Outer Dowsing Offshore Wind

Preliminary Environmental Information Report

Volume 2, Appendix 12.1: Offshore and Intertidal Ornithology Baseline Characterisation Report

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OUTER DOWSING OFFSHORE WIND

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Abbreviations

Acronym	Expanded name
AoS	Area of Search
ASL	Above sea level
BDMPS	Biologically defined minimum population scales
BTO	British Trust for Ornithology
CI	Confidence interval
CL	Confidence limits
CV	Coefficient of variance
DAS	Digital Aerial Surveys
DCO	Development Consent Order
ECC	Export Cable Corridor
ETG	Expert Topic Group
GIG	Green Investment Group
GSD	Ground Sample Distance
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (a wholly owned Green Investment Group portfolio company), Gulf Energy Development and TotalEnergies
JNCC	Joint Nature Conservation Committee
LCL	Lowe Confidence Level
NA	Not Applicable
NEWS	Non-Estuarine Waterbird Surveys
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
QA	Quality assurance
SPA	Special Protection Area
TE	TotalEnergies
UCL	Upper Confidence Level
WeBS	Wetland Bird Survey
WTG	Wind Turbine Generator

Terminology

Term	Definition
Array Area	The area offshore within the PEIR Boundary within which the generating stations (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling are positioned.
Baseline	The status of the environment at the time of assessment without the development in place.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of an impact with the sensitivity of a receptor, in accordance with defined significance criteria.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Intertidal	Area where the ocean meets the land between high and low tides.
Landfall	The location at the land-sea interface where the offshore export cable will come ashore.
Outer Dowsing Offshore Wind	The Project
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the PEIR Boundary within which the export cable running from the array to landfall will be situated.
Onshore infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection.
Preliminary Environmental Information Report (PEIR)	The PEIR is written in the style of a draft Environmental Statement (ES) and provides information to support and inform the statutory consultation process in the pre-application phase. Following that consultation, the PEIR documentation will be updated to produce the Project's ES that will accompany the application for the Development Consent Order (DCO).
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
study area	Area(s) within which environmental impact may occur – to be defined on a receptor-by-receptor basis by the relevant technical specialist.
The Project	Outer Dowsing Offshore Wind including proposed onshore and offshore infrastructure

12 Offshore and Intertidal Ornithology

12.1 Introduction

Project Background

12.1.1 GTR4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (hereafter "the Project"). The Project will be located approximately 54km from the Lincolnshire coastline in the southern North Sea. The Project will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (see Volume 1, Chapter 3: Project Description for full details).

12.1.2 This technical annex has been produced to provide the findings from offshore and intertidal ornithology data to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from the Project. It has also been produced to support Volume 2, Chapter 12: Offshore and Intertidal Ornithology of the Preliminary Environmental Information Report (PEIR). In addition, the data within this report are used to inform potential Project impacts as presented within Volume 2, Chapter 12.2: Collision Risk Modelling Assessment Annex and Volume 2, Chapter 12.3: Displacement Assessment Annex.

Aims and Objectives

12.1.3 The aim of this report is to present the results from offshore ornithological surveys and to determine the ornithological receptors that characterise the baseline environment and are of relevance to the assessment of potential impacts from the Project. The data sources used to define the baseline characteristics include site-specific digital aerial surveys (DAS) for offshore ornithology, alongside existing data sources extracted from a desk-based review.

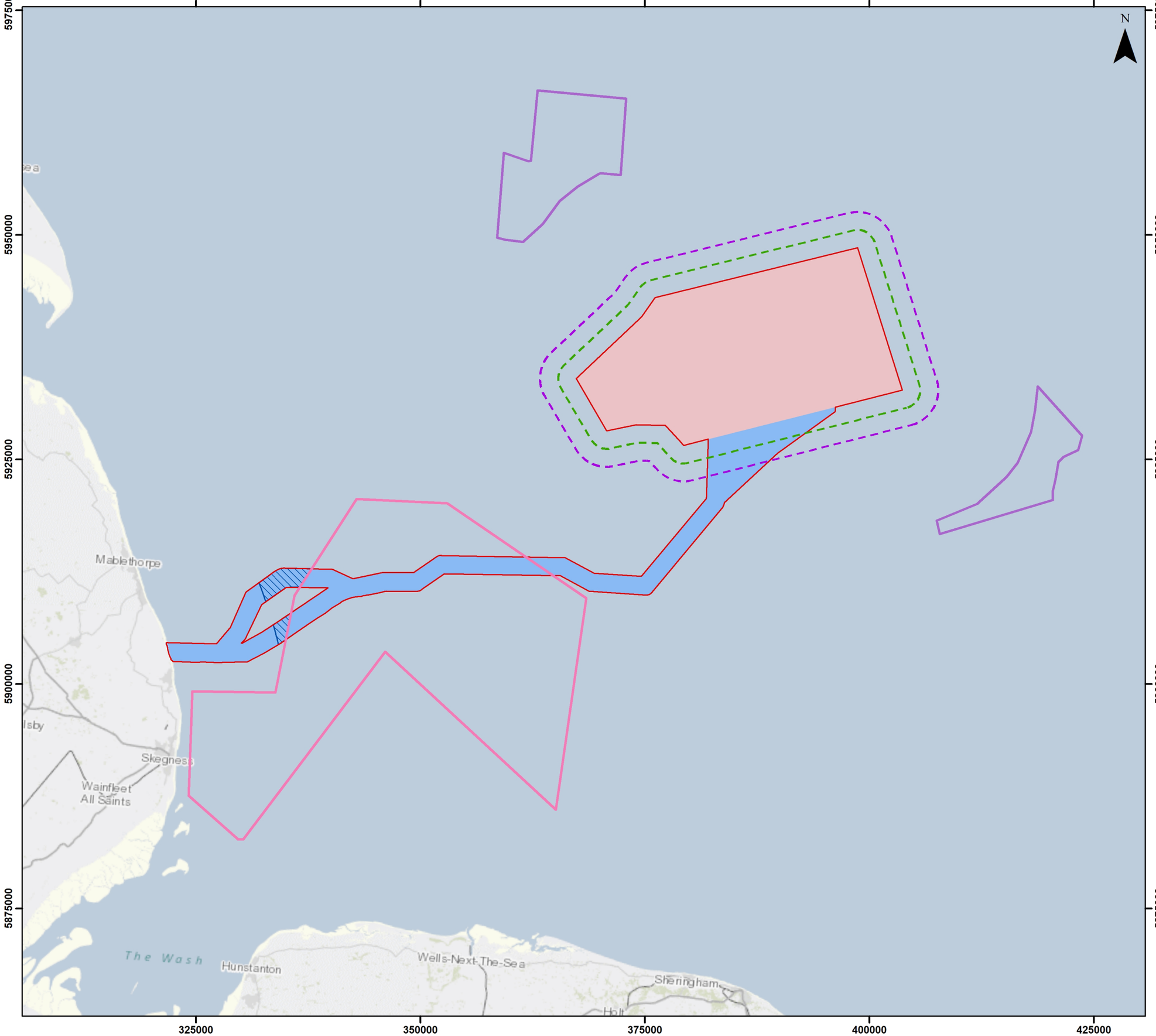
12.1.4 This report is based on information on ornithological receptors in the Project array area and associated buffer from the 18 consecutive months of DAS undertaken between March 2021 and August 2022 that were available at the time of preparing this PEIR. Data were used to determine:

- Abundance and density estimates of birds (monthly and for bio-seasons);
- Bird behaviours (flying and sitting on the water);
- Spatial distribution within the site and across bio-seasons.

Study Area

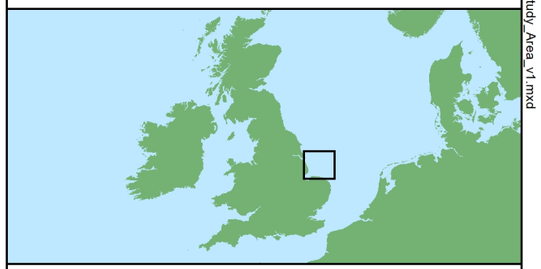
12.1.5 The study area for the offshore ornithological receptors covers 926km^2, covering all the sea within the Project array area and a 4km surrounding buffer, the Export Cable Corridor (ECC) and the cable landfall area. Within the assessment, the high levels of mobility of birds was also taken into account, recognising that some recorded birds may nest outside of the Project survey area but fly into or across the area at different times of the year for feeding and/or migration.

12.1.6 The study area for offshore ornithology and its relation to the Project is presented in Figure 12.1.



Legend

- Offshore PEIR Boundary
- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- Artificial Nesting Structure Search Area
- Biogenic Reef Restoration Search Area
- 2km Buffer from Array Area
- 4km Buffer from Array Area



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:400,000

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Offshore Boundaries relevant to Offshore Ornithology

Figure 12.1

OUTER DOWSING OFFSHORE WIND

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Nomenclature

12.1.7 Throughout this report the bird species names that are used are those that are in common use amongst English ornithologists, and this corresponds to the "British (English) vernacular name 2022" column of the list of English and scientific names prepared by the British Ornithologists' Union (BOU, 2022). The corresponding scientific names from that publication are listed in the glossary on scientific bird names at the front of this document.

12.2 Ornithological Data to Inform Baseline

Key Data Sources

12.2.1 The data sources in Table 12.1 provide species-specific information on the distribution and abundance of birds in the Project study area.

Table 12.1: Key sources of ornithological data used to characterise the baseline environment for the Project

Source	Date	Summary	Coverage of study area
Outer Dowsing DAS data.	2021 – 2022	DASs conducted monthly by HiDef between March 2021 and August 2022.	The Project array area, plus a 4km buffer.
JNCC – red-throated diver, little gull and common scoter winter numbers in the Greater Wash survey report (Lawson *et al.,* 2016).	2002 - 2008	DASs undertaken to assess the importance of the Greater Wash to red-throated diver, little gull and common scoter.	Coverage of inshore areas and Offshore ECC relevant to the Project.
Wildfowl and Wetlands Trust – Aerial surveys of waterbirds in the UK.	2004-2009	Aerial surveys of waterbirds around the UK.	Coverage of inshore waters relevant to the Project from survey grids GW4, GW8, GW9 and GW10.
British Trust for Ornithology (BTO) Non-Estuarine Waterbird Surveys (NEWS).	1984 - 2016	NEWS provides recordings focused on intertidal habitats along the UK coastline. These were conducted in 1984/1985, 1997/98, 2006/07 and 2015/16.	Covers the Offshore ECC and cable landfall.
BTO Wetland Bird Survey (WeBS).	Annual Reports	Annual survey reports of wetland waterbirds. Most recent being Frost *et al.*, (2021).	Coverage of UK intertidal and wetland zones. Source contains information which can be drawn upon at a Project specific scale, or a wider regional scale.
Census of kittiwake breeding on offshore	2022	Project survey of kittiwake breeding on oil and gas platforms in proximity	All oil and gas platforms within 20km

Source	Date	Summary	Coverage of study area
oil and gas platforms.		to the Project array area. Undertaken during July 2022.	of the Project array area.
Potential impacts of offshore wind farms on birds	Various dates	Data on seabird populations and demographic rates for use in assessments e.g. Mitchell *et al.,* (2004); BirdLife International (2004); Eaton *et al.,* (2015); Musgrove et al., (2013); Furness, (2015); Horswill *et al*., (2017), JNCC (2020); Brenchley *et al*., (2013)	These sources contain information which can be drawn upon at a Project specific scale, or a wider regional scale.
Bird breeding ecology	Various dates	Information on the breeding ecology of various bird species e.g. Cramp and Simmons (1977-94); Del Hoyo *et al*., (1992-2011); Robinson (2005).	Generic information applicable to the Project ornithological receptors.
Bird distribution	Various dates	Publicly available reports of bird distribution in UK waters e.g. Stone et al., (1995); Brown and Grice (2005); Kober *et al*., (2010); Balmer *et al*. (2013); WWT (2013); Brenchley *et al*., (2013).	UK wide coverage with information that can be drawn upon at an Project specific scale, or a wider regional scale.
Bird migration and foraging movements	Various dates	Bird movements during breeding season foraging trips and migratory movements e.g. Wernham *et al*., (2002); Thaxter *et al.,* (2012); Woodward *et al.,* (2019).	These sources contain information which can be drawn upon at an Project specific scale, or a wider regional scale.

Digital Aerial Surveys

Digital Aerial Survey Methodology

12.2.2 A survey campaign programme of high-resolution DAS of offshore ornithological activity took place March 2021 and February 2023 by HiDef. Surveys consisted of 2.5km-spaced transects across the Project development area (500km^2) plus a 4km buffer, creating an overall survey area of 926.39km^2. At PEIR, the first 18-months of abundance and density estimates are presented and used within ornithological assessments. An additional monthly survey was carried out between March and August 2022 providing two monthly surveys (a doubling of survey effort) for these months.

12.2.3 Surveys were undertaken using an aircraft equipped system with four HiDef Gen II cameras with sensors set to a resolution of 2cm Ground Sample Distance (GSD) aligning with the best practice guidance from Natural England (Parker *et al.,* 2022a). Each camera sampled a strip of 125m width, separated from the next camera by ~25m, thus providing a combined sampled width of 500m within a 575m overall strip. The survey method included achieving a minimum of 15% coverage of the survey area and data from two out of the four cameras were processed to achieve this. This ensured the survey had sufficient coverage and number of transects for precise abundance estimation, with the remaining unprocessed data archived. The survey dates and area coverage for the surveys completed and considered within this PEIR are provided in Table 12.2 below.

12.2.4 Surveys were flown at a height of approximately 550m above sea level (ASL; ~1800'). Flying at this height ensures that there is no risk of flushing species that are easily disturbed by aircraft noise. Thaxter *et al*. (2016) recommends a minimum flight altitude of 460 – 500m ASL.

Table 12.2: Dates and coverage of digital aerial surveys of the Project study area included in the PEIR.

Survey date	Area covered (km^2)	Area covered (%)	Total number of transects analysed	Total length of transects analysed (km)
22 March 2021	151.84	16.40	22	607.36
04 April 2021	151.97	16.40	22	607.88
12 May 2021	152.19	16.40	22	608.74
09 June 2021	151.38	16.40	22	605.53
24 July 2021	151.68	16.40	22	606.71
14 August 2021	152.13	16.40	22	608.53
07 September 2021	151.71	16.40	22	606.83
09 October 2021	152.23	16.50	22	608.92
02 November 2021	152.07	16.40	22	608.29
15 December 2021	151.63	16.40	22	606.51
06 January 2022	152.63	16.40	22	606.50
23 February 2022	151.65	16.40	22	606.59
11 March 2022	152.19	16.40	22	608.74
22 March 2022	152.29	16.50	22	609.15
02 April 2022	151.55	16.40	22	606.22
15 April 2022	151.94	16.40	22	607.75
02 May 2022	151.53	16.40	22	606.13
17 May 2022	152.28	16.50	22	609.14
09 June 2022	151.75	16.40	22	607.01
21 June 2022	151.18	16.30	22	604.74
04 July 2022	151.89	16.40	22	607.55
16 July 2022	152.29	16.50	22	609.17
08 August 2022	152.16	16.40	22	608.66
23 August 2022	151.91	16.40	22	607.65

375000

400000

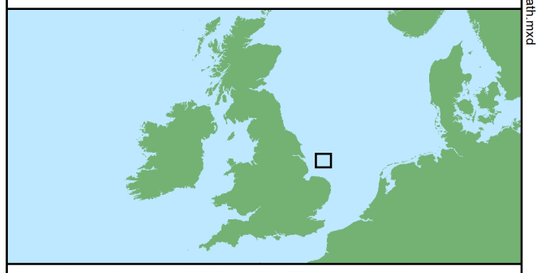
N

5950000

5925000

Legend

- Array Area
- 2km Buffer from Array Area
- 4km Buffer from Array Area
- Transects



Coordinate System: WGS 1984 UTM Zone 31N

0 5 10 km

Scale: 1:200,000

Preliminary Environmental Information Report

The Project Survey Design, Flown between March 2021 and August 2022, with 2km & 4km Buffer and 2.5km Spaced Transects

Figure 12.2

OUTER DOWSING OFFSHORE WIND

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Image Analysis

12.2.5 Images were analysed by trained reviewers who located, identified and recorded all birds in each image. Where identification down to species level was not possible, a group level was assigned (e.g., 'Shearwater species'). The grouping for birds not identifiable to species level is provided in Table 12.3. Additional behavioural information was also recorded, including whether the bird was sitting, loafing on land or other objects, flying, diving, or taking off. Detail on approximate age, sex and any other details of interest was also recorded where possible.

12.2.6 To ensure high data quality, an internal quality assurance (QA) process was carried out on the data from each survey. A 'blind' review of 20% of the raw data was carried out and results compared to those of the original analysis. If 90% agreement was not attained during the QA process, then corrective action was initiated: the remaining data set was reviewed and where appropriate, the failed reviewer's data discarded and all the data re-reviewed.

Table 12.3: Grouping level for birds not identifiable to species level.

Species	Species Grouping Level 1	Species Grouping Level 2	Species Grouping Level 3		Species Grouping Level 4
Fulmar	NA	NA	NA	NA	Fulmar/gull species
Lesser black-backed gull	Large gull species	Unknown gull species	NA		
Great black-backed gull					
Herring gull					
Kittiwake	Small gull species		Tern/small gull species	Auk/small gull species	
Little gull					
Black-headed gull					
Common gull					
Sandwich tern	NA	Tern species		NA	NA
Common tern	Arctic/common tern ('Commic tern')				
Arctic tern					
Arctic skua	Skua species	NA	NA	NA	
Great skua					
Red-throated diver	Diver species	NA	Large auk/diver species	NA	
Guillemot	Large auk	Auk species		Auk/small gull species	Auk/shearwater species
Razorbill					
Little Auk	Small auk		NA		
Puffin					
Manx shearwater	Shearwater species	NA	NA	NA	
Curlew	Wader species	NA	NA	NA	NA

Existing Datasets to Inform Baseline of the Array Area

12.2.7 The DAS were carried out over the array area from March 2021 to August 2022 found several species of seabird utilising the area. The most abundant species found were guillemot (maximum abundance 18,697 birds), razorbill (maximum abundance 6,256 birds) and kittiwake (maximum abundance 5,641 birds) and in total 23 species were recorded during the DAS. The shallow sandy seabed habitats in the array area are suitable for foraging seabirds. Further information on the Project array area habitat is provided in the species accounts below.

Existing Datasets to Inform Baseline of the Offshore ECC

12.2.8 Available data to inform the baseline of the Offshore ECC is based on Lawson *et al*., (2016), which provides information on the abundance of red-throated diver, little gull and common scoter in the Greater Wash SPA survey area. Data collection (DAS) was undertaken between 2002 and 2008. The resulting mean peak population estimate for these species were 1,787, 2,153, and 3,517 individuals, respectively. Of these species, little gull is not considered at risk of displacement in the Offshore ECC, and therefore further consideration below is given to red-throated diver and common scoter only.

12.2.9 The Project Offshore ECC overlaps with the Greater Wash SPA by 151.2 km². Based on this data and the overlap of the Offshore ECC with the Greater Wash SPA, the average and maximum predicted densities of common scoter and red-throated diver in the Offshore ECC are presented in Table 12.4 below. The estimated number of birds present in this overlap is based on the average density of birds (per km²) within the Offshore ECC area multiplied by the overlap area (km²), which results in a mean estimate of 35.1 for red-throated diver and 0.6 for common scoter within the Greater Wash SPA section of the Offshore ECC at any one time.

Table 12.4: Predicted average and maximum density of common scoter and red-throated diver in the Project Offshore ECC based on data by Lawson *et al*., (2016)

Species	Average density in the Offshore ECC (birds/km²)	Maximum density in the Offshore ECC (birds/km²)
Common scoter	0.004	0.029
Red-throated diver	0.232	0.692

WWT Aerial Surveys of Waterbirds in Strategic Wind farm Areas (WWT 2008, 2009)

12.2.1 Between 2004 and 2006, the WWT undertook comprehensive aerial surveys of nearshore areas of strategic wind farm areas in Northwest England, the Greater Wash, and in the Thames.

12.2.2 In the Greater Wash, large numbers of birds were observed. Across inshore areas (GW4), surveys revealed aggregations of scoters, divers and intertidal species; across survey period 2, two 1,000 strong flocks of scoters were recorded.

12.2.3 Areas further north-west of the wash (survey blocks GW 8, GW9, GW10 (WWT (2007)) were largely characterised by pelagic species, such as auks, gannets and kittiwakes.

British Trust for Ornithology (BTO) Non-Estuarine Waterbird Surveys (NEWS)

12.2.1 Across December, January and February of the winter of 2015/16, data was collected by the BTO for the third Non-estuarine Waterbird Survey (NEWS III). Surveys covered 53% of the non-estuarine coast of the UK, including the area of interest along the Lincolnshire Coast, within the Offshore ECC and the landfall for the Project. Although the survey area covers a larger region than the landfall for the Project, it provides an indication of bird species present within the intertidal area over a prolonged period to identify what the potential key species are for assessment purposes. Species counts and population estimates are presented in Table 12.5 below. Populations are considered nationally important if they make up over 1% of the UK population. Of the species recorded in the BTO NEWS survey data, no species populations were considered nationally important.

Table 12.5: Population estimates from BTO NEWS survey data collected during the winter (December, January and February) of 2015/16 for intertidal species along the Lincolnshire coast using methodologies set out in Austin *et al.* (2017). Nationally important populations make up greater than 1% of the UK population

Species	Population Estimate	Nationally important (>1%)
Bar-tailed Godwit	5 (0-15)	No
Black-headed Gull	539 (266-810)	No
Common Gull	414 (161-668)	No
Common Scoter	80 (0-160)	No
Cormorant	54 (2-126)	No
Curlew	96 (0-288)	No
Dunlin	1 (0-3)	No
Great Black-backed Gull	76 (44-107)	No
Great Crested Grebe	1 (0-3)	No
Great Northern Diver	1 (0-3)	No
Herring Gull	686 (356-1,249)	No
Lesser Black-backed Gull	6 (1-11)	No
Mallard	37 (0-79)	No
Mediterranean Gull	1 (0-3)	No
Mute Swan	41 (0-123)	No
Oystercatcher	68 (4-169)	No
Redshank	19 (0-57)	No
Red-throated Diver	5 (2-11)	No
Ringed Plover	18 (2-48)	No
Sanderling	124 (51-238)	No
Turnstone	6 (0-18)	No

Site-specific intertidal surveys

12.2.2 Site-specific surveys of intertidal birds have been undertaken for the Project at the proposed landfall zone (Wolla Bank Landfall), with data collected using vantagepoint surveys. Surveys focussed specifically on waterbirds, though other notable sightings (e.g. raptor/owl species listed on Annex 1 of the EC Birds Directive or Schedule 1 of the Wildlife & Countryside Act 1981 (as amended) or particularly large flocks of species of conservation concern) were recorded.

12.2.3 Survey data for the Wolla Bank Landfall is presented in Table 12.6. The table presents peak counts of each waterbird species, with the total number of birds for each species summed within each hourly count. The table also shows the proportional frequency of observation for each species, i.e., the proportion of survey periods in which each species was recorded (n=84), in order to show how regularly each species uses the survey area.

12.2.4 Further information on intertidal surveys can be found in Volume 1, Appendix 22.3: Winter Bird Survey Report 2022-2023.

Table 12.6: Peak count of waterbird species recorded at Wolla Bank Landfall Location on each survey data, the number of hourly counts in which each species was observed and the proportional frequency of those observations.

Species	# counts in which species observed	Proportional frequency of counts in which species observed (%)	13/09/22	29/09/22	14/10/22	24/10/22	14/11/22	29/11/22	05/12/22	20/12/22	10/01/23	24/01/23	01/02/23	13/02/23	28/02/23	27/03/23
Pink-footed goose	3	3.57	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Greylag goose	1	1.19	0	32	0	0	0	0	0	0	0	0	0	0	0	0
Canada goose	1	1.19	0	0	0	0	0	0	0	11	0	0	0	0	0	0
Dark-bellied brent goose	2	2.38	0	0	0	7	0	0	4	0	0	0	0	0	0	0
Shelduck	1	1.19	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Mallard	1	1.19	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Wigeon	2	2.38	0	0	33	0	0	0	0	0	0	0	0	500	0	0
Teal	1	1.19	0	0	0	12	0	0	0	0	0	0	0	0	0	0
Pintail	1	1.19	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Eider	1	1.19	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Common scoter	12	14.29	0	0	0	18	23	13	7	10	40	14	0	0	0	15
Oystercatcher	15	17.86	2	2	0	2	0	4	2	0	3	0	3	2	0	0
Golden plover	4	4.76	23	0	0	0	34	0	0	0	0	0	0	0	0	0
Grey plover	3	3.57	0	0	0	0	0	1	0	1	1	0	0	0	0	0
Curlew	17	20.24	0	0	2	1	2	0	0	2	0	8	16	18	5	6
Sanderling	29	34.52	0	3	11	0	0	12	19	7	11	3	7	4	4	3
Dunlin	5	5.95	0	0	0	0	17	7	12	6	0	0	0	0	0	0
Redshank	1	1.19	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Black-headed gull	46	54.76	4	8	12	12	13	9	10	17	10	9	16	15	9	30
Common gull	63	75.00	18	11	55	10	7	16	16	32	35	12	16	59	12	19
Great black-backed gull	6	7.14	0	0	0	0	0	0	3	2	4	0	0	0	2	1
Herring gull	28	33.33	3	3	9	4	5	2	2	5	4	3	16	5	3	4
Lesser black-backed gull	11	13.10	0	2	2	0	2	2	1	0	0	2	2	0	1	2
Red-throated diver	11	10.71	0	0	0	0	1	1	0	0	0	0	1	1	1	1
Great northern diver	7	8.33	0	0	0	0	0	1	1	1	1	1	0	0	0	0
Cormorant	12	14.29	0	0	0	2	2	2	0	2	2	0	3	1	2	3
Marsh harrier	1	1.19	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Data analysis (DAS)

Data Treatment

12.2.5 For presentation in this report, raw count DAS data were trimmed to the survey area. Data were processed to estimate density, abundance and distribution of key species and species groups.

12.2.6 Records which were identified to species level were separated out from those identified to group level. Birds identified to group level only were apportioned to species level as outlined in Table 12.3 above.

12.2.7 The most appropriate method to incorporate data from months during which two surveys were undertaken (between March and August 2022) was to calculate the mean abundance or density of birds within each month for which two surveys were undertaken. The mean monthly abundance or density was then used within the assessments as normal. For example, the mean seasonal peak abundance was then calculated across the same bio-season between years, using the mean abundance from May 2022, with the single survey abundance from May 2021.

Population Estimates

12.2.8 Population estimates for seabirds recorded in the Project array area, array area plus 2km buffer and array area plus 4km buffer were calculated for each species.

12.2.9 Each strip transect was treated as a statistically independent random sample from the site. The length and breadth (i.e. the width of the field of view of the camera) of each transect were multiplied together to give the transect area; dividing the number of observations for each species on each transect by the transect area gives a point estimate of the density of that species for the transect. The density of animals at the site (and hence the population size by multiplying by the area of the site), the standard deviation, the 95% confidence intervals (CIs) and coefficient of variance (CV) were then estimated using a nonparametric block bootstrap method with replacement (Buckland *et al.,* 2001), to ensure equal transect effort was sampled across each bootstrap iteration. This was done by using transect ID as the sampling unit with replacement. A group of transects were randomly sampled until their total length equalled approximately the same length as the total survey length.

12.2.10 A total of 1,000 bootstrap iterations were performed from which the mean and standard deviation of the sampled means were calculated, as well as the relative standard error (or CV) as defined by the standard deviation divided by the mean. Data were processed in the R programming language (R Core Team, 2021; version 4.1.1). The upper and lower confidence limits (CLs) define the range that the population estimate falls within with 95% certainty. The CV is a measure of the precision of the population and density estimates.

12.2.11 For most species these abundance estimates relate to absolute abundance, but for diving species such as auks, the abundance relates to relative abundance due to a proportion of animals being submerged at the time of survey.

Apportionment of Unidentified Birds

12.2.12 As per Table 12.3, species which were not possible to identify to a species level were categorised as belonging to a higher-level group. Where it was not possible to assign a bird to the species group level, the bird was categorised as potentially belonging to a number of different higher-level groups. To avoid underestimating species abundance due to the omission of birds not identifiable to a species group level, the density of each unidentified species grouping was then added proportionately to each member species of that group. The proportions were calculated from the ratios of positively identified birds in that group, undertaken on a survey-by-survey basis. For example, if identified guillemots and razorbills occurred in a 4:1 ratio, then 80% of unidentified large auks would be assigned to guillemot and 20% to razorbill. All confidence levels of species identifications were used in the analysis.

Correction for Availability Bias

12.2.13 During the DAS, a proportion of seabirds that spend any time underwater, especially while feeding, will not be detectable at the surface. For species considered within this survey, this is predominantly applicable to auk species such as guillemot, razorbill and puffin which undertake regular foraging dives underwater. To account for this within the survey data, the density and abundance estimates therefore need to be corrected to allow for this 'availability bias'.

12.2.14 A fixed species-specific correction factor was applied for each auk recorded on the sea surface during the DASs. For guillemots and razorbills, correction factors were derived from time spent underwater (during the chick-rearing stage) presented in Thaxter *et al*., (2010), estimating that the proportion of time spent at the surface for guillemots and razorbills was 0.7595 and 0.8182 respectively. For puffins, results from data loggers reported in Spencer (2012) were used, showing that the proportion of time spent at the surface was 0.8584.

Flight Direction of seabirds

12.2.15 Wind rose diagrams were created to present the flying direction of seabirds, where each cardinal point (north, east, south, west, and intercardinal point (north-east, south-east, south-west, north-west) indicates the total number of birds recorded flying in that direction in a given survey. Flight directions have been grouped by bio-season at PEIR because no obvious patterns were observed within the monthly survey data.

Bio-seasons

12.2.16 Across the calendar year, bird behaviour and abundance will vary depending upon the bio-season. To establish the level of importance any seabird species has within the study area during any particular period of time, separate bio-seasons are recognised in this technical baseline report. The biologically defined minimum population scales (BDMPS) bio-seasons are based on those in Furness (2015), hereafter referred to as bio-seasons. The use of the BDMPS bio-seasons has been agreed through the Offshore and Intertidal Ornithology Expert Topic Group (ETG) (Volume 1, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3). Six bio-seasons are defined in this report, though not all six are applicable for all seabird species, with different combinations used depending on the biology and life history of a species. The bio-seasons are as follows:

- Return migration: when birds are migrating to breeding grounds;

- Migration-free breeding: when birds are attending colonies, nesting and provisioning young;
- Post-breeding migration: when birds are migrating to wintering areas or dispersing from colonies;
- Migration-free winter: when non-breeding birds are over-wintering in an area;
- Breeding: Bio-season from modal return to the colony until the modal departure from the colony at the end of the breeding season; and
- Non-breeding: bio-season from modal departure from the colony at the end of the breeding season to modal return to the colony the following year.

12.2.17 The bio-seasons used for species described in the species accounts in Section 12.3 are outlined in Table 12.7. Notably, bio-seasons for little gull were not included in Furness (2015), and so bio-seasons were based off Cramp & Simmons (1983) and expert judgement based on data presented in Table 12.7.

Table 12.7: Bio-seasons used for detailed species accounts, based on Furness (2015) unless specified otherwise.

Species	Return Migration	Migration-free Breeding	Post-breeding Migration	Migration-free Winter	Breeding	Non-breeding
Kittiwake	January to April	May to July	August to December	NA	NA	NA
Little gull[1]	NA	NA	NA	NA	April to June	July to March
Common gull[2]	January to April	May to July	August to December	NA	NA	NA
Great black-backed gull	NA	NA	NA	NA	April to August	September to March
Herring gull	NA	NA	NA	NA	April to August	September to March
Lesser black-backed gull	March to April	May to July	August to October	November to February	NA	NA
Sandwich tern	March to May	June	July to September	NA	NA	NA
Common tern	April to May	June	July to September	NA	NA	NA
Guillemot	NA	NA	NA	NA	March to Jul	August to February
Razorbill	January to March	April to July	August to October	November to December	NA	NA

[1] Based on Robinson (2005)
[2] Common gull not included in Furness (2015) – based on kittiwake as closely related and have similar life history

Species	Return Migration	Migration-free Breeding	Post-breeding Migration	Migration-free Winter	Breeding	Non-breeding
Puffin	NA	NA	NA	NA	April to July	August to March
Red-throated diver	February to April	May to August	September to November	December to January	NA	NA
Gannet	December to March	April to August	September to November	NA	NA	NA

12.3 Results

Offshore Ornithology Survey Results

12.3.1 Over the 18-month survey period (March 2021 to August 2022) considered to date, the following bird species (Table 12.8) were recorded within the Project array area and associated 4km buffer. Across the surveys, several species were recorded in the Project survey area in only trivial numbers deemed too low to warrant detailed species accounts although the raw data for these species is presented within Appendix A; these species are in italic font in Table 12.8.

12.3.2 Following the recent guidance from Natural England (Parker *et al.*, 2022a) the data used for all species was the array area plus 2km buffer except for red-throated diver which used the array area plus 4km buffer (the maximum extent of the surveys).

Table 12.8: Bird species recorded in site-specific DAS of the Project array area and 4km buffer.

Divers and pelagic species	Gulls	Skuas and terns	Auks	Other
Red-throated diver	Kittiwake	Sandwich tern	*Little auk*	*Oystercatcher*
Great northern diver	*Black-headed gull*	Common tern	Guillemot	*Shag*
Fulmar	Little gull	*Arctic tern*	Razorbill	
Manx shearwater	Common gull	*Great skua*	Puffin	
Gannet	Great black-backed gull	*Arctic skua*		
	Herring gull			
	Lesser black-backed gull			

Kittiwake

DAS Data

12.3.3 Over the first 18-months of DAS, kittiwake were observed within the Project array area in all 24 surveys. Kittiwake presence was relatively high across the Project survey area through all three bio-seasons. Raw counts ranged from seven individuals (October 2021) to 973 individuals (April 2021), with abundance and density peaking at a mean of 5,641 birds and 11.28 birds/km^2 respectively in April 2021 (Table 12.10).

12.3.4 In the array area plus 2km buffer, raw counts ranged from 15 (October 2021) to 1,270 (April 2021), with abundance and density peaking at a mean of 7,650 birds and 10.93 birds/km^2 respectively in April 2021 (Table 12.10). The monthly mean population estimates are presented in Table 12.11.

Kittiwake overview

12.3.5 The nearest kittiwake colony to the Project is the Flamborough and Filey Coast SPA (FFC). This is located approximately 95km from the Project and is within the mean maximum foraging range of kittiwake (156.1km, standard deviation 144.5km) (Woodward *et al.*, 2019). A tracking study of 20 birds breeding at the FFC SPA in 2017 found an average foraging range of 88.7km. Trips ranged in length from 3.2km to 324km, with birds travelling into the North Sea northwest and southwest of the colony (Wischnewski *et al.*, 2017). The utilisation distributions produced from the 2017 tracking data indicate that the Project is just outside the core and home foraging ranges of kittiwake from this SPA but there are high densities during the migrating bio-seasons.

12.3.6 Outside the breeding season, impacts on kittiwake have been compared to the UK North Sea BDMPS, consisting of 829,937 individuals during autumn migration (August to December), and 627,816 individuals during spring migration (January to April) (Furness, 2015).

Table 12.9: Kittiwake bio-season abundance and density estimates in the Project array area.

BDMPS Bio-seasons	Months	Bio-season peak abundance in array area (n)	Bio-season peak density in array area (n/km^2)
Return migration	Jan-Apr	5,641	11.28
Migration-free breeding	May-Jul	3,410	6.85
Post-breeding migration	Aug-Dec	1,726	3.47

Spatial density distribution and flight direction

12.3.7 During the autumn migration period and migration-free breeding bio-seasons, highest densities of kittiwake were found in the east of the study area (predominantly within the 4km buffer area), with a high density also in the north of the region in the autumn migration bio-season (Figure 12.4). During the spring migration bio-season, densities were highest in the centre of the study area (Figure 12.4).

12.3.8 Across the survey period, 43% of birds were recorded flying. Across all three bio-seasons, no strong patterns in flight direction were observed, though a slight bias towards flights towards the NE was visible in the migration-free breeding and return migration bio-seasons (Figure 12.5)

Foraging/Usage hotspots

12.3.9 The FFC SPA is the closest SPA to the Project array area and using species distribution models and hotspot mapping (Cleasby *et al.*, 2020) hotspots were identified on the east end of the Project footprint (Figure 12.3) using Getis-Ord hotspot analysis (Cleasby *et al.*, 2020).

Table 12.10: Kittiwake raw counts, estimated abundance and estimated density in the Project array area plus array area and the array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	534	3,196	6.39	25	723	4377	6.25
April 21	973	5,641	11.28	40	1,270	7,650	10.93
May 21	262	1,578	3.16	19	394	2,469	3.53
June 21	59	357	0.71	54	123	747	1.07
July 21	225	1,358	2.72	67	399	2,404	3.43
August 21	148	886	1.77	55	551	3,175	4.53
September 21	212	1,326	2.65	34	267	1,684	2.41
October 21	7	60	0.12	86	15	116	0.17
November 21	21	134	0.27	67	26	169	0.24
December 21	30	175	0.35	90	48	280	0.40
January 22	11	66	0.13	82	17	102	0.15
February 22	96	586	1.17	52	129	784	1.12
March S01 22	485	2,835	5.69	44	558	3,326	4.77
March S02 22	307	1,896	3.81	55	481	2,920	4.19
April S01 22	575	3,457	6.94	37	782	4,641	6.65
April S02 22	744	4,325	8.69	55	1,042	6,186	8.87
May S01 22	576	3,410	6.85	50	799	4,820	6.91
May S02 22	202	1,228	2.47	42	415	2,584	3.7
June S01 22	58	334	0.67	60	174	1,062	1.52
June S02 22	397	2,369	4.76	42	585	3,489	5.00
July S01 22	58	343	0.69	69	83	496	0.71
July S02 22	75	431	0.86	75	187	1,140	1.63
August S01 22	290	1,726	3.47	48	834	4,740	6.80
August S02 22	35	225	0.45	46	94	517	0.74

Table 12.11: Kittiwake (array area only) monthly mean population estimates

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Year 1 Mean Population Estimate	No Data	No Data	3,196	5,641	1,578	357	1,358	886	1,326	60	134	175
Calendar Year 1 UCL (97.5%)	No Data	No Data	4,372	7,181	3,087	513	1,884	1,464	2,008	101	179	242
Calendar Year 1 LCL (2.5%)	No Data	No Data	2,128	4,271	617	225	895	502	723	23	85	107
Calendar Year 2 Mean Population Estimate	66	586	2,366	3,891	2,319	1,352	387	976	No Data	No Data	No Data	No Data
Calendar Year 2 UCL (97.5%)	98	761	3,293	4,972	2,773	1,756	513.5	1,642	No Data	No Data	No Data	No Data
Calendar Year 2 LCL (2.5%)	35	411	1,546	2,894	1,931	985	268	398	No Data	No Data	No Data	No Data

250000 300000 350000 400000 450000 500000

6050000 6000000 5950000 5900000 5850000 5800000

N

Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- 4km Buffer from Array Area

Kittiwake Hotspots (Cleasby *et al.*, 2020)

- Maximum Curvature
- Statistically Significant Getis-Ord hotspot
- Top 5% Getis-Ord hotspot
- Top 1% Getis-Ord hotspot

Hotspots identified at the UK-scale for Black-legged Kittiwakes using Getis-Ord hotspot analysis with a neighbourhood size of d = 10 km based on FPT analysis or Maximum Curvature. Getis-Ord hotspots defined as all cells with the top 1% of calculated Gi* scores; all cells within the top 5% of Gi* score; all cells in which Gi* scores were deemed statistically significant at the $\alpha < 0.01$ level.

Coordinate System: WGS 1984 UTM Zone 31N

0 25 50 km

Scale: 1:1,000,000

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Foraging Hotspots of Kittiwake Colony from FFC SPA (Cleasby *et al.*, 2020)

Figure 12.3

OUTER DOWSING OFFSHORE WIND

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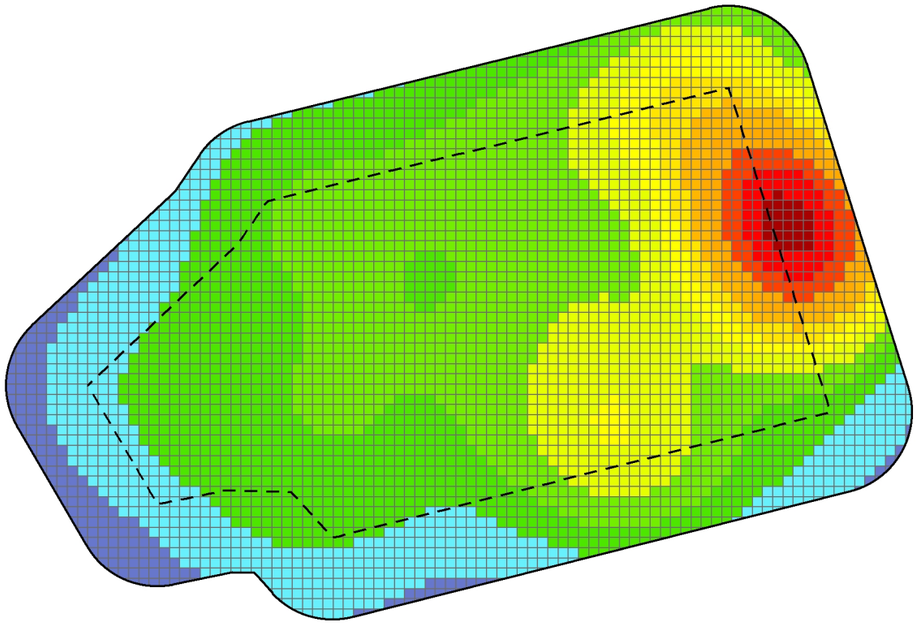
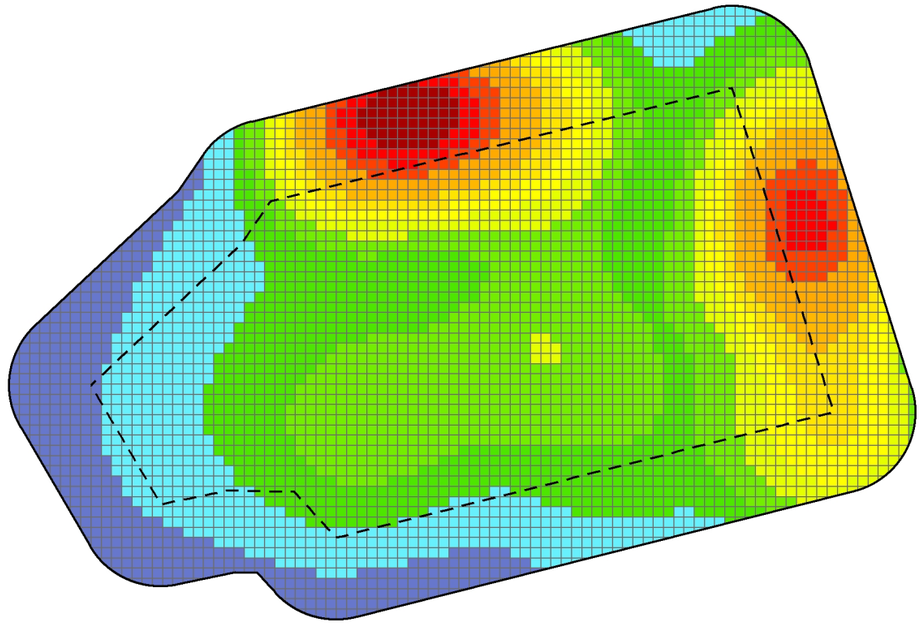
Document Path: G:\GIS\GIS_Projects\0152 Outer Dowsing EIA\GIS\Figures\PEIR\Ornithology Technical Baseline\ODOW_0152_ORTB_Fig12.3_Kittiwake_Hotspots.mxd

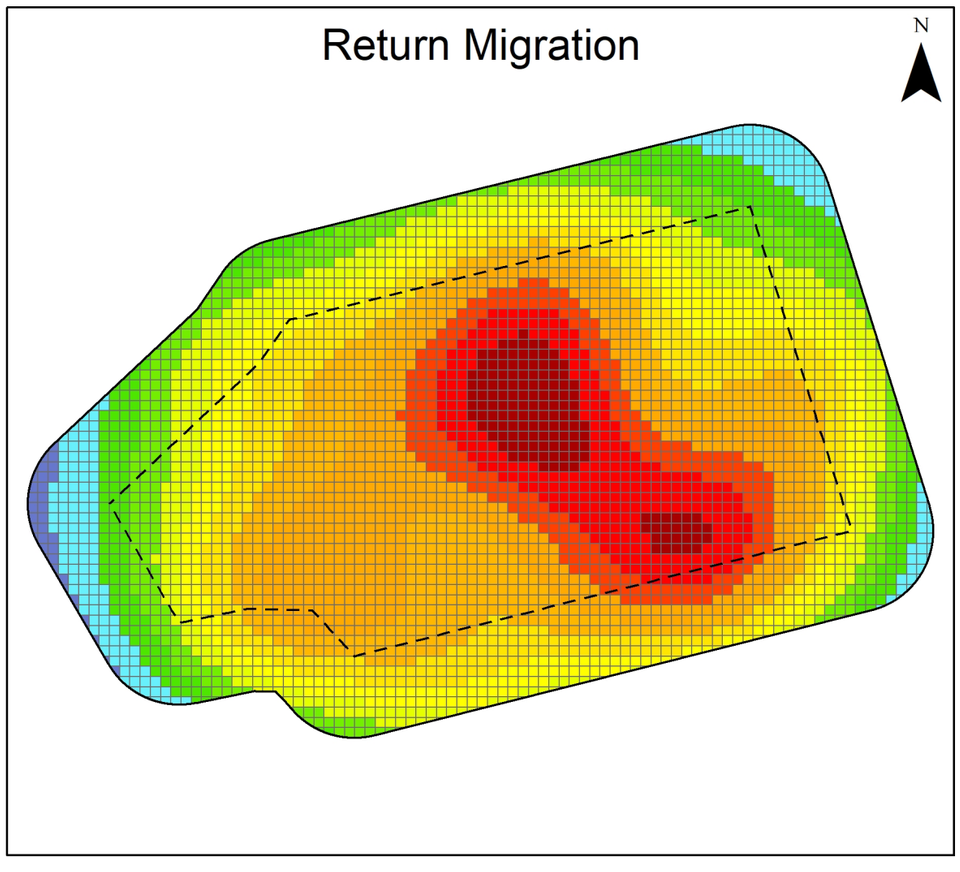
Migration-Free Breeding



Post-breeding Migration



Return Migration

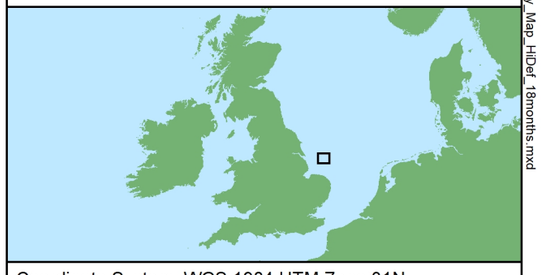


Legend

- Array Area
- Area Area 4km Buffer

Predicted Kittiwake Density (birds / km^2)

- 0 - 2.58
- 2.59 - 4.66
- 4.67 - 6.74
- 6.75 - 8.82
- 8.83 - 10.89
- 10.90 - 12.97
- 12.98 - 15.05
- 15.06 - 17.13
- 17.14 - 19.20
- 19.21 - 21.28
- 21.29 - 23.36
- 23.37 - 25.44



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

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Bio-season Spatial Density Distribution of Black-legged Kittiwake within the Project Array Area plus 4km Buffer

Figure 12.4

OUTER DOWSING OFFSHORE WIND

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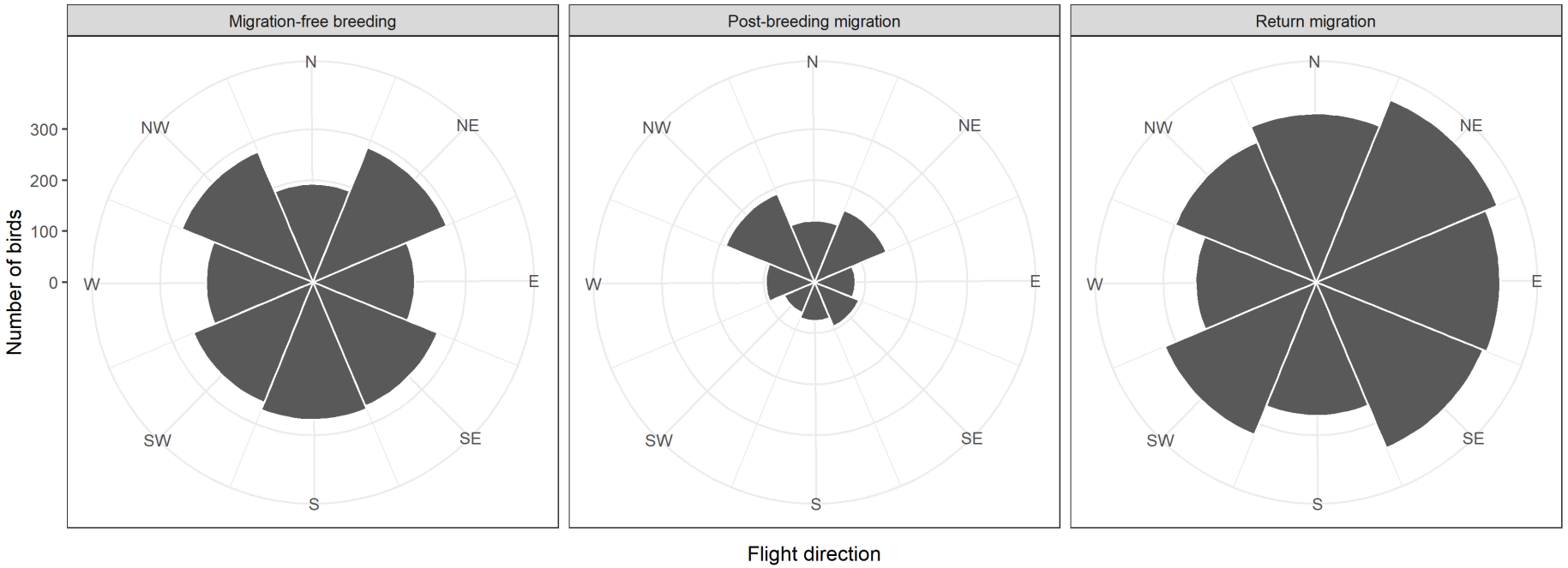


Figure 12.5: Flight direction rose diagrams of kittiwakes across different bio-seasons in the Project array area and 4km buffer

Little Gull

DAS Data

12.3.11 Little gull were recorded in the Project array area in 6 out of the 18 months considered to date. Raw counts (excluding zero counts) ranged from 1 (August 2021 & March 2022) to 42 (October 2021), with abundance and density peaking at 249 birds and 0.50 birds/km^2 respectively in October 2021 (Table 12.12).

12.3.12 In the array area plus 2km buffer, raw counts ranged from 1 on four different surveys to 66 (October 2021), with abundance and density peaking at 395 birds and 0.56 birds/km^2 respectively in October 2021 (Table 12.12). The monthly mean population estimates are presented in Table 12.13.

Little Gull Overview

12.3.13 The little gull breeding bio-season based on Cramp & Simmons (1983) implies a non-breeding bio-season from August to March and breeding season from April to July. However, across surveys, no birds were recorded across the breeding season apart from July. Little gulls are considered passage migrants to Britain and Ireland, with gulls generally remaining closely inshore while using the English Channel to leave the North Sea and move towards wintering areas predominantly in the western Mediterranean (Stone *et al.*, 1995; Skov *et al.,* 1995). With little gulls only recorded in July within the breeding season, it was considered that these birds were unlikely to be breeding birds but instead undertaking post-breeding migrations. To reflect this, the non-breeding bio-season was extended to include July.

Table 12.12: Little gull raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	0	0	0.00	0	0	0	0.00
April 21	0	0	0.00	0	1	7	0.01
May 21	0	0	0.00	0	0	0	0.00
June 21	0	0	0.00	0	1	7	0.01
July 21	2	12	0.02	100	2	13	0.02
August 21	1	6	0.01	100	1	7	0.01
September 21	14	85	0.17	86	17	97	0.14
October 21	42	249	0.50	88	66	395	0.56
November 21	0	0	0.00	0	0	0	0.00
December 21	0	0	0.00	0	0	0	0.00
January 22	0	0	0.00	0	0	0	0.00
February 22	0	0	0.00	0	0	0	0.00
March S01 22	1	6	0.01	100	1	7	0.01
March S02 22	2	12	0.02	100	4	24	0.03
April S01 22	0	0	0.00	0	0	0	0.00
April S02 22	0	0	0.00	0	0	0	0.00
May S01 22	0	0	0.00	0	0	0	0.00
May S02 22	0	0	0.00	0	0	0	0.00
June S01 22	0	0	0.00	0	0	0	0.00
June S02 22	0	0	0.00	0	0	0	0.00
July S01 22	0	0	0.00	0	0	0	0.00
July S02 22	0	0	0.00	0	0	0	0.00
August S01 22	0	0	0.00	0	0	0	0.00
August S02 22	1	6	0.01	100	1	6	0.01

Table 12.13:Little gull monthly mean population estimates (array area only)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calendar Year 1 Mean Population Estimate	No Data	No Data	0	0	0	0	12	6	85	249	0	0
Calendar Year 1 UCL (97.5%)	No Data	No Data	0	0	0	0	36	18	125	365	0	0
Calendar Year 1 LCL (2.5%)	No Data	No Data	0	0	0	0	0	0	41	139	0	0
Calendar Year 2 Mean Population Estimate	0	0	9	0	0	0	0	3	No Data	No Data	No Data	No Data
Calendar Year 2 UCL (97.5%)	0	0	27	0	0	0	0	9	No Data	No Data	No Data	No Data
Calendar Year 2 LCL (2.5%)	0	0	0	0	0	0	0	0	No Data	No Data	No Data	No Data

Table 12.14: Little gull bio-season abundance and density estimates in the Project array area.

BDMPS Bio-seasons	Months	Bio-season peak abundance in array area (n)	Bio-season peak density estimate in array area (n/km^2)
Breeding	May-Jun	0	0.00
Non-breeding	Jul-April	249	0.50

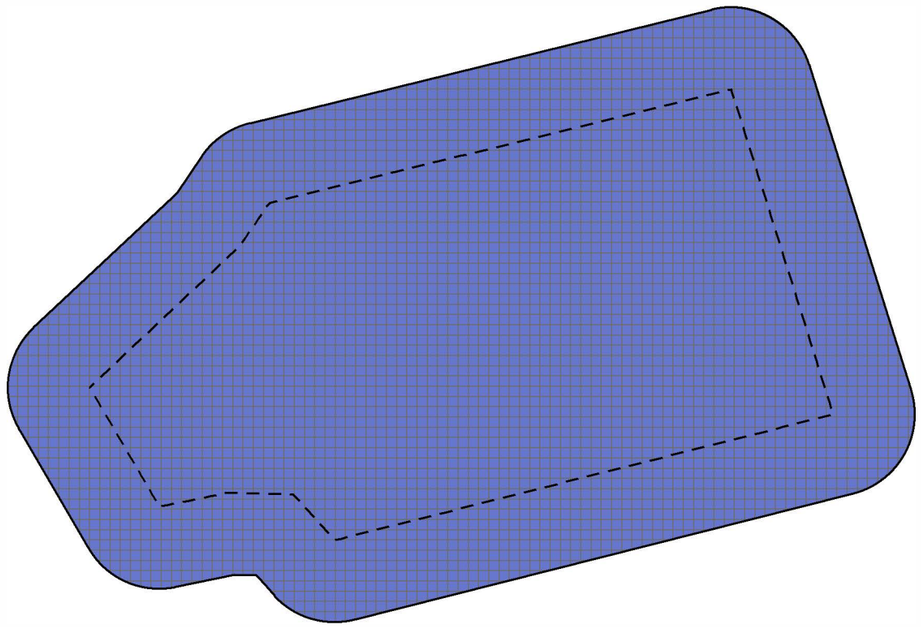
Spatial Density Distribution and Flight Direction

12.3.14 Little gull were recorded in lower numbers compared to other species, though when numbers markedly peaked in October 2021 during their post breeding migration, birds were found mainly in the south-west of the study area. The little gull is a rare breeding bird in the UK with only one pair breeding between 2013-2017 (EBBA2, 2023) so it is highly likely that the birds found in the survey area are migratory birds and not foraging breeding birds.

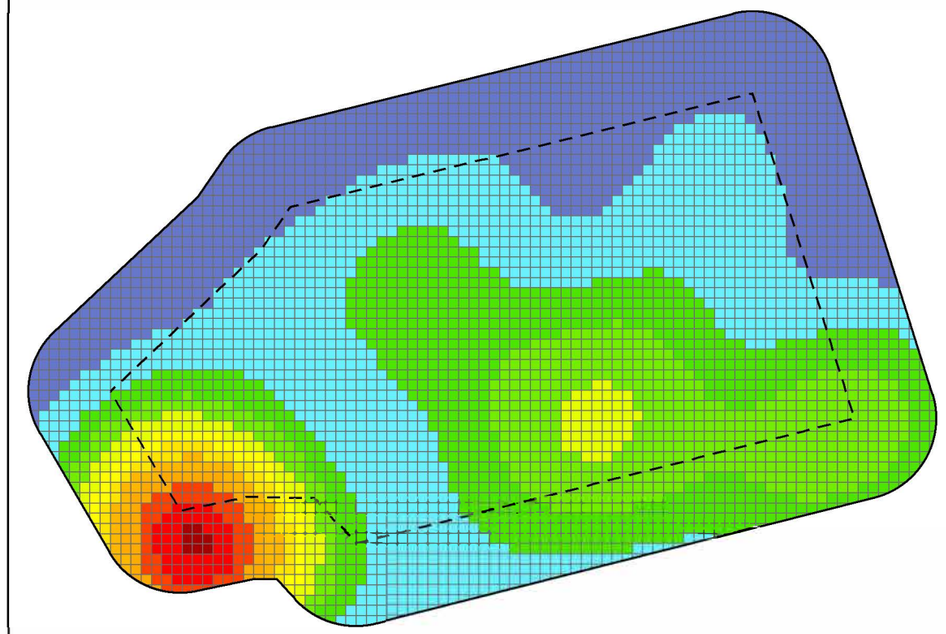
12.3.15 Across the survey period, 88% of birds were recorded flying. During the peak in October 2021, birds were mainly heading in south-westerly and westerly directions. However, in September 2021, birds were predominantly flying in north-westerly directions.

12.3.16 Birds were recorded throughout the area in the non-breeding season, though the density was highest in the south-west of the survey area Figure 12.6.

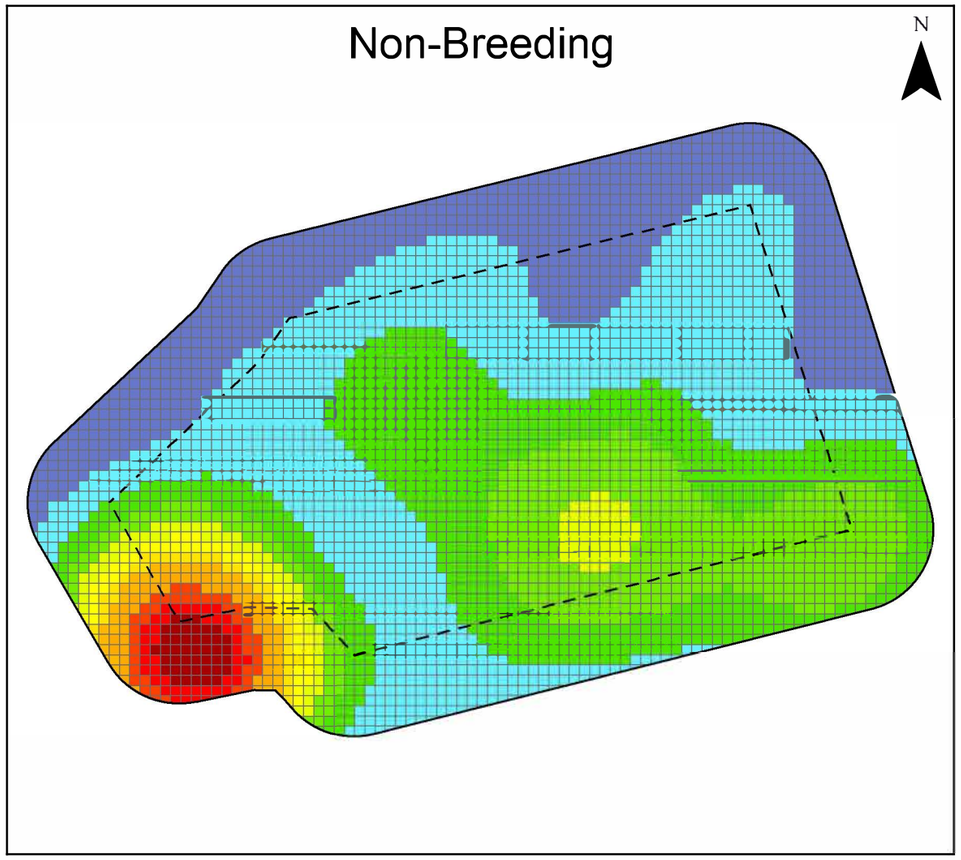
Migration-Free Breeding



Post-Breeding Migration



Non-Breeding

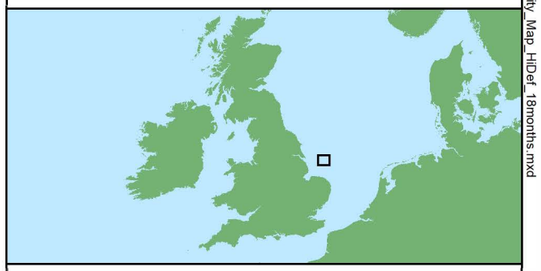


Legend

- Array Area
- Area Area 4km Buffer

Predicted Little Gull Density (birds / km^2)

- 0 - 0.38
- 0.39 - 0.71
- 0.72 - 1.04
- 1.05 - 1.36
- 1.37 - 1.69
- 1.70 - 2.01
- 2.02 - 2.34
- 2.35 - 2.66
- 2.67 - 2.99
- 3.00 - 3.32
- 3.33 - 3.64
- 3.65 - 3.97



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Little Gull within the Project Array Area plus 4km Buffer

Figure 12.6

OUTER DOWSING OFFSHORE WIND

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Great Black-Backed Gull

DAS Data

12.3.17 Great black-backed gull were recorded on 12 of the 18 months within the Project array area considered for this PEIR. Raw counts (excluding zero counts) ranged from 1 (May 2022) to 13 (September 2021), with abundance and density peaking at 72 birds and 0.14 birds/km^2 respectively in September 2021 (Table 12.15).

12.3.18 In the array area plus 2km buffer, raw counts ranged from 1 (several months) to 19 (September 2021), with abundance and density peaking at 120 birds and 0.17 birds/km^2 respectively in September 2021 (Table 12.15).

Great Black-Backed Gull Overview

12.3.19 The mean maximum foraging range of this species is 73km, though this was recorded from just a single study so is of low confidence (Woodward et al., 2019). There are no known large colonies within this range of the Project.

Table 12.15: Great black-backed gull raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	2	12	0.02	100	2	18	0.03
April 21	2	17	0.03	0	4	29	0.04
May 21	0	0	0.00	0	1	6	0.01
June 21	0	0	0.00	0	0	0	0.00
July 21	0	0	0.00	0	0	0	0.00
August 21	0	0	0.00	0	0	0	0.00
September 21	13	72	0.14	31	19	120	0.17
October 21	6	34	0.07	17	14	84	0.12
November 21	6	37	0.07	67	6	38	0.05
December 21	6	36	0.07	33	11	66	0.09
January 22	3	18	0.04	33	5	31	0.04
February 22	0	0	0.00	0	2	13	0.02
March S01 22	2	12	0.02	0	2	12	0.02
March S02 22	0	0	0.00	0	0	0	0.00
April S01 22	2	12	0.02	0	2	13	0.02
April S02 22	0	0	0.00	0	1	6	0.01
May S01 22	0	0	0.00	0	0	0	0.00
May S02 22	1	6	0.01	100	1	6	0.01
June S01 22	0	4	0.01	0	2	19	0.03
June S02 22	3	18	0.04	33	3	19	0.03
July S01 22	0	0	0.00	0	0	0	0.00
July S02 22	0	0	0.00	0	3	19	0.03
August S01 22	6	36	0.07	33	8	43	0.06

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
August S02 22	0	0	0.00	0	1	6	0.01

Bio-Season Peak Estimates

12.3.20 Great black-backed gull were present in the Project array area across both bio-seasons. Presence was greatest during the non-breeding bio-season (September to March), with a peak estimate of 72 birds and peak density of 0.14 birds/km^2 (Table 12.16).

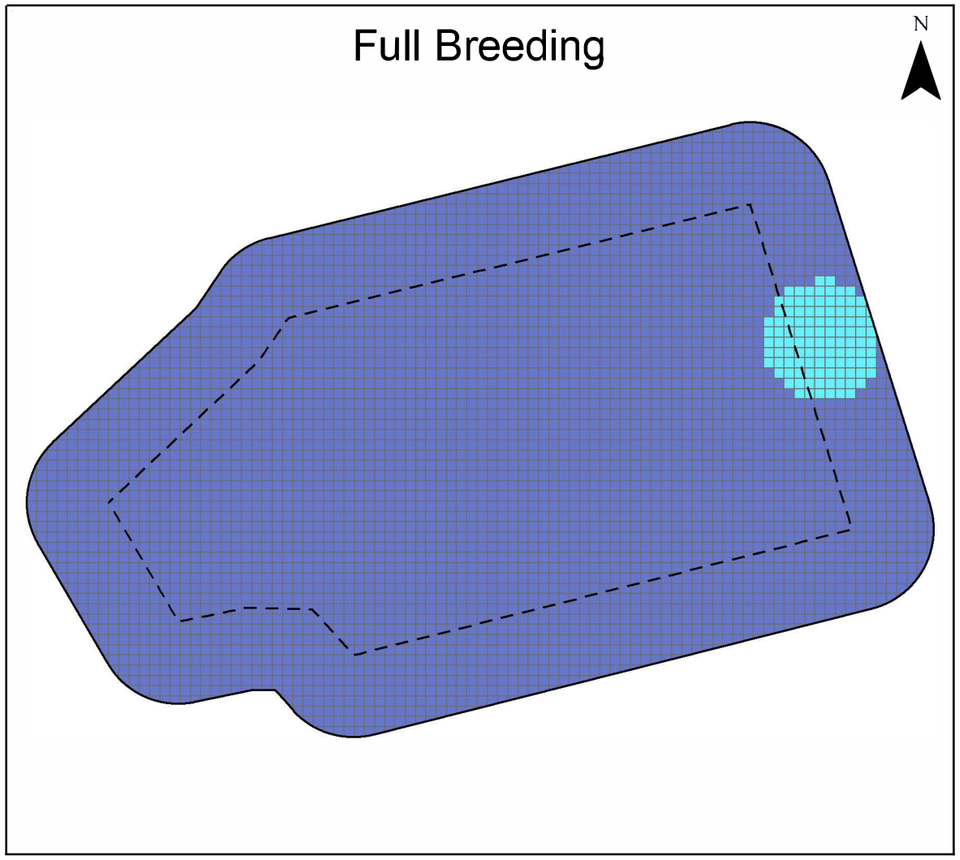
Table 12.16: Great black-backed gull bio-season abundance and density estimates in the Project array area plus 2km buffer.

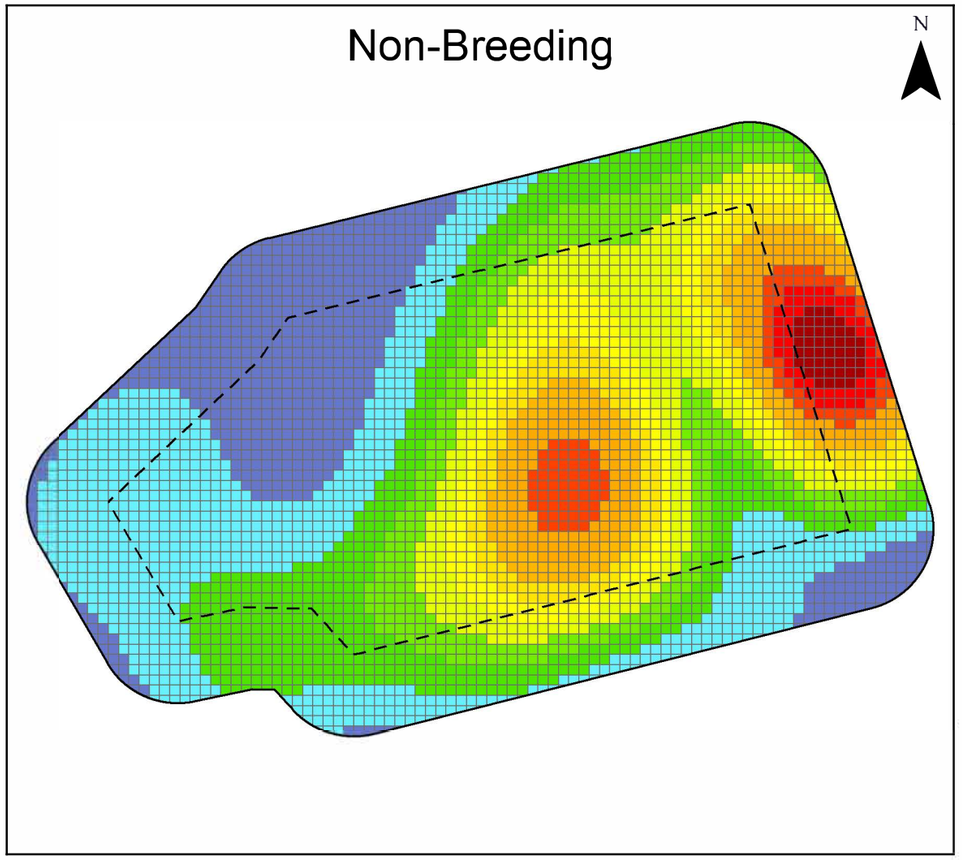
BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Breeding	Apr - Aug	17	0.03	29	0.04
Non-breeding	Sep - Mar	72	0.14	120	0.17

Spatial Density Distribution and Flight Direction

12.3.21 During the non-breeding season, highest densities of birds were found in the centre and in east of the survey area, while in the breeding season the low number of birds were also found in the east (Figure 12.7).

12.3.22 Across the survey period, 27% of birds were recorded flying. In the breeding season the predominant direction of flight was south-west whereas with the non-breeding season with birds recorded flying in all directions, though a peak of birds flying to the north-west was recorded (Figure 12.8).





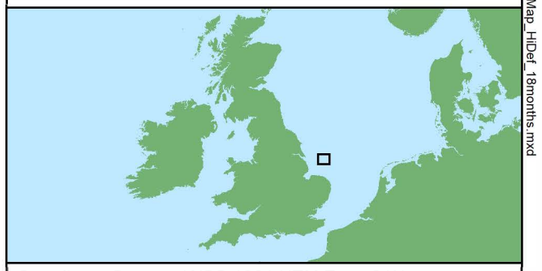
Legend

Array Area

Area Area 4km Buffer

Predicted Great Black-backed Gull Density (birds / km^2)

- 0 - 0.136
- 0.137 - 0.270
- 0.271 - 0.404
- 0.405 - 0.538
- 0.539 - 0.672
- 0.673 - 0.806
- 0.807 - 0.939
- 0.940 - 1.073
- 1.074 - 1.207
- 1.208 - 1.341
- 1.342 - 1.475
- 1.476 - 1.609



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Great Black-backed Gull within the Project Array Area plus 4km Buffer

Figure 12.7

OUTER DOWSING OFFSHORE WIND

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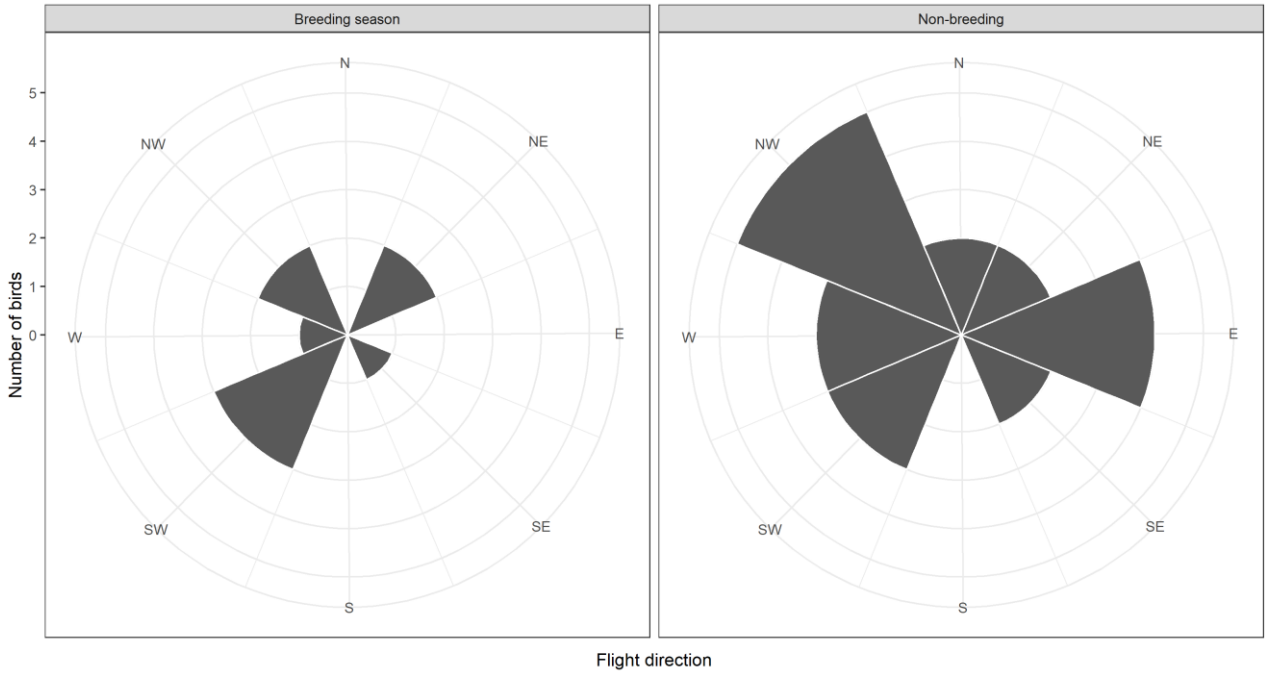


Figure 12.8: Flight direction rose diagrams of great black-backed gulls across different bio-seasons in the Project array area and 4km buffer.

Herring Gull

DAS Data

12.3.23 Herring gull were recorded within the Project the array area in 10 of the 18 months. Raw counts (excluding zero counts) ranged from 1 (several months) to 26 (June 2022), with abundance and density peaking at 172 birds and 0.34 birds/km^2 respectively in June 2022 (Table 12.17).

12.3.24 In the array area plus 2km buffer, raw counts ranged from 1 (several months) to 42 (June 2022), with abundance and density peaking at 274 birds and 0.39 birds/km^2 respectively in April 2022 (Table 12.17).

Herring Gull Overview

12.3.25 The nearest herring gull breeding sites to the Project lie at FFC SPA and on the north Norfolk coast. In recent years, birds have been recorded breeding at several locations, including Blakeney Point (latest count 39 nests in 2020), Holkham (latest count 119 nests in 2018) and Outer Trial Bank (latest count 1,001 nests in 2018) (JNCC, 2022). These sites are located approximately 60km from the Project. The mean maximum foraging range of herring gull is 58.8km (standard deviation = 14.9km) (Woodward *et al*., 2019) and is thus within foraging range of the Project. In addition, none of these breeding locations are part of a designated population and it is not considered that there is any connectivity with other designated breeding populations of herring gull.

12.3.26 It is therefore considered that herring gulls recorded at the Project during breeding season originate from the north Norfolk coast (approximately 1,225 pairs).

12.3.27 Outside the breeding season, impacts on herring gull have been compared to the UK North Sea and Channel BDMPS, consisting of 466,511 individuals during the non-breeding season (September to February) (Furness, 2015).

Table 12.17: Herring gull raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	2	13	0.02	100	2	13	0.02
April 21	1	7	0.01	0	2	14	0.02
May 21	0	0	0.00	0	0	0	0.00
June 21	6	37	0.07	83	6	38	0.05
July 21	2	13	0.02	100	3	19	0.03
August 21	0	0	0.00	0	0	0	0.00
September 21	0	0	0.00	0	0	0	0.00
October 21	0	0	0.00	0	1	7	0.01
November 21	0	0	0.00	0	0	0	0.00
December 21	0	0	0.00	0	0	0	0.00
January 22	2	13	0.02	50	2	13	0.02
February 22	0	0	0.00	0	0	0	0.00
March S01 22	1	6	0.02	0	1	7	0.02
March S02 22	0	0	0.00	0	0	0	0.00
April S01 22	5	30	0.06	60	5	30	0.04
April S02 22	2	12	0.02	50	2	12	0.02
May S01 22	2	12	0.02	100	2	12	0.02
May S02 22	1	7	0.01	100	1	6	0.01
June S01 22	1	6	0.01	0	4	25	0.03
June S02 22	26	172	0.34	12	42	274	0.39
July S01 22	3	18	0.03	100	6	38	0.05
July S02 22	0	0	0.00	0	3	19	0.03
August S01 22	0	0	0.00	0	0	0	0.00
August S02 22	0	1	0.00	0	0	1	0.00

Bio-Season Peak Estimates

12.3.28 Herring gull were present in the Project array area across both bio-seasons. Presence was greatest during the breeding bio-season (April to August), with a peak estimate of 172 birds and peak density of 0.34 birds/km^2 (Table 12.18).

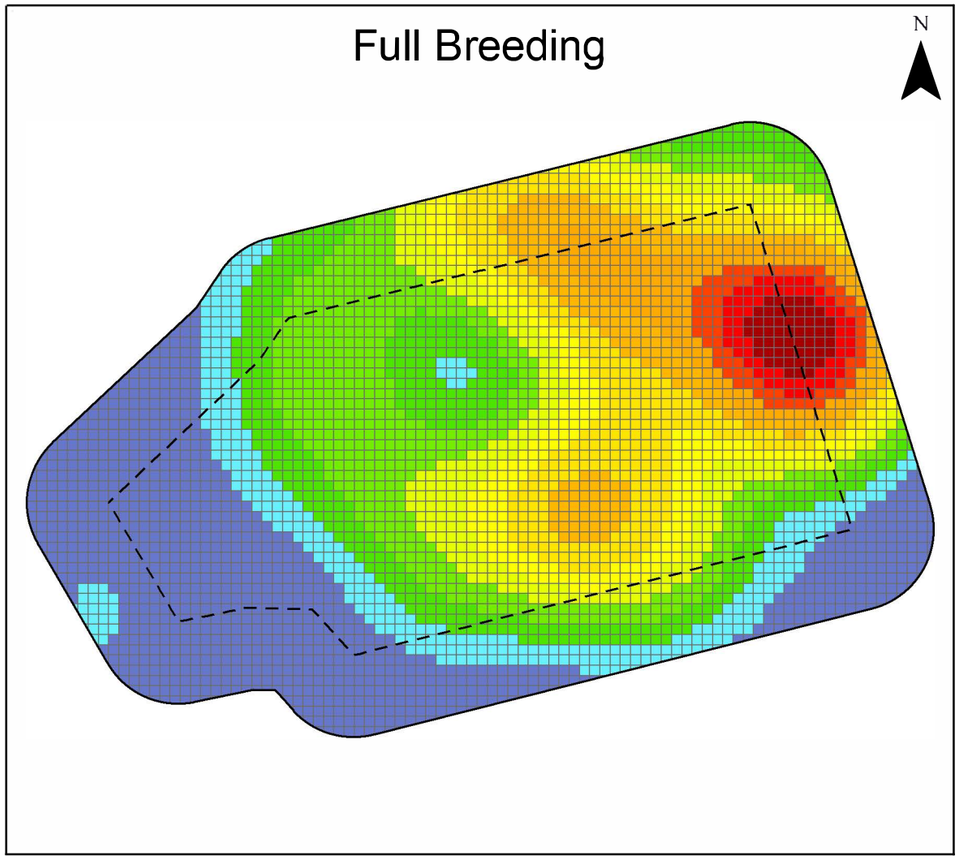
Table 12.18: Herring gull bio-season abundance and density estimates in the Project array area and array area +2km buffer.

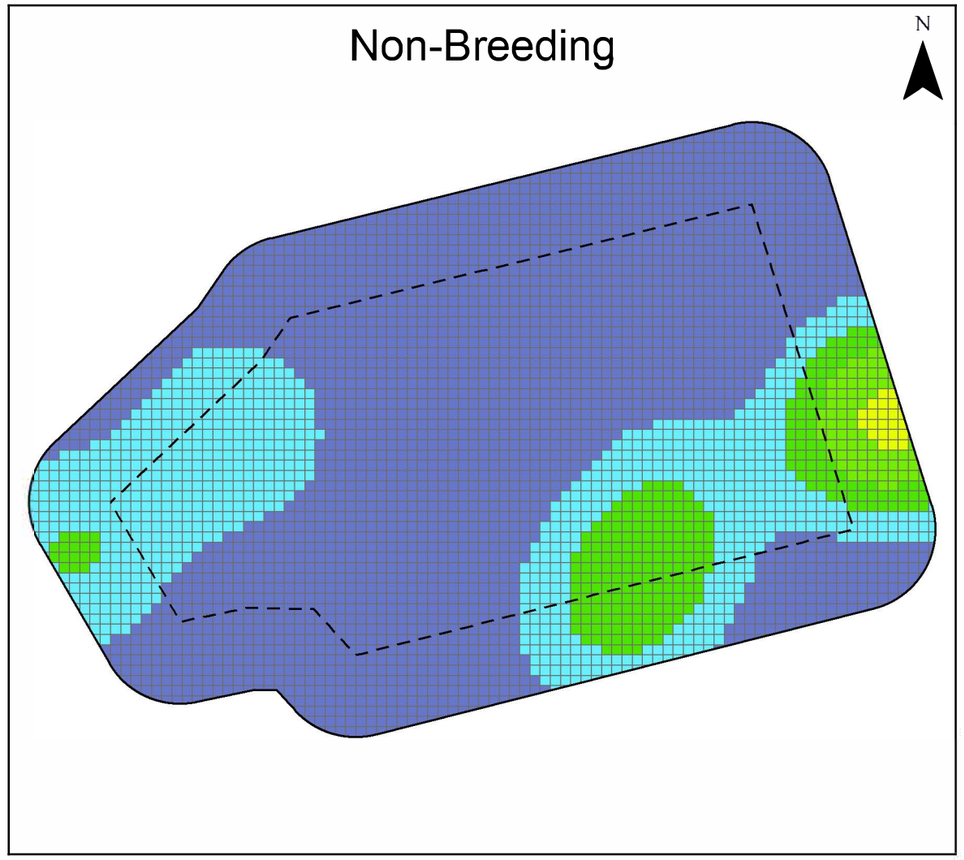
BDMPS Bio-seasons	Months	Bio-season peak abundance in array area (n)	Bio-season peak density estimate in array area (n/km^2)	Bio-season peak abundance within 2km buffer (n)	Bio-season peak density within 2km buffer (n/km^2)
Breeding	Apr - Aug	172	0.34	274	0.39
Non-breeding	Sep - Mar	13	0.02	13	0.02

Spatial Density Distribution and Flight Direction

12.3.29 Herring gull were recorded throughout the survey area, though highest densities appeared to be in the north and centre of the survey area during the breeding season Figure 12.9).

12.3.30 Across the survey period, 43% of birds were recorded flying. In the breeding season there was no clear pattern of flight direction whereas in the non-breeding bio-season, birds were predominantly recorded flying towards the south-east (Figure 12.10).





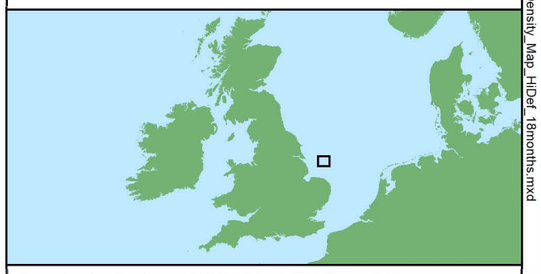
Legend

Array Area

Area Area 4km Buffer

Predicted Herring Gull Density (birds / km^2)

- 0 - 0.047
- 0.048 - 0.094
- 0.095 - 0.140
- 0.141 - 0.187
- 0.188 - 0.234
- 0.235 - 0.281
- 0.282 - 0.327
- 0.328 - 0.374
- 0.375 - 0.421
- 0.422 - 0.468
- 0.469 - 0.514
- 0.515 - 0.561



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Herring Gull within the Project Array Area plus 4km Buffer

Figure 12.9

OUTER DOWSING OFFSHORE WIND

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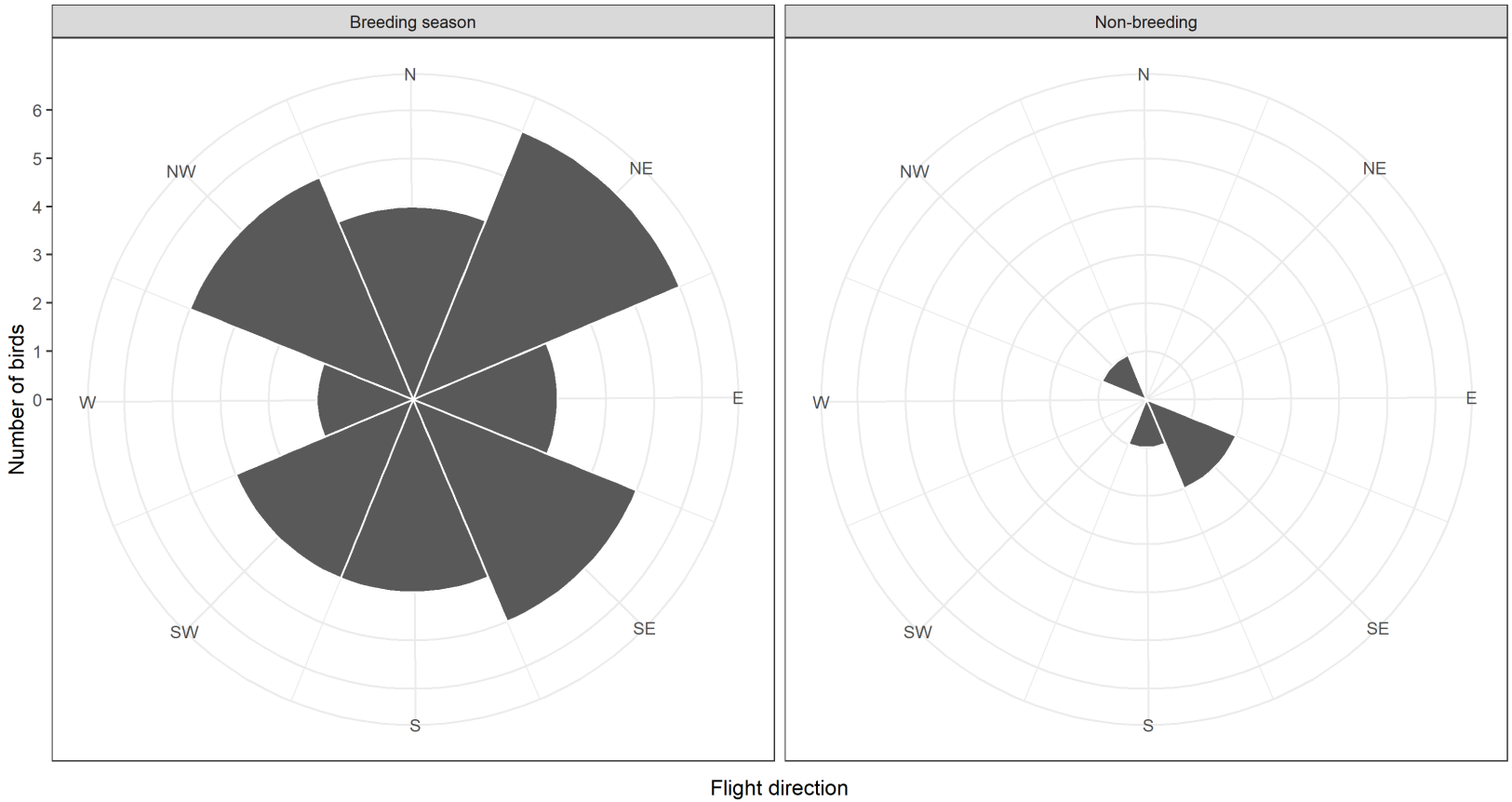


Figure 12.10: Flight direction rose diagrams of herring gulls across different bio-seasons in the Project array area and 4km buffer.

Lesser Black-Backed Gull

DAS Data

12.3.31 Lesser black-backed gull were recorded in the array area in 14 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (March, May, October and November 2021) to 10 birds (August 2022), with abundance and density peaking at 59 birds and 0.12 birds/km^2 respectively in August 2022 (Table 12.19).

12.3.32 In the array area plus 2km buffer, raw counts ranged from 1 (several months) to 12 (August 2022), with abundance and density peaking at 71 birds and 0.10 birds/km^2 respectively in September 2021 (Table 12.19).

Lesser Black-Backed Gull Overview

12.3.33 The nearest lesser black-backed gull breeding sites to the Project are found on the north Norfolk coast with the vast majority found on the Outer Trial Bank (1,294 nests in 2018) (JNCC, 2022). This site is located approximately 90km km from the Project array area, which means it is within the mean maximum foraging range of lesser black-backed gull (127 km, standard deviation 109 km) (Woodward *et al*., 2019).

12.3.34 The nearest SPA that supports breeding lesser black-backed gull as a qualifying feature is the Alde-Ore Estuary SPA. This SPA lies 147km from the Project array area and is beyond the mean maximum foraging range but within the mean maximum foraging range plus one standard deviation. Tracking data collected from breeding adults at this colony suggests that the Project does not fall within the home range of this population (Thaxter *et al*., 2015).

12.3.35 Outside the breeding season, impacts on lesser black-backed gull have been compared to the UK North Sea and Channel BDMPS, consisting of 209,007 individuals during autumn migration (August to December), 39,314 individuals during the winter (November to February) and 197,483 individuals during spring migration (March to April) (Furness, 2015).

Table 12.19: Lesser black-backed gull raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	1	6	0.01	100	1	7	0.01
April 21	4	24	0.05	100	4	25	0.03
May 21	1	6	0.01	100	1	7	0.01
June 21	3	18	0.04	100	3	18	0.03
July 21	3	19	0.04	67	3	19	0.03
August 21	0	0	0.00	0	0	0	0.00
September 21	3	18	0.04	0	6	31	0.04
October 21	1	6	0.01	100	1	7	0.01
November 21	1	6	0.01	100	1	7	0.01
December 21	0	0	0.00	0	0	0	0.00
January 22	0	0	0.00	0	0	0	0.00
February 22	0	0	0.00	0	0	0	0.00
March S01 22	3	12	0.02	67	6	36	0.05
March S02 22	0	0	0.00	0	0	0	0.00
April S01 22	2	12	0.02	100	2	13	0.02
April S02 22	1	6	0.01	100	2	12	0.02
May S01 22	0	0	0.00	0	4	25	0.04
May S02 22	1	6	0.01	100	2	13	0.02
June S01 22	1	7	0.01	0	3	18	0.03
June S02 22	2	12	0.02	50	3	18	0.03
July S01 22	2	13	0.03	100	2	12	0.02
July S02 22	1	6	0.01	100	3	18	0.03
August S01 22	10	59	0.12	90	12	71	0.10

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
August S02 22	1	7	0.01	0	3	19	0.03

Bio-Season Peak Estimates

12.3.36 Lesser black-backed gull were present in the Project array area in consistent numbers across all four bio-seasons. Presence was greatest during the post-breeding migration bio-season (August to October), with a peak estimate of 59 birds and peak density of 0.12 birds/km^2 (Table 12.20).

Table 12.20: Lesser black-backed gull bio-season abundance and density estimates in the Project array area plus 2km buffer.

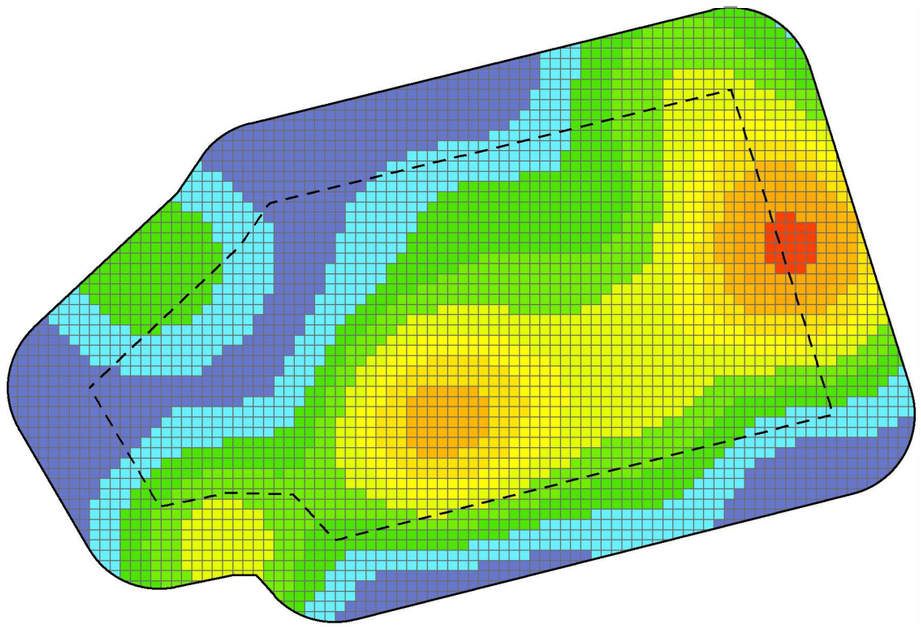
BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Return migration	March - April	24	0.05	25	0.03
Migration-free breeding	May - July	19	0.04	25	0.04
Post-breeding migration	Aug – Oct	59	0.12	71	0.10
Migration-free winter	Nov - Feb	6	0.01	6	0.01

Spatial Density Distribution and Flight Direction

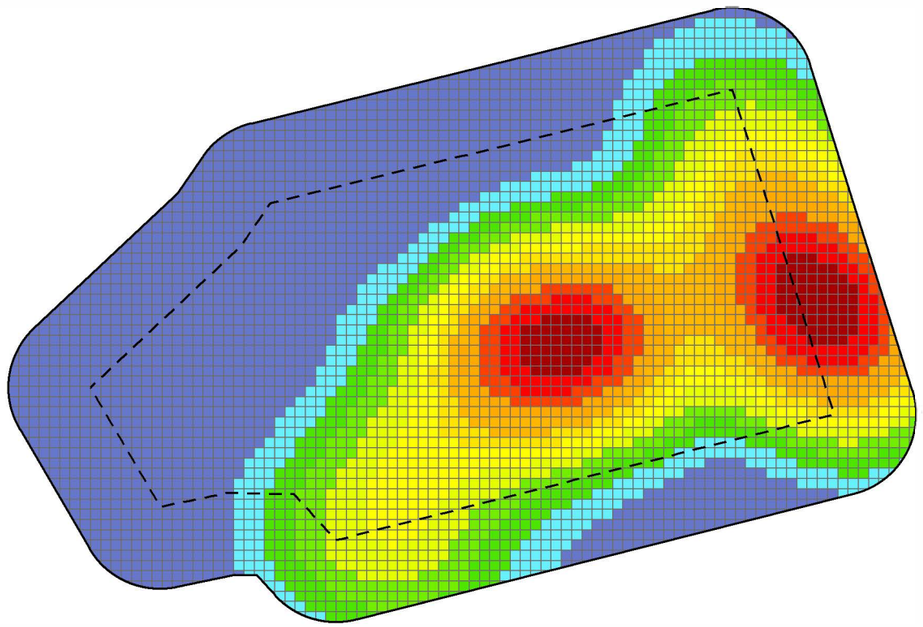
12.3.37 Lesser black-backed gulls were recorded throughout the survey region, with densities in the migration-free breeding and autumn migration bio-seasons being highest towards the east of the survey area (Figure 12.11).

12.3.38 Across the survey period, 78% of birds were recorded flying. In the migration-free breeding season, birds were predominantly flying towards the south, whereas other bio-seasons showed no clear trends (Figure 12.12).

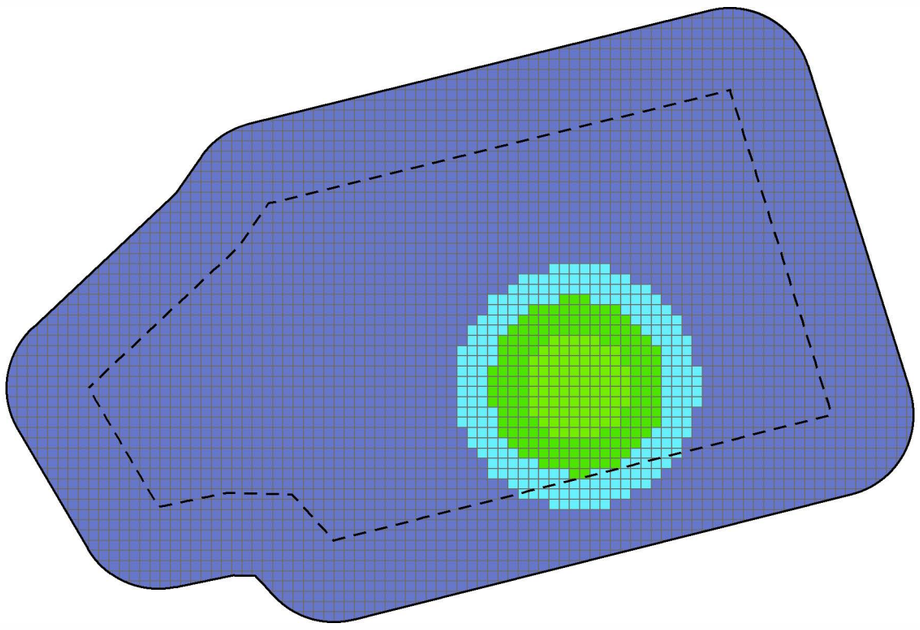
Migration-Free Breeding



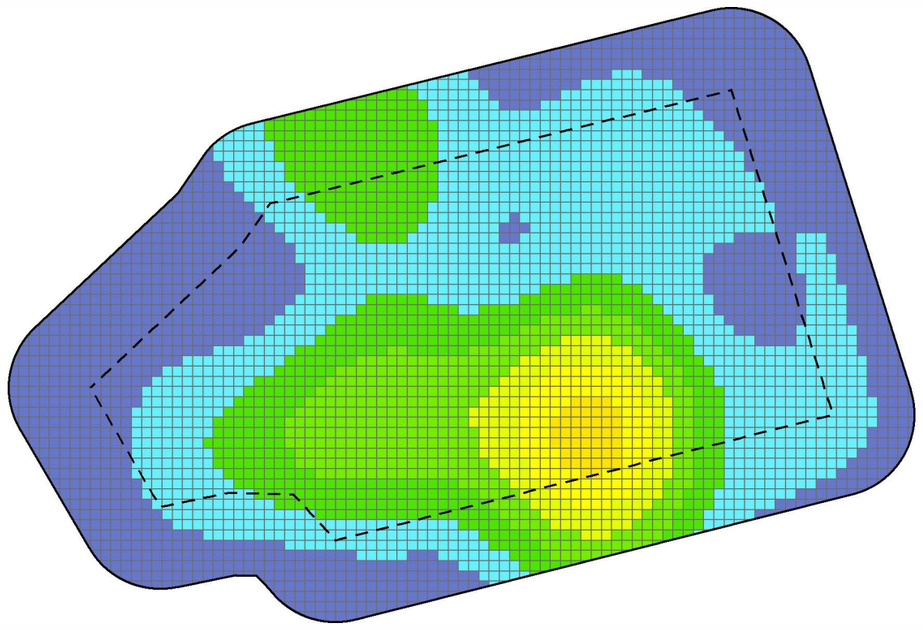
Post-Breeding Migration



Winter



Return Migration

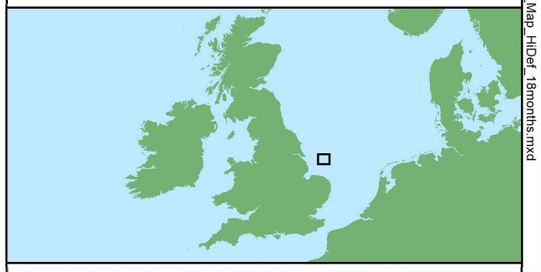


Legend

- Array Area
- Area Area 4km Buffer

Predicted Lesser Black-Backed Gull Density (birds / km^2)

- 0 - 0.021
- 0.022 - 0.042
- 0.043 - 0.063
- 0.064 - 0.084
- 0.085 - 0.105
- 0.106 - 0.126
- 0.127 - 0.147
- 0.148 - 0.168
- 0.169 - 0.189
- 0.19 - 0.21
- 0.211 - 0.231
- 0.232 - 0.252



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Lesser Black-backed Gull within Outer Dowsing Array Area plus 4km Buffer

Figure 12.11

OUTER DOWSING OFFSHORE WIND

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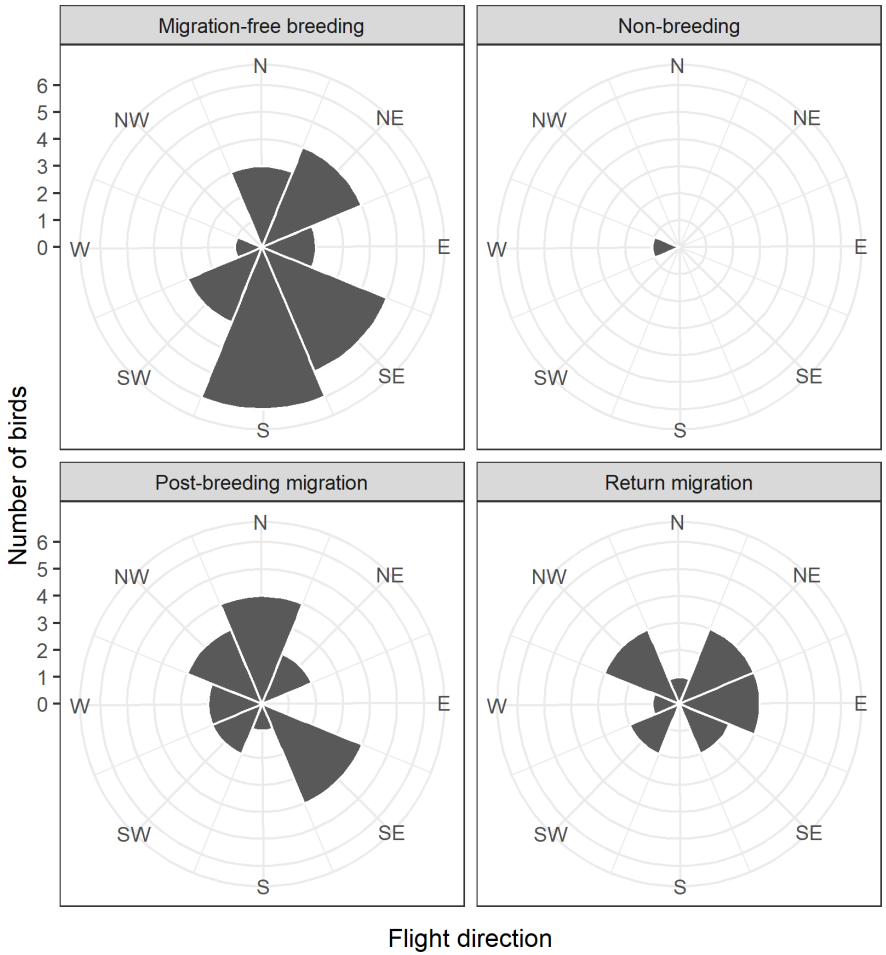


Figure 12.12: Flight direction rose diagrams of lesser black-backed gulls across different bio-seasons in the Project array area and 4km buffer.

Sandwich Tern

DAS Data

12.3.39 Sandwich tern were recorded in the array area in 8 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (April 2021 & July 2022) to 21 (May 2021), with abundance and density peaking at 164 birds and 0.33 birds/km^2 respectively in May 2021 (Table 12.21).

12.3.40 In the array area plus 2km buffer, raw counts ranged from 1 (several months) to 30 (May 2021), with abundance and density peaking at 216 birds and 0.31 birds/km^2 respectively in May 2021 (Table 12.21).

Sandwich Tern Overview

12.3.41 The nearest breeding population of Sandwich terns to ODOW is located within the North Norfolk Coast SPA, of which Sandwich tern is a qualifying feature. Within the boundary of the North Norfolk Coast SPA, Sandwich tern breed at two principal colonies; Blakeney Point and Scolt Head (JNCC, 2022; Perrow et al., 2017). Blakeney Point and Scolt Head are approximately 70km and 77km from the Project array, respectively, and therefore they both lie outside with the mean maximum foraging range and the mean maximum foraging range plus one standard deviation of Sandwich tern, 34.3km (±23.2km) from the Project array area.

12.3.42 The most recent breeding numbers for Sandwich tern in 2020 were 4,160 nests at Scolt Head and 2,425 nests at Blakeney Point with a total number of breeding adults within the North Norfolk Coast SPA found to be 14,588 based on the most recent 2020-2022 colony count (JNCC, 2022).

12.3.43 Outside the breeding season, the predicted mortality of Sandwich terns due to impacts from the Project has been compared to the appropriate BDMPS for the season in question. The relevant background population is considered to be the UK North Sea and Channel BDMPS, consisting of 38,051 individuals during autumn migration (July to September), and spring migration (March to May) (Furness, 2015).

Table 12.21: Sandwich tern raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	0	0	0.00	0	0	0	0.00
April 21	1	6	0.01	100	1	6	0.01
May 21	21	164	0.33	95	30	216	0.31
June 21	3	19	0.04	100	3	18	0.03
July 21	0	0	0.00	0	1	0	0.00
August 21	0	0	0.00	0	0	0	0.00
September 21	2	14	0.03	100	3	19	0.03
October 21	0	0	0.00	0	0	0	0.00
November 21	0	0	0.00	0	0	0	0.00
December 21	0	0	0.00	0	0	0	0.00
January 22	0	0	0.00	0	0	0	0.00
February 22	0	0	0.00	0	0	0	0.00
March S01 22	0	0	0.00	0	0	0	0.00
March S02 22	0	0	0.00	0	0	0	0.00
April S01 22	0	0	0.00	0	0	0	0.00
April S02 22	17	105	0.21	100	29	185	0.26
May S01 22	16	102	0.2	88	24	163	0.23
May S02 22	12	72	0.14	100	15	92	0.13
June S01 22	14	119	0.24	100	16	137	0.20
June S02 22	8	47	0.09	100	10	60	0.08
July S01 22	0	0	0.00	0	0	0	0.00
July S02 22	1	6	0.01	100	1	6	0.01
August S01 22	0	0	0.00	0	0	0	0.00
August S02 22	0	0	0.00	0	0	0	0.00

Bio-Season Peak Estimates

12.3.44 Sandwich tern were present in the Project array area across all three bio-seasons. Presence was greatest during the return migration bio-season (March to May), with a peak estimate of 164 birds and peak density of 0.33 birds/km^2 (Table 12.22).

Table 12.22: Sandwich tern bio-season abundance and density estimates in the Project array area and array area plus 2km buffer.

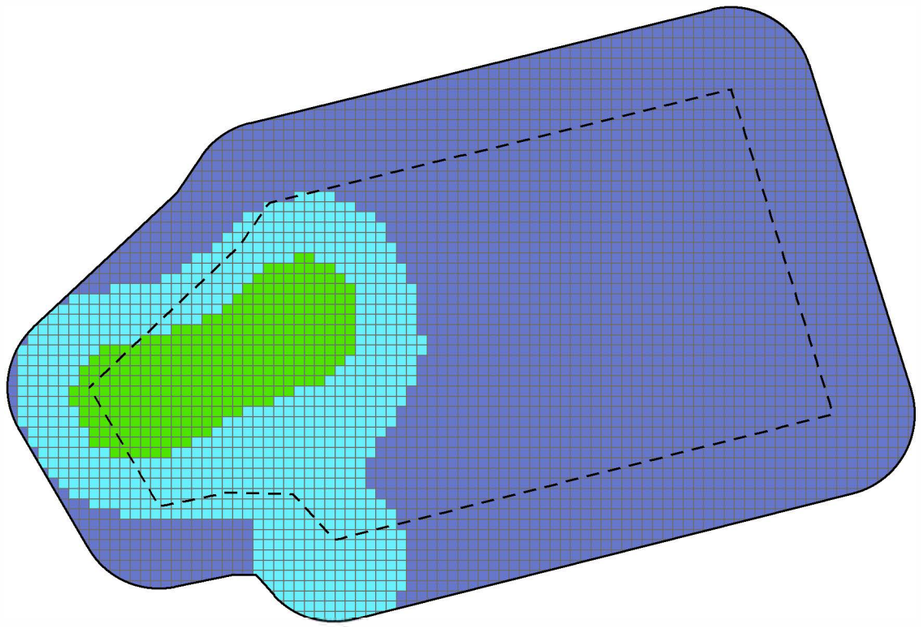
BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Return migration	Mar - May	164	0.33	216	0.31
Migration-free breeding	June	119	0.24	137	0.20
Post-breeding migration	July - Sep	14	0.03	19	0.03

Spatial Density Distribution and Flight Direction

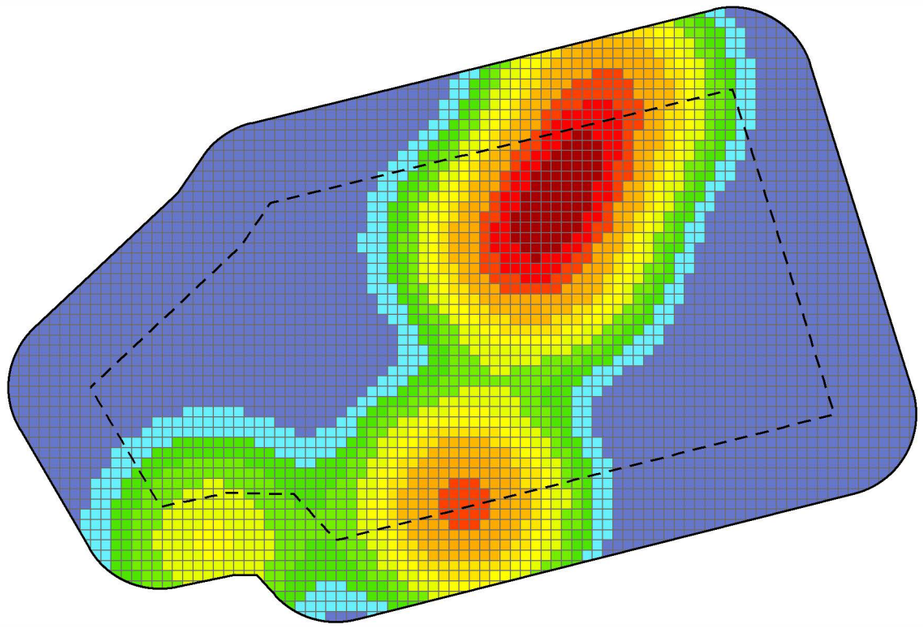
12.3.45 Sandwich terns were distributed throughout the survey area, though during the migration-free breeding and spring migration bio-seasons, densities were highest in the south-west of the region (Figure 12.13).

12.3.46 Across the survey period, 97% of birds were recorded flying. Across the breeding and post-breeding migration bio-seasons, only low numbers of birds were recorded flying (Figure 12.14). Larger numbers were recorded in the return migration bio-season, with birds predominantly flying towards the south and south-east.

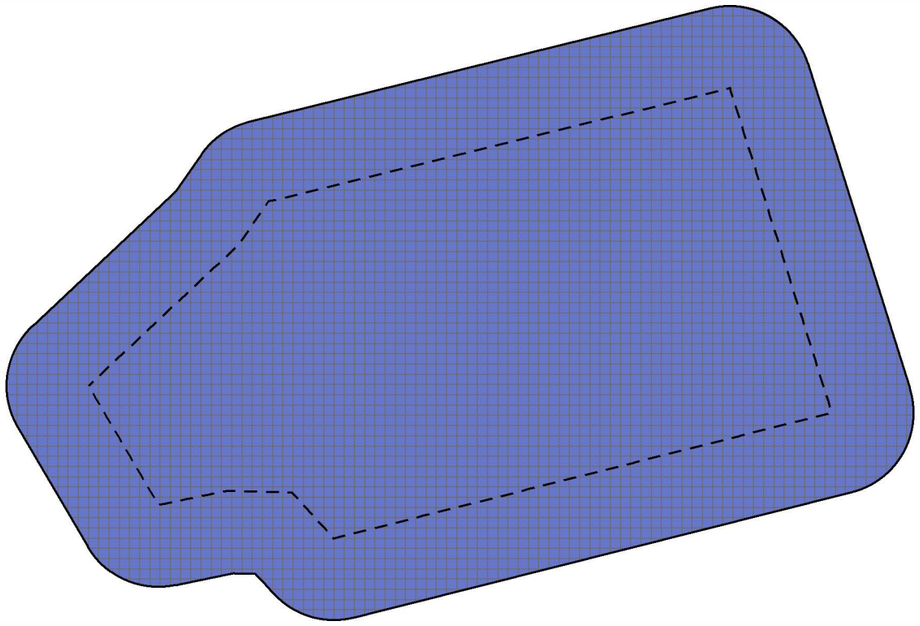
Migration-Free Breeding



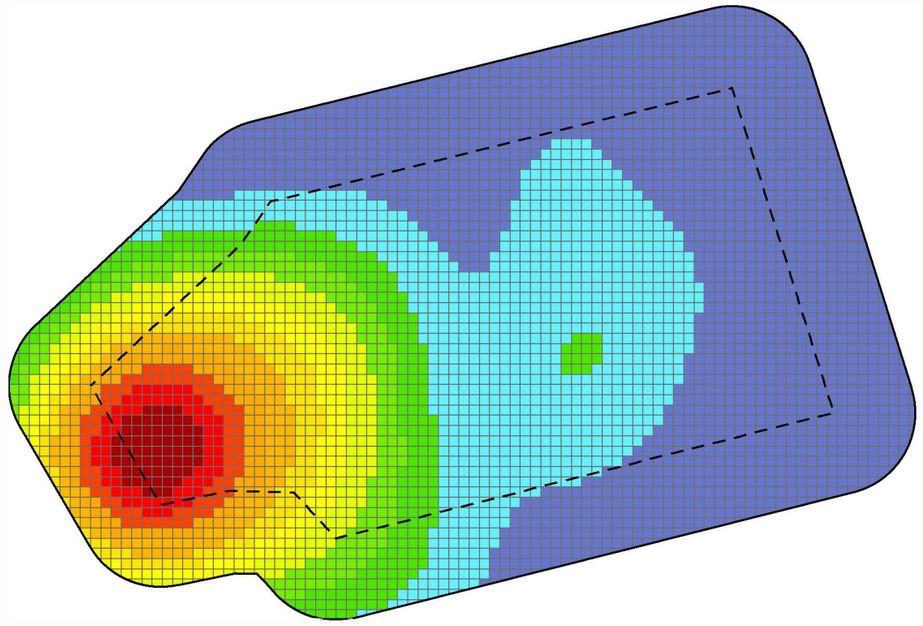
Post-Breeding Migration



Winter



Return Migration

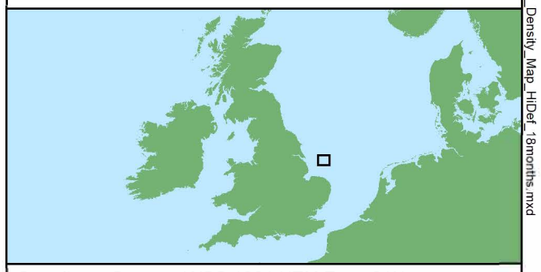


Legend

- Array Area
- Area Area 4km Buffer

Predicted Sandwich Tern Density (birds / km^2)

- 0 - 0.092
- 0.093 - 0.184
- 0.185 - 0.276
- 0.277 - 0.368
- 0.369 - 0.460
- 0.461 - 0.552
- 0.553 - 0.644
- 0.645 - 0.736
- 0.737 - 0.828
- 0.829 - 0.920
- 0.921 - 1.012
- 1.013 - 1.104



Coordinate System: WGS 1984 UTM Zone 31N

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Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Sandwich Tern within the Project Array Area plus 4km Buffer

Figure 12.13

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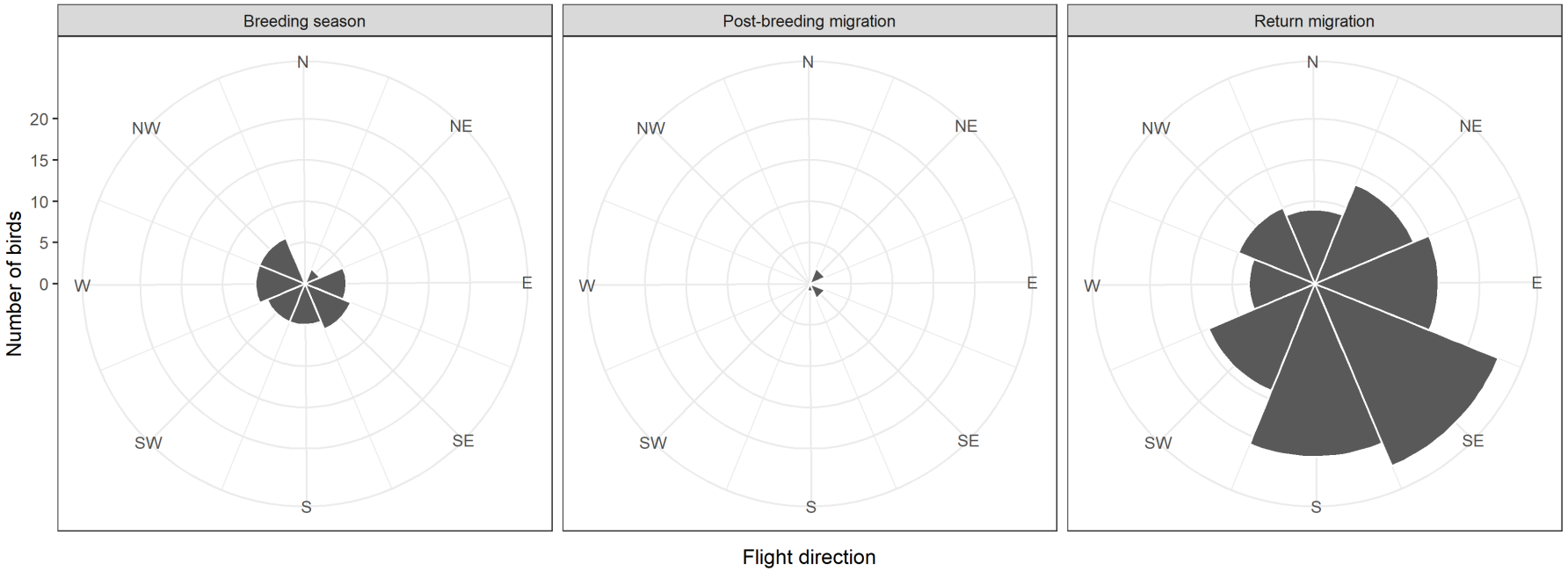


Figure 12.14: Flight direction rose diagrams of sandwich terns across different bio-seasons in the Project array area and 4km buffer.

Common Tern

DAS Data

12.3.47 Common terns were recorded in the array area in 8 out of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (June 2022) to 189 (September 2021), with abundance and density peaking at 1,925 and 3.85 respectively in September 2021 (Table 12.23).

12.3.48 In the array area plus 2km buffer, raw counts ranged from 1 (June 2022) to 189 (September 2021), with abundance and density peaking at 1,295 and 3.85 respectively in September 2021 (Table 12.23).

Common Tern Overview

12.3.49 The mean maximum foraging range (±SD) of common tern is 18km (±8.9km), and the maximum recorded foraging range is 30km (Woodward et al., 2019). The nearest colonies are in the North Norfolk Coast SPA, at least 65km from ODOW and therefore out with the core foraging range of the colonies. The SPA breeding population is 232 pairs (JNCC, 2022).

12.3.50 Outside the breeding season, impacts on common tern are to be assessed relative to the UK North Sea and Channel BDMPS, consisting of 144,911 individuals during autumn migration (late July to early September), and spring migration (April to May) (Furness, 2015).

Table 12.23: Common tern raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	0	0	0.00	0	0	0	0
April 21	0	0	0.00	0	0	0	0
May 21	11	96	0.19	64	16	136	0.19
June 21	2	15	0.03	100	2	18	0.03
July 21	0	0	0.00	0	0	0	0
August 21	0	63	0.12	0	4	132	0.19
September 21	189	1,925	3.85	85	264	2,871	4.10
October 21	0	0	0.00	0	0	0	0
November 21	0	0	0.00	0	0	0	0
December 21	0	0	0.00	0	0	0	0
January 22	0	0	0.00	0	0	0	0
February 22	0	0	0.00	0	0	0	0
March S01 22	0	0	0.00	0	0	0	0
March S02 22	0	0	0.00	0	0	0	0
April S01 22	0	0	0.00	0	0	0	0
April S02 22	8	96	0.19	100	9	109	0.16
May S01 22	0	0	0.00	0	0	0	0
May S02 22	10	69	0.14	100	20	146	0.21
June S01 22	1	23	0.05	100	1	31	0.04
June S02 22	1	6	0.01	100	1	7	0.01
July S01 22	0	0	0.00	0	0	0	0
July S02 22	2	12	0.02	100	2	18	0.03
August S01 22	6	81	0.16	100	12	126	0.18
August S02 22	4	35	0.07	100	9	66	0.09

Bio-season peak estimates

12.3.51 Common tern were present in the Project array area in three bio-seasons, the return migration, migration-free breeding, and post-breeding migration bio-seasons. Presence in the array area was greatest during the post-breeding migration bio-season (July to September), with a peak estimate of 1,925 birds and peak density of 3.85 birds/km^2 (Table 12.24).

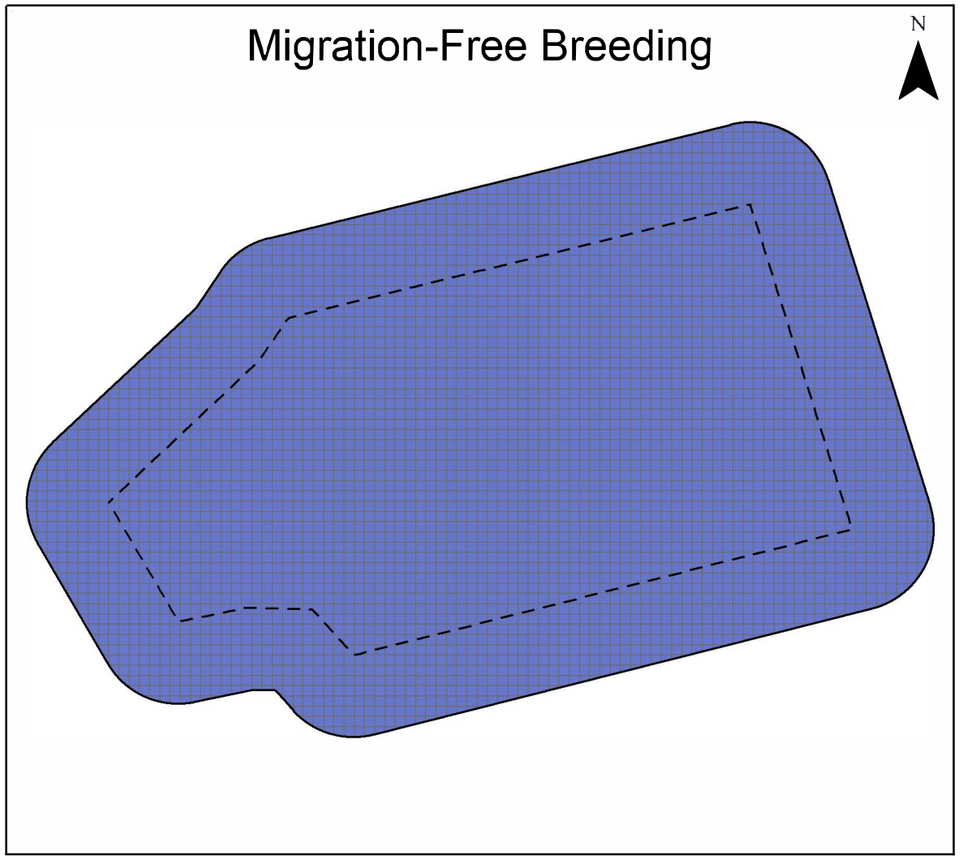
Table 12.24: Common tern bio-season abundance and density estimates in the Project array area.

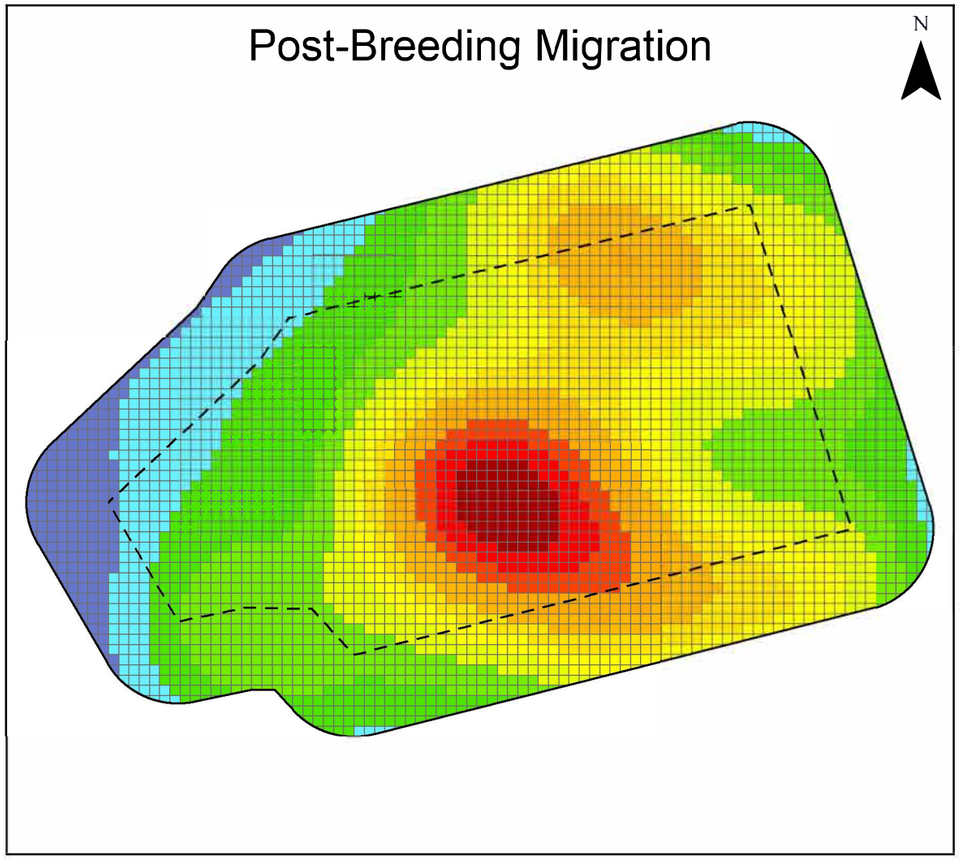
BDMPS Bio-seasons	Months	Bio-season peak abundance in array area (n)	Bio-season peak density in array area (n/km^2)
Return Migration	Apr-May	96	0.19
Migration-free breeding	Jun-Jul	23	0.05
Post-breeding migration	July-Sep	1,925	3.85
Migration-free winter	Oct-Mar	0	0.00

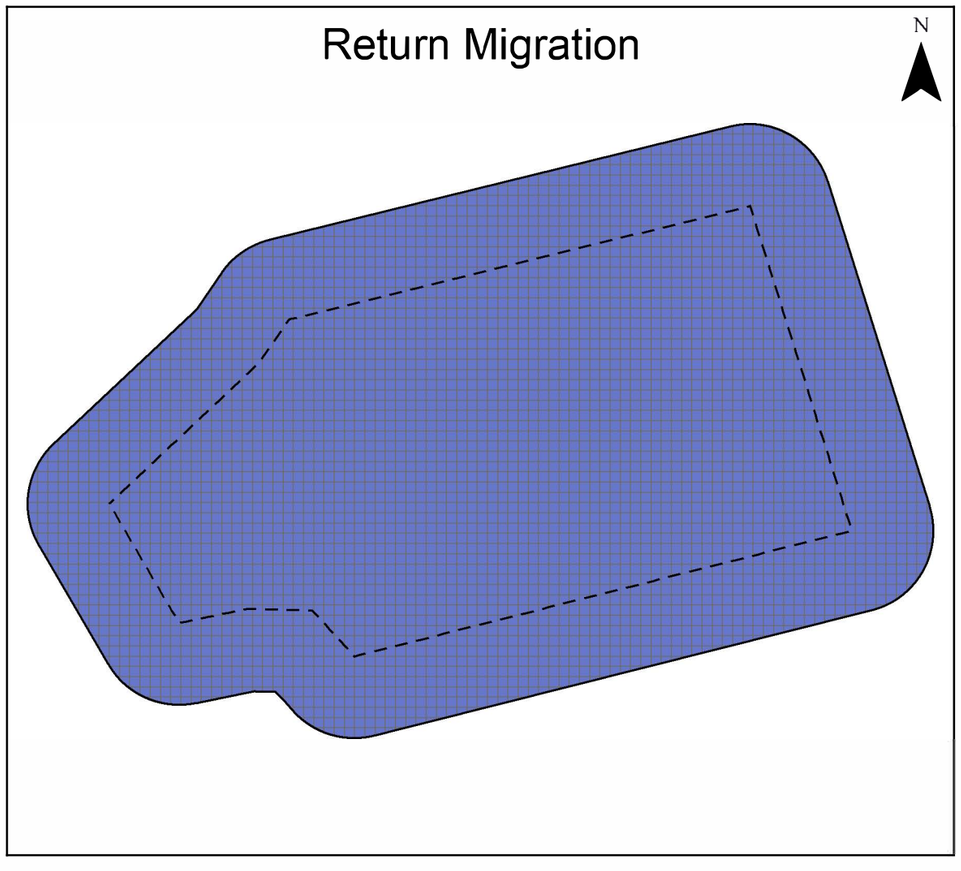
Spatial Density Distribution and Flight Direction

12.3.52 Common terns were recorded in lower numbers compared to other species, though recorded birds were recorded throughout the survey area (Figure 12.15)

12.3.53 Across the survey period, 91% of birds were recorded flying. Across the migration-free breeding bio-season, no birds were recorded flying, and only low numbers in the return migration bio-season. However, in the post-breeding migration bio-season, birds were recorded flying in all directions, with greatest numbers recorded flying towards the north-west and south-west (Figure 12.16).





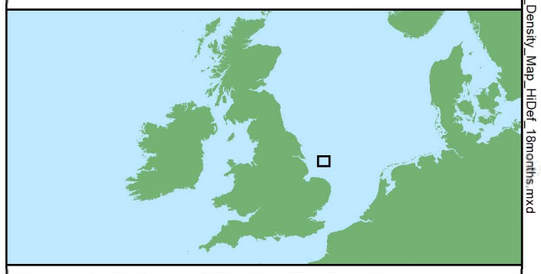


Legend

- Array Area
- Area Area 4km Buffer

Predicted Common Tern Density (birds / km^2)

- 0 - 0.49
- 0.50 - 0.96
- 0.97 - 1.42
- 1.43 - 1.89
- 1.90 - 2.35
- 2.36 - 2.82
- 2.83 - 3.29
- 3.30 - 3.75
- 3.76 - 4.22
- 4.23 - 4.68
- 4.69 - 5.15
- 5.16 - 5.62



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

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Bio-season Spatial Density Distribution of Common Tern within the Project Array Area plus 4km Buffer

Figure 12.15

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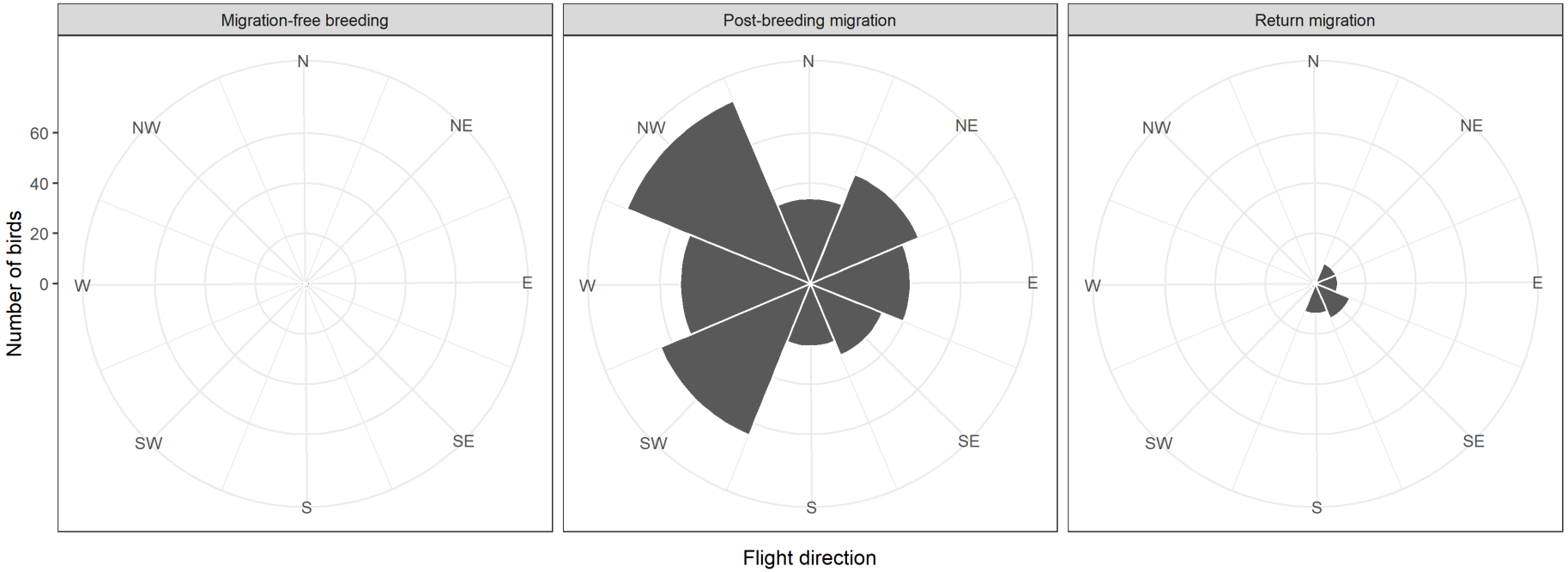


Figure 12.16: Flight direction rose diagrams of common terns across different bio-seasons in the Project array area and 4km buffer.

Guillemot

DAS Data

12.3.54 Guillemot were recorded in the array area in all 18 months within the Project array area. Raw counts ranged from 59 (January 2022) to 2,381 (April 2021), with abundance and density peaking at 18,697 birds and 37.40 birds/km^2 respectively in April 2021 (Table 12.25).

12.3.55 In the array area plus 2km buffer, raw counts ranged from 71 (January 2022) to 3,652 (August 2022), with abundance and density peaking at 28,373 birds and 40.68 birds/km^2 respectively in August 2022 (Table 12.25).

Guillemot Overview

12.3.56 The mean maximum foraging range of breeding adult guillemots is 73.2km, standard deviation 80.5km, and is out with the range of the Project, though within the mean maximum foraging range plus one standard deviation (Woodward *et al.*, 2019). Based on the existing information regarding this species, its foraging range, and at sea distribution, it is concluded that there is connectivity between the Project during the breeding season with the nearest breeding population of the FFC SPA (Figure 12.17). The UK North Sea and Channel BDMPS is considered to be the relevant background population for guillemot during the non-breeding season (Furness, 2015), which consists of 1,617,306 birds.

Table 12.25: Guillemot raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	547	4,854	9.70	5	824	7,127	10.18
April 21	2,381	18,697	37.40	3	3,154	25,484	36.40
May 21	410	3,347	6.70	1	653	5,329	7.62
June 21	83	734	1.48	4	142	1,187	1.70
July 21	718	5,730	11.46	2	993	8,118	11.59
August 21	1,336	11,167	22.34	0	2,042	16,467	23.52
September 21	1,695	14,349	28.70	0	2,661	22,248	31.77
October 21	542	4,529	9.05	5	774	6,469	9.23
November 21	554	4,554	9.10	2	764	6,393	9.14
December 21	285	2,356	4.69	6	375	3,186	4.56
January 22	59	538	1.08	3	71	655	0.94
February 22	446	3,568	7.13	7	573	4,614	6.59
March S01 22	741	5,810	11.67	4	895	7,312	10.49
March S02 22	753	6,383	12.82	6	1,015	8,666	12.42
April S01 22	2,365	18,055	36.27	13	3,625	28,579	40.98
April S02 22	1,091	8,463	17.00	7	1,650	13,144	18.84
May S01 22	1,090	8,705	17.48	1	1,690	13,806	19.80
May S02 22	324	2,659	5.34	2	570	4,709	6.74
June S01 22	174	1,285	2.59	3	361	2,886	4.14
June S02 22	440	3,468	6.97	1	615	4,854	6.96
July S01 22	232	1,734	3.49	2	362	2,933	4.20
July S02 22	564	4,560	9.16	1	1,214	10,311	14.79
August S01 22	1,320	10,624	21.34	0	3,652	28,373	40.68
August S02 22	278	2,201	4.42	0	451	3,294	4.73

Bio-Season Peak Estimates

12.3.57 Guillemot were present in the Project array area consistently across both bio-seasons. Presence in the array area was greatest during the breeding bio-season (March to July), with a peak estimate of 18,697 birds and peak density of 37.4 birds/km^2 (Table 12.26).

12.3.58 In the array area plus 2km buffer, guillemot numbers were similarly greatest during the non-breeding bio-season, with a peak abundance of 28,373 birds and peak density of 40.68 birds/km^2 (Table 12.26).

Table 12.26: Guillemot bio-season abundance and density estimates in the Project array area plus 2km buffer.

BDMPS Bio-seasons	Months	Bio-season peak abundance in array area (n)	Bio-season peak density estimate in array area (n/km^2)	Bio-season peak abundance within 2km buffer (n)	Bio-season peak density within 2km buffer (n/km^2)
Breeding	Mar-Jul	18,697	37.40	25,484	36.40
Non-breeding	Aug-Feb	14,349	28.70	28,373	40.68

Spatial Density Distribution and Flight Direction

12.3.59 Guillemot were recorded throughout the survey area. During the breeding season, densities were spread relatively evenly, though during the non-breeding season, densities were highest in the north of the survey area (Figure 12.18). Further analysis of the data in the non-breeding season showed this was predominantly driven by trends during post-natal dispersion (Figure 12.19).

12.3.60 Across both bio-seasons, birds were recorded during every survey. Across the survey period, only 3% were recorded flying. Notably, in the breeding season the largest number were recorded flying towards the north and north-west, whereas in the non-breeding bio-season, birds appeared to be predominantly flying in southerly directions suggesting dispersal from the breeding area or food supply moving south in winter (Figure 12.20).

Foraging/Usage Hotspots

12.3.61 The FFC SPA is the closest SPA to the Project array area and using species distribution models and hotspot mapping (Cleasby *et al.*, 2020) hotspots were identified to the north of the OWF footprint (Figure 12.17) using Getis-Ord hotspot analysis (Cleasby *et al.*, 2020). However, the Project array is clearly beyond the core foraging range from FFC SPA.

250000 300000 350000 400000 450000 500000

6050000 6000000 5950000 5900000 5850000 5800000

N

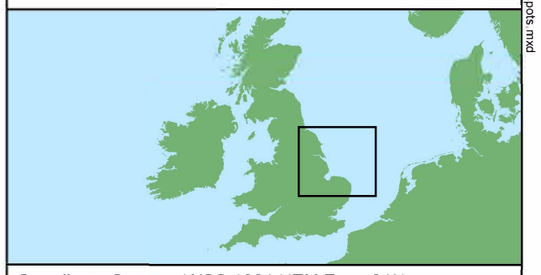
Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- 4km Buffer from Array Area

Guillemot Hotspots (Cleasby *et al.*, 2020)

- Maximum Curvature
- Statistically Significant Getis-Ord hotspot
- Top 5% Getis-Ord hotspot
- Top 1% Getis-Ord hotspot

Hotspots identified at the UK-scale for Common Guillemots using Getis-Ord hotspot analysis with a neighbourhood size of d = 9 km based on FPT analysis or Maximum Curvature.



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Foraging Hotspots of Guillemot Colony from FFC SPA (Cleasby *et al.*, 2020)

Figure 12.17

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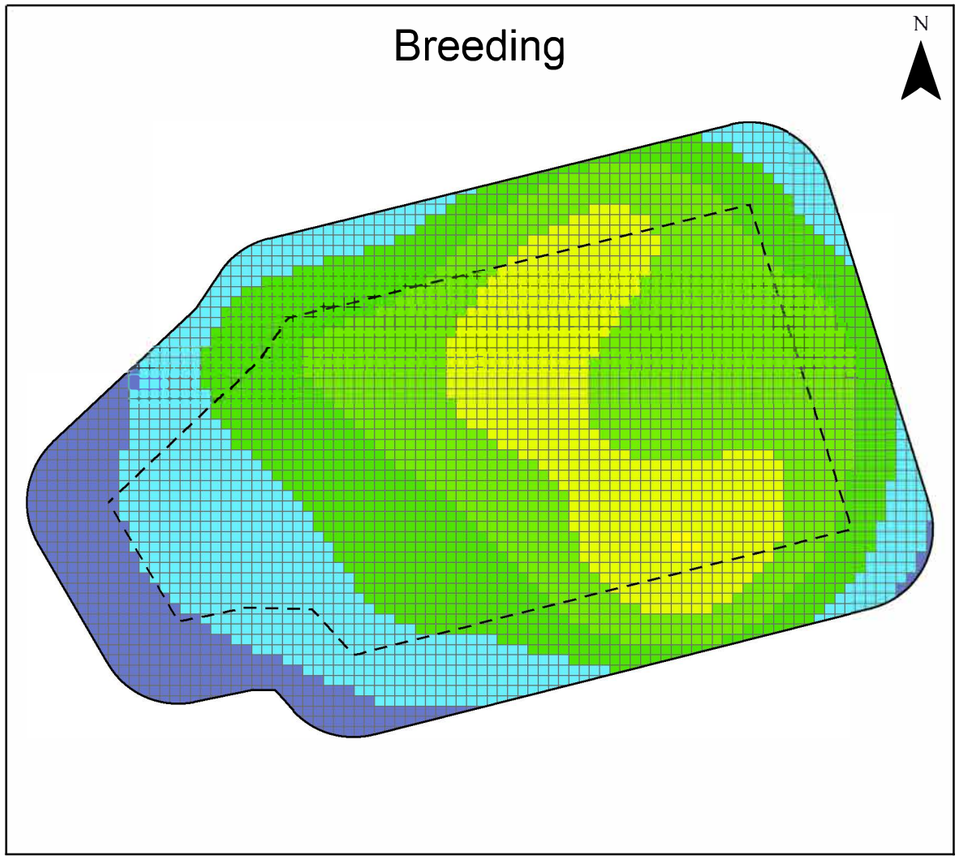
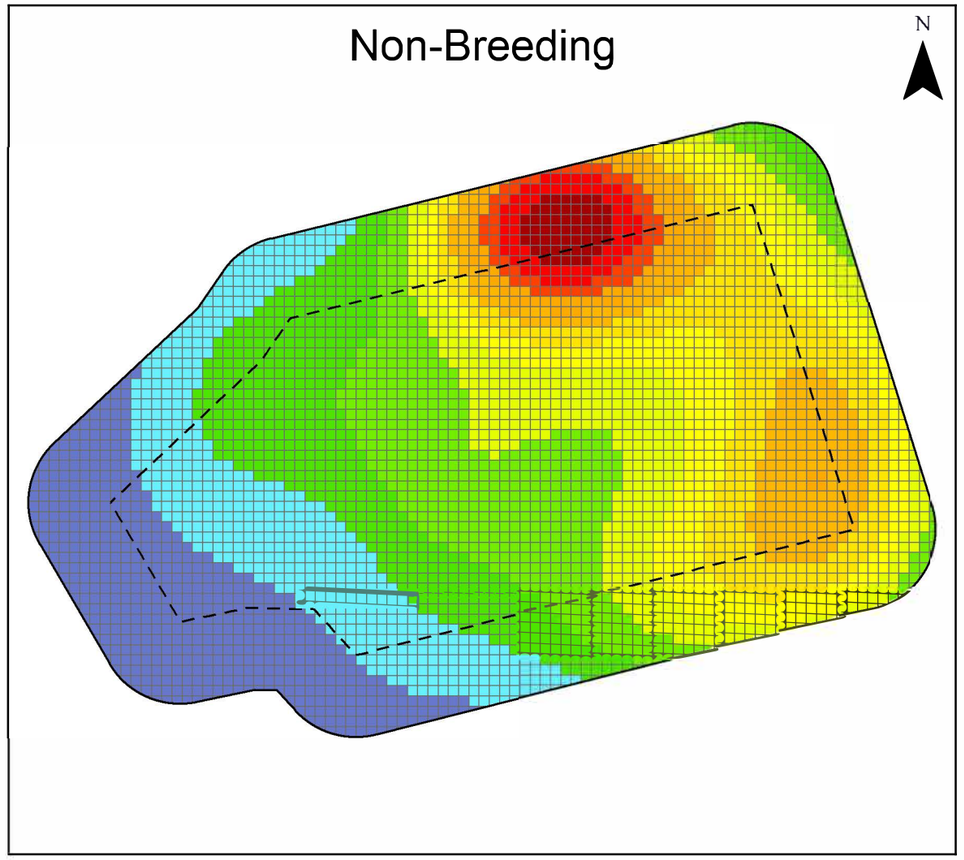


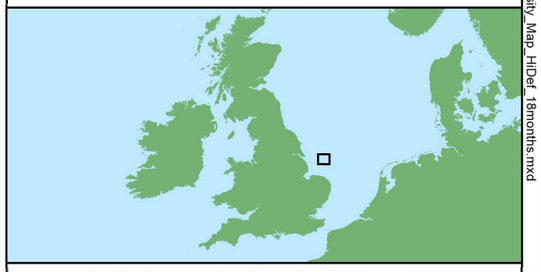


Legend

- Array Area
- Area Area 4km Buffer

Predicted Guillemot Density (birds / km^2)

- 0 - 18.5
- 18.6 - 34.2
- 34.3 - 49.8
- 49.9 - 65.4
- 65.5 - 81.1
- 81.2 - 96.7
- 96.8 - 112.3
- 112.4 - 128.0
- 128.1 - 143.6
- 143.7 - 159.2
- 159.3 - 174.9
- 175.0 - 190.5



Coordinate System: WGS 1984 UTM Zone 31N

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Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Guillemot within the Project Area plus 4km Buffer

Figure 12.18

OUTER DOWSING OFFSHORE WIND

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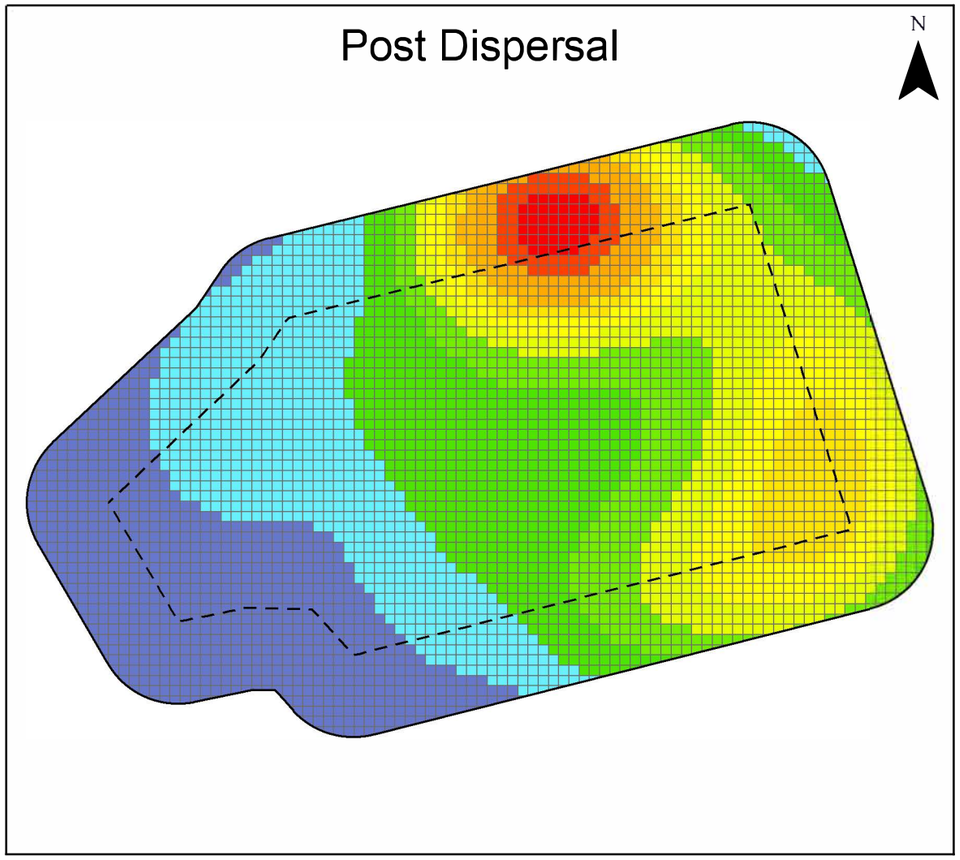
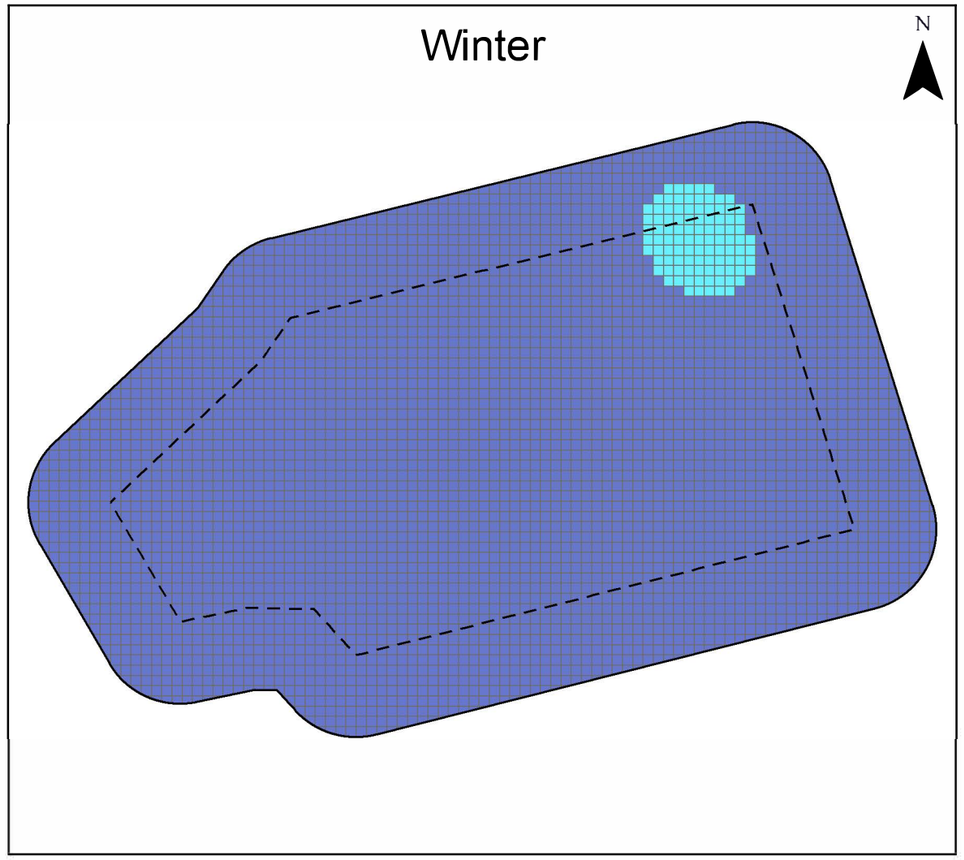
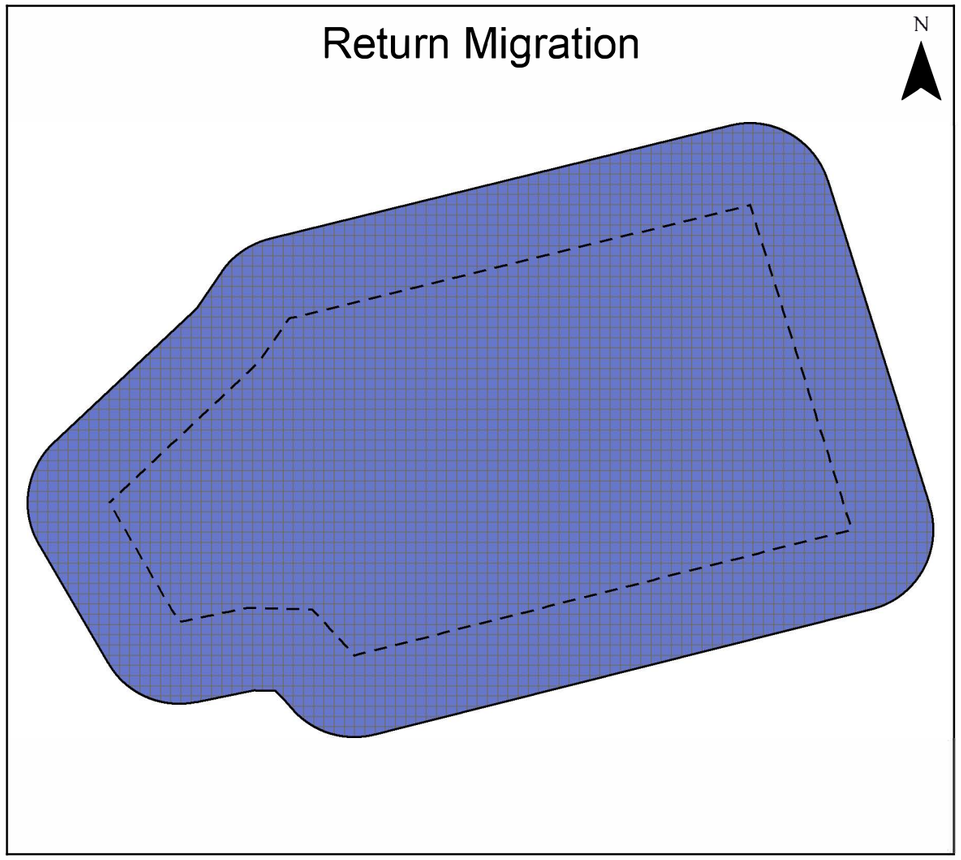






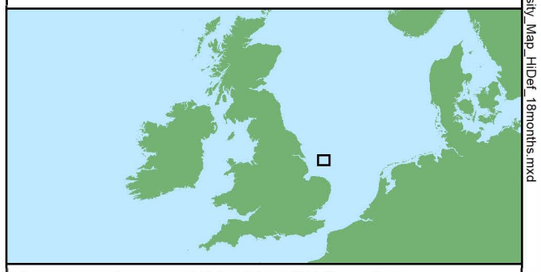
Legend

Array Area

Area Area 4km Buffer

Predicted Guillemot Density (birds / km^2)

- 0 - 18.5
- 18.6 - 34.2
- 34.3 - 49.8
- 49.9 - 65.4
- 65.5 - 81.1
- 81.2 - 96.7
- 96.8 - 112.3
- 112.4 - 128.0
- 128.1 - 143.6
- 143.7 - 159.2
- 159.3 - 174.9
- 175.0 - 190.5



Coordinate System: WGS 1984 UTM Zone 31N

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Scale: 1:300,000

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Non-breeding Bio-season Spatial Density Distribution of Common Guillemot within the Project Array Area plus 4km Buffer

Figure 12.19

OUTER DOWSING OFFSHORE WIND

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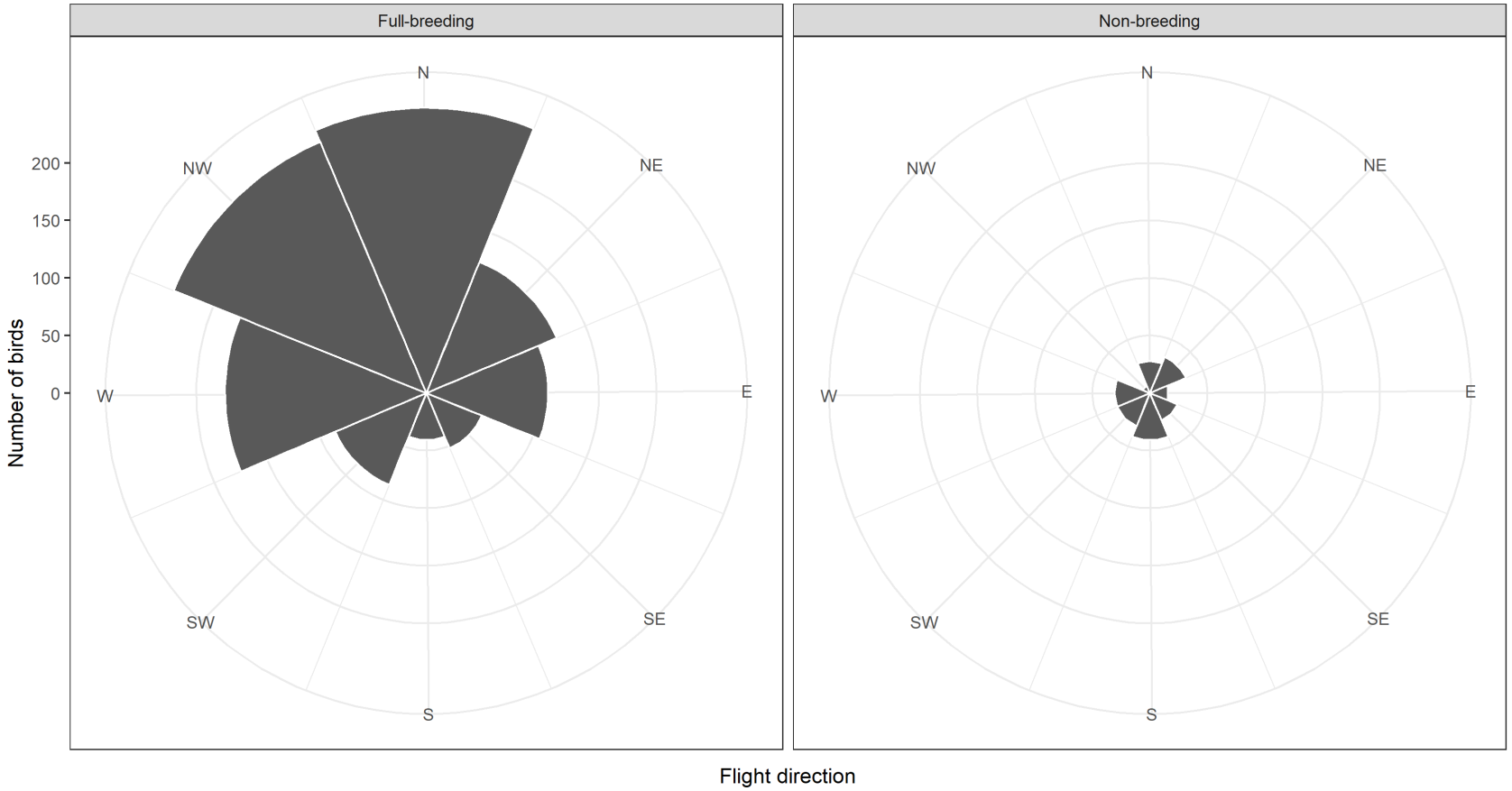


Figure 12.20: Flight direction rose diagrams of guillemots across different bio-seasons in the Project array area and 4km buffer.

Razorbill

DAS Data

12.3.62 Razorbill were recorded in the array area in all 18 months within the Project array area. Raw counts ranged from 16 (June 2021) to 854 (April 2021), with abundance and density peaking at 6,256 and 12.51 respectively in March 2021 (Table 12.27).

12.3.63 In the array area plus 2km buffer, raw counts ranged from 21 (June 2022) to 1,043 (April 2021), with abundance and density peaking at 7,951 and 11.35 respectively in April 2021 (Table 12.27).

Table 12.27: Razorbill raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	418	3,482	6.97	4	533	4,518	6.45
April 21	854	6,256	12.51	3	1,043	7,951	11.35
May 21	39	347	0.70	8	59	503	0.72
June 21	16	167	0.33	12	21	225	0.32
July 21	241	1,884	3.76	3	334	2,692	3.85
August 21	173	1,402	2.80	0	333	2,339	3.34
September 21	153	1,151	2.30	0	189	1,500	2.14
October 21	91	703	1.41	18	110	892	1.27
November 21	222	1,795	3.59	2	313	2,570	3.68
December 21	190	1,645	3.29	0	244	2,201	3.14
January 22	51	456	0.92	0	61	537	0.77
February 22	446	3,858	7.71	1	697	5,229	7.47
March S01 22	296	2.388	4.70	4	419	3,270	4.68
March S02 22	122	1,066	2.14	1	170	1,409	2.02
April S01 22	191	1,405	2.82	22	273	2,078	2.98
April S02 22	113	835	1.68	18	211	1,546	2.22
May S01 22	214	1,631	3.27	5	334	2,549	3.65
May S02 22	31	260	0.53	0	50	427	0.61
June S01 22	19	155	0.30	5	55	414	0.60
June S02 22	28	207	0.42	0	42	313	0.45
July S01 22	41	294	0.58	5	59	449	0.64
July S02 22	234	1,812	3.65	1	508	4,301	6.17
August S01 22	28	199	0.40	0	41	306	0.44
August S02 22	31	221	0.44	0	60	427	0.61

Bio-Season Peak Estimates

12.3.64 Razorbill were present in the Project array area across all four bio-seasons. Presence in the Project array area was greatest during the migration-free breeding bio-season (April to July), with a peak estimate of 6,256 birds and peak density of 12.51 birds/km^2 (Table 12.28).

12.3.65 In the array area plus 2km buffer, razorbill numbers were similarly greatest during the migration-free breeding bio-season, with a peak abundance of 7,951 and peak density of 11.35 (Table 12.28).

Table 12.28: Razorbill bio-season abundance and density estimates in the Project array area plus 2km buffer.

BDMPS Bio-seasons	Months	Array area		Array + 2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Return migration	Jan-Mar	3,858	7.71	5,229	7.47
Migration-free breeding	Apr-Jul	6,256	12.51	7,951	11.35
Post-breeding migration	Aug-Oct	1,402	2.80	2,339	3.34
Migration-free winter	Nov-Dec	1,795	3.59	2,570	3.68

Spatial Density Distribution and Flight Direction

12.3.66 Razorbill were recorded throughout the survey area across all seasons, with highest densities in the centre and south-east of the area (Figure 12.22)

12.3.67 Across the survey period, only 4% were recorded flying. Across the migration-free breeding bio-season, birds were recorded flying in all directions, though the greatest number were recorded flying towards the north-west (Figure 12.23). Only low numbers were recorded in the migration-free winter bio-season with no clear trend. Across the post-breeding migration bio-season, almost all birds were recorded flying in southerly directions. In the return migration bio-season, birds were recorded in all directions, with a slight bias towards easterly directions.

Foraging/Usage Hotspots

12.3.68 The FFC SPA is the closest SPA to the Project array area and using species distribution models and hotspot mapping (Cleasby *et al., 2*020) hotspots were identified to the north of the OWF footprint (Figure 12.21) using Getis-Ord hotspot analysis (Cleasby *et al., 2*020). However, similarly to guillemot, the Project is considerably outside of the core breeding season foraging hotspots from FFC SPA.

250000 300000 350000 400000 450000 500000

6050000 6000000 5950000 5900000 5850000 5800000

N

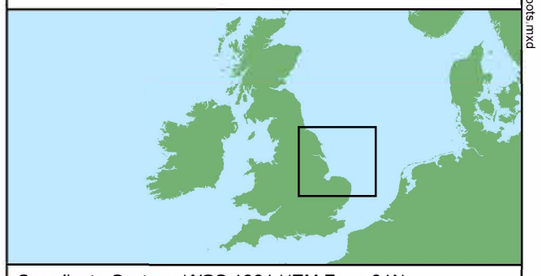
Legend

- Array Area
- Offshore Export Cable Corridor
- ORCP Search Area
- 4km Buffer from Array Area

Razorbill Hotspots (Cleasby *et al.*, 2020)

- Maximum Curvature
- Statistically Significant Getis-Ord hotspot
- Top 5% Getis-Ord hotspot
- Top 1% Getis-Ord hotspot

Hotspots identified at the UK-scale for Razorbills using Getis-Ord hotspot analysis with a neighbourhood size of d = 7 km based on FPT analysis or Maximum Curvature.



Coordinate System: WGS 1984 UTM Zone 31N

0 25 50 km

Scale: 1:1,000,000

Preliminary Environmental Information Report

Foraging Hotspots of Razorbill Colony from FFC SPA (Cleasby *et al.*, 2020)

Figure 12.21

OUTER DOWSING OFFSHORE WIND

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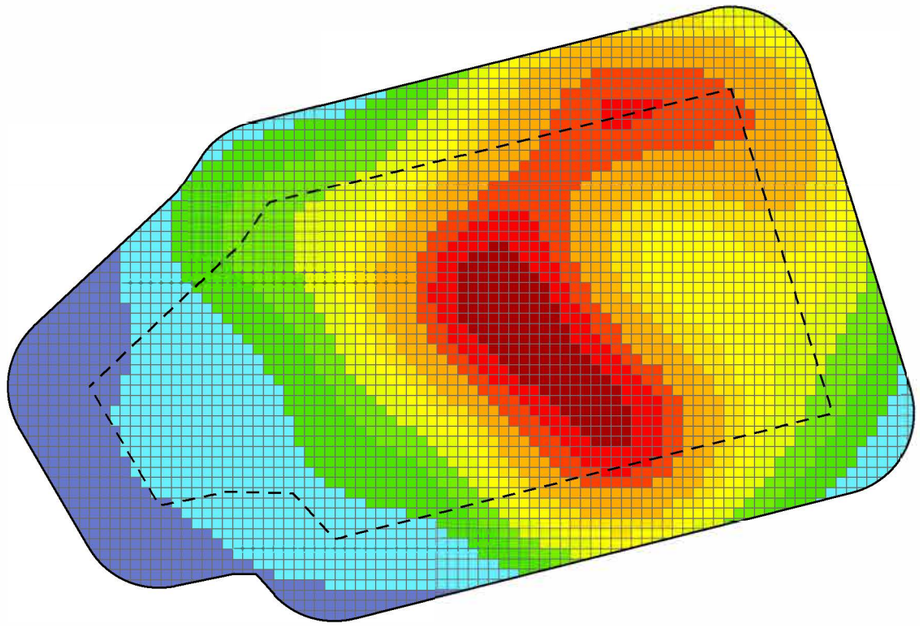
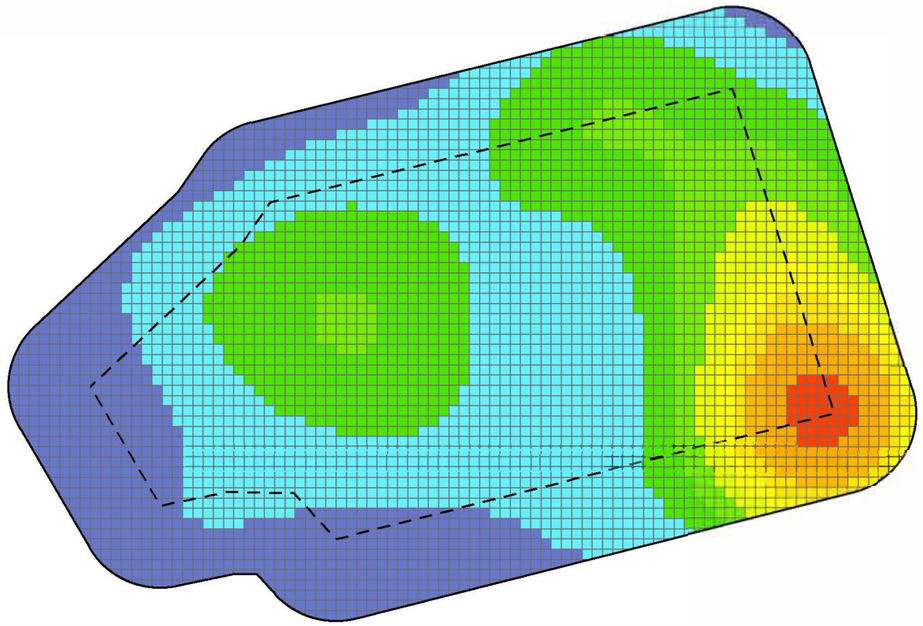
Document Path: G:\GIS\GIS_Projects\t0152 Outer Dowsing EIA\GIS\Figures\PEIR\Ornithology Technical Baseline\ODOW_0152_ORTB_Fig12.22_Razorbill_Hotspots.mxd

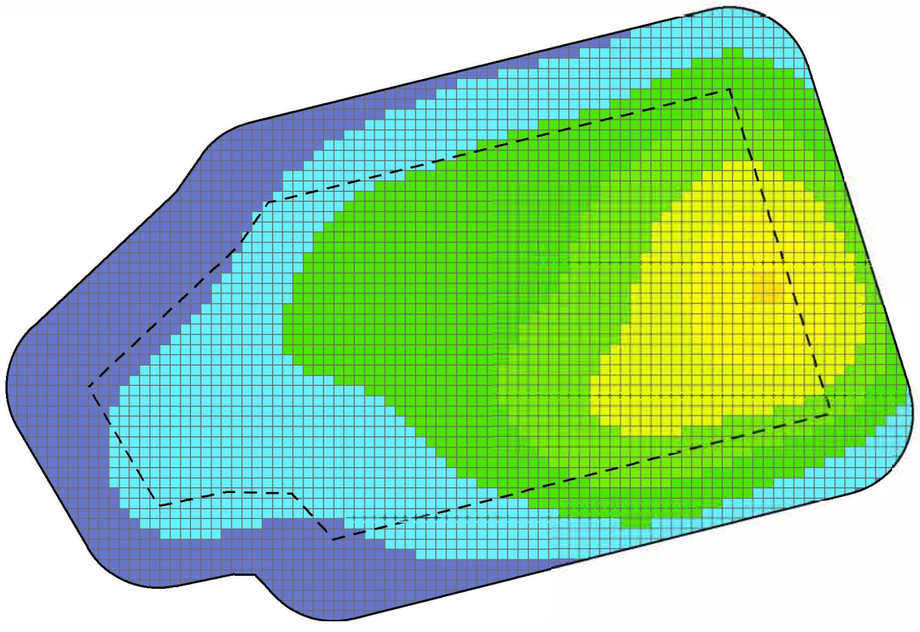
Migration-Free Breeding



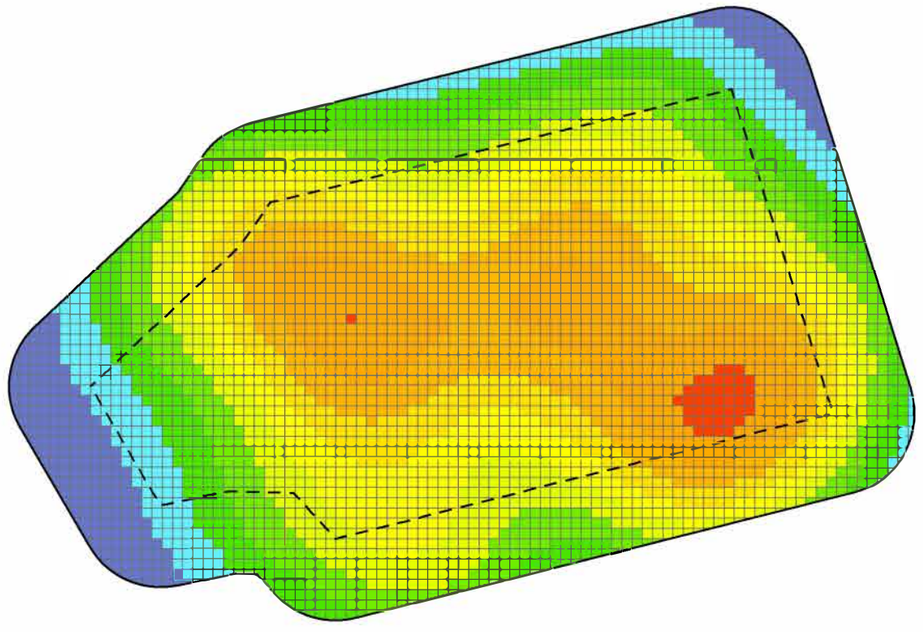
Post-Breeding Migration



Winter



Return Migration

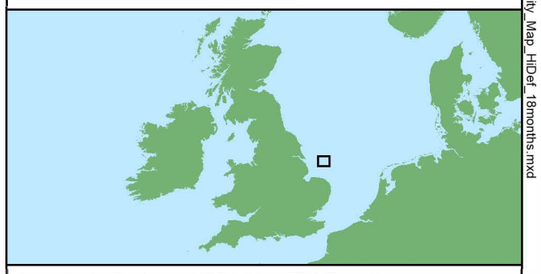


Legend

- Array Area
- Area Area 4km Buffer

Predicted Razorbill Density (birds / km^2)

- 0 - 2.20
- 2.21 - 3.79
- 3.80 - 5.39
- 5.40 - 6.99
- 7.00 - 8.59
- 8.60 - 10.19
- 10.20 - 11.78
- 11.79 - 13.38
- 13.39 - 14.98
- 14.99 - 16.58
- 16.59 - 18.17
- 18.18 - 19.77



Coordinate System: WGS 1984 UTM Zone 31N

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Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Razorbill within the Project Array Area plus 4km Buffer

Figure 12.22

OUTER DOWSING OFFSHORE WIND

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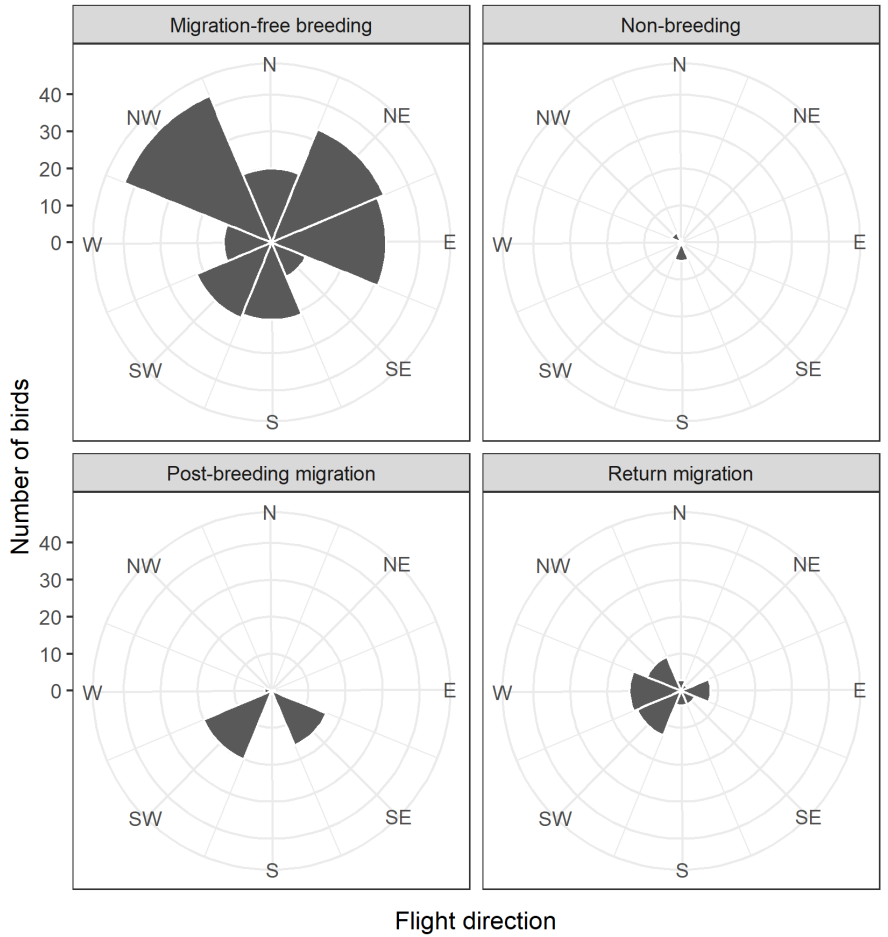


Figure 12.23: Flight direction rose diagrams of razorbills across different bio-seasons in the Project array area and 4km buffer.

Puffin

DAS data

12.3.69 Puffin were recorded in the array area in 16 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (June 2021, May & August 2022) to 81 (October 2021), with abundance and density peaking at 1,078 and 2.16 respectively in August 2021 (Table 12.29).

12.3.70 In the array area plus 2km buffer, raw counts ranged from 1 (February & August 2022) to 119 (August 2021), with abundance and density peaking at 1,575 and 2.25 respectively in August 2021 (Table 12.29).

Puffin Overview

12.3.71 The nearest puffin colony to the Project is the FFC SPA and is listed as a component of the breeding seabird assemblage. The colony is 95km from the Project array area and within the mean maximum foraging range of breeding adult puffin (137.1km, standard deviation 128.3km) (Woodward *et al*., 2019). The latest colony count from FFC SPA was 4,279 birds recorded on the sea in 2018 (JNCC, 2022).

12.3.72 Outside the breeding season, impacts on puffin have been compared to the UK North Sea and Channel BDMPS, consisting of 231,957 individuals during the non-breeding season (mid-August to March) (Furness, 2015).

Table 12.29: Puffin raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	20	206	0.41	10	28	279	0.40
April 21	4	30	0.06	25	5	40	0.06
May 21	2	22	0.05	0	2	38	0.06
June 21	1	21	0.05	0	2	33	0.05
July 21	15	179	0.36	0	21	283	0.41
August 21	72	1,078	2.16	0	119	1,575	2.25
September 21	74	877	1.76	0	89	1,113	1.58
October 21	81	807	1.61	1	112	1,167	1.66
November 21	41	381	0.76	0	55	510	0.72
December 21	3	38	0.08	0	5	59	0.08
January 22	0	0	0.00	0	0	0	0.00
February 22	0	12	0.02	0	1	13	0.01
March S01 22	17	221	0.44	0	27	316	0.45
March S02 22	5	100	0.20	20	8	150	0.21
April S01 22	2	21	0.03	0	3	30	0.05
April S02 22	7	90	0.17	29	9	112	0.16
May S01 22	26	227	0.45	0	30	304	0.43
May S02 22	1	12	0.02	0	2	19	0.02
June S01 22	3	26	0.04	33	4	40	0.05
June S02 22	0	0	0.00	0	0	0	0.00
July S01 22	5	56	0.12	0	9	90	0.13
July S02 22	14	141	0.28	7	26	295	0.43
August S01 22	5	52	0.10	0	7	85	0.12
August S02 22	1	19	0.03	0	1	20	0.02

Bio-Season Peak Estimates

12.3.73 Puffin were present in the Project array area across all four bio-seasons, though presence was comparatively lower in the migration-free breeding season. Presence in the array area was greatest during the post-breeding migration bio-season (July to August), with a peak estimate of 1,078 birds and peak density of 2.16 birds/km^2 (Table 12.30).

12.3.74 In the array area plus 2km buffer, puffin numbers were similarly greatest during the post-breeding migration bio-season, with a peak abundance of 1,575 and peak density of 2.25 (Table 12.30).

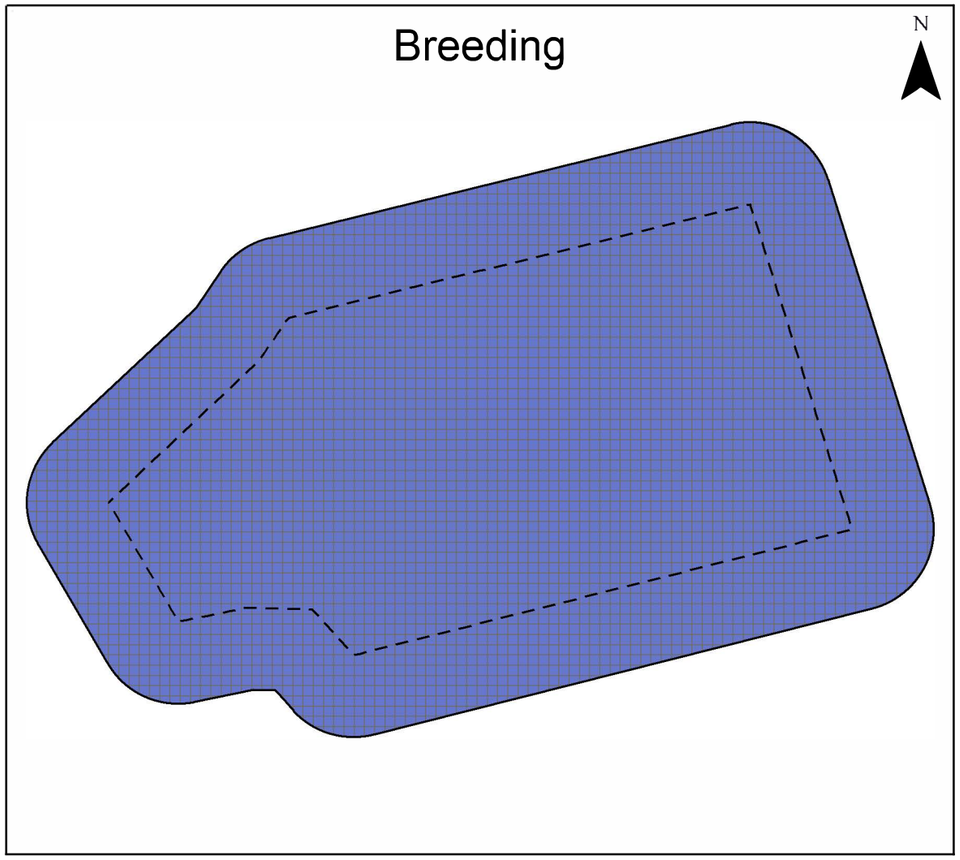
Table 12.30: Puffin bio-season abundance and density estimates in the Project array area plus 2km buffer

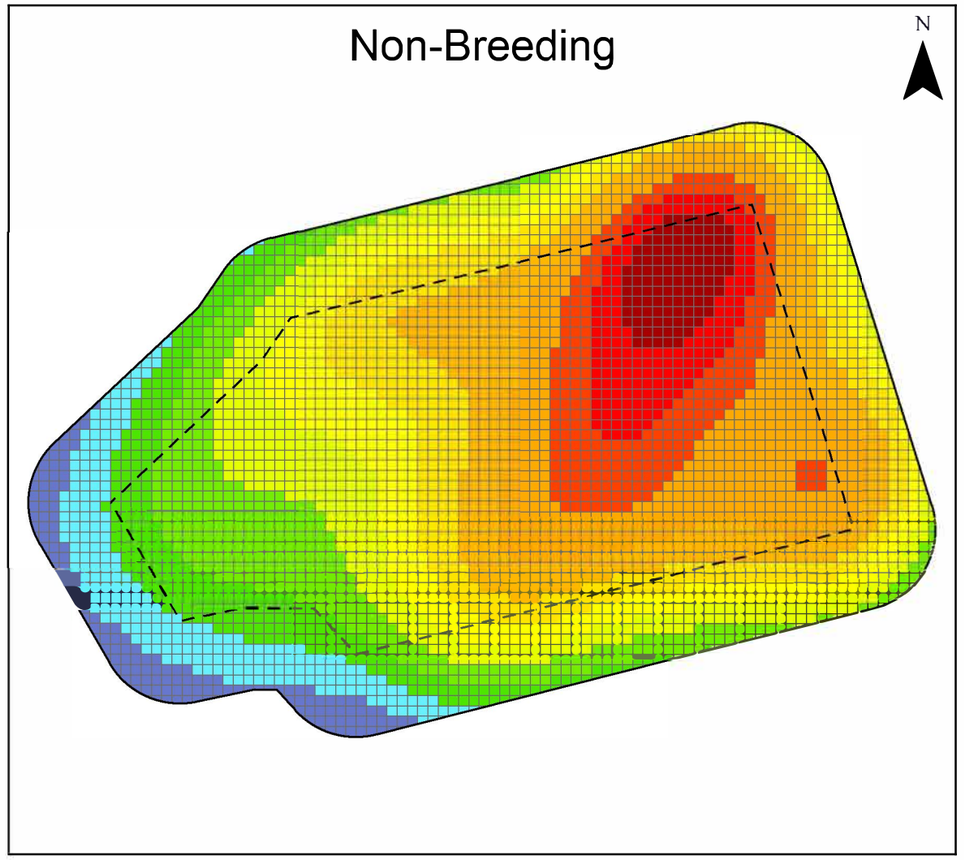
BDMPS Bio-seasons	Months	Array area		Array area + 2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Breeding	Apr - July	227	0.45	304	0.43
Non-breeding	Aug - Mar	1,078	2.16	1,575	2.25

Spatial Density Distribution and Flight Direction

12.3.75 Puffin were recorded throughout the survey area, though highest densities appeared to be in the east (e.g. in August 2021).

12.3.76 Across the survey period, only 2% were recorded flying. Of the months where flight direction data is available, birds in March 2021 were mainly heading in south-westerly directions, whereas birds in April 2021 were mainly flying in easterly directions.



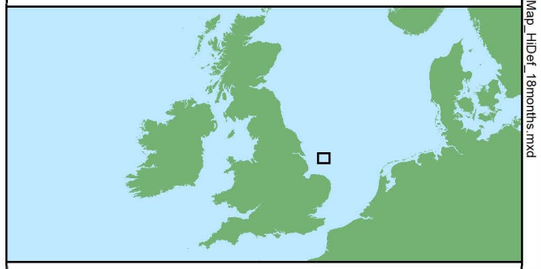


Legend

- Array Area
- Area Area 4km Buffer

Predicted Puffin Density (birds / km^2)

- 0.31 - 0.71
- 0.72 - 1.11
- 1.12 - 1.52
- 1.53 - 1.92
- 1.93 - 2.32
- 2.33 - 2.72
- 2.73 - 3.12
- 3.13 - 3.53
- 3.54 - 3.93
- 3.94 - 4.33
- 4.34 - 4.73
- 4.74 - 5.14



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Atlantic Puffin within the Project Array Area plus 4km Buffer

Figure 12.24

OUTER DOWSING OFFSHORE WIND

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Red-Throated Diver

DAS Data

12.3.77 Red-throated diver were recorded in the array area in 9 of the 18 months considered to date within the Project array area. Raw counts (excluding zero counts) ranged from 1 (May 2021 & 2022) to 33 (April 2022), with abundance and density peaking at 199 and 0.40 respectively in March 2022 (Table 12.31).

12.3.78 In the array area plus 4km buffer, raw counts ranged from 1 (November 2021, January 2022 & May 2022) to 48 (April 2022), with abundance and density peaking at 295 and 0.32 respectively in August 2021 (Table 12.31).

Red-Throated Diver Overview

12.3.79 The nearest SPA with red-throated diver as a qualifying feature to the Project is the Greater Wash SPA, which is 23.4km from the Project array area and overlaps with the offshore ECC. The SPA has a wintering aggregation 1,787 red-throated divers which is approximately 8% of the wintering UK population (JNCC, 2022).

12.3.80 During the migration seasons (September to November and February to April), the relevant background population is considered to be the UK North Sea BDMPS, consisting of 13,277 individuals (Furness, 2015). The southwest North Sea BDMPS population of 10,177 individuals is relevant to the winter period (December and January) (Furness, 2015).

Table 12.31: Red-throated diver raw counts, estimated abundance and estimated density in the Project array area and array area plus 4km buffer.

Survey	Array area only				Array area plus 4km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	28	166	0.33	4	44	269	0.29
April 21	25	149	0.30	0	33	204	0.22
May 21	1	12	0.02	0	2	19	0.02
June 21	0	0	0.00	0	0	0	0.00
July 21	0	0	0.00	0	0	0	0.00
August 21	0	0	0.00	0	0	0	0.00
September 21	0	0	0.00	0	0	0	0.00
October 21	3	18	0.04	33	4	25	0.03
November 21	0	0	0.00	0	1	7	0.01
December 21	2	13	0.02	50	4	24	0.03
January 22	0	0	0.00	0	1	6	0.01
February 22	3	18	0.04	0	3	19	0.02
March S01 22	6	36	0.07	0	6	36	0.04
March S02 22	15	95	0.19	0	21	132	0.14
April S01 22	33	199	0.40	6	48	295	0.32
April S02 22	4	24	0.05	0	6	36	0.04
May S01 22	2	12	0.02	50	3	19	0.02
May S02 22	1	6	0.01	0	1	7	0.01
June S01 22	0	0	0.00	0	0	0	0.00
June S02 22	0	0	0.00	0	0	0	0.00
July S01 22	0	0	0.00	0	0	0	0.00
July S02 22	0	0	0.00	0	0	0	0.00
August S01 22	0	0	0.00	0	0	0	0.00
August S02 22	0	0	0.00	0	0	0	0.00

Bio-Season Peak Estimates

12.3.81 Red-throated diver were present in the Project array area across all four bio-seasons, with a consistent and relatively low presence through the migration-free breeding, post-breeding migration, and migration-free winter bio-seasons. Presence was comparatively higher during the return migration bio-season (February to April), with a peak estimate of 166 birds and peak density of 0.33 birds/km^2 (Table 12.32).

12.3.82 In the array area plus 4km buffer, red-throated diver numbers were similarly greatest during the return migration bio-season, with a peak abundance of 269 birds and peak density of 0.29 birds/km^2 (Table 12.32).

Table 12.32: Red-throated diver bio-season abundance and density estimates in the Project array area plus 4km buffer

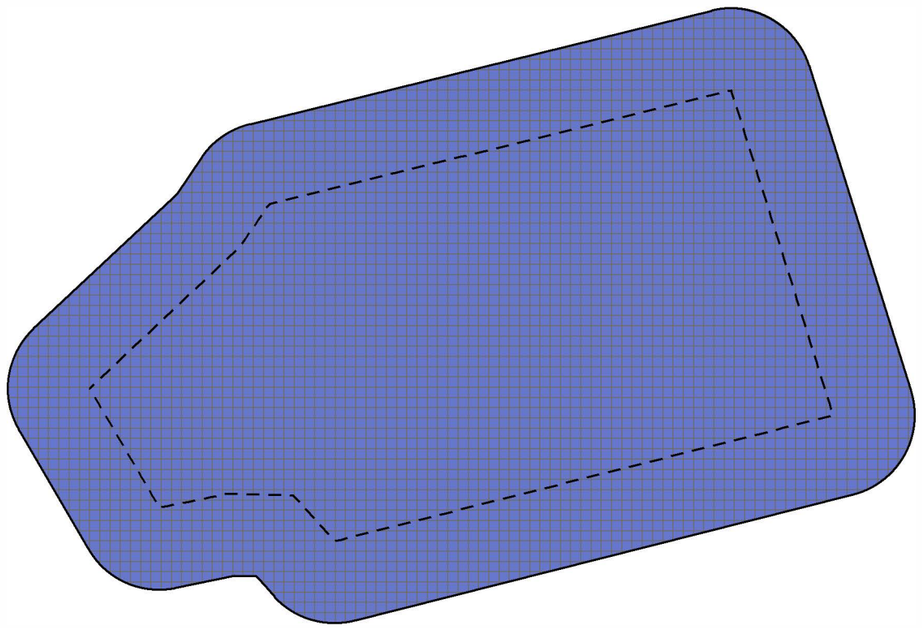
BDMPS Bio-seasons	Months	Array area		Array area + 4km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Return migration	Feb-Apr	199	0.40	295	0.32
Migration-free breeding	May-Aug	12	0.02	19	0.02
Post-breeding migration	Sep-Nov	18	0.04	25	0.03
Migration-free winter	Dec-Jan	13	0.02	24	0.03

Spatial Density Distribution and Flight Direction

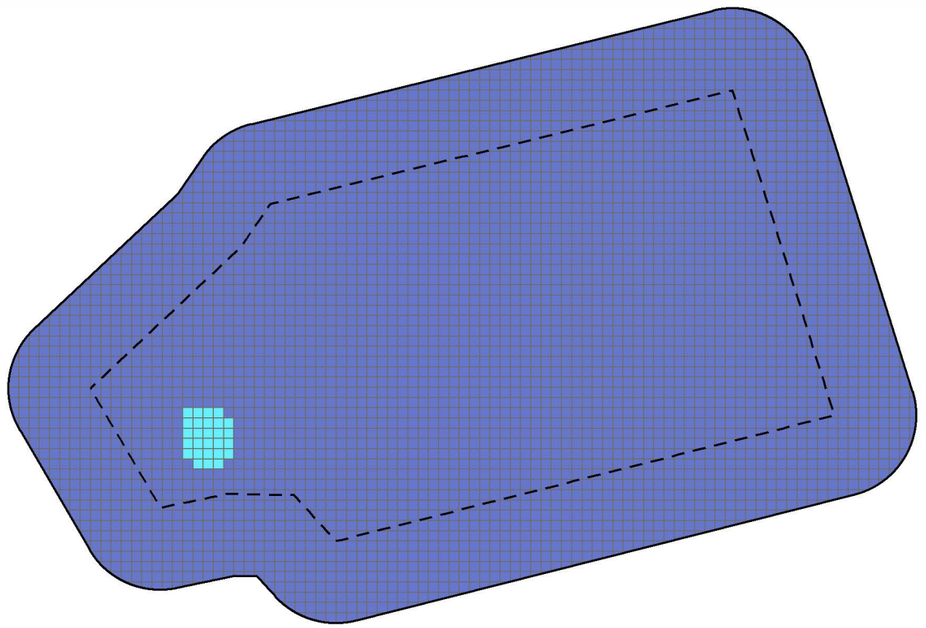
12.3.83 Red-throated divers were recorded throughout the survey area, though during the spring migration bio-season where most individuals were recorded, densities were highest towards the south of the survey area (Figure 12.25).

12.3.84 Across the survey period, only 5% were recorded flying. Of the months where flight direction data is available, in April 2022 where numbers peaked birds were predominantly flying south and birds in March 2021 and 2022 were mainly heading in south-westerly and northeast directions, whereas birds in October and December 2021 were mainly flying in southerly and south-westerly directions.

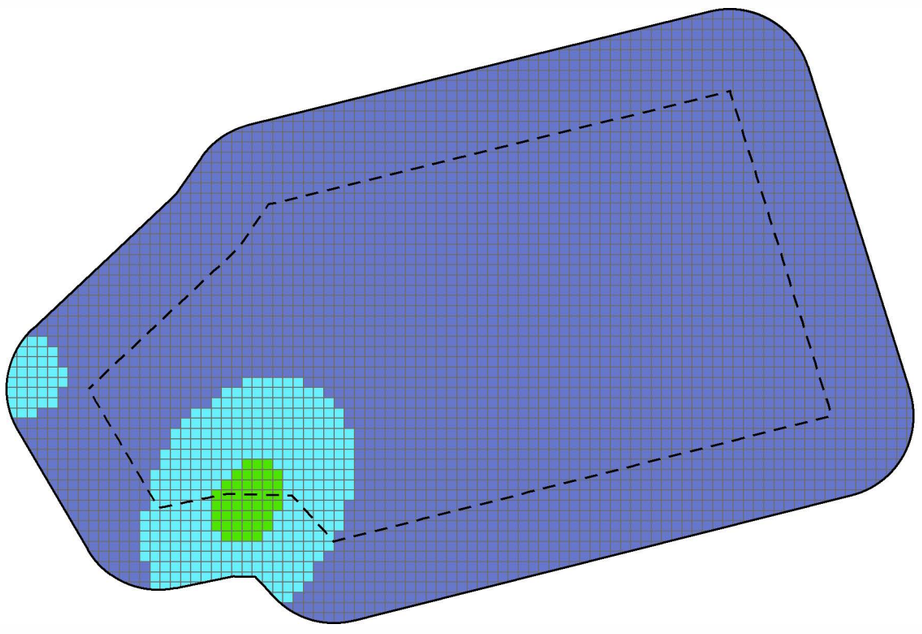
Breeding



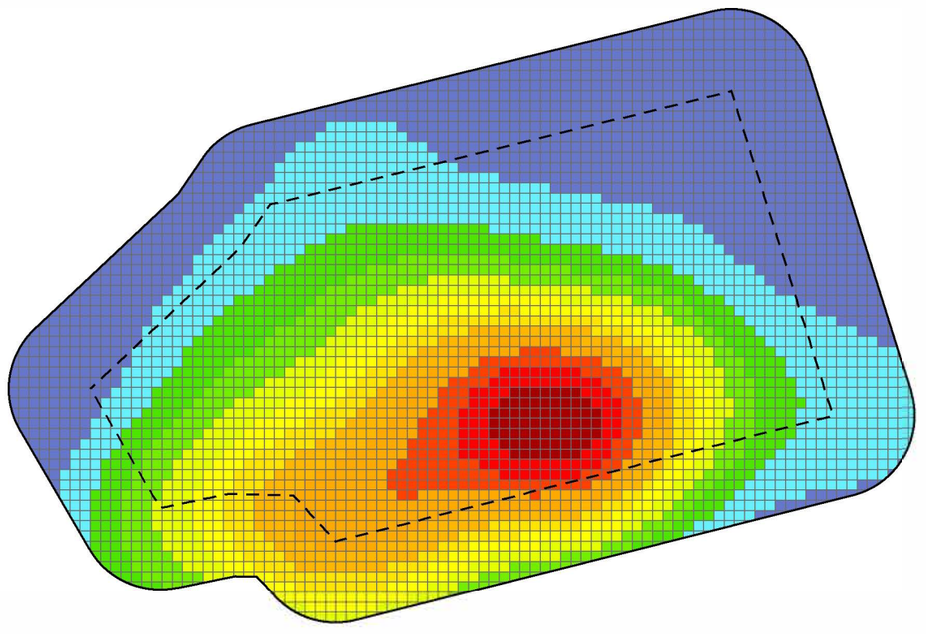
Post-Breeding Migration



Winter



Return Migration

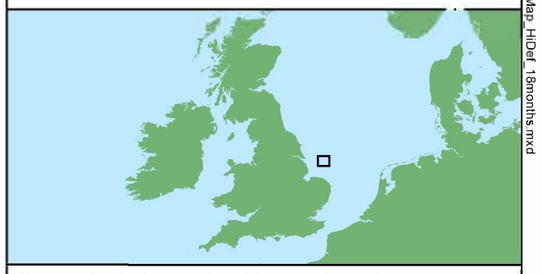


Legend

- Array Area
- Area Area 4km Buffer

Predicted Red-Throated Diver Density (birds / km^2)

- 0 - 0.113
- 0.114 - 0.225
- 0.226 - 0.338
- 0.339 - 0.450
- 0.451 - 0.562
- 0.563 - 0.675
- 0.676 - 0.787
- 0.788 - 0.900
- 0.901 - 1.012
- 1.013 - 1.125
- 1.126 - 1.237
- 1.238 - 1.349



Coordinate System: WGS 1984 UTM Zone 31N

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Scale: 1:300,000

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Bio-season Spatial Density Distribution of Red-throated Diver within the Project Array Area plus 4km Buffer

Figure 12.25

OUTER DOWSING OFFSHORE WIND

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Fulmar

DAS Data

12.3.85 Fulmar were recorded in the array area in 15 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (several months) to 17 (April 2022), with abundance and density peaking at 117 birds and 0.23 birds/km^2 respectively in April 2022 (Table 12.33).

12.3.86 In the array area plus 2km buffer, raw counts ranged from 1 (several months) to 22 (April 2022), with abundance and density peaking at 144 birds and 0.21 birds/km^2 respectively in April 2022 (Table 12.33).

Fulmar Overview

12.3.87 Fulmar has a large mean maximum foraging range plus one standard deviation (542.3km ±657.9km) (Woodward et al., 2019). This means that many of the fulmar breeding colonies in Scotland are within the foraging range of the Project (Stroud *et al.*, 2016) although birds recorded during the breeding season are more likely to come from smaller, closer colonies, including FFC and North Norfolk Coast SPAs.

12.3.88 Outside the breeding season, impacts on fulmar have been assessed relative to the UK North Sea BDMPS. This consists of 957,502 individuals during autumn migration (September to October) and spring migration (December to March), and 568,736 individuals during winter (November) (Furness, 2015).

Table 12.33: Fulmar raw counts, estimated abundance and estimated density in the Project array area and 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	1	16	0.03	0	2	38	0.05
April 21	8	48	0.10	75	8	49	0.07
May 21	0	0	0.00	0	0	0	0.00
June 21	2	12	0.02	0	5	36	0.05
July 21	11	66	0.13	45	11	67	0.09
August 21	0	6	0.01	0	4	31	0.04
September 21	3	18	0.03	0	3	18	0.03
October 21	0	0	0.00	0	0	0	0.00
November 21	0	0	0.00	0	0	0	0.00
December 21	2	19	0.04	50	2	24	0.03
January 22	3	18	0.04	67	4	30	0.04
February 22	1	10	0.02	100	4	29	0.04
March S01 22	0	0	0.00	0	0	0	0.00
March S02 22	5	36	0.07	20	8	48	0.07
April S01 22	17	117	0.23	59	22	144	0.21
April S02 22	6	30	0.06	50	7	43	0.06
May S01 22	4	18	0.03	50	12	74	0.10
May S02 22	0	0	0.00	0	0	0	0.00
June S01 22	1	9	0.02	100	1	13	0.02
June S02 22	6	41	0.08	67	6	43	0.06
July S01 22	1	6	0.01	0	1	7	0.01
July S02 22	7	47	0.09	0	10	66	0.09
August S01 22	12	75	0.15	0	14	92	0.13
August S02 22	1	6	0.01	0	1	6	0.01

Bio-Season Peak Estimates

12.3.89 Fulmar were present in the Project array area across both bio-seasons. Presence was greatest during the breeding bio-season (January to August), with a peak estimate of 117 birds and peak density of 0.23 birds/km^2 (Table 12.34).

Table 12.34: Fulmar bio-season abundance and density estimates in the Project array area plus 2km buffer.

BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Breeding season	Jan - Aug	117	0.23	144	0.21
Non-breeding season	Sep - Dec	19	0.04	24	0.03

Spatial Density Distribution and Flight Direction

12.3.90 Due to the relatively low number of fulmars recorded, there was insufficient data to provide a reliable insight into spatial density distribution and flight directions.

Manx Shearwater

DAS Data

12.3.91 Fulmar were recorded in the array area in 5 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (June 2022) to 32 (July 2022), with abundance and density peaking at 229 birds and 0.46 birds/km^2 respectively in July 2022 (Table 12.35).

12.3.92 In the array area plus 2km buffer, raw counts ranged from 1 (June 2022) to 36 (July 2022), with abundance and density peaking at 259 birds and 0.37 birds/km^2 respectively in July 2022 (Table 12.35).

Manx Shearwater Overview

12.3.93 Manx shearwater does not breed near to the Project and is considered to be a passage species in the area. Similarly to fulmar, Manx shearwater have a large mean maximum foraging range plus one standard deviation (1346.8km ±1018.7km) (Woodward et al., 2019). This means that many of the fulmar breeding colonies in Scotland are within the foraging range of the Project (Stroud et al., 2016).

Table 12.35: Manx shearwater raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	0	0	0.00	0	0	0	0.00
April 21	0	0	0.00	0	0	0	0.00
May 21	0	0	0.00	0	0	0	0.00
June 21	0	0	0.00	0	0	0	0.00
July 21	0	15	0.03	0	0	25	0.03
August 21	0	0	0.00	0	0	0	0.00
September 21	0	0	0.00	0	0	0	0.00
October 21	0	0	0.00	0	0	0	0.00
November 21	0	0	0.00	0	0	0	0.00
December 21	0	0	0.00	0	0	0	0.00
January 22	0	0	0.00	0	0	0	0.00
February 22	0	0	0.00	0	0	0	0.00
March S01 22	0	0	0.00	0	0	0	0.00
March S02 22	0	0	0.00	0	0	0	0.00
April S01 22	3	19	0.04	67	3	18	0.02
April S02 22	0	0	0.00	0	0	0	0.00
May S01 22	0	0	0.00	0	0	0	0.00
May S02 22	0	0	0.00	0	0	0	0.00
June S01 22	0	0	0.00	0	0	0	0.00
June S02 22	1	6	0.01	100	1	6	0.01
July S01 22	0	13	0.02	0	0	13	0.02
July S02 22	32	229	0.46	0	36	259	0.37
August S01 22	26	158	0.32	15	31	193	0.28
August S02 22	7	45	0.09	0	8	47	0.07

Bio-Season Peak Estimates

12.3.94 Manx shearwater were present in the Project array area across both bio-seasons. Presence was greatest during the breeding bio-season (January to August), with a peak estimate of 117 birds and peak density of 0.23 birds/km^2 (Table 12.34).

Table 12.36: Manx shearwater bio-season abundance and density estimates in the Project array area and array area plus 2km buffer.

BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Breeding season	Apr - Aug	229	0.46	259	0.37
Post breeding migration	Aug – Oct	45	0.09	47	0.07
Return migration	Mar - May	19	0.04	18	0.02

Spatial Density Distribution and Flight Direction

12.3.95 Manx shearwater were recorded in relatively low numbers, and are not considered a key species at risk of displacement or collision impacts from the Project. Therefore, further consideration to the spatial density distribution and flight direction has not been given as it is not considered important for informing Project design.

Gannet

DAS Data

12.3.96 Gannet were recorded in the array area in 17 of the 18 months within the Project array area. Raw counts (excluding zero counts) ranged from 1 (January 2022) to 190 (April 2022), with abundance and density peaking at 1,119 birds and 2.25 birds/km^2 respectively in April 2022 (Table 12.37).

12.3.97 In the array area plus 2km buffer, raw counts ranged from 1 (January 2022) to 242 (April 2022), with abundance and density peaking at 1,446 birds and 2.07 birds/km^2 respectively in April 2022 (Table 12.37).

Gannet Overview

12.3.98 The nearest breeding colony of gannet to the Project is located at the FFC SPA. This is located approximately 95km northwest of the Project array area and within the mean maximum foraging range of gannets (315.2km, standard deviation 194.2km) (Woodward *et al*., 2019). The most recent population found at FFC SPA is 13,392 pairs in 2017 (Aitken *et al*., 2017).

12.3.99 Migration season impacts on gannet has been assessed relative to the UK North Sea and Channel BDMPS. This consists of 456,298 individuals during autumn migration (September to November), and 248,385 individuals during spring migration (December to March) (Furness, 2015).

Table 12.37: Gannet raw counts, estimated abundance and estimated density in the Project array area and array area plus 2km buffer.

Survey	Array area only				Array area plus 2km buffer		
	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)	% Flying	Raw count (n)	Abundance estimate (n)	Density estimate (n/km^2)
March 21	33	196	0.39	48	44	234	0.33
April 21	95	552	1.10	52	149	793	1.13
May 21	8	48	0.09	75	15	55	0.08
June 21	8	48	0.10	75	13	66	0.09
July 21	21	126	0.25	38	54	192	0.27
August 21	17	100	0.20	65	29	127	0.18
September 21	10	59	0.12	30	28	108	0.15
October 21	18	107	0.21	44	27	119	0.17
November 21	11	65	0.13	45	53	169	0.24
December 21	0	0	0.00	0	0	7	0.01
January 22	1	6	0.01	100	1	30	0.04
February 22	3	19	0.04	67	5	234	0.33
March S01 22	34	185	0.37	38	39	240	0.34
March S02 22	11	70	0.14	73	17	103	0.15
April S01 22	44	254	0.51	45	59	355	0.51
April S02 22	190	1,119	2.25	25	242	1,446	2.07
May S01 22	119	699	1.4	48	168	1,018	1.46
May S02 22	17	99	0.2	47	24	145	0.21
June S01 22	20	117	0.23	30	30	161	0.23
June S02 22	73	431	0.87	11	88	528	0.76
July S01 22	51	294	0.59	57	58	353	0.51
July S02 22	49	299	0.6	49	88	517	0.74
August S01 22	43	252	0.5	33	52	311	0.45
August S02 22	12	65	0.13	25	13	78	0.11

Bio-Season Peak Estimates

12.3.100 Gannet were present in the Project array area across all three bio-seasons. Presence was greatest during the migration-free breeding bio-season (April to August), with a peak estimate of 1,119 birds and peak density of 2.25 birds/km^2 (Table 12.38).

12.3.101 In the array area plus 2km buffer, gannet numbers were similarly greatest during the return migration bio-season, with a peak abundance of 1,446 birds and peak density of 2.07 birds/km^2 (Table 12.38).

Table 12.38: Gannet bio-season abundance and density estimates in the Outer Dowsing array area plus 2km buffer

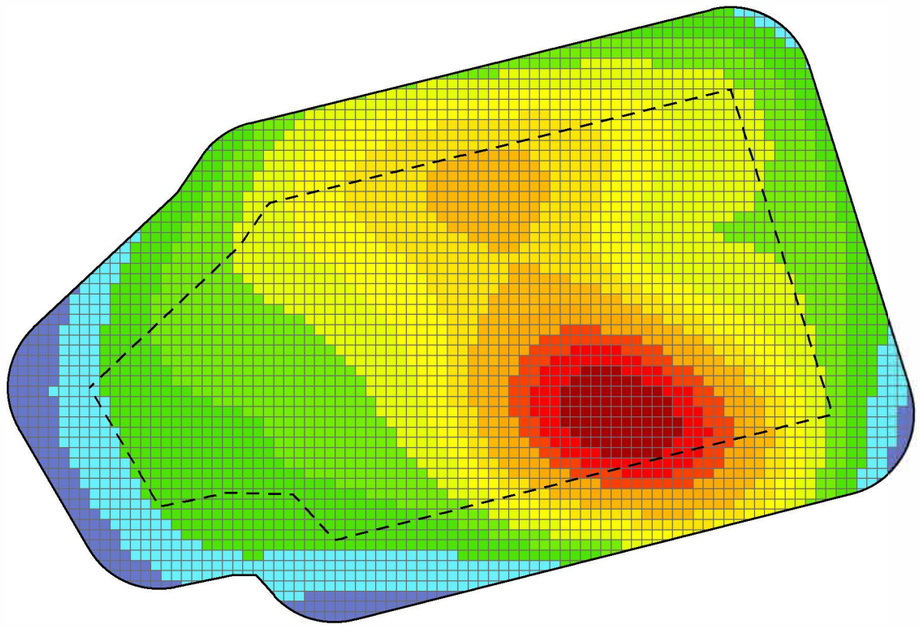
BDMPS Bio-seasons	Months	Array area		Array area +2km buffer	
		Bio-season peak abundance (n)	Bio-season peak density (n/km^2)	Bio-season peak abundance (n)	Bio-season peak density (n/km^2)
Return migration	Dec-Mar	196	0.39	234	0.33
Migration-free breeding	Apr-Aug	1,119	2.25	1,446	2.07
Post-breeding migration	Sep-Nov	107	0.21	169	0.24

Spatial Density Distribution and Flight Direction

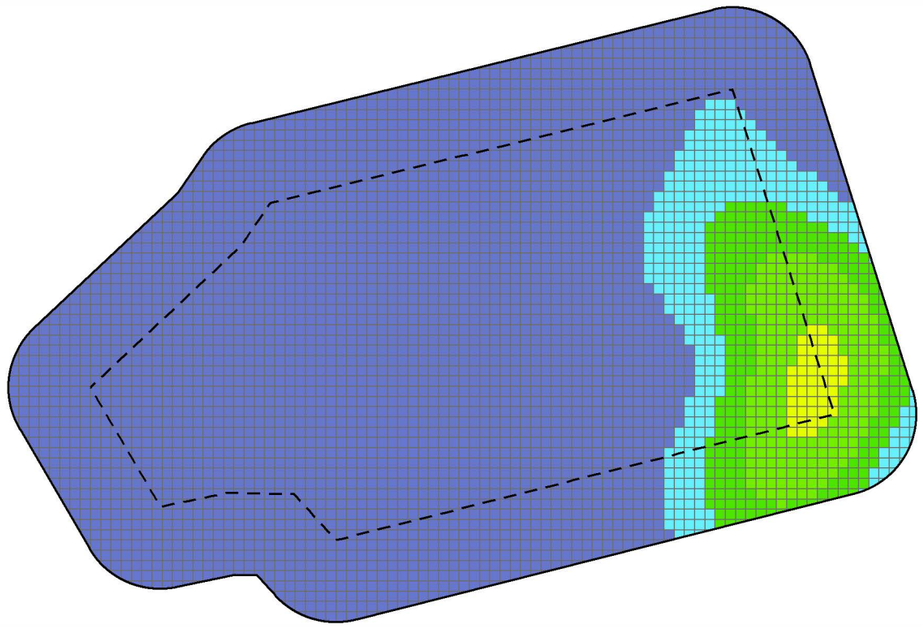
12.3.102 Gannet were recorded throughout the survey area, though highest densities appeared to be in south-east of the survey area during the migration-free breeding and spring migration bio-seasons (Figure 12.26).

12.3.103 Across the survey period, a mean of 40% of birds were recorded flying. In the migration-free breeding season, birds were predominantly recorded flying in south-easterly directions, with a peak of birds recorded flying towards the north-west (Figure 12.27). In the post-breeding migration, gannets were recorded flying in all directions in small numbers with no clear trend. Similarly, in the return migration bio-season, birds were recorded flying in larger numbers in all directions, though a peak of birds was recorded flying towards southerly directions.

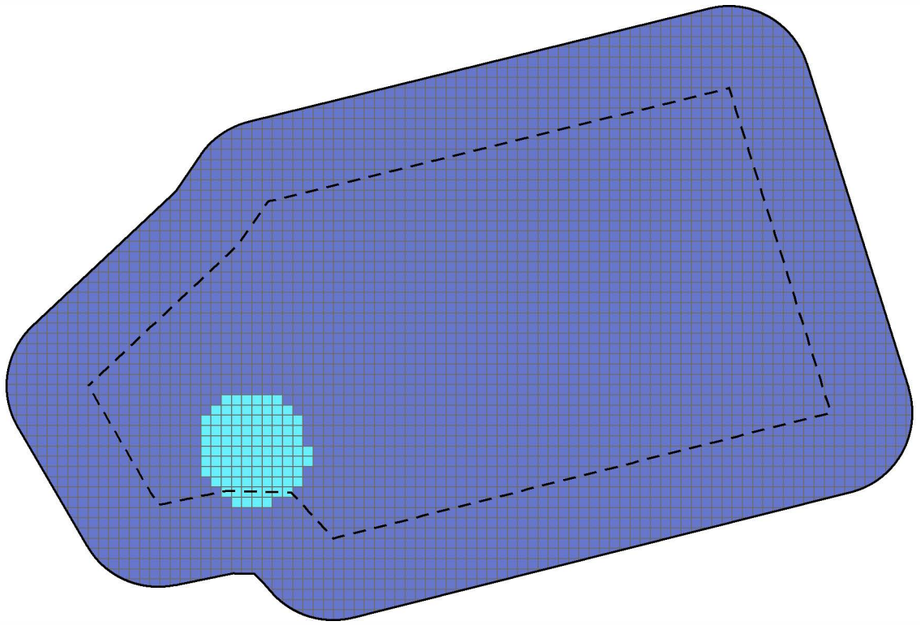
Migration-Free Breeding



Post-Breeding Migration



Return Migration

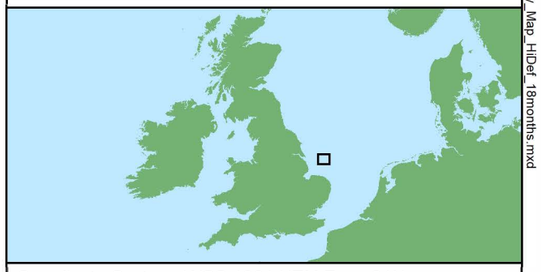


Legend

- Array Area
- Area Area 4km Buffer

Predicted Gannet Density (birds / km^2)

- 0 - 0.82
- 0.83 - 1.27
- 1.28 - 1.72
- 1.73 - 2.16
- 2.17 - 2.61
- 2.62 - 3.06
- 3.07 - 3.51
- 3.52 - 3.96
- 3.97 - 4.41
- 4.42 - 4.85
- 4.86 - 5.30
- 5.31 - 5.75



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:300,000

Preliminary Environmental Information Report

Bio-season Spatial Density Distribution of Northern Gannet within the Project Array Area plus 4km Buffer

Figure 12.26

OUTER DOWSING OFFSHORE WIND

Date: 09/05/2023
Produced By: BPHB
Revision: 0.1

GoBe

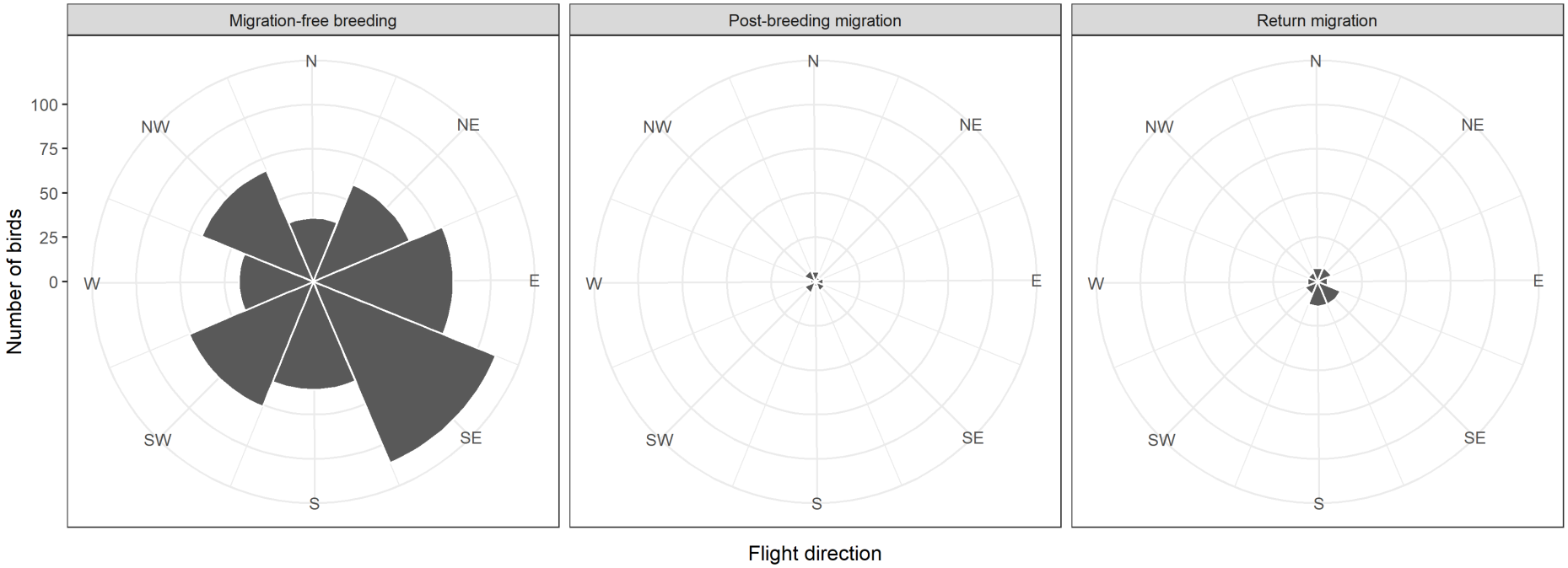


Figure 12.27: Flight direction rose diagrams of gannets across different bio-seasons in the Project array area and 4km buffer.

Less Abundant Bird Species

12.3.104 Less abundance species recorded across surveys are outlined below, with abundance and density estimates presented in Annex A – counts of all species.

12.3.105 Oystercatcher were recorded in the array area in a single survey in August 2021, with a raw count of 3 individuals. This corresponded to an abundance estimate of 50 individuals, and density estimate of 0.1 individuals per km^2. No further individuals were recorded across the wider survey area.

12.3.106 Curlew were recorded in the array area in four surveys, single individuals in June and July 2022 and a peak of two individuals in August 2022, corresponding to an abundance of 12 individuals and a density estimate of 0.01 individuals per km^2.

12.3.107 Black-headed gull were recorded across 6 surveys in the Project array area, with only one month having a raw count greater than 1. The peak occurred in October 2021, with 6 individuals recorded, corresponding to an abundance estimate of 36 individuals, and a density estimate of 0.07 individuals per km^2. Across the wider survey area, slightly higher numbers were recorded in July only, with 10 individuals recorded within the 4km buffer in July 2021.

12.3.108 Arctic tern were recorded in low numbers across the Project array area, recorded in 7 survey months, and a peak raw count of 11 individuals in May 2022. This corresponded to an abundance estimate of 71, and a density estimate of 0.14 individuals per km^2. Across the wider survey area, numbers were slightly higher, with a peak of 23 individuals recorded within the 4km buffer in May 2022.

12.3.109 Great skua was recorded across 2 surveys in the Project array area, recorded in August 2021 and May 2022. These corresponded to an abundance estimate of 7 and 6 individuals respectively, and a density estimate of 0.01 individuals per km^2. Across the wider survey area, a third great skua was recorded within the 4km buffer in August 2021.

12.3.110 Arctic skua were recorded across 2 surveys in the Project array area, with a peak of 5 individuals recorded in September 2021. This corresponded to an abundance estimate of 31 individuals and a density estimate of 0.06 individuals per km^2. Across the wider survey area, only one further arctic skua was recorded within the 4km buffer.

12.3.111 A singular little auk was recorded in March 2021 in the Project array area, corresponding to an abundance estimate of 2 and a density estimate of 0 individuals per km^2. No further individuals were recorded across the wider survey area.

12.3.112 A singular great northern diver was recorded in April 2021 in the Project array area, corresponding to an abundance estimate of 6 and a density estimate of 0.01 individuals per km^2. No further individuals were recorded across the wider survey area.

12.3.113 Three shags were recorded in the Project array area, with one individual recorded in December 2021, February 2022 and March 2022. This corresponded to an abundance estimate of 6 and density estimate of 0.01 individuals per km^2 across all three months. Across the wider survey area, an additional 3 individuals were recorded within the 4km buffer, with 2 additional individuals in December 2021, and one individual in January 2022.

12.3.114 Notably, while being highlighted as present in the area by other data sources (e.g. Lawson *et al.*, 2016), no common scoter were recorded within the survey area.

Unidentified Birds

12.3.115 Unidentified birds were recorded throughout the survey period with the greatest numbers recorded in August and September 2021. The summer peaks of non-identification relate primarily to difficulties separating razorbill and guillemot and reflect the large number of birds present at that time. These are especially hard to distinguish when birds are in moult and accompanied by juveniles.

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Annex A – counts of all species

Table 12.1: Overview of survey data for Project in the array area, 2km buffer and 4km buffer. Note that 4km buffer abundance and densities have not been corrected for auk availability bias.

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
Array area only							
22-Mar-21	Kittiwake	6.39	3,196	2,128	4,372	555	17.36
	Black-headed Gull	0.01	6	0	18	6	96.17
	Common Gull	0.02	12	0	35	11	95.8
	Great Black-backed Gull	0.02	12	0	28	8	63.29
	Herring Gull	0.02	13	0	29	8	59.15
	Lesser Black-backed Gull	0.01	6	0	18	6	94.29
	Little Auk	0.00	2	2	3	1	14.88
	Guillemot	9.70	4,854	3,972	5,760	427	8.8
	Razorbill	6.97	3,482	2,806	4,196	384	11.03
	Puffin	0.41	206	114	318	50	24.27
	Red-throated Diver	0.33	166	69	287	56	33.57
	Fulmar	0.03	16	0	37	11	68.03
	Gannet	0.39	196	88	327	63	31.84
04-Apr-21	Kittiwake	11.28	5,641	4,273	7,181	769	13.63
	Common Gull	0.02	12	0	29	8	62.75
	Great Black-backed Gull	0.03	17	5	36	9	48.81
	Herring Gull	0.01	7	0	20	6	79.13
	Lesser Black-backed Gull	0.05	24	6	41	10	41.35
	Sandwich Tern	0.01	6	0	18	6	97.32
	Guillemot	37.4	18,697	13,880	24,833	3,000	16.05
	Razorbill	12.51	6,256	3,765	9,386	1,564	25
	Puffin	0.06	30	8	60	13	43.33
	Red-throated Diver	0.30	149	58	256	50	33.53

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Great Northern Diver	0.01	6	0	18	6	99.32
	Fulmar	0.10	48	23	77	15	30.37
	Gannet	1.10	552	370	750	99	17.86
12-May-21	Kittiwake	3.16	1,578	617	3,087	704	44.57
	Common Gull	0.01	6	0	18	6	94.62
	Lesser Black-backed Gull	0.01	6	0	18	6	100.41
	Sandwich Tern	0.33	164	109	226	31	18.85
	Common Tern	0.19	96	46	159	31	31.31
	Guillemot	6.70	3,347	2,771	4,017	316	9.44
	Razorbill	0.70	347	166	579	109	31.41
	Puffin	0.05	22	6	50	16	72.73
	Red-throated Diver	0.02	12	0	29	8	65.24
	Gannet	0.09	48	12	88	20	40.29
09-Jun-21	Kittiwake	0.71	357	225	513	76	21.23
	Black-headed Gull	0.01	6	0	18	6	94.64
	Common Gull	0.01	6	0	18	6	92.11
	Herring Gull	0.07	37	0	86	23	60.9
	Lesser Black-backed Gull	0.04	18	0	53	17	95.94
	Sandwich Tern	0.04	19	0	47	13	66.73
	Common Tern	0.03	15	0	40	12	77.66
	Arctic Tern	0.02	9	0	24	7	73.09
	Guillemot	1.48	734	533	934	100	13.62
	Razorbill	0.33	167	87	259	43	25.75
	Puffin	0.05	21	7	45	13	61.9
	Fulmar	0.02	12	0	29	8	66.49
	Gannet	0.10	48	12	100	24	48.5
24-Jul-21	Kittiwake	2.72	1,358	895	1,884	258	18.98
	Black-headed Gull	0.01	6	0	18	6	90.78
	Little Gull	0.02	12	0	36	12	100.25

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Common Gull	0.03	18	0	53	16	93.74
	Herring Gull	0.02	13	0	29	8	65.67
	Lesser Black-backed Gull	0.04	19	6	39	9	49.3
	Arctic Tern	0.01	6	0	18	6	95.21
	Guillemot	11.46	5,730	4,121	7,672	960	16.75
	Razorbill	3.76	1,884	834	3,262	712	37.79
	Puffin	0.36	179	135	223	28	15.64
	Fulmar	0.13	66	18	120	26	39.46
	Manx Shearwater	0.03	15	0	37	10	69.25
	Gannet	0.25	126	53	210	43	33.85
14-Aug-21	Oystercatcher	0.10	50	0	128	36	72.25
	Kittiwake	1.77	886	502	1,464	250	28.17
	Little Gull	0.01	6	0	18	6	95.76
	Common Tern	0.12	63	6	162	43	67.74
	Arctic Tern	0.01	3	1	7	2	64.57
	Great Skua	0.01	7	0	18	6	94.61
	Guillemot	22.34	11,167	5,151	18,578	3,815	34.16
	Razorbill	2.80	1,402	554	2,507	600	42.8
	Puffin	2.16	1,078	737	1,462	235	21.8
	Fulmar	0.01	6	0	18	6	99.04
	Gannet	0.20	100	61	141	20	20.14
07-Sep-21	Kittiwake	2.65	1,326	723	2,008	333	25.08
	Little gull	0.17	85	41	125	23	26.17
	Common gull	0.00	1	1	1	1	53.82
	Great black-backed gull	0.14	72	29	122	24	32.61
	Lesser black-backed gull	0.04	18	6	35	9	46.72
	Sandwich tern	0.03	14	1	30	8	57.46
	Common tern	3.85	1,925	1,346	2,641	339	17.58

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Arctic tern	0.05	27	8	53	12	43.43
	Arctic skua	0.06	31	6	59	14	45.1
	Guillemot	28.7	14,349	11,433	17,077	1,584	11.04
	Razorbill	2.30	1,151	783	1,551	230	19.98
	Puffin	1.76	877	657	1,104	135	15.39
	Fulmar	0.03	18	6	35	9	49.21
	Gannet	0.12	59	30	89	15	25.63
09-Oct-21	Kittiwake	0.12	60	23	101	21	35.06
	Black-headed gull	0.07	36	6	70	17	45.72
	Little gull	0.50	249	139	365	60	23.89
	Common gull	0.04	18	0	39	10	54.17
	Great black-backed gull	0.07	34	0	94	28	79.79
	Lesser black-backed gull	0.01	6	0	18	6	100.44
	Arctic skua	0.01	6	0	18	6	100.15
	Guillemot	9.05	4,529	3,457	5,731	512	11.30
	Razorbill	1.41	703	419	1,054	158	22.48
	Puffin	1.61	807	620	1,000	114	14.13
	Red-throated diver	0.04	18	0	40	10	52.88
	Gannet	0.21	107	47	176	32	30.05
02-Nov-21	Kittiwake	0.27	134	85	179	25	18.08
	Great black-backed gull	0.07	37	6	74	18	49.32
	Lesser black-backed gull	0.01	6	0	18	6	93.99
	Guillemot	9.10	4,554	3,570	5,511	509	11.18
	Razorbill	3.59	1,795	1,349	2,227	249	13.87
	Puffin	0.76	381	310	446	42	11.02
	Gannet	0.13	65	29	102	19	28.17
15-Dec-21	Kittiwake	0.35	175	107	242	36	20.16
	Great black-backed gull	0.07	36	17	59	12	32.87

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Guillemot	4.69	2,356	1,966	2,699	165	7.03
	Razorbill	3.29	1,645	1,232	2,143	275	16.72
	Puffin	0.08	38	17	70	18	47.37
	Red-throated diver	0.02	13	0	29	8	63.54
	Fulmar	0.04	19	0	40	10	51.08
	Shag	0.01	6	0	18	6	96.48
06-Jan-22	Kittiwake	0.13	66	35	98	17	25.08
	Great black-backed gull	0.04	18	6	35	9	47.00
	Herring gull	0.02	13	0	30	9	66.38
	Guillemot	1.08	538	361	729	96	17.84
	Razorbill	0.92	456	266	693	124	27.19
	Fulmar	0.04	18	0	46	13	70.57
	Gannet	0.01	6	0	18	6	94.54
23-Feb-22	Kittiwake	1.17	586	411	761	90	15.34
	Common gull	0.01	6	0	18	6	93.18
	Guillemot	7.13	3,568	2,740	4,546	458	12.84
	Razorbill	7.71	3,858	3,229	4,439	345	8.94
	Puffin	0.02	12	2	26	8	66.67
	Red-throated diver	0.04	18	6	36	9	48.20
	Fulmar	0.02	10	0	30	10	96.23
	Gannet	0.04	19	0	36	9	49.08
	Shag	0.01	6	0	18	6	95.18
11-Mar-22	Kittiwake	5.69	2,835	1,635	4,237	685	24.16
	Little gull	0.01	6	0	18	6	98.42
	Common gull	0.17	83	24	154	34	39.88
	Great black-backed gull	0.02	12	0	29	8	64.12
	Herring gull	0.01	6	0	18	6	98.65
	Lesser black-backed gull	0.02	12	0	29	8	65.51
	Guillemot	11.67	5,810	3,932	8,043	1,099	18.92

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Razorbill	4.7	2,338	1,360	3,442	601	25.71
	Puffin	0.44	221	127	334	63	28.51
	Red-throated diver	0.07	36	12	62	13	36.04
	Gannet	0.37	185	82	316	61	32.86
	Shag	0.01	6	0	18	6	91.66
22-Mar-22	Kittiwake	3.81	1,896	1,456	2,348	227	11.97
	Little gull	0.02	12	0	36	12	96.93
	Guillemot	12.82	6,383	5,267	7,559	546	8.55
	Razorbill	2.14	1,066	703	1,464	224	21.01
	Puffin	0.20	100	56	162	29	29.00
	Red-throated diver	0.19	95	53	136	22	22.62
	Fulmar	0.07	36	6	68	16	43.17
	Gannet	0.14	70	29	120	24	33.77
02-Apr-22	Kittiwake	6.94	3,457	2,660	4,390	444	12.83
	Black-headed gull	0.01	6	0	18	6	92.27
	Great black-backed gull	0.02	12	0	36	12	98.57
	Herring gull	0.06	30	6	58	14	46.72
	Lesser black-backed gull	0.02	12	0	29	8	63.79
	Guillemot	36.27	18,055	14,430	22,174	1,984	10.99
	Razorbill	2.82	1,405	920	1,929	275	19.57
	Puffin	0.03	21	6	40	11	52.38
	Red-throated diver	0.40	199	103	301	52	26.19
	Fulmar	0.23	117	65	176	29	24.64
	Manx shearwater	0.04	19	0	41	12	64.09
	Gannet	0.51	254	133	386	69	26.97
15-Apr-22	Kittiwake	8.69	4,325	3,127	5,553	621	14.36
	Herring gull	0.02	12	0	30	8	67.89
	Lesser black-backed gull	0.01	6	0	18	6	97.36
	Sandwich tern	0.21	105	40	181	37	34.58

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Common tern	0.19	96	41	151	28	28.62
	Arctic tern	0.09	46	17	81	17	35.93
	Guillemot	17.00	8,463	5,753	11,357	1,413	16.70
	Razorbill	1.68	835	463	1,283	188	22.51
	Puffin	0.17	90	26	179	37	41.11
	Red-throated diver	0.05	24	6	46	11	45.76
	Fulmar	0.06	30	0	63	16	54.14
	Gannet	2.25	1119	609	1755	293	26.21
02-May-22	Kittiwake	6.85	3,410	2,888	4,038	294	8.62
	Herring gull	0.02	12	0	28	8	63.64
	Sandwich tern	0.20	102	28	194	44	42.65
	Arctic tern	0.14	71	33	122	23	32.69
	Great skua	0.01	6	0	18	6	96.62
	Guillemot	17.48	8,705	7,167	10,304	844	9.70
	Razorbill	3.27	1,631	1,121	2,246	284	17.41
	Puffin	0.45	227	136	344	65	28.63
	Red-throated diver	0.02	12	0	28	8	62.51
	Fulmar	0.03	18	0	35	9	48.88
	Gannet	1.40	699	478	1,000	137	19.51
17-May-22	Kittiwake	2.47	1,228	974	1,507	140	11.37
	Great black-backed gull	0.01	6	0	18	6	96.26
	Herring gull	0.01	7	0	18	6	91.98
	Lesser black-backed gull	0.01	6	0	18	6	96.86
	Sandwich tern	0.14	72	29	122	24	33.38
	Common tern	0.14	69	23	125	27	38.21
	Arctic tern	0.01	6	0	19	6	98.08
	Guillemot	5.34	2,659	2,126	3,284	291	10.94
	Razorbill	0.53	260	160	384	67	25.77
	Puffin	0.02	12	2	27	8	66.67

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Red-throated diver	0.01	6	0	18	6	97.73
	Gannet	0.20	99	46	164	31	30.84
09-Jun-22	Kittiwake	0.67	334	175	530	92	27.45
	Great black-backed gull	0.01	4	0	12	3	95.40
	Herring gull	0.01	6	0	18	6	94.86
	Lesser black-backed gull	0.01	7	0	18	6	91.77
	Sandwich tern	0.24	119	41	221	47	39.09
	Common tern	0.05	23	0	64	18	77.53
	Guillemot	2.59	1,285	951	1,633	175	13.62
	Razorbill	0.30	155	55	273	62	40.00
	Puffin	0.04	26	2	61	17	65.38
	Fulmar	0.02	9	0	23	7	72.16
	Gannet	0.23	117	64	181	30	25.64
21-Jun-22	Curlew	0.01	6	0	18	6	101.04
	Kittiwake	4.76	2,369	1,795	2,981	309	13.04
	Great black-backed gull	0.04	18	6	36	10	52.64
	Herring gull	0.34	172	57	318	68	39.60
	Lesser black-backed gull	0.02	12	0	29	8	66.26
	Sandwich tern	0.09	47	12	86	19	38.63
	Common tern	0.01	6	0	18	6	101.42
	Guillemot	6.97	3,468	2,790	4,179	385	11.10
	Razorbill	0.42	207	81	352	84	40.58
	Fulmar	0.08	41	12	74	16	38.07
	Manx shearwater	0.01	6	0	18	6	96.48
	Gannet	0.87	431	211	694	123	28.39
04-Jul-22	Curlew	0.01	6	0	18	6	92.44
	Kittiwake	0.69	343	227	470	62	17.96
	Herring gull	0.03	18	0	45	13	70.21
	Lesser black-backed gull	0.03	13	0	35	12	90.95

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Guillemot	3.49	1,734	1,117	2,559	403	23.24
	Razorbill	0.58	294	20	752	245	83.33
	Puffin	0.12	56	6	130	40	71.43
	Fulmar	0.01	6	0	18	6	100.97
	Manx shearwater	0.02	13	0	36	12	94.89
	Gannet	0.59	294	145	462	81	27.27
16-Jul-22	Curlew	0.01	6	0	18	6	91.93
	Kittiwake	0.86	431	309	557	65	14.98
	Black-headed gull	0.01	6	0	18	6	94.56
	Common gull	0.02	12	0	29	8	64.64
	Lesser black-backed gull	0.01	6	0	18	6	95.17
	Sandwich tern	0.01	6	0	18	6	101.53
	Common tern	0.02	12	0	29	8	64.11
	Guillemot	9.16	4,560	3,558	5,638	574	12.59
	Razorbill	3.65	1,812	1,116	2,557	423	23.34
	Puffin	0.28	141	85	211	37	26.24
	Fulmar	0.09	47	12	88	20	41.92
	Manx shearwater	0.46	229	46	511	133	57.89
	Gannet	0.60	299	227	378	39	12.86
08-Aug-22	Kittiwake	3.47	1,726	686	2,930	589	34.11
	Great black-backed gull	0.07	36	6	75	19	52.66
	Herring gull	0.00	1	0	2	1	93.97
	Lesser black-backed gull	0.12	59	6	133	33	55.76
	Common tern	0.16	81	16	189	48	59.29
	Arctic tern	0.02	11	0	31	10	83.29
	Guillemot	21.34	10,624	6,154	15,652	2,673	25.16
	Razorbill	0.40	199	56	417	108	54.27
	Puffin	0.10	52	16	96	27	51.92
	Fulmar	0.15	75	12	156	37	48.34

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Manx shearwater	0.32	158	35	326	79	49.48
	Gannet	0.50	252	142	364	58	22.81
23-Aug-22	Curlew	0.02	12	0	35	11	90.5
	Kittiwake	0.45	225	109	354	65	28.92
	Little gull	0.01	6	0	18	6	93.20
	Lesser black-backed gull	0.01	7	0	18	6	88.74
	Common tern	0.07	35	6	70	18	49.61
	Guillemot	4.42	2,201	1,487	3,098	432	19.63
	Razorbill	0.44	221	62	452	127	57.47
	Puffin	0.03	19	5	34	10	52.63
	Fulmar	0.01	6	0	18	6	93.09
	Manx shearwater	0.09	45	0	123	41	90.03
	Gannet	0.13	65	24	115	23	35.53
Array area plus 2km buffer							
22-Mar-21	Kittiwake	6.25	4,377	3,243	5,626	607	13.86
	Black-headed Gull	0.01	6	0	18	6	95.72
	Common Gull	0.03	18	0	47	13	68.97
	Great Black-backed Gull	0.03	18	0	36	9	49.13
	Herring Gull	0.02	13	0	30	8	64.37
	Lesser Black-backed Gull	0.01	7	0	18	6	94.39
	Little Auk	0.00	3	2	3	1	13.43
	Guillemot	10.18	7,127	5,887	8,626	687	9.64
	Razorbill	6.45	4,518	3,804	5,300	399	8.83
	Puffin	0.4	279	179	387	50	17.92
	Red-throated Diver	0.33	233	122	359	60	25.63
	Fulmar	0.05	38	6	81	19	49.67
	Gannet	0.33	234	105	392	75	32.08
04-Apr-21	Kittiwake	10.93	7,650	6,234	9,127	748	9.78
	Little gull	0.01	7	0	23	7	98.82

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Common gull	0.02	12	0	29	8	64.92
	Great black-backed gull	0.04	29	11	50	11	36.65
	Herring gull	0.02	14	0	30	9	60.95
	Lesser black-backed gull	0.03	25	6	47	11	42.45
	Sandwich tern	0.01	6	0	18	6	95.28
	Guillemot	36.4	25,484	19,290	32,300	3,559	13.97
	Razorbill	11.35	7,951	5,362	11,043	1,637	20.59
	Puffin	0.06	40	10	83	18	45.00
	Red-throated diver	0.26	181	90	287	51	27.84
	Great northern diver	0.01	7	0	18	6	92.02
	Fulmar	0.07	49	24	77	15	28.93
	Gannet	1.13	793	571	1,029	121	15.21
12-May-21	Kittiwake	3.53	2,469	981	4,361	864	34.99
	Common gull	0.01	7	0	18	6	91.14
	Great black-backed gull	0.01	6	0	18	6	99.10
	Lesser black-backed gull	0.01	7	0	19	6	96.64
	Sandwich tern	0.31	216	145	296	40	18.17
	Common tern	0.19	136	81	204	32	22.97
	Guillemot	7.62	5,329	4,221	6,858	672	12.61
	Razorbill	0.72	503	271	763	131	26.04
	Puffin	0.06	38	8	78	23	60.53
	Red-throated diver	0.03	18	0	36	10	50.44
	Gannet	0.08	55	18	98	21	36.74
09-Jun-21	Kittiwake	1.07	747	420	1,260	220	29.41
	Black-headed gull	0.01	6	0	18	6	93.21
	Little gull	0.01	7	0	19	7	92.39
	Common gull	0.02	13	0	30	8	65.94
	Herring gull	0.05	38	0	93	24	62.03
	Lesser black-backed gull	0.03	18	0	54	18	98.28

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Sandwich tern	0.03	18	0	47	13	68.87
	Common tern	0.03	18	0	42	12	63.6
	Arctic tern	0.02	12	0	28	7	56.35
	Guillemot	1.70	1,187	895	1,513	157	13.23
	Razorbill	0.32	225	123	348	58	25.78
	Puffin	0.05	33	10	63	17	51.52
	Fulmar	0.05	36	12	64	14	36.82
	Gannet	0.09	66	24	118	25	37.26
24-Jul-21	Kittiwake	3.43	2,404	1,395	3,899	648	26.92
	Black-headed gull	0.07	48	0	123	34	70.19
	Little gull	0.02	13	0	37	12	95.87
	Common gull	0.04	32	0	71	19	59.47
	Herring gull	0.03	19	0	41	10	51.51
	Lesser black-backed gull	0.03	19	0	36	10	50.67
	Arctic tern	0.01	6	0	18	6	100.00
	Guillemot	11.59	8,118	5,661	11,173	1,461	18.00
	Razorbill	3.85	2692	1,411	4,155	816	30.31
	Puffin	0.41	283	217	352	44	15.55
	Fulmar	0.09	67	24	120	26	37.89
	Manx shearwater	0.03	25	0	54	14	54.62
	Gannet	0.27	192	77	336	67	34.87
14-Aug-21	Oystercatcher	0.07	50	0	133	38	75.01
	Kittiwake	4.53	3,175	981	6,770	1,638	51.58
	Little gull	0.01	7	0	18	6	91.46
	Common tern	0.19	132	12	314	79	59.59
	Arctic tern	0.01	6	1	13	4	60.96
	Great skua	0.02	13	0	30	9	70.53
	Guillemot	23.52	16,467	9,567	25,305	4,384	26.62
	Razorbill	3.34	2,339	874	4,305	1,054	45.06

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Puffin	2.25	1,575	1,113	2,057	305	19.37
	Fulmar	0.04	31	6	66	16	51.31
	Gannet	0.18	127	80	175	25	19.39
07-Sep-21	Kittiwake	2.41	1,684	1,021	2,500	393	23.33
	Little gull	0.14	97	54	141	23	23.08
	Common gull	0.00	1	1	1	1	52.81
	Great black-backed gull	0.17	120	63	192	32	26.00
	Herring gull	0.00	1	0	2	1	92.03
	Lesser black-backed gull	0.04	31	12	57	12	39.86
	Sandwich tern	0.03	19	2	37	9	48.12
	Common tern	4.10	2,871	2,055	3,661	407	14.16
	Arctic tern	0.05	34	9	67	15	43.59
	Arctic skua	0.04	31	6	63	15	47.95
	Guillemot	31.77	22248	17879	26,599	2,716	12.21
	Razorbill	2.14	1,500	1,144	1,885	231	15.40
	Puffin	1.58	1,113	864	1,342	149	13.39
	Fulmar	0.03	18	0	36	9	50.71
	Gannet	0.15	108	71	148	21	18.81
09-Oct-21	Kittiwake	0.17	116	63	179	30	25.79
	Black-headed gull	0.05	37	6	71	17	43.96
	Little gull	0.56	395	248	553	78	19.58
	Common gull	0.04	31	7	54	13	39.68
	Great black-backed gull	0.12	84	6	223	63	74.88
	Herring gull	0.01	7	0	19	6	95.14
	Lesser black-backed gull	0.01	7	0	18	6	92.42
	Arctic skua	0.01	7	0	19	6	96.76
	Guillemot	9.23	6,469	5,133	8,132	700	10.82
	Razorbill	1.27	892	581	1,307	172	19.28
	Puffin	1.66	1,167	884	1,483	178	15.25

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Red-throated diver	0.03	25	6	48	11	43.23
	Gannet	0.17	119	59	186	34	27.78
02-Nov-21	Kittiwake	0.24	169	118	220	27	15.73
	Great black-backed gull	0.05	38	6	79	19	50.75
	Lesser black-backed gull	0.01	7	0	18	7	93.56
	Guillemot	9.14	6,393	5,114	7,592	641	10.03
	Razorbill	3.68	2,570	1,987	3,186	332	12.92
	Puffin	0.72	510	418	601	57	11.18
	Red-throated diver	0.01	7	0	18	6	98.46
	Gannet	0.24	169	83	293	53	31.18
15-Dec-21	Kittiwake	0.40	280	186	389	55	19.35
	Great black-backed gull	0.09	66	35	101	18	26.76
	Guillemot	4.56	3,186	2,599	3,817	271	8.51
	Razorbill	3.14	2,201	1,618	2,856	361	16.40
	Puffin	0.08	59	22	121	33	55.93
	Red-throated diver	0.02	12	0	30	8	67.08
	Fulmar	0.03	24	0	53	14	56.05
	Shag	0.02	12	0	29	8	63.82
06-Jan-22	Kittiwake	0.15	102	46	169	33	31.48
	Great black-backed gull	0.04	31	12	53	11	35.17
	Herring gull	0.02	13	0	30	9	66.53
	Guillemot	0.94	655	459	861	103	15.73
	Razorbill	0.77	537	330	772	128	23.84
	Fulmar	0.04	30	6	57	15	47.37
	Gannet	0.01	7	0	18	6	95.18
23-Feb-22	Kittiwake	1.12	784	581	977	102	12.95
	Common gull	0.01	7	0	18	6	95.91
	Great black-backed gull	0.02	13	0	30	9	66.99
	Guillemot	6.59	4,614	3,623	5,809	525	11.38

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Razorbill	7.47	5,229	4,280	6,127	508	9.72
	Puffin	0.01	13	2	29	10	76.92
	Red-throated diver	0.03	18	0	36	9	51.10
	Fulmar	0.04	29	0	71	20	68.44
	Gannet	0.04	30	6	60	15	47.21
	Shag	0.01	6	0	18	6	99.16
11-Mar-22	Kittiwake	4.77	3,326	2,100	4,772	690	20.75
	Little gull	0.01	7	0	24	7	101.01
	Common gull	0.14	95	36	169	34	35.11
	Great black-backed gull	0.02	12	0	30	9	70.58
	Herring gull	0.01	7	0	18	6	94.89
	Lesser black-backed gull	0.05	36	6	78	19	51.69
	Guillemot	10.49	7,312	5,286	9,606	1,176	16.08
	Razorbill	4.68	3,270	2,064	4,490	668	20.43
	Puffin	0.45	316	206	465	80	25.32
	Red-throated diver	0.05	37	12	64	14	37.60
	Gannet	0.34	240	116	390	70	28.90
	Shag	0.01	6	0	18	6	97.99
22-Mar-22	Kittiwake	4.19	2,920	2,413	3,478	285	9.73
	Little gull	0.03	24	0	60	16	65.47
	Guillemot	12.42	8,666	7,191	10,634	806	9.30
	Razorbill	2.02	1,409	972	1,890	255	18.10
	Puffin	0.21	150	93	219	35	23.33
	Red-throated diver	0.17	120	69	176	29	24.13
	Fulmar	0.07	48	12	89	20	40.17
	Gannet	0.15	103	48	167	31	29.68
02-Apr-22	Kittiwake	6.65	4,641	3,663	5,819	545	11.72
	Black-headed gull	0.01	6	0	18	6	93.70
	Great black-backed gull	0.02	13	0	36	12	97.62

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Herring gull	0.04	30	6	60	15	47.71
	Lesser black-backed gull	0.02	13	0	30	8	63.26
	Guillemot	40.98	28,579	22,693	34,893	3,005	10.51
	Razorbill	2.98	2,078	1,498	2,718	282	13.57
	Puffin	0.05	30	9	54	14	46.67
	Red-throated diver	0.34	240	131	360	60	24.90
	Fulmar	0.21	144	85	205	31	21.04
	Manx shearwater	0.02	18	0	42	13	70.83
	Gannet	0.51	355	188	543	92	25.74
15-Apr-22	Kittiwake	8.87	6,186	4,844	7,686	767	12.39
	Great black-backed gull	0.01	6	0	18	6	98.57
	Herring gull	0.02	12	0	30	9	69.50
	Lesser black-backed gull	0.02	12	0	30	9	71.07
	Sandwich tern	0.26	185	95	281	48	25.47
	Common tern	0.16	109	55	169	29	26.25
	Arctic tern	0.07	49	20	86	17	34.95
	Guillemot	18.84	13,144	9,507	17,023	1,977	15.04
	Razorbill	2.22	1,546	919	2,312	356	23.03
	Puffin	0.16	112	37	212	42	37.50
	Red-throated diver	0.05	36	17	59	12	31.20
	Fulmar	0.06	43	12	77	18	41.34
	Gannet	2.07	1,446	890	2,112	321	22.20
02-May-22	Kittiwake	6.91	4,820	3,979	5,732	456	9.45
	Common gull	0.01	7	0	18	6	95.70
	Herring gull	0.02	12	0	29	8	62.52
	Lesser black-backed gull	0.04	25	0	54	14	56.83
	Sandwich tern	0.23	163	53	290	61	37.50
	Arctic tern	0.19	132	80	190	29	21.42
	Great skua	0.01	7	0	18	6	91.47

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Guillemot	19.80	13,806	11,389	16,732	1,492	10.81
	Razorbill	3.65	2,549	1,859	3,362	383	15.03
	Puffin	0.43	304	200	429	77	25.33
	Red-throated diver	0.02	13	0	30	8	63.35
	Fulmar	0.10	74	35	122	23	30.80
	Gannet	1.46	1,018	752	1,358	154	15.11
17-May-22	Kittiwake	3.70	2,584	1,717	4,079	638	24.69
	Great black-backed gull	0.01	6	0	18	6	95.65
	Herring gull	0.01	6	0	18	6	93.90
	Lesser black-backed gull	0.02	13	0	30	9	67.61
	Sandwich tern	0.13	92	48	144	26	27.48
	Common tern	0.21	146	59	244	47	31.55
	Arctic tern	0.01	8	1	20	6	80.36
	Guillemot	6.74	4,709	3,682	6,095	641	13.61
	Razorbill	0.61	427	279	598	91	21.31
	Puffin	0.02	19	5	38	11	57.89
	Red-throated diver	0.01	7	0	18	6	87.91
	Gannet	0.21	145	85	220	35	23.95
09-Jun-22	Kittiwake	1.52	1,062	520	1,914	381	35.82
	Great black-backed gull	0.03	19	3	48	13	65.32
	Herring gull	0.03	25	0	65	18	74.65
	Lesser black-backed gull	0.03	18	0	47	13	68.68
	Sandwich tern	0.2	137	59	234	46	33.55
	Common tern	0.04	31	0	72	20	64.79
	Guillemot	4.14	2,886	1,685	4,586	847	29.35
	Razorbill	0.60	414	204	727	149	35.99
	Puffin	0.05	40	7	85	19	47.50
	Fulmar	0.02	13	0	27	7	55.66
	Gannet	0.23	161	95	232	36	22.03

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
21-Jun-22	Curlew	0.01	7	0	18	6	90.68
	Kittiwake	5.00	3,489	2,456	4,897	650	18.63
	Great black-backed gull	0.03	19	0	36	10	50.41
	Herring gull	0.39	274	113	472	94	34.17
	Lesser black-backed gull	0.03	18	0	36	9	50.79
	Sandwich tern	0.08	60	18	108	23	38.49
	Common tern	0.01	7	0	18	7	96.87
	Guillemot	6.96	4,854	3,958	5,925	525	10.82
	Razorbill	0.45	313	130	553	124	39.62
	Fulmar	0.06	43	12	76	17	38.43
	Manx shearwater	0.01	6	0	18	6	95.89
	Gannet	0.76	528	307	797	128	24.17
04-Jul-22	Curlew	0.01	7	0	18	6	94.43
	Kittiwake	0.71	496	366	634	69	13.80
	Herring gull	0.05	38	0	95	27	71.12
	Lesser black-backed gull	0.02	12	0	36	12	97.17
	Guillemot	4.20	2,933	2,053	4,110	547	18.65
	Razorbill	0.64	449	97	1,017	308	68.60
	Puffin	0.13	90	20	188	57	63.33
	Fulmar	0.01	7	0	18	6	95.66
	Manx shearwater	0.02	13	0	36	12	90.79
	Gannet	0.51	353	196	524	85	23.86
16-Jul-22	Curlew	0.01	7	0	18	6	92.82
	Kittiwake	1.63	1,140	699	1,743	268	23.48
	Black-headed gull	0.01	7	0	18	6	94.10
	Common gull	0.03	18	0	37	10	52.22
	Great black-backed gull	0.03	19	0	54	18	95.76
	Herring gull	0.03	19	0	47	13	69.02
	Lesser black-backed gull	0.03	18	0	47	13	69.05

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Sandwich tern	0.01	6	0	18	6	97.34
	Common tern	0.03	18	0	37	10	52.02
	Guillemot	14.79	10,311	6,461	15,198	2,321	22.51
	Razorbill	6.17	4,301	2,465	6,568	1,142	26.55
	Puffin	0.43	295	155	473	88	29.83
	Fulmar	0.09	66	29	109	21	30.67
	Manx shearwater	0.37	259	61	588	147	56.54
	Gannet	0.74	517	389	662	70	13.51
08-Aug-22	Kittiwake	6.80	4,740	1,732	8,566	1,783	37.62
	Great black-backed gull	0.06	43	12	89	21	48.33
	Herring gull	0.00	1	0	2	1	95.18
	Lesser black-backed gull	0.10	71	18	144	34	47.45
	Common tern	0.18	126	30	239	56	44.19
	Arctic tern	0.02	12	0	32	10	85.74
	Guillemot	40.68	28,373	10,036	50,929	11,431	40.29
	Razorbill	0.44	306	73	645	177	57.84
	Puffin	0.12	85	41	129	29	34.12
	Fulmar	0.13	92	24	184	40	43.51
	Manx shearwater	0.28	193	52	399	90	46.69
	Gannet	0.45	311	206	427	57	18.21
23-Aug-22	Golden plover	0.03	24	0	91	24	98.41
	Curlew	0.02	12	0	36	12	95.10
	Kittiwake	0.74	517	156	1,117	261	50.43
	Little gull	0.01	6	0	18	6	98.97
	Great black-backed gull	0.01	6	0	18	6	102.32
	Lesser black-backed gull	0.03	19	0	48	13	71.89
	Common tern	0.09	66	24	114	24	35.50
	Guillemot	4.73	3,294	2,361	4,374	576	17.49
	Razorbill	0.61	427	194	731	155	36.30

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Puffin	0.02	20	5	36	11	55.00
	Fulmar	0.01	6	0	18	6	96.20
	Manx shearwater	0.07	47	0	131	39	83.95
	Gannet	0.11	78	35	127	24	30.74
Array area plus 4km buffer (correction factor not applied to auks)							
22-Mar-21	Kittiwake	5.96	5,520	4,326	6,824	624	11.30
	Black-headed gull	0.01	7	0	19	6	96.71
	Common gull	0.05	43	12	77	17	39.23
	Great black-backed gull	0.03	31	0	74	19	59.91
	Herring gull	0.01	12	0	31	8	66.63
	Lesser black-backed gull	0.01	7	0	19	6	95.68
	Little auk	0.01	10	3	22	6	62.68
	Guillemot	7.76	7,183	6,056	8,514	642	8.93
	Razorbill	4.98	4,610	4,042	5,195	311	6.73
	Puffin	0.32	297	228	371	38	12.52
	Red-throated diver	0.29	269	166	393	61	22.46
	Fulmar	0.08	71	11	155	40	56.61
	Gannet	0.29	268	128	438	79	29.24
04-Apr-21	Kittiwake	9.75	9,022	7,339	10,847	910	10.09
	Little gull	0.01	13	0	31	9	66.14
	Common gull	0.01	13	0	30	8	62.18
	Great black-backed gull	0.03	29	11	50	11	35.88
	Herring gull	0.02	19	2	41	10	52.02
	Lesser black-backed gull	0.03	31	7	54	12	37.72
	Sandwich tern	0.01	7	0	19	7	95.64
	Guillemot	24.44	22,618	17,993	274,20	2,462	10.88
	Razorbill	7.91	7,316	5,209	9,980	1,201	16.41
	Puffin	0.04	41	16	69	14	34.65
	Red-throated diver	0.22	204	109	310	52	25.49

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Great northern diver	0.01	7	0	19	6	97.81
	Fulmar	0.06	56	25	90	17	29.60
	Gannet	0.99	913	682	1,175	131	14.33
12-May-21	Kittiwake	3.08	2,846	1,431	4,683	860	30.21
	Common gull	0.01	7	0	18	6	89.85
	Great black-backed gull	0.01	7	0	19	6	98.34
	Lesser black-backed gull	0.01	7	0	19	6	97.70
	Sandwich tern	0.25	234	150	321	45	19.11
	Common tern	0.17	156	89	232	36	22.87
	Guillemot	5.27	4,879	3,996	6,060	520	10.64
	Razorbill	0.64	589	404	805	105	17.67
	Puffin	0.04	40	11	77	17	42.59
	Red-throated diver	0.02	19	0	41	10	52.87
	Gannet	0.10	93	48	145	25	26.69
09-Jun-21	Kittiwake	1.14	1,055	678	1,567	236	22.35
	Black-headed gull	0.01	6	0	19	6	94.45
	Little gull	0.01	6	0	19	6	100.12
	Common gull	0.01	13	0	31	9	65.23
	Herring gull	0.04	37	0	91	24	65.64
	Lesser black-backed gull	0.03	25	0	65	18	72.78
	Sandwich tern	0.05	48	18	83	17	35.50
	Common tern	0.03	26	3	56	14	53.79
	Arctic tern	0.01	13	0	30	8	58.19
	Guillemot	1.31	1,211	966	1,460	131	10.75
	Razorbill	0.35	322	204	450	62	19.19
	Puffin	0.04	38	13	69	14	36.46
	Fulmar	0.04	37	13	62	13	35.09
	Gannet	0.09	81	30	152	32	39.48
24-Jul-21	Kittiwake	3.16	2,927	1,834	4,461	702	23.97

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Black-headed gull	0.07	62	7	152	37	60.34
	Little gull	0.01	13	0	37	12	93.22
	Common gull	0.04	38	6	82	20	53.16
	Herring gull	0.02	19	0	41	10	51.97
	Lesser black-backed gull	0.03	26	7	48	11	41.80
	Sandwich tern	0.01	7	0	19	6	96.07
	Arctic tern	0.01	6	0	19	6	96.44
	Arctic skua	0.01	7	0	19	6	93.23
	Guillemot	8.91	8,247	6,173	10,466	1,119	13.56
	Razorbill	3.51	3,248	1,887	4,846	761	23.42
	Puffin	0.35	321	256	389	36	11.02
	Fulmar	0.08	75	25	128	27	35.61
	Manx shearwater	0.12	114	5	303	87	76.48
	Gannet	0.36	335	188	506	84	25.06
14-Aug-21	Oystercatcher	0.05	50	0	127	36	72.35
	Kittiwake	5.71	5,283	2,135	9,232	1,890	35.77
	Little gull	0.01	13	0	31	9	67.60
	Great black-backed gull	0.01	13	0	37	12	94.69
	Common tern	0.49	453	125	1,019	230	50.73
	Arctic tern	0.02	17	3	40	11	63.95
	Great skua	0.01	13	0	31	9	68.90
	Guillemot	24.64	22,795	13,551	35,153	5,508	24.16
	Razorbill	3.82	3,532	1,402	6,101	1,238	35.05
	Puffin	2.12	1,959	1,466	2,505	266	13.53
	Fulmar	0.03	30	6	61	15	48.49
	Manx shearwater	0.01	7	0	19	7	97.77
	Gannet	0.19	177	119	229	29	16.33
07-Sep-21	Kittiwake	2.29	2,117	1,481	2,920	378	17.83
	Little gull	0.12	111	62	162	27	23.64

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Common gull	0.01	7	1	19	6	91.53
	Great black-backed gull	0.21	191	78	356	72	37.48
	Herring gull	0.01	7	0	19	6	90.26
	Lesser black-backed gull	0.04	37	13	61	13	33.88
	Sandwich tern	0.02	20	2	38	10	50.29
	Common tern	4.39	4,062	3,212	5,013	446	10.96
	Arctic tern	0.08	72	33	115	21	28.89
	Arctic skua	0.03	31	6	61	14	44.83
	Guillemot	28.23	26,122	20,472	31,909	2,960	11.33
	Razorbill	1.78	1,644	1,272	2,005	190	11.55
	Puffin	1.41	1,301	1,090	1,515	109	8.33
	Fulmar	0.02	19	0	37	10	49.12
	Manx shearwater	0.05	45	0	162	45	99.47
	Gannet	0.18	171	131	217	22	12.56
09-Oct-21	Kittiwake	0.16	150	86	224	35	22.90
	Black-headed gull	0.05	49	12	90	20	40.59
	Little gull	0.80	737	537	966	115	15.51
	Common gull	0.04	38	13	65	13	34.59
	Great black-backed gull	0.12	108	21	245	65	60.27
	Herring gull	0.02	16	0	34	9	56.28
	Lesser black-backed gull	0.01	8	0	22	7	80.09
	Arctic skua	0.01	6	0	19	6	97.72
	Guillemot	6.92	6,401	5,305	7,514	569	8.89
	Razorbill	1.19	1,102	802	1,449	174	15.71
	Puffin	1.25	1,157	920	1,454	136	11.72
	Red-throated diver	0.03	25	6	47	10	41.27
	Gannet	0.18	166	83	263	46	27.44
02-Nov-21	Kittiwake	0.24	225	173	276	27	11.93

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Little gull	0.03	26	0	61	17	65.08
	Great black-backed gull	0.05	43	12	83	19	43.27
	Lesser black-backed gull	0.01	6	0	19	6	96.03
	Guillemot	7.18	6,644	5,466	7,788	599	9.01
	Razorbill	3.02	2,794	2,193	3,405	311	11.13
	Puffin	0.59	544	462	622	42	7.60
	Red-throated diver	0.01	7	0	19	6	93.17
	Fulmar	0.01	7	0	19	7	102.77
	Gannet	0.35	322	158	522	93	28.73
15-Dec-21	Kittiwake	0.42	390	261	538	71	18.11
	Little gull	0.01	6	0	19	6	97.43
	Great black-backed gull	0.09	86	42	133	23	26.90
	Guillemot	3.39	3,138	2,635	3,650	261	8.30
	Razorbill	2.32	2,144	1,601	2,731	283	13.16
	Puffin	0.07	62	27	114	25	39.11
	Red-throated diver	0.03	24	0	54	14	54.76
	Fulmar	0.03	25	0	55	14	55.46
	Shag	0.02	20	0	48	13	66.50
06-Jan-22	Kittiwake	0.15	139	78	213	36	25.44
	Great black-backed gull	0.03	31	12	54	12	36.77
	Herring gull	0.02	18	0	41	10	54.59
	Guillemot	0.63	581	418	752	84	14.41
	Razorbill	0.58	542	356	766	101	18.57
	Red-throated diver	0.01	6	0	19	6	98.62
	Fulmar	0.04	38	12	72	16	42.61
	Gannet	0.01	7	0	19	6	94.14
	Shag	0.01	7	0	19	6	94.75

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
23-Feb-22	Kittiwake	1.34	1,236	884	1,714	227	18.34
	Common gull	0.03	31	1	86	25	78.43
	Great black-backed gull	0.01	13	0	30	9	67.35
	Guillemot	4.45	4,116	3,337	5,062	438	10.62
	Razorbill	5.54	5,127	4,377	5,917	404	7.87
	Puffin	0.01	12	4	27	7	57.88
	Red-throated diver	0.02	19	0	42	10	55.03
	Fulmar	0.05	45	10	92	22	47.68
	Gannet	0.03	31	6	61	15	47.16
	Shag	0.01	6	0	19	6	99.49
11-Mar-22	Kittiwake	4.26	3,925	2,586	5,665	774	19.72
	Black-headed gull	0.01	6	0	19	6	98.55
	Little gull	0.01	7	0	19	6	93.87
	Common gull	0.1	96	36	162	33	33.9
	Great black-backed gull	0.01	13	0	30	8	63.87
	Herring gull	0.01	7	0	19	6	99.53
	Lesser black-backed gull	0.04	36	6	78	20	53.65
	Guillemot	7.22	6,655	5,170	8,471	871	13.09
	Razorbill	3.38	3,120	2,196	4,034	475	15.20
	Puffin	0.33	307	198	418	57	18.33
	Red-throated diver	0.04	36	12	66	15	39.95
	Gannet	0.29	271	145	411	68	24.89
	Shag	0.01	7	0	19	6	92.43
22-Mar-22	Kittiwake	4.00	3,684	3,026	4,350	337	9.13
	Little gull	0.03	25	0	60	17	67.47
	Lesser black-backed gull	0.01	13	0	30	9	65.8
	Guillemot	9.11	8,396	7,290	9,567	603	7.18
	Razorbill	1.62	1,494	1,048	1,971	231	15.40

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Puffin	0.18	163	119	207	23	14.01
	Red-throated diver	0.14	132	71	200	34	25.53
	Fulmar	0.07	61	24	103	21	34.58
	Gannet	0.18	163	96	232	36	21.93
02-Apr-22	Kittiwake	6.06	5,587	4,559	6,873	578	10.34
	Black-headed gull	0.01	7	0	19	6	93.00
	Great black-backed gull	0.01	13	0	37	13	96.81
	Herring gull	0.03	32	6	61	15	45.57
	Lesser black-backed gull	0.01	12	0	30	8	66.30
	Guillemot	30.14	27,787	22,898	32,763	2,443	8.79
	Razorbill	2.29	2,114	1,675	2,576	227	10.70
	Puffin	0.03	29	11	50	11	35.87
	Red-throated diver	0.32	295	188	413	59	19.89
	Fulmar	0.19	171	112	240	34	19.67
	Manx shearwater	0.02	19	0	47	13	67.62
	Gannet	0.42	387	211	566	94	24.10
15-Apr-22	Kittiwake	7.95	7,330	5,703	9,049	854	11.65
	Great black-backed gull	0.01	7	0	19	7	99.94
	Herring gull	0.02	19	0	48	14	70.62
	Lesser black-backed gull	0.01	12	0	31	9	68.23
	Sandwich tern	0.25	230	137	343	54	23.2
	Common tern	0.15	138	65	213	39	27.65
	Arctic tern	0.05	51	20	88	18	35.23
	Guillemot	13.83	12,751	9,978	15,701	1,482	11.62
	Razorbill	1.68	1,550	1,041	2,175	297	19.10
	Puffin	0.15	137	71	212	37	26.47
	Red-throated diver	0.04	36	13	61	12	33.11
	Fulmar	0.05	43	12	78	17	39.51
	Gannet	1.91	1,757	1,156	2,467	349	19.85

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Marsh harrier	0.01	6	0	19	7	101.25
02-May-22	Kittiwake	6.42	5,915	5,128	6,821	436	7.36
	Common gull	0.01	7	0	19	7	97.90
	Herring gull	0.01	12	0	30	8	64.45
	Lesser black-backed gull	0.03	25	0	59	15	58.90
	Sandwich tern	0.23	214	85	359	70	32.79
	Arctic tern	0.17	158	109	217	28	17.43
	Great skua	0.01	7	0	19	6	97.47
	Guillemot	14.73	13,582	11,143	16,170	1,282	9.43
	Razorbill	2.90	2,677	2,030	3,424	370	13.80
	Puffin	0.40	369	253	503	64	17.29
	Red-throated diver	0.02	19	0	37	10	49.46
	Fulmar	0.09	81	41	130	24	28.75
	Gannet	1.40	1,288	974	1,635	171	13.23
17-May-22	Kittiwake	3.58	3,298	2,261	4,789	661	20.04
	Great black-backed gull	0.01	7	0	18	6	92.90
	Herring gull	0.01	12	0	37	12	100.41
	Lesser black-backed gull	0.01	12	0	30	9	67.95
	Sandwich tern	0.11	104	55	152	25	23.93
	Common tern	0.19	173	84	277	51	29.28
	Arctic tern	0.01	8	1	21	6	81.97
	Guillemot	4.98	4,592	3,761	5,634	484	10.54
	Razorbill	0.53	485	360	615	67	13.67
	Puffin	0.03	29	9	61	15	49.09
	Red-throated diver	0.01	7	0	19	6	93.76
	Gannet	0.25	230	157	322	41	17.87
09-Jun-22	Kittiwake	1.81	1,667	981	2,613	434	26.03
	Great black-backed gull	0.02	22	3	49	13	57.36
	Herring gull	0.03	31	0	89	25	80.46

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Lesser black-backed gull	0.02	19	0	48	13	69.97
	Sandwich tern	0.16	148	66	246	49	32.94
	Common tern	0.04	36	0	85	21	58.02
	Guillemot	3.32	3,061	2,014	4,673	717	23.40
	Razorbill	0.52	483	265	756	121	25.02
	Puffin	0.04	38	12	71	15	39.27
	Fulmar	0.02	22	6	39	9	39.79
	Gannet	0.24	219	134	302	44	19.94
21-Jun-22	Curlew	0.01	6	0	19	6	96.81
	Kittiwake	4.63	4,266	3,224	5,665	623	14.60
	Great black-backed gull	0.03	31	6	60	14	45.48
	Herring gull	0.41	378	219	588	91	24.12
	Lesser black-backed gull	0.04	36	12	67	15	40.89
	Sandwich tern	0.07	68	24	115	25	36.05
	Common tern	0.01	7	0	19	7	94.11
	Guillemot	5.29	4,875	4,196	5,571	365	7.49
	Razorbill	0.37	340	178	529	92	26.86
	Fulmar	0.05	44	13	80	17	38.37
	Manx shearwater	0.01	7	0	19	6	89.25
	Gannet	0.77	714	471	1,005	137	19.18
04-Jul-22	Curlew	0.01	6	0	19	6	96.50
	Kittiwake	0.92	851	556	1,277	189	22.21
	Herring gull	0.05	44	0	101	27	60.90
	Lesser black-backed gull	0.01	12	0	37	12	96.06
	Guillemot	3.68	3,396	2,514	4,408	484	14.25
	Razorbill	0.67	621	263	1162	234	37.66
	Puffin	0.13	124	52	213	43	34.28
	Fulmar	0.01	7	0	19	7	99.40
	Manx shearwater	0.03	25	0	60	17	65.95

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
	Gannet	0.55	512	356	682	85	16.55
16-Jul-22	Curlew	0.01	6	0	18	6	97.35
	Kittiwake	1.99	1,832	1,244	2,532	334	18.21
	Black-headed gull	0.01	12	0	30	9	68.35
	Common gull	0.04	38	13	66	14	35.23
	Great black-backed gull	0.02	19	0	55	18	94.72
	Herring gull	0.02	19	0	47	13	67.33
	Lesser black-backed gull	0.05	43	12	77	18	40.23
	Sandwich tern	0.01	7	0	19	6	95.88
	Common tern	0.03	25	0	55	14	56.03
	Guillemot	14.5	13,370	8,557	19,401	2,821	21.09
	Razorbill	6.52	6,009	3,907	8,443	1,185	19.72
	Puffin	0.47	436	257	662	107	24.37
	Fulmar	0.09	86	48	126	21	23.73
	Manx shearwater	0.44	408	169	739	149	36.53
	Gannet	0.92	853	665	1,055	100	11.67
08-Aug-22	Kittiwake	11.90	10,974	3,425	23,092	5,116	46.62
	Common gull	0.01	7	0	19	6	92.17
	Great black-backed gull	0.06	55	18	100	21	38.02
	Herring gull	0.06	54	0	163	53	98.67
	Lesser black-backed gull	0.08	78	18	149	35	44.51
	Common tern	0.21	191	78	326	65	33.71
	Arctic tern	0.02	19	0	46	13	66.90
	Guillemot	43.98	40,538	16,788	71,905	13,963	34.44
	Razorbill	0.49	449	245	721	128	28.36
	Puffin	0.10	91	52	131	21	22.66
	Fulmar	0.12	115	47	194	41	35.63
	Manx shearwater	0.28	256	97	480	97	37.83
	Gannet	0.52	483	319	652	85	17.53

Month	Species	Density estimate (n/km²)	Population estimate (individuals)	Lower 95% CI (individuals)	Upper 95% CI (individuals)	SD (individuals)	CV (%)
23-Aug-22	Golden plover	0.08	76	0	195	55	72.94
	Curlew	0.01	12	0	36	11	93.06
	Kittiwake	1.07	984	266	2,316	519	52.67
	Little gull	0.01	6	0	19	6	98.41
	Great black-backed gull	0.01	12	0	30	9	69.6
	Herring gull	0.01	7	0	19	6	91.78
	Lesser black-backed gull	0.02	19	0	48	13	69.29
	Common tern	0.18	169	55	335	71	41.58
	Guillemot	4.33	3,988	2,962	5,263	600	15.04
	Razorbill	0.55	509	289	736	115	22.50
	Puffin	0.04	33	16	54	11	31.66
	Fulmar	0.01	6	0	18	6	97.08
	Manx shearwater	0.05	49	0	138	41	83.93
	Gannet	0.14	128	71	191	31	24.07