FIVE ESTUARIES OFFSHORE WIND FARM

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ENVIRONMENTAL STATEMENT

VOLUME 6, PART 5, ANNEX 4.1: OFFSHORE ORNITHOLOGY TECHNICAL REPORT

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Five Estuaries Offshore Windfarm

Ornithology Technical Annex 4.1

Date:	09 February 2024
Tel:	0141 342 5404
Web:	www.macarthurgreen.com
Address:	93 South Woodside Road |Glasgow | G20 6NT

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1 INTRODUCTION

The proposed Five Estuaries (VE) project will comprise offshore wind turbines (WTGs), offshore converter station, inter-array cables, interconnector cables and offshore and onshore export cables taking power to an onshore converter station. The VE project covers an area of 128km^2, split between north and south areas which extend eastwards from the operational Galloper offshore wind farm. At the closest point the array areas are located approximately 37km offshore (Figure 1).

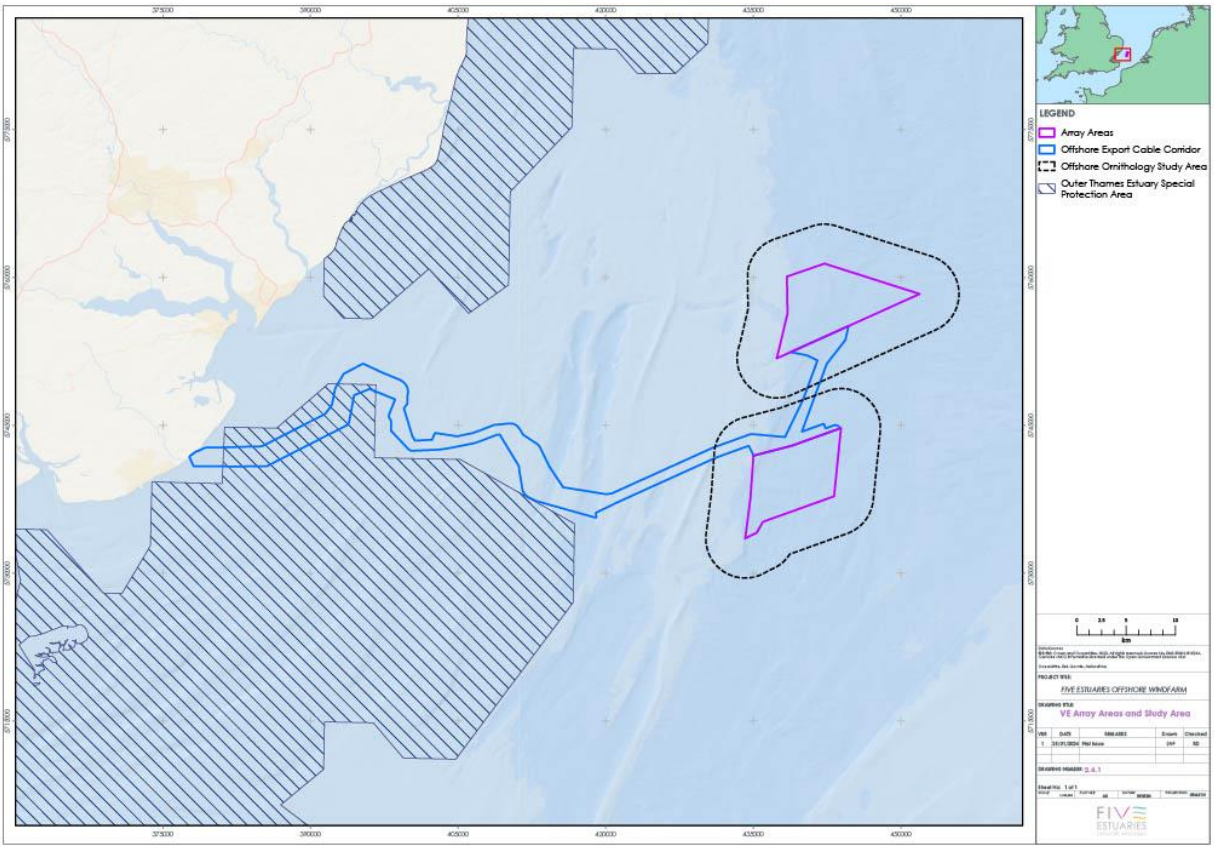

Figure 1. Five Estuaries Array Areas (purple lines) and 4km buffer area (dashed black lines) used for ornithology surveys.

The offshore ornithological assessment (Environmental Impact Assessment (EIA) Report, Volume 6, Part 2, Chapter 4: Offshore Ornithology) is informed using baseline site characterisation data collected by digital aerial survey methods, conducted by HiDef. Further details of the survey methods, analysis of the data collected, and the results obtained are provided in relevant sections of this technical report.

The aim of this report is to present full details of the baseline information from the site-specific surveys which have been used to undertake the offshore ornithology EIA and Habitats Regulations Assessment (HRA).

Sections on aerial survey methodology (section 2.1) and image analysis (section 2.2) were supplied by HiDef.

This Offshore Ornithology Technical Report comprises eight documents (including the current one - **Annex 4.1**) containing the following data and information.

Volume 6, Part 5, Annex 4.2 provides tables of the mean and 95% confidence intervals for total seabird abundance (bird in flight and on the water) and **Volume 6, Part 5, Annex 4.3** provides the equivalent densities, calculated for each calendar month for each species recorded, presented for north and south array areas separately, and for the array areas, array areas plus 2km buffer and array areas plus 4km buffer.

Volume 6, Part 5, Annexes 4.4 and 4.5 provide the equivalent abundance and density data as presented in Annexes 4.2 and 4.3, but for each of the 24 surveys individually.

Volume 6, Part 5, Annexes 4.6 and 4.7 provide the seasonal peak abundance and density data (respectively) as presented.

Volume 6, Part 5, Annex 4.8 provides the deterministic and stochastic collision risk modelling input parameters and outputs.

Volume 6, Part 5, Annex 4.9 provides maps illustrating where birds were recorded during the HiDef aerial surveys.

Volume 6, Part 5, Annex 4.10 provides a comparison of collision risk modelling results obtained from the different models (deterministic and stochastic, the latter using two alternative tools).

Volume 6, Part 5, Annex 4.11 provides details of the bootstrap methodology used to obtain confidence intervals for the baseline survey data.

Volume 6, Part 5, Annex 4.12 provides details of digital video aerial surveys of seabirds and marine mammals at Five Estuaries Annual report for March 2019 to February 2020 and **Annex 4.13** provides details of digital video aerial surveys of seabirds and marine mammals at Five Estuaries Tow-year report for March 2019 to February 2020.

Volume 6, Part 5, Annex 4.14 provides migratory collision risk modelling.

Volume 6, Part 5, Annex 4.15 provides an apportioning note.

Volume 6, Part 5, Annex 4.16 provides a population visibility analysis.

2 DATA SOURCES

HiDef has undertaken monthly aerial surveys across the wind farm as detailed in Table 2-1. Surveys began in March 2019 and completed, without any breaks, in February 2021 (24 months in total). All these data have been analysed for this assessment.

Table 2-1 Months when aerial surveys were conducted at Five Estuaries.

Month	2019	2020	2021
Jan		X	X
Feb		X	X
Mar	X	X	
Apr	X	X	
May	X	X	
Jun	X	X	
Jul	X	X	

Month	2019	2020	2021
Aug	X	X	
Sep	X	X	
Oct	X	X	
Nov	X	X	
Dec	X	X	

The following survey methods were supplied by HiDef.

2.1 Survey Methods

A series of strip transects spaced 2.5km apart were flown monthly between March 2019 and February 2021 across the survey area, which includes a 4km buffer around the proposed VE array areas, resulting in an overall survey area of 606km^2. Each array area of the wind farm (north and south) and its associated buffer was covered by nine transects. The transects are oriented approximately north-west to south-east, perpendicular to the depth contours along the coast.

Surveys were undertaken using an aircraft equipped with four HiDef Gen II cameras with sensors set to a resolution of 2cm Ground Sample Distance ('GSD'). Each camera sampled a strip of 125m width, separated from the next camera by ~25m, providing a combined sampled width of 500m within a 575m overall strip. Following discussion with Natural England, data from three cameras were analysed on each survey, providing a survey coverage rate of approximately 15% (mean coverage 14.6% sd 0.3), which is higher than the 10% rate typically used to date for offshore wind farm site characterisation.

The surveys were flown along transects at a height of approximately 550m above sea level (ASL). Flying at this height ensures that there is no risk of flushing those species which have been proven to be easily disturbed by aircraft noise (Thaxter et al. 2016 recommends a minimum flight altitude of 500m ASL).

Position data for the aircraft were captured from a Garmin GPSMap 296 receiver with differential GPS enabled to give 1m accuracy for the positions and recording updates in location at one second intervals for later matching to bird and marine mammal observations.

2.2 Data Review and Object Detection

Data were viewed by trained HiDef reviewers who marked any objects in the footage as requiring further analysis, as well as determining which are birds, marine megafauna (defined within this report as cetaceans, pinnipeds or other large, non-avian marine fauna) or anthropogenic objects such as ships or buoys.

As part of HiDef's quality assurance ('QA') process, an additional 'blind' review of 20% of the raw data was carried out and the results compared with those of the original review. If 90% agreement is not attained during the QA process, then corrective action is initiated: the remaining data are reviewed and where appropriate, the failed reviewer's data discarded and all the data re-reviewed. In addition, additional training is then given to the reviewer to improve performance. No re-reviews were required for the current data set.

An object is only recorded where it reaches a reference line (known as 'the red line') which defines the true transect width of 125m for each camera. By excluding objects that do not cross the red line, biases to abundance estimates caused by flux (movement of objects in the video footage relative to the aircraft, such as 'wing wobble') are eliminated.

2.3 Object Identification

Images marked as requiring further analysis were reviewed by specialist ornithologists and marine mammal specialists for identification to the lowest taxonomic level possible and for assessment of the approximate age and the sex of each animal, as well as any behaviour traits visible from the imagery.

At least 20% of all objects were selected at random and subjected to a separate 'blind' QA process. If less than 90% agreement was attained for any individual camera then corrective action was initiated: if appropriate, the failed identifier's data were discarded and the data re-identified. Any disputed identifications were passed to a third-party expert ornithologist for a final decision. The level of agreement within the QA process is calculated as the final number of agreements as a percentage of all identifications subjected for QA for the entire survey.

All objects were assigned to a species group and where possible, each of these then further identified to species level. The species identifications were given a confidence rating of 'possible', 'probable' or 'definite'.

It is important to note that these confidence ratings are not a standardised assessment and thus an estimate of probability cannot be applied to identification reliability. The likelihood of achieving a definite or probable identification is not consistent for all component members of a species group. For example, someone undertaking identification of a large auk species may find it easier to be confident of a guillemot identification than a razorbill. Confidence scores should not be used to filter or weight the probability of 'large auk' being one species or another in any analysis, as this will lead to biased results, particularly if the identification rate is low.

Any animals that could not be identified to species level were assigned to a category 'No ID'. If, on occasion, the unidentified bird is suspected of belonging to two different possible genera, then a broader group category may be used. For example, a bird would usually be assigned to the group category 'Shearwater species' if identified as a Manx shearwater, or to 'Auk species' if identified as a guillemot. However, if the bird has the potential to be either, then it would be assigned to the group category 'Shearwater / Auk species' and the species level recorded as 'No ID'.

In the case of birds, additional information was recorded on basic behaviour (whether the bird was sitting, loafing on land or other objects, or flying). More detail was recorded where possible on foraging behaviour, approximate age, sex and any other details of interest. Aging of birds was based on moults and is mostly conducted on flying individuals and species which show seasonal variation in plumage.

Anthropogenic activity was recorded as either 'man-made object', 'fishing boat' or 'other boat'. Further details were noted in the comments, including further specifying the type of object (e.g. 'fishing buoy', 'marker buoy', 'wind turbine') or noting any names and numbers that can be seen.

2.4 Data quality check

HiDef's method is designed to ensure low rejection of data on grounds of quality, such as low cloud, sun glare or other issues. Care is taken to avoid surveying in low cloud or poor visibility by careful selection of survey days with the correct survey conditions. In the unlikely event that low cloud occurs during a survey, the pilot is instructed to either avoid areas affected and return to those at the end of the survey, return to a nearby base and wait for cloud to clear or abandon the survey. Sun glare is avoided by design of the survey rig which uses angled cameras on a rotating plinth. This means that the cameras are angled away from any sun glare at all times, with the camera rig rotated in between transects to ensure that this angle is maintained.

All data undergoes a full check on return to the office consisting of a review of every camera and every transect. Any issues that may affect usability of the data are flagged at this stage may result in a re-fly of the survey.

Glare is recorded on all cameras throughout the survey. For each individual survey, on one of the cameras (known as the 'weather camera' the following weather conditions are also recorded – sea state and turbidity. Operators carrying out bird and mammal identification carry out environmental checks of the data and score sun glare and turbidity on a scale from 1 - 4 in which score 4 is a high degree of sun glare or turbidity in which the data should not be used because it would affect detection rates. Sea state is scored based on the World Meteorological Organisation (WMO) Sea State code, in which score 6 or more is a high degree of sea state in which the data should not be used as it would affect detection rates.

All data were geo-referenced, taking into account the offset from the transect line of the cameras, and compiled into a single output; Geographical Information System (GIS) files for the Observation and Track data are issued in ArcGIS shapefile format, using UTM31N projection, WGS84 datum.

2.5 Bird Abundance and Density Estimates

The raw data, supplied as plane GPS track logs, containing details for each image location and observation logs, containing details of all objects (seabird, marine mammal, vessel, etc.) recorded were analysed using R (R Development Core Team 2012). Analysis was conducted for each survey separately. Bird locations were assigned to the following sub-zones; wind farm, wind farm plus 2km buffer and wind farm plus 4km buffer (note that each buffer width also included the wind farm data).

Density (birds/km^2) and abundance were estimated using design-based methods, with the density estimated for the surveyed area and multiplied up to the total area to obtain an abundance estimate. This makes the assumption that the area surveyed is representative of the unsurveyed regions, thus the design of survey is important (hence 'design based').

Standard deviations and confidence intervals for each species were obtained using a bootstrap resampling method, with 1,000 iterations. One approach for undertaking this resampling is to use each transect as the smallest independent unit for resampling (e.g. each of the 1,000 resampled datasets comprises a set of randomly selected transects with replacement). For sites with many larger number of transects this approach is appropriate, however for smaller sites such as Five Estuaries, this would result in a rather limited range of resamples available and hence low precision. To increase the sample size for resampling, without violating the independence of the sampling units an alternative approach was developed. Since bird observations recorded along a transect are analogous to events recorded over time, it was appropriate to employ a time-series bootstrap method. For each survey, the data along each transect were assigned to segments 500m long. A test for auto-correlation along the transects was conducted to identify for each species the maximum number of sequential segments over which significant auto-correlation could be detected. This distance (i.e. number of segments) defined the block size applied in the bootstrap simulations, where the block size is the smallest 'unit' resampled. Thus, if there was no evidence for a species' locations being auto-correlated along a transect then the block size was the individual segment (i.e. this yielded the maximum number of samples), while a significant estimate of auto-correlation across three segments, for example, would result in the data being grouped in blocks of three segments for resampling (taken to the extreme, if significant auto-correlation was detected across all segments along a transect, the block size would be the number of segments in the transect and resampling would revert to being conducted at the level of transect). In practice for most species significant auto-correlation was limited to one to two segments at most (or there was no evidence for significant auto-correlation). The species for which auto-correlation was most evident were razorbill and guillemot with significant auto-correlation extending across up to five segments. During its development, this method was discussed with representatives from Natural England and the RSPB and it was agreed on the basis of these discussions that this approach appeared to be robust and appropriate for the current purposes.

The upper and lower 95% confidence limits were obtained as the 25th and 975th values from the ranked resampled data. The width of the confidence interval obtained using this method reflects the degree of aggregation in the species, with highly aggregated species estimated with lower precision (i.e. species observed frequently as individuals will have a small range of estimated densities, while species recorded in occasional large groups will have a wide range of estimated densities).

Analysis was conducted for the north and south areas separately and individually for each of the 24 surveys. Monthly estimates were obtained as the average of the value in each calendar month. Seasonal peaks were extracted from the monthly values, using the month assignments in Furness (2015), applying the full breeding seasons and adjusting the migration seasons to avoid overlaps if spring migration is defined as January to March and the full breeding season as March to August, the latter was prioritised and spring migration defined as January to February).

Birds were recorded as either sitting on the sea surface ('sitting') or in flight ('flying'). Analysis was conducted with both datasets combined ('all birds') and for birds in flight only. The former were used in the baseline characterisation and displacement assessment, while the latter were used in the collision risk modelling (CRM).

2.6 Apportioning of birds not identified to species level

The full tables of positively identified birds and the unidentified groups are provided in Table 2-2 and Table 2-3 respectively.

Table 2-2 Number of positively identified seabirds recorded within the wind farm array areas and 4km buffers for both north and south array areas, summed across all surveys.

Species	North	South
Arctic skua	-	2

Species	North	South
Black-headed gull	10	16
Brent Goose	-	2
Common gull	7	22
Common tern	1	7
Cormorant	-	6
Fulmar	41	131
Gannet	324	361
Great black-backed gull	64	84
Great skua	-	7
Guillemot	1276	1677
Herring gull	27	39
Kittiwake	481	520
Lesser black-backed gull	221	577
Little gull	9	5
Puffin	1	1
Razorbill	758	678
Red-throated diver	14	13
Sandwich tern	1	1

Approximately 9% of the seabirds recorded during the surveys could not be positively assigned to species level, of which almost two-thirds (63%) were either classed as either 'Auk species' or 'large auk'. The 'auk species' group were assigned to guillemot, razorbill and puffin in proportion to the rates of positively identified birds, and the 'large auks' to guillemot and razorbill. No other unidentified groups were apportioned to species due to the challenge of appropriately assigning mixed membership groups (e.g. 'auk / small gull') to constituent species since there is no robust means top perform this. However, the number of individuals involved was small and this does not therefore have a large effect on the results obtained.

Table 2-3 Number of birds assigned to species groups in the 4km buffer area for both north and south array areas, summed across all surveys.

Species	North	South
Arctic / common tern	3	12
Auk / shearwater species	-	2
Auk / small gull	11	21
Auk species	33	30
Black-backed gull species	4	-
Diver species	1	-
Fulmar / gull species	15	53
Gull species	6	13
Large auk	182	217
Large auk / diver species	9	9
Large gull species	8	20
Skua (excluding great skua)	-	2
Small gull species	20	15
Tern / small gull	1	3
Tern species	1	1

2.7 Availability Bias

Guillemots, razorbills and puffins spend a proportion of their time foraging beneath the water surface and therefore some individuals present in a given area will not be observable in aerial images. Density and abundance estimates need to be adjusted to allow for these unobserved individuals.

Fixed species-specific correction factors were applied to the number of each auk species recorded on the sea surface. The values used for guillemot and razorbill were those recommended by JNCC in its submission during the examination phase of East Anglia ONE (JNCC 2013), referred to as Method C, which stated that 24% of guillemots and 17% of razorbills are underwater at any time (these percentages do not include birds in flight). For puffin a value of 14% was used, taken from Spencer (2012), and as applied in the Hornsea 4 wind farm assessment.

Availability bias adjustment was applied following apportioning of unidentified auks among species. For completeness, three sets of auk density and abundance estimates are provided:

- The unapportioned values without adjustment for availability bias,
- As above with the inclusion of unidentified auks apportioned using the relative numbers of positively identified individuals, and
- As above following adjustment for availability bias.

2.8 Spatial Distributions

Maps of the array areas and bird observations are provided in Annex 4.9. For species recorded in low numbers these figures plot all the observations (i.e. obtained across all surveys), while more commonly recorded species are combined by season (using the definitions in Furness 2015). The seasons used are detailed in Table 2-4.

Table 2-4 Species specific seasonal definitions and biologically defined minimum nonbreeding population sizes (in brackets) have been taken from Furness (2015).

Species	Breeding	Migration-free breeding	Migration - autumn	Winter	Migration - spring	Non-breeding
Red-throated diver	Mar-Aug	May-Aug	Sep-Nov (13,277)	Dec-Jan (10,177)	Feb-Apr (13,277)	
Fulmar	Jan-Aug	Apr-Aug	Sep-Oct (957,502)	Nov (568,736	Dec-Mar (957,502)	-
Gannet	Mar-Sep	Apr-Aug	Sep-Nov (456,298)	-	Dec-Mar (248,385)	-
Arctic skua	May-Jul	Jun-Jul	Aug-Oct (6,427)	-	Apr-May (1,227)	-
Great skua	May-Aug	May-Jul	Aug-Oct (19,556)	Nov-Feb (143)	Mar-Apr (8,485)	-
Puffin	Apr-Aug	May-Jun	Jul-Aug	Sep-Feb	Mar-Apr	Mid-Aug-Mar (231,957)
Razorbill	Apr-Jul	Apr-Jul	Aug-Oct (591,874)	Nov-Dec (218,622)	Jan-Mar (591,874)	-
Guillemot	Mar-Jul	Mar-Jun	Jul-Oct	Nov	Dec-Feb	Aug-Feb (1,617,306)
Common tern	May-Aug	Jun	Jul-Sep (308,841)	-	Apr-May (308,841)	-
Kittiwake	Mar-Aug	May-Jul	Aug-Dec (829,937)	-	Jan-Apr (627,816)	-

Species	Breeding	Migration-free breeding	Migration - autumn	Winter	Migration - spring	Non-breeding
Little gull (Not included in Furness 2015)	Apr-Jul	May-Jul	-	-	-	Aug-Apr
Lesser black-backed gull	Apr-Aug	May-Jul	Aug-Oct (209,007)	Nov-Feb (39,314)	Mar-Apr (197,483)	-
Herring gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Feb (466,511)
Great black-backed gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Mar (91,399)

* Not included in Furness (2015). Natural England (2012) states: Breeding black-throated divers migrate to saltwater habitats from August, returning to their breeding sites from April. Birds are also seen in small numbers on eastward passage through the English Channel in April and May.

2.9 Collision Risk Modelling

CRM was conducted using the Band (2012) model, scripted to run in the R statistical environment by DMP Stats and HiDef[1]. All modelling used Band CRM Option 2, since the flight height sample sizes recorded on the surveys were very small (kittiwake 135, gannet 53, lesser black-backed gull 42, great black-backed gull 3 and herring gull 0).

Typically the largest source of variation in collision mortality estimates is due to variation in densities, therefore upper and lower 95% confidence estimates on density (calculated as described above) were used alongside the central point density for each calendar month. The full set of input parameters and results are provided in Annex 4.6.

3 ORNITHOLOGY BASELINE

3.1 Overview of Bird Species Recorded

The following bird species (Table 3-1) were recorded during surveys within the array areas plus 4km buffer (the presence of the species is noted as N or S for the North and South array areas respectively).

Table 3-1 Bird species recorded during surveys of the array areas and the 4km buffer between March 2019 and February 2021.

Species	Array Area	4km buffer
Red-throated Diver	N, S	N, S
Fulmar	N, S	N, S
Gannet	N, S	N, S
Cormorant	S	S
Arctic skua		S
Great Skua	S	S
Puffin		N, S
Razorbill	N, S	N, S
Guillemot	N, S	N, S

[1] https://github.com/HiDef-Aerial-Surveying/stochLAB

Species	Array Area	4km buffer
Auk Species	*N, S*	*N, S*
Common Tern	N	N, S
Sandwich tern	S	N, S
Kittiwake	N, S	N, S
Black-headed Gull	S	N, S
Little Gull	N	N, S
Common Gull	N, S	N, S
Lesser Black-backed Gull	N, S	N, S
Herring Gull	N, S	N, S
Great Black-backed Gull	N, S	N, S

4 SUMMARY SPECIES ACCOUNTS

The following species accounts use the values in Annex 4.2, the abundance of birds recorded both in flight and on the sea surface in the North and South array areas.

4.1.1 Arctic skua

4.1.1.1 *North*

No Arctic skuas were recorded in the North array.

4.1.1.2 *South*

Arctic skuas were recorded in the South array 4km buffer in September in one year only and in the South array 2km buffer in November in one year only, in each case of a single individual.

4.1.2 Auk species

4.1.2.1 *North*

Only 9% of large auks (guillemot and razorbill) were not identified to species level. There was a clear seasonal pattern in unidentified auk numbers, with none recorded in June and July and a peak in the wind farm of just over 100 in December.

4.1.2.2 *South*

Only 9% of large auks (guillemot and razorbill) were not identified to species level. There was a clear seasonal pattern in unidentified auk numbers, with none recorded in June, July and August and a peak in the wind farm of just over 130 in February.

4.1.3 Black-headed gull

4.1.3.1 *North*

Black-headed gulls were recorded in low numbers in the 2km and 4km buffers between July and December with a peak abundance of 24 in the 4km buffer in July.

4.1.3.2 South

Black-headed gulls were recorded in low numbers in the array area, 2km and 4km buffers in March and between July and December with peak abundances of 17 in the 4km buffer in both March and July.

4.1.4 Common gull

4.1.4.1 North

Common gulls were recorded in low numbers in February, April, and December in the 2km and 4km buffers and April and December in the wind farm. The peak array abundance was 3 and in the 4km buffer was 10.

4.1.4.2 South

Common gulls were recorded in low numbers in January to April in the array area and June and September in the 2km and 4km buffers. The peak array area abundance was 10 and in the 4km buffer was 30.

4.1.5 Common tern

4.1.5.1 North

Common terns were only recorded in September in the array area , with a single individual in one year, giving a peak abundance of 3.

4.1.5.2 South

Common terns were recorded in the 2km and 4km buffers in June, July and September, with a peak abundance of 13.

4.1.6 Cormorant

4.1.6.1 North

No cormorants were recorded in the North array.

4.1.6.2 South

Cormorants were recorded in the South array in September in one year only, giving a peak abundance of 21.

4.1.7 Fulmar

4.1.7.1 North

Fulmars were recorded in the 4km buffer in all months except February and in the array area in January and March to July. The array area peak was 21 and the 4km buffer peak was 28.

4.1.7.2 South

Fulmars were recorded in the 4km buffer in all months except December and in the array area from March to September. The array area peak was 24 and the 4km buffer peak was 133 in August.

4.1.8 Gannet

4.1.8.1 North

Gannets were recorded in the 2km and 4km buffer sin all months and all except January, February and May in the array area . The array area peak was 142 in November and the 4km peak was 575 in the same month.

4.1.8.2 South

Gannets were recorded in the 4km buffer in all months, all except January in the 2km buffer and all except January and December in the array area . The array area peak was 142 in November and the 4km peak was 383 in the same month.

4.1.9 Great black-backed gull

4.1.9.1 North

Great black-backed gulls were primarily recorded in the nonbreeding season, with none in the array area from April to September and a single individual in the buffers during that period. The array area peak was 17 in December and in the 4km buffer was 125 in the same month.

4.1.9.2 South

Great black-backed gulls were recorded in only January and September in the array area , but most months in the 4km buffer (absent in May, July and November). The array area peak was 11 and the 4km buffer peak was 123.

4.1.10 Great skua

4.1.10.1 North

No great skuas were recorded in the North array.

4.1.10.2 South

Great skuas were recorded in the 4km buffer in April, August and September and the array area in August. The peak on the array area was 3 and in the 4km buffer was 14.

4.1.11 Guillemot

4.1.11.1 North

Guillemots were recorded on the array area in all months except June and August and all months in the buffers. Abundance peaked in the nonbreeding season, with 326 in the array area in March and 1,548 in the 4km buffer in February (including apportioned auks and accounting for availability bias).

4.1.11.2 South

Guillemots were recorded in the array area in all months except July and August and all months in the buffers. Abundance peaked in the nonbreeding season, with 1,413 in the array area in February and 4,311 in the 4km buffer in the same month (including apportioned auks and accounting for availability bias).

4.1.12 Herring gull

4.1.12.1 North

Herring gulls were recorded in July, September and December in the array area and July to December in the 4km buffer. The array area peak abundance was 7 and in the 4km buffer was 38.

4.1.12.2 South

Herring gulls were recorded in August and October in the array area and all months except March, November and December in the 4km buffer. The array area peak abundance was 7 and in the 4km buffer was 49.

4.1.13 Kittiwake

4.1.13.1 North

Kittiwakes were recorded in all months in the array area and buffers. The array area peak was 105 in March and the 4km buffer peak was 420 in the same month.

4.1.13.2 South

Kittiwakes were recorded in all months except September in the array area and all months except in the buffers. The array area peak abundance was 103 in March and in the 4km buffer was 533 in the same month.

4.1.14 Lesser black-backed gull

4.1.14.1 North

Lesser black-backed gulls were recorded in January, June, July and September in the array area and all months in the 4km buffer. The array area peak abundance was 477 in July and in the 4km buffer was 519 in the same month.

4.1.14.2 South

Lesser black-backed gulls were recorded in all months except January, February, July and October in the array area and in all months in the 4km buffer. The array area peak abundance was 112 in August and in the 4km buffer was 1,201 in June.

4.1.15 Little gull

4.1.15.1 North

Little gulls were recorded in low numbers in February, April, October and November in the 4km buffer and April and November in the array area . The peak array area abundance was 7 and in the 4km buffer was 10.

4.1.15.2 South

No little gulls were recorded in the array area and only low numbers in January, October and November in the 4km buffer. The peak in the 4km buffer was 7.

4.1.16 Puffin

4.1.16.1 North

No puffins were recorded in the array area or 2km buffer, with a single individual recorded in the 4km buffer in one March survey giving a peak abundance of 3.

4.1.16.2 South

No puffins were recorded in the array area or 2km buffer, with a single individual recorded in the 4km buffer in one November survey giving a peak abundance of 3.

4.1.17 Razorbill

4.1.17.1 North

Razorbills were recorded on the array area and buffers in all months except June, July and September. Abundance peaked in the array area with 290 in December and 1,270 in the 4km buffer in the same month (including apportioned auks and accounting for availability bias).

4.1.17.2 South

Razorbills were recorded on the array area in all months except June to September and the same months (except August) in the 4km buffer. Abundance peaked in the array area with 181 in February and 769 in the 4km buffer in the same month (including apportioned auks and accounting for availability bias).

4.1.18 Red-throated diver

4.1.18.1 North

Red-throated divers were recorded in the array area in January and in the buffers in January to March, May, September, October and December. The array area peak was 3 and the 4km buffer peak was 17.

4.1.18.2 South

Red-throated divers were recorded in the array area in February and in the buffers in January to April and December. The array area peak was 3 and the 4km buffer peak was 13.

4.1.19 Sandwich tern

4.1.19.1 North

Sandwich terns were only recorded in April in the 4km buffer on one survey, with a single individual in one year, giving a peak abundance of 3. None were recorded in the array area.

4.1.19.2 South

Sandwich terns were only recorded in the wind farm in October in one year giving a peak abundance of 3 across the array area and buffers.

5 REFERENCES

Band, W. 2012. Using a collision risk model to assess bird collision risks for offshore wind farms. The Crown Estate Strategic Ornithological Support Services (SOSS) report SOSS-02. SOSS Website. Original published Sept 2011, extended to deal with flight height distribution data March 2012.

Furness, R.W. 2015. Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Report Number 164. 389 pp.

JNCC 2013. JNCC Expert Statement on ornithological issues for written representations in respect of the East Anglia ONE offshore wind farm. 30th July 2013.

Natural England 2012 TIN131. Black-throated diver: species information for marine Special Protection Area consultations.

R Development Core Team 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/

Spencer, S.M. (2012). Diving behaviour and identification of sex of breeding Atlantic puffins (*Fratercula arctica*), and nest-site characteristics of Alcids on Petit Manan Island, Maine. MSc Thesis submitted to University of Massachusetts Amherst in May 2012.

Thaxter, C.B., Ross-Smith, V.H. and Cook, A.S.C.P. 2016. How high do birds fly? A review of current datasets and an appraisal of current methodologies for collecting flight height data: Literature review. BTO Research Report No. 666.

PHONE 0333 880 5306
EMAIL fiveestuaries@rwe.com
WEBSITE www.fiveestuaries.co.uk
ADDRESS Five Estuaries Offshore Wind Farm Ltd
Windmill Hill Business Park
Whitehill Way, Swindon, SN5 6PB
COMPANY NO Registered in England and Wales
company number 12292474