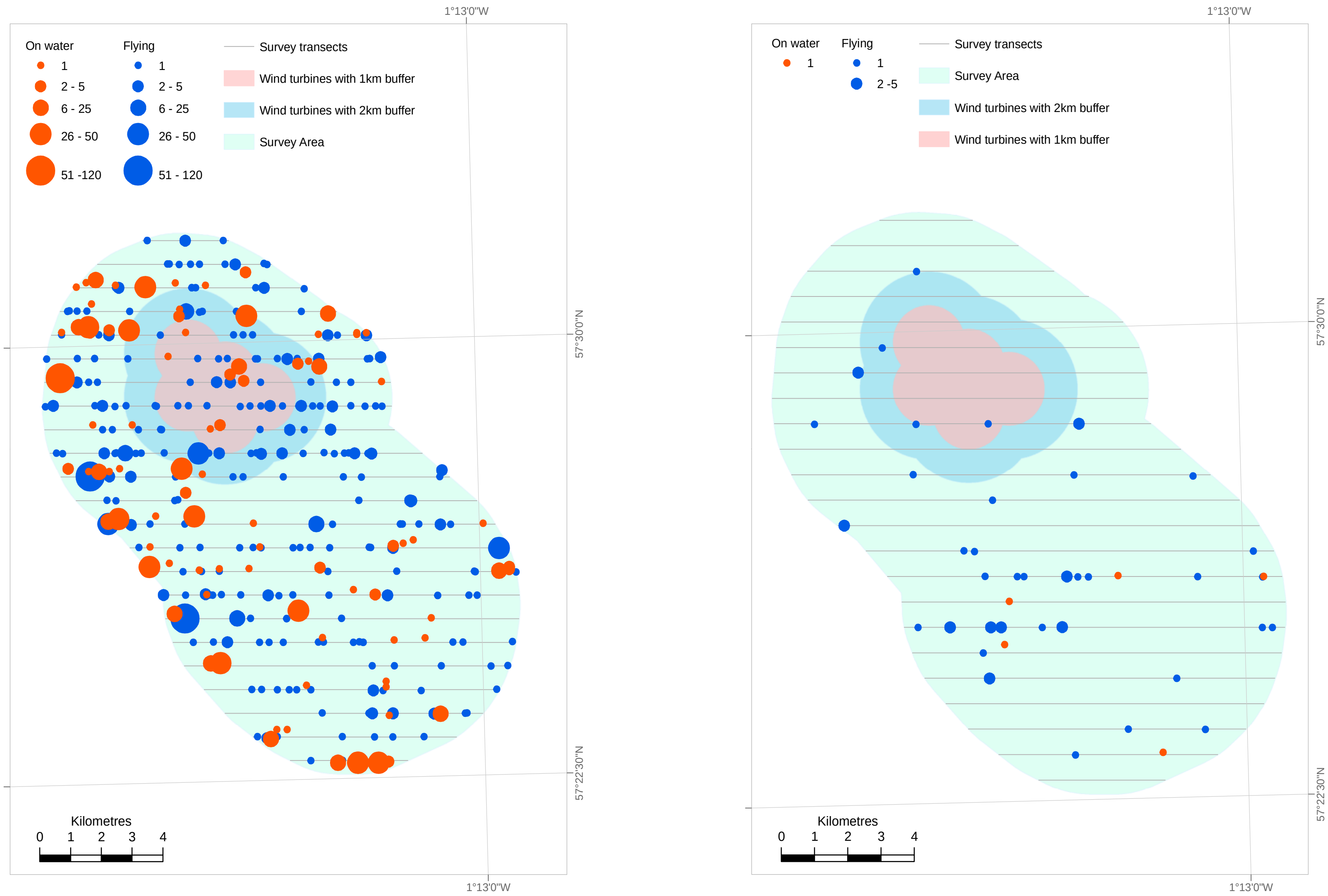


Fig. 11. Distribution and abundance of kittiwakes recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (10 survey days) and b) the autumn/winter period (10 survey days).



a) Colony-attendance period

b) Winter period

Likely origins

229.Breeding kittiwakes range moderate distances to forage; the MMFR is 60 km (Thaxter *et al., 2*013). The closest colonies are those along the Buchan Ness to Collieston 22 km at closest, Troup, Pennan and Lion's Heads SPA 54 km at closest and Fowlsheugh 74 km at closest. GPS tracking tags fitted to kittiwakes at Copinsay and Muckle Skerry Orkney show that Orkney birds occasionally forage off the Buchan coast (FAME website). Tracking studies of kittiwakes breeding at Fowlsheugh shows that birds from this colony may occasionally forage in the Survey Area. The regional breeding population is therefore defined as far west as colonies between Rosehearty and Bay of Cullen, and as far south as the large Fowlsheugh colony.

230.Outside the breeding season kittiwakes range very widely (Wernham *et al.,* 2002). The birds seen in the Survey Area from September onwards, and possibly during August also, are likely to originate from any of the colonies in eastern and northern Scotland, and overseas colonies in particular those in Norway.

Status and protection

231.The Scottish population has an unfavourable conservation status on account of a long term decline. It has declined by approximately 66% over the past 25 years, equating to an average decline rate of 4.2% per annum (SNH 2012, Mitchell *et al*., 2004). The decline is linked to food supply and sea temperature changes (JNCC, 2014).

232.Qualifying species of Buchan Ness to Collieston SPA, Troup, Pennan and Lion's Heads SPA, Fowlsheugh SPA and East Caithness Cliffs. Also a qualifying species at several SPAs in Orkney and Forth Islands SPA, but all these are further away than the maximum foraging distance of birds attending breeding colonies.

Vulnerability to windfarm impacts

233.Kittiwakes are considered to have very low vulnerability to vessel disturbance and displacement by structures (Table 3). However, they are considered to have a relatively high vulnerability to collision risk because they commonly fly at the height of offshore wind turbines (Furness *et al.* 2013) and therefore collision rate modelling has been undertaken for this species (Caloo 2014b Annex 2 to Technical Report).

Relevance to Project

234.Although the numbers of kittiwake using the WT+1km area are low in the context of the regional population size, this species is rated as moderate priority because of the potential for collision strikes with offshore wind turbines and the species' poor conservation status.

Information gaps

235.None of importance.

Comparison with additional 2014 summer surveys

236.During the two July surveys in 2013 kittiwake densities varied from 0.64 to 0.85 birds/km^2 with a mean across the two surveys of 0.74 birds/km^2 (Tables 3d and 6d in Caloo 2013c Annex 3 to Technical Report). In 2014, across the three surveys in the same month densities varied from 0.36 birds/km^2 to 3.85 birds/km^2, with a mean of 2.33 birds/km^2.

237.On the two surveys on consecutive days in early August 2013 (5th and 6th) densities of 4.7 birds/km^2 and 42.1 birds/km^2 were recorded. On the single survey in early August 2014 (5th) a density of 14.3 birds/km^2 was recorded (Tables 3d and 6d in Caloo 2013c Annex 3 to Technical Report). There were no surveys in late August during 2013, but the two surveys at this time of year in 2014 found densities of birds of 1.19 to 1.52 birds/km^2, suggesting densities declined rapidly through the month. By September in both years very few birds remained in the Survey Area, with single sightings in both years (Tables 3d and 6d in Caloo 2013c Annex 3 to Technical Report).

Arctic tern

Overview

238. Arctic terns are a strict summer migrant to Scotland and were recorded in highly variable numbers in July and August only (Table 22). The few July records may be locally breeding birds, but the high numbers of birds present in August are likely to be passage birds from breeding sites to the north of the region. Insufficient data was available to reliably calculate densities for the breeding season.

Table 22. Arctic tern average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	**Records**	**Birds**	**Density** (km^{-2})	**cv**	**95% LCL no. birds**	**Number of birds**	**95% UCL no. birds**	**% flying**	**Density** (km^{-2})	**Number of birds**	**95% UCL no. birds**
Turbines + 1km												
Post-breeding	2	17	233	3.81	57%	19	50	128	9%	7.40	97	255
Turbines + 2 km												
Post-breeding	2	17	233	3.81	57%	45	115	296	9%	7.40	223	589
Turbines + 3 km												
Post-breeding	2	17	233	3.81	57%	79	203	523	9%	7.40	395	1,042
Survey Area												
Post-breeding	2	17	233	3.81	57%	252	649	1,672	9%	7.40	1,263	3,327
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23a. c and e), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c). Alternative seasonality (August as part of the breeding season) is provided in Caloo 2014d, Tables 2 and 4-7).												

Colony-attendance period

239. The only Arctic terns seen during the colony-attendance period (May to July) were three 'not-in-transect' flying birds recorded in July outside the WT+1km area. Because these birds were not in-transect they do not contribute to the density calculated by the Distance Analysis. Three birds represent approximately 1% of the assumed regional breeding population of 276 adults.

Post-breeding/autumn passage

240. The estimated number of Arctic terns present in the Survey Area during the post-breeding/autumn passage period (August) was 649 birds and the peak estimated number was 1,263 (Table 22). These numbers represent 0.4% and 0.8% respectively of the passage migration BDMPS population of 163,930 birds for the North Sea region and Channel area (Furness, 2014)

241. Based on the density in the Survey Area, the estimated mean number of Arctic terns during the autumn migration period (August) in the WT+1km area was 50 individuals. The 95% upper confidence limit of this mean is 128 individuals. These numbers represent 0.03% and 0.08% respectively of the passage migration BDMPS population of 163,930 birds for the North Sea and Channel area (Furness, 2014) and thus the WT+1km area is considered to have negligible importance as a foraging area for the autumn passage population.

Behaviour

242.The maps showing the distribution of records shows that birds were approximately evenly spread over the Survey Area (Fig. 13).

243.Surprisingly, only 6% of the Arctic terns estimated to be present were in flight.

244.All flying Arctic terns recorded were estimated to be at or below 10 m above the sea, suggesting that this species would be at no risk of collision with turbine rotors.

Likely origins

245.The maximum foraging range of breeding Arctic tern is 30 km, and the MMFR is 24 km (Thaxter *et al., 2*013). The Survey Area lies at the expected outer foraging range limit of Arctic terns breeding on the Buchan coast; the closest colony is 28 km away at St Fergus Gas Terminal (138 AON in 2010). Although this colony may have been the source of the birds seen in the Survey Area in July, it is also likely that they were non-breeding birds or passage birds.

246.The Arctic terns seen in the Survey Area in August are likely to be autumn passage birds from breeding grounds further north in Scotland, and possibly Scandinavia and the Baltic also (Wernham *et al., 2*003)

Status and protection

247.The Scottish population has an unfavourable conservation status and has undergone a 72% decline in numbers since the mid 1980s, this long term decline linked to poor food supply and nest predation (SNH, 2012).

248.Qualifying species at ten SPAs in Orkney and Shetland, the closest of which is Pentland Firth Islands 167 km away.

249.Arctic tern is on Annexe 1 of the EU Birds Directive.

Vulnerability to windfarm impacts

250. Arctic terns are considered to have low vulnerability to vessel disturbance and displacement by structures (Table 3) and a moderate vulnerability to collision risk because they occasionally fly at the height of offshore wind turbines (Furness, Wade, & Masden, 2013). Collision rate modelling has been undertaken for this species (Caloo, 2014b Annex 2 to Technical Report) on account of its high nature conservation value.

251.On account of the above information, Arctic tern is considered to be a species of moderate priority to the EIA assessment. Nevertheless, although this species has potential for collision risk and has an unfavourable conservation status, the numbers using the Project area are very low in the context of regional populations.

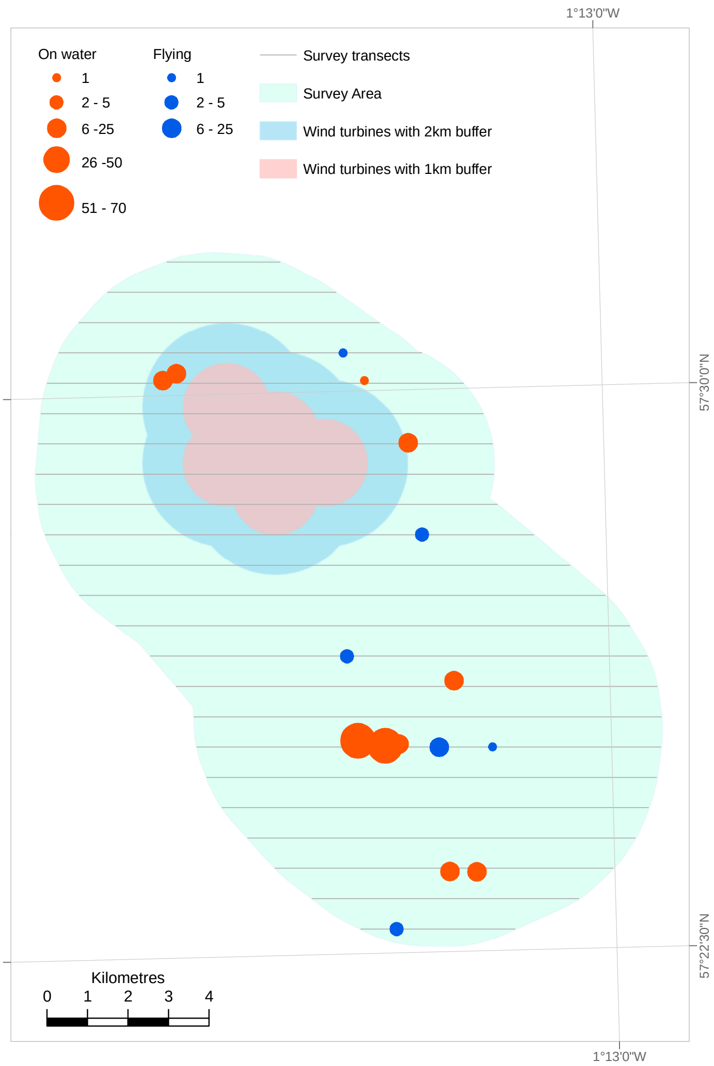
Relevance to Project

252.On account of the above information, Arctic tern is considered to be a species of moderate priority to the EIA assessment. Nevertheless, although this species has potential for collision risk and has an unfavourable conservation status, the numbers using the Project area are very low in the context of regional populations.

Information gaps

253. The size of the regional post-breeding/autumn passage population is poorly quantified and this makes it difficult to fully evaluate the importance of the area potentially affected by the Project. This information gap is does not limit the undertaking a robust impact assessment.

Fig. 13. Distribution and abundance of Arctic terns recorded during ESAS surveys between June 2013 and May 2014 (20 survey days).



Comparison with additional 2014 summer surveys

254.In early August 2013 two surveys were conducted on consecutive days, on the 5th and 6th August. The numbers of Arctic terns present changed greatly between the two days, with an estimate of 35 birds (0.21 birds/km^2) present in the Survey Area on the 5th, and 1,189 birds (6.97 birds/km^2) present on the 6th (Table 3e and 4e in Caloo 2013c Annex 2 to Technical Report). On the 5th August 2014, the number of birds estimated to be in the Survey Area was 36 (0.21 birds/km^2), all on the water. Outside early August, the only records are of single birds on the 28th July 2014 (in flight) and 10th September 2014 (on the water) respectively.

255.These results are consistent with an autumn passage of Arctic terns through the site primarily concentrated in early August, when the density of birds present can vary greatly even between consecutive days, but with occasional birds passing through the site from late July to early September.

Common guillemot

Overview

256.Common guillemots (hereafter just 'guillemots') were present in the Survey Area in large to very large numbers throughout the year, with the vast majority of birds seen being on the water (Table 23). Particularly large numbers were present in August 2013, the period after adults have departed colonies and may have accompanying chicks.

Colony-attendance period

257.The defined regional breeding population is based on the Seabird 2000 census results. (Mitchell *et al.,* 2004). After accounting for adults that were not attending the colonies at the time of counting (using a correction factor of x1.34, Mitchel *et al*., 2004), the size of the regional population for the colony-attendance part of the breeding season (April to July) is estimated at 200,851 adults. The actual number of birds present in this period is likely to be greater because of the presence of non-breeding immature birds.

258.The mean estimated number of guillemots present in the Survey Area during the colony-attendance period was 2,407 birds and the peak estimated number was 5,976 (Table 23). These estimates represent 1.2% and 2.9% respectively of the assumed regional breeding population of 200,851 adults.

259.Based on the density in the northern part of the Survey Area, the estimated mean number of common guillemots in the WT+1km and 95%UCL of this mean was 249 individuals and 295 individuals respectively. These numbers represent 0.1% and 0.14% of the regional breeding population and thus the WT+1km area is considered to have low importance as a foraging area for the regional breeding population during the colony-attendance period.

Chicks-on-sea period

260.For the reasons explained earlier, the assumed regional population during the chick-on-sea part of the guillemot breeding season (August) is based on a larger geographic area. Although this period is defined as August there were nevertheless chicks present on the July surveys (Table 24) however in early July at least these would have been recently fledged and therefore unlikely to have moved far from their breeding colony.

261.The mean estimated number of guillemots present in the Survey Area during the chick-on-sea period was 27,910 birds and the peak estimated number was 29,083 birds (Table 23). These estimates represent 4.8% and 5.0% respectively of the assumed regional post-breeding population of 576,185 adults for the chicks-on-sea stage of the breeding season. The estimated maximum number also represents approximately 1.6% of the national (UK) population, thus exceeding the 1% threshold (by convention) for national importance.

262.Based on the density in the whole Survey Area, the estimated mean number of guillemots during this stage of the breeding season in the WT+1km area was 2,136 individuals (all age classes). The 95% upper confidence limit of this mean is 3,169 individuals. These numbers represent approximately 0.4% and 0.6% respectively of the assumed regional post-breeding population of 576,185 adults for the chicks-on-sea stage of the breeding season (Mitchell *et al.,* 2004) and thus the WT+1km area is considered to have low importance as a foraging area for the regional population at this time of year.

263.The percentage of guillemots that were aged to be chicks during the months of July and August, together with abundance in these months, give a rough indication of the value the Survey Area and WT+1km as a nursery area for chicks (Table 24). In 2013 the percentage of chicks present in the Survey Area was low, being approximately 2.5% in early July declining to approximately 1% in early August. The percentage of chicks present in July 2014 (up to 18%) was much greater than in 2013, whereas approximately similar percentages were present in August. The chicks present in early July will have been recently fledged from colonies and therefore likely to have been of relatively local origin compared to chicks seen on later dates by when birds would have had time to disperse well away from their breeding colonies.

Table 23. Guillemot average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Colony attendance	9	790	1855	19.08	9%	210	249	295	12%	57.43	749	1,203
Chicks at sea	2	483	4668	163.70	24%	1,439	2,136	3,169	0%	170.57	2,225	3,938
Winter	9	306	440	3.04	16%	30	40	52	4%	9.35	122	212
Turbines + 2 km												
Colony attendance	9	790	1855	19.08	9%	485	575	683	12%	57.43	1,733	2,781
Chicks at sea	2	483	4668	163.70	24%	3,328	4,938	7,328	0%	170.57	5,145	9,105
Winter	9	306	440	3.04	16%	70	92	120	4%	9.35	282	490
Turbines + 3 km												
Colony attendance	9	790	1855	19.08	9%	859	1,018	1,208	12%	57.43	3,066	4,920
Chicks at sea	2	483	4668	163.70	24%	5,888	8,737	12,966	0%	170.57	9,104	16,110
Winter	9	306	440	3.04	16%	124	162	212	4%	9.35	499	868
Survey Area												
Colony attendance	9	1280	2708	14.12	7%	2,146	2,407	2,701	17%	35.05	5,976	8,341
Chicks at sea	2	483	4668	163.70	24%	18,808	27,910	41,418	0%	170.57	29,083	51,462
Winter	9	306	440	3.04	16%	397	518	676	4%	9.35	1,594	2,772
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23b, d and f, 24), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

Winter period

The mean estimated number of guillemots present in the Survey Area during the autumn/winter period (September to March) was 518 birds and the peak estimated number was 1,594 birds (Table 23). These estimates both represent <0.1% of the estimated minimum non-breeding period population of 1,617,306 birds for the North Sea and Channel BDMPS region (Furness, 2014). Incorporating the high densities recorded in September 2014 (mean 6.01 birds/km^2, peak 31.49 birds/km^2, see 'Comparison with additional 2014 summer surveys'; Table 6f in Caloo 2014c, Annex 3 of Technical Report) leads to a Survey Area mean of 1,025 and a peak estimate of 5,369 birds. These values represent 0.1% and 0.3% of the estimated non-breeding BDMPS population.

Table 24. The percentage of guillemots seen on survey visits that were chicks.

Survey visit	No of birds seen	% chicks
Year 1 (2013)		
08/07/2013	319	1.9%
09/07/2013	1073	2.6%
05/08/2013	3038	0.9%
06/08/2013	1673	1.0%
Year 2 (2014)		
01/07/2014	350	18.0%
08/07/2014	356	16.9%
28/07/2014	163	8.6%
05/08/2014	2073	1.6%
25/08/2014	1134	0.4%
26/08/2014	893	1.0%

264. Based on the density in the whole Survey Area in the winter period, the estimated mean number of guillemots in the WT+1km and 95%UCL of this mean was 40 individuals and 52 individuals respectively. These estimates both represent <0.01% of the assumed regional winter period population and thus the WT+1km area is considered to have negligible importance as a foraging area for the autumn and winter population. Using the adjusted density estimate including the September 2014 results in an estimated mean of 78 birds in the WT+1km (<0.01% of the winter population). Due to the way the separate analyses were carried out, there is no readily available value for the 95%UCL of this adjusted calculation. However, assuming that the peak winter density estimated for the Survey Area (31.49 birds/km^2) is valid for the WT+1km area, this represents a peak number of 409 birds or 0.03% of the assumed autumn/winter period BDMPS population. Using this approach does not alter the importance level of the WT+1km area during this time of year.

Behaviour

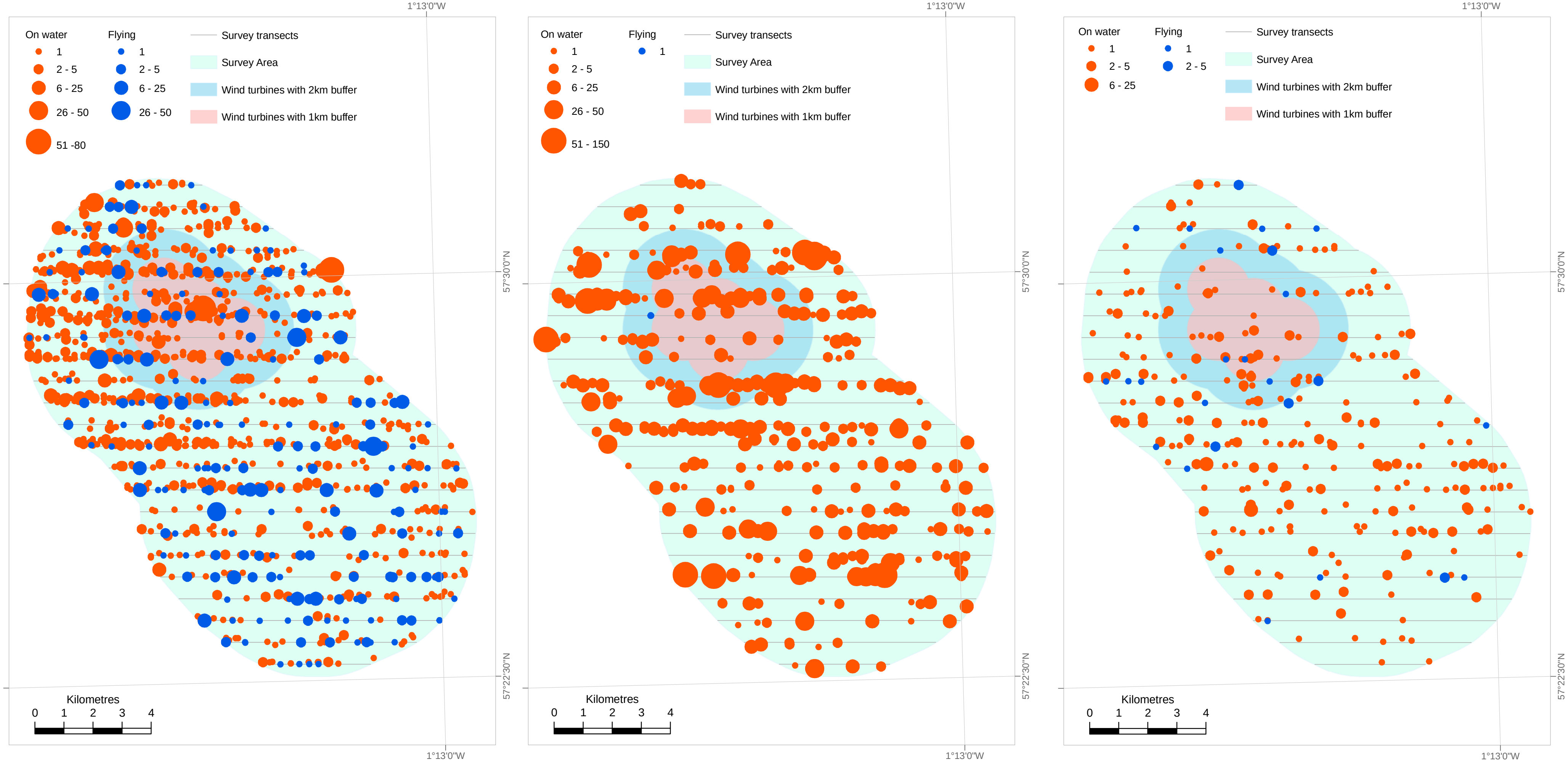
265. The maps showing the distribution of records shows that guillemots were approximately evenly spread over the Survey Area (Fig. 14a, b and c).

266. Between zero (chicks-on sea period) and 12% (colony-attendance period) of the guillemots estimated to be present were in flight, the remainder were sitting on the sea (Table 23).

267. All flying guillemots recorded were estimated to be at or below 5 m above the sea, suggesting that this species would be at no risk of collision with turbine rotors.

268. During the colony-attendance period there was a strong tendency for guillemot flights to be along a N/NW - S/SE orientation (Fig. 15). This possibly indicates connectivity to the large colonies in the Troup Head area, as this is the only colony within the maximum foraging range in N/NW direction and there are no colonies within foraging range in a S/SE direction. Surprisingly, E - W orientated flights in colony-attendance period were relatively scarce; flights along this orientation would be expected for birds breeding in the Bullars of Buchan and nearby colonies, the closest by far to the Survey Area.

Fig. 14. Distribution and abundance of common guillemots recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (8 survey days), b) the chicks-on-sea period (2 survey days) and c) the winter period (10 survey days).

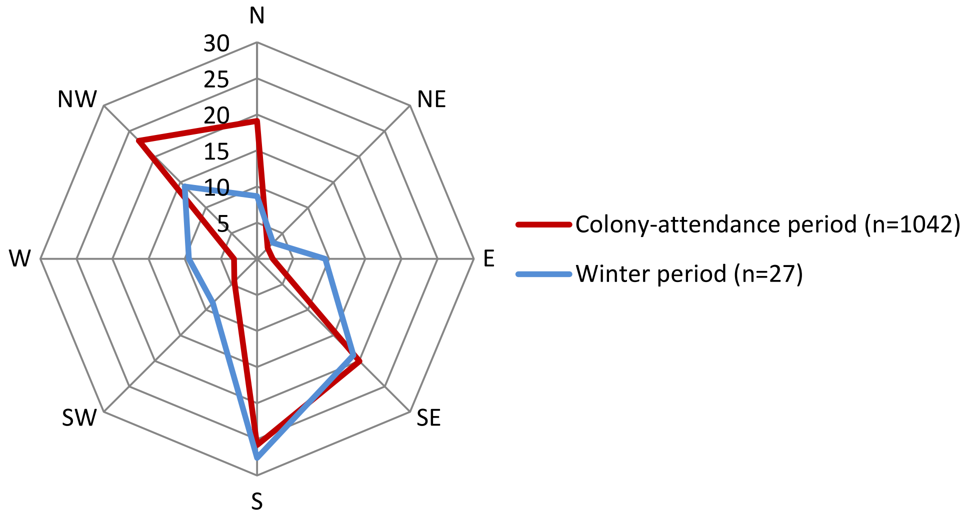


a) Colony-attendance period

b) Chicks-on-the-sea period

21. a) Winter period

Fig. 15. Guillemot flight directions (%) recorded during ESAS surveys between June 2013 and May 2014. (n = number of records).



Likely origins

270.Breeding guillemots travel moderate distances to forage; the maximum foraging distance is reported to be 135 km and the MMFR is 84 km (Thaxter *et al., 2*013). During the colony-attendance part of the breeding season the birds using the Project area are most likely to be from colonies along Buchan, Gordon, Aberdeenshire and Kincardine coasts. The regional population has thus been defined as colonies as far west as Troup Head, Pennan and Lion's Head, and as far south as colonies between Catterline and Inverbervie.

271.The birds present in the chicks-on-sea part of the breeding season (August), by when guillemots will have departed breeding colonies, are likely to comprise a mix of birds from the areas listed above and from further afield, in particular from colonies in Caithness and perhaps Orkney and Shetland also.

272.The birds seen in the Survey Area during the autumn and winter are likely to originate from any of the colonies in eastern and northern Scotland, and may also include birds from Scandinavia (Wernham *et al*., 2002; Furness, 2014).

Status and protection

273.The Scottish population has an unfavourable conservation status; it has shown moderate long-term decline amounting to -26% since 1986 (SNH, 2012; Mitchell *et al*., 2004). The decline is linked to food supply and sea temperature changes (JNCC, 2014).

274.Qualifying species at Buchan Ness to Collieston SPA, Troup, Pennan and Lion's Heads SPA, Fowlsheugh SPA and. Also a qualifying species at East Caithness Cliffs SPA, eleven SPAs in Orkney and Shetland and Firth Islands SPA; all these colonies are a further away from the Survey Area than the maximum foraging distance of breeding birds when attending a colony.

Vulnerability to windfarm impacts

275.Guillemots are considered to have moderate vulnerability to vessel disturbance (Table 3) (Furness *et al*., 2012); their vulnerability to disturbance is heightened during the chicks-on-sea part of the breeding season due to the presence of dependent chicks and because adults undergo complete wing moult at this time of year rendering them temporarily flightless. Guillemots have a low vulnerability to displacement by structures and collision risk (Table 3) (Furness *et al.* 2013).

Relevance to Project

276. The surveys show that the area potentially affected by the windfarm has disproportionately high value to guillemots during the colony attendance and chicks-on-sea periods (April to August), particularly during August. Concerns are likely to be moderate at these times due to the potential to displace birds from important foraging grounds. Guillemot is considered to be a species of moderate priority to the EIA assessment.

Information gaps

277. There is uncertainty whether very high densities of guillemots recorded in the Survey Area in August 2013 are a regular feature.

278. There is uncertainty over the full geographic extent of the breeding origins of the guillemots present in the chicks-on-sea stage of the breeding season, in particular whether they include birds from colonies in Orkney and Shetland.

279. These information gaps do not prevent the undertaking of a robust impact assessment.

Comparison with additional 2014 summer surveys

280. For guillemot (Tables 3f and 6f in Caloo 2014c Annex 2 to Technical Report) the density of birds recorded in July 2014 are similar to those recorded in July 2013. The density of birds recorded in August 2014, are much lower than those recorded in August 2013. The average density of birds across the three surveys in August 2014 is less than a third than that recorded in the same month during the previous year (51 birds/km^2 compared to 157 birds/km^2) (Table 6f in Caloo 2014c Annex 2 to Technical Report). Therefore, using the August 2013 estimates for the chicks-on-sea period in the assessment is considered particularly precautionary.

281. The densities of birds recorded during the two surveys in September 2014 were considerably higher than those recorded during the two surveys in September 2013. The average density of birds across the two September surveys in 2013 was only 2.1 birds/ km^2 compared to an average density of 30.85 birds/km^2 in 2014 (Table 6f in Caloo 2014c Annex 3 to Technical Report). Although elevated, the density of birds in September recorded in 2014 was still less than recorded in the previous month (average density of 31 birds/km^2 in September 2014 compared to 51 birds/km^2 in August 2014). Including the September 2014 density value in a dataset spanning October 2013 to March 2014 (Table E.3 in Caloo 2014a, Annex 2 to Technical Report) allows the calculation of a new winter period density. This yields a mean density of 6.01 birds/km^2, reflecting a Survey Area population of 1,025 birds and a WT+1km population of 78 birds during winter.

Razorbill

Overview

282. Razorbills were present in the Survey Area in moderate to very large numbers throughout the year, with the vast majority of birds seen being on the water (Table 25). Particularly large numbers were present in August 2013, the period after adults have departed colonies and may have accompanying chicks.

Colony-attendance period

283. The defined regional breeding population is based on the Seabird 2000 census results (Mitchell *et al.,* 2004). After accounting for adults that were not attending the colonies at the time of counting using a correction factor of x1.34 (Mitchel *et al*., 2004), the size of the regional breeding population is estimated at 11,312 adults. The actual number of razorbills present in the defined region during the breeding season is likely to be greater than this figure because of the presence of non-breeding immature birds.

Table 25. Razorbill average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	**Records**	**Birds**	**Density** (km^{-2})	**cv**	**95% LCL no. birds**	**Number of birds**	**95% UCL no. birds**	**% flying**	**Density** (km^{-2})	**Number of birds**	**95% UCL no. birds**
Turbines + 1km												
Colony attendance	9	94	209	2.33	15%	23	30	40	11%	11.98	156	243
Chicks at sea	2	269	1071	55.09	25%	476	719	1,085	0%	73.68	961	1,653
Winter	9	47	96	0.75	29%	6	10	16	7%	2.49	32	79
Turbines + 2 km												
Colony attendance	9	94	209	2.33	15%	53	70	93	11%	11.98	361	562
Chicks at sea	2	269	1071	55.09	25%	1,101	1,662	2,508	0%	73.68	2,223	3,821
Winter	9	47	96	0.75	29%	14	23	37	7%	2.49	75	182
Turbines + 3 km												
Colony attendance	9	94	209	2.33	15%	94	124	164	11%	11.98	639	995
Chicks at sea	2	269	1071	55.09	25%	1,949	2,940	4,437	0%	73.68	3,933	6,762
Winter	9	47	96	0.75	29%	25	40	65	7%	2.49	133	323
Survey Area												
Colony attendance	9	137	274	1.58	14%	212	269	343	12%	6.34	1,081	1,690
Chicks at sea	2	269	1071	55.09	25%	6,225	9,393	14,173	0%	73.68	12,562	21,599
Winter	9	47	96	0.75	29%	79	128	207	7%	2.49	424	1,031
Refer to Caloo 2014a for: sample size, average and maximum density, CV, % flying (Tables 23b, d and f, 24), average and maximum abundance and CLs for four different areas (Tables 25a-c, 26a-c, 27a-c and 28a-c).												

284. The mean estimated number of razorbills present in the Survey Area during the colony-attendance period was 269 birds and the peak estimated number was 1,081 (Table 25). These estimates represent 2.4% and 9.5% respectively of the assumed regional breeding population of 11,312 adults.

285. Based on the density in the northern part of the Survey Area, the estimated mean number of razorbills during the colony-attendance part of the breeding season in the WT+1km area was 30 individuals (all age classes). The 95% upper confidence limit of this mean is 40 individuals. These numbers represent 0.3% and 0.4% respectively of the regional population for the colony-attendance part of the breeding season of 11,312 adults (Mitchell *et al.,* 2004) and thus the WT+1km area is considered to have low importance as a foraging area for the regional breeding population.

Chicks-on-sea period

286. For the reasons explained earlier, the assumed regional population of razorbill during the chick-on-sea part breeding season (August) is based on a larger geographic area.

287. The mean estimated number of razorbills present in the Survey Area during the chicks-on-sea part of the breeding season (August) was 9,393 birds and the peak estimated number was 12,562 (Table 25). These estimates represent 15.1% and 20.2% respectively of the assumed regional population of 62,058 adults for the chicks-on-sea stage of the breeding season (Mitchell *et al.,* 2004). The maximum estimated number in the Survey Area in August 2013 also represents approximately 5.7% of the national population, thus comfortably exceeding the 1% threshold (by convention) for national importance. This shows that the Survey Area has (at least in August 2013) high importance as a foraging site.

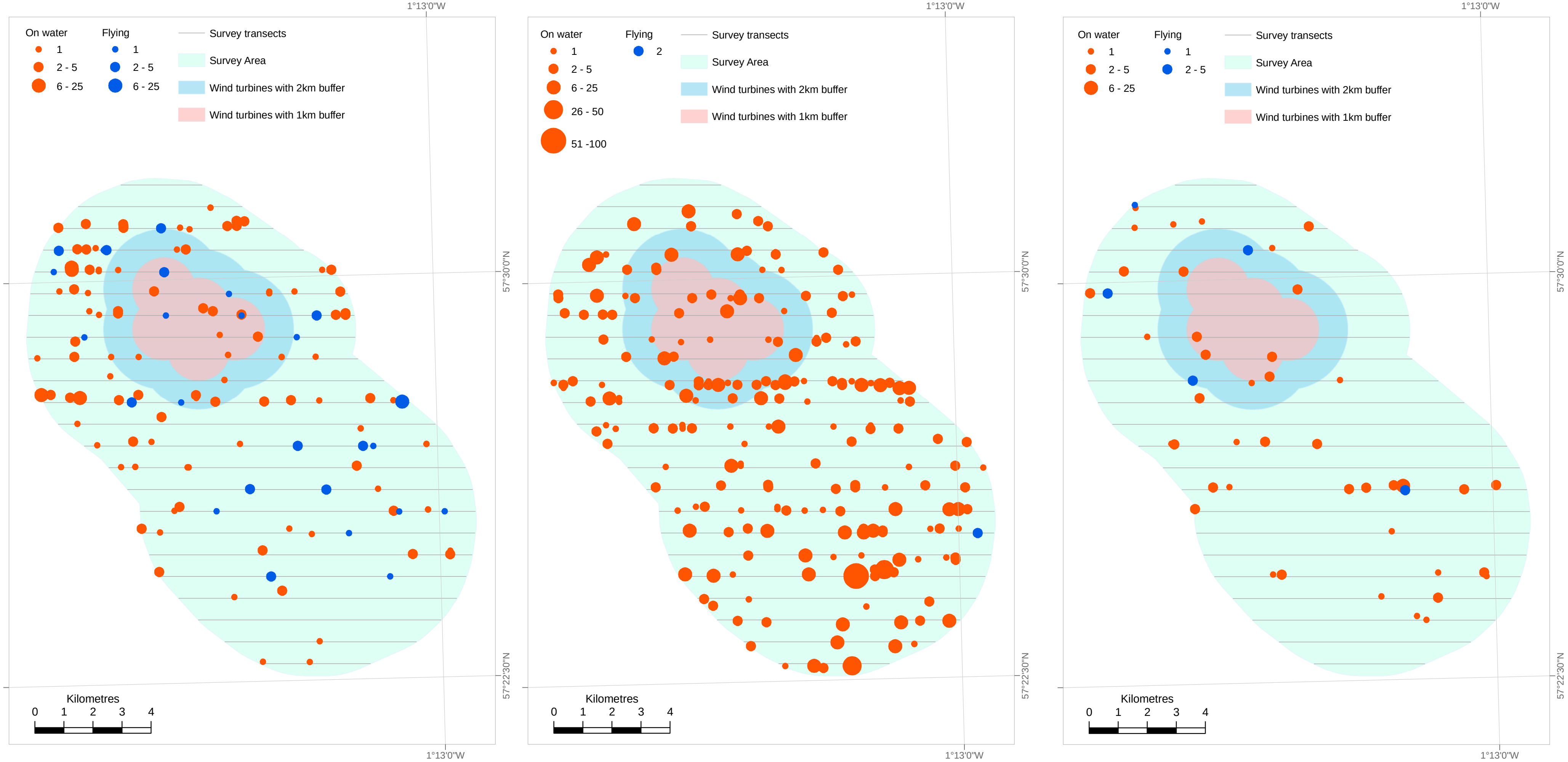
288. Based on the density in the whole Survey Area, the estimated mean number of razorbills in the WT+1km area during this period was 719 individuals (all age classes). The 95% upper confidence limit of this mean is 1,085 individuals. These numbers represent approximately 1.2% and 1.7% respectively of the assumed regional population of 62,058 adults for the chicks-on-sea stage of the breeding season (Mitchell *et al.,* 2004) and thus the WT+1km area is considered to have moderate importance as a foraging area for the regional population at this time of year.

Table 26. The percentage of razorbills seen on survey visits that were chicks.

Survey visit	No of birds seen	% chicks
Year 1 (2013)		
08/07/2013	37	18.9%
09/07/2013	32	9.4%
05/08/2013	534	6.0%
06/08/2013	587	2.4%
Year 2 (2014)		
01/07/2014	36	19.4%
08/07/2014	57	17.5%
28/07/2014	63	7.9%
05/08/2014	441	2.5%
25/08/2014	30	0%
26/08/2014	11	0%

289. The percentage of razorbills that were aged to be chicks during the months of July and August, together with abundance in these months, give a rough indication of the value the Survey Area and WT+1km as a nursery area for chicks (Table 26). There was a similar pattern in both 2013 and 2014; relatively high percentages (approximately 19%) of chicks were present in early July, dropping to a few percent by early August, and (in 2014 at least) to zero by late August. These changes, together with the variable numbers of birds present, suggest that there is considerable flux of birds using the Survey Area at this time of year. The chicks present in early July will have been recently fledged from colonies and therefore likely to have been of relatively local origin compared to chicks seen on later dates by when birds would have had time to disperse well away from their breeding colonies.

Fig. 16. Distribution and abundance of razorbills recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (8 survey days), b) the chicks-on-sea period (2 survey days and c) the autumn/winter period (10 survey days).



a) Colony-attendance period

b) Chicks-on-the-sea period

c) winter period

Winter period

291.The mean estimated number of razorbills present in the Survey Area during the winter period (September to March) was 128 birds and the peak estimated number was 424 birds (Table 25). These estimates represent <0.1% and 0.19% respectively of the estimated minimum non-breeding period population of 218,622 birds for the North Sea and Channel BDMPS region (Furness, 2014).

292.Based on the density in the Survey Area in the winter period, the estimated mean number of razorbills in the WT+1km and 95%UCL of this mean was 10 individuals and 16 individuals respectively. These estimates both represent <0.01% of the assumed regional winter period population.

Behaviour

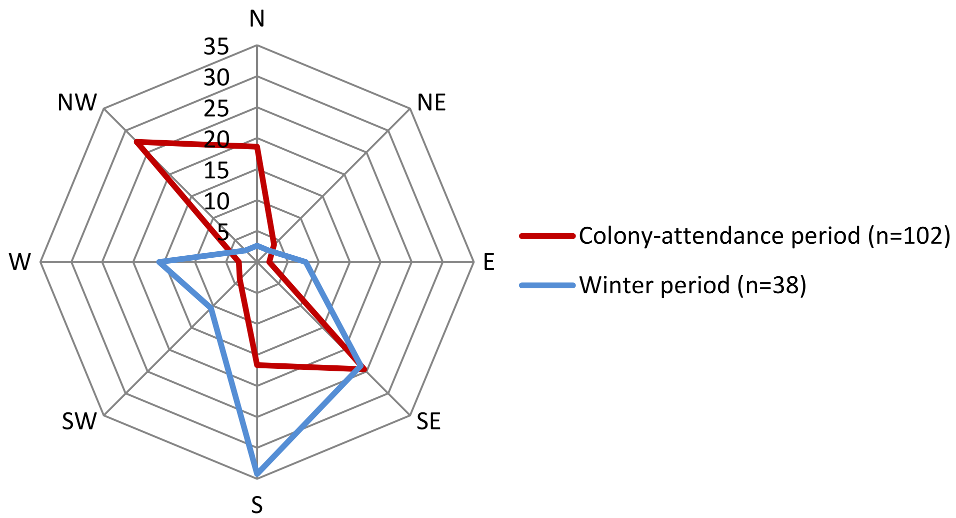
293.The maps showing the distribution of records shows that razorbills were approximately evenly spread over the Survey Area (Fig. 16a, b and c).

294.Between zero (chicks-on sea period) and 11% (colony-attendance period) of the razorbills estimated to be present were in flight, the remainder were sitting on the sea.

295.All flying razorbills recorded were estimated to be at or below 5 m above the sea, suggesting that this species would be at no risk of collision with turbine rotors.

296.During the colony-attendance period there was a strong tendency for razorbill flights to along a N/NW - S/SE orientation (Fig. 17). This possibly indicates connectivity to the large colonies in the Troup Head area, as this is the only colony within the maximum foraging range in N/NW direction and there are no colonies within foraging range in a S/SE direction. Surprisingly, E - W orientated flights in the colony-attendance period were very scarce; flights along this orientation would be expected for birds breeding at the Bullars of Buchan and nearby colonies, the closest by far to the Survey Area.

Fig. 17. Razorbill flight directions (%) recorded during ESAS surveys between June 2013 and May 2014. (n = number of records).



Likely origins

297.Breeding razorbills travel moderate distances to forage; the maximum foraging distance is reported to be 95 km and the MMFR is 49 km (Thaxter *et al.,* 2013). The closest colonies are at those along the Buchan Ness to Collieston coast 22 km at closest and Troup, Pennan and Lion's Head 54 km at closest and Fowlsheugh 74 km at closest and these colonies are likely to be the origin of birds seen in the Survey Area in the colony-attendance period.

298.The birds present in Survey Area in August, by when razorbills have departed breeding colonies, are likely to comprise a mix of birds breeding within the region in particular the colonies listed above and birds from further afield, in particular from colonies in Caithness and Orkney.

299.Razorbills from colonies in eastern Scotland typically overwinter several hundred kilometres to the south, in particular in the Bay of Biscay (Wernham *et al.,* 2002). The birds seen in the Survey Area from November onwards are likely to originate from overseas for example Faeroes, Iceland and Scandinavia.

Status and protection

300.There is uncertainty about recent population trends for Scottish breeding razorbill a due to low monitoring effort. Between 1986 and 2000 numbers showed a 13% increase. (SNH, 2012; Mitchell *et al*., 2004)

301.Qualifying species of Buchan Ness to Collieston SPA, Troup, Pennan and Lion's Heads SPA, Fowlsheugh SPA and. Also a qualifying species at East Caithness Cliffs SPA, eleven SPAs in Orkney and Shetland and Firth Islands SPA; all these colonies are a further away from the Survey Area than the maximum foraging distance of breeding birds when attending a colony.

Vulnerability to windfarm impacts

302.Razorbills are considered to have moderate vulnerability to vessel disturbance (Furness *et al*., 2012); their vulnerability to disturbance is heightened during the chicks-on-sea part of the breeding season due to the presence of dependent chicks and because adults undergo complete wing moult at this time of year rendering them temporarily flightless. Razorbills are considered to have low vulnerability to displacement by structures (Table 8.5) (Furness *et al*., 2012) and collision risk (Furness *et al*., 2013).

Relevance to Project

303.On account of the very high densities at times present in the chick-on-sea part of the breeding season, and vulnerability to disturbance at this time of the year razorbill is considered to be a species of high priority to the EIA assessment.

Information gaps

304.There is uncertainty whether very high densities of razorbills recorded in the Survey Area in August 2013 are a regular feature.

305.There is uncertainty over the full geographic extent of the breeding origins of the razorbills present in the chicks-on-sea stage of the breeding season, in particular whether they include birds from colonies in Orkney and Shetland.

306.These information gaps do not prevent the undertaking of a robust impact assessment.

Comparison with additional 2014 summer surveys

307.The density of razorbills during the three surveys in July 2014 was about twice as high as recorded in July 2013; estimates in July 2014 were between 2.2 and 3.6 birds/km^2 compared to 1.1 to 2.0 birds/km in July 2013 (Tables 3g and 6g in Caloo 2014c Annex 3 to Technical Report).

308.In August 2013 there were two surveys during early August (5th and 6th). Densities of 35 birds/km^2 and 71 birds/km^2 were recorded on these two surveys respectively, giving an average of 53 birds/km^2 (Table 3g in Caloo 2014c Annex 3 to Technical Report). During early August in 2014 there was only a single survey on the 5th which gave a density of 21 birds/km^2, which is less than half the average density for early August in 2013. During two surveys towards the end of August 2014 (25th and 26th) much lower densities were recorded, 1.5 and 0.5 birds/km^2 respectively, similar to that recorded in September. There were no surveys in late August 2013 with which to compare these results. Therefore, using the August 2013 estimates for the chicks-at-sea period in the assessment is considered particularly precautionary.

309. The results for the two surveys in September 2014 are very similar to those recorded in the same month during 2013, with densities of 0.85 and 1.55 birds/km^2 during the 2013 surveys (mean 1.2 birds/km^2, Table 6g) and 0.75 and 1.51 birds/km^2 (mean 1.1 birds/km^2) during the 2014 surveys.

310. Thus, these results suggest a period of elevated densities post-colony attendance in early August during both years, when the mean density of birds is approximately 37 birds/km^2 (i.e., average of mean of 53 birds/km^2 in 2013 and mean of 21 birds/km^2 in 2014). By September in both years, numbers had dropped to winter densities.

Puffin

Overview

311. Puffins were present in the Survey Area in moderate numbers in the spring and summer months but were scarce in the winter (Table 27).

Table 27. Puffin average and maximum density and abundance estimates for each season of the survey year (June 2013 to May 2014) derived from Distance Analysis. Values for the density coefficient of variation (cv) and 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) of abundance are also presented.

Season	Sample size			Average for season						Maximum for season		
	Surveys	Records	Birds	Density (km^{-2})	cv	95% LCL no. birds	Number of birds	95% UCL no. birds	% flying	Density (km^{-2})	Number of birds	95% UCL no. birds
Turbines + 1km												
Colony attendance	11	485	842	9.14	8%	103	119	138	3%	51.74	675	799
Post-breeding	2	117	246	6.52	-%	69	85	104	0%	9.83	128	164
Winter	9	133	263	1.6	12%	17	21	26	3%	0.45	6	16
Turbines + 2 km												
Colony attendance	11	485	842	9.14	8%	238	276	319	3%	51.74	1,561	1,847
Post-breeding	2	117	246	6.52	-%	161	197	241	0%	9.83	297	382
Winter	9	133	163	1.6	12%	39	48	59	3%	0.45	14	37
Turbines + 3 km												
Colony attendance	11	485	842	9.14	8%	421	488	564	3%	51.74	2,762	3,269
Post-breeding	2	117	246	6.52	-%	284	348	427	0%	9.83	525	675
Winter	9	133	263	1.6	12%	86	70	105	3%	0.45	24	65
Survey Area												
Colony attendance	11	855	1,441	7.97	7%	1,207	1,359	1,530	4%	39.63	6,758	7,934
Post-breeding	2	117	246	6.52	-%	907	1,111	1,362	0%	9.83	1,676	2,155
Winter	9	133	263	1.6	12%	223	273	335	3%	10.15	1,730	2,255
Refer to Caloo 2014d for: sample size, average and maximum density, CV, % flying (Tables 2a-c, 3), average and maximum abundance and CLs for four different areas (Tables 4a-c, 5a-c, 6a-c and 7a-c).												

Colony-attendance period

312. The defined regional breeding population based on the Seabird 2000 census results is 89,906 adults (Apparently Occupied Burrows multiplied by 2) (Mitchell *et al.,* 2004). The actual number of puffins present in the defined region during the breeding season is likely to be greater than this figure because of the presence of non-breeding immature birds.

313. The mean estimated number of puffins present in the Survey Area during the colony-attendance period was 1,359 birds and the peak estimated number was 6,758 (Table 27). These estimates represent 1.5% and 7.5% respectively of the assumed regional breeding population of 89,906 adults.

314. Based on the density in the Northern part of the Survey Area, the estimated mean number of puffins during the breeding season (April to August) in the WT+1km area was 119 individuals (all age classes). The 95%UCL of this mean is 138 individuals. These numbers represent 0.1% and 0.2% respectively of the regional breeding population of 89,906 adults and thus the WT+1km area is considered to have low importance as a foraging area for the regional breeding population.

Post-breeding period

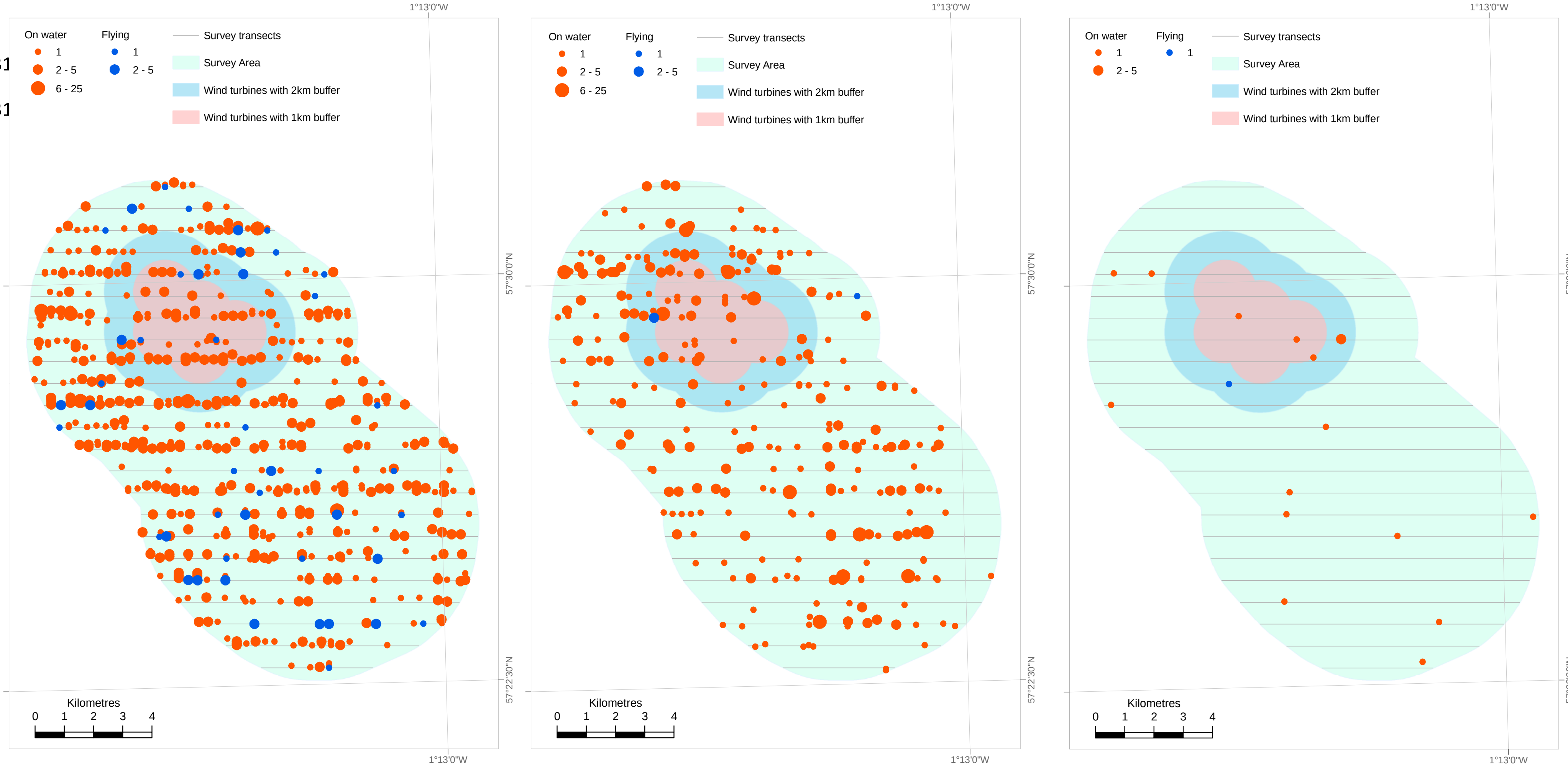
315. The mean estimated number of puffins present in the Survey Area during the post-breeding period (September) was 1,111 birds and the peak estimated number was 1,676 (Table 27). These estimates represent 1.2% and 1.9% respectively of the regional breeding population of 89,906 adults (Mitchell *et al.,* 2004).

316. Based on the density in whole Survey Area, the estimated mean number of puffins in the WT+1km area in the post-breeding period (September) was 85 individuals. The 95% upper confidence limit of this mean is 104 individuals. These numbers represent 0.09% and 0.12% respectively of the regional breeding population of 89,906 adults (Mitchell *et al.,* 2004) and thus the WT+1km area is considered to have low importance as a foraging area for the regional post-breeding population. The actual number of birds present in the region during this time of year is likely to be substantially greater because of the presence of non-breeding immature birds. Indeed, the estimated non-breeding BDMPS population for the North Sea and Channel for mid-August to March is 218,622 birds (Furness, 2014).

Table 28. The percentage of puffins seen on survey visits that were juveniles.

Survey visit	No of birds seen	% juveniles
Year 1 (2013)		
08/07/2013	21	0%
09/07/2013	17	0%
05/08/2013	130	10.8%
06/08/2013	195	5.1%
Year 2 (2014)		
01/07/2014	2	0%
08/07/2014	3	0%
28/07/2014	59	17.0%
05/08/2014	166	17.0%
25/08/2014	15	46.7%
26/08/2014	18	33.3%

Fig. 18. Distribution and abundance of puffins recorded during ESAS surveys between June 2013 and May 2014 for a) the colony-attendance period (8 survey days), b) the August and September (4 survey days) and c) the winter period (8 survey days).



a) Colony-attendance period b) August and September c) Winter period

319.There was a similar pattern of occurrence of juvenile puffins in the Survey Area in both 2013 and 2014 (Table 28). No juvenile puffins were present in early July, which was to be expected as this is before puffins fledge. Relatively high percentages (up to 17%) of the puffins present in late July/early August were juveniles. By late August (in 2014) approximately 40% of the puffins present were juveniles but by this time abundance was much lower abundance (Table 28). These changes suggest that there is considerable flux of puffins using the Survey Area at this time of year.

Winter period

320.The mean estimated number of puffins present in the Survey Area during the winter period (September to March) was 273 birds and the peak estimated number was 1,730 birds (Table 27). These estimates represent 0.1% and 0.7% respectively of the estimated minimum non-breeding period population of 231,957 birds for the North Sea and Channel BDMPS region (Furness, 2014).

321.Based on the density in the whole Survey Area in the winter period, the estimated mean number of puffins in the WT+1km and 95%UCL of this mean was 21 individuals and 26 individuals respectively. These estimates represent <0.01% and 0.01% of the assumed regional winter period population and thus the WT+1km area is considered to have negligible importance as a foraging area for the regional autumn and winter population.

Behaviour

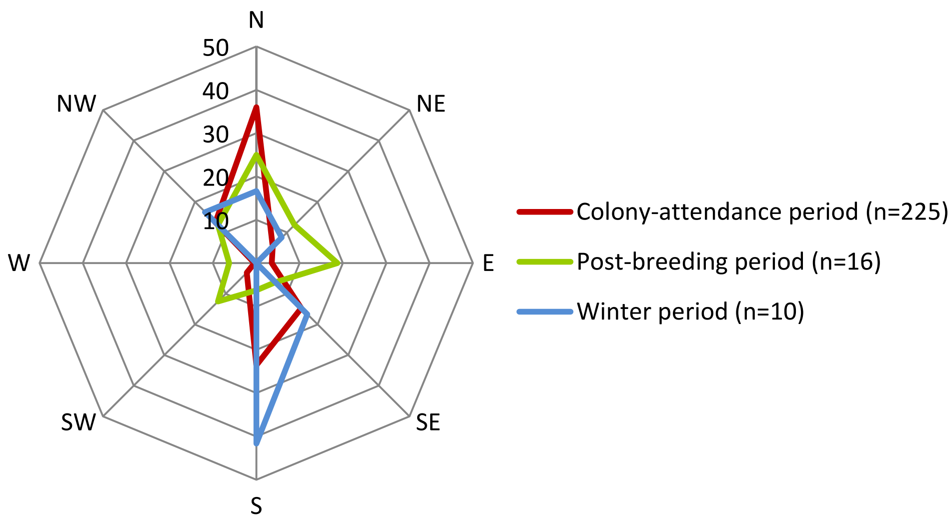
322.The maps showing the distribution of records shows that birds were approximately evenly spread over the Survey Area (Fig. 18a, b and c).

323.On average, approximately 3% of puffins estimated to be present were in flight, the remainder were sitting on the sea.

324.All flying puffins recorded were estimated to be at or below 5 m above the sea, suggesting that this species would be at no risk of collision with turbine rotors.

325.During the colony-attendance period there was a strong tendency for puffin flights to have a N – S orientation (Fig. 19). This is an unexpected result as the closest colonies are to the west and south-west, directions with no recorded flights. N-S orientated flights during the colony-attendance period may be associated with summer movements of non-breeding birds (immatures) along the east coast, but his is purely speculation.

Fig. 19. Puffin flight directions (%) recorded during ESAS surveys between June 2013 and May 2014. (n = number of records).



Likely origins

326.Breeding puffins travel large distances to forage; the maximum foraging distance is reported to be 200 km and the MMFR is 105 km (Thaxter *et al.,* 2012). Only relatively small numbers breed within 105 km from the Survey Area, in along the Buchan Ness to Collieston coast 22 km at closest, at Troup, Pennan and Lion's Head 54 km at closest and Fowlsheugh 74 km at closest. However, it is unlikely that breeding birds from these colonies alone could account for the high densities recorded in the Survey Area in June. It is likely that the high densities present in June were due to the presence of either large numbers of non-breeding immature birds and/or breeding birds from large colonies in the Firth of Forth. Therefore, the regional population has been defined as extending from as far west as the East Caithness Cliffs and as far south as the large colony on the Isle of May.

327.The birds present in the Survey Area in September, by when puffins have departed breeding colonies, are likely to comprise a mix of birds breeding within the region and birds from further afield, in particular from colonies in Orkney and Shetland, and Faeroes and Norway (Skov *et al., 19*95).

328.During the winter (October to February) most puffins move out of the North Sea, those that remain in the region are likely to from breeding grounds in eastern Britain and Norway (Wernham *et al.,* 2002).

Status and protection

329.Between the mid 1980s and 2000 numbers breeding in Scotland increased by 13% (Mitchell *et al*., 2004). Numbers breeding on the Isle of May in 2013 were almost 10% larger than the number of breeding birds estimated in 2000 (based on data on the CEH website, see: http://www.ceh.ac.uk/news/news_archive/puffin_isle_of_may_count_2013_37.html and in Mitchell *et al*. (2004).

330.Qualifying species at Forth Islands SPA, East Caithness Cliffs SPA, North Caithness Cliffs SPA and Hoy SPA. The distance from the Survey Area to these SPAs is greater than MMFR distance but below the maximum foraging range distance of breeding puffin.

Vulnerability to windfarm impacts

331.Puffins are considered to have low vulnerability to vessel disturbance, displacement by structures and offshore wind turbine collision risk (Table 3).

Relevance to Project

332.On account of the above information, puffin is considered to be a species of low priority to the EIA assessment.

333.Rated as low priority.

Information gaps

334.The area potentially affected by the Project is further from all large colonies than the MMFR distance of 105 km. Therefore, there is uncertainty whether the birds present in the colony-attendance period are breeding birds, and if so, from which colonies.

335.This information gap does not prevent the undertaking of a robust impact assessment.

Comparison with additional 2014 summer surveys

336.For puffin, the average density of birds across surveys in July 2014 was very similar to that present in the same month during the previous year, whereas for both August and September the average densities present during 2014 were considerably lower than in 2013 (Table 6h in Caloo 2014c Annex 3 to Technical Report).

337. Looking at these results in greater detail (Table 3h in Caloo 2014c Annex 3 to Technical Report), in early August in both years, the early post-breeding season, relatively high densities of birds where recorded across all surveys, with densities of 9.0 birds/km^2 and 14.3 birds/km^2 for the two 2013 surveys and a density of 11.4 birds/km^2 for the single 2014 survey at this time of year. In 2013, these relatively high densities apparently continued into September, with densities of 9.8 birds/km^2 and 3.20 birds/km^2 recorded during the two September surveys. In contrast during 2014, densities had dropped dramatically by late August, and during the four surveys in late August and early September densities varied between 0.92 birds/km^2 and 1.28 birds/km^2. Therefore, using the September 2013 estimates for the post-breeding period in the assessment is considered particularly precautionary.

Collision Risk Modelling – Results Summary

338.Tables 28 to 35 provide a summary of collision risk modelling results for eight key seabird species: gannet, Arctic skua, great skua, herring gull, great black-backed gull, kittiwake, Arctic tern and common tern. For gannet and the gulls the predicted number of collisions is season-specific and presented for both Option 1 and 2 of the basic Band model. For skuas and terns only Option 2 was used as insufficient site-specific flight height data was available. Avoidance rates and associated uncertainty (sd) recommended by the SNCBs (Joint Guidance, 25 November 2014) on the basis of an MS commissioned report (Cook *et al.* 2014) are provided throughout.

339.With the exception of Arctic tern (see rationale in the section ‘Seabirds seasons’) seasonality for all species is in line with SNH/JNCC recommendations (letter, dated 6 February 2015). Collision estimates reflect all birds, regardless of age class.

340.Caloo 2014b (Annex 2 to the Technical Report) and Caloo 2014d (stand-alone report) provide substantial detail on the approach taken to collision risk modelling, parameters used, uncertainty associated with estimates and the impact of accuracy of flight height estimation during surveys. As these reports predate the latest CRM guidance the avoidance rates and restricted model options (e.g. to not use the Extended model for gannet and kittiwake) currently recommended are not included. The below tables reflect the latest developments with respect to SNCB guidance instead.

Table 28. Seasonal collision mortality estimates for gannet

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	98%	98.7%	98.9%	99.1%
Breeding	Option 1	Site	511.9	10.2	6.7	5.6	4.6
	Option 2	Generic	548.9	11	7.1	6	4.9
Non-breeding	Option 1	Site	144.4	2.9	1.9	1.6	1.3
	Option 2	Generic	154.8	3.1	2	1.7	1.4
Note: Avoidance rate of 98.9% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for gannet (0.989). Rates in light grey reflect the recommended inclusion of ±2SD (0.002). Other avoidance rates provided for context. Estimates rounded to one decimal.							

Table 29. Seasonal collision mortality estimates for Arctic skua

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	98%	99%	99.5%
Autumn passage	Option 2	Generic	0.2725	0.0136	0.0054	0.0027	0.0014
Note: Avoidance rate of 98% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for Arctic skua. Other avoidance rates provided for context.							

Table 30. Seasonal collision mortality estimates for great skua.

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	98%	99%	99.5%
Autumn passage	Option 2	Generic	0.6912	0.0346	0.0138	0.0069	0.0035
Note: Avoidance rate of 98% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for great skua. Other avoidance rates provided for context.							

Table 31. Seasonal collision mortality estimates for herring gull

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	99.4%	99.50%	99.6%
Breeding	Option 1	Site	113.2	5.7	0.7	0.6	0.5
	Option 2	Generic	85.1	4.3	0.5	0.4	0.3
Non-breeding	Option 1	Site	1552.1	77.6	9.3	7.8	6.2
	Option 2	Generic	1166.6	58.3	7	5.8	4.7
Note: Avoidance rate of 99.5% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for herring gull (0.995). Rates in light grey reflect the recommended inclusion of ±2SD (0.001). Other avoidance rates provided for context. Estimates rounded to one decimal.							

Table 32. Seasonal collision mortality estimates for great black-backed gull.

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	99.4%	99.50%	99.6%
Breeding	Option 1	Site	68.7	3.4	0.4	0.3	0.3
	Option 2	Generic	55.3	2.8	0.3	0.3	0.2
Non-breeding	Option 1	Site	905.3	45.3	5.4	4.5	3.6
	Option 2	Generic	728.7	36.4	4.4	3.6	2.9
Note: Avoidance rate of 99.5% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for great black-backed gull (0.995). Rates in light grey reflect the recommended inclusion of ±2SD (0.001). Other avoidance rates provided for context. Estimates rounded to one decimal.							

Table 33. Seasonal collision mortality estimates for kittiwake

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	98%	98.7%	98.9%	99.1%
Breeding	Option 1	Site	1509.4	75.5	19.6	16.6	13.6
	Option 2	Generic	1325.2	66.3	17.2	14.6	11.9
Non-breeding	Option 1	Site	158.6	7.9	2.1	1.7	1.4
	Option 2	Generic	139.3	7	1.8	1.5	1.3
Avoidance rate of 98.9% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for kittiwake (0.989). Rates in light grey reflect the recommended inclusion of ±2SD (0.002). Other avoidance rates provided for context. Estimates rounded to one decimal.							

Table 34. Seasonal collision mortality estimates for Arctic tern

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	98%	99%	99.5%
Post-breeding	Option 2	Generic	7.87	0.39	0.16	0.08	0.04
Note: Avoidance rate of 98% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for Arctic tern. Other avoidance rates provided for context.							

Table 35. Seasonal collision mortality estimates for common tern

Season	Band Model	Flight height data	Predicted number of collisions under different avoidance rates				
			0%	95%	98%	99%	99.5%
Breeding	Option 2	Generic	1.9	0.09	0.04	0.02	0.01
Note: Avoidance rate of 98% (dark grey) reflects the Basic Band avoidance rate recommended by the SNCBs for common tern. Other avoidance rates provided for context.							

Marine Mammal Results

341.The numbers of marine mammals recorded from each site visit are presented in Table 36.

342.Based on a total of 2,506.8 km and 129.7 hours of survey effort (with two observers), sightings rate (in number of animals observed) by measure of effort for each species, and for the unidentified species in grouped form, are summarised in Table 37. A full breakdown of sightings rate by survey date is given in Table A1.13.

343.The average and maximum group size for each species identified are presented with number of encounters and number of animals observed in Table 38.

344.A breakdown of number of animals sighted by behaviour is presented in Table 39.

345.A breakdown of number of animals observed by survey date is given in Figure 20.

346.The results maps (Fig. 21) show the locations of marine mammal species recorded during the ESAS surveys.

347.The tables of occurrence (Tables 37 and 40) and maps of distribution for each species (Fig. 21) present considerable detail on the pattern of seasonal distribution and occurrence of marine mammals in the Survey Area. In total, six species of marine mammal were sighted during the surveys, and for most species few animals have been observed.

348.The main exception is harbour porpoise, which is observed in most months and in the highest numbers of any species recorded at the site. Coarse measures of relative abundance show an average of 1.765 animals observed per survey hour, which is between 5 and 6 times as high as the nearest species sighting rate.

349.Animals were, in general, most often sighted as individuals. The exception was the white-beaked dolphin which was never observed as an individual; large herds are not uncommon in the North Sea (Reid *et al.* 2003), although the largest group observed during the ESAS surveys was of 6 animals. Maximum group size for the other species peaked at 6 for harbour porpoise (Table 38).

350.In general, slow and fast swim behaviour dominate across the sightings; what this confirms about species' use of the site is limited, other than to suggest regular transiting at a minimum.

351.There is no single month exhibiting unusually high numbers of animals, but, it appears from the data that more marine mammals are seen in the summer months than at other times of the year (Figure 20). The species that have been recorded at the site may make seasonal movements to inshore waters for foraging or breeding activities; Reid *et al*. (2003) suggest this as a possibility for harbour porpoise, which shows a notable peak in summer months at the site.

352.Minke whales are most often sighted in the UKCS between May and September (Reid *et al*. 2003), which fits the pattern of the survey data. This species is often associated with feeding aggregations between July and September, although no such aggregations have been observed during the surveys to date (all sightings have been of single animals). Reid *et al*. (2003) report white-beaked dolphins as occurring year-round, but most frequently between June and October; the data collected suggest that this is true for the Survey Area. Reid *et al*. (2003) report a general movement to offshore waters near the continental shelf edge in winter months, but that some individuals may be found around the north-east coast of Scotland in winter. The single sighting of a group of two individuals of this species does not provide sufficient data to corroborate this, although the sighting did occur in late autumn. Although improved observation conditions are found in summer compared to other months, there are a number of surveys through the year with good sea conditions which record few animals, so it is possible that seasonal movements may be occurring.

353.A small number of grey seals and even fewer harbour seals were recorded during the surveys. Grey seal sightings were generally higher during the summer surveys, which may link with the September onwards breeding season during which animals may be onshore or further inshore than the Survey Area. Harbour seal numbers are too low to determine any meaningful temporal pattern.

354. It should be noted that it is possible that some individuals were seen more than once during each survey and that the numbers are inflated compared to reality. However, detection probability is likely to be low for all species (either because the animal is too far away to see or because it is under the water and hence not visible) and thus the numbers presented are likely to be an underestimate of reality. As such, it is important to focus discussion on relative abundance measures, such as temporal patterns and species occurrence.

355. The figures of distribution show that marine mammals are found across the Survey Area; sightings from the surveys do not show areas of clear enhanced importance compared to other areas within the Survey Area.

356. A summary of occurrence, behaviour, relevance to Project and information for each observed species is provided in Table 40.

Table 36. The total number of marine mammals observed in each survey and in total (including both on-effort and off-effort sightings).

Species	Number of animals observed by survey date																				Total
	2013												2014								
	8/6	9/6	6/7	9/7	5/8	6/8	9/9	19/9	5/11	9/11	25/11	29/12	7/2	19/2	26/3	2/4	20/4	28/4	2/5	3/5	
Harbour porpoise	5	19	12	64	35	10	51	10	0	1	2	2	0	3	0	3	6	2	4	0	229
White-beaked dolphin	3	20	0	0	12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39
Grey seal	9	5	4	5	2	0	1	0	1	0	2	1	1	1	0	0	2	1	2	1	38
Minke whale	2	0	0	5	7	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	16
Harbour seal	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	4
Risso's dolphin	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Unidentified species																					
Dolphin	0	3	3	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Seal	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	3
Cetacean	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Small cetacean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Marine mammal	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 37. Number of animals recorded for each marine mammal species

Species	Number of animals observed		
	Total	Per hour	Per km
Harbour porpoise	229	1.765	0.091
White-beaked dolphin	39	0.301	0.016
Grey seal	38	0.293	0.015
Minke whale	16	0.123	0.006
Harbour seal	4	0.031	0.002
Risso's dolphin	2	0.015	0.001
Unidentified species			
Dolphin	12	0.093	0.005
Seal	3	0.023	0.001
Cetacean	2	0.015	0.001
Small cetacean	1	0.008	<0.001
Marine mammal	1	0.008	<0.001

Table 38. Summary of group sizes observed for each species

Species	Number of encounters	Number of animals observed	Average group size	Maximum group size
Harbour porpoise	156	229	1.47	6
White-beaked dolphin	9	39	4.32	6
Grey seal	35	38	1.09	4
Minke whale	16	16	1	1
Harbour seal	4	4	1	1
Risso’s dolphin	1	2	2	2

Table 39. Behaviour recorded for each marine mammal sighting in each survey

Species and behaviour	Total sightings of behaviour	%
Harbour porpoise		
Slow swim	142	62
Fast swim	50	22
Milling	37	16
White-beaked dolphin		
Slow swim	25	64
Fast swim	8	21
Breaching	6	15
Grey seal		
Slow swim	21	55
Bottling	16	42
Escape dive	1	3
Minke whale		
Slow swim	15	94
Logging	1	6
Harbour seal		
Bottling	2	50
Slow swim	1	25
Escape dive	1	25
Risso's dolphin		
Slow swim	2	100
Unidentified species		
Dolphin		
Slow swim	7	58
Breaching	3	25
Fast swim	2	17
Seal		
Bottling	2	67
Logging	1	33
Cetacean		
Slow swim	2	100
Small cetacean		
Slow swim	1	100
Marine mammal		
Diving from surface	1	100

Figure 20. Number of marine mammals sighted in the ESAS Survey Area by survey month (June 2013 to May 2014).

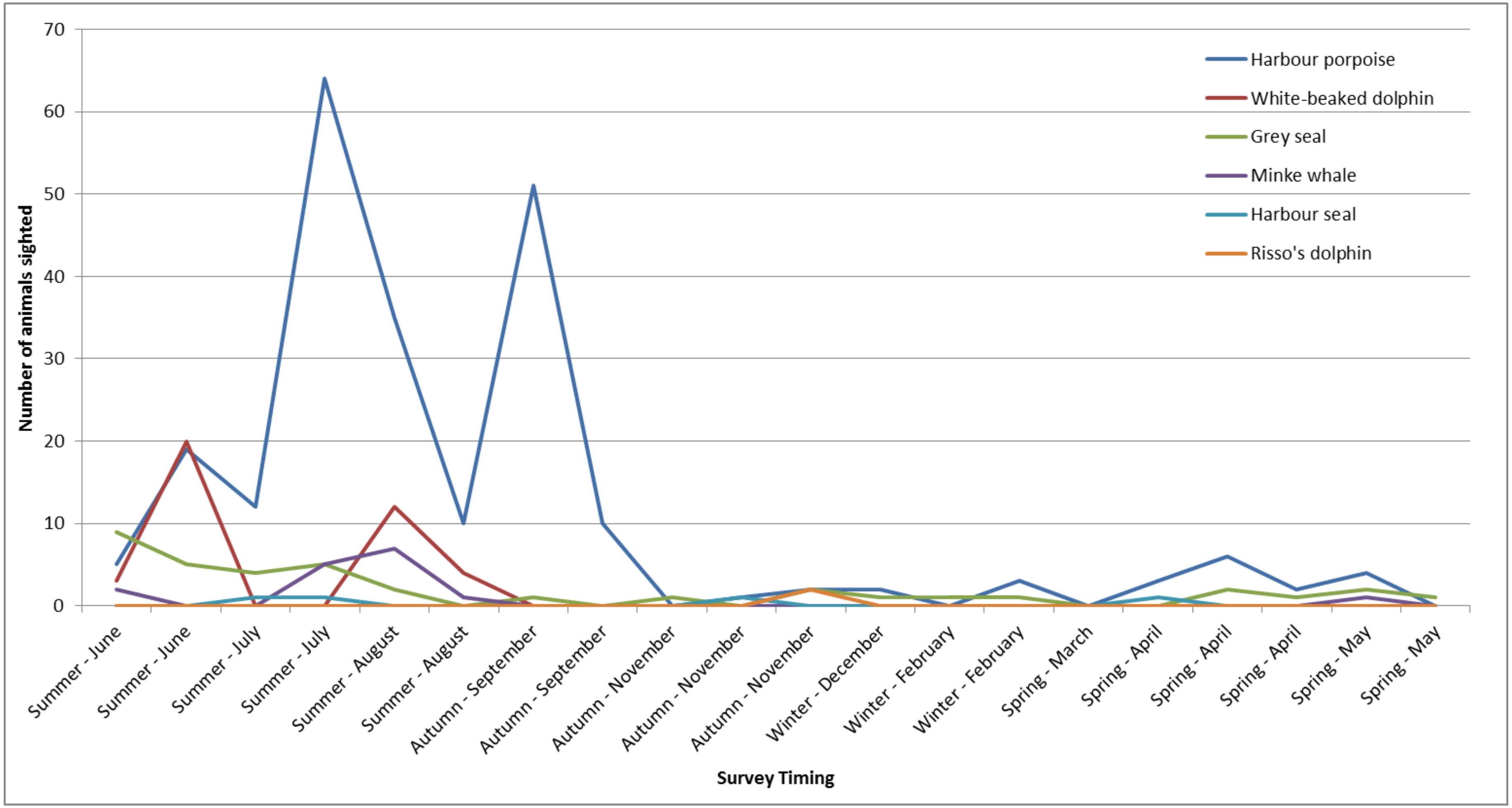


Figure 21. Marine mammals sighted in the ESAS Survey Area (June 2013 to May 2014)

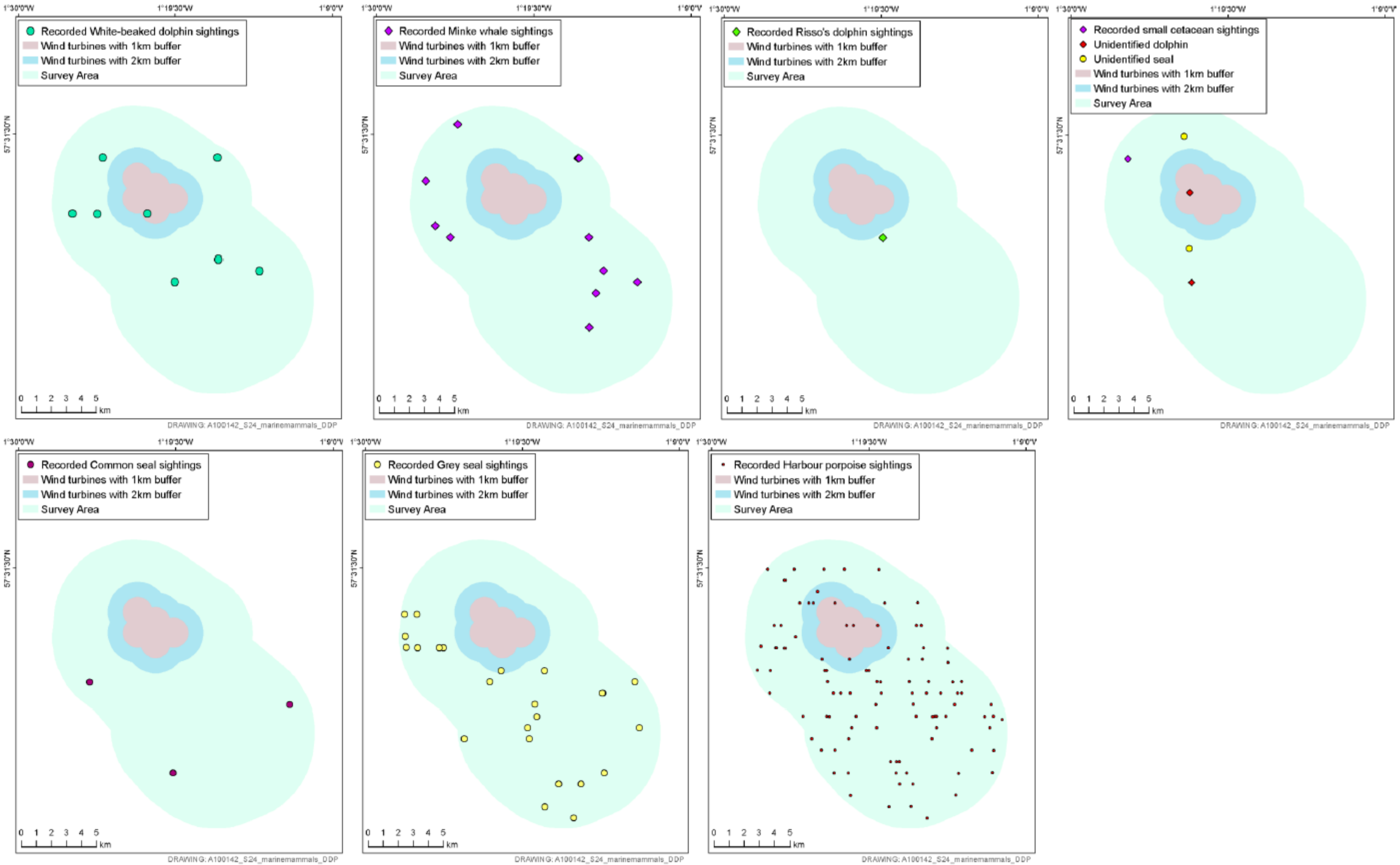


Table 40. Species account summary

Species	Occurrence	Behaviour	Status in Project	Information Gaps
Harbour porpoise	229 animals sighted, from a high of 64 in the second July survey to a low of zero in some of the autumn/winter surveys	Primarily slow swimming, although fast swimming and milling observed	Protected species. Important for consideration in EIA, but likely of low importance due to lack of impact mechanisms.	No baseline data gaps identified.
White-beaked dolphin	39 animals sighted, 20 of which were during one June survey and 12 of which were during one August survey	Primarily seen swimming slowly, with some fast swimming and breaching	Protected species, cable export route located in MPA search location assigned for this species. Important for consideration in EIA, but likely of low importance due to lack of impact mechanisms.	
Grey seal	38 animals in total, peak of 9 animals in the June 2013 survey and decline to 0 – 2 animals per survey thereafter	Slow swimming and bottling (upright with head above water, may sleep in this state) and escape diving	Protected species, with SAC locations designated for this species. Will be considered in EIA, but likely of low importance due to low sightings rate.	
Minke whale	16 animals sighted, none in autumn or winter	Slow swimming, with one incidence of logging (still at the surface)	Protected species, with cable export route located in MPA search location assigned for this species. Important for consideration in EIA, but likely of low importance due to lack of impact mechanisms.	
Harbour seal	4 animals in total, maximum of 1 in any survey	Bottling, slow swimming and one incidence of escape diving	Protected species, with SAC locations designations for this species. Will be considered in EIA, but likely of low importance due to very low sightings rate.	
Risso's dolphin	2 animals in total, observed as a pair in the November survey	Slow swimming	Protected species. Will be considered in EIA, but likely of low importance due to very low sightings rate.	

358. From a review of existing data, the EIA concludes that the white-beaked dolphin, harbour porpoise and minke whale are the whale species most commonly observed within the Survey Area. Atlantic white-sided dolphin, bottlenose dolphin, fin whale, humpback whale, killer whale and Risso's dolphin have been encountered in the surrounding waters during other, regional surveys. The number of grey and harbour seals in the Survey Area was predicted to be low, which is consistent with the literature review presented in the ES.

359. The survey results confirm that harbour porpoise, white-beaked dolphin and minke whale are the most commonly observed marine mammals in the Survey Area. The only other cetacean identified during the surveys was the Risso's dolphin, which was observed on one occasion only. This suggests that other cetaceans are infrequent visitors to the site.

360. The harbour porpoise was the most commonly sighted marine mammal from the surveys. The harbour porpoise is the most common cetacean on the UKCS (Reid *et al*. 2003) and it is not surprising that it is also the case within the Survey Area; indeed, Evans, Baines and Coppock (2011) report peak sightings around northern Scotland between July and September, which is reflected in the survey data. Scoping responses from JNCC/SNH suggest that the eastern Aberdeenshire coastal area may be of particular importance for white-beaked dolphins, thus their status as second most common species recorded at the site is not unexpected.

361. The literature review presented in the ES indicates that both grey and harbour seals are likely to be found at the site; this is confirmed by the surveys. The surveys show that grey seals are relatively far more prevalent than harbour seals, but that both are present in low numbers.

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APPENDIX 1: ADDITIONAL ESAS RESULTS TABLES

Table A1.1. Survey sea state conditions June 2013 – May 2014.

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
08/06/2013	06:06	N	2	2	NE	0.5	0	N	4
	06:30	N	2	2	NE	0.5	0	N	4
	07:04	N	2	2	NE	0.5	0	N	4
	07:48	N	2	2	NE	0.5	0	N	4
	08:34	N	2	2	NE	0.5	0	N	4
	09:28	N	2	2	NE	0.5	0	N	4
	10:19	N	2	2	NE	0.5	0	N	4
	11:14	N	2	2	NE	0.5	0	N	4
	11:40	N	2	2	NW	0.5	0	N	4
	12:08	N	2	2	NW	0.5	0	N	4
	12:56	N	2	2	NW	0.5	0	N	4
	13:42	N	2	2	NW	0.5	0	N	4
09/06/2013	06:09	NE	2	2	0	0	0	N	4
	06:40	NE	2	2	0	0	0	N	4
	07:20	NE	2	2	0	0	0	N	4
	08:06	NE	2	2	0	0	0	N	4
	08:52	NE	1	1	0	0	0	N	4
	09:43	NE	1	1	0	0	0	N	4
	10:37	NE	1	1	0	0	0	N	4
	11:30	NE	1	1	0	0	0	N	4
	12:21	NE	1	0	0	0	0	N	4
	13:08	NE	1	0	0	0	0	N	4
	13:55	NE	2	2	0	0	0	N	4
	14:37	NE	2	2	0	0	0	N	4
08/07/2013	06:01	S	3	3	SE	0.5	0	N	4
	06:25	S	3	3	SE	0.5	0	N	4
	07:00	S	3	3	SE	0.5	1	N	4
	07:41	S	3	3	SE	0.5	0	N	3
	08:00	S	3	3	SE	0.5	0	N	2
	08:05	S	3	3	SE	0.5	0	N	1
	08:10	S	3	3	SE	0.5	0	N	2
	08:20	S	4	4	SE	0.5	0	N	2
	08:31	S	4	4	SE	0.5	1	N	3
	09:19	S	4	4	SE	0.5	0	N	4
	09:55	S	4	4	SE	0.5	0	N	3
	10:12	S	4	4	SE	0.5	0	N	3
	11:02	S	4	4	SE	0.5	0	N	3
	11:28	S	4	4	SE	0.5	0	N	3
	12:48	S	4	4	SE	0.5	0	N	2
	13:36	S	4	4	SE	0.5	0	N	2
	14:19	S	4	4	SE	0.5	0	N	2
	14:58	S	4	4	SE	0.5	0	N	2
09/07/2013	06:07	W	1	1	S	0.5	1	N	4
	06:38	W	1	2	S	0.5	0	N	4

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
	07:17	W	1	2	S	0.5	0	N	4
	07:23	W	1	2	S	0.5	1	N	4
	07:26	W	1	1	S	0.5	1	N	4
	07:50	W	1	2	S	0.5	2	N	4
	08:03	W	1	2	S	0.5	0	N	4
	08:25	W	1	1	S	0.5	0	N	4
	08:50	W	1	1	S	0.5	0	N	4
	09:43	W	1	1	S	0.5	0	N	4
	10:00	W	2	2	S	0.5	0	N	4
	10:10	W	1	1	S	0.5	0	N	4
	10:36	W	0	0	S	0.5	0	N	4
	11:30	W	1	1	S	0.5	0	N	4
	11:52	W	2	2	S	0.5	0	N	4
	11:57	W	3	3	S	0.5	0	N	4
	12:00	W	3	4	S	0.5	0	N	4
	12:20	W	4	4	S	0.5	0	N	4
	13:07	W	4	4	S	0.5	1	N	4
	13:53	W	4	4	S	0.5	0	N	4
	14:33	W	4	4	S	0.5	0	N	4
	14:50	W	3	3	S	0.5	0	N	4
05/08/2013	05:11	SW	2	2	S	1	0	N	4
	05:34	SW	2	2	S	1	0	N	4
	06:07	SW	2	2	S	1	0	N	4
	06:40	SW	2	2	S	1	0	LR	4
	06:49	SW	2	2	S	1	0	LR	4
	07:07	SW	1	1	S	1	0	N	4
	07:34	SW	1	1	S	1	0	N	4
	08:20	SW	2	2	SE	1	0	LR	4
	09:10	SW	2	2	SE	1	0	R	4
	10:03	SW	2	2	SE	1	0	R	4
	10:56	SW	2	2	SE	1	0	R	4
	11:45	SW	2	2	SE	1	0	R	4
	12:30	SW	2	2	SE	1	0	R	4
	13:16	SW	2	2	SE	1	0	R	4
	13:53	SW	2	2	SE	1	0	R	4
06/08/2013	06:34	NW	3	3	NW	1	1	N	4
	07:04	NW	3	3	NW	1	0	N	4
	07:18	NW	4	4	NW	1	0	N	4
	07:34	NW	4	4	NW	1	2	N	4
	08:27	NW	4	4	NW	1	0	N	4
	09:12	NW	2	2	NW	1	0	N	4
	10:00	NW	2	2	NW	1	0	N	4
	10:52	NW	2	2	NW	1	0	N	4
	11:47	NW	2	2	NW	1	0	N	4
	12:33	NW	2	2	NW	1	0	N	4
	13:19	NW	2	2	NW	1	0	N	4
	13:45	NW	2	2	NW	0.5	0	N	4
	14:03	NW	2	2	NW	0.5	0	N	4

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
	14:43	NW	2	2	NW	0.5	0	N	4
09/09/2013	05:39	S	2	2	SW	1	0	N	4
	05:56	S	2	2	SW	1	0	N	4
	06:25	S	1	1	V	0.5	1	N	4
	07:04	S	1	2	V	0.5	0	N	4
	07:30	S	1	1	V	0.5	0	N	4
	07:44	S	1	1	V	0.5	0	N	4
	08:28	S	1	1	V	0.5	0	N	4
	09:14	S	1	1	V	1	0	N	4
	09:30	S	1	1	V	1	0	N	4
	10:00	S	1	1	V	1	0	N	4
	10:05	S	1	2	V	1	0	N	4
	10:42	NW	1	2	V	1	0	N	4
	11:23	NW	1	2	E	1	0	N	4
	11:47	NW	3	3	E	1	0	N	4
	12:03	NW	3	3	E	1	0	N	4
	12:37	NW	3	3	E	1	0	N	4
	13:45	NW	3	3	NW	0.75	0	N	4
	14:24	NW	3	3	NW	0.75	0	N	4
	15:04	NW	3	3	NW	0.75	0	N	4
	15:49	NW	3	3	NW	0.75	0	N	4
19/09/2013	08:28	SW	2	2	NW	1.5	0	N	4
	08:55	SW	2	2	V	1	0	N	4
	09:30	SW	3	3	V	1	0	N	4
	09:40	SW	3	3	V	1	0	LR	4
	10:12	SW	3	3	V	1	0	LR	4
	10:53	SW	3	3	V	1	0	LR	4
	11:40	SW	3	3	V	1	0	LR	4
	12:31	SW	3	3	V	1	0	LR	4
	12:55	SW	3	3	V	1	0	N	4
	13:16	SW	3	3	V	1	0	N	4
	13:58	SW	3	3	V	1	0	LR	4
	14:14	SW	3	3	V	1	0	N	4
	14:40	SW	3	3	V	1	0	N	4
	15:18	SW	3	3	V	1	0	N	4
05/11/2013	07:45	W	2	2	NE	1.5	0	N	4
	08:03	W	2	2	NE	1.5	0	N	4
	08:34	W	2	2	NE	1.5	0	N	4
	09:10	S	2	2	NE	2	0	N	4
	09:51	S	2	2	NE	2	0	N	4
	10:33	S	2	2	NE	2	0	N	4
	11:19	S	2	2	NE	2	0	N	4
	12:02	S	2	2	NE	2	0	N	4
	12:44	S	2	2	NE	2	0	ILR	4
	13:24	S	3	3	NE	2	0	N	4
	13:54	SW	4	4	NE	1.5	0	N	4
	14:02	SW	4	4	NE	1.5	0	N	4
	14:38	SW	4	4	NE	1.5	0	N	4

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
09/11/2013	08:00	SW	3	3	CON	1	0	N	4
	08:28	SW	3	3	CON	1	0	N	4
	09:02	SW	3	3	CON	1	0	N	4
	09:41	SW	3	3	CON	1	0	N	4
	10:24	SW	3	3	CON	1	0	N	4
	10:52	SW	2	2	CON	1	0	N	4
	11:08	SW	3	3	CON	1	0	N	4
	11:45	SW	2	2	CON	1	0	N	4
	11:58	SW	2	2	CON	1	0	N	4
	12:40	SW	2	2	CON	1	0	N	4
	13:21	SW	2	2	CON	1	0	N	4
	14:01	SW	3	3	CON	1	0	N	4
	14:38	SW	3	3	CON	1	0	N	4
25/11/2013	07:50	W	4	4	NE	2	0	N	4
	08:09	W	4	4	NE	2	0	N	4
	08:39	W	4	4	NE	2	0	N	4
	09:17	W	4	4	NE	2	0	N	4
	09:57	W	4	4	NE	2	0	N	4
	10:42	W	4	4	NE	2	0	N	4
	11:15	W	2	2	NE	2	0	N	4
	11:28	W	2	2	NE	2	0	N	4
	12:12	W	2	2	NE	1.5	0	N	4
	12:44	W	3	3	NE	1.5	0	N	4
	12:55	W	3	3	NE	1.5	0	N	4
	13:35	W	3	3	NE	1.5	0	N	4
	14:13	W	3	3	NE	1.5	0	N	4
	14:48	W	3	3	NE	1.5	0	N	4
29/12/2013	08:45	W	3	3	N	1.5	0	N	4
	09:11	W	4	4	N	1.5	0	N	4
	09:46	W	4	4	N	1.5	0	N	4
	10:26	W	4	4	N	1.5	0	N	4
	11:07	W	4	4	N	1.5	0	N	4
	11:52	W	4	4	N	1.5	0	N	4
	12:42	W	4	4	N	1.5	0	N	4
	13:25	W	4	4	N	1.5	0	N	4
	14:07	SW	2	2	CON	1.5	0	N	4
	14:46	SW	2	2	CON	1.5	0	N	4
07/02/2014	08:23	W	3	3	SE	1	0	N	4
	08:52	W	3	3	SE	1	0	N	4
	09:26	NW	5	5	SE	1	0	N	4
	09:46	NW	4	4	CON	1	0	N	4
	10:06	NW	4	4	CON	1	0	N	4
	10:47	NW	4	4	CON	1	0	N	4
	11:32	NW	4	4	CON	1	0	N	4
	12:19	NW	5	5	CON	1	0	N	4
	13:02	NW	5	5	CON	1	0	N	4
	13:41	NW	5	5	CON	1.25	0	N	4
	14:10	NW	4	4	CON	1.25	0	N	4

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
19/02/2014	07:48	NE	3	3	E	1	0	N	4
	08:07	NE	3	3	E	1	0	N	4
	08:35	NE	3	3	E	1	0	N	4
	09:13	NE	3	3	E	1	0	N	4
	09:52	NE	3	3	E	1	1	N	4
	10:36	NE	3	3	E	1	0	N	4
	11:20	NE	3	3	E	1	0	N	4
	12:03	NE	2	2	E	1	0	N	4
	12:45	NE	2	2	E	1	0	N	4
	13:25	NE	2	2	E	1	0	N	4
	14:02	NE	2	2	E	1	0	N	4
	14:38	NE	2	2	E	1	0	N	4
26/03/2014	06:08	NE	2	2	E	1	2	N	4
	06:25	NE	2	2	E	1	0	N	4
	07:03	NE	2	2	E	1	0	N	4
	07:22	NE	3	3	NE	1	0	N	4
	07:41	NE	4	4	NE	1	0	N	4
	08:22	NE	4	4	NE	1	0	N	4
	09:06	NE	4	4	NE	1	0	N	4
	09:54	NE	4	4	NE	1	0	N	4
	10:41	NE	4	4	NE	1	0	N	4
	11:23	NE	4	4	NE	1	0	N	4
	12:07	NE	5	5	NE	1	0	N	4
02/04/2014	05:55	E	2	2	CON	1	0	N	3
	06:23	E	2	2	CON	1	0	N	3
	06:57	E	2	2	CON	1	0	N	3
	07:35	E	2	2	CON	1	0	N	3
	08:16	E	2	2	CON	1	0	N	3
	09:01	E	2	2	CON	1	0	N	3
	09:50	E	2	2	CON	1	0	N	3
	10:31	E	2	2	CON	1	0	N	3
	11:11	E	2	2	CON	1	0	N	3
	11:51	E	2	2	CON	1	0	N	3
	12:13	E	3	3	CON	1	0	N	3
	12:31	E	3	3	CON	1	0	N	3
20/04/2014	06:32	S	3	3	SE	1	3	N	4
	06:51	S	2	2	SE	1	0	N	4
	07:18	S	2	2	SE	1	3	N	4
	07:26	S	2	3	SE	1	0	N	4
	07:56	S	2	2	SE	1	0	N	4
	08:34	S	2	2	SE	1	1	N	4
	09:19	S	2	2	SE	1	0	N	4
	10:03	S	2	2	SE	1	0	N	4
	10:48	S	2	2	SE	0.5	0	N	4
	11:31	SE	2	2	SE	0.5	0	N	4
	12:10	SE	2	2	SE	0.5	0	N	1
	12:20	SE	2	2	SE	0.5	0	N	1
	12:23	SE	2	2	SE	0.5	0	N	1

Date	Start time GMT	Wind direction	Wind force (Beaufort)	Sea State (1-4)	Swell direction	Swell height (m)	Sun glare (1-4)	Rain	Visibility (1-4)
	12:26	SE	2	2	SE	0.5	0	N	3
	12:47	SE	2	2	SE	0.5	0	N	1
	12:53	SE	2	2	SE	0.5	0	N	1
	13:02	SE	2	2	SE	0.5	0	N	1
	13:10	SE	2	2	SE	0.5	0	N	1
	13:20	SE	2	2	SE	0.5	0	N	1
28/04/2014	06:15	N	3	3	E	1	3	N	4
	06:19	N	2	2	E	1	3	N	4
	06:40	N	2	2	E	1	0	N	4
	07:15	N	2	2	E	1	3	N	4
	07:35	N	2	2	E	1	2	N	4
	07:53	N	2	2	E	1	0	N	4
	08:33	N	3	3	E	1	2	N	4
	09:17	N	2	2	E	1	0	N	4
	10:05	N	2	2	E	1	0	N	4
	10:47	N	2	2	E	1	0	N	4
	11:27	N	2	2	E	1	0	N	4
	12:06	N	2	2	E	1	0	N	3
	12:30	N	1	1	E	1	0	N	3
	12:42	N	1	1	E	1	0	N	4
	12:48	N	2	2	E	1	0	N	4
02/05/2014	10:39	NE	2	2	NE	1.5	0	N	4
	10:56	NE	2	2	NE	1.5	0	N	4
	11:22	NE	2	2	NE	1.5	0	N	4
	11:59	NE	2	2	NE	1.5	0	N	4
	12:37	NE	2	2	NE	1.5	0	N	4
	13:18	NE	2	2	NE	1.5	0	N	4
	14:03	NE	2	2	NE	1.5	0	N	4
	14:47	NE	3	3	NE	1.5	0	N	4
	15:06	NE	2	2	NE	1.5	0	N	4
	15:26	NE	2	2	NE	1.5	0	N	4
	16:06	NE	2	2	NE	1.5	0	N	4
	16:20	NE	2	2	NE	1	2	N	4
	16:44	NE	2	2	NE	1	0	N	4
	17:17	NE	2	2	NE	1	3	N	4
	18:14	NE	2	2	NE	1	2	N	4
	18:24	NE	1	1	NE	1	2	N	4
	18:51	NE	1	1	NE	1	0	N	4
	19:26	NE	1	1	NE	1	0	N	4
03/05/2014	05:14	S	3	3	S	1	1	N	4
	05:42	S	4	4	S	1	1	N	4
	05:53	S	4	4	S	1	0	N	4
	06:35	S	4	4	S	1	3	N	4
	07:21	SW	4	4	SW	1	0	N	4
	08:05	SW	4	4	SW	1	1	N	4
	08:44	SW	4	4	SW	1	0	N	4
	09:25	SW	4	4	SW	1	0	N	4
	10:00	SW	4	4	SW	1	0	N	4

Table A1.2. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 8th and 9th June 2013.

Type	Species	8th June				9th June				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	2	8	22	32	5	10	32	47	7	18	54	79
	Manx shearwater	0	0	1	1	2	0	1	3	2	0	2	4
	Storm petrel	0	2	3	5	0	3	4	7	0	5	7	12
	Gannet	0	33	84	117	0	30	80	110	0	63	164	227
	Dunlin	0	0	0	0	0	2	0	2	0	2	0	2
	Arctic skua	0	0	0	0	0	1	0	1	0	1	0	1
	Lesser black-backed gull	0	1	0	1	0	0	0	0	0	1	0	1
	Herring gull	0	3	2	5	0	13	8	21	0	16	10	26
	Great black-backed gull	0	0	0	0	0	9	3	12	0	9	3	12
	Kittiwake	1	42	80	123	119	44	121	284	120	86	201	407
	Common tern	0	3	0	3	0	0	0	0	0	3	0	3
	Guillemot	254	119	495	868	846	69	124	1039	1100	188	619	1907
	Razorbill	31	5	22	58	136	8	13	157	167	13	35	215
	Guillemot/razorbill	0	1	36	37	5	4	1	10	5	5	37	47
	Puffin	295(2)	34	152	481(2)	722	40	86	848	1017(2)	74	238	1329(2)
	Auk sp.	3	1	0	4	2	0	0	2	5	1	0	6
	Starling	0	0	0	0	0	0	1	1	0	0	1	1
Mammals	White-beaked dolphin	0	0	0	0	20(10)	0	0	20(10)	20	0	0	20(10)
	Harbour Porpoise	3	0	0	3	11	0	0	11	14	0	0	14
	Grey Seal	2	0	0	2	2	0	0	2	4	0	0	4
	Minke Whale	1(1)	0	0	1(1)	0	0	0	0	1(1)	0	0	1(1)

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.3. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 8th and 9th July 2013.

Type	Species	8th July				9th July				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	15(1)	29	92	136(1)	12	23	65	100	27(1)	52	157	236(1)
	Manx shearwater	0	0	1	1	0	0	0	0	0	0	1	1
	Storm petrel	0	1	0	1	0	7	10	17	0	8	10	18
	Gannet	3	19	67	89	3	31	76	110	6	50	143	199
	Purple sandpiper	0	0	1	1	0	0	0	0	0	0	1	1
	Curlew	0	0	1	1	0	0	0	0	0	0	1	1
	Arctic skua	0	0	1	1	0	0	0	0	0	0	1	1
	Great skua	1	0	1	2	0	1	0	1	1	1	1	3
	Common gull	0	3	1	4	0	0	0	0	0	3	1	4
	Lesser black-backed gull	0	0	1	1	0	0	0	0	0	0	1	1
	Herring gull	0	2	22	24	0	0	2	2	0	2	24	26
	Great black-backed gull	0	0	0	0	0	0	1	1	0	0	1	1
	Kittiwake	0	28	103	131	0	22	52	74	0	50	155	205
	Arctic tern	0	0	3	3	0	0	0	0	0	0	3	3
	Guillemot	87	24	208	319	405	133	535	1073	492	157	743	1392
	Razorbill	24	1	12	37	16	7	9	32	40	8	21	69
	Guillemot/razorbill	1	0	4	5	1	0	95	96	2	0	99	101
	Puffin	9	0	15	24	20	1	8	29	29	1	23	53
	Auk sp.	0	0	3	3	0	0	0	0	0	0	3	3
	Swift	0	0	0	0	0	0	2	2	0	0	2	2
Mammals	Dolphin sp.	0	0	0	0	1	0	0	1	1	0	0	1
	Harbour Porpoise	2	0	0	2	29	0	0	29	31	0	0	31
	Common Seal	1	0	0	1	0	0	0	0	1	0	0	1
	Grey Seal	0	0	0	0	4	0	0	4	4	0	0	4
	Seal sp.	1(1)	0	0	1(1)	0	0	0	0	1(1)	0	0	1(1)
	Minke Whale	0	0	0	0	2	0	0	2	2	0	0	2

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.4. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 5th and 6th August 2013.

Type	Species	5th August				6th August				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	18(5)	16	52	86(5)	383(1)	51	160	594(1)	401(6)	67	212	680(6)
	Sooty shearwater	0	0	0	0	5	0	0	5	5	0	0	5
	Manx shearwater	0	6	7	13	4	2	5	11	4	8	12	24
	Balearic shearwater	1	0	0	1	0	0	0	0	1	0	0	1
	Storm petrel	0	1	2	3	0	2	2	4	0	3	4	7
	Gannet	24	49	93	166	13	20	50	83	37	69	143	249
	Dunlin	0	0	2	2	0	0	0	0	0	0	2	2
	Pomarine skua	0	0	0	0	1	0	0	1	1	0	0	1
	Arctic skua	0	0	1	1	1	0	2	3	1	0	3	4
	Great skua	2	0	4	6	2	0	0	2	4	0	4	8
	Common gull	0	1	2	3	0	0	2	2	0	1	4	5
	Herring gull	0	0	0	0	0	0	3	3	0	0	3	3
	Great black-backed gull	0	0	0	0	0	0	1	1	0	0	1	1
	Kittiwake	148(40)	39	307	494(40)	1260(100)	279	400	1939(100)	1408(140)	318	707	2433(140)
	Arctic tern	0	7	23	30	222	16	160	398	222	23	183	428
	Guillemot	3037	0	1	3038	1669	1	3	1673	4706	1	4	4711
	Razorbill	534	0	0	534	581	2	4	587	1115	2	4	1121
	Guillemot/razorbill	2052(140)	0	0	2052(140)	4933(70)	0	1	4934(70)	6985(210)	0	1	6986(210)
	Puffin	125	0	5	130	183	2	11	196	308	2	16	326
Mammals	White-beaked dolphin	7	0	0	7	4(4)	0	0	4(4)	11(4)	0	0	11(4)
	Harbour Porpoise	22	0	0	22	5	0	0	5	27	0	0	27
	Grey Seal	1	0	0	1	0	0	0	0	1	0	0	1
	Minke Whale	4	0	0	4	1	0	0	1	5	0	0	5

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.5. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 9th and 19th September 2013.

Type	Species	9th September				19th September				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Red-throated diver	0	0	0	0	0	0	1	1	0	0	1	1
	Fulmar	93	81	226	400	18	33	89	140	111	114	315	540
	Storm petrel	0	0	0	0	0	1	0	1	0	1	0	1
	Petrel sp.	0	0	0	0	0	0	1	1	0	0	1	1
	Gannet	9	27	84	120	14	36	44	94	23	63	128	214
	Common scoter	0	0	7	7	0	0	0	0	0	0	7	7
	Kestrel	0	0	0	0	0	0	1	1	0	0	1	1
	Great skua	0	0	2	2	0	0	2	2	0	0	4	4
	Skua sp.	0	0	1	1	0	0	0	0	0	0	1	1
	Herring gull	0	1	0	1	0	1	3	4	0	2	3	5
	Great black-backed gull	1	1	3	5	0	0	2	2	1	1	5	7
	Kittiwake	0	1	4	5	0	0	2	2	0	1	6	7
	Guillemot	28	0	0	28	33	2	4	39	61	2	4	67
	Razorbill	33	0	0	33	12	3	5	20	45	3	5	53
	Guillemot/razorbill	3	0	0	3	10	0	0	10	13	0	0	13
	Puffin	208	0	1	209	38	1	1	40	246	1	2	249
	Auk sp.	1	0	0	1	0	0	0	0	1	0	0	1
	Meadow Pipit	0	0	0	0	0	0	39	39	0	0	39	39
Mammals	Harbour Porpoise	31	0	0	31	7	0	0	7	38	0	0	38

Table A1.6. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 5th and 9th November 2013.

Type	Species	5th November				9th November				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	20	78	166	264	18	21	28	67	38	99	194	331
	Storm petrel	0	0	1	1	0	0	0	0	0	0	1	1
	Gannet	9	25	50	84	6	12	11	29	15	37	61	113
	Greylag goose	0	0	2	2	0	0	0	0	0	0	2	2
	Pomarine skua	0	0	0	0	0	0	2	2	0	0	2	2
	Great skua	0	0	0	0	1	0	0	1	1	0	0	1
	Herring gull	1	5	23	29	0	17	14	31	1	22	37	60
	White-winged gull sp.	0	0	0	0	0	0	1	1	0	0	1	1
	Great black-backed gull	37	25	43	105	16(1)	15	18	49(1)	53(1)	40	61	154(1)
	Large gull sp. (HG, LB or GB)	1	0	2	3	0	0	6	6	1	0	8	9
	Kittiwake	1	1	20	22	2	2	12	16	3	3	32	38
	Guillemot	20	1	15	36	184	6	7	197	204	7	22	233
	Razorbill	3	0	1	4	6	10	36	52	9	10	37	56
	Guillemot/razorbill	0	0	0	0	22	1	23	46	22	1	23	46
	Little Auk	1	0	4	5	0	0	2	2	1	0	6	7
	Puffin	5	0	5	10	7	1	0	8	12	1	5	18
	Auk sp.	0	0	4	4	0	0	0	0	0	0	4	4
Mammals	Common Seal	0	0	0	0	1	0	0	1	1	0	0	1
	Grey Seal	1	0	0	1	0	0	0	0	1	0	0	1
	Seal sp.	0	0	0	0	1	0	0	1	1	0	0	1

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.7. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 25th November and 29th December 2013.

Type	Species	25th November				29th December				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Red-throated diver	0	0	1	1	0	0	0	0	0	0	1	1
	Fulmar	22	81	250	353	6	23	41	70	28	104	291	423
	Gannet	1	5	21	27	1	6	13	20	2	11	34	47
	Great skua	0	0	0	0	0	0	1	1	0	0	1	1
	Herring gull	3	35	43	81	49	25	134	208	52	60	177	289
	Great black-backed gull	6	15	25	46	32	16	41	89	38	31	66	135
	large gull sp. (HG, LB or GB)	0	0	2	2	8	0	1	9	8	0	3	11
	Kittiwake	0	4	8	12	0	4	8	12	0	8	16	24
	Guillemot	64	2	9	75	16	6	9	31	80	8	18	106
	Razorbill	3	0	3	6	0	0	25	25	3	0	28	31
	Guillemot/razorbill	3	1	8	12	1	0	0	1	4	1	8	13
	Little Auk	1	0	0	1	0	0	0	0	1	0	0	1
	Puffin	3	0	3	6	0	0	0	0	3	0	3	6
Mammals	Risso's Dolphin	2	0	0	2	0	0	0	0	2	0	0	2
	Harbour Porpoise	0	0	0	0	2	0	0	2	2	0	0	2
	Grey Seal	2	0	0	2	1	0	0	1	3	0	0	3

Table A1.8. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1, 3 and 6 to 23 on 7th and 19th February 2014.

Type	Species	7th February				19th February				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	0	30	84	114	7	7	18	32	7	37	102	146
	Gannet	0	0	1	1	0	1	18	19	0	1	19	20
	Herring gull	12(1)	46	71	129(1)	1	28	93	122	13(1)	74	164	251(1)
	Great black-backed gull	6	14	16	36	1	11	23	35	7	25	39	71
	Large gull sp. (HG, LB or GB)	0	0	2	2	0	0	18	18	0	0	20	20
	Kittiwake	1	1	0	2	1	1	7	9	2	2	7	11
	Guillemot	11	0	26	37	46	6	12	64	57	6	38	101
	Razorbill	4	0	5	9	22	0	1	23	26	0	6	32
	Guillemot/razorbill	0	0	1	1	0	0	4	4	0	0	5	5
	Puffin	0	0	0	0	0	0	1	1	0	0	1	1
	Auk sp.	0	0	0	0	0	1	0	1	0	1	0	1
Mammals	Harbour Porpoise	0	0	0	0	3	0	0	3	3	0	0	3
	Grey Seal	1	0	0	1	1	0	0	1	2	0	0	2

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.9. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 20 and 22 on 26th March and 2nd April 2014.

Type	Species	26th March				2nd April				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	0	7	14	21	25	5	7	37	25	12	21	58
	Gannet	2	7	47	56	1	5	18	24	3	12	65	80
	Common gull	0	0	0	0	0	0	2	2	0	0	2	2
	Lesser black-backed gull	0	0	0	0	0	1	0	1	0	1	0	1
	Herring gull	1	13	12	26	0	1	8	9	1	14	20	35
	Great black-backed gull	0	0	4	4	0	2	1	3	0	2	5	7
	Kittiwake	0	34	57	91	8	11	19	38	8	45	76	129
	Guillemot	7	11	92	110	65	73	400	538	72	84	492	648
	Razorbill	0	2	5	7	12	6	14	32	12	8	19	39
	Guillemot/razorbill	0	0	31	31	0	10	5	15	0	10	36	46
	Little Auk	1	0	0	1	0	0	2	2	1	0	2	3
	Puffin	1	0	3	4	5	0	2	7	6	0	5	11
	Black redstart	0	0	0	0	0	0	1	1	0	0	1	1
Mammals	Harbour Porpoise	0	0	0	0	1	0	0	1	1	0	0	1
	Common Seal	0	0	0	0	1	0	0	1	1	0	0	1

Table A1.10. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 20th April and 28th April 2014.

Type	Species	20th April				28th April				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	1	8	15	24	6	7	18	31	7	15	33	55
	Gannet	0	6	15	21	0	9	18	27	0	15	33	48
	Herring gull	0	1	1	2	0	0	0	0	0	1	1	2
	Great black-backed gull	0	0	1	1	0	0	0	0	0	0	1	1
	Kittiwake	0	11	54	65	13	27	93	133	13	38	147	198
	Guillemot	41	179	696	916	85	19	75	179	126	198	771	1095
	Razorbill	3	30	42	75	2	0	2	4	5	30	44	79
	Guillemot/razorbill	0	0	79	79	0	0	0	0	0	0	79	79
	Puffin	0	2	0	2	1	0	1	2	1	2	1	4
	Auk sp.	0	0	2	2	0	0	0	0	0	0	2	2
	Robin	0	0	1	1	0	0	0	0	0	0	1	1
Mammals	Small cetacean	0	0	0	0	1(1)	0	0	1(1)	1(1)	0	0	1(1)
	Harbour Porpoise	4	0	0	4	2	0	0	2	6	0	0	6
	Grey Seal	1	0	0	1	1	0	0	1	2	0	0	2

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.11. Birds and marine mammals: summary of raw numbers recorded during ESAS surveys of transects 1 to 23 on 2nd and 3rd May 2014.

Type	Species	2nd May				3rd May				Subtotals			Grand Total
		On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	Total seen	On water	Flying - in transect	Flying - not in transect	
Birds	Fulmar	7	16	29	52	0	2	13	15	7	18	42	67
	Gannet	1	7	18	26	0	3	10	13	1	10	28	39
	Kittiwake	74(10)	56	78	208(10)	1	164	89	254	75(10)	220	167	462(10)
	Guillemot	239(6)	43	76	358(6)	51	45	291	387	290(6)	88	367	745(6)
	Razorbill	1	0	5	6	0	0	3	3	1	0	8	9
	Puffin	2	0	1	3	0	0	0	0	2	0	1	3
	Auk sp.	0	0	0	0	0	0	3	3	0	0	3	3
Mammals	Grey Seal	1	0	0	1	0	0	0	0	1	0	0	1
	Minke Whale	1(1)	0	0	1(1)	0	0	0	0	1(1)	0	0	1(1)

Number in brackets indicates how many of the total number of individuals on the water were recorded on-effort but not in-transect

Table A1.12. Birds and marine mammals: additional off-effort records from within survey area during ESAS surveys June 2013 – May 2014.

Species	Survey period																				Total
	1		2		3		4		6		7		9		10		11		12		
	8 Jun	9 Jun	8 Jul	9 Jul	5 Aug	6 Aug	9 Sep	19 Sep	05 Nov	09 Nov	25 Nov	29 Dec	7 Feb	19 Feb	26 Mar	2 Apr	20 Apr	28 Apr	2 May	3 May	
Fulmar			2						1			1									4
Sooty shearwater					1	1															2
Storm petrel	6			4	2		1														13
Gannet			1																		1
Common scoter												1									1
L. bl. ba. gull	1																				1
Herring gull	101		92	3		1			1	3	7	24	3			1					236
Glaucous gull											1										1
G. bl. ba. gull				2	1							10									13
Kittiwake	60					1						1									62
Guillemot/razorbill	80																				80
Swift				2																	2
Swallow				2																	2
Marine mammal sp.			1																		1
Cetacean sp.					1			1													2
White-beaked dolphin					5																5
Dolphin sp.			3	1	2		1														7
Harbour Porpoise			7	26	5	5	11	1			2					1	1		4		63
Common Seal				1																	1
Grey Seal	6	1	1	1	1												1		1	1	13
Minke Whale	1			2	1																4

Table A1.13. Behaviour recorded for each marine mammal sighting in each survey

Species and behaviour	8/6	9/6	6/7	9/7	5/8	6/8	9/9	19/9	5/11	9/11	25/11	29/11	7/2	19/2	26/3	2/4	20/4	28/4	2/5	3/5
Harbour porpoise																				
Slow swim	5	16	7	38	17	6	31	3		1		1		3		2	6	2	4	
Fast swim		3	5	7	13	4	9	5			2	1				1				
Milling				19	5		11	2												
White-beaked dolphin																				
Slow swim	3	10			12															
Fast swim		4				4														
Breaching		6																		
Grey seal																				
Slow swim	2		4	4	2		1				2		1	1			1	1	2	
Bottling	7	5		1					1			1					1			
Escape dive																				1
Minke whale																				
Slow swim	2			4	7	1													1	
Logging				1																
Harbour seal																				
Bottling			1							1										
Slow swim				1																
Escape dive																1				
Risso's dolphin																				
Slow swim											2									
Unidentified species																				
Dolphin																				
Slow swim		3	1	3																
Fast swim			2																	

Species and behaviour	8/6	9/6	6/7	9/7	5/8	6/8	9/9	19/9	5/11	9/11	25/11	29/11	7/2	19/2	26/3	2/4	20/4	28/4	2/5	3/5
Breaching					2		1													
Seal																				
Logging			1																	
Bottling									1	1										
Cetacean																				
Slow swim					1			1												
Small cetacean																				
Slow swim																		1		
Marine mammal																				
Diving from surface			1																	

APPENDIX 2. REVIEW OF OFFSHORE WIND FARM IMPACTS ON SEABIRDS

Introduction

1. Species-specific summaries of the potential effects of offshore windfarms presented here are based on the most comprehensive review currently available: 'Assessing vulnerability of marine bird populations to offshore windfarms'(Furness, Wade & Masden, 2013) . The review synthesises the available results from a wide range of ornithological monitoring at offshore windfarms and assesses species-specific collision risk, displacement and disturbance vulnerability. It uses data and expert opinion to update and develop the species sensitivity indices first proposed by Garthe and Huppop (2004) and provides collision and displacement/disturbance vulnerability indices for 38 marine bird species. It is particularly relevant to the proposed Project as species-specific conservation importance measures used to calculate the vulnerability index use the proportion of the biogeographic population that occurs in Scotland. Additionally, a proportion of sample data on which the vulnerability scores are based are from bird monitoring in the same general sea area, namely, Moray Firth and Neart na Gaoithe, Firth of Forth.

2. In Furness *et al*. (2013) collision risk vulnerability index values range between 0 and 1,306. These values are categorised and described in the species specific reviews here as very low (<200), low (200-400), moderate (400-600), high (600-1,000) and very high (>1,000). Displacement/disturbance index values range between 0 and 32 and are categorised and described as very low (≤5), low (6-10), moderate (11-15), high (16-20) and very high (>20). Descriptors for both collision risk and displacement/disturbance indices were determined from by-eye assessments of Figs A2.1 and A2.2 respectively.

3. Included in the review are all species with a total of 10 or more individuals recorded on ESAS surveys between June 2013 and May 2014 and all species recorded at least once during ESAS surveys that have an above average conservation importance score in Furness *et al*. (2013).

Limitations of the review

4. The review by Furness *et al*. (2013) assesses seabird vulnerability to offshore windfarms based on best information available at the time of writing. However, as the authors recognise, limited and inconsistent information on macro-avoidance - birds altering their flight path to avoid the whole windfarm - and micro-avoidance - birds entering the windfarm and avoiding individual turbines – make it difficult to assess reliably marine bird vulnerability to offshore wind energy development (Furness *et al*., 2013). Analysis of ongoing GPS tracking data (e.g. FAME project http://www.fameproject.eu/en/) are likely to improve understanding of how seabirds respond to windfarms and will likely require that statements in (Furness *et al*., 2013), and here, be revised in the near future.

5. A feature of much of the data used in Furness *et al*. (2013) and, as a requirement of the ESAS method, the bird data in this report, is that it is obtained from boat-based monitoring during good sea conditions (sea states 0 to 4) at wind speeds below 17 knots. Seabird behaviour during poor weather conditions and above these wind-speeds is therefore poorly represented. Offshore industry wind-speed data for the Hywind Pilot Park (http://www.4coffshore.com/windfarms/windspeeds.aspx) gives a 10-year (2000-2009) mean of 10.31 m/s (20 knots). It follows that the majority of the data on which Furness *et al*. (2013) is based and bird data used to assess the likely impact of the proposed Hywind Project will represent seabird behaviour for less than 50% of the time in this location. Analysis of current and future GPS seabird tracking data will allow behaviour in adverse weather conditions to be more fully incorporated into vulnerability indices. Finally, the extent to which seabirds habituate to offshore windfarms is not well understood and largely beyond the scope of Furness *et al*. (2013). For different species, this may have positive and/or negative effects on vulnerability through reduced habitat loss and increased collision risk respectively.

Fig. A2.1. Collision risk vulnerability index scores (based on results in Furness et al. 2013) for seabirds recorded during ESAS surveys between June 2013 and May 2014

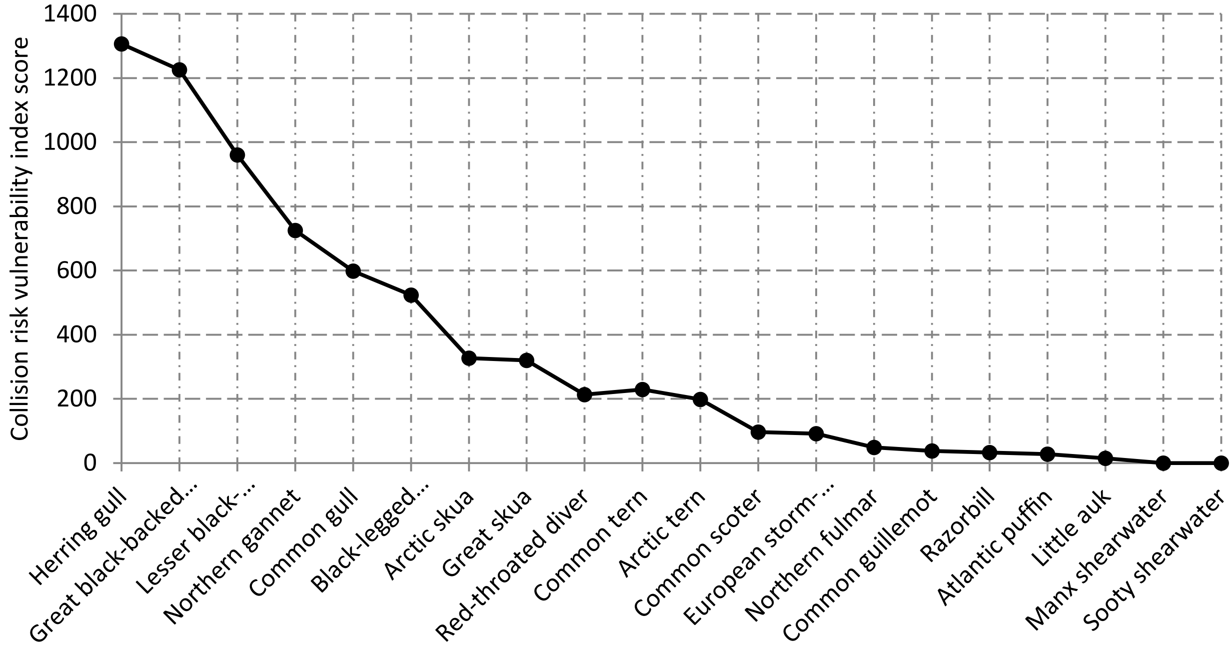
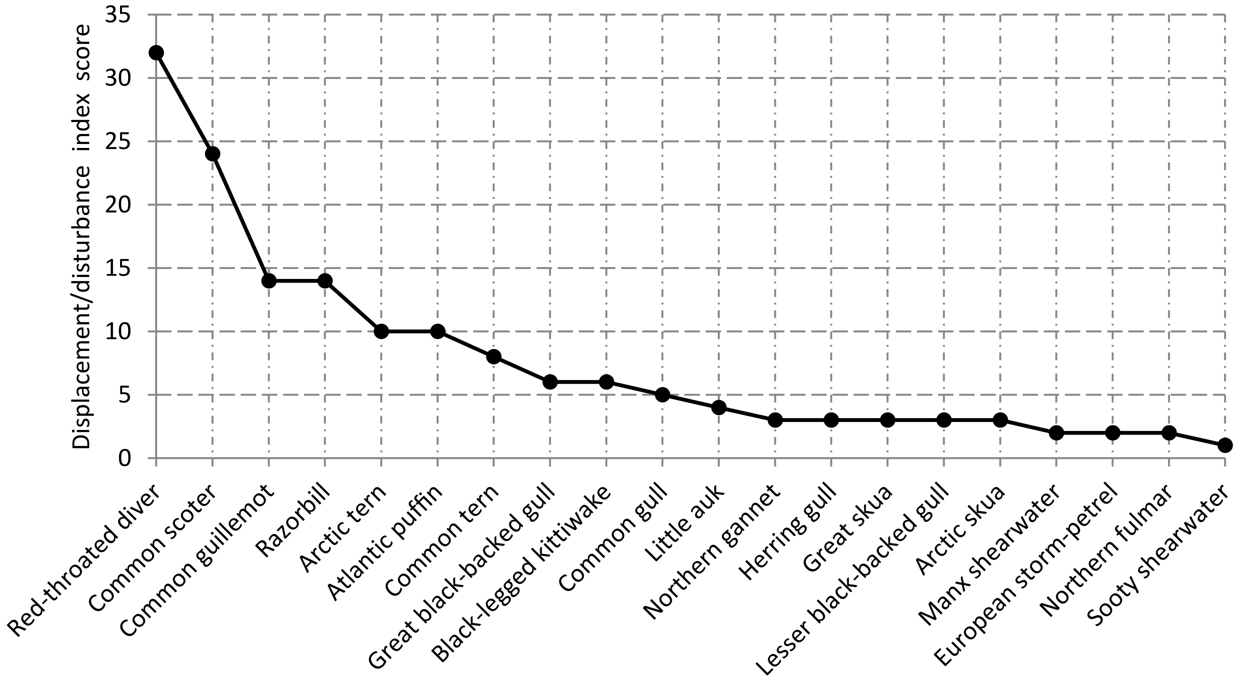


Fig. A2.2 Displacement/disturbance vulnerability index scores (based on results in Furness et al. 2013) for seabirds recorded during ESAS surveys between June 2013 and May 2014



Species-specific impact reviews

Fulmar

6. For collision risk, findings in Furness *et al*. (2013) indicate that fulmar has very low vulnerability (Fig. A2.1). This is principally explained by a low proportion of birds (1%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.).

7. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that fulmar has very low vulnerability (Fig. A2.2). This is principally attributed to low sensitivity to disturbance and generalist foraging strategies over large marine areas.

Storm petrel

8. For collision risk, findings in Furness *et al*. (2013) indicate that storm petrel has very low vulnerability (Fig. A2.1). This is principally explained by a very low proportion of birds (2%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and very high flight manoeuvrability.

9. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that storm petrel has very low vulnerability (Fig. A2.2). This is principally attributed to a low sensitivity to disturbance and generalist foraging strategies over large marine areas.

Manx shearwater

10. For collision risk, findings in Furness *et al*. (2013) assess Manx shearwater as the second least vulnerable of the 38 seabird species reviewed (Fig. A2.1) because the species is assessed not to fly at turbine blade height (ca. 20-150 m a.s.l.).

11. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that Manx shearwater has very low vulnerability (Fig. A2.2). This is principally attributed to a very low sensitivity to disturbance and generalist foraging strategies over large marine areas.

Gannet

12. For collision risk, findings in Furness *et al*. (2013) indicate that gannet has a relatively high vulnerability compared to the other seabird species assessed (Fig. A2.1). This is principally explained by the proportion of birds (16%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a high conservation importance score.

13. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that gannet has very low vulnerability (Fig. A2.2). This is attributed to a low sensitivity to disturbance and generalist foraging strategies over large marine areas.

Arctic skua

14. For collision risk, findings in Furness *et al*. (2013) indicate that Arctic skua has low vulnerability (Fig. A2.1). This is principally explained by a proportion of birds (10%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and very high flight manoeuvrability.

15. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that Arctic skua has very low vulnerability (Fig. A2.2). This is principally attributed to low sensitivity to disturbance and generalist foraging strategies.

Great skua

16. For collision risk, findings in Furness *et al*. (2013) indicate that great skua has low vulnerability (Fig. A2.1). This is principally explained by a proportion of birds (10%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and very high flight manoeuvrability.

17. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that great skua has very low vulnerability (Fig. A2.2). This is principally attributed to low sensitivity to disturbance and generalist foraging strategies.

Common gull

18. For collision risk, findings in Furness *et al*. (2013) indicate that common gull has relatively moderate vulnerability (Fig. A2.1) compared to other seabird species assessed. This is principally explained by the proportion of birds (23%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.), very high flight manoeuvrability combined with an average conservation importance score.

19. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that common gull has very low vulnerability (Fig. A2.2). This is principally attributed to below average sensitivity to disturbance and above average habitat use flexibility.

Herring gull

20. For collision risk, Furness *et al*. (2013) assess herring gull as the most vulnerable of the 38 seabird species reviewed (Fig. A2.1). This very high collision risk vulnerability is principally explained by a relatively high proportion of birds (35%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a high conservation importance score.

21. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that herring gull has very low vulnerability (Fig. A2.2). This is principally attributed to below average sensitivity to disturbance and generalist foraging strategies over large marine areas.

Great black-backed gull

22. For collision risk Furness *et al*. (2013) assess great black-backed gull as the second most vulnerable of the 38 seabird species reviewed (Fig. A2.1). This very high collision risk vulnerability is principally explained by a relatively high proportion of birds (35%) flying at turbine blade height (ca. 20-150 m a.s.l.) and a high conservation importance score.

23. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that great black-backed gull has low vulnerability (Fig. A2.2). This is principally attributed to below average sensitivity to disturbance, and above average habitat use flexibility.

Kittiwake

24. For collision risk, findings in Furness *et al*. (2013) indicate that kittiwake has relatively moderate vulnerability (Fig. A2.1) compared to other seabird species assessed. This is principally explained by the proportion of birds (16%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.), very high flight manoeuvrability, above average time spent flying and night-time flying and an average conservation importance score.

25. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that kittiwake has low vulnerability (Fig. A2.2). This is principally attributed to below average sensitivity to disturbance, and above average habitat use flexibility.

Arctic tern

26. For collision risk, findings in Furness *et al*. (2013) indicate that Arctic tern has very low vulnerability (Fig. A2.1). This is principally due to the low proportion of birds (5%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and very high flight manoeuvrability.

27. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that Arctic tern has moderate vulnerability (Fig. A2.2) This is principally attributed to below average sensitivity to disturbance, habitat specific foraging strategies combined with a high conservation importance score.

Common guillemot

28. For collision risk, findings in Furness *et al*. (2013) indicate that common guillemot has very low vulnerability (Fig. A2.1). This is principally explained by a very low proportion of birds (1%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a low proportion of time spent flying.

29. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that common guillemot has moderate vulnerability (Fig. A2.2). This is attributed to above average sensitivity to disturbance, habitat specific foraging strategies combined with a high conservation importance score.

30. The extent to which guillemots are displaced from operational windfarms differs between studies.

31. There are few analyses of post-construction monitoring at offshore windfarms where breeding guillemot are within foraging range. At Robin Rigg, West Scotland the post-construction monitoring report covering pre-construction (over 4 years), construction (ca. 2 years) and post-construction (2 years) states a decline in numbers during the construction phase followed by a degree of recovery post-construction with monthly patterns of abundance reported to be 'fairly consistent between the phases of monitoring (Canning *et al*. 2013). At Barrow offshore windfarm, NW England no significant trends in auk numbers were reported after a single year of post-construction monitoring at the windfarm and a reference site. (Barrow Offshore Wind Ltd, 2009). At the adjacent Ormonde windfarm, analysis of results from a single post-construction survey in (May) concluded that guillemots were 'significantly' more abundant in the reference area than in the windfarm area pre-construction, however, were significantly more abundant in the windfarm area than the reference area during construction (Vatenfall, 2010). At North Hoyle, Wales, a 'highly significant' increase in guillemot numbers (estimated at 55%) was reported since the windfarm became operational. However, this finding appears to result from comparing monitoring results from the operational period with those from the construction period (PMSS, 2006). At Arklow Bank "no statistical difference" in the number of guillemots recorded between pre and post construction was reported (Barton *et al.*, 2009). Despite potential weaknesses in the datasets on which many of these statements are based, taken together they suggest, that in the early post-construction phase at least, there is a potential for guillemots to be partly displaced from the windfarm footprint during the breeding season.

32. Outside the breeding season monitoring studies at offshore windfarms in Denmark and the Netherlands indicate conflicting evidence on the extent that guillemot are displaced, however, 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. Studies at Horns Rev, Denmark report that although guillemots were recorded in relatively low numbers in the windfarm and buffer compared to the wider monitoring area during the pre-construction surveys, no guillemots occurred within 4 km of the windfarm during the construction period representing a significant decrease. In the operational period the selectivity index for the windfarm plus a 4 km buffer was significantly lower, compared to the equivalent figure for the pre-construction period suggesting a reduced use of the sea area occupied by, and surrounding the windfarm during the operational period (Diersche & Garthe 2006). However, these findings were not corroborated by a significant result when a subset of the Horns Rev guillemot data was analysed (Petersen *et al*., 2006) and therefore some caution is implied when interpreting the response of guillemot to the Horns Rev windfarm. Furthermore, the authors stress that displaced birds should not only

be attributed to the physical presence of the turbines, but possibly also to service boat traffic, which occurred on *ca.* 150 days of the year.

33. Compared to Horns Rev, the modelled results from the Egmond aan Zee and the adjacent Princess Amalia windfarm, the Netherlands (Leopold, Dijkman & Teal, 2011) did not conclusively show that guillemots were displaced from either of these windfarms. Where guillemots were significantly displaced (2 out of 9 survey visits) this was not total, with birds recorded within both windfarms. However, the authors suggest that higher turbine density probably increased displacement of guillemots. The authors of this study conclude that the magnitude of the displacement effect for guillemots was less than 50% (Leopold *et al*., 2011).

34. There is limited evidence of guillemot flights deflecting around or away from windfarms. Visual monitoring during boat surveys at Egmond aan Zee reported that guillemots showed a "strong avoidance behaviour in their flight pattern" in the vicinity of the farm, deflecting typically at between 2 km and 4 km from the windfarm perimeter (Lindeboom *et al*., 2011). At Horns Rev, Denmark, visual monitoring from an observation platform positioned at the edge of the windfarm found that 3.8% (sample size not given) of flying guillemots/razorbills were either within or flying into the windfarm (Diersche & Garthe, 2006). Summarising the barrier effect of windfarms on seabirds in German marine areas, guillemots were categorised as having a strong deflection/avoidance response (Diersche & Garthe, 2006).

35. The risk of guillemots colliding with wind turbine rotors is likely to be very low based on reported flying heights at operational windfarms. Of approximately 1,000 flying guillemots recorded during two years of monitoring in the vicinity of Arklow Bank, Ireland, no birds were recorded flying at a height over 20 m above the sea surface (Barton, Pollock & Harding, 2009, 2010). At North Hoyle, Wales, only 4% (3 of 85) birds flying in the vicinity of the windfarm were above 20 m. The review of offshore windfarm effects on birds (Diersche & Garthe 2006) acknowledges the low flying height of guillemots. Although the evidence from these operational windfarms strongly suggests a very low risk of guillemots colliding with turbines, a single fatality reported in a review of the number of collision victims at windfarms in eight European countries demonstrates that collisions do occur (Hötker, Thomsen & Jeromin 2006). It is not known if this fatality occurred as a result of collision with a rotor or a turbine tower.

Razorbill

36. For collision risk, findings in Furness *et al*. (2013) indicate that razorbill has very low vulnerability (Fig. A2.1). This is principally explained by a very low proportion of birds (1%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a low proportion of time spent flying.

37. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that razorbill has moderate vulnerability (Fig. A2.2). This is attributed to above average sensitivity to disturbance, habitat specific foraging strategies combined with a high conservation importance score.

38. In general, the evidence of the displacement, barrier and collision effects of existing windfarms on razorbills appears to be similar as those for guillemot, a closely related species. This is partly because the difficulty in identifying between the two species has resulted in undifferentiated records with findings and conclusions grouped as guillemot/razorbill. This is justified because it is assumed that these species respond similarly to windfarm developments (Christensen, Clausager & Petersen, 2003).

39. There are few analyses of construction and post-construction monitoring at offshore windfarms where breeding razorbill are within foraging range. At Robin Rigg West Scotland, Canning *et al*. (2013) report a decline in the number of razorbills during the construction phase compared to the pre-construction period followed by a degree of recovery during the post-construction phase with slightly more birds recorded during operational year two compared with year one. The monthly patterns of abundance were reported as consistent between monitoring phases apart from during September when apparently many more razorbills were recorded during pre-construction compared to with construction and post-construction monitoring (Canning *et al*., 2013) (Note. The text contradicts the cited graph, the graph showing pre-construction peak in October). At North Hoyle, Wales, razorbills were recorded within the windfarm perimeter (PMSS 2006), and at Arklow Bank, Ireland, the numbers of razorbills in the vicinity of the single row of turbines were reported to have increased generally, however there was "no evidence of any

relationship between the increase in numbers and the distance to the nearest turbine" (Barton *et al*., 2009). Despite weaknesses in the datasets on which some of these statements are based, taken together they suggest, that in the early post-construction phase at least, there is a potential for razorbills to be partly displaced from the windfarm footprint during the breeding season.

40. Outside the breeding season at Horns Rev, Denmark razorbills/guillemots were totally displaced from the windfarm during the construction phase and showed a reduced selectivity of the windfarm and its buffer during the operational phase (Diersche & Garthe, 2006). By contrast, the modelled results for razorbill from Egmond aan Zee, the Netherlands, identified only one of five surveys where the probability of finding birds within the perimeter of the windfarm was significantly lower than expected on the basis of the general distribution pattern in the larger Survey Area. Some razorbills, like some guillemots, were found amongst the Egmond aan Zee turbines, but unlike guillemots they were never recorded within the adjacent Princess Amalia windfarm where turbine density was higher, suggesting that 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%.

41. There is limited evidence in post-construction monitoring reports of razorbill flights deflecting around or away from windfarms. Studies at Egmond aan Zee reported that razorbills showed "strong avoidance behaviour in their flight pattern" in the vicinity of the farm deflecting typically at between 2 km and 4 km from the windfarm perimeter (Lindeboom *et al*., 2011). At Horns Rev, visual monitoring from an observation platform positioned at the edge of the windfarm found that 3.8% (sample size not given) of flying guillemots/razorbills were either within or flying into the windfarm (Diersche & Garthe, 2006). Summarising the barrier effect of windfarms on seabirds in German marine areas, razorbills were categorised as having a strong deflection/avoidance response (Diersche & Garthe, 2006).

42. The risk of razorbills colliding with wind turbines is likely to be very low based on reported flying heights from existing windfarm studies. Of approximately 1,100 flying razorbills monitored over two years in the vicinity of the Arklow Bank windfarm, Ireland, no birds were recorded flying at a height over 20 m above the sea surface (Barton *et al*. 2009, 2010). At North Hoyle, Wales, of 85 birds flying in the vicinity of the windfarm three were flying higher than 20 m above the sea surface. The review of offshore windfarm effects on birds acknowledges the general low flying height of razorbills (Diersche & Garthe, 2006). Evidence from other operational windfarms to some extent corroborates the very low risk of razorbills colliding with turbines with no fatalities recorded in a review of the number of collision victims at windfarms in eight European countries (Hötker *et al*. 2006) although the low probability of detecting such fatalities should be recognised.

Puffin

43. For collision risk, findings in Furness *et al*. (2013) indicate that puffin has very low vulnerability (Fig. A2.1). This is principally explained by a very low proportion of birds (1%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a low proportion of time spent flying.

44. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that puffin has low vulnerability (Fig. A2.2). This is attributed to below average sensitivity to disturbance, habitat specific foraging strategies combined with a high conservation importance score.

45. There is little field-based evidence on the effects on puffins from operational windfarms. This is because existing offshore windfarms for which published results are available are located in areas where puffins are naturally scarce. Occasionally puffins were recorded during Horns Rev, Egmond aan Zee and Arklow Bank post-construction monitoring but not in sufficient numbers to undertake any statistical analysis of effects (Leopold *et al*., 2011; Petersen, 2005).

46. The extent to which windfarms are likely to act as a barrier to puffins is unknown. However, a recent study looking at the theoretical energy costs of a barrier effect concludes, "If an Atlantic puffin were to travel an additional 10,000 m due to the presence of windfarms then it would expend 103% of its DEE [daily energy expenditure] on the extended flight activity alone" (Masden *et al*., 2010). Given the high numbers of puffins present in and around the proposed Project, the within-foraging range puffin population could be adversely affected if puffins are deflected away or around the proposed Project in order to exploit foraging

opportunities. Note that, the relative energetic cost to puffin of additional flight activity is estimated to be approximately three times that of common guillemot due to their less efficient flight, highlighting the caution required when assuming similar effects for apparently similar species.

47. The review of offshore windfarm effects on birds categorises displacement, barrier and collision risk effects all as unknown for puffin (Diersche and Garthe, 2006). No puffin fatalities are reported in a review of the number of collision victims at windfarms in eight European countries (Hötker *et al*., 2006) although the very low probability of detecting seabird fatalities should be recognised together with the natural scarcity of this species in the areas studied.

Little auk

48. For collision risk, findings in Furness *et al*. (2013) indicate that little auk has very low vulnerability (Fig. A2.1). This is principally explained by a low proportion of birds (1%) recorded flying at turbine blade height (ca. 20-150 m a.s.l.) and a low proportion of time spent flying.

49. For displacement and disturbance from windfarm developments, findings in Furness *et al*. (2013) indicate that little auk has very low vulnerability (Fig. A2.2). This is attributed to below average sensitivity to disturbance, above average habitat use flexibility and a low conservation importance score.

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APPENDIX 3. COLLISION RISK TO BARNACLE GEESE

In scoping opinion MS-LOT requested that the collision risk to Svalbard Barnacle geese that might migrate through the Hywind turbine deployment area should be addressed. This appendix summarises the analyses undertaken to demonstrate the approx. magnitude of this risk. The methods and parameters used for this exercise are described in WWT Consulting (2014) and Band (Band, 2000) were used Tables 1 and 2).

The method assumes that the population migrates evenly across a migration front (illustrated in WWT Consulting (2012) of 298 km wide and that the wind farm lies within the migration corridor with the turbines would be located parallel to this front (the worst case scenario).

The modelling predicts that for a 98% avoidance rate the average number of barnacle geese collisions due to the Hywind wind farm would be just 0.07 birds per year (Table 2).

Table 1. Parameter values for Stage 1 of Band Model for barnacle goose and Band Stage 1 collision risk prediction.

Parameter	Value
Bird length	0.7 m
Wingspan	1.5 m
Flap (0) or Glide (1)	Flap
Bird speed *(automatic)*	17.0 m/sec
WTG Unit no. blades	3
Rotor blade max chord	5.50 m
Rotor blade pitch	10.0 º
Rotor diameter	154m
Band Model Stage 1 collision risk prediction	7.1%

Table 2. Parameter values to calculate no. of transits per annum by Svalbard barnacle geese through rotors swept area and Band Stage 1 collision risk prediction.

Parameter	Value
Spring population	33,000
Autumn population	33,000
Migration front with	298 km
% of flight at rotor height	30%
Estimated flights p.a. at rotor height	19,800
Estimated no. of transits p.a. through the 5 Hywind rotors	51.2
No. of collisions p.a. from the 5 Hywind rotors with no avoidance (51.2 x stage 1 collision risk)	3.7
No. of collisions p.a. from the 5 Hywind rotors with 98% avoidance	0.07

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