

# **European Offshore Wind Deployment Centre** Environmental Statement

## Appendix 10.1: Ornithology Baseline and EIA Technical Report

**VATTENFALL**



**Technip**

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Aberdeen Renewable Energy Group



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**GENESIS**

# *Report*

## **Ornithological Baseline and Impact Assessment**

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## 1 NON TECHNICAL SUMMARY

This report presents the results from baseline ornithological surveys undertaken in order to inform the Environmental Impact Assessment (EIA) prepared for the proposed European Offshore Wind Deployment Centre (EOWDC) and the findings of the impact assessment undertaken.

The proposed EOWDC development lies to the north of Aberdeen, in Aberdeen Bay, approximately 2 km at its closest point, off the coast. The proposed development comprises of the potential installation of 11 wind turbines and a potential future option of an ocean laboratory, which would be subject to a separate application. The EOWDC is a test centre for wind turbine technology and therefore the potential structures of the wind turbines that could be installed are currently unknown. In order to take these uncertainties into account a worst case scenario has been applied when assessing the potential impacts.

Prior to undertaking any assessment a variety of bird surveys have been commissioned since 2005 aimed at identifying the potential bird sensitivities that may occur within Aberdeen Bay throughout the year. The surveys comprised of monthly boat-based bird surveys undertaken between February 2007 and April 2008 and again from August 2010 to present. Further boat-based bird surveys are planned until at least August 2011. Due to the proximity of the proposed development to land, Vantage Point surveys have been undertaken on a monthly basis for a period of three years between March 2005 and October 2005 and March 2006 to March 2008. The surveys complimented those undertaken by boat and provide data on birds present in nearshore waters of Aberdeen Bay. In addition to the boat-based and Vantage Point surveys, three studies using radar have been commissioned: in October 2005, April 2007 and April 2010. These radar studies provided information on the use of Aberdeen Bay over a wider area and during periods of darkness and or poor visibility.

The data from all the surveys have been used to help inform the impact assessment.

The impact assessment has considered all species of bird recorded from all surveys undertaken in Aberdeen Bay. It has also considered other sources of published data, e.g. North-east Scotland Bird Reports, JNCC aerial surveys (Söhle *et al.* 2006; Lewis *et al.* 2008) and the Birds of North-east Scotland (Buckland, Bell & Picozzi 1990).

The potential impacts on all bird species that were identified as qualifying species for a Special Protected Area (SPA) have been assessed in detail within the impact assessment. Other species which were recorded in significant numbers and had the potential to be impacted by the proposed EOWDC have also been addressed within the main impact assessment, Section 4. All other species that occurred in low numbers for which it was determined that there is unlikely to be a significant effect based on the data collected and relevant published documents have been summarised at the end of the report.

For the purposes of this impact assessment an evidence based approach has been used to determine potential impacts as well as expert judgement based on the baseline information and results from other offshore wind farms. An impact matrix has been used to provide a structure and consistency of approach and has been used as tool to help inform the impact assessment. However, the results from the impact matrices have not been considered to be definitive, nor in isolation. The assessment is ultimately based on the latest published data available on potential impacts, i.e. wherever possible an evidence based approach has been adopted.



The impact assessment recognises that under the EIA Regulations, significance is used to determine the relative importance of an effect on a feature. Whereas under the Habitats Regulations it is a coarse filter to determine whether a further Appropriate Assessment is required (IEEM 2010). In determining the level of significance for the EIA the recommendations made in Maclean *et al.* (2009) have been used.

Two types of sensitivity have been identified: Non-impact and Species specific sensitivities.

*Non-impact sensitivities* are based largely on legislative requirements and population sizes. Species with relatively small populations and/or are qualifying species for a designated site have been considered to be of high sensitivity. Species with larger populations or are a non-qualifying species are assessed as having a lower sensitivity.

*Species specific sensitivities* have been undertaken in line with recommendations made in Maclean *et al.* (2009). Sensitivities of species groups to particular impacts have been ranked and combined with the non-impact sensitivities to give an overall sensitivity. The main types of impact identified are:

- Collision Mortality,
- Barrier effect,
- Displacement (including disturbance and indirect impacts, i.e. depletion of prey).

### Collision Risk

Collision risk modelling has been undertaken based upon the Band *et al.* (2000) model. For the purposes of this assessment a range of avoidance rates have been considered to give a range of potential mortality rates. The avoidance rates used are 98%, 99% and 99.5% based on SNH guidance (SNH 2010). However, in order to determine potential effects a precautionary 98% has been used for nearly all species within this EIA. Not all species recorded within Aberdeen Bay are at significant risk of collision. The level of risk depends on a large extent as to whether the species frequently flies at rotor height. Birds can fly at any height and may change depending upon weather conditions or behaviour. However, by using data from both site specific boat-based survey data and other extensive data sets from other offshore wind farm locations a large sample size of flight heights are available for collision risk assessment. The species selected for collision risk modelling have been selected on their frequency of flying at rotor height and the frequency at which they are recorded in Aberdeen Bay. Collision risk modelling was undertaken on the following species:

- |                      |                 |
|----------------------|-----------------|
| • Red-throated diver | • Guillemot     |
| • Fulmar             | • Common gull   |
| • Gannet             | • Herring gull  |
| • Cormorant          | • Kittiwake     |
| • Pink-footed goose  | • Sandwich tern |
| • Barnacle goose     | • Common tern   |
| • Common scoter      |                 |

### Barrier effect

Barrier effects may arise should the species avoid flying through the proposed development and by doing so incur additional energetic costs required to fly the extra distance around the turbines (Speakman, Gray & Furness 2009; Masden *et al.* 2010).

The risk of an impact is largely dependent on the number of times a bird may have to cross the obstruction and also the individuals' fitness. Should a bird be required to avoid an area only once or twice a year when undertaking a migration then it is likely that the potential impact will be lower than if a bird regularly flies around a barrier, e.g. between a feeding or roosting site (Speakman, Gray & Furness 2009).

In order to assess the potential impacts from displacement it is assumed that, unless data from other wind farms indicated otherwise, all individuals avoid flying through the site and detour around it and by doing so fly further than would have otherwise been the case. To calculate the potential length of a detour it is assumed that the detour started 1 km in front of the proposed development and that the bird detoured back on to the original course 1 km beyond the proposed development. Where appropriate, results from energetics modelling have been considered to assess the potential incremental increase in daily energy expenditure (Speakman, Gray & Furness 2009).

### Displacement

Disturbance caused by the proposed EOWDC may lead to displacement of birds from potential feeding areas, resulting in effective habitat loss. Displacement may be caused by disturbance from vessels associated with the proposed development or from secondary impacts, i.e. the depletion of prey in the development area. The significance of the displacement is difficult to quantify but for species that rely on localised or patchy food supplies the affect may be more significant than it is for species that have a wide area of food supply. Based on the Maclean *et al.* (2009) report, the impact assessment has considered sensitivity of a species depending on its habitat flexibility, i.e. how restricted is the species to a particular habitat preference.

### Significance of impact

The potential significance of the impact is based on the possible magnitude of an effect occurring and the overall sensitivity of each species to the impact. The results from which indicate the likely significance any impact may have on the receptor. However, this is only an indicative sensitivity and evidence from existing wind farms and expert judgement is used to determine whether the potential impact was likely to be either significant or adverse.

Where the potential significance is identified as being negligible or minor it is considered to be of limited or no concern. Moderate significance is of concern but may be tolerable depending on the causes that give rise to the potential impact. Major concerns are considered to be a potentially significant effect.

### Determining potential adverse effects.

The Habitats and Birds Directives require an assessment to be undertaken to determine whether there are any potential adverse effects on a species. In order to do this the impact assessment has identified all the relevant SPAs for which there may be an interaction with the qualifying species and the proposed development. The assessment to ascertain whether there is an adverse effect on site integrity is a judgement based one based on the best available evidence.

### Assessment of cumulative impacts

The cumulative impact assessment considers all other industries which have the potential to impact on the birds that may be present at the proposed development location, these include:

- Offshore renewables,

- Shipping,
- Aggregates,
- Dredging,
- Oil & gas.

Offshore renewable projects that have been identified as having the potential for a cumulative effect include two developments in the Moray Firth and three in the Firth of Forth. The sites in the Moray Firth are approximately 150 km to the north and those in the Firth of Forth approximately 120 km to the south of the proposed development.

The construction of the proposed EOWDC may overlap with construction activities being undertaken at other planned developments. However, given the stage of development of the renewable projects yet to be constructed and the uncertainty as to the types of foundations and turbines that will be used, there is sparse information available to incorporate into any impact assessment, which limits the effectiveness of cumulative assessments considering conceptual projects yet to be subject to a formal planning application and for which no environmental or design data are currently available.

Therefore, the cumulative impact assessment can only be undertaken with data available from the currently operating Beatrice demonstrator project in the Moray Firth. Although, the assessment does wherever possible consider potential cumulative impacts from other yet unconsented renewable projects.

Shipping associated with the harbour which has been undertaken in Aberdeen Bay over many centuries with currently approximately 16,000 vessel movements per year. There are no known plans that are likely to cause a significant increase in the level of shipping currently being undertaken in Aberdeen Bay and any impacts shipping may currently be having on the birds within Aberdeen Bay will be part of the baseline.

There are no aggregates activities within Aberdeen Bay. There are no licensed dredging sites within Aberdeen Bay but occasional dredging of the harbour may occur, with the next dredging scheduled for 2012.

Aside from associated shipping there are no oil and gas related activities within Aberdeen Bay.

### Assessment of in-combination impacts

The Conservation (Natural Habitats, & c.) Regulations 1994 (as amended) require that a Habitats Regulations Appraisal (HRA) must be conducted by a competent authority. The HRA considers the implications for European sites in view of the European sites conservation objectives, in respect of any plan or project which is not directly connected with or necessary to the management of the European site for conservation purposes and which is likely to have a significant effect on the European site either alone or *in-combination* with other plans or projects.

Therefore the term 'in-combination' will be used when considering the impacts of the proposals with other plans or projects on European sites.

The main industries considered for potential in-combination impacts are proposed offshore wind farms, aggregate industry, dredging, oil and gas and shipping. Of these, proposed offshore wind farms and shipping are the only activities identified for which there is a potential for an in-combination impact.

### Impact assessment summary

The results of the initial impact assessment identified 36 species of bird that due to either their conservation status, i.e. are a qualifying species for an SPA or due to the numbers recorded within the proposed development area could be impacted by the proposed development.

Following the use of matrices to indicate the significance of a potential impact arising from the construction, operation and decommissioning of the proposed development an evidence based assessment has been undertaken to determine the overall significance of the potential impacts.

The results indicate that for most species the proposed development is likely only to have a negligible or a minor effect on the species present.

However, the impact assessment has identified the potential for impacts of moderate significance on four species of bird: red-throated diver, little tern, Sandwich tern and common tern.

Red-throated diver may be displaced from the area of the proposed development during construction, operation and decommissioning phases. Site specific data indicate that although the higher numbers of red-throated diver occur to the north of the proposed development area a proportion of the local regional population may be displaced. The effects of the possible displacement on red-throated divers are unknown but could be significant were all those displaced not to survive. However, this scenario is considered improbable as the red-throated diver is not resident in Aberdeen Bay and the proposed development is in an area not favoured by red-throated diver. Any Divers that may be displaced will be able to move to other suitable foraging areas. Therefore, although the impact may be moderate in terms of displacement the actual impact on the Diver population within Aberdeen Bay will be negligible or minor.

Three species of Tern were identified as being at potential risk of a moderately significant impact due to possible indirect impact on their prey should pile driving occur during the construction period. However, it is also considered that any displacement of prey would be temporary as fish would return to the area following cessation of piling. Consequently, the possible impacts were considered to be of a temporary nature and would not have a long-term effect.

### Mitigation and Monitoring

Detailed mitigation and monitoring measures aimed to avoid, remove or reduce any potentially significant impacts will be developed more fully during consultation with the Regulator and their statutory advisors and other stakeholders.

The main potential impacts arising from the proposed development relate primarily to direct or indirect displacement effects on Divers and Terns. Mitigation measures that may be considered as measures to help avoid, remove or reduce them include:

- Minimising the proposed development area as far as practicable in the early design stage.
- Vessel management plans to ensure vessels minimise disturbance as far as practicable,
- Installing Foundation types that reduce noise levels during construction,
- Timing and duration of installation,
- Minimising aviation and navigation lighting.

It is important that monitoring is undertaken that is designed to address specific concerns or potential impacts identified during the EIA process. Poorly designed *ad hoc* monitoring is likely to be inefficient and not provide useful or meaningful results. It is therefore important that a detailed monitoring programme is developed in collaboration with the Regulator and statutory advisors and taking note of key stakeholders comments during the consultation period. A detailed monitoring programme aimed at specific issues or concerns would be developed with the Regulator and advisors should consent be granted.

## **2 BIRD SURVEY METHODS**

### **2.1 Introduction**

Three different types of bird surveys have been undertaken since 2005 in order to obtain suitable ornithological survey data to inform the Environmental Impact Assessment and, if required, Habitat Regulations Appraisals.

Monthly boat-based surveys were undertaken between February 2007 to April 2008 and an additional 12 months of surveys commenced in August 2010. In addition to the Boat-based surveys, three years of Vantage Point surveys were undertaken from March 2005 to October 2005 and between March 2006 and March 2008 and three radar surveys were carried out in October 2005, April 2006 and April 2010 (Figure 2-1).

The results from these surveys along with additional information have been used to help inform the Environmental Impact Assessment.

### **2.2 Boat-based Survey Methodology & Data Analysis**

#### **Survey Area and Transects Route**

There have been two periods of boat-based bird surveys undertaken in support of the proposed development.

Between February 2007 and April 2008 boat-based surveys were undertaken on a monthly basis. Each survey covered an area of 101.6 km<sup>2</sup>, which included the then proposed development site plus a buffer zone and a 'control' survey area located immediately to the north (Figure 2-2). The 'control' survey area of 50.8 km<sup>2</sup> was the same size as the then proposed EOWDC site (including the buffer zone). The site proposed at the time the surveys were being undertaken represented 12% of the total area surveyed, and 24% of the proposed EOWDC survey area. The distance of the shoreline to the proposed EOWDC survey area varied between 0.6 km to 7 km and to the 'control' survey area between 0.5 km to 6 km. The 'control' survey area was positioned in an area exhibiting similar physical attributes (bathymetry and seabed type) to that of the development site survey area (IECS 2008).

Various transect designs were considered when establishing the survey methodology (e.g. parallel to the coast, perpendicular and zigzag). At the time it was considered that a perpendicular alignment provided the best option in terms of data collection and analysis, as it best captured environmental factors such as depth and wave exposure. As such, the sampling design comprised a grid of systematically spaced line transects approximately perpendicular to the coast. The transects, spaced 1 km apart, were conducted perpendicular to the coast on an approximately east-west orientation (Figure 2-2).

The 'control' and development areas each consisted of 10 main transects 6.5 km long, together with nine short legs 1 km long, and therefore constituted two separate samples. The 20 transects were travelled over two days, preferably on two consecutive days (with 10 transects per day). The transects were steamed at a constant speed of approximately 8 knots. The survey route was designed to give a total boat transect length of 74 km per site, considered to be approximately the maximum length of transect which can be covered in daylight hours during the winter at this location.

The 'short legs', which preserved the spacing of 1 km between the main transects, were surveyed to gather additional data. The shoreward side was always covered in both the inshore and offshore short legs. To ensure coverage of the shallow areas, it was necessary to operate the 300 m band transect on the port side when

commencing from the south end of the site, and on the starboard side when starting from the north end of the site. The four start points for the 'control' and proposed EOWDC survey areas were randomised between the surveys. The transect band on the main transects were operated alternatively on the port and starboard sides to avoid the sun glare.

In order to reduce disturbance to birds (and marine mammals) prior to and after surveying, the survey vessel did not travel through the survey area when positioning or returning from the northernmost extent of the site. Instead, the boat followed an offshore route outside the survey area.

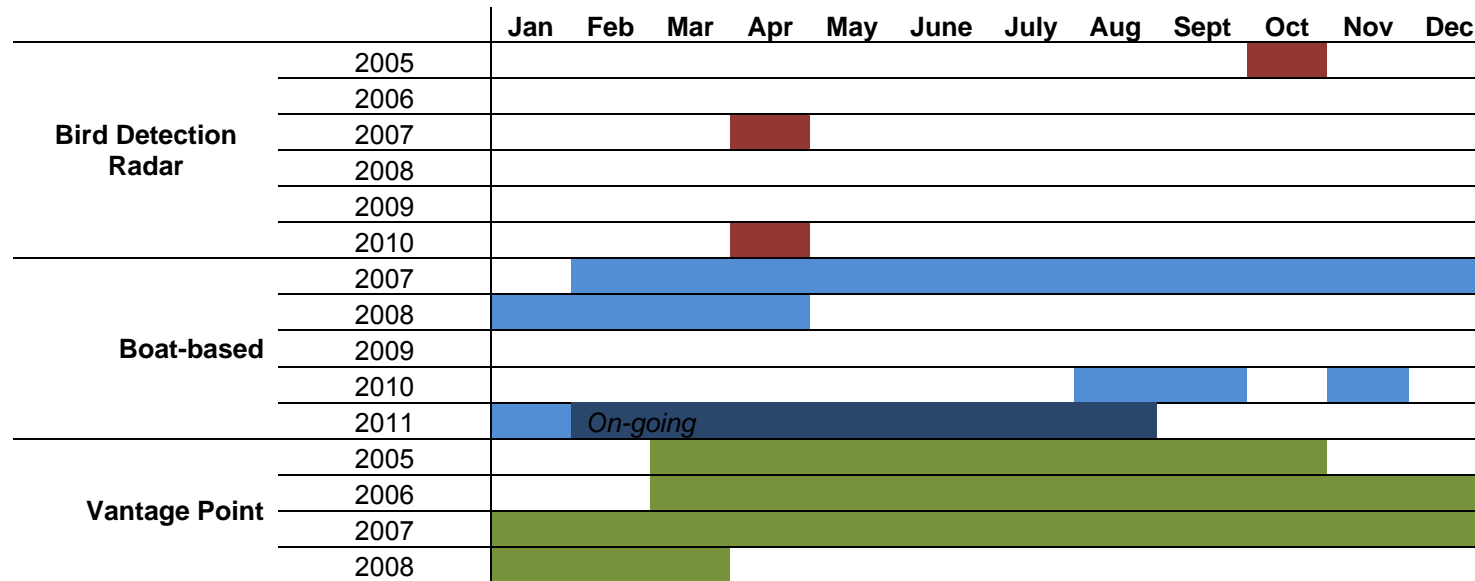
Following the completion of the Year 1 bird surveys the location and size of the proposed development was amended. This meant that although the previous surveys did cover the revised location for the proposed development (Figure 2-3), to ensure better potential for future monitoring an alternative survey area was designed for the boat-based bird surveys undertaken since August 2010 (Figure 2-4).

In addition to the differing survey area due to the revised location of the proposed development, the survey design was also amended to take into account advances in understanding of the limitations in using Before After Control Impact (BACI) designs. The use of the gradient approach allows distance from the development footprint to be included as a covariate within the analysis. Consequently, it improves the future potential to detect change in seabird distributions and abundances. Three areas were surveyed each month to the north, south and eastwards outwards to 25 km allowing a gradient approach to be used (SMRU 2011b). The total surveyed area each month was 339 km<sup>2</sup>, comprising of three strata: 150.8 km<sup>2</sup> (north), 82.8 km<sup>2</sup> (south) and 105.2 km<sup>2</sup> (offshore) (Figure 2-4).

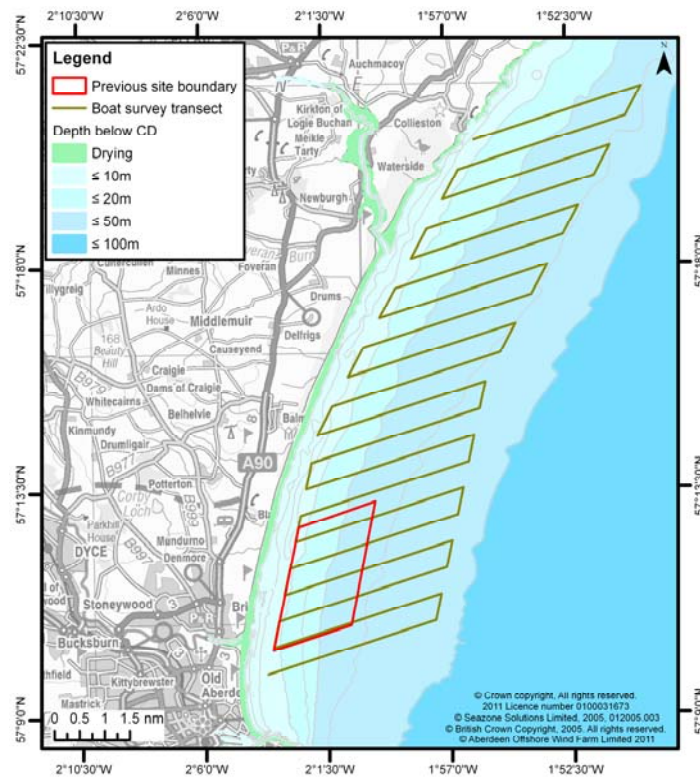
The surveys undertaken since August 2010 have also been undertaken in equally spaced zigzag line transect as opposed to linear parallel surveys as previously undertaken. By doing so this allows continuous surveying and less time wasted in transit between parallel transects. It also provides coverage of the full depth, distance to shore and wave exposure gradients present. The survey design was carried out using the Distance software to ensure even coverage probability within each stratum.

The start point of transects routes was randomised to account for any confounding effects of time of day and port activity e.g. bird activity may decline from a morning peak and port activity increase.

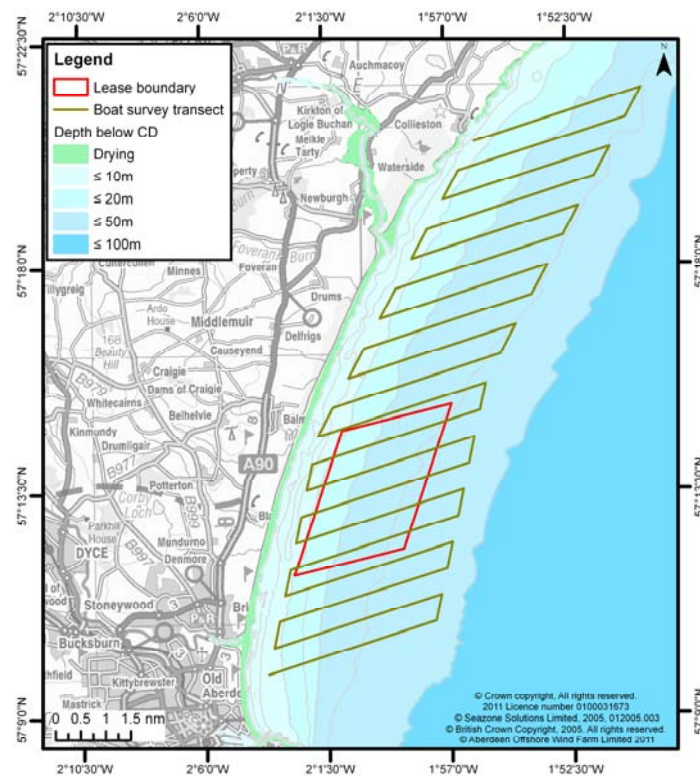
Figure 2-1: Survey periods



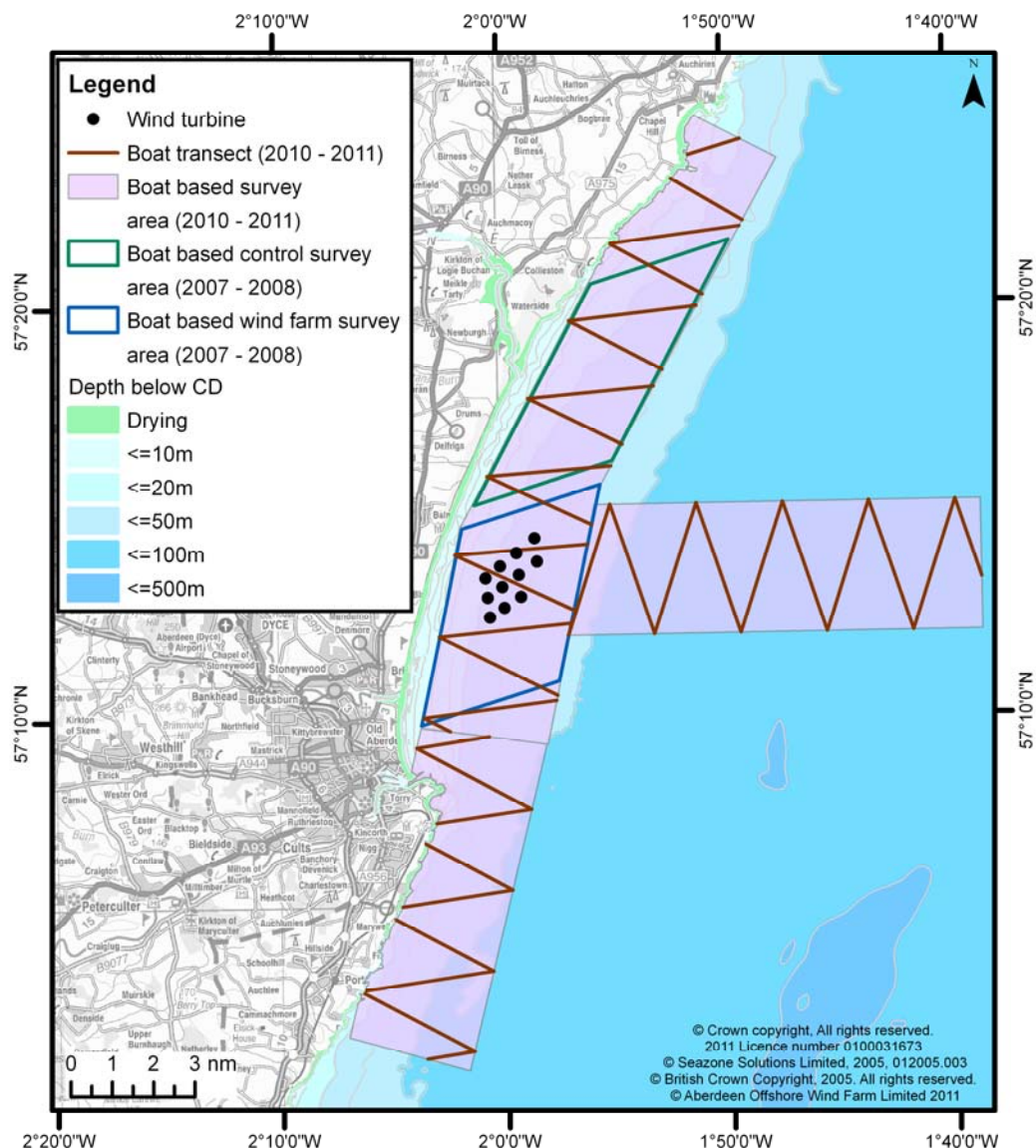




**Figure 2-2: Areas surveyed from boats for birds and marine mammals between February 2007 and March 2008 and the proposed EOWDC location at the time surveys were undertaken.**



**Figure 2-3: Areas surveyed from boats for birds and marine mammals between February 2007 and March 2008 and the revised EOWDC location.**



**Figure 2-4: Survey strata and transects in the context of previous areas surveyed and the approximate area of the development site.**

### Survey Programme

Between February 2007 and March 2008 and August 2010 to January 2011, surveys were conducted once every month during daylight hours and efforts were made to undertake the survey over two consecutive days. Due to issues arising outwith the control of the project no surveys were undertaken during October 2011 and December 2011. However, double the number of surveys will be undertaken in periods of potentially higher sensitivity in June and July 2011. Surveys were primarily conducted in conditions of less than sea state 3 with consideration given to residual swell levels prior to the surveys being undertaken. The times of the surveys were dependent on the weather conditions, availability of the survey boat and of the observers. However, the survey programme was scheduled to cover different tidal states, and times of the day (where possible during the longer hours of daylight in the

summer), in order to get an adequate coverage of the factors that may affect the distribution, abundance and activities of birds and marine mammals in the Aberdeen Bay area.

Boat-based surveys were conducted in February 2008 to coincide with the Vantage Point (VP) watches (See Section 2.3) with shore-based observations undertaken by an experienced bird/marine mammal observer, to monitor any potential disturbance of birds and marine mammals by the survey vessel.

### Sampling Methods

Both boat-based survey programmes employed the standard seabird census techniques for use on a boat platform as described by Camphuysen *et al.* (2003). The methods involved a band transect, operated on one side and ahead of the ship, and with short time-intervals in a continuous series, to sample short stretches of water with a known surface area and location.

All surveys were undertaken by a team of three experienced observers who had been Joint Nature Conservation Committee (JNCC) European Seabirds at Sea (ESAS) trained and included observers who had completed the JNCC's Seabirds at Sea Team (SAST) training course for seabird surveyors (Edinburgh 2005 & 2006), and had experience of surveying seabird populations including numerous ship-based seabird surveys.

Observers undertook a 90° scan with a 300 m band transect using a snapshot technique. The 300 m strip on one side of the ship with the best visibility (least glare etc.) was divided into a series of distance bands running perpendicular to the ship (using the Camphuysen *et al.* 2003 divisions).

Birds observed within the band (A-D) were noted as being '*in transect*'. Flying birds were recorded '*in transect*' using the *snapshot technique* to overcome biases caused by the flux of flying birds. Bird data were summarised on field data forms every minute using a snapshot at a speed of 8 kts (frequency of snapshot could be adjusted according to the speed of the boat). A recording interval of 1 minute was considered to be most applicable for such a relatively small area and coastal location, subsequently allowing a more detailed analysis of species distribution.

Two observers were present on the observation deck counting birds simultaneously. The role of the primary observer was to detect by naked eye, birds on the sea (within transect) and in the air through an arc of 90°. The secondary observer recorded observations and assisted the primary observer in the detection of birds by naked eye. The third observer was dedicated to the forward detection of divers and seaducks, which are known to flush from the sea surface at considerable distance from the vessel. In contrast to the first two observers, detection of birds by the third observer was made by continuous forward scanning using high quality binoculars in order to improve the detection of escaping and diving birds. Each bird was only recorded once, and 'ship associates' were ignored. The third observer assisted the main team of two observers during the spring migration (March, April & May) and autumn migration (September & October) when it was thought that potentially large movements of divers, seaducks and auks might occur during these periods. All three surveyors alternated roles during surveys to reduce observer fatigue and standardise findings.

Distance and band estimates of Observers were checked during surveys to ensure consistency across transects and observers.

In addition to the parameters required by the ESAS methodology, extra information was recorded by the observers in order to assess the potential problems of double counting and bird disturbance (particularly to Divers and seaducks) created by the

survey vessel. The extra information included the behavioural response from the approaching vessel (e.g. escaped/dived or flushed) and the distance at which the birds responded.

For each observation the details shown in Table 2-1 were recorded.

**Table 2-1: Biological variables collected by bird surveyors and order of recording priority.**

1	Species:	Identification to species level. However, this is not always possible and in this case the most precise identification possible should be given e.g. common guillemot/razorbill, large gull sp. (great black-backed gull/lesser black-backed gull and herring gull).
2	Numbers:	Number of individuals present within the sighting.
3	Transect:	A tick placed in a column of the recording sheet if the bird is ' <i>in transect</i> '. A blank is left if the bird is not ' <i>in transect</i> '.
4	Behaviour:	On the water or flying.
5	Distance from the ship:	Distances of the bird from ship are estimated using a range finder, and coded as follows. For birds on the water the SAST sub-divide the 300 m band transect into four zones. A: 0-50 m, B: 50-100 m, C: 100-200 m, D: 200-300 m and E> 300 m. For flying birds; 1: 0-100 m, 2: 100-1,000 m and 3: > 1,000 m.
6	Flight height:	The distribution of flying height is estimated and assessed from the ship, by categorising any birds seen in flight to its altitude. Categories are expressed as 0-2 m, 2-10 m, 10-15 m, 15-25 m, 25-50 m, 50-100 m, 100-200 m, >200 m to avoid confusion. Flight height categories follow the COWRIE guidelines.
7	Direction:	Flight direction of each sighting is recorded.
8	Behavioural response to survey vessel:	Flushed to flight (F) or diving in response to survey vessel (E/D).
9	Distance of response:	Distances of the bird flushed to flight or diving from the ship estimated in metres.
10	Plumage, moult, age and sex of the bird:	Where age is unknown, a blank is left otherwise coded as follows: A: Adult and IMM: Immature. For plumage, S: summer and W: winter are used.
11	Cetaceans:	Cetacean and sea mammal sightings recorded where appropriate.

Additional environmental data in the form of a survey log was maintained during the surveys, with data collated including weather conditions and sea state, as well as additional observations such as positions of fishing boats and other vessels, with observational data on species logged on modified SAST recording sheets. Prior to the survey programme commencing, all transect start and finish points were inputted into the ship's GPS system, and subsequent transects were then steamed using these co-ordinates. Survey logging of transects was determined using a handheld GPS. Output from the GPS provided the position (in latitude and longitude), speed, and bearing of the boat for every time interval recorded.



## Boat-based Surveys Data Treatment and Analysis

### *Estimating population size in the ship-based survey areas*

Total population size within an area surveyed was estimated using a variety of methods, including:

- Extrapolation of density
- Distance sampling; and
- Summed interpolated (kriged) abundances derived from geostatistical analyses

The effectiveness of the methods for producing accurate total population size estimates is discussed in McSorley *et al.* (2005). Distance sampling is a widely applied method of estimating total numbers and is currently the only method that allows estimation of 95 confidence limits. This method, using the *Distance* computer programme, is used as a primary method of estimating population size for the most frequently recorded species in this report. However, *Distance* may not produce accurate results where the numbers of observations are very small; where this is the case, use of an alternative method is necessary to estimate population size. Where distance sampling was not possible (<50 different observations), simple extrapolation of the overall sample density was used to estimate the total numbers of birds in the ship-based seabird survey areas. Further details are provided below.

### *Distance sampling using Distance computer programme*

Distance sampling is a widely used and accepted statistical method that accounts for a major source of potential underestimation during surveys. The method has been demonstrated to produce accurate population estimates for seabirds (Buckland *et al.*, 2001), and is widely available and accessible through the use of Distance 5.0 software (Thomas *et al.*, 2002).

There are four basic assumptions of distance sampling that should be adhered to if an unbiased density estimate is to be obtained:

1. Birds directly on or close to the transect line are always detected.
2. Birds are detected at their initial location prior to natural movement or movement in response to the observer's presence. It is assumed that birds do not move in response to the survey platform.
3. Distances are accurately measured.
4. Objects are distributed randomly with respect to the survey transects.

All birds recorded on the sea surface 'in transect' (on the main transects) were included for analysis. The data input to the *Distance* computer programme was restricted to those collected on the main transects, as the inclusion of data from 'short legs' risked double sampling of birds from the areas at the corners where the boat turned to begin the next main transect (Buckland *et al.*, 2001).

Data collected during the 'snapshot' (i.e. flying birds in 'transect') were not suitable for distance sampling (Camphuysen *et al.* 2003). Since only data collected on the sea surface may be included in the distance sampling analyses, the population estimates may be artificially reduced, as they exclude birds in flight. In order to rectify overall population estimates, estimation of birds in flight using extrapolation of birds recorded at the time of the snapshot (i.e. 'in transect'), were added to population estimates on the sea surface.

The population size in flight was estimated by multiplying the overall density in flight by the total study area.

#### *Extrapolation of overall estimate*

Where distance sampling using the *Distance* computer programme was not possible (<50 observations), simple extrapolations of the overall density were used to estimate the total number of birds in the ship-based seabird survey areas. The extrapolation of overall density is a relatively quick and simple method of estimating total abundance within the sampled area. However, this method makes assumptions about the data used; overall density assumes that birds are uniformly distributed across the study site (i.e. there is no clumping due to social aggregation or habitat selection), and use of mean density is only accurate if sample densities are normally distributed.

Correction factors were applied to birds on the water to account for variations in detection at different distances from the ship's trackline. These were applied by multiplying the number of birds recorded for a species by its correction factor to give a value with which to calculate the density of each seabird species on the water. Due to the small sample size, it was not possible to calculate correction factors for the study area, instead published corrections factors based upon large data sets were applied to the data (Table 2-2).

The population size on the water was estimated by multiplying the corrected overall density per sampled area by the total study area. As correction factors cannot be applied to flying birds recorded 'in transect', simple extrapolation was used to estimate population size in flight as discussed in previous section. Estimated populations in flight and on water were added together to produce a total population size for the 'control' and proposed EOWDC survey areas.

**Table 2-2: Correction factors from Skov *et al.* (1995).**

Species	Correction Factors
Red-throated diver	1.4
Great cormorant	1.2
Northern fulmar	1.2
Northern gannet	1.4
Mew (common) gull	2.2
Common scoter	1.7
Herring gull	1.2
Great black-backed gull	1.7
Black-legged kittiwake	1.8
Sandwich tern	1.5
Common tern	1.5
Common guillemot/razorbill	1.6
Common guillemot	1.6
Razorbill	1.6
Atlantic puffin	2.0

#### **Population estimate tables**

Where distance sampling using the *Distance* computer programme was not possible (<50 observations), simple extrapolations of the overall density were used to estimate the total number of birds in the ship-based seabird survey areas. Table 2-3 shows the species and months eligible for *Distance* during the Year 1 survey programme.

**Table 2-3: Summary table of month/species where *Distance* was applicable in the 'control' and proposed EOWDC survey areas.**

Species	EOWDC survey area	'control' survey area
Red-throated diver	N/A	N/A
Common scoter	N/A	N/A
Common eider	N/A	N/A
Northern fulmar	N/A	N/A
Northern gannet	N/A	N/A
Great cormorant	N/A	N/A
Common gull	N/A	N/A
Herring gull	N/A	N/A
Great black-backed gull	N/A	N/A
Black-legged kittiwake	N/A	July 07
Sandwich tern	N/A	N/A
Common tern	N/A	N/A
Common guillemot	Feb 07, May 07 to Oct 07	May 07 to Oct 07
Razorbill	N/A	Aug 2007
Common guillemot / razorbill	N/A	N/A
Atlantic puffin	N/A	Sept 07

### 2.3 Vantage Point surveys

Vantage Point (VP) Surveys were undertaken from a total of six locations between March 2005 and March 2008: Two locations were used throughout: Drums and Balmedie and two were in very similar locations: Blackdog and Murcar, and Donmouth and Promenade (Table 2-4) (EnviroCentre 2007a,b; Alba Ecology 2008a,b).

**Table 2-4: Vantage Point Survey Locations in Aberdeen Bay.**

Years	Site	Elevation (metres)
March 2005 – October 2005	Promenade	10
March 2006 – March 2008	Donmouth	11
March 2005 – October 2005	Murcar	15
March 2006 – March 2008	Blackdog	16
March 2005 – October 2005	Balmedie	21
March 2006 – March 2008		
March 2005 – October 2005	Drums	16
March 2006 – March 2008		

Watches were conducted during daylight hours in conditions of good visibility, by a single observer with binoculars and telescope for two hours from each VP site. Two surveys were undertaken at each location most months, with up to four surveys per month in the then proposed EOWDC area (Donmouth and Blackdog) (Figure 2-5). Surveys were conducted at dawn and dusk (alternating between dawn and dusk surveys between each site visit). Dawn surveys started approximately 30 minutes before sunrise and dusk surveys extended to sunset or within about 15 minutes after.

At the start of each survey (along with any changes during the survey), the observer recorded the weather conditions, visibility, cloud cover, sea state, time of high tide and height (from tide tables), wind speed and direction, times of sunrise and sunset. In conditions of poor visibility (<1 km) surveys were not conducted or aborted if necessary.

The one to two hour long surveys were broken into 10 minute intervals, during which the observer counted all the individual birds moving through their telescope field of view (straight out from the VP, covering 0-3km and approximately 60°), noting their direction of flight, estimated distance from shore and flight height. If the birds exhibited notable behaviour, such as feeding, roosting, diving and fighting, this was also recorded.

Distance from shore was categorised into 0-1 km, 1-2 km, 2-3km and 3+ km distance bands, where possible based on marker buoys (Balmedie: 1 km (NJ990175) and Blackdog: 2.3 km (NJ986132)). Flight height was categorised in to 0-30 m, 30-150 m and 150+ m height bands, based on the size of the proposed wind turbines.

At the start of each survey period, the visible area was scanned with binoculars and the species, approximate number and behaviour of any birds on the sea surface and shore was recorded. During the two hour long survey general notes on birds on the sea surface and on the shore within the immediate field of view were recorded. Any significant changes to large feeding flocks out at sea or large movements of birds along the foreshore were also recorded.

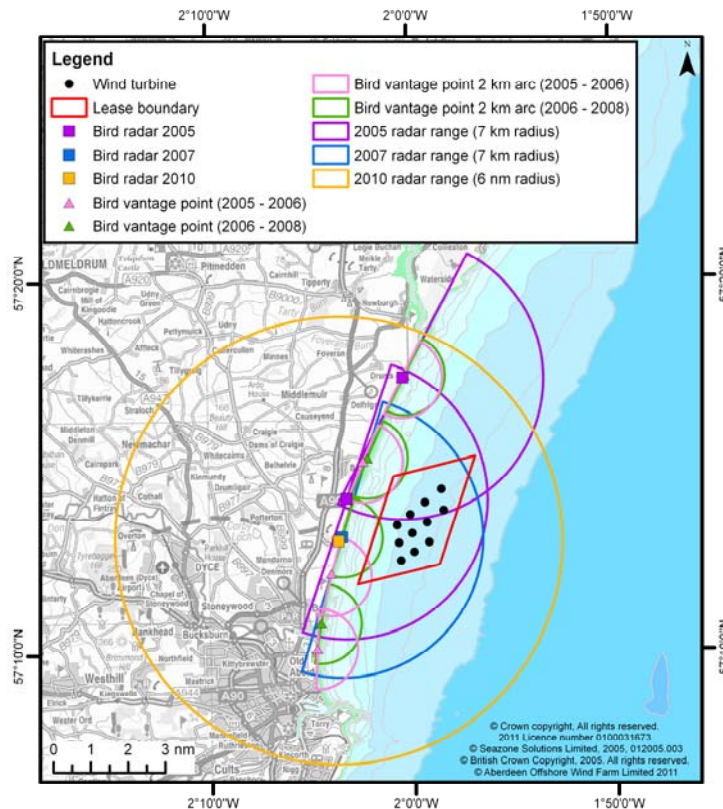
A total of 294 VP surveys and 582 hours of surveys have been undertaken over a period of three years from six sites and across four different areas of Aberdeen Bay (Table 2-5).

**Table 2-5: Vantage Point survey summary.**

	<b>No. of VP Surveys</b>	<b>No. of Hours</b>
Drums	55	114
Balmedie	52	102
Blackdog	84	167
Murcar *	10	16
Donmouth	83	163
Promenade *	10	20
<b>Total</b>	<b>294</b>	<b>582</b>

\* - Data collected between March 2005 and October 2005.





**Figure 2-5: Location of the Vantage Point and radar survey sites and the location of the proposed EOWDC.**

Data obtained from Vantage Point surveys has been used to complement the data collected further offshore from boat-based surveys. The benefits of Vantage Point surveys are that data on seabird distributions passing close to shore are obtained which may otherwise be missed from purely boat-based surveys. Comparing the data with that obtained from boat-based surveys a better understanding of bird distributions are obtained. However, it is recognised that there is an increasing probability of birds being missed with increasing distance from the observer and unlike with boat-based data it is not possible to produce detectability functions to data collected by Vantage Points. In order to calculate detectability functions it is assumed that there is an even density of birds across the area or that there is a constant age or sex ratio. This is not the case from shore-based counts and therefore detectability functions cannot be produced from data collected from Vantage Point surveys.

## 2.4 Bird Detection Radar Surveys

Bird Detection radar has been used on three occasions during periods predicted to be of high migration in Aberdeen Bay: October 2005, April 2006 and April 2010 (Table 2-6).

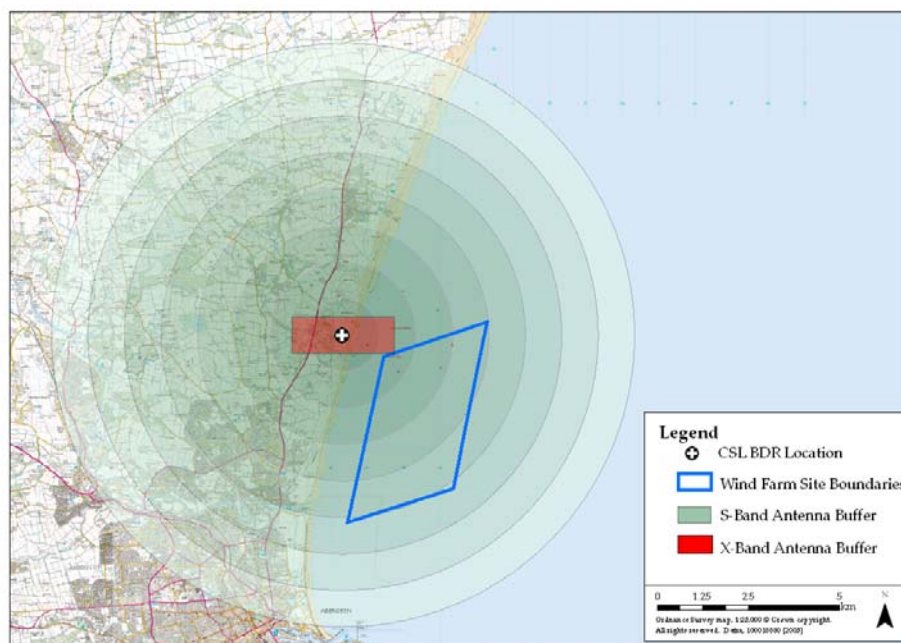
The use of Bird Detection radar has allowed the tracking of bird movements continuously up to a range of 11 km including during periods of darkness or poor weather conditions. The radar could detect bird movements, their flight trajectory, flight speed and altitude to a height of 1.4 km. In favourable conditions the radar could track birds for up to 22 km and could detect animals as small as insects. The radar was used in all weather conditions including periods of poor visibility, rain and during hours of darkness.

The original surveys were undertaken at Easter Hatton and Drums but were later moved to Blackdog, closer to the proposed development area (Figure 2-6, Figure 2-7). The survey undertaken in April 2010 was aimed to coincide with period of peak pink-footed goose migration. However, delays in starting meant that it was not deployed until 24 April.

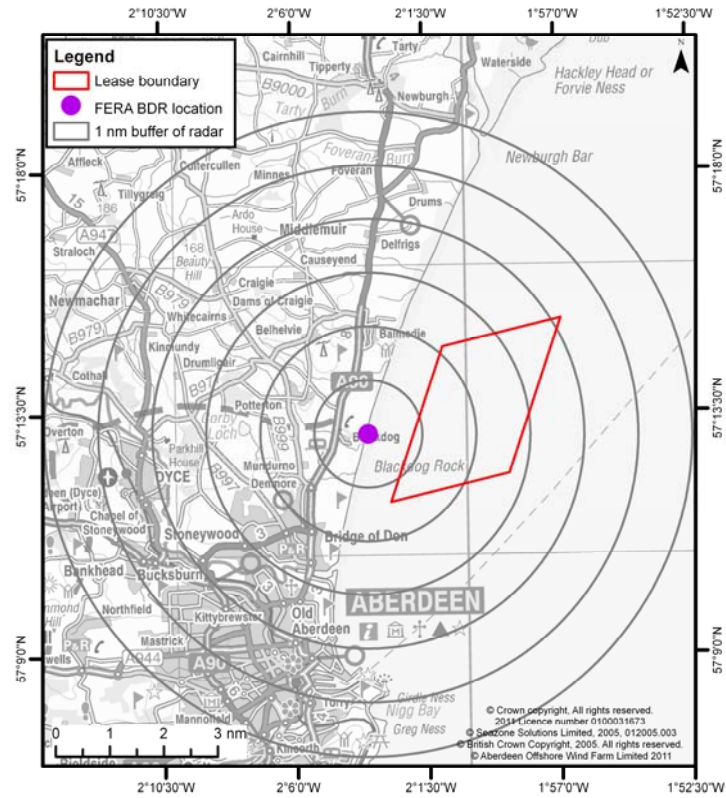
In addition to manning and monitoring the live radar screens, detailed vantage point field monitoring synchronised with the radar deployment was undertaken during the surveys. The observers confirmed the species and composition of the tracks initially detected by radar as well as providing additional information such as flock size and formation, height and flight behaviour. The radar ornithologists swapped between the roles of radar monitoring and visual tracking approximately every 2 hours in order to minimise observer fatigue during periods of observation (Walls *et al.* 2010).

**Table 2-6: Location and duration of radar studies undertaken in Aberdeen Bay.**

Location	Range (km)	Start Date	End date	Running time (hr)	
Drums	7	24 October 2005	29 October 2005	115	Walls <i>et al.</i> 2006
Easter Hatton	7	29 October 2005	3 November 2005	104	Walls <i>et al.</i> 2006
Blackdog	7	11 April 2007	26 April 2007	N/A	Simms <i>et al.</i> 2007
Blackdog	11	14 April 2010	29 April 2010	124	Walls <i>et al.</i> 2010



**Figure 2-6: Outline radar coverage from Blackdog location during April 2007 surveys.**



(Source FERA 2010)

**Figure 2-7: Location of radar study undertaken in April 2010 in relation to proposed development area.**

### **3      IMPACT ASSESSMENT METHODOLOGY**

### 3.1 Introduction

This section identifies the potential impacts arising from the proposed development on birds. It is based on site specific data from Aberdeen Bay obtained in order to inform the project and for the purposes of this assessment. It also draws upon other published information on the birds likely to be present in the area, i.e. North-east Scotland Bird Reports and JNCC reports. The results are summarised for each species in Section 4.

Whenever possible additional information from existing offshore wind farms has been used in order to inform the impact assessment.

A request for a formal scoping opinion was made in 2010 and a number of comments were received with respect to potential ornithological impacts arising from the proposed project. These have been considered when undertaking this impact assessment.

The assessment is based on the project parameters as outlined in the project description (Section 3).

### 3.2 Potential Impacts

There are a large number of publications that provide detailed analysis of the potential impacts the development of an offshore wind farm may have on birds (e.g. Percival 2001; Langston & Pullan 2003; Drewitt & Langston 2006; Zucco *et al.* 2006).

The conclusions from all the publications identify three (or four if disturbance is considered separate from displacement) main potential impacts:

**Collision risk:** Birds are at risk of colliding with wind turbines. The level of collision depends on the location and size of the development and the species present. Different species are at varying risks of collision depending on a number of factors including the heights at which they fly and the proportion of time that they are flying at within the range of the rotor blades. Species such as Auks, Divers and Scoter fly predominantly below rotor height where as other species such as Gulls may more frequently fly at rotor height. Avoidance rates are very important in determining the level of risk. Far field avoidance, where birds make detours to avoid flying through the wind farms at distances of one or more kilometres has been reported for many species, e.g. Gannets, Geese and Swans and sea-duck and near-field avoidance where a bird makes a quick detour at relatively close proximity to the wind turbines, e.g. Gulls and Terns. Other factors influencing collision risk include the frequency of passage, i.e. breeding birds flying through a site to and from a breeding colony and potentially weather conditions and visibility with birds at potentially greater risk during periods of poorer weather or at night. Overall, the majority of studies pertaining to offshore wind farms have indicated very low collision risks with most species having near-field avoidance rates of 99% or more and some far-field avoidance rates ranging from 50% for Divers and eider to over 90% for gannets and common scoter. The potential significance of any collision mortality depends on the population size, its conservation status the longevity of the species and its fecundity rate. Long-lived species with low fecundity rates and with small or declining populations are at greatest risk of being significantly affected by collision mortality.

**Displacement:** Birds that would otherwise use an area may avoid entering the wind farm and therefore be displaced. The displacement may be caused by a number of reasons. Birds may not enter the site due to the physical presence of the wind turbines as may be the case for red-throated diver or they may be disturbed (a disturbance impact) from the site by the vessels associated with the development, e.g. Divers and Scoter. There may also be an indirect impact on the food supply that could be reduced and therefore birds search elsewhere for their prey, e.g. Terns.

The level of displacement reported has varied across species and sites with some displacement identified for Divers, cormorants and possibly Auks. The significance of any displacement, should it occur, is dependent on the scale and duration of impact and whether other suitable sites are available to which the birds may go.

**Barrier effects:** Birds may avoid flying through the wind farms and select to fly over or around them. Should they choose to fly around them then this may entail flying further than they would otherwise have done so. Many species have been recorded avoiding offshore wind farms by flying around them, often by altering course at a distance of 1 km or more, e.g. wildfowl and gannets. This increase in flight distance causes a corresponding increase in energy expenditure that may, depending on the frequency that the effect occurs and the fitness of the individual bird, have a negative impact on the bird. The greatest concerns arise when birds undertake frequent flights around the wind farm, e.g. to and from feeding grounds or roost sites.

The impact assessment has been based on the above recognised potential effects.

### 3.3 Temporal Scales

There are four main phases in the development proposed programme that are considered:

- Pre-construction,
- Construction,
- Operation,
- Decommissioning,

#### Pre-construction phase

During the pre-construction phase baseline data have been obtained using boat-based, land-based and radar surveys. The collection of the data over a number of years provides baseline information on usage of the proposed development area and further afield by birds that have the potential to be impacted. It provides the basis upon which the potential impacts can be assessed and against which any changes in populations can be measured

#### Construction phase

The construction phase is of relatively short duration and consequently potential impacts arising from it are predicted to also be of short duration. As this is a demonstrator project the exact type of turbines that may be installed is still to be determined.

Construction activities involve the use of a number of vessels to install the turbines and cables that may cause disturbance and consequently displacement to species that avoid vessels, e.g. Divers and Scoter. The installation of turbines may cause the temporary displacement of prey species depending on the installation technique, e.g. pile-driving.

#### Operational phase

Potential impacts arising from the operational phase are collision mortality, displacement and barrier effects. There may be some disturbance from maintenance vessels that could cause displacement and a very small loss of habitat due to the direct physical impact on the seabed of the eleven wind turbines.

#### Decommissioning

How the turbines will eventually be decommissioned is still to be determined but it will involve the use of a number of vessels and the use of cutting equipment. The potential effects arising from decommissioning are predicted to be similar to those from installation, i.e. displacement.



### 3.4 Designated Sites

Although the proposed site does not lie within a designated area, there are a number of SPAs along the east coast of Scotland that have the potential to be impacted by the proposed development. For the purposes of the EIA, qualifying species from SPAs between Troup, Pennan and Lion's Head 74 km to the north and Forth Islands SPA approximately 134 km to the south have been considered (Table 3-1) and assessed against the relevant Conservation Objectives. The selection of sites is based largely on the potential foraging areas or known passage routes of the species recorded during surveys undertaken within the proposed development area.

For the purposes of the impact assessment all SPA species have been considered to be Very Highly sensitive if individually cited or Highly sensitive if cited as part of an assemblage. The potential effects on SPA species are assessed within the main impact section (Section 4).

#### Conservation Objectives

To avoid deterioration of the habitats of the qualifying species (listed [*for each site*]) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site,
- Distribution of the species within site,
- Distribution and extent of habitats supporting the species,
- Structure, function and supporting processes of habitats supporting the species,
- No significant disturbance of the species.

**Table 3-1: SPAs identified as being at potential risk of adverse effect from proposed project.**

SPA	Approximate distance EOWDC (km)	Qualifying species
Troup, Pennan and Lion's Head SPA	74.3	Article 4.1 - <i>Breeding</i> - Guillemot Article 4.2 - at least 20,000 seabirds breeding season, 150,000 individual seabirds including: razorbill, kittiwake, herring gull, fulmar guillemot.
Loch of Strathbeg SPA	47.6	Article 4.1 - <i>Breeding</i> - Sandwich tern. <i>Winter</i> - barnacle goose, whooper swan. Article 4.2 - <i>Winter</i> - greylag goose, pink-footed Goose Article 4.2 - supporting at least 20,000 waterfowl. Over winter supports 49,452 individual waterfowl including: teal, greylag goose, pink-footed goose, barnacle goose, whooper swan.
Buchan Ness to Collieston Coast SPA	9.5	Article 4.2 - supporting at least 20,000 seabirds. Breeding the area regularly supports 95,000 individual seabirds including: guillemot, kittiwake, herring gull, shag, and fulmar.
Ythan Estuary, Sands of Forvie and Meikle Loch SPA	7.2	Article 4.1 - <i>breeding</i> Sandwich tern, common tern, little tern. Article 4.2 - <i>wintering</i> pink-footed geese, common eider, <i>breeding</i> , diverse assemblage of breeding seabirds (13 species). regularly supporting over 20,000 waterfowl including redshank and lapwing.
Loch of Skene	21	Article 4.2 - <i>winter</i> greylag goose.
Fowlsheugh SPA	31.1	Article 4.2 by regularly supporting in excess of 20,000 individual seabirds. The colony regularly supports 145,000 seabirds. The colony further qualifies under Article 4.2 by regularly supporting populations of European importance of the migratory species: common guillemot, black-legged kittiwake, razorbill, fulmar, herring gull.
Montrose SPA	61	Article 4.2 - <i>winter</i> - greylag goose, knot, pink-footed goose, redshank. Article 4.2 - supporting at least 20,000 waterfowl. Winter, the area regularly supports 54,917 individual waterfowl, including: dunlin, oystercatcher, common eider, wigeon, shelduck, redshank, knot, greylag goose, pink-footed goose.
Firth of Tay and Eden Estuary	96	Article 4.1 - <i>Breeding</i> - little tern, Marsh harrier <i>Winter</i> , bar-tailed godwit Article 4.2 - <i>Winter</i> , greylag goose, pink-footed Goose, redshank. Supporting at least 20,000 waterfowl. In winter, the area regularly supports 34,074 individual waterfowl including: velvet scoter, pink-footed goose, greylag goose, redshank, cormorant, shelduck, common eider, bar-tailed godwit, common scoter, black-tailed godwit, goldeneye, red-breasted Merganser, goosander, oystercatcher, grey plover, sanderling, dunlin, long-tailed duck.



Firth of Forth SPA	124	<p>Article 4.1 - <i>Passage</i>; Sandwich tern, Winter; bar-tailed godwit, golden plover, red-throated diver, Slavonian grebe.</p> <p>Article 4.2 - <i>Winter</i> - knot, pink-footed goose, redshank, shelduck, turnstone.</p> <p>Article 4.2 - supporting at least 20,000 waterfowl. Winter, regularly supports 86,067 individual waterfowl including: scaup, Slavonian grebe, golden plover, bar-tailed godwit, pink-footed goose, shelduck, knot, redshank, turnstone, great crested grebe, cormorant, red-throated diver, mallard, curlew, common eider, long-tailed duck, common scoter, velvet scoter, goldeneye, red-breasted Merganser, oystercatcher, ringed plover, grey plover, lapwing, dunlin, wigeon</p>
Imperial Dock, Leith SPA	130	<p>Article 4.1 - breeding season common tern.</p>
Forth Islands SPA	134	<p>Article 4.1 - breeding season – Arctic tern, common tern, roseate tern, Sandwich tern.</p> <p>Article 4.2 - Breeding season – gannet, lesser black-backed gull, puffin, shag.</p> <p>Article 4.2 - Supporting at least 20,000 seabirds</p> <p>Breeding season the area regularly supports 90,000 individual seabirds including razorbill, guillemot, kittiwake, herring gull, cormorant, fulmar, puffin, lesser black-backed gull, shag, gannet, Arctic tern, common tern, roseate tern, Sandwich tern.</p>

### 3.5 EIA Methodology

Species regularly recorded offshore and that are qualifying species for an SPA presented in Table 3-1 have been assessed in the main section of this document (Section 4). Records of all other species are summarised in section 5. However, it is recognised that species may also occur in the area that were not recorded and others may have been under recorded due to their nocturnal flights or intermittent migration. However, there is no recorded evidence of any migration corridor across Aberdeen Bay and therefore for those species only infrequently recorded or were not recorded offshore, i.e. many waders, wildfowl and passerines no further assessment has been made as there is not likely to be any significant or adverse effect to these species from the proposed development.

It is recognised that the strict use of a matrix approach when undertaking an EIA can be inflexible and risks drawing erroneous conclusions. However, the use of an impact matrix can and does provide structure to an otherwise judgemental process and as long as the matrix is used appropriately it can be a useful tool in identifying the overall potential significance of an impact. The development of impact specific matrices by Maclean *et al.* (2009) has provided more focussed and robust matrices specific to potential impacts.

For the purposes of this EIA an evidence based approach has been used to determine potential impacts as well as expert judgement based on the baseline information and results from other offshore wind farms. An impact matrix has been used to provide a structure and consistency of approach and has been used as tool to help inform the impact assessment. The structure and content of the tables are based on those originally developed by Percival *et al.* (1999) and developed further by Maclean *et al.* (2009). They have been widely used in various similar forms for nearly all offshore wind farms. However, the results from the impact matrices have not been considered to be definitive, nor in isolation. The assessment is ultimately based on the latest published data available on potential impacts, i.e. wherever possible an evidence based approach has been adopted.

#### Determining Significance.

What may be considered to be significant differs across legislative requirements.

Under the EIA Regulations, significance is used to determine the relative importance of an effect on a feature. Whereas under the Habitats Regulations it is a coarse filter to determine whether a further Appropriate Assessment is required (IEEM 2010).

In determining the level of significance for the EIA the recommendations made in Maclean *et al.* (2009) have been used.

Two types of sensitivity have been identified:

- Non-impact specific sensitivity
- Species specific sensitivity

For non-impact sensitivities a series of definitions have been used to describe the potential sensitivity of the species to the impact (Table 3-2) (Percival 1999).

*Very High:* - For the purposes of the EIA a very high sensitivity was identified for all species, which are listed as cited interests for an SPA and within range of potential interaction, i.e. was within the known foraging range of the species. Foraging ranges were taken from Roos (2010) and Thaxter *et al.* (2010). The SPAs that were identified as having a potential for interaction are presented in (Table 3-1).

**High:** - A definition of high sensitivity was given for species identified as being part of an SPA assemblage or within the potential area of impact greater than 1% of the national population could be affected. Species for which less than 300 pairs nest in the UK were also considered as being of high sensitivity.

**Medium:** - Species were considered to be of medium sensitivity if a regionally important population was potentially affected. For the purposes of the EIA the regional population was defined as being between the Firth of Forth and Troup Head. Regional populations were based on latest SPA populations and mean 5 year peak WeBS counts (Table 3-15). If greater than 1% of the regional population was considered as being potentially effected then the species was considered to be Medium sensitivity.

**Low:** All species that were not covered by any of the above categories were given a low sensitivity.

**Table 3-2: Definition of terms relating to the non-impact sensitivity of the species.**

Sensitivity	Definition
Very High	Cited interest of SPAs. Cited means mentioned in the citation test for the site as a qualifying species for which the site is designated.
High	Other species that contribute to the integrity of the SPA. An impact on a local population of more than 1 per cent of the national population of a species. An impact on ecologically sensitive species (e.g. large birds of prey or rare birds - <300 pairs in Britain).
Medium	Regionally important population of a species, either because of population size or distributional context, EU Birds Directive Annex 1, EU Habitats Directive priority habitat/species or Species of European Conservation Concern (SPEC) and or Wildlife and Countryside Act Schedule 1 species (if not covered above). UK BAP priority species (if not covered above).
Low	Any other species of conservation interest (e.g. species listed on the Birds of Conservation Concern not covered above).

Further refined species specific sensitivity assessment has been undertaken in line with recommendations made in Maclean *et al* (2009). Sensitivities of species groups to particular impacts are ranked and combined with the non-impact sensitivities to give an overall sensitivity. The main types of impact identified are:

- Collision Mortality,
- Barrier effect,
- Displacement (including disturbance and indirect impacts, i.e. depletion of prey).

#### **Collision Mortality**

Collision risk modelling has been undertaken based upon the Band *et al.* (2000) model.

The Risk is assessed based on the probability of a bird flying through the rotor swept area and the probability of it colliding. This is then multiplied by number of flights predicted to occur through rotor swept area based on site specific data and no avoidance.

However, data from existing offshore wind farms indicate that there is a significant avoidance of wind turbines, typically greater than 99% (e.g. Pettersson 2005, Petersen *et al.* 2006) and the probability of a bird colliding takes this into account by including an avoidance rate. For the purposes of this assessment a range of avoidance rates have been used to give a range of potential mortality rates. The avoidance rates used are 98%, 99% and 99.5% based on SNH guidance (SNH 2010) but it is also noted that Maclean *et al.* (2009) recommended avoidance rates of 99% or greater. However, in order to determine potential effects a precautionary 98% has been used for nearly all species within this EIA.

Not all species recorded within Aberdeen Bay are at significant risk of collision. The level of risk depends on a large extent as to whether the species frequently flies at rotor height. Birds can fly at any height and may change depending upon weather conditions or behaviour. However, by using data from both site specific boat-based survey data (Table 3-3) and other extensive data sets from other offshore wind farm locations a large sample size of flight heights are available for collision risk assessment.

The species selected for collision risk modelling were selected on their frequency of flying at rotor height and the frequency at which they were recorded in Aberdeen Bay. Collision risk modelling was undertaken on the following species:

- Red-throated diver
- Fulmar
- Gannet
- Cormorant
- Pink-footed goose
- Barnacle goose
- Common scoter
- Guillemot
- Common gull
- Herring gull
- Kittiwake
- Sandwich tern
- Common tern

Body sizes were obtained from BTO BirdFacts website (BTO 2011).

Annual Mortality Rates were obtained from BTO BirdFacts website (BTO 2011).

Avoidance Rates from SNH (2010).

Flight speeds were obtained from Pennychuick (1997), Alerstam *et al.* (2007).

**Table 3-3: Flight heights of birds recorded in Aberdeen Bay.**

Species	Boat-based surveys 2007-2008		
	Sample size	%>15 m	%>25 m
Red-throated diver	55	7	0
Black-throated diver	3	0	0
Common scoter	377	30	1
Velvet scoter	7	0	0
Common eider	93	3	0
Long-tailed duck	17	0	0
Wigeon	1	100	100
Teal	1	100	100
Tufted duck	2	0	0
Goldeneye	2	0	0
Fulmar	213	1	0
Manx shearwater	9	0	0
Gannet	404	29	17
Cormorant	44	7	0
Shag	17	0	0
Great skua	8	63	25
Arctic skua	16	38	19
Long-tailed skua	1	1	0
Black-headed gull	4	0	0
Common gull	494	71	33
Kittiwake	907	43	22
Herring gull	362	55	40
Lesser black-backed gull	1	100	1
Great black-backed gull	128	79	60
Common tern	22	23	14
Arctic tern/Com. tern	24	17	0
Sandwich tern	79	53	4
Guillemot	271	1	1
Razorbill	354	0	0
Guillemot/Razorbill	398	0	0
Puffin	32	0	0
Little auk	7	0	0
Golden plover	2	0	0
Oystercatcher	1	100	100
Dunlin	2	0	0
Curlew	2	0	0
Shelduck	7	14	0
Barnacle goose	817	62	35
Goose sp.	85	100	100
Meadow pipit	7	0	0
Swift	1	0	0
Skylark	1	0	0

Flight heights were collected as being at greater than 15 m and greater than 25 m. Those at 25 m or above have been considered to be at risk of collision. It is not possible to produce frequency plots of flight heights from these data but existing published data from other offshore developments have been used to put into a wider context using a much larger data set the data collected from Aberdeen Bay.

Species sensitivities are based on the results from the collision risk modelling and the adult survival rates (Table 3-4) combined with the non-impact sensitivities (Table 3-2) to give an overall sensitivity presented in Table 3-5.

**Table 3-4: Sensitivity of population based on adult survival rate.**

Sensitivity Due to Population recovery Time	Definition
Very High	Annual Survival > 0.90 – Fulmar, Gannet, Manx shearwater, Barnacle goose, Eider, Auks, Kittiwake, Lesser black-backed gull, Great black-backed gull, Black-headed gull, Common tern, Arctic tern
High	Annual Survival 0.85 – 0.90 – Cormorant, Shag, Pink-footed goose, greylag goose, Shelduck, Skuas, Herring gull, Common gull, sandwich tern, Little tern
Medium	Annual Survival 0.80 – 0.85 – Divers, Swans,
Low	Annual Survival <0.80 Ducks, Grebes <sup>(1)</sup> Waders

Source: BTO Birdfacts (2011) 1 = Abt & Konter (2009)

**Table 3-5: Overall sensitivity of species to collision.**

Non-impact Sensitivity (Table 3-2)	Sensitivity of Receptor (based on adult survival rate) (Table 3-4)			
	Very High	High	Medium	Low
Very High	Very High	Very High	High	Medium
High	Very High	High	High	Medium
Medium	Very High	High	Medium	Low
Low	High	Medium	Low	Low

### Barrier effect

Barrier effects may arise should the species avoid flying through the proposed development and by doing so incur additional energetic costs required to fly the extra distance around the turbines (Speakman, Gray & Furness 2009; Masden *et al.* 2010). The risk of an impact is largely dependent on the number of times a bird may have to cross the obstruction and also the individuals' fitness. Should a bird be required to avoid an area only once or twice a year when undertaking a migration then it is likely that the potential impact will be lower than if a bird regularly flies around a barrier, e.g. between a feeding or roosting site (Speakman, Gray & Furness 2009).

In order to assess the potential impacts from displacement it was assumed that, unless data from other wind farms indicates otherwise, all individuals avoided flying through the site and detoured around it and by doing so had to fly further than would have otherwise been the case. To calculate the potential length of detour it was assumed that the detour started 1 km in front of the proposed development and the bird detoured back on to the original course 1 km beyond the proposed development. The original distance the bird would have flown if had not detoured is subtracted from

the additional distance the bird has flown to get a figure for the potential increase in distance travelled. However, it is also recognised that some birds may start to detour at greater distance than 1 km and others may not and some may not detour at all.

It was assumed that all flights were potentially along the longest axis, i.e. north-south.

The total length of the proposed development is approximately 4 km and the width 2 km. The distance flown in order to avoid the proposed development from 1 km all round is 7.2 km. Therefore, the incremental increase in flight distance caused by flying around the proposed development is 3.2 km.

Where appropriate, results from energetics modelling have been considered to assess the potential incremental increase in daily energy expenditure (Speakman, Gray & Furness 2009).

To assess the potential sensitivity of a species to a barrier effect a species specific sensitivity, based on wing loads (Table 3-6), combined with non-impact sensitivities (Table 3-2), have been used to provide an overall sensitivity (Table 3-7) after Maclean *et al.* (2009).

**Table 3-6: Species sensitivity due to barrier effects.**

Sensitivity due to barrier effects	Species
Very High	Black-throated diver
High	Red-throated diver
Medium	Ducks,
Low	Fulmars, Skuas and Gulls Gannets, Terns, Waders & Passerines

**Table 3-7: Overall sensitivities due to barrier effect**

Non-impact Sensitivity (Table 3-2)	Species Sensitivity due to barrier effects (Table 3-6)			
	Very High	High	Medium	Low
Very High	Very High	Very High	High	Medium
High	Very High	Very High	High	Medium
Medium	Very High	High	Medium	Low
Low	High	Medium	Low	Low

### Displacement

Disturbance caused by the proposed EOWDC may lead to displacement of birds from potential feeding areas, resulting in effective habitat loss. This may be caused by a number of reasons but for some species for which displacement have been

identified it is not known why displacement occurs. Displacement may be caused by disturbance from vessels associated with the proposed development or from secondary impacts, i.e. the depletion of prey in the development area. However, whatever the cause, the effects are the same; birds are displaced from an area and relocate to somewhere else. The significance of the displacement is difficult to quantify but for species that rely on localised or patchy food supplies the affect may be more significant than it is for species that have a wide area of food supply. Based on the Maclean *et al.* (2009) report the impact assessment has considered sensitivity of a species depending on its habitat flexibility, i.e. how restricted is the species to a particular habitat preference (Table 3-8). Potential impacts relating to disturbance by vessels are addressed in the species accounts.

The overall sensitivity is based on the species specific and non-impact sensitivities (Table 3-9).

**Table 3-8: Species sensitivity due to displacement.**

Sensitivity due to habitat flexibility	Species
Very High	Red-necked grebe
High	Divers, Scoter, Cormorant , Great-crested Grebe
Medium	Eider, Common Tern, Arctic Tern, Little Gull
Low	Sandwich Tern, Great Black-backed Gull, Auks, Great Skua, Black-headed Gull, Kittiwake, Gannet, Lesser Black-backed Gull, Herring Gull, Fulmar.

**Table 3-9: Overall sensitivity due to displacement.**

Non-impact Sensitivity (Table 3-2)	Species Sensitivity due to barrier effects (Table 3-8)			
	Very High	High	Medium	Low
Very High	Very High	Very High	High	Medium
High	Very High	Very High	High	Medium
Medium	Very High	High	Medium	Low
Low	High	Medium	Low	Low

For the purposes of the assessment two assumptions have been made as to the level of displacement that may occur. For Divers and Auks it is assumed that there is total displacement within the proposed EOWDC area and out to 1 km beyond the furthest turbine. There is then a further 50% displacement of birds out a further 1 km. For other species of seabird for which displacement effects may occur, e.g. seaduck, it is assumed that there is total displacement within the proposed development area and 80% displacement out to 1 km and 20% displacement out an additional 1 km. This takes into account the current understanding of the differing potential



displacement effects on species but is still precautionary, as for many species displacement effects of this magnitude have not been recorded.

In order to determine potential number of birds at risk of being displaced the maximum recorded density obtained from any location from any of the boat-based surveys has been used. This provides a very precautionary number for the potential numbers of birds displaced, as for the majority of species peak densities were recorded outwith the proposed development area.

A worked example is presented in Table 3-10.

**Table 3-10: An example of calculations used for potential displacement.**

Calculations used for displacement	
Area	Peak density of common scoter – 23.1 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 23.1 = 99
Area of 1 km buffer at 80% displacement = 12.3 km <sup>2</sup>	(12.3 * 23.1)*0.8 = 227
Area of 2 km buffer at 20% displacement = 20.3 km <sup>2</sup>	(20.3 * 23.1)/0.2 = 94
Total displaced	99+227+94 = 420

### Magnitude of effect

The magnitude of effect for potential displacement and collision mortality is based on the definitions developed by Percival (1999) (Table 3-11). However, this is not suitable for determining the potential magnitude arising from barrier effect and consequently the assessment of the potential magnitude of barrier effects is based on Maclean *et al.* (2009)

Table 3-12).

**Table 3-11: Definition of potential magnitude of an effect from collision mortality and displacement.**

Magnitude	Definition
Very High	Potential total loss or very major alteration to key elements/features of the baseline conditions such that post development character/composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: >80% of population/habitat lost
High	Potential for major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/composition/attributes will be fundamentally changed. Guide: 20-80% of population/habitat lost
Medium	Potential for loss or alteration to one or more key elements/features of the baseline conditions such that post development character/ composition/ attributes of baseline will be partially changed. Guide: 5-20% of population/habitat lost
Low	Potential for a minor shift away from baseline conditions. Change arising from the loss/ alteration will be discernible but underlying character/ composition/ attributes of baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/habitat lost
Negligible	Potential for a very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation. Guide: <1% of population/habitat lost

**Table 3-12: Criteria used to determine one of the components of the magnitude of impact due to barrier effect.**

Magnitude of impact	Definition
Very High	(i) Wind farm is located between breeding site and key foraging area of a species flying through the site in nationally or internationally important numbers and/or (ii) is located close to key stopover, breeding or wintering site of species flying through the site in internationally important numbers and/or (iii) is located along the migration route of a species flying through the site in internationally important numbers.
High	(i) Wind farm is located close to key stopover, breeding or wintering site of species flying through the site in nationally important numbers and/or (ii) is located along the migration route of a species flying through the site in nationally important numbers.
Medium	(i) Wind farm is located between breeding site and key foraging area of a species flying through the site in regionally important numbers (ii) is located close to key stopover, breeding or wintering site of a species flying through the site in nationally important numbers (ii) Is located along the migration route of a species flying through the site in regionally important numbers.
Low	(i) Wind farm is located between breeding site and key foraging area of any other breeding species and/or (ii) is located close to a key stopover, breeding or wintering site of any other species and/or (iii) likely to be located on a migration route of any other species.
Negligible	None of the above

By combining the overall sensitivity of a receptor with the potential magnitude an indicative overall significance of the impact to the receptor is obtained (Table 3-13). However, it is recognised that this is only indicative and evidence from existing wind farms and expert judgement is used to determine whether the potential impact is likely to be either significant or adverse.

**Table 3-13: Potential significance of impact.**

Magnitude	Overall Sensitivity of Receptor			
	Very High	High	Medium	Low
Very High	Major	Major	Major	Moderate
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

### *Implications of significance*

Where the potential significance is identified as being negligible or minor it is considered to be of limited or no concern. Moderate significance is of concern but may be tolerable depending on the causes that give rise to the potential impact. Major concerns are considered to be a potentially significant effect.

It should be noted that the significance derived at by the use of matrices is only a guide and the final conclusions of the impact assessment for each species is drawn upon the currently available evidence for each species.

### **Determining potential adverse effects.**

To determine potential adverse effects the assessment is based on the Conservation Objectives and qualifying species of the site.

To identify whether an impact is potentially adverse with respect to potential impacts on population levels a measure based upon the 1% of baseline mortality rate has been used as a guide. This guidance is based on an EC Report on the application of the Birds Directive and although does not relate specifically to impacts from wind farms does provide suitable guidance against which an assessment can be made (EC 2000). If there is an increase in the baseline mortality rate of more than 1% then there is the potential for an adverse effect.

In order to determine whether there is the potential for an adverse effect the SPA population of the species has to be determined. Population levels can increase or decrease often by natural change. Consequently, the population within the SPA citation may not be comparable with the more recent counts and by making an assessment against historical population levels as published in the sites citation an inaccurate conclusion may be drawn. For the purposes of this assessment the latest SPA population figures have been used, although it is recognised that the population at the time of citation may still be relevant. The figures have been obtained from SNH and JNCC sources (SNH 2011, JNCC 2011a) (Table 3-15).

For many species of bird present in Aberdeen Bay it is likely that birds of the same species may be from different SPA sites, e.g. guillemots may be from Fowlsheugh SPA, Troup, Pennan and Lion's Head SPA and Buchan Ness to Collieston SPA. It is not possible to identify from which specific SPA the birds present within Aberdeen Bay are from. Without this information the assessment assumes that any birds potentially at risk of an impact are all from a single SPA. However, it also recognises that this will not be the case and a proportion of birds will be from other designated sites.

Ultimately the approach to ascertaining whether there is a potential adverse effect on site integrity is a judgement based on the totality of the evidence available.

### **3.6 Assessment of cumulative impacts**

The assessment of cumulative impact considers all other activities that have the potential to significantly impact on the birds that may be present at the proposed development location, these possible activities include:

- Offshore renewables,
- Shipping,
- Aggregates,
- Dredging,
- Oil & gas.

Offshore renewable projects that have been identified as having the potential for a cumulative effect include two developments in the Moray Firth and three in the Firth of Forth. The sites in the Moray Firth are approximately 150 km to the north and those in the Firth of Forth approximately 120 km to the south of the proposed development (Table 3-14).

The construction of the EOWDC is planned for 2013 and 2014 and so there is the potential for an overlap in construction activities in 2014 with Neart Na Gaoithe and Beatrice offshore wind farms. However, given the stage of development of the renewable projects yet to be constructed and the uncertainty as to the types of foundations and turbines that will be used, there is sparse information available to incorporate into any impact assessment, which limits the effectiveness of cumulative assessments considering conceptual projects yet to be subject to a formal planning application and for which no environmental or design data are currently available.

Therefore, the cumulative impact assessment can only be undertaken with data available from the currently operating Beatrice demonstrator project in the Moray Firth. Although, the assessment does wherever possible the potential cumulative impacts from other yet unconsented renewable projects.

Shipping associated with Aberdeen harbour, has been undertaken in Aberdeen Bay over many centuries with currently approximately 16,000 vessel movements per year. There are no known plans that are likely to cause a significant increase in the level of shipping currently being undertaken in Aberdeen Bay and any impacts shipping may currently be having on the birds within Aberdeen Bay will be part of the baseline.

There are no aggregates activities within Aberdeen Bay. There are no licensed dredging sites within Aberdeen Bay but occasional dredging of the harbour may occur, with the next dredging scheduled for 2012.

Aside from associated shipping there are no oil and gas related activities within Aberdeen Bay.

**Table 3-14: Potential renewable energy developments.**

Name of development	Developer	MW	Possible number of Turbines	Project timeframe construction
The Beatrice Demonstrator	Joint Venture Talisman and Scottish and Southern Energy	10	2	Installed operational
The Moray Firth Eastern Development	Moray Offshore Renewables Ltd	1,300	67	Construction starts 2015
The Moray Firth Western Development			Not yet known	Unknown >2015 (EIA commences 2013)
Beatrice	Sea Energy Renewables Ltd & Scottish and Southern Energy	920	184	2014
Firth of Forth: Phase 1	SeaGreen	1,075	215	2015
Firth of Forth: Phase 2		1,435	287	Unknown >2015
Firth of Forth: Phase 3		955	191	Unknown >2015
Neart na Gaoithe	Mainstream Renewable Power	420	130	2014
Inch Cape	SeaEnergy	905	181	2015

### 3.7 Assessment of in-combination impacts

The Conservation (Natural Habitats, & c.) Regulations 1994 (as amended) require that a Habitats Regulations Appraisal (HRA) must be conducted by a competent authority. The HRA considers the implications for European sites in view of the European sites conservation objectives, in respect of any plan or project which is not directly connected with or necessary to the management of the European site for conservation purposes and which is likely to have a significant effect on the European site either alone or *in-combination* with other plans or projects.

Therefore the term 'in-combination' will be used when considering the impacts of the proposals with other plans or projects on European sites and their associated qualify features or species.

The main industries considered for potential in-combination impacts are proposed offshore wind farms, aggregate industry, dredging, oil and gas and shipping. Of these, proposed offshore wind farms and shipping are the only activities identified for which there is a potential for an in-combination impact.

**Table 3-15: National, Scottish and Regional SPA species populations.**

<b>Species</b>	<b>Season</b>	<b>National Pop<sup>n</sup></b>	<b>Scottish Pop<sup>n</sup></b>	<b>Regional SPA Pop<sup>n</sup></b>	<b>1% regional SPA Pop<sup>n</sup></b>
<b>Whooper swan</b>	Summer	<15 <i>p.</i>	3-7 <i>p.</i>	0	0
	Winter	10,678 <i>i.</i>	4,142 <i>i.</i>	330	3 <i>i.</i>
<b>Red-throated diver</b>	Summer	1,014 – 1,551 <i>p.</i>	1,000 – 1,500 <i>p.</i>	0	0
	Winter	17,000 <i>i.</i>	2,270 <i>i.</i>	317 <i>i.</i> <sup>(1)</sup>	3 <i>i.</i> <sup>(1)</sup>
<b>Great-crested grebe</b>	Summer	8,000 <i>p.</i>	240 – 365 <i>p.</i>	0	0
	Winter	16,000 <i>i.</i>	900 – 1,500 <i>i.</i>	156	2 <i>i.</i>
<b>Fulmar</b>	Summer	530,000 Aon	486,000 Aon	6,418 Aon	128 <i>i.</i>
	Winter	-	-	-	-
<b>Northern gannet</b>	Summer	230,000 Aon	182,511 Aon	51,647 Aon	1,032 <i>i.</i>
	Winter	-	-	-	-
<b>Manx shearwater</b>	Summer	277,803 – 311,263 <i>p.</i>	126,545 Aon	0	0
	Winter	0	0	0	0
<b>Great cormorant</b>	Summer	8,400 <i>p.</i>	3,600 Aon	198 <i>p.</i>	3 <i>i.</i>
	Winter	23,000 <i>i.</i>	9 – 11,000 <i>i.</i>	-	-
<b>European shag</b>	Summer	27,000 Aon	21,500 – 30,000 Aon	3,218 <i>p.</i>	64 <i>i.</i>
	Winter	-	60,000 – 80,000 <i>i.</i>	-	-
<b>Pink-footed goose</b>	Summer	0	0	0	0
	Winter	340,000 <i>i.</i>	200,000 <i>i.</i>	348,000 <i>i.</i>	3,480 <i>i.</i>
<b>Greylag goose</b>	Summer	35,177	25,000 <i>i.</i>	0	0
	Winter <sup>(2)</sup>	83,677	85,000 <i>i.</i>	6,529 <i>i.</i>	65 <i>i.</i>
<b>Barnacle goose (Svalbard pop<sup>n</sup>)</b>	Summer	0	0	0	0
	Winter	32,000 <i>i.</i>	32,000 <i>i.</i>	2,200 <i>i.</i>	22 <i>i.</i>
<b>Shelduck</b>	Summer	11,000 <i>i.</i>	1,750 <i>p.</i>	-	-
	Winter	78,000 <i>i.</i>	70,000 <i>i.</i>	5,268 <i>i.</i>	53 <i>i.</i>
<b>Eurasian wigeon</b>	Summer	400 <i>p.</i>	240 – 400 <i>p.</i>	-	-
	Winter	359,236 <i>i.</i>	76,000 – 96,000 <i>i.</i>	6,083 <i>i.</i>	61 <i>i.</i>
<b>Eurasian Teal</b>	Summer	<2,050 <i>p.</i>	1,950 – 3,400 <i>p.</i>	-	-
	Winter	192,000 <i>i.</i>	22,500 – 125,000 <i>i.</i>	504 <i>i.</i>	5 <i>i.</i>
<b>Mallard</b>	Summer	48,000 – 114,000 <i>p.</i>	17,000 – 43,000 <i>p.</i>	-	-
	Winter	352,000 <i>i.</i>	65,000 – 90,000 <i>i.</i>	2,546 <i>i.</i>	25 <i>i.</i>

Species	Season	National Pop <sup>n</sup>	Scottish Pop <sup>n</sup>	Regional SPA Pop <sup>n</sup>	1% regional SPA Pop <sup>n</sup>
Goldeneye	Summer	200 <i>p.</i>	125 – 150 <i>p.</i>	-	-
	Winter	25,000 <i>i.</i>	10,000 – 12,000 <i>i.</i>	836 <i>i.</i>	8 <i>i.</i>
Common eider	Summer	31,000 <i>p.</i>	20,000 <i>p.</i>	1,500 <i>p.</i>	30 <i>i.</i>
	Winter	73,000 <i>i.</i>	64,500 <i>i.</i>	9,000 <i>i.</i> <sup>(1)</sup>	90 <i>i.</i> <sup>(1)</sup>
Long-tailed duck	Summer	0	0	0	0
	Winter	16,000 <i>i.</i>	15,000 <i>i.</i>	<100 <i>i.</i> <sup>(1)</sup>	1 <i>i.</i> <sup>(1)</sup>
Common scoter	Summer	9 – 52 <i>p.</i>	9 – 52 <i>p.</i>	6,500 <i>i.</i> <sup>(1)</sup>	65 <i>i.</i>
	Winter	50,000 – 65,000 <i>i.</i>	25,000 – 30,000 <i>i.</i>	2,187 <i>i.</i>	22 <i>i.</i>
Velvet scoter	Summer	0	0	600 <i>i.</i> <sup>(1)</sup>	6 <i>i.</i>
	Winter	3,000 <i>i.</i>	2,500 – 3,500 <i>i.</i>	-	-
Red-breasted Merganser	Summer	2,400 <i>p.</i>	2,000 <i>p.</i>	80 <i>i.</i> <sup>(1)</sup>	<1 <sup>(1)</sup>
	Winter	10,200 <i>i.</i>	8,500 <i>i.</i>	-	-
Guillemot	Summer	1,300,000 <i>i.</i>	780,000 <i>p.</i>	86,187 <i>i.</i>	861 <i>i.</i>
	Winter	-	750,000 <i>i.</i>	-	-
Razorbill	Summer	110,000 <i>p.</i>	93,300 <i>p.</i>	12,275 <i>i.</i>	123 <i>i.</i>
	Winter	-	50,000 – 250,000 <i>i.</i>	-	-
Atlantic puffin	Summer	579,000 <i>p.</i>	493,000 <i>p.</i>	58,867 Aon	1,177 <i>i.</i>
	Winter	-	20,000	-	-
Great skua	Summer	9,650 <i>p.</i>	9,650 <i>p.</i>	-	-
	Winter	0	0	0	0
Arctic skua	Summer	2,100 <i>p.</i>	2,100 <i>p.</i>	-	-
	Winter	0	0	0	0
Black-headed gull	Summer	130,000 <i>p.</i>	43,200 Aon	-	-
	Winter	2,200,000 <i>i.</i>	150,000 <i>i.</i>	-	-
Common gull	Summer	48,000 <i>p.</i>	48,100 <i>p.</i>	-	-
	Winter	620,000 – 721,000 <i>i.</i>	79,700 <i>i.</i>	-	-
Herring gull	Summer	131,000 Aon	72,000 Aon	-	-
	Winter	450,000 <i>i.</i>	91,000 <i>i.</i>	9,801 <i>p.</i>	196 <i>i.</i>
Lesser black-backed gull	Summer	110,000 <i>p.</i>	25,000 Aon	2,920 <i>p.</i>	58 <i>i.</i>
	Winter	118,000 – 131,000 <i>i.</i>	200 – 600 <i>i.</i>	-	-
Great black-backed gull	Summer	17,000 <i>p.</i>	14,800 Aon	-	-
	Winter	71,000 – 81,000 <i>i.</i>	7,500 – 10,000 <i>i.</i>	-	-



Species	Season	National Pop <sup>n</sup>	Scottish Pop <sup>n</sup>	Regional SPA Pop <sup>n</sup>	1% regional SPA Pop <sup>n</sup>
Black-legged kittiwake	Summer	370,000 <i>p.</i>	282,200 Aon	48,894 <i>p.</i>	818 <i>i.</i>
	Winter	-	10,000 <i>i.</i>	-	-
Little tern	Summer	1,900 <i>p.</i>	331 Aon	36 <i>p.</i>	<1 <i>i.</i>
	Winter	0	0	0	0
Sandwich tern	Summer	11,000 <i>p.</i>	1,100 Aon	645 <i>p.</i>	13 <i>i.</i>
	Winter	0	0	0	0
Common tern	Summer	10,000 <i>p.</i>	4,800 Aon	384 <i>p.</i>	8 <i>i.</i>
	Winter	0	0	0	0
Arctic tern	Summer	52,600 <i>p.</i>	47,300 <i>p.</i>	903 <i>p.</i>	18 <i>i.</i>
	Winter	0	0	0	0

(1) = non SPA species in Aberdeen Bay; (2) = Icelandic wintering population of greylag goose

Sources: BTO 2011, Calbrade *et al.* 2010; Forrester *et al* 2009, NESBR

*p.* = pairs; *i.* = individuals; Aon = Apparently occupied nests

### 3.8 Impact assessment summary

The results from undertaking the impact assessment based on the matrices are summarised below in three separate tables:

- Collision risk
- Barrier effect
- Displacement

Each of the results are considered further within the individual species assessments presented in Section 4 where the use of site specific information, evidence from existing offshore developments and expert judgement are used to determine the risk and potential significance from each impact for each the main species recorded during the studies undertaken.

**Table 3-16: Potential sensitivities and significance of impact from collision risk.**

Species	Non Impact Sensitivity	Adult Survival	Overall Collision sensitivity	Magnitude	Significance
Whooper swan	Very High	Medium	High	Negligible	Negligible
Pink-footed goose	Very High	High	Very High	Negligible	Minor
Greylag goose	Very High	High	Very High	Negligible	Minor
Barnacle goose	Very High	Very High	Very High	Negligible	Minor
Shelduck	Very High	High	Very High	Negligible	Minor
Eurasian wigeon	Very High	Low	Medium	Negligible	Negligible
Eurasian Teal	Very High	Low	Medium	Negligible	Negligible
Mallard	Very High	Low	Medium	Negligible	Negligible
Common eider	Very High	Very High	Very High	Negligible	Minor
Long-tailed duck	Very High	Low	Medium	Negligible	Negligible
Common scoter	Very High	Low	Medium	Negligible	Negligible
Velvet scoter	Very High	Low	Medium	Negligible	Negligible
Goldeneye	Very High	Low	Medium	Negligible	Negligible
Red-Brst Merganser	Very High	Low	Medium	Negligible	Negligible
Red-throated diver	High	Medium	High	Negligible	Negligible
Fulmar	Very High	Very High	Very High	Negligible	Minor
Manx shearwater	Low	Very High	High	Negligible	Negligible
Northern gannet	Very High	Very High	Very High	Low	Moderate
Great cormorant	Very High	High	Very High	Negligible	Minor
European shag	Very High	High	Very High	Negligible	Minor
Great-crested grebe	Very High	Low	Medium	Negligible	Negligible
Arctic skua	Medium	High	High	Negligible	Negligible
Great skua	Medium	High	High	Negligible	Negligible
Golden plover	Very High	Low	Medium	Negligible	Negligible
Kittiwake	Very High	Very High	Very High	Low	Moderate
Black-headed gull	Low	Very High	High	Negligible	Negligible
Common gull	Low	High	Medium	Negligible	Negligible
Herring gull	Very High	High	Very High	Low	Moderate
Lsr blkck-backed gull	Very High	Very High	Very High	Low	Moderate
Grt blkck-backed gull	Low	Very High	High	Low	Minor
Little tern	Very High	High	Very High	Negligible	Minor
Sandwich tern	Very High	High	Very High	Low	Moderate
Common tern	Very High	Very High	Very High	Low	Moderate
Arctic tern	Very High	Very High	Very High	Low	Moderate
Guillemot	Very High	Very High	Very High	Negligible	Minor
Razorbill	Very High	Very High	Very High	Negligible	Minor
Atlantic puffin	Very High	Very High	Very High	Negligible	Minor

**Table 3-17: Potential sensitivity and significance of impact from barrier effects.**

Species	Non Impact Sensitivity	Barrier	Overall Barrier sensitivity	Magnitude	Significance
Whooper swan	Very High	Medium	High	Low	Minor
Pink-footed goose	Very High	Medium	High	Medium	Moderate
Greylag goose	Very High	Medium	High	Low	Minor
Barnacle goose	Very High	Medium	High	High	Major
Shelduck	Very High	Medium	High	Negligible	Negligible
Eurasian wigeon	Very High	Medium	High	Negligible	Negligible
Eurasian Teal	Very High	Medium	High	Negligible	Negligible
Mallard	Very High	Medium	High	Negligible	Negligible
Common eider	Very High	Medium	High	Medium	Moderate
Long-tailed duck	Very High	Medium	High	Low	Minor
Common scoter	Very High	Medium	High	Medium	Moderate
Velvet scoter	Very High	Medium	High	Medium	Moderate
Goldeneye	Very High	Medium	High	Negligible	Negligible
Red-Brst Merganser	Very High	Medium	High	Low	Negligible
Red-throated diver	High	High	Very High	Medium	Major
Fulmar	Very High	Low	Medium	Medium	Minor
Manx shearwater	Low	Low	Low	Negligible	Negligible
Northern gannet	Very High	Low	Medium	Low	Minor
Great cormorant	Very High	Low	Medium	Low	Minor
European shag	Very High	Low	Medium	Low	Minor
Great-crested grebe	Very High	Medium	High	Negligible	Negligible
Arctic skua	Medium	Low	Low	Low	Negligible
Great skua	Medium	Low	Low	Low	Negligible
Golden plover	Very High	Low	Medium	Low	Minor
Kittiwake	Very High	Low	Medium	Low	Minor
Black-headed gull	Low	Low	Low	Low	Negligible
Common gull	Low	Low	Low	Low	Negligible
Lsr bick-backed gull	Very High	Low	Medium	Low	Minor
Herring gull	Very High	Low	Medium	Medium	Minor
Grt bick-backed gull	Low	Low	Low	Low	Negligible
Little tern	Very High	Low	Medium	Low	Minor
Sandwich tern	Very High	Low	Medium	Medium	Minor
Common tern	Very High	Low	Medium	Low	Minor
Arctic tern	Very High	Low	Medium	Low	Minor
Guillemot	Very High	Low	Medium	Medium	Minor
Razorbill	Very High	Low	Medium	Medium	Minor
Atlantic puffin	Very High	Low	Medium	Medium	Minor

**Table 3-18: Potential sensitivity and significance of impact from displacement and Disturbance.**

Species	Non Impact Sensitivity	Displacement	Overall Displacement sensitivity	Magnitude	Significance
Whooper swan	Very High	Low	Medium	Negligible	Negligible
Pink-footed goose	Very High	Medium	High	Negligible	Negligible
Greylag goose	Very High	Medium	High	Negligible	Negligible
Barnacle goose	Very High	Medium	High	Negligible	Negligible
Shelduck	Very High	Low	Medium	Negligible	Negligible
Eurasian wigeon	Very High	Low	Medium	Negligible	Negligible
Eurasian Teal	Very High	Low	Medium	Negligible	Negligible
Mallard	Very High	Low	Medium	Negligible	Negligible
Common eider	Very High	Medium	High	High	Major
Long-tailed duck	Very High	High	Very High	Low	Moderate
Common scoter	Very High	High	Very High	High	Major
Velvet scoter	Very High	High	Very High	High	Major
Goldeneye	Very High	Low	Medium	Negligible	Negligible
Red-Brst Merganser	Very High	Medium	High	Medium	Moderate
Red-throated diver	High	Very High	Very High	Medium	Major
Fulmar	Very High	Low	Medium	Negligible	Negligible
Manx shearwater	Low	Low	Low	Negligible	Negligible
Northern gannet	Very High	Low	Medium	Negligible	Negligible
Great cormorant	Very High	High	Very High	Low	Moderate
European shag	Very High	High	Very High	Low	Moderate
Great-crested grebe	Very High	High	Very High	Negligible	Minor
Arctic skua	Medium	Low	Low	Negligible	Negligible
Great skua	Medium	Low	Low	Negligible	Negligible
Golden plover	Very High	Low	Low	Negligible	Negligible
Kittiwake	Very High	Low	Medium	Negligible	Negligible
Black-headed gull	Low	Low	Low	Negligible	Negligible
Common gull	Low	Low	Low	Negligible	Negligible
Lsr blk-backed gull	Very High	Low	Medium	Negligible	Negligible
Herring gull	Very High	Low	Medium	Negligible	Negligible
Grt blk-backed gull	Low	Low	Low	Negligible	Negligible
Little tern	Very High	Low	Medium	Negligible	Negligible
Sandwich tern	Very High	Low	Medium	Medium	Minor
Common tern	Very High	Medium	High	Low	Minor
Arctic tern	Very High	Medium	High	Low	Minor
Guillemot	Very High	Medium	High	Low	Minor
Razorbill	Very High	Medium	High	Low	Minor
Atlantic puffin	Very High	Low	Medium	Low	Minor

## **4 SPECIES ACCOUNTS**

## 4.1 Whooper swan (*Cygnus cygnus*)

### 4.1.1 Protection & Conservation Status

The whooper swan is listed in Annex I of the Birds Directive, Appendix II of the Bern Convention, Appendix II of the Bonn Convention, Schedule 1 under the Wildlife and Countryside Act, 1981 and is on the Amber List of Species of Conservation Concern.

### 4.1.2 Background

Whooper swan		
GB Population	Breeding: <15 prs. Winter: 10,678 ind.	Holling 2010 Calbrade <i>et al.</i> 2010
Scotland	Breeding: 3 – 7prs Winter: 4,142	Forrester <i>et al.</i> 2007
International threshold	210 ind.	Calbrade <i>et al.</i> 2010
GB threshold	57 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Loch of Strathbeg – 333 ind	SNH 2011 JNCC 2011a
European population estimate	Breeding 16,000 – 21,000 Wintering >65,000	Birdlife 2004
European population trend	Status: 'Large increase' Trend: 'secure'	Birdlife 2004
World population	180,000 'adults'	Birdlife 2011

Whooper swans are a rare breeding bird in the UK and Scotland with less than 15 pairs nesting each year, approximately half of which nest in Scotland. Wintering birds arrive from their main breeding grounds in Iceland during October and November and spend the winter on lowland farmland, lochs and marshland (Forrester *et al.* 2007). In North-east Scotland small numbers of whooper swans can occur in many of the freshwater lochs but the main wintering area is the Loch of Strathbeg where over 300 whooper swans have occurred in recent years, although up to 600 were present there in the early 1980's (Buckland, Bell & Picozzi 1990).

Satellite tagging studies have indicated that the majority of whooper swans migrating along the east coast are associated with the wintering sites in East Anglia but no birds were recorded flying along the North-east coast of Scotland with birds crossing the Firth of Forth moving predominantly north-west/south-east direction (Griffin, Rees & Hughes 2010).

#### Boat-based surveys

No whooper swans were recorded during boat-based surveys undertaken in Aberdeen Bay.

#### Vantage Point surveys

The only record of whooper swan during any of the surveys was of a flock of five birds, which were recorded inland heading north-west at Drums during October 2005. The birds were flying at approximately 20 m altitude.

#### Bird Detection Radar

No whooper swans were recorded during any of the radar studies undertaken.

### 4.1.3 Summary of Results

Only one flock of whooper swans was recorded during surveys undertaken in Aberdeen Bay. The flock was flying inland and below 20 m.

#### 4.1.4 Initial Assessment of Significance

Whooper swan	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	High	Low	Minor
Displacement	Medium	Negligible	Negligible

#### 4.1.5 Species Sensitivities

##### Qualifying species

There are twenty Special Protection Areas (SPA) in the UK for which whooper swan is a qualifying species, of which one is within an area of potential impacts from the proposed development:

- Loch of Strathbeg SPA & Ramsar (47.6 km).

Formerly whooper swan was also a qualifying feature for the Loch of Skene SPA and under the last review, the Loch of Skene held 307 whooper swan based on the 5 year peak mean from between 1991/92 and 1995/96 (Stroud *et al.* 2001). Recent counts at Loch of Skene indicate a decline in the use of the site by whooper swans with peak counts of 27 in 2007.

The Loch of Strathbeg review reported 183 whooper swans (3.3% of the wintering population in Great Britain) based on the 5yr peak mean from between 1991/92 and 1995/96 (Stroud *et al.* 2001). More recent data have recorded a five year peak mean of 333 whooper swans with the latest published counts being of 92 in 2008 (Calbrade *et al.* 2010).

##### Flight height

The median flight height for whooper swans across the Moray Firth is 1 m with 83% of flights at or below 20 metres and 100% of flights below 50 m. Elsewhere, recorded flight height have been higher, e.g. across the Wash the median flight heights are higher at 30 m with 22% below turbine height (Griffin, Rees & Hughes 2010).

##### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys indicate that whooper swans are infrequent within the area of the proposed development with no sightings within the footprint of the proposed development and only one sighting of five birds flying inland. Data from satellite tagging studies indicates a relatively low usage of the coast from North-east coast of Scotland by whooper swans, with the majority of birds flying overland (Griffin, Rees & Hughes 2010).

Evidence from other offshore wind farms indicate that migrating whooper swans will, if migrating along the coast, remain in nearshore waters. Nearly 90% of migrating whooper swans in Liverpool Bay were recorded within 2.5 km of the coast with 70% along the coastline (RBA 2005).



Flight height data obtained from radio tracking studies suggest that the majority of whooper swans fly below turbine height. Evidence from existing wind farms indicate that 70% of whooper swans fly below 30 m (RBA 2005).

Based on the evidence from existing offshore wind farms and site specific data indicating a very low, if any, usage of the area by whooper swans, the risk of any significant impact or adverse affect on whooper swans is negligible.

#### **Barrier effect**

Evidence from studies undertaken in Sweden suggests that Swans (including whooper swan) and geese may avoid flying into wind farms during migration (Pettersson 2005).

In order to avoid the turbines the birds may incur additional energetic expenditure. The proposed EOWDC is at its longest point approximately 4 km and at its widest 2 km. Assuming birds avoid the wind farm at 1,000 m then they may incur an overall increase in flight distance of 3.2 km. For whooper swans flying to or from Iceland the potential increase in distance flown in order to avoid the turbines is negligible.

#### **Displacement**

Whooper swans rarely settle on the sea surface and tend to do so only in poor weather during periods of migration. They do not forage offshore and therefore there will not be any potential displacement of whooper swans due to the proposed development.

#### **Cumulative and in-combination**

The very low level of usage of the site indicates that there will not be any cumulative or in-combination impacts.

### **4.1.6 Conclusions**

#### **Habitats Appraisal**

Based on the available evidence from site specific surveys undertaken at the proposed development area and other offshore wind farms in particular, the very low usage of the site during migration and that the Loch of Strathbeg SPA is located to the north and therefore birds migrating from Iceland will not cross the proposed development area to and from their breeding grounds. It is concluded that the proposed development will not have an adverse effect on whooper swans as a qualifying feature for Loch of Strathbeg SPA.

#### **Environmental Impact Assessment**

Based on the apparently low numbers crossing the proposed development site and the known behaviour of Swans, it is predicted that there will not be a significant environmental impact arising from the proposed development on whooper swans.

## 4.2 Pink-footed goose (*Anser brachyrhynchus*)

### 4.2.1 Protection & Conservation Status

The Pink-footed goose is listed in Appendix II of the Bern Convention, Appendix II of the Bonn Convention and is on the Amber List of Species of Conservation Concern.

### 4.2.2 Background

Pink-footed goose		
GB Population	Winter – 340,000 ind.	Calbrade <i>et al.</i> 2010
Scotland Population	Winter – 200,000 ind.	Forrester <i>et al.</i> 2007
International threshold	2,700 ind.	Calbrade <i>et al.</i> 2010
GB threshold	2,400 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Ythan Estuary, Sands of Forvie and Meikle Loch – 16,300 (07/08) Loch of Strathbeg 53,454 (08/09) Firth of Forth: 3,220 (08/09) Firth of Tay & Eden Estuary: 2,704 (08/09) Montrose Basin: 38,911 (08/09)	Calbrade <i>et al.</i> 2010
European population estimate	Breeding 50,000 – 69,000 pairs Wintering – >290,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	310,000 'adults'	Birdlife 2011

The pink-footed goose population that winters in the UK breed in Iceland and eastern Greenland. They migrate to the UK in the autumn in large numbers during September and October and winter in eastern Scotland, north-west England and Norfolk and start returning north in March and April. In North-east Scotland pink-footed geese are widespread occurring across the region from September through to April. Peak numbers occur in mid-October when pink-footed geese arrive from their breeding grounds during which time up to 25% of the British population may occur at the Loch of Strathbeg and Meikle Loch. Birds disperse southward for the winter and return again in March when birds overwintering to south of the region migrate northwards. Between October and March the number of pink-footed geese in the region is lower but those that remain feed on farmland and roost in large numbers on a few freshwater lochs, primarily Loch of Strathbeg and Meikle Loch.

Birds flying offshore peak during September and October with up to 800 birds per month past Peterhead with numbers dropping in November and December when less than 100 birds per month have been recorded. There is a smaller passage of pink-footed geese past Peterhead during April when 200 birds per month were recorded. Sightings were of birds out to 3 km from shore (Innes 1996).

The pink-footed goose population has increased substantially in recent decades from approximately 50,000 in the 1960's to a present day total of approximately 340,000 individuals and this increase has been reflected in the number of birds occurring in North-east Scotland where the use to be only 1,000 to 2,000 birds present to over 50,000 in recent years (Buckland, Bell & Picozzi 1990; Calbrade *et al.* 2010; NESBR).

### Boat-based surveys

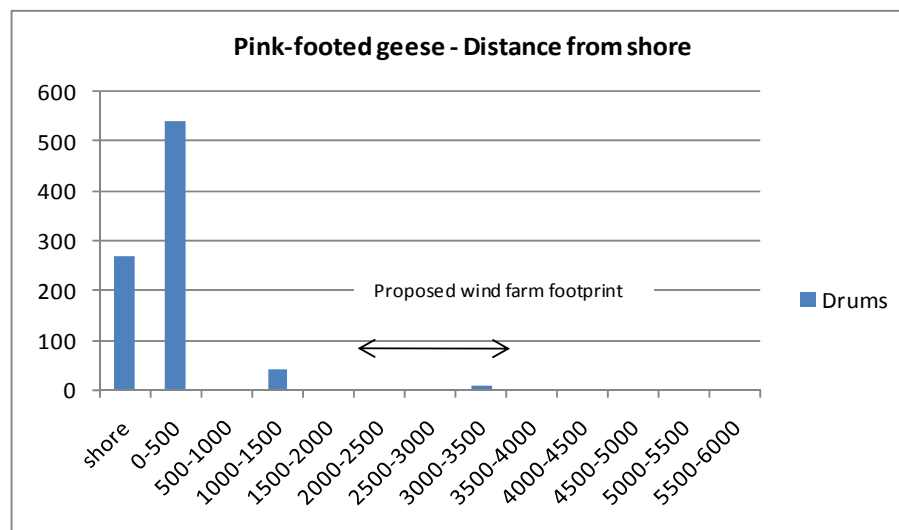
No pink-footed geese were recorded during any of the boat-based surveys undertaken between February 2007 and April 2008 and again from August 2010 and January 2011 (SMRU 2011b).

### Vantage Point surveys

In Aberdeen Bay, pink-footed geese were recorded from four Vantage Point sites between October and March but none were recorded during 23 hours of survey undertaken during September and October 2005. There was only one record of three birds in September (Alba Ecology 2008a) and no records of pink-footed geese during April. Counts were of a relatively small number of skeins comprising of between 18 and 230 individuals and only three skeins of pink-footed geese were recorded between October and March 2006. The majority of sightings were of birds between 1-3 km from the coast and between 50% and 100% of were flying between 30 m–150 m.

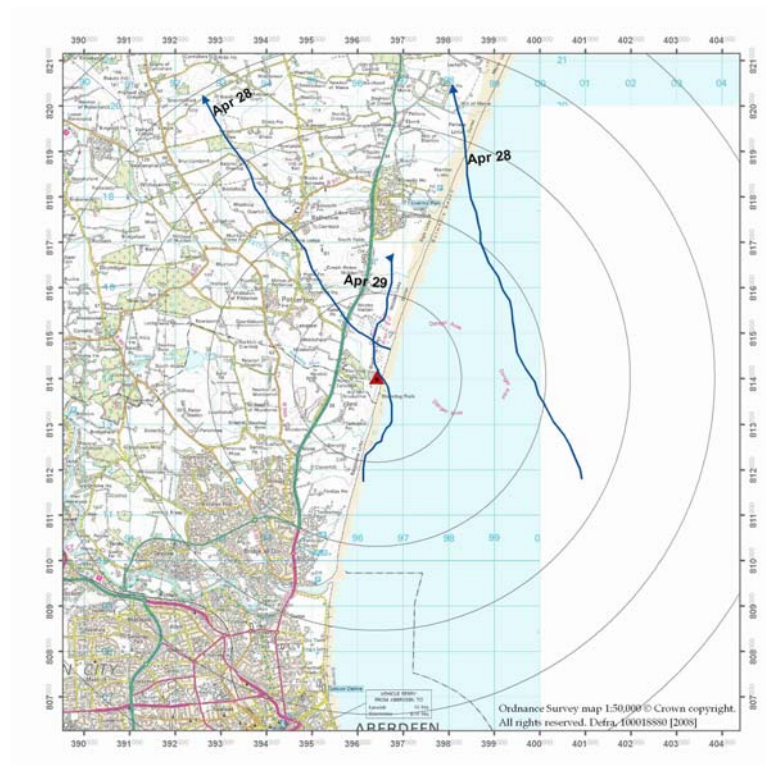
### Bird Detection Radar

During radar studies undertaken in October 2005 a total of 12 skeins of pink-footed geese were recorded totalling 858 birds. All sightings were made from Drums with no records from Easter Hatton (Walls *et al.* 2005). Birds were recorded out to 3.0 km with the majority within 500 m from shore (Figure 4-1).



**Figure 4-1: Number of pink-footed geese and distance from shore observed from surveys at Drums in October 2005 (Adapted from Walls *et al.* 2006).**

Seventeen days of radar studies recorded 102 pink-footed geese in four skeins flying north between 11 April and 26 April 2007. All sightings were from between 0.5 km and 2 km from shore and below 30 m (Simms *et al.* 2007). A further radar study aimed to detect migrating geese across Aberdeen Bay during six days in April 2010 recorded three skeins of geese, one of which was confirmed to be pink-footed geese. All three skeins were moving northwards and the one skein that was visually observed was of 90 birds (Plonczkier & Simms 2010).



**Figure 4-2: Flight directions of Geese sp. crossing Aberdeen Bay April 2010.**

#### 4.2.3 Summary of Results

Pink-footed geese were occasionally recorded in Aberdeen Bay during migration periods. Numbers recorded were generally low with no significant migration detected. The majority of birds were recorded flying above 30 m and most sightings were of birds within 2 km from shore.

Numbers of pink-footed geese recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.2.4 Initial Assessment of Significance

<b>Pink-footed goose</b>	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	High	Medium	Moderate
Displacement	High	Negligible	Negligible

#### 4.2.5 Species Sensitivities

##### Qualifying species

The nearest SPAs to the proposed development for which the pink-footed goose is a qualifying species are the Ythan Estuary, Sands of Forvie and Meikle Loch SPA & Ramsar and the Loch of Strathbeg SPA & Ramsar. Elsewhere, the Montrose Basin, Firth of Forth and Firth of Tay & Eden Estuary SPA & Ramsar, also have pink-footed geese as qualifying species (SNH 2011).

### Flight height

No pink-footed geese were recorded from boat-based surveys but flight heights from Vantage Point surveys indicated that between 50 – 100% of recorded flights were between 30 – 150 m above the sea surface and therefore at potential risk of collision.

Data from other offshore wind farms have recorded 46% of all flights as flying at potential rotor height (n=12,294).

### Collision risk

Evidence from site specific surveys indicate that pink-footed geese occur in Aberdeen Bay particularly during the spring and autumn and are more frequently recorded within 2 km of the coast than further offshore (Figure 4-1).

Collision Risk Modelling undertaken for pink-footed goose is based on:

- Body length of 65 cm
- Wingspan of 153 cm
- Flight speed of 18.8 m.s<sup>-1</sup>
- % at rotor height –46%
- Avoidance rate – 98, 99, 99.5%

(Koffijberg & Mennobart 1995; Gremillet, Schmid & Culik 1995)

The number of pink-footed geese recorded within the proposed development area was very low. Therefore, the collision risk modelling undertaken was based on a very precautionary 'worst-case' scenario using following assumptions:

1. The total number of pink-footed geese passing through North-east Scotland each autumn is 340,000. This is based on the entire UK wintering population occurring in North-east Scotland, which is not thought to be the case, as some but an unknown number of geese will arrive directly into the north-west England from their breeding grounds in Iceland (WWT 2007).
2. All pink-footed geese migrate south across a front of up to 5 km offshore and 5 km inland and therefore over a 10 km wide front. The maximum width of the proposed development is 3.6 km and therefore intercepts 36% of the potential flight path. This is precautionary as site specific data indicates that the majority of geese fly within 1 km from shore (Figure 4-1) and therefore do not interact with potential development. However, for the purposes of the collision risk modelling it assumed that 36% of the UK wintering population of pink-footed geese cross the proposed development area, i.e. 122,400 birds and that they pass through the site each autumn and spring, i.e. a total passage of 244,800 birds per year.
3. Those that do fly across the development area, 46% do so at turbine height and that there is no far field avoidance.
4. The same rate of passage occurs during the spring as it does during the autumn is also very precautionary as the numbers of pink-footed geese in the spring are always significantly lower than those in the autumn indicating that less pink-footed geese will pass through the region during the spring migration.

The Collision Risk Modelling has been undertaken on these precautionary assumptions using a range of avoidance rates: 98%, 99% and 99.5%.

**Table 4-1: Results from collision risk modelling undertaken on pink-footed geese.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
8.4%	56	28	14

Based on the various very precautionary scenarios and using a precautionary avoidance rate of 99% as recommended by SNH, it is predicted that up to a total of 28 collisions per year may occur (Table 4-1).

The annual mortality rate for pink-footed goose is 13.7% (BTO 2011). Consequently, out of a population of 340,000 an annual mortality of 45,560 pink-footed geese may be predicted. Therefore, 1% of the baseline mortality is 4,556 birds per year.

Based on the results from the very precautionary Collision Risk Modelling undertaken, the number of pink-footed geese that may collide is lower than the rate of mortality which may cause concern of a potentially significant impact on pink-footed geese.

To assess whether there is the potential for an adverse effect on pink-footed geese as qualify species for the relevant regional SPAs, the assessment is based on the 5 year peak mean counts as opposed to numbers published at the time of SPA citation as the populations of pink-footed geese have increased significantly since the SPA citations were originally made. It is also assumed that each SPA population is separate from each other and any collision impacts relate to birds only associated with that SPA. This is known to be an incorrect and precautionary assumption as evidence from ringing studies indicates that pink-footed geese frequently move between sites during the winter period and that many birds migrate south-west from North-east Scotland to north-west England and are therefore not going to interact with the proposed development (WWT 2007; Mitchell & Hearn 2004). As the counts relate only to the autumn passage of geese the modelling is based on a similar rate of passage across each site in the spring.

**Table 4-2: Predicted natural mortality rates of pink-footed geese at relevant SPAs.**

Site SPA/Ramsar	Population	Natural Mortality	1% of Natural Mortality
Ythan Estuary, Sands of Forvie and Meikle Loch	16,300	2,233	22
Loch of Strathbeg	53,454	7,323	73
Firth of Forth	3,220	441	4
Firth of Tay and Eden Estuary	2,704	370	4
Montrose Basin	38,911	5,330	53

Based on the above and the precautionary guidance threshold of a 1% increase in baseline mortality, the results from the Collision Risk Modelling indicate that there is the potential for an adverse effect to occur should all the potential collisions relate to geese associated with three of the SPAs. However, this is based on the very precautionary assumptions made that the whole Icelandic population of pink-footed geese pass through the area and do so through a 10 km wide coastal corridor during both the autumn and spring migrations.

Intensive surveys have been undertaken at offshore wind farms to assess the potential collision risk of pink-footed geese. All studies undertaken to date have



indicated a very high avoidance rate for pink-footed geese and very low risk of collision.

Studies undertaken at Barrow offshore wind farm in the East Irish Sea reported that pink-footed geese recorded flying in line of the wind farm adjusted their flight height to pass above the wind farm and continue their migration. Of the nine pink-footed geese recorded entering the wind farm at rotor height, all flew between the turbines without any collisions. No collisions were observed from a total of 16,542 observed passing birds of all species during the 21 days survey at Walney Island (BOW 2007).

The results from three years of studies assessing the potential impacts on birds in the Kalmar Sound from the two offshore wind farms of Utgrunden and Yttre Stengrund recorded very few collisions of any species. Although only a small proportion of the birds observed were pink-footed geese, nearly 120,000 other geese were recorded flying through the Sound. These were mainly barnacle, brent and white-fronted goose. Both prior and post construction the majority of the Geese flew along the shores of the Sound, with relatively few through the wind farm area. However, the number of geese migrating through the wind farm area increased from 6% of the total prior to construction to 13% of the total post construction. A total of 7,224 geese were recorded in the autumns of 2001 and 2002, all of which were seen to avoid the turbines.

At Nysted offshore wind farm in Denmark intensive radar studies undertaken tracked amongst other species (notably eider), approximately 10,000 geese each autumn and the results indicate that there was a significant decrease in the proportion of flocks entering the wind farm from between the pre-construction period and the current operational period. It reported that post construction, 9% of the birds entered the turbines compared with 40% crossing the same location before construction and no geese were recorded colliding with the turbines (Deshom & Kahlert 2005).

Similar results obtained from Horns Rev have also indicated that Geese, including pink-footed geese avoid operating offshore wind farms. A total of 11 flocks of geese observed on an intercept course with Horns Rev, one flock of 53 individuals was observed entering the wind farm area, without changing course, the remaining 10 flying past also without apparently altering course. Although course changes could have occurred before entering the radar area or due to their original line of approach they had no need to consider altering course. The flock that did alter course increased flight altitude when approaching the wind farm and when flying within the wind farm, ultimately flying at rotor height. Within the wind farm, the birds appeared to show less stability in flight resulting in a disrupted flock structure. The mean altitude of geese flocks was 64.2m and all flocks were within the rotor height (Christensen *et al.* 2004).

A total of 560 hours of observations undertaken at the eight turbines that make up the Rønland offshore wind farm in Denmark used both visual observations and radar to detect birds at night. Out of 30,977 birds recorded, 7,309 were Brent geese. Two collisions: one of a cormorant and the other of a pale bellied Brent goose were recorded during the study. This accounts for 0.07% of the total observations. Observations indicate that approximately 8% of all birds flew within 100 metres of the turbines and 4.5% of the flocks. But the risks of collision were much lower than those reported at other Danish wind farms (Jensen 2006).

Table 4-3 presents a summary of the data obtained on geese from existing constructed wind farms and the actual number of observed collisions. It is recognised that the total number of geese recorded includes geese observed that may not have had to take any avoidance behaviour as they were not originally flying in line with the turbines and also the observed collisions only occur during periods of daylight.



**Table 4-3: Summary of data obtained on geese from constructed offshore wind farms.**

Wind farm	No. of turbines	Length of study post construction	Species recorded	Total no. recorded	No of observed collisions
Utgrunden & Yttre Stergrund <sup>1</sup>	12	2 years	Bean goose	284	0
			Pink-footed goose	3	0
			White-fronted goose	9,992	0
			Greylag goose	1,143	0
			Canada Goose	311	0
			Barnacle goose	68,787	0
			Brent goose	17,592	0
			Red-breasted goose	1	0
			Goose <i>Sp.</i>	5,293	0
Nysted <sup>2</sup>	72	3 years	Barnacle Goose	2,353	0
			Brent Goose	3,450	0
Horns Rev <sup>2</sup>	80	3 years	Greylag goose	123	0
			Brent goose	142	0
			Goose <i>sp</i>	10	0
Rønland <sup>3</sup>	8	3 years	Brent goose	7,309	1
Barrow <sup>4</sup>	30	1 year	Pink-footed goose	4,732	0
<b>Totals</b>	<b>202</b>	<b>12 years</b>	<b>8 Species</b>	<b>121,525</b>	<b>1</b>

References - <sup>1</sup> Pettersson 2005, <sup>2</sup> Petersen *et al.* 2006, <sup>3</sup> Jensen 2006, <sup>4</sup> BOW 2007

Based on the above evidence and the highly precautionary nature of the Collision Risk Modelling undertaken and the site specific data indicating a low usage of the site by pink-footed geese it is concluded that risk of a significant or adverse effect is negligible.

### Barrier effect

Although pink-footed geese may fly through wind farms (e.g. BOW 2007) they have also been recorded avoiding wind farms consequently there may be a barrier effect

Should a barrier effect occur then pink-footed geese will fly around the proposed development. By doing so, this could cause an overall increase in flying distance of up to approximately 3.2 km. For a bird migrating from Iceland to North-east Scotland, a distance of over 1,000 km then this will cause an increase of 0.3% in flight distance. This is considered to be a negligible impact and not cause any adverse effect.

### Displacement

Pink-footed geese do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### Cumulative and in-combination

Potential cumulative and in-combination impacts on pink-footed geese have been addressed by many Round 1 and Round 2 offshore wind farms.

Cumulative collision risk totals based on Collision Risk Modelling are presented in Table 4-4. The collision risk modelling undertaken at the time was based on avoidance rates of 95%, 99% and 99.5%. Based on an avoidance rate of 99% a total of up to 167 pink-footed geese are predicted to be impacted from all the currently consented offshore wind farms. Based on the total UK population of 340,000 and 1%

baseline mortality rate of 4,556 individuals per year the cumulative impacts are therefore considered to be minor.

**Table 4-4: Predicted potential collision mortality for pink-footed geese.**

Site	Avoidance rate		
	95%	99%	99.5%
Ormonde	77	15	8
Walney	6	1	<1
West of Duddon Sands	5	1	<1
Barrow	15	15	8
Docking Shoal		15	8
Humber Gateway		48	24
Lincs	171 - 262	34 – 52	17 – 26
Lynn & Inner Dowsing	100 - 165	20 – 33	10 – 17
<b>Total</b>	<b>374 - 530</b>	<b>149 – 167</b>	<b>69 – 85</b>

Further evidence to support the conclusions that the potential impacts from collision risk are minor come from Population Viability Analysis (PVA) undertaken on pink-footed geese which indicate that the pink-footed goose population may be able to withstand an increase in mortality (from whichever source) of 5,000 birds per year (Trinder *et al.* 2005). Further PVA commissioned by DECC to model the possible effects of additional mortality on the pink-footed goose population over a 25 year period indicated that over a 25 year period there was a 2% chance of the pink-footed goose population decreasing to below 150,000 if, due to collisions, wind farms increase the annual mortality by more than 1,000 birds over and above current impacts, e.g. hunting. (Trinder 2008). The predicted level of mortality from all offshore wind farms based on precautionary collision risk modelling indicates that the level of mortality is below the threshold above which cumulative mortality rates could have an adverse effect.

#### 4.2.6 Conclusions

##### Habitats Appraisal

Based on the site specific data indicating a low usage of the area by pink-footed geese and evidence from existing offshore wind farms indicating a very high avoidance rate; an adverse effect is not predicted to occur at any of the SPAs for which pink-footed goose is a qualifying species.

##### Environmental Impact Assessment

Based on the site specific data and data from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on pink-footed geese.

### 4.3 Greylag goose (*Anser anser*)

#### 4.3.1 Protection & Conservation Status

The Greylag goose is listed in Appendix II of the Bern Convention, Appendix II of the Bonn Convention and is on the Amber List of Species of Conservation Concern.

#### 4.3.2 Background

Greylag goose (Icelandic)		
GB Population	Winter – 85,000 ind.	Calbrade <i>et al.</i> 2010
Scottish Population	Summer – 25,000 prs Winter – 85,000 ind.	Forrester <i>et al.</i> 2007
International threshold	870 ind.	Calbrade <i>et al.</i> 2010
GB threshold	819 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Loch of Skene: 790 (2010) Loch of Strathbeg: 580 (2007) Montrose Basin: 2,519 (2011) Firth of Tay: 2,640 (08/09)	SNH 2011 JNCC 2011a
European population estimate	Breeding 120,000 – 190,000 prs Wintering – >390,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	1 – 1.100,000 'adults'	Birdlife 2011

Greylag geese breed in Iceland, north-west Scotland and many parts of Eurasia. They winter along the north-west and east coasts of Scotland particularly in Orkney where the population of over wintering birds has increased substantially in recent years from 3,000 in the 1990's to 43,000 in 2003 (Forrester *et al.* 2007). During the winter birds forage on farmland and are relatively sedentary until March when they start returning to their breeding grounds (Forrester *et al.* 2007).

In North-east Scotland greylag geese have been recorded passing Peterhead primarily in October with relatively few at other times of the year. In October up to 180 birds per month were recorded between 1978 and 1988 (Innes 1996). The wintering population of greylag geese in North-east Scotland has decreased in recent years as birds that used to winter in the region are now thought to do so in Orkney. Only relatively small numbers now winter at what used to be large winter roosts, particularly the Loch of Skene and Dinnet lochs that held up 15,000 and 30,000 birds each in the 1990's and now hold less than 1,000 birds each (Buckland, Bell & Picozzi 1990; NESBR).

The Greylag goose is notified feature for Corby Loch SSSI, which lies 4 km north of Aberdeen. Up until the early 1990's there was a winter roost of greylag geese of up to 2,600 birds but since then the numbers roosting there have declined and the loch is now only infrequently used by greylag geese (Hearn & Mitchell 2004, NESBR).

#### Boat-based surveys

No Greylag geese were recorded during any of the boat-based surveys undertaken between February 2007 and April 2008.

#### Vantage Point surveys

In Aberdeen Bay, greylag geese were recorded from Vantage Point sites during December and January 2006/2007 when four small skeins were recorded totalling 37 birds flying between 1-3 km from shore and none within the 30-150 m height band

(EnviroCenter 2007b). Further singles were recorded once in August 2006 and March 2008.

### Bird Detection Radar

No positive sightings of greylag geese were made from the radar studies undertaken in October 2005, April 2007 or April 2010.

#### 4.3.3 Summary of Results

Greylag geese were only occasionally recorded in Aberdeen Bay with the only records of note during December and January. The few sightings were of birds below 30 m and within 3 km from shore.

Numbers of greylag geese recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.3.4 Initial Assessment of Significance

<b>Greylag goose</b>	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	High	Low	Minor
Displacement	High	Negligible	Negligible

#### 4.3.5 Species Sensitivities

##### Qualifying species

The nearest SPAs to the proposed development for which the Greylag goose is a qualifying species is the Loch of Skene SPA and the Loch of Strathbeg SPA & Ramsar. The greylag goose is also a qualifying species for Montrose Basin SPA & Ramsar and Firth of Tay SPA & Ramsar (SNH 2011).

##### Flight height

No greylag geese were recorded from boat-based surveys but flight heights from Vantage Point surveys indicated that none were flying between 30 m – 150 m and therefore not at potential risk of collision.

There is very limited data on flight heights of greylag geese from other offshore wind farms (Table 4-3). However, data from birds moving to and from roosts in North-east Scotland recorded 33% of flights as being between 50 m– 150 m (Patterson 2006).

##### Collision risk

Evidence from site specific surveys indicate that greylag geese occasionally occur in Aberdeen Bay particularly during the winter. However, as there were only six records of a total of 39 birds from all surveys and all were flying below turbine height the frequency of occurrence is low. Evidence from other offshore wind farms for all geese species indicate that they have a very high avoidance rate and even if the area is used more extensively than records suggest, this and low flight altitude indicate that the risk of collision is low and the impact on greylag geese should it occur, negligible.

### **Barrier effect**

Although greylag geese may fly through wind farms they have also been recorded avoiding wind farms; consequently, there may be a barrier effect

Should a barrier effect occur then greylag geese will fly around the proposed development. By doing so this could cause an overall increase in flying distance of up to approximately 3.2 km. For a bird migrating from Iceland to North-east Scotland, a distance of approximately 1,000 km then this will cause an increase of 0.3% in flight distance. This is considered to be a negligible impact and will not cause any adverse effect.

### **Displacement**

Greylag geese do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### **Cumulative and in-combination**

No cumulative or in-combination impacts on greylag geese have been recorded for any of the existing Round 1 or Round 2 offshore wind farms. There are no data available yet on whether greylag geese are being recorded during surveys being undertaken for the planned Round 3 offshore wind farms or those in Scottish Territorial Waters. However, the majority of greylag geese wintering in the UK are now doing so in Orkney and Caithness (Calbrade *et al.* 2010) and are therefore not at risk of potential risk with other offshore wind farms to the south.

On the basis that there is unlikely to be any substantial interaction with other offshore wind farms and that, as with other Geese, it is predicted that there will be a high avoidance rate, small potential of a barrier effect and no displacement, it is concluded that there will be a negligible adverse effect or cumulative impact.

## **4.3.6 Conclusions**

### **Habitats Appraisal**

Based on the site specific data indicating a low usage of the area by greylag geese and evidence from existing offshore wind farms indicating a very high avoidance rate for Geese as a whole an adverse effect is not predicted to occur at any of the SPAs for which greylag goose is a qualifying species.

### **Environmental Impact Assessment**

Based on the site specific data and data from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on greylag geese.

#### 4.4 Barnacle goose (*Branta leucopsis*)

##### 4.4.1 Protection & Conservation Status

The barnacle goose is listed in Annex I of the Birds Directive, Appendix II of the Bern Convention, Appendix II of the Bonn Convention and is on the Amber List of Species of Conservation Concern.

##### 4.4.2 Background

Barnacle goose (Svalbard)		
GB Population	Winter – 32,000 ind.	Calbrade <i>et al.</i> 2010
Scottish Population	Winter – 32,000 ind.	Calbrade <i>et al.</i> 2010
International threshold (Svalbard)	270 ind.	Calbrade <i>et al.</i> 2010
GB threshold	220 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Loch of Strathbeg	JNCC
European population estimate	Breeding 41 – 54,000 pairs Wintering – 370,000	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population (Svalbard)	32,000 ind.	Calbrade <i>et al.</i> 2010

Barnacle geese breed in the Arctic and winter in the UK and the mainland of Europe. They arrive in their UK wintering grounds during September and October and migrate north again during the spring. There are two distinct populations wintering in the UK. Birds from Svalbard occur in North-east Scotland as mainly passage migrants on their way to and from their main wintering site on the Solway Firth. Barnacle geese from Greenland winter along the west coast of Scotland and are not known to occur in the region.

The population of barnacle geese wintering in the Solway has increased considerably since the 1940's when there were 300 individuals. The wintering population has now increased to around 30,000 (Forrester *et al.* 2007).

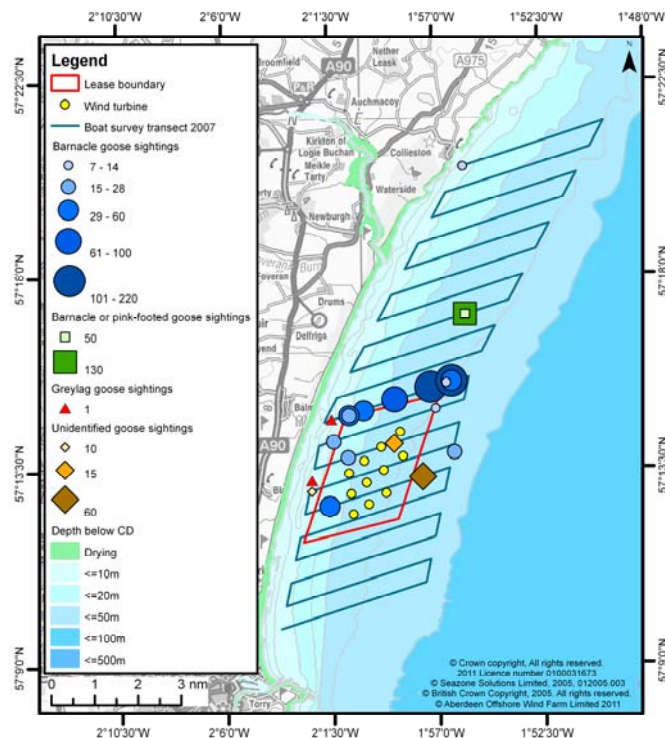
Barnacle geese have been recorded passing Peterhead from late September through to late October when up to 400 birds per month have been recorded and again in the spring when up to 250 birds per month were recorded flying north during April and May. Birds were recorded out to a distance of 3 km (Innes 2006).

Peak counts at Loch of Strathbeg and elsewhere in North-east Scotland vary considerably across years but numbers have increased with up to 680 in October 2006 (NESBR 2007) and an exceptional 6,000 in September 2005. During the same period up to 2,270 were recorded flying south at Blackdog (Buckland, Bell & Picozzi 1990; NESBR 2006). The Loch of Strathbeg is an important staging post for barnacle geese from Svalbard and is one of only three sites in the UK that holds internationally important numbers; the others being the Solway Firth and Lindisfarne (Calbrade *et al.* 2010).

##### Boat-based surveys

A total of 831 barnacle geese were recorded from boat-based surveys undertaken between February 2007 and January 2008. All sightings were made on the 12 October 2007 when 14 skeins of barnacle geese were recorded ranging in size from 7 to 220 birds, the majority of which were recorded along a single transect (Figure 4-3) indicating a single 'pulse' of migrating barnacle geese occurred during that survey period. The majority of birds were flying in a southerly direction and 29%

were flying above 200 metres; 32% were between 15 m and 200 m and 6% between 25 m and 200 m.



**Figure 4-3: Geese distribution in Aberdeen Bay - February 2007 to April 2008 (all sightings).**

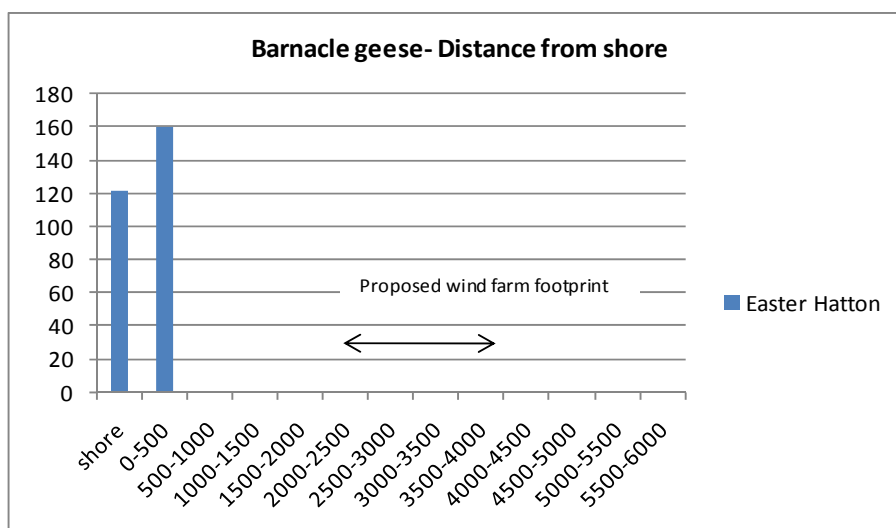
#### Vantage Point surveys

No Barnacle geese were recorded during the autumn of 2005 but up to 300 barnacle geese per hour were recorded past Drums in September 2006 and single skeins of 29 in December 2007 and 17 in January 2008 (Alba Ecology 2008b). Of the 300 birds recorded in 2006, nine birds per hour were recorded flying between 30 m and 150 m above sea surface. The majority of records were from between 1-2 km from shore with no sightings further offshore.

#### Bird Detection Radar

A total of five flocks of barnacle geese, comprising 281 birds were recorded during the Bird Detection Radar studies undertaken in October 2005. All sightings were of birds flying below 35 m and were within 500 m from shore (Figure 4-4) (Walls *et al.* 2006).





(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-4: Number of barnacle geese recorded and distance from shore at Easter Hatton during October 2005.**

#### 4.4.3 Summary of Results

Barnacle geese were the most frequently recorded goose in Aberdeen Bay where large numbers were recorded passing through the bay during September 2006 and on one date in October 2007. Relatively few barnacle geese were recorded outwith these peak periods. No geese were reported as having landed in the bay. Land based observations recorded the majority of birds within 2 km from shore but there were sightings out to at least 3 km. Of those birds recorded in flight from boat-based surveys 6 were flying above 25 m but below 200 m. Land-based observations recorded all barnacle geese as flying below 35 m.

The numbers of barnacle geese passing through Aberdeen Bay were above the threshold for a site of national and international importance.

#### 4.4.4 Initial Assessment of Significance

Barnacle goose	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	High	High	Major
Displacement	High	Negligible	Negligible

#### 4.4.5 Species Sensitivities

##### Qualifying species

The nearest SPAs to the proposed development for which the Svalbard population of the Barnacle goose is a qualifying species are the Loch of Strathbeg and Solway Firth SPAs (JNCC 2011a, SNH 2011).

### Flight height

Data from site specific boat-based studies recorded up to 6% of the barnacle geese as flying between 25 m and 200 m and therefore at turbine height.

There are currently no other data available on flight heights of barnacle geese from other UK offshore wind farms.

### Collision risk

Evidence from site specific surveys indicate that barnacle geese occur in Aberdeen Bay particularly during the spring and autumn and are more frequently recorded within 2 km of the coast than further offshore.

Collision Risk Modelling undertaken for barnacle goose is based on:

- Body length of 64 cm
- Wingspan of 139 cm
- Flight speed of 18.0 m.s<sup>-1</sup>
- Percentage at rotor height –100%
- Avoidance rate – 98, 99, 99.5%

(Patterson 2006)

As the number of barnacle geese recorded within the proposed development area was low, in order to undertake collision risk modelling based a potentially realistic 'worst-case' scenario the following assumptions were made:

1. The total number of barnacle geese passing through North-east Scotland each autumn is 2,200, based on the peak count at Loch of Strathbeg since 2004 (Calbrade *et al.* 2010).
2. All barnacle geese migrate south across a front of up to 5 km offshore and 5 km inland and therefore over a 10 km wide front. The maximum width of the proposed development is 3.6 km and therefore intercepts 36% of the potential flight path. This is precautionary as site specific data indicates that the majority of geese fly within 1 km from shore and therefore do not interact with potential development. However, for the purposes of the collision risk modelling it assumed that 36% of the total Svalbard population of barnacle geese pass through the offshore area, i.e. 23,040 birds per year.
3. That 46% of those that do fly across the development area do so at turbine height. This is based on data from pink-footed geese.
4. That a return passage during the spring occurs at the same level as in the autumn. This is highly precautionary as records of barnacle geese in North-east Scotland are relatively few compared to the autumn counts.

The Collision Risk Modelling has been undertaken on these precautionary assumptions using a range of avoidance rates: 98%, 99% and 99.5%.

**Table 4-5: Results from collision risk modelling undertaken on barnacle geese.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
8.5%	5.3	2.6	1.3

Based on the various scenarios and using a precautionary avoidance rate of 99% as recommended by SNH, it is predicted that a total of 2.6 collisions per year may occur (Table 4-5).

The annual mortality rate for barnacle goose is 9% (BTO 2011). Consequently, out of a population of 32,000 an annual mortality of 2,880 barnacle geese may be predicted. Therefore, 1% of the baseline mortality is 28 birds per year.

Based on the results from the precautionary Collision Risk Modelling undertaken, the number of barnacle geese that may collide is lower than that that may cause concern of a potentially significant impact or adverse effect on the barnacle goose population as a whole.

To assess whether there is the potential for an adverse effect on barnacle goose as a qualifying species for the relevant regional SPAs the assessment is based on the 5 year peak mean counts as opposed to numbers published at the time of SPA citation as the populations of barnacle geese have increased significantly since the SPA citations were originally made. It also, incorrectly, assumes that each SPA population is separate from each other and any collision impacts relate to birds only associated with that SPA.

**Table 4-6: Natural mortality rates for barnacle geese associated with relevant SPAs.**

Site SPA	Population	Natural Mortality	1% of Natural Mortality
Loch of Strathbeg	726	65	0.6
Solway Firth	29,403	2,646	26

Based on the above, the results from the Collision Risk Modelling indicate that there is the potential for an adverse effect to occur should all potential collisions relate to geese associated with only the Loch of Strathbeg SPA.

As described in section 4.2.5 there are numerous studies indicating that Geese are at low risk of collision. Nearly 87,000 barnacle geese were recorded migrating past two offshore wind farms in Kalmar Sound and avoidance behaviour was observed and no collisions detected (Pettersson 2005). Similar results from other offshore wind farms for other similar species of geese support the findings of the study.

Based on the above evidence and the highly precautionary nature of the Collision Risk Modelling undertaken and the site specific data indicating a relatively low usage of the site by barnacle geese, it is concluded that risk of an adverse effect is negligible and the potential significance of any impact minor.

#### Barrier effect

Although barnacle geese may fly through wind farms they have also been recorded avoiding wind farms consequently there may be a barrier effect (Pettersson 2005).

Should a barrier effect occur then barnacle geese will fly around the proposed development. By doing so this could cause an overall increase in flying distance of up to approximately 3.2 km. For a bird migrating from Svalbard to North-east Scotland, a distance of approximately 2,500 km then this will cause an increase of 0.1% in flight distance. This is considered to be a negligible impact and not cause any adverse effect.

#### Displacement

Barnacle geese do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### **Cumulative and in-combination**

Barnacle geese migrating from Svalbard to the Solway Firth do so by travelling down the west coast of Norway before crossing to north-east and eastern Scotland and flying south-west to the Solway where they winter. Their return flights are similar but more direct and to the south of the proposed development area (Griffin, Rees & Hughes 2010). Consequently, there are little cumulative or in-combination impacts from existing offshore wind farms. There is the potential for cumulative impacts arising with planned developments in the Firth of Forth area. However, no data are available on the number or size of turbines being considered by the developments nor any data on whether barnacle geese have been observed from offshore surveys. Therefore no cumulative impact assessment is possible. However, the very high avoidance rates recorded for geese and the relatively low flight heights recorded indicate that the potential for a significant environmental impact or an adverse effect is unlikely.

#### **4.4.6 Conclusions**

##### **Habitats Appraisal**

Based on the site specific data indicating a low usage of the area by barnacle geese and evidence from existing offshore wind farms indicating a very high avoidance rate; an adverse effect is not predicted to occur at any of the SPAs for which barnacle goose is a qualifying species.

##### **Environmental Impact Assessment**

Based on the site specific data and data from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on barnacle geese.

## 4.5 Shelduck (*Tadorna tadorna*)

### 4.5.1 Protection & Conservation Status

The Shelduck is listed in Appendix II of the Bern Convention, Appendix II of the Bonn Convention and is on the Amber List of Species of Conservation Concern.

### 4.5.2 Background

Shelduck		
GB Population	Summer – 11,000 prs. Winter – 78,000 ind.	BTO 2011
Scottish Population	Summer – 1,750 prs. Winter – 7,000 ind.	Forrester <i>et al.</i> 2007
International threshold	3,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	782 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Montrose Basin: 988 (08/09) Firth of Forth: 3,166 (08/09) Forth of Tay and Eden Estuary 1,114 ind.	Calbrade <i>et al.</i> 2010 JNCC 2011a
European population estimate	Breeding: 41 – 54,000 pairs Wintering: 370,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population	580,000 – 710,000 'adults'	Birdlife 2011

Shelduck is a widespread coastal breeding species in the UK with a UK population of 11,000 pairs, of which 1,750 pairs breed in Scotland (Forrester *et al.* 2007). In winter they occur along coastal estuaries and mud flats. A proportion of Scottish breeding shelduck undertake a seasonal migration to Helgoland during July where they moult and return to eastern England in late August after which they then move north to their wintering grounds. There is also a moulting flock in the Firth of Forth.

In Eastern Scotland Shelduck occur widely in suitable coastal habitats with the main sites being the Firth of Forth and Montrose Basin where mean peak counts of up to 3,166 and 988 have been recorded between 2004 and 2009 (Calbrade *et al.* 2010).

Sightings of shelduck past Peterhead occurred throughout the year but with a distinct spring passage when up to 300 birds per month pass, predominantly northwards. The majority of sightings were within a few hundred metres from shore (Innes 2006).

In North-east Scotland Shelduck occur along all suitable coasts and in particular, the Ythan Estuary where up to 200 birds may occur in the spring and between 50 and 80 pairs breed on the adjacent Forvie nature reserve (Buckland, Bell & Picozzi 1990). During the autumn and winter numbers in the region are lower until March when birds start returning to the region.

#### Boat-based surveys

Seven Shelduck were recorded during boat-based surveys with two in April, four in May and one in January. The January bird was heading north while the spring birds were flying in a southerly direction. All records were of birds flying below 25 m.

#### Vantage Point surveys

Shelduck were recorded infrequently during vantage point surveys with a total of 37 individuals over the three years of surveys. Most records were between March and May, although the maximum count was in August when ten were seen in 2006.

There were two records during winter months with one in January 2008 and three in February 2007.

### Bird Detection Radar

Five Shelduck were recorded, with one at Drums and four at Easter Hatton in five days of surveys during October 2005 (Walls *et al* 2005). A further 20 birds were seen during additional radar studies undertaken at Blackdog in April 2007 (Simms *et al.* 2007).

#### 4.5.3 Summary of Results

Shelduck were regularly recorded in low numbers from shore based counts, particularly during the spring period. Of those for which flight heights were reported all Shelduck were flying below 25 m.

The numbers of shelduck recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.5.4 Initial Assessment of Significance

Shelduck	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	High	Negligible	Negligible
Displacement	Medium	Negligible	Negligible

#### 4.5.5 Species Sensitivities

##### Qualifying species

There are three SPAs in the region for which shelduck are part of the qualifying assemblage: Montrose Basin, Firth of Forth and Forth & Tay Estuary SPA.

##### Flight height

Of those recorded in flight and for which flight heights were recorded all were flying below 25 m.

Elsewhere data from other offshore wind farms on flight heights for shelduck are limited with only eleven recorded flight heights from surveys undertaken at ten offshore wind farms. The few records recorded 36% of flights at rotor height.

##### Collision risk

Evidence from site specific monitoring indicate shelduck are scarce in Aberdeen Bay and those for which flight heights were recorded were below turbine height and most records were of birds within 2 km of the coast. Consequently the risk of significant environmental impact arising from collision is low and should it occur the significance on the regional population negligible. The SPAs for which shelduck are qualifying species as part of assemblages are over 60 km away and the likelihood of shelduck associated with these SPAs at risk of collision from the proposed development is remote. The risk of an adverse effect on the qualifying species being caused by collision mortalities arising from the proposed development is negligible.

### **Barrier effect**

There is no evidence from existing offshore wind farms as to whether a barrier effect may occur. However, based on behaviour of other wildfowl it is predicted that at least some shelduck will avoid flying through the proposed development.

Should a barrier effect occur then shelduck may fly around the proposed development. This would incur an overall increase in flying distance of approximately 3.2 km. The movements of shelduck in Aberdeen Bay are not fully understood but there is no evidence of any regular feeding or roosting flights across the bay. Consequently, many flights are potentially *ad hoc* and or passage related; therefore, any additional energetic costs arising from the proposed development will not be regular but likely to be only occasional. The relatively small additional distance flown should shelduck fly around the proposed development will not be significant nor have an adverse effect.

### **Displacement**

Shelduck do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### **Cumulative and in-combination**

The low level of usage of the site by shelduck indicates that there will not be any cumulative or in-combination impacts.

## **4.5.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs for which shelduck is a qualifying species that will be effected by the proposed development.

### **Environmental Impact Assessment**

Based on the relatively low numbers of shelduck recorded and their known behaviour it is predicted that there will not be a significant environmental impact arising from the proposed development on shelduck.



## 4.6 Eurasian Wigeon (*Anas Penelope*)

### 4.6.1 Protection & Conservation Status

The (Eurasian) wigeon is listed in Appendix II of the Bonn Convention, Appendix III of the Berne Convention and is on the Amber List of Species of Conservation Concern.

### 4.6.2 Background

Wigeon		
GB Population	Winter 359,236 ind.	Calbrade <i>et al.</i> 2010
Scottish Population	Summer – 240 – 400 prs. Winter 76,000 – 96,000 ind.	Forrester <i>et al.</i> 2007
International threshold	15,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	4,060 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Montrose Basin: 3,944 ind. Firth of Forth: 2,139 ind.	Calbrade <i>et al.</i> 2010 JNCC 2011a
European population estimate	Breeding 85,000 – 100,000 pairs Wintering – >140,000 individuals	Birdlife 2004
European population trend	Status 'decreasing' Trend 'moderate decline'	Birdlife 2004
World population	2,800,000 to 3,300,000	Birdlife 2011

Wigeon occur widely across northern Europe and Russia and there is a relatively small breeding population in the UK with between 48 and 124 pairs (Holling *et al.* 2010). In the autumn wigeon arrive from central and eastern Europe and Russia to winter in the UK where there is a large wintering population of 360,000 individuals of which between 76,000 and 96,000 winter in Scotland (Wernham *et al.* 2002, Forrester *et al.* 2007).

During the non-breeding season wigeon are mainly coastal, foraging on mudflats and coastal foreshores.

The main wintering sites in Scotland are the Moray Firth where up to 20,000 wigeon may winter and the Dornoch Firth with up to 15,000 wintering wigeon. In North-east Scotland wigeon occur with an average peak count in the region between 1992 and 2002 of 3,045 (Forrester *et al.* 2007). On the Ythan Estuary peak counts of wigeon occur during the winter months when up to 1,000 birds may be present, particularly during November and December (NESBR). Peak numbers of wigeon passing Peterhead occurred during September and October with few sightings during the winter. There is evidence of a small spring passage of birds heading north during March, April and May (Innes 1996). All sightings at Peterhead were of birds passing within a few hundred metres from shore.

#### Boat-based surveys

Twenty-eight wigeon were recorded during boat-based surveys with a flock of 20 birds in September 2007 and nine birds in three flocks in October. The only other record was of a single bird in April.

#### Vantage Point surveys

Wigeon were observed flying through Aberdeen Bay between April 2007 and March 2008 with up to seven birds per hour passing Blackdog during October 2007. The majority of sightings from the Donmouth were between 2–3 km from shore whereas those from Blackdog were predominantly 2 – 3 km from shore. All records were of birds flying below 30 metres.



Further records all of less than 20 birds were from Blackdog in August, September and December, Balmedie in September and Drums in December (EnviroCentre 2007b).

### Bird Detection Radar

Sixteen wigeon were recorded, at Easter Hatton during the radar studies undertaken in October 2005 and 10 were seen from Blackdog during further radar studies undertaken in April 2007 (Walls *et al* 2005, Simms *et al.* 2007).

#### 4.6.3 Summary of Results

Relatively few wigeon were recorded during surveys undertaken in Aberdeen Bay. Most records were obtained from Vantage Point surveys with birds recorded out to 3 km from shore. Of those for which flight height was reported, all wigeon were flying below 30 m.

#### 4.6.4 Initial Assessment of Significance

Wigeon	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Negligible	Negligible
Displacement	Medium	Negligible	Negligible

#### 4.6.5 Species Sensitivities

##### Qualifying species

There are two SPAs in the region for which wigeon are part of the qualifying assemblage: Montrose Basin and Firth of Forth SPA & Ramsar.

##### Flight height

Observations made from site specific boat-based and land-based surveys recorded all but one wigeon as flying below 30 m in flight.

Elsewhere data from other offshore wind farms on flight heights for wigeon are limited with only 60 recorded flight heights from surveys undertaken at ten offshore wind farms. The few records recorded 38% of flights at rotor height.

##### Collision risk

Evidence from site specific monitoring indicate wigeon are regular in Aberdeen Bay but in relatively low numbers. Evidence from other offshore wind farms indicate that the majority of wigeon fly below 30 m. At Nysted offshore wind farm where 1% of all records were of wigeon and passage rates of up to 20 birds per hour were detected no collisions were recorded (Petersen *et al.* 2006). At Kalmar Sound 25,000 wigeon were counted during migration and no collisions observed (Pettersson 2005). Based on the relatively low numbers of wigeon recorded and evidence from offshore wind farms where wigeon are relatively common it is concluded that the risk of an adverse effect on wigeon from collision mortalities arising from the proposed development is negligible.

### **Barrier effect**

Evidence from studies undertaken at Kalmar Sound suggest that there is the potential for some barrier effects as wigeon can avoid flying through offshore wind farms. Should a barrier effect occur then wigeon will fly around the proposed development. This may incur an overall increase in flying distance of approximately 3.2 km. There is no evidence of any regular feeding or roosting flights by wigeon across Aberdeen Bay and the seasonal occurrence of wigeon recorded suggest that the majority of birds are on migration. The relatively small additional distance flown should wigeon fly around the proposed development compared to the total distance of their migration will not be significant nor have an adverse effect.

### **Displacement**

Wigeon do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### **Cumulative and in-combination**

The low level of usage of the site by wigeon and the relatively few recorded from other UK developments indicate that there will not be any cumulative or in-combination impacts.

#### **4.6.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs for which wigeon is a qualifying species that will be effected by the proposed development.

### **Environmental Impact Assessment**

Based on the relatively low numbers of wigeon recorded and their known behaviour it is predicted that there will not be a significant environment impact arising from the proposed development on wigeon.

## 4.7 Eurasian Teal (*Anas crecca*)

### 4.7.1 Protection & Conservation Status

The (Eurasian) teal is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.7.2 Background

Teal		
GB Population	Summer – 155 – 2,600 prs. Winter – 192,000 ind.	BTO 2011
Scottish population	Summer – 1,950 – 3,400 prs Winter – 22,500 – 125,000 ind.	Forrester <i>et al.</i> 2007
International threshold	5,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	1,920 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Loch of Strathbeg: 504 ind.	SNH 2011 Calbrade <i>et al.</i> 2010
European population estimate	Breeding 920,000 – 120,000 ind. Wintering – >730,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population (Svalbard)	5,9 – 6,900,000 'adults'	Birdlife 2011

The teal is an uncommon breeding duck in the UK occurring on freshwater lochs and marshes. The majority of the UK population breed in Scotland where an estimated 3,400 pairs of teal breed (Forrester *et al.* 2007).

Following breeding, teal occur in both freshwater and coastal habitats feeding on seeds and grasses. There is a substantial increase in the numbers of teal in winter as migrants from northern Europe and Russia arrive during September and October and remain until March and April. About 6% of Scotland's wintering population of teal occur in North-east Scotland with most birds occurring on freshwater Lochs, e.g. Loch of Strathbeg and Loch of Skene. Elsewhere teal occur on the river Don where there may be up to 100 birds present.

Passage of teal past Peterhead occurs throughout the year but with a very distinct autumn passage with up to 550 birds during September. A smaller spring passage occurs during April and May. All sightings of teal made at Peterhead were of birds within a few hundred metres from the shore (Innes 1996).

#### Boat-based surveys

Three teal were seen from boat-based surveys with one in October and two in November.

#### Vantage Point surveys

Teal were infrequently recorded during the three years of Vantage Point surveys with a total of 43 birds recorded of which 26 were in September.

#### Bird Detection Radar

During the five days of observations undertaken at Easter Hatton and Drums during October 2005 as part of the Bird Detection Radar studies, 187 teal were recorded in seven flocks, all at Drums. (Walls *et al.* 2005). Additional radar studies undertaken over seventeen days in April 2007 recorded seven teal at Blackdog (Simms *et al.* 2007).

#### 4.7.3 Summary of Results

Aside from birds recorded from land-based counts at Drums in October 2005 relatively few teal were recorded during surveys undertaken in Aberdeen Bay.

#### 4.7.4 Initial Assessment of Significance

Teal	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Negligible	Negligible
Displacement	Medium	Negligible	Negligible

#### 4.7.5 Species Sensitivities

##### Qualifying species

The Loch of Strathbeg is the only SPA in the vicinity of the proposed development for which teal is a qualifying species.

##### Flight height

The only flight height recorded was of one bird flying at an altitude of greater than 30 m.

Elsewhere data from other offshore wind farms on flight heights for teal is very limited with records from a number of other offshore wind farms but the flight heights not being reported. There was one flock of 11 teal recorded at Beatrice Demonstration Project and all were flying at rotor height.

##### Collision risk

Teal were recorded across Aberdeen Bay in low numbers with peak counts occurring during periods of migration. Evidence from other offshore wind farms on the potential of collision risk is limited but a total of 2,300 teal were recorded during studies in Kalmar Sound and none were reported to collide. Evidence for other species of wildfowl indicate that wildfowl have high avoidance rates. Based on the low numbers of teal recorded within the proposed development area and the predicted high avoidance rates it is concluded that the risk of an adverse effect or significant environmental impact on teal from collision mortalities arising from the proposed development is negligible.

##### Barrier effect

Evidence from studies undertaken at Kalmar Sound suggest that there is the potential for some barrier effects as wildfowl avoid flying through wind farms. Teal may avoid flying through offshore wind farms and if so may incur an overall increase in flying distance of approximately 3.2 km. There is no evidence of any regular feeding or roosting flights by teal across Aberdeen Bay and the seasonal occurrence of teal recorded suggest that the majority of birds are on migration. The relatively small additional distance flown should teal fly around the proposed development compared to the total distance of their migration will not be significant nor have an adverse effect.

### **Displacement**

Teal do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

### **Cumulative and in-combination**

The low level of usage of the site by teal and the relatively few recorded from other UK developments indicate that there will not be any cumulative or in-combination impacts.

#### **4.7.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs for which teal is a qualifying species that will be adversely effected by the proposed development.

### **Environmental Impact Assessment**

Based on the relatively low numbers of teal recorded and their known behaviour it is predicted that there will not be a significant environmental impact arising from the proposed development on teal.

## 4.8 Mallard (*Anas platyrhynchos*)

### 4.8.1 Protection & Conservation Status

The mallard is listed in Appendix II of the Bonn Convention Appendix III of the Bern Convention and is on the Green List of Species of Conservation Concern.

### 4.8.2 Background

Mallard		
GB Population	Summer – 48,000 – 114,000 prs. Winter – 352,000 ind.	BTO 2011
Scottish population	Summer – 17,000 – 43,000 prs Winter – 65,000 – 90,000 ind.	Forrester <i>et al.</i> 2007
International threshold	20,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	3,520 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth 2,546 ind (91/92-95/96)	SNH 2011
European population estimate	Breeding 920,000 – 120,000 ind. Wintering – >730,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population (Svalbard)	5,900,000 – 6,900,000 'adults'	Birdlife 2011

Mallard is the most common and widespread duck in Britain with a breeding population of up to 114,000 pairs and wintering population of approximately 352,000 individuals.

Mallard breed primarily on freshwater habitats but in winter occur widely on estuaries and shallow lochs (Forrester *et al.* 2007). Although the Scottish population is largely semi-resident, with only relatively localised movements, the wintering population is increased by migrants from Europe and Russia, which arrive during the autumn (Wernham *et al.* 2002). In North-east Scotland the main wintering areas are the Loch of Strathbeg and Loch of Skene with relatively small numbers of a hundred or less occurring on the Ythan Estuary (NESBR). Mallard were recorded throughout the year at Peterhead with a distinct peak in October and November when up to 500 birds were recorded (Innes 1996).

#### Boat-based surveys

Two mallard were recorded in January 2008, two in September 2010 and one in November 2010.

#### Vantage Point surveys

Mallard were infrequently recorded in Aberdeen Bay during the three years the Vantage Point surveys were undertaken with a total of 52 birds counted. There was no obvious seasonal variation in the small numbers of counts made, with 33 birds in June being the biggest count.

#### Bird detection Radar

No mallard were recorded from radar studies in October 2005 but nine were recorded at Blackdog during the radar surveys undertaken in April 2007 (Simms *et al.* 2007).

### 4.8.3 Summary of Results

Mallard were infrequently recorded in Aberdeen Bay with most sightings from Vantage Point surveys.

#### 4.8.4 Initial Assessment of Significance

<b>Mallard</b>	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Negligible	Negligible
Displacement	Medium	Negligible	Negligible

#### 4.8.5 Species Sensitivities

##### Qualifying species

There is one SPA in the region for which mallard is part of the qualifying assemblage: Firth of Forth SPA.

##### Flight height

Very few records of mallard were made from site specific boat-based or land-based surveys and no records of their of flight heights were made.

Elsewhere there is very limited data from other offshore wind farms on flight heights for mallard with only six recorded flight heights from surveys undertaken at ten offshore wind farms. Of those recorded 33% of flights were at rotor height.

##### Collision risk

Evidence from site specific monitoring indicated that mallard are scarce in Aberdeen Bay and primarily occur in near-shore waters. Evidence from other offshore wind farms indicated that mallard are at low risk of collision from offshore wind farms. A total of nearly 5,500 mallard were recorded during studies undertaken in Kalmar Sound and no collisions were recorded (Pettersson 2005). Based on the relatively low numbers of mallard recorded and evidence of a potentially high avoidance rate from other developments where mallard are relatively more common, it is predicted that the risk of an adverse or significant environmental effect on mallard from collision mortalities arising from the proposed development is negligible.

##### Barrier effect

Evidence from studies undertaken at Kalmar Sound suggests that there is the potential for some barrier effects as mallard may avoid flying through offshore wind farms. Should a barrier effect occur then mallard will fly around the proposed development. This may incur an overall increase in flying distance of approximately 3.2 km. There is no evidence of any regular feeding or roosting flights by mallard across Aberdeen Bay nor any regular usage of the site itself. Any additional distance flown should mallard fly around the proposed development will be small compared to the total distance of their migration and will not be significant nor have an adverse effect.

##### Displacement

Mallard do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.



### **Cumulative and in-combination**

The low level of usage of the site by mallard and the relatively few recorded from other UK developments indicate that there will not be any cumulative or in-combination impacts.

#### **4.8.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs for which mallard is a qualifying species that will be effected by the proposed development.

### **Environmental Impact Assessment**

Based on the relatively low numbers of mallard recorded and their known behaviour it is predicted that there will not be a significant environmental impact arising from the proposed development on mallard.

## 4.9 Common eider (*Somateria mollissima*)

### 4.9.1 Protection & Conservation Status

The (common) eider is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.9.2 Background

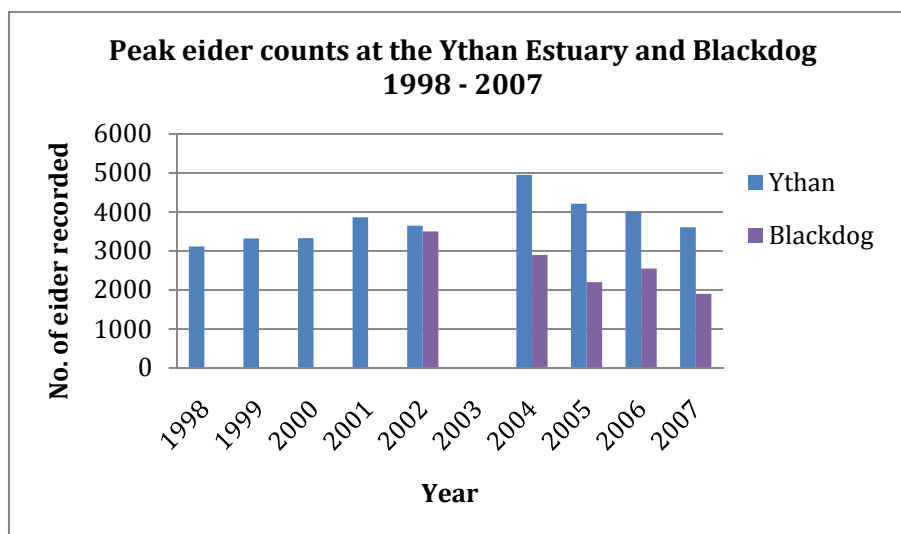
Eider		
GB Population	Summer – 31,000 pairs Winter 73,000 ind.	BTO 2011
Scottish Population	Summer - 20,000 nesting females Winter – 64,500 ind.	Forrester <i>et al.</i> 2007
International threshold	12,850 ind.	Calbrade <i>et al.</i> 2010
GB threshold	730 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Ythan Estuary Montrose Basin Firth of Tay & Eden Firth of Forth	SNH 2011 JNCC 2011a
European population estimate	Breeding 840,000 – 1,200,000 prs Wintering – 1,700,000 individuals	Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population	3.1 – 3,800,000 'adults'	Birdlife 2011

Eiders occur in coastal waters throughout northern Britain, particularly in areas where suitable prey of molluscs and crustaceans occur in shallow water of usually less than 3 metres. Breeding colonies are often large and flocks of many thousands of birds can occur in suitable nearshore areas. It is the commonest breeding seaduck in the UK with a breeding population of 31,000 pairs of which approximately 20,000 occur in Scotland.

Following breeding, eiders can congregate into large moulting flocks in specific areas with main areas being Firth of Forth, Shetland, Ythan, Aberdeen Bay and Montrose Basin (Cork Ecology 2004a). The largest moulting flock occurs off Murcar, in Aberdeen Bay, where up to 9,000 have been recorded (Forrester *et al.* 2007).

Although eiders in the UK are largely non-migratory there is some winter dispersal away from the breeding areas with a proportion of birds from North-east Scotland wintering in the Tay Estuary. The east coast of Scotland holds a substantial proportion of the UK wintering population with approximately 59,000 birds. The major wintering areas along the east coast of Scotland are the Tay Estuary, Firth of Forth, Montrose Basin, Orkney, Ythan and the Moray Firth (Cork Ecology 2004a). First winter birds remain near the Ythan Estuary (Baillie & Milne 1988).

The most important areas for eider in North-east Scotland are the Ythan Estuary, where up to 1,500 eider breed, and Aberdeen Bay where a large flock occurs during July and August when they undergo a post-breeding moult. Peak counts at the Ythan Estuary occur during May with maximum counts of up to 4,952 in 2004 and a five year peak mean of 3,333 individuals (NESBR, Calbrade *et al.* 2010). This is lower than the numbers present on the estuary during the 1980's when between 6,000 and 7,000 eider were recorded (Buckland, Bell & Picozzi 1990). Peak numbers in Aberdeen Bay are generally lower with generally between 1,000 – 2,000 birds present although a maximum count in recent years of 3,500 was in August 2002. However, numbers of eider present in Aberdeen Bay have also decreased since the peak counts in the 1980's when over 9,000 were recorded there every August (Buckland, Bell & Picozzi 1990; NESBR) (Figure 4-5).



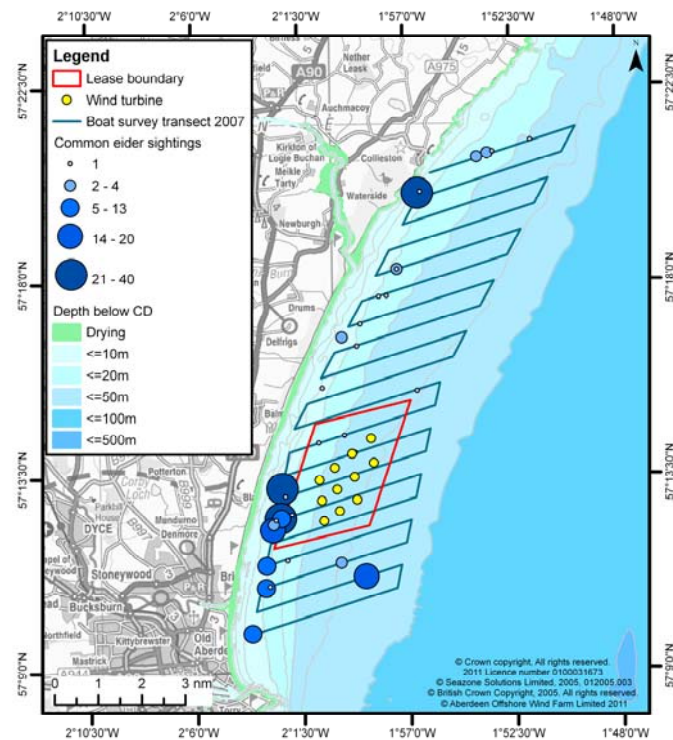
**Figure 4-5: Peak eider counts at Ythan Estuary and Blackdog**

Eiders are recorded passing Peterhead throughout the year but there is a strong seasonal variation with a marked spring passage of birds moving north of up to 175 birds per hour in March. The peak count was of 3,000 birds over three hours in April 1982 a year when over 30,000 eider were counted flying north between February and April (Buckland, Bell & Picozzi 1990; Innes 1996). There is a smaller movement of birds in the autumn of up to 100 birds per hour during October. Although eider occurred out to 3 km from shore, the majority of sightings were within several hundred metres from shore (Innes 1996).

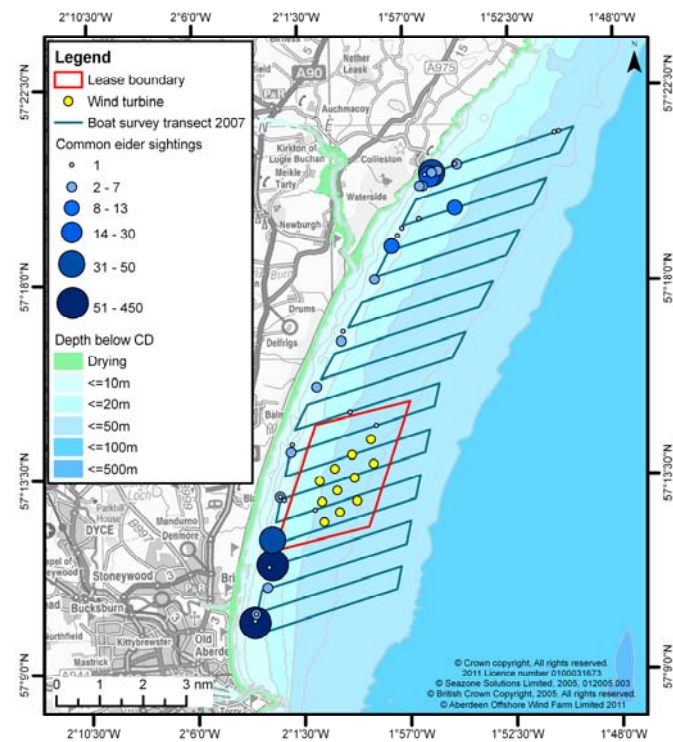
#### Boat-based surveys

Common eiders were recorded throughout the year in inshore shallow waters predominantly in water depths of less than 10 metres (Figure 4-6, Figure 4-7, Figure 4-8). The majority of sightings were of birds outwith the 300 metre transect with only 77 birds 'in transect' and no records of eider 'in transect' during June, July and August. Consequently, the population estimates are under-representative to the total number of birds that may be present in the area. Maximum counts of common eider outwith the survey area were at Blackdog where 450 birds were present in September 2007 and 434 in September 2010 (SMRU 2011b).

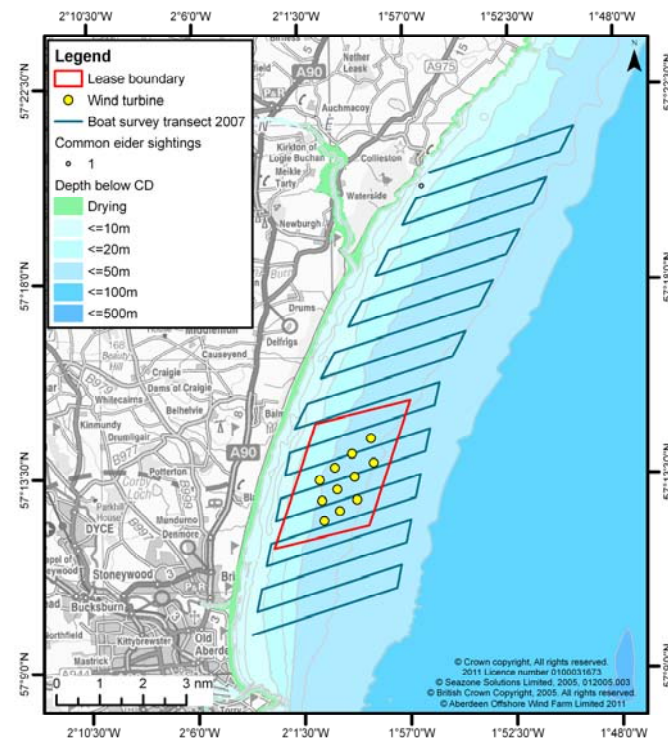
The boat-based survey data indicate that the majority of eider occur in waters less than 20 m deep and in particular less than 10 m. There were no records of eider within the proposed development area with the majority of eider to the south-west in near-shore waters approximately 1 km from the nearest potential turbine location.



**Figure 4-6: Common eider distribution in Aberdeen Bay during winter period: November to March (all sightings).**



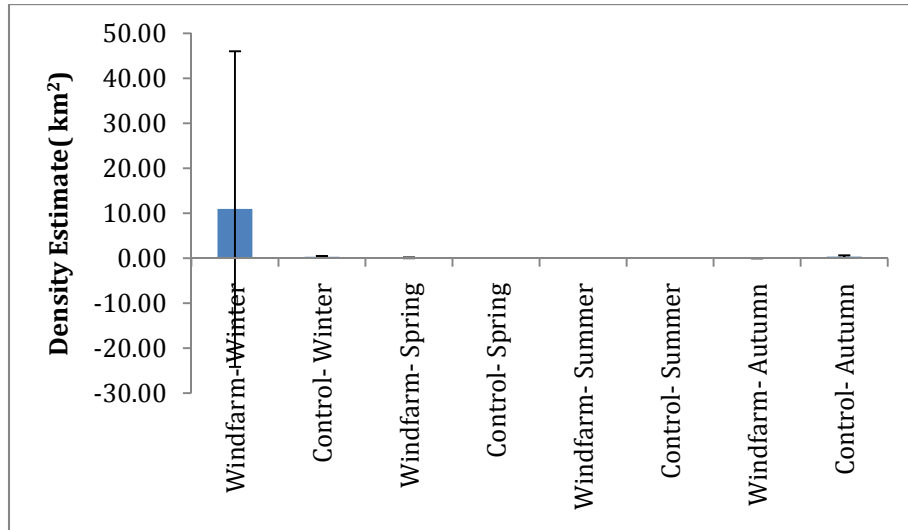
**Figure 4-7: Common eider distribution in Aberdeen Bay during spring and autumn periods: April, May, September and October (all sightings).**



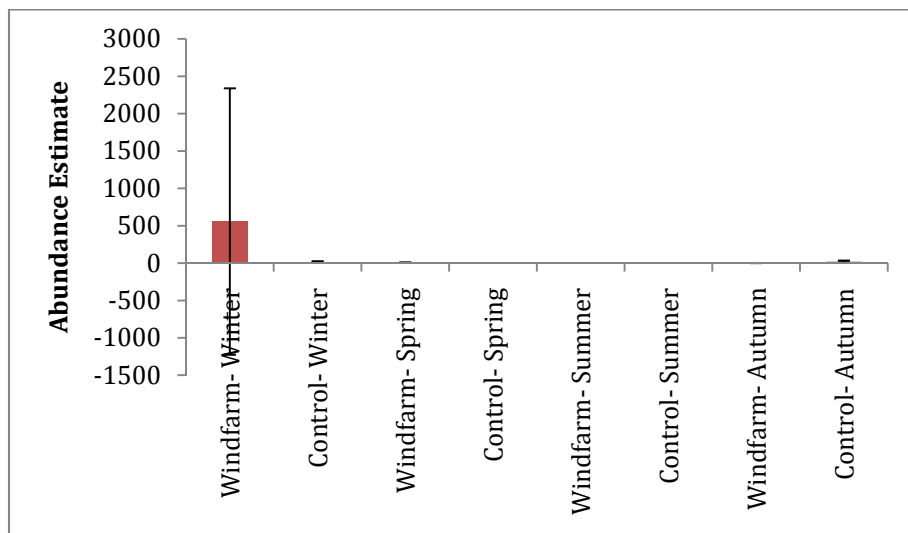
**Figure 4-8: Common eider distribution in Aberdeen Bay during summer period: June, July, August (all sightings).**

**Table 4-7: Seasonal estimates of density and abundance of eider in the EOWDC and 'control' Areas.**

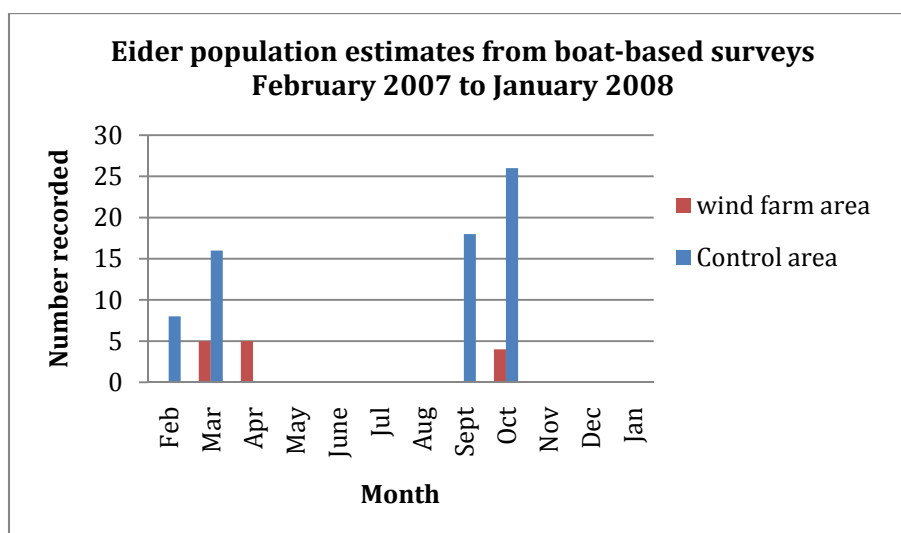
	Density Estimate (km <sup>2</sup> )	S.E	Estimated Abundance	SE	Number of observation
Development - winter	10.95	35.08	556	1.78	3
Control -winter	0.31	0.19	16	10	5
Development - Spring	0.12	0.07	6	3.8	6
Control - Spring	0.00	0.00	0	0.0	0
EOWDC - Summer	0.00	0.00	0	0	0
Control - Summer	0.00	0.00	0	0.0	0
EOWDC - Autumn	0.03	0.00	2	0.2	1
Control - Autumn	0.36	0.29	19	14.8	2



**Figure 4-9: Seasonal estimates (+/- SE) of density of eiders in the proposed EOWDC and 'control' Areas.**



**Figure 4-10: Seasonal estimates (+/- SE) of abundance of eiders in the proposed EOWDC and 'control' Areas.**



**Figure 4-11: Common eider monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

**Table 4-8: Common eider monthly population estimates in Aberdeen Bay: Boat-based surveys 2007 – 2008.**

Month	On water estimate	In flight estimate	Total estimate
February	8	0	8
March	0	21	21
April	5	0	0
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	0
September	18	0	18
October	27	3	30
November	0	0	0
December	0	0	0
January	0	0	0

### Vantage Point surveys

Peak movements of eider in Aberdeen Bay occurred during dawn and dusk with up to 10 birds per hour between December and March and increasing up to 32 birds per hour passing in April 2007 before decreasing to mainly less than 10 birds per hour from June through to August (EnviroCentre 2007a,b; Alba Ecology 2008a,b).

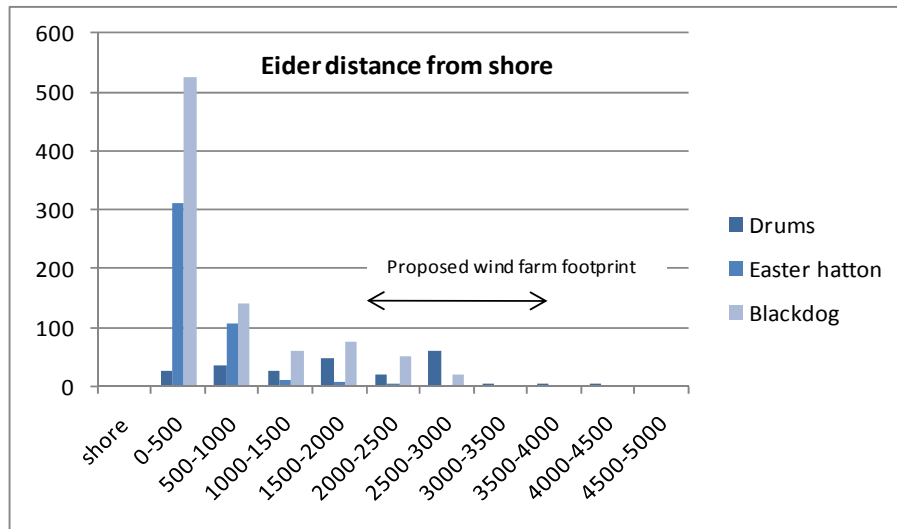
Between 96% and 98% of all flights were below 30 m with the majority of observations within 2 km of the coast and fewer between 2 km and 3 km away. Highest numbers were consistently recorded at Balmedie and Drums, which were the two closest Vantage Point sites to the Ythan Estuary.

### Bird Detection Radar

Eider were frequently recorded during the Bird Detection Radar studies undertaken in October 2005. A total of 680 birds were recorded, of which 449 were at Easter Hatton and 231 at Drums. Of those recorded in flight the maximum flight height was 10 m with the mean flight height of between 2 m and 3 m (Walls *et al.* 2006).

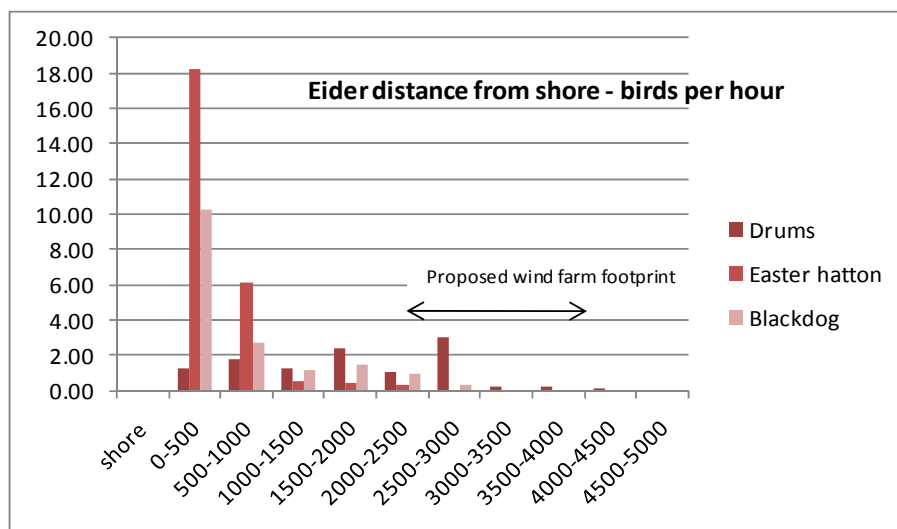


Additional radar studies undertaken in April 2007 recorded 855 eider at Backdog and of those recorded in flight, all were below 30 m. All sightings were of birds within 3 km from shore with the majority being within 500 m (Figure 4-12) (Simms *et al.* 2007).



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-12: Distances from shore for common eider from three locations in Aberdeen Bay during surveys undertaken in October (Drums & Hatton) and April (Blackdog).**



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007).

**Figure 4-13: Number of common eider per hour and distance from shore from three locations in Aberdeen Bay during surveys undertaken in October (Drums & Hatton) and April (Blackdog).**

#### 4.9.3 Summary of Results

The Ythan Estuary and Aberdeen Bay are both important areas for eider throughout the year. The Ythan Estuary is the largest breeding colony of eider in the UK and Aberdeen Bay holds nationally important numbers, particularly during the post-breeding period of July and August.

The results from boat-based surveys recorded relatively few eider with peak numbers during the winter and autumn periods. No eider were recorded within transect in either the proposed EOWDC area or the 'control' area between May and August. Data from land-based observations also recorded peak numbers of eider between December and April with a peak, in April, of up to 32 birds per hour. Eider were recorded out to at least 3 km from shore but as significant majority of sightings were within 1 km from shore.

All those recorded in flight from boat-based surveys were flying below 25 m and of those recorded from shore 96% and 98% were below 30 metres.

The breeding population on the Ythan Estuary and the number of birds using Aberdeen Bay are of national importance.

#### 4.9.4 Initial Assessment of Significance

Eider	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	High	Medium	Moderate
Displacement	High	High	Major

#### 4.9.5 Species Sensitivities

##### Qualifying species

There are four SPAs in the region for which eider is a qualifying species as part of waterfowl assemblages: Ythan Estuary, Sands of Forvie and Meikle Loch SPA, Montrose Basin SPA & Ramsar, Firth of Forth SPA and Firth of Tay and Eden Estuary SPA.

##### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded all eiders in flight as being below 25 m and therefore not at risk of collision. Data obtained from land-based vantage point surveys recorded between 96% and 98% as being below 30 m.

Elsewhere in the UK there is very limited data from other offshore wind farms on flight heights for eider. Extensive studies undertaken in Denmark and Sweden have recorded significant numbers of eider. The proportion flying at rotor height is overall 26% with a mean flight height of 13.7 m (n=34,857).

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that eider are widespread and frequent within Aberdeen Bay. They occur widely with the majority of sightings occurring in nearshore waters within 1 km of the shore and in water depths of <20 m.

Studies undertaken in Denmark indicate that eider have a very high avoidance rate and that the majority of birds will detour around the wind farm. Birds flying within wind farms are unusual and when doing so 89% of all flights are below turbine height. Modelling undertaken for the significantly larger Nysted Offshore wind farm predicted that out of 235,000 passing eiders that between 0.018 and 0.02 birds might collide with a turbine (Petersen *et al.* 2006).

In Sweden at the two wind farms in the Kalmar Sound eiders are the most abundant species and over 1.2 million eider were recorded during the study period of which three were seen to collide with the turbines (Pettersson 2006).

Consequently there is substantial volume of evidence to indicate that the risk of collision by eider is extremely low.

The numbers of eider recorded in Aberdeen Bay are significantly lower than those studied in Denmark and Sweden and in neither of these studies was there any evidence of a significant impact from collision. Furthermore, site specific data indicates that relatively few eider in Aberdeen Bay occur beyond 2 km of the coast and therefore within the potential area of risk from the proposed development. Radar studies indicated up to six times more eider passing within 500 metres from shore compared to between 2.5 km and 3 km from shore.

Based on the results from other offshore wind farms that have demonstrated significant avoidance rate and very low risk of collision as well as the relatively low usage of the site due to its distance from shore it is concluded that the potential effect from collision risk is negligible.

### Barrier effect

Studies undertaken in Sweden and Denmark have shown that there is the potential for significant barrier effect, with eiders changing flight directions at least 1 km from offshore wind turbines and flying around them. At Nysted offshore wind farm in Denmark radar studies undertaken tracked over 300,000 eider each autumn. The results indicated that there was a significant decrease in the proportion of flocks entering the wind farm from between the pre-construction period and the operational period. It was found that post construction, 9% of the birds entered the turbines compared with 40% crossing the same location before construction, i.e. there was a clear tendency for flocks to alter course and avoid the wind farm. Flocks that did continue into the wind farm adjusted their flight trajectories and tended to fly down the visually clear corridors between the rows of turbines (Deshom & Kahlert 2005). Further monitoring at Nysted reported a reduction of between 63% and 83% in the use of the wind farm airspace by migrating birds post construction compared to preconstruction (Petersen 2006), therefore providing evidence of large-scale avoidance behaviour of migrating birds.

Therefore it is predicted that the proposed development may cause a barrier effect to eiders in Aberdeen Bay.

There is no evidence of regular daily movements of eider within Aberdeen Bay to and from feeding or roosting areas. Should it occur with eider making daily movements from the Ythan Estuary to Aberdeen Bay to the south of the proposed development and the birds select to fly around the turbines up to 1 km away then they may incur an additional flight distance of up to 3.2 km each way, or a total of 6.4 km. This may increase the daily energy expenditure to between 2.0% and 2.5% (Caldrow, Stillman & West 2007; Speakman, Gray & Furness 2009). This is a relatively small increase in daily energy expenditure and is unlikely to have an adverse effect on eiders in Aberdeen Bay.

The peak numbers of eider in Aberdeen Bay occur during July and August when the adult eider undergo a complete wing moult over a period of four weeks, during which time they become flightless. The daily energetic costs during this period increase but the birds remain within certain areas where they can forage and cannot undergo daily flight movements (Guillemette *et al.* 2007). Consequently, there is no incremental increase in daily energy expenditure due to the barrier effect during this period of higher energy expenditure.

Data obtained from three years of Vantage Point surveys did not detect any evidence to suggest that there are regular daily flights by eider across the proposed development area and so a regular barrier effect that may cause a long-term increase in daily energetic costs is not predicted. There is the potential for a relatively small *ad hoc* increase as birds move around the bay but as most movements are within 1 km of the coast regular barrier effects are unlikely. It is predicted that the possible impacts arising from a potential barrier effect will be minor and there will be no adverse effect or significant environmental impact.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should displacement occur, that no eider will be within the proposed development area and there will be 80% displacement out to a distance of 1 km and a further 50% decrease in abundance out to 2 km from the wind farm.

Based on the peak density obtained from boat-based surveys of 10.9 birds/km<sup>2</sup> during the winter period, should there be a total displacement of eider from within the proposed development area then it is predicted that up to 47 eider may be displaced during periods of peak density. Based on an 80% displacement out to 1 km (a total surface area of 12.3 km<sup>2</sup>) from the proposed development area then it is predicted that a total of 154 eider may be displaced with a further 44 out to 2 km should there be 20% displacement. Therefore, the maximum number of eider potentially displaced is up to 198 birds based on the highest densities recorded from any survey within Aberdeen Bay and at least some displacement out to 2 km.

Based on the estimated total of 198 potentially displaced eider out of a peak reported count of 3,500 eider at Blackdog (Figure 4-5), it is predicted that up to 6% of the eider within Aberdeen Bay may be displaced. However, the distribution of eider within Aberdeen Bay is clustered with peak numbers occurring at various sites across the bay during different seasons (Sohle *et al.* 2006). The area off Blackdog regularly records the peak counts of eider in Aberdeen Bay (NESBR) and should displacement occur a greater proportion of eider might be affected than is estimated using densities obtained from boat-based surveys.

The Tuno Knob offshore wind farm in Denmark is a relatively small wind farm of ten turbines in an area that holds up to 5,800 eider. Post-construction monitoring at Tuno Knob has indicated that the distribution of eider is closely related to their prey and although there may be some displacement immediately post-construction there is unlikely to be any significant displacement of eider from the proposed development area as long as their prey remain available (Guillemette *et al.* 1999). Evidence from studies undertaken at Nysted offshore wind farm have indicated that although there was an avoidance of the area during construction there was a subsequent increase of 48% within the wind farm area post-construction but a decrease in numbers out to 2 and 4 km (Zucco *et al.* 2006).

These two studies demonstrate that eiders do not avoid wind farms post-construction and their distribution is closely aligned to the availability of prey. The main prey items for eider are mussels (*mytilus edulus*). Evidence from constructed wind farms indicates that there is likely to be an increase in mussels around the base of turbines and that no significant impacts have been detected on mussels from the construction of wind farms. Consequently, there is unlikely to be a negative impact on prey availability for eiders within Aberdeen Bay.

Based on the evidence from existing offshore wind farms it is predicted that the potential impact from displacement is minor.

Calculations used for displacement	
Area	Peak density of eider – 10.9 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 10.9 = 47
Area of EOWDC 1 km buffer – 12.3 km <sup>2</sup> @ 80%	(12.3 * 10.9)*0.8 = 107
Area of EOWDC 2 km buffer – 20.3 km <sup>2</sup> @ 20%	(20.3 * 10.9)*0.2 = 44
Total predicted displacement	47+107 + 44 = 198

### Disturbance

Eiders may be disturbed by vessels both during the construction phase and during operations from maintenance vessels. Studies have indicated that there may be displacement from large vessels out to 1,000 m (Larsen & Laubek 2005).

During construction there may be a number of vessels operating within the area but they will likely be focussed around a single point where the turbine is being installed. Consequently, eider may be displaced from within 1 km radius of the installation; an area of 3 km<sup>2</sup>. Based on the highest recorded density of 10.9 birds/km<sup>2</sup>, it is therefore predicted that up to 33 eider may be displaced from the vicinity during construction. This equates to approximately 1% of the peak eider population within Aberdeen Bay based on the peak estimated figure of 3,500 individuals. The construction period will be of short duration and the impacts from construction vessels temporary. Consequently, any potential impact is predicted to be negligible.

Displacement by service boats may diminish the re-population potential of the EOWDC. It is not known how many service vessels may be required but based on the scale of the proposed development there is unlikely to be frequently more than one vessel on any one occasion. The presence of the proposed development in the vicinity of the intensively used Aberdeen Harbour means that the potential increase of one vessel movement on a regular basis will not have any noticeable difference to the number of vessels already using Aberdeen Bay. Any specific displacement caused by the service or construction boats will be temporary as eiders will be able to move into the area once the vessels leave.

It is concluded that the effect of disturbance from construction or service boats is negligible.

### Cumulative and in-combination

The potential future Ocean Pod will require additional vessel movements within the proposed development area. Should this occur then there is the potential for a cumulative effect on eider. It is not yet known what type of structure the Ocean Pod may be or how it will be installed or the number of vessel movements will be required. However, it is a single structure and it is predicted that the level of disturbance will be no greater than that arising from the installation of a single wind turbine. The scale of disturbance is therefore predicted to be localised and of short duration.

Aside from the historical and on-going levels of shipping, there are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts. The eiders present are known to travel to the Tay during the winter and have the potential to interact with other offshore wind farm planned in the area. However, the location of the wind farms in the Firth of Forth area, in particular their distance from shore, are such that eiders are unlikely to be frequently recorded in any of the areas of the proposed developments. Consequently there are unlikely to be any cumulative or in-combination impacts.

#### 4.9.6 **Conclusions**

##### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating both a very low collision risk and little, if any, displacement and that there are not expected to be any significant barrier effects; it is predicted that there will not be any adverse effects on the SPAs for which eider is a qualifying species.

##### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on eider.

#### 4.10 Long-tailed duck (*Clangula hyemalis*)

##### 4.10.1 Protection & Conservation Status

Long-tailed duck is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Green List of Species of Conservation Concern.

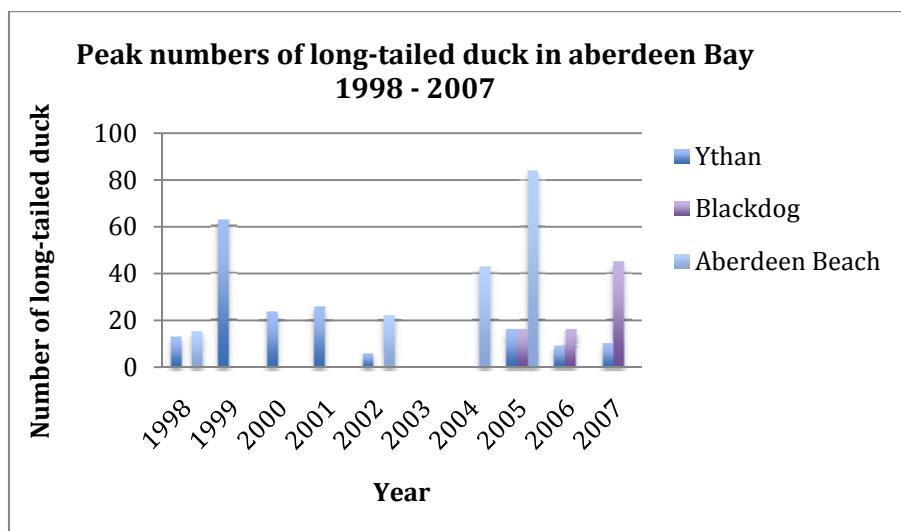
##### 4.10.2 Background

Long-tailed duck		
GB Population	Winter – 16,000 ind.	BTO 2011
Scottish Population	Winter – 15,000 ind.	Forrester <i>et al</i> 2007
International threshold	20,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	160 ind.	1% of GB Pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Firth of Forth Firth Tay & Eden	SNH 2011
European population estimate	Breeding 7,669 – 17,294 pairs Wintering – 4,700,000 individuals	Hagemeijer & Blair 1997
European population trend	Status 'decreasing' Trend 'moderate decline'	Birdlife 2004
World population	6.2 to 6,800,000 ind.	Birdlife 2011

Long-tailed duck breed in the high Arctic with significant breeding population in Russia where up to 5 million pairs are estimated to breed. In north-west Europe, breeding populations are considerably smaller with less than 18,000 pairs in Sweden, Iceland and Finland. Long-tailed duck do not breed in the UK but an estimated 16,000 winter in the UK of which 15,000 winter in Scottish waters, primarily in Shetland, Orkney and the Moray Firth (Forrester *et al.* 2007). Outwith the breeding season long-tailed duck occur along sheltered coasts, often with soft sandy sediments and can dive to depths of up to 60 metres so can occur further offshore than many other species of seaduck.

In North-east Scotland long-tailed duck are an uncommon winter visitor with most sightings and peak numbers occurring in Aberdeen Bay where less than a hundred birds may occur (Figure 4-14). Passage of birds passing Peterhead occurred from September to May with peak counts of up to 14 birds per hour during March. Although most sightings at Peterhead were within a few hundred metres from the shore long-tailed duck were seen as far out as 3 km (Innes 1996).



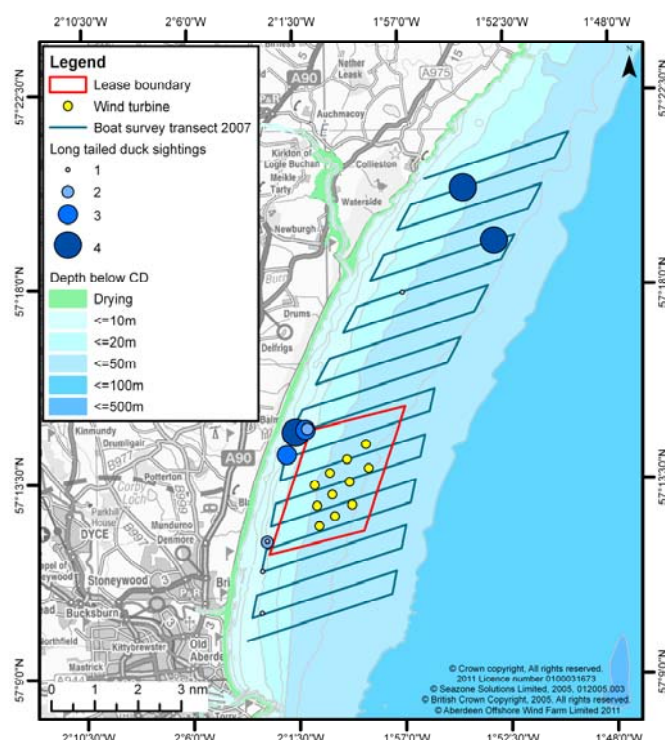


(Source NESBR)

**Figure 4-14: Peak numbers of long-tailed duck recorded at the Ythan, Blackdog and Aberdeen Beach 1998 – 2007.**

### Boat-based surveys

A total of 33 long-tailed duck were recorded from ship-based surveys in January, April, October, and November. All sightings were of birds close inshore, flying parallel to the coast (Figure 4-15) (IECS 2008, SMRU 2011b).



**Figure 4-15: Long-tailed duck distribution in Aberdeen Bay (all sightings).**

### Point surveys

Long-tailed duck were regularly recorded in low numbers within Aberdeen Bay, primarily between December and March with a peak count of up to 25 birds per hour

passing Blackdog in November 2007. However, numbers passing were usually less than five birds per hour at other sites (Alba Ecology 2008b). All birds were recorded flying below 30 metres with the majority of sightings between 1 km to 3 km from shore.

#### Bird Detection Radar

A total of 17 long-tailed duck were recorded during the radar studies in October 2005 with seven at Drums and ten at Easter Hatton. Although long-tailed duck were recorded out to 2.7 km from shore the majority of sightings were within 2 km from the coast. The mean flight heights were 2 m above sea surface with the maximum height of 4 m (Walls *et al.* 2005). Forty-seven birds were recorded during radar studies undertaken at Blackdog in April 2007. All birds were flying below 30 m and 90% of sightings were within 1.5 km of the coast (Simms *et al.* 2007).

#### 4.10.3 Summary of Results

Relatively small numbers of long-tailed duck occur in Aberdeen Bay with peak counts of usually less than 50 birds, occurring in any month between November and March. Although long-tailed duck can occur throughout the bay the main areas are the Ythan mouth, Blackdog and the Donmouth. The majority of sightings are of birds within 2 km of the shore and at least 90% of the birds recorded in flight were flying below 30 m.

No counts of long-tailed duck within Aberdeen Bay were of national importance.

#### 4.10.4 Initial Assessment of Significance

Long-tailed duck	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Low	Minor
Displacement	Very High	Low	Moderate

#### 4.10.5 Species Sensitivities

##### Qualifying species

There are two SPAs in the region for which long-tailed duck is a qualifying species as part of waterfowl assemblages: Firth of Forth SPA and Firth of Tay and Eden Estuary SPA.

##### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded all seventeen long-tailed ducks for which flight heights were recorded as flying below 25 m. Data from site specific radar studies recorded a mean flight height of 2 m and a maximum of 4 m.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that long-tailed duck occur in relatively low numbers within Aberdeen Bay. Studies undertaken in Sweden indicate that long-tailed duck have a very high avoidance rate and that the majority of birds will either detour around the wind farm or fly below turbine height (Pettersson 2006). Consequently,

there is evidence to indicate that the risk of collision by long-tailed duck is extremely low.

The numbers of long-tailed duck recorded in Aberdeen Bay were significantly lower than those studied in Denmark and Sweden and in neither of these studies was there any evidence of a significant impact from collision.

Based on the results from site specific study indicating the low altitude at which long-tailed duck fly and evidence from other offshore wind farms it is predicted that there is a very low risk of collision and that the potential effect from collision is negligible.

### Barrier effect

Studies undertaken in Sweden and Denmark have shown that there is the potential for a barrier effect, with long-tailed duck changing flight directions at least 1 km from offshore wind turbines and flying around them. Therefore, it is predicted that the proposed development may cause a barrier effect to long-tailed duck in Aberdeen Bay.

Data obtained from nearly three years of Vantage Point surveys plus additional radar studies and boat-based surveys did not detect any evidence to suggest that there are regular daily flights by long-tailed duck across the proposed development area and so a regular barrier effect that may cause a long-term increase in daily energetic costs is not predicted. There is the potential for a relatively small *ad hoc* increase as birds move around the bay but as most movements are within 2 km of the coast regular barrier effects are unlikely. It is predicted that the potential impacts arising from barrier effect will be minor and there will be no adverse effect or significant environmental impact.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should displacement occur, that no long-tailed duck will be within the proposed development area out to a distance of 1 km and a further 50% decrease in abundance occurs out to 2 km from the wind farm. However, very few long-tailed duck were recorded from any surveys and any displacement will impact on a relatively low number of birds and any that are displaced will be able to re-locate if needed to alternative areas. Data from aerial surveys identify Cruden Bay to the North and Bridge of Don to the south of the proposed development as being the main areas for long-tailed duck (Sohle *et al.* 2006).

Based on the low numbers of long-tailed duck recorded in the vicinity of the proposed development and that alternative areas of Aberdeen Bay are known to be suitable for long-tailed it is predicted that the potential impact from displacement is negligible.

### Disturbance

Long-tailed ducks may be disturbed by vessels both during the construction phase and during operations from maintenance vessels. Studies have indicated that there may be displacement from supply vessels (Pettersson 2006).

During construction there may be a number of vessels operating within the area but will likely be focussed around a single point where the turbine is being installed. The numbers of long-tailed duck present in the vicinity of the proposed development are relatively low. Evidence from existing wind farms indicates that long-tailed duck may fly up to 2 km from the vessel once disturbed and return once the vessel departs (Pettersson 2006).

It is not known how many service vessels may be required but based on the scale of the proposed development there is unlikely to be frequently more than one vessel on

site at any one time. The presence of the proposed development in the vicinity of the intensively used Aberdeen Harbour means that the potential increase of one vessel movement on a regular basis will not make any noticeable difference to the number of vessels already using Aberdeen Bay. Any specific displacement caused by the service boats will be temporary as long-tailed duck will be able to move into the area once the vessels leave.

It is concluded that the effect of disturbance from construction or service boats is negligible.

#### **Cumulative and in-combination**

The potential future Ocean Pod will require additional vessel movements within the proposed development area. Should this occur then there is the potential for a cumulative effect on long-tailed duck. It is not yet known what type of structure the Ocean Pod may be or how it will be installed or the number of vessel movements will be required. However, it is likely to be a single structure and it is predicted that the level of disturbance arising from the installation of it will be no greater than that arising from the installation of a single wind turbine. The scale of disturbance is therefore predicted to be localised and of short duration.

Aside from the historical and on-going levels of shipping, there are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts. Based on the numbers present and the low risk of any adverse effect from the proposed development on its own there are no known potential cumulative or in-combination impacts.

#### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating both a very low collision risk, little displacement and that there are not expected to be any significant barrier effects; it is predicted that there will not be any adverse effects on the SPAs for which long-tailed duck is a qualifying species.

#### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on long-tailed duck.

#### 4.11 Common scoter (*Melanitta nigra*)

##### 4.11.1 Protection & Conservation Status

Common scoter is listed in Schedule I of the Wildlife and Countryside Act, Appendix II of the Bonn Convention Appendix III of the Bern Convention and is on the Red List of Species of Conservation Concern for a breeding species and Amber List for wintering species.

##### 4.11.2 Background

Common scoter		
GB Population	Breeding 9 – 52 pairs Winter – 50 – 65,000 ind.	Holling 2010 Cranswick 2001
Scottish Population	Breeding – 9 – 52 pairs Winter – 25,000 – 30,000 ind.	Holling 2010 Forrester <i>et al.</i> 2007
International threshold	16,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	500 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth Firth of Tay & Eden	SNH 2011
European population estimate	Breeding 100,000 – 130,000 pairs Wintering – 610,000 individuals	Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population	2,100,000 – 2,400,000 'adults'	Birdlife 2011

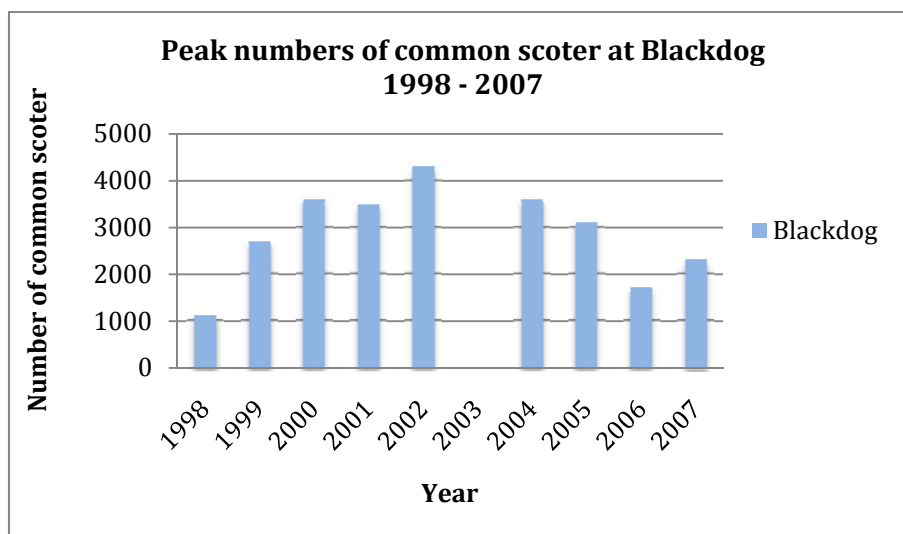
Common scoter breeds across the boreal and subarctic zones of Eurasia and has a European breeding population of up to 130,000 pairs. There is a small breeding population in the UK with between 9 and 52 pairs breeding in Scotland (Holling 2010).

Common scoter is a common winter visitor occurring in waters predominantly less than 20 m deep where they forage on benthic mussels and crustaceans. They are generally gregarious and form large flocks in suitable areas. In eastern Scotland the main wintering areas are the Moray Firth, Firth of Forth, St Andrews Bay, Carnoustie, Lunan Bay and Aberdeen Bay where a combined total of c.9,000 individuals winter (based on 5 year peak mean counts) (Calbrade *et al.* 2010).

Common scoters also occur during the summer months at regular 'moult' sites where flocks of up to 3,000 individuals may occur (Cork Ecology 2004a). The main summering sites are Aberdeen Bay, Firth of Forth, St Andrew's Bay, St Cyrus and Lunan Bay where a combined total across all sites total of c.6,500 birds may summer (Cork Ecology 2004a)

In North-east Scotland common scoter occur regularly in large numbers in a few preferred areas; particularly Aberdeen Bay. Numbers are lowest during the winter months when there are usually less than 200 birds present (Wilson *et al.* 2006). During the summer months a 'moult' flock of common scoter is present in Aberdeen Bay, primarily between the Donmouth and Balmedie to the south and west of the proposed development, with peak counts of up to 4,750 birds occurring (Buckland, Bell & Picozzi 1990; NESBR) (Figure 4-16).

Common scoter were recorded passing Peterhead throughout the year with a strong seasonal variation. Numbers passing Peterhead were generally low during the winter months with less than four birds per hour. There is a peak spring passage during April when up to 13 birds per hour were recorded with a decrease thereafter. Most sightings were of birds between 300 to 500 metres from shore but some were out to 3 km (Innes 1996).



(Source NESBR)

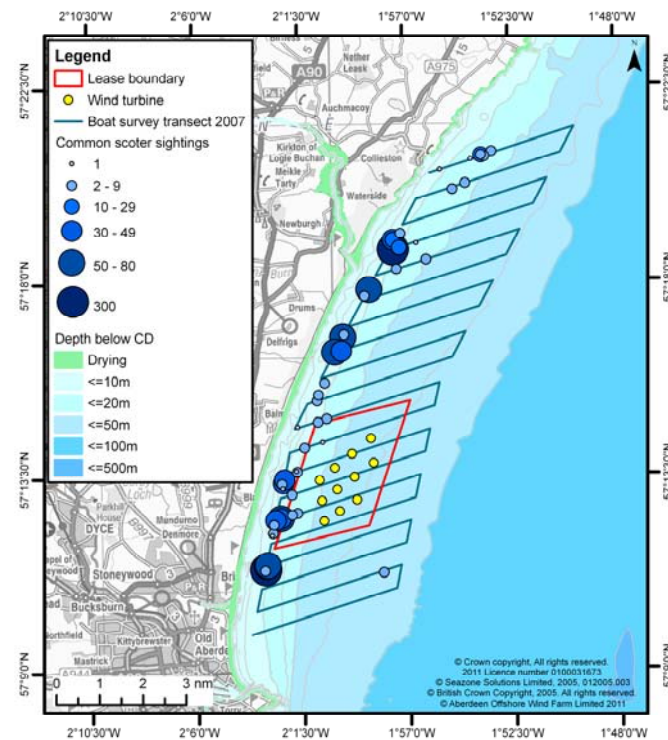
**Figure 4-16: Peak numbers of common scoter recorded at Blackdog between 1998 and 2007.**

#### Boat-based surveys

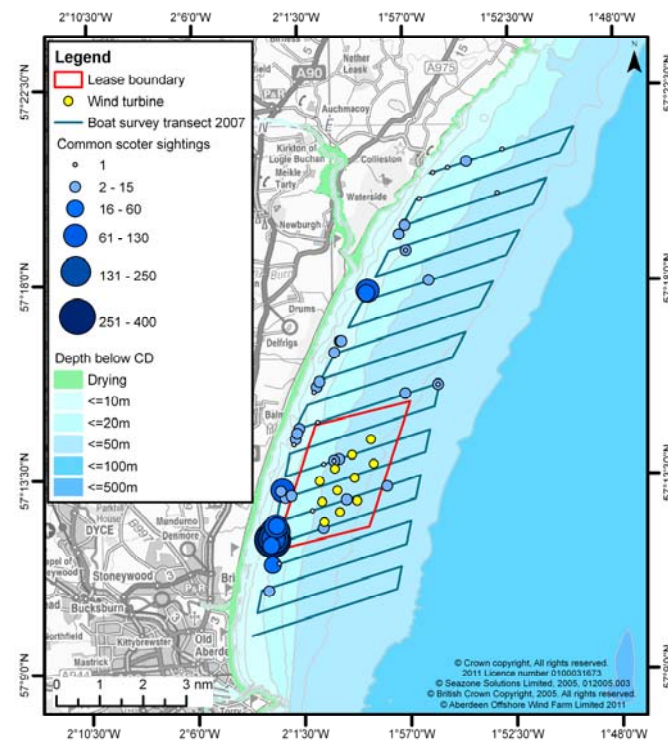
Common scoters were recorded in coastal waters of Aberdeen Bay throughout the year with peak counts during June and July. All records were of birds in water depths of less than 20 m with the majority of sightings within 2 km of the coast and in water depths of less than 10 m. There were relatively few records of common scoter within the proposed development area with small numbers present during the spring and autumn migration periods. The largest flocks were recorded between Donmouth and Balmedie with a cluster of flocks totalling 1,200 common scoter in July 2007 (Figure 4-17, Figure 4-18, Figure 4-19) (IECS 2008).

Additional surveys undertaken between August 2010 and January 2011 recorded common scoter within the proposed development area. Peak totals occurred in September and January when approximately 100 birds were present (Figure 4-20) (SMRU 2011b).



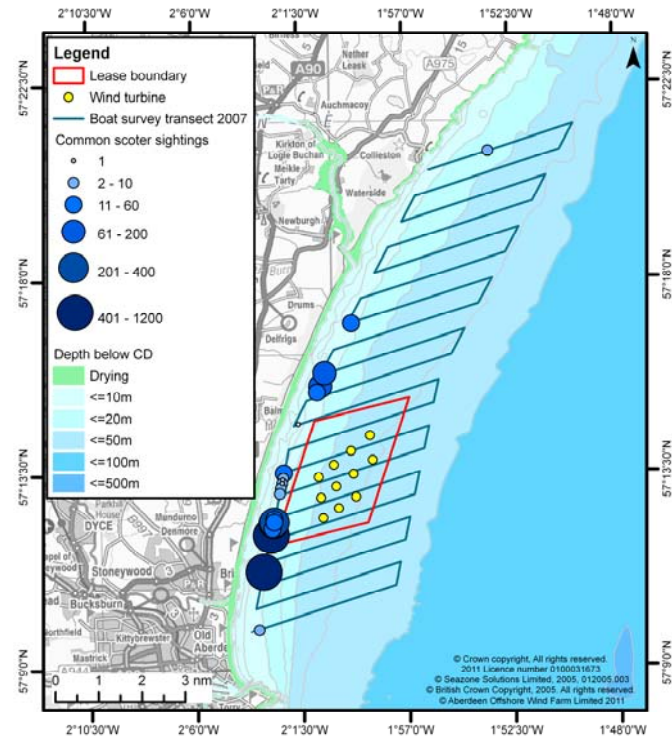


**Figure 4-17: Common scoter distribution in Aberdeen Bay during winter period: November to March (all sightings).**

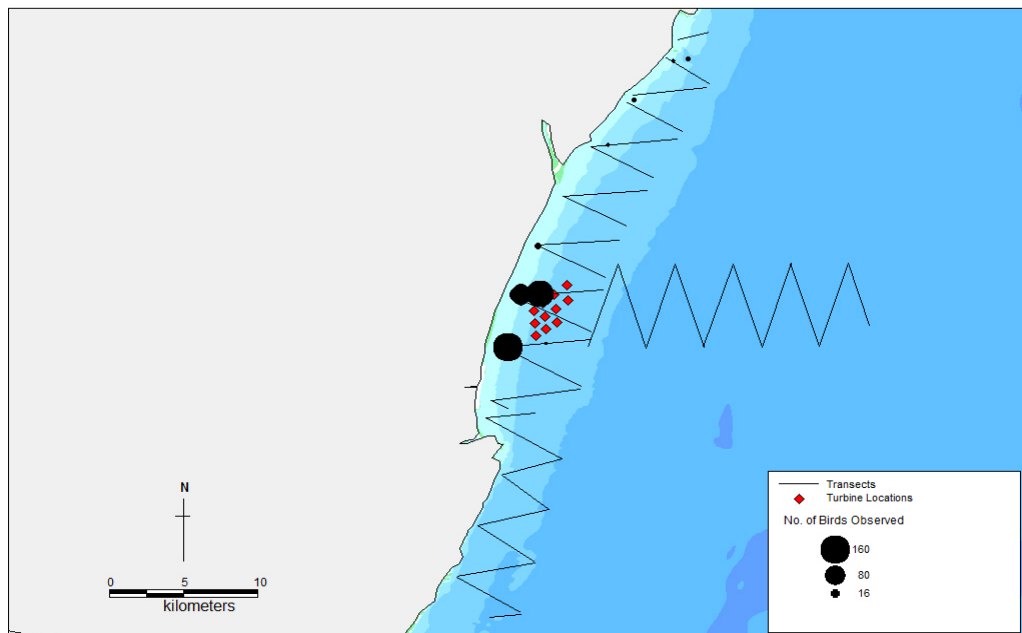


**Figure 4-18: Common scoter distribution in Aberdeen Bay during spring and autumn periods: (all sightings).**





**Figure 4-19: Common scoter distribution during summer period: June to August (all sightings).**

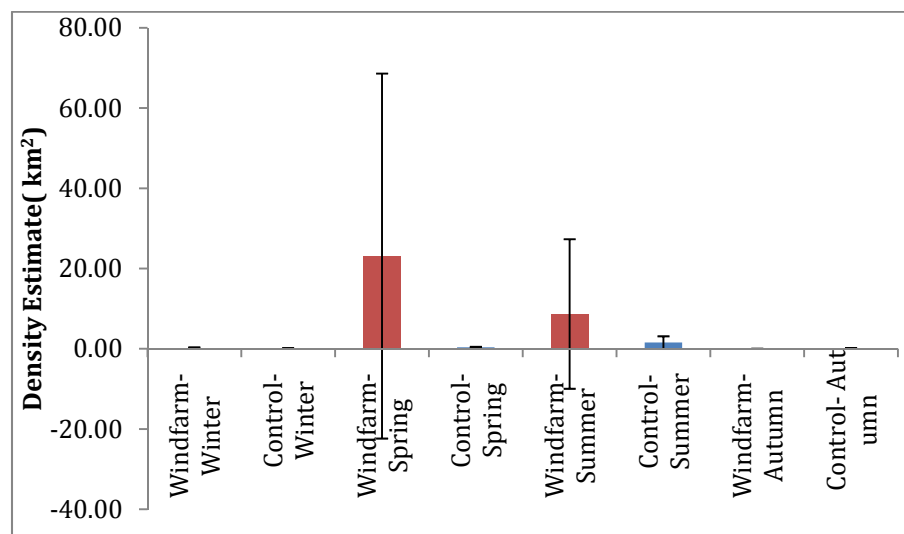


**Figure 4-20: On-effort observations of all species of seaduck (Common Scoter, Unidentified Scoter species, Common Eider and Long-tailed Duck) along transects during August, September and November 2010 and January 2011.**

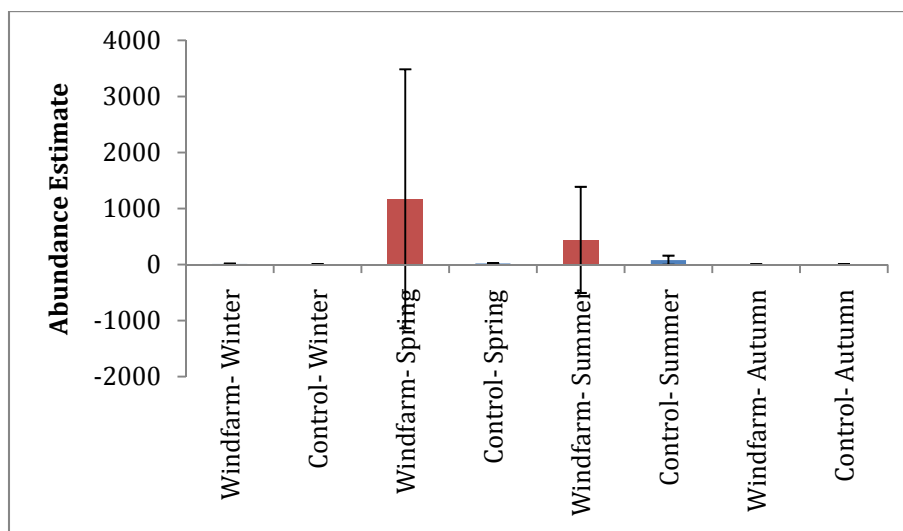
Most sightings from boat-based surveys were of birds when not on transect and outwith the 300 m transect width. Consequently, the number of birds recorded for population estimates were relatively low. Greatest numbers were recorded within the wider proposed EOWDC development area but not within the footprint of the proposed development; with seasonal estimates using *Distance* sampling indicating peak numbers in the proposed EOWDC development area of 1,175 individuals and 442 individuals in the summer period (Table 4-9, Figure 4-21, Figure 4-22).

**Table 4-9: Seasonal estimates of density and abundance of Common Scoters in the proposed EOWDC and 'control' Areas**

	Density Estimate (km <sup>2</sup> )	S.E	Estimated Abundance	SE	Number of Observations
EOWDC - winter	0.23	0.15	12	7.7	4
Control -winter	0.09	0.09	5	4.6	2
EOWDC - Spring	23.1	45.48	1,157	2,310	4
Control - Spring	0.39	0.11	20	5.9	5
EOWDC - Summer	8.69	18.62	442	946	5
Control - Summer	1.55	1.58	79	80	1
EOWDC - Autumn	0.02	0.02	1	1.4	1
Control - Autumn	0.10	0.08	5	4.2	4



**Figure 4-21: Seasonal estimates (+/- SE) of density of Common Scoters in the proposed EOWDC and 'control' Areas.**



**Figure 4-22: Seasonal estimates (+/- SE) of abundance of Common Scoters in the proposed EOWDC and 'control' Areas.**

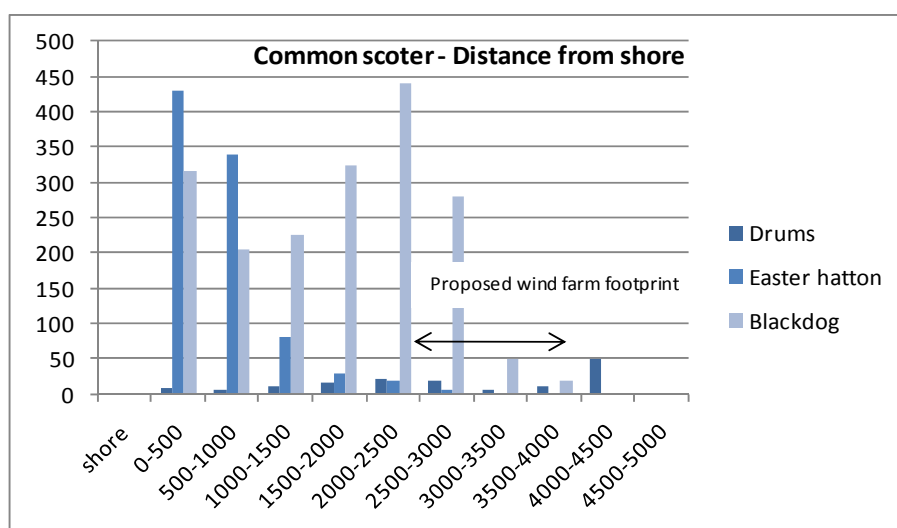
### Vantage Point surveys

Results from monthly vantage point counts undertaken in Aberdeen Bay throughout the year recorded relatively low numbers of common scoter between December and February with numbers increasing from March onwards and peak movements between June and September when up to nearly 200 birds per hour were recorded passing in July 2007 (Alba Ecology 2008a,b). This is in contrast to the records from Peterhead where most sightings occurred during the spring and relatively few sightings during the summer. Birds were recorded at all Vantage Point sites with peak numbers at Balmedie, Murcar and the Promenade during June. Of those for which flight heights were recorded at least 95% were flying below 30 m with the majority of those recorded at greater than 30 m being at Donmouth. Most records were within 1 km and 2 km from shore, with relatively few between 2-3 km.

### Bird Detection Radar

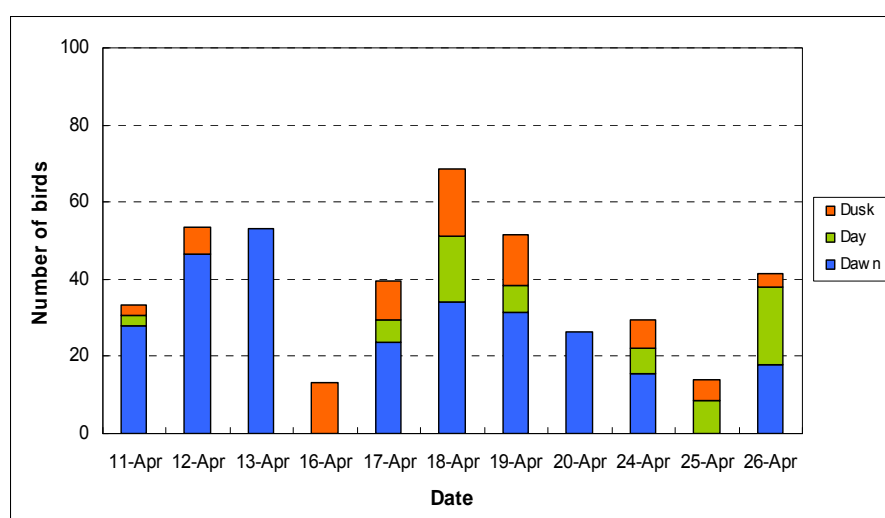
Common scoter were frequently recorded during the Bird Detection Radar studies undertaken during October 2005 with a total of 1,054 sightings of which 911 were at Easter Hatton and 143 at Drums. Common scoter recorded at Easter Hatton were generally less than 2 km from shore with those at Drums between 4 km and 4.5 km from shore. Of those recorded in flight all were flying below 5 m. (Walls *et al.* 2006).

A seventeen day radar study was undertaken at Blackdog between 11 and 26 of April 2007. During this survey a total of 1,872 common scoter were recorded in relatively small flocks of no more than 60 birds (Simms *et al.* 2007). Unlike the surveys undertaken in October 2005, approximately 50% of all common scoter were between 2 km and 4 km from shore (Figure 4-23). Although April is a period of spring migration for common scoter, there was no clear difference between the numbers of birds heading north as opposed to flying south, which indicates that the movements of birds during this period may have related to foraging movements as opposed to migrating individuals. As the majority of sightings were during the first two hours of dawn the movements recorded may also relate to birds redistributing after night time drifting (Figure 4-24).



(Adapted from Walls *et al* 2006, Simms *et al* 2007)

**Figure 4-23: Distance from shore for common scoter from three locations in Aberdeen Bay during surveys undertaken in October (Drums & Hatton) and April (Blackdog).**



(Source Simms *et al*. 2007)

**Figure 4-24: The diurnal flight behaviour of common scoter at Blackdog.**

### 4.11.3 Summary of Results

Common scoters were frequently recorded throughout the year during surveys undertaken across Aberdeen Bay. Peak numbers recorded during boat-based surveys were during the spring and summer months with most records from within the proposed EOWDC survey area. Land based surveys recorded peak numbers of common scoter during the summer months with most birds being recorded off Blackdog. Most common scoter were recorded with 2 km of the coast and in waters of less than 10 m. However, a survey undertaken in April recorded the majority of common scoter off Blackdog as being between 1 km and 3 km from shore.

Of those recorded in flight at least 95 of common scoter were recorded flying below 30 m.

Peak counts of common scoter recorded within Aberdeen Bay are of national importance but are not of international importance.

#### 4.11.4 Initial Assessment of Significance

Common scoter	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Medium	Moderate
Displacement	Very High	High	Major

#### 4.11.5 Species Sensitivities

##### Qualifying species

There are two SPAs in the region for which common scoter is a qualifying species as part of waterfowl assemblages: Firth of Forth SPA and Firth of Tay and Eden Estuary SPA.

##### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded 377 common scoter in flight of which 1% were recorded as flying above 25 m and therefore at risk of collision.

Extensive studies undertaken, particularly in the East Irish Sea have recorded large numbers of common scoter of which 4.0% have been recorded at rotor height and mean flight height of 9.3 m.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that common scoter are widespread and frequent within Aberdeen Bay and occur in large flocks in certain areas. They occur widely with the majority of sightings occurring in nearshore waters within 3 km of the shore and in water depths of <20 m.

Collision Risk Modelling undertaken for common scoter is based on:

- Body length of 49 cm
- Wingspan of 84 cm
- Flight speed of 20.9 m.s<sup>-1</sup>

Avoidance rates ranging from between 98%, 99% and 99.5% have been used.

As no common scoters were recorded in flight from boat-based surveys undertaken within the proposed development area, the collision risk calculation is based on the maximum number of birds recorded in flight from within the 'control' area to the north. This is a precautionary assumption as the proposed development area is in water depths greater than typical foraging depths for common scoter and is therefore infrequently used but it does take into account the possibility that birds may potentially fly through the area to other feeding locations.

**Table 4-10: Predicted number of potential collisions for common scoter.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
6.6	0.27	0.13	0.06

Based on the precautionary avoidance rate of 98% it is predicted that a total of 0.27 collisions per year may occur (Table 4-10).

The annual mortality rate for common scoter is 22.7% (BTO 2011). Consequently, out of a peak regional population of 4,300 individuals an annual mortality of 976 common scoter, may be predicted. Therefore, 1% of the baseline mortality is 10 birds per year.

Based on the results from collision risk modelling, which predicts a total of 0.27 collisions per year there will not be a significant impact on the common scoter due to collisions.

The Firth of Forth SPA is approximately 134 km away and has a five year peak mean population of 1,070 individuals. Therefore an annual mortality rate of 243 scoter. Should the whole of the wintering population in the Firth of Forth SPA fly through the proposed development area then the collision risk modelling predicts there will not be an adverse effect on the population due to collision.

The Firth of Tay & Eden Estuary SPA lies approximately 96 km away from the proposed development and has a five year peak mean population of 1,037 scoters. Therefore, an annual mortality rate of 235. Should the whole of the wintering population in Firth of Tay & Eden Estuary SPA fly through the proposed development area the collision risk modelling predicts that there will not be an adverse effect on the population due to collision.

No collisions have been reported from post-construction monitoring studies undertaken in Denmark and Sweden indicating that common scoter have a very high avoidance rate and that the majority of birds will detour around the proposed development.

Based on the results the very low risk of collision and results from operating wind farms that have demonstrated significant avoidance rates by common scoter it is concluded that the potential effect from collision risk is negligible.

### Barrier effect

Studies undertaken in Sweden and Denmark have shown that there is the potential for a barrier effect on common scoter with changes flight directions up to 1 km from offshore wind turbines and flying around them (Christensen & Hounisen 2004, 2005). Therefore it is predicted that the proposed development may cause a barrier effect to common scoter in Aberdeen Bay.

There is no evidence of regular daily movements of common scoter within Aberdeen Bay to and from feeding or roosting areas. However, most flight activity at Blackdog was recorded at dawn and these may be birds moving from a roost site to feeding areas (Figure 4-24). Should a barrier effect occur with common scoter making daily movements from one location to another around the proposed development area then they may incur an additional flight distance of up 3.2 km each way, or a total of 6.4 km. This may increase the daily energy expenditure to between 2.2% and 2.6% (Speakman, Gray & Furness 2009). This is a relatively small increase in daily energy expenditure and is unlikely to have an adverse effect on common scoter in Aberdeen Bay.

As with eider, the peak numbers of common scoter in Aberdeen Bay occur during July and August when the adults undergo a complete wing moult over a period of four weeks, during which time they become flightless. The daily energetic costs during this period may increase but the birds remain within certain areas where they can forage and cannot undergo daily flight movements, consequently, there is no incremental increase in daily energy expenditure due to the barrier effect during this period of higher energy expenditure.

Data obtained from nearly three years of Vantage Point surveys did not detect any evidence to suggest that there are regular daily flights by common scoter across Aberdeen Bay, although the increased frequency in flights at dawn indicates that these may occur. Should they do so then there may be a relatively small increase in energetic expenditure.

The incremental increase in the distance migrating common scoter from their breeding grounds in Scandinavia or Russia may incur should they be displaced during their migration to or from the Firth of Forth or Firth Tay & Eden Estuary SPAs will be negligible and not cause an adverse effect.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should displacement occur, that no common scoter will be within the proposed development area and there will be 80% displacement out to a distance of 1 km and a further 50% decrease in abundance out to 2 km from the proposed development.

Based on the peak density obtained from boat-based surveys of 23.1 birds/km<sup>2</sup> during the spring period, should there be a total displacement of common scoter from within the proposed development area then it is predicted that up to 99 common scoter may be displaced during periods of peak density. Based on an 80% displacement out to 1 km from the proposed development area it is predicted that up to a further 227 common scoter may be displaced and an additional 94 out to 2 km should there be 20% displacement between 1 km and 2 km from the proposed development. Therefore, the maximum number of common scoter potentially displaced is up to 420 birds based on the highest densities recorded from any survey within Aberdeen Bay and displacement out to 2 km.

Based on the estimated total of 420 potentially displaced common scoter out of a peak reported count of 4,300 common scoter at Blackdog (Figure 4-16), it is predicted that up to 10% of the common scoter within Aberdeen Bay may be displaced. However, the distribution of common scoter within Aberdeen Bay is clustered with peak numbers occurring at various sites across the bay during different seasons (Sohle *et al.* 2006). The area off Blackdog regularly records the peak counts of common scoter in Aberdeen Bay (NESBR) and should displacement occur, a greater proportion of common scoter may be affected than is estimated using densities obtained from boat-based surveys alone.

However, intensive post-construction monitoring undertaken at Horns Rev offshore wind farm has indicated that displacement of common scoter may not occur and that birds will occur within an operating wind farm with a similar frequency as outwith (Petersen & Fox 2007). Similar results have suggested that this may also be the case at UK wind farms, e.g. Rhyl Flats.

These studies indicate that common scoter do not avoid wind farms post-construction.

Based on the evidence from existing offshore wind farms it is predicted that the potential impact from displacement is minor.

Calculations used for displacement	
Area	Peak density of common scoter – 23.1 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 23.1 = 99
Area of 1 km buffer at 80% displacement = 12.3 km <sup>2</sup>	(12.3 * 23.1)*0.8 = 227
Area of 2 km buffer at 20% displacement = 20.3 km <sup>2</sup>	(20.3 * 23.1)/0.2 = 94
Total displaced	99+227+94 = 420



### **Disturbance**

Common scoter may be disturbed by vessels, both during the construction phase and during operations from maintenance vessels. Studies have indicated that there may be displacement from large vessels out to 1,000 m (Larsen & Laubek 2005).

During construction there may be a number of vessels operating within the area but these will likely be focussed around a single point where the turbine is being installed. Consequently, common scoter may be displaced from within 1 km radius of the installation; an area of 3 km<sup>2</sup>. Based on the highest recorded density of 23.1 birds/km<sup>2</sup>, it is predicted that up to 69 common scoter may be displaced from the vicinity during the construction period. This equates to approximately 1.5% of the peak common scoter population within Aberdeen Bay based on the peak estimated figure of 4,300 individuals. The construction period will be of short duration and the displacement impacts from construction vessels temporary. Consequently, any potential impact is predicted to be negligible.

Displacement by service boats may reduce the re-population potential of the proposed development area. It is not known how many service vessels may be required but based on the scale of the proposed development there is unlikely to be more than one vessel at the site on any one occasion. The presence of the proposed development in the vicinity of the intensively used Aberdeen Harbour means that the potential increase by vessel movement will not have any noticeable difference to the number of vessels already using Aberdeen Bay. Any specific displacement caused by the service or construction boats will be temporary as common scoter will be able to move into the area once the vessels leave.

It is concluded that the effect of disturbance from construction or service boats is negligible.

### **Cumulative and in-combination**

The potential future Ocean Pod will require additional vessel movements within the proposed development area during the installation and maintenance of it. Should this occur then there is the potential for a cumulative effect to common scoter. It is not yet known what type of structure the Ocean Pod may be or how it will be installed or the number of vessel movements will be required. However, it is a single structure and it is predicted that the level of disturbance will be no greater than that arising from the installation of a single wind turbine. The scale of disturbance is therefore predicted to be localised and of short duration.

Aside from the historical and on-going levels of shipping, there are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts. There is not predicted to be any cumulative or in-combination impacts arising at other planned developments as their locations offshore and their water depths indicate that common scoter may not regularly occur in these areas. Studies undertaken at the Beatrice demonstrator wind farm have recorded one flock of 13 common scoter (Talisman 2005). Consequently there are unlikely to be any cumulative or in-combination impacts.

#### **4.11.6 Conclusions**

##### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating both a very low collision risk and little, if any, displacement and that there are not expected to be any

significant barrier effects; it is predicted that there will not be any adverse effects on the SPAs for which common scoter is a qualifying species.

#### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on common scoter.

## 4.12 Velvet scoter (*Melanitta fusca*)

### 4.12.1 Protection & Conservation Status

Velvet scoter is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

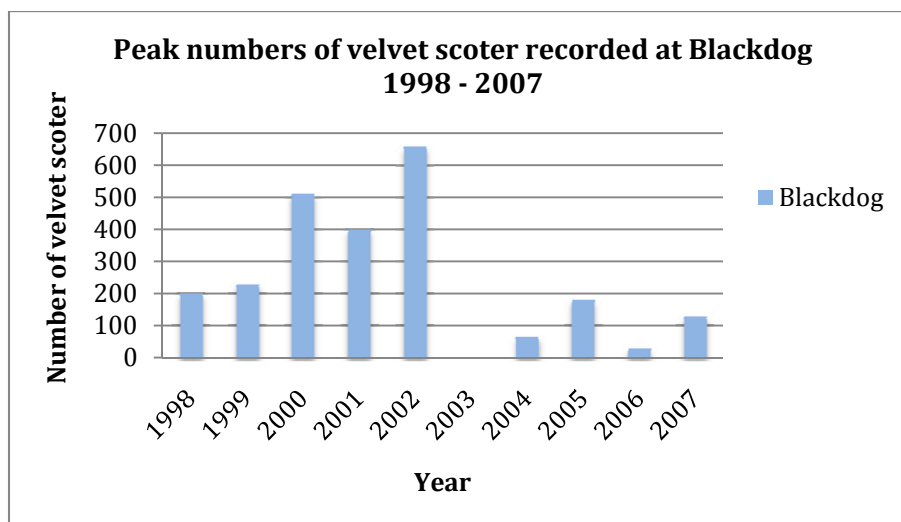
### 4.12.2 Background

Velvet scoter		
GB Population	Winter – 3,000 ind.	BTO 2011
Scottish Population	Winter – 2,500 – 3,500	Forrester <i>et al.</i> 2007
International threshold	10,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	30 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth Firth of Tay & Eden Estuary	SNH 2011
European population estimate	Breeding 85,000 – 100,000 pairs Wintering – >140,000 individuals	Birdlife 2004
European population trend	Status ‘declining’ Trend ‘moderate decline’	Birdlife 2004
World population	1,700,000 – 3,000,000	Birdlife 2011

Velvet scoters do not breed in the UK but are a regular but uncommon winter visitor with an estimated wintering population of approximately 3,000 individuals along the east coast of the UK (Wernham *et al.* 2002). The main areas for velvet scoter along the east coast of Scotland are the Moray Firth, St Andrew’s Bay and the Firth of Forth with a total of about 2,000 birds wintering (Calbrade *et al.* 2010).

During the late summer, small numbers of velvet scoter occur amongst the larger flocks of moulting common scoter and numbers increase for the rest of the year with peak wintering numbers in February.

During the winter months velvet scoter are uncommon in North-east Scotland with ones and twos being reported around the coasts. Peak numbers occur during July and August when velvet scoter occur amongst the moulting common scoter flock in Aberdeen Bay. Peak numbers vary considerably across years but up to 600 individuals have been recorded (Buckland, Bell & Picozzi 1990; NESBR) (Figure 4-25).



(Source NESBR)

**Figure 4-25: peak numbers of velvet scoter recorded at Blackdog between 1998 and 2007.**

Passage of velvet scoter past Peterhead occurs during spring and autumn with peak counts of up to 300 birds occurring in October and evidence of a small spring passage when up to 150 birds were recorded during April (Innes 1996).

#### Boat-based surveys

Four sightings of velvet scoter were made from boat-based surveys totalling 14 birds. Two singles in February, a flock of five in July and seven in November (IECS 2008).

#### Vantage Point surveys

In Aberdeen Bay low numbers of velvet scoter were recorded during the winter months with an increase in numbers during the year and a peak passage of velvet scoter of usually less than one bird per hour during June. Results from all the Vantage Point counts undertaken recorded only two velvet scoter flying above 30 m. Most birds were recorded between 1 km and 3 km from shore (EnviroCentre 2007a, 2007b, Alba Ecology 2008b).

#### Bird Detection Radar

A total of 28 velvet scoter were recorded during radar surveys in October 2005. Numbers were split fairly evenly between the two sites at which surveys were undertaken with 13 at Drums and 15 at Easter Hatton. All sightings were within 2.5 km from shore and all birds recorded in flight were flying below 10 m (Walls *et al* 2005).

Six velvet scoter were recorded at Blackdog within 1 km of the coast between 11 and 26 April 2007 (Simms *et al.* 2007).

#### 4.12.3 Summary of Results

Velvet scoter were only occasionally recorded throughout the year during surveys undertaken across Aberdeen Bay. A total of fourteen velvet scoter were recorded from boat-based surveys and a peak from shore-based counts occurred in June. Most velvet scoter were recorded between 1 km and 3 km off the coast

Of those recorded in flight all but one were recorded flying below 30 m.

Although no counts during surveys undertaken across Aberdeen Bay were of national importance peak counts from Blackdog have, in the past, been of national importance.

#### 4.12.4 Initial Assessment of Significance

<b>Velvet scoter</b>	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Medium	Moderate
Displacement	Very High	High	Major

#### 4.12.5 Species Sensitivities

##### Qualifying species

There are two SPAs in the region for which velvet scoter is a qualifying species as part of waterfowl assemblages: Firth of Forth SPA and Firth of Tay and Eden Estuary SPA.

##### Flight height

The small number of flight heights obtained from boat-based surveys undertaken in Aberdeen Bay reported all flights as flying below 25 m and therefore not at risk of collision. There was one record of a velvet scoter flying above 30 m.

Elsewhere in the UK small numbers (<20) of velvet scoter have been recorded all of which have been flying below rotor height with a mean flight height of less than 1 m.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that velvet scoter are generally uncommon in Aberdeen Bay, occurring within the larger common scoter flocks. They occur mainly within 3 km of the coast and in waters less than 20 metres.

Evidence from elsewhere indicates that velvet scoter detour around wind farms and are at low risk of collision. A total of nearly 1,600 velvet scoters were recorded in the Kalmar Sound and no collisions were recorded (Pettersson 2006).

Consequently, the risk of an impact arising due to collisions is low and significance should it occur negligible.

The two SPAs in the region for which velvet scoter is a qualifying species as part of an assemblage are both over 90 km away. The probability of birds from these SPA populations flying through the proposed development area at turbine height is low and consequently the risk of collision is also very low. Therefore there will not be an adverse effect on the population due to collision.

##### Barrier effect

Studies undertaken in Sweden and Denmark have shown that there is the potential for a barrier effect on velvet scoter with changes in flight directions of up to 1 km from offshore wind turbines and birds seen flying around wind farms. Therefore, it is predicted that the proposed development may cause a barrier effect to common scoter in Aberdeen Bay.

There is no evidence of regular daily movements of velvet scoter within Aberdeen Bay to and from feeding or roosting areas. However, velvet scoter frequently mix in flocks of common scoter and should a barrier effect occur for common scoter then it may also do so for velvet scoter. As with common scoter, the potential additional increase in daily energy expenditure due to possible displacement may be between 2.2% and 2.6% (Speakman, Gray & Furness 2009). This is a relatively small increase in daily energy expenditure and is unlikely to have an adverse effect or significant impact on velvet scoter in Aberdeen Bay.

The incremental increase in the distance migrating velvet scoter from their breeding grounds in Scandinavia or Russia may incur should they be displaced during their migration to or from the Firth of Forth or Firth Tay & Eden Estuary SPAs will be negligible and not cause an adverse effect.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that, should displacement occur, there will be 100% displacement of velvet scoter within the proposed development area and out to a distance of 1 km. A further 50% decrease in abundance occurs out to 2 km from the wind farm. However, very few velvet scoter were recorded during site specific surveys undertaken within the bay and peak counts from Blackdog have, in recent years, been below 200 individuals (Figure 4-25). There are no reports on whether velvet scoter are displaced by offshore wind farms but evidence of little or no displacement to the closely related common scoter indicate that displacement is unlikely to occur. Based on this assumption then it is predicted that there will not be an adverse effect or significant impact from the proposed development on velvet scoter.

### Disturbance

Disturbance effects on velvet scoter will be similar to those identified for common scoter and they may be disturbed by vessels, both during the construction phase and during operations from maintenance vessels. The numbers of velvet scoter recorded within the proposed development area were very low and it is therefore predicted that disturbance from either construction or service vessels will have a negligible impact and not cause an adverse effect.

### Cumulative and in-combination

Aside from the historical and on-going levels of shipping, there are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on velvet scoter present within Aberdeen Bay. There is not predicted to be any cumulative or in-combination impacts arising at other planned developments as their locations offshore and their water depths indicate that velvet scoter may not regularly occur in these areas. No velvet scoter were reported during studies undertaken at the Beatrice demonstrator wind farm (Talisman 2005). Consequently there are unlikely to be any cumulative or in-combination impacts.

#### 4.12.6 Conclusions

### Habitats Appraisal

Based on the evidence from existing offshore wind farms indicating a very low collision risk, potentially little or no displacement and no significant barrier effects; it is predicted that there will not be any adverse effects on the SPAs for which velvet scoter is a qualifying species.

### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on velvet scoter.



### 4.13 Common goldeneye (*Bucephala clangula*)

#### 4.13.1 Protection & Conservation Status

The (Common) goldeneye is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Green List of Species of Conservation Concern.

#### 4.13.2 Background

Goldeneye		
GB population	Breeding – 200 pairs Winter – 25,000 ind	BTO 2011
Scottish population	Breeding: 120 - 150 prs Winter: 10,000 – 12,000 ind.	Holling <i>et al.</i> 2010 Forrester <i>et al.</i> 2007
International threshold	11,500 ind.	Calbrade <i>et al.</i> 2010
GB threshold	249 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth: 581 ind. (08/09) Firth of Tay & Eden Estuary: 255 ind	Calbrade <i>et al.</i> 2010 SNH 2011
European population estimate	Breeding 490 – 590,000 prs Wintering – >310,000 ind	Birdlife 2004
European population trend	Status 'secure' Trend 'small increase'	Birdlife 2004
World population	2,5 – 4,600,000 'adults'	Birdlife 2011

Goldeneye breed beside freshwater habitats across northern Europe with a total breeding population of up to 590,000 pairs primarily in Sweden, Finland and Russia. There is a small and localised breeding population in the UK with approximately 120 to 150 pairs nesting in Scotland (Holling *et al.* 2010).

During the winter goldeneye move away from the breeding sites and move onto both fresh and salt water bodies. In eastern Scotland the Firth of Forth holds the largest wintering population in the UK with a peak mean of 581 over the last five years. This is considerably lower than recent historical counts at the site where over 2,000 goldeneye used to be regularly recorded (Cork Ecology 2004a).

In North-east Scotland goldeneye has only recently colonised the region as a scarce breeding bird with a small but increasing population of about 30 nests, inland with relatively small numbers wintering along the coasts and inland freshwater. The main areas are Loch of Skene and Loch of Strathbeg where peak numbers of up to 100 to 200 birds may occur (Buckland, Bell & Picozzi 1990; NESBR).

On the coast goldeneye are rarely recorded between June and September with birds present from October onwards when numbers passing Peterhead peak with up to 2 birds per hour between November and January (Innes 1996). All sightings of goldeneye at Peterhead were of birds within 1 km of the shore.

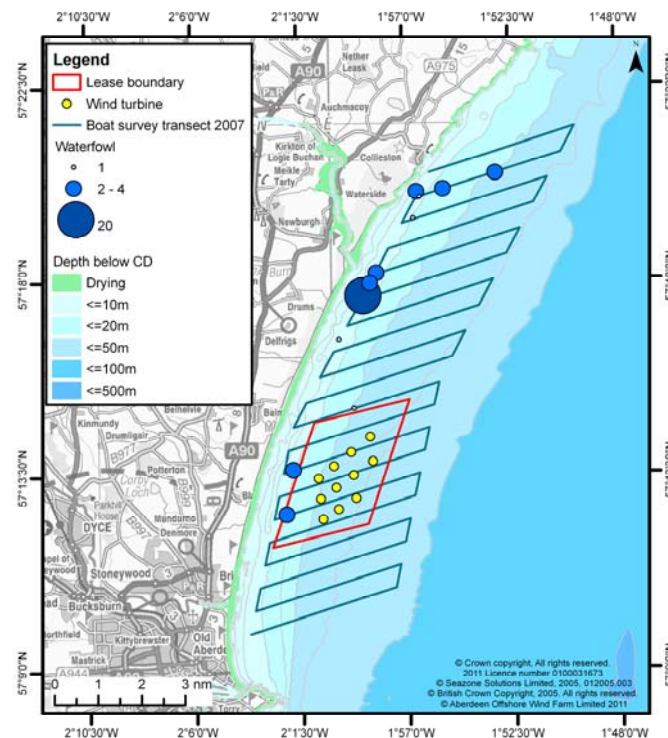
#### Boat-based surveys

Five goldeneye were recorded from boat-based surveys with three in April and two in November.

#### Vantage Point surveys

Small numbers of goldeneye were recorded passing through Aberdeen Bay with a total of 41 records between November and April over the three years of data collection.

Five goldeneye were recorded from boat-based surveys with three in April and two in November.



**Figure 4-26: Waterfowl distribution in Aberdeen Bay - February 2007 to April 2008 (all sightings).**

### Bird Detection Radar

No goldeneye were recorded during the radar studies undertaken at Easter Hatton and Drums during October 2005 but three were recorded at Blackdog during the additional radar surveys undertaken at Blackdog during April 2007 (Simms *et al.* 2007).

### 4.13.3 Summary of Results

Goldeneye were infrequently recorded in Aberdeen Bay with most sightings from Vantage Point surveys between November and April.

### 4.13.4 Initial Assessment of Significance

Goldeneye	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Negligible	Negligible
Displacement	Medium	Negligible	Negligible

#### 4.13.5 Species Sensitivities

##### Qualifying species

There are two SPAs for which goldeneye are part of the qualifying assemblages: Firth of Forth SPA and Firth of Tay & Eden Estuary SPA. Goldeneye was also listed as part of the qualifying assemblages in original citation for the Loch of Strathbeg but is not so for subsequently updated ones.

##### Flight height

Very few records of goldeneye were made from site specific boat-based or land-based surveys and only two records of their flight altitudes were made. Both were of birds flying below 25 m.

Elsewhere there is very limited data from other offshore wind farms on flight heights for goldeneye.

##### Collision risk

Evidence from site specific monitoring indicated that goldeneye are scarce in Aberdeen Bay and primarily occur in near-shore waters. Evidence from other offshore wind farms indicated that goldeneye are at low risk of collision from offshore wind farms. A total of nearly 3,100 goldeneye were recorded during studies undertaken in Kalmar Sound and no collisions were recorded (Pettersson 2005). Based on the relatively low numbers of goldeneye recorded and evidence from other wildfowl of a potentially high avoidance rate it is predicted that the risk of an adverse or significant environmental effect on goldeneye from collision mortalities arising from the proposed development is negligible.

##### Barrier effect

Evidence from studies undertaken at Kalmar Sound suggests that there is the potential for some barrier effects as goldeneye may avoid flying through offshore wind farms. Should a barrier effect occur then goldeneye will fly around the proposed development. This may incur an overall increase in flying distance of approximately 3.2 km. There is no evidence of any regular feeding or roosting flights by goldeneye across Aberdeen Bay nor any regular usage of the site itself. Any additional distance flown should goldeneye fly around the proposed development will be small compared to the total distance of their migration and will not be significant nor have an adverse effect.

##### Displacement

Goldeneye do not use Aberdeen Bay for feeding or roosting and therefore no displacement effects will occur.

##### Cumulative and in-combination

The low level of usage of the site by goldeneye and the relatively few recorded from other UK developments indicate that there will not be any cumulative or in-combination impacts.

#### 4.13.6 Conclusions

##### Habitats Appraisal

There are no SPAs for which goldeneye is a qualifying species that will be effected by the proposed development.

### **Environmental Impact Assessment**

Based on the relatively low numbers of goldeneye recorded and their known behaviour it is predicted that there will not be a significant environmental impact arising from the proposed development on goldeneye.

#### 4.14 Red-breasted merganser (*Mergus serrator*)

##### 4.14.1 Protection & Conservation Status

Red-breasted merganser is listed in Appendix II of the Bonn Convention, Appendix III of the Bern Convention and is on the Green List of Species of Conservation Concern.

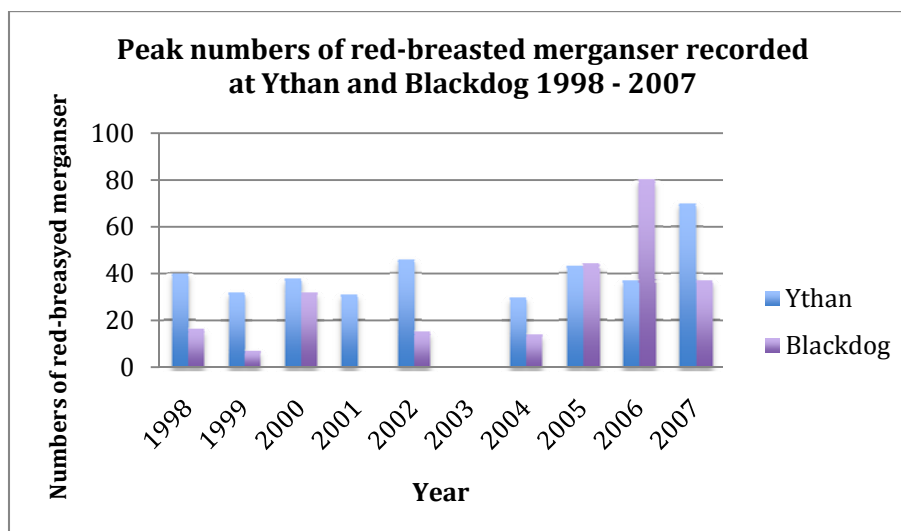
##### 4.14.2 Background

Red-breasted merganser		
GB Population	Breeding: 2,400 prs. Winter: 10,200 ind.	Birdlife 2004
Scottish population	Breeding: 2,000 prs Winter: 8,500 ind	Forrester <i>et al.</i> 2007.
International threshold	1,700 ind.	Calbrade <i>et al.</i> 2010
GB threshold	98 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth	SNH 2011
European population estimate	Breeding 59,818 – 84,484 pairs Wintering – 89,000 ind.	Hagemeijer & Blair 1997 Birdlife 2004
European population trend	Status 'secure' Trend 'small decline'	Birdlife 2004
World population	510,000 – 610,000	Birdlife 2011

Red-breasted merganser breed across northern Europe with the largest populations occurring in Scandinavia. In Scotland there is an estimated 2,000 pairs. The UK wintering population is estimated to 10,200 individuals, of which 8,500 occur in Scotland; dispersed around the coasts with the main wintering areas in the Moray Firth, Firth of Forth, St Cyrus and Montrose Basin and the Scottish west coast. During August and September adult red-breasted mergansers undergo a wing moult and become flightless for a period. During this period they congregate in flocks in regular areas including the Cromarty Firth, Inner Moray Firth and in Aberdeen Bay. There is evidence of migration during the spring and autumn with peak passage during March/April and October (Forrester *et al.* 2007).

Outwith the breeding season between 85% and 90% of red-breasted merganser occur along coasts and estuaries feeding on a variety of fish species (Cork Ecology 2004a).

In North-east Scotland red-breasted merganser is a scarce and possibly irregular breeder but is widespread in generally low numbers along the coasts during the winter. Peak numbers occur at Loch of Strathbeg, Ythan Estuary and in Aberdeen Bay primarily between November and February.



(Source NESBR)

**Figure 4-27: Peak numbers of red-breasted merganser in Aberdeen Bay between 1998 and 2007.**

Peak numbers pass Peterhead throughout the year but highest numbers occur during March and April with up to 2.4 birds per hour with most sightings within a few hundred metres from shore and nearly all sightings within 1 km from shore (Innes 1995).

#### Boat-based surveys

During boat-based surveys, one red-breasted merganser was recorded in March at the Donmouth (IECS 2008).

#### Vantage Point surveys

Data from Vantage Point Counts undertaken between March 2005 and March 2008 recorded peak numbers of red-breasted merganser in October and November when up to four birds per hour were recorded passing the Donmouth in October 2007. Up to nineteen birds were recorded in April 2006 and ten off the Promenade during March 2005 (EnviroCentre 2007a).

Out of the 84 sightings of birds in flight there was only one record of a bird flying above 30 metres. At Blackdog most sightings were of birds between 1–2 km from the shore, whereas at the Donmouth birds were recorded out to 3 km (Alba Ecology 2008b).

#### Bird Detection Radar

A total of 51 red-breasted merganser were recorded during five days of surveys at Drums and Easter Hatton in October 2005. Fourteen were at Drums and 37 at Easter Hatton. Birds were recorded out to 3 km from shore but the majority were within 2 km, with peak numbers within 500 m of the coast. The mean flight height was 14 m with one record of birds at 40 m (Walls *et al.* 2006).

Red-breasted mergansers were frequently recorded during the 17 days of radar surveys undertaken at Blackdog in April 2007. A total of 31 records of 76 individuals were recorded with a mean flock size of two and a peak count of seven birds (Simms *et al.* 2007). All birds were seen flying below 30 m above sea surface and the majority, 60, of sightings were of birds flying south.

#### 4.14.3 Summary of Results

There was one sighting of red-breasted merganser from the boat-based surveys but they were regularly recorded from land-based studies with peak numbers in October and November. The majority of birds were within 2 km of the coast with most within 500 m.

Of those recorded in flight all but two were recorded flying below 30 m.

No counts during any surveys undertaken across Aberdeen Bay were of national importance.

#### 4.14.4 Initial Assessment of Significance

<b>Red-breasted merganser</b>	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Low	Negligible
Displacement	High	Medium	Moderate

#### 4.14.5 Species Sensitivities

##### Qualifying species

Red-breasted Merganser is a qualifying species as part of waterfowl assemblages: Firth of Forth SPA, a site with a 5 year mean peak count of 410 individuals (Calbrade *et al.* 2010).

##### Flight height

No flight heights were obtained from boat-based surveys undertaken in Aberdeen Bay. One was recorded as flying above 30 m from Vantage Point surveys and one from radar surveys. However, the mean flight height was recorded as being 14 m.

Elsewhere in the UK 10% of all flights have been recorded at rotor height (n=71).

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that red-breasted merganser are widespread in Aberdeen Bay and occur out to 3 km from shore. Consequently they are at risk of interacting with the proposed development.

At other offshore wind farms, over 9,000 red-breasted mergansers were recorded in the Kalmar Sound and although birds were recorded flying through the wind farms there were no recorded collisions. There was also clear evidence of avoidance behaviour with a four-fold decrease in the number of mergansers flying through zone post-construction (Pettersson 2006).

The majority of red-breasted mergansers were within 2 km of the shore and therefore not at risk of collision. Furthermore most sightings were of birds flying below 25 m and evidence from operating wind farms has indicated a very high avoidance rate. Therefore, the risk of a significant impact arising due to collisions is low and the significance of any impact, should it occur, would be negligible.

The only SPA in the region for which red-breasted merganser is a qualifying species is over 130 km away. The probability of birds from this SPA flying through the proposed development area at turbine height is low and consequently the risk of



collision is also very low. Therefore there will not be an adverse effect on the population due to collision.

### Barrier effect

Studies undertaken in Sweden and Denmark have shown that there is the potential for a barrier effect on red-breasted merganser with changes in flight directions up to 1 km from offshore wind turbines and birds seen flying around wind farms. Therefore, it is predicted that the proposed development may cause a barrier effect to red-breasted merganser in Aberdeen Bay.

There was no evidence from Vantage Point surveys or radar studies of any regular daily movements of red-breasted merganser within Aberdeen Bay to and from feeding or roosting areas. Should a barrier effect occur it is likely to be on an occasional *Ad hoc* basis and if so then it is predicted on the occasions that it occurs the increase in flight distance will cause an increase of between 1% and 1.5% of daily energy expenditure. This is a relatively small increase in daily energy expenditure and is unlikely to have an adverse effect on or significant impact on red-breasted merganser in Aberdeen Bay.

The incremental increase in the distance migrating red-breasted merganser from their breeding grounds will incur on their way to or from the Firth of Forth SPA, should they be displaced, will be negligible and not cause an adverse effect.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should 100% displacement occur, then no red-breasted merganser will be within the proposed development area out to a distance of 1 km. There may be a gradual in the number of birds present with a further 50% decrease in abundance out to 2 km from the wind farm. Very few red-breasted merganser were recorded from the site specific surveys undertaken within the bay and peak counts from Blackdog are below 80 individuals (Figure 4-27). Evidence from Sweden also suggest that operating wind farms cause little or no displacement (Pettersson 2006). Studies undertaken at Nysted offshore wind farm recorded more red-breasted mergansers during post-construction surveys than during pre-construction including in the wider area.

Based on the distribution of red-breasted mergansers in Aberdeen Bay and evidence from other sites then it is predicted that there will not be an adverse effect or significant impact from the proposed development on red-breasted merganser due to displacement.

### Disturbance

Studies undertaken in Sweden concluded that although red-breasted mergansers could be disturbed by vessels they returned to areas once the vessels departed. There will be both construction traffic and maintenance vessels associated with the proposed development. These may cause some disturbance to red-breasted mergansers when on site but this will be temporary. The numbers of red-breasted merganser recorded within the proposed development area were very low and it is therefore predicted that disturbance from either construction or service vessel will have a negligible impact and not cause an adverse effect.

### Cumulative and in-combination

Aside from the historical and on-going levels of shipping, there are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on red-breasted merganser present within Aberdeen Bay. There is not predicted to be any cumulative or in-combination impacts arising at other

planned developments as their locations offshore and their water depths indicate that red-breasted merganser may not regularly occur in these areas. No red-breasted mergansers were reported during studies undertaken at the Beatrice demonstrator wind farm (Talisman 2005). Consequently, there are unlikely to be any cumulative or in-combination impacts.

#### **4.14.6 Conclusions**

##### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating a very low collision risk potentially little or no displacement and no significant barrier effects, it is predicted that there will not be any adverse effects on the SPAs for which red-breasted merganser is a qualifying species.

##### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on red-breasted merganser.

#### 4.15 Red-throated diver (*Gavia stellata*)

##### 4.15.1 Protection & Conservation Status

The red-throated diver is listed in Annex I of the Birds Directive, Appendix II of the Bern Convention, Appendix II of the Bonn Convention, Schedule 1 under the Wildlife and Countryside Act, 1981 and is on the Amber List of Species of Conservation Concern.

##### 4.15.2 Background

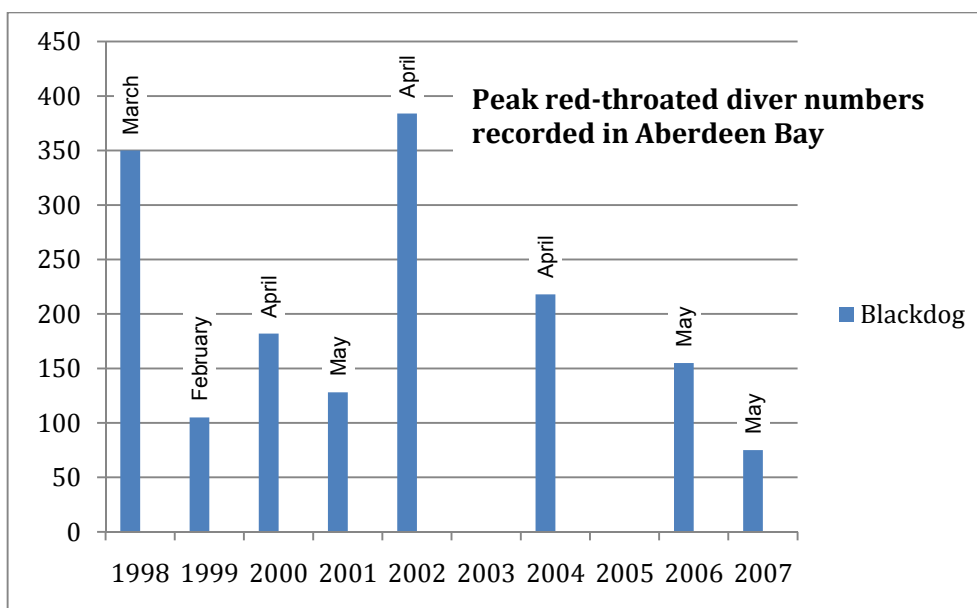
Red-throated diver		
GB Population	Breeding: 1,014 – 1,551 prs. Winter: 17,000 ind.	Calbrade <i>et al.</i> 2010
Scotland	Breeding: 1,000 – 1,500 prs. Winter: 2,270 ind.	Forrester <i>et al.</i> 2007
International threshold	3,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	170 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth SPA 317 ind.	SNH 2011 JNCC 2011a Calbrade <i>et al.</i> 2010
European population estimate	Breeding 32,000 – 92,000 Wintering >51,000	Birdlife 2004
European population trend	Status: 'Depleted' Trend: 'stable'	Birdlife 2004
World population	200 – 590,000 'adults'	Birdlife 2011

Red-throated divers are relatively common around the Scottish coasts and spend much of the year at sea only coming onto fresh water during the breeding season. The species is entirely coastal in its wintering distribution, often being associated with shallow coastal inshore sandy bays during the winter months (Lack, 1986). The major prey items are crustaceans, sand eels, sprat, herring, flatfish and codling and, as the name of the species suggests, these items are obtained by diving. The majority of wintering individuals are located down the east coast of Britain. Recent findings from aerial survey data have estimated the UK wintering population of this species to be now in the region of 17,000 birds (O'Brien *et al.* 2008).

Red-throated divers are a very rare breeding species in North-east Scotland but are a common wintering and passage species around all coasts.

Historically peak numbers of red-throated diver occurred during the late autumn and early winter periods with a peak count of 1,470 birds between Don Mouth and Collieston in October 1979 (Buckland, Bell & Picozzi 1990). In more recent years Aberdeen Bay has held up to 400 red-throated divers during a peak spring period between March and May. However, numbers recorded appear to have decreased (Figure 4-28). Outwith the peak spring period, red-throated diver occur in lower numbers throughout the year particularly during the summer months. There is also an increase in numbers during the autumn with birds returning from their more northerly breeding grounds. Counts of up to nearly 180 birds have been recorded in the bay during September (Lewis *et al.* 2008). Evidence from studies undertaken by JNCC in 2005/06 indicated that the distributions of red-throated diver within the bay may vary slightly across the year. However, peak counts are most frequent between the Donmouth and Balmedie and at the Newburgh Bar at the mouth of the Ythan Estuary. There are very few records of any red-throated divers in water depths of greater than 20 m (Söhle *et al.* 2006; Lewis *et al.* 2008).

Three aerial surveys undertaken by the JNCC in Aberdeen Bay between December 2005, January 2006 and May 2006 recorded a maximum of 39 red-throated divers in May (Söhle *et al.* 2006).



**Figure 4-28: Peak numbers of red-throated diver recorded in Aberdeen Bay between 1998 and 2007. (Source NESBR).**

#### 4.15.3 Survey Results

##### Boat-based surveys

Boat-based surveys were undertaken on a monthly basis between February 2007 and April 2008 and from August 2010 to present. The surveys recorded red-throated divers throughout the year in Aberdeen Bay with the majority of sightings during the spring and autumn and relatively few between June, July and August. The majority of sightings were in waters less than 10 m and within 1 – 2 km of the coast. There were very few records of red-throated diver within the proposed development area. The peak in May probably reflected movement of divers heading to northern Scottish breeding sites or back across to Scandinavia, whilst the increase in winter months indicated the presence of a wintering population in Aberdeen Bay.

Based on extrapolation of overall density, including birds recorded in short-transect lengths, a total of 93 birds were estimated to be using the proposed EOWDC survey area during the passage period in May 2007. Numbers were estimated to be lower for the rest of the year with an estimated 55 birds present in December (Table 4-11). Population estimates were lower in the 'control' area, particularly during the winter months (Table 4-12).

**Table 4-11: Red-throated diver monthly population estimate within the proposed EOWDC area.**

Month	On water estimate	In flight estimate	Total estimate
February 2007	16	0	16
March 2007	11	3	14
April 2007	34	0	34
May 2007	88	5	93
June 2007	26	0	26
July 2007	9	0	9
August 2007	22	0	22
September 2007	7	5	13
October 2007	16	0	16
November 2007	26	0	26
December 2007	52	3	55
January 2008	33	0	33

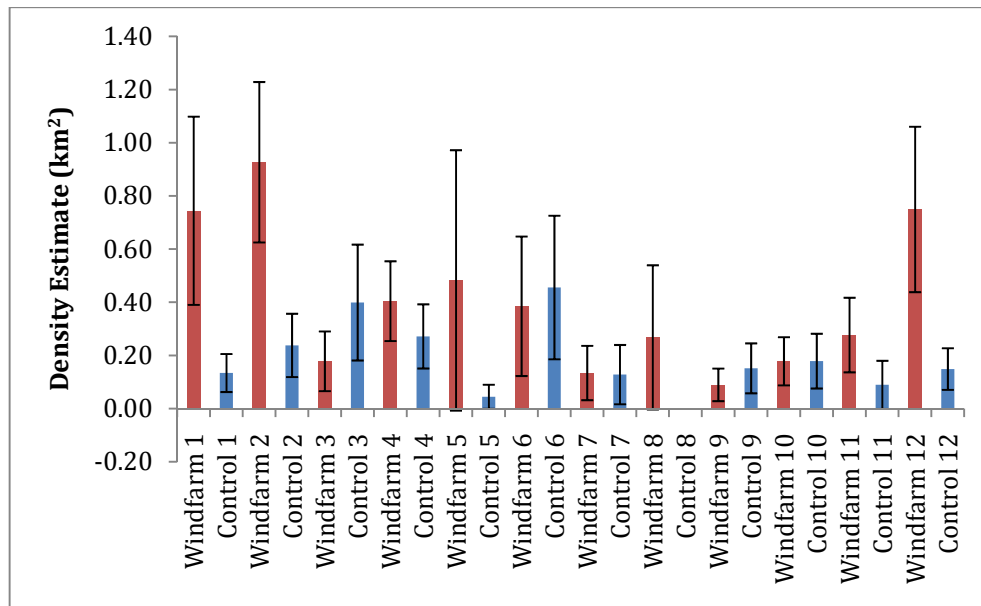
**Table 4-12: Red-throated diver monthly population estimate within the 'control' survey area.**

Month	On water estimate	In flight estimate	Total estimate
February 2007	4	0	4
March 2007	29	0	29
April 2007	7	0	7
May 2007	0	0	0
June 2007	41	0	41
July 2007	13	0	13
August 2007	0	0	0
September 2007	13	3	15
October 2007	13	0	13
November 2007	7	0	7
December 2007	9	3	11
January 2008	10	0	10

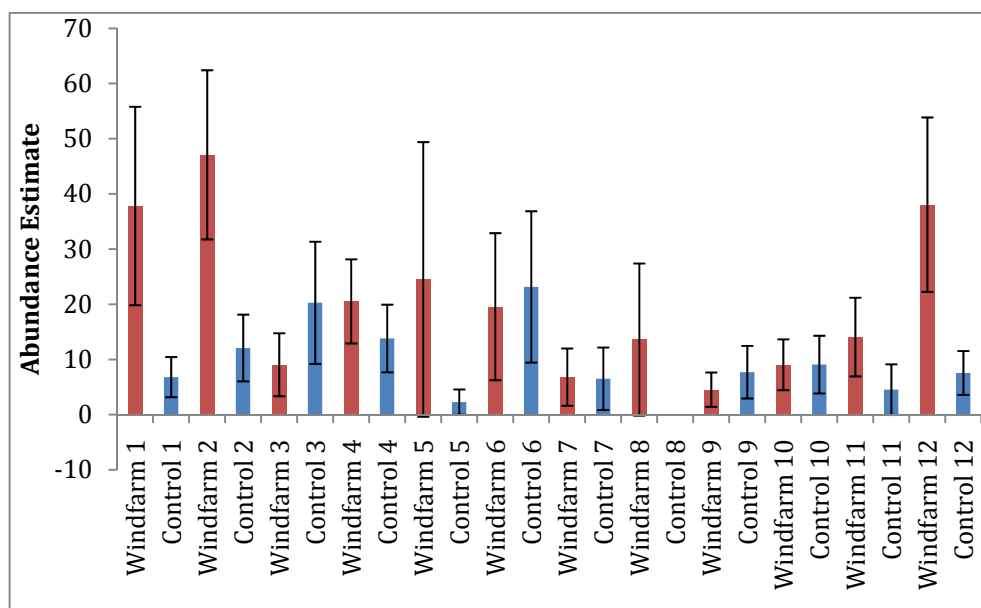
Further analysis of the data collected between February 2007 and January 2008, undertaken by the Sea Mammal research Unit (SMRU) using Distance Sampling techniques, recorded peak estimated abundance during the winter months with an estimated abundance within the proposed EOWDC survey area of 38 birds in December and January and 47 birds in February and relatively lower numbers of less than 30 birds in spring. Densities were also higher in the winter with up to 0.9 birds/km<sup>2</sup> in the proposed EOWDC area (Table 4-13, Figure 4-30) (SMRU 2011a).

**Table 4-13: Monthly estimates of density and abundance of Red-throated diver in the proposed EOWDC and 'control' areas (using Distance sampling).**

Month	Location	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
January	EOWDC	0.744	0.354	38	18.0	15
	Control	0.134	0.072	7	3.6	3
February	EOWDC	0.927	0.302	47	15.3	26
	Control	0.238	0.119	12	6.0	11
March	EOWDC	0.178	0.112	9	5.7	4
	Control	0.399	0.218	20	11.1	9
April	EOWDC	0.404	0.150	21	7.6	19
	Control	0.272	0.121	14	6.1	12
May	EOWDC	0.482	0.490	25	24.9	6
	Control	0.045	0.045	2	2.3	1
June	EOWDC	0.385	0.262	20	13.3	6
	Control	0.456	0.270	23	13.7	9
July	EOWDC	0.134	0.102	7	5.2	2
	Control	0.128	0.112	6	5.7	3
August	EOWDC	0.268	0.271	14	13.8	1
	Control	0.000	0.000	0	0.0	0
September	EOWDC	0.089	0.061	5	3.1	2
	Control	0.152	0.094	8	4.8	4
October	EOWDC	0.178	0.091	9	4.6	4
	Control	0.179	0.103	9	5.2	4
November	EOWDC	0.277	0.140	14	7.1	6
	Control	0.089	0.090	5	4.6	2
December	EOWDC	0.749	0.311	38	15.8	16
	Control	0.149	0.078	8	4.0	3



**Figure 4-29: Monthly estimates (+/- SE) of density of red-throated divers in the proposed EOWDC and 'control' Areas. February 2007 – January 2008 (Wind farm 1-12 and 'control' 1-12 refers to months).**



**Figure 4-30: Monthly estimates (+/- SE) of abundance of red-throated Divers in the proposed EOWDC and 'control' Areas; February 2007 – January 2008 (Wind farm 1-12 and 'control' 1-12 refers to months).**

Distribution maps from boat-based surveys indicate that red-throated divers exhibit a preference for water shallower than 20 m, but with concentrations observed on the 'short legs' of the survey, around the 5 m to 10 m depth contour line (Figure 4-31, Figure 4-32, Figure 4-33).



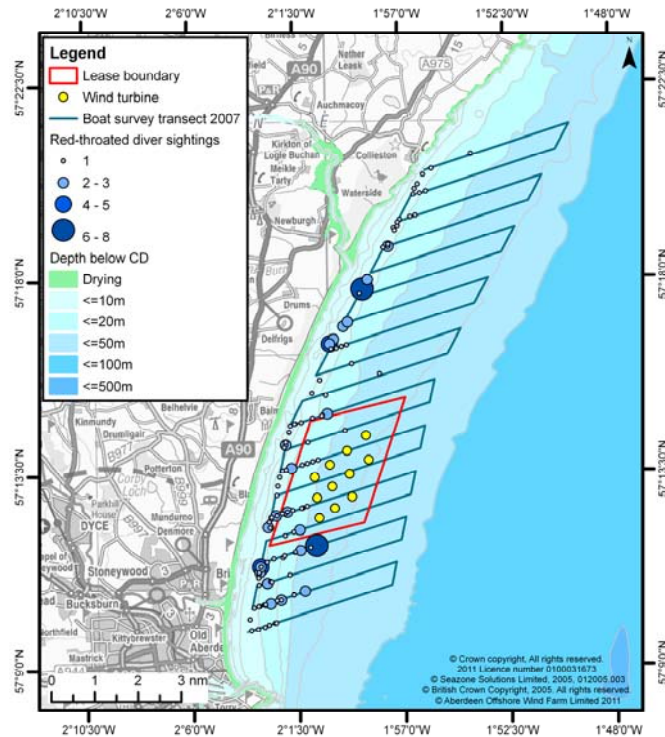


Figure 4-31: Red-throated diver distribution during winter period: November to March; 2007 – 2008 (all sightings).

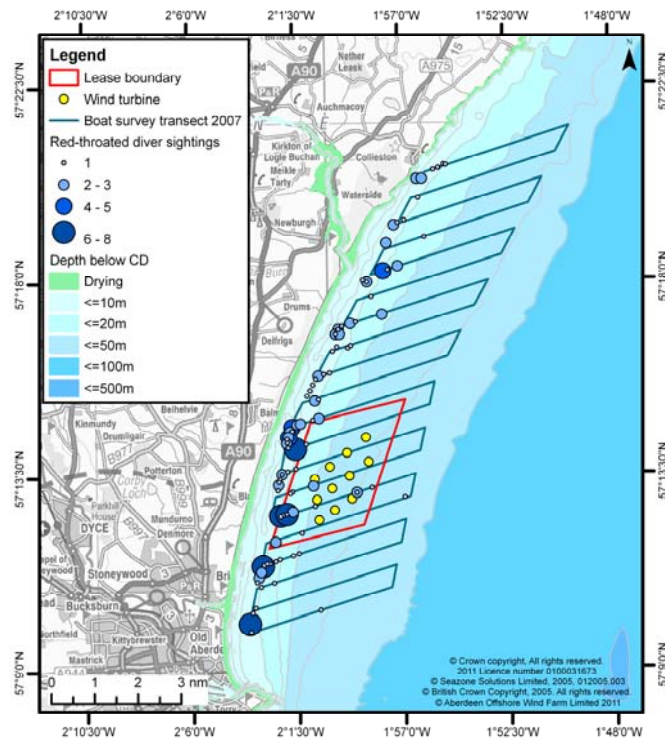
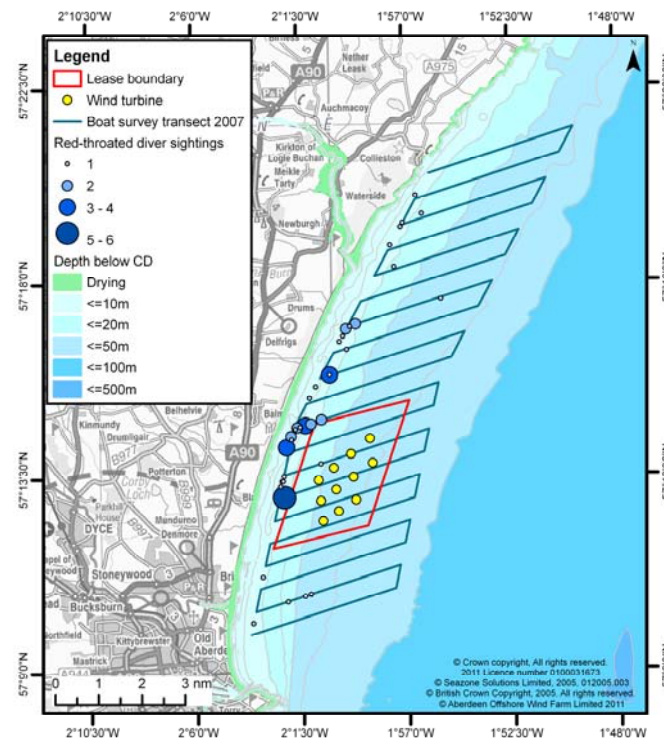
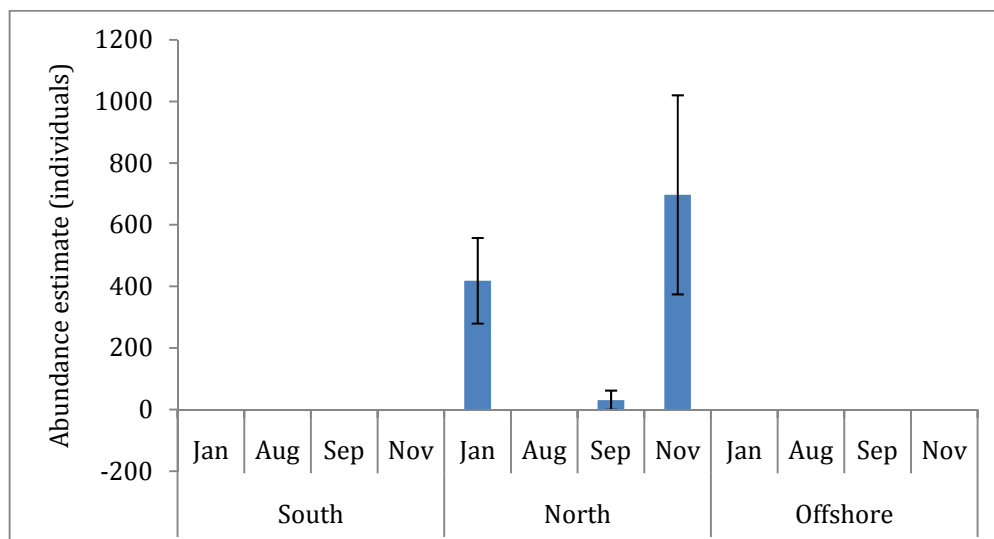


Figure 4-32: red-throated diver distribution during passage: April, May and September, October; 2007 (all sightings).

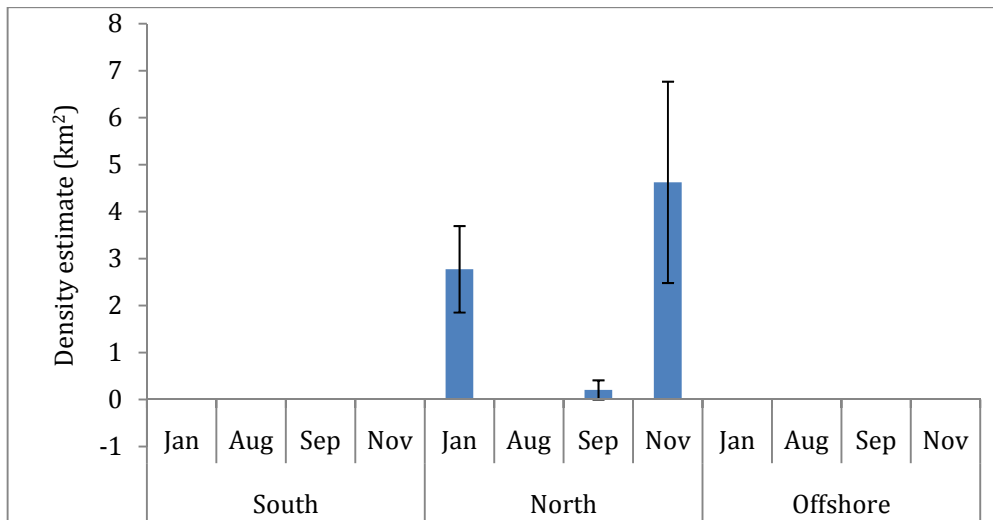


**Figure 4-33: red-throated diver distribution during summer period: June, July and August 2007- (all sightings).**

Additional boat-based data collected between August 2010 and January 2011 recorded a peak abundance estimate using *Distance* sampling techniques of 697 red-throated diver at a density of 4.9 birds/km<sup>2</sup> in the northern survey area during November 2010 with very low abundances to the south or offshore (Figure 4-34, Figure 4-35) (SMRU 2011b).

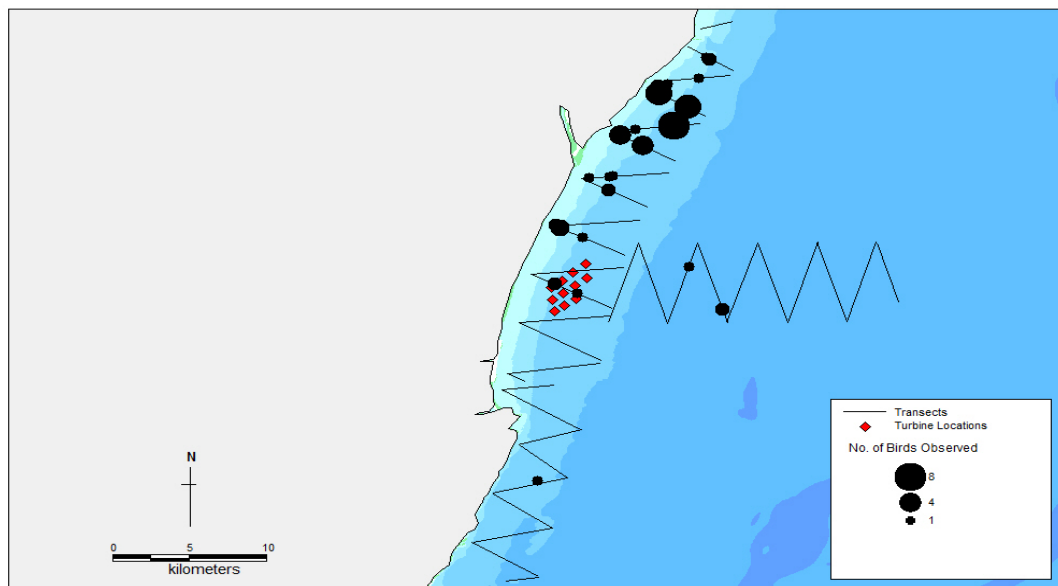


**Figure 4-34: Abundance estimates for red-throated diver between August 2010 and January 2011.**



**Figure 4-35: Density estimates for red-throated diver between August 2010 and January 2011.**

Most sightings during this period were to the north of the proposed development area with less than five red-throated diver recorded from all surveys within the footprint of the proposed development (Figure 4-36).



**Figure 4-36: On-effort observations of all Diver species (Red-throated and Unidentified Diver species) along transects during August, September and November 2010 and January 2011**

#### Vantage Point surveys

Data from vantage point surveys were collected in Aberdeen Bay between March 2005 and October 2005 and also from April 2006 to March 2008.

The results indicate a strong seasonal variation across the year with peak numbers occurring in the bay during April and May with a mean of up to 40 birds/hour passing

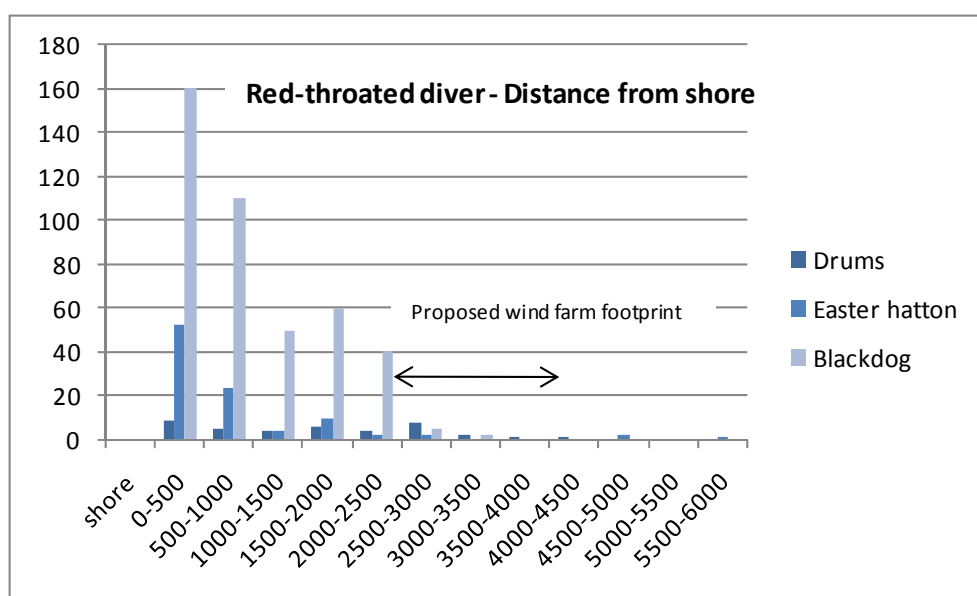
in April 2007 and peak counts of 28 birds off Murcar, over four hours of observation, during May 2005 (Alba Ecology 2008a). Red-throated divers were seen at all vantage point locations, mainly within 1 km or out to 2 km from shore with most records from Murcar, Drums and Balmedie and generally lower numbers at Blackdog and Donmouth.

Of those recorded in flight between 3% and 16% were between 30 to 150 metres above the sea surface, i.e at potential rotor height.

### Bird Detection Radar

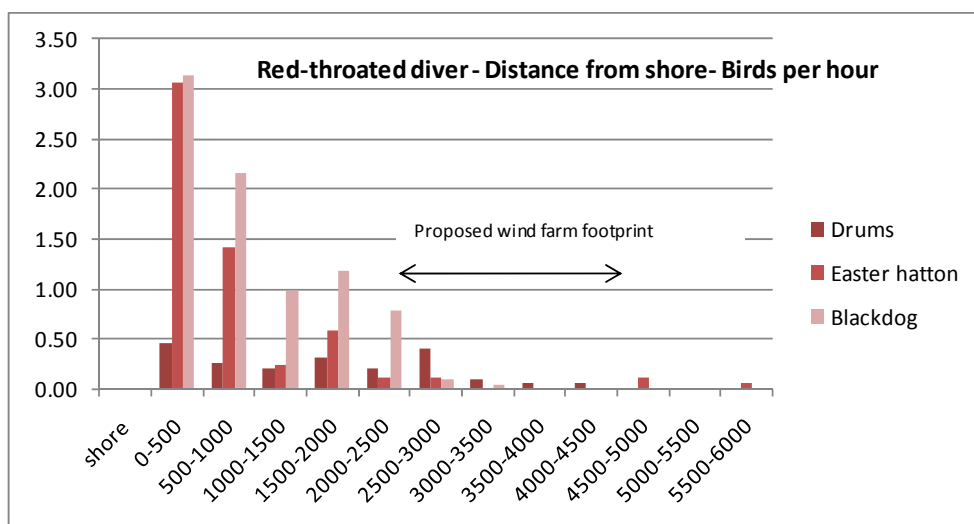
During radar studies undertaken in October 2005 a total of 157 red-throated divers were recorded, of which 65 were at Drums and 95 were at Easter Hatton (Walls *et al* 2005). Peak numbers were recorded within 500 m from shore although small numbers were recorded out to 5.5 km. Of those recorded in flight the mean height was 5 m with a maximum height of 40 m (Walls *et al*. 2006).

In April 2007, further Bird Detection Radar surveys were undertaken at Blackdog for a period of 17 days. During this time a total of 427 birds were recorded usually as singles with a maximum flock size of four birds (Simms *et al*. 2007). The majority of sightings were of birds within 1.5 km of the coast, although birds further offshore may have been missed (Figure 4-37, Figure 4-38).



(Adapted from Walls *et al*. 2006, Simms *et al*. 2007)

**Figure 4-37: Distances from shore for red-throated diver from three locations in Aberdeen Bay during surveys undertaken in October 2005 (Drums & Hatton) and April 2007 (Blackdog).**



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-38: Number of red-throated diver per hour and distance from shore from three locations in Aberdeen Bay during surveys undertaken in October 2005 (Drums & Hatton) and April 2007 (Blackdog).**

#### 4.15.4 Summary of Results

Red-throated diver occur throughout the year in Aberdeen Bay with peak numbers occurring during the winter and spring periods. Peak numbers of red-throated diver recorded within the proposed EOWDC survey area was 93 in May 2007 and peak density of 0.9 birds/km<sup>2</sup> in February 2007. Further surveys identified potentially main areas for red-throated diver to the north of the proposed development where densities of up to 4.9 birds/km<sup>2</sup> were recorded during November 2010. Evidence from boat-based surveys supports the findings from the Vantage Point and radar studies that most red-throated diver occur within 2 km of the shore and in water depths of less than ten metres. Estimated numbers of red-throated diver recorded in Aberdeen Bay were below the threshold for a site of international importance but the bay may, on occasions, hold nationally important numbers.

The number of red-throated diver flying above 30 m and therefore at risk of potential collision varied from between 0% and 16%.

#### 4.15.5 Initial Assessment of Significance

Red-throated diver	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	Very High	Medium	Major
Displacement	Very High	Medium	Major

#### 4.15.6 Species Sensitivities

##### Qualify species

There are no SPAs for red-throated diver that are within the area of potential impact from the proposed development. It is recognised that currently Aberdeen Bay is an area of search with respect to becoming a potential SPA and could include red-

throated diver as a qualifying species. However, it is understood that it is currently unlikely to become an SPA in the foreseeable future.

### Flight height

Red-throated diver typically fly low and just above wave height. Site specific data obtained from boat-based surveys recorded 55 red-throated divers in flight all of which were recorded as flying below 25 m. Evidence from other locations have recorded 99.6% of red-throated divers as flying below 30 m (LAL 2005, RBA 2005).

### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys and other data sources indicate that red-throated diver are widespread and frequent within Aberdeen Bay.

In order to determine potential effects of collision mortality on red-throated diver a collision risk assessment has been undertaken based on a collision probability of 9% and over a range of possible avoidance rates of 98%, 99% and 99.5%.

In order to determine whether any potential increase in mortality is significant the assessment is based on the precautionary figure of 1% of the baseline mortality rate for the population as has previously been considered for other offshore developments and based on EC Guidance (EC 2000).

The peak population estimate for red-throated diver recorded in Aberdeen Bay from any source is an estimated 697 individuals in November 2010 at a density of 4.9 birds/km<sup>2</sup>. (SMRU 2011).

The annual mortality rate for red-throated diver is 16% (BTO 2011).

Consequently, out of a population of 697 individuals in Aberdeen Bay an annual mortality of 111 red-throated divers may be predicted. Therefore, 1% of the baseline mortality is 1.1 birds per year, i.e. an increase in mortality rate of more than 1 bird per year caused by collisions may be considered significant.

The Firth of Forth SPA has a wintering population of 317 individuals and therefore an annual mortality rate of 51 birds per year and a baseline mortality rate of 0.5 birds per year.

**Table 4-14: Predicted number of collisions for various avoidance rates for red-throated diver**

Collision probability	Avoidance rate (%)		
	98	99	99.5
9%	0.08	0.04	0.02

Based on the various scenarios and using a precautionary avoidance rate of 98% it is predicted that a total of 0.08 collisions per year may occur (Table 4-14) this is lower than the 1% baseline mortality rate of 1.1 birds per year for Aberdeen Bay and 0.5 birds per year for the Firth of Forth SPA.

Evidence from other offshore wind farms indicates that red-throated diver are at low risk of collision. Studies undertaken at Horns rev and Nysted offshore wind farms in Denmark indicate that red-throated divers avoid wind farms. Sixty-one Divers were tracked using radar none of which were recorded flying into the wind farm. Instead they were recorded as being deflected westward and flying around the wind farm (Petersen *et al.* 2006). Red-throated divers are therefore unlikely to come into direct contact with them (Petersen *et al.* 2006).



Based on the results from the Collision Risk Modelling and evidence from other sites it is concluded that the potential impact of collision risk is negligible.

### Barrier effect

Evidence from studies undertaken in Denmark indicate that red-throated divers may avoid flying through wind farms; consequently, there may be a barrier effect on red-throated divers within Aberdeen Bay. Should a barrier effect occur out to a distance of 1km from the proposed development then a Diver may detour around the wind turbines causing it to increase its flight by a total of 3.2 km. Energetics modelling predicts that by flying around the proposed development the additional 3.2 km will cause an increase in energy usage of 8.5 KJ or 1% of daily energy expenditure (Speakman, Gray & Furness 2009).

There is no evidence of any regular daily movement in the form of feeding or roosting movements across Aberdeen Bay by red-throated diver and so any increase in energy expenditure due to the avoidance of the wind turbines should it occur is not predicted to be on daily basis and consequently any incremental increase in energy expenditure is likely to be *Ad hoc* and not a regular event. An increase in potential daily energy expenditure of 1% is small and likely to be within the range of natural daily variations and it is therefore not considered to be significant and consequently based on current evidence the likely predicted effects from potential barrier impacts are considered to be negligible.

### Displacement

Evidence from post-construction monitoring undertaken in the UK and Denmark suggests that red-throated divers may avoid wind farms (Ecology Consulting 2009, 2010; Petersen *et al.* 2006). The results from the monitoring undertaken at the Kentish Flats Offshore Wind Farm do not show 100% avoidance but do indicate a reduced usage of the site out to 1 km. Based on the results from the monitoring data, the worst-case scenario is that there is a 100% displacement of red-throated divers from the proposed development out to 1 km and a further 50% decrease out to 2 km from the area.

Based on the peak density of 4.9 birds/km<sup>2</sup>, should there be a total displacement of red-throated diver from within the proposed development then it is predicted that up to 21 red-throated diver may be displaced during periods of peak density. Based on a 100% displacement out to 1 km (a total surface area of 12.3 km<sup>2</sup>) from the proposed development then it is predicted that up to 60 red-throated diver may be displaced and a further 50 out to 2 km should there be 50% displacement between 1 km and 2 km from the proposed development. Therefore, the maximum number of red-throated diver potentially displaced is up to 131 birds based on the highest densities recorded from any survey within Aberdeen Bay and displacement out to 2 km.

Evidence from boat based surveys suggest that peak densities occur to the north of the proposed development area and outwith the immediate zone of displacement effect (Figure 4-31, Figure 4-32, Figure 4-33, Figure 4-36) and that densities within the vicinity of the development are typically much lower at below 1 bird/km<sup>2</sup> (Figure 4-29 Figure 4-30). Consequently, it is predicted that should displacement occur, the number of Divers typically displaced will be between 16 individuals (with 1 km of displacement) and 26 birds (with up to 2 km of displacement). Furthermore, the distribution of divers across Aberdeen Bay is largely within 3 km of the shore and therefore densities to the east of the proposed development, i.e. within the proposed development area, will be lower than has been used for this assessment which has not taken this decrease in offshore red-throated diver density into account.



Based on the maximum estimated population of 697 birds at a density of 4.9 birds/km<sup>2</sup>, it is predicted that up to 19% of the red-throated diver population of Aberdeen Bay may be displaced. Based on site specific numbers from the proposed development area 4% may be displaced. Should red-throated divers be displaced then they are predicted to relocate to other suitable foraging areas. Evidence from surveys indicates that areas to the north of the proposed development area are preferred over areas within the vicinity of the proposed development.

Red-throated diver numbers within Aberdeen Bay vary across seasons and years and there is no evidence of the population of red-throated divers within Aberdeen Bay being at carrying capacity as numbers fluctuate considerably across years. Consequently, should displacement occur it is not predicted to, nor is there any evidence for, any increase in the mortality rate of red-throated diver.

Based on site specific data and results from other sites it is concluded that the potential impact of displacement is at worst moderate and most likely minor.

Calculations used for displacement		
Area	Peak density of red-throated diver – 4.9 birds/km <sup>2</sup>	Typical density of red-throated diver – 1 bird/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 4.9 = 21	4.3 * 1 = 4
Area of 1 km buffer = 12.3 km <sup>2</sup> (100% displacement)	(12.3 * 4.9) = 60	12.3 * 1 = 12
Area of 2 km buffer – 20.3 km <sup>2</sup> (50% displacement)	(20.3 * 4.9) * 0.5 = 50	(20.3 * 1) / 2 = 10
Total number potentially displaced	21 + 60 + 50 = 131	4 + 12 + 10 = 26

## Disturbance

Red-throated divers are predicted to be disturbed by vessels both during construction and during operation from maintenance vessels. Previous studies have indicated that there may be total displacement from within 100 m of a vessel and varying degrees of displacement at distances up to 1,000 m. Some displacement may occur beyond 1,000 m but this is not reliably quantified or attributed to the survey vessel. The average displacement recorded is 82% of all birds within 1 km (Norman & Ellis 2005). When disturbed divers respond to approaching vessels by low, direct flights usually perpendicular to the line of approach and that these flights are generally below 15 m (Norman and Ellis 2005)

During construction there may be a number of vessels operating within the area but will likely be focussed around a single point where the turbine is being installed. Consequently, up to 82% of the Divers may be displaced from within 1 km radius of the installation; an area of 3 km<sup>2</sup>. Based on the highest recorded density of 4.9 birds/km<sup>2</sup>, it is therefore predicted that up to 15 red-throated diver may be displaced from the vicinity during construction. This equates to approximately 2% of the red-throated diver population within Aberdeen Bay based on the peak estimated figure of 697 individuals recorded in November 2010. The construction period will be of short duration and the impacts of construction vessels temporary. Consequently, any potential impact is predicted to be negligible.

Displacement by service boats within the EOWDC area assumes that red-throated divers are not already deterred by the turbines. If that is the case, then the presence of service boats may diminish the re-population of the site. It is not known how many service vessels may be required but based on the scale of the proposed development it is unlikely to be more than one vessel on any one occasion. The presence of the proposed development in the vicinity of the intensively used Aberdeen Harbour means that the potential increase of one vessel movement on a

regular basis will not have any noticeable difference to the number of vessels already using Aberdeen Bay. Any specific displacement caused by the service boats will be temporary as Divers will be able to move into the area once the vessels leave. In addition the wide distribution of Divers is such that there are alternative suitable sites that displaced Divers could utilise.

It is concluded that the effect of service boats is much smaller than assuming total displacement from the EOWDC area and the potential impact from disturbance is minor.

### Cumulative Impacts

There is the potential for cumulative impacts with other offshore wind farms, planned or proposed and other activities such as shipping.

With respect to other wind farms, three occur in the Firth of Forth (Inch Cape, Neart na Gaoithe and Firth of Forth) in an area not known to hold significant numbers of red-throated diver. Consequently there is not predicted to be any cumulative impact from these three wind farms.

Evidence from aerial surveys and site specific data at Beatrice indicate that the two wind farms planned in the Moray Firth (Beatrice and Moray Firth Offshore Wind Farms) are also in areas where red-throated diver may not occur (Söhle *et al.* 2006; Lewis *et al.* 2008; Brookes 2009). Consequently, the likelihood of a cumulative impact arising is considered to be low.

There is the potential for a cumulative impact with respect to disturbance arising from other activities, notably vessel activities in the area. Although there will be an increase in vessel movements during the construction period, post-construction it is likely that there will be less than one vessel per day. This increase is within the day-to-day variation in the number of vessels operating in and out of Aberdeen Harbour and is therefore unlikely to be noticeable.

The potential future Ocean Pod will require additional vessel movements within the proposed development area during its construction and operation. Should this occur then there is the potential for a cumulative effect on red-throated diver. It is not yet known what type of structure the Ocean Pod may be or how it will be installed or the number of vessel movements will be required. However, it is a single structure and it is predicted that the level of disturbance will be no greater than that arising from the installation of a single wind turbine. The scale of disturbance is therefore predicted to be localised and of short duration.

It is concluded that the cumulative effect of service boats is much smaller than assuming total displacement from the proposed development area and the potential cumulative impact is negligible.

#### 4.15.7 Conclusions

### Habitats Appraisal

No designated sites for which red-throated diver is a qualifying species have been identified as being at risk of a potential adverse effect.

### Environmental Impact Assessment

Red-throated divers are widely distributed in Aberdeen Bay and in varying numbers. The assessment has been based on the peak densities and maximum counts recorded within the bay and is based on a series of worst-case assumptions.

Based on the low numbers of Divers recorded flying at turbine height, either within Aberdeen Bay or at other offshore wind farms, the collision risk for red-throated diver

is very low and there is not likely to be a significant effect on the population arising from collision mortality rates.

There is the potential for up to 19% of the red-throated diver population within Aberdeen Bay to be displaced based on there being total avoidance of the EOWDC site out to 1 km and a further 50% decrease out to as far as 2 km. However, evidence from post construction monitoring at other offshore wind farms indicates that following construction total displacement will not occur. Furthermore, evidence from boat-based and land-based surveys indicate that the proposed development is not a major area for red-throated divers in Aberdeen Bay and alternative areas to the north are favoured. Therefore, the percentage of the population potentially displaced will be lower than has been used in this assessment. There is no evidence to suggest that, should displacement occur that any displaced red-throated divers will be at increased risk of mortality.

Disturbance from construction and maintenance vessels will occur but the impact will be localised and temporary. The number of predicted vessel movements associated with the proposed development are within the variable range of vessel activity associated with the intensively used Aberdeen harbour and unlikely to be noticed above the existing activities.

It is predicted that, although there may be some displacement of red-throated divers away from the proposed EOWDC area, there will not be a significant environmental impact arising from the proposed development on red-throated diver.

#### 4.16 Northern Fulmar (*Fulmaris glacialis*)

##### 4.16.1 Protection & Conservation Status

The (northern) fulmar is listed in Appendix II of the Bonn Convention, Schedule 1 under the Wildlife and Countryside Act, 1981 and is on the Amber List of Species of Conservation Concern.

##### 4.16.2 Background

Fulmar		
GB Population	538,000 nests	Mitchell <i>et al</i> 2004
Scottish population	486,000 AoS	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	5,000	1% of GB Pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Fowlsheugh: 246 prs Buchan Ness to Collieston: 1,370 prs Troup Pennan and Lion's Heads: 636 prs Forth Islands: 402 prs	JNCC (2011)
European population estimate	Breeding: 2.8 – 4.400,000 Wintering: 1,500,000	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	15 – 30,000,000 'adults'	Birdlife 2011

Fulmars are one of the most abundant pelagic birds in the North Atlantic with a global population of up to 30 million individuals and a UK breeding population of over 500,000 individuals. The fulmar population has increased dramatically during the last couple of centuries and numbers in Britain doubled between 1969 – 1970 and 1985 – 1987 (Wernham *et al.* 2002).

After fledging, young fulmars spend up to four years at sea, during which time they are thought to disperse widely and rarely visit land (Wernham *et al.* 2002). They feed at sea often scavenging behind fishing vessels.

The UK population is estimated to be 538,000 apparently occupied nests (AoN) and therefore in excess of a million birds, of which approximately 80% are in Scotland (Mitchell *et al.* 2004).

In North-east Scotland the fulmar population has increased with over a 118% increase in the number of breeding bird in Moray, 136% increase between Banff and Buchan and 167% increase in Kincardine and Deeside (Mitchell *et al.* 2004).

During a ten year study of seabird movements at Peterhead, fulmars passed along the north-east coast throughout the year but were scarcest in winter, with a general pattern of a modest southward movement. In spring numbers increase with the majority of birds heading north. In the autumn numbers of fulmars passing Peterhead decreased with the majority of birds still heading north (Innes 1992). During periods of poor weather the number of fulmars passing along the coast can be large with regular counts of over a 1,000 birds per hour during these periods (Buckland, Bell & Picozzi 1990).

##### 4.16.3 Survey Results

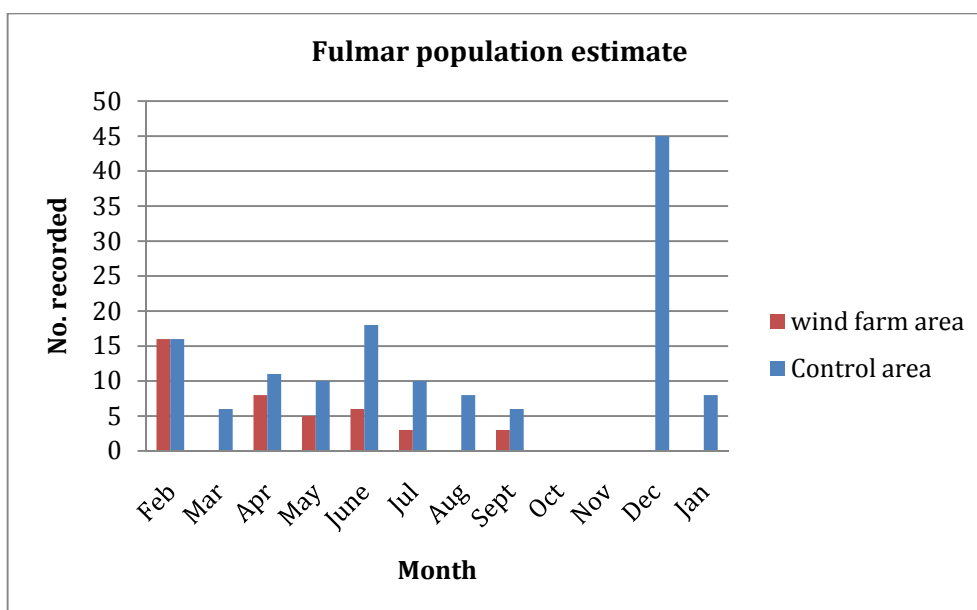
###### Boat-based surveys

Fulmars were recorded widely across Aberdeen Bay throughout the year from boat-based surveys. However, population estimates were relatively low, particularly in the

proposed EOWDC survey area where there were no records of fulmars in transect between October 2006 and January 2007. Peak numbers were recorded within the 'control' survey area to the north where up to 45 birds were recorded during December (Figure 4-41, Table 4-15). Numbers of fulmar within Aberdeen Bay were lowest from August through to November with no fulmars recorded within transect during October and November (IECS 2008) (Figure 4-39). There were very few records of fulmar recorded in proposed development area throughout the year.

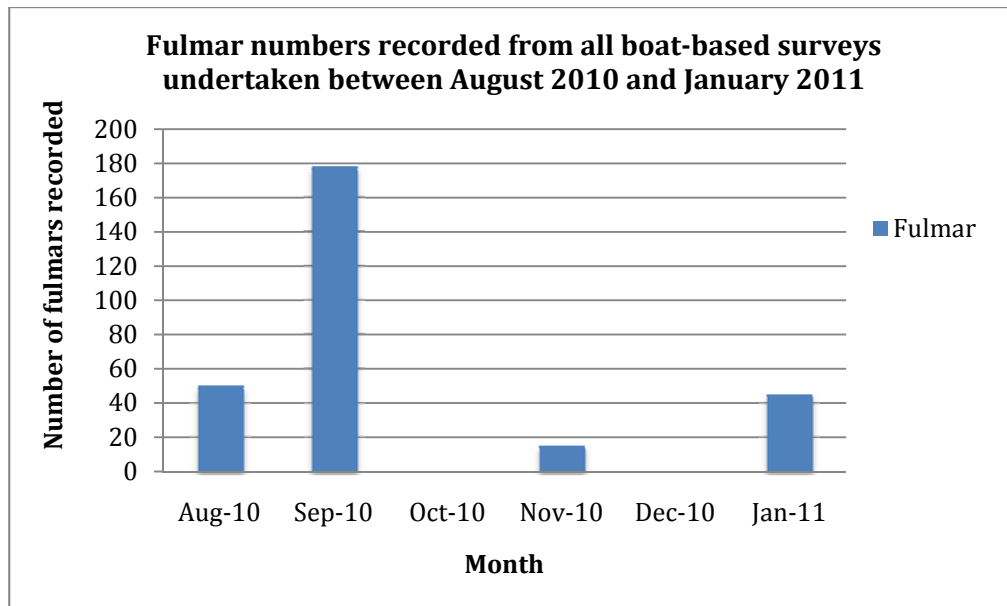
**Table 4-15: Fulmar monthly population estimates in Aberdeen Bay: Boat-based surveys 2007 – 2008.**

Month	On water estimate	In flight estimate	Total estimate
	No.	No.	No.
February	8	24	32
March	3	3	6
April	9	10	19
May	0	21	21
June	6	6	12
July	8	6	14
August	6	3	9
September	6	0	6
October	0	0	0
November	0	0	0
December	3	42	45
January	0	8	8



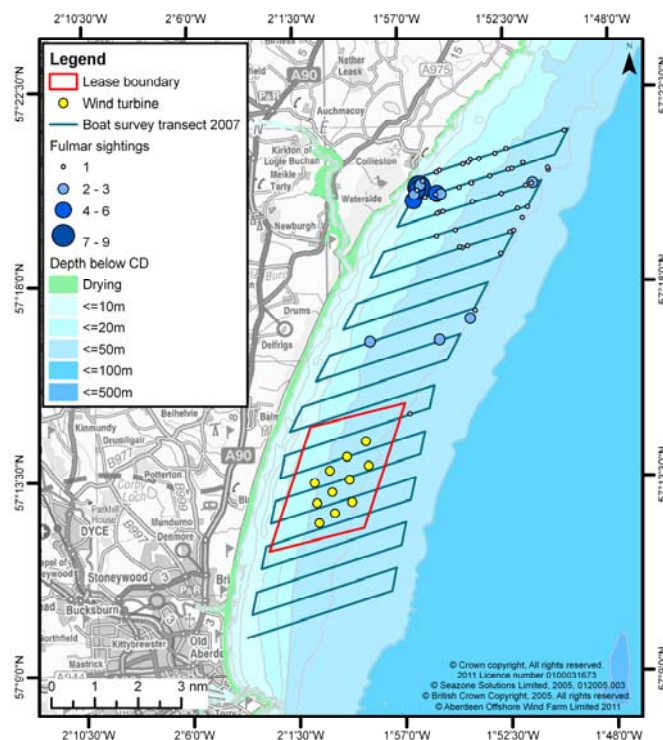
**Figure 4-39: Fulmar monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

Additional data collected between August 2010 and January 2011 recorded a total of 178 fulmars in September 2010 and lower numbers less than 50 individuals, during the rest of the period (Figure 4-40) (SMRU 2011b). There was insufficient detections to undertake *Distance* sampling analysis on any of the fulmar data.



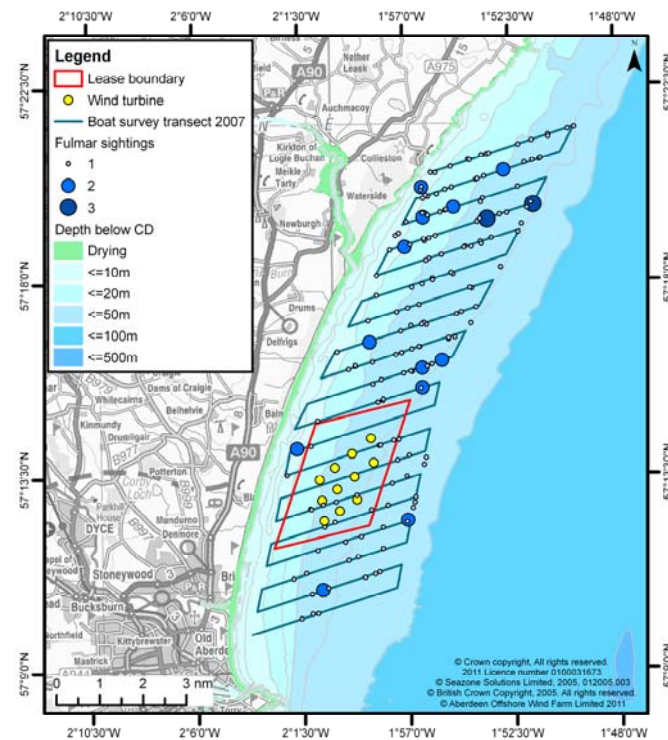
**Figure 4-40: Numbers of fulmar recorded from boat-based surveys undertaken in Aberdeen Bay between August and January 2011. (Note no counts were made in October or December 2010).**

Fulmar distribution within Aberdeen Bay was widespread, particularly during the breeding season. During the winter period there were fewer records and a cluster of observations to the north of the survey area near to breeding colonies. During post-breeding season the majority of fulmar sightings were further offshore with relatively few recorded in nearshore waters. (Figure 4-41, Figure 4-42, Figure 4-43, Figure 4-44). Flight height data from boat-based surveys recorded <0.5% of flights below 15 m.

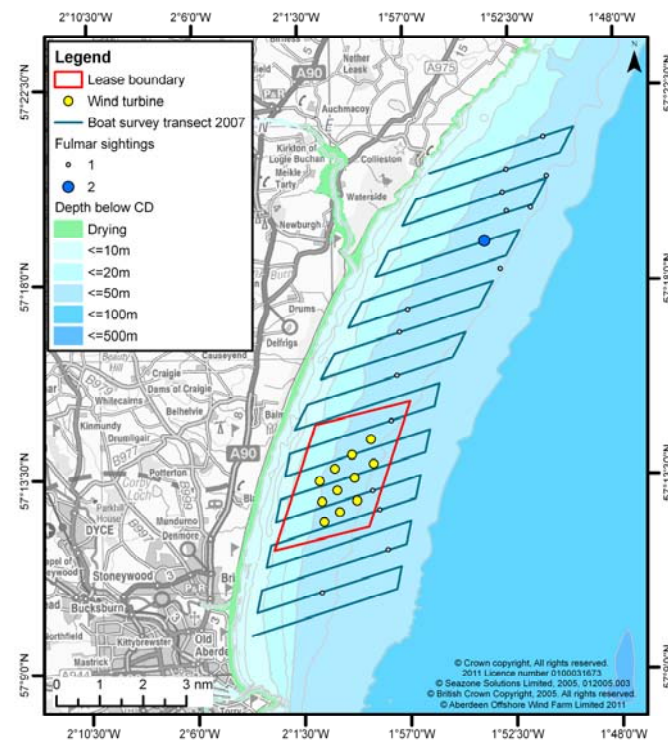


**Figure 4-41: Fulmar distribution during winter period: November to February (all sightings).**



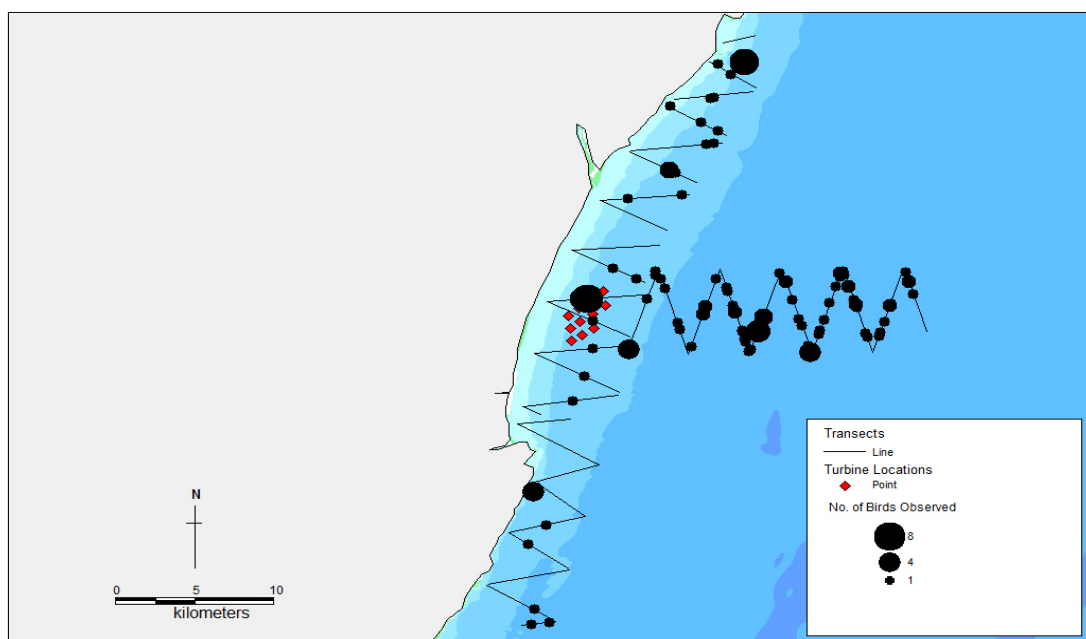


**Figure 4-42: Fulmar distribution during breeding season: March to August (all sightings).**



**Figure 4-43: Fulmar distribution during post-breeding: September and October (all sightings).**





**Figure 4-44: On-effort observations of Fulmar along transects during August, September and November 2010 and January 2011.**

### Vantage Point surveys

In Aberdeen Bay fulmars were present during peak dawn and dusk activity periods between April and September in numbers generally less than 20 birds per hour but occasionally up to 75 birds per hour during peak periods in June (Alba Ecology 2008a). This is considerably lower than the number of birds recorded at Peterhead during the same seasonal period where between 300 to 400 birds per hour were recorded (Innes 1992).

Numbers of fulmar sighted within Aberdeen Bay decreased during the winter months with less than three birds per hour passing through any one Vantage Point site in Aberdeen Bay between October 2006 and March 2007. Twenty-five fulmars were recorded during a hundred hours of observations between October 2006 and March 2007 (EnviroCentre 2007b) and twenty-four between October 2007 and March 2008 (Alba Ecology 2008b).

Most records during the winter months were of birds at least 1 km from the shore, with the majority being between 2 km and 3 km offshore. Of those recorded in flight at least 80% of all flights were below 30 m.

### Bird Detection Radar

No fulmars were recorded during five days of observations undertaken at Easter Hatton and Drums during October 2005. Further radar studies undertaken at Blackdog over a seventeen day period in April 2007 recorded 158 fulmars at a rate of three birds per hour during April (Simms *et al.* 2007).

#### 4.16.4 Summary of Results

Fulmars occur throughout the year in Aberdeen Bay with peak numbers during the late summer, late winter and spring periods. Very few fulmars were recorded in nearshore waters during the post-breeding and early winter periods. Fulmars were more frequently recorded within the 'control' survey to the north and in offshore waters than within the proposed offshore EOWDC survey area, where there was a peak count of sixteen birds in February 2006. Results from the Vantage Point and radar studies suggest that the majority of fulmars occur between 2–3 km offshore and between 0.5% and 20% of all flights were below 30 m. The numbers recorded from boat-based and Vantage Point land based surveys were lower than the peak counts reported for Aberdeen Bay from other land based counts.

Numbers of fulmar recorded in Aberdeen Bay were below the threshold for a site of international importance.

#### 4.16.5 Initial Assessment of Significance

Fulmar	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Medium	Minor
Displacement	Medium	Negligible	Negligible

#### 4.16.6 Species Sensitivities

##### Qualify species

There are twenty-five SPAs for which fulmar is a qualifying species all of which are within the potential foraging range from the proposed development of 664 km. However, for the purposes of this assessment four colonies have been identified as being within close enough proximity for there to be a potential significant effect:

- Buchan Ness - Collieston SPA (9.5 km).
- Fowlsheugh SPA (31.1 km).
- Forth Islands SPA (124.4 km).
- Troup, Pennan and Lion's Heads SPA (74.3 km).

Fulmar populations at the time of designation or at the time of last review at each of the sites were:

- Buchan Ness to Collieston SPA held 1,765 apparently occupied nest (AoN). Recent counts indicate a slight decline to 1,370 AoN;
- Fowlsheugh SPA held 1,170 AoN. Recent counts indicate a decline to 246 AoN.
- Forth Islands held 1,600 AoN. Recent counts indicate a decline to 402 AoN.
- Troup, Pennan and Lion's Head SPA held 4,400 AoN.

*Note – the 'recent counts' may not be complete and therefore the declines suggested may not be genuine decreases.*

### Flight height

Data obtained from boat-based surveys did not record any fulmars flying above 25 m and less than 0.5% were flying above 15 m (n=214).

Elsewhere data from other offshore wind farms have recorded less than 1% at rotor height and a mean flight height 17 metres (n=1,734).

### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys indicate that fulmars are widespread across Aberdeen Bay with increasing numbers offshore including within the proposed development area (Figure 4-41 to Figure 4-44). All sightings within Aberdeen Bay were of birds flying below 25 m and therefore not at risk of collision.

There is only one record of a fulmar collision with an offshore wind farm with one recorded at Blyth (Zucco *et al.* 2006). Evidence from other offshore wind farms indicate that fulmars fly predominantly below turbine height and are therefore not at significant risk of collision.

Based on the evidence from existing offshore wind farms and site specific data indicating a very low level of flight height, predominantly below turbine height, it is concluded that the risk of any significant impact or adverse affect on fulmars from collision is negligible.

Collision Risk Modelling undertaken for fulmar is based on:

- Body length of 52 cm
- Wingspan of 117 cm
- Flight speed of 13 m.s<sup>-1</sup>

Modelling has been undertaken based on a collision probability of 9.8% and over a range of possible avoidance rates of 98%, 99% and 99.5%.

**Table 4-16: Predicted number of collisions for various avoidance rates for fulmar.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
9.8%	0.08	0.04	0.02

Based on the various scenarios and using a precautionary avoidance rate of 98% it is predicted that a total of 0.08 collisions per year may occur (Table 4-16). The current SPA population across all four SPAs is 6,418 AoN; approximately 12,836 adults.

The annual mortality rate for fulmar is 3% (BTO 2011). Consequently, out of a population of 12,836 individuals an annual mortality of 385 fulmars may be predicted. Therefore, 1% of the baseline mortality is 3.8 birds per year, i.e. an increase in mortality rate of more than 3 birds per year caused by collisions may be considered significant.

For the individual SPAs the increase in mortality which could cause an adverse effect is lower.

- Fowlsheugh has the lowest currently reported population for a SPA of 246 AoN (492 individuals) then an increase in mortality of more than 0.1 bird per year could be adverse.

- Buchan Ness to Collieston SPA has a current population of 2,740 individuals (1,370 AoN) and an annual mortality of 82 birds per year. Therefore 1% of baseline mortality is 0.8 birds per year.
- Recent counts at the Forth Islands SPA are of 804 individuals (402 AoN). An annual mortality of 24 birds per year. 1% of baseline mortality is therefore 0.2 birds per year.
- Troup, Pennan and Lion's Head SPA held 4,400 AoN, 8,800 individuals. An annual mortality of 264 birds per year. 1% of baseline mortality is therefore 3 birds per year.

Site specific data and results from other offshore wind farm locations indicate that less than 1.0% of fulmars fly at above 20 – 25 m and consequently the risk of collision is very remote. The results from the collision risk modelling also indicate that the risk of a collision is very low and that it is predicted that 0.08 fulmar per year may collide with the wind turbines when 1% of flights are at rotor height. This is lower than 1% baseline mortality rates for any of the SPAs identified as being at potential risk from the proposed development.

Based on the site specific evidence and the results from collision risk modelling it is concluded that the risk of a significant environmental impact is negligible and an adverse effect minor.

#### Barrier effect

The number of fulmars reported at operating wind farms is very low consequently there is little or no evidence of any barrier effect. The few records from Danish studies suggest that fulmars may avoid flying through the operating wind farm and consequently there may be a barrier effect.

In order to avoid the turbines the birds may incur additional energetic expenditure. The proposed EOWDC is at its longest point approximately 4 km and at its widest 2 km. Assuming birds avoid the proposed development area at 1,000 m then they may incur an overall increase in flight distance of 3.2 km.

Fulmars are extremely efficient fliers and during the breeding season can travel many hundreds of kilometres in single feeding trips up to 580 km (Roos *et al.* 2010) and outwith the breeding season forage widely across the North Sea and North Atlantic. Consequently, any additional increase in foraging distance due to avoidance of flying through the proposed development and its significance will be minor.

#### Displacement

Fulmars are primarily an aerial species spending relatively little time on the sea surface and do so primarily when preening or feeding or during periods of calm weather. There are no data available from constructed wind farms to determine whether fulmars are displaced from wind farms.

Data from boat-based surveys undertaken between 2007 and 2008 recorded a peak count of 16 fulmars in the proposed EOWDC survey area during February (Figure 4-39). This is less than 0.3% of the SPA fulmar population. There is no evidence from the surveys that the area is used extensively by fulmars and should there be total displacement that the displaced fulmars will not find other suitable areas. Fulmars forage over a wide area in search of small fish (sandeels), crustaceans and squid. They also scavenge extensively around fishing vessels (Phillips *et al.* 2009). Consequently, it is predicted that should displacement occur the magnitude of the effect and its significance will be negligible.

### **Cumulative and in-combination**

The very large range that fulmars can fly suggest that any individual fulmar may interact with any of the proposed offshore wind farms in Scottish waters and elsewhere. Consequently, there is the potential for cumulative and in-combination effects. The closest constructed offshore wind farm is the Beatrice demonstrator project in the Moray Firth. Collision Risk Modelling undertaken for that project suggested that one fulmar every three years may collide with the turbines (Talisman 2005). However, there is no evidence to suggest any likely significant impact on fulmar from collision risks; nor any impact from barrier effect or displacement. The relatively low level of usage of the site indicates the potential for a cumulative or in-combination effect to be low and the magnitude negligible.

#### **4.16.7 Conclusions**

##### **Habitats Appraisal**

Based on the available evidence from site specific surveys undertaken at the proposed development area, in particular the relatively low usage of the site along with evidence from existing wind farms it is concluded that the proposed development will not have an adverse effect on fulmars as qualifying features for Buchan Ness - Collieston SPA, Fowlsheugh SPA, Forth Islands SPA, Troup, Pennan and Lion's Heads SPA.

##### **Environmental Impact Assessment**

Based on the very low usage of the site and the known behaviour of fulmar it is predicted that there will not be a significant environment impact arising from the proposed development on fulmars.

## 4.17 Northern Gannet (*Morus bassanus*)

### 4.17.1 Protection & Conservation Status

The (Northern) gannet is listed in Appendix III of the Bern Convention, and is on the Amber List of Species of Conservation Concern.

### 4.17.2 Background

Gannet		
GB population	Breeding: 230,000 prs	Mitchell <i>et al</i> 2004
Scottish population	Breeding: 182,511 AoS Winter: 'a few thousand'	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	4,600 ind.	1% of GB Pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Forth Islands: 44,000 prs	JNCC
European population estimate	Breeding 300,000 – 310,000 prs Wintering – unknown	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	950,000 – 1,200,000 'adults'	Birdlife 2011

Gannets are widespread across the whole of the North Sea but breed at relatively few but typically large colonies. They have a prolonged breeding season with adults attending colonies from January through to November with chicks fledging from August to October. During the breeding season adults will forage up to 500 km from the breeding colony, although more typically it is within 100 km from the colony. Gannets recorded in Aberdeen Bay during the breeding season are likely to be from the colony at Troup head or potentially Bass Rock as opposed to those from Fair Isle or further afield.

Once fledged, chicks move predominantly southwards wintering between the Bay of Biscay and Senegal. However, many gannets may also spend at least part of the winter in the North Sea.

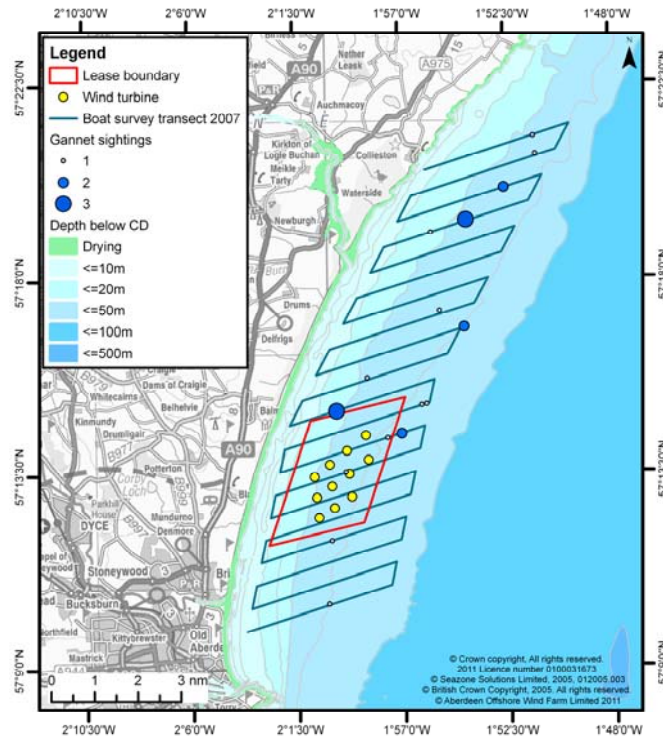
The gannet population has increased in recent decades with up to 230,000 pairs recorded during the Seabird 2000 censuses (Mitchell *et al.* 2004).

In North-east Scotland gannets occur throughout the year in variable numbers. During a ten year study of seabird movements at Peterhead, gannets were scarcest during the winter, but numbers increased in the spring from April onwards, peaking in May. During the summer and early autumn numbers recorded passing Peterhead remained relatively high before decreasing from October onwards (Buckland, Bell & Picozzi 1990; Innes 1991).

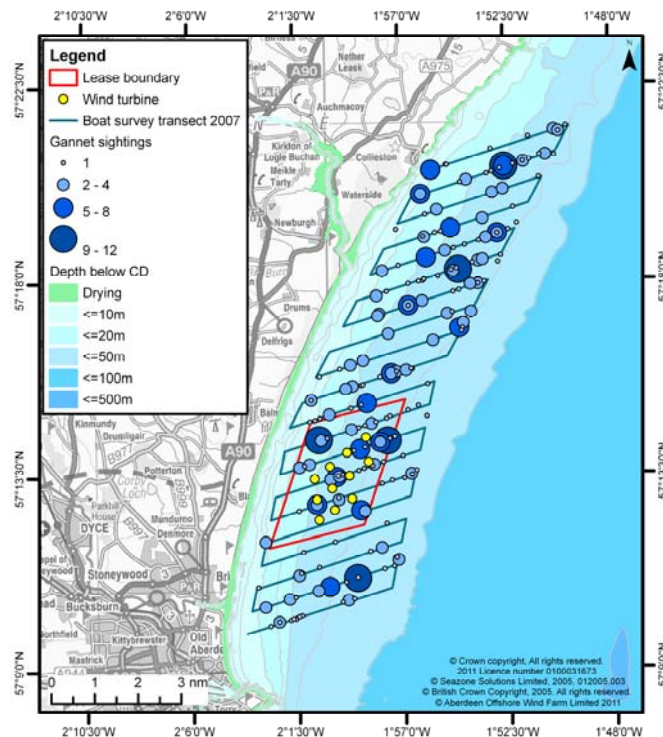
### Boat-based surveys

Gannets were recorded throughout Aberdeen Bay from boat-based surveys with no areas identified as being of particular importance but with the majority of sightings in water depths of between 20 m and 50 m (Figure 4-45, Figure 4-46, Figure 4-47). Numbers of gannets recorded were lowest between November and March and highest during the breeding season from April to August when gannets were widespread throughout the area.



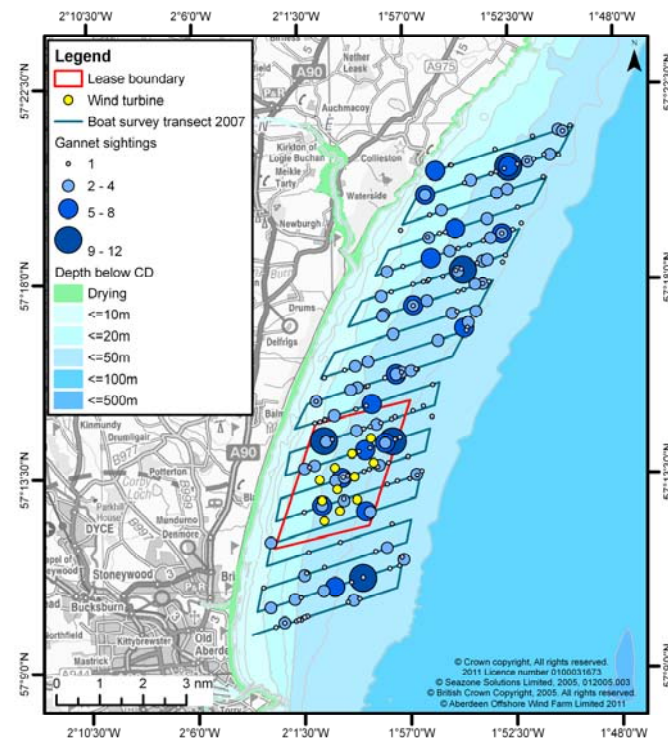


**Figure 4-45: Gannet distribution during winter period: November to March (all sightings)**



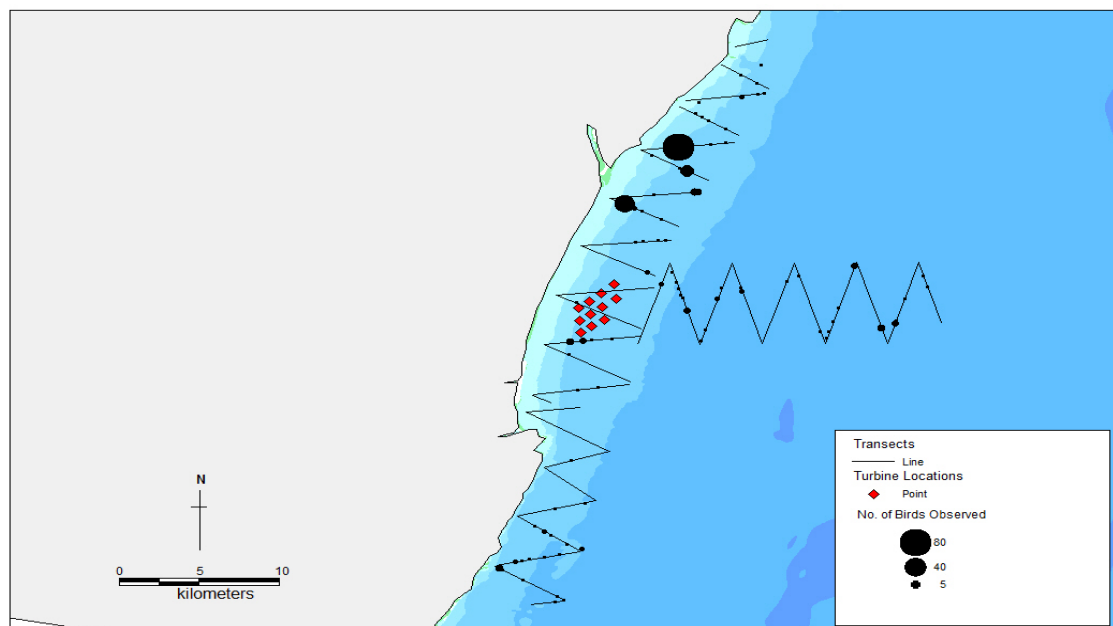
**Figure 4-46: Gannet distribution during breeding season: April to August (all sightings).**





**Figure 4-47: Gannet distribution during post-breeding: September and October (all sightings).**

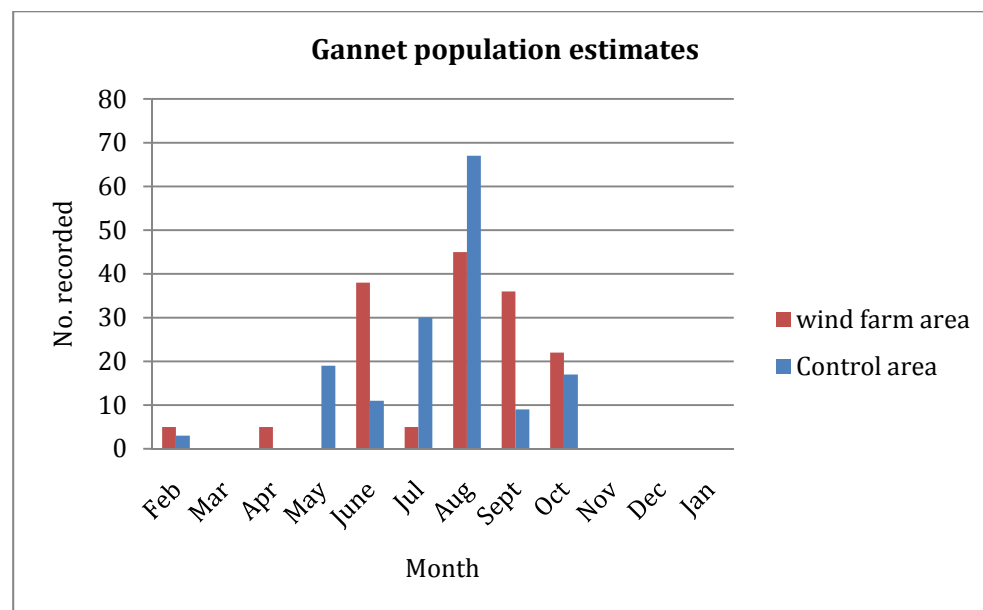
Additional surveys undertaken between August 2010 and January 2011 recorded gannets in low numbers in offshore waters with clusters to the north of the Ythan Estuary and relatively few within the proposed development area (Figure 4-48).



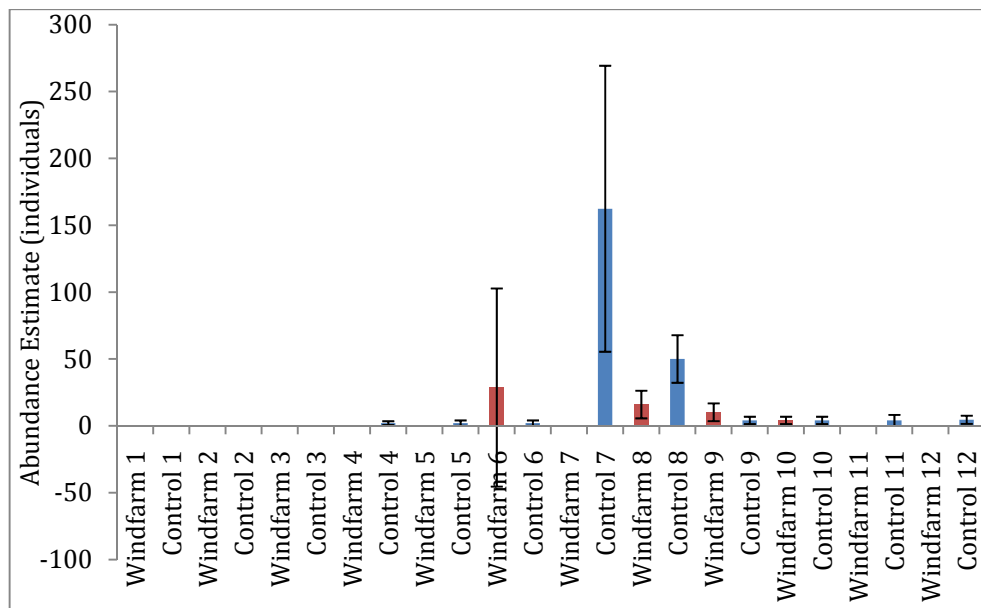
**Figure 4-48: On-effort observations of Northern Gannet along transects during August, September and November 2010 and January 2011.**

Relatively few gannets were recorded from boat-based surveys during the winter months with an increase in numbers in June and a peak in July, August and September (Figure 4-49).

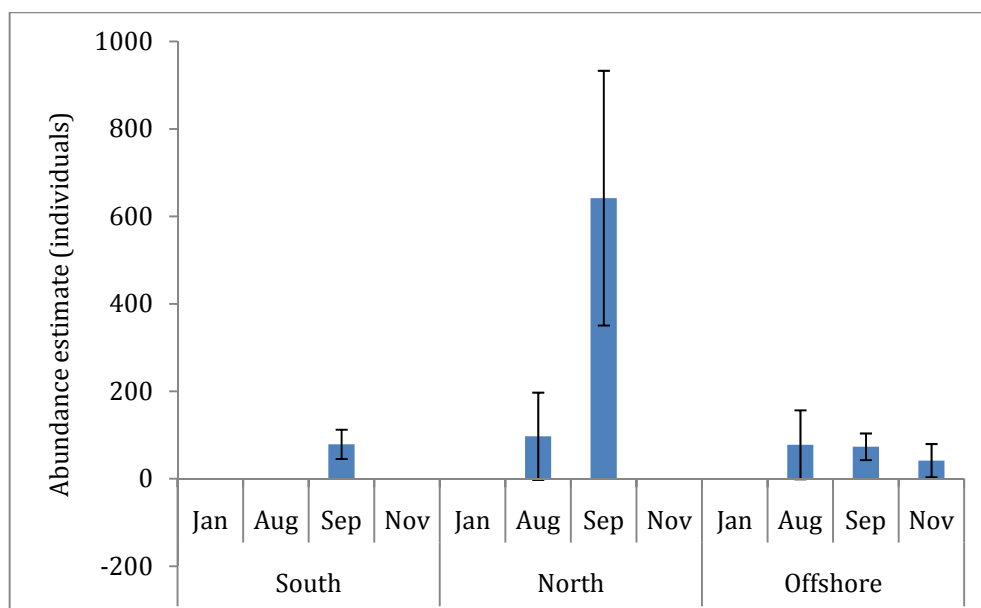
*Distance* analysis of the first year's data estimated a peak density of 3.1 birds/km<sup>2</sup> during July within the 'control' area when none were recorded within the proposed EOWDC survey area. Within the EOWDC area peak numbers were estimated to be in June and August (Figure 4-50 Figure 4-52). Additional *Distance* sampling analysis undertaken on the data collected between August 2010 and January 2011 estimated significantly higher numbers during September primarily in areas that had not previously been surveyed to the north of the proposed development area, with an abundance estimate of 642 birds in September and a density of 4.26 birds/km<sup>2</sup> (Figure 4-51, Figure 4-53).



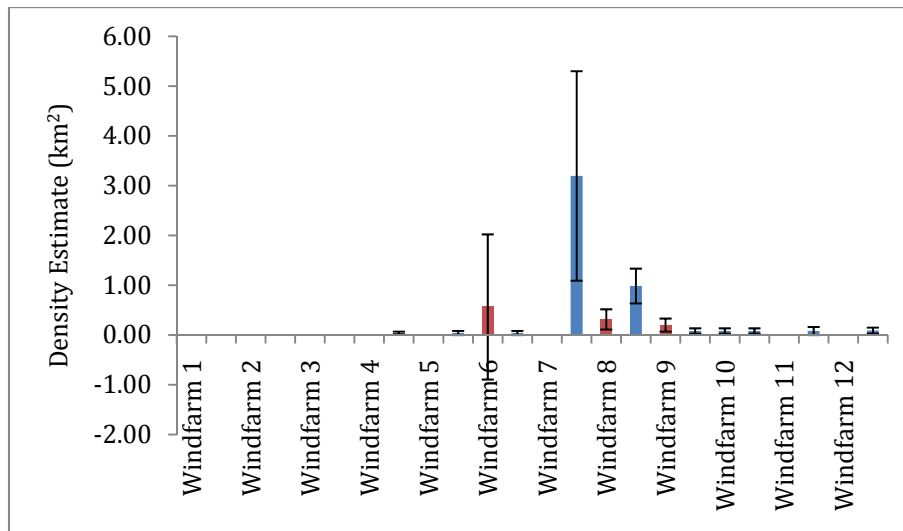
**Figure 4-49: Gannet monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**



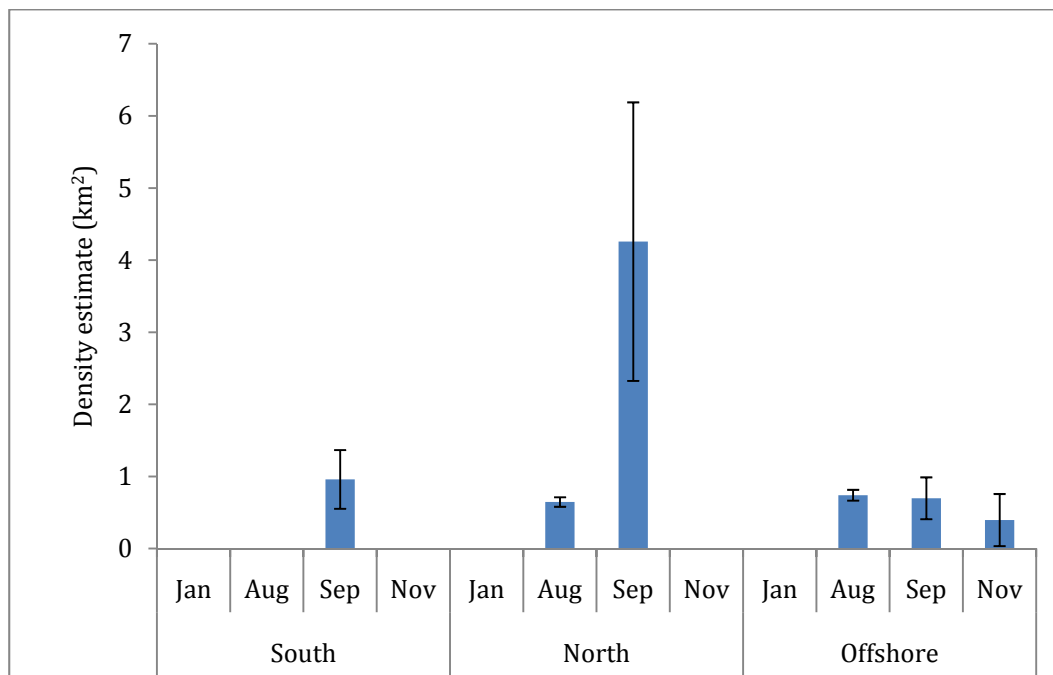
**Figure 4-50: Monthly estimates (+/- SE) of abundance of gannets in the wind farm and 'control' Areas; February 2007 – January 2008 ('windfarm' 1-12 and 'control' 1-12 refers to months).**



**Figure 4-51: Monthly estimates (+/- SE) of abundance of gannet in the South, North and Offshore Strata between August 2010 and January 2011.**



**Figure 4-52: Monthly estimates (+/- SE) of density of gannets in the proposed EOWDC and 'control' Areas (wind farm 1-12 and 'control' 1-12 refers to months).**



**Figure 4-53: Monthly estimates (+/- SE) of density of gannet in the South, North and Offshore Strata between August 2010 and January 2011.**

Flight heights of gannets recorded during the boat-based surveys indicated that 29% of all flights were above 15 m and 17% were above 25 m.

#### Vantage Point surveys

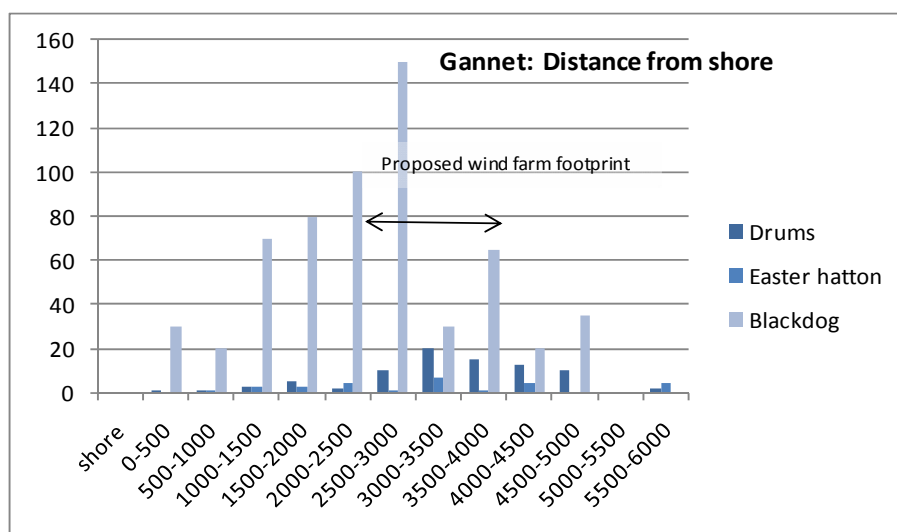
Gannets were observed from all Vantage Point sites, with a peak count of up to 120 birds per hour in July 2007 and 90 birds per hour in September 2006 (Alba Ecology 2008a, EnviroCentre 2007a) which is similar to the numbers recorded at

Peterhead during this period (Innes 1991). Numbers of gannets in Aberdeen Bay decreased after October with typically less than five birds per hour passing (EnviroCentre 2007b) and typically lower numbers during the winter with less than ten birds per hour between October and March (EnviroCentre 2007b, Alba Ecology 2008b).

Flight heights recorded between April and September 2006 from Vantage Point surveys recorded 25% of all gannets between 30–150 metre height across all Vantage Point Sites but between 40% and 50% were recorded within the same height bands between April to September 2007 (Alba Ecology 2008a). Gannets were recorded out to at least 3 km from shore with the majority of sightings between 2 and 3 km.

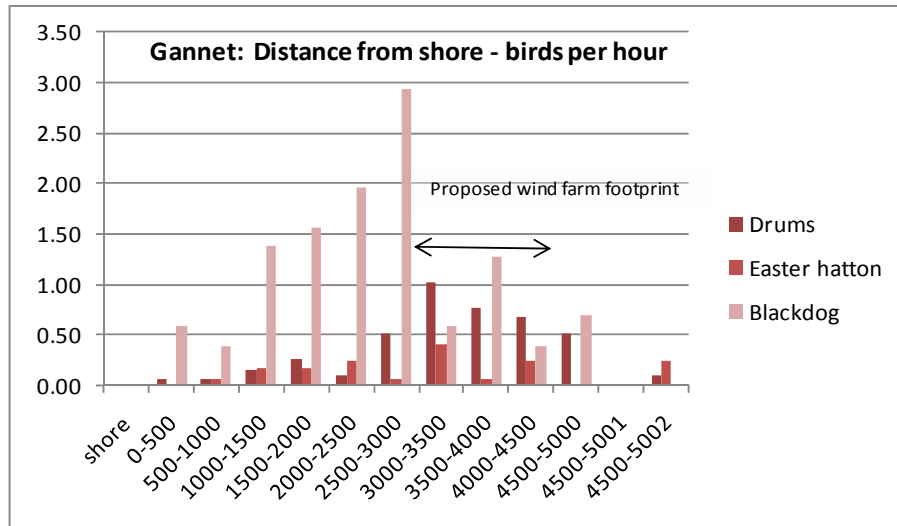
### Bird Detection Radar

A total of 110 gannets were recorded during the radar studies undertaken in October 2005. Sightings were of birds out to 6 km from shore with peak numbers recorded at between 3 km and 5 km (Figure 4-54). Of those recorded in flight the mean height was 8 m above the sea surface with a maximum height of 30 m (Walls *et al.* 2006). A total of 633 gannets were recorded at a mean rate of 12.4 birds per hour at Blackdog during radar studies undertaken in April 2007. During this period the maximum flock size was of 64 birds but the mean flock size was of three (Simms *et al.* 2007). The majority of sightings were of birds flying between 1 km and 3 km offshore with a peak monthly rate of 2.9 birds per hour between 2.5 km and 3.0 km (Figure 4-55). All those recorded in flight were flying below 30 m.



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-54: Distances from shore for gannet from three locations in Aberdeen Bay during surveys undertaken in October (Drums & Hatton) and April (Blackdog).**



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-55: Number of gannets per hour and distances from shore from three locations in Aberdeen Bay during surveys undertaken in October (Drums & Hatton) and April (Blackdog).**

#### 4.17.3 Summary of Results

Gannet occur throughout the year in Aberdeen Bay with peak numbers between June and September and relatively few records between November and April. Gannets were more frequently recorded within the 'control' area and to the north of the Ythan compared to the proposed development area where there was a peak estimated abundance of 45 birds in August compared to 642 birds in September 2010 to the north. Results from the Vantage Point and radar studies suggest that the majority of gannets occur between 2–3 km offshore. Of those recorded in flight 83% of all flights were below 25 m.

Numbers of gannet recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.17.4 Initial Assessment of Significance

Gannet	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Low	Minor
Displacement	Medium	Negligible	Negligible

#### 4.17.5 Species Sensitivities

##### Qualify species

There are two SPAs for which gannet is a qualifying species both of which may be within foraging range from the proposed development

- Fair Isle SPA (c. 253 km)
- Forth Islands SPA (124.4 km).

Gannet populations at the time of designation or at the time of last review at each of the sites were:

- Fair Isle SPA held 1,166 apparently occupied nest (AoN). Recent counts indicate a an increase to 3,582 AoN (2009).
- Forth Islands SPA held 21,600 pairs. Recent counts indicate an increase of 48,065 AoN (2004).

### Flight height

Data obtained from boat-based surveys recorded 404 gannets in flight of which 17% were recorded flying above 25 m.

Elsewhere published data from other offshore wind farms have recorded 14% of gannets flying at rotor height with a mean flight height of 10.25m (n=9,154).

### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys indicate that gannets are widespread across Aberdeen Bay with peak numbers of passing birds between 1 km and 3 km from shore (Figure 4-45 to Figure 4-48). 17% of all sightings of flying birds were of birds flying greater than 25 m above sea surface. Consequently, gannets are at risk of collision with the proposed development.

Collision Risk Modelling undertaken for gannet is based on:

- Body length of 94 cm
- Wingspan of 180 cm
- Flight speed of 15 m.s<sup>-1</sup>

The Collision Risk Modelling is based on a collision probability of 12% and a range of potential avoidance rates from 98%, 99% and 99.5% have been used.

**Table 4-17: Predicted number of collisions for various avoidance rates for gannet.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
12%	1.66	0.83	0.41

Based on the various scenarios and using a precautionary avoidance rate of 98% it is predicted that a total of 1.6 collisions per year may occur. The current SPA population in the region is 51,647 pairs.

The annual mortality rate for gannet is 8.1% (BTO 2011). Consequently, out of a population of 51,647 pairs (103,294 adults) an annual mortality of 8,367 gannets may be predicted. Therefore, 1% of the baseline mortality is 84 birds per year, i.e. an increase in mortality rate of more than 84 birds per year caused by collisions may be considered significant.

For the two individual SPAs the increase in mortality that could cause an adverse effect is lower:

- Fair Isle SPA has a current population of 3,582 AoN (5,164 adults); therefore an annual mortality rate of 418 adults. 1% of baseline mortality is therefore 4 individuals.



- Forth Islands SPA has a current population of 48,065 AoN (96,130 adults); therefore an annual mortality rate of 7,786 adults. 1% of baseline mortality is therefore 78 individuals.

The results from the collision risk modelling indicate that between 1 and 2 gannets per year may collide with the proposed development. This is lower than either of the baseline mortality rates used to indicate whether the potential impact is will have an adverse effect.

There is no evidence that gannets from Fair Isle occur within the region during the breeding season. Foraging activity will likely remain within the waters around Shetland and therefore it is not predicted that there will be any impact on gannets associated with the Fair Isle SPA during the breeding season.

Tagging data of birds from the Bass Rock colony indicates that they forage widely and are potentially at collision risk with the proposed development (Hamer *et al.* 2000). Based on the collision risk modelling undertaken, should all the potential collisions be of birds arising from the Bass Rock colony in the Forth SPA, 124 km away, then there will be a very small increase in the baseline mortality rate and below the level that may be of concern.

The regional population of gannet include a colony at Troup Head to the north of the proposed development, where a total of 1,810 AoN were counted in 2007 (JNCC 2011a). Therefore, the breeding population is 3,620 individuals and will have an annual mortality of 434 birds. The 1% baseline mortality will therefore be 4 birds per year. Based on the collision risk modelling which predicts an annual collision mortality of between 1 and 2 birds per year it is predicted that even if all the gannets within the EOWDC development area are from Troup Head the potential impact will not be significant and its effects will be negligible.

Evidence from existing wind farms indicates that gannets avoid flying through wind farms and may have a significant far field avoidance rate; this behaviour will further reduce the risk of potential collision.

### Barrier effect

The number of gannets reported at operating wind farms is low consequently there is limited evidence of any barrier effect. However, studies undertaken at Danish offshore wind farms indicates that gannets avoid flying through operating wind farms and consequently there may be a barrier effect (Zucco *et al.* 2006).

In order to avoid the turbines gannets may incur additional energetic expenditure. The proposed EOWDC is at its longest point approximately 4 km and at its widest 2 km. Assuming birds avoid the proposed development area at 1,000 m then they may incur an overall increase in flight distance of 3.2 km.

Gannets are extremely efficient fliers and during the breeding season can travel many hundreds of kilometres in single feeding trips up to 364 km from the colony and over 900 km in a single trip (Hamer *et al.* 2007). The additional distance of up to 3.2 km an individual gannet may have to fly in order to detour around the proposed development is therefore negligible. Furthermore, there is no evidence that the area is used as regular flyway or feeding location consequently the significance of any potential impact arising from a barrier effect is also negligible.

### Displacement

Although gannets are primarily an aerial species evidence from tracking studies indicate that they may spend up to half their time away from colonies on the sea surface (Lewis *et al.* 2001). Consequently, gannets may be displaced from an area if they avoid entering wind farms.

Data from boat-based surveys undertaken between 2007 and 2008 recorded a peak count of 29 gannets in June at a density of 0.5 birds/km<sup>2</sup> in the proposed EOWDC survey area (SMRU 2011a); this is less than 0.02% of the SPA population. Gannet distribution was generally spread evenly across the bay with higher densities recorded to the north of the proposed development area. There is no evidence from the surveys that the area is used extensively by gannets and should there be total displacement that the displaced gannets will not find other suitable areas. Evidence from tracking studies indicate that gannets can forage across a very wide area and that the potential loss of 4 km<sup>2</sup> of sea surface is very small compared to the total area in which they forage. Consequently, it is concluded that any potential impact due to displacement, should it occur, will be negligible.

### Cumulative and in-combination

The theoretical very large foraging range that gannets can fly suggest that any individual gannet may interact with a number of the proposed offshore wind farms in Scottish waters. Published data elsewhere indicates that gannets from colonies in Shetland or eastern England are unlikely to occur in Aberdeen Bay during the breeding season (Langston 2011), although they may occur during periods of passage.

Consequently, there is low potential for cumulative or in-combination effects with respect to gannets from Fair Isle SPA or Bempton Cliffs SPA. However, there is evidence to suggest that the gannets from the Forth Island SPA may occur within the Aberdeen Bay area. Populations from this SPA may also interact with potential offshore wind farm developments currently proposed the Firth of Forth area, namely: Neart na Gaoithe, Inch Cape and Firth of Forth offshore wind farms. There is currently very limited information on the proposed developments as decisions on the location, scale and numbers of turbines are still to be decided. Based on the scoping reports it is currently predicted that there may be an additional 526 turbines within the Firth of Forth area (Table 4-18). Information on the use of these areas by gannets is limited with no published information currently available from on-going studies being undertaken for the proposed wind farms. It is therefore not possible to undertake cumulative/in-combination collision risk assessment based on collision risk modelling or an assessment on possible cumulative displacement or barrier impacts.

**Table 4-18: Predicted wind farms that may have an in-combination impact on gannets in the Firth of Forth.**

Project	Estimated no. of turbines	Area (km <sup>2</sup> )	Predicted Application date
Inch Cape	181	151	2012
Neart Na Gaoithe	130	105	2012
Firth of Forth (phase I)	215	597	2013

There is a magnitude difference in scale between the proposed development and those planned in the Firth of Forth area and it is a significantly greater distance from the Forth SPA. Any potential incremental increase arising from the proposed development will likely be minor by comparison and therefore not have a significant cumulative or in-combination impact.

Collision Risk Modelling undertaken for Beatrice offshore wind farm predicted a total of five gannets per year may collide with the Beatrice demonstrator project development based on a 98% avoidance rate (Talisman 2005). The additional mortality from the proposed development may increase this by one or two birds per

year. Based on a population of 3,620 adults at Troup Head the potential increase in mortality will be above the 1% of baseline mortality. This increase in mortality is considered to be of moderate significance but does not take into account the reported far field avoidance rates.

There are two planned offshore wind farms within the Moray Firth that could potentially have a cumulative impact on the gannets at Troup head (Table 4-19). There is little information on the number or scale of turbines and there is no published information currently available from on-going studies being undertaken for the proposed wind farms. It is therefore not possible to undertake cumulative collision risk assessment based on collision risk modelling or an assessment on possible cumulative displacement or barrier impacts. The scale of the proposed development is significantly smaller than those proposed in the Moray Firth and consequently based on the current information on gannet distribution the scale of potential impact significantly lower.

**Table 4-19: Predicted wind farms that may have a cumulative impact on gannets in the Moray Firth.**

Project	Estimated no. of turbines	Area (km <sup>2</sup> )	Predicted Application date
Moray Firth (phase 1)	200	296	2012
Beatrice	184	131	2012

#### 4.17.6 Conclusions

##### Habitats Appraisal

Based on the available evidence from site specific surveys undertaken at the proposed development area, tagging studies undertaken at the relevant SPA and collision risk modelling it is concluded that the proposed development will not have an adverse effect on gannets as qualifying species for Fair Isle SPA or Forth Islands SPA. There is the potential for a cumulative impact but there are no data available to undertake such an assessment. However, the distance and scale of the proposed development from other projects is such that any in-combination impact will likely be relatively small and of minor or negligible significance.

##### Environmental Impact Assessment

Based on the site specific data and the known behaviour of gannets it is predicted that there will not be a significant environmental impact arising from the proposed development on gannets. However, there is the potential for a moderate cumulative impact with gannets associated with the Troup Head gannet colony and the existing Beatrice demonstrator project.

#### 4.18 Manx shearwater (*Puffinus puffinus*)

##### 4.18.1 Protection & Conservation Status

The Manx shearwater is listed in Appendix II of the Bern Convention, and is on the Amber List of Species of Conservation Concern.

##### 4.18.2 Background

Manx shearwater		
GB Population	277,803 - 312,263 prs	Mitchell <i>et al</i> 2004
International threshold	Unknown	-
GB threshold	5,400 ind.	1% of GB Pop <sup>a</sup>
Designated east coast sites where species is a noted feature	None	JNCC
European population estimate	Breeding 350,000 – 390,000 Wintering – unknown	Birdlife 2004
European population trend	Status 'localised' Trend 'unknown'	Birdlife 2004
World population	340,000 – 410,000 ind.	JNCC 2011

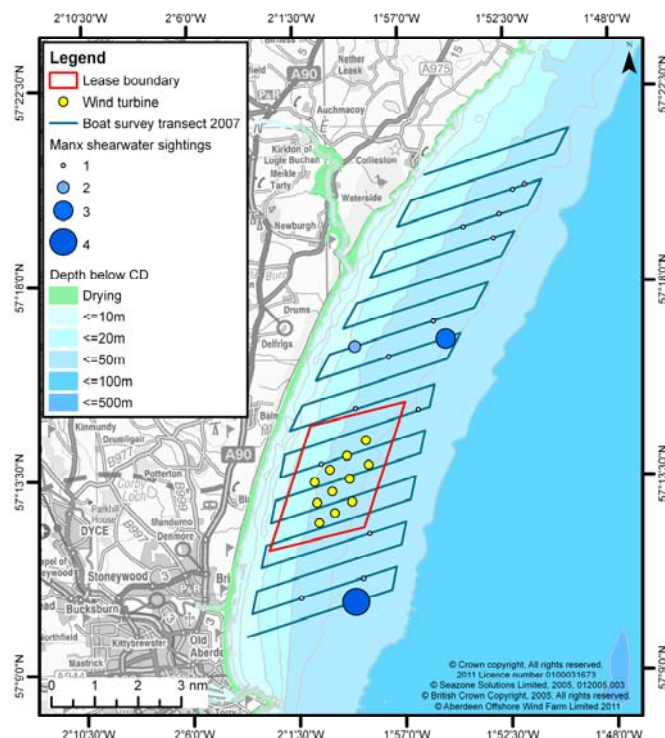
Most of the world population of Manx shearwaters breed in Britain and Ireland. The world population is estimated to be between 338,000 and 411,000 pairs of which up to 374,000 pairs nest in Britain and Ireland (Mitchell *et al.* 2004).

There are no breeding colonies in the North Sea but outwith the breeding season Manx shearwaters disperse widely and migrate south to winter in waters off South America (Wernham *et al.* 2002).

In North-east Scotland Manx shearwaters occur in relatively low numbers from late spring through to the autumn. Studies undertaken off Peterhead identified a passage of Manx shearwaters from April through to November with peak numbers passing in June and July with up to ten birds per hour. The number of birds passing varies considerably with the majority of sightings occurring in periods of rain or sea mist and fewer records during periods of bright fine whether (Innes 1992).

##### Boat-based surveys

A total of 40 Manx shearwaters were recorded from all boat-based surveys between May and November with sightings scattered across Aberdeen Bay (Figure 4-56). Ninety percent of all records were of birds in flight with the majority heading north (IECS 2008).



**Figure 4-56. Shearwater distribution in Aberdeen Bay February 2007 to April 2008 (all sightings).**

#### Vantage Point surveys

Manx shearwaters were observed in Aberdeen Bay from vantage point surveys between April and November with a peak of up to five birds per hour during June 2006 and one bird per hour during August 2005. Only one bird seen in October (EnviroCentre 2007a,b; Alba Ecology 2008a,b).

#### Bird Detection Radar

There were five sightings of Manx shearwaters during the seventeen days of observations undertaken in April 2007 (Simms *et al.* 2007).

#### 4.18.3 Summary of Results

Manx shearwaters were recorded in low numbers from between April and November with a peak in June. Of those recorded in flight from boat based surveys all flights were below 30 m and most sightings were of birds approximately 1 km from shore.

Numbers of Manx shearwater recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.18.4 Initial Assessment of Significance

<b>Manx shearwater</b>	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	Low	Negligible	Negligible
Displacement	Low	Negligible	Negligible

#### 4.18.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the North Sea for which Manx shearwater is a qualifying species. Of the four UK SPAs for which Manx shearwater is a qualifying species, two are in Wales and the other two are off western Scotland.

##### Flight height

Of those recorded in flight and for which flight heights were recorded all Manx shearwaters were flying below 15 m.

Elsewhere data from other offshore wind farms have recorded all Manx shearwater as flying below turbine height. Data from Walney offshore wind farm reported 5,999 sightings of which 99% were flying below 5 m (Dong 2006).

##### Collision risk

Evidence from site specific monitoring and elsewhere indicate that Manx shearwaters rarely fly at turbine height and therefore are not at risk of collision.

##### Barrier effect

The number of Manx shearwaters reported at operating wind farms is very low consequently there is little or no evidence of any barrier effect.

Should a barrier effect occur then the Manx shearwaters will fly around the proposed development. This would incur an overall increase in flying distance of approximately 3.2 km. Manx shearwaters are a highly pelagic species spending a significant proportion of their time in flight and travelling vast distances. The additional energetic cost that may be incurred if a barrier effect occurs will be negligible and not have any significant impact on Manx shearwaters.

##### Displacement

Relatively few Manx shearwaters were recorded from either the boat-based or the land-based surveys. Of those recorded over 90% were of birds in flight, indicating that Aberdeen Bay is not used as an area for birds to settle on the sea surface.

There are currently no constructed wind farms anywhere in the world where Manx shearwater regularly occur from which conclusions can be drawn to assess whether or not there may be a displacement effect. However, the relatively low usage of Aberdeen Bay by Manx shearwaters and the observation that over 90% of Manx shearwaters recorded were only in flight indicates that there will not be a significant impact should displacement occur and the significance of any potential impact will be negligible.

#### **Cumulative and in-combination**

The very low level of usage of the site by Manx shearwater indicates that there will not be any cumulative or in-combination impacts.

#### **4.18.6 Conclusions**

##### **Habitats Appraisal**

There are no SPAs for which Manx shearwater is a qualifying species that will be adversely affected by the proposed development.

##### **Environmental Impact Assessment**

Based on the relatively low numbers of Manx shearwaters recorded and their known behaviour it is predicted that there will not be a significant environmental impact arising from the proposed development on Manx shearwaters.



## 4.19 Great cormorant (*Phalacrocorax carbo*)

### 4.19.1 Protection & Conservation Status

The (great) cormorant is listed in Annex III of the Bern Convention and is on the Green List of Species of Conservation Concern.

### 4.19.2 Background

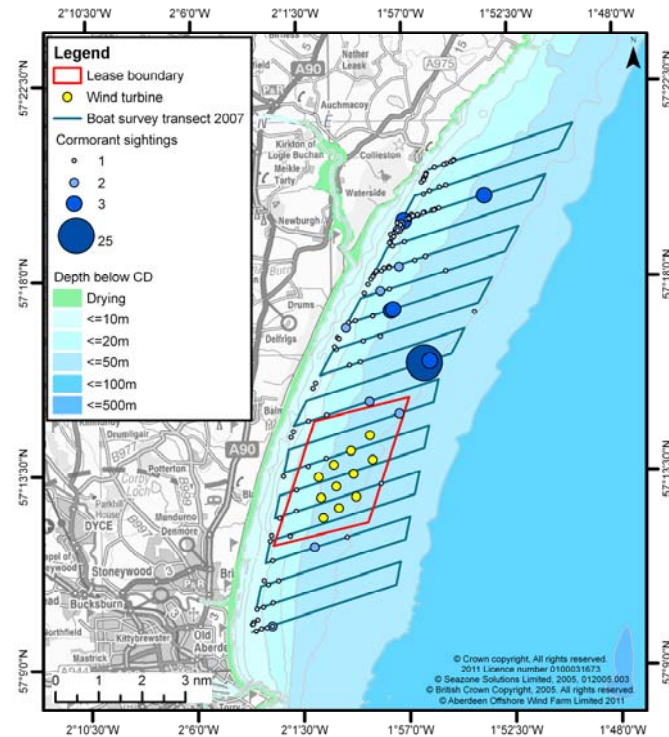
Cormorant		
GB population	Breeding: 8,400 prs Winter: 23,000 ind.	BTO 2011
Scottish population	Breeding: 3,600 AoN Winter: 9,000 – 11,000 ind.	Forrester <i>et al.</i> 2007
International threshold	1,200 ind.	Calbrade <i>et al.</i> 2010
GB threshold	230 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Forth Islands: 198 prs Firth of Forth: wintering assemblage Firth of Tay & Eden Estuary: wintering assemblage	SNH 2011 JNCC 2011a
European population estimate	Breeding: 310 – 370,000 prs Wintering: unknown	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	1,4 – 2,900,000 ind.	Birdlife 2011

Cormorants occur widely across the UK breeding and wintering on both freshwater bodies inland and also at coastal locations. Breeding occurs in colonies from April through to September when coastal breeding birds remain largely within nearshore waters. Following breeding, there is some dispersal away from the breeding areas with many birds moving south during the winter. The population of cormorant has increased across the whole of the UK but has decreased in certain localised areas. In North-east Scotland the number of breeding cormorants has recently increased with new colonies being formed to the north of Aberdeen Bay.

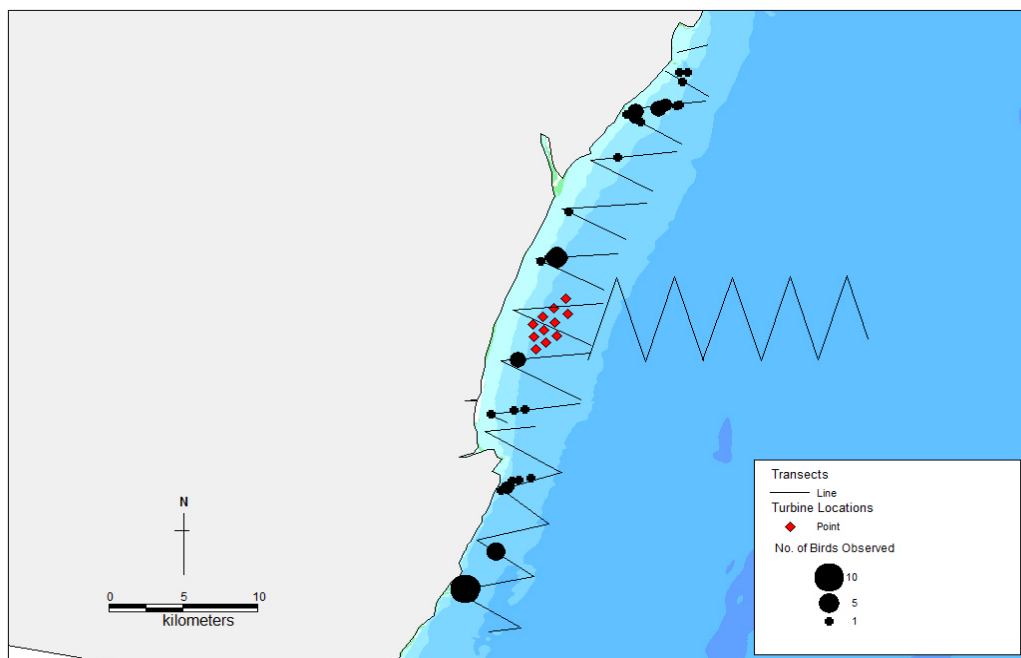
Results from ten years of observations undertaken at Peterhead indicate strong seasonal differences with peak numbers of cormorant occurring during the autumn and winter and relatively low numbers between May and August. Peak counts of up to 20 birds per hour were recorded in October with the majority of sightings shortly after dawn. Nearly all observations were within 500 metres of the coast (Innes 1991). Elsewhere cormorants occur widely along the coast with up to 150 birds being recorded on the Ythan Estuary (NESBR).

### Boat-based surveys

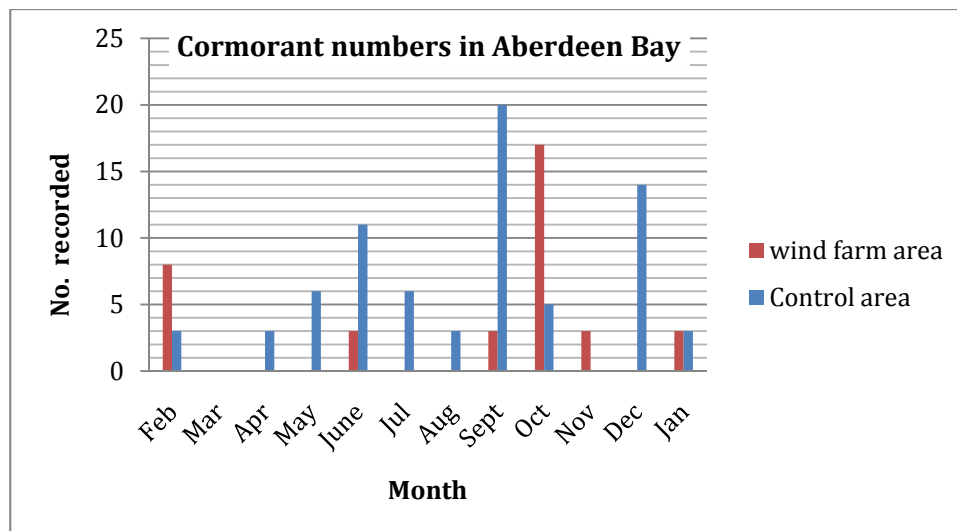
Cormorants were recorded in low numbers from boat-based surveys throughout the year. With the exception of one record of 25 birds nearly all sightings were of birds in nearshore waters and in water depths of less than 20 m. Concentrations were recorded in the shallow waters from the Ythan Estuary to Collieston (Figure 4-57) (IECS 2008). Peak numbers of cormorant were recorded during September and October with a population estimate of up to 20 birds in the 'control' area and 17 birds within the survey area for the proposed EOWDC during October (Figure 4-59). Data collected between August 2010 and January 2011 recorded low numbers of cormorants during August with a total of 8 birds seen throughout the surveyed area and peak numbers of cormorants during September when a total of 32 were recorded (Figure 4-58) (SMRU 2011b).



**Figure 4-57: Cormorant distribution February 2007 to January 2008 (all sightings).**



**Figure 4-58: On-effort observations of all cormorant species (great cormorant and shag) along transects during August, September and November 2010 and January 2011.**

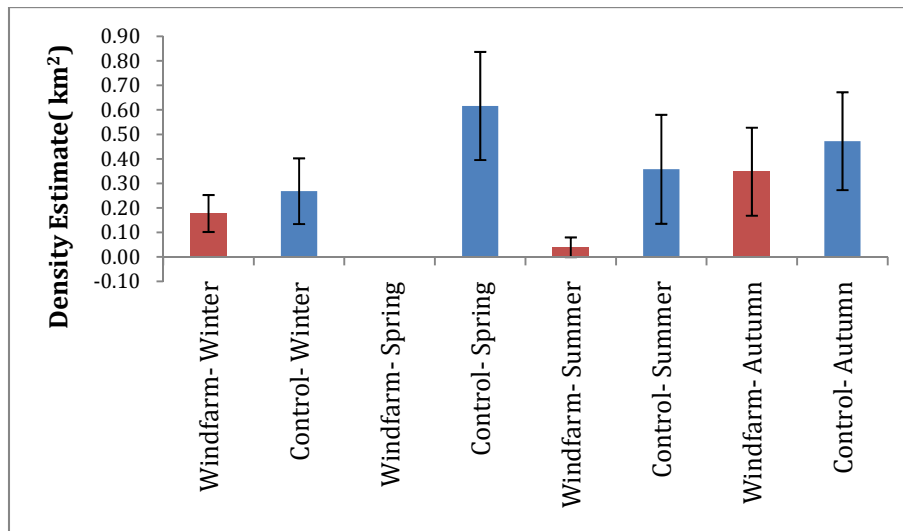


**Figure 4-59: Cormorant monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

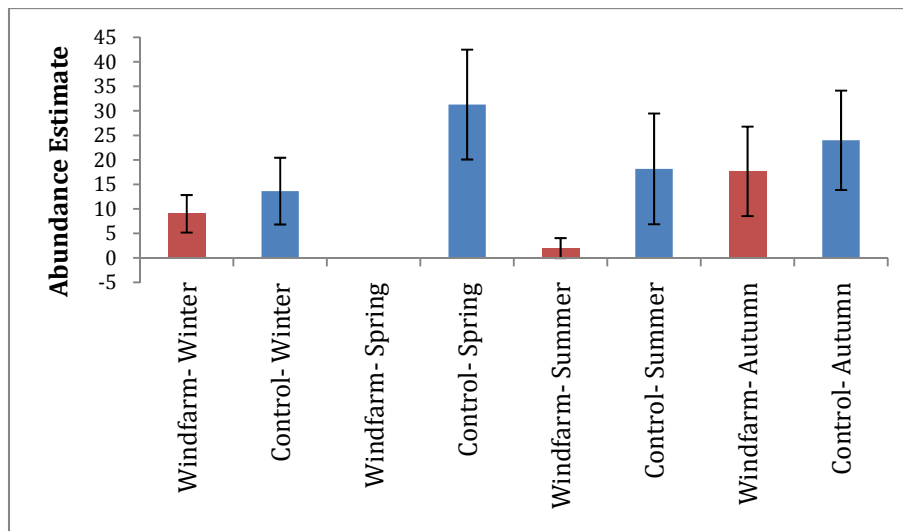
There were not enough records to undertake *Distance* sampling on a monthly basis. However, *Distance* sampling was possible on seasonal data. Peak overall estimated abundances were during the spring and autumn periods with the majority of sightings within the 'control' area. Throughout the year, the numbers of cormorant estimated to be in the 'control' area were higher than within the proposed EOWDC area (Table 4-20, Figure 4-60, Figure 4-61).

**Table 4-20: Seasonal estimates of density and abundance of cormorants in the proposed EOWDC and 'control' Areas**

	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
EOWDC- Winter	0.177	0.075	9	3.8	6
Control- Winter	0.268	0.134	14	6.8	9
EOWDC- Spring	0.000	0.000	0	0.0	0
Control- Spring	0.616	0.221	31	11.2	24
EOWDC- Summer	0.039	0.040	2	2.0	1
Control- Summer	0.358	0.223	18	11.3	9
EOWDC- Autumn	0.348	0.180	18	9.1	6
Control- Autumn	0.472	0.200	24	10.1	10



**Figure 4-60: Seasonal estimates (+/- SE) of density of cormorants in the proposed EOWDC and 'control' Areas.**



**Figure 4-61: Seasonal estimates (+/- SE) of abundance of cormorants in the proposed EOWDC and 'control' Areas.**

### Vantage Point surveys

Cormorants were present during peak dawn and dusk activity periods in Aberdeen Bay throughout the year with peak numbers between June and September. Up to 15 birds per hour passed during peak periods. During the winter months the number of cormorants within Aberdeen Bay was lower with less than five birds per hour passing any one Vantage Point (EnviroCentre 2007b). Of those recorded in flight, 8% of cormorants were flying between 30 m and 150 m above sea surface with 0.5 birds per hour doing so during the winter months and up to one per hour during summer months (EnviroCentre 2007b). The majority of sightings were within 2 km of the coast (Alba Ecology 2008b).

### Bird Detection Radar

A total of 96 cormorants were recorded during Bird Detection Radar studies undertaken during October 2005. The number of observations made between the two sites from which the surveys were undertaken was similar, with 47 cormorants recorded at Drums and 49 at Easter Hatton (Walls *et al.* 2006). Forty-three

cormorants were recorded off Blackdog over a seventeen day period in April 2007. Most sightings were of single birds but a flock of three was recorded (Simms *et al.* 2007).

#### 4.19.3 Summary of Results

Cormorants were regularly recorded in Aberdeen Bay throughout the year. Peak numbers occurred in the spring and autumn with most sightings within the 'control' area. Peak abundance of 31 birds and a density of 0.61 birds/km<sup>2</sup> occurred in the 'control' area during the spring. The majority of sightings were within 2 km of the coast and of those recorded in flight, 92% of all flights were below 30 m.

Numbers of cormorant recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.19.4 Initial Assessment of Significance

Cormorant	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Low	Minor
Displacement	Very High	Low	Moderate

#### 4.19.5 Species Sensitivities

##### Qualifying species

The nearest SPA to the proposed development for which cormorant is a qualifying breeding species is the Forth Islands SPA. The cormorant is also a qualifying species for the Firth of Forth SPA and Firth of Tay & Eden Estuary SPA for which the species is listed under Article 4.2 as part of wintering waterfowl assemblage (SNH 2011).

##### Flight height

Of those recorded in flight from boat-based surveys and for which flight heights were recorded all were flying below 25 m and 7% were flying between 15 m and 25 m. Data obtained from Vantage Point counts indicated that 8% were flying between 30 m and 150 m.

Data from other offshore wind farms have recorded overall 4% of cormorant as flying at rotor height with a mean flight height of 8.6 m (n=20,416).

##### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys indicate that cormorants are widespread in nearshore waters across Aberdeen Bay (Figure 4-57, Figure 4-58). There were no records of cormorants flying at rotor height from boat-based surveys and therefore a figure of 4% based on data from other offshore developments has been used for the Collision Risk Modelling.

Collision with offshore wind turbines have been reported (Zucco *et al.* 2006)

Collision Risk Modelling undertaken for cormorant is based on:

- Body length of 84 cm

- Wingspan of 160 cm
- Flight speed of 19.4 m.s<sup>-1</sup>

(Koffijberg & Mennobart 1995; Gremillet, Schmid & Culik 1995)

**Table 4-21: Predicted number of collisions for various avoidance rates for cormorant.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
8.9%	1.23	0.62	0.31

Based on the various scenarios and using a precautionary avoidance rate of 98% it is predicted that a total of 1.23 collisions per year may occur (Table 4-21).

The annual mortality rate for cormorant is 12% (BTO 2011). Consequently, out of a population of 198 pairs (396 individuals) at the Forth Islands SPA an annual mortality of 47 cormorants may be predicted. Therefore, 1% of the baseline mortality is 0.5 birds per year.

However, the Forth Islands SPA is 124 km away and the maximum reported foraging distance for breeding cormorants is 35 km (Roos 2010). Therefore, the proposed development is outwith the range of potential adverse effect on the breeding cormorants at the Forth Islands SPA.

Cormorants associated with the non-breeding wintering assemblages at the Firth of Forth and Firth of Tay & Eden Estuary SPA will remain within or in the vicinity of those sites during the non-breeding seasons. Both sites are in excess of 90 km away from the proposed development and therefore not at risk of an adverse effect from the proposed development.

Within North-east Scotland cormorants breed to the north of the proposed development with colonies on the Forvie National Nature reserve (NNR), Boddam area and Loch of Strathbeg. The majority of birds recorded from boat-based and land-based surveys were recorded in the 'control' area to the north and therefore are likely to be birds associated with these colonies. Based on an estimated breeding population of 150 pairs (300 individuals) an increase in mortality of 0.3 birds per year could be significant.

Results from collision risk modelling indicate that should all the cormorants at risk of collision be from colonies to the north of the proposed development, in order for less than 0.3 birds per year to collide with the turbines an avoidance rate of more than 99.5% is required. This is significantly lower than the precautionary 98% avoidance rate predicted.

Evidence from existing wind farms indicate that cormorants take avoidance behaviour and that up to 43% will do so before being at risk of collision. Furthermore studies undertaken at Ronland Offshore wind farm in Denmark recorded only one observation of cormorant at risk of collision after 560 hours of observations (Jensen 2006). Data from Sweden also indicates a significant reduction in the number of cormorants flying through the wind farm site once in operation compared to pre-construction (Zucco *et al.* 2006).

Based on the site specific evidence and the results from collision risk modelling it is concluded that risk of a significant environmental impact is minor and any possible adverse affect negligible.

### Barrier effect

Although cormorants are regularly recorded within operating wind farms there is also evidence of a barrier effect with birds detouring around turbines (Petersen *et al.* 2006).

Should a barrier effect occur then cormorants will fly around the proposed development. By doing so this could cause an overall increase in flying distance of up to approximately 3.2 km. For a bird foraging at the maximum recorded foraging range from a colony of 35 km this additional distance would equate to an additional 10% of flight distance and add between 1% and 2% to the daily energy expenditure (Speakman, Gray & Furness 2009).

Foraging ranges of up to 35 km have been reported as unusual with only 5% of flights being of that distance and typical foraging range being of 5 km or less (Roos 2010). The additional 1 – 2% of daily energy expenditure that could be incurred by avoiding the proposed development area will not on an *ad hoc* basis have a significant effect and as foraging flights of that distance are unusual and not predicted to take place on a daily basis there will not be any detrimental cumulative impact caused by regular flights around the proposed development. Based on the evidence from existing offshore wind farms and site specific data it is concluded that the potential barrier effect will have a minor impact of cormorants

### Displacement

Although cormorants may fly around wind farms they have also been regularly recorded within constructed offshore wind farms where they use the turbine structures for perches and have been recorded feeding within arrays of wind turbines (Petersen 2004). Consequently, although there may be an effect to flying birds cormorants do occur within wind farms and there is not total displacement and it is not predicted that there will be a significant effect arising from the proposed development on cormorants from displacement effects.

### Cumulative and in-combination

The three closest SPAs for which cormorant is a qualifying species are all over 90 km away. The proposed offshore wind farms within the Firth of Forth area or the Moray Firth are all in waters largely in excess of 20 m water depth and therefore in areas where cormorants are unlikely to regularly occur. For example, only two cormorants were recorded over a year of surveys at the Beatrice Offshore wind farm demonstrator project (Talisman 2005). There is therefore no evidence of a likely adverse or significant effect on cormorants from either the proposed development on its own or in combination with other plans or programmes.

## 4.19.6 Conclusions

### Habitats Appraisal

There are no SPAs for which cormorant is a qualifying species that will be adversely affected by the proposed development.

### Environmental Impact Assessment

Based on the site specific data and data from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on cormorants.



## 4.20 European shag (*Phalacrocorax aristotelis*)

### 4.20.1 Protection & Conservation Status

The (European) shag is included in annex I of the Wild Birds Directive and Annex II of the Bern Convention. It is included on the Amber List of Species of Conservation Concern.

### 4.20.2 Background

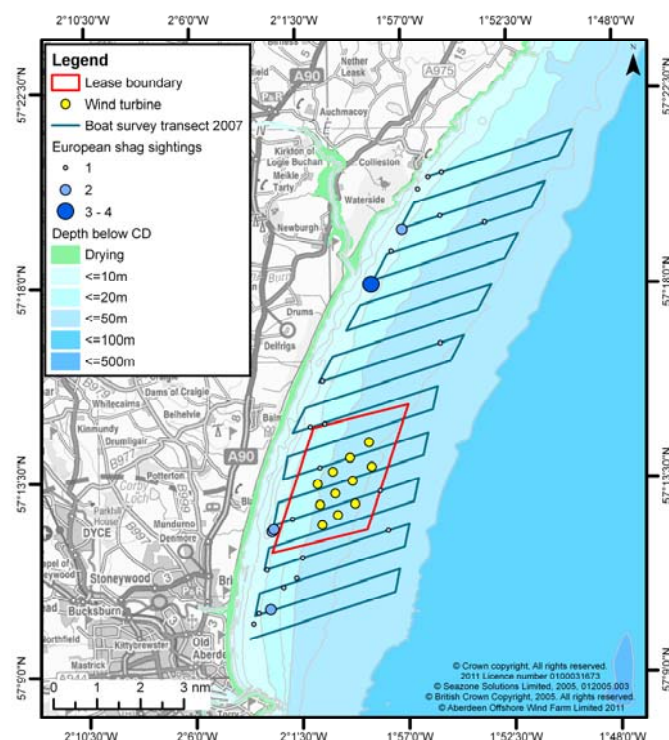
Shag		
GB Population	Summer: 27,000 prs	BTO 2011
Scottish population	Summer: 21,500 – 30,000 prs Winter: 60,000 – 80,000 ind.	Forrester <i>et al.</i> 2007
International threshold	2,000 ind	Calbrade <i>et al.</i> 2010
GB threshold	540 ind	1% of GB population
Designated east coast sites where species is a noted feature	Buchan Ness – Collieston Coast: 331 prs Forth Islands: 480 prs	SNH 2011 JNCC 2011a
European population estimate	Breeding 75,000 – 81,000 pairs Wintering – >92,000	Birdlife 2004
European population trend	Status 'secure' Trend 'moderate decline'	Birdlife 2004
World population	230 – 240,000 'adults'	Birdlife 2011

The (European) shag occurs widely along rocky coastal areas of the UK where they breed in loose colonies along suitable rocky shores and forage typically within approximately 4 km of the shore. Outwith the breeding season, shags disperse locally up to 100 km away from their breeding colonies and are not strongly migratory. They remain within nearshore coastal waters often around rocky coasts or in large shallow sandy bays feeding, primarily, on a variety of fish species. The breeding population in the UK has increased substantially during the 20<sup>th</sup> century from 34,000 pairs in 1969/1970 to 43,000 pairs in 1985-1988.

In North-east Scotland, shags occur widely along all coasts and regular daily movements to and from roosting sites have been recorded at Peterhead. Peak counts at Peterhead occurred from October through to March where up to 1,200 birds per hour have been recorded flying north at dawn and counts of 3,000 to 4,000 birds have been recorded (Buckland, Bell & Picozzi 1990). During the breeding season the numbers of birds at Peterhead were considerably lower with less than 200 birds per hour passing (Innes 1991).

### Boat-based surveys

Only fourteen shags were recorded 'in transect' during boat-based surveys with all but one within approximately 2 km of the coast and in water depths of less than 20 m. Further records of birds detected but not in transect are included in Figure 4-62 and indicate that occasional records may occur further offshore.



**Figure 4-62: Shag distribution in Aberdeen Bay - February 2007 to April 2008 (all sightings).**

## Vantage Point surveys

In Aberdeen Bay shags were recorded in low numbers throughout the area. Peak numbers occurred in April with three birds per hour during April 2006 and eight birds per hour in April 2007 (EnviroCentre 2007a, Alba Ecology 2008a). Numbers decreased to less than one bird per hour during the winter months (EnviroCentre 2007b, Alba Ecology 2008b). Most shags were recorded between 1 km and 3 km from shore and at least 93% were flying below 30 m (EnviroCentre 2007a).

## Bird Detection Radar

One shag was recorded at Easter Hatton during the five days of observations undertaken at both Drums and Easter Hatton in October 2005 (Walls *et al.* 2005). A further 14 birds were recorded during the 17 days of surveys undertaken in April 2007 (Simms *et al.* 2007).

### 4.20.3 Summary of Results

Although shags were recorded regularly in Aberdeen Bay throughout the year numbers were generally low. Peak numbers occurred in the spring and autumn with most sightings within 2 km from the shore. Of those recorded in flight, 93% of all flights were below 30 m.

Numbers of shag recorded in Aberdeen Bay were below the threshold for a site of national importance.

#### 4.20.4 Initial Assessment of Significance

Shag	Overall sensitivity	Magnitude	Significance
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Collision	Very High	Negligible	Minor
Barrier	Medium	Low	Minor
Displacement	Very High	Low	Moderate

#### 4.20.5 Species Sensitivities

##### Qualifying species

The shag is a qualifying species for Buchan Ness to Collieston Coast SPA which lies approximately 9.5 km to the north of the proposed development and also the Forth Islands SPA which lies approximately 124 km to the south of the proposed development. (SNH 2011).

##### Flight height

Of those recorded in flight from boat-based surveys and for which flight heights were recorded all were flying below 15 m.

Data from other offshore wind farms have recorded 12% of shags as flying at rotor height (n=230).

##### Collision risk

Evidence from site specific monitoring from boat-based and land-based surveys indicate that shags are uncommon within the area of the proposed development. All sightings from boat-based surveys were of birds flying below rotor height and therefore not at risk from collision with the turbines. Further evidence from other offshore wind farms further indicates that shags flying at rotor height are unusual (ERM 2005).

Based on the relatively low numbers of shags recorded within the area of the proposed development and evidence indicating that shags rarely fly at rotor height it is predicted that very few collisions will occur and any impacts will be negligible and not cause an adverse effects on shag as qualifying species for either the Buchan Ness to Collieston Coast SPA and Forth Islands SPA.

##### Barrier effect

There is little or no evidence from existing offshore wind farms to determine whether or not a barrier effect may occur. However, should it do so then shags will fly around the proposed development. By doing so this could cause an overall increase in flying distance of up to approximately 3.2 km. For a bird foraging at the maximum recorded foraging range from a colony of 17 km (Roos 2010) this additional distance would equate to an additional 18% of flight distance and add between 1% and 2% to the daily energy expenditure (Speakman, Gray & Furness 2009).

Foraging ranges of up to 17 km are unusual and mean foraging ranges are less than 7 km from the colony consequently the majority of foraging being undertaken by shags associated with the SPA will be out with the proposed development area and there will not be a barrier effect. The additional 1 to 2% of daily energy expenditure that may be incurred on the occasions that shags do forage further and maybe avoid the proposed EOWDC area will not on an *ad hoc* basis have a significant effect and as foraging flights of that distance are unusual and not predicted to take place on a daily basis there will not be any detrimental cumulative impact caused by regular flights around the proposed development. Based on the evidence from existing

offshore wind farms and site specific data it is concluded that the potential barrier effect will have a negligible impact on shags.

### **Displacement**

There is limited data from existing offshore wind farms that shags occur within operating wind farms (Christensen & Hounisen 2005). However, should displacement occur then an area of approximately 4 km<sup>2</sup> may not be utilised by shags. Data from boat-based surveys indicate that shags are relatively uncommon within the vicinity of the proposed development and that the area is not an important location for shags. Even if displacement does occur the number of birds potentially displaced will be small and that their displacement into other areas will not have a detrimental effect. Based on the evidence from site specific surveys it is predicted that there will not be any significant environmental or adverse effects on shags from displacement impacts.

### **Cumulative and in-combination**

Of the two SPAs for which shag is a qualifying species: the Forth Islands SPA is 124 km away and will not be impacted by the proposed development and the Buchan Ness to Collieston Coast SPA is 9.5 km away. No adverse effects are predicted upon either of these sites from the proposed development on its own. The proposed offshore wind farms within the Firth of Forth area and the Moray Firth are in deeper waters but may still be in areas where shags can forage. No data are available as to whether shags are being recorded at any of the planned wind farm locations. However, the distance from shore for all the planned Round 3 and Scottish Territorial Water wind farms locations indicate that they are unlikely to be frequently used as areas of importance for shags. The Beatrice demonstrator project recorded just 63 shags over a 12 month period indicating that the area is not extensively used by this species (Talisman 2005).

There is therefore no evidence of a likely adverse or significant effect on shags from either the proposed development on its own or in combination with other plans or programmes.

## **4.20.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs for which the shag is a qualifying species that will be adversely effected by the proposed development.

### **Environmental Impact Assessment**

Based on the site specific data and data from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on shags.

## 4.21 Great crested grebe (*podiceps cristatus*)

### 4.21.1 Protection & Conservation Status

The great crested grebe is listed in Annex I of the Birds Directive, Appendix II of the Bern Convention, Appendix II of the Bonn Convention, Schedule 1 under the Wildlife and Countryside Act, 1981 and is on the Green List of Species of Conservation Concern.

### 4.21.2 Background

The great-crested grebe is a widespread breeding species in the UK with an estimated breeding population of 8,000 pairs. They breed on freshwater habitats but can winter on along estuaries with an estimated 1,800 out of the UK wintering population of 16,000 doing so.

The main wintering area along the east coast of Scotland is the Firth of Forth where a mean peak of 156 great-crested grebe has been recorded over the last five years (Calbrade *et al.* 2010). In North-east Scotland great-crested grebes are an uncommon breeding and wintering species.

Great crested grebe		
GB population	Summer: 8,000 prs Winter: 16,000 ind.	BTO 2011
Scottish population	Summer: 240 – 365 prs Winter: 900 – 1,500 ind.	Forrester <i>et al.</i> 2007
International threshold	3,600 ind.	Calbrade <i>et al.</i> 2010
GB threshold	159 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth	SNH 2011 JNCC 2011a
European population estimate	Breeding 300, – 450,000 prs Wintering >240,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'moderate decline'	Birdlife 2004
World population	920,000 – 1,400,000 'adults'	Birdlife 2011

### Vantage Point surveys

There was one record of a great-crested grebe from the Vantage Point surveys in October 2007 (Alba Ecology 2008b).

### 4.21.3 Initial Assessment of Significance

Great-crested grebe	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	High	Negligible	Negligible
Displacement	Very High	Negligible	Minor

#### 4.21.4 **Species Sensitivities**

##### **Qualify species**

The nearest SPA for which great-crested grebe is a qualifying species is the Firth of Forth SPA, c134 km to the south of the proposed development. Great-crested grebe qualifies under Article 4.2 as part of a wintering waterfowl assemblage and the population at the time of citation was 720 individuals, 7% of GB population (SNH 2011).

##### **Status**

Great-crested grebes are rarely recorded within Aberdeen Bay and there was only one sighting from any of the project specific surveys. Records from other sources support the finding that great-crested grebes are infrequent in the bay (NESBR).

##### **Cumulative**

The very low level of usage of the site indicates that there will not be any cumulative or in-combination impact.

#### 4.21.5 **Conclusions**

##### **Habitats Appraisal**

Based on the available evidence from site specific surveys undertaken at the proposed development area, in particular the very low usage of the site by great-crested grebes and the distance the site is from the Firth of Forth SPA, it is concluded that the proposed development will not have an adverse effect on great-crested grebe as qualifying species.

##### **Environmental Impact Assessment**

Based on the very low usage of the site it is predicted that there will not be a significant environment impact arising from the proposed development on great-crested grebe.

## 4.22 Great skua (*Stercorarius skua*)

### 4.22.1 Protection & Conservation Status

The great skua is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.22.2 Background

Great skua		
GB population	Breeding: 9,650 prs	Mitchell <i>et al</i> 2004
Scottish population	Breeding: 9,650 prs	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	192 ind.	1% of GB Pop <sup>1</sup>
Designated east coast sites where species is a noted feature	None	SNH 2011 JNCC 2011a
European population estimate	Breeding 16,000 pairs Wintering – unknown	Birdlife 2004
European population trend	Status 'secure' Trend 'Large increase'	Birdlife 2004
World population	16,000 pairs	Mitchell <i>et al</i> 2004

Approximately 60% of the world population of great skua nest in the UK, all of which nest in north and north-west Scotland. They are summer migrants to the UK arriving at their breeding colonies in April and May and departing primarily during August and September. During the breeding season non-breeding immature birds may also be present at the colonies. Following breeding, birds disperse into the North Sea and Atlantic and migrate southwards to their wintering grounds in the Bay of Biscay and West Africa. Autumn passage of great skuas is estimated to be between 2,000 to 10,000 birds when they remain largely offshore occurring in relatively low densities across the North Sea (Forrester *et al.* 2007).

During the breeding season they feed on fish, often following fishing vessels or by kleptoparasitising fish from other seabirds but they will also kill smaller seabirds.

In North-east Scotland great skuas occur between April and November with peak numbers in July and August with up to 10 birds per hour past Peterhead (Innes 1993).

### Boat-based surveys

Great skua were recorded from July to September with 27 sightings from the whole survey area. Sightings were recorded throughout the bay with no areas of significant concentrations recorded and very records were from within the proposed EOWDC development area (Figure 4-63).



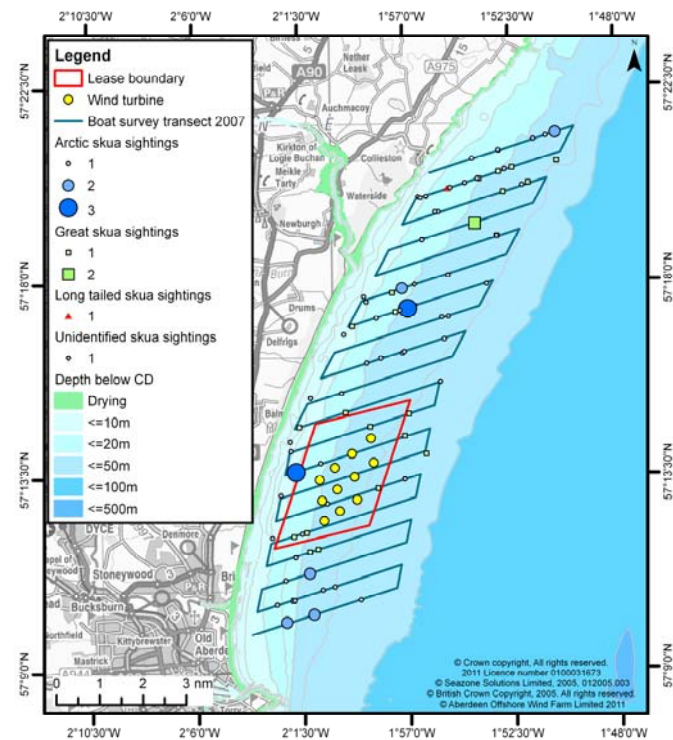


Figure 4-63: Skua distribution February 2007 to April 2008 (all sightings).

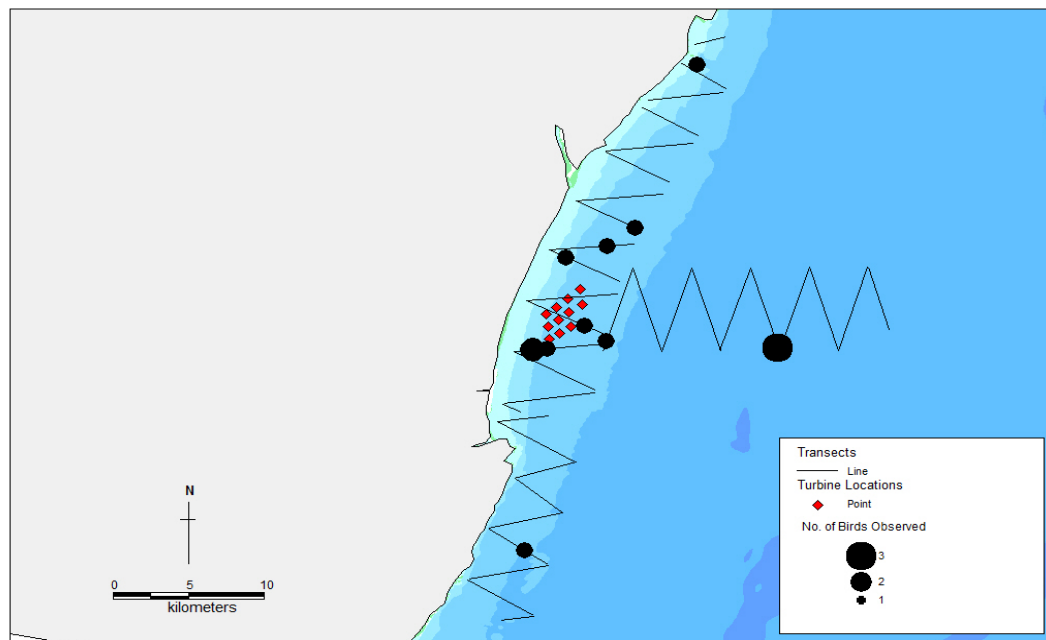


Figure 4-64: On-effort observations of all Skua species (great, Arctic and pomarine) along transects during August, September and November 2010 and January 2011.

### Vantage Point surveys

Great skuas were recorded in relatively low numbers from Vantage Point counts from April and October with peak counts during August and September when up to three birds per hour were recorded. Most observations of birds were between 1–3 km from shore and between 84% and 87% were flying below 30 m.

### Bird Detection Radar

Ten great skuas were recorded during the radar studies in October 2005 and seven during April 2007. All but one of the sightings was of single birds (Walls *et al* 2005, Simms *et al*. 2007).

#### 4.22.3 Summary of Results

Great skuas were widely recorded across Aberdeen Bay in relatively low numbers from all surveys from between April and October. Peak counts were during the period of autumn migration when up to three birds per hour were recorded in August and September. There were also a smaller number of sightings during the spring migration with most records from April.

Of those recorded in flight, during boat-based surveys, 25% were recorded flying above 25 m and between 13% and 16% were recorded above 30 m from land-based surveys.

No counts of great skua from any of the surveys undertaken within Aberdeen Bay were of national importance.

#### 4.22.4 Initial Assessment of Significance

Great skua	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	Low	Low	Negligible
Displacement	Low	Negligible	Negligible

#### 4.22.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the region for which the great skua is a qualifying species but over 73% of the UK breeding population of great skuas do occur in SPAs in northern Scotland.

##### Flight height

Observations from boat-based surveys undertaken in Aberdeen Bay reported two out of the eight great skuas for which flight heights were recorded as being above 25 m, i.e. 25% of flights were at rotor height..

Elsewhere in the UK out of 239 recorded flight heights of great skua obtained from boat-based surveys, 4% were recorded as being at rotor height.

##### Collision risk

Data obtained from boat-based and land-based surveys recorded great skuas across Aberdeen Bay in relatively low numbers particularly during the autumn passage

periods. There is relatively little data from other constructed offshore wind farms to determine possible avoidance rates but these are assumed to be relatively high and 96% of flights are below rotor height.

Based on the relatively low usage of the site, the broad distribution of great skua across Aberdeen Bay and the high percentage of birds recorded as flying below rotor height it is concluded that there is a low risk of collision and that should it occur its significance on the species will be negligible.

### **Barrier effect**

There are no data from any constructed wind farms to determine whether or not a barrier effect may occur. Should it do so, there will be an incremental increase in energy expenditure as the bird flies around the wind turbines. However, the increase in flight distance caused by doing so will be insignificant for a bird flying to or from its wintering grounds in the Bay of Biscay (or further south) and its breeding grounds in northern Scotland. The significance of any increase in energy expenditure will, if it occurs, be negligible.

### **Displacement**

There are no data available to determine whether great skuas may be displaced from the proposed development area. Should they do so then they will forage elsewhere for their prey whether that is from scavenging behind fishing vessels, stealing it from other birds or catching it themselves. There is no indication that the proposed area is of any significant importance for great skua and therefore any displacement, should it occur, will be negligible.

### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on great skuas.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded 51 great skuas over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of great skuas that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, although great skuas will be recorded within the area, the relatively far distance the proposed development is from the other planned offshore wind farms and its relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

## **4.22.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs in the region for which great skua is a qualifying species.

### **Environmental Impact Assessment**

Based on the relatively low densities of great skuas recorded in Aberdeen Bay and their broad distribution it is predicted that there will not be a significant impact arising from the proposed development on great skuas.

## 4.23 Arctic skua (*Stercorarius parasiticus*)

### 4.23.1 Protection & Conservation Status

The Arctic skua is listed in Appendix III of the Bern Convention and is on the Red List of Species of Conservation Concern.

### 4.23.2 Background

Arctic skua		
GB Population	Breeding: 2,100 prs	Mitchell <i>et al</i> 2004
Scottish population	Breeding 2,100 prs	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	50	Minimum
Designated east coast sites where species is a noted feature	None	SNH 2011 JNCC 2011a
European population estimate	Breeding 40,000 – 140,000 pairs Wintering – unknown	Birdlife 2004
European population trend	Status 'secure' Trend 'unknown'	Birdlife 2004
World population	85,000 – 340,000 pairs	Mitchell <i>et al</i> 2004

Within the UK Arctic skuas only nest in north and western Scotland where they are a summer migrant arriving on their breeding grounds during April and May and departing primarily in August and September. They feed on fish, primarily sandeels, that they often obtain from other seabirds as they enter the seabird colonies.

During migration from August to October Arctic skua occur widely offshore in low densities across the North Sea but may favour inshore waters where they can scavenge food from other seabirds, particularly Terns. In North-east Scotland peak passage occurs during August with a maximum of 326 Arctic skuas over a four hour period in August 1983 passing Peterhead (Buckland, Bell & Picozzi 1990).

#### Boat-based surveys

A total of 64 Arctic skuas were recorded from ship-based surveys undertaken between June and November 2007 and a further 16 were recorded between September and November 2010. Arctic skuas were recorded widely throughout the bay with no concentrations identified (Figure 4-63).

#### Vantage Point surveys

In Aberdeen Bay Arctic skuas were recorded between April and October with peak numbers of up to five birds per hour in July (EnviroCentre 2007a,b). Birds were recorded out to 3 km from shore with at least 78% of the sightings below turbine height.

#### Bird Detection Radar

Fourteen Arctic skuas were recorded by visual observations undertaken during Bird Detection radar studies in October 2005 and a further single observation was made at Blackdog in April 2007 (Walls *et al* 2006, Simms *et al.* 2007).

### 4.23.3 Summary of Results

Arctic skuas were widely recorded across Aberdeen Bay in relatively low numbers from all surveys from between April and October. Peak count numbers were during July when up to five birds per hour were recorded from land-based observations.

There was also a number of sightings during the spring and autumn migration periods.

Of those recorded in flight, 19% were recorded flying above 25 m from boat-based surveys and 22% above 30 m from land-based surveys.

No counts of Arctic skua from any of the surveys within Aberdeen Bay were of national importance.

#### 4.23.4 Initial Assessment of Significance

Arctic skua	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	Low	Low	Negligible
Displacement	Low	Negligible	Negligible

#### 4.23.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the region for which the Arctic skua is a qualifying species but over 24% of the UK breeding population of Arctic skuas do occur in seven SPAs in Orkney and Shetland.

##### Flight height

Observations from boat-based surveys undertaken in Aberdeen Bay reported 16% of all flights above 25 m.

Elsewhere in the UK out of 50 recorded flight heights for Arctic skua four, i.e. 8%, were at rotor height.

##### Collision risk

Data obtained from boat-based and land-based surveys recorded Arctic skuas across Aberdeen Bay in relatively low numbers particularly during the autumn passage periods. There is relatively little data from other constructed offshore wind farms to determine possible avoidance rates but it is assumed to be relatively high and 92% of flights are below rotor height.

Based on the relatively low usage of the site, the broad distribution of Arctic skua across Aberdeen Bay and the high percentage of birds recorded as flying below rotor height it is concluded that there is a low risk of collision and that should it occur its significance on the species will be negligible.

##### Barrier effect

Data from post-construction monitoring studies undertaken in Denmark indicate that Arctic skua do not avoid entering wind farms consequently there is not thought to be a significant barrier effect (Zucco *et al.* 2006).

##### Displacement

There are no data available to determine whether Arctic skuas may be displaced from the proposed development area. However, they are known to follow Gulls, which may enter the proposed development area and Arctic skuas have been shown

not to avoid wind farms. There is no indication any potential displacement effect but should it occur its significance is predicted to be negligible.

#### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on Arctic skuas.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded 16 Arctic skuas over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of Arctic skuas that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, although great skuas will be recorded within the area, the relatively far distance the proposed development is from the other planned offshore wind farms and its relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

#### **4.23.6 Conclusions**

##### **Habitats Appraisal**

There are no SPAs in the region for which Arctic skua is a qualifying species.

##### **Environmental Impact Assessment**

Based on the relatively low numbers of Arctic skuas recorded in Aberdeen Bay and their broad distribution it is predicted that there will not be a significant impact arising from the proposed development on Arctic skuas.

## 4.24 Golden plover (*Pluvialis apricaria*)

### 4.24.1 Protection & Conservation Status

Golden plover is listed in Annex I of the Birds Directive, Schedule II of the Wildlife & Countryside Act, Appendix II of the Bonn Convention. Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.24.2 Background

Golden plover		
GB Population	Summer: 23,000 prs Winter: 250,000 nd.	BTO 2011
Scottish Population	Summer – 15,000 prs Autumn – 20,000 – 60,000 ind Winter: 25,000 – 35,000 ind.	Forrester <i>et al</i> 2007
International threshold	9,300 ind.	Calbrade <i>et al.</i> 2010
GB threshold	4,000 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Firth of Forth: 2,970 ind.	SNH 2011 JNCC 2011
European population estimate	Breeding 436,000- 740,000 prs Wintering – 820,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'unknown breeding moderate increase wintering	Birdlife 2004
World population	640,000 to 1,200,000 ind.	Birdlife 2011

Golden plover breed on upland moorlands in northern Britain and Europe with the largest European populations in Iceland where up to 310,000 pairs (BirdLife 2004).

The UK holds 80% of the breeding population of the southern race of golden plover *P. apricaria apricaria* which has undergone a significant decline of 20% between the 1960's and 1980's (EC 2009). The breeding population occurs widely across the uplands of northern Britain and particularly Scotland where 15,000 pairs occur (Forrester *et al.* 2007).

In winter the UK population increases with birds arriving from Iceland and the Continent where they spend the winter on arable land, often winter crops, and open grassland. Birds return to the same areas and often same fields each year. Golden plover recorded in eastern Britain are thought to be predominantly birds from Scandinavia or further east whereas those from Iceland occur predominantly in western Britain and Ireland. Birds occurring in North-east Scotland are therefore most likely to be local breeding birds and from populations to the north and east (Wernham *et al.* 2002).

In North-east Scotland golden plover are a decreasing breeding species inland but occur widely during the winter at a few favoured locations near the coast each winter. Peak numbers in the region occur on the Ythan Estuary during the autumn as migrants. Maximum counts in recent years have been up to 9,000 birds but more often peak numbers are between 3,000 to 4,000 individuals (Buckland Bell & Picozzi



1990; NESBR). Birds forage and roost on the Ythan at low tide but move away as far as 10 km during high tides (Buckland Bell & Picozzi 1990).

#### Boat-based surveys

No golden plover were recorded from boat based surveys.

#### Vantage Point surveys

No golden plover were recorded from Vantage Point surveys

#### Bird Detection Radar

Golden plover were observed on three occasions but in large numbers during radar and visual surveys undertaken in October 2005. A total of 2,170 golden plover were recorded in three flocks along the shoreline and out to 3,300 m. Their mean flight height was 35 m and therefore at potential risk of collision (Walls *et al.* 2006)

#### Summary of Results

Golden plover were only recorded during land-based surveys undertaken on October 2005. The majority of sightings were of birds along the shore, although one flock occurred out as far as 3,300 metres offshore.

##### 4.24.3 Initial Assessment of Significance

Golden plover	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	Medium	Low	Minor
Displacement	Low	Negligible	Negligible

##### 4.24.4 Species Sensitivities

#### Qualifying species

Golden plover is a qualifying species as part of an assemblage for the Firth of Forth SPA.

#### Flight height

Flight heights recorded from land based surveys undertaken in October 2005 recorded a mean flight height of 35 m. Elsewhere very few golden plover have been recorded at offshore wind farms and all have been below turbine height.

#### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that golden plover are rarely recorded offshore in Aberdeen Bay. However, flocks of golden plover can occur. However, the only flock recorded offshore was to the north of the proposed development and were of birds likely associated with the Ythan Estuary also to the north, therefore golden plover are not at risk of collision. It is possible that golden plover may cross Aberdeen Bay during periods of passage. However, there is no indication that there are any regular movements across the bay nor that there is a flyway across the proposed development area.

Studies undertaken in Denmark have also indicated that golden plover fly above the turbine height during passage and are not at risk of collision and that other species of wader flying at rotor height demonstrated effective avoidance behaviour when near to offshore wind turbines (Petersen *et al.* 2006). Consequently, there is evidence to indicate that the risk of collision to golden plover in Aberdeen Bay is low and that the potential effect from collision is negligible.

### Barrier effect

Data obtained from nearly three years of Vantage Point surveys plus additional radar studies and boat-based surveys did not detect any evidence to suggest that there are regular daily flights by golden plover across the proposed development area and so a regular barrier effect that may cause a long-term increase in daily energetic costs is not predicted. There is the potential for a relatively small *ad hoc* increase if golden plover cross the bay during migration but this would cause a very small incremental increase in energetic costs. It is predicted that the potential impacts arising from barrier effect will at worst be minor but most likely be negligible due to the relatively small incremental increase in flight distance compared to the likely total length of migration.

### Displacement

No golden plover were recorded at the proposed development area and therefore no displacement effects will occur.

### Cumulative and in-combination

It is possible that birds migrating long distances from Scandinavia or Russia may interact with one or more wind farm. However, it is not known where the golden plover recorded at the Ythan Estuary originate from or where they may migrate to and therefore it is not possible to undertake an evidence based cumulative or in-combination impact assessment.

The only data available that may be of relevance is from the Beatrice demonstrator project which did not record any golden plover during its surveys. Data from other proposed projects in the Moray Firth and the Firth of Forth are not currently available.

### Habitats Appraisal

Based on the very low usage of the proposed development area by golden plover and some evidence from existing offshore wind farms indicating a low collision risk, it is predicted that there will not be any adverse effects on the Firth of Forth SPA for which golden plover is a qualifying species.

### Environmental Impact Assessment

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on golden plover.

## 4.25 Black-legged kittiwake (*Rissa tridactyla*)

### 4.25.1 Protection & Conservation Status

The (black-legged) kittiwake is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.25.2 Background

Kittiwake		
GB population	Breeding: 370,000 prs	Mitchell <i>et al</i> 2004
Scottish population	Breeding: 282,200 AoN Winter: est. 10,000 ind	Forrester <i>et al.</i> 2007
GB threshold	?	Calbrade <i>et al.</i> 2010
International threshold	20,000 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Buchan Ness to Collieston Coast: 12,542 AoN (2007) Fowlsheugh: 11,140 AoN (2006) Forth Islands: 2,316 AoN (2009) Troup Pennan & Lion's Head: 14,896 AoN (2007)	SNH 2011 JNCC 2011a
European population estimate	Breeding 24,000 – 58,000 pairs Wintering – >11,000	Birdlife 2004
European population trend	Status 'depleted' Trend 'moderate increase'	Birdlife 2004
World population	97,000 – 270,000 'adults'	Birdlife 2011

Kittiwakes are the most numerous species of gull in the world and highly pelagic. It is the most abundant breeding gull in the UK nesting in often very large colonies on coastal cliffs. Kittiwakes start arriving back at their colonies during March and April and depart during August and September. During the breeding season they can forage widely with adults flying in excess of 100 km to suitable foraging sites.

Post-breeding, both adults and juveniles disperse across the North Sea and the north Atlantic with a greater proportion of unsuccessful breeders wintering off eastern Canada compared to those that have been successful that winter largely in the eastern Atlantic (Bogdanova *et al.* 2011).

In North-east Scotland kittiwakes are recorded throughout the year but with lowest numbers between November and March and peak numbers generally during July and August. On occasions there are records of exceptionally large movements of kittiwakes along Aberdeenshire coast. In April 1978 over 44,000 kittiwakes were recorded flying past Collieston and over 80,000 are estimated to have flown past Aberdeenshire on 29 October 1969 (Buckland, Bell & Picozzi 1990).

Observations off Peterhead occur out to 3 km with most records of birds closest to shore during poor weather (Innes 1991).

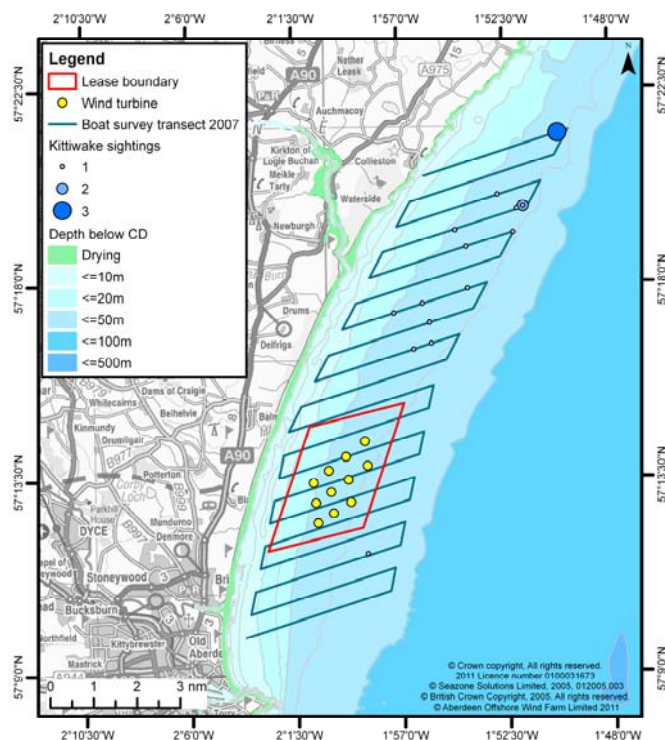
### Boat-based surveys

Kittiwakes were the most frequently recorded Gull from boat-based surveys. They were recorded throughout Aberdeen Bay with the majority of sightings in water depths of between 10 m and 20 m and between 1 km and 3 km from the shore. Year 1 data indicated significantly more kittiwakes in to the north compared to those within the proposed EOWDC survey area. Relatively low numbers were recorded during

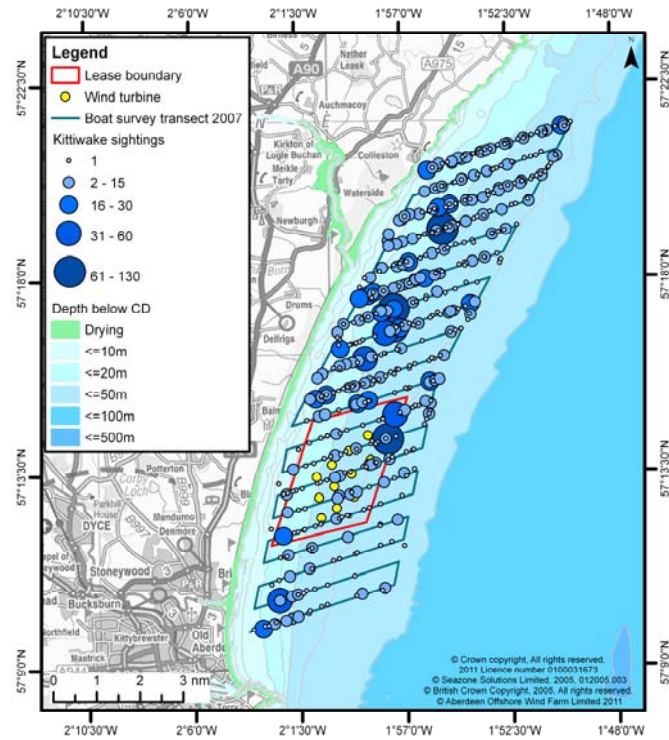
the winter period and none within the footprint of the proposed development area (Figure 4-65)

Peak numbers occurred during the breeding season between April and July, with highest numbers to the north (Figure 4-66). Post-breeding, the numbers of kittiwake recorded decreased with low numbers recorded within the proposed development area (Figure 4-67).

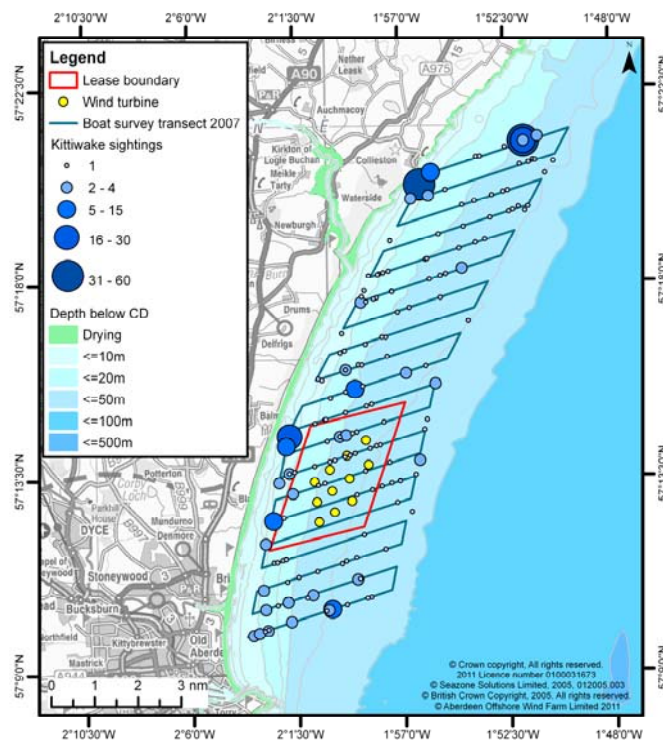
Data collected from between August 2010 and January 2011 have indicated greater numbers within the vicinity of the proposed development compared to elsewhere (Figure 4-68).



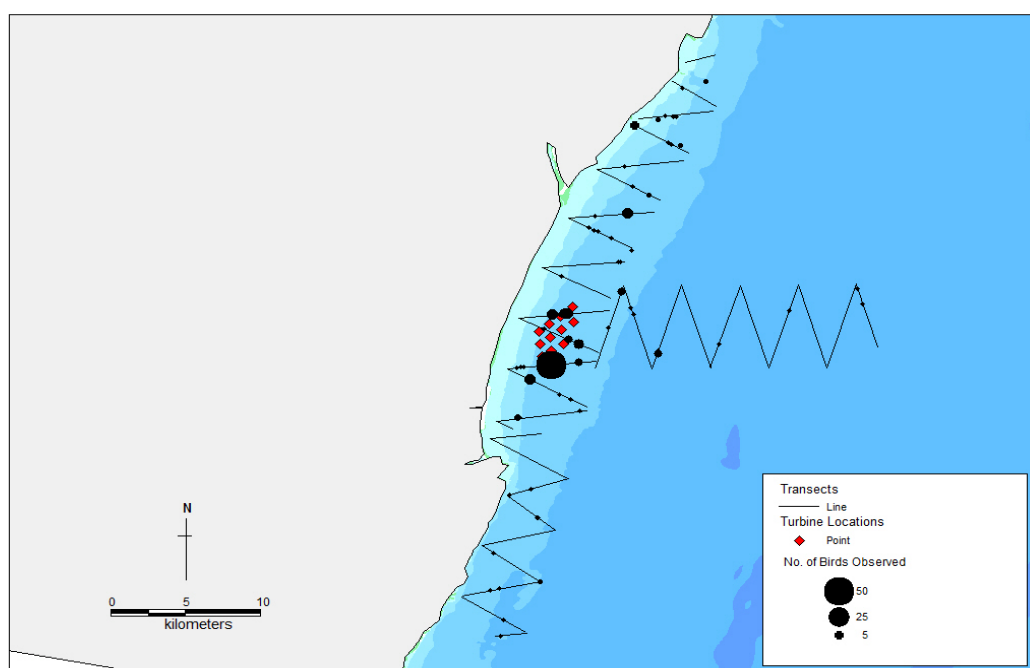
**Figure 4-65: Kittiwake distribution in Aberdeen Bay during winter period: November to March (all sightings).**



**Figure 4-66: Kittiwake distribution in Aberdeen Bay during breeding season: April – July (all sightings).**



**Figure 4-67: Kittiwake distribution in Aberdeen Bay during post-breeding: August - October (all sightings).**



**Figure 4-68: On-effort observations of kittiwake along transects during August, September and November 2010 and January 2011.**

There was a strong seasonal variation in the frequency of sightings with relatively high numbers in June and July when there was a peak of c.2,300 kittiwakes within the surveyed area. Outwith the peak period numbers of kittiwakes recorded were relatively low with an estimated abundance of less than 14 birds in the proposed EOWDC development area during the autumn and only one bird during the winter period (

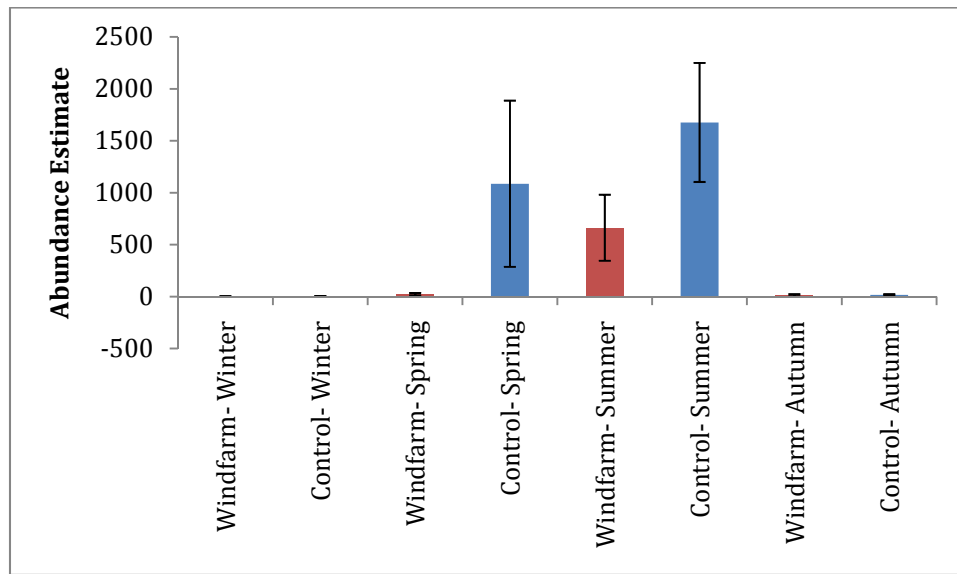
Table 4-22). Peak density estimates occurred during the spring and summer when up to 33 birds/km<sup>2</sup> were recorded.

Monthly data collected from between August 2010 and January 2011 recorded peak abundance estimate of 870 birds in the northerly survey area during September with relatively few birds to the south or offshore (Figure 4-71). Densities of kittiwakes during September were 5.7 birds/km<sup>2</sup> (Figure 4-72).

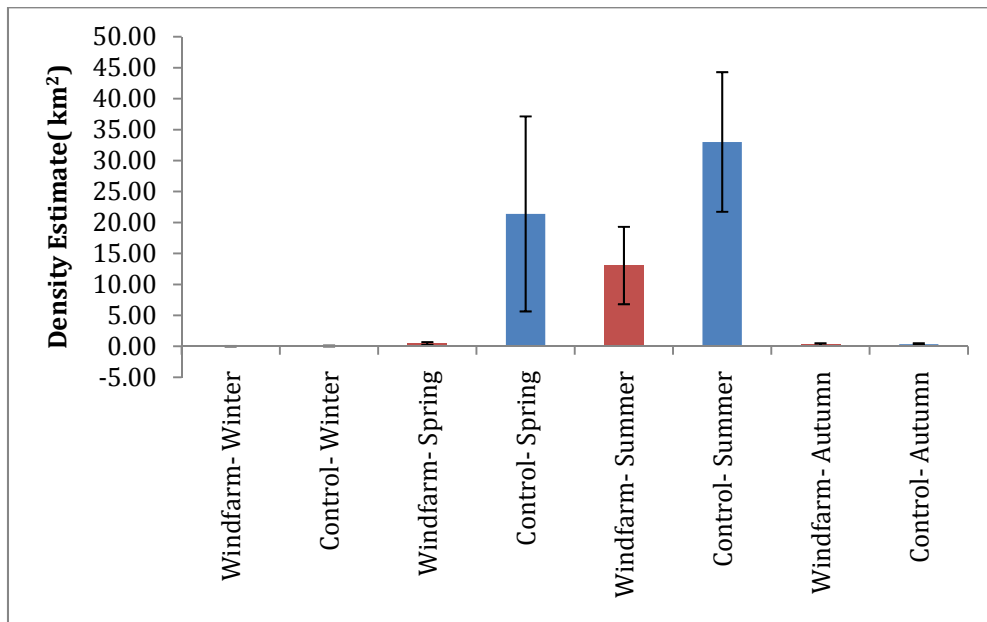
**Table 4-22: Seasonal estimates of density and abundance of kittiwakes in the proposed EOWDC and 'control' areas.**

Season	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
EOWDC- Winter	0.025	0.025	1	1.3	1
Control- Winter	0.049	0.050	3	2.5	2
EOWDC- Spring	0.453	0.229	23	11.6	12
Control- Spring	21.383	15.748	1,086	800.0	16
EOWDC- Summer	13.046	6.251	663	317.6	33
Control- Summer	33.000	11.277	1,676	572.9	60
EOWDC- Autumn	0.276	0.206	14	10.5	7
Control- Autumn	0.332	0.149	17	7.5	9



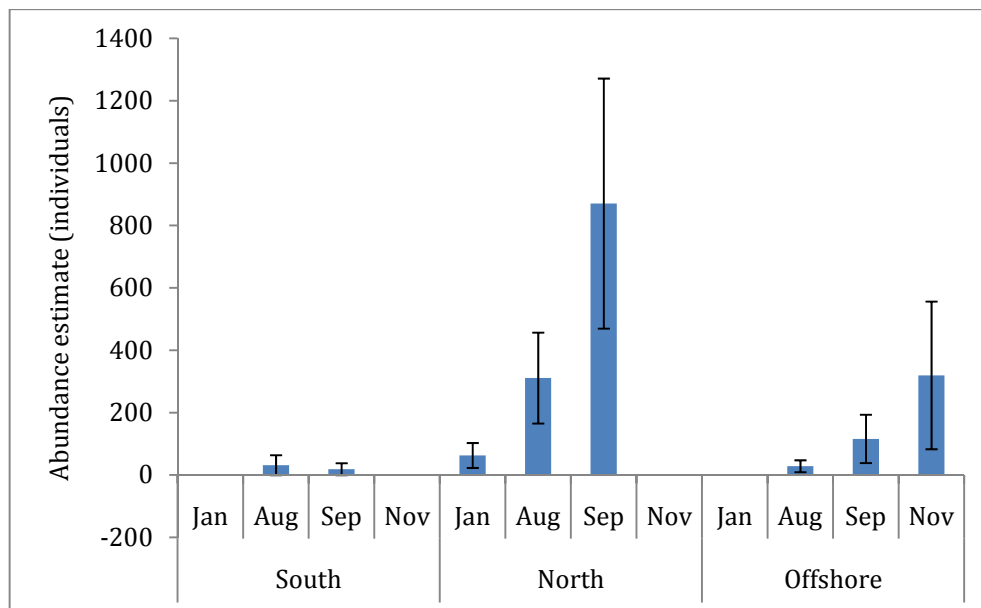


**Figure 4-69: Seasonal estimates (+/- SE) of abundance of kittiwakes in the proposed EOWDC and 'control' areas; February 2007 – January 2008.**

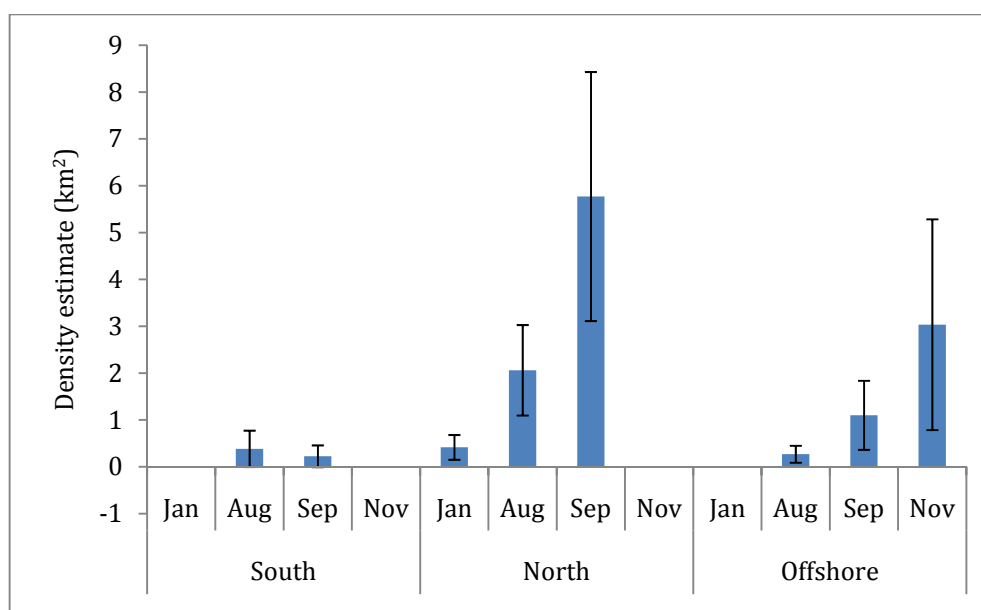


**Figure 4-70: Seasonal estimates (+/- SE) of density of kittiwakes in the proposed EOWDC and 'control' areas.**





**Figure 4-71: Monthly estimates (+/- SE) of abundance of Black-legged Kittiwake in the South, North and Offshore Strata; August 2010 to January 2011.**



**Figure 4-72: Monthly estimates (+/- SE) of density of Black-legged Kittiwake in the South, North and Offshore Strata; August 2010 to January 2011.**

### Vantage Point surveys

Vantage Point counts at four locations within Aberdeen Bay recorded kittiwakes throughout the year. Peak numbers were of up to 160 birds per hour during August 2005 and 200 birds per hour in July 2006 but numbers of passing birds were more frequently at <100 birds per hour (EnviroCentre 2007a, Alba Ecology 2008a). During the winter months there were considerably fewer kittiwakes present in Aberdeen Bay with less than 10 birds per hour recorded (Alba Ecology 2008b) Birds were recorded out to 3 km from shore with peak numbers within 1-3 km and at least 42% of sightings were of birds flying between 30-150 m from the sea surface.

### Bird Detection Radar

One kittiwake was recorded at Easter Hatton during the Radar studies undertaken in October 2005 (Walls *et al.* 2005) and 26 were recorded during April 2007 radar surveys at a rate of 0.5 birds per hour (Simms *et al.* 2007).

#### 4.25.3 Summary of Results

Kittiwakes were recorded throughout Aberdeen Bay in highly seasonally variable numbers. During the winter periods very few kittiwakes were recorded. However during the breeding season kittiwakes were frequently recorded with estimated populations within the 'control' area during this period of 1,676 birds and 663 birds in the proposed EOWDC development area. Peak densities of 33 birds/km<sup>2</sup> were recorded to the north of the proposed development during the summer months. Land-based observations also recorded peak numbers during the summer months with a peak in July. Of those for which flight height was recorded, 22% were greater than 25 m above the sea surface.

The majority of sightings were between 1 km and 3 km from the coast.

#### 4.25.4 Initial Assessment of Significance

Kittiwake	Overall sensitivity	Magnitude	Significance
Collision	Medium	Medium	Minor
Barrier	Very High	Low	Minor
Displacement	Medium	Low	Negligible

#### 4.25.5 Species Sensitivities

##### Qualifying species

Kittiwake is a qualifying species for four SPAs within the region: Buchan Ness to Collieston, Fowlsheugh, Troup, Pennan & Lion's Head and Forth Islands SPAs.

##### Flight height

Flight altitude data obtained from boat-based surveys reported 22% of flights at above 25 m.

Elsewhere out of over 14,000 recorded flight altitudes for kittiwake 13% were at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that kittiwakes are widespread and frequent within Aberdeen Bay and with a distinct seasonal peak during the summer months.

Collision Risk Modelling undertaken for kittiwake is based on:

- Body length of 39 cm
- Wingspan of 108 cm

- Flight speed of 10.5 m.s<sup>-1</sup>

The Collision Risk Modelling is based on a collision probability of 11.9% and been undertaken over a range of avoidance rate from 98%, 99% and 99.5% have been used.

**Table 4-23: Predicted number of collisions per year for kittiwake**

Collision probability	Avoidance rate (%)		
	98	99	99.5
11.9%	3.6	1.8	0.9

Based on the precautionary avoidance rate of 98% it is predicted that a total of four collisions per year may occur (Table 4-23).

The annual mortality rate for kittiwake is 6% (BTO 2011). Consequently, out of a peak local population of 2,339 individuals in both the 'control' and EOWDC areas during summer 2007 an annual mortality of 140 kittiwakes may be predicted. Based on the regional SPA population of kittiwakes of 83,156 individuals, the annual mortality rate will be 4,989 individuals and therefore the 1% baseline mortality rate is 50 birds per year. The results from the Collision Risk Modelling predict a total of four kittiwakes per year may collide with the wind turbines.

The Buchan Ness to Collieston Coast SPA lies approximately 9.5 km away from the proposed development and holds approximately 25,000 breeding kittiwakes, based on the latest available counts in 2007. The colony will therefore have an annual mortality of 1,505 birds. It is likely that many of kittiwakes recorded within Aberdeen Bay during the breeding period are associated with this colony. The results from the collision risk modelling which predict a mortality of four kittiwakes per year, indicate that there will not be an adverse effect on the population of kittiwakes associated with the SPA based on the precautionary assumption that an increase of 1% above baseline mortality could be adverse, i.e. more than 15 kittiwakes a year collide with the turbines.

The Fowlsheugh SPA lies 31 km away from the proposed development and holds 11,140 breeding pairs of kittiwake based on latest counts. Therefore, the annual mortality rate from this colony is 1,337 birds per year. Based on the results from the collision risk modelling it is concluded that if all the kittiwakes at risk of collision are from Fowlsheugh then there is unlikely to be an adverse effect on the SPA population.

The Troup Pennan & Lion's Head SPA lies 74.3 km to the north of the proposed development and holds 29,792 breeding kittiwakes. The annual mortality is estimated to be 1,787 birds per year and consequently, based on a 1% of annual mortality threshold, an adverse effect on kittiwakes from this colony is not predicted.

The Forth Islands SPA is approximately 124 km to the south and holds 4,632 breeding kittiwakes. However, the maximum foraging range for kittiwakes reported is 83 km (Roos 2010) and therefore the SPA is outwith the maximum foraging range for breeding kittiwakes and there will not be an adverse effect on the population due to collision.

Based on the results of the Collision Risk Modelling and the current regional and SPA populations, it is predicted that that the potential population affect caused by collision impacts with the proposed development on kittiwakes is negligible.

#### Barrier effect

Data from post-construction monitoring studies undertaken in Denmark indicate that although kittiwakes may make some avoidance response they are generally not affected by offshore wind turbines and do not avoid entering wind farms.

Consequently, there is not thought to be a significant barrier effect on kittiwakes from the proposed development (Zucco *et al.* 2006).

### **Displacement**

Although during periods of construction the number of kittiwakes present in the area may be reduced once in operation evidence to suggest that kittiwakes may be attracted to the area. Therefore no displacement is predicted.

### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on kittiwakes.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth all of which have the potential to contribute to a possible cumulative and in-combination effects. The only data available is that from the Beatrice Demonstrator Project which recorded 2,943 kittiwakes over a period of 12 months of pre-construction surveys (Talisman 2005). Collision Risk Modelling undertaken for the Beatrice Demonstrator Project predicted up to 9 kittiwakes per year may collide with the two turbines. The effect from the potential collisions was concluded not to be significant.

The size, scale and exact locations of the Round 3 wind farms and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of kittiwakes that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, based on the known distribution and behaviour of kittiwakes it is predicted that they will be widespread across many of the possible areas at which wind farms may, in the future, be constructed.

## **4.25.6 Conclusions**

### **Habitats Appraisal**

There are four SPAs for which kittiwakes are a qualifying species in the region and based on the results from the Collision Risk Modelling which predicts an annual collision mortality rate of four birds per year and the likely foraging ranges kittiwakes it is predicted that there will not be an adverse effect on the SPAs.

### **Environmental Impact Assessment**

Based on the results from Collision Risk Modelling undertaken and the potential number of kittiwakes, which may collide with the proposed development. It is predicted that there will not be a significant impact arising from the proposed development on regional population of kittiwakes.

## 4.26 Black-headed gull (*Larus ridibundus*)

### 4.26.1 Protection & Conservation Status

The black-headed gull is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.26.2 Background

Black-headed gull		
GB population	Breeding: 130,000 prs Wintering: 2.1 – 2,200,000 ind	Mitchell <i>et al</i> 2004 BTO 2011
Scottish population	Breeding: 43,200 AoN Wintering: 155,500 ind.	Forrester <i>et al.</i> 2007
International threshold	20,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	19,000 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	None	SNH 2011 JNCC 2011a
European population estimate	Breeding 1.5 – 2,200,000 pairs Wintering – >3,200,000 individuals	Birdlife 2004
European population trend	Status 'secure' Trend 'moderate decline'	Birdlife 2004
World population	2.1 – 2,800,000 pairs	Mitchell <i>et al</i> 2004

Black-headed gulls are the most widespread seabird breeding in Britain and Ireland with similar numbers nesting inland as on the coast. The majority of the breeding population is semi-resident with the majority of the UK population undertaking only localised seasonal movements. However, the UK wintering population is bolstered by birds from northern and eastern Europe.

Outside the breeding season black-headed gulls occur in inshore tidal waters largely avoiding rocky or exposed coasts, preferring inlets, bays and estuaries with sandy or muddy beaches (Snow & Perrins 1998). Black-headed gulls are primarily a coastal species and are scarce offshore.

In North-east Scotland black-headed gulls occur throughout the year with peak numbers at Peterhead between July and February with nearly all sightings of birds passing Peterhead within 200 m of the coast (Innes 1994). The number of wintering black-headed gulls is 13,500 individuals of which nearly 12,000 are found along the coast (Forrester *et al.* 2007).

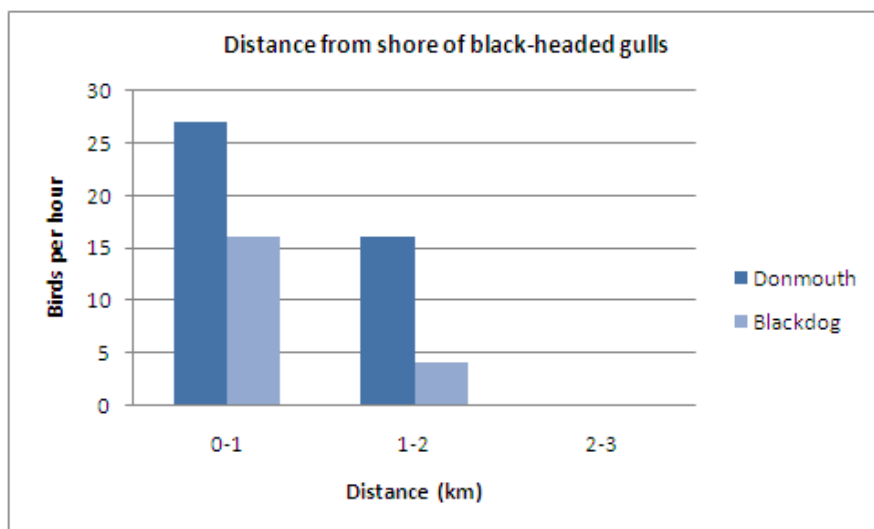
### Boat-based surveys

Nine sightings of black-headed gulls were made from boat-based surveys undertaken between February 2007 and January 2008. Eight of the nine sightings were made in November and all were inshore (IECS 2008).

### Vantage Point surveys

Black-headed gulls occur throughout the year in Aberdeen Bay but there were large variations in numbers between years. In 2006, peak numbers occurred in June with up to 5 birds per hour passing all within 2 km of the coast and the majority within 1 km (EnviroCentre 2007a). However, in 2007 peak counts occurred in July and August when up to 90 birds per hour passed the Donmouth (Alba Ecology 2008a). During the winter months numbers of black-headed gulls recorded were much lower with a peak count of less than 30 birds per hour in February 2008 (Alba Ecology 2008b). In 2006, 48% of sightings were within the 30-150 m height band across all

vantage point sites and in 2007, 9% were within the same height band (Alba Ecology 2008a).



**Figure 4-73: Number of black-headed gulls per hour recorded off Aberdeen Bay from Vantage Point Counts April 2006 – March 2008 and their distance from shore.**

#### Bird detection Radar

One-hundred and forty-three black-headed gulls were recorded from observations undertaken during Bird Detection Radar surveys in October 2005 (Walls *et al.* 2006). Fourteen were recorded at Blackdog over a seventeen day period in April 2007 (Simms *et al.* 2007).

#### 4.26.3 Summary of Results

Black-headed gulls were rarely recorded from boat-based surveys with most observations made from Vantage Point surveys. Numbers of black-headed gulls varied between years and across the seasons. Lowest numbers were during the winter months and peak counts from between June and August. Peak counts were of up to 90 birds per hour passing the Donmouth during July and August.

The majority of sightings were within 1 km of the coast there were very few records beyond 2 km from the shore. Of those recorded in flight up to 48% were recorded flying between 30 m and 150 m but numbers at these heights varied considerably.

No counts of black-headed gulls from any of the surveys were of national importance.

#### 4.26.4 Initial Assessment of Significance

Black-headed gull	Overall sensitivity	Magnitude	Significance
Collision	High	Negligible	Negligible
Barrier	Low	Low	Negligible
Displacement	Low	Negligible	Negligible

#### 4.26.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the region for which black-headed gull is a qualifying species.

##### Flight height

Only four observations of flight altitudes were obtained from boat-based surveys. All were of birds flying below 25 m.

Elsewhere, out of 16,358 recorded flight altitudes for black-headed gull 13% were at rotor height.

##### Collision risk

Data obtained from boat-based and land-based surveys recorded black-headed gulls mainly within 1 km of the coast with most records during the summer months and lower numbers during the winter. Data from coastal wind farms have recorded relatively low avoidance behaviour towards wind turbines by black-headed gulls and they are known to collide with turbines. However, nearly all the sightings of black-headed gull were within 2 km of the coast and the majority were within 1 km (Figure 4-73). Boat-based surveys recorded very few black-headed gulls offshore.

Based on the very few records of black-headed gull in the vicinity of the proposed development there is considered to be a very low risk of collision and, should it occur, its significance on the species will be negligible.

##### Barrier effect

Data from post-construction monitoring studies undertaken in Denmark indicate that black-headed gulls are generally not affected by offshore wind turbines and do not avoid entering wind farms. Consequently, there is not thought to be a significant barrier effect (Zucco *et al.* 2006).

##### Displacement

Very few black-headed gulls were recorded within the area of the proposed development and black-headed gulls are not known to show any significant displacement effects. There is no indication of any potential displacement effect but should it occur its significance is predicted to be negligible.

##### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on black-headed gulls.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded six black-headed gulls over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of black-headed gulls that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, based on the known behaviour of black-headed gulls, in particular their coastal distribution it is predicted that the risk of any cumulative or in-combination effects is low and the consequences negligible.



#### 4.26.6 **Conclusions**

##### **Habitats Appraisal**

There are no SPAs in the region for which black-headed gull is a qualifying species.

##### **Environmental Impact Assessment**

Based on the relatively low numbers of black-headed gulls recorded in Aberdeen Bay and that were not recorded in the proposed development area it is predicted that there will not be a significant impact arising from the proposed development on black-headed gulls.

## 4.27 Common gull (*Larus canus*)

### 4.27.1 Protection & Conservation Status

The common gull is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.27.2 Background

Common gull		
GB Population	Breeding: 48,000 prs Winter: 620 – 721,000 ind.	BTO 2011
Scottish population	Breeding: 48,100 AoN Winter: 79,700 ind.	Forrester <i>et al.</i> 2007
International threshold	20,000 ind.	Calbrade <i>et al.</i> 2010
GB threshold	9,000 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	None	SNH 2011 JNCC 2011a
European population estimate	Breeding 590,000 – 1,500,000 pairs Wintering – >910,000	Birdlife 2004
European population trend	Status 'depleted' Trend 'unknown'	Birdlife 2004
World population	2,500,000 – 3,700,000 pairs	Birdlife 2011

Common gulls occur throughout much of Scotland breeding in colonies usually inland and foraging in fields, estuaries and nearshore waters. During the autumn the UK population is augmented by migrants from northern Europe that winter in the UK. In Scotland an estimated 100,000 to 200,000 common gulls occur during the spring and autumn passage (Forrester *et al.* 2007).

During the breeding season common gulls remain close to shore with relatively few sightings of common gulls from offshore waters. Outwith the breeding season common gulls disperse southward to southern Scotland and England but wintering birds remain largely in nearshore waters often occurring in large numbers in river estuaries where large roosts can occur. Spring passage occurs during March and April across a broad front.

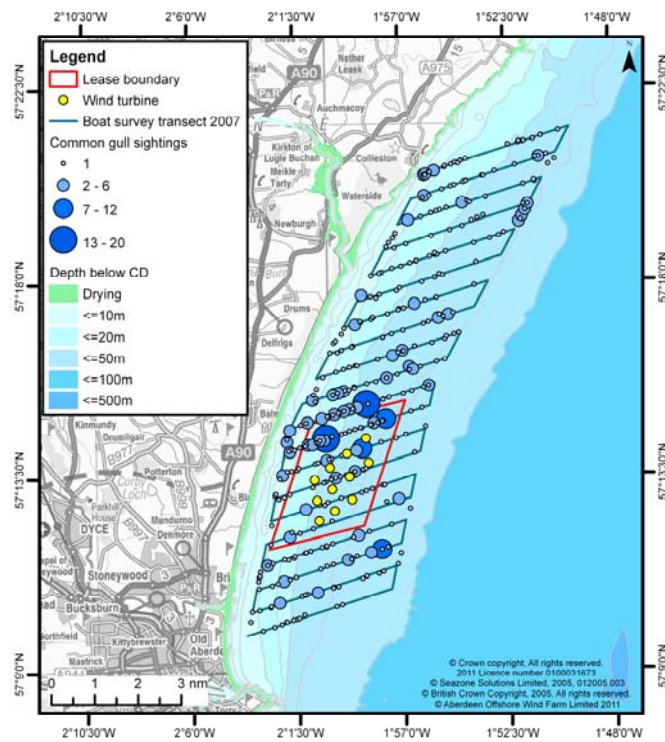
In North-east Scotland peak numbers occur on the Ythan Estuary during October and November and there is some evidence of a spring and autumn passage of birds past Peterhead. Relatively few common gulls nest along the coast although an increasing population have nested on the flat roofs of nearby industrial estates since 1984. Historically there were large breeding colonies inland up Deeside where there were up to 17,000 pairs in the Coreen Hills up Deeside. Up to 900 birds per month were recorded passing Peterhead during July and August (Buckland, Bell & Picozzi 1990).

### Boat-based surveys

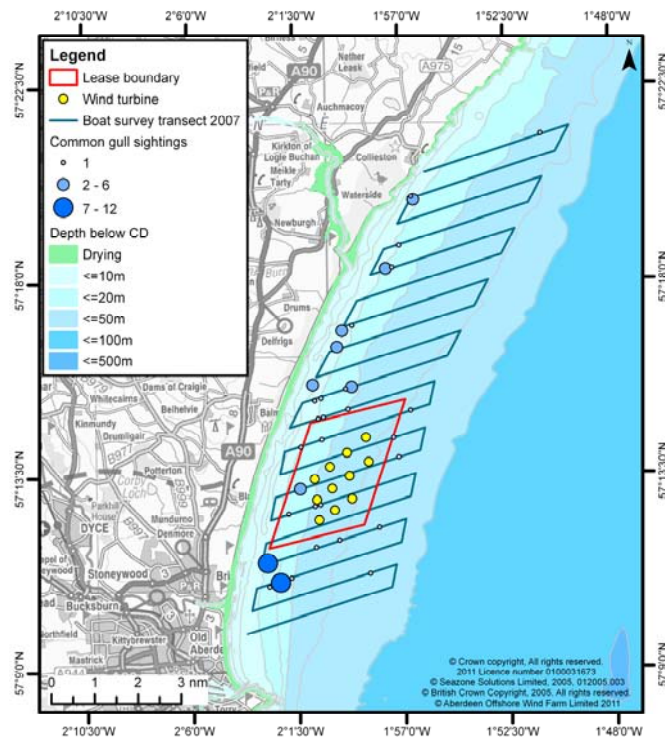
Common gulls were recorded throughout the year in Aberdeen Bay from boat-based surveys. Numbers were highest during the autumn, particularly November and February and March. Very few common gulls were recorded during June and July (Figure 4-77). Although common gulls were widely recorded throughout the surveyed area the majority of records during the winter were off Balmedie between 2 km and 3 km from shore and within the northern part of the proposed development area.

During the breeding season significantly fewer common gulls were recorded and most records were in nearshore waters with few birds recorded within the footprint of the proposed development (Figure 4-75).

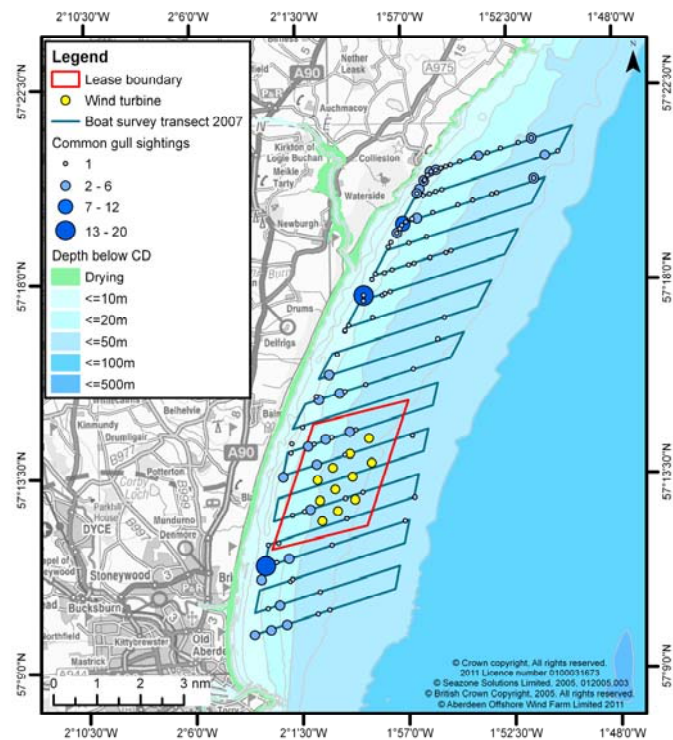
Post-breeding, the numbers of common gulls within Aberdeen Bay increased with widely scattered records in predominantly nearshore waters (Figure 4-76)



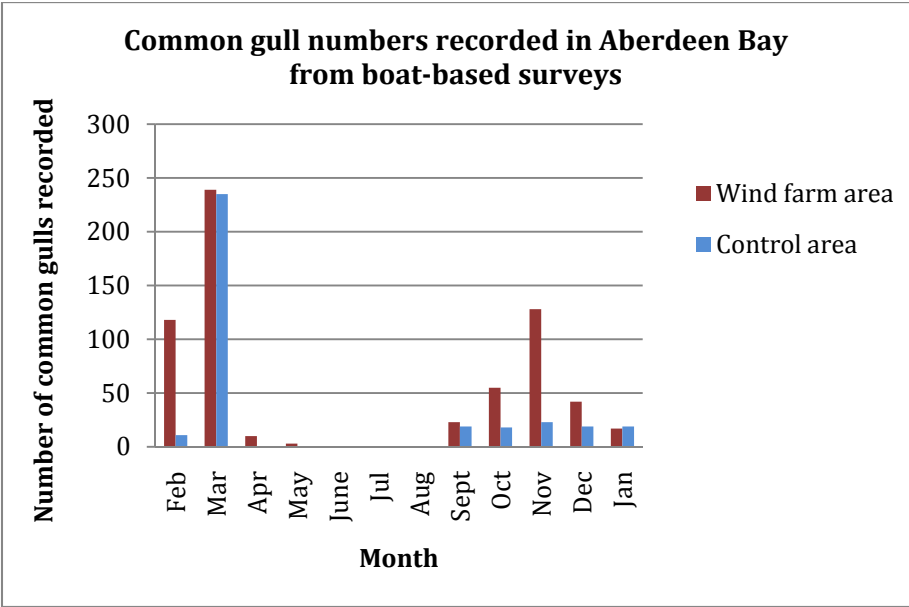
**Figure 4-74: Common gull distribution in Aberdeen Bay during winter period: November to March (all sightings).**



**Figure 4-75: Common gull distribution during breeding season: April to July (all sightings).**



**Figure 4-76: Common gull distribution during post-breeding: August to October (all sightings).**

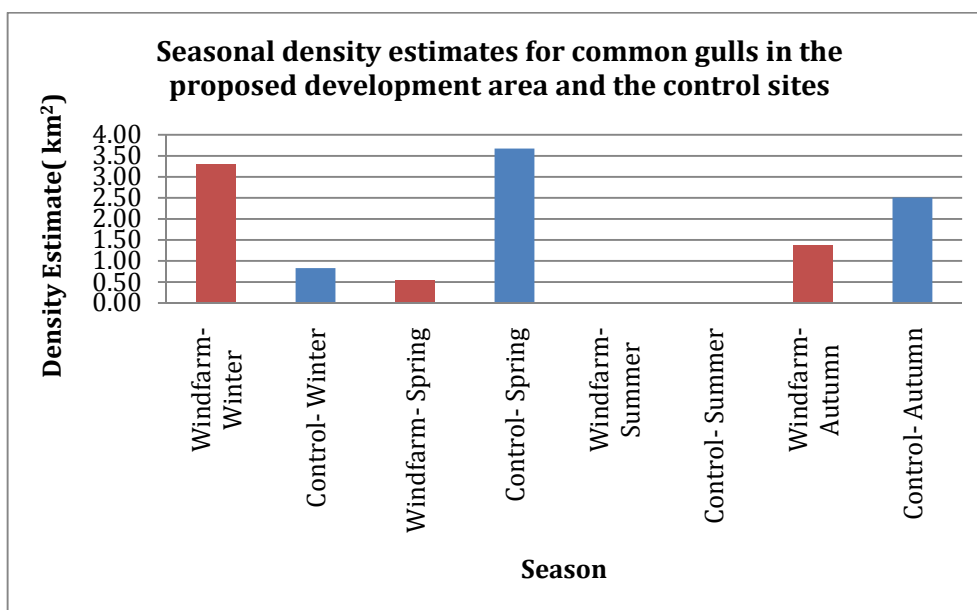


**Figure 4-77: Common gull monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

There were not enough sightings to undertake a monthly assessment using *Distance*. However, estimated densities on seasonal basis were able to be calculated and estimated peak autumn and spring abundances of 128 and 187 birds respectively. During the autumn and spring peak numbers occurred in the 'control' survey area whilst in the winter peak numbers occurred in the proposed development area (Table 4-24, Figure 4-78).

**Table 4-24: Seasonal estimates of density and abundance of Common gulls in the proposed EOWDC and 'control' areas.**

Season	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
EOWDC - Winter	3.300	1.071	168	54.4	47
Control- Winter	0.832	0.239	42	12.1	24
EOWDC - Spring	0.535	0.529	27	26.9	9
Control- Spring	3.673	2.193	187	111.4	16
EOWDC - Summer	0.000	0.000	0	0.0	0
Control - Summer	0.000	0.000	0	0.0	0
EOWDC- Autumn	1.365	0.630	69	32.0	15
Control - Autumn	2.510	1.772	128	90.0	9



**Figure 4-78: Seasonal estimates of density (+/- SE) of Common Gulls in the proposed EOWDC and 'control' areas**

#### Vantage Point surveys

In Aberdeen Bay common gulls were recorded throughout the year with peak numbers during periods of passage when up to 130 birds per hour passed Balmedie in April 2007, 150 birds per hour in February 2008 and up to 60 birds per hour passing during August 2006 (Alba Ecology 2008a,b; EnviroCentre 2007a). The majority of sightings were within 0-2 km of the coast with up to 50% of birds flying between 30-150 m.

### Bird Detection Radar

A total of 490 common gulls were recorded during the Bird Detection Radar studies undertaken at Drums and Easter Hatton during October 2005. Eighty per-cent of sightings were made at Drums (Walls *et al.* 2006).

In April 2007, 336 common gulls were recorded over a seventeen day period at Blackdog at a rate of 6.5 birds per hour. The mean flock size was of six birds but a maximum flock of 68 was recorded (Simms *et al.* 2007).

#### 4.27.3 Summary of Results

Common gulls were recorded throughout the year with peak numbers during early spring and early autumn with peak counts of up to 150 birds per hour in February 2008. There were relatively few sightings during the breeding season and no sightings from boat-based surveys in August when up to 60 birds per hour were recorded from Vantage Point surveys.

The majority of sightings were within 2 km of the coast with relatively few records beyond 2 km from the shore. Of those recorded in flight up to 50% were recorded flying between 30 m and 150 m.

No counts of common gull from any of the surveys within Aberdeen Bay were of national importance.

#### 4.27.4 Initial Assessment of Significance

Common gull	Overall sensitivity	Magnitude	Significance
Collision	Medium	Negligible	Negligible
Barrier	Low	Low	Negligible
Displacement	Low	Negligible	Negligible

#### 4.27.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the region for which common gull is a qualifying species.

##### Flight height

Observations from boat-based surveys recorded 33% of flight at above 25 m (n=494). Data from onshore surveys recorded up to 30% of flight heights as being above 30 m.

Elsewhere, out of 5,074 recorded flight altitudes for common gull, 21% were at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that common gulls are widespread throughout Aberdeen Bay, particularly between November and March (Figure 4-74).

Collision Risk Modelling undertaken for common gull is based on

- Body length of 41 cm
- Wingspan of 120 cm



- Flight speed of 13.4 m.s<sup>-1</sup>

Collision Risk Modelling was undertaken based on a collision probability of 9.6% and across various avoidance rates of 98%, 99% and 99.5%.

**Table 4-25: Predicted number of collisions per year for common gull.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
9.6%	4.9	2.4	1.2

Based on the precautionary avoidance rate of 98% it is predicted that a total of 4.9 collisions per year may occur (Table 4-25).

The annual mortality rate for common gull is 14% (BTO 2011). Consequently, out of a peak Aberdeen Bay population of 474 individuals in both the 'control' and potential development areas during March (Figure 4-77), an annual mortality of 66 common gulls may be predicted. Therefore, 1% of the baseline mortality is <1 bird per year. The regional coastal breeding population comprising of roof nesting birds in and around Aberdeen is estimated to be 1,240 breeding adults (Calladine *et al.* 2006) which will therefore have an annual mortality of 174 birds per year and a 1% baseline mortality of 2 birds. Should all the birds at risk of collision during the breeding season be from these colonies then it is predicted that at a 98% avoidance rate the effects from collision risk may be significant.

Based on the results from collision risk modelling, which predicts a total of nearly 5 collisions per year there may be a significant impact on common gull due to collisions.

However, studies relating to other species of gull have reported avoidance rates at greater than 99% and therefore it is predicted that the number of common gulls will be lower than has been indicated by the Collision Risk Modelling and is likely to be one to two birds per year.

### Barrier effect

Evidence from existing offshore wind farms indicate that offshore wind farms do not have a significant barrier effect on Gulls and there is no evidence for any potential barrier effect to common gulls (Zucco *et al.* 2006). However, should it occur, the relatively short increase in distance, estimated to be at most 3.2 km, that common gulls may have to fly is predicted not to be significant in terms of increased energetic expenditure. Consequently, the potential impact from the barrier effect is predicted to be negligible.

### Displacement

There is no evidence from any offshore wind farm that there will be any displacement effect on common gulls from offshore wind farms but should it occur its significance is predicted to be negligible.

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on black-headed gulls.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which did not record any common gulls over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of common gulls that



may be present in the planned development areas. However, the location of the proposed developments are further offshore and common gulls are not predicted to occur in significant numbers within these areas. Consequently, it is predicted that the risk of any cumulative or in-combination effects is low and the consequences negligible.

#### **4.27.6 Conclusions**

##### **Habitats Appraisal**

There are no SPAs within the region for which common gulls are listed as a qualifying species.

##### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on breeding common gulls.

## 4.28 Lesser black-backed gull (*Larus fuscus*)

### 4.28.1 Protection & Conservation Status

The Lesser-black backed gull is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.28.2 Background

Lesser black-backed gull		
GB population	Breeding: 110,000 prs Winter: 118 – 131,000 ind.	BTO 2011
Scottish population	Breeding: 25,000 AoN Winter: 200 – 600 ind.	Forrester <i>et al.</i> 2007
International threshold	5,500 ind.	Calbrade <i>et al.</i> 2008
GB threshold	500 ind.	Calbrade <i>et al.</i> 2008
Designated east coast sites where species is a noted feature	Forth Islands 2,920 prs	JNCC 2011a
European population estimate	Breeding 300,000 – 350,000 pairs Wintering – >130,000	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	910,000 – 1,100,000 'adults'	Birdlife 2011

The lesser black-backed gull breeds in colonies located around the UK coastline. There are approximately 110,000 breeding pairs in the UK, of which 21% occur in Scotland. In Scotland this species is principally a summer migrant with a small but increasing wintering population.

Lesser black-backed gulls occur in both inshore and offshore waters, often further offshore than many other species of gull during the breeding season. They are both scavengers and, offshore, fish often from fishing vessels.

In North-east Scotland the species is predominantly a summer migrant and is scarce during the winter months. At Peterhead passage of lesser black-backed gulls occurred between March and May with a peak in April with no records between October and February. The majority of sightings were within close proximity of the coast (Innes 1994).

### Boat-based surveys

Only two sightings of lesser black-backed gulls were made during boat-based surveys undertaken between February 2007 and January 2008. Both were in June of birds within the proposed EOWDC survey area (IECS 2008).

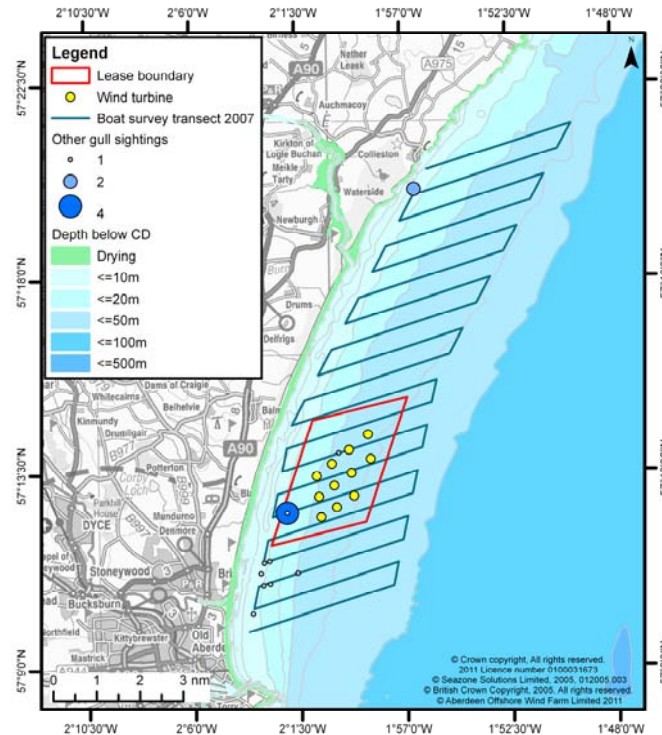
A further 40 lesser black-backed gulls were recorded throughout the surveyed area during September 2010.

### Vantage Point surveys

Lesser black-backed gulls were recorded in relatively low numbers at all Vantage Point sites between April and September. Peak counts occurred in June and July with up to two birds per hour recorded. Although lesser black-backed gulls were recorded out to 3 km from the shore, the vast majority were within 0-2 km from the shore. 40% of all flights were within the 30 -150 m height band. During the winter period, lesser black-backed gulls were scarce in Aberdeen Bay with nineteen records between October 2007 and March 2008 (Alba Ecology 2008b).

### Bird Detection Radar

Six lesser black-backed gulls were recorded during the radar studies undertaken in October 2005 and three at Blackdog during April 2007 (Walls *et al.* 2005, Simms *et al.* 2007).



**Figure 4-79: Other Gull distribution in Aberdeen Bay - February 2007 to April 2008 (all sightings).**

#### 4.28.3 Summary of Results

Lesser black-backed gulls were recorded in relatively low numbers between April and September with only two sightings from boat-based surveys and small numbers from land-based observations. Of those for which flight height was recorded, 40% were within 30 – 150 m of the sea surface.

The majority of sightings were within 2 km of the coast with relatively few records beyond 2 km from the shore.

No counts of lesser black-backed gull from any of the surveys within Aberdeen Bay were of national importance.

#### 4.28.4 Initial Assessment of Significance

Lesser black-backed gull	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Low	Minor
Displacement	Medium	Negligible	Negligible

#### 4.28.5 Species Sensitivities

##### Qualifying species

The only SPA in the region for which lesser black-backed gull is a qualifying species is Forth Islands SPA where 2,920 pairs nest.

##### Flight height

Observations of flight altitudes were obtained from Vantage Point surveys which recorded 40% of lesser black-backed gulls as flying between 30 m and 150 m.

Elsewhere, out of 24,481 recorded flight altitudes for lesser black-backed gull, 22% were at rotor height.

##### Collision risk

Data obtained from boat-based and land-based surveys recorded relatively few lesser black-backed gulls nearly all within 2 km of the coast and all but one during the summer months. Data from coastal wind farms have recorded relatively low avoidance behaviour towards wind turbines by lesser black-backed gulls and they are known to collide with turbines. However, as nearly all the sightings of lesser black-backed gull were within 2 km of the coast and therefore not at risk of collision with the proposed development and there were relatively few sightings it is considered that there is a very low risk of collision and, should it occur, its significance on the species will be negligible.

Although lesser black-backed gulls are known to forage up to 300 km from their colonies and therefore those from the Forth Islands SPA may be at risk of collision with the proposed development. The majority of foraging trips are considerably smaller and therefore not at risk (Camphuysen 1995; Ens *et al.* 2008).

##### Barrier effect

Data from post-construction monitoring studies undertaken in Denmark and Sweden indicate that lesser black backed gulls are generally not affected by offshore wind turbines and do not avoid entering wind farms. Consequently, there is not thought to be a significant barrier effect (Zucco *et al.* 2006).

##### Displacement

Very few lesser black-backed gulls were recorded within the area of the proposed development and they are not known to show any significant displacement effects. There is no indication of any potential displacement effect but should it occur its significance is predicted to be negligible.

##### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on black-headed gulls.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which did not record any lesser black-backed gulls over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of gulls that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, based on the known behaviour of lesser black-backed gulls they may occur in the areas of the proposed developments but are predicted to

be in relatively low densities it is therefore predicted that the risk of any cumulative or in-combination effects is low and the consequences negligible.

#### 4.28.6 **Conclusions**

##### **Habitats Appraisal**

The only SPA for which lesser black-backed gull is a qualifying species is the Forth Islands SPA, which is 124 km away. Although within the potential foraging range of lesser black-backed gull, the numbers recorded from boat-based and land-based surveys were low and consequently it is predicted that there not be an adverse effect on the SPA.

##### **Environmental Impact Assessment**

Based on the relatively low numbers of lesser black-backed gulls recorded in Aberdeen Bay it is predicted that there will not be a significant impact arising from the proposed development on lesser black-backed gulls.

## 4.29 Herring gull (*Larus argentatus*)

### 4.29.1 Protection & Conservation Status

The herring gull is listed in Appendix III of the Bern Convention and is on the Red List of Species of Conservation Concern.

### 4.29.2 Background

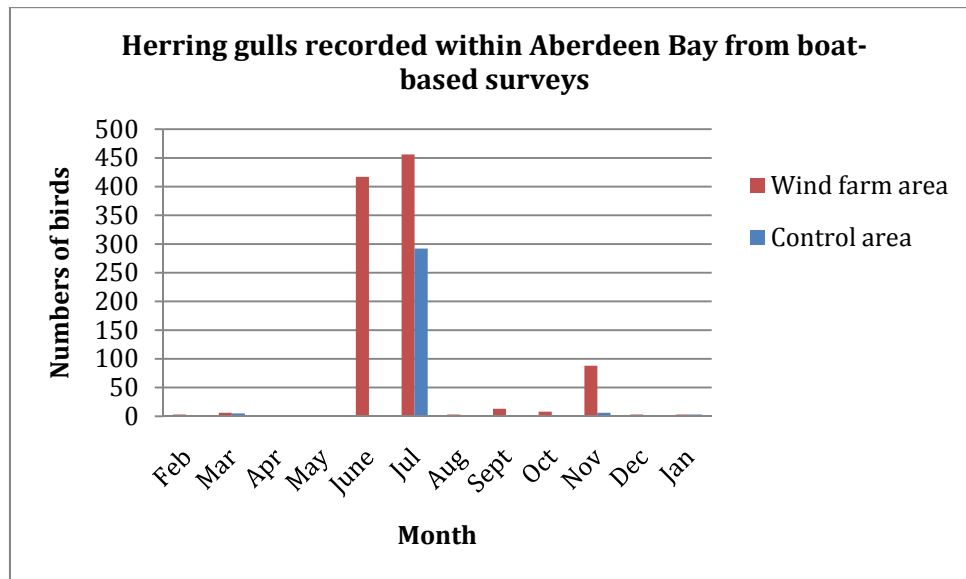
Herring gull		
GB Population	Breeding: 131,000 pairs	BTO 2011
Scottish population	Breeding: 72,000 AoN Wintering: 91,000 ind.	Forrester <i>et al</i> 2007
International threshold	5,900 ind	Calbrade <i>et al.</i> 2010
GB threshold	4,500 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Buchan Ness to Collieston – 3,079 AoN (2007) Fowlsheugh – 122 AoN (2008) Forth Islands – 6,600 prs Troup Pennan & Lion's Heads – 4,200 prs	SNH 2011 JNCC 2011a
European population estimate	Breeding 764,000 – 1,400,000 prs Wintering – >800,000	Birdlife 2004
European population trend	Status 'secure' Trend 'overall increase'	Birdlife 2004
World population	2,700,000 – 5,700,000 'adults'	Birdlife 2011

Herring gulls are widespread around the British coasts with largest concentrations along rocky coastlines of northern and western Scotland and north-west England. Following breeding, there is a general southerly movement of herring gulls with breeding birds at any one area replaced by birds from more northerly colonies. They are opportunistic feeders, scavenging and predating a wide range of foods. At sea, herring gulls forage extensively around fishing vessels.

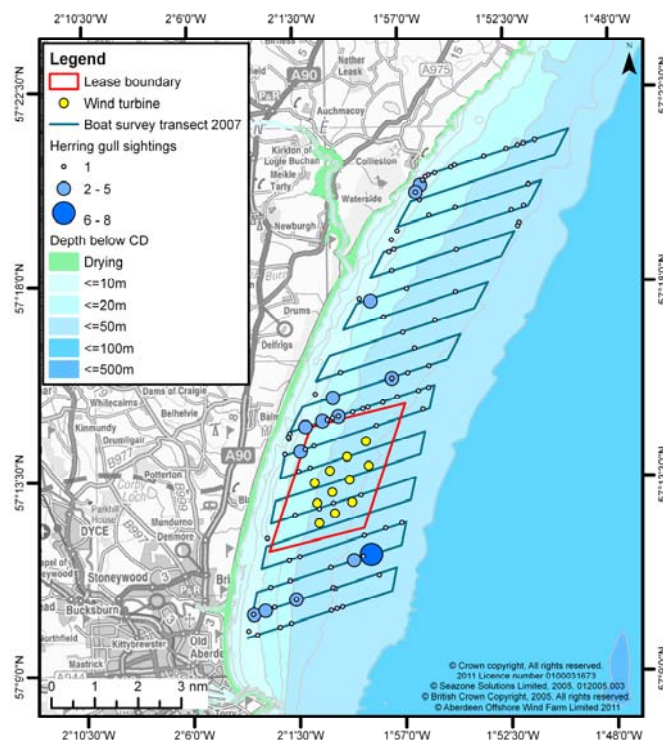
In North-east Scotland the breeding population has decreased since the 1960's when 42,500 apparently occupied nests were recorded to 15,000 in 2002. They occur throughout the year in North-east Scotland and a spring passage has been recorded past Peterhead between March and June and peak numbers occur from July and August (Innes 1994).

### Boat-based survey

Herring gulls were recorded throughout the year within Aberdeen Bay but there was distinct seasonal variations in the numbers of herring gull present with relatively low numbers present between November and March (Figure 4-81), with a significant increase in the number of birds during the breeding season, particularly in June and July (Figure 4-82; Figure 4-80). Following breeding the number of herring gulls decreased with just a few birds recorded offshore (Figure 4-83). Peak population estimates within the wider proposed EOWDC development area occurred during June and July with up to 456 birds recorded during July. Of those recorded in flight 40% of herring gulls were flying above 25 m.

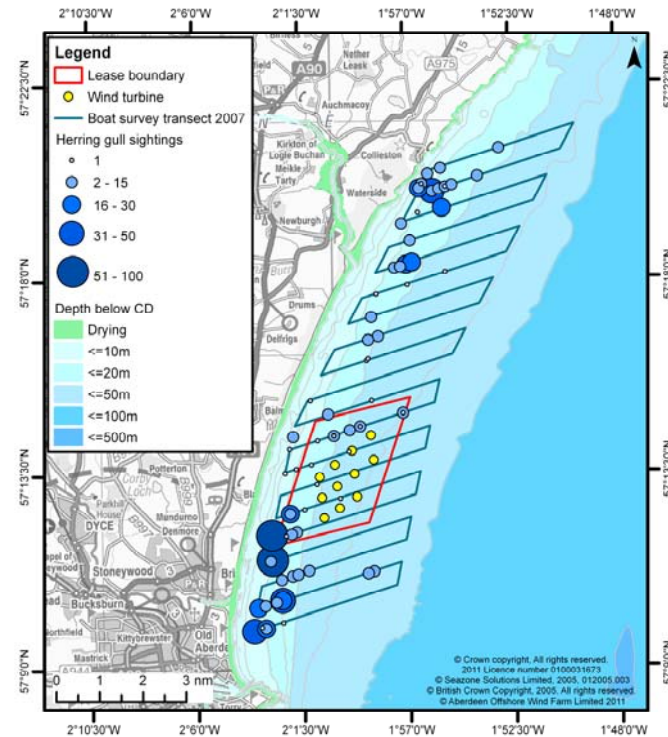


**Figure 4-80: Herring gull monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

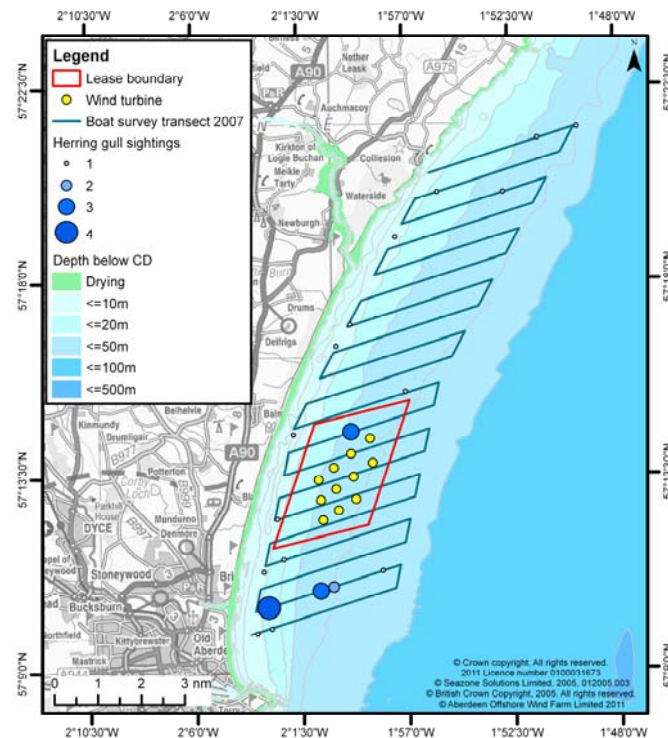


**Figure 4-81: Herring gull distribution during winter period: November to March (all sightings).**





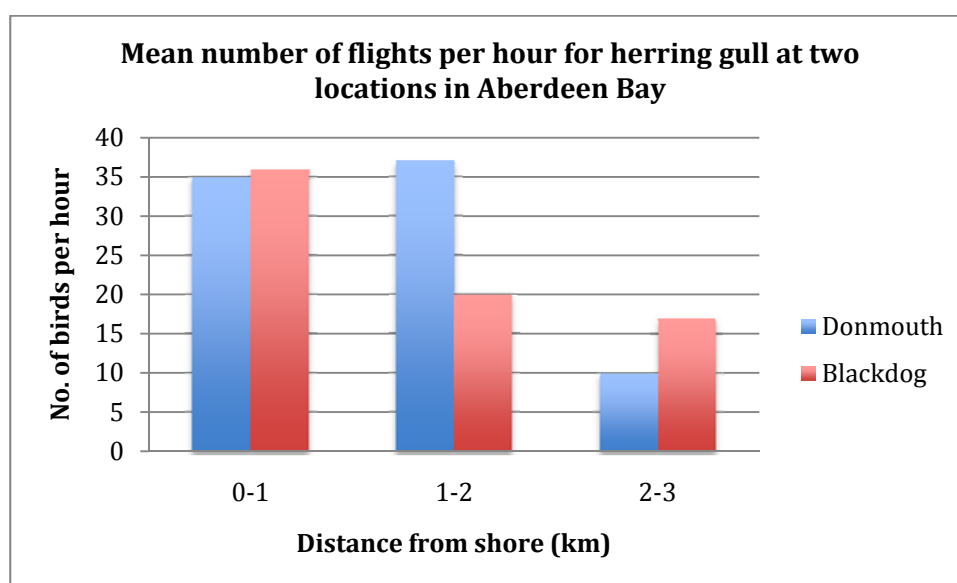
**Figure 4-82: Herring gull distribution during breeding season: April, May, September and October (all sightings).**



**Figure 4-83: Herring gull distribution during post-breeding: June to August (all sightings).**

### Vantage Point surveys

Vantage point counts undertaken in Aberdeen Bay between March 2005 and October 2005 and again from April 2006 to March 2008 recorded herring gulls during every month and across all four survey sites. Peak numbers occurred during June when up to 240 birds per hour were recorded with 50% of all records within the 30-150 m height band (Alba Ecology 2008a, EnviroCentre 2007a). During the winter months herring gulls were still regularly recorded with generally less than 100 birds per hour, with a peak of 180 birds per hour at the Donmouth in March 2008 (Alba Ecology 2008b). The majority of all sightings were within 2 km of the coast with considerably fewer sightings beyond 2 km (Figure 4-84). Of those in flight 48% of herring gulls were recorded as flying between 30-150 m.



**Figure 4-84: Mean number of herring gulls per hour passing two Vantage Points in Aberdeen Bay and their distance from shore.**

### Bird Detection Radar

Three hundred and eighty herring gulls were recorded during the Radar studies in October 2005. The majority of birds were recorded at Drums where 86% of all sightings occurred (Walls *et al.* 2005).

A total of 34 herring gulls were recorded during seventeen days of observations undertaken at Blackdog during April 2007 (Simms *et al.* 2007).

#### 4.29.3 Summary of Results

Herring gulls were recorded throughout the year with peak numbers from boat-based surveys during June and July and relatively few records during other times of year. Land-based observations recorded higher numbers of herring gulls than the boat-based surveys in particular during the winter and spring periods when few if any were seen offshore.

The majority of sightings were within 2 km of the coast with relatively few records beyond 2 km from the shore. Of those recorded in flight up to 50% were recorded flying between 30 m and 150 m.

No counts of herring gull from any of the surveys within Aberdeen Bay were of national importance.

#### 4.29.4 Initial Assessment of Significance

Herring gull	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Medium	Minor
Displacement	Medium	Negligible	Negligible

#### 4.29.5 Species Sensitivities

##### Qualifying species

Herring gull is a qualifying species for four SPAs that could potentially interact with the proposed development: Buchan Ness to Collieston, Fowlsheugh and Forth Islands SPAs, Troup Pennan & Lion's Heads.

##### Flight height

Flight altitude data obtained from boat-based surveys reported 40% of flights at above 25 m.

Elsewhere, out of nearly 15,000 recorded flight altitudes for herring gull 24% were at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that herring gulls are widespread and frequent within Aberdeen Bay and with a distinct seasonal peak during the summer months.

Collision Risk Modelling undertaken for herring gull is based on:

- Body length of 60 cm
- Wingspan of 144 cm
- Flight speed of 13.4 m.s<sup>-1</sup>

The Collision Risk Modelling is based on a collision probability of 11% and been undertaken over a range of avoidance rate from 98%, 99% and 99.5% have been used.

**Table 4-26: Predicted number of collisions per year for herring gull.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
11%	7.2	3.6	1.8

Based on the precautionary avoidance rate of 98% it is predicted that a total of 7.2 collisions per year may occur (Table 4-26).

Based on the regional SPA population of herring gulls of 19,562 individuals, the annual mortality rate will be 2,347 individuals and therefore the 1% baseline mortality

rate will be 235 birds per year. The results from the Collision Risk Modelling predict a total of 7 herring gulls per year may collide with the turbines.

The Buchan Ness to Collieston Coast SPA lies approximately 9.5 km away from the proposed development and holds approximately 6,158 breeding herring gulls. Based on the latest available counts in 2007. The colony will therefore have an annual mortality of 739 birds. It is likely that many of herring gulls recorded within Aberdeen Bay during the breeding period are associated with this colony. The results from the collision risk modelling predict an annual mortality of 7 herring gulls per year indicating that there will not likely be an adverse effect on the population of herring gulls associated with the SPA based on the precautionary assumption that an increase of 1% above baseline mortality could be adverse, i.e. more than 8 herring gulls a year collide with the turbines. However, the predicted mortality of 7 birds per year is close but it is based on a series of precautionary figures that assume the peak numbers recorded within the development area are constant throughout the year. It is therefore predicted that the number estimated to collide each year is precautionary as is the avoidance rates which have been reported as being greater than 99%.

The Fowlsheugh SPA lies 31 km away from the proposed development and holds 122 breeding pairs of herring gull based on latest counts. Therefore, the annual mortality rate from this colony is 14 birds per year. Based on the results from the collision risk modelling it is concluded that if all the herring gulls at risk of collision are from Fowlsheugh then there is the potential for an adverse effect on the SPA population

The Forth Islands SPA is approximately 124 km away and holds 13,200 herring gulls. However, the SPA is too far away for breeding herring gulls from the SPA to occur regularly, if at all, within the proposed development area during the breeding season. Therefore, there will not be an adverse effect on the population due to collision.

The number of herring gulls recorded within the proposed development area was lower than elsewhere, with the majority of sightings within 2 km of the coast (Figure 4-84). Data from tagging studies confirms that although maximum foraging distances may mean that birds from the SPAs could occur within the proposed development area they also show that the majority of foraging is very coastal and within the tidal zones. Consequently, it is predicted that the potential affect from collision risk on herring gulls is moderate to minor.

### **Barrier effect**

Data from post-construction monitoring studies undertaken in Denmark and Sweden indicate that although herring gulls may make some avoidance response they are generally not affected by offshore wind turbines and do not avoid entering wind farms. Consequently, there is not thought to be a significant barrier effect on herring gulls from the proposed development (Zucco *et al.* 2006).

### **Displacement**

There have been no reported displacement effects on herring gulls from offshore wind farms but some evidence of an increase in numbers within the constructed offshore wind farm areas. No displacement is predicted.

### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on herring gulls.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice

Demonstrator Project which recorded 193 herring gulls over a period of 12 months of pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of gulls that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, based on the known behaviour of herring gulls and that they remain largely within coastal waters it is predicted that the risk of any cumulative or in-combination effects is low and the consequences negligible.

#### **4.29.6 Conclusions**

##### **Habitats Appraisal**

There are three SPAs for which herring gulls are a qualifying species in the region and based on the results from the Collision Risk Modelling which predicts an annual collision mortality rate of up to seven birds per year and the likely foraging ranges herring gulls it is predicted that there will not be an adverse effect on the Forth Islands SPA but may be one for Fowlsheugh SPA.

##### **Environmental Impact Assessment**

Based on the results from Collision Risk Modelling undertaken and the potential number of herring gulls, which may collide with the proposed development and the likely foraging ranges of the herring gulls present in the region it is predicted that there will not be a significant impact arising from the proposed development on regional population of herring gulls.

### 4.30 Great black-backed gull (*Larus marinus*)

#### 4.30.1 Protection & Conservation Status

The great-black backed gull is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

#### 4.30.2 Background

Great black-backed gull		
GB population	Breeding: 17,000 prs Winter: 71 – 81,000 ind	Mitchell <i>et al</i> 2004 BTO 2011
Scottish population	Breeding: 14,800 AoN Winter: 7,500 – 10,000 ind	Forrester <i>et al.</i> 2007
International threshold	4,400 ind.	Calbrade <i>et al</i> 2010
GB threshold	400 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	None	SNH 2011 JNCC 2011a
European population estimate	Breeding 110,000 – 180,000 pairs Wintering – >150,000	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	540 – 750,000 'adults'	Birdlife 2011

The great black-backed gull is Britain's largest breeding gull. It occurs widely around UK coast, particularly in areas of rocky coastlines. It is an opportunistic feeder being a predator, scavenger and food pirate and frequently occurs around fishing vessels.

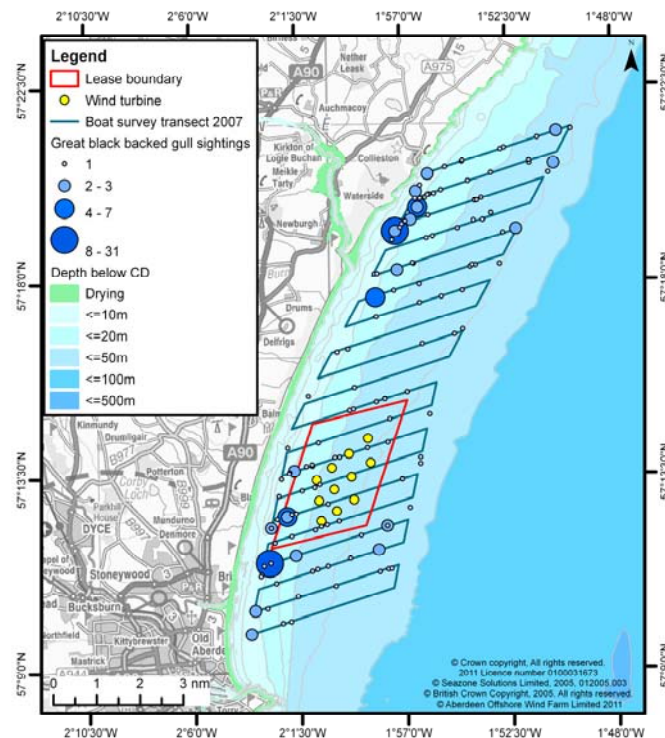
The UK population is approximately 17,000 pairs of which 14,800 are in Scotland and of those, the majority are in the north and west of Scotland. In North-east Scotland the great black-backed gull is a scarce breeding species with 72 pairs in 2002 (Forrester *et al.* 2007). The UK population is largely sedentary with some localised winter movements and migrants from northern Europe arriving during the winter.

In North-east Scotland great black-backed gulls occur around all coasts with numbers increasing from July and August onwards. No obvious passage of birds was detected at Peterhead during the ten years of observations undertaken between 1978 and 1988 (Innes 1994).

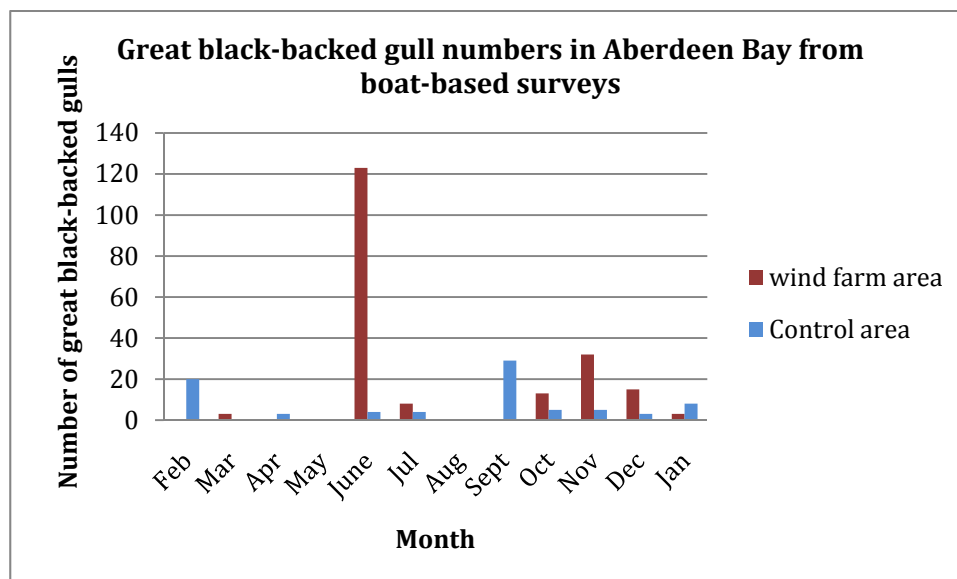
#### Boat-based surveys

Great black-backed gulls were recorded widely across Aberdeen Bay, predominantly within 1 to 2 km from the coast, throughout the year in relatively low numbers (Figure 4-85). Peak counts from boat-based surveys were during June with 127 birds in transect with relatively lower numbers during other months. The peak count in June included 123 birds within the EOWDC area that were associated with a fishing vessel and therefore causing a potentially inflated number of birds in a localised area. Aside from the peak count in June there was a notable increase in numbers during the autumn from September to December (Figure 4-86). Additional surveys undertaken between August 2010 and January 2011 recorded only five birds in August and increased up 19 birds across the whole surveyed area during November and January (SMRU 2011b).





**Figure 4-85: Great black-backed gull distribution in Aberdeen Bay February 2007 to January 2008 (all sightings).**



**Figure 4-86: Great black-backed monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

### Vantage Point surveys

Great black-backed gulls were recorded in Aberdeen Bay throughout the year with peak counts of up to 15 birds per hour in June 2006 and eight birds per hour in August 2007 (Alba Ecology 2008a, EnviroCentre 2008a). Relatively low numbers of six or less birds per hour were recorded during the rest of the year (EnviroCenter



2007b, Alba Ecology 2008b). Recorded flight heights of 'black-backed gulls' (both lesser and great-black-backed) indicate that 40% of all flights occur within 30-150 m from sea surface and the majority of flights are within 1 km of the coast.

### Bird Detection Radar

A total of 41 great-black-backed gulls were recorded during Bird Detection Radar studies in October 2005 (Walls *et al.* 2005) and one bird was recorded during 17 days of observations in April 2007 (Simms *et al.* 2007).

#### 4.30.3 Summary of Results

Great black-backed gulls were recorded in relatively low numbers throughout the year. Peak counts occurred in June when a flock was recorded associating with a fishing vessel. Land-based observations also recorded peak numbers during June and August. Outwith the breeding season the numbers of great black-backed gulls were lower. Of those for which flight height was recorded, 40% were within 30 - 150 m of the sea surface.

The majority of sightings were within 1 km of the coast with relatively few records beyond 1 km from the shore.

No counts of great black-backed gull from any of the surveys within Aberdeen Bay were of national importance.

#### 4.30.4 Initial Assessment of Significance

Great black-backed gull	Overall sensitivity	Magnitude	Significance
Collision	High	Low	Minor
Barrier	Low	Low	Negligible
Displacement	Low	Negligible	Negligible

#### 4.30.5 Species Sensitivities

##### Qualifying species

There are no SPAs in the region for which great black-backed gull is a qualifying species.

##### Flight height

Observations of flight altitudes were obtained from boat-based Surveys recorded 60% of great black-backed gulls as flying above 25 m.

Elsewhere 28% of great black-backed gulls have been recorded at rotor height.

##### Collision risk

Data obtained from boat-based and land-based surveys recorded relatively few great black-backed gulls with nearly all sightings within 2 km of the coast. Consequently, it is considered that there is a very low risk of collision and, should it occur, its significance on the species will be negligible.

### **Barrier effect**

Data from post-construction monitoring studies undertaken in Denmark indicate that there is no barrier effect on great black backed gulls from constructed wind farms (Zucco *et al.* 2006).

### **Displacement**

Data from operating wind farms indicate that great black-backed gulls may be attracted to offshore wind farms and that there are no displacement effects.

### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause a cumulative impact on black-headed gulls.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded 424 great-black backed gulls and predicted six collisions per year (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of gulls that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative impact arising from the proposed plans. Based on the known behaviour of great black-backed gulls they may occur in the areas of the proposed developments and be at risk of collision. However, based on the location and scale of the proposed development any cumulative impact will be relatively small and predicted to be negligible.

## **4.30.6 Conclusions**

### **Habitats Appraisal**

There are no SPAs in the region for which great black-backed gull is a qualifying species.

### **Environmental Impact Assessment**

Based on the low numbers of great black-backed gulls recorded and that most sightings were within 2 km from the coast it is predicted that there will not be a significant impact arising from the proposed development on great black-backed gulls.

#### 4.31 Little tern (*Sterna albifrons*)

##### 4.31.1 Protection & Conservation Status

The Little tern is listed in Annex I of the Birds Directive, Schedule I of the Wildlife and Countryside Act, Appendix II of the Bonn Convention, Appendix II of the Bern Convention and is on the Amber List of Species of Conservation Concern.

##### 4.31.2 Background

Little tern		
GB population	Breeding: 1,900 prs	Mitchell <i>et al</i> 2004
Scottish population	Breeding: 331 AoN	Forrester <i>et al.</i> 2007
International threshold	490 ind.	Calbrade <i>et al.</i> 2010
GB threshold	50 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Ythan Estuary Sands of Forvie and Meikle Loch – 36 pairs (2009) Firth of Tay & Eden Estuary (0 pairs)	SNH 2011 JNCC 2011a
European population estimate	Breeding 35,000 – 55,000 Wintering – none	Birdlife 2004
European population trend	Status 'declining' Trend 'moderate decline'	Birdlife 2004
World population	190,000 – 410,000	Birdlife 2011

The little tern is the smallest of Britain's terns, nesting in small colonies along sand and shingle beaches where they often suffer from disturbance and predation.

They arrive from their West African wintering grounds from April onwards and depart in August and September. They feed on small fish, foraging in close in-shore waters.

In North-east Scotland only sixteen little terns were recorded during ten years of observations at Peterhead. All were recorded between May and August and were within a few hundred metres of the shore. Little terns breed in the region at the Ythan Estuary where they return from their wintering grounds at the end of April. The numbers nesting varies considerably across years with many years having only a few pairs and others occasionally over 70 pairs nesting. The number of young fledged also varies considerably with most years producing only a few young due to predation and weather. During years where nests fail early on birds may leave the region by the end of June and early July but in years where nesting has been successful birds may remain in the area through to August or early September (Buckland, Bell & Picozzi 1990; NESBR).

##### Boat-based surveys

No little terns were recorded from any of the boat-based surveys.

##### Vantage Point surveys

Nine little terns were recorded during May 2005 but none from Vantage Point counts between May and August 2006 and only 11 during the same period in 2007 (Alba Ecology 2008a). The only sighting in 2006 was of six birds in September 2006 (EnviroCentre 2007a). All sightings were within 1 – 2 km of the coast and flying below 30 m.

##### Bird Detection Radar

There were no records of little tern from surveys undertaken during the radar studies.

#### 4.31.3 Summary of Results

Very few little terns were recorded from any of the surveys undertaken during the study. There were no sightings from boat-based surveys and only 11 little terns over nearly three years of Vantage Point surveys undertaken between May and August 2006 and 2007. There were six birds in September 2006. All sightings were of birds flying below 30 m.

No counts of little tern from any of the surveys within Aberdeen Bay were of national importance.

#### 4.31.4 Initial Assessment of Significance

Little tern	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Moderate
Barrier	Medium	Low	Minor
Displacement	Medium	Negligible	Negligible

#### 4.31.5 Species Sensitivities

##### Qualifying species

The little tern is a qualifying species for the Ythan Estuary, Sands of Forvie and Meikle Loch SPA where 36 pairs nested in 2009 and Firth of Tay and Eden Estuary where they last bred in 2007 and now no pairs breed.

##### Flight height

The only records of little tern were from Vantage Point surveys, which recorded a total of 18 little terns, all of which were flying below 30 m.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that relatively few little terns occur in Aberdeen Bay and when they do they remain within 2 km of the coast and below turbine height. Consequently, it is predicted that the risk of a collision by little tern with the proposed development is extremely low.

Little terns typically forage between 3 m – 8 m above the surface and are therefore at low risk of collision (ECON 2006). Collisions of turbines by little terns have been reported from Zeebrugge harbour where an array of turbines are lined up along the harbour wall across which little terns fly to and from their colonies (Everaert & Stienen 2006). There have been no other collisions reported from other offshore wind farms where little terns occur.

Based on the small number of little terns potentially occurring within the proposed development area and the low flight heights it is predicted that the risk of collision is low.

##### Barrier effect

Studies undertaken in UK and Belgium have shown that there is unlikely to be a barrier effect with little terns recorded foraging within operating wind farms and no evidence of any strong avoidance behaviour. As little terns forage predominantly within 2 km of the coast there will not be a barrier effect.

### Displacement

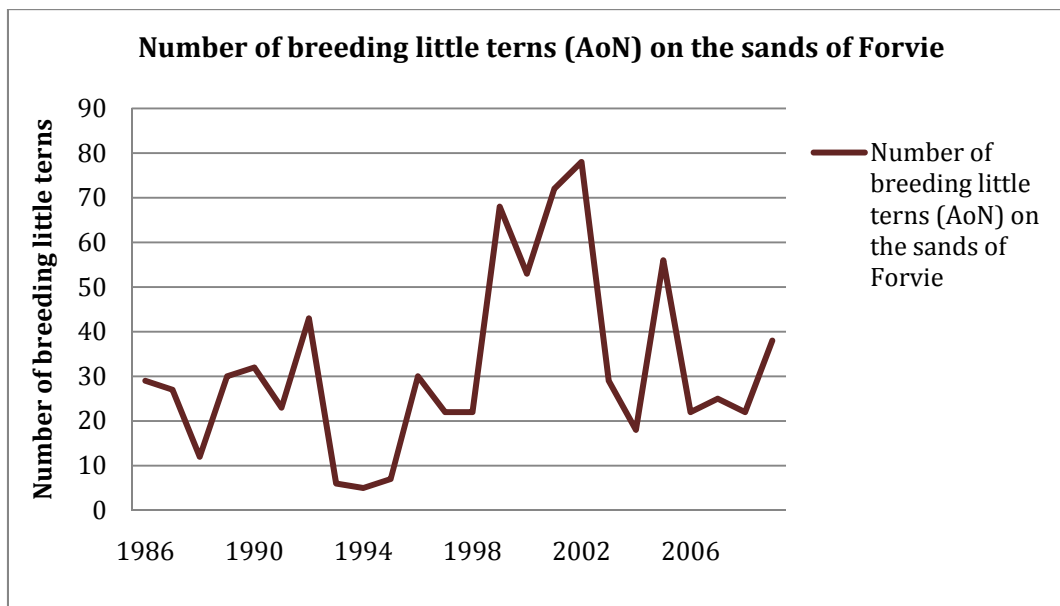
Evidence from studies undertaken in Belgium and the UK have not shown any evidence of a displacement effect. Four years of intensive studies undertaken at Scroby sands offshore wind farm reported that following construction there was a greater use of the area than there had been previously. This increase in use was thought to be due to the formation of a new sand bar within the wind farm thus providing better foraging opportunities (ECON 2008). Consequently, it is predicted that there will be no displacement effects on little terns due to potential development.

### Disturbance

Little terns may not be impacted directly by activities associated with the proposed development. i.e. vessel movements, but evidence from monitoring undertaken at Scroby Sands indicates that there is the potential for a secondary impact should the prey of little terns be affected (ECON 2008). Little terns forage on small fish often, young clupeids. Monitoring undertaken at Scroby Sands recorded a reduction in the availability of young herring following the construction of a wind farm by pile-driving and a subsequent breeding failure of little terns (ECON 2008). The little terns were able to compensate for the reduction in available prey by foraging further afield and changing prey items and there has not been any evidence of an overall population decline in the number of little terns in the area but the locations where the terns foraged and the sizes of colonies have varied. Breeding success varies considerably across years and the size of the colonies may change significantly from one year to the next. Consequently, the link between the decline in young herring, and subsequent localised reduction in tern breeding success, being caused by the construction of the wind farm has not been confirmed. However an effect on little tern breeding success could not be discounted.

The significance of any potential effect depends on the scale of displacement and its duration. It also depends on whether other suitable foraging areas can be located. Although these are difficult to predict any potential impacts upon prey are expected to be relatively short-term as they should affect only one or two breeding seasons depending on whether significant pile-driving takes place and whether construction is undertaken over one or two years. Following cessation of construction new juvenile fish will be available the season following construction.

The numbers of breeding little terns breeding at the Sands of Forvie each year is highly variable as is their breeding success with many years where they fail to produce many, if any young (Figure 4-87).



AoN = Apparently Occupied Nest (Adapted from JNCC 2011b and NESBR)

**Figure 4-87: Numbers of breeding little terns at the Sands of Forvie since 1986.**

Based on the evidence from studies undertaken at Scroby Sands, there is the potential for a moderate effect on little terns should the construction of the proposed development cause a significant decline in potential prey items of little terns during the breeding season. However, should it occur it is predicted that the duration of impact would last no longer than one or two seasons as juvenile fish will be available the following season.

#### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts.

Although there are other planned offshore wind farms none are in areas where little terns will likely occur and therefore no cumulative or in-combination impacts are predicted.

#### Habitats Appraisal

Based on the evidence from existing offshore wind farms indicating both a very low collision risk, little or no displacement and that there are not expected to be any barrier effects; it is predicted that there will not be any adverse effects on the SPA for which little tern is a qualifying species. However, should pile-driving be undertaken, there is the potential for an impact on the prey of little terns during the construction period. If this occurs there is the potential for a localised adverse effect during the construction periods but thereafter breeding success would not be affected by the proposed development. Little terns regularly have unsuccessful breeding seasons and therefore the population can withstand one or two poor breeding seasons should they occur without having an adverse effect on the population.

#### Environmental Impact Assessment

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on little tern. Although impacts arising from the potential reduction in the availability of suitable prey species during the breeding season could have a temporary impact.

## 4.32 Sandwich tern (*Sterna sandvicensis*)

### 4.32.1 Protection & Conservation Status

The Sandwich tern is listed in Annex I of the Birds Directive, Appendix II of the Bonn Convention, Appendix II of the Bern Convention and is on the Amber List of Species of Conservation Concern.

### 4.32.2 Background

Sandwich tern		
GB population	Breeding: 11,000 prs	Mitchell <i>et al</i> 2004
Scottish population	1,100 AoN	Forrester <i>et al.</i> 2007
International threshold	1,700 ind.	Calbrade <i>et al.</i> 2010
GB threshold	200 ind.	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Ythan Estuary, Sands of Forvie and Meikle Loch: 645 prs (2009) Loch of Strathbeg: 1 pr (2010) Firth of Forth: 1,617 ind. (passage) Forth Islands: 0 prs (2010)	SNH 2011 JNCC 2011a
European population estimate	Breeding 82 – 130,000 pairs Wintering – unknown	Birdlife 2004
European population trend	Status 'depleted' Trend 'small decline'	Birdlife 2004
World population	490 – 640,000 individuals	Birdlife 2011

Sandwich terns are regular summer migrants to UK waters and breed at coastal colonies on undisturbed beaches. They regularly move colonies and numbers at each colony can vary considerably across years.

Birds return to their breeding grounds during April and remain in the area until the autumn. The number of terns breeding is highly variable and their success depends on the availability of suitable prey, predation and weather. Sandwich terns forage offshore for small fish species, particularly sandeels and clupeids. The distance that they forage varies depending on prey availability with distances of up to 67 km reported.

The British breeding population is approximately 11,000 pairs of which 1,100 pairs breed in Scotland.

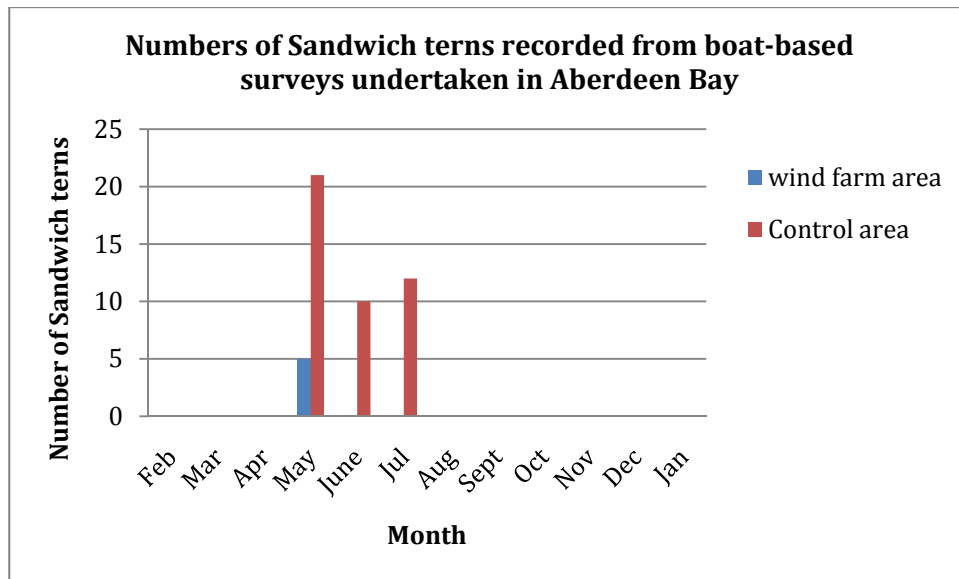
In North-east Scotland Sandwich terns breed at the Sands of Forvie where up to 1,800 pairs have bred although recent counts have been lower and occasionally at the Loch of Strathbeg where recently very small numbers have attempted to breed.

At Peterhead Sandwich terns have been recorded from March to October with peak numbers of up to three birds per hour in May and June.

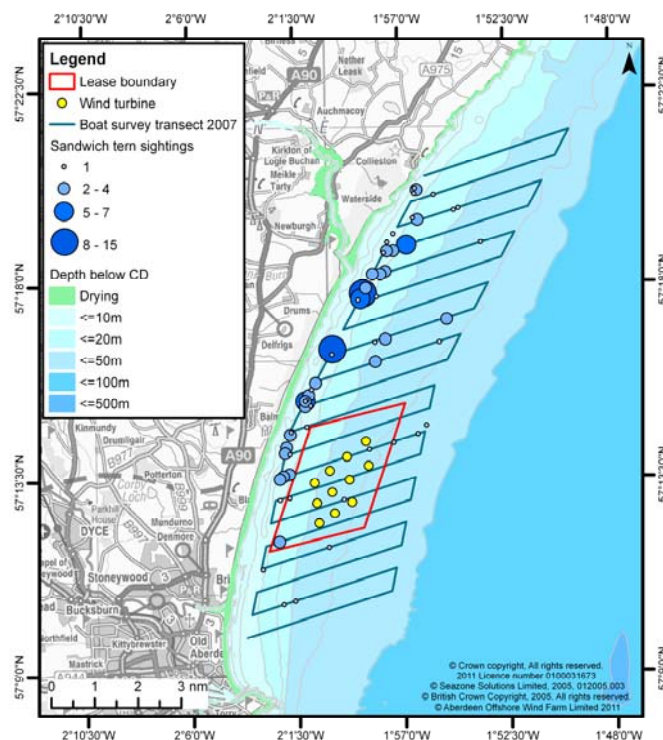
### Boat-based surveys

Although Sandwich terns are a common breeding species at the nearby Sands of Forvie, relatively few were recorded from boat-based surveys undertaken in the proposed development area. A total of five Sandwich terns were recorded within the proposed EOWDC survey area, all in May. Larger numbers were recorded in the area to the north of the proposed EOWDC area where a total of 43 birds were recorded between May and July (Figure 4-88; Figure 4-89). Nearly all sightings were of birds inshore and in water depths of less than 10 m (IECS 2008).





**Figure 4-88: Sandwich tern monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**



**Figure 4-89: Sandwich tern distribution in Aberdeen Bay during breeding season: April – August (all sightings).**

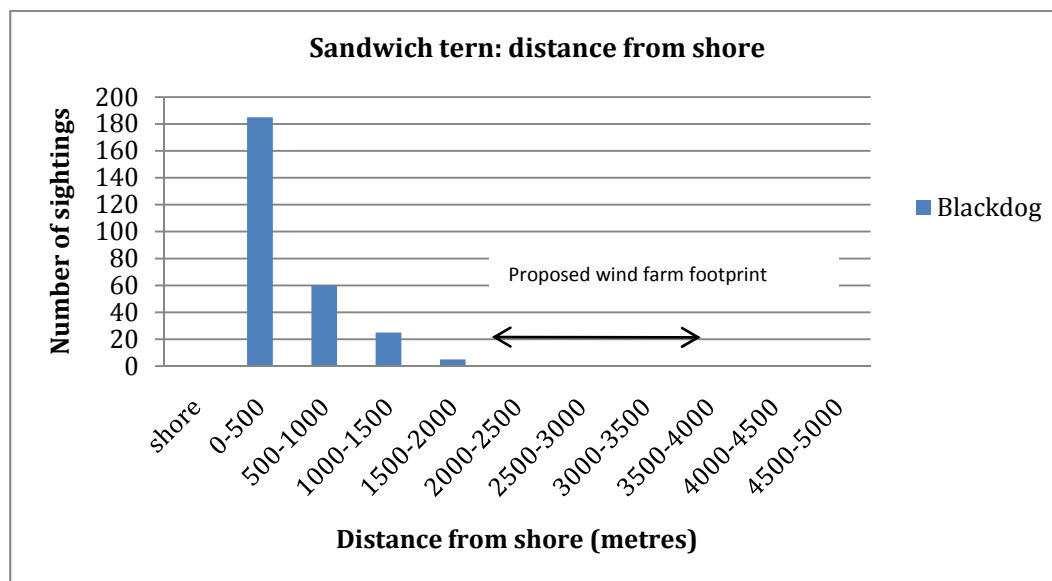
#### Vantage Point surveys

Sandwich terns occur in Aberdeen Bay from March through to October with peak counts in May when up to 100 birds per hour were recorded, and August 2007 when up to 300 birds per hour were recorded (Alba Ecology 2008a). A significant decrease in the number of birds was recorded in Aberdeen Bay during the breeding season of June and July with generally less than 50 birds per hour passing. Birds were recorded predominantly within the 0-2 km of the shore with few records beyond 2 km

(Figure 4-90). Of those for which flight height was recorded at least 44% were recorded at between 30-150 m above the sea surface.

### Bird Detection Radar

There were no sandwich terns recorded during the radar surveys undertaken at Drums and Easter Hatton during October 2005. In April 2007 a total of 298 Sandwich terns were recorded from Blackdog at a rate of nearly six birds per hour (Simms *et al.* 2007). All sightings were within 2 km from shore but this may in part be due to birds being missed further offshore.



**Figure 4-90: Distances from shore for Sandwich terns from Blackdog (April 2007).**

### 4.32.3 Summary of Results

Relatively few Sandwich terns were recorded from boat-based surveys undertaken in Aberdeen Bay. Peak numbers were in May and August with lower numbers during the period of chick rearing in June and July. The majority of sightings were within 500 m from shore with few sightings of birds beyond 2 km. Of those recorded in flight, 44% of Sandwich terns were flying between 30 – 150 m.

No counts of Sandwich tern from any of the surveys within Aberdeen Bay were of national importance.

### 4.32.4 Initial Assessment of Significance

Sandwich tern	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Medium	Minor
Displacement	Medium	Medium	Minor

#### 4.32.5 Species Sensitivities

##### Qualifying species

The Sandwich tern is a qualifying species for the Ythan Estuary, Sands of Forvie and Meikle Loch SPA & Ramsar where 645 pairs nested in 2009; Loch of Strathbeg where 1 – 2 pairs nested in 2010, Forth Islands where no Sandwich terns now breed and the Firth of Forth which supports a post-breeding (passage) population of 1,617 individuals.

##### Flight height

Data from boat-based surveys recorded 4% of all flights at above 25 m, whereas 44% of those from Vantage Point Counts were reported as being at rotor height. Elsewhere, 12% of all flights have been reported as being at rotor height (n=5,080).

##### Collision risk

Collision Risk Modelling undertaken for sandwich tern is based on:

- Body length of 38 cm
- Wingspan of 100 cm
- Flight speed of 10.5 m.s<sup>-1</sup>

The Collision Risk Modelling is based on a collision probability of 11.8% and been undertaken over a range of avoidance rate from 98%, 99% and 99.5% have been used.

**Table 4-27: Predicted number of collisions per year for Sandwich tern.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
11.8%	0.4	0.2	0.1

Based on the precautionary avoidance rate of 98% it is predicted that a total of 0.4 collisions per year may occur (Table 4-27).

The annual mortality rate for Sandwich tern is 11% (BTO 2011).

Based on the regional SPA population of Sandwich tern of 645 breeding pairs the annual mortality rate will be 142 individuals and therefore the 1% baseline mortality rate is 1.4 birds per year. The results from the Collision Risk Modelling predict a total of less than 1 bird per year may collide with the wind turbines.

Collision Risk Modelling has been undertaken based on the higher 12% of all flights at rotor height as reported from other offshore wind farms. The results from the modelling indicate an annual mortality rate of 1.2 birds per year, which is similar to the 1% baseline mortality rate.

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that relatively few Sandwich terns occur in area of the proposed development with nearly all sightings within 2 km of the coast and the majority within 1 km.

Data from existing offshore wind farms have reported relatively high number of collisions of sandwich tern with wind turbines (e.g. Everaert & Stienen 2006). However they have also demonstrated high avoidance rates of more than 99%. The number of collisions recorded has been largely due to the high number of transits made by the Sandwich terns at the sites. Site specific data indicates a low usage of the proposed development area and low numbers of transits across the site consequently a low risk of collision.

Based on the small numbers of sandwich terns recorded within the proposed development area and the relatively high avoidance rates reported for Sandwich terns, it is predicted that the risk of collision is low and the significance negligible.

### Barrier effect

Studies undertaken in UK and Belgium have shown that there is unlikely to be a barrier effect with sandwich terns recorded foraging within operating wind farms and no evidence of any strong avoidance behaviour. As the Sandwich terns in Aberdeen Bay forage predominantly within 2 km of the coast and there will not be a barrier effect.

### Displacement

Evidence from studies undertaken in Belgium and the UK have not shown any evidence of a displacement affect on Sandwich terns with birds entering operating wind farms. Therefore, predicted that any potential impact from displacement will be negligible.

### Disturbance

As with little terns, Sandwich terns are not predicted to be impacted directly by disturbance from construction or operating vessels. However, they could, in theory, be impacted indirectly if the construction of the proposed project has an impact on the availability of their prey. However, unlike with little terns this potential impact has not been reported from any offshore wind farm.

Sandwich terns feed predominantly on sandeels and clupeids (young herring) and should they be impacted by construction activities in the vicinity of the proposed development then Sandwich terns may have to either forage more widely or find alternative prey. It is not possible to determine whether either possible impacts are potentially likely but Sandwich terns do forage widely in the coastal waters of Aberdeen Bay and appear not to occur in the EOWDC area so those that are effected may be able to relocate should their be a localised effect.

There is no evidence of an indirect impact on breeding Sandwich terns from other constructed offshore wind farms but there is the potential for a temporary moderate effect on Sandwich terns should the construction of the proposed development cause a significant decline in the prey of Sandwich during the breeding season. If this effect occurs it is predicted that it would last no longer than a single season before fish numbers returned back to the population levels prior to construction.

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts.

Outwith Aberdeen Bay there are further planned wind farms in the Moray Firth and Firth of Forth areas. The exact locations, size and type of turbines are unknown and no site specific data are available to inform the cumulative or in-combination assessment.

Surveys undertaken at the Beatrice Demonstrator Project located in the Moray Firth did not record any Sandwich terns and there are no Sandwich tern colonies in the Moray Firth area. Therefore, Sandwich terns are unlikely to occur regularly in the Moray Firth. Sandwich tern is a qualifying species for its post-breeding passage population in the Firth of Forth SPA and as breeding species in the Forth Islands SPA. The SPA citation for the Forth Islands states 22 pairs of Sandwich tern but no pairs have nested there in recent years.

The detailed distribution of Sandwich terns in the Firth of Forth is unknown and there are no site specific data available to indicate whether Sandwich terns occur in the vicinity of the planned offshore wind farms. However, published seabirds at sea data indicate low densities occurring in the Firth of Forth area during the summer months with no records offshore during September or October (Stone *et al.* 1995). The Firth of Forth SPA is also approximately 124 km away from the proposed development and therefore the risk of any cumulative or in-combination impacts are low.

#### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating both a very low collision risk, little or no displacement and that there are not expected to be any barrier effects; it is predicted that there will not be any adverse effects on the SPA for which Sandwich tern is a qualifying species. However, should there be an impact on the prey items of Sandwich terns during the construction period then there is the potential for a short-term adverse effect for a single season but after which no adverse effects are predicted.

#### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on sandwich tern. Although impacts arising from the potential reduction in the availability of suitable prey species during the breeding season could be possible.

### 4.33 Common tern (*Sterna hirundo*)

#### 4.33.1 Protection & Conservation Status

The common tern is listed in Annex I of the Birds Directive, Appendix II of the Bonn Convention, Appendix II of the Bern Convention and is on the Green List of Species of Conservation Concern.

#### 4.33.2 Background

Common tern		
GB population	10,000 prs	BTO 2011
Scottish population	4,800 AoN	Forrester <i>et al.</i> 2007
International threshold	1,900 ind	Calbrade <i>et al.</i> 2010
GB threshold	200 ind	Calbrade <i>et al.</i> 2010
Designated east coast sites where species is a noted feature	Ythan Estuary, Sands of Forvie and Meikle Loch – 6 pairs (2006). Forth Islands 378 prs	SNH 2011 JNCC 2011a
European population estimate	Breeding 270 – 570,000 pairs Wintering – unknown	Birdlife 2004
European population trend	Status 'secure' Trend 'stable'	Birdlife 2004
World population	1.6 – 4,600,000 individuals	Birdlife 2011

Common terns are a widespread summer visitor to the UK, arriving from their wintering grounds off West Africa during April and May and departing in August and September. They nest colonially along coasts and inland along rivers and freshwater bodies. Coastal breeders feed predominantly on small fish, which are caught by plunge diving in nearshore waters, shallow bays and lagoons. They have however been reported to forage up to 34 km from their breeding sites.

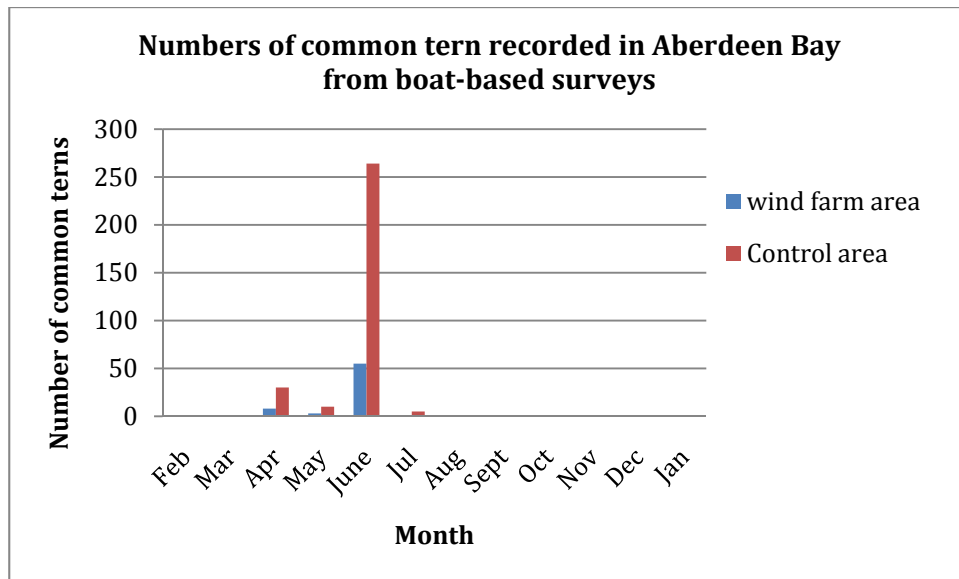
There are approximately 10,000 pairs in Britain of which approximately 4,800 nest in Scotland. In North-east Scotland common terns are found along all the region's coasts with the largest coastal breeding colonies at the Sands of Forvie. They also breed inland of Aberdeen and birds from these colonies may forage offshore. Peak numbers arrive during May and the birds remain in the region until August and September.

The identification of common and Arctic tern is difficult at any range and consequently records of distant passing birds are not assigned to either species and are recorded as 'commic' terns.

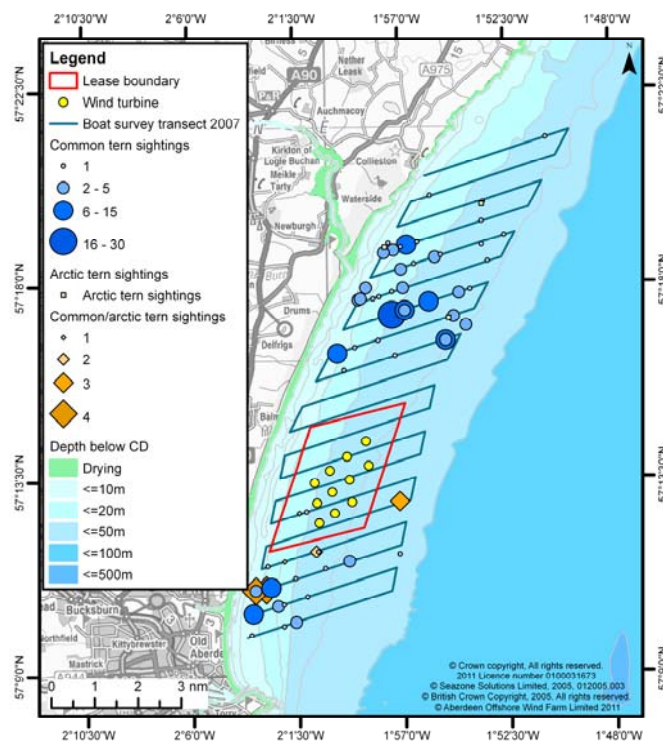
Passage of 'commic' terns past Peterhead occurs from April to September with peak numbers of up to 40 birds per month during July. Most records were of birds within several hundred metres from the shore.

#### Boat-based survey

Common terns were recorded from boat-based surveys between May and September. Peak counts occurred in June with a population estimate of 264 birds in the 'control' area and 55 birds in the proposed development area (IECS 2008). There were no records of common terns from boat-based surveys between October and March in the first year of data collection but eight were recorded during September 2010. There were no confirmed sightings of common tern within the proposed development area although two birds were recorded as either common or Arctic tern. The majority of sightings were to the north near the Ythan Estuary (Figure 4-92 and Figure 4-93).

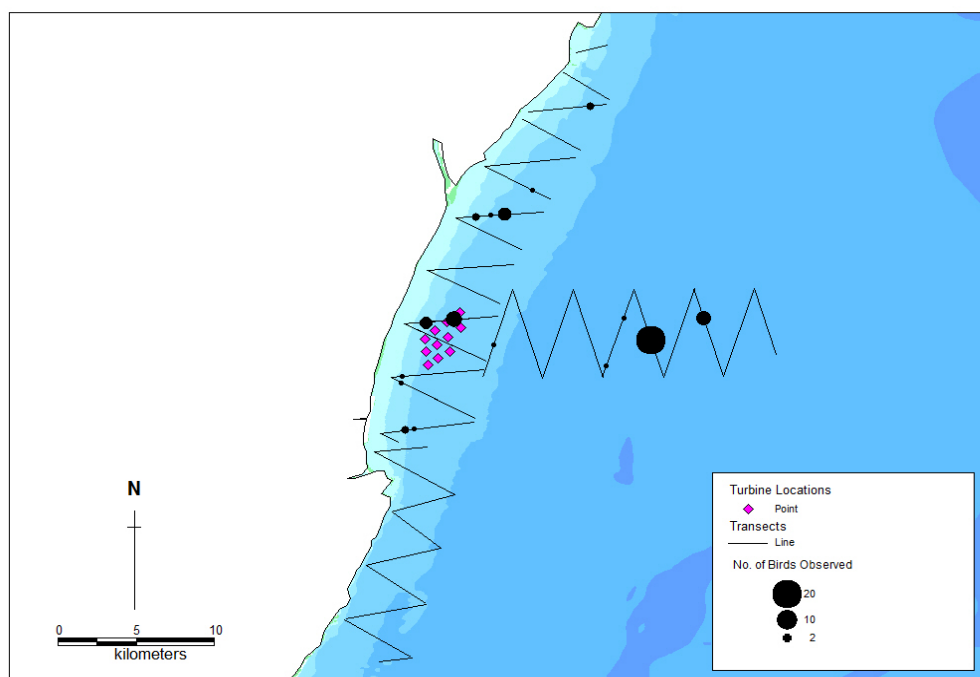


**Figure 4-91: Common tern monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**



**Figure 4-92: Common tern and Arctic tern distribution in Aberdeen Bay during breeding season: April – July (all sightings).**





**Figure 4-93: On-effort observations of Tern species (Common, Arctic Sandwich and Unidentified Tern species) along transects during August, September and November 2010 and January 2011.**

#### Vantage Point surveys

In Aberdeen Bay common terns were recorded from April through to September with peak counts varying across years. In 2006 peak counts occurred during July and August when up to 50 birds per hour were recorded compared to a peak of less than 10 birds per hour in August 2005 and five birds per hour during the same period in 2007 (EnviroCentre 2007a, Alba Ecology 2008a). In 2008, the peak counts occurred in May when up to ten birds per hour passed the Donmouth. Relatively low numbers were recorded during June when birds were breeding.

The majority of sightings were of birds between 0–2 km from the coast and at least 83% of sightings were of birds flying below 30 m.

#### Bird Detection Radar

There were no common terns recorded during the radar surveys undertaken at Drums and Easter Hatton during October 2005. In April 2007 a total of 14 common terns were recorded from Blackdog at a rate of 0.27 birds per hour (Simms *et al.* 2007).

#### 4.33.3 Summary of Results

Numbers of common terns from boat-based surveys peaked during June when up to 264 birds were present in the 'control' area. The timing of peak counts varied between years with some occurring in May and others in July and August when up to 50 birds per hour were recorded. The majority of sightings were within 2 km of the coast and at least 83 of sightings were of birds flying below 30 m.

The peak count of estimated abundance in June was greater than the threshold of national importance.

#### 4.33.4 Initial Assessment of Significance

Common tern	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Low	Minor
Displacement	Medium	Low	Minor

#### 4.33.5 Species Sensitivities

##### Qualifying species

The common tern is a qualifying species for the Ythan Estuary, Sands of Forvie and Meikle Loch SPA where six pairs nested in 2009 and the Forth Islands SPA where 378 pairs nest.

##### Flight height

Out of 22 recorded flight heights for common tern obtained from site specific boat-based surveys, 14% of flights were above 25 m.

Elsewhere, out of 2,060 recorded flight heights, 11% have been recorded as being at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that common terns may occur within the proposed development area but in lower numbers than areas to the north. A peak estimated population of 55 birds occurred in the proposed EOWDC survey area during June when 264 birds were in the 'control' area to the north.

Collision Risk Modelling undertaken for common tern is based on:

- Body length of 33 cm
- Wingspan of 88 cm
- Flight speed of 10.9 m.s<sup>-1</sup>

The Collision Risk Modelling is based on a collision probability of 11.8% and been undertaken over a range of avoidance rate from 98%, 99% and 99.5%.

**Table 4-28: Predicted number of collisions per year for common tern**

Collision probability	Avoidance rate (%)		
	98	99	99.5
11.8%	3.5	1.7	0.8

Based on the precautionary avoidance rate of 98% it is predicted that a total of 3.5 collisions per year may occur (Table 4-28).

The annual mortality rate for common tern is 10% (BTO 2011). Based on the regional SPA population of 768 breeding adults, the annual mortality rate will be 77 individuals and therefore the 1% baseline mortality rate is less than one bird per year. The results from the Collision Risk Modelling predict a total of 3.5 common terns per year may collide with the wind turbines.

Six pairs of common tern nest on the Sands of Forvie and consequently an increase in adult mortality could have an adverse effect. The Sands of Forvie lies approximately 7.2 km away from the proposed development and therefore may be within the potential foraging range of breeding common terns, which although have been estimated to forage less than 25 km away from their nests are more likely to be within 4 km and 6 km (Roos 2010).

A total of 378 pairs of common tern nest at the Firth of Forth, which lies approximately 124 km away and therefore outwith the maximum foraging range recorded for common terns.

Data obtained from Zeebrugge, where common terns frequently pass across an array of turbines, have reported relatively high collision mortalities although very low collision probabilities of 0.1% for birds flying at rotor height and 0.007% for birds at all altitudes (Everaert & Stienen 2006). Consequently the use of a 98% avoidance rate is very precautionary and it is predicted that avoidance of greater than 99% is likely. Based on this the number of potential collisions by common terns may be between one to two birds per year.

Based on the results from the collision risk modelling and the relatively small number of common terns potentially occurring within the proposed development area it is predicted that the risk of collision is low but the significance may be moderate or minor.

### Barrier effect

Studies undertaken in UK, Belgium Denmark and Sweden have shown that there is unlikely to be a barrier effect, with common (or common/Arctic) terns recorded foraging within operating wind farms and no evidence of any strong avoidance behaviour. Post-construction monitoring undertaken at Kentish Flats have shown a potential barrier effect with fewer common terns flying through the operating wind farm than compared to prior construction (Gill *et al.* 2008). The location of the proposed development to the south of the tern colony on the Sands of Forvie and that site specific monitoring indicates that areas to the north of the proposed development are preferred indicates that there are unlikely to be any significant or adverse effects to common terns caused by the potential barrier effect.

### Displacement

Evidence from studies undertaken in Denmark where common terns were seen to enter operating wind farms indicates that there may be little or no displacement. Should displacement occur, site specific data indicates that common terns may forage elsewhere, particularly to the north where then numbers of common terns present were higher.

### Disturbance

Common terns may not be impacted directly by activities associated with the proposed development, i.e. vessel movements, but there is the potential for a secondary impact should the prey of common terns be affected by construction activities, particularly pile driving. Common terns forage on small fish, young clupeids, and crustaceans (shrimps). Should the construction of the proposed

development cause a reduction in the availability of prey to breeding terns then this cause an adverse effect.

The location of nearest tern colonies 7 km away and that more common terns were recorded to the north of the development area indicate that should there be a reduction of suitable prey in the vicinity of the proposed development from pile driving, then there are other areas where common terns may forage, e.g. in the Ythan Estuary. Any potential impact will likely last for no more than the one or two seasons during construction as juvenile fish will be available as prey following cessation of construction.

The significance of any potential effect depends on the type of installation technique used the subsequent scale of disturbance and its duration. It also depends on whether other suitable foraging areas are available. Although these are difficult to predict any potential impacts upon prey are expected to be relatively short-term as they should only effect one or two breeding seasons, as new juvenile fish will become available the season following construction. Post construction monitoring undertaken at Kentish Flats did not record any reduction in the number of terns using the area and noted an increase in overall numbers indicating no significant effect from construction on Terns (Gill *et al.* 2008).

Based on the results from site specific surveys and evidence from studies undertaken at other constructed wind farms it is predicted that any potential impact may be of moderate significance.

#### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts.

Outwith Aberdeen Bay there are further planned wind farms in the Moray Firth and Firth of Forth areas. The exact locations, size and type of turbines are unknown and no site specific data are available to inform the cumulative or in-combination assessment.

Collision Risk Modelling undertaken for all species of tern recorded at the Beatrice Demonstrator Project located in the Moray Firth predicted an annual mortality rate of less than 1 bird per year. The additional mortality rate is therefore low and of minor significance.

The detailed distribution of common terns in the Firth of Forth is unknown and there are no site specific data available to indicate whether common terns occur in the vicinity of the planned offshore wind farms. However, published seabirds at sea data indicate low or very densities occurring in the Firth of Forth area with no records in the area where wind farms may in the future be developed (Stone *et al.* 1995). The Firth of Forth SPA is also approximately 124 km away from the proposed development and therefore the risk of any cumulative or in-combination impacts are low.

#### **Habitats Appraisal**

Based on the evidence from existing offshore wind farms indicating both a very low collision risk, little or no displacement or barrier effects; it is predicted that there will not be any adverse effects on the SPA for which common tern is a qualifying species. However, should there be an impact on the prey species for common tern during the construction period then there is the potential for a localised impact.

#### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on

common tern, although there may be a temporary moderate impact if the construction of the proposed development causes a displacement of fish species.

#### 4.34 Arctic tern (*Sterna paradisaea*)

##### 4.34.1 Protection & Conservation Status

The Arctic tern is listed in Annex I of the Birds Directive, Appendix II of the Bonn Convention, Appendix II of the Bern Convention and is on the Amber List of Species of Conservation Concern.

##### 4.34.2 Background

Arctic tern		
GB Population	52,600 pairs	BTO 2011
Scottish population	47,300	Forrester <i>et al.</i> 2007
International threshold	Unknown	Calbrade <i>et al.</i> 2010
GB threshold	1,000	1% of UK breeding pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Forth Islands: 908 prs	SNH 2011 JNCC 2011a
European population estimate	Breeding 500,000 – 900,000 pairs Wintering – none	Birdlife 2004
European population trend	Status 'secure' Trend 'unknown'	Birdlife 2004
World population	2,000,000 mature individuals	Birdlife 2011

Arctic terns are a summer migrant to the northern Europe and winter in the Antarctic. They arrive on their breeding grounds during April and May and depart during August and September. They breed in colonies on undisturbed beaches and islands and numbers in colonies varies considerably across years with birds regularly switching colonies. They forage in mainly coastal waters feeding predominantly on small fish by plunge diving to just below the surface.

An estimated passage of up to 200,000 Arctic terns may occur in Scotland. In North-east Scotland Arctic terns occur from April through to September with peak numbers in July when up to 40 birds per month were recorded past Peterhead (Innes 1994).

##### Boat-based surveys

Three Arctic terns were recorded in July 2007 from boat-based surveys (IECS 2008).

##### Vantage Point surveys

Arctic terns were regularly recorded in Aberdeen Bay from April through to October with a distinct peak in numbers between June and August. Peak numbers varied considerably across years with up to 150 birds per hour passing Drums in July 2008 but a peak of only up to ten birds per hour in June 2007 (EnviroCentre 2007a, Alba Ecology 2008a). Birds were recorded less than 2 km from shore and up to 36% of sightings were greater than 30 m above sea surface.

##### Bird Detection Radar

There were no Arctic terns recorded during the radar surveys undertaken at Drums and Easter Hatton during October 2005. In April 2007, 2 Arctic terns were recorded from Blackdog (Simms *et al.* 2007).

A further 23 common/Arctic terns were recorded during the April 2007 radar surveys (Simms *et al.* 2007). All terns recorded from the radar surveys were seen flying below 30 m.

#### 4.34.3 Summary of Results

Numbers of Arctic terns recorded from boat-based surveys was very low but they were regularly recorded from land-based counts from April through to October with peak counts during July. Numbers recorded varied but were generally less than 10 birds per hour with one exceptional count of 150 birds per hour in July. The majority of sightings were within 2 km of the coast and 36% of all sightings were of birds flying above 30 m.

There is no UK threshold but the peak count of 150 birds per hour in July 2008 was less than the 1% of the national breeding population.

#### 4.34.4 Initial Assessment of Significance

Arctic tern	Overall sensitivity	Magnitude	Significance
Collision	Very High	Low	Moderate
Barrier	Medium	Low	Minor
Displacement	Medium	Low	Minor

#### 4.34.5 Species Sensitivities

##### Qualifying species

The Arctic tern is a qualifying species for the Forth Islands SPA where 908 pairs nest.

##### Flight height

There were no species specific flight heights recorded for Arctic terns from site specific boat-based surveys. Out of the 24 flights for 'commic' (common/Arctic) terns none were above 25 m.

Elsewhere, very few Arctic terns have been reported from other offshore wind farm surveys (n= 122) but for those that have, 24% have been recorded at rotor height.

##### Collision risk

Only three Arctic terns were recorded from site specific boat-based surveys undertaken in Aberdeen Bay but more were recorded from Vantage Point Counts with up to 36% of flight altitudes above 30 m. Nearly all sightings were of birds within 2 km of the coast, indicating that there is a low risk of collision with the proposed development. Avoidance rates for Arctic terns are unknown but based on the similar common tern results from Zeebrugge it is predicted that should Arctic terns occur in the vicinity of the proposed development they will have a high avoidance rate and the risk of collision low and any potential impacts negligible.

##### Barrier effect

Studies undertaken in Denmark and Sweden have shown that there is unlikely to be a barrier effect with common/Arctic terns recorded foraging within operating wind farms and no evidence of any strong avoidance behaviour. And there are unlikely to be any significant or adverse effects to Arctic terns caused by the potential barrier effect.



### **Displacement**

Evidence from studies undertaken in Denmark where common/Arctic terns were seen to enter operating wind farms indicates that there may be little or no displacement. As very few Arctic terns were recorded beyond 2 km the use of the site by Arctic tern appears to be very low and therefore it is predicted that there will be little or no displacement effect.

### **Disturbance**

Arctic terns may not be impacted directly by activities associated with the proposed development, i.e. vessel movements but there is the potential for a secondary impact should the prey of Arctic terns be affected by construction activities. Arctic terns are opportunistic feeders foraging on small fish and crustaceans. Should the construction of the proposed development cause a reduction in the availability of prey to Arctic terns then this could cause an adverse effect.

However, very few Arctic terns were recorded and there is no evidence to suggest that the proposed development area and the surrounds are particularly important for Arctic terns and that should their prey be displaced that they would not be able to find alternative areas to forage. Any potential impact will likely last for no more than one or two seasons as juvenile fish will be available as prey the following year.

Based on the results from site specific surveys and evidence from studies undertaken at other constructed wind farms it is predicted that any potential impact on Arctic tern will be low and of minor significance.

### **Cumulative and in-combination**

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts.

Outwith Aberdeen Bay there are further planned wind farms in the Moray Firth and Firth of Forth areas. The exact locations, size and type of turbines are unknown and no site specific data are available to inform the cumulative or in-combination assessment.

The detailed distribution of Arctic terns in the Firth of Forth is unknown and there are no site specific data available to indicate whether Arctic terns occur in the vicinity of the planned offshore wind farms. However, published seabirds at sea data indicate low or very densities occurring in the Firth of Forth area with no records in the area where wind farms may in the future be developed (Stone *et al.* 1995). The Forth Islands SPA is also approximately 124 km away from the proposed development and therefore the risk of any cumulative or in-combination impacts are low.

### **Habitats Appraisal**

The only SPA in the region for which Arctic tern is listed as a qualifying species is the Forth Islands SPA, which is approximately 124 km to the south. The risk of an adverse effect on the qualifying species is therefore low and its significance should there be one, is negligible.

### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on Arctic tern. However, there may be a temporary minor impact if there is disturbance to prey during construction.

### 4.35 Common Guillemot (*Uria aalge*)

#### 4.35.1 Protection & Conservation Status

The (common) guillemot is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

#### 4.35.2 Background

Guillemot		
GB Population	Breeding: 1,300,000 ind.	BTO 2011
Scottish population	Breeding: 780,000 prs Winter: 750,000 ind.	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	13,000 ind.	1 of GB Pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Buchan Ness to Collieston Coast – 19,296 ind. (2007) Fowlsheugh 50,566 ind. (2009) Troup, Pennan and Lion's head – 16,325 ind. (2007) Forth Islands 16,000	SNH 2011 JNCC 2011a
European population estimate	Breeding 2,000,000-2,700,000 prs. Wintering – 4,300,000 ind.	Birdlife 2004
European population trend	Status 'secure' Trend 'large increase'	Birdlife 2004
World population	7,300,000 – 7,400,000	Mitchell <i>et al</i> 2004

The guillemot is one the most abundant seabirds in the northern hemisphere with a large population in the Atlantic. Numbers in Britain and Ireland have increased substantially during the last 30 years. Guillemots breed at most locations around the coast of Britain and Ireland where there is suitable cliff nesting habitat. The species is extremely gregarious, colonial nesting is the norm and colonies can contain tens of thousands of individuals (Wernham *et al.* 2002).

Birds may start to return to the colonies from their offshore wintering areas as early as October although many do not return until the spring. During the breeding season birds remain in proximity of their colonies but may forage in excess of 100 km from their breeding sites. The chick leaves the colony with the male when about three weeks old and still flightless. The male accompanies the chick for a further six to eight weeks while it develops and the adult undergoes a complete moult during which time it has a period that it becomes flightless.

Guillemots feed on a variety of small pelagic shoaling fish, especially lesser sandeels, sprats and members of the family Gadidae, which they catch by underwater pursuit after diving from the surface.

Guillemots feed mainly close offshore and are numerous around Britain and Ireland throughout the year. The species is dispersive, rather than migratory with many adults remaining within a few hundred kilometres of their colonies throughout the year. During late summer and early autumn the adults undergo a period of moult during which time they become flightless for a period. They are also accompanied by their flightless chicks during this period.

There is an estimated 1,000,000 pairs of guillemots nesting in Britain of which 75% are in Scotland, the majority in Shetland, Orkney, Caithness, Sutherland and Western Isles (Mitchell *et al.* 2004).

In North-east Scotland the guillemot occurs widely throughout the region and there are number of significant breeding colonies with a population of 150,000 individuals.

The region therefore holds approximately 10% of the UK and Scottish breeding populations.

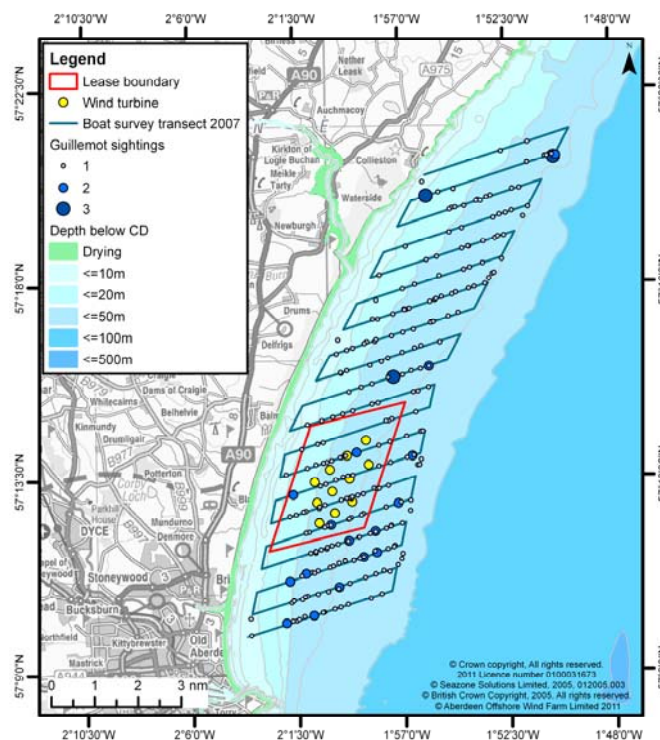
A distinct passage of guillemots has been recorded off Peterhead with a northerly passage of birds in the spring when up to 24,000 birds per hour have been recorded. A smaller passage of birds occurs in the autumn with up to 400 birds per hour passing.

The passage of birds recorded past Peterhead extended from a few hundred metres from the shore to over 3 km (Innes 1990).

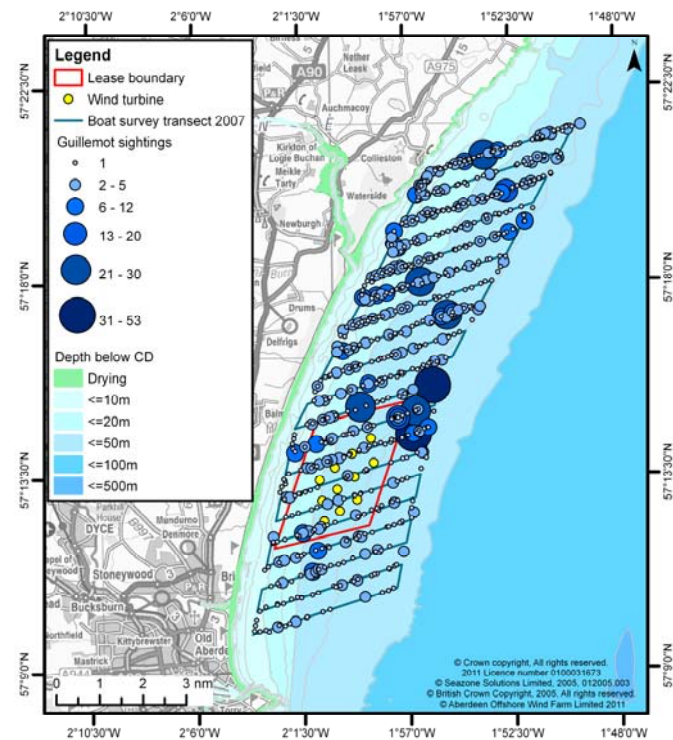
### Boat-based surveys

Guillemot was the most frequently recorded species from boat-based surveys between February 2007 and January 2008. Guillemots were recorded throughout the year and throughout the surveyed area with birds recorded in shallow nearshore waters and further offshore in deeper waters of 30 m or more. Although the distribution of guillemots was fairly even across the surveyed area, more guillemots were recorded to the north and offshore of the proposed EOWDC area than within the proposed development area outwith the breeding season (Figure 4-94).

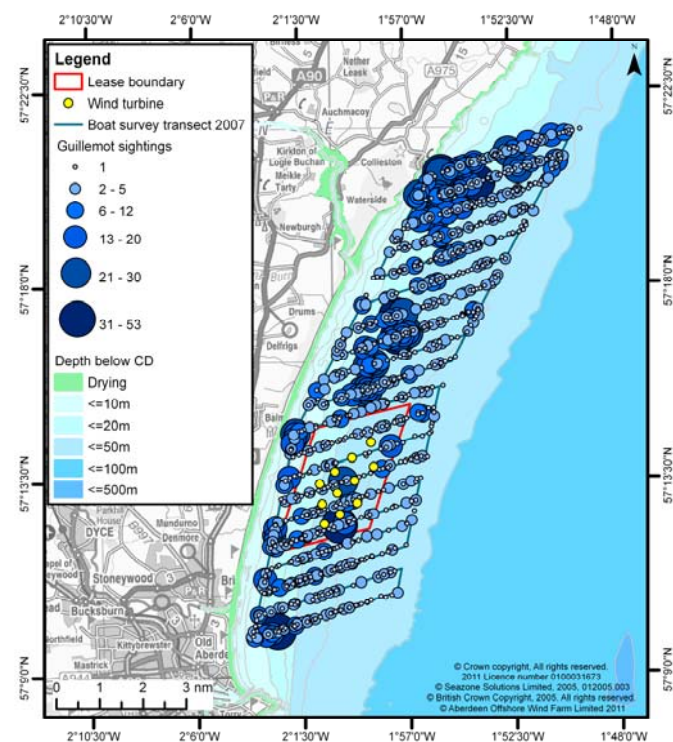
During the breeding season the numbers of guillemot present across the whole of the survey area were relatively low but evenly distributed in water depths of between 20 m and 50 m (Figure 4-95, Figure 4-96).



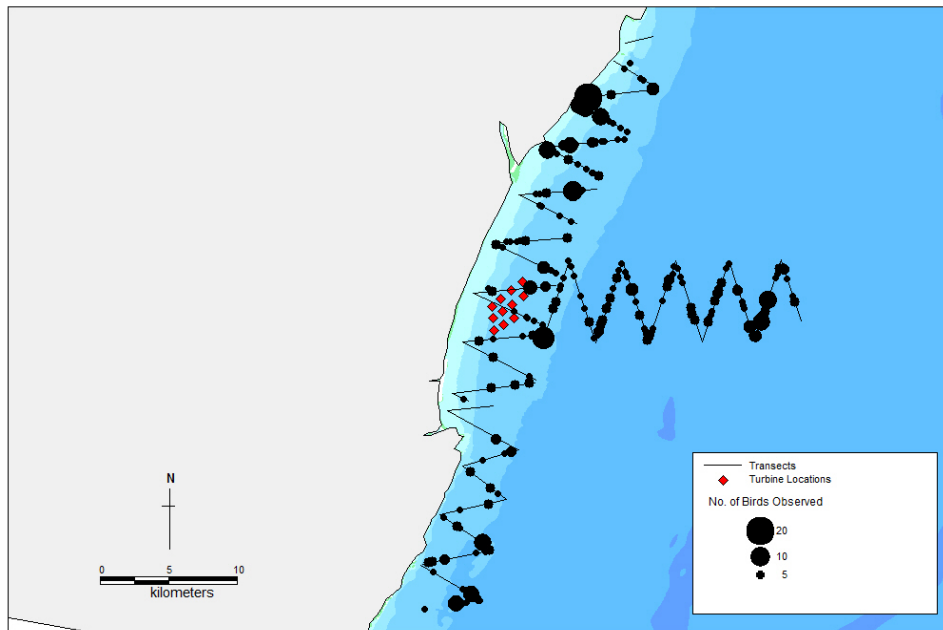
**Figure 4-94: Guillemot distribution in Aberdeen Bay during winter period: November to February (all sightings).**



**Figure 4-95: Guillemot distribution in Aberdeen Bay during breeding season: March to June (all sightings).**

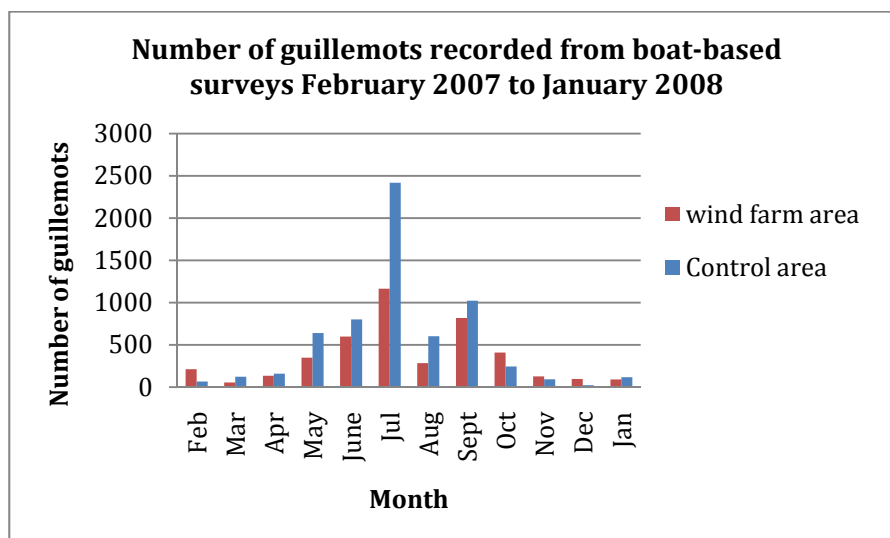


**Figure 4-96: Guillemot distribution during post-breeding: July to October (all sightings).**

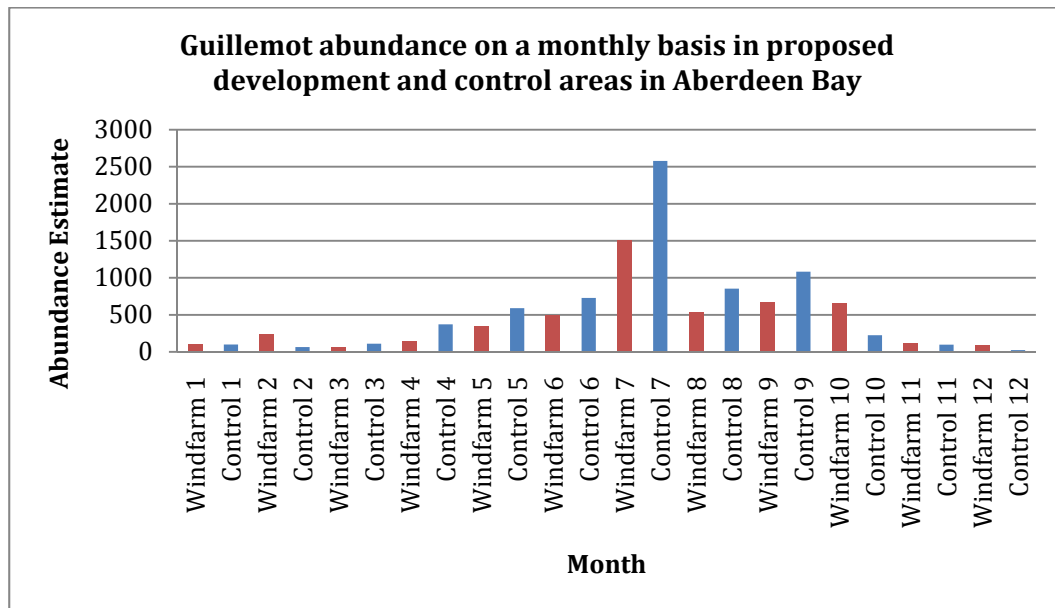


**Figure 4-97: On-effort observations of Auk species (guillemot, razorbill and Puffin) along transects during August, September and November 2010 and January 2011.**

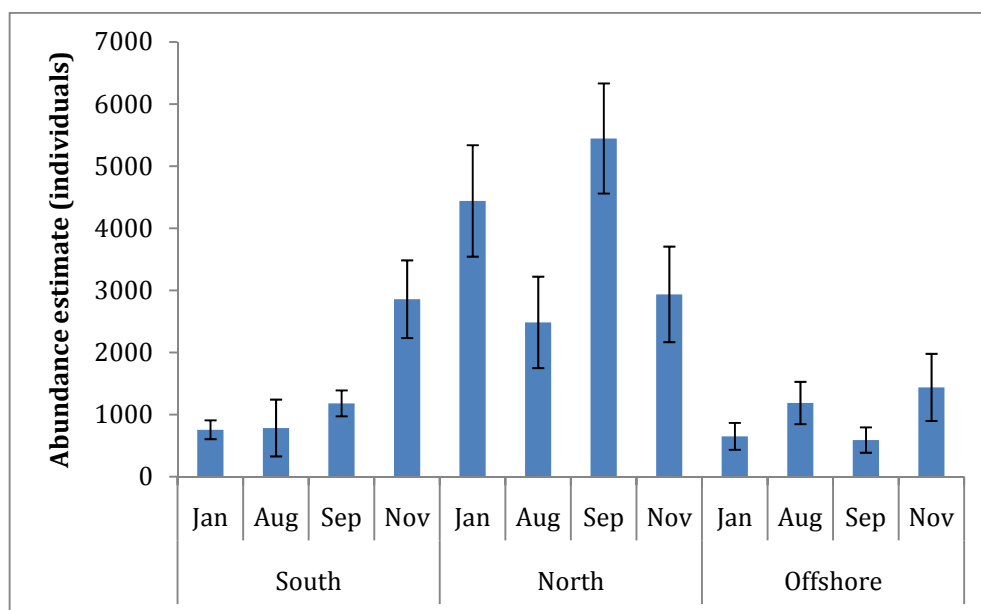
Numbers of guillemot in the winter period were lower than during the summer months when numbers peaked in July (Figure 4-98). Estimated monthly numbers using *Distance* analysis indicate a population of up to 2,578 guillemots within the 'control' area during July and a further 1,511 in the proposed EOWDC survey area. Densities of up to 51 birds/km<sup>2</sup> and 30 birds/km<sup>2</sup> were estimated during this period (Figure 4-101, Figure 4-99). The highest abundance estimates were from the northern survey area with estimated abundances of nearly 5,500 individuals during September and a density of 36 birds/km<sup>2</sup> (SMRU 2011b).



**Figure 4-98: Guillemot monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

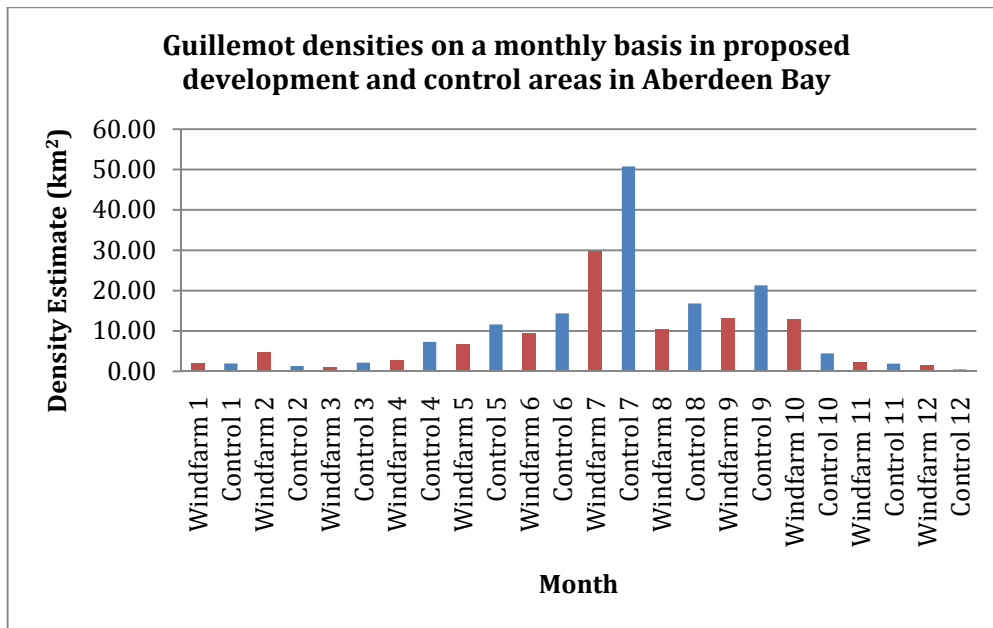


**Figure 4-99: Monthly estimates of abundance of guillemots in the proposed EOWDC and 'control' areas from February 2007 to January 2008.**

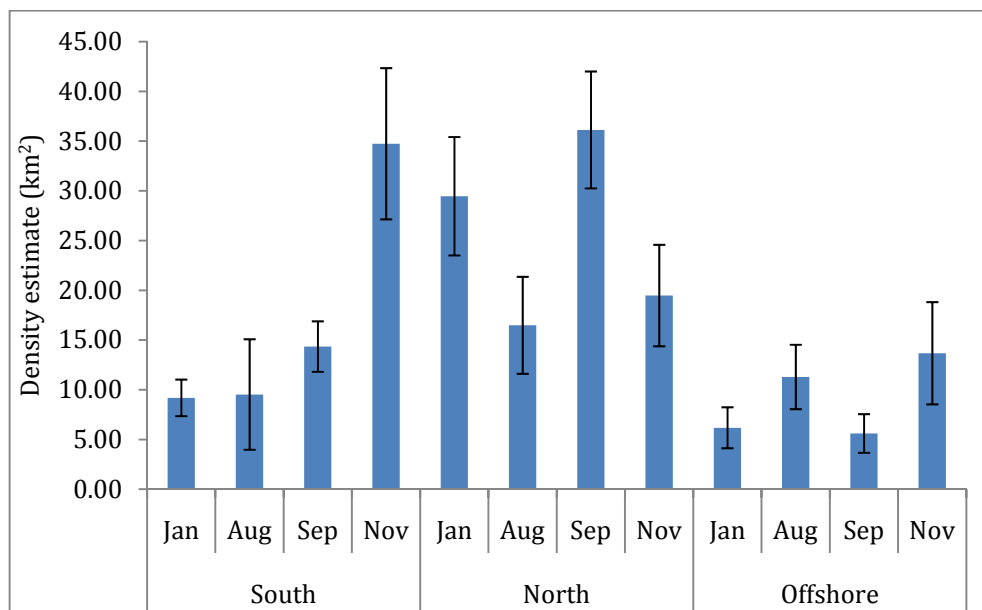


**Figure 4-100: Monthly estimates (+/- SE) of abundance of guillemot in the South, North and Offshore Strata between August 2010 and January 2011.**





**Figure 4-101: Monthly estimates of density of guillemots in the proposed EOWDC and 'control' areas; February 2007 – January 2008 ('Windfarm' 1-12 and 'control' 1-12 refers to months).**



**Figure 4-102: Monthly estimates (+/- SE) of density of Common Guillemot in the South, North and Offshore Strata.**

### Vantage Point surveys

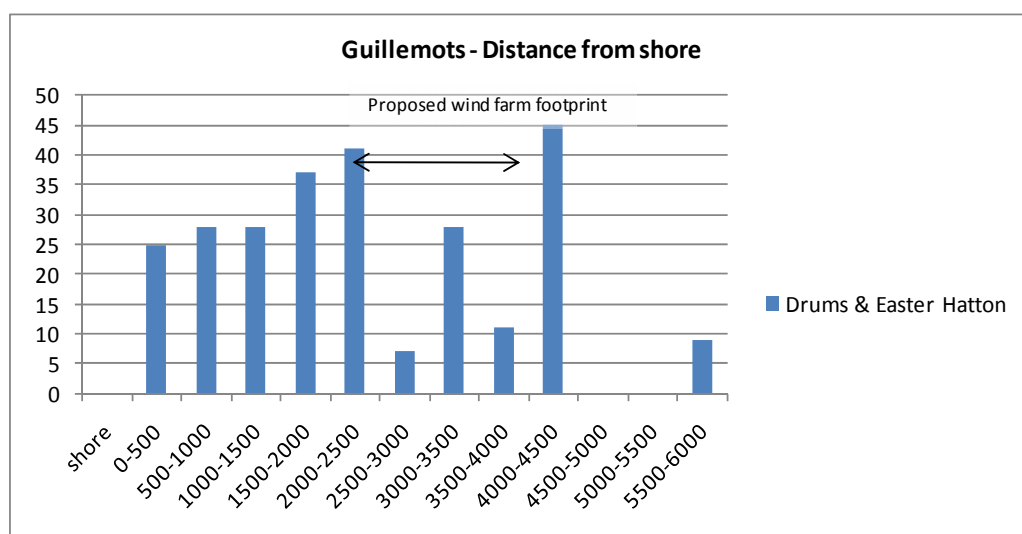
Guillemots were present in Aberdeen Bay throughout the year. Relatively low numbers were present between December and February with numbers increasing from March onwards. Up to 250 birds per hour were recorded flying past in March 2007, increasing to up to 400 birds per hour during April 2007. (EnviroCentre 2007a,b). At least 98% of all flights were below 30 m. Relatively few birds were



recorded within 1 km of the coast with most between 1 km and 3 km; (Alba Ecology 2008a,b).

#### Bird Detection Radar

A total of 259 guillemots were recorded during the Bird Detection Radar studies undertaken in October 2005. The numbers recorded between the two survey sites were broadly similar with 108 at Drums and 151 at Easter Hatton. The distribution of guillemots was different between the two sites, with a larger proportion of birds at Easter Hatton recorded within 2.5 km from shore compared to Drums where a greater proportion were recorded out to 4.5 km. Combining observations from both sites suggests a generally broad distribution of guillemots (Walls *et al.* 2006).



(Adapted from Walls *et al.* 2006, Simms *et al.* 2007)

**Figure 4-103: Guillemot distribution from shore from observation at Drums and Easter Hatton in October 2005.**

#### 4.35.3 Summary of Results

Guillemots were recorded widely across Aberdeen Bay from all surveys. Data from boat-based surveys indicate peak counts in the bay occur during the post-breeding period, particularly in July with more birds recorded within the 'control' site than within the proposed EOWDC development area. Relatively high numbers remain within the area until November after which numbers of guillemots in the area decrease. Land based observations recorded peak numbers during April. Data from boat-based surveys recorded guillemots widely across the surveyed areas and land-based observations recorded most guillemots from between 1.5 km and 4.5 km from the coast.

No counts during any surveys undertaken across Aberdeen Bay were of national importance.

#### 4.35.4 Initial Assessment of Significance

Guillemot	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Medium	Minor
Displacement	High	Low	Minor

#### 4.35.5 Species Sensitivities

##### Qualifying species

There are four SPAs in the region for which guillemot is a qualifying species: Buchan Ness to Collieston Coast, Fowlsheugh, Troup, Pennan and Lion's Head and Forth Islands SPA.

##### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded 271 guillemots in flight of which 1% were recorded as flying above 25 m and therefore at risk of collision.

Elsewhere in the UK out of over 6,000 guillemots for which flight heights have been recorded less than 1% have been recorded at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that guillemots are widespread and frequent within Aberdeen Bay and occur throughout the area.

Collision Risk Modelling undertaken for guillemot is based on:

- Body length of 40 cm
- Wingspan of 70 cm
- Flight speed of 16.5 m.s<sup>-1</sup>

Collision Risk Mortality has been based on a collision probability of 7% and a range of avoidance rates of 98%, 99% and 99.5% have been used.

**Table 4-29: Predicted number of collisions per year for guillemot.**

Collision probability	Avoidance rate (%)		
	98	99	99.5
7%	0.04	0.02	0.01

Based on the precautionary avoidance rate of 98% it is predicted that a total of 0.04 collisions per year may occur (Table 4-29).

The annual mortality rate for guillemot is 5.4% (BTO 2011). Consequently, out of a peak regional population of 5,447 individuals (Figure 4-100) an annual mortality of 294 guillemot, may be predicted. Therefore, 1% of the baseline mortality is 3 birds per year.

Based on the results from collision risk modelling, which predicts a total of 0.04 collision per year there will not be a significant impact on the guillemot due to collisions.

The Buchan Ness to Collieston Coast SPA lies approximately 9.5 km away from the proposed development and holds 19,296 individual guillemots on the latest counts in 2007. The colony has an annual mortality of 1,041 guillemots. It is likely that the majority of guillemots within Aberdeen Bay during the breeding period are associated with this colony. The results from the collision risk modelling which predict an annual mortality of 0.04 guillemots per year indicate that there will not be an adverse effect on guillemot associated with the SPA based on the precautionary assumption that an increase of 1% above baseline mortality could be adverse, i.e. more than ten guillemots a year collide with the turbines.

The Fowlsheugh SPA lies 31 km away from the proposed development and holds 50,566 guillemots based on latest counts. Therefore, the annual mortality rate is 2,730 birds per year. Based on the results from the collision risk modelling it is concluded that even if all the guillemots at risk of collision are from Fowlsheugh there will not be an adverse effect.

Troup Pennan and Lion's Heads SPA is 74 km to the north of the proposed development and, based on the latest counts holds 16,325 guillemots and therefore an annual mortality rate of 881 guillemots. The results of the collision risk modelling indicate that there not be an adverse effect on guillemots associated with this SPA.

The Forth Islands SPA is approximately 124 km away and holds 16,888 guillemots therefore an annual mortality rate of 912 guillemots. Should the whole of the population in the Firth of Forth SPA fly through the proposed development area then the collision risk modelling predicts there will not be an adverse effect on the population due to collision.

Based on the results the very low risk of collision it is concluded that the potential effect from collision risk is negligible.

### **Barrier effect**

Studies undertaken in Sweden and Denmark indicate that there is some potential for a barrier effect to occur with a reduced number of birds crossing the constructed wind farms.

During the breeding season it is predicted that there may be regular flights to and from colonies some of which will intersect the proposed development area. The distance guillemots forage varies depend upon the availability of suitable prey and at what stage during the breeding season they are. Maximum foraging ranges are up to 123 km but the median range is 38 km during incubation and 5 km during chick rearing (Roos 2010). Should a barrier effect occur with guillemots from either Fowlsheugh or Buchan Ness to Collieston Coast SPAs making daily movements from one location to another around the proposed development area then they may incur an additional flight distance of up 3.2 km each way, or a total of 6.4 km. This may increase the daily energy expenditure to between 2.0% and 2.5% (Speakman, Gray & Furness 2009).

The location and size of the proposed development is such that it will only occupy a relatively small zone through which birds may avoid flying. No significant concentrations of guillemots were recorded in the vicinity of the proposed development and therefore it is not considered to be a particularly favourable area for foraging. Regular daily movements by individual birds that could cause an incremental increase in distance of foraging flights on a daily basis is not predicted to occur, i.e. birds from colonies will forage over a wider area and will not need to detour around the proposed development on a regular daily basis.

Based on the above it is concluded that the potential incremental increases in foraging distances are unlikely to cause an adverse effect or significant impact on guillemots.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should displacement occur, no guillemots will be within the proposed development area out to a distance of 1 km and a 50% decrease in abundance occurs between 1 km and 2 km from the proposed development.

Based on the peak density obtained from boat-based surveys of 50.7 birds/km<sup>2</sup> in the 'control' area during July, should there be a total displacement of guillemot from within the proposed development area then it is predicted that up to 218 guillemot may be displaced during periods of peak density. Based on a 100% displacement out to 1 km (a total surface area of 12.3 km<sup>2</sup>) from the proposed development area then it is predicted that up to 623 guillemot may be displaced and a further 515 out to 2 km should there be 50% displacement. Therefore, the maximum number of guillemot potentially displaced is up to 1,355 birds based on the highest densities recorded from any survey within Aberdeen Bay and displacement out to 2 km.

Based on the estimated total of 1,355 potentially displaced guillemots out of a peak reported count of 5,447 guillemot, it is predicted that up to 25% of the guillemots within Aberdeen Bay may be displaced. This is based on a peak density obtained from the 'control' area to the north, the peak density from within the EOWDC area was lower at 30 birds/km<sup>2</sup>; consequently, the figure used in this assessment is therefore precautionary.

Based on the regional population estimate of 88,737 guillemots obtained from the regional SPA counts then approximately 1.5% of the regional population may be displaced.

Site specific surveys recorded guillemots throughout the survey area and no specific concentrations were detected, although densities tended to be higher to the north of the proposed development area. However, should there be a displacement effect there is no evidence to suggest that the loss of the area of the proposed development will be significant and that individuals displaced will not be able to find suitable foraging areas elsewhere. Therefore, there is no evidence to suggest that any displacement will have a negative impact on guillemots.

Post-construction monitoring undertaken at Horns Rev offshore wind farm has indicated that displacement of guillemots can occur. However, results from other operating wind farms have not shown a total displacement of guillemots. Guillemots have been recorded at the constructed Kentish Flats offshore wind farm but in reduced numbers (Gill *et al.* 2008). Counts from surveys undertaken during construction at Lynn and Inner Dowsing recorded on average more guillemots during construction than pre-construction but this also included the 'control' areas and more guillemots were also recorded during post-construction surveys at Egmond aan Zee offshore wind farm than were counted prior to construction. There is therefore some evidence to suggest that total displacement of guillemots from within the EOWDC area will not occur.

Based on the evidence from existing offshore wind farms it is predicted that the potential impact from displacement may be moderate.

Calculations used for displacement	
Area	Peak density of guillemot – 50.7 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 50.7 = 218
Area of 1 km buffer – 12.3 km <sup>2</sup>	12.3 * 50.7 = 623
Area of 2 km buffer – 20.3 km <sup>2</sup> at 50% displacement.	(20.3 * 50.7)/2 = 515
Total potentially displaced	218 + 623 + 515 = 1,355

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on guillemots.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded 19 guillemots over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of guillemots that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, although the developments are within the potential foraging ranges of guillemots from a number of SPAs the, relatively far, distance the proposed development is from the other planned offshore wind farms and its relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

### 4.35.6 Conclusions

#### Habitats Appraisal

Based on site specific data and the broad distribution of guillemots in Aberdeen Bay plus evidence from existing offshore wind farms indicating a very low collision risk and recognising that there is potential for some but not total avoidance and potentially some displacement it is predicted that there will not be any adverse effects on the SPAs for which guillemot is a qualifying species.

#### Environmental Impact Assessment

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on guillemots.

#### 4.36 Razorbill (*Alca torda*)

##### 4.36.1 Protection & Conservation Status

The razorbill is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

##### 4.36.2 Background

Razorbill		
GB population	Breeding: 110,000 prs.	BTO 2011
Scottish population	Breeding: 93,300 prs Winter: 50,000 – 250,000 ind.	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	2,200 ind	1% of GB Pop <sup>n</sup>
Designated east coast sites where species is a noted feature	Buchan Ness to Collieston Coast: 4,179 ind. (2007) Fowlsheugh: 4,632 ind. (2009) Firth of Forth: 3,464 ind Troup Pennan & Lion's Heads	SNH 2011 JNCC 2011a
European population estimate	Breeding 430,000 – 770,000 pairs Wintering – >500,000 individuals	Birdlife 2004
European population trend	Status 'secure' Trend 'unknown'	Birdlife 2004
World population	610 – 630,000	Mitchell <i>et al</i> 2004

The global distribution of razorbill is restricted to the North Atlantic and adjacent waters of the Arctic. In the breeding season, adult razorbills concentrate in shallow coastal waters at or near breeding colonies, which are usually situated on steep cliffs, often in the vicinity of guillemots. Relatively little is known about movements of razorbills away from their breeding colonies, although they are believed to be more southerly than guillemots (Wernham *et al.* 2002). During the winter razorbills can occur in Firths and larger estuaries and shallow marine areas such as St. Andrews Bay (Forrester *et al.* 2007). Razorbills feed chiefly on fish, with some invertebrates. Sandeel are a favoured prey item, which they catch by underwater pursuit after diving from the surface.

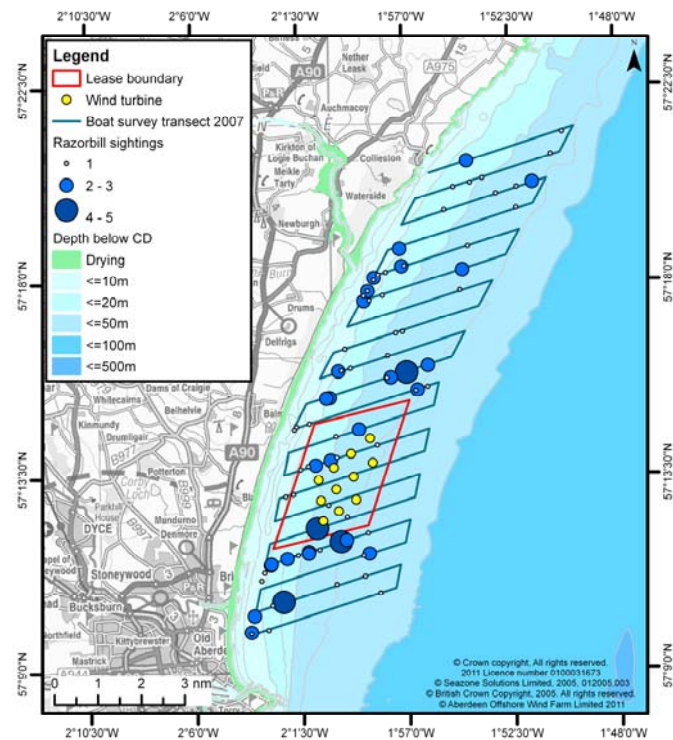
There is an estimated 110,000 pairs of razorbill nesting in Britain of which 93,000 pairs occur in Scotland and approximately 9,000 individuals within the two main colonies in North-east Scotland.

In North-east Scotland razorbills occur widely across the region, particularly during the breeding season. Peak passage occurs during April with a smaller autumn passage recorded.

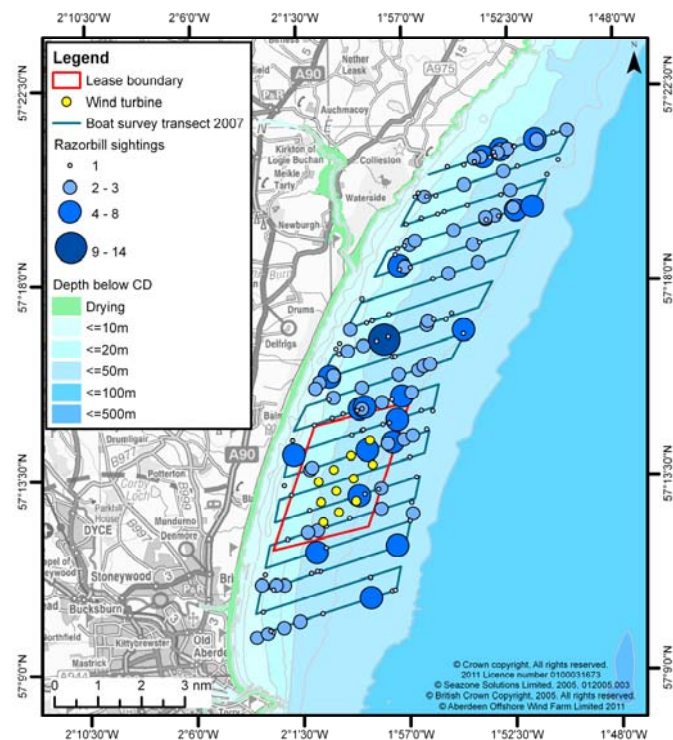
##### Boat-based surveys

Razorbills were recorded throughout the year and across the whole of the surveyed area. Peak numbers occurred during post-breeding surveys between June and September, particularly to the north of the proposed development area. Relatively lower numbers were recorded between November and February (Figure 4-104, Figure 4-105, Figure 4-106). Razorbills were recorded within the footprint of the proposed development with peak numbers during the breeding season.



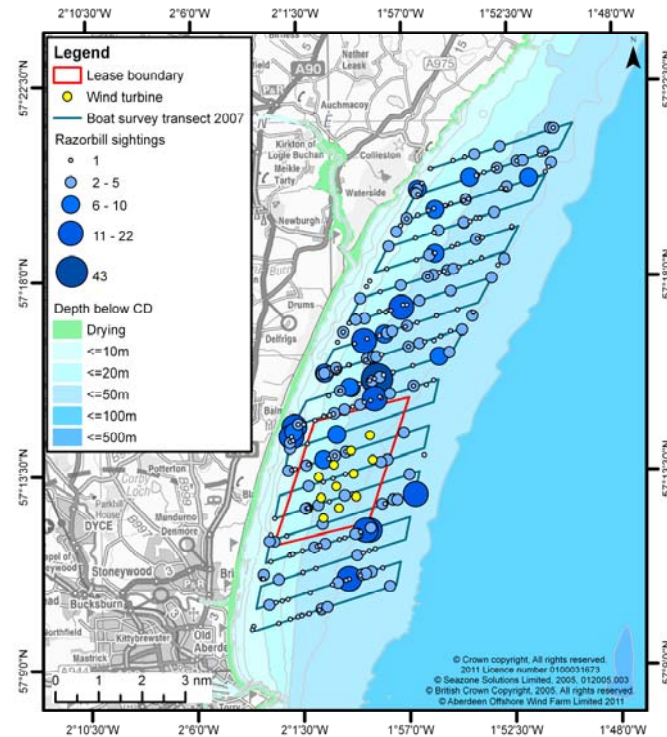


**Figure 4-104: Razorbill distribution in Aberdeen Bay during winter period: November to February (all sightings).**



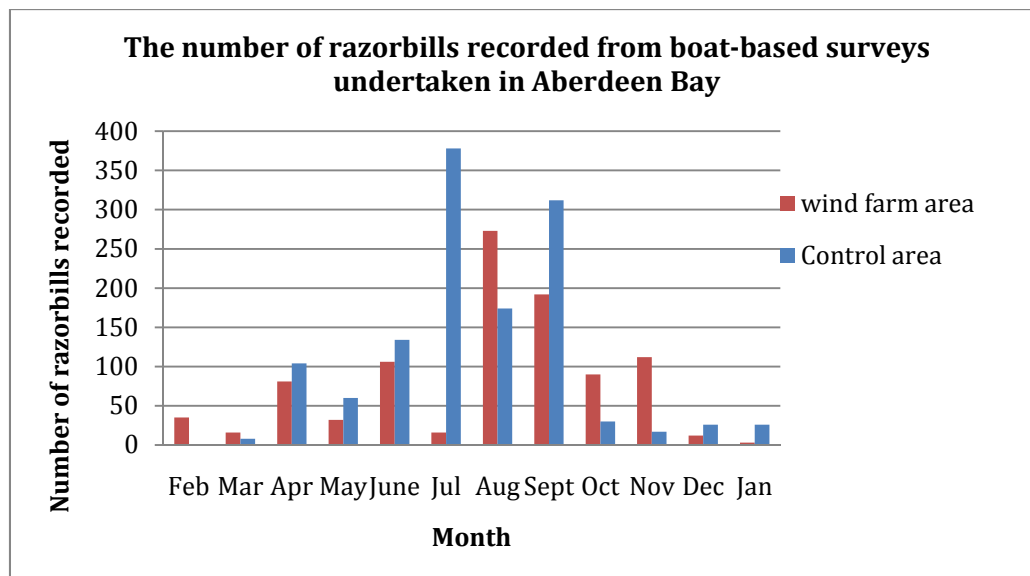
**Figure 4-105: Razorbill distribution in Aberdeen Bay during breeding season: March to June (all sightings).**





**Figure 4-106: Razorbill distribution in Aberdeen Bay during post-breeding: July to October (all sightings).**

Peak counts were of 378 birds in the 'control' area during July and 273 birds in the proposed EOWDC development area during in August (Figure 4-107).

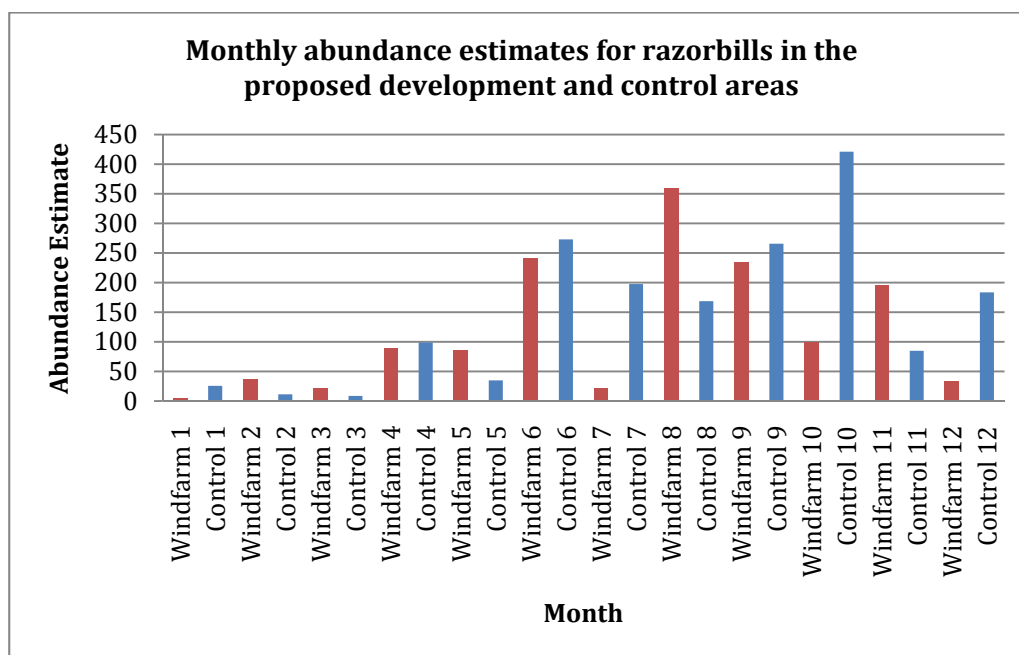


**Figure 4-107: Razorbill monthly population estimates in proposed EOWDC and 'control' areas: Boat-based surveys 2007 – 2008.**

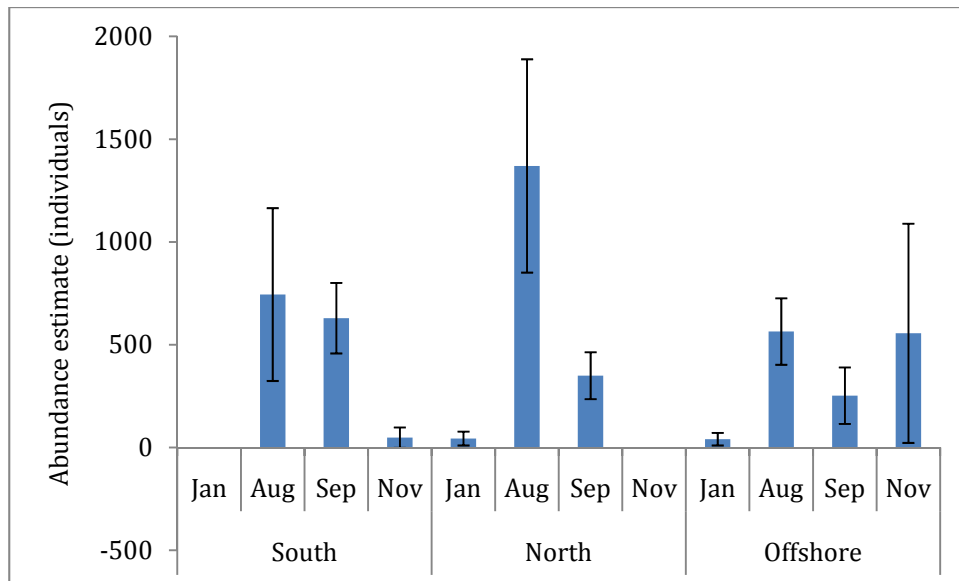
Estimated abundances using *Distance* sampling on the first years of data, estimated peak abundance of razorbill within the proposed development during August with an

estimated abundance of 359 birds. The highest abundance was within the 'control' area to the north with a total of 421 birds in October. Very low numbers were recorded throughout the area between January and March (Figure 4-108). Data obtained from between August 2010 and January 2011 recorded peak abundance in the northern survey area of 1,370 razorbills during August with decreasing numbers in most areas during the autumn and winter periods (Figure 4-109).

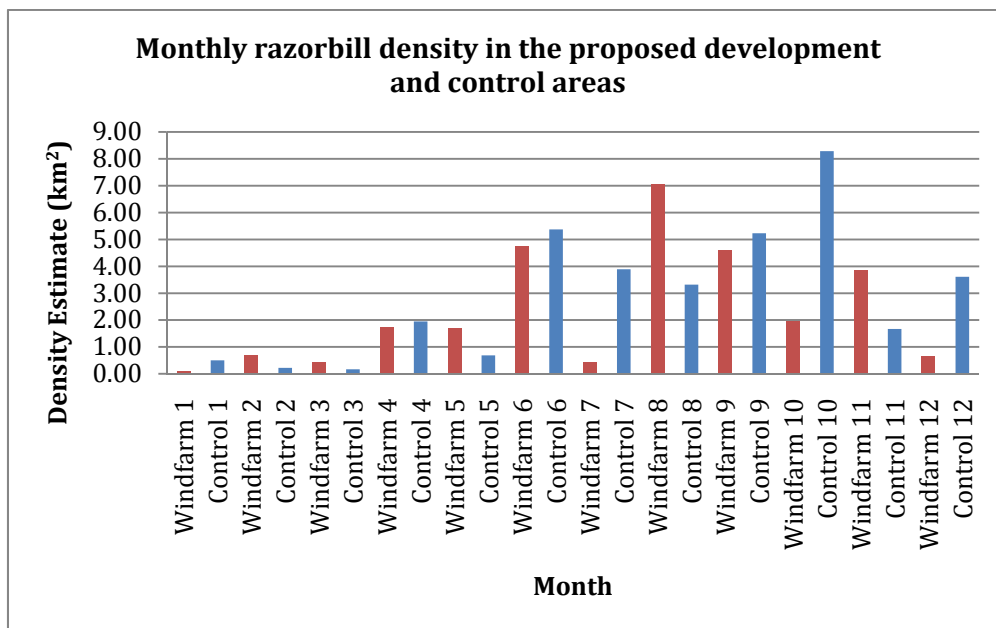
Peak densities of razorbills were 8.3 birds/km<sup>2</sup> within the 'control' area during October and 9 birds/km<sup>2</sup> in the southern and northern areas during August (Figure 4-109, Figure 4-110) (SMRU 2011b).



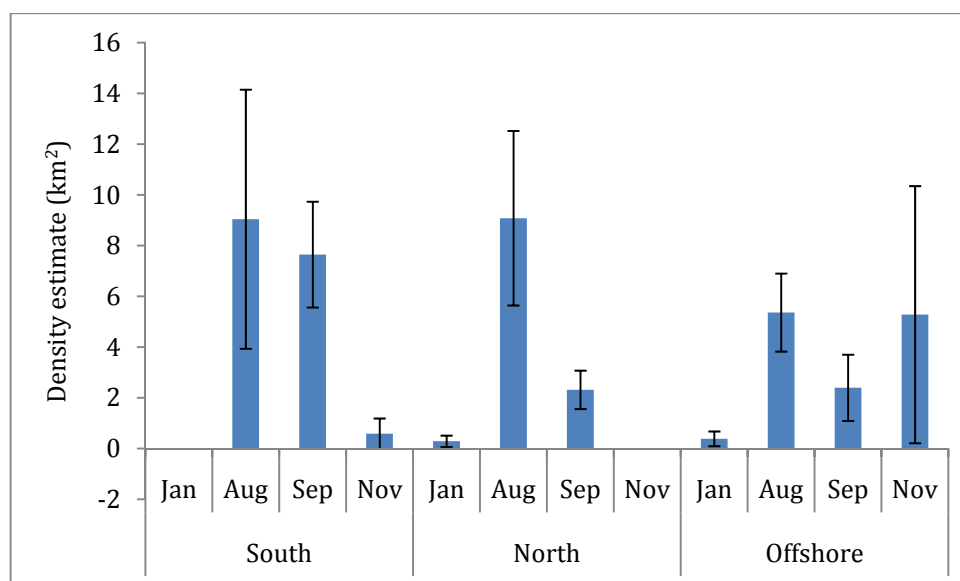
**Figure 4-108: Monthly estimates (+/- SE) of abundance of razorbills in the proposed EOWDC and 'control' areas (Wind farm 1-12 and 'control' 1-12 refers to months).**



**Figure 4-109: Monthly estimates (+/- SE) of abundance of Razorbill in the South, North and Offshore Strata.**



**Figure 4-110: Monthly estimates (+/- SE) of density of razorbills in the proposed EOWDC and 'control' areas (Wind farm 1-12 and 'control' 1-12 refers to months).**



**Figure 4-111: Monthly estimates (+/- SE) of density of Razorbill in the South, North and Offshore Strata.**

Although birds were recorded in all water depths the majority of sightings were in areas where water depth was 20 m or below (IECS 2008). All those recorded in flight flew below 25 m.

#### Vantage Point surveys

Razorbills were recorded significantly less frequently in Aberdeen Bay than guillemots with a peak of up to seven birds per hour in March 2006 and five birds per hour during September 2007 (EnviroCentre 2007a,b; Alba Ecology 2008a). All birds recorded were flying below 30 m and unlike guillemot, most were flying between 1 and 2 km from shore.

#### Bird Detection Radar

There were no razorbills recorded during the radar surveys undertaken at Drums and Easter Hatton during October 2005. In April 2007 a total of 12 razorbills were recorded from Blackdog (Simms *et al.* 2007).

#### 4.36.3 Summary of Results

Razorbills were widely recorded across Aberdeen Bay from all surveys. Low numbers were present at the beginning of the year but increased from April onwards. Data from boat-based surveys indicate peak counts in the bay between July and September but also a high count in October. Birds were recorded in relatively equal numbers across both the 'control' site and the proposed EOWDC survey area. Land based observations recorded peak numbers during April and September.

Data from boat-based surveys recorded razorbills widely across the surveyed areas and land-based observations recorded most birds from between 2.0 km and 4.0 km from the coast.

All those recorded in flight were seen to be flying below 25 m.

No counts during any surveys undertaken across Aberdeen Bay were of national importance.

#### 4.36.4 Initial Assessment of Significance

<b>Razorbill</b>	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Medium	Minor
Displacement	High	Low	Minor

#### 4.36.5 Species Sensitivities

##### Qualifying species

There are four SPAs in the region for which razorbill is a qualifying species: Buchan Ness to Collieston Coast, Fowlsheugh, Troup, Pennan and Lion's Head and Forth Islands SPA.

##### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded 354 razorbills in flight of which none were recorded as flying above 25 m and therefore at risk of collision.

Elsewhere out of 3,299 razorbills for which flight heights have been recorded 4% have been at rotor height.

##### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that razorbills are widespread and frequent within Aberdeen Bay and occur in relatively low densities throughout the area.

No razorbills have been reported as flying at rotor height within Aberdeen Bay or from other wind farms and no reports of collisions by razorbills have been found. Consequently, it is concluded that the risk of a collision with a turbine is very small and that collision mortality will not cause an adverse effect or significant impact to razorbills.

##### Barrier effect

As with guillemots, studies undertaken in Sweden and Denmark indicate that there is some potential for a barrier effect to occur with a reduced number of guillemots/razorbill crossing the constructed wind farms.

During the breeding season it is predicted that there may be regular flights to and from colonies some of which will intersect the proposed development area. The distance razorbills forage varies depending upon the availability of suitable prey and at what stage during the breeding season they are. Maximum foraging ranges are up to 150 km but most foraging occurs within 10 km of the colony (Roos 2010; Thaxter *et al.* 2010). Should a barrier effect occur with razorbills from either Fowlsheugh or Buchan Ness to Collieston Coast SPAs making daily movements from one location to another around the proposed development area then they may incur an additional flight distance of up 3.2 km each way, or a total of 6.4 km. This may increase the daily energy expenditure to between 2.0% and 2.5% (Speakman, Gray & Furness 2009).

The location and size of the proposed development is such that it will only occupy a relatively small zone through which birds may avoid flying. No significant

concentrations of razorbills were recorded in the vicinity of the proposed development and therefore it is not considered to be a particularly favourable area for foraging. Regular daily movements by individual birds that could cause an incremental increase in distance of foraging flights on a daily basis is not predicted to occur, i.e. birds from colonies will forage over a wider area and will not need to detour around the proposed development on a regular daily basis.

Based on the above it concluded that the potential incremental increases in foraging distances are unlikely to cause an adverse effect or significant impact on razorbills.

### Displacement

Based on the results from the monitoring data, the worst-case scenario is that should displacement occur, no razorbill will be within the proposed development area out to a distance of 1 km and a further 50% decrease in abundance occurs out to 2 km from the proposed development area.

Based on the peak density obtained from boat-based surveys of 9.0 birds/km<sup>2</sup> in the 'control' area during August, should there be a total displacement of razorbills from within the proposed development area it is predicted that up to 39 razorbills may be displaced during periods of peak density. Based on a 100% displacement out to 1 km from the proposed development area then it is predicted that up to 111 razorbills may be displaced and a further 91 out to 2 km should there be 50% displacement from between 1 km and 2 km. Therefore, the maximum number of razorbill potentially displaced is up to 241 birds based on the highest densities recorded from any survey within Aberdeen Bay and displacement out to 2 km.

Based on the estimated total of 241 razorbills potentially displaced out of a peak reported count of 1,369 razorbills (Figure 4-109), it is predicted that up to 18% of the razorbills within Aberdeen Bay may be displaced. This is based on a peak density obtained from surveys to the north of the development area and are therefore unlikely to be impacted by displacement effects; consequently the figure used is precautionary.

Based on the regional SPA population of 12,175 razorbills then approximately 1.9% of the regional population may be displaced.

Site-specific surveys recorded razorbills throughout the survey area and no specific concentrations were detected; although densities tended to be higher to the north of the proposed development area. However, should there be a displacement effect there is no evidence to suggest that the loss of the area of the proposed development will be significant and that individuals displaced will not be able to find suitable foraging areas elsewhere. Therefore, there is no evidence to suggest that any displacement will have a negative impact on razorbills.

Post-construction monitoring undertaken at Horns Rev offshore wind farm has indicated that displacement of razorbills occur. However, results from other operating wind farms suggest that this may not be the case and that total displacement from the area of the proposed development may not occur. Densities of razorbills within the area were not higher than elsewhere and consequently it is not thought that the proposed location is of particular importance, particularly as densities of razorbills tended to be higher to the north. Consequently, should displacement occur there are other areas where razorbills could relocate and it is predicted that any potential impact caused by displacement will be minor.

Calculations used for displacement	
Area	Peak density of razorbill – 9.0 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 9.0 = 39
Area of 1 km buffer – 12.3 km <sup>2</sup>	12.3 * 9 = 111
Area of 2 km buffer – 20.3 km <sup>2</sup> (50% displacement)	(20.3 * 9)/2 = 91
Total number at potential displacement	39+111+91 = 241

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on razorbills.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded one razorbill over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of razorbills that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, although the developments are within the potential foraging ranges of razorbills from a number of SPAs the relatively far distance the proposed development is from the other planned offshore wind farms and it's relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

### 4.36.6 Conclusions

#### Habitats Appraisal

Based on site specific data and broad distribution of razorbills in Aberdeen Bay plus evidence from existing offshore wind farms indicating a very low collision risk and recognising that there is potential for some but not total avoidance and potentially some displacement it is predicted that there will not be any adverse effects on the SPA for which razorbill is a qualifying species.

#### Environmental Impact Assessment

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on razorbills.



### 4.37 Guillemot/Razorbill (*Uria alage/Alca torda*)

#### 4.37.1 Background

Guillemot and razorbill can be difficult to separate in the field and consequently a proportion of birds are not identified to either species but are instead recorded as either guillemot or razorbill.

#### Boat-based surveys

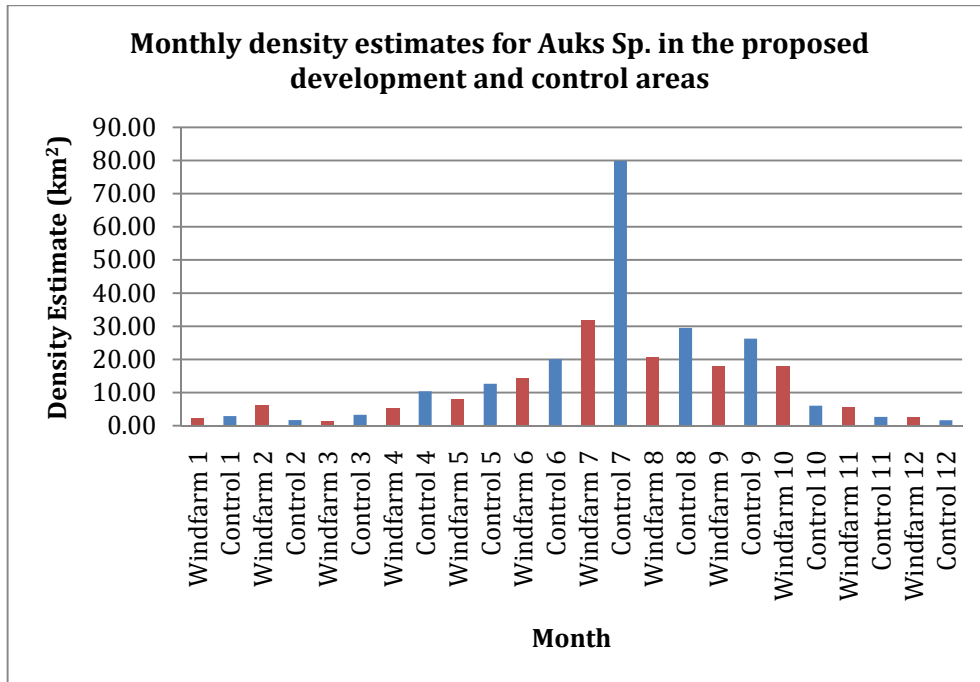
Data from boat-based surveys undertaken between February 2007 and January 2008 indicate a similar pattern of distribution for guillemot/razorbill as was found for each individual species. Peak numbers occurred during July with an estimated 4,058 birds recorded in the 'control' area to the north and 1,620 in the wider proposed development area. Outwith the peak post-breeding period there was an estimated density of less than 6 birds/km<sup>2</sup> from November through to March. Throughout the year densities and abundance were greater within the 'control' area than within the proposed development area (Table 4-30, Figure 4-110, Figure 4-108).

Within the footprint of the proposed development relatively low numbers of guillemots/razorbills were recorded particularly during the breeding and post-breeding seasons.

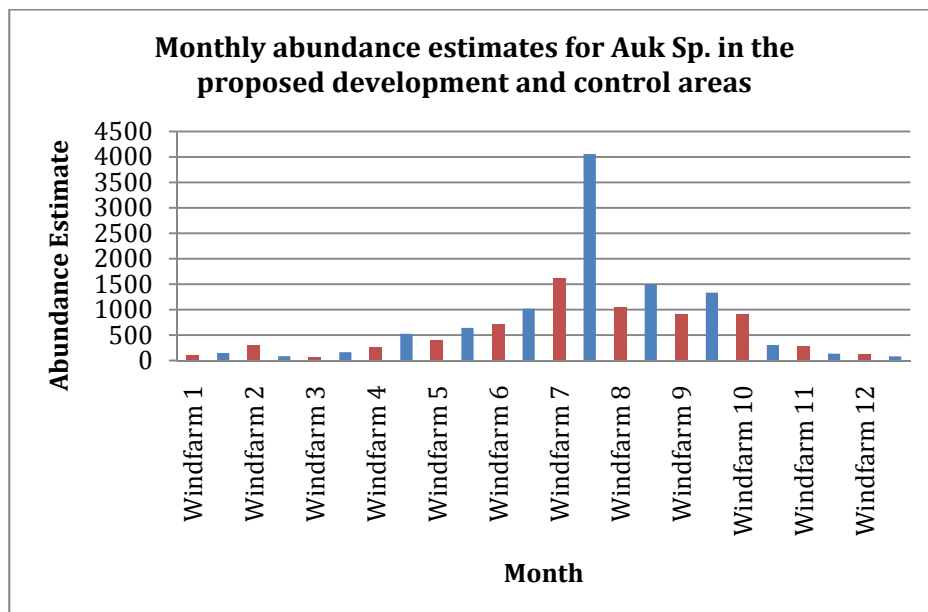
**Table 4-30: Monthly estimates of density and abundance of guillemots, razorbills and individuals not identified to either species in the proposed EOWDC and 'control' areas.**

Month	Location	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
January	EOWDC	2.154	0.509	109	25.9	30
	Control	2.908	0.546	148	27.7	45
February	EOWDC	6.135	0.751	312	38.2	169
	Control	1.662	0.285	84	14.5	52
March	EOWDC	1.486	0.389	75	19.7	23
	Control	3.262	0.598	166	30.4	43
April	EOWDC	5.147	0.790	261	40.2	138
	Control	10.377	1.481	527	75.2	260
May	EOWDC	8.001	1.147	406	58.2	85
	Control	12.646	1.856	642	94.3	151
June	EOWDC	14.219	2.607	722	132.4	109
	Control	20.070	2.828	1,020	143.7	180
July	EOWDC	31.882	4.153	1620	211.0	192
	Control	79.886	10.083	4,058	512.2	330
August	EOWDC	20.613	3.916	1047	198.9	104
	Control	29.480	5.655	1,498	287.2	178
September	EOWDC	17.920	2.500	910	127.0	180
	Control	26.274	2.410	1,335	122.4	221
October	EOWDC	17.839	1.854	906	94.2	187
	Control	6.010	0.867	305	44.0	77
November	EOWDC	5.447	0.602	277	30.6	55
	Control	2.659	0.515	135	26.2	29

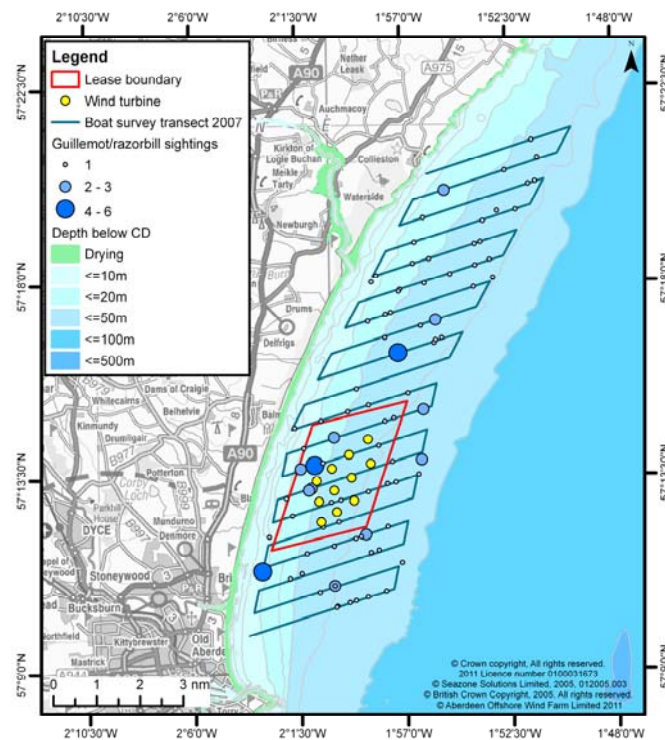
Month	Location	Density Estimate (km <sup>2</sup> )	SE	Estimated Abundance	SE	No. Observations
December	EOWDC	2.585	0.714	131	36.3	38
	Control	1.635	0.362	83	18.4	14



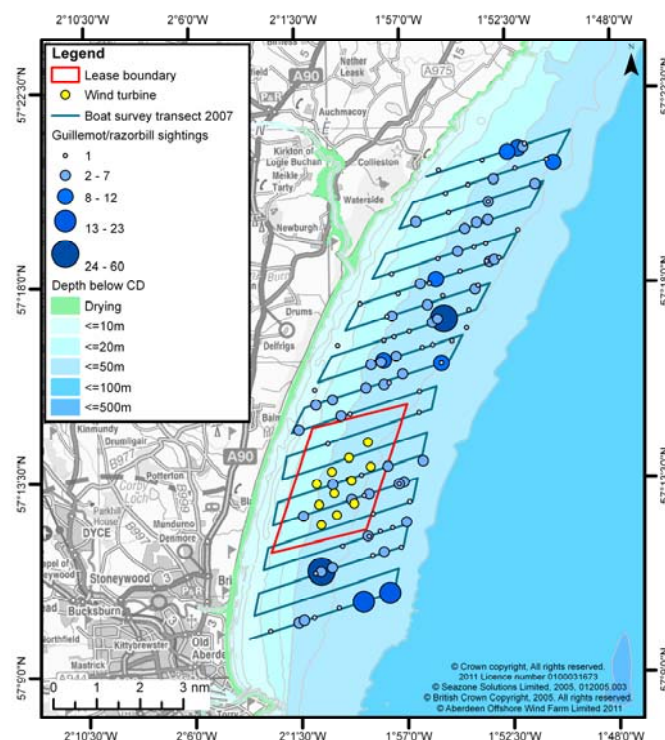
**Figure 4-112: Monthly estimates (+/- SE) of density of guillemots, razorbills and individuals not identified to species in the proposed EOWDC and 'control' areas ('Windfarm' 1-12 and 'control' 1-12 refers to months).**



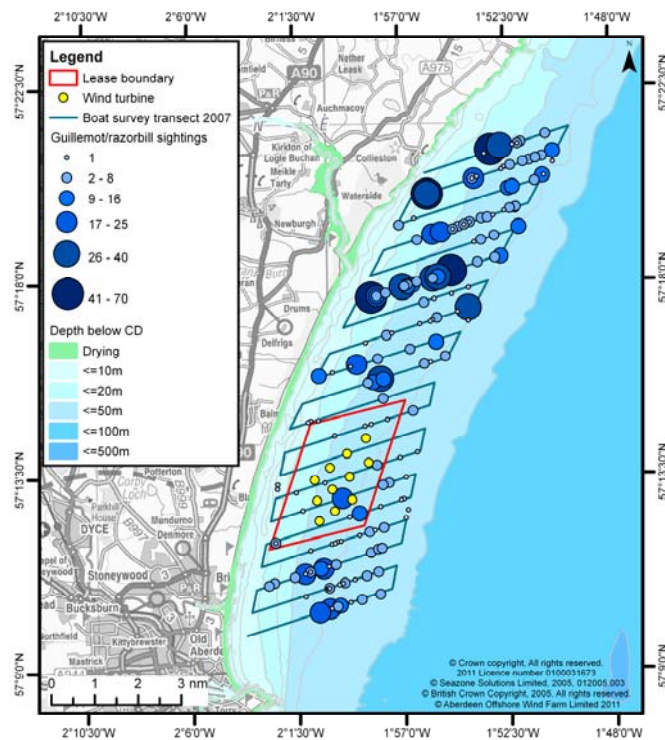
**Figure 4-113: Monthly estimates (+/- SE) of abundance of guillemots, razorbills and individuals not identified to species in the 'wind farm' and 'Control' areas (Wind farm 1-12 and 'control' 1-12 refers to months).**



**Figure 4-114: Guillemot/Razorbill distribution in Aberdeen Bay during winter period: November to February (all sightings).**



**Figure 4-115: Guillemot/Razorbill distribution in Aberdeen Bay during breeding season: March to June (all sightings).**



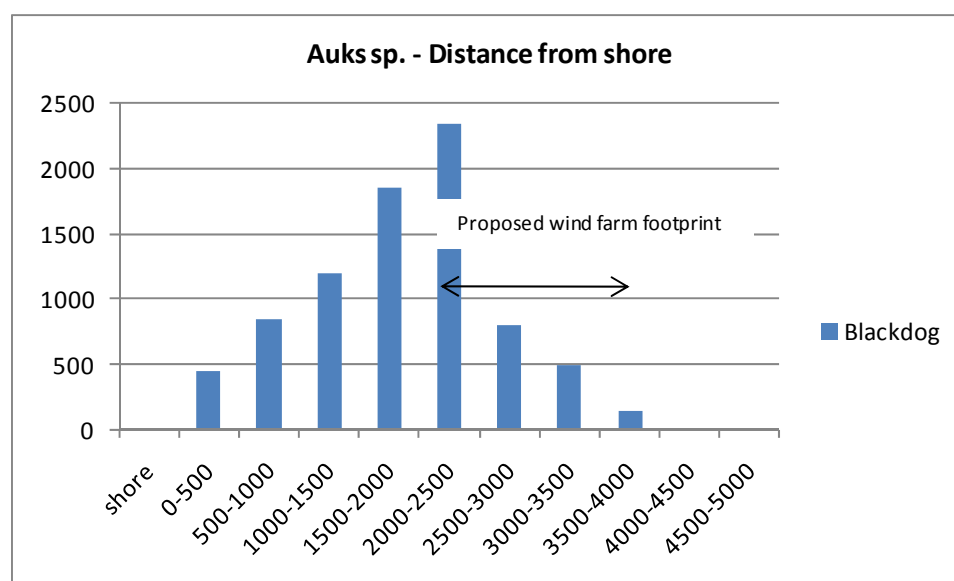
**Figure 4-116: Guillemot/Razorbill distribution in Aberdeen Bay during post-breeding: July to October (all sightings).**

#### Vantage Point surveys

Unidentified Auks were recorded throughout the year during Vantage Point surveys. Peak numbers occurred during April when up to 600 birds an hour were recorded passing Drums and November when up to 120 birds per hour were recorded passing Balmedie. Aside from these two peak counts numbers passing all Vantage Point sites were considerably lower and often less than 10 birds per hour at other sites during the same period (Alba Ecology 2008a). During the breeding season the numbers of unidentified Auks was lower than during the post-breeding season.

#### Bird Detection Radar

A total of 38 Auks were not identified to species level during surveys undertaken at Drums and Easter Hatton during October 2005. During the seventeen days of radar surveys undertaken in April 2007, a total of 7,787 unidentified Auks were recorded with a mean passage rate of 153 birds per hour making this the most frequently recorded 'species' during the April surveys. There was a distinct peak of up to 2,500 birds passing per hour on the evening of 12 April (Simms *et al.* 2007). The majority of sightings were within 1.5 km and 3 km from the coast (Figure 4-117)



(Adapted from Simms *et al.* 2007)

**Figure 4-117: Distances from shore for Auks Sp. from Blackdog (April 2007).**

#### 4.37.2 Summary of Results

Unidentified Auks were widely recorded across Aberdeen Bay from all surveys. Relatively low numbers were present at the beginning of the year but increased from April onwards. Data from surveys indicate peak numbers in the bay during July with a decrease in numbers from August onwards. Significantly more birds were recorded in the 'control' area than within the proposed development area.

Data from boat-based surveys recorded unidentified Auks widely across the surveyed areas and land-based observations recorded most from between 2.0 km and 4.0 km from the coast.

#### 4.37.3 Initial Assessment of Significance

Guillemot/Razorbill	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Medium	Minor
Displacement	High	Low	Minor

#### 4.37.4 Species Sensitivities

##### Qualifying species

There are four SPAs in the region for which both guillemots and razorbills are a qualifying species: Buchan Ness to Collieston Coast, Fowlsheugh, Troup, Pennan and Lion's Head and Forth Islands SPA.

##### Flight height

Flight heights for both guillemots and razorbill are discussed previously and both species show that between 96% and 100% of flights are below turbine height.

### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that both guillemots and razorbill are widespread and frequent within Aberdeen Bay and occur throughout the area.

Collision Risk Modelling undertaken for guillemot has indicated a very low risk of collision and it is likely that the majority of unidentified guillemot/razorbills will be of this species. The number of birds recorded in flight was very similar to guillemot and it is therefore predicted that the total number of birds at risk of collision is very low and that there will not be a significant impact on the guillemot/razorbill due to collisions.

### Barrier effect

The potential barrier effect for guillemot/razorbill has been addressed previously under the respective species sections.

### Displacement

To determine the potential impacts on guillemots/razorbill from displacement it is assumed that there will be total displacement within the proposed development area and out to a distance of 1 km and then a further 50% decrease in abundance out to 2 km from the proposed development area.

Based on the peak density obtained from boat-based surveys of 79.8 birds/km<sup>2</sup> in the 'control' area during July, should there be a total displacement of guillemot/razorbills from within the proposed development area it is predicted that up to 2,133 birds may be displaced out to 2 km during periods of peak density. Based on peak densities recorded within the proposed development area, which were lower, 850 guillemots/razorbill may be displaced.

Based on the regional population 101,000 guillemot and razorbills obtained from the regional SPA counts then between 1% and 2% of the regional population may be displaced. However, as previously discussed, total avoidance is not considered likely and any displaced birds will be able to find other alternative foraging areas based on the broad distribution of guillemots in the area and their wide foraging areas. Consequently it is not thought any significant impact or adverse effect will occur.

Calculations used for displacement	'control'	EOWDC
Area	Peak density of guillemot/razorbill – 79.8 birds/km <sup>2</sup>	Peak density of guillemot/razorbill – 31.8 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 79.8 = 343	4.3 * 31.8 = 137
Area of 1 km buffer – 12.3 km <sup>2</sup>	12.3 * 79.8 = 981	12.3 * 31.8 = 391
Area of 2 km buffer – 20.3 km <sup>2</sup> (50% displacement)	(20.3 * 79.8)/2 = 809	(20.3 * 31.8)/2 = 322
Total potential displacement	343 + 981 + 809 = 2,133	137 + 391 + 322 = 850

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on either guillemots or razorbills. Information required to inform potential cumulative impacts from possible future offshore wind farm projects outwith Aberdeen Bay is currently unavailable. However, the relative distance the proposed development is from the other planned offshore wind farms and its relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

#### 4.37.5 **Conclusions**

##### **Habitats Appraisal**

Based on site specific data and broad distribution of both guillemots and razorbills in Aberdeen Bay plus evidence from existing offshore wind farms indicating a very low collision risk and recognising that there is potential for some but not total avoidance and, potentially, some displacement it is predicted that there will not be any adverse effects on the SPAs for which either guillemot or razorbill are qualifying species.

##### **Environmental Impact Assessment**

Based on evidence from existing offshore wind farms it is predicted that there will not be a significant environmental impact arising from the proposed development on guillemots or razorbills.



#### 4.38 Atlantic Puffin (*Fratecula arctica*)

##### 4.38.1 Protection & Conservation Status

The (Atlantic) puffin is listed in Appendix III of the Bern Convention and is on the Amber List of Species of Conservation Concern.

##### 4.38.2 Background

Puffin		
GB Population	Breeding: 579,000 prs	BTO 2011
Scottish population	Breeding: 493,000 prs Winter: est. 20,000 ind	Forrester <i>et al.</i> 2007
International threshold	Unknown	-
GB threshold	10,400 ind.	1% of GB Pop <sup>1</sup>
Designated east coast sites where species is a noted feature	Firth of Forth (58,867 AoN)	SNH 2011 JNCC 2011a
European population estimate	Breeding 5,700,000 – 7,300,000 pairs Wintering – unknown	Birdlife 2004
European population trend	Status 'depleted' Trend 'unknown'	Birdlife 2004
World population	5,500,000 – 6,600,000 pairs	Mitchell <i>et al</i> 2004

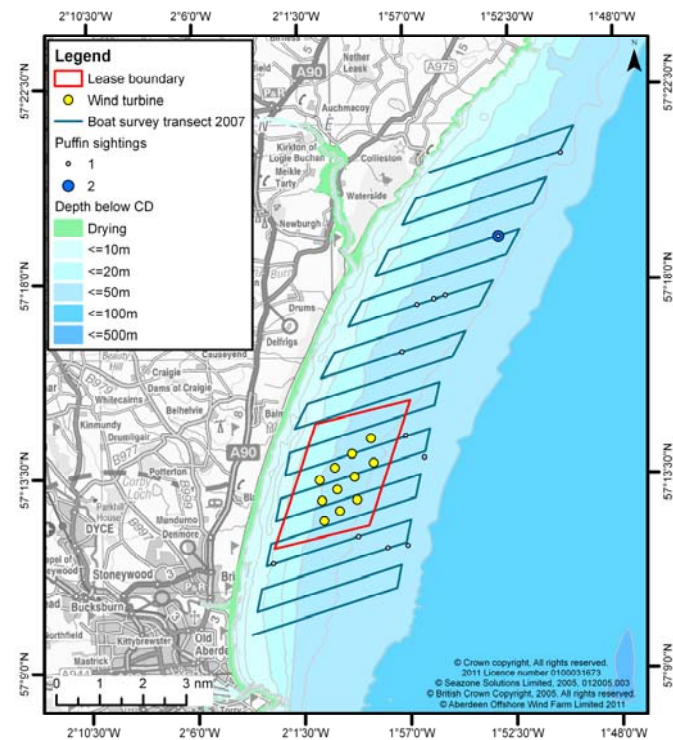
Puffins are restricted to the North Atlantic and adjacent waters of the Arctic, with the species main stronghold in Iceland and north Norway. Puffins remain offshore until the breeding season when they move inshore and start attending colonies during early spring. The species is highly colonial, with pairs typically nesting in underground burrows dug in the soil of offshore islands. Following breeding, puffins leave the colonies and disperse widely to offshore waters. Puffins mainly feed on fish with sandeels a favoured prey item that they catch by underwater pursuit after diving from the surface.

The UK breeding population is estimated to be approximately 600,000 pairs of which 493,000 are in Scotland and 2,500 nest in North-east Scotland.

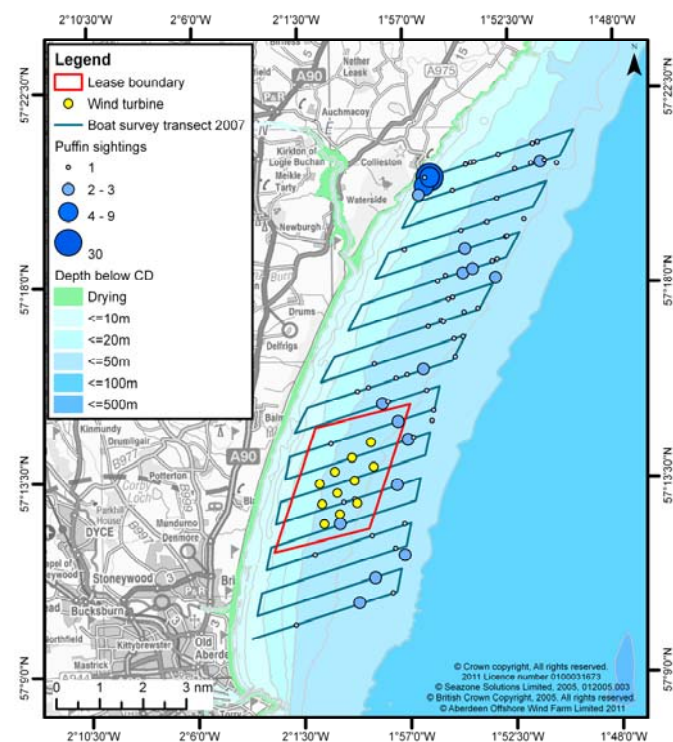
In North-east Scotland puffins are rarely recorded outwith the breeding season with peak counts past Peterhead of up to 15 birds per hour in June and July.

##### Boat-based survey

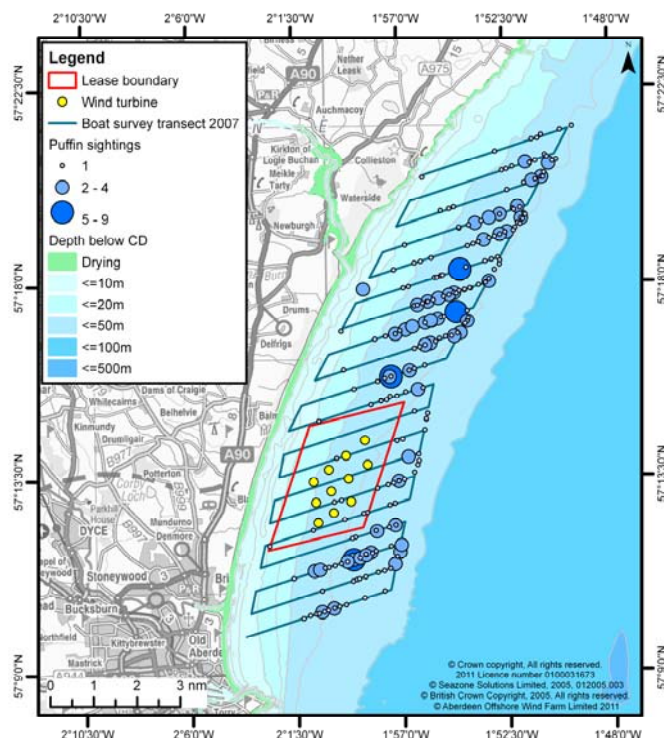
Unlike guillemots and razorbills, puffins were recorded predominantly in water depths of 30 m or more, with relatively few birds in near-shore waters. There were very few records of puffin between November and February with numbers increasing from March onwards. However, numbers in Aberdeen Bay were still relatively low with peak concentrations during the breeding season near Collieston where small numbers breed. Peak numbers occurred in the post-breeding season between August and October with the majority of birds to the north and very few records within the footprint of the proposed development area (Figure 4-118, Figure 4-119, Figure 4-120).



**Figure 4-118: Puffin distribution in Aberdeen Bay during winter period: October to February (all sightings).**



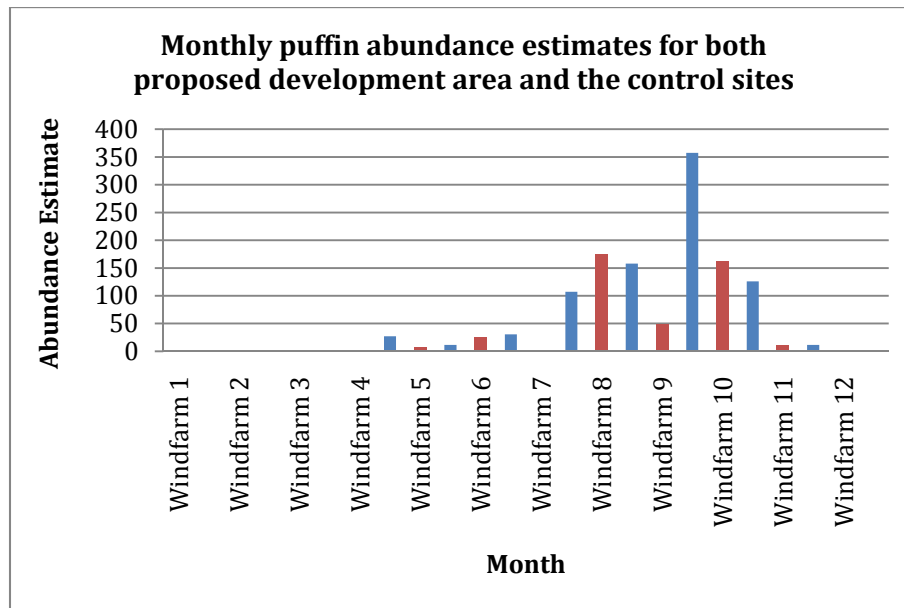
**Figure 4-119: Puffin distribution in Aberdeen Bay during breeding season: March to July (all sightings).**



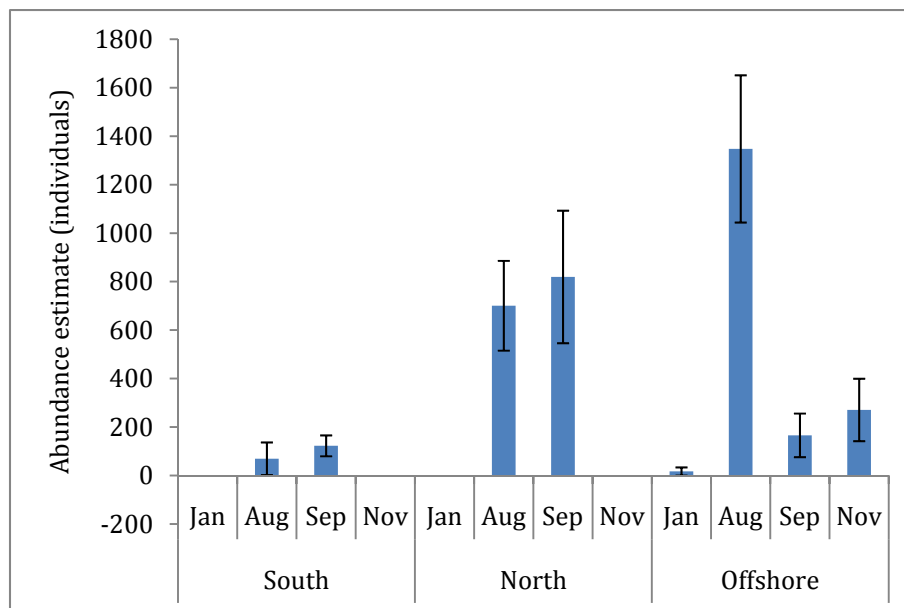
**Figure 4-120: Puffin distribution in Aberdeen Bay during post-breeding: August to September (all sightings).**

Puffins were only recorded between May and November with peak counts in the post-breeding season with an estimated population of 700 and 800 birds in the northern survey area during August and September 2010 and 1,347 individuals in offshore waters during August. Within the 'control' area peak abundance was during September when 357 individuals were estimated within the 'control' area and 48 were present in the proposed EOWDC development area. Within the proposed EOWDC development area peak numbers of puffin occurred during August and October when peak counts of 175 and 163 respectively were recorded (Figure 4-123, Figure 4-121).

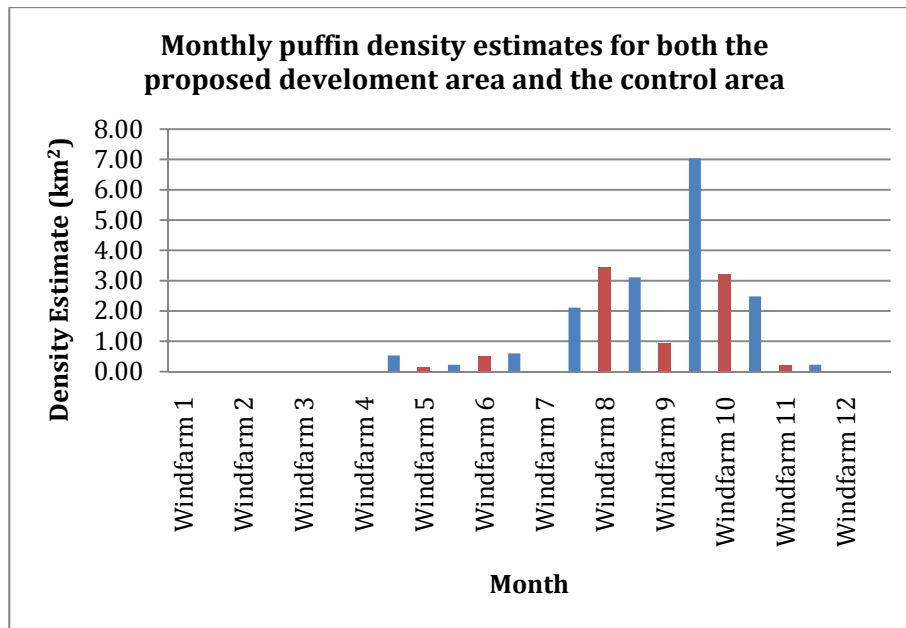
Peak densities also occurred between August to October when 12.8 birds/km<sup>2</sup> were recorded in offshore areas during August and 7 birds/km<sup>2</sup> during October in the 'control' area. Within the proposed development area a peak density of 3.4 birds/km<sup>2</sup> was recorded in August.



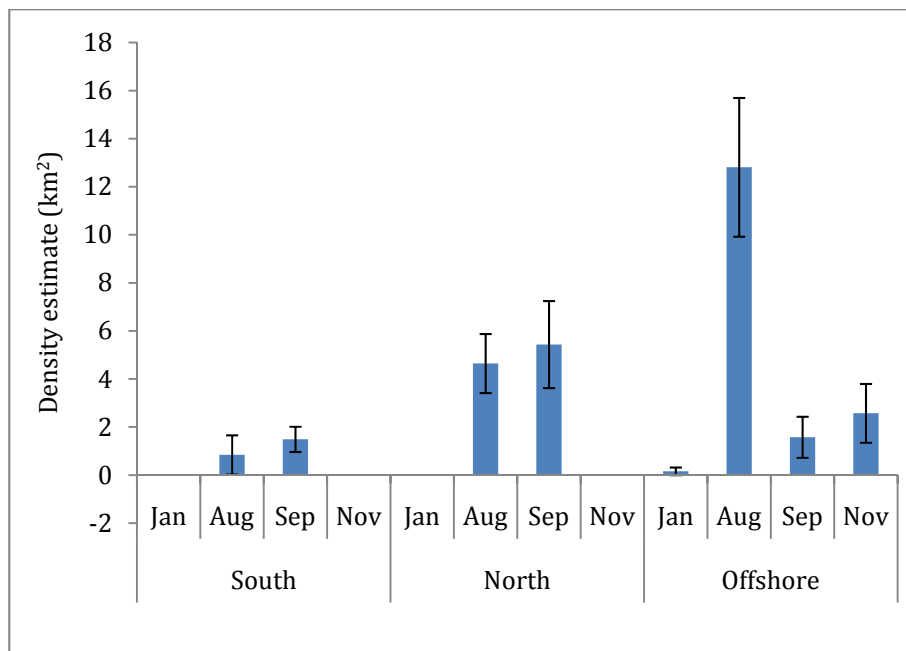
**Figure 4-121: Monthly estimates (+/- SE) of abundance of puffins in the proposed EOWDC and 'Control' areas; February 2007 to January 2008 ('Windfarm' 1-12 and 'Control' 1-12 refers to months).**



**Figure 4-122: Monthly estimates (+/- SE) of abundance of Atlantic Puffin in the South, North and Offshore Strata; August 2010 to January 2011.**



**Figure 4-123: Monthly estimates (+/- SE) of density of puffins in the proposed EOWDC and 'control' areas February 2007 to January 2008 ('Windfarm' 1-12 and 'Control' 1-12 refers to months).**



**Figure 4-124: Monthly estimates (+/- SE) of density of Atlantic Puffin in the South, North and Offshore Strata; August 2010 to January 2011.**

#### Vantage Point surveys

In Aberdeen Bay puffins were scarce during the winter period with only one sighting between October 2006 and March 2007. Between April and September low numbers of puffin were recorded with a passage of two birds per hour and a peak of three birds per hour in April. All sightings were of birds flying below 30 m and between 1 km and 3 km from shore.

## Bird Detection Radar

One puffin was recorded during radar studies in October 2005 (Walls *et al* 2005).

### 4.38.3 Summary of Results

Puffins were widely recorded across Aberdeen Bay from all surveys. No puffins were recorded between December and March and relatively low numbers were recorded until July when the number of puffins recorded increased with a peak during the post-breeding period. Peak numbers of puffins during July and September were recorded within the 'control' area whereas in August and October peak numbers were within the proposed development area.

Of those recorded in flight, all puffins recorded during boat-based and land-based surveys were recorded as flying below 30 m.

No counts of puffin from any of the surveys undertaken within Aberdeen Bay were of national importance.

### 4.38.4 Initial Assessment of Significance

Guillemot	Overall sensitivity	Magnitude	Significance
Collision	Very High	Negligible	Minor
Barrier	Medium	Medium	Minor
Displacement	Medium	Low	Minor

### 4.38.5 Species Sensitivities

#### Qualifying species

The only SPA in the region for which puffin is a qualifying species is the Forth Islands SPA where 58,867 pairs of puffins nest on the Isle of May.

#### Flight height

Flight heights obtained from boat-based surveys undertaken in Aberdeen Bay recorded 32 puffins in flight none of which were recorded as flying above 25 m and therefore at risk of collision.

Elsewhere in the UK very few puffins have been recorded in flight and all have been below turbine height (n=35).

#### Collision risk

Evidence from site specific monitoring using boat-based and land-based surveys and other data sources indicate that puffins are widespread and frequent within Aberdeen Bay and occur in relatively low densities throughout the area.

No puffins were recorded as flying at rotor height within Aberdeen Bay or from other wind farms and no reports of collisions of puffins have been found. Consequently, it is concluded that the risk of a collision with a turbine is very small and that any collision mortality, should it occur, will not cause an adverse effect or significant impact to puffins



### Barrier effect

There is no data available to determine whether puffins may be impacted by a barrier effect as very few puffins have been reported near to constructed offshore wind farms.

During the breeding season it is predicted that there may be regular flights to and from colonies some of which will intersect the proposed development area. The distance puffins' forage varies depending upon the availability of suitable prey and at what stage during the breeding season they are. Maximum foraging ranges are up to 137 km away from the colony although most foraging ranges will be considerably closer than this (Roos 2010; Thaxter *et al.* 2010). Should a barrier effect occur with birds from Fowlsheugh or to the north of Collieston making daily movements from one location to another around the proposed development area then they may incur an additional flight distance of up 3.2 km each way, or a total of 6.4 km. This may increase the daily energy expenditure to between 2.0% and 2.5% (Speakman, Gray & Furness 2009).

The location and size of the proposed development is such that it will only occupy a relatively small zone through which birds may avoid flying. No significant concentrations of puffins were recorded but they did tend to occur further offshore than either guillemot or razorbill and therefore have a higher potential to interact with the proposed development. However, puffins had a wide distribution offshore and regular daily movements by individual birds that could cause an incremental increase in the length of foraging flights on a daily basis is not predicted to occur, i.e. birds from colonies will forage over a wider area and will not need to detour around the proposed development on a regular daily basis.

Based on the above it is concluded that the potential incremental increases in foraging distances are unlikely to cause an adverse effect or significant impact on puffins.

### Displacement

The worst-case scenario is that should 100% displacement occur, no puffin will be within the proposed development area out to a distance of 1 km and then a further 50% decrease in abundance occurs out to 2 km from the proposed development area.

Based on the peak density obtained from boat-based surveys of 12.8 birds/km<sup>2</sup> in the offshore area during August, should there be a total displacement of puffins from within the proposed development area it is predicted that up to 55 puffins may be displaced during periods of peak density. Based on a 100% displacement out to 1 km from the proposed development area then it is predicted that up to 157 puffins may be displaced and a further 130 out to 2 km should there be 50% displacement from between 1 km and 2 km. Therefore, the maximum number of puffin potentially displaced is up to 342 birds based on the highest densities recorded from any survey within Aberdeen Bay and displacement out to 2 km.

Based on the estimated total of 342 puffins potentially displaced out of a peak reported count of 1,347 (Figure 4-121), it is predicted that up to 25% of the puffins within Aberdeen Bay may be displaced. However, this is based on a peak density obtained from surveys further offshore from the development and densities within the proposed development area were significantly lower at between 3 and 5 birds per/km<sup>2</sup>.

Based on the regional SPA population 117,734 puffins and the highest densities recorded from site specific surveys approximately 0.3% of the regional population may be displaced.



Site specific surveys recorded puffins throughout the survey area and no specific concentrations were detected; although densities tended to be higher further offshore compared to those recorded from the proposed development area. Should there be a displacement effect there is no evidence to suggest that the loss of the area of the proposed development will be significant and that individuals displaced will not be able to find suitable foraging areas elsewhere. Therefore, there is no evidence to suggest that any displacement will have a negative impact on puffins.

Densities of puffins within the proposed development area were not higher than elsewhere and consequently it is not thought that the proposed location is of particular importance for puffin, particularly as densities tended to be higher further offshore and in the 'control' area. Consequently, should displacement occur there are other areas where puffins could relocate and it is predicted that any potential impact caused by displacement will be minor.

Calculations used for displacement	
Area	Peak density of puffin – 12.8 birds/km <sup>2</sup>
Area of EOWDC – 4.3 km <sup>2</sup>	4.3 * 12.8 = 55
Area of 1 km buffer – 12.3 km <sup>2</sup>	12.3 * 12.8 = 157
Area of 2 km buffer = 20.3 km <sup>2</sup> .	(20.3 * 12.8)/2 = 130
Area of 50% displacement	
Total potential displacement	55 + 157 + 130 = 342

### Cumulative and in-combination

There are no other additional activities within Aberdeen Bay that may cause either cumulative or in-combination impacts on puffins.

Outwith Aberdeen Bay there are a number of planned offshore wind farms in the Firth of Forth and the Moray Firth. The only data available is that from the Beatrice Demonstrator Project which recorded 16 puffins over a period of 12 months pre-construction surveys (Talisman 2005). The size, scale and exact locations of the Round 3 and those in Scottish Territorial Waters are currently not known and there are no data available to determine the number of puffins that may be present in the planned development areas. Consequently, it is not possible to determine whether there will be a cumulative or in-combination impact arising from the proposed plans. However, although the developments within the Firth of Forth area are within foraging ranges of puffins from the Isle of May the relatively large distance the proposed development is from the other planned offshore wind farms and its relatively small scale reduces the risk of a potentially significant cumulative or in-combination effect.

### 4.38.6 Conclusions

#### Habitats Appraisal

Based on the distance the relevant SPA is from the proposed development site and the broad distribution of puffins in Aberdeen it is predicted that there will not be an adverse effect on the SPA for which puffin is a qualifying species.

#### Environmental Impact Assessment

Based on the numbers and distribution of puffins in Aberdeen Bay and their predicted behaviour towards wind farms it is concluded that there will not be a significant environmental impact arising from the proposed development on puffins.

## 5 OTHER SPECIES

The following bird species were recorded during the surveys undertaken within Aberdeen Bay, including radar studies and Vantage Point Counts. The numbers recorded for the following species were either low or they are not qualifying species for any SPAs likely to be affected by the proposed development.

Further detailed assessment for these species has not been undertaken as either the numbers recorded were very low or, as was the case for most waders, the majority of records were of birds within very close proximity to shore or even, on occasions, overland. Consequently, the risk of an interaction with the proposed development is negligible.

### 5.1 Mute swan

Four mute swans were recorded during the Vantage Point surveys with three in April 2007 and one in December 2006 (AlbaEcology 2008a, EnviroCenter 2007b).

### 5.2 Brent goose

Twenty Brent geese were recorded off Murcar in September 2005 and a further 19 from visual observations undertaken at the same time as the Bird Detection Radar studies in October 2005. A further skein of five birds was recorded in during further radar studies in April 2007 (Walls *et al.* 2006, Simms *et al.* 2007).

### 5.3 Tufted duck

A pair of tufted duck were recorded flying north in April 2007 from boat-based surveys and 11 were recorded at Blackdog during the radar surveys undertaken in April 2007 (Simms *et al.* 2007).

### 5.4 Black-throated diver

A single black-throated diver was recorded heading south past Blackdog in September 2006 it was recorded flying between, 0-30 m above sea level and between 1-2 km offshore (EnviroCentre 2007a). A further black-throated diver was seen flying past Blackdog in January 2007 and two past Don Mouth in February 2007 (EnviroCentre 2007b). One black-throated diver was recorded at Blackdog during the April 2007 radar surveys (Simms *et al.* 2007).

### 5.5 Great northern Diver

One great northern diver was recorded from boat-based surveys in January 2011.

Seven great northern divers were recorded from Vantage Point surveys undertaken between March 2005 and March 2008. Singles were recorded in June, July, August, and December and three in September. All were recorded flying below 30 m (Alba Ecology 2008a, EnviroCenter 2007b).

### 5.6 Sooty shearwater

A single sighting in November 2010 was the only record from boat-based surveys (SMRU 2011b). During Vantage Point surveys undertaken between April and October 2006 a total of 12 sooty shearwaters were recorded and a further 15 between April 2007 and November 2007 (EnviroCentre 2007a, Alba Ecology 2008a,b). All sightings were of birds flying below 30 metres and predominantly more than 2 km from shore. One sooty shearwater was recorded flying north in October and one was recorded at Drums, during the radar studies in October 2005. (IECS 2008; Walls *et al.* 2005).

### 5.7 **European Storm petrel**

One record from Vantage Point surveys was of a single bird in October 2007.

### 5.8 **Grey Heron**

Singles at Murcar in August 2005, Drums in October 2005, Donmouth in June 2006 and Balmedie in August 2006 were the only records. One was seen from boat-based surveys undertaken in August 2010.

### 5.9 **Sparrowhawk**

One was recorded during radar surveys in April 2007.

### 5.10 **Kestrel**

One kestrel was recorded at the Donmouth in March 2007.

### 5.11 **Buzzard**

One was recorded during radar surveys undertaken in April 2007.

### 5.12 **Osprey**

A single osprey was seen at the Donmouth in July 2007.

### 5.13 **Oystercatcher**

Small numbers recorded from land based observations with maximum counts of 10 in August 2006 and 11 in April 2006 at Drums and 43 at Blackdog in April 2007.

### 5.14 **Ringed plover**

Fifteen ringed plover were recorded at Drums in October 2005.

### 5.15 **Northern Lapwing**

A total of 930 lapwing were recorded at Drums in October 2005.

### 5.16 **Knot**

15 at Balmedie in August 2005 and Four in January at the Donmouth were the only records.

### 5.17 **Sanderling**

Small numbers of sanderling were regularly recorded along the beach of Aberdeen Bay. Peak totals were of 110 at Blackdog in April 2007, 49 at Easter Hatton in October 2005 and 12 at Blackdog during September 2006.

### 5.18 **Dunlin**

Small numbers of dunlin were recorded during land-based counts with four at Drums and 11 at Blackdog in June 2006. Two dunlin were recorded from boat-based surveys both flying below 30 m.

### 5.19 **Black-tailed godwit**

Eighteen black-tailed godwits in April at Blackdog in 2007 was the only record.

#### 5.20 **Bar-tailed godwit**

Six at Balmedie in April 2005, one at Drums in October 2005, one in September 2006 and two in April 2006 both at Blackdog were the only sightings.

#### 5.21 **Whimbrel**

Singles at Drums in April 2005 June 2006 at Blackdog and Drums in April 2006 were the only records.

#### 5.22 **Curlew**

Curlew were generally regularly recorded in small numbers of less than 40 birds throughout the year from land-based observations. One exception was of counts undertaken in October 2005 when 941 were recorded at Drums and 235 at Easter Hatton.

#### 5.23 **Redshank**

Three sightings of redshank were all from Blackdog where there were 25 in April 2006, seven in June 2006 and 27 in April 2007. There were no other sightings of redshank from other land-based or boat-based surveys.

#### 5.24 **Turnstone**

Three turnstone were recorded from land-based counts in October 2005.

#### 5.25 **Long-tailed skua**

There was one record, in May, of an adult long-tailed skua flying north from boat-based surveys.

#### 5.26 **Pomarine skua**

In Aberdeen Bay, Pomarine skuas were recorded in very small numbers between June and September with 2 in June and one in August. All records were of birds flying below 30 m. A further 12 Pomarine skuas were recorded during radar studies undertaken in October 2005. Six were at Drums and six at Easter Hatton (Walls *et al* 2005).

#### 5.27 **Glaucous gull**

A total of seven glaucous gulls were recorded from the surveys. All were made during Vantage Point counts with a total of six records at Blackdog between November 2007 and March 2008 and one at the Donmouth in February 2008.

#### 5.28 **Little gull**

In Aberdeen Bay little gulls are scarce with four at drums in May 2005 and a total of twenty recorded between April and July 2006 with a peak count in May 2006 of up to 2 birds per hour (EnviroCentre 2007a). There were no records of little gulls during 2007 surveys and only one record in March 2008.

There was one further record in August 2010 (SMRU 2011b).

Little gulls were recorded out to 3 km from shore and half of all sightings were of birds flying between 30-150 m.

One little gull was recorded at Easter Hatton during the radar studies in October 2005. (Walls *et al* 2005).

#### 5.29 **Sabine's gull**

One was seen from Easter Hatton during radar studies in October 2005 (Walls *et al.* 2006).

#### 5.30 **Black guillemot**

There were two records of black guillemot from Vantage Point surveys: four birds of Drums in November 2007 and one there in March 2008.

#### 5.31 **Little auk**

The majority of records of little auk were from surveys undertaken in November 2007 when up to 194 little auks were recorded from land-based observations. Boat-based records were during October and November with a total of 12 birds seen. A further five were recorded in April 2007. All sightings were of birds in flight, flying below 15 m.

#### 5.32 **Woodpigeon**

A single woodpigeon was seen in April 2007.

#### 5.33 **Swift**

Two in June 2007 at the Donmouth.

#### 5.34 **Skylark**

Two skylark were seen in April 2007.

#### 5.35 **Swallow**

There were only a few sightings of swallows reported from land-based observations with a maximum 8 at Blackdog in April 2007 and ones or twos from other observation points during the summer months.

#### 5.36 **Sand martin**

A single sand martin was recorded during April 2007 at Blackdog.

#### 5.37 **Meadow pipit**

A single meadow pipit was recorded in March 2007 at the Donmouth.

#### 5.38 **Redstart**

Two redstarts were recorded at Easter Hatton during October 2005.

#### 5.39 **Blackbird**

A flock of 25 blackbirds were recorded from land-based observations undertaken at Drums during November 2007.

#### 5.40 **Redwing**

A single redwing was recorded in October 2005.

#### 5.41 **Carrion Crow**

Four carrion crows were recorded from land-based observations in April 2007. One at the Donmouth, two at Blackdog and one at Balmedie.

5.42 **Linnet**

Four linnets were recorded from land-based counts in April 2007.

5.43 **Snow bunting**

A flock of thirteen were recorded at Blackdog during November 2007.

## 6 SUMMARY

For the main species recorded from surveys undertaken within the proposed development area the results from the Impact Assessment presented in Section 4, are summarised in Table 6-1. The results presented do not take into account any specific mitigation measures that may be developed in the future that would further reduce the risks and remove or remedy any significant or adverse impacts that may arise (see Section 7).

The results of the assessment identified 36 species of bird that due to either their conservation status, i.e. are a qualifying species for an SPA or due to the numbers recorded within the proposed development area could be impacted by the proposed development.

Three potential impacts were identified: Collision, Displacement and Barrier effects. The potential for both direct and indirect disturbance has also been considered as part of the displacement assessment.

Following the use of a series of matrices to indicate the significance of a potential impact arising from the construction, operation and decommissioning of the proposed development an evidence based assessment has been undertaken to determine the overall significance of the potential impacts.

The results indicate that for most species the proposed development is only likely to have a negligible or at worse a minor effect on the species present.

The impact assessment has identified the potential for impacts of moderate significance on four species of bird: red-throated diver, little tern, Sandwich tern and common tern.

Red-throated diver may be displaced from the area of the proposed development during construction, operation and decommissioning phases. Site specific data indicate that although the higher numbers of red-throated diver occur to the north of the proposed development area a proportion of the local regional population may be displaced. The effects of the possible displacement on red-throated divers are unknown but could be significant were all those displaced not to survive. However, this scenario is considered improbable as the proposed development is in an area not favoured by red-throated diver and any Divers that may be displaced will be able to move to other suitable foraging areas. Therefore, although the impact may be moderate in terms of displacement the actual impact on the Diver population within Aberdeen Bay will be negligible or minor.

Three species of Tern were identified as being at potential risk of a moderately significant impact due to possible indirect impact on their prey should pile driving occur during the construction period. However, it is also considered that any displacement of prey would be temporary as fish would return to the area following cessation of piling. Consequently, the possible impacts were considered to be of a temporary nature and would not have a long-term effect.



**Table 6-1: Summary of Species Impact Assessment.**

Species	Collision Risk	Barrier	Displacement	Overall Assessment
Whooper swan	Negligible	Negligible	Negligible	Negligible
Pink-footed goose	Negligible	Negligible	Negligible	Negligible
Greylag goose	Negligible	Negligible	Negligible	Negligible
Barnacle goose	Minor	Negligible	Negligible	Minor
Shelduck	Negligible	Negligible	Negligible	Negligible
Eurasian wigeon	Negligible	Negligible	Negligible	Negligible
Eurasian Teal	Negligible	Negligible	Negligible	Negligible
Mallard	Negligible	Negligible	Negligible	Negligible
Common eider	Negligible	Minor	Minor	Minor
Long-tailed duck	Negligible	Minor	Negligible	Negligible
Common scoter	Negligible	Negligible	Minor	Minor
Velvet scoter	Negligible	Negligible	Minor	Minor
Goldeneye	Negligible	Negligible	Negligible	Negligible
Red-Brst Merganser	Negligible	Negligible	Negligible	Negligible
Red-throated diver	Negligible	Negligible	Moderate	Moderate
Fulmar	Negligible	Minor	Negligible	Minor
Manx shearwater	Negligible	Negligible	Negligible	Negligible
Northern gannet	Negligible	Negligible	Negligible	Negligible
Great cormorant	Negligible	Minor	Negligible	Minor
European shag	Negligible	Negligible	Negligible	Negligible
Great-crested grebe	Negligible	Negligible	Negligible	Negligible
Arctic skua	Negligible	Negligible	Negligible	Negligible
Great skua	Negligible	Negligible	Negligible	Negligible
Golden plover	Negligible	Minor	Negligible	Minor
Kittiwake	Negligible	Negligible	Negligible	Negligible
Black-headed gull	Negligible	Negligible	Negligible	Negligible
Common gull	Minor	Negligible	Negligible	Minor
Herring gull	Minor	Negligible	Negligible	Minor
Lsr black-backed gull	Negligible	Negligible	Negligible	Negligible
Grt black-backed gull	Negligible	Negligible	Negligible	Negligible
Little tern	Negligible	Negligible	Moderate	Moderate
Sandwich tern	Negligible	Negligible	Moderate	Moderate
Common tern	Minor	Negligible	Moderate	Moderate
Arctic tern	Minor	Negligible	Minor	Minor
Guillemot	Negligible	Negligible	Minor	Minor
Razorbill	Negligible	Negligible	Minor	Minor
Atlantic puffin	Negligible	Negligible	Minor	Minor

## 7 MITIGATION & MONITORING

Detailed mitigation and monitoring measures aimed to avoid, remove or reduce any potentially significant impacts will be developed more fully during consultation with the Regulator and their statutory advisors and other stakeholders.

The main potential impacts arising from the proposed development relate primarily to direct or indirect displacement effects on Divers and Terns. Mitigation measures that may be considered as measures to help avoid, remove or reduce them include:

*Minimising the proposed development area:* By reducing as far as practicable the overall area of the proposed development, the total area and consequently the total number of red-throated divers that may be displaced will be minimised. A number of factors need to be taken into consideration when identifying the location of turbines, including the minimum distance turbines may be able to operate effectively. The current lay out is based on the minimum practical distance possible between turbines, taking into account the physical properties of the likely turbines, features of the seabed, water depth, other sea users as well as comments received during the consultations undertaken during the development of this project. Subject to further consultation, it is currently predicted that there will not be any significant change in the positions of the currently planned wind turbine locations, which covers an area of 4.3 km<sup>2</sup>.

*Vessel management plans:* The potential disturbance of seaduck and Divers and other seabirds from the proposed development area by construction, maintenance or decommissioning vessels may be reduced by minimising the number vessels used during any of phases of the proposed project. Furthermore, ensuring that all vessels use the existing shipping lanes within Aberdeen Bay for as much time as possible will minimise the number of birds potentially displaced.

*Foundation types:* The use of monopiles as a type of foundation requires the use pile-driving to install them, which may cause an indirect effect on prey species. By selecting alternative foundation types, e.g. gravity based structures or jackets that require smaller piles, there is the potential to reduce the risk of an impact on the prey species and therefore reduce the possibility of a displacement effect being caused by construction activities. Further consideration of the foundation types used by the proposed project will be made during the consenting process. Means to minimise the potential effects of noise generated by pile-driving, should it occur, would be considered in line with the latest relevant guidance and would for example include 'soft-start'.

*Timing and duration of installation:* The timing and duration of installation have still to be determined. Site-specific data indicate that there are birds present in Aberdeen Bay throughout the year with peak numbers occurring at different times of year depending on the species. Therefore, it may not be possible to select a period for construction activities to take place at a specific time of year that has relatively lower bird numbers present and therefore less sensitive. It is also recognised that there may be other environmental and project aspects, e.g. fish spawning periods or vessel availability that will need to be considered when identifying potential development construction periods. The timing of possible construction would be further considered during the consenting process when details on the potential project schedule are developed.

*Minimising aviation and navigation lighting:* Birds can be attracted to bright lights, e.g. lighthouses, particularly during poor weather conditions. In order to reduce the risk of birds being attracted to the proposed development all lighting will be kept as far as practicable to a minimum but still kept within the requirements to ensure safety.

Discussions with the relevant authorities on minimum lighting requirements to ensure safety would be held.

It is essential that any monitoring undertaken is designed to address specific concerns or potential impacts identified during the EIA process. Poorly designed *ad hoc* monitoring is likely to be inefficient and not provide useful or meaningful results. It is therefore important that any monitoring programme is developed in collaboration with the Regulator and statutory advisors and takes note of key stakeholders comments arising from the consultation period.

A detailed monitoring programme aimed at specific issues or concerns would be developed with the Regulator and advisors should consent be granted.

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## 8 APPENDIX A

### 8.1 Collision risk modelling

The following section describes and defines the key terms used in the collision risk modelling, following the recommendations made in the SNH approach and also to that having been used in previous offshore wind farm assessments.

The *risk area* is the two-dimensional window facing a bird approaching the proposed development from any given direction. It is defined here as the width of the application area multiplied by the height of the proposed turbine rotors.

Birds may face a wider span of turbines if they approach from other directions (east to west) across the proposed development but, the assumption of this particular flight path is precautionary, since this approach direction has the highest *rotor-swept area* to risk-area ratio and so the highest potential collision risk of any approach path.

The number of birds that are expected to pass through the airspace that would actually be swept by the rotors (the “rotor swept area”) was calculated using the following equation:

- *total passing through the risk area \* ratio of the rotor swept area to the risk area.*

The proposed development design is planned to use a number of yet undeveloped turbine types with the exact detail of these machines not yet known. The maximum turbine that is expected to be deployed could be up to 10MW. In order to make predictions for the worst-case scenario, the turbines were assumed to be 11, 10MW machines, because these machines result in a greater rotor-swept area than the alternative machines.

Any birds that were recorded as flying through the proposed development at Potential Collision Height was considered to be “at risk” of passing through the airspace swept by a turbine rotor (a rotor transit). Potential Collision Height was defined as a height band between 25-150m. Bird flight height information was used to calculate the portion of flying birds expected to be at potential collision height.

The directional modelling process is described below and illustrated using the real data for gannet. The following steps relate to the steps set out in the collision risk calculations for each species, given in the results section.

#### Step 1:

The peak totals of each key species seen flying at the EOWDC within the 300m transect during the snapshot scans were calculated. In order to build a degree of precaution into the model, the month with the highest peak total of birds detected in flight was used. In order to calculate the % of birds at collision risk height taken as birds flying 25m – 150m, both site specific survey data was used (where available) and generic information on flight height information (Cook, Wright & Burton *in prep.*). The rate at which birds were detected during the surveys was calculated by dividing the species total by the total number of survey minutes.

#### Example:

- *29 Gannets recorded in flight during the September survey.*
- *Total gannets flying at Potential Collision Height (using 17 site specific collision height value) = 4.93*
- *Total gannets flying at potential collision height (using 14% site specific collision height value) = 4.06*

### Step 2:

The rate at which birds were detected during the survey was calculated by dividing the species totals by the total number survey minutes.

#### Example:

- *Gannets recorded during the IECS survey (361 minutes of survey effort in the EOWDC area) =  $R = 0.0136$  birds per minute, (or 0.011 using 14% generic collision height)*

### Step 3:

The bird detection rates collected in survey areas (e.g. 'control' or EOWDC) were scaled down to the size of the proposed development licence area. This was accomplished by multiplying the survey detection rate by the ratio of the transect area to the proposed development area.

#### Example:

- For gannet  $R_{SITE} = \text{ratio EOWDC transect to survey area (0.393)} \times \text{survey detection rate (0.0136)} = 5.34 \times 10^{-3}$

### Step 4

The number of birds flying through the Risk Area during an average year was then extrapolated from the overall detection rate. This was calculated by multiplying the rate per minute ( $R_{SITE}$ ) by the total number of minutes that the species was considered to be potentially active during the year. In the absence of good information on the potentially active periods of any of the key species, it was assumed, as a precaution, that all could fly at any time of the day. Thus the potentially active period was taken to be 365 days x 24 hours, or 525,600 minutes for all.

#### Example:

- *The average number of gannets flying through the EOWDC Risk Area was estimated to be  $0.0136 \times 525,600 = 7,148$  birds (or 5,781 birds using 14% of birds at collision height).*

### Step 5

The size of the *risk area*, which is defined as the width of the proposed development area multiplied by the height of the proposed turbine rotors was = 540,000 m<sup>2</sup>.

#### Example:

- *The risk area at EOWDC was calculated by: Width of EOWDC area (2,600 m) \* Height of turbines (10MW 150 m).*

### Step 6

The total rotor swept area was calculated using the following equation: total passing through the risk area \* ratio of the *rotor swept area* to the *risk area*.

Example: The areas swept by one 10MW turbine rotor of up to 150 m diameter was  $\pi \times 75^2 = 17,671$ . With their being potentially up to 11 of these turbines at the EOWDC, the total *rotor swept area* was taken to be  $11 \times 17,671 = 194,161$ .

### Step 7

The ratio of the rotor-swept area to the risk area was calculated by dividing the rotor swept area by the risk area.

#### Example:

- *rotor swept area (194, 161) / 540,000 = 0.35*

**Step 8**

The annual number of birds flying through the rotor swept area was calculated from the annual numbers through the risk area by direct proportion.

Example:

*At the EOWDC the rotor swept area formed 0.35 of the risk area, so the estimated number of gannets through the rotor swept area is 7,148 \* 0.35 = 2,501 birds (or 2,023 birds using 14% flying at collision height).*

**Step 9**

The probability of collision was calculated for each key species, using the spreadsheet supplied by SNH for this purpose. The input parameters relating to the species were sourced from Snow and Perrins (1998) (length and wingspan) and Alerstom *et al.*, (2007) (average flight speed). The parameters for the likely turbine specifications for a 10 MW machine were provided by AOWFL and are outlined in the Project Description (Chapter 3).

Example:

- *The probability of collision for the gannet was calculated as 12, or 0.12*

<b>Gannet</b>											
K: [1D or [3D] (0 or 1)	1		<b>Calculation of alpha and p(collision) as a function of radius</b>								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	□	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
Bird Length	0.94	m	0.025	0.575	3.78	10.84	0.73	0.00091	9.12	0.61	0.00077
Wingspan	1.8	m	0.075	0.575	1.26	4.19	0.28	0.00212	2.46	0.17	0.00124
F: Flapping (0) or gliding (+1)	1		0.125	0.702	0.76	3.30	0.22	0.00278	1.19	0.08	0.00100
			0.175	0.860	0.54	3.12	0.21	0.00367	0.70	0.05	0.00083
Bird speed	15	m/sec	0.225	0.994	0.42	3.52	0.24	0.00533	1.35	0.09	0.00204
RotorDiam	150	m	0.275	0.947	0.34	3.21	0.22	0.00594	1.51	0.10	0.00280
Rotation Period	2.97	sec	0.325	0.899	0.29	2.97	0.20	0.00650	1.61	0.11	0.00352
			0.375	0.851	0.25	2.77	0.19	0.00701	1.66	0.11	0.00419
			0.425	0.804	0.22	2.61	0.18	0.00747	1.68	0.11	0.00481
			0.475	0.756	0.20	2.46	0.17	0.00788	1.68	0.11	0.00538
Bird aspect ratio: □	0.52		0.525	0.708	0.18	2.33	0.16	0.00825	1.67	0.11	0.00591
			0.575	0.660	0.16	2.21	0.15	0.00857	1.65	0.11	0.00638
			0.625	0.613	0.15	2.10	0.14	0.00884	1.62	0.11	0.00681
			0.675	0.565	0.14	1.99	0.13	0.00906	1.58	0.11	0.00719
			0.725	0.517	0.13	1.89	0.13	0.00923	1.54	0.10	0.00752
			0.775	0.470	0.12	1.79	0.12	0.00936	1.50	0.10	0.00781
			0.825	0.422	0.11	1.70	0.11	0.00944	1.45	0.10	0.00804
			0.875	0.374	0.11	1.61	0.11	0.00947	1.40	0.09	0.00823
			0.925	0.327	0.10	1.52	0.10	0.00945	1.34	0.09	0.00837
			0.975	0.279	0.10	1.43	0.10	0.00938	1.29	0.09	0.00846
			<b>Overall p(collision) =</b>				<b>Upwind</b>	<b>14.1%</b>		<b>Downwind</b>	<b>10.1%</b>
								<b>Average</b>	<b>12%</b>		



**Step 10**

The estimated number of turbine collisions each year, assuming no avoiding action and that the turbines were operating 85% of the time to take account of periods when the winds would be inefficient to operate, was calculated as the estimated annual numbers of birds flying through the rotor swept area, multiplied by the probability of collision, multiplied by 0.85.

Example:

- *For the gannet, 2,501 (estimated number of bird collisions per year) \* 0.12 (probability of collision) \* 0.85 (time that turbines were operating) = 255 birds per year (or 206 when applying 14% flying at collision height).*

These values are both precautionary as it assumes birds are active 24 hours a day and do not avoid the turbines.

Various plausible avoidance rates were then applied to this estimate to give a more realistic range of collisions. The avoidance rates applied were 98% (assumed to be the worst case scenario) 98% and 99%.

98% avoidance 255 (or 206) birds \* 0.02 = 5.1 (or 4.1\*) gannet collisions annually,

99 % avoidance 255 (or 206) birds \* 0.01 = 2.55 (or 2.06\*) gannet collisions annually,

99.5% avoidance 255 (or 206) birds \* 0.005 = 1.27 (1.03\*) gannet collisions annually,

\*Uses 14% of birds in flight flying at collision height

**Goose collision risk methodology**

In the absence of site specific survey data that was suitable to estimate collision risk for the pink-footed goose and barnacle goose a different approach was applied based on the assumption that the whole UK wintering populations of pink-footed goose and Svalbard population of Barnacle goose undertake a twice yearly migration across the proposed development area in a 10 km band.

**Pink footed geese:**

The proposed development risk area in a north south direction has a length of 3.6 km and it was assumed that 244,800 pink footed geese would migrate through the risk area every year. The number of birds flying across the risk window at potential collision height was calculated as 46% of 244,800 = 112,608 individuals. The rotor swept area is 194,161 m<sup>2</sup> and the proportion of the rotor swept area to the risk window is 0.35. The number of birds calculated to fly across the rotor swept area is 39,412.

**Barnacle goose:**

The proposed development risk area in a north south direction has a length of 3.6 km and it was assumed that 32,000 barnacle geese would migrate across a 10 km band of the offshore area, twice a year. The number of birds potentially flying through the risk area is 23,040 birds per year. The number of birds flying across the risk area at potential collision height was calculated as 46% of 23,040 = 10,958. The rotor swept area is 194,161 m<sup>2</sup> and the proportion of the rotor swept area to the risk window is 0.35. The number of birds calculated to fly across the rotor swept area is 3,709.

## 8.2 Summary of the collision risk outputs

**Table 8-1: Pink-footed goose Collision Risk Calculations**

Step in collision risk Process	Peak numbers of flying birds (applying generic flight height information 46%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	Used proportion of UK population of pink footed geese migrating along a 10km band
<b>Step 2:</b> Rate at which birds detected at PCH	Not applicable
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	Not applicable
<b>Step 4:</b> Estimated annual total of birds through the risk area	112,608.0000
<b>Step 5:</b> Size of the risk area	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500
<b>Step 8:</b> Annual number of birds flying through the rotor area	39412.8000
<b>Step 9:</b> Probability of collision (Band Model)	8.4%
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance and 100% operational time	3,310.6752
Assuming an operational time of 85%	2,814.0739
Assuming a 98% avoidance rate	56.2815
Assuming a 99% avoidance rate	28.1407
Assuming a 99.5% avoidance rate	14.0704

**Table 8-2: Barnacle goose Collision Risk Calculations**

Step in collision risk Process	Peak numbers of flying birds (applying generic flight height information 46%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	Used proportion of UK population of barnacle geese migrating along a 10km band
<b>Step 2:</b> Rate at which birds detected at PCH	Not applicable
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	Not applicable
<b>Step 4:</b> Estimated annual total of birds through the risk area	10,598.00
<b>Step 5:</b> Size of the risk area	540000.00
<b>Step 6:</b> Total rotor swept area	194,161.00
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.35
<b>Step 8:</b> Annual number of birds flying through the rotor area	3709.30
<b>Step 9:</b> Probability of collision (Band Model)	8.5
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance and 100% operational time	315.29
Assuming an operational time of 85%	268.00
Assuming a 98% avoidance rate	5.36
Assuming a 99% avoidance rate	2.68
Assuming a 99.5% avoidance rate	1.34

**Table 8-3: Common scoter Collision Risk Calculations**

Step in collision risk Process	Peak numbers of flying birds (applying generic flight height information 46%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	1.04
<b>Step 2:</b> Rate at which birds detected at PCH	0.034
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	0.0013
<b>Step 4:</b> Estimated annual total of birds through the risk area	699.7499
<b>Step 5:</b> Size of the risk area	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500
<b>Step 8:</b> Annual number of birds flying through the rotor area	244.9125
<b>Step 9:</b> Probability of collision (Band Model)	0.066
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance and 100% operational time	16.1642
Assuming an operational time of 85%	13.7396
Assuming a 98% avoidance rate	0.2748
Assuming a 99% avoidance rate	0.1374
Assuming a 99.5% avoidance rate	0.0687

**Table 8-4: Gannet Collision Risk Calculations**

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height 17%)	Peak numbers of flying birds (applying generic flight height information 14%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	4.93	4.06
<b>Step 2:</b> Rate at which birds detected at PCH	0.01	0.01
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	0.01	0.00
<b>Step 4:</b> Estimated annual total of birds through the risk area	2,820.90	2323.09
<b>Step 5:</b> Size of the risk area	540,000.00	540,000.00
<b>Step 6:</b> Total rotor swept area	194,161.00	194,161.00
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.35	0.35
<b>Step 8:</b> Annual number of birds flying through the risk area	987.31	813.08
<b>Step 9:</b> Probability of collision (Band Model)	12%	12%
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance and 100% operational time	118.48	97.57
Assuming an operational time of 85%	100.71	82.93
Assuming a 98% avoidance rate	2.01	1.66
Assuming a 99% avoidance rate	1.01	0.83
Assuming a 99.5% avoidance rate	0.50	0.41

**Table 8-5: Cormorant Collision Risk Calculations**

<b>Step in collision risk Process</b>	<b>Peak numbers of flying birds (applying site specific flight height 0%)</b>	<b>Peak numbers of flying birds (applying generic flight height information 4%)</b>
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	Not applicable	4.06
<b>Step 2:</b> Rate at which birds detected at PCH	Not applicable	0.01
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	Not applicable	0.00
<b>Step 4:</b> Estimated annual total of birds through the risk area	Not applicable	2323.09
<b>Step 5:</b> Size of the risk area	Not applicable	540000.00
<b>Step 6:</b> Total rotor swept area	Not applicable	194161.00
<b>Step 7:</b> Ratio of rotor swept area to the risk area	Not applicable	0.35
<b>Step 8:</b> Annual number of birds flying through the risk area	Not applicable	813.08
<b>Step 9:</b> Probability of collision (Band Model)	Not applicable	8.9%
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance and 100% operational time	Not applicable	72.36
Assuming an operational time of 85%	Not applicable	61.51
Assuming a 98% avoidance rate	Not applicable	1.23
Assuming a 99% avoidance rate	Not applicable	0.62
Assuming a 99.5% avoidance rate	Not applicable	0.31

Table 8-6: Fulmar Collision Risk Calculations

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height)	Peak numbers of flying birds (applying generic flight height information)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	N/A	0.4200
<b>Step 2:</b> Rate at which birds detected at PCH	N/A	0.0007
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	N/A	0.0003
<b>Step 4:</b> Estimated annual total of birds through the risk area	N/A	147.0433
<b>Step 5:</b> Size of the risk area	540000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	N/A	51.4651
<b>Step 9:</b> Probability of collision (Band Model)	0.0940	0.0940
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	N/A	4.8377
Assuming an operating time of 85%	N/A	4.1121
Assuming a 98% avoidance rate	N/A	0.0822
Assuming a 99% avoidance rate	N/A	0.0411
Assuming a 99.5% avoidance rate	N/A	0.0206



Table 8-7 Red-throated diver collision risk calculations

Step in collision risk Process	Peak numbers of flying birds No site specific flight height data available	Peak numbers of flying birds (applying generic flight height information 4%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	N/A	0.2500
<b>Step 2:</b> Rate at which birds detected at PCH	N/A	0.0007
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	N/A	0.0003
<b>Step 4:</b> Estimated annual total of birds through the risk area	N/A	150.9947
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	N/A	52.8482
<b>Step 9:</b> Probability of collision (Band Model)	0.0900	0.0900
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	N/A	4.7563
Assuming an operating time of 85%	N/A	4.0429
Assuming a 98% avoidance rate	N/A	0.0809
Assuming a 99% avoidance rate	N/A	0.0404
Assuming a 99.5% avoidance rate	N/A	0.0202

Table 8-8 Guillemot collision risk calculations

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height 1%)	Peak numbers of flying birds (applying generic flight height information 1%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	0.1400	0.1400
<b>Step 2:</b> Rate at which birds detected at PCH	0.0005	0.0005
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	0.0002	0.0002
<b>Step 4:</b> Estimated annual total of birds through the risk area	93.5874	93.5874
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	32.7556	32.7556
<b>Step 9:</b> Probability of collision (Band Model)	0.0770	0.0770
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	2.5222	2.5222
Assuming an operating time of 85%	2.1439	2.1439
Assuming a 98% avoidance rate	0.0429	0.0429
Assuming a 99% avoidance rate	0.0214	0.0214
Assuming a 99.5% avoidance rate	0.0107	0.0107

**Table 8-9: Common gull collision risk calculations**

<b>Step in collision risk Process</b>	<b>Peak numbers of flying birds (applying site specific flight height 33%)</b>	<b>Peak numbers of flying birds (applying generic flight height information 22%)</b>
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	12.8700	8.1900
<b>Step 2:</b> Rate at which birds detected at PCH	0.0419	0.0267
<b>Step 3:</b> Rate of bird detections scaled to EOWDC area	0.0165	0.0105
<b>Step 4:</b> Estimated annual total of birds through the risk area	8,659.4055	5,510.5308
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	3030.7919	1928.6858
<b>Step 9:</b> Probability of collision (Band Model)	0.0960	0.0960
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	290.9560	185.1538
Assuming an operating time of 85%	247.3126	157.3808
Assuming a 98% avoidance rate	4.9463	3.1476
Assuming a 99% avoidance rate	2.4731	1.5738
Assuming a 99.5% avoidance rate	1.2366	0.7869

Table 8-10: Herring gull collision risk calculation

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height 42%)	Peak numbers of flying birds (applying generic flight height information 24%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	16.8000	10.0800
<b>Step 2:</b> Rate at which birds detected at PCH	0.0538	0.0323
<b>Step 3:</b> Ratio of survey area to EOWDC area	0.0212	0.0127
<b>Step 4:</b> Estimated annual total of birds through the risk area	11122.5046	6673.5028
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	3,892.8766	2,335.7260
<b>Step 9:</b> Probability of collision (Band Model)	0.1100	0.1100
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	428.2164	256.9299
Assuming an operating time of 85%	363.9840	218.3904
Assuming a 98% avoidance rate	7.2797	4.3678
Assuming a 99% avoidance rate	3.6398	2.1839
Assuming a 99.5% avoidance rate	1.8199	1.0920

**Table 8-11: Kittiwake collision risk calculations**

<b>Step in collision risk Process</b>	<b>Peak numbers of flying birds (applying site specific flight height 22%)</b>	<b>Peak numbers of flying birds (applying generic flight height information 13%)</b>
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	7.4800	4.4200
<b>Step 2:</b> Rate at which birds detected at PCH	0.0249	0.0147
<b>Step 3:</b> Ratio of survey area to EOWDC area	0.0098	0.0058
<b>Step 4:</b> Estimated annual total of birds through the risk area	5,133.1388	3,033.2184
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	1,796.5986	1,061.6264
<b>Step 9:</b> Probability of collision (Band Model)	0.1190	0.1190
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	213.7952	126.3335
Assuming an operating time of 85%	181.7259	107.3835
Assuming a 98% avoidance rate	3.6345	2.1477
Assuming a 99% avoidance rate	1.8173	1.0738
Assuming a 99.5% avoidance rate	0.9086	0.5369

Table 8-12: Sandwich tern collision risk calculations.

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height 4%)	Peak numbers of flying birds (applying generic flight height information 12%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	0.8400	2.5200
<b>Step 2:</b> Rate at which birds detected at PCH	0.0028	0.0084
<b>Step 3:</b> Ratio of survey area to EOWDC area	0.0011	0.0033
<b>Step 4:</b> Estimated annual total of birds through the risk area	576.4487	1729.3462
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	201.7571	605.2712
<b>Step 9:</b> Probability of collision (Band Model)	0.1180	0.1180
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	23.8073	71.4220
Assuming an operating time of 85%	20.2362	60.7087
Assuming a 98% avoidance rate	0.4047	1.2142
Assuming a 99% avoidance rate	0.2024	0.6071
Assuming a 99.5% avoidance rate	0.1012	0.3035

Table 8-13: Common tern collision risk calculations

Step in collision risk Process	Peak numbers of flying birds (applying site specific flight height 14%)	Peak numbers of flying birds (applying generic flight height information 8%)
<b>Step 1:</b> Number of birds in transect at Potential Collision Height	7.7000	4.4000
<b>Step 2:</b> Rate at which birds detected at PCH	0.0247	0.0141
<b>Step 3:</b> Ratio of survey area to EOWDC area	0.0097	0.0055
<b>Step 4:</b> Estimated annual total of birds through the risk area	5097.8146	2913.0369
<b>Step 5:</b> Size of the risk area	540,000.0000	540,000.0000
<b>Step 6:</b> Total rotor swept area	194,161.0000	194,161.0000
<b>Step 7:</b> Ratio of rotor swept area to the risk area	0.3500	0.3500
<b>Step 8:</b> Annual number of birds flying through the risk area	1,784.2351	1,019.5629
<b>Step 9:</b> Probability of collision (Band Model)	0.1180	0.1180
<b>Step 10:</b> Estimated number of collisions per year assuming no avoidance	210.5397	120.3084
Assuming an operating time of 85%	178.9588	102.2622
Assuming a 98% avoidance rate	3.5792	2.0452
Assuming a 99% avoidance rate	1.7896	1.0226
Assuming a 99.5% avoidance rate	0.8948	0.5113



Red-throated diver											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	□	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.66	m	0.025	0.575	4.33	10.39	0.61	0.00076	8.66	0.51	0.00064
Wingspan	1.11	m	0.075	0.575	1.44	4.04	0.24	0.00178	2.31	0.14	0.00102
F: Flapping (0) or gliding (+1)	1		0.125	0.702	0.87	3.24	0.19	0.00238	1.14	0.07	0.00084
			0.175	0.860	0.62	3.11	0.18	0.00320	0.53	0.03	0.00054
Bird speed	17	m/sec	0.225	0.994	0.48	3.39	0.20	0.00449	0.91	0.05	0.00120
RotorDiam	150	m	0.275	0.947	0.39	3.05	0.18	0.00493	1.11	0.07	0.00180
RotationPeriod	3.00	sec	0.325	0.899	0.33	2.79	0.16	0.00533	1.23	0.07	0.00235
			0.375	0.851	0.29	2.58	0.15	0.00568	1.30	0.08	0.00286
			0.425	0.804	0.25	2.40	0.14	0.00599	1.33	0.08	0.00333
			0.475	0.756	0.23	2.24	0.13	0.00626	1.35	0.08	0.00376
Bird aspect ratio: □	0.59		0.525	0.708	0.21	2.10	0.12	0.00649	1.34	0.08	0.00415
			0.575	0.660	0.19	1.97	0.12	0.00668	1.33	0.08	0.00449
			0.625	0.613	0.17	1.85	0.11	0.00682	1.30	0.08	0.00479
			0.675	0.565	0.16	1.74	0.10	0.00692	1.27	0.07	0.00505
			0.725	0.517	0.15	1.64	0.10	0.00698	1.24	0.07	0.00527
			0.775	0.470	0.14	1.53	0.09	0.00700	1.19	0.07	0.00544
			0.825	0.422	0.13	1.44	0.08	0.00697	1.15	0.07	0.00558
			0.875	0.374	0.12	1.34	0.08	0.00691	1.10	0.06	0.00567
			0.925	0.327	0.12	1.25	0.07	0.00680	1.05	0.06	0.00572
			0.975	0.279	0.11	1.16	0.07	0.00665	1.00	0.06	0.00572
				Overall p(collision) =			Upwind	10.9%		Downwind	7.0%
								Average	9.0%		

**Table 8-15: Cormorant – Band model collision risk calculations.**

Cormorant											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.84	m	0.025	0.575	4.94	13.27	0.68	0.00086	11.55	0.60	0.00074
Wingspan	1.6	m	0.075	0.575	1.65	5.00	0.26	0.00193	3.27	0.17	0.00127
F: Flapping (0) or gliding (+1)	1		0.125	0.702	0.99	3.86	0.20	0.00249	1.75	0.09	0.00113
			0.175	0.860	0.71	3.59	0.18	0.00323	1.01	0.05	0.00091
Bird speed	19.4	m/sec	0.225	0.994	0.55	3.47	0.18	0.00402	0.63	0.03	0.00073
RotorDiam	150	m	0.275	0.947	0.45	3.36	0.17	0.00477	1.16	0.06	0.00164
RotationPeriod	3.00	sec	0.325	0.899	0.38	3.08	0.16	0.00515	1.30	0.07	0.00218
			0.375	0.851	0.33	2.85	0.15	0.00550	1.39	0.07	0.00268
			0.425	0.804	0.29	2.65	0.14	0.00581	1.44	0.07	0.00315
			0.475	0.756	0.26	2.48	0.13	0.00608	1.46	0.08	0.00358
Bird aspect ratio: $\square$	0.53		0.525	0.708	0.24	2.34	0.12	0.00632	1.47	0.08	0.00398
			0.575	0.660	0.21	2.20	0.11	0.00652	1.46	0.08	0.00433
			0.625	0.613	0.20	2.07	0.11	0.00668	1.44	0.07	0.00465
			0.675	0.565	0.18	1.96	0.10	0.00681	1.42	0.07	0.00494
			0.725	0.517	0.17	1.84	0.10	0.00689	1.39	0.07	0.00518
			0.775	0.470	0.16	1.74	0.09	0.00695	1.35	0.07	0.00539
			0.825	0.422	0.15	1.64	0.08	0.00696	1.31	0.07	0.00557
			0.875	0.374	0.14	1.54	0.08	0.00694	1.26	0.07	0.00570
			0.925	0.327	0.13	1.44	0.07	0.00688	1.22	0.06	0.00580
			0.975	0.279	0.13	1.35	0.07	0.00679	1.17	0.06	0.00586
			Overall p(collision) =				Upwind	10.8%		Downwind	6.9%
								Average	8.9%		

Table 8-16: Gannet – Band model collision risk calculations.

Gannet											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.94	m	0.025	0.575	3.82	10.95	0.73	0.00091	9.22	0.61	0.00077
Wingspan	1.8	m	0.075	0.575	1.27	4.22	0.28	0.00211	2.50	0.17	0.00125
F: Flapping (0) or gliding (+1)	1		0.125	0.702	0.76	3.32	0.22	0.00277	1.22	0.08	0.00101
			0.175	0.860	0.55	3.13	0.21	0.00366	0.70	0.05	0.00081
Bird speed	15	m/sec	0.225	0.994	0.42	3.53	0.24	0.00529	1.34	0.09	0.00200
RotorDiam	150	m	0.275	0.947	0.35	3.21	0.21	0.00589	1.51	0.10	0.00276
RotationPeriod	3.00	sec	0.325	0.899	0.29	2.97	0.20	0.00645	1.60	0.11	0.00347
			0.375	0.851	0.25	2.78	0.19	0.00695	1.65	0.11	0.00413
			0.425	0.804	0.22	2.61	0.17	0.00741	1.68	0.11	0.00475
			0.475	0.756	0.20	2.47	0.16	0.00782	1.68	0.11	0.00532
Bird aspect ratio: $\beta$	0.52		0.525	0.708	0.18	2.34	0.16	0.00818	1.67	0.11	0.00584
			0.575	0.660	0.17	2.22	0.15	0.00849	1.65	0.11	0.00631
			0.625	0.613	0.15	2.10	0.14	0.00876	1.62	0.11	0.00673
			0.675	0.565	0.14	2.00	0.13	0.00898	1.58	0.11	0.00711
			0.725	0.517	0.13	1.89	0.13	0.00915	1.54	0.10	0.00744
			0.775	0.470	0.12	1.79	0.12	0.00927	1.49	0.10	0.00772
			0.825	0.422	0.12	1.70	0.11	0.00935	1.45	0.10	0.00795
			0.875	0.374	0.11	1.61	0.11	0.00938	1.40	0.09	0.00814
			0.925	0.327	0.10	1.52	0.10	0.00936	1.34	0.09	0.00828
			0.975	0.279	0.10	1.43	0.10	0.00929	1.29	0.09	0.00837
				Overall p(collision)			Upwind	13.9%		Downwind	10.0%
				=							
								Average	12.0%		

**Table 8-17: Fulmar – Band model collision risk calculations.**

<b>Fulmar</b>											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.52	m	0.025	0.575	3.57	8.84	0.63	0.00079	7.12	0.51	0.00064
Wingspan	1.17	m	0.075	0.575	1.19	3.52	0.25	0.00189	1.80	0.13	0.00096
F: Flapping (0) or gliding (+1)	1		0.125	0.702	0.71	2.88	0.21	0.00257	0.78	0.06	0.00069
			0.175	0.860	0.51	2.81	0.20	0.00351	0.53	0.04	0.00066
Bird speed	14	m/sec	0.225	0.994	0.40	3.03	0.22	0.00488	0.99	0.07	0.00159
RotorDiam	150	m	0.275	0.947	0.32	2.74	0.20	0.00538	1.14	0.08	0.00224
RotationPeriod	3.00	sec	0.325	0.899	0.27	2.51	0.18	0.00582	1.23	0.09	0.00285
			0.375	0.851	0.24	2.32	0.17	0.00622	1.27	0.09	0.00341
			0.425	0.804	0.21	2.16	0.15	0.00657	1.29	0.09	0.00391
			0.475	0.756	0.19	2.02	0.14	0.00686	1.29	0.09	0.00436
Bird aspect ratio: $\beta$	0.44		0.525	0.708	0.17	1.89	0.14	0.00710	1.27	0.09	0.00476
			0.575	0.660	0.16	1.78	0.13	0.00730	1.24	0.09	0.00511
			0.625	0.613	0.14	1.67	0.12	0.00744	1.21	0.09	0.00541
			0.675	0.565	0.13	1.56	0.11	0.00753	1.17	0.08	0.00566
			0.725	0.517	0.12	1.46	0.10	0.00757	1.13	0.08	0.00586
			0.775	0.470	0.12	1.36	0.10	0.00756	1.08	0.08	0.00600
			0.825	0.422	0.11	1.27	0.09	0.00749	1.03	0.07	0.00610
			0.875	0.374	0.10	1.18	0.08	0.00738	0.98	0.07	0.00614
			0.925	0.327	0.10	1.09	0.08	0.00721	0.93	0.07	0.00613
			0.975	0.279	0.09	1.00	0.07	0.00700	0.87	0.06	0.00607
				Overall p(collision)			Upwind	11.8%		Downwind	7.9%
				=							
								Average	9.8%		

Table 8-18: Pink-footed goose Band model collision risk calculations

Pink-footed goose											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.65	m	0.025	0.575	4.79	15.34	0.82	0.00102	13.61	0.72	0.00091
Wingspan	1.53	m	0.075	0.575	1.60	5.69	0.30	0.00227	3.96	0.21	0.00158
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.96	4.26	0.23	0.00283	2.16	0.11	0.00143
			0.175	0.860	0.68	3.86	0.21	0.00360	1.28	0.07	0.00120
Bird speed	18.8	m/sec	0.225	0.994	0.53	3.68	0.20	0.00440	0.93	0.05	0.00111
RotorDiam	150	m	0.275	0.947	0.44	3.16	0.17	0.00462	1.02	0.05	0.00149
RotationPeriod	3.00	sec	0.325	0.899	0.37	2.86	0.15	0.00494	1.14	0.06	0.00197
			0.375	0.851	0.32	2.63	0.14	0.00525	1.22	0.06	0.00244
			0.425	0.804	0.28	2.44	0.13	0.00552	1.27	0.07	0.00287
			0.475	0.756	0.25	2.28	0.12	0.00576	1.29	0.07	0.00326
Bird aspect ratio: $\alpha$	0.42		0.525	0.708	0.23	2.13	0.11	0.00595	1.29	0.07	0.00361
			0.575	0.660	0.21	2.00	0.11	0.00611	1.28	0.07	0.00393
			0.625	0.613	0.19	1.87	0.10	0.00623	1.26	0.07	0.00420
			0.675	0.565	0.18	1.76	0.09	0.00631	1.24	0.07	0.00444
			0.725	0.517	0.17	1.65	0.09	0.00635	1.20	0.06	0.00464
			0.775	0.470	0.15	1.54	0.08	0.00636	1.17	0.06	0.00481
			0.825	0.422	0.15	1.44	0.08	0.00633	1.12	0.06	0.00493
			0.875	0.374	0.14	1.34	0.07	0.00626	1.08	0.06	0.00502
			0.925	0.327	0.13	1.25	0.07	0.00615	1.03	0.05	0.00507
			0.975	0.279	0.12	1.16	0.06	0.00600	0.98	0.05	0.00508
			Overall p(collision) =				Upwind	10.2%	Downwind	6.4%	
								Average	8.3%		

Barnacle Goose											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.64	m	0.025	0.575	4.58	14.08	0.78	0.00098	12.36	0.69	0.00086
Wingspan	1.39	m	0.075	0.575	1.53	5.27	0.29	0.00220	3.54	0.20	0.00148
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.92	4.00	0.22	0.00278	1.89	0.11	0.00131
			0.175	0.860	0.65	3.66	0.20	0.00356	1.08	0.06	0.00105
Bird speed	18	m/sec	0.225	0.994	0.51	3.52	0.20	0.00439	0.88	0.05	0.00110
RotorDiam	150	m	0.275	0.947	0.42	3.08	0.17	0.00471	1.04	0.06	0.00158
RotationPeriod	3.00	sec	0.325	0.899	0.35	2.81	0.16	0.00508	1.16	0.06	0.00210
			0.375	0.851	0.31	2.59	0.14	0.00540	1.24	0.07	0.00259
			0.425	0.804	0.27	2.41	0.13	0.00569	1.28	0.07	0.00303
			0.475	0.756	0.24	2.25	0.12	0.00593	1.30	0.07	0.00343
Bird aspect ratio: $\square$	0.46		0.525	0.708	0.22	2.10	0.12	0.00614	1.30	0.07	0.00379
			0.575	0.660	0.20	1.97	0.11	0.00630	1.29	0.07	0.00412
			0.625	0.613	0.18	1.85	0.10	0.00643	1.27	0.07	0.00440
			0.675	0.565	0.17	1.74	0.10	0.00651	1.24	0.07	0.00464
			0.725	0.517	0.16	1.63	0.09	0.00656	1.20	0.07	0.00485
			0.775	0.470	0.15	1.52	0.08	0.00657	1.16	0.06	0.00501
			0.825	0.422	0.14	1.43	0.08	0.00653	1.12	0.06	0.00514
			0.875	0.374	0.13	1.33	0.07	0.00646	1.07	0.06	0.00522
			0.925	0.327	0.12	1.23	0.07	0.00635	1.02	0.06	0.00527
			0.975	0.279	0.12	1.14	0.06	0.00619	0.97	0.05	0.00527
				Overall p(collision) =			Upwind	10.5%		Downwind	6.6%
								Average	8.5%		

**Table 8-20: Common scoter Band model collision risk calculations**

<b>Common Scoter</b>											
K: [1D or [3D] (0 or 1)	1		<b>Calculation of alpha and p(collision) as a function of radius</b>								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\square$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.49	m	0.025	0.575	5.32	13.28	0.64	0.00079	11.56	0.55	0.00069
Wingspan	0.84	m	0.075	0.575	1.77	5.00	0.24	0.00180	3.28	0.16	0.00118
F: Flapping (0) or gliding (+1)	0		0.125	0.702	1.06	3.89	0.19	0.00232	1.78	0.09	0.00107
			0.175	0.860	0.76	3.63	0.17	0.00304	1.05	0.05	0.00088
Bird speed	20.9	m/sec	0.225	0.994	0.59	3.52	0.17	0.00379	0.53	0.03	0.00057
RotorDiam	150	m	0.275	0.947	0.48	3.10	0.15	0.00408	0.72	0.03	0.00095
RotationPeriod	3.00	sec	0.325	0.899	0.41	2.79	0.13	0.00435	0.88	0.04	0.00137
			0.375	0.851	0.35	2.55	0.12	0.00458	0.98	0.05	0.00176
			0.425	0.804	0.31	2.35	0.11	0.00478	1.04	0.05	0.00212
			0.475	0.756	0.28	2.17	0.10	0.00494	1.07	0.05	0.00244
Bird aspect ratio: $\square$	0.58		0.525	0.708	0.25	2.02	0.10	0.00507	1.09	0.05	0.00273
			0.575	0.660	0.23	1.88	0.09	0.00517	1.08	0.05	0.00298
			0.625	0.613	0.21	1.75	0.08	0.00523	1.07	0.05	0.00320
			0.675	0.565	0.20	1.63	0.08	0.00525	1.05	0.05	0.00339
			0.725	0.517	0.18	1.51	0.07	0.00525	1.02	0.05	0.00354
			0.775	0.470	0.17	1.40	0.07	0.00521	0.98	0.05	0.00365
			0.825	0.422	0.16	1.30	0.06	0.00513	0.95	0.05	0.00373
			0.875	0.374	0.15	1.20	0.06	0.00502	0.90	0.04	0.00378
			0.925	0.327	0.14	1.10	0.05	0.00488	0.86	0.04	0.00380
			0.975	0.279	0.14	1.01	0.05	0.00470	0.81	0.04	0.00378
			<b>Overall p(collision) =</b>				<b>Upwind</b>	<b>8.5%</b>	<b>Downwind</b>	<b>4.8%</b>	
								<b>Average</b>	<b>6.6%</b>		



**Table 8-21: Guillemot Band model collision risk calculations**

Guillemot											
K: [1D or 3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.4	m	0.025	0.575	4.20	10.08	0.61	0.00076	8.36	0.51	0.00063
Wingspan	0.7	m	0.075	0.575	1.40	3.94	0.24	0.00179	2.21	0.13	0.00100
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.84	3.17	0.19	0.00240	1.07	0.06	0.00081
			0.175	0.860	0.60	3.05	0.18	0.00324	0.47	0.03	0.00050
Bird speed	16.5	m/sec	0.225	0.994	0.47	3.10	0.19	0.00422	0.69	0.04	0.00093
RotorDiam	150	m	0.275	0.947	0.38	2.76	0.17	0.00460	0.88	0.05	0.00147
RotationPeriod	3.00	sec	0.325	0.899	0.32	2.50	0.15	0.00493	0.99	0.06	0.00196
			0.375	0.851	0.28	2.30	0.14	0.00522	1.06	0.06	0.00240
			0.425	0.804	0.25	2.12	0.13	0.00546	1.09	0.07	0.00281
			0.475	0.756	0.22	1.97	0.12	0.00567	1.10	0.07	0.00317
Bird aspect ratio: $\beta$	0.57		0.525	0.708	0.20	1.83	0.11	0.00582	1.09	0.07	0.00348
			0.575	0.660	0.18	1.70	0.10	0.00594	1.08	0.07	0.00375
			0.625	0.613	0.17	1.59	0.10	0.00601	1.05	0.06	0.00398
			0.675	0.565	0.16	1.48	0.09	0.00604	1.02	0.06	0.00417
			0.725	0.517	0.14	1.37	0.08	0.00602	0.98	0.06	0.00431
			0.775	0.470	0.14	1.27	0.08	0.00596	0.94	0.06	0.00441
			0.825	0.422	0.13	1.17	0.07	0.00586	0.89	0.05	0.00447
			0.875	0.374	0.12	1.08	0.07	0.00572	0.84	0.05	0.00448
			0.925	0.327	0.11	0.99	0.06	0.00553	0.79	0.05	0.00445
			0.975	0.279	0.11	0.90	0.05	0.00530	0.74	0.04	0.00437
				Overall p(collision)							
				=			Upwind	9.6%		Downwind	5.8%
								Average	7.7%		

**Table 8-22: Guillemot / Razorbill Band model collision risk calculations**

Guillemot											
K: [1D or 3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.4	m	0.025	0.575	4.20	10.08	0.61	0.00076	8.36	0.51	0.00063
Wingspan	0.7	m	0.075	0.575	1.40	3.94	0.24	0.00179	2.21	0.13	0.00100
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.84	3.17	0.19	0.00240	1.07	0.06	0.00081
			0.175	0.860	0.60	3.05	0.18	0.00324	0.47	0.03	0.00050
Bird speed	16.5	m/sec	0.225	0.994	0.47	3.10	0.19	0.00422	0.69	0.04	0.00093
RotorDiam	150	m	0.275	0.947	0.38	2.76	0.17	0.00460	0.88	0.05	0.00147
RotationPeriod	3.00	sec	0.325	0.899	0.32	2.50	0.15	0.00493	0.99	0.06	0.00196
			0.375	0.851	0.28	2.30	0.14	0.00522	1.06	0.06	0.00240
			0.425	0.804	0.25	2.12	0.13	0.00546	1.09	0.07	0.00281
			0.475	0.756	0.22	1.97	0.12	0.00567	1.10	0.07	0.00317
Bird aspect ratio: $\square$	0.57		0.525	0.708	0.20	1.83	0.11	0.00582	1.09	0.07	0.00348
			0.575	0.660	0.18	1.70	0.10	0.00594	1.08	0.07	0.00375
			0.625	0.613	0.17	1.59	0.10	0.00601	1.05	0.06	0.00398
			0.675	0.565	0.16	1.48	0.09	0.00604	1.02	0.06	0.00417
			0.725	0.517	0.14	1.37	0.08	0.00602	0.98	0.06	0.00431
			0.775	0.470	0.14	1.27	0.08	0.00596	0.94	0.06	0.00441
			0.825	0.422	0.13	1.17	0.07	0.00586	0.89	0.05	0.00447
			0.875	0.374	0.12	1.08	0.07	0.00572	0.84	0.05	0.00448
			0.925	0.327	0.11	0.99	0.06	0.00553	0.79	0.05	0.00445
			0.975	0.279	0.11	0.90	0.05	0.00530	0.74	0.04	0.00437
				Overall p(collision) =			Upwind	9.6%		Downwind	5.8%
								Average	7.7%		

**Table 8-23: Common gull Band model collision risk calculations**

Common gull											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.41	m	0.025	0.575	3.41	10.05	0.75	0.00094	8.33	0.62	0.00078
Wingspan	1.2	m	0.075	0.575	1.14	3.93	0.29	0.00220	2.20	0.16	0.00123
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.68	3.12	0.23	0.00291	1.01	0.08	0.00094
			0.175	0.860	0.49	2.96	0.22	0.00387	0.79	0.06	0.00103
Bird speed	13.4	m/sec	0.225	0.994	0.38	2.93	0.22	0.00491	0.97	0.07	0.00162
RotorDiam	150	m	0.275	0.947	0.31	2.59	0.19	0.00532	1.07	0.08	0.00219
RotationPeriod	3.00	sec	0.325	0.899	0.26	2.37	0.18	0.00575	1.15	0.09	0.00278
			0.375	0.851	0.23	2.19	0.16	0.00613	1.18	0.09	0.00331
			0.425	0.804	0.20	2.03	0.15	0.00645	1.20	0.09	0.00379
			0.475	0.756	0.18	1.90	0.14	0.00672	1.19	0.09	0.00422
Bird aspect ratio: $\beta$	0.34		0.525	0.708	0.16	1.77	0.13	0.00694	1.17	0.09	0.00460
			0.575	0.660	0.15	1.66	0.12	0.00710	1.15	0.09	0.00492
			0.625	0.613	0.14	1.55	0.12	0.00721	1.11	0.08	0.00519
			0.675	0.565	0.13	1.44	0.11	0.00727	1.07	0.08	0.00540
			0.725	0.517	0.12	1.34	0.10	0.00727	1.03	0.08	0.00556
			0.775	0.470	0.11	1.25	0.09	0.00722	0.98	0.07	0.00567
			0.825	0.422	0.10	1.16	0.09	0.00712	0.93	0.07	0.00572
			0.875	0.374	0.10	1.07	0.08	0.00696	0.88	0.07	0.00572
			0.925	0.327	0.09	0.98	0.07	0.00675	0.82	0.06	0.00567
			0.975	0.279	0.09	0.89	0.07	0.00649	0.76	0.06	0.00557
				Overall p(collision)							
				=			Upwind	11.6%		Downwind	7.6%
								Average	9.6%		

Herring Gull											
K: [1D or 3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.6	m	0.025	0.575	3.41	10.87	0.81	0.00101	9.15	0.68	0.00085
Wingspan	1.44	m	0.075	0.575	1.14	4.20	0.31	0.00235	2.47	0.18	0.00139
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.68	3.28	0.24	0.00306	1.17	0.09	0.00110
			0.175	0.860	0.49	3.08	0.23	0.00402	0.90	0.07	0.00118
Bird speed	13.4	m/sec	0.225	0.994	0.38	3.07	0.23	0.00516	1.11	0.08	0.00187
RotorDiam	150	m	0.275	0.947	0.31	2.78	0.21	0.00571	1.26	0.09	0.00258
RotationPeriod	3.00	sec	0.325	0.899	0.26	2.56	0.19	0.00621	1.34	0.10	0.00324
			0.375	0.851	0.23	2.38	0.18	0.00666	1.37	0.10	0.00384
			0.425	0.804	0.20	2.22	0.17	0.00705	1.39	0.10	0.00440
			0.475	0.756	0.18	2.09	0.16	0.00740	1.38	0.10	0.00490
Bird aspect ratio: $\square$	0.42		0.525	0.708	0.16	1.96	0.15	0.00768	1.36	0.10	0.00534
			0.575	0.660	0.15	1.85	0.14	0.00792	1.34	0.10	0.00573
			0.625	0.613	0.14	1.74	0.13	0.00810	1.30	0.10	0.00607
			0.675	0.565	0.13	1.63	0.12	0.00823	1.26	0.09	0.00636
			0.725	0.517	0.12	1.53	0.11	0.00830	1.22	0.09	0.00659
			0.775	0.470	0.11	1.44	0.11	0.00832	1.17	0.09	0.00677
			0.825	0.422	0.10	1.35	0.10	0.00829	1.12	0.08	0.00689
			0.875	0.374	0.10	1.26	0.09	0.00820	1.07	0.08	0.00696
			0.925	0.327	0.09	1.17	0.09	0.00806	1.01	0.08	0.00698
			0.975	0.279	0.09	1.08	0.08	0.00787	0.95	0.07	0.00695
			Overall p(collision) =				Upwind	13.0%		Downwind	9.0%
								Average	11.0%		

**Table 8-25: Kittiwake Band model collision risk calculations**

<b>Kittiwake</b>											
K: [1D or [3D] (0 or 1)	1		<b>Calculation of alpha and p(collision) as a function of radius</b>								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\square$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.39	m	0.025	0.575	2.67	7.74	0.74	0.00092	6.02	0.57	0.00072
Wingspan	1.08	m	0.075	0.575	0.89	3.16	0.30	0.00225	1.43	0.14	0.00102
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.53	2.60	0.25	0.00310	0.66	0.06	0.00078
			0.175	0.860	0.38	2.56	0.24	0.00426	0.85	0.08	0.00142
Bird speed	10.5	m/sec	0.225	0.994	0.30	2.65	0.25	0.00568	1.11	0.11	0.00239
RotorDiam	150	m	0.275	0.947	0.24	2.41	0.23	0.00631	1.21	0.12	0.00317
RotationPeriod	3.00	sec	0.325	0.899	0.21	2.22	0.21	0.00687	1.26	0.12	0.00389
			0.375	0.851	0.18	2.06	0.20	0.00736	1.27	0.12	0.00455
			0.425	0.804	0.16	1.92	0.18	0.00779	1.27	0.12	0.00513
			0.475	0.756	0.14	1.80	0.17	0.00814	1.25	0.12	0.00564
Bird aspect ratio: $\square$	0.36		0.525	0.708	0.13	1.69	0.16	0.00843	1.22	0.12	0.00609
			0.575	0.660	0.12	1.58	0.15	0.00865	1.18	0.11	0.00647
			0.625	0.613	0.11	1.48	0.14	0.00881	1.14	0.11	0.00678
			0.675	0.565	0.10	1.38	0.13	0.00889	1.09	0.10	0.00702
			0.725	0.517	0.09	1.29	0.12	0.00891	1.04	0.10	0.00720
			0.775	0.470	0.09	1.20	0.11	0.00886	0.99	0.09	0.00730
			0.825	0.422	0.08	1.11	0.11	0.00874	0.93	0.09	0.00734
			0.875	0.374	0.08	1.03	0.10	0.00855	0.88	0.08	0.00731
			0.925	0.327	0.07	0.94	0.09	0.00829	0.82	0.08	0.00721
			0.975	0.279	0.07	0.86	0.08	0.00797	0.76	0.07	0.00704
			<b>Overall p(collision) =</b>				<b>Upwind</b>	<b>13.9%</b>		<b>Downwind</b>	<b>9.8%</b>
								<b>Average</b>	<b>11.9%</b>		

**Table 8-26: Sandwich tern Band model collision risk calculations**

<b>Sandwich tern</b>											
K: [1D or [3D] (0 or 1)	1		<b>Calculation of alpha and p(collision) as a function of radius</b>								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.38	m	0.025	0.575	2.67	7.53	0.72	0.00090	5.81	0.55	0.00069
Wingspan	1	m	0.075	0.575	0.89	3.09	0.29	0.00220	1.36	0.13	0.00097
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.53	2.56	0.24	0.00305	0.61	0.06	0.00073
			0.175	0.860	0.38	2.53	0.24	0.00421	0.82	0.08	0.00136
Bird speed	10.5	m/sec	0.225	0.994	0.30	2.64	0.25	0.00566	1.10	0.11	0.00237
RotorDiam	150	m	0.275	0.947	0.24	2.40	0.23	0.00628	1.20	0.11	0.00315
RotationPeriod	3.00	sec	0.325	0.899	0.21	2.21	0.21	0.00684	1.25	0.12	0.00386
			0.375	0.851	0.18	2.05	0.20	0.00733	1.26	0.12	0.00451
			0.425	0.804	0.16	1.91	0.18	0.00775	1.26	0.12	0.00509
			0.475	0.756	0.14	1.79	0.17	0.00810	1.24	0.12	0.00560
Bird aspect ratio: $\square$	0.38		0.525	0.708	0.13	1.68	0.16	0.00838	1.21	0.12	0.00604
			0.575	0.660	0.12	1.57	0.15	0.00860	1.17	0.11	0.00641
			0.625	0.613	0.11	1.47	0.14	0.00875	1.13	0.11	0.00672
			0.675	0.565	0.10	1.37	0.13	0.00883	1.08	0.10	0.00696
			0.725	0.517	0.09	1.28	0.12	0.00884	1.03	0.10	0.00713
			0.775	0.470	0.09	1.19	0.11	0.00878	0.98	0.09	0.00723
			0.825	0.422	0.08	1.10	0.10	0.00866	0.92	0.09	0.00726
			0.875	0.374	0.08	1.02	0.10	0.00846	0.87	0.08	0.00723
			0.925	0.327	0.07	0.93	0.09	0.00820	0.81	0.08	0.00712
			0.975	0.279	0.07	0.85	0.08	0.00787	0.75	0.07	0.00695
			<b>Overall p(collision) =</b>				<b>Upwind</b>	<b>13.8%</b>	<b>Downwind</b>	<b>9.7%</b>	
							<b>Average</b>	<b>11.8%</b>			

**Table 8-27: Common Tern Band model collision risk calculations.**

Common tern											
K: [1D or [3D] (0 or 1)	1		Calculation of alpha and p(collision) as a function of radius								
NoBlades	3					Upwind:			Downwind:		
MaxChord	3	m	r/R	c/C	$\square$	collide		contribution	collide		contribution
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
BirdLength	0.33	m	0.025	0.575	2.78	7.76	0.71	0.00089	6.03	0.55	0.00069
Wingspan	0.99	m	0.075	0.575	0.93	3.16	0.29	0.00217	1.44	0.13	0.00099
F: Flapping (0) or gliding (+1)	0		0.125	0.702	0.56	2.61	0.24	0.00300	0.59	0.05	0.00068
			0.175	0.860	0.40	2.57	0.24	0.00412	0.80	0.07	0.00128
Bird speed	10.9	m/sec	0.225	0.994	0.31	2.62	0.24	0.00540	1.02	0.09	0.00212
RotorDiam	150	m	0.275	0.947	0.25	2.37	0.22	0.00598	1.13	0.10	0.00285
RotationPeriod	3.00	sec	0.325	0.899	0.21	2.18	0.20	0.00649	1.18	0.11	0.00352
			0.375	0.851	0.19	2.02	0.18	0.00694	1.20	0.11	0.00412
			0.425	0.804	0.16	1.88	0.17	0.00732	1.19	0.11	0.00466
			0.475	0.756	0.15	1.75	0.16	0.00763	1.18	0.11	0.00513
Bird aspect ratio: $\square$	0.33		0.525	0.708	0.13	1.64	0.15	0.00788	1.15	0.11	0.00553
			0.575	0.660	0.12	1.53	0.14	0.00806	1.11	0.10	0.00587
			0.625	0.613	0.11	1.43	0.13	0.00818	1.07	0.10	0.00615
			0.675	0.565	0.10	1.33	0.12	0.00823	1.03	0.09	0.00636
			0.725	0.517	0.10	1.23	0.11	0.00821	0.98	0.09	0.00650
			0.775	0.470	0.09	1.14	0.10	0.00813	0.93	0.08	0.00658
			0.825	0.422	0.08	1.06	0.10	0.00799	0.87	0.08	0.00659
			0.875	0.374	0.08	0.97	0.09	0.00777	0.81	0.07	0.00654
			0.925	0.327	0.08	0.88	0.08	0.00750	0.76	0.07	0.00642
			0.975	0.279	0.07	0.80	0.07	0.00715	0.70	0.06	0.00623
			Overall p(collision) =				Upwind	12.9%		Downwind	8.9%
								Average	10.9%		



