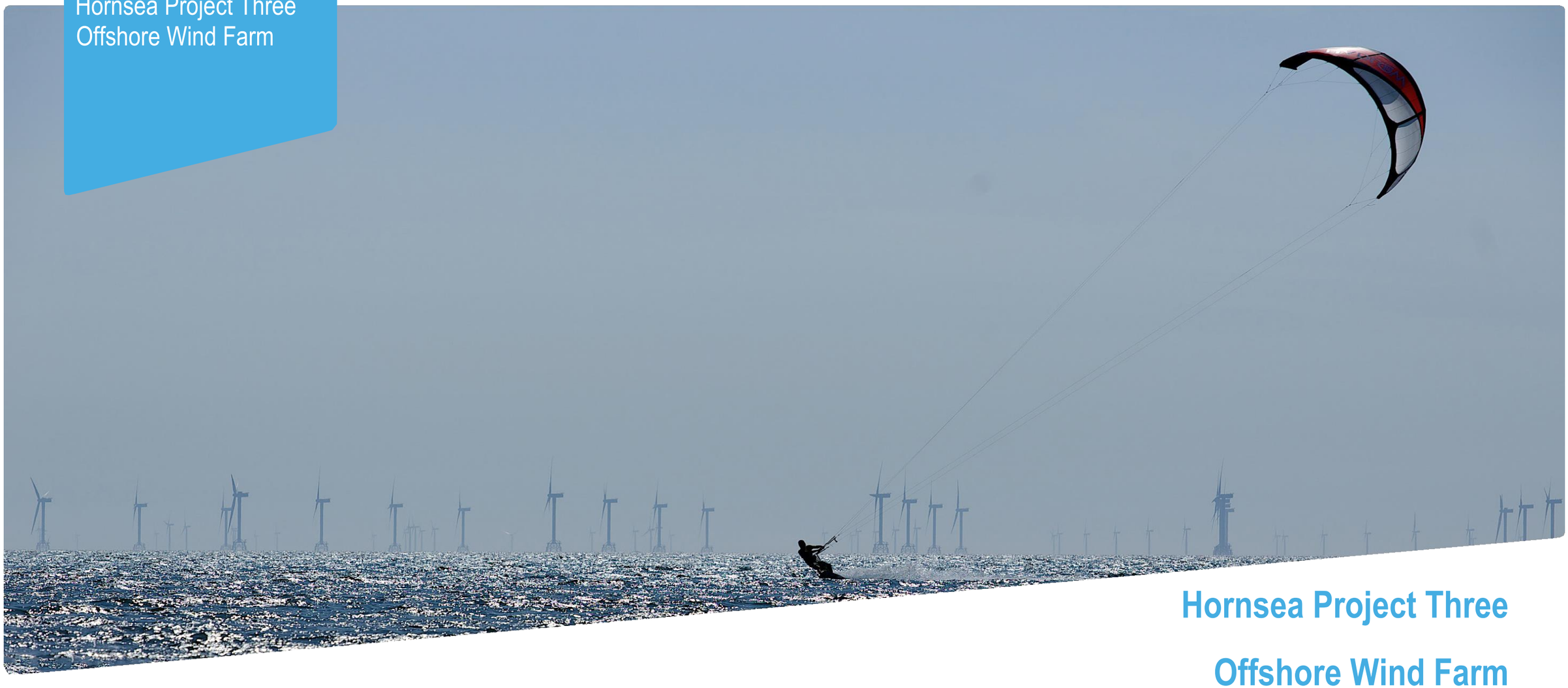
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Environmental Statement:
Volume 5, Annex 5.1 - Baseline Characterisation Report

PINS Document Reference: A6.5.5.1
AFPF Regulation 5(2)(a)

Date: May 2018

Hornsea 3
Offshore Wind Farm

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Environmental Impact Assessment

Environmental Statement

Volume 5

Annex 5.1 – Baseline Characterisation Report

Report Number: A6.5.5.1

Version: Final

Date: May 2018

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5 Howick Place,

London, SW1P 1WG

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Prepared by: NIRAS Consulting Ltd.

Checked by: Felicity Browner, Sophie Banham

Accepted by: Sophie Banham

Approved by: Sophie Banham

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Glossary

Term	Definition
Bathymetry	The measurement of water depth in oceans, seas and lakes
Birds Directive	European Parliament and Council Directive 2009/147/EC on the conservation of wild birds – a key legislative measure for the protection of birds in the European Union
Development Consent Order	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Export cable route (ECR) corridor	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Three array area to the Norwich Main National Grid substation, within which the export cables will be located. The final ECR corridor will be located within the ECR corridor search area and will be defined via a site selection process considering technical, physical and environmental constraints.
Former Hornsea Zone	The Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases (AfLs), were agreed with The Crown Estate for Hornsea Project One, Hornsea Project Two, Hornsea Project Three and Hornsea Project Four. The Hornsea Zone has therefore been dissolved and is referred to throughout the Hornsea Project Three Scoping Report as the former Hornsea Zone.
Habitats Directive	Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI).
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
Hornsea Project One	The first offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.2 gigawatts (GW) or 1,200 MW and includes all necessary offshore and onshore infrastructure required to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Project One throughout the Environmenal Statement.
Hornsea Project Three offshore wind farm	The third offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 2.4 GW (2,400 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at Norwich Main, Norfolk. Referred to as Hornsea Three throughout the Environmental Statement.
Hornsea Project Two	The second offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.8 GW (1,800 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Project Two throughout the Environmental Statement.
Impact	Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact).
Mean High Water Spring (MHWS)	The height of mean high water during spring tides in a year.
Nationally Significant Infrastructure Project (NSIP)	Large scale development including power generating stations which requires development consent under the Planning Act 2008. An offshore wind farm project with a capacity of more than 100 MW constitutes an NSIP.
Planning Inspectorate (PINS)	The executive agency of the Department for Communities and Local Government responsible for operating the planning process for NSIPs.
Statutory Nature Conservation Bodies	Comprised of JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage these agencies provide advice in relation to nature conservation to government

Acronyms

Unit	Description
ASL	Above Sea Level
BDMPS	Biologically Defined Minimum Population Scale
CI	Confidence Interval
CV	Coefficient of Variation
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
EIA	Environmental Impact Assessment
EU	European Union
EWG	Expert Working Group
FAME	Future of the Atlantic Marine Environment
GPS	Global Positioning System
GSD	Ground Sample Distance
HRA	Habitats Regulations Assessment
HVAC	High Voltage Alternating Current

Unit	Description
IPC	Infrastructure Planning Commission
JNCC	Joint Nature Conservation Committee
MHWS	Mean High Water Spring
MMO	Marine Management Organisation
NNR	National Nature Reserve
PCH	Potential Collision Height
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
pSPA	Potential Special Protection Area
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STAR	Seabird Tracking and Research
UK	United Kingdom
VOR	Valued Ornithological Receptor

Units

Unit	Description
m	Metres
km	Kilometres
km^2	Square kilometres
MW	Megawatt

1. Baseline Characterisation

1.1 Introduction

1.1.1 Context

1.1.1.1 The purpose of this Annex is to provide a detailed baseline characterisation of birds within and around the Hornsea Three offshore wind farm including the array area and the offshore export cable route with relevant study areas shown in Figure 1.2. It was agreed in consultation with the Statutory Nature Conservation Bodies (SNCBs) as part of the Evidence Plan process (Consultation Report Annex 1 Evidence Plan) that offshore ornithology would encompass all those bird populations with the likelihood to interact with Hornsea Three below Mean High Water Springs (MHWS). Those bird populations with a greater propensity to interact with Hornsea Three above MHWS (e.g. breeding ringed plover), are considered in Volume 3, Chapter 3: Terrestrial Ecology.

1.1.1.2 Site specific offshore aerial bird surveys have been conducted in order to collect data for an ornithological characterisation of the Hornsea Three array area[1] plus a 4 km buffer. This characterisation informs the baseline against which potential impacts of the proposed development are assessed. This Annex includes data from twenty aerial surveys undertaken between April 2016 and November 2017.

1.1.1.3 An overview of the baseline, together with the impact assessment, cumulative and transboundary impact assessment are provided in the Volume 2, Chapter 5: Offshore Ornithology. Details of the offshore ornithology study area, legislation and guidance, consultation, data sources, and methodology for data collection are also included within Volume 2, Chapter 5: Offshore Ornithology.

1.1.1.4 It is recommended that this Baseline Characterisation Report is read in-conjunction with Volume 2, Chapter 5: Offshore Ornithology.

1.1.2 Purpose and scope

1.1.2.1 This report presents an outline of the study methodology, together with baseline results from the site-specific aerial surveys which were designed to best inform the ornithological baseline characterisation of the Hornsea Three array area. This report therefore:

- Collates all ornithological data gathered to date for the Hornsea Three application and provides a baseline description of the ornithological interests within the Hornsea Three array area and export cable route; and
- Establishes the ornithological importance of Hornsea Three for breeding, wintering and migratory birds by analysing aerial survey data, and other data sources from the wider area.

1.1.2.2 In relation to nature conservation importance, three key potential legislative impact pathways on the seabird assemblage during the construction, operation and maintenance, and decommissioning of Hornsea Three have been identified:

- The potential for the project to adversely affect seabirds of highest conservation concern, listed on Annex 1 of the EU Birds Directive (2009/147/EC, the codified version - updated to incorporate the original Directive and all amendments of Council Directive (79/409/EEC)), and/or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended);
- The potential for the project to adversely affect qualifying ornithological features of nearby designated sites; Natura 2000 sites (Special Protection Areas (SPAs)), sites of national value (Sites of Special Scientific Interest (SSSIs)), and internationally designated sites (Ramsar); and
- The potential for the project to adversely affect other species in internationally-, nationally- or regionally-important numbers in winter, during migration, or whilst commuting locally between foraging areas (which may include Hornsea Three) and breeding colonies.

1.1.2.3 The structure of this report is as follows:

- Section 1.2 provides an overview of the methodologies used to gather, analyse and present baseline data, as well as the rationale behind, and procedures used, to define population importance and sensitivity for each key species;
- Section 1.3 presents the results gathered from desk-based studies and aerial surveys to characterise the baseline environment. Information is provided for raw counts of all species recorded at Hornsea Three;
- Section 1.4 presents an overview of each key species' sensitivity based on a literature review.
- Section 1.5 identifies sites of conservation concern with potential connectivity with Hornsea Three during the breeding season, based on the foraging behaviour of those species designated as qualifying features at relevant sites of conservation concern.
- Section 1.6 contains individual species accounts for species recorded during surveys of Hornsea Three and provides discussion pertaining to trends in spatial, seasonal or inter-annual variation. The relative importance of Hornsea Three to the species' background populations are also considered in a wider spatial context.
- Section 1.7 then takes all the presented information to summarise which species should be considered for impact assessment, based on the importance of the populations recorded during the baseline period.

[1] This is where the offshore wind farm will be located, which will include the turbines, wind turbine and offshore structure foundations, array cables, offshore accommodation platforms and a range of offshore substations as well as offshore interconnector cables and export cables (Volume 1, Chapter 3: Project Description).

1.1.3 Relevant legislation

1.1.3.1 This section provides a brief introduction to the relevant international conventions, European directives and relevant UK legislation.

1.1.3.2 Within the European Union, the key legislative measures providing for the protection of birds are the European Parliament and Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive'), and Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'). In addition, the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) may be relevant as Ramsar sites are typically protected in the UK through designations as SPAs and SSSIs.

1.1.3.3 Articles 2 and 3 of the Birds Directive aim to maintain the populations of all wild bird species across their natural range and encourage various activities, which promote this. Article 4 of the Birds Directive allows for the designation of SPAs for rare and vulnerable species listed in Annex I of the Birds Directive, as well as for regularly occurring migratory species, especially wetland species of international significance. The Birds Directive satisfies the commitments of the European Community under the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention).

1.1.3.4 SPAs designated under the Birds Directive (together with Special Areas of Conservation designated under the Habitats Directive) form part of the network of Natura 2000 sites.

1.1.3.5 The Habitats and Birds Directives have been transposed into UK legislation through the Conservation of Habitats and Species Regulations 2010 (as amended) and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (together the 'Habitats Regulations'). These Regulations allow for the designation of SPAs and set out a mechanism for the protection of those sites.

1.1.3.6 The Wildlife and Countryside Act 1981 (as amended) implements the Birds Directive in the UK. The Act provides protection for wild birds by making it an offence to kill, injure, or take any wild bird or take, damage or destroy the nest or eggs of a wild bird, as well as disturb breeding birds listed on Schedule 1 of the Act. The Act also provides for the designation of Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR) in the UK.

1.1.4 Consultation with key stakeholders

Hornsea Project One and Hornsea Project Two

1.1.4.1 Hornsea Three has similarities, both in terms of its nature and location, to Hornsea Project One and Hornsea Project Two. The matters relevant to Hornsea Three, which were raised by consultees during the pre-application and examination phases of these projects, are detailed in Volume 2, Chapter 5: Offshore Ornithology. All of these matters will be considered in the Environmental Impact Assessment (EIA) for Hornsea Three, with responses specific to Hornsea Three in relation to those issues that arose during the application and examination phases of Hornsea Project One and Hornsea Project Two also detailed in Volume 2, Chapter 5: Offshore Ornithology.

Hornsea Three

1.1.4.2 Hornsea Three has used the Evidence Plan process, the purpose of which is to agree the information Hornsea Three needs to supply, as part of a DCO application for Hornsea Three. The Evidence Plan (Annex 2 to the RIAA) seeks to ensure compliance with the Habitats Regulations Assessment (HRA) and EIA.

1.1.4.3 As part of the Evidence Plan process, the Ornithology Expert Working Group (EWG) was established with representatives from the key regulatory bodies, their advisors and statutory nature conservation bodies, including the MMO, Natural England and the RSPB. Between March 2016 and the publication of this ES, a number of EWG meetings were held that included discussion of key issues with regard to the ornithological elements of Hornsea Three, including baseline data collection, characterisation of the baseline environment and assessment methodologies. The identification of key issues was informed by consultation undertaken for Hornsea Project One and Hornsea Project Two, where appropriate. The matters discussed during EWG meetings are detailed in Volume 2, Chapter 5: Offshore Ornithology.

1.2 Methodology

1.2.1 Site-specific aerial surveys

1.2.1.1 A series of strip transects have been flown monthly since April 2016 following the protocol (HiDef, 2016) agreed with Natural England and the RSPB in April 2016. The survey methodology was designed to provide information suitable to support an EIA and Habitats Regulations Assessment ("HRA") of the potential effects of a large offshore wind farm, for which an accurate assessment of abundance and distribution of seabirds is required.

1.2.1.2 Aerial surveys involve transects placed 2.5 km apart within Hornsea Three plus a 4 km buffer (Figure 1.2) using a transect-based survey design in which strip transects are placed approximately perpendicular to the depth contours along the coast. Such a design ensures that each transect samples a similar range of habitats (primarily relating to water depth) and reduces the difference in bird abundance estimates for each transect.

1.2.1.3 Surveys were undertaken using an aircraft equipped with four (4) HiDef Gen II cameras with sensors set to a resolution of 2 centimetres ("cm") Ground Sample Distance ("GSD"). Each camera sampled a strip of 125 m width, separated from the next camera by ~25m, thus providing a combined sampled width of 500 m within a 575 m overall strip. The surveys covered the Hornsea Three array area plus a 4 km buffer representing an area of 1,230 km^2. The extent of the survey buffer is based on guidance from UK SNCBs in relation to the assessment of displacement impacts, with a 4 km buffer recommended for the most sensitive species (divers and sea ducks) (JNCC *et al.*, 2017) Analyses were conducted utilising data from two of the four cameras representing 10% coverage of this area, with this level of coverage deemed to be sufficient for baseline characterisation based on the results of previous surveys.

1.2.1.4 The surveys were flown using a Diamond DA42 aircraft at a height of approximately 550 m above sea level ("ASL") (~1800'). Flying above 500 m ensures that there is no risk of flushing those species which have been proven to be easily disturbed by aircraft noise (Thaxter *et al*., 2015).

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

1.2.2 Former Hornsea Zone boat-based surveys

1.2.2.1 A series of monthly boat-based surveys of seabirds across the former Hornsea Zone (plus a 10 km buffer) (Figure 1.2) commenced in March 2010 and were completed in February 2013, encompassing three breeding, migratory and winter periods.

1.2.2.2 JNCC was consulted in January 2010, on the proposed survey methodology for ornithology surveys across the Hornsea Zone. This methodology was formally approved, as part of the PINS (formerly the IPC) planning process, in the Scoping Opinions for Hornsea Project One (IPC, 2010) and Hornsea Project Two (The Planning Inspectorate, 2012). Full details of these surveys and the methodology employed are included in the Hornsea Project Two Ornithology Technical Report Part 1, Section 2 (see PINS Document Reference 7.5.5.1 available from https://infrastructure.planninginspectorate.gov.uk).

1.2.3 Data processing

Data review and object detection

1.2.3.1 Data collected during aerial surveys were analysed by trained reviewers who marked any objects in footage that require further analysis as well as determining which objects were birds or other objects that may be recorded during surveys (marine mammals, ships, etc.). A review of raw data was then conducted incorporating 20% of the raw dataset with the results obtained compared to the original review. If 90% agreement was not attained during this process the remaining dataset was reviewed and, if necessary all data re-analysed.

1.2.3.2 All objects identified by the data review were assigned to a species group and where possible, each of these then further identified to species level. Species identifications were given a confidence rating of possible, probable or definite.

Population estimates and distribution

1.2.3.3 The abundance of each species observed was estimated separately using a design-based strip transect analysis with variance and confidence intervals ("CI") derived through 10,000 bootstraps. The bootstrapping technique uses total length of transect to limit selection rather than total number of transects. This method has an advantage when transects are of unequal length and provides better precision estimates.

1.2.3.4 In a strip transect analysis, each transect is treated as an independent analysis unit, and the assumption is made that transects can be treated as statistically independent random samples from the site. The length of each transect and its breadth (i.e. the width of the field of view of the camera) multiplied together give the transect area; dividing the number of observations on that transect by the transect area gives a point estimate of the density of that species for the site. The density of animals at the site (and hence the population size), the standard deviation, 95% CI and coefficient of variance ("CV") are then estimated using a non-parametric bootstrap method with replacement (Buckland *et al*., 2001). Population estimates are calculated by multiplying the resulting density estimate by the area of the whole site. The upper and lower confidence intervals for the density and population estimates define the range that the abundance metric falls within with 95% certainty.

1.2.3.5 Density estimates and population estimates are calculated separately for birds on the water, birds in flight and total birds (birds on the water and birds in flight combined). As these estimates are calculated using a bootstrap method (random sampling with replacement) these estimates are relative and as such, totalling the relevant abundance metrics for birds on the water and birds in flight may not necessarily equal the combined abundance metric.

Availability bias

1.2.3.6 In wildlife surveys, a proportion of seabirds that spend any time underwater, especially while feeding, will not be detectable at the surface. This may lead to an under-estimate of their abundance during surveys, known as availability bias. For species that make long dives underwater, this bias might be significant (e.g. auks). This is particularly the case for digital aerial survey data which provide a snapshot of the birds' behaviour at the time of detection.

1.2.3.7 There are two main approaches to account for availability bias either by using double platform surveys (for example Borchers *et al*., 2002) which is logistically difficult to achieve and relatively expensive or by using known data on time spent underwater to apply correction factors to abundance estimates (for example Barlow *et al*., 1988).

1.2.3.8 Barlow *et al.* (1988) used an equation to determine the proportion of time that an animal is not available in equation 1:

$$\Pr(being\ visible) = \frac{(s+t)}{(s+d)}$$

1.2.3.9 Where s is the average time spent below the surface, t is the window of time that the animal is within view and d is the average time spent at the surface. In the case of digital video surveys, the value of t is negligibly small and is treated as 0.

1.2.3.10 All available data for seabirds relate to diving behaviour obtained by direct observation, or in the case of guillemots and razorbills, to data obtained during the breeding season using data loggers. Thaxter *et al*. (2010) give average times for these species engaged in flying, feeding and spent underwater during the chick-rearing period. The correction for availability applied here used the mean time spent underwater (1.9 and 0.8 hours for guillemots and razorbills respectively) as a percentage of the mean time spent at sea not flying (8.0 and 4.6 hours respectively). Thus the percentage time spent underwater for guillemots is 23.75% and for razorbills of 17.4%. For puffins, data from data loggers were used from Spencer (2012), which estimated that puffins spend 14.16% of daylight time underwater when not flying.

1.2.3.11 These figures are only applied to estimates of relative abundance of birds sitting on the sea, and should be added to the true abundance of flying birds to give an estimate of true abundance for the species. For this reason, it was necessary to calculate the percentage of birds as a total of all observations and apply these to the estimates of abundance for guillemot and razorbill. Because of low sample sizes of guillemots and razorbills in many months, the percentage of sitting birds was used to calculate the correction factors for abundance estimates within the proposed development area. These percentage figures were used to scale up the relative abundance estimate of guillemots, razorbills and puffins sitting on the sea by factors of 1.2375, 1.174 and 1.1416 respectively, and then added to abundance estimates for flying birds. A scaling factor was also applied for large auks and auk species in proportion to the ratio of the estimated abundance of sitting guillemots, razorbills and puffins to each other and to other species within each of the mapped grid cells.

1.2.4 Analysis of former Hornsea Zone ornithological data

1.2.4.1 As part of the preparation of data for use in the EIA for Hornsea Three, a detailed analysis of the boat-based and digital aerial data has been conducted in order to understand the inherent variability in the boat-based survey data and how this affects the compatibility of these boat-based data with digital aerial data (see Annex 5.4 Data Hierarchy Report).

1.2.4.2 This analysis has produced the following outputs:

- Seasonal density estimates for the Hornsea Three area (plus relevant buffers) for key species and seasons;
- Identification of the seasonal and annual variability in population density for key species for each analysis area;
- Investigation of suitable co-variates (such as sea temperature, bathymetry, distance from shore, chlorophyll a) that might explain observed variability in densities and flight heights; and
- Detailed analysis including statistical analysis and, where possible, predictive modelling.

1.2.4.3 The production of these outputs allowed for the following analyses to be conducted which in turn inform discussions in relation to Hornsea Three:

- Identification of the extent of boat-based ornithological records across the Hornsea Three area;
- Characterisation of the uncertainty in population estimates and density distribution;
- Comparison of population estimates for 10 key species for Hornsea Three with those derived for the Hornsea Project One and Hornsea Project Two sites;
- Analysis of the variability in patterns of observed flight heights across the former Hornsea Zone by season and year;
- Comparison of the results of the boat-based and aerial surveys; and
- Discussion in relation to the implications of the above for collision risk modelling and displacement analysis.

1.2.4.4 The results of the above analyses are used to inform the assessments undertaken for Hornsea Three by identifying whether, in those months where only one survey was completed as part of the aerial survey programme, the data adequately captures the variability inherent in seabird populations. For months where two surveys have been conducted the aerial survey data are considered to adequately capture this variability. The process by which population estimates or densities are identified is presented in 'A method for assessing priority of seabird density data for use in EIA at Hornsea 3. Addendum 1' with the abundance metrics used for displacement analyses and collision risk modelling identified in Annex 5.2: Analysis of Displacement Impacts on Seabirds and Annex 5.3: Collision Risk Modelling.

1.2.5 Defining population importance and sensitivity levels

1.2.5.1 The significance of an impact on any particular species can be determined as a combination of the size and importance of the species' population affected, and the sensitivity of the species to that particular impact.

1.2.5.2 The importance of species present in Hornsea Three was defined in relation to estimated international, national and regional populations through the use of the 1% threshold criterion. The 1% threshold for each population is obtained by dividing the respective biogeographic population by 100. The qualification of any SPA species found within the survey areas and the conservation status of each species as per the latest Birds of Conservation Concern classification (Eaton *et al*., 2009), and any national or international designated status (e.g., Annex I, Schedule 1) are also considered. It is important to note that other criteria (e.g. the conservation importance of a species) are also considered when identifying Valued Ornithological Receptors with these criteria presented in Section 1.6.

1.2.5.3 Threshold values for international populations were derived from figures provided in Wetlands International (2014), Mitchell *et al.* (2004) or del Hoyo *et al*. (1996). The 1% criterion, whilst not necessarily of biological relevance, has been previously used as a standard for designating areas of conservation interest (Kuijken, 2006). National population thresholds were derived from Musgrove *et al.* (2013), Burton *et al.* (2012) or Stienen *et al.* (2007). Appropriate numbers for both breeding and wintering populations were determined for each species from the most recent literature, taking into account seasonal patterns of movement (e.g., Furness, 2015).

1.2.5.4 Classification of the regional importance of breeding populations observed on site (i.e., if the population exceeded 1% of the regional population) was based on the following:

- Estimates of foraging range (e.g. Thaxter *et al*., 2012);
- Data presented from the Seabird 2000 census in Mitchell *et al*. (2004) and the subsequent JNCC Seabird Monitoring Programme (SMP; JNCC 2017); and/ or
- Colony-specific data, where available (e.g. tagging studies as part of the Future of the Atlantic Marine Environment (FAME) project [www.fameproject.eu]).

1.2.5.5 For non-breeding species present in winter or on passage, the relevant regional population was considered to be the North Sea with relevant Biologically Defined Minimum Population Scale (BDMPS) populations taken from Furness (2015). Furness (2015) uses demographic data, to incorporate the number of immature birds associated with breeding colonies within the BDMPS populations defined for the non-breeding and passage seasons.

1.2.5.6 Species were assigned sensitivity levels based on the evaluation of ornithological effects of offshore wind farms by Wade *et al.* (2016). When a species or impact was not detailed by Wade *et al.* (2016) information from Langston (2010), Maclean *et al*. (2009) and Garthe and Hüppop (2004) was consulted. A summary of core data from these sources including species-specific collision risk, displacement and barrier effect sensitivities can be found in Table 1.6. This evaluation used the data outlined in Table 1.6, in addition to analysing the behavioural ecology of the species and synthesising current field research on the vulnerability of these species to specific impact types, and has been used to help inform which species found during baseline surveys are taken forward for impact assessment in Volume 2, Chapter 5: Offshore Ornithology, as Valued Ornithological Receptors (VORs).

1.3 Baseline characterisation

1.3.1 Study areas

1.3.1.1 In order to characterise the baseline environment a number of study areas have been defined:

- The Hornsea Three array area plus 4 km buffer across which aerial surveys were undertaken (Figure 1.2);
- The Hornsea Three offshore export cable route including all offshore areas below MHWS (Figure 1.2);
- The former Hornsea Zone comprising the former Hornsea Zone plus a 10 km buffer across which boat-based surveys have previously been undertaken (Figure 1.2); and
- The North Sea, which represents the regional offshore ornithology study area and coincides with the northern and southern North Sea as defined by the regional seas identified by JNCC for implementing UK nature conservation strategy (JNCC, 2004) (Figure 1.1).

1.3.1.2 The first three study areas provide a site-specific baseline with the North Sea offshore ornithology study area providing a wider context for the site-specific data including consideration of species specific foraging ranges, migration routes and wintering areas. In addition, a number of areas present in the North Sea that are considered important for birds are also discussed as part of the wider baseline characterisation (i.e. Dogger Bank, Frisian Front and Brown Ridge).

1.3.2 Seabirds in the wider southern North Sea

1.3.2.1 Extensive ornithological surveys (e.g., Carter *et al*., 1993; Stone *et al*., 1995), reviews (e.g., Stienen *et al*., 2007, Furness, 2015) as well as results from previous Round 1, 2 and 3 offshore wind farm Environmental Statements and monitoring reports have shown that the southern North Sea, extending roughly between the Humber and the Strait of Dover and incorporating Hornsea Three, is an important area for seabirds. This is particularly the case during passage and in winter months when British breeding birds are joined by birds that have migrated from continental Europe and Fennoscandia. Because of the mix of birds present, it is probable that the Hornsea Three site is used by birds (i) overwintering in the area; (ii) foraging from nearby breeding coastal colonies; and (iii) on post-breeding dispersal, migration and pre-breeding return at different times of the year.

1.3.2.2 As well as true pelagic seabirds (e.g., gannet, fulmars and auks), other species that spend part of their annual life cycle at sea (e.g., divers, gulls and seaducks) may also be present in particular months, with periodic numbers of non-seabird migrants also present (e.g., wildfowl, waders and passerines).

1.3.2.3 Stienen *et al*. (2007) demonstrated that the southern North Sea area is an important corridor for migration of some seabird species in particular. For instance, the great majority (40-100%) of the flyway population of great skua use the Strait of Dover to leave the North Sea, as well as 30-70% of the lesser black-backed gull population.

1.3.2.4 In order to characterise the distribution of seabirds in the North Sea this report utilises data associated with Natural England's seabird sensitivity mapping for English territorial waters project (WWT Consulting and MacArthur Green, 2013). The project analysed boat-based and aerial data collected between 1979 and 2011 to produce predicted density grids for seabird species that occur in UK waters. Density grids were produced, where possible for two seasons, summer (April to September) and winter (October and March). For some species, these seasonal extents prevent characterisation of migratory movements with this identified where necessary in species accounts in Section 1.6.

The marine environment of the North Sea

1.3.2.5 Seabird distribution is the result of a combination of interacting factors. Prey distribution is thought to be more important than physical factors, although nest site availability and foraging ranges for each species are also limiting factors (see Stone *et al*., 1995 for review). Each species' behaviour in the Southern North Sea is discussed in more detail in the Species Accounts below.

1.3.2.6 Physical processes such as wind and weather conditions may have a seasonal effect on seabird distribution, often indirectly through prey distribution. Water movements, temperature and salinity may also have an effect on accumulating prey.

1.3.2.7 Mixing of waters brings nutrients to the surface which encourages plankton growth, and attracts fish and seabirds. Fronts between water masses with different properties may also be highly productive for birds. Plume fronts exist at the outflow of many large rivers in the southern North Sea (Stone *et al*., 1995).

1.3.2.8 The 'Flamborough Front' which forms the boundary between the southern North Sea and northern North Sea (Figure 1.1), is a rich 200 mile long nutrient flow, resulting from the meeting of cooler waters from the north and warmer waters of the south. This results in a nutrient upwelling which moves to the north in summer and south in winter. The presence of this front means the region can support a wide range of marine species, some of which are at either their southern or northern limit of distribution (Pingree and Griffiths, 1978). The oceanographic conditions associated with this frontal system appear to converge across the region in which Hornsea Three is located.

1.3.2.9 At the point of convergence, warm and cold waters mix, and create conditions that increase plankton growth and secondary productivity (ICES, 2008). This in turn increases the seasonal availability of food to fish and shellfish species, which may influence the distribution patterns of fish and shellfish species within the region in which Hornsea Three is located. This nutrient-rich water provides a rich food source for a large number and diversity of seabirds and marine mammals, although relatively little is currently known of the spatial and temporal distribution of seabirds across this region (Jones *et al*., 2004). In addition to the Flamborough Front, several temporary fronts of seasonal importance occur throughout the southern North Sea.

1.3.2.10 Upwellings are common at shelf breaks and are often characterised by higher bird densities. The southern North Sea has two major sandbank systems which provide conditions for fish to spawn; the Dogger Bank in the north and the Brown Ridge located off the Norfolk coastline. Both are probably of great importance to feeding birds (Jones *et al*., 2004). These sandbanks also cause tidal upwellings, which concentrate zooplankton and hence the fish that prey upon them. Auks have been found to remain mostly within coastal shelf waters, while fulmars are most common at the outer shelf, shelf edge and deep waters (Stone *et al*., 1995). Discussion is provided in relation to the importance of these features for seabirds in the following sections.

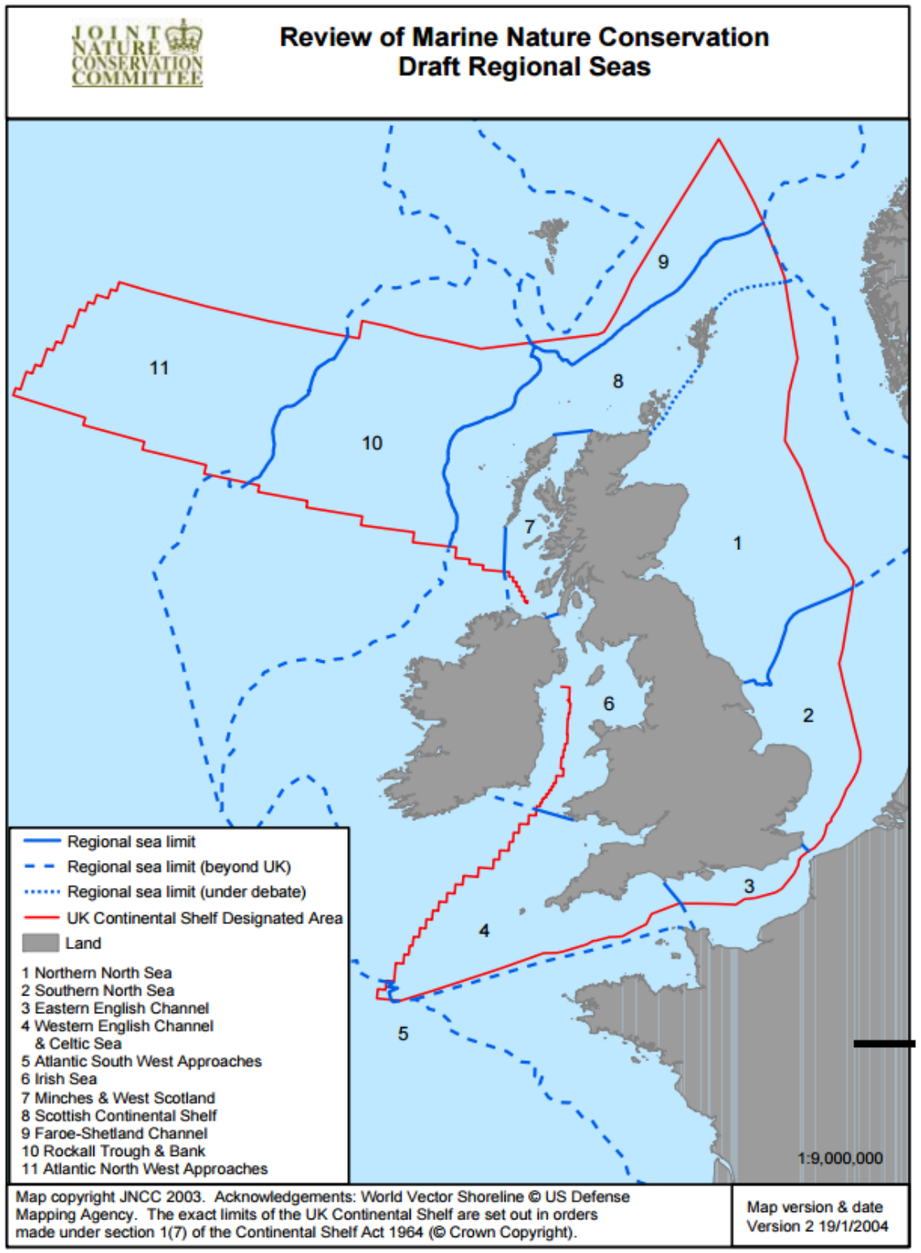


Figure 1.1: Draft Regional Seas in UK waters (JNCC, 2004) (Hornsea Three is located in Area 2 – Southern North Sea).

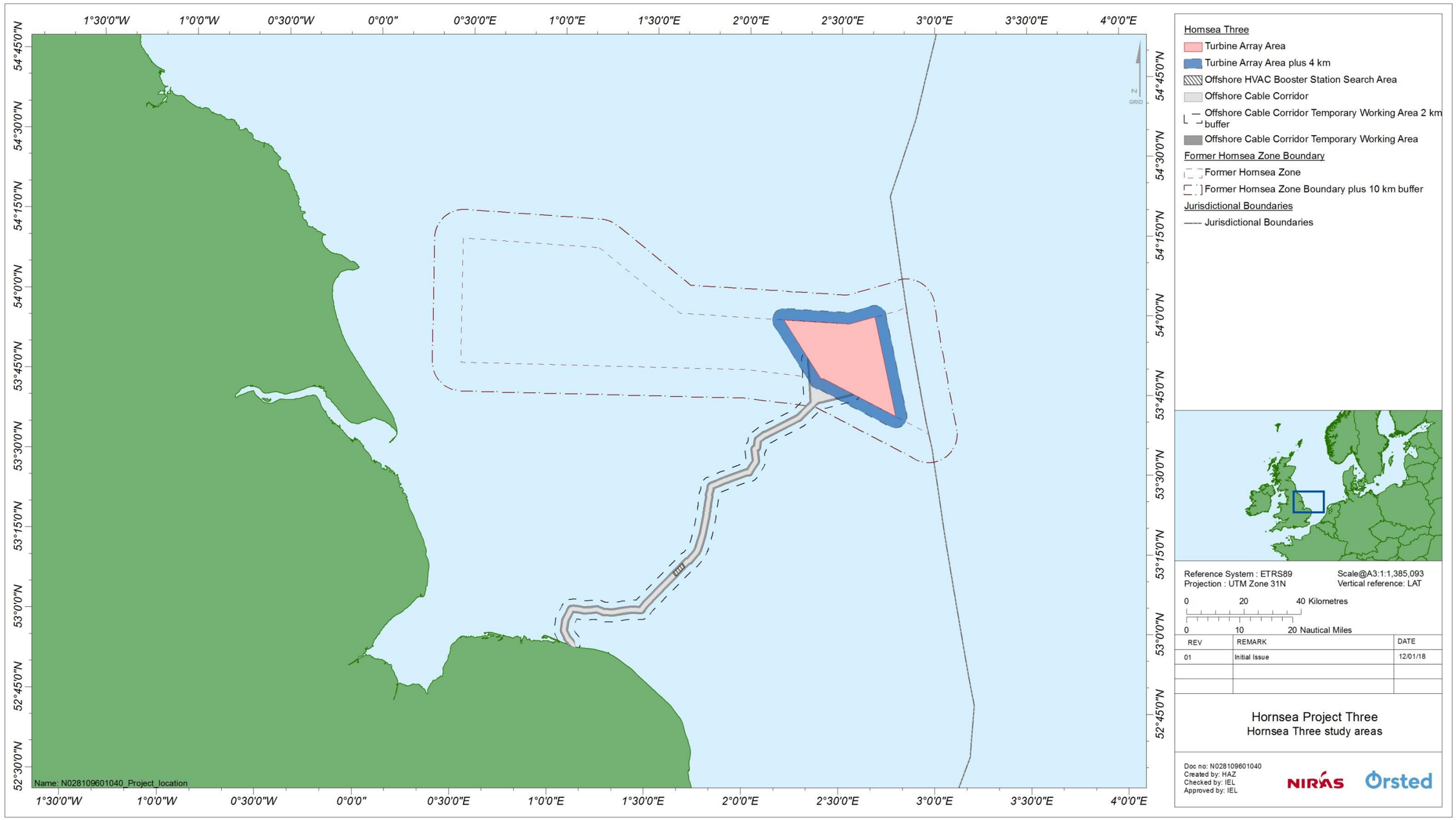


Figure 1.2: Study areas defined to characterise the ornithological baseline at Hornsea Three.

Bathymetry and sea conditions

1.3.2.11 The North Sea is mainly shallow (<100 m), particularly in the southern part where depths rarely exceed 50 m. These shallow areas are characterised by sand substrates or sand and gravel mixtures. The sandy conditions provide an ideal habitat for species such as sandeels, an important dietary component for many seabirds.

1.3.2.12 In winter, surface waters are warmer offshore than inshore, with warm water masses entering the English Channel from the southwest, passing into the southern North Sea. In summer, surface temperature increases in shallow coastal waters. Surface salinity is lower nearer the coasts than further offshore, and the southern North Sea is characterised by low salinity water along continental coasts.

Seabird prey species and distribution

1.3.2.13 The important prey species of seabirds in the North Sea are summarised in Table 1.1. A full description of the fish community present at Hornsea Three is provided in Annex 3.1: Fish and Shellfish Technical Report with a summary presented below.

Table 1.1: Seabird prey species.

Seabird species/species group	Important prey species
Fulmars and shearwaters	Crustaceans, squid, fish, offal, carrion mostly from surface.
Gannet	Mackerel
	Herring
Skuas	Fish, caught through piracy of other birds.
Little gull	No specific data relating to the marine environment, thought to be chiefly small fish and invertebrates.
Large gulls	Omnivorous: fish, offal, carrion from surface and through piracy of other birds.
Kittiwake	Sandeel spp.
	Sprat
	Other species: capelin, herring, cod, whiting, pollock, crustaceans, molluscs.
Terns	Herring, sprat, sandeel spp.
Auks	Sandeel spp., sprat, herring, capelin, mackerel, cod, haddock, whiting.

1.3.2.14 The fish communities characterising the Hornsea Three fish and shellfish study area were found to comprise mainly demersal fish species such as whiting *Merlangius merlangus*, dab *Limanda limanda*, plaice *Pleuronectes platessa*, solenette *Buglossidium luteum* and grey gurnard *Eutrigla gurnardus*, all of which were recorded in abundance during trawl surveys (Volume 2, Chapter 3: Fish and Shellfish Ecology). The Hornsea Three fish and shellfish study area was also found to be characterised by other demersal species such as lemon sole *Microstomus kitt*, common sole *Solea solea* and cod *Gadus morhua*. Small demersal species including the short spined sea scorpion *Myoxocephalus scorpius*, lesser weaver *Echiichthys vipera*, dragonet *Callionymus lyra* and scaldfish *Arnoglossus laterna* were also recorded in surveys across the former Hornsea Zone including the Hornsea Three array area.

1.3.2.15 Pelagic species recorded in the Hornsea Three fish and shellfish study area included sprat, herring and mackerel *Scomber scombrus* with sprat *Sprattus sprattus* and herring *Clupea harengus* identified as being two of the key characterising species within the Hornsea Three fish and shellfish study area. Mackerel was found to have seasonal variability and appeared to be more abundant in autumn with very low numbers occurring in spring. Sprat showed strong seasonal patterns in abundance, with notably higher abundances in spring than autumn. The high abundances recorded during the spring (April) otter trawl survey may coincide with the start of the peak spawning period for this species (May to June; Coull *et al*., 1998). As with sprat, herring also showed a strong seasonal pattern, with high abundances recorded during the spring survey in inshore areas close to the Humber Estuary and lower abundances in autumn.

1.3.2.16 Two sandeel species were recorded in trawl surveys within the Hornsea Three fish and shellfish study area: lesser sandeel *Ammodytes tobianus* and greater sandeel. These species were generally recorded at low abundances during trawl surveys, particularly during otter trawl surveys, compared to many of the other characterising species. Sandeel were also recorded during epibenthic beam trawls and at generally higher abundances than in otter trawls, however, abundances were still lower than for many other key species such as solenette, dab and scaldfish. It should be noted, however, that these survey methods are not specifically designed to sample sandeel. Sandeel abundances as recorded during trawl surveys across the former Hornsea Zone were generally found to be highest to the west of the Hornsea Three array area.

Former Hornsea Zone

1.3.2.17 Based on divisions according to geographic, hydrographic and physical differences within the North Sea in Stone *et al*. (1995), (Figure 1.3), the Hornsea Zone potentially falls within three sectors; (i) the Western North Sea sector, which stretches along a relatively coastal strip from northeast Scotland to the Greater Wash; (ii) the Central and Northern North Sea sector which is mainly marine in nature, although encompasses the western coastline of Norway; and (iii) the South and East North Sea sector, which stretches from Kent, across the English Channel and northwards to Norfolk, and includes much of coastal Netherlands, Belgium and Denmark, including the Kattegat, Wadden Sea and German Bight.

1.3.2.18 The division of the North Sea into a number of sectors by Stone *et al*. (1995) allows comparisons of relative importance of Hornsea Three to each species population found within the Hornsea Zone survey areas, in relation to the wider area. The meeting of these three sectors at the location of the Hornsea Zone means that the differing characteristics of each may play a role in influencing seabird abundance and distribution within the site.

1.3.2.19 The Western North Sea sector contains breeding colonies such as at Flamborough Head and the Farne Islands and was characterised by Stone *et al*. (1995) as being important for auks throughout the year. The area was also used in winter by gulls and eider, with gulls and terns abundant in summer. Skuas, among other species, pass through the area on autumn passage.

1.3.2.20 The Central and North Sea sector was characterised as being important for guillemots, although less so during the breeding season, when birds are constrained to coastal colonies. Fulmars, gannets and kittiwakes were also found throughout the year, with other gulls more widespread during winter. Depth in this sector is mostly shallow, with the exception of the Rinne off the coast of Norway.

1.3.2.21 The South and East North Sea sector is characterised as being a shallow area of low salinity which forms a distinct zone of distribution for many species. During winter, it was described by Stone *et al*. (1995) as being the most important area in north-west European waters for divers, grebes and seaduck. Gulls are common throughout the year, with common gulls and great black-backed gulls most abundant in winter, lesser black-backed gulls in summer, and herring gulls throughout the year. Little gulls are abundant during migration peaks. The area is also important for terns in summer and for auks in winter.

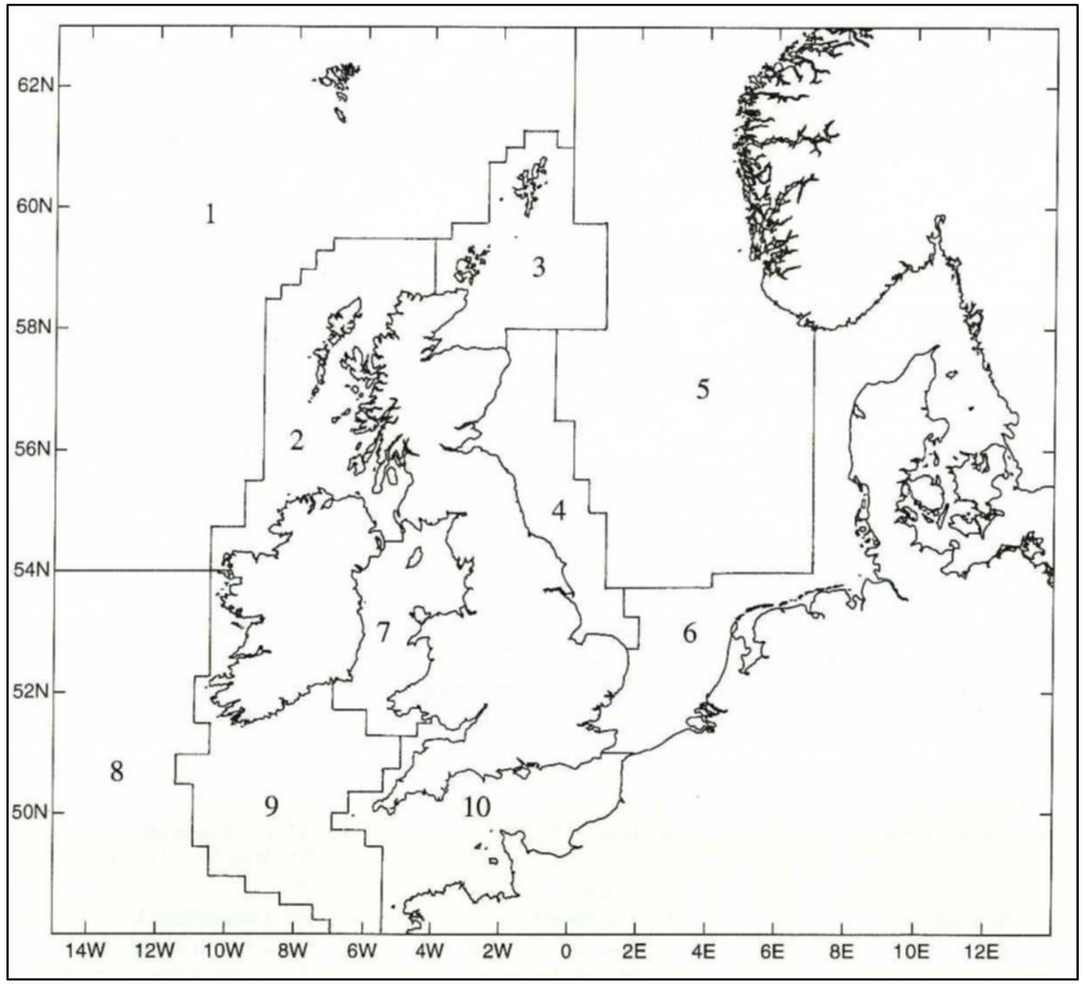
1.3.2.22 As a reflection of this mixture of habitat types, the area is likely to include a bird assemblage comprising a mixture of 'true' seabirds, some species which spend part of their annual life cycle at sea (e.g., divers and seaduck), some species associated with the shallow sea area of the Greater Wash, and a wide range of other species on migration both to and from the UK and continental Europe, such as waterbirds and passerines.

Dogger Bank

1.3.2.23 The Dogger Bank covers an area of approximately 17,600 km^2 in the centre of the North Sea, some 100 km from the coast of England, and close to the eastern boundary of the Hornsea Zone (Figure 1.2). It continues north-eastwards across the Dutch sector and into the German sector of the North Sea. The majority of the area lies in shallow waters, rising to less than 20 m depth (Diesing *et al*., 2009).

1.3.2.24 The Dogger Bank is important in terms of commercial fisheries for both groundfish species and sandeels (*Ammodytes spp.*). It has also been identified as a region of high annual phytoplankton production.

1.3.2.25 Predatory fish species present on the Dogger Bank include whiting *Merlangius merlangus*, plaice *Pleuronectes platessa*, mackerel *Scomber scombrus* and cod *Gadus morhua*, with dab *Limanda limanda* and grey gurnard *Eutrigla gurnardus* being particularly abundant.



1 North-west oceanic
2 North-west shelf
3 Shetland, Orkney & Moray Firth
4 Western North Sea
5 Central & northern North Sea
6 Southern & eastern North Sea
7 Irish Sea
8 South-west oceanic
9 Celtic Sea
10 English & Bristol Channels

Figure 1.3: Areas for analysis of seabird distribution in Stone *et al*. (1995) (Hornsea Three lies within Zone 5 – Central and northern North Sea).

1.3.2.26 Sandeels are a significant prey resource for seabirds such as auks and kittiwake. The distribution of sandeels within the North Sea is highly localised and they are abundant in the Dogger Bank region, concentrated along the edges in water depths of around 20-30 m, where fronts meet.

1.3.2.27 Hotspots of seabird concentrations within the extent of British Fishery Limits were identified by JNCC in order to identify potential marine SPAs, based on the top 1% qualifying numbers and regularity of occurrence (Kober *et al*., 2010). Four regions were identified as being particularly important, all located in Scotland, with the closest to Hornsea Three being the outer Firth of Forth for gannet, kittiwake, guillemot and puffin.

1.3.2.28 A number of 'near-qualifying' areas were identified, including Dogger Bank, which is important for guillemot in winter (as reported by Skov *et al*., 1995). Kober *et al*. (2010) reported an estimated 35,869 individuals within the area. Little gull (passage, 98 individuals) and little auk (winter, 3,950 individuals) were also identified as having qualifying numbers only in this area, as was a general seabird assemblage (breeding, summer, winter). Of these, little gull is particularly important.

1.3.2.29 As part of the baseline work undertaken for the wider Dogger Bank Round Three Offshore Wind Farm Zone for the Strategic Environmental Assessment, boat-based surveys undertaken by DECC between March and September 2008 recorded a range of common pelagic seabird species (DECC, 2009). Guillemot and razorbill were recorded within the study areas at significant densities of up to approximately 50 and 20 birds per km^2 respectively during surveys undertaken in March. Five further species were considered to occur at moderate densities within the Zone over the course of the surveys, namely fulmar, gannet, herring gull, great black-backed gull and kittiwake.

1.3.2.30 Aerial surveys for The Crown Estate by visual transect and digital survey between May 2009 and April 2010 recorded similar species, although in somewhat lower numbers (The Crown Estate, 2010). The relative abundance of species of auk (guillemot and razorbill) was found to be highest in the winter months (>15 birds per km^2), with auks recorded as being widespread across the study area.

1.3.2.31 Monthly boat-based surveys have been undertaken within the Dogger Bank offshore wind farm zone (as identified by Strategic Environmental Assessment (DECC, 2009) since January 2010 as part of the Dogger Bank Project One Offshore Wind Farm baseline studies (Forewind, 2010). During the reported six months of data collection, guillemot were recorded in the greatest densities (up to 2.5 per km^2 during March), with feeding being the most common behaviour (Gardline, 2010). Counts of kittiwake, northern fulmar, gannet and razorbill were also high (i.e., more than 1.0 per km^2), relative to other species such as great skua, gull species, little auk and puffin.

Frisian Front

1.3.2.32 Birdlife International's Important Bird Area (IBA) programme has aimed to identify, document and conserve sites that are key for the long-term viability of bird populations. BirdLife International has implemented a network of terrestrial IBAs which has formed a scientific reference for the designation of SPAs. It is currently compiling seabird information for Europe to extend the IBA network into the marine environment. In the UK, the closest identified marine IBA to Hornsea Three is The Wash, which is already afforded SPA protection. No other sites are located along the east coast.

1.3.2.33 The Frisian Front IBA and proposed SPA, lying in Dutch waters, is the closest IBA / proposed SPA to the former Hornsea Zone, and occupies an area of approximately 2,880 km^2. According to Noordzee Natura 2000 (a project aimed at designating Natura 2000 areas in the North Sea), the site has been proposed by the Netherlands government as an SPA for great skua, great black-backed gull, guillemot and lesser black-backed gull. In late summer and autumn, great skua achieves the criterion that 1% of the total European population is present at the site. The guillemot population achieves the criterion that more than 20,000 individuals regularly occur at the site.

Brown Ridge

1.3.2.34 Apart from Natura 2000 areas, the Brown Ridge has been identified as an area of sensitivity by Noordzee Natura 2000. This sand bank lies almost entirely within the Dutch part of the North Sea and is located roughly halfway between the Dutch and English coast. It is an important wintering area for several bird species and high concentrations of guillemots and razorbills in winter, which have migrated from Scotland with their young. These concentrations can exceed the 1% limit of the biogeographic population or 20,000 individuals. High concentrations of great black-backed gull, great skua and herring gull also occur in winter, albeit below the 1% threshold of the biogeographic population or below the 20,000 individual threshold (the criteria used for the European Bird Directive assessments).

1.3.3 Recent seabird population trends

Overview

1.3.3.1 Increasing sea temperatures have had impacts on seabird populations in the UK, mainly through indirect effects via the food chain, on which they rely (JNCC, 2013). Sea-surface temperatures in the north east Atlantic and UK coastal waters have been rising since the 1980s by around 0.2-0.9°C per decade, with the most rapid rises occurring in the southern North Sea and the English Channel (Holliday *et al*., 2008).

1.3.3.2 Climate-driven changes in the food chain have had acute negative impacts upon seabirds breeding on Britain's North Sea coast. Rising sea temperatures caused a change in the North Sea plankton community in the late 1980s and consequently large reductions in abundance of the zooplankton on which larval fish feed (Beaugrand *et al*., 2003). Climate impacts on plankton may be responsible for the association between warmer sea-surface temperatures and poor sandeel productivity (Arnott and Ruxton, 2002).

1.3.3.3 Low breeding success of kittiwakes, and of other species that rely on sandeels such as common guillemot, has occurred with increasing frequency in recent years. Kittiwakes in eastern Britain have fledged fewer young in recent, warmer years (Frederiksen *et al*., 2004; Frederiksen *et al*., 2007), which is thought to be linked to the relationship between temperature and sandeel productivity.

1.3.3.4 Observations at colonies have confirmed that seabirds were catching fewer and smaller sandeels than normal during years of poor breeding performance (JNCC, 2017). The calorific content of these sandeels was much lower than usual in 2004, which was one of the least successful breeding seasons for seabirds overall in recent times (Wanless *et al*., 2005). Long-term declines in numbers of kittiwake are expected to continue unless the recent rises in sea-surface temperature are reversed (Frederiksen *et al*., 2004).

1.3.3.5 Winter storms can make it difficult for seabirds to forage at sea and consequently result in reduced survival. At times, this impact can be dramatic and some storms have resulted in large-scale mortality events or 'wrecks', when large numbers of dead or emaciated seabirds have been washed up on the shore (e.g., puffins in spring 2013 (www.birdguides.com)). Frederiksen *et al.* (2008) demonstrated that mortality during storms has had a significant negative effect upon the numbers of European shags breeding at a colony in south-east Scotland.

1.3.3.6 An increase in frequency of extreme weather events, as predicted by climate-change models, could lead to population declines and an increasing probability of extinction of vulnerable species from exposed areas (Frederiksen *et al*., 2008). Increased storminess and sea level rise may also reduce available breeding habitat for shoreline-nesting species (e.g., terns).

Seabird Monitoring Programme (SMP) Data Trends

1.3.3.7 Seabird population trends have been used by UK Government as a 'sustainable development strategy indicator'. JNCC, through the SMP (JNCC, 2017), publishes annual updates on seabird population trends. The latest trends in species relevant to Hornsea Three are summarised in Table 1.2 (JNCC, 2013). Note that red-throated diver is not included in this table as it has not been monitored by Operation Seafarer, Seabird 2000 census or included in the Seabird Colony Register.

1.3.3.8 The closest seabird colony to Hornsea Three is the Flamborough and Filey Coast pSPA, (which is an update and extension to the Flamborough Head and Bempton Cliffs SPA) (see Section 1.5). This pSPA colony is designated for nationally important populations of kittiwake, gannet, guillemot and razorbill with an additional seabird assemblage within which fulmar is the only listed component. However, the pSPA also supports cormorant, shag, herring gull and puffin (Natural England, 2014).

1.3.3.9 When compared to other colonies around the coast of the UK, historical survey effort at the Flamborough and Filey Coast pSPA is low. However, in most cases data have been collected in 1987 and 2000 reflecting increased survey effort associated with the Seabird Colony Register Census and Seabird 2000, respectively with increased survey effort, especially relating to breeding success in recent years (Babcock *et al.,* 2017).

1.3.3.10 Although survey effort has been low at this colony, the SMP data does indicate fluctuations in the populations of those species present at the Flamborough and Filey Coast pSPA. The most dramatic increase has been observed for the gannet population at the SPA which has increased from 780 occupied nests in 1987 to 11,061 occupied nests in 2012. Increasing trends in population size have also been observed for the guillemot and razorbill populations at the SPA.

1.3.3.11 A decreasing trend has been observed for the kittiwake population at the pSPA which has decreased from 85,395 occupied nests across the original SPA in 1987 to an estimated 44,520 pairs across the whole pSPA in 2008-2012 (Natural England, 2014) although the most recent whole colony count in 2016 reported 51,001 Apparently Occupied Nests (AONs) (Davison, 2017). However, the population estimate from 1987 and therefore the overall population trend has been contested (Smart Wind, 2014). Decreasing trends in population size have also been observed for puffin and herring gull.

1.3.3.12 The population of fulmar at the SPA showed an increasing trend between 1987 and 2000 increasing from 971 occupied sites to 1,355 occupied sites. However, this trend has since reversed with 878 occupied sites estimated in 2008 (at the original SPA).

Table 1.2: Summary of seabird population trends in the UK (JNCC, 2016).

Species	Population change (%)		
	1985-88	*1985-88 to 1998-2002*	*2000-2015*
Fulmar	+77	-3	-31
Manx shearwater	N/A	N/A	N/A
European storm-petrel	N/A	N/A	N/A
Leach's storm-petrel	N/A	N/A	N/A
Gannet	+39	+39[1]	+34[2]
Cormorant	+9	+10	-8
Shag	+21	-27	-34
Arctic skua	+226	-37	-64
Great skua	+148	+26	+18
Kittiwake	+24	-25	-44
Black-headed gull	+5	0	+38
Common gull	+25	+36	N/A
Lesser black-backed gull	+29	+40	N/A
Herring gull	-48	-13	N/A
Great black-backed gull	-7	-4	-11
Sandwich tern	+33	-15	+13
Common tern	+9	-9	-10
Arctic tern	+50	-31	+17
Guillemot	+77	+31	+5
Razorbill	+16	+21	+32
Puffin	+15	+19	N/A

[1] Change between censuses in 1984-85 and 2004-05.
[2] Change between censuses in 2003-04 and colonies surveyed in 2013-14 and 2015.

1.3.4 Raw counts of birds recorded in Hornsea Three baseline surveys

1.3.4.1 A total of 32,302 birds were recorded during sixteen aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017. Results comprise a total of 21 seabird species with guillemot, kittiwake and razorbill the three most frequently encountered species. These three species accounted for over 81% of all bird records (Table 1.3). Only 7.7% of all records could not be assigned to species level. Further discussion in relation to monthly abundance of each species included in Table 1.3 is provided in the species accounts in Section 1.6.

1.3.4.2 A total of three non-seabird species were recorded comprising one curlew, sixteen golden plover and one red-breasted merganser. There were also an additional twelve records of wader species and three records of passerine species that could not be assigned to species level.

Table 1.3: Raw counts of seabirds recorded during aerial surveys of Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Species	No. of records
Red-throated diver	8
Fulmar	1,054
Cory's shearwater	1
Manx shearwater	29
European storm-petrel	1
Gannet	1,221
Arctic skua	11
Great skua	7
Puffin	96
Razorbill	1,908
Guillemot	19,490
Sandwich tern	7
Common tern	33
Arctic tern	51
Kittiwake	4,803
Black-headed gull	7
Little gull	13

Species	No. of records
Common gull	42
Lesser black-backed gull	261
Herring gull	89
Great black-backed gull	722
Unidentified birds	2,448
Total	**32,302**

1.3.5 Seasonal definitions and population importance

1.3.5.1 Seasonal definitions outline different periods of the annual cycle for a species. There are four seasons that can be applied to different periods within the annual cycle however, these seasons are not applicable for some species, with different combinations used depending on the biology and life history of a species:

- Breeding: when birds are attending colonies, nesting and provisioning young;
- Post-breeding: when birds are migrating to wintering areas or dispersing from colonies;
- Non-breeding: when birds are over-wintering in an area; and
- Pre-breeding: when birds are migrating to breeding grounds.

1.3.5.2 Seasonal definitions are required in the first instance to determine the importance of populations estimated within Hornsea Three. Seasonal definitions are then used in further assessment to apportion impacts to relevant seasons in order to determine the impact upon relevant populations. These have been defined using a range of sources including Furness (2015), Kober *et al*. (2010) and the seasonal definitions used for previous offshore wind farm assessments considered to be comparable to Hornsea Three (i.e. Hornsea Project Two). Seasonal definitions for species relevant to Hornsea Three are included in Table 1.4.

1.3.5.3 The seasonal definitions presented in Table 1.4 take account of the seasonal trends in bird populations at Hornsea Three and the wider former Hornsea Zone, therefore considering, in the breeding season for example, both local breeding populations that may have connectivity with Hornsea Three and populations of migrating birds moving through Hornsea Three. The consideration of all populations that may interact with Hornsea Three in a given month is important so as not to over or under-estimate the importance of Hornsea Three in a given season. It also ensures that the apportioning of birds to relevant populations (e.g. SPA breeding populations or non-breeding populations) is not over or under-estimated. Detailed consideration of the phenology in the abundance of a number of potentially key species (defined based on assessments undertaken for Hornsea Project Two) has been undertaken and is presented in Annex 3: Phenology, connectivity and apportioning for features of FFC pSPA to the RIAA. This includes a discussion on the trends in the abundance of these species at projects throughout the former Hornsea Zone and trends in the abundance of immature and adult birds.

1.3.5.4 Regional, national and international populations are shown in Table 1.5 and have been defined for every species recorded in Hornsea Three. These have been derived using a number of sources that are outlined here and referenced in footnotes below Table 1.5. Where possible, these populations have been calculated using data contemporaneous with the aerial surveys undertaken at Hornsea Three.

1.3.5.5 Regional populations are defined using the BDMPS relevant to each species. The BDMPS is defined as the smallest geographical range and population scale that can be supported by evidence relating to the life history of a species including seasonal distribution and migratory movements. Relevant BDMPS populations are calculated for all seasons defined for a species, with those in the breeding season based on the number of birds within foraging range of Hornsea Three and those in the post-breeding, non-breeding and pre-breeding seasons obtained from Furness (2015) or other relevant sources.

1.3.5.6 The regional, national and international population levels presented in Table 1.5 are divided by 100 in order to provide the 1% thresholds against which population estimates calculated for each species in Hornsea Three plus a 4 km buffer are assessed. This is used as part of an initial screening exercise to identify those species for which further assessment is required. Originally developed for the Ramsar Convention (Kuijken, 2006), the 1% threshold level signifying importance has been used extensively for site designation (Kuijken, 2006) and in assessing potential impacts of proposed developments (Skov *et al*., 2007) and its use here is considered appropriate. Where possible, thresholds are taken from temporally appropriate population levels, with particular attention given in this assessment to breeding, post-breeding, non-breeding and pre-breeding populations.

1.3.5.7 Although some 1% thresholds are low in terms of actual numbers of individuals, a value of 50 individuals is normally used as a minimum threshold in the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) reports (e.g. Frost *et al*., 2017), and is considered relevant here.

Table 1.4: Seasonal definitions for species considered in this report[2].

Species	Source	Seasonal definitions			
		Breeding	***Post-breeding***	***Non-breeding***	***Pre-breeding***
Common scoter	Lawson *et al.* (2015)			Oct-Mar	
Red-throated diver	Furness (2015)	May-Aug	Sept-Nov	Dec-Jan	Feb-Apr
Fulmar	Furness (2015)	Apr-Aug	Sep-Oct	Nov	Dec-Mar
Cory's shearwater	Kober *et al.* (2010)		Jul-Oct	Nov-Jun	
Manx shearwater	Furness (2015)	Jun-Jul	Aug-Oct	Nov-Feb	Mar-May
European storm petrel	Kober *et al.* (2010)	Jun-Oct		Nov-May	
Gannet	Furness (2015)	Apr-Aug	Sep-Nov		Dec-Mar
Arctic skua	Furness (2015)	Jun-Jul	Aug-Oct	Nov-Mar	Apr-May
Great skua	Furness (2015)	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr
Puffin	Furness (2015)	May-Jul[3]		Aug-Apr	
Razorbill	Furness (2015)	Apr-Jul	Aug-Oct	Nov-Dec	Jan-Mar
Guillemot	Furness (2015)	Mar-Jul[4]		Aug-Feb	
Little tern	Furness (2015)	Jun	Jul-Sep	Oct-Mar	Apr-May
Sandwich tern	Furness (2015)	Jun	Jul-Sep	Oct-Feb	Mar-May
Common tern	Furness (2015)	Jun	Jul-Sep	Oct-Mar	Apr-May
Arctic tern	Furness (2015)	Jun	Jul-Sep	Oct-Mar	Apr-May
Kittiwake	Furness (2015)	Apr-Jul[5]	Aug-Dec		Jan-Mar
Black-headed gull	Kober *et al.* (2010)	Apr-Aug		Sep-Mar	
Little gull	Kober *et al.* (2010)			Aug-Apr	
Common gull	Kober *et al.* (2010)	Apr-Aug		Sep-Mar	
Lesser black-backed gull	Furness (2015)	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr
Herring gull	Furness (2015)	May-Jul		Aug-Apr[6]	

[2] Grey cells indicate not relevant for the species occurrence in the North Sea.
[3] Furness (2015) defines the non-breeding BDMPS as August to March and the migration-free breeding season as May to June. July has been identified as part of the breeding season and April as part of the non-breeding season (see Annex 3: Phenology, connectivity and apportioning for features of FFC pSPA to the RIAA).
[4] Furness (2015) defines the non-breeding season as August to February and the migration-free breeding season as March to June. Therefore July as been included as part of the breeding season on a precautionary basis.
[5] Furness (2015) defines the spring BDMPS as January to April however, in line with assessments conducted for previous offshore wind farm projects, April has been included as part of the breeding season
[6] Furness (2015) defines the non-breeding BDMPS as September to March and the migration-free breeding season as May-July. As there are no breeding colonies with potential connectivity to Hornsea Three, April and August are included as part of the non-breeding season

Species	Source	Seasonal definitions			
Great black-backed gull	Furness (2015)	May-Jul		Aug-Apr[7]	

Table 1.5: Regional, national and international population importance levels for species included in this report. (All population estimates are for individual birds) (The 1% threshold for each population is obtained by dividing the respective population by 100)[8].

Species	Breeding			Post-breeding		Non-breeding		Pre-breeding	
	Regional BDMPS[9]	*National[10]*	*International[11]*	*Regional BDMPS[12]*	*National[12]*	*Regional BDMPS[12]*	*National[13]*	*Regional BDMPS[12]*	*National*
Common scoter		104	550,000			6,107	100,000		
Red-throated diver		2,600	150,000-450,000	13,277	17,650	10,177	17,000	13,277	17,650
Fulmar	11,745	1,000,000	5,400,000 – 8,200,000	957,502	1,785,696	568,736	1,125,103	957,502	1,785,696
Cory's shearwater			504,000 – 507-000						
Manx shearwater		600,000	680,000 – 820,000	8,507	1,589,402			8,507	1,589,402
European storm petrel		52,000	600,000 – 1,360,000		250,000				
Gannet	24,988	440,000	780,000	456,298	1,002,252			248,385	910,273
Arctic skua		2,400	30,000 – 70,000	6,427	11,714			1,227	6,338
Great skua		19,200	32,000	19,556	35,892	143	1,541	8,485	33,575
Puffin	1,960	1,160,000	11,000,000 – 13,200,000			231,957	536,514		
Razorbill		260,000	1,060,000	591,874	1,198,788	218,622	560,044	591,874	1,198,788
Guillemot		1,900,000	5,600,000 – 5,800,000			1,617,306	2,756,526		
Little tern		3,800	16,500-22,600	3,524	5,126			3,524	5,126
Sandwich tern		24,000	166,000 – 171,000	38,051	48,812			38,051	48,812
Common tern		24,000	440,000 – 680,000	144,911	209,750			144,911	209,750
Arctic tern		106,000	1,000,000	163,930	235,328			163,930	235,328
Kittiwake	102,002	760,000	6,600,000	829,937	1,741,523			627,816	1,319,342
Black-headed gull		280,000	4,200,000 – 5,600,000				2,199,483		

[7] Furness (2015) defines the non-breeding BDMPS as September to March and the migration-free breeding season as May-July. As there are no breeding colonies with potential connectivity to Hornsea Three, April and August are included as part of the non-breeding season
[8] Grey cells indicate that the season or biological scale is not relevant for the species occurrence in the North Sea..
[9] Calculated based on those colonies within the mean-maximum or maximum foraging range of a species.
[10] Sourced from Musgrove *et al*. (2013).
[11] Sourced from Wetlands International (2014), Mitchell *et al*. (2004), del Hoyo *et al*. (1996) or Birdlife International (2017).
[12] Sourced from Furness (2015) unless otherwise stated.
[13] Sourced from Musgrove *et al*. (2013), Burton *et al*. (2012) or Furness (2015).

Species	Breeding			Post-breeding		Non-breeding		Pre-breeding	
Little gull			72,000 – 174,000	30,000 – 75,000[14]					
Common gull		98,000	1,200,000 – 2,250,000				705,392		
Lesser black-backed gull	4,544	220,000	530,000 – 570,000	209,007	372,311	39,314	80,473	197,483	360,787
Herring gull		280,000	1,300,000 – 3,100,000			466,511	639,810		
Great black-backed gull		34,000	330,000 – 540,000			91,399	143,521		

[14] Sourced from Stienen *et al*. (2007).

1.4 Overview of species sensitivity

1.4.1.1 Consideration of the sensitivity of seabird species to the potential impacts arising from the construction, operation and maintenance, and decommissioning of Hornsea Three is provided in Table 1.6. These sensitivity values have been obtained from a number of sources including Wade *et al* (2016), Bradbury *et al.* (2014) Maclean *et al.* (2009), Langston (2010) and Garthe and Hüppop (2004).These are used to provide context and inform conclusions in relation to the identification of VORs.

1.4.1.2 The majority of the information presented in Table 1.6 is sourced from Wade *et al.* (2016) with this being the most recently published review of the vulnerability of seabirds to offshore wind farms. Wade *et al.* (2016) uses the sensitivity definitions presented in Furness *et al.* (2013) to develop a method to incorporate uncertainty into indices ranking the vulnerability of seabird species. The uncertainty level associated with each vulnerability score was defined by Wade *et al.* (2016) based on the quantity and quality of available data. When identifying VORs for which collision risk modelling (Annex 5.3: Collision Risk Modelling) or displacement analysis (Annex 5.2: Analysis of Displacement Impacts on Seabirds) are required, the uncertainty indices presented in Wade *et al.* (2016) are taken into account (indicated through shading in Table 1.6).

Table 1.6: Summary of seabird sensitivities to impacts associated with offshore wind farms (Wade *et al.* (2016) unless stated otherwise). Sensitivities from Wade *et al.* (2016) are shaded to indicate the uncertainty level associated with the sensitivity level assigned to a species

Species	Displacement[15]	Habitat loss[15]	Collision risk[16]	Barrier effects[17]
Common scoter	Very High	High	Low	Moderate
Red-throated diver	Very High	High	Moderate	High
Fulmar	Very Low	Very Low	Very Low	Low
Cory's shearwater	Very Low	Very Low	Very Low	-
Manx shearwater	Very Low	Very Low	Very Low	-
European storm-petrel	Very Low	Very Low	Low	-
Gannet	High	Very Low	High	Very low
Arctic skua	Very Low	Low	High	Low
Great skua	Very Low	Low	High	Low
Puffin	Moderate	Moderate	Very Low	High
Razorbill	High	Moderate	Very Low	High
Guillemot	High	Moderate	Very Low	High
Little tern	Low	High	Moderate	Very low
Sandwich tern	Low	Moderate	High	Very low
Common tern	Low	Moderate	Moderate	Very Low
Arctic tern	Low	Moderate	Moderate	Very Low
Kittiwake	Low	Low	High	Low
Black-headed gull	Low	Low	High	Low
Little gull[18]	Very Low	Moderate	Low	Low
Common gull	Low	Low	Very High	Low
Lesser black-backed gull	Low	Very Low	Very High	Low
Herring gull	Low	Very Low	Very High	Low
Great black-backed gull	Low	Very Low	Very High	Low

Key to shading – uncertainty level

Not included in Wade *et al.* (2016)	Very low	Low	Moderate	High	Very high

1.5 Designated sites

1.5.1.1 Breeding seabirds are central-place foragers, with the nest or colony forming the central location. Foraging range varies widely between species and is determined by environmental conditions, dietary needs, flight physiology and ability to transport food.

[15] The five point scales in Wade *et al.* (2016), Bradbury *et al.* (2014), Maclean *et al.* (2009) and Garthe and Hüppop (2004) have been translated to sensitivities of Very High, High, Moderate, Low and Very Low in Table 1.6. Where the sensitivity of a species has been obtained from Langston (2010) this is identified in Table 1.6 as Langston (2010) uses a three point scale (High, Moderate and Low risk).
[16] Based on the overall vulnerability score in Wade *et al.* (2016)
[17] Taken from Maclean *et al.* (2009) or Langston (2010)
[18] Garthe and Hüppop (2004)

1.5.1.2 The foraging range of each species was used to infer potential connectivity between Hornsea Three and important colonies or designated sites. Generally mean-maximum foraging range (Thaxter *et al*., 2012) is considered to be the appropriate metric to determine connectivity between a breeding colony and a Project site. However, additional data from tracking studies (e.g. Wakefield *et al*., 2013, the Future of the Atlantic Marine Environment (FAME) (http://www.fameproject.eu/en/project/partnership/) and Seabird Tracking and Research (STAR) projects) have been incorporated into the assessment for Hornsea Three. The mean-maximum foraging range of a species is the average maximum length of the trip taken by individuals to obtain food, based on data obtained from relevant studies of that species (Thaxter *et al*., 2012). A maximum foraging range encompasses the longest distance from home colony recorded for a given species.

1.5.1.3 According to recent Natural England and JNCC guidance (Natural England/JNCC, 2013), mean maximum foraging range is a suitable metric for determining connectivity because "it recognises that different maxima have been estimated or measured for the same species, and the mean maximum range incorporates this variability without relying on single values that might be unrepresentative of all colonies". Mean-maximum foraging range is the primary metric used to determine connectivity and regional populations throughout this chapter. However, in some cases, it has been considered that the maximum foraging range should be used, with evidence from baseline surveys and also from tagging results recently published as part of the Future of the Atlantic Marine Environment (FAME) project [www.fameproject.eu] showing that birds (including fulmar and guillemot at northern Scottish colonies) may travel further than previously thought.

1.5.1.4 The distance between Hornsea Three, and the relevant breeding colonies indicated that, for the majority of species, the proposed development is beyond their mean-maximum foraging ranges even from the nearest colony.

1.5.1.5 Table 1.7 shows SPAs with possible connectivity to Hornsea Three, and the listed species within foraging range (Thaxter *et al*., 2012). This potential for connectivity is also used to inform the evaluation of species' importance. SPAs along the east coast of the UK from Hermaness, Shetland to Foreness Point, Kent have been considered where species that are a qualifying feature of an SPA were recorded within Hornsea Three. These designated sites are considered fully within the RIAA for Hornsea Three.

1.5.1.6 There are a number of SPAs, potentially at risk of being affected by development associated with Hornsea Three during the breeding season (Table 1.7):

- Flamborough and Filey Coast pSPA;
- Farne Islands SPA;
- Coquet Island SPA;
- Northumberland Marine SPA;
- Forth Islands SPA;
- Outer Firth of Forth and
- Alde-Ore Estuary SPA.

1.5.1.7 Natural England has initiated formal consultation on the extension of the Flamborough and Bempton Cliffs SPA. Currently the extension is a potential SPA (pSPA) and has been renamed the Flamborough and Filey Coast pSPA. The pSPA is based on a revised site boundary, revised interest features and new reference populations. The existing SPA, Flamborough Head and Bempton Cliffs was originally designated for kittiwake. Flamborough and Filey Coast pSPA is to be designated for breeding populations of kittiwake, gannet, guillemot and razorbill. The pSPA also regularly supports an assemblage feature of over 20,000 seabirds (215,750 individuals) with fulmar the only listed additional component to those listed for the SPA. Other non-listed assemblage features include puffin, herring gull, shag and cormorant. Hornsea Three is located approximately 149 km from the pSPA, and therefore falls within the mean-maximum (± 1 SD) foraging range of gannet (229.4 km) and fulmar (400 km) and the maximum foraging range of puffin (200 km). The mean-maximum foraging ranges from the pSPA of guillemot, kittiwake, razorbill and herring gull do not interact with Hornsea Three. However, tracking data collected as part of the FAME/STAR projects indicates that there is potential connectivity between kittiwake from the pSPA and Hornsea Three.

1.5.1.8 In addition to Flamborough and Filey Coast pSPA, there is predicted connectivity between three further SPAs and Hornsea Three at which fulmar is a qualifying feature. These are the Forth Islands SPA, Farne Islands SPA and Coquet Island SPA. These SPAs are located approximately 383 km, 304 km and 283 km from Hornsea Three, respectively and therefore within the mean-maximum foraging range of fulmar (400 km) from these SPAs.

1.5.1.9 The remaining SPA designated for features with potential connectivity in the breeding season is the Alde-Ore Estuary SPA. The mean-maximum foraging range of lesser black-backed gull (141 km) from this SPA interacts with the export cable route for Hornsea Three.

1.5.1.10 The final SPA with qualifying features that has the potential to interact with Hornsea Three is the Greater Wash pSPA. The HRA Screening Report (Annex 1 to the Hornsea Three RIAA) for Hornsea Three identified the potential for a Likely Significant Effect on the red-throated diver and common scoter features of the pSPA due to impacts associated with the construction or maintenance of the export power cable.

1.5.1.11 During the non-breeding period, birds from colonies further afield may also be present within Hornsea Three, although there is significant uncertainty regarding how many individuals from each of the colonies will be affected by Hornsea Three. Details of how potential impacts are apportioned across colonies from within the region are provided in the supporting documents to the RIAA for Hornsea Three.

Table 1.7: Qualifying SPA species with foraging ranges that interact with Hornsea Three from relevant breeding colonies.

(p)SPA	Distance to Hornsea Three (km)	Qualifying feature	Justification	Cited SPA population (pairs)	Current SPA population (year of count) (pairs)
Breeding season					
Flamborough and Filey Coast	149 (array area)	Fulmar (assemblage feature)	Foraging range (400 ± 245.8 km) overlaps with array area	1,447	1,447 (Natural England, 2014)
		Gannet	Foraging range (229.4 ±124.3 km) overlaps with array area	8,469	12,494 (2015) (JNCC, 2017)
		Kittiwake	FAME tracking data indicate connectivity with array area	44,520	51,001 (2016) (Davison, 2017)
		Puffin (non-listed assemblage feature)	Foraging range (105.4 ± 46.0 km) overlaps with array area	980[19]	1,960 (Natural England, 2014)
Farne Islands	304 (array area)	Fulmar (non-listed assemblage feature)	Foraging range (400 ± 245.8 km) overlaps with array area	542	244 (2016) (JNCC, 2017)
Coquet Island	283 (array area)	Fulmar (non-listed assemblage feature)	Foraging range (400 ± 245.8 km) overlaps with array area	125	42 (2016) (JNCC, 2017)
Northumberland Marine	268 (array area)	Fulmar (non-listed assemblage feature)	Foraging range (400 ± 245.8 km) overlaps with array area	341	286 (2016) (JNCC, 2017)
Forth Islands	384 (array area)	Fulmar (assemblage feature)	Foraging range (400 ± 245.8 km) overlaps with array area	798	688 (2015) (JNCC, 2017)
Alde-Ore Estuary	189 (export cable)	Lesser black-backed gull	Foraging range (141.0 ± 50.8 km) overlaps with export cable route	21,700	6,000 (Stroud *et al.*, 2016)
Non-breeding season					
Greater Wash	0 (export cable)	Common scoter	Export cable directly overlaps with pSPA boundary	3,463	3,463 (Natural England and JNCC, 2016)
	0 (export cable)	Red-throated diver	Export cable directly overlaps with pSPA boundary	1,511	1,511 (Natural England and JNCC, 2016)

[19] Note that the breeding population of puffin at Flamborough and Filey Coast pSPA as stated in the departmental brief for the pSPA (Natural England, 2014) incorrectly applied the correction factor for individuals on land to breeding pairs as reported in Lloyd *et al.* (1991) and as such the actual number of breeding adults is double that stated in the Flamborough and Filey Coast pSPA departmental brief. The figure provided here is the corrected value.

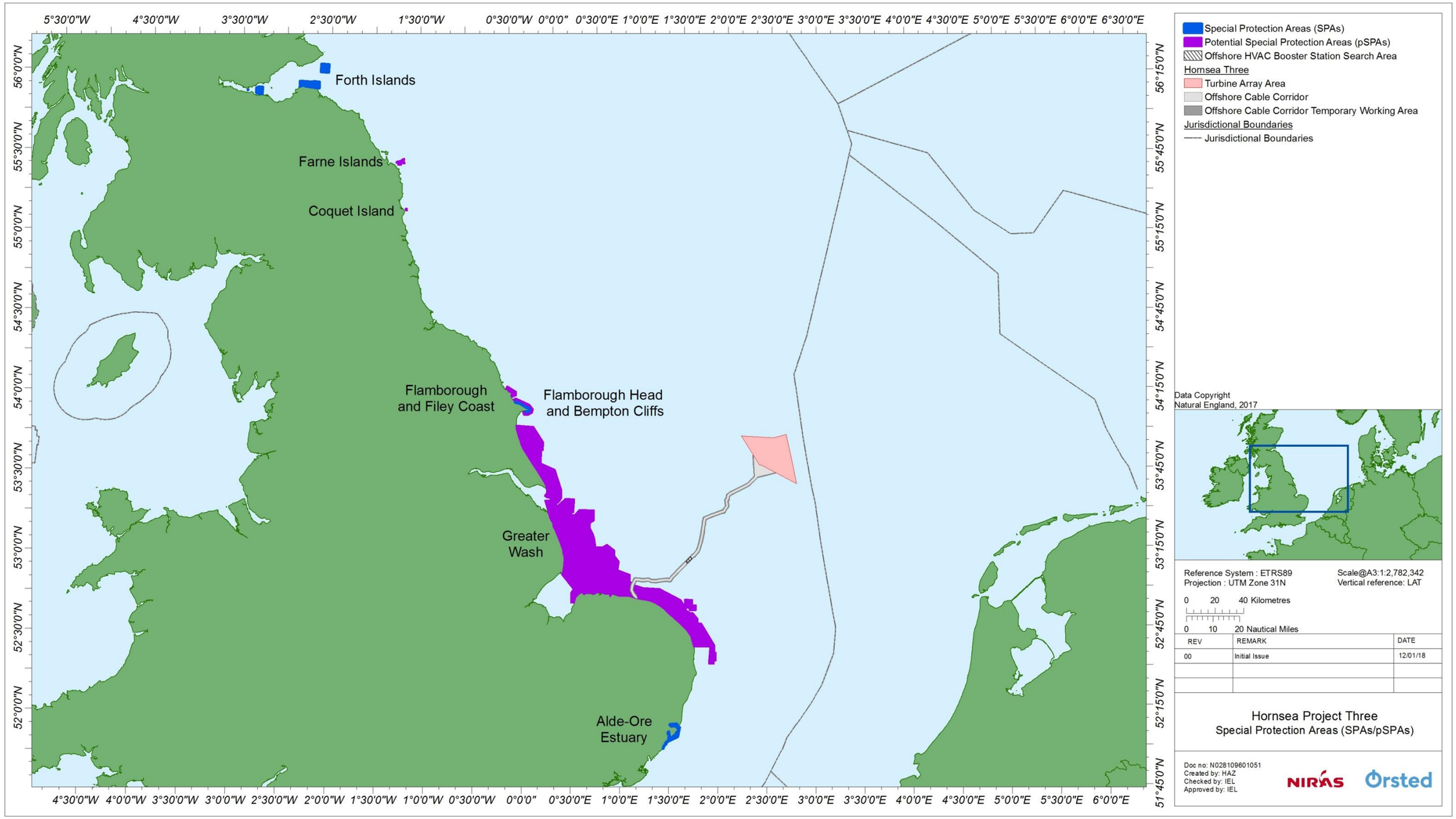


Figure 1.4: Special Protection Areas of relevance to offshore ornithological receptors in relation to Hornsea Three.

1.6 Species accounts

1.6.1 Overview

1.6.1.1 The definition of offshore ornithology for the purposes of Volume 2, Chapter 5: Offshore Ornithology incorporates all birds that occur below MHWS. This therefore includes the intertidal environment where the Hornsea Three export cable makes landfall on the Norfolk coast. Surveys of the intertidal habitat at the export cable landfall identified a narrow strip of cobble/shingle/sand which was considered to provide minimal opportunities for foraging and roosting by intertidal birds. As such, it was considered that there would be no impacts on intertidal bird species and these are not considered for further assessment. This section therefore includes species accounts for seabird species that may utilise the Hornsea Three array area and the Hornsea Three offshore export cable route.

1.6.1.2 Those species that may occur at the Hornsea Three array area have been identified using site-specific aerial surveys undertaken between April 2016 and November 2017. Species accounts are therefore presented for all species recorded during these surveys. The species accounts for these species present aerial survey data from Hornsea Three plus a 4 km buffer. For species included in this section, population estimates for Hornsea Three plus a 4 km buffer are used as a screening tool to identify those species which require further assessment within Volume 2, Chapter 5: Offshore Ornithology. Species identified for further assessment are summarised in Section 1.7. For species along the Hornsea Three export cable route, the suite of species considered is based on those identified as part of the designation for the Greater Wash pSPA. Information relating to the abundance and distribution of these species has been obtained from the departmental brief for the Greater Wash pSPA and supporting documents (Lawson *et al.* 2015; Parsons *et al.,* 2015; Wilson *et al.,* 2014).

1.6.1.3 The occurence of of each species in the North Sea has also been considered using relevant data sources. Shapefiles associated with Natural England's Seabird Sensitivity Analysis Mapping Tool (WWT Consulting and MacArthur Green, 2013) have been used to identify the distribution of relevant species in the English North Sea, focussed on the area in which Hornsea Three is located. The underlying data supporting the shapefiles associated with the mapping tool were collected during boat-based and aerial surveys between 1979 and 2012. These data were analysed using distance analysis and density surface modelling to produce predicted densities across a 3 km by 3 km grid covering English territorial waters. A full description of the process is provided in the reports associated with the mapping tool (WWT Consulting and MacArthur Green, 2013).

1.6.1.4 Each species account also includes an overview of species conservation status and sensitivity to impacts associated with offshore wind developments. All Special Protection Areas on the east coast of the UK (Shetland to Kent) at which the relevant species is a qualifying feature either in it's own right or as part of an assemblage have been identified. Behavioural information recorded during baseline surveys relating to flight direction, is also presented within individual species accounts.

1.6.1.5 Flight height data has been obtained from surveys of the former Hornsea Zone (see Annex 5.3: Collision Risk Modelling for information in relation to flight height data from aerial surveys). A description of these surveys is provided in Section 1.2.2. These data have been analysed to identify only those observations recorded in transects occurring at Hornsea Three plus a 4 km buffer and are used to describe the potential collision risk to birds posed by Hornsea Three based on a lower rotor tip height of 33.18 m and an upper rotor tip height of 197.18 m, both at MSL. As the former Hornsea Zone boat-based flight height data was collected using five metre height bands, the 35 and 195 m height bands representing heights from 32.5-37.5 m and 192.5 – 197.5 m, respectively have been used as lower and upper limits of the rotor swept area through which birds would be at potential collision risk. No post-hoc fitting of data to specific rotor swept areas (i.e. 33.18 – 197.18 m) has been undertaken. Flight height behaviour is only included in the following species accounts for those species for which over 100 records exist with this considered sufficient to provide a PCH representative of flight behaviour (Natural England, 2013). In addition generic flight height data from Johnston *et al.* (2014) have also been presented where relevant, although it should be noted that these data may not represent the flight behaviour of birds at Hornsea Three with flight behaviour potentially influenced by site-specific ecological factors.

1.6.1.6 Data from aerial surveys carried out between 2004 and 2008 collated in reports produced by the Department of Energy and Climate Change (DECC, formerly the Department for Business, Enterprise and Regulatory Reform (BERR) and the Department for Trade and Industry (DTI)) have also been considered. Survey results from three of the Greater Wash aerial survey blocks in particular have been referred to as they overlap with, or sit very close to, the westernmost limit of the former Hornsea Zone. These are GW2, GW9 and GW10 with these blocks show in WWT Consulting (2009) and Department for Business Enterprise and Regulatory Reform (2007). Because survey coverage was not consistent across all zones and the reports contain only raw counts, these survey data should only be used to inform the temporal pattern of use of the wider area by these species. Because these survey blocks are also closer to the coast than Hornsea Three, they may indicate a pattern of use of more coastal waters in this region.

1.6.1.7 A VOR was identified where the numbers present at Hornsea Three plus a 4 km buffer breached the 1% threshold of the regional population in any season. It is considered that any impacts on species occurring in numbers of less than 1% of the relevant regional population will not be significant. This process is not however, applied as a definitive threshold with expert judgement also used to identify species for which this threshold may not be applicable and therefore ensure that species are not erroneously omitted from further assessment. Each species account section then uses criteria associated with a species conservation status and the importance of populations estimated within Hornsea Three and a 4 km buffer to identify the relevant conservation value for a VOR (Table 1.8). These selection criteria were informed by the Chartered Institute of Ecology and Environmental Management's (CIEEM) (2010) guidance and adapted to relevance for the avifauna present within Hornsea Three.

Table 1.8: Definition of terms relating to the conservation value of ornithological receptors.

Conservation Value	Definition
Negligible	Conservation status All species of lowest conservation status (e.g., Green-listed species listed on the Birds of Conservation Concern).
	Importance None
Local	Conservation status Any other species of conservation status (e.g., Amber-listed species listed on the Birds of Conservation Concern) not covered in the categories below.
	Importance A species which is present at Hornsea Three in numbers lower than 1% of the regional population.
Regional	Conservation status Species listed on the Birds of Conservation Concern Red list; and/or Species that are the subject of a specific action plan within the UK or are listed as Species of Principal Importance in England (Section 41 of the NERC Act 2006).
	Importance A species which is present at Hornsea Three in numbers of greater than 1% of the regional population.
National	Conservation status Species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) not already covered by International criteria; Species listed on Annex 1 of the EU Birds Directive; Bird species that form part of an SSSI that may potentially interact with Hornsea Three at some stage of their life cycle; At least 50% of the UK breeding or non-breeding population found in ten or fewer sites; and/or An impact on an ecologically-sensitive species (<300 breeding pairs or <900 wintering individuals in the UK).
	Importance A species which is present at Hornsea Three in numbers of greater than 1% of the national population.
International	Conservation status Bird species that form part of a cited interest of an SPA or Ramsar site that may potentially interact with Hornsea Three at some stage of their life cycle including those listed as assemblage features; and/or At least 20% of the European breeding or non-breeding population is found in the UK.
	Importance A species which is present at Hornsea Three in numbers of greater than 1% of the international biogeographic population.

1.6.2 Common scoter (*Melanitta nigra*)

Status overview

1.6.2.1 Common scoter is not listed under Annex I of the EU Birds Directive (2009/147/EEC) but is included on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is also currently red-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.2.2 The majority of the UK wintering population of common scoter is concentrated in a few large flocks off the mouths of major estuaries around the UK coast. A review of numbers for the UK and survey work at key sites suggested that the number of wintering common scoter is likely to be in the region of 100,000 birds (Musgrove *et al*., 2011).

1.6.2.3 The UK breeding population of common scoter has declined by more than 50% in recent years, and was estimated at between 18 and 43 pairs in 2014, with all but one (Norfolk) in northern Scotland (Holling *et al*., 2016).

1.6.2.4 Common scoter is listed as a qualifying interest species in the non-breeding season for five SPAs and three pSPAs on the UK east coast (Table 1.9). The Hornsea Three export cable route passes through the Greater Wash pSPA. These SPAs held 22.4% of the UK non-breeding population and 1.4% of the biogeographic population (1,600,000 individuals) at time of designation (JNCC, 2013).

1.6.2.5 Wade *et al*. (2016) assessed common scoter as being at low risk of collision with turbines. However, the species is considered to be at very high risk of displacement and high risk of habitat loss due to a limited flexibility in habitat use. Maclean *et al*. (2009) assessed common scoter as being of moderate risk to barrier effects (Table 1.6).

Table 1.9: SPAs cited for common scoter on the UK east coast in the non-breeding season.

SPA	Distance to Hornsea Three (km)	Cited SPA population (individuals)
Firth of Forth	376	2,880
Firth of Tay and Eden Estuary	412	3,100
Greater Wash pSPA	0 (export cable)	3,463
Lindisfarne	311	670
Moray Firth pSPA	555	5,479
Moray and Nairn Coast	523	1,254[20]
Outer Firth of Forth and St Andrews Bay Complex pSPA	654	4,677
The Wash	156	830
Total		22,353

Seasonal abundance and distribution

Hornsea Three array area

1.6.2.6 No common scoter were recorded during the aerial surveys undertaken across Hornsea Three plus a 4 km buffer.

Hornsea Three export cable route

1.6.2.7 Lawson *et al.* (2015), which presents survey data collected across the Greater Wash, indicates that a mean-peak population of 6,107 common scoter occurs in the that area (Figure 1.7). The Greater Wash for which the distribution of common scoter was calculated in Lawson *et al.* (2015) incorporates approximately 25 km of the export cable route. However, the main concentrations of common scoter in the Greater Wash occur along the North Norfolk Coast and into The Wash, with densities of up to 56.6 birds/km^2 occurring in these areas. Figure 1.5 suggests however, that relatively low densities (1.89 birds/km^2) of common scoter may occur along the export cable route.

Conclusion

1.6.2.8 Common scoter was not recorded during aerial surveys of the Hornsea Three array area and therefore it is considered highly unlikely that impacts will occur on common scoter within the Hornsea Three array area. However, the Hornsea Three export cable route passes through the Greater Wash pSPA which is designated for common scoter. Although the density of common scoter is notably low in the area of the pSPA through which the export cable passes, common scoter has a very high vulnerability to displacement impacts and is therefore identified as a VOR with an International conservation value.

1.6.2.9 Common scoter is, therefore, considered for further assessment for impacts associated with Hornsea Three in relation to the proposed export cable only.

[20] Sourced from Stroud *et al.* (2016)

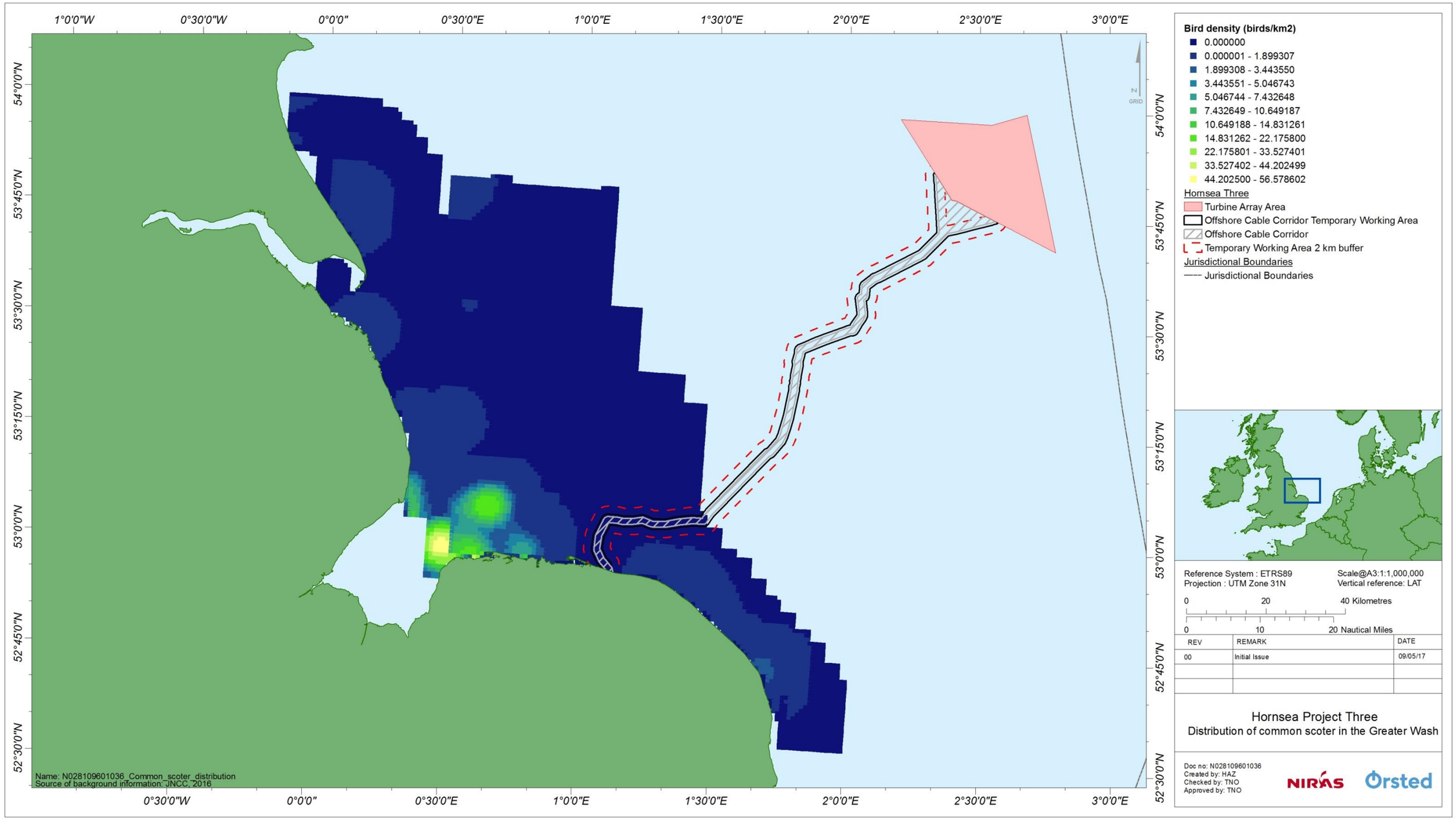


Figure 1.5: Distribution of common scoter in the Greater Wash, calculated from data collected between 2002 and 2008 (Lawson *et al.*, 2015).

1.6.3 Red-throated diver (*Gavia stellata*)

Status overview

1.6.3.1 Red-throated diver is listed on Annex I of the EU Birds Directive (2009/147/EEC) and Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently green-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.3.2 An estimated 1,300 pairs of red-throated diver breed in Britain, with the majority of pairs found in the north and west of Scotland (Musgrove *et al.,* 2013; Balmer *et al.,* 2013). The wintering population around Britain has been estimated at 17,000 individuals (O'Brien *et al*., 2008) and the 1% threshold for national importance is 170 birds (Musgrove *et al*., 2011). Wintering red-throated divers show a preference for sheltered shallow waters and sandy bays along North Sea coasts, and several important areas off the east coast of England have recently been identified; in particular the outer Thames Estuary and the Greater Wash (O'Brien *et al*., 2008). Numbers may however fluctuate widely in response to weather and other factors affecting the supply of prey species such as sandeels, crustaceans and small fish (Lack, 1986).

1.6.3.3 Red-throated diver is listed as a qualifying interest species in the non-breeding season for two SPAs and one potential SPA on the UK east coast; the Outer Thames Estuary SPA, Firth of Forth SPA and Greater Wash pSPA. The Outer Thames Estuary SPA regularly supports wintering red-throated diver in numbers of European importance (6,466 individuals – wintering 1989–2006/07) (Natural England/JNCC, 2010), which is around 38% of the British wintering population. The Greater Wash potential SPA regularly supports 1,511 red-throated diver, or nearly 9% of the British wintering population, making this the second most important area for red-throated diver around the coast of the UK after the Outer Thames Estuary (Natural England, 2016).

1.6.3.4 Red-throated diver is also included as a potential qualifying feature of a number of Scottish pSPAs in the non-breeding season including:

- Outer Firth of Forth and St Andrews Bay Complex pSPA (851 individuals representing 5% of the Great Britain population); and
- Moray Firth pSPA (324 individuals representing 1.8% of the Great Britain population).

1.6.3.5 The Firth of Forth SPA held 90 red-throated divers or 2% of the UK non-breeding population at the time of designation. A similar figure (80 birds) was the most recently available five-year mean for wintering red-throated divers in the Forth Estuary (2004 - 2009) (Calbrade *et al*., 2010). This therefore represents 0.47% of the most recent non-breeding national population estimate (O'Brien *et al.,* 2008).

1.6.3.6 Available evidence from ringing studies suggests that red-throated divers may move considerable distances from their breeding grounds in the non-breeding season, with recoveries from Shetland-ringed birds in Kent, Ireland, France and the Netherlands. Birds ringed in Greenland and Scandinavia have also been recovered in the UK, indicating that not all birds recorded in the former Hornsea Zone may breed in the UK (Wernham *et al*., 2002).

1.6.3.7 Wade *et al*. (2016) assessed red-throated divers as being at very high risk of displacement from offshore wind farms, and there is published evidence from some offshore wind farm studies to support this (e.g., Petersen, 2005; Barton *et al*., 2008). Red-throated diver has also been assessed as being at high risk of barrier effects (Maclean *et al*., 2009) and habitat loss due to a limited flexibility in habitat use., and at moderate risk of collision with turbines due to limited flight manoeuvrability (Wade *et al*., 2016) (Table 1.6).

Seasonal abundance and distribution

Hornsea Three array area

1.6.3.8 Red-throated diver were recorded in only two of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. A total of six birds were recorded during May 2016 translating to a population estimate of 66 birds. Although this population occurred during the defined breeding season for red-throated diver (Table 1.4), these birds clearly do not constitute breeding birds. There is considered to be no connectivity between Hornsea Three and red-throated diver breeding areas with the closest sites being in northern Scotland (Balmer *et al.* 2013; Parkin and Knox, 2010). Birds recorded at Hornsea Three during the defined breeding season for red-throated diver are therefore considered to be non-breeding birds or birds on passage. In addition to those birds recorded in May 2016, two birds were recorded in April 2017, translating to a population estimate of 30 birds.

1.6.3.9 The populations of red-throated diver estimated from aerial surveys do not surpass the 1% regional threshold of the migratory population of red-throated diver that occurs in the south-west North Sea (133 individuals).

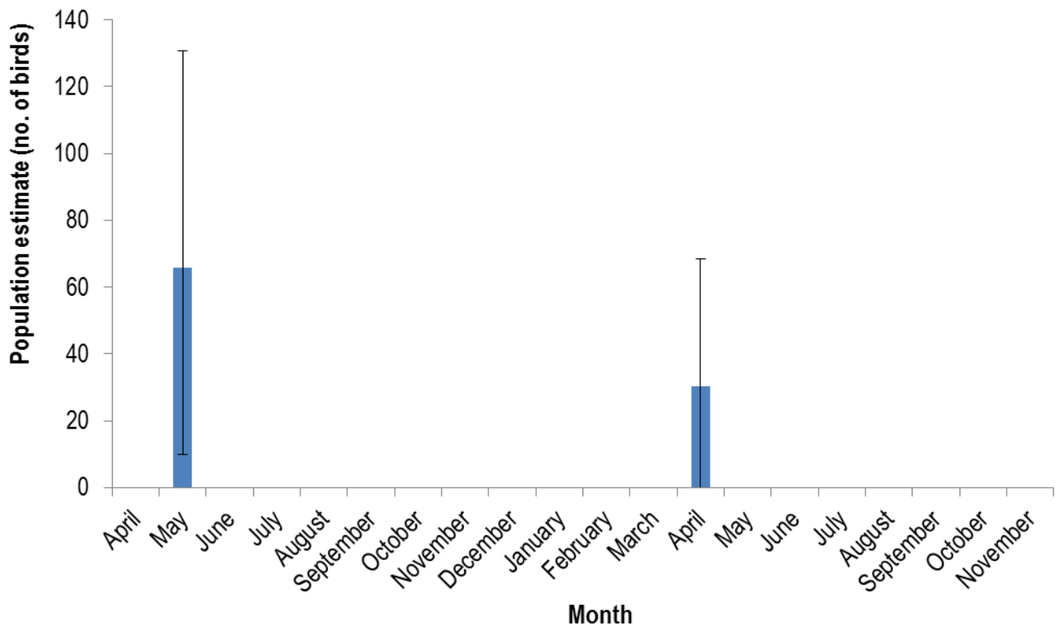


Figure 1.6: Population estimates of red-throated diver (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

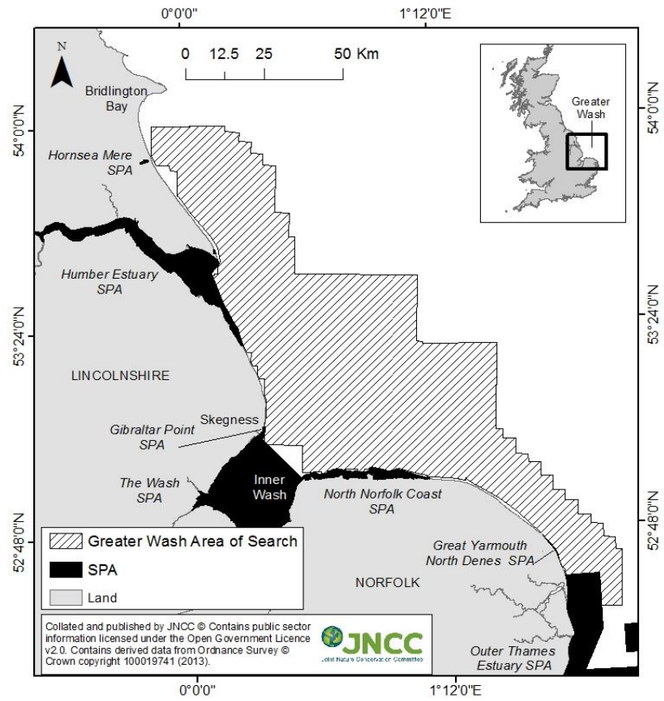


Figure 1.7: The Greater Wash Area of Search as defined in Lawson *et al.* (2015).

Hornsea Three export cable route

1.6.3.10 Lawson *et al.* (2015), which presents survey data collected across the Greater Wash, indicates that a mean-peak population of 1,787 red-throated divers occurs in the area which extends from Bridlington Bay (East Yorkshire) in the north to the boundary between the counties of Norfolk and Suffolk in the south, extending to approximately 60 km offshore in some places (Figure 1.7). The Greater Wash for which the distribution of red-throated diver was calculated in Lawson *et al.* (2015) incorporates approximately 25 km of the export cable route. The main concentrations of red-throated diver in the Greater Wash are located off the north Norfolk coast and the Lincolnshire coast, around Gibraltar Point with densities of up to 3.38 birds/km^2 occurring in these areas. Figure 1.8 suggests that relatively low densities (0.67 birds/km^2) of red-throated diver may occur along the export cable route.

Conclusion

1.6.3.11 The populations of red-throated diver recorded at Hornsea Three during aerial surveys do not exceed the 1% importance threshold of the regional migratory BDMPS population of red-throated diver in the south-west North Sea. Therefore the number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect. However, the Hornsea Three export cable passes through the Greater Wash pSPA for which red-throated diver is a proposed qualifying feature and, hence, red-throated diver is identified as a VOR and considered to be of International conservation value.

1.6.3.12 Red-throated diver is, therefore, considered for further assessment for impacts associated with the Hornsea Three export cable only.

Table 1.10: Monthly population estimates and densities of red-throated diver in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*	*Flying*	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	67	66	131	10	0	0.05	0.05	0.11	0.01
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	0	0	0	0	0	0	0	0	0	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	30	30	68	0	0	0.02	0.02	0.06	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

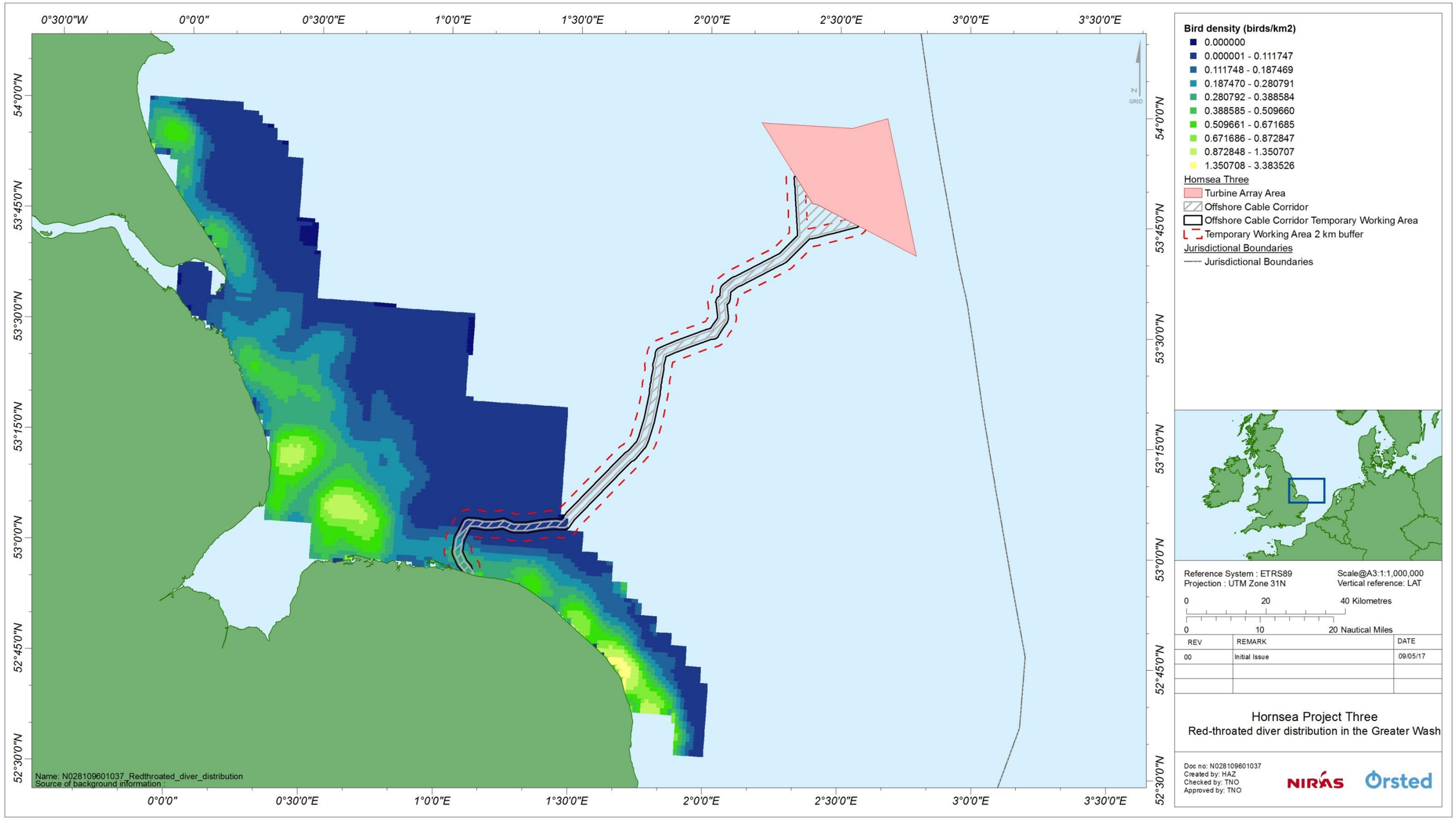


Figure 1.8: Distribution of red-throated diver in the Greater Wash, calculated from data collected between 2002 and 2008 (Lawson *et al.*, 2015).

1.6.4 Fulmar (*Fulmarus glacialis*)

Status overview

1.6.4.1 Fulmar is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Fulmar is however currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.4.2 Fulmar numbers and distribution around the UK have increased considerably since the mid-19th century (Pennington *et al*., 2004). The species is one of the most common seabirds in Britain, with an estimated breeding population of 499,081 pairs (Mitchell *et al*., 2004), although since Seabird 2000 when the UK breeding population was last estimated, the population is predicted to have decreased by 31% (JNCC, 2016). The largest breeding colonies are located off the north and west coasts of Scotland with birds often present at these colonies outside of the breeding season.

1.6.4.3 Between March and July, fulmars are distributed widely across the southern North Sea, although numbers are relatively low compared to further north along Scottish coasts, where the majority of British colonies occur (Stone *et al*., 1995). The predicted density of fulmar calculated using boat-based and aerial survey data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013) suggests that, the Hornsea Three array area supports relatively low to moderate densities of the species (Figure 1.38). The highest predicted densities in the North Sea in the summer (Apr to Sep) occur to the north-west of Hornsea Three off the Northumberland coast. From August to November, distribution extends southwards from the main breeding colonies (Stone *et al.,* 1995). Through the rest of the winter this species is very widely distributed across the whole North Sea, although it is evident that the continental shelf edge is important for fulmar at most times of the year, with the closest area of high concentrations to Hornsea Three being at Dogger Bank (Stone *et al*., 1995). Predicted densities in the winter (October to March), suggest moderate densities of fulmar occur at Hornsea Three (Figure 1.38), although these densities are lower than those predicted in the summer. The highest predicted densities in the winter again occur to the north-west of Hornsea Three approximately 40 km from the Yorkshire coast.

1.6.4.4 Fulmars forage at sea over a wide area in search of small fish (sandeels), crustaceans and squid. They also scavenge extensively around fishing vessels, with offal and fish discards from trawlers now forming a major part of their diet (Phillips *et al*., 2009).

1.6.4.5 Fulmar is currently listed as a qualifying interest species in the breeding season for 17 SPAs on the east coast of the UK. These SPAs are designated for 200,765 breeding pairs (Table 1.11), representing approximately 40% of the national population of fulmar as recorded during Seabird 2000 (Mitchell *et al.* 2004).

1.6.4.6 Hornsea Three lies within the mean maximum foraging range of fulmar (400 ± 245.8 km; Thaxter *et al.,* 2012) from four SPAs and one pSPA, Northumberland Marine SPA, Flamborough and Filey Coast pSPA, Forth Islands SPA, Farne Islands SPA and Coquet Island SPA (Table 1.7). Fulmar is not a qualifying feature in its own right but is listed as a main component of the seabird assemblage at the Flamborough and Filey Coast pSPA and the Forth Islands SPA and is a non-listed assemblage feature at the Northumberland Marine SPA, Farne Islands SPA and Coquet Island SPA.

Table 1.11: SPAs cited for breeding fulmar on the UK east coast. Hornsea Three lies within the mean-maximum foraging range of fulmar from those sites in bold.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs)
Buchan Ness to Collieston Coast	453	1,765
Calf of Eday	654	1,955
Copinsay	620	1,615
Coquet Island (non-listed assemblage)	**283**	125 breeding adults
East Caithness Cliffs	583	15,000
Fair Isle	654	35,210
Farne Islands (non-listed assemblage)	**304**	542 breeding adults
Fetlar	751	9,500
Forth Islands	**384**	**798**
Foula	725	46,800
Flamborough and Filey Coast pSPA	**149**	**1,447**
Fowlsheugh	425	1,170
Hermaness, Saxa Vord and Valla Field	773	19,539
Hoy	628	35,000
North Caithness Cliffs	604	14,700
Northumberland Marine	268	341
Noss	708	6,350
Rousay	657	1,240
Sumburgh Head	683	2,542
Troup, Pennan and Lion's Heads	493	4,400
West Westray	667	1,400
Total		200,765

1.6.4.7 Wade *et al*. (2016) assessed fulmar as being at very low risk of displacement from wind farms although this is associated with a high degree of uncertainty. A similar conclusion was also drawn for collision with turbines due to a limited proportion of flights occurring at turbine height. Fulmar is considered to be at very low risk of habitat loss (Wade *et al*., 2016) and low risk of barrier effects (Maclean *et al*., 2009) (Table 1.6).

Seasonal abundance and distribution

1.6.4.8 Fulmars were recorded in all twenty aerial surveys undertaken across Hornsea Three plus a 4 km buffer. In the breeding season (April to August) a peak population estimate of 1,554 birds occurred in August 2017. This population and those recorded in April, May and June of both 2016 and 2017 and July 2016 exceed the 1% importance threshold of the regional breeding population (117 individuals). However, none of these populations exceed the 1% importance threshold of the national breeding population.

1.6.4.9 In surveys undertaken in the post-breeding season (September to October), a peak population estimate of 1,347 birds occurred in September 2016 (Table 1.12). This population does not exceed the 1% importance threshold of the post-breeding regional BDMPS population for fulmar (9,575 individuals). Similarly, for surveys undertaken in the pre-breeding season (December to March), the peak population of 997 birds that occurred in December was also not of regional importance.

1.6.4.10 The non-breeding season for fulmar is defined as November. A peak population of 450 fulmars were estimated to be present within Hornsea Three plus a 4 km buffer during the aerial survey undertaken during November 2017. This population does not exceed the 1% importance threshold of the regional BDMPS population for fulmar (5,687 individuals) (Table 1.5).

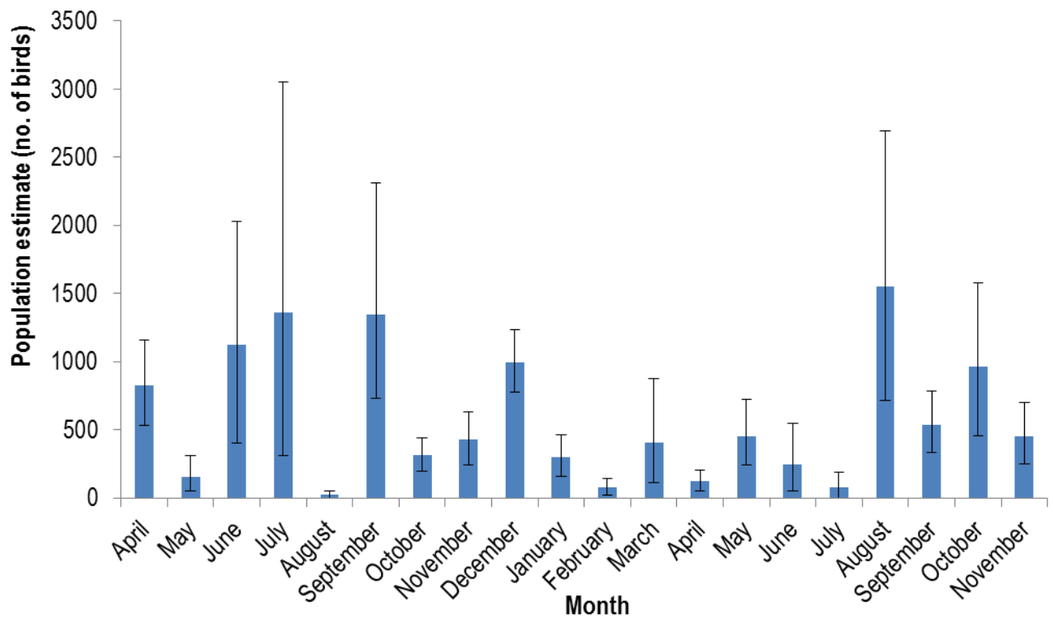


Figure 1.9: Population estimates of fulmar (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Table 1.12: Monthly population estimates and densities of fulmar in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*	*Flying*	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*
April 2016	164	666	829	1161	531	0.13	0.54	0.67	0.94	0.43
May 2016	55	103	157	314	50	0.04	0.08	0.13	0.25	0.04
June 2016	327	798	1127	2027	405	0.27	0.65	0.92	1.65	0.33
July 2016	222	1139	1360	3056	310	0.18	0.93	1.11	2.48	0.25
August 2016	11	12	23	52	0	0.01	0.01	0.02	0.04	0
September 2016	222	1148	1347	2316	731	0.18	0.93	1.09	1.88	0.59
October 2016	121	193	314	440	200	0.1	0.16	0.26	0.36	0.16
November 2016	133	296	429	635	240	0.11	0.24	0.35	0.52	0.2
December 2016	386	625	997	1239	776	0.31	0.51	0.81	1.01	0.63
January 2017	132	169	301	468	160	0.11	0.14	0.24	0.38	0.13
February 2017	43	34	78	143	20	0.04	0.03	0.06	0.12	0.02
March 2017	192	216	404	879	112	0.16	0.18	0.33	0.71	0.09
April 2017	91	30	121	205	55	0.07	0.02	0.1	0.17	0.04
May 2017	221	224	452	724	245	0.18	0.18	0.37	0.59	0.2
June 2017	99	147	250	546	51	0.08	0.12	0.2	0.44	0.04
July 2017	33	46	79	193	0	0.03	0.04	0.06	0.16	0
August 2017	165	1443	1554	2696	716	0.13	1.17	1.26	2.19	0.58
September 2017	55	500	540	789	333	0.04	0.41	0.44	0.64	0.27
October 2017	196	780	967	1581	454	0.16	0.63	0.79	1.28	0.37
November 2017	165	287	450	699	250	0.13	0.23	0.37	0.57	0.2

Behaviour

1.6.4.11 A total of 263 fulmars were recorded in flight within Hornsea Three plus a 4 km buffer during boat-based surveys of the former Hornsea Zone. Of these, none were recorded flying above 15 metres. This is consistent with generic flight height data presented in Johnston *et al.* (2014) which estimated the proportion of fulmar at potential collision height as 1% when using a lower rotor tip height of 20 m.

1.6.4.12 Flight direction was recorded for 275 fulmars across all surveys (Figure 1.10). As flight direction was recorded for a large number of birds, the prevailing flight direction in the breeding season was investigated. Birds were recorded flying in all directions with the highest number of birds recorded flying in either a south-westerly, northerly-westerly, northerly and north-easterly directions.

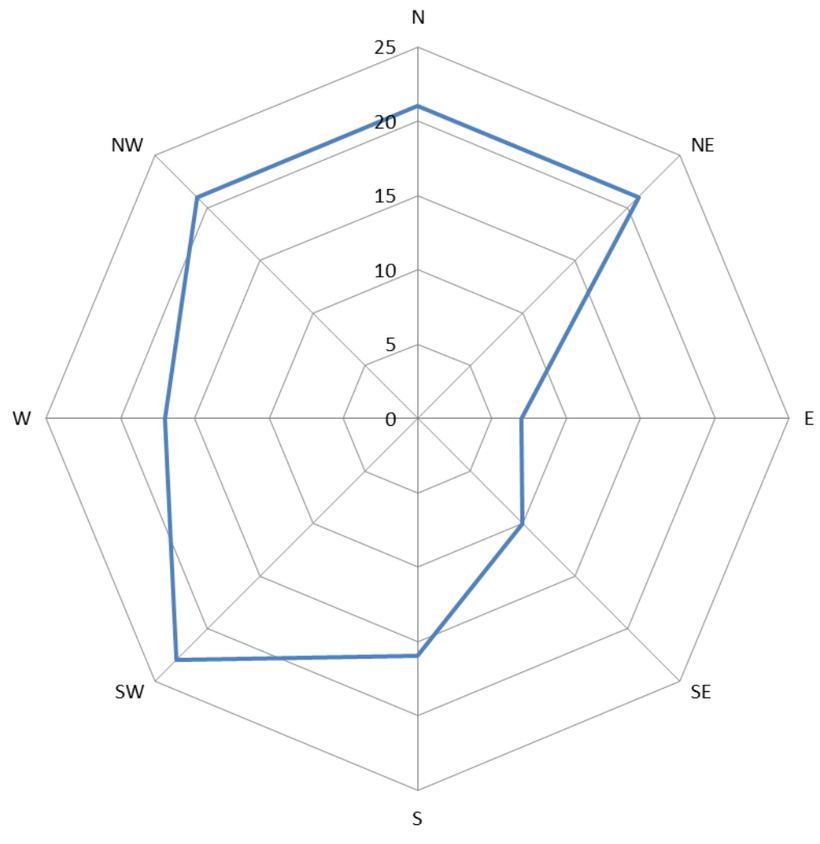


Figure 1.10: Flight directions of fulmars in the breeding season recorded during aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

Conclusion

1.6.4.13 Fulmar is considered to have an International conservation status due to the potential for interaction between birds from a number of SPA breeding colonies and Hornsea Three based on the extensive mean-maximum foraging range of the species (Thaxter *et al.,* 2012). In addition to this, population estimates of fulmar in Hornsea Three plus a 4 km buffer in the breeding season for April, May and June of both survey years and July 2016 and August 2017 exceed the 1% importance threshold of the regional population (Table 1.12; Table 1.5). The 1% importance thresholds of the national and international populations for fulmar are not surpassed in any month however.

1.6.4.14 Therefore, based on potential SPA connectivity and the regional importance of fulmar populations Hornsea Three, fulmar is identified as a VOR and considered for further assessment as a species with an International conservation value.

1.6.5 Cory's shearwater (*Calonectris borealis*)

Status overview

1.6.5.1 Cory's shearwater is not listed under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Scopoli's shearwater (*Calonectris diomedea*), from which Cory's shearwater was recently divided into two species, is included on Annex I of the EU Birds Directive (2009/147/EEC). The species is not listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.5.2 The nominate species of Cory's shearwater (*Calonectris borealis)* is a scarce visitor to British waters predominantly in late summer and early autumn, with a small number in spring (Forrester *et al.,* 2007). The species breeds on islands in the Atlantic (including the Azores and Canary Islands), wintering off southern Africa and the Americas with British waters appearing to represent the northernmost extent of the species range (Wernham *et al.,* 2002; Stone *et al.,* 1995). Although there are records of the species in the North Sea, the largest concentrations in British waters occur off the southwestern approaches and off Cornwall (Brown and Grice, 1995).

1.6.5.3 The diet of Cory's shearwater is composed mostly of fish, squid and crustaceans which are obtained by plunging and surface seizing. The species is also regularly attracted to trawlers to feed on offal (del Hoyo *et al.,* 1992).

1.6.5.4 Langston (2010) assessed Cory's shearwater as being at very low risk of displacement from wind farms and collision with turbines with this due to a limited proportion of birds occurring at turbine height. The species is not assessed in terms of barrier effects in Maclean *et al*. (2009) or Langston (2010) however, barrier effects are not considered to be an issue for this species due to its pelagic nature. Overall, Cory's shearwater is assessed as being at low risk from offshore wind developments (Table 1.6).

Seasonal abundance and distribution

1.6.5.5 Cory's shearwater was recorded in only one of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. One bird was recorded during the July 2017 survey translating to a population estimate of eleven birds. There is no post-breeding BDMPS population of Cory's shearwater and therefore this population is compared to the 1% importance threshold of the total international breeding population which it does not surpass.

Conclusion

1.6.5.6 Cory's shearwater is considered to have a National conservation status as the species was recently split from Scopoli's shearwater which is included on Annex 1 of the EU Birds Directive (2009/147/EEC). The peak population of Cory's shearwater estimated during aerial surveys was 11 birds in September. This peak population estimate does not exceed the relevant 1% importance thresholds of the international population (Table 1.5) of Cory's shearwater. The number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect and as such Cory's shearwater is not considered for further assessment.

Table 1.12: Monthly population estimates and densities of Cory's shearwater in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*	*Flying*	*On water*	*Combined*	*Upper confidence limit*	*Lower confidence limit*
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	0	0	0	0	0	0	0	0	0	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.6 Manx shearwater (*Puffinus puffinus*)

Status overview

1.6.6.1 Manx shearwater is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Manx shearwater is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.6.2 Manx shearwater is a summer visitor to UK waters, occurring at breeding colonies between March and September. Seabird 2000 estimated the British breeding population at 295,089 breeding pairs, with large colonies on the west coast of Scotland and off south-west Wales (e.g., Rum, Skomer and Skokholm) (Mitchell *et al*., 2004). However, it is evident that the British population of Manx shearwater is now higher with 316,070 breeding pairs estimated on Skomer Island, Wales in 2012 alone (Perrins *et al.,* 2012). The majority of Manx shearwater breeding colonies are found on the western coast of the UK, with only one potential small colony, on the Isle of May, found on the eastern coast of Britain (Balmer *et al*., 2013). Manx shearwater is also included as part of the potential designation for the Outer Firth of Forth and St Andrews Bay Complex pSPA (2,885 individuals), although the status of these birds is uncertain and are likely to be a mixture of breeding birds from distant colonies, sabbatical adults, pre-breeding age birds and possibly failed breeders.

1.6.6.3 Counts of more than 100 individuals off the east coast of Britain are uncommon, and the species is rare in the North Sea in winter months, as birds migrate to the south Atlantic for the winter, primarily off the east coast of South America (Forrester *et al*., 2007). This is supported by predicted densities of the species in the North Sea in both summer and winter as calculated by WWT Consulting and MacArthur Green, 2013).

1.6.6.4 Manx shearwaters spend most of their lives at sea, only coming ashore to breed. They typically eat small squid, fish, including sandeels and free-swimming crustaceans, which they catch by shallow plunge-diving or surface feeding (Forrester *et al*., 2007).

1.6.6.5 Wade *et al*. (2016) assessed Manx shearwater as being at very low risk of collision with turbines due to a limited proportion of birds occurring at turbine height although this was associated with a high level of uncertainty. The species is also considered at very low risk of displacement although this also has a high associated level of uncertainty. A similar conclusion was also drawn for habitat loss associated with wind farms due to the high flexibility of Manx shearwater in terms of habitat use. The species is not assessed in terms of barrier effects in Maclean *et al*. (2009) or Langston (2010) however, the species is not considered likely to be exposed due to their notable wide ranging pelagic nature. Overall, Manx shearwater is assessed as being at low risk from offshore wind developments (Table 1.6).

Seasonal abundance and distribution

1.6.6.6 Manx shearwater were recorded in four of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer (Table 1.13; Figure 1.11) with the highest population estimate occurring in August 2016 (179 birds).

1.6.6.7 There are no breeding colonies of Manx shearwater considered to have connectivity with Hornsea Three and therefore any birds recorded during surveys conducted in the breeding season (June-July) are considered to be either non-breeding birds, failed breeding birds or birds on passage to breeding colonies. As such, all populations recorded during surveys are compared against the 1% regional threshold of the migratory BDMPS population (1% threshold = 85 birds). Manx shearwaters were recorded at Hornsea Three in July 2016 and July 2017 with 11 birds in both months, neither of these populations exceed the 1% regional threshold of the migratory BDMPS population.

1.6.6.8 The population of birds at Hornsea Three plus a 4 km buffer in the August and September 2016 surveys exceed the 1% importance threshold of the regional BDMPS population. However, neither of these population estimates exceed the 1% importance threshold of the national population of Manx shearwater that migrates through UK waters (1% threshold = 15,894 individuals).

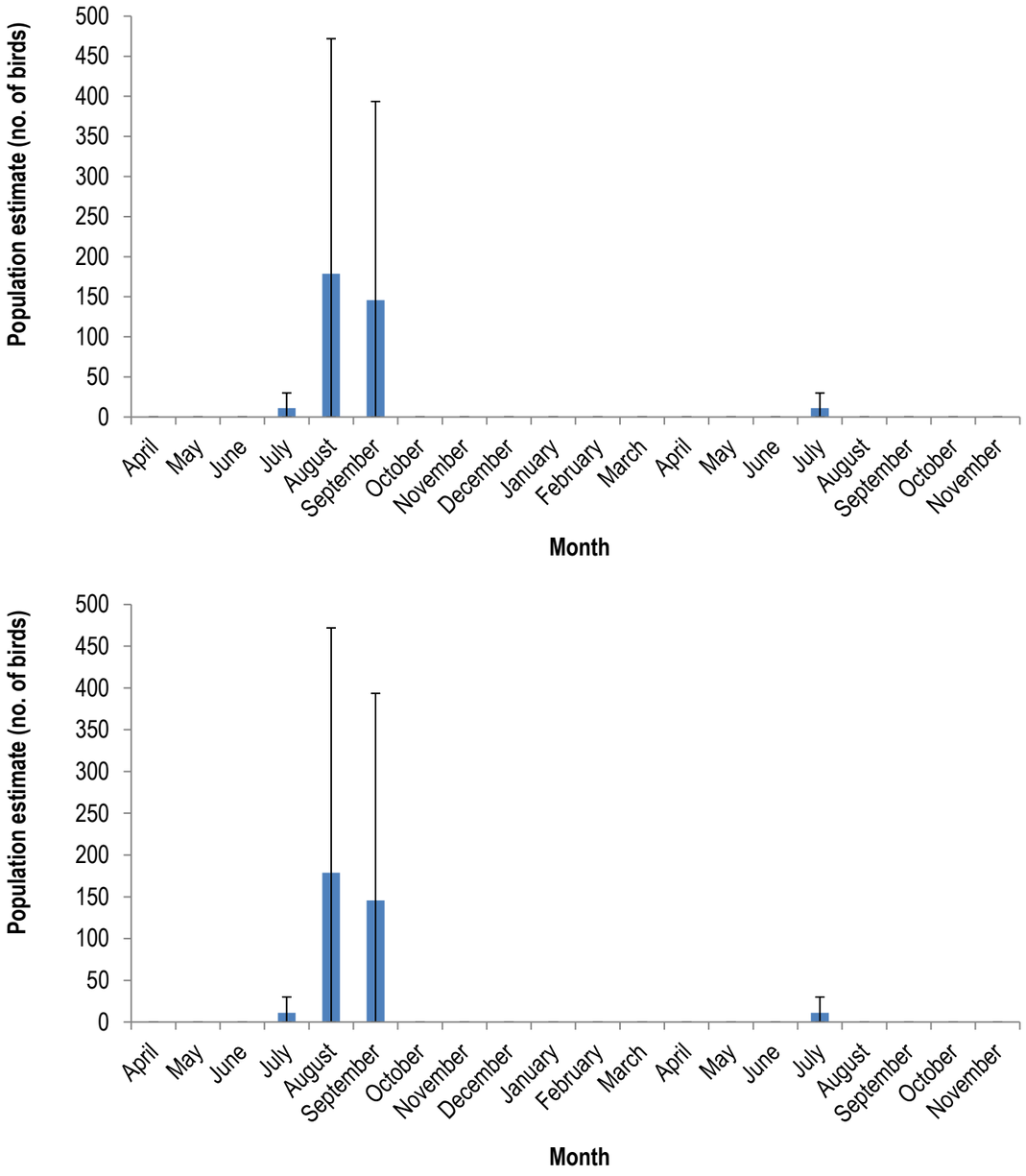


Figure 1.11: Population estimates of Manx shearwater (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.6.9 Manx shearwater is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015). The peak population of Manx shearwater estimated during aerial surveys was 179 birds in August (Table 1.13). This peak population estimate does not exceed relevant 1% importance thresholds of the international or national populations (Table 1.5) but does exceed the 1% importance threshold of the regional post-breeding BDMPS population for the species.

1.6.6.10 Although the peak population of Manx shearwater is potentially of regional importance, the species is not considered vulnerable to the impacts associated with offshore wind farms (Table 1.6). The number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect. Therefore, Manx shearwater is not considered for further assessment.

Table 1.13: Monthly population estimates and densities of Manx shearwater in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	11	0	11	30	0	0.01	0	0.01	0.02	0
August 2016	0	179	179	472	0	0	0.15	0.15	0.38	0
September 2016	0	146	146	394	0	0	0.12	0.12	0.32	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.7 Storm petrel (*Hydrobates pelagicus*)

Status overview

1.6.7.1 Storm petrel is listed on Annex I of the EU Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.7.2 Storm-petrels breed at a small number colonies around the UK, primarily on Shetland, Orkney, the Western Isles and the west coast of Scotland, as well as on islands off the Welsh coast, Isles of Scilly and the Channel Islands. Seabird 2000 estimated the UK breeding population to be 25,710 pairs, however outside of Orkney and Shetland, there are no breeding colonies on the east coast of Britain (Mitchell *et al*., 2004; Balmer *et al*., 2013). After the breeding season, birds migrate south and spend the winter off the coast of southern Africa.

1.6.7.3 Storm-petrel is listed as a qualifying interest species in the breeding season for two SPAs on the UK east coast; Auskerry SPA (3,600 pairs) in Orkney and Mousa SPA (4,750 pairs) in Shetland. These two SPAs held 10% of the UK breeding population, and 3.0% of the global population at the time of designation. Although the most recent population estimate for Auskerry has shown a decline, the population on Mousa has more than doubled (JNCC, 2017). The maximum foraging distance of this species is not currently known, however storm petrels are known to forage at distances at least 65 km from their colonies (Thaxter *et al*., 2012). Connectivity to Hornsea Three, which lies 632 km from the nearest SPA is however considered very unlikely.

1.6.7.4 Storm petrel is classed as an uncommon to scarce migrant off the Yorkshire coast in late summer and autumn (Thomas, 2011) with this supported by predicted densities of the species in the North Sea as calculated from boat-based and aerial survey data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013).

1.6.7.5 Wade *et al*. (2016) assessed storm petrel as being at very low risk of displacement from wind farms and habitat loss due to a high flexibility in habitat use. The species is also considered to be at low risk of collision with turbines due to a limited proportion of birds at turbine height. However, the sensitivities presented in Wade *et al.* (2016) for displacement and collision both have very high degrees of uncertainty associated with them. Although the species has not assessed in terms of barrier effects in Maclean *et al*. (2009) or Langston (2010) however, the species is not considered likely to be exposed due to their notable wide ranging pelagic nature (Table 1.6).

Seasonal abundance and distribution

1.6.7.6 Storm petrel was recorded in only one of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer (Table 1.14). One bird was recorded during the September 2016 survey translating to a population estimate of eleven birds. Although this observation occurred during the breeding season as defined for storm petrel by Kober *et al.* (2010), this is almost certainly a non-breeding bird with the closest breeding colonies to Hornsea Three located in northern Scotland, far beyond the maximum foraging range of the species (Thaxter *et al.* 2012). Even when considering a population of 11 birds, this does not exceed any of the relevant population thresholds for storm petrel (Table 1.5).

Conclusion

1.6.7.7 Storm petrel is listed on Annex 1 of the EU Birds Directive meaning the species has a National conservation status. The peak population of European storm petrel estimated during aerial surveys was 11 birds in September (Table 1.14). This peak population estimate does not exceed the relevant 1% importance thresholds of the international or national populations (Table 1.5) of storm petrel. The number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect. Therefore, storm petrel is not considered for further assessment.

Table 1.14: Monthly population estimates and densities of storm petrel in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	11	0	11	30	0	0.01	0	0.01	0.02	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.8 Gannet (*Morus bassanus*)

Status overview

1.6.8.1 Gannet is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Gannet is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.8.2 Gannet is a widely dispersed species throughout the southern North Sea outside of the breeding season with an estimated flyway population of 892,000 individuals (Stienen *et al*., 2007). Of this population, it is estimated that 40-60,000 birds pass through the southern North Sea en route through the Strait of Dover, with 10,000 birds remaining in the area through winter (Stienen *et al*., 2007). From March to August gannets are present in low densities in the southern North Sea with populations concentrated on the shelf edge or, in the breeding season, around the major colonies (Stone *et al.,* 1995). The predicted density of gannet calculated using boat-based and aerial survey data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013) suggests that densities of the species are relatively low at Hornsea Three during the summer (April to September) (Figure 1.39). However, the population of gannet at Bempton Cliffs (a component of FFC pSPA) is now much larger than throughout the majority of the period across which data used to inform Figure 1.39 was collected (see Section 1.3.3 and paragraph 1.6.8.4). In the winter (October to March), predicted densities of gannet at Hornsea Three are again relatively low (Figure 1.39).

1.6.8.3 Data from the 2004 to 2008 reports, Aerial Surveys of Waterbirds in the UK (DECC, 2009), show gannet numbers in the Greater Wash survey blocks GW2, GW9 and GW10, were at their peak during July, with a mean of 390 birds. Birds were seen less frequently during the winter surveys.

1.6.8.4 The UK breeding population of gannet has been estimated at 220,000 pairs (Musgrove *et al*., 2013). The species breeds at 26 large colonies around the UK, the nearest to the former Hornsea Zone being at Bempton Cliffs (Flamborough and Filey Coast pSPA) (Balmer *et al*., 2013). This colony was estimated at 7,859 nests in 2009 (JNCC, 2017), and increased to an estimated 9,947 pairs in 2011, 11,061 pairs in 2012 and 12,494 pairs in 2015. The gannet colony at Bass Rock is one of the largest in the UK, with an estimated breeding population of 75,259 pairs in 2009 (JNCC, 2017). Breeding birds have been shown by satellite-tagging to range widely across the North Sea, at times as far as the Norwegian coast (Hamer *et al*., 2007). However, an analysis of tracking data by Wakefield *et al.* (2013) suggested that, in the North Sea there was limited overlap between the foraging areas of gannets from Bempton Cliffs breeding colony and the breeding colony at Bass Rock.

1.6.8.5 Langston *et al*. (2013) provides the results of three years of tracking data and presents kernel density estimation (KDE) of foraging range of gannet from FFC pSPA. The results indicated that although low, there was some level of usage by gannets at Hornsea Three during the breeding season (Figure 1.12).

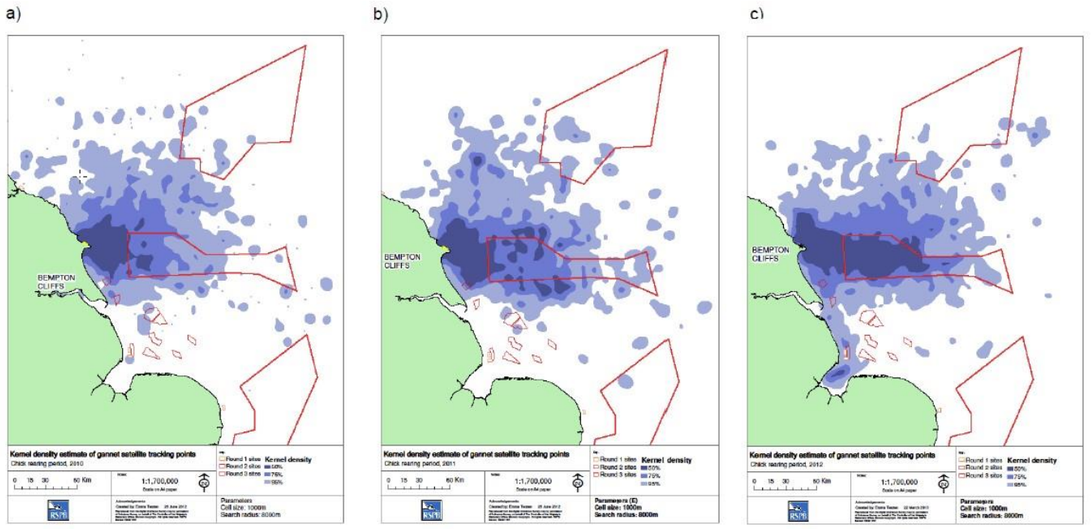


Figure 1.12: Gannet foraging range by Kernel Density Estimation during chick-rearing seasons 2010-2012 (a to c), showing 50%, 75% and 95% density contours (taken from Langston *et al.* (2013)).

1.6.8.6 Gannet is listed as a qualifying interest species in the breeding season for four SPAs and two pSPAs on the UK east coast (Table 1.15). These SPAs were designated for 54,495 pairs at time of designation, representing nearly 25% of the current national population of gannet. The breeding population of gannet has increased at all seven of these SPAs since their designation, with an increase in the UK gannet population of 39% between 1984/85 and 2004/05 and a further increase of 34% between 2004/05 and 2013-15 (JNCC, 2016). Hornsea Three lies within the mean-maximum forging range of gannet (229.4 ± 124.3 km) (Thaxter *et al*., 2012) from only the Flamborough and Filey Coast pSPA although the Forth Islands SPA is within the estimated maximum foraging range of 590 km. However, Wakefield *et al.* (2013) indicates that the foraging areas of gannets from these two colonies shows no overlap between birds from the Forth Islands SPA and Hornsea Three.

1.6.8.7 Wade *et al*. (2016) assessed gannet as being at high risk of collision with turbines due to a moderate proportion of birds at collision height, a moderate flight agility and moderate proportion of time spent in flight. Gannet is also considered to be at high risk of displacement and habitat loss associated with offshore wind farms. Maclean *et al*. (2009) assessed gannet as being at very low risk of barrier effects (Table 1.6).

Table 1.15: SPAs cited for breeding gannet on the UK east coast. Hornsea Three is within the mean-maximum foraging range of gannet from those sites in bold.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs)
Fair Isle	654	1,166
Forth Islands	384	21,600
Flamborough and Filey Coast pSPA	149	8,469
Hermaness, Saxa Vord and Valla Field	773	16,400
Noss	708	6,860
Outer Firth of Forth and St Andrews Bay Complex pSPA	654	10,945 individuals
Total		54,495*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

Seasonal abundance and distribution

1.6.8.8 Gannets were recorded in all twenty aerial surveys conducted across Hornsea Three plus a 4 km buffer. The peak population during the breeding season (April to August) was recorded in August 2017 when an estimated 2,207 birds occurred (Table 1.16; Figure 1.13). This population and those recorded in April, May, June, July 2016 and July 2017 exceed the 1% importance threshold of the regional breeding population (1% threshold = 250 individuals). However, none of these populations exceed the 1% importance threshold of the national breeding population (4,400 individuals).

1.6.8.9 In surveys undertaken in the post-breeding season as defined for gannet (September to November) a peak population of 2,638 birds was recorded during October 2017. This population does not exceed the 1% importance threshold of the post-breeding BDMPS population for gannet (1% threshold = 4,563 individuals). Similarly, during surveys undertaken in the pre-breeding season (December to March) the peak population of 1,099 birds that occurred in December was also not of regional importance (1% threshold = 2,484 individuals).

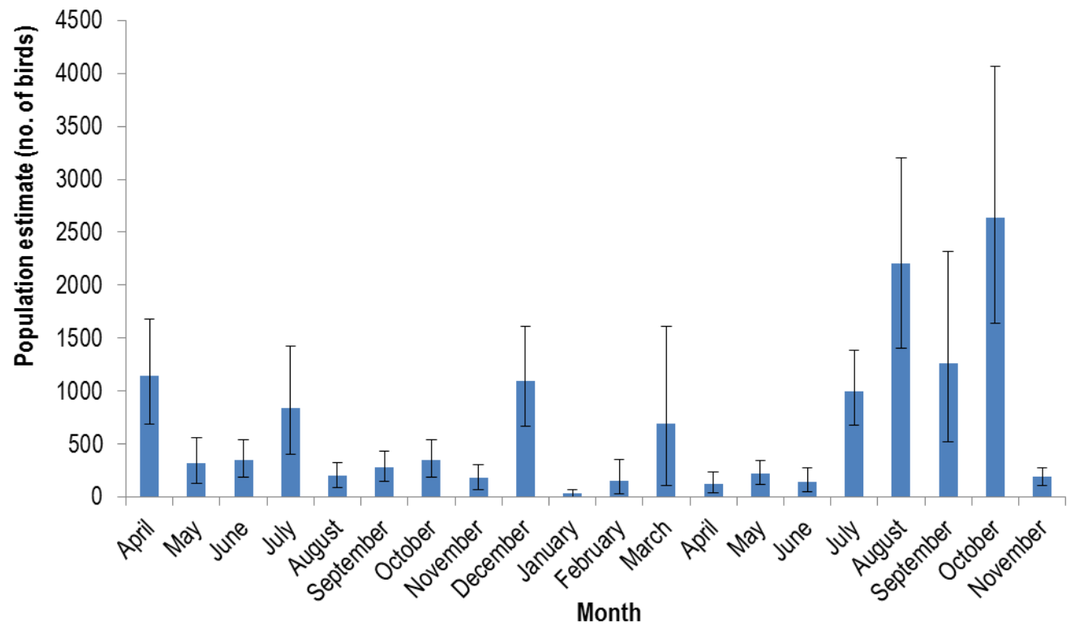


Figure 1.13: Population estimates of gannet (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Behaviour

1.6.8.10 A total of 142 gannets were recorded in flight within Hornsea Three plus a 4 km buffer during boat-based surveys of the former Hornsea Zone. Of these, only two were recorded flying above 32.5 m giving a PCH value of 7.3%. When the generic flight height data from Johnston *et al.* (2014) is analysed to calculate a PCH value based on the turbine parameters for Hornsea Three, 3.1% (0.9-6.8%) of gannets are at potential risk height.

1.6.8.11 Flight direction was recorded for 377 gannets during all aerial surveys undertaken across Hornsea Three plus 4 km buffer. Of these 164 were in the breeding season (Figure 1.14) with the majority recorded flying in a northerly direction.

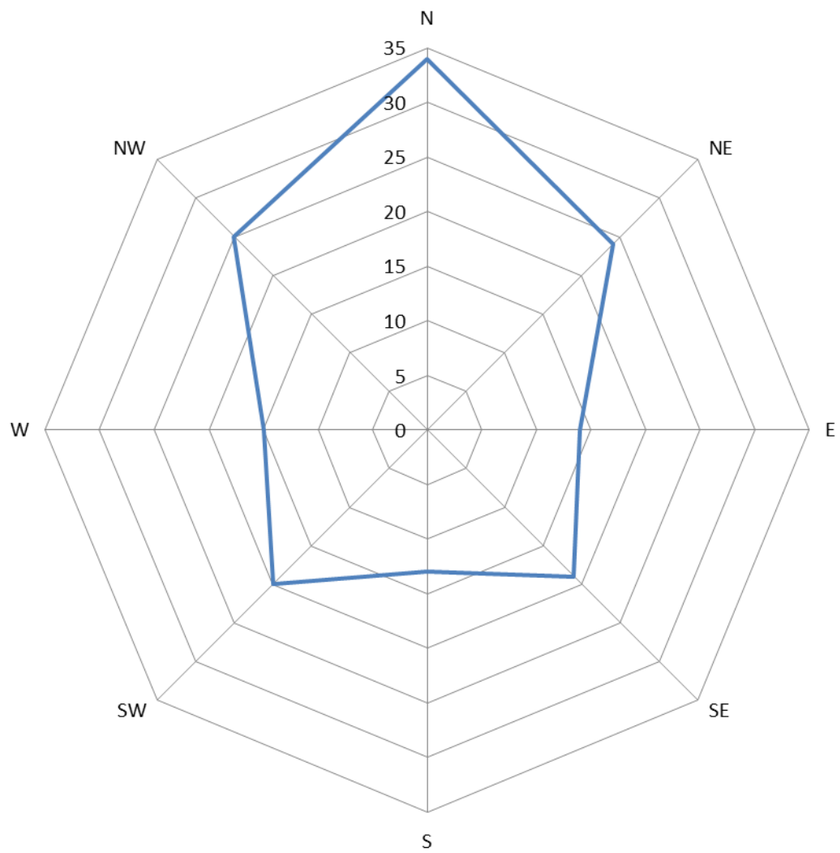


Figure 1.14: Flight directions of gannets in the breeding season recorded during aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

Conclusion

1.6.8.12 Gannet is considered to have an International conservation status as there is the potential for connectivity between the Flamborough and Filey Coast pSPA breeding colony and Hornsea Three based on the mean-maximum foraging range of gannet (229.4 km). In addition to this, population estimates of gannet in Hornsea Three plus a 4 km buffer in the breeding season for all months between April and July in both survey years and August 2017 exceed the 1% importance threshold of the regional breeding population (Table 1.16; Table 1.5). The 1% importance thresholds of the national and international populations for gannet are not surpassed in any month. Therefore based on potential SPA connectivity and the regional importance of gannet populations within Hornsea Three plus a 4 km buffer, gannet is identified as a VOR and considered for further assessment as a species with an International conservation value.

Table 1.16: Monthly population estimates and densities of gannet in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	200	946	1140	1682	691	0.16	0.77	0.93	1.37	0.56
May 2016	44	279	321	559	130	0.04	0.23	0.26	0.45	0.11
June 2016	83	260	343	538	183	0.07	0.21	0.28	0.44	0.15
July 2016	154	681	835	1422	400	0.12	0.55	0.68	1.15	0.33
August 2016	44	154	198	321	90	0.04	0.13	0.16	0.26	0.07
September 2016	122	156	278	433	151	0.1	0.13	0.23	0.35	0.12
October 2016	153	197	350	540	190	0.12	0.16	0.28	0.44	0.15
November 2016	54	122	176	300	70	0.04	0.1	0.14	0.24	0.06
December 2016	587	509	1099	1612	671	0.48	0.41	0.89	1.31	0.55
January 2017	22	11	33	70	0	0.02	0.01	0.03	0.06	0
February 2017	11	145	156	350	30	0.01	0.12	0.13	0.28	0.02
March 2017	111	580	688	1613	110	0.09	0.47	0.56	1.31	0.09
April 2017	46	76	122	233	41	0.04	0.06	0.1	0.19	0.03
May 2017	33	187	220	340	120	0.03	0.15	0.18	0.28	0.1
June 2017	44	99	143	270	50	0.04	0.08	0.12	0.22	0.04
July 2017	408	593	1000	1388	679	0.33	0.48	0.81	1.13	0.55
August 2017	777	1423	2207	3202	1406	0.63	1.16	1.79	2.6	1.14
September 2017	245	1017	1259	2319	520	0.2	0.83	1.02	1.88	0.42
October 2017	883	1753	2638	4063	1637	0.72	1.42	2.14	3.3	1.33
November 2017	143	44	187	269	110	0.12	0.04	0.15	0.22	0.09

1.6.9 Arctic skua (*Stercorarius parasiticus*)

Status overview

1.6.9.1 Arctic skua is currently red-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015) due to its significant recent decline with the UK breeding population showing declines of 37% between 1985/88 and 1998/2002 and 64% between 1998/2002 and 2015 (JNCC, 2016). The species is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

1.6.9.2 Arctic skua is a passage migrant in spring and autumn in the North Sea, and a scarce UK breeding species, restricted to Shetland, Orkney, north Scotland and the Western Isles (Forrester et al., 2007). Seabird 2000 estimated the Scottish breeding population at 2,136 pairs (Mitchell *et al*., 2004).

1.6.9.3 DECC (2009) shows that no Arctic skuas were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10. Birds recorded as 'skua spp.' were also recorded, however, albeit in low numbers, with only one or two birds recorded in March and May. Predicted densities of Arctic skua in the North Sea (WWT Consulting and MacArthur Green, 2013) during the summer (April to September) suggest Hornsea Three does not support high densities of the species (Figure 1.40). Low densities were also recorded throughout the North Sea with the highest predicted densities between 0.05 and 0.08 birds/km^2 with these occurring inshore of Hornsea Three. The generic seasonal definitions used in WWT Consulting and MacArthur Green (2013), potentially lead to an overlap between the breeding season and post-breeding passage movements of Arctic skua through the North Sea. This may therefore lead to certain areas appearing to support high densities of Arctic skua throughout the summer when these high densities only actually occur during the post-breeding season.

1.6.9.4 Arctic skua is listed as a qualifying interest species in the breeding season for seven SPAs on the UK east coast (Table 1.17). These SPAs are designated for 790 breeding pairs representing approximately 37% of the UK breeding population as recorded during Seabird 2000 (Mitchell *et al.* 2004). Since designation, populations at all of these SPAs have decreased (JNCC, 2017). Hornsea Three does not lie within the maximum known foraging range of this species (75 km; Thaxter *et al*., 2012) from these SPAs.

1.6.9.5 Wade *et al*. (2016) assessed Arctic skua as being at high risk of collision with turbines due to a high proportion of time spent in flight. Risk of displacement and habitat loss resulting from offshore wind farms were ranked as very low and low, respectively due to the species ability to utilise a wide-range of habitats, although the species sensitivity to displacement reported by Wade *et al.* (2016) has an associated very high degree of uncertainty. Maclean *et al.* (2009) assessed Arctic skua as being at low risk of barrier effects from offshore wind farms (Table 1.6).

Table 1.17: SPAs for breeding Arctic skua on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs)
Fair Isle	654	110
Fetlar	751	130
Foula	725	133
Hoy	628	59
Papa Westray (North Hill and Holm)	672	150
Rousay	657	130
West Westray	667	78
Total		790

Seasonal abundance and distribution

1.6.9.6 Arctic skuas were recorded in six of the aerial surveys conducted across Hornsea Three plus a 4 km buffer. Hornsea Three is not considered to be within foraging range of Arctic skua from any UK colonies with the closest located in northern Scotland beyond the maximum foraging range reported for this species (Thaxter *et al.* 2012). As Hornsea Three is located beyond the maximum foraging range of Arctic skua from all UK SPAs, all records of Arctic skua at Hornsea Three are considered to be non-breeding or migrating birds with population estimates compared to the relevant regional and national post-breeding season population thresholds.

1.6.9.7 The peak count of Arctic skua across all surveys occurred in September 2016 with a population of 56 birds estimated (Table 1.18; Figure 1.15). This population does not surpass the 1% importance threshold of the regional post-breeding population of Arctic skua that migrates through the North Sea (1% threshold = 64 individuals) (Table 1.5).

Figure 1.15: Population estimates of Arctic skua (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.9.8 The peak population of Arctic skua estimated at Hornsea Three plus a 4 km buffer was 56 birds in September (Table 1.17), based on observations of 5 birds. Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three due to the ephemeral nature of such movements. Therefore the criteria in Table 1.8 relating to population importance cannot be applied for Arctic skua. However, all remaining criteria in Table 1.8 can be used to identify the importance of Arctic skua in relation to Hornsea Three.

1.6.9.9 Arctic skua is red-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015) and as such has a Regional conservation status. Arctic skua colony counts indicate a 74% decline in the UK breeding population of Arctic skua between 1986 and 2011 (JNCC, 2011) with only 179 apparently occupied territories estimated in 2014 (Holling *et al*., 2016). Therefore, Arctic skua is identified as a VOR and included for further assessment where it is assigned an International conservation value, on a precautionary basis as the population that interacts with Hornsea Three is unknown and may consist of a large proportion of birds from breeding UK SPA colonies.

Table 1.18: Monthly population estimates and densities of Arctic skua in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	11	0	11	30	0	0.01	0	0.01	0.02	0
May 2016	22	0	22	50	0	0.02	0	0.02	0.04	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	11	0	11	30	0	0.01	0	0.01	0.02	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	34	22	56	131	0	0.03	0.02	0.05	0.11	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	16	0	16	47	0	0.01	0	0.01	0.04	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.10 Great skua (*Stercorarius skua*)

Status overview

1.6.10.1 Great skua is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Great skua is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.10.2 The species regularly occurs in the North Sea on spring and autumn passage, with some birds remaining for the winter months (Stone *et al*., 1995). Great skuas breed on Shetland, Orkney and the Western Isles (Balmer *et al.,* 2013), with an estimated population of 9,634 pairs during Seabird 2000 (Mitchell *et al*., 2004). The UK breeding population of great skua has shown increases of 26% between 1985-88 and 1998-2002 and 18% between 1998-2002 and 2015. Great skuas breed close to other seabird colonies, in order to scavenge and parasitize food from other seabirds, as well as predating other birds and nests.

1.6.10.3 DECC (2009) shows that almost no great skuas were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with only one or two birds recorded during July. Predicted densities of great skua in the North Sea (WWT Consulting and MacArthur Green, 2013) during the summer suggest the species is relatively abundant closer to the eastern coast of England with lower densities at Hornsea Three (Figure 1.41). The generic seasonal definitions used in WWT Consulting and MacArthur Green (2013), potentially lead to an overlap between the breeding season and post-breeding passage movements of great skua through the North Sea. This may therefore lead to certain areas appearing to support high densities of great skua throughout the summer when these high densities only actually occur during the post-breeding season. In the winter predicted densities of the species are relatively low throughout the North Sea only reaching 0.04 birds/km^2 at Hornsea Three.

1.6.10.4 Great skua is listed as a qualifying interest species in the breeding season for seven SPAs on the UK east coast (Table 1.19). These SPAs are designated for 6,126 breeding representing approximately 64% of the UK population as recorded during Seabird 2000 (Mitchell *et al.* 2004). None of these SPA colonies lie within the maximum known foraging range of this species (219 km) (Thaxter *et al*., 2012) from Hornsea Three.

Table 1.19: SPAs for breeding great skua on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs)
Fair Isle	654	110
Fetlar	751	508
Foula	725	2,270
Hermaness, Saxa Vord and Valla Field	773	788
Hoy	628	1,900
Noss	708	420
Ronas Hill – North Roe and Tingon	758	130
Total		6,126

1.6.10.5 Wade *et al*. (2016) assessed great skua as being at high risk of collision with turbines due to a high proportion of time spent in flight. Risk of displacement and habitat loss resulting from offshore wind farms were considered to be very low and low, respectively due to the species ability to use a wide range of habitats, although the species sensitivity to displacement reported by Wade *et al.* (2016) has an associated high degree of uncertainty. Maclean *et al*. (2009) assessed great skua as being at low risk of barrier effects from offshore wind farms (Table 1.6).

Seasonal abundance and distribution

1.6.10.6 Great skuas were recorded in six of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. These records occurred during the September, December and March 2016 and August, September and October 2017 surveys. The populations estimated during the August 2017, September 2016 and 2017 and October 2017 surveys do not surpass the 1% importance threshold of the post-breeding regional BDMPS population for great skua (1% threshold = 196 individuals). Similarly, the estimated populations in December and March do not surpass the 1% importance threshold of the non-breeding regional BDMPS population (50 birds) for great skua.

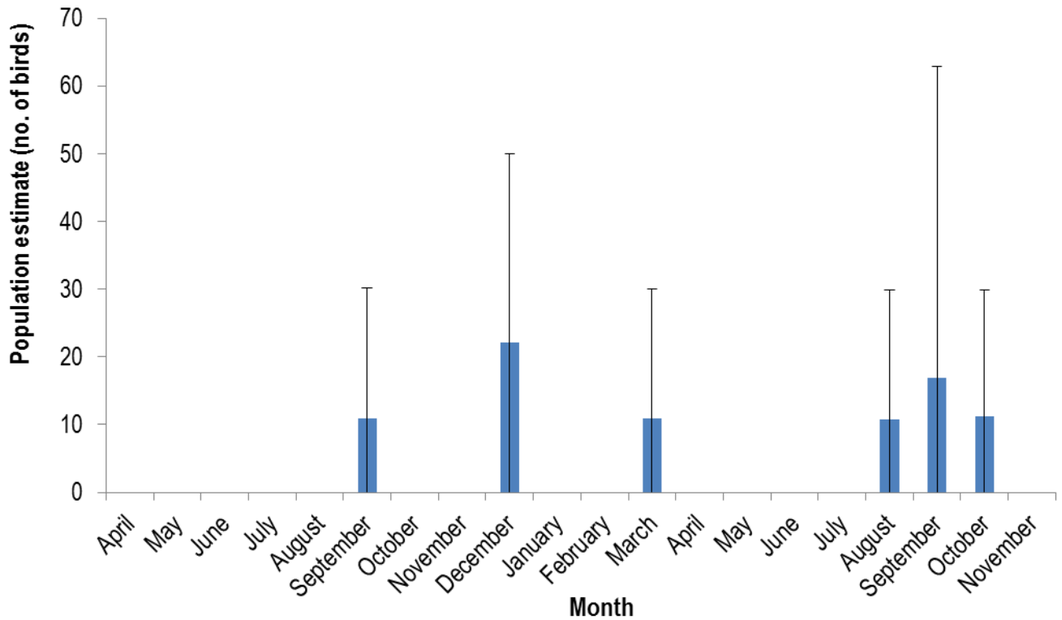


Figure 1.16: Population estimates of great skua (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.10.7 Great skua is considered to have a National conservation status as over 50% of the UK breeding population is found in ten or fewer sites. The peak population of great skua estimated at Hornsea Three plus a 4 km buffer was 22 birds in December (Table 1.20), based on observations of 2 birds. Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three due to the ephemeral nature of such movements. Thereforethe criteria in Table 1.8 relating to population importance cannot be applied for great skua. However, all remaining criteria in Table 1.8 can be used to identify the importance of Arctic skua in relation to Hornsea Three. As such, great skua is identified as a VOR and considered for further assessment, where it is considered to be of International conservation value, on a precautionary basis as the population that interacts with Hornsea Three is unknown and may consist of a large proportion of birds from breeding UK SPA colonies.

Table 1.20: Monthly population estimates and densities of great skua in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	11	0	11	30	0	0.01	0	0.01	0.02	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	22	0	22	50	0	0.02	0	0.02	0.04	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
September 2017	17	0	17	63	0	0.01	0	0.01	0.05	0
October 2017	11	0	11	30	0	0.01	0	0.01	0.02	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.11 Puffin (*Fratercula arctica*)

Status overview

1.6.11.1 Puffin is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is however currently red-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.11.2 Puffins are one of the most abundant seabird species in Britain, breeding in coastal colonies. Seabird 2000 recorded 579,500 pairs at breeding colonies around Britain (Mitchell *et al*., 2004). Lesser sandeel is the commonest prey item for puffins, but they also eat sprat, herring and a wide range of young gadoid fish (Harris, 1984).

1.6.11.3 During the breeding season puffin are aggregated around their colonies along the east coast and high densities are found in the Flamborough Head area. During post-breeding, however, the birds disperse towards the north-western North Sea before spreading out more widely throughout the winter months (Stone *et al*., 1995).

1.6.11.4 Between April and July, the Flamborough Head area has densities of up to five birds/km^2 due to the high numbers of birds foraging in the area local to the breeding colony. This continues into the non-breeding season months of August to September as the puffins are leaving the colony (Stone *et al*., 1995). Predicted densities of puffin in the summer (April to September) as derived from boat-based and aerial data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013) suggest high densities of the species occur in inshore areas along the eastern coast of England between the two main breeding colonies on this coast at Flamborough and the Farne Islands (Figure 1.42). Predicted densities in the summer at Hornsea Three are relatively low. In the winter, predicted densities of puffin are relatively low at Hornsea Three with the highest predicted densities associated with the Dogger Bank area to the north of Hornsea Three (Figure 1.42).

1.6.11.5 DECC (2009) shows that no puffins were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10. Birds recorded as 'auk spp.' were recorded, however, with a means of 693 and 722 in March and May respectively. Numbers were lower throughout the rest of the year, but this was still one of the most frequently recorded species groups during these aerial surveys.

1.6.11.6 Puffin is listed as a qualifying interest species in the breeding season for eleven SPAs and two pSPAs on the UK east coast (Table 1.21). The distance between Hornsea Three and the nearest designated site (Flamborough and Filey Coast pSPA) is within the mean-maximum foraging range ± 1 standard deviation (105.4 ± 46 km) of puffin (Thaxter *et al*., 2012) (Table 1.21). Puffin is a non-listed assemblage feature at Flamborough and Filey Coast pSPA. No other SPAs are within the mean-maximum or maximum foraging range (200 km); (Thaxter *et al.,* 2012) of puffin.

Table 1.21: SPAs for breeding puffin on the UK east coast. Hornsea Three is within maximum foraging range of those SPAs highlighted in bold.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Coquet Island	283	31,686 breeding adults
East Caithness Cliffs	583	1,750
Fair Isle	654	23,000 individuals
Farne Islands	304	76,798 breeding adults
Forth Islands	384	14,000
Flamborough and Filey Coast pSPA	149	1,960 breeding adults
Foula	725	48,000
Hermaness, Saxa Vord and Valla Field	773	55,000 individuals
Hoy	628	3,500
North Caithness Cliffs	604	1,750
Northumberland Marine	268	108,484 individuals
Noss	708	2,348 individuals
Outer Firth of Forth and St Andrews Bay Complex pSPA	345	61,086 individuals
Total		374,140*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

1.6.11.7 Wade *et al*. (2016) assessed puffin as being at moderate risk of displacement and habitat loss due to offshore wind farms due to the limited ability of the species to utilise alternative habitats. The species is considered to be at very low risk of collision with turbines due to an very low proportion of birds flying at turbine height. Maclean *et al*. (2009) assessed auks as being at high risk of barrier effects at offshore wind farms (Table 1.6).

Seasonal abundance and distribution

1.6.11.8 Puffins were recorded in twelve of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. Two seasons are defined for puffin, a breeding season from May to July and a non-breeding season from August to April (Table 1.5). The peak population recorded in the breeding season occurred in May 2016 when a population of 352 birds was estimated (Table 1.22; Figure 1.17). This surpasses the 1% threshold of regional importance for puffin (1% threshold = 50 birds) with the populations estimated in May 2017 and July 2017 also surpassing the threshold for regional importance.

1.6.11.9 In surveys undertaken in the non-breeding season, puffins were recorded in seven surveys with an estimated peak population of 266 birds occurring in April 2016 (Table 1.22; Figure 1.17). This population does not exceed the 1% importance threshold of the regional non-breeding BDMPS population for puffin (1% threshold = 2,320 individuals) (Table 1.5).

Behaviour

1.6.11.10 All but one of the puffins recorded during aerial surveys of Hornsea Three plus a 4 km buffer were recorded sitting on the sea surface. The single bird in flight was recorded flying in a south-westerly direction.

Conclusion

1.6.11.11 On a precautionary basis, puffin is considered to have an International conservation status as, based on the mean-maximum foraging range ± 1 standard deviation (105.4 ± 46.0 km), there is potential connectivity between Hornsea Three and the breeding colony at the Flamborough and Filey Coast pSPA. Population estimates of puffin at Hornsea Three plus a 4 km buffer exceed the 1% importance thresholds of relevant regional populations in May 2016 and 2017 and July 2017 (Table 1.22, Table 1.5). The 1% importance thresholds of the national and international populations for puffin are not surpassed in any month.

1.6.11.12 Therefore based on potential SPA connectivity and the regional importance of puffin populations at Hornsea Three, puffin is identified as a VOR and considered for further assessment as a species of International conservation value.

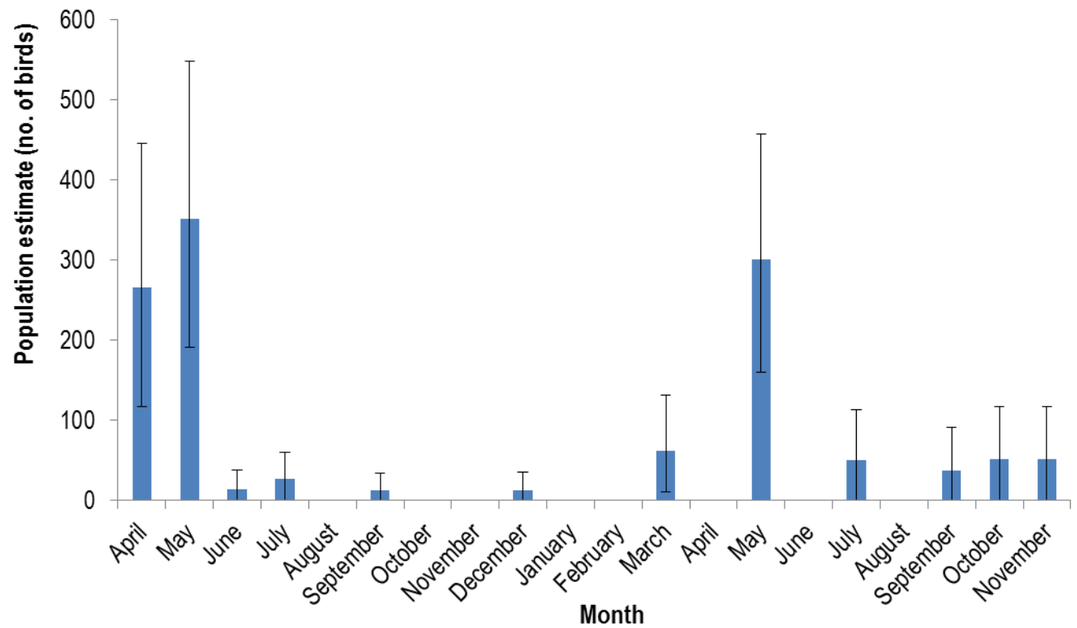


Figure 1.17: Population estimates of puffin (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Table 1.22: Monthly population estimates and densities of puffin in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	266	266	446	118	0.00	0.22	0.22	0.36	0.10
May 2016	0	352	352	548	192	0.00	0.29	0.29	0.45	0.16
June 2016	0	14	14	38	0	0.00	0.01	0.01	0.03	0.00
July 2016	0	26	26	60	0	0.00	0.02	0.02	0.05	0.00
August 2016	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
September 2016	0	13	13	35	0	0.00	0.01	0.01	0.03	0.00
October 2016	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
November 2016	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
December 2016	0	13	13	35	0	0.00	0.01	0.01	0.03	0.00
January 2017	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
February 2017	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
March 2017	15	47	62	132	11	0.01	0.04	0.05	0.11	0.01
April 2017	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
May 2017	0	301	301	457	160	0.00	0.24	0.24	0.37	0.13
June 2017	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
July 2017	0	50	50	114	0	0.00	0.04	0.04	0.09	0.00
August 2017	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
September 2017	0	37	37	91	0	0.00	0.03	0.03	0.07	0.00
October 2017	0	52	52	118	0	0.00	0.05	0.05	0.10	0.00
November 2017	0	52	52	117	0	0.00	0.05	0.05	0.10	0.00

1.6.12 Razorbill *(Alca torda)*

Status overview

1.6.12.1 Razorbill is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.12.2 Razorbill is one of the most common seabirds in Britain, breeding in large colonies with other seabirds on suitable coastal cliffs. Seabird 2000 recorded 164,557 individuals at breeding colonies around Britain (Mitchell *et al*., 2004). The closest large colony to Hornsea Three is at Flamborough and Filey Coast pSPA (previously Flamborough Head and Bempton Cliffs SPA) which held an estimated 10,570 pairs in 2008-12. However, Hornsea Three is outside of the mean-maximum (48.5 km) and maximum (95 km) foraging ranges of razorbill as reported by Thaxter *et al.* (2012).

1.6.12.3 High densities of razorbills have been recorded in the north-western North Sea with lower densities recorded overwintering in the southern North Sea (Stone *et al*., 1995). With a flyway population of some 482,000 birds in the southern North Sea, between 1.3 and 2.0% of the biogeographic population are estimated to move through this area (Stienen *et al*., 2007).

1.6.12.4 From April to August during the incubating and chick-rearing season, razorbills are generally confined to coastal areas from Flamborough Head northwards along the east coast. Predicted densities of razorbill (WWT Consulting and MacArthur Green, 2013) during the summer (April to September) are highest in inshore areas along the eastern coast of England between Yorkshire and Northumberland, extending into offshore areas, although not as far as Hornsea Three, from the breeding colony at Flamborough (Figure 1.43). From August to September densities of more than five birds/km^2 can be found in the Flamborough area, as young birds disperse from the colony with their parents. Very few birds were found further offshore, near to the area in which Hornsea Three will be located (Stone *et al*., 1995). Between October and March there are low to moderate densities in the southern North Sea with the highest densities associated with the Dogger Bank area to the north of Hornsea Three (Figure 1.43; Stone *et al*., 1995).

1.6.12.5 DECC (2009) shows razorbill numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were very low, with the average number of birds peaking during the breeding season (May) (2 birds). A higher number of birds recorded as 'auk spp.' were recorded, however, with means of 693 and 722 in March and May.

1.6.12.6 Razorbill is listed as a qualifying interest species in the breeding season for eleven SPAs and one pSPA on the UK east coast (Table 1.23). These SPAs are designated for 41,821 pairs representing approximately 38% of the most UK population as counted during Seabird 2000 (Mitchell *et al.* 2004). The closest SPA to Hornsea Three is Flamborough and Filey Coast pSPA at which there are 10,570 pairs, however Hornsea Three is outside of the mean-maximum (± 1 SD) and maximum foraging range of razorbill (48.5 ± 35.0 km and 95 km, respectively) from all colonies in Table 1.23.

1.6.12.7 Wade *et al*. (2016) assessed razorbill as being at high risk of displacement from wind farms and moderate risk of habitat loss due to the limited ability of the species to utilise alternative habitats. The species is considered to be at very low risk of collision with turbines due to a low proportion of birds flying at turbine height. Maclean *et al*. (2009) assessed auks as being at high risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.23: SPAs for breeding razorbill on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs[21])
East Caithness Cliffs	583	10,586
Fair Isle	654	2,278
Farne Islands	304	572 breeding adults
Forth Islands	384	1,400
Flamborough and Filey Coast pSPA	149	10,570
Foula	725	4,154
Fowlsheugh	425	3,886
North Caithness Cliffs	604	2,680
Northumberland Marine	268	286
St Abb's Head and Fast Castle	384	1,461
Troup, Pennan and Lion's Heads	493	3,216
West Westray	667	1,304
Total		41,821*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

[21] Where populations are provided as individuals these have been corrected using a standard 0.67 correction factor (Mitchell *et al.* 2004).

Seasonal abundance and distribution

1.6.12.8 Razorbills were recorded in all of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer with the exception of the August 2016 survey. In surveys undertaken during the breeding season defined for razorbill (April to July) a peak population of 736 birds was estimated in April 2017 (Table 1.24; Figure 1.18). This population estimate does not exceed the 1% threshold for national importance[22] (1% threshold = 2,600 individuals).

1.6.12.9 In the post-breeding season (August to October), the peak population of razorbill was estimated in October 2017 (4,022 birds) (Table 1.24; Figure 1.18). This population does not surpass the 1% threshold of regional importance (1% threshold = 5,912 individuals). Similarly in the pre-breeding season (January to March), the peak population of 2,972 birds estimated in March does not exceed the 1% threshold of regional importance (1% threshold = 5,912 individuals).

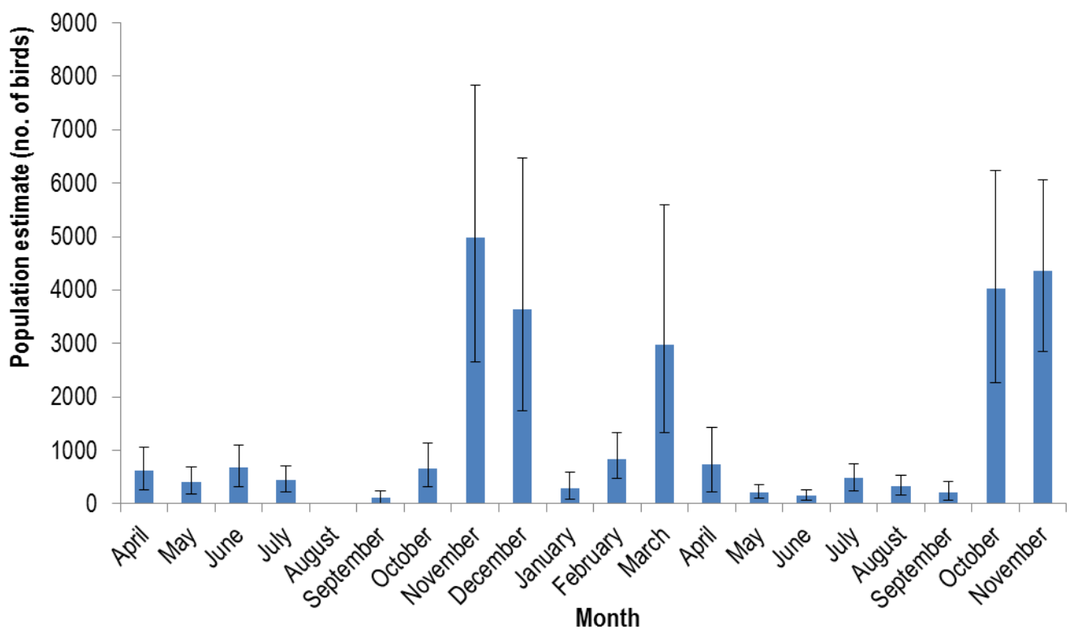


Figure 1.18: Population estimates of razorbill (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

[22] No regional breeding population is defined for razorbill as Hornsea Three is not within foraging range from any seabird colonies that support breeding razorbill.

1.6.12.10 The largest populations of razorbill estimated from aerial survey data were in the non-breeding season (November to December). In the three surveys undertaken in this season populations of 4,976 (November 2016), 3,648 (December) and 4,352 (November 2017) birds were estimated. These populations all exceed the 1% threshold of regional importance (2,186 individuals) but do not exceed the 1% importance threshold of the national non-breeding population of razorbill (1% threshold = 5,600 individuals).

Behaviour

1.6.12.11 A total of 1,266 razorbills were recorded during aerial surveys of Hornsea Three plus a 4 km buffer. Of these 94 were recorded in flight with remaining birds associated with the sea surface. Of these birds, 47% were recorded flying in a north-easterly direction and approximately 21% in a north-westerly direction.

Conclusion

1.6.12.12 Razorbill is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015) meaning the species has a Local conservation status. Population estimates of razorbill at Hornsea Three plus a 4 km buffer surpass the 1% importance threshold of the regional population in all non-breeding season months (November and December). Razorbill is considered to have a high vulnerability to displacement impacts associated with offshore wind farms (Wade *et al.,* 2016). As such, razorbill is identified as a VOR and considered for further assessment where it is assigned a Regional conservation value.

Table 1.24: Monthly population estimates and densities of razorbill in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	618	618	1056	263	0.00	0.50	0.50	0.86	0.21
May 2016	30	371	400	695	174	0.02	0.31	0.33	0.56	0.14
June 2016	0	684	684	1090	329	0.00	0.55	0.55	0.89	0.27
July 2016	0	444	444	707	226	0.00	0.36	0.36	0.57	0.18
August 2016	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
September 2016	0	108	108	241	0	0.00	0.09	0.09	0.20	0.00
October 2016	39	630	669	1132	313	0.03	0.52	0.55	0.92	0.25
November 2016	557	4419	4976	7843	2648	0.45	3.59	4.04	6.37	2.15
December 2016	430	3218	3648	6474	1739	0.35	2.62	2.97	5.26	1.41
January 2017	17	275	292	582	82	0.01	0.23	0.24	0.47	0.07
February 2017	27	817	843	1323	476	0.02	0.67	0.69	1.08	0.39
March 2017	20	2952	2972	5594	1329	0.02	2.39	2.41	4.55	1.08
April 2017	92	645	736	1426	225	0.07	0.53	0.60	1.16	0.18
May 2017	0	221	221	352	106	0.00	0.18	0.18	0.29	0.09
June 2017	0	155	155	270	59	0.00	0.13	0.13	0.22	0.05
July 2017	0	476	476	750	246	0.00	0.39	0.39	0.61	0.20
August 2017	0	334	334	527	164	0.00	0.27	0.27	0.43	0.13
September 2017	0	219	219	411	70	0.00	0.18	0.18	0.33	0.06
October 2017	88	3934	4022	6230	2270	0.07	3.19	3.26	5.06	1.85
November 2017	186	4166	4352	6053	2860	0.15	3.38	3.53	4.92	2.32

1.6.13 Guillemot *(Uria aalge)*

Status overview

1.6.13.1 Guillemot is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.13.2 Guillemot is one of the most abundant seabird species in Britain, breeding in large colonies on suitable coastal cliff habitat. Seabird 2000 recorded 1,322,830 individuals at breeding colonies in Britain (Mitchell *et al*., 2004). The closest large colonies to Hornsea Three are at Flamborough and Filey Coast pSPA and, slightly further afield, at the Farne Islands. Guillemots mostly prey on small fish species such as lesser sandeels, sprat and gadoid fish (Mitchell *et al.,* 2004).

1.6.13.3 The southern North Sea is important for guillemots throughout the year with high densities occurring in all months. With a total flyway population of 1,990,000 birds, 1.5 to 3.0% of the biogeographic population resides in or flies through the southern North Sea (Stienen *et al*., 2007).

1.6.13.4 From March to June, guillemot densities are high in the southern North Sea, notably in the Dogger Bank area. These densities of between two and five birds/km^2 reflect both high levels of pre-breeding activity (when birds are foraging more widely in the area from further afield) and also that local colonies are showing more concentrated foraging activity at the start of the breeding season. This is evident in the Flamborough Head area (Stone *et al*., 1995). During July and August, chicks and adults depart the colonies resulting in high densities (more than five birds/km^2) being found in both these months around Flamborough Head and Dogger Bank.

1.6.13.5 A similar distribution is evident in predicted densities of guillemot in the summer (April to September) calculated using boat-based and aerial data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013). The highest densities are associated with inshore areas between the Northumberland coast and Flamborough with densities extending offshore from the Flamborough breeding colony in a north-easterly direction (Figure 1.44). In the winter (October to March) densities are lower throughout the North Sea with the main concentration of guillemot associated with the Dogger Bank area (Figure 1.44).

1.6.13.6 Guillemot numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were very low (DECC, 2009), with the average number of birds peaking during the breeding season (May) (6 birds). A higher number of birds recorded as 'auk spp.' were seen, however, with the highest averages of 693 and 722 in March and May respectively. Numbers were lower throughout the rest of the year, but this was still one of the most frequently recorded species groups during aerial surveys.

1.6.13.7 Guillemot is listed as a qualifying interest species in the breeding season for nineteen SPAs and one pSPA on the UK east coast (Table 1.25). These SPAs are designated for 487,801 breeding pairs representing approximately 37% of the UK breeding population as recorded during Seabird 2000 (Mitchell *et al.* 2004).

1.6.13.8 The closest colony to Hornsea Three is Flamborough and Filey Coast pSPA (previously Flamborough Head and Bempton Cliffs SPA) which supported 41,607 pairs in 2008-12. The distance between Hornsea Three and Flamborough and Filey Coast pSPA is approximately 149 km, further than the mean-maximum foraging range of guillemot (84.2 ± 50.1 km; Thaxter *et al.,* 2012).

1.6.13.9 Wade *et al*. (2016) assessed guillemot as being at high risk of displacement from wind farms and moderate risk from habitat loss due to the limited ability of the species to utilise alternative habitats. The species is considered to be at very low risk of collision with turbines due to a very low proportion of birds flying at turbine height. Maclean *et al*. (2009) assessed auks as being at high risk of barrier effects at offshore wind farms (Table 1.6).

Seasonal abundance and distribution

1.6.13.10 Guillemot were recorded in all of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. During surveys undertaken in the breeding season defined for guillemot (March to July), a peak population of 19,360 birds was estimated in June 2016 (Table 1.26; Figure 1.19). The populations estimated to be present at Hornsea Three plus a 4 km buffer in this month surpass the 1% threshold of national importance[23] (1% threshold = 19,000 individuals).

1.6.13.11 In the non-breeding season a peak population of 26,561 birds was estimated from aerial survey data collected in November 2017 (Table 1.26; Figure 1.19). This population and those estimated in August, September, November and December 2016 and August, September and October 2017 exceed the 1% threshold of regional importance (16,173 individuals) but are not considered to be of national significance (1% threshold = 27,565 individuals).

[23] No regional breeding population is defined for guillemot as Hornsea Three is not within foraging range of guillemot from any breeding colonies

Table 1.25: SPAs for breeding guillemot on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Buchan Ness to Collieston Coast	453	8,640
Calf of Eday	654	8,472
Copinsay	620	19,732
East Caithness Cliffs	583	71,489
Fair Isle	654	21,641
Farne Islands	304	32,875
Forth Islands	384	16,000
Flamborough and Filey Coast pSPA	149	41,607
Foula	725	25,125
Fowlsheugh	425	37,822
Hermaness, Saxa Vord and Valla Field	773	16,750
Hoy	628	13,400
Marwick Head	662	25,259
North Caithness Cliffs	604	25,661
Northumberland Marine	268	65,751 individuals
Noss	708	26,110
Outer Firth of Forth and St Andrews Bay Complex pSPA (breeding)	345	28,123 individuals
Rousay	657	7,102
St Abb's Head to Fast Castle	384	21,273
Sumburgh Head	683	10,720
Troup, Pennan and Lion's Heads	493	29,882
West Westray	667	28,241
Total		487,801*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA or the Northumberland Marine SPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

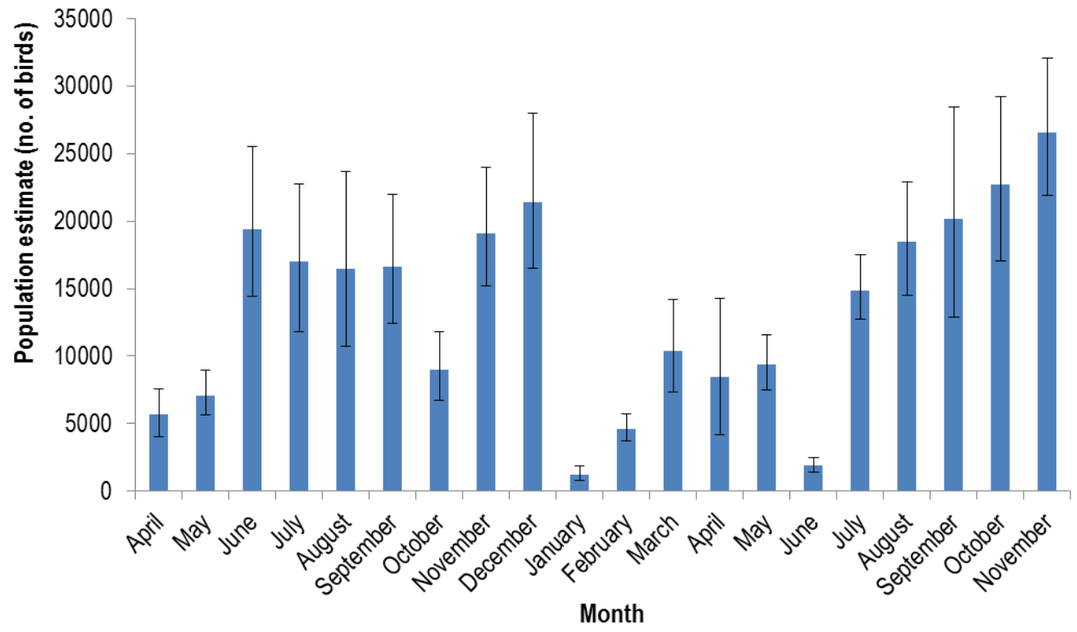


Figure 1.19: Population estimates of guillemot (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Behaviour

1.6.13.12 A total of 19,490 guillemot were recorded during aerial surveys of Hornsea Three plus a 4 km buffer. The majority of these birds were sitting on the sea surface with only 447 recorded in flight. Of these birds, 388 were recorded in the non-breeding season (Figure 1.20). There was a clear north-easterly bias in the recorded flight directions with 39% of birds recorded flying in that direction.

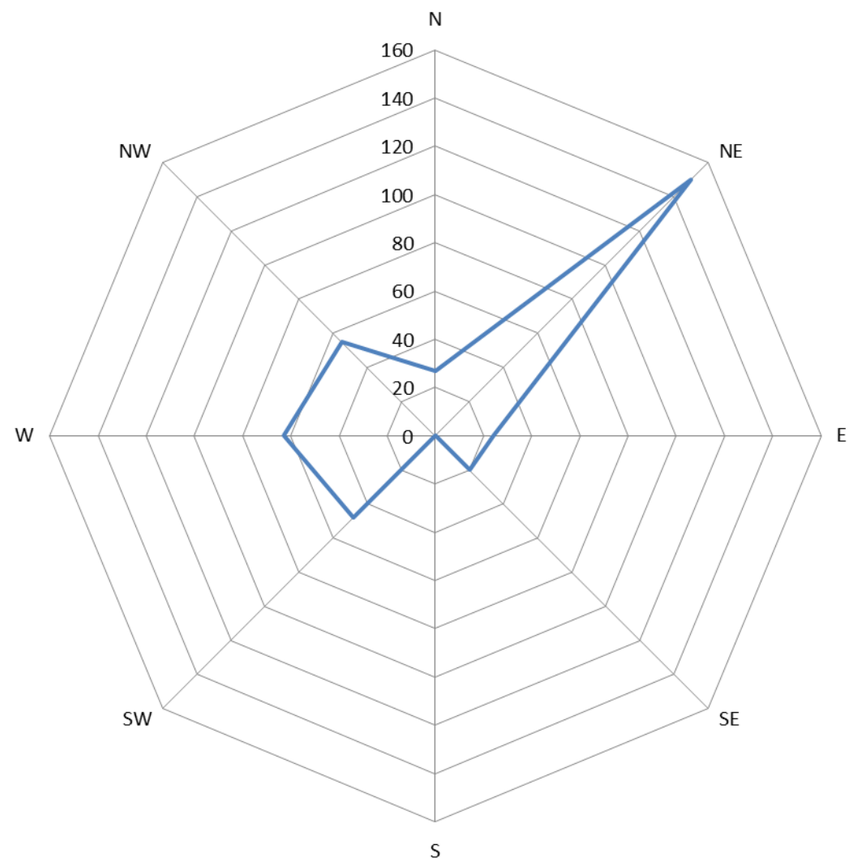


Figure 1.20: Flight directions of guillemots in the non-breeding season recorded during aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

Conclusion

1.6.13.13 Population estimates of guillemot at Hornsea Three plus a 4 km buffer exceed the 1% importance thresholds of the relevant national breeding and regional non-breeding populations (Table 1.26; Table 1.5). The 1% importance thresholds of the international populations for guillemot are not surpassed in any month. Guillemot is considered to have a high vulnerability to displacement impacts associated with offshore wind farms (Wade *et al.,* 2016). As such, guillemot is identified as a VOR and considered for further assessment where it is assigned a National conservation value.

Table 1.26: Monthly population estimates and densities of guillemot in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	167	5481	5648	7593	4029	0.14	4.46	4.60	6.17	3.27
May 2016	59	7018	7078	8926	5671	0.05	5.70	5.75	7.25	4.61
June 2016	36	19324	19360	25501	14421	0.03	15.70	15.73	20.72	11.72
July 2016	32	16978	17010	22725	11832	0.03	13.80	13.83	18.47	9.62
August 2016	0	16482	16482	23661	10698	0.00	13.39	13.39	19.23	8.69
September 2016	0	16600	16600	21958	12392	0.00	13.49	13.49	17.85	10.07
October 2016	181	8784	8965	11787	6686	0.15	7.14	7.29	9.58	5.43
November 2016	604	18465	19069	24014	15162	0.49	15.01	15.50	19.52	12.32
December 2016	2088	19336	21424	27960	16478	1.70	15.72	17.42	22.72	13.39
January 2017	71	1158	1229	1879	756	0.06	0.94	1.00	1.53	0.61
February 2017	40	4541	4580	5717	3685	0.03	3.69	3.72	4.65	2.99
March 2017	197	10183	10380	14180	7307	0.16	8.27	8.43	11.52	5.94
April 2017	166	8307	8473	14303	4192	0.13	6.75	6.88	11.62	3.41
May 2017	87	9300	9388	11587	7513	0.07	7.56	7.63	9.42	6.11
June 2017	0	1876	1876	2438	1411	0.00	1.52	1.52	1.98	1.15
July 2017	88	14780	14868	17513	12705	0.07	12.01	12.08	14.23	10.33
August 2017	11	18456	18466	22940	14492	0.01	14.99	15.00	18.64	11.78
September 2017	0	20163	20163	28431	12892	0.00	16.38	16.38	23.11	10.48
October 2017	1710	20969	22679	29221	17024	1.39	17.04	18.43	23.75	13.83
November 2017	545	26017	26561	32067	21879	0.44	21.14	21.58	26.06	17.78

1.6.14 Little tern (*Sternula albifrons*)

Status overview

1.6.14.1 Little tern is listed on both Annex I of the EU Birds Directive (2009/147/EEC) and Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is also amber-listed on the UK Birds of Conservation Concern (Eaton *et al.* 2015).

1.6.14.2 Little terns are summer visitors to Britain, breeding in coastal colonies. Seabird 2000 recorded 1,947 pairs in Britain (Mitchell *et al*., 2004). The closest large colonies to Hornsea Three are currently in North Norfolk (Blakeney Point, Holkham, Scolt Head and Winterton). There are smaller colonies at Gibraltar Point (Lincolnshire), Spurn Point and Easington (Humberside) and Long Nanny (Northumberland) (SMP, 2017).

1.6.14.3 Little tern is listed as a qualifying interest species in the breeding season for 18 SPAs and 4 pSPAs on the UK east coast (Table 1.27). At the time of designation these SPAs supported 1,325 little terns, representing nearly 70% of the national breeding population of the species. Hornsea Three is beyond the maximum known foraging range from any UK SPA for little terns (11 km) (Thaxter *et al*., 2012).

1.6.14.4 Wade *et al*. (2016) assessed little tern as being at low risk of displacement from wind farms and high risk of habitat loss due to the species limited ability to utilise alternative habitats. The species is also assessed as being at moderate risk of collision with turbines due to the high proportion of time the species spends in flight although this level of sensitivity has an associated very high level of uncertainty. Maclean *et al*. (2009) assessed terns as being at very low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.27: SPAs for breeding little tern on the UK east coast.

SPA	Distance to Hornsea Three array area/export cable route (km)	Cited SPA population (pairs) (unless otherwise stated)
Alde-Ore Estuary	189	48[24]
Benacre to Easton Bavents	160	21
Blackwater Estuary	244	36[24]
Colne Estuary	238	38[24]
Dungeness, Romney Marsh and Rye Bay pSPA	316	35
Firth of Tay and Eden Estuary	412	25
Foulness	254	24[24]
Gibraltar Point	157	40
Great Yarmouth North Denes	126	277
Greater Wash pSPA	0 (export cable)	798
Hamford Water	222	39
Humber Estuary	141	51
Lindisfarne	311	42
Medway Estuary and Marshes	285	24
Minsmere – Walberswick	170	32
North Norfolk Coast	128	400
Northumbria Coast	241	40
Northumberland Marine	268	90 individuals
Outer Thames Estuary pSPA	122	746 individuals
Teesmouth and Cleveland Coast	220	40
The Wash	156	30
Ythan Estuary, Sands of Forvie and Meikle Loch pSPA	453	41
Total		1,325*

*Total does not include the Greater Wash pSPA, Northumberland Marine SPA and the Outer Thames Estuary pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

[24] Sourced from Stroud *et al.* (2016)

Seasonal abundance and distribution

Hornsea Three array area

1.6.14.5 No little terns were recorded during the aerial surveys undertaken across Hornsea Three plus a 4 km buffer.

Hornsea Three export cable route

1.6.14.6 The Hornsea Three export cable route passes through the Greater Wash pSPA at which little tern is a qualifying feature. The pSPA is designated to afford protection to the foraging areas of little tern from a number of breeding colonies that are adjacent to the pSPA. These colonies form part of the designation for the Humber Estuary SPA, Gibraltar Point SPA, North Norfolk Coast SPA, Great Yarmouth North Denes SPA and two further colonies at Eccles and Caister, both in Norfolk. Of potential relevance to Hornsea Three are the three colonies that form part of the North Norfolk Coast SPA with the closest of these to the export cable route at Blakeney Point. Parsons *et al.* (2015) presents the maximum alongshore foraging extents of birds from colonies within the North Norfolk Coast SPA with birds foraging up to 7 km east and west from each colony and seaward to a maximum distance of 2.13 km (Figure 1.36). This therefore suggests no connectivity with the area in which the Hornsea Three export cable is located.

Conclusion

1.6.14.7 Little tern was not recorded during aerial surveys of the Hornsea Three array area and therefore it is considered highly unlikely that impacts will occur on little tern at this component of the Project. The Hornsea Three export cable route passes through the Greater Wash pSPA at which little tern is a qualifying feature. However, it is considered highly unlikely that birds from breeding colonies that form part of the North Norfolk Coast SPA that utilise foraging areas in the Greater Wash pSPA will occur in the area in which the Hornsea Three export cable is located. In addition, little tern are not considered vulnerable to the impacts that may arise during the installation of the Hornsea Three export cable (Table 1.6). As such, little tern is not considered for further assessment.

1.6.15 Sandwich tern (Thalasseus sandvicensis)

Status overview

1.6.15.1 Sandwich tern is listed on Annex I of the EU Birds Directive (2009/147/EEC), and the species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.15.2 Sandwich terns are summer visitors to Britain, breeding in coastal colonies. Seabird 2000 recorded 10,536 pairs in Britain (Mitchell *et al.,* 2004). The closest large colonies to Hornsea Three are on the north Norfolk Coast at Blakeney Point and Scolt Head. After the breeding season, Sandwich terns migrate south to the west coast of Africa, returning the following spring (Wernham *et al*., 2002). Sandwich terns feed on a variety of small, surface-feeding fish including sandeels but also cephalopods and crustaceans that they catch by plunge-diving (Brown and Grice, 2005).

1.6.15.3 Predicted densities of Sandwich tern in the summer (April to September) shown in Figure 1.45 (WWT Consulting and MacArthur Green, 2013), indicate that the species is abundant off the north Norfolk coast with relatively low densities present at Hornsea Three and in surrounding sea areas.

1.6.15.4 Sandwich tern is listed as a qualifying interest species in the breeding season for eight SPAs and two pSPAs on the UK east coast (Table 1.28). These SPAs held 8,943 pairs at the time of designation. The distance between these SPAs and Hornsea Three is beyond the maximum foraging range of Sandwich terns (54 km) (Thaxter *et al*., 2012).

1.6.15.5 Wade *et al*. (2016) assessed Sandwich tern as being at low risk of displacement from wind farms (with a low degree of associated uncertainty) and moderate risk of habitat loss due to the species moderate ability to utilise alternative habitats. Sandwich tern is considered to be at low risk of disturbance from vessels although this conclusion has a high degree of associated uncertainty. The species is also assessed as being at high risk of collision with turbines due to the high proportion of time the species spends in flight. Maclean *et al*. (2009) assessed terns as being at very low risk of barrier effects at offshore wind farms (Table 1.6).

Seasonal abundance and distribution

Hornsea Three array area

1.6.15.6 Sandwich terns were recorded in two of the aerial surveys conducted across Hornsea Three plus a 4 km buffer. A total of three birds were recorded during the August 2017 survey with four recorded in the September 2017 survey. These counts translate to population estimates of 35 and 162 birds respectively (Table 1.29, Figure 1.21). These birds are migratory individuals with this population not surpassing the 1% threshold for regional importance (1% threshold = 381 individuals).

Table 1.28: SPAs for breeding Sandwich tern on the UK east coast.

SPA	Distance to Hornsea Three array area/export cable route (km)	Cited SPA population (pairs) (unless otherwise stated)
Alde-Ore Estuary	189	169[25]
Coquet Island	283	1,300
Farne Islands	304	862
Forth Islands	384	440
Foulness	254	267
Greater Wash pSPA	0 (export cable)	3,852
Loch of Strathbeg	479	280
North Norfolk Coast	128	4,500
Northumberland Marine	268	4,324 individuals
Ythan Estuary, Sands of Forvie and Meikle Loch pSPA	453	1,125
Total		8,943*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA, the Northumberland Marine SPA or Outer Thames Estuary pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

Hornsea Three export cable route

1.6.15.7 The Hornsea Three export cable route passes through the Greater Wash pSPA at which Sandwich tern is a qualifying feature. The pSPA is designated to afford protection to the foraging areas of Sandwich tern from a number of breeding colonies that are adjacent to the pSPA. These colonies form part of the designation for the North Norfolk Coast SPA. Within the North Norfolk Coast SPA are two breeding colonies located at Scolt Head and Blakeney Point. The predicted usage of offshore areas by Sandwich tern for foraging from these colonies is presented in Wilson *et al.* (2014). These maps indicate that there is minimal connectivity between Sandwich terns from these two breeding colonies and the area of the Greater Wash pSPA through which the Hornsea Three export cable will pass (Figure 1.22).

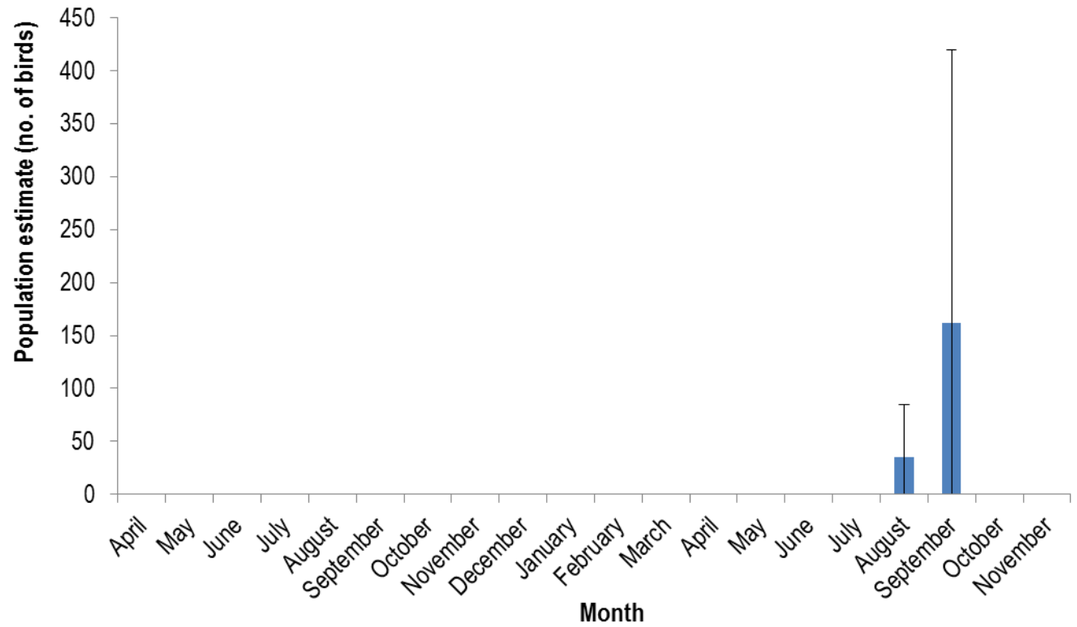


Figure 1.21: Population estimates of Sandwich tern (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.15.8 The populations of Sandwich tern estimated at Hornsea Three do not exceed the 1% importance threshold of the regional population. Although traditional survey methods are unlikely to capture the movements of migratory birds it is considered unlikely that the regional population threshold for Sandwich tern will be surpassed in any season and highly unlikely that impacts associated with the array area will be significant. Sandwich tern is therefore not considered for further assessment in relation to impacts associated with the array area.

1.6.15.9 The Hornsea Three export cable route passes through the Greater Wash pSPA at which Sandwich tern is a qualifying feature. The predicted usage of the area in which the Hornsea Three export cable is located is notably low. However, on a precautionary basis the species is included for further assessment for impacts associated with the Hornsea Three export cable only.

[25] Sourced from Stroud *et al.* (2016)

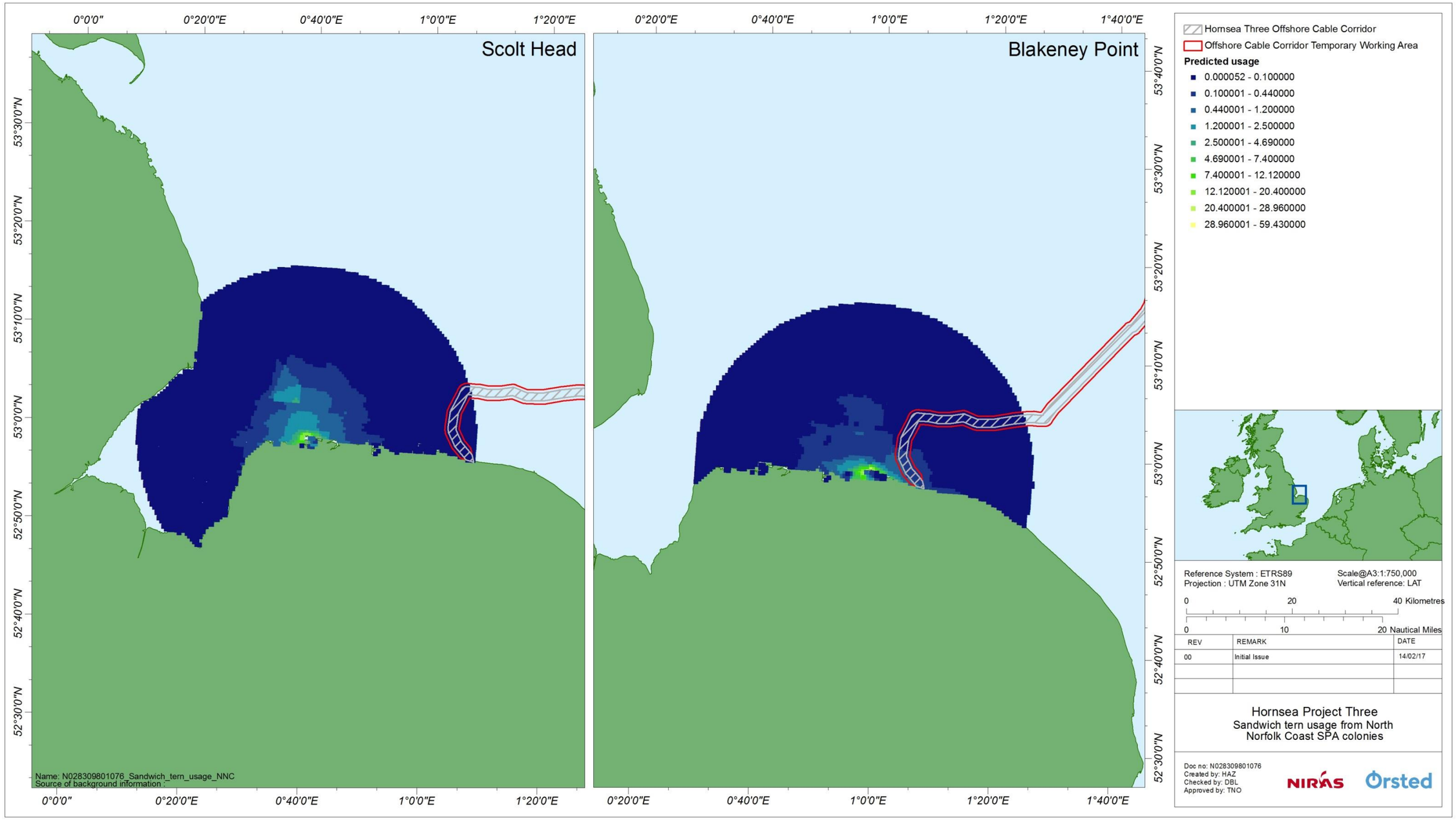


Figure 1.22: Predicted usage of offshore areas along the North Norfolk Coast by Sandwich terns from the breeding colonies at Scolt Head and Blakeney Point (data obtained from Natural England)

Table 1.29: Monthly population estimates and densities of Sandwich tern in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	0	0	0	0	0	0	0	0	0	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	35	0	35	85	0	0.03	0	0.03	0.07	0
September 2017	145	0	162	420	0	0.12	0	0.13	0.34	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.16 Common tern (*Sterna hirundo*)

Status overview

1.6.16.1 Common tern is listed on Annex I of the EU Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.16.2 Common terns are summer visitors to Britain, breeding in colonies at coastal sites and also inland. Seabird 2000 recorded 10,308 pairs in Britain (Mitchell *et al*., 2004). The closest large colonies (i.e. SPAs) to Hornsea Three are Coquet Island (Northumberland), the Farne Islands (Northumberland) and Scolt Head (Norfolk). In autumn, common terns migrate south to the west coast of Africa, returning the following spring (Wernham *et al*., 2002). Common terns have a broad diet compared to other terns that includes sandeels, clupeid and gadoid fish (Mitchell *et al*., 2004).

1.6.16.3 DECC (2009) shows that common/Arctic tern numbers in the Greater Wash survey blocks GW2, GW9 and GW10 were low, with average numbers peaking during the breeding season (May) (20 birds). Predicted densities of the species in the North Sea (WWT Consulting and MacArthur Green, 2013) during the summer (April to September) indicate that the highest densities occur in inshore areas, extending offshore of Flamborough Head (Figure 1.46). The generic seasonal definitions used in WWT Consulting and MacArthur Green (2013), potentially lead to an overlap between the breeding season and post-breeding passage movements of common tern through the North Sea. This may therefore lead to certain areas appearing to support high densities of common tern throughout the summer when these high densities only actually occur during the post-breeding season

1.6.16.4 It is likely that any common terns recorded at Hornsea Three were on passage between breeding colonies and wintering grounds, with birds from UK breeding colonies as well as others in northern Europe potentially involved (Wernham *et al*., 2002). Common tern is listed as a qualifying interest species in the breeding season for eleven SPAs and four pSPAs on the UK east coast (Table 1.30). These SPAs are designated for 4,136 breeding pairs representing approximately 40% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004). Hornsea Three lies beyond the maximum foraging range of common tern from these SPAs (30 km) (Thaxter *et al*., 2012) and therefore common tern occurs only on passage (particularly in autumn) through Hornsea Three with no apparent connectivity to SPAs where they are a breeding feature.

1.6.16.5 Wade *et al*. (2016) assessed common tern as being at low risk of displacement from wind farms (with a low level of associated uncertainty) and moderate risk of habitat loss due to the species moderate ability to utilise alternative habitats. Common tern is considered to be at low risk of disturbance from vessels although this conclusion has a high degree of associated uncertainty. The species was considered to be at moderate risk of collision with turbines due to the high proportion of time the species spends in flight. Maclean *et al*. (2009) assessed terns as being at very low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.30: SPAs for breeding common tern on the UK east coast.

SPA	Distance to Hornsea Three array area/export cable route (km)	Cited SPA population (pairs) (unless otherwise stated)
Breydon Water	139	155
Coquet Island	283	1,189
Cromarty Firth	566	294
Farne Islands	304	183
Forth Islands	384	334
Foulness	254	186
Greater Wash pSPA	0 (export cable)	510
Inner Moray Firth	555	310
North Norfolk Coast	128	1000
Northumberland Marine	268	2,572 individuals
Outer Firth of Forth and St Andrews Bay Complex pSPA	345	-
Outer Thames Estuary pSPA	122	532 individuals
Teesmouth and Cleveland Coast pSPA	220	-
The Wash	156	220
Ythan Estuary, Sands of Forvie and Meikle Loch	453	265
Total		4,136*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA, the Greater Wash pSPA, the Northumberland Marine SPA or Outer Thames Estuary pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

Seasonal abundance and distribution

Hornsea Three array area

1.6.16.6 Common terns were recorded in two of the aerial surveys conducted across Hornsea Three plus a 4 km buffer. A total of three birds were recorded during the September 2016 survey with thirty recorded in the May 2017 survey. These counts translate to population estimates of 314 and 1,184 birds respectively (Table 1.31; Figure 1.23). These birds are migratory individuals with this population not surpassing the 1% threshold for regional importance (1% threshold = 1,449 individuals).

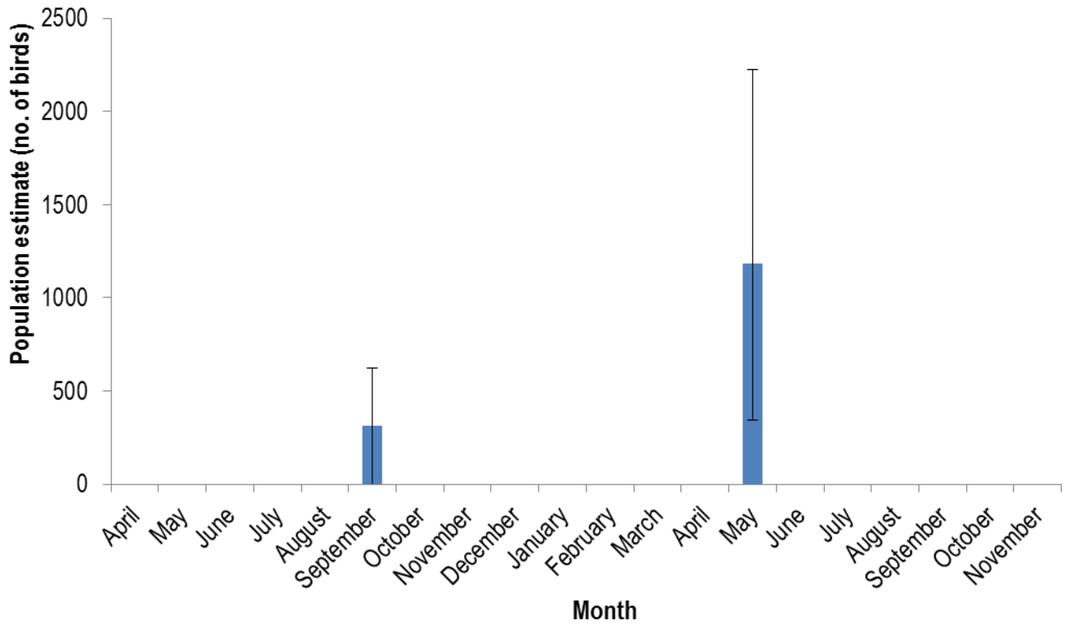


Figure 1.23: Population estimates of common tern (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Hornsea Three export cable route

1.6.16.7 The Hornsea Three export cable route passes through the Greater Wash pSPA at which common tern is a qualifying feature. The pSPA is designated to afford protection to the foraging areas of common tern from a number of breeding colonies that are adjacent to the pSPA. These colonies form part of the designation for the North Norfolk Coast SPA and Breydon Water SPA with those within the North Norfolk Coast SPA of relevance to Hornsea Three. Within the North Norfolk Coast SPA are three breeding colonies located at Holkham, Scolt Head and Blakeney Point. The predicted usage of offshore areas by common tern for foraging from the breeding colonies at Scolt Head and Blakeney Point is presented in Wilson *et al.* (2014). These maps indicate that there is negligible connectivity between common terns from these two breeding colonies and the area of the Greater Wash pSPA through which the Hornsea Three export cable will pass (Figure 1.24).

Conclusion

1.6.16.8 Common tern is listed on Annex 1 of the EU Birds Directive and therefore the species is considered to have a National conservation status. The peak population of common tern estimated at Hornsea Three plus a 4 km buffer was 1,184 birds in May 2017(Table 1.31). Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three due to the ephemeral nature of such movements. Thereforethe criteria in Table 1.8 relating to population importance cannot be applied for common tern. As such, on a precautionary basis common tern identified as a VOR and is considered for further assessment, where it is considered to be of International conservation value as the population that interacts with Hornsea Three is unknown and may include birds from breeding UK SPA colonies.

1.6.16.9 The Hornsea Three export cable route passes through the Greater Wash pSPA at which common tern is a qualifying feature. The predicted usage of the area in which the Hornsea Three export cable is located is notably trivial. In addition, common tern are not considered vulnerable to the impacts that may arise during the installation of the Hornsea Three export cable (Table 1.6). As such, common tern is not considered for further assessment.

1.6.16.10 Common tern is, therefore, considered for further assessment for impacts associated with the Hornsea Three array area only.

Table 1.31: Monthly population estimates and densities of common tern in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	257	0	314	624	0	0.21	0	0.25	0.51	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	1476	0	1184	2229	341	1.2	0	0.96	1.81	0.28
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

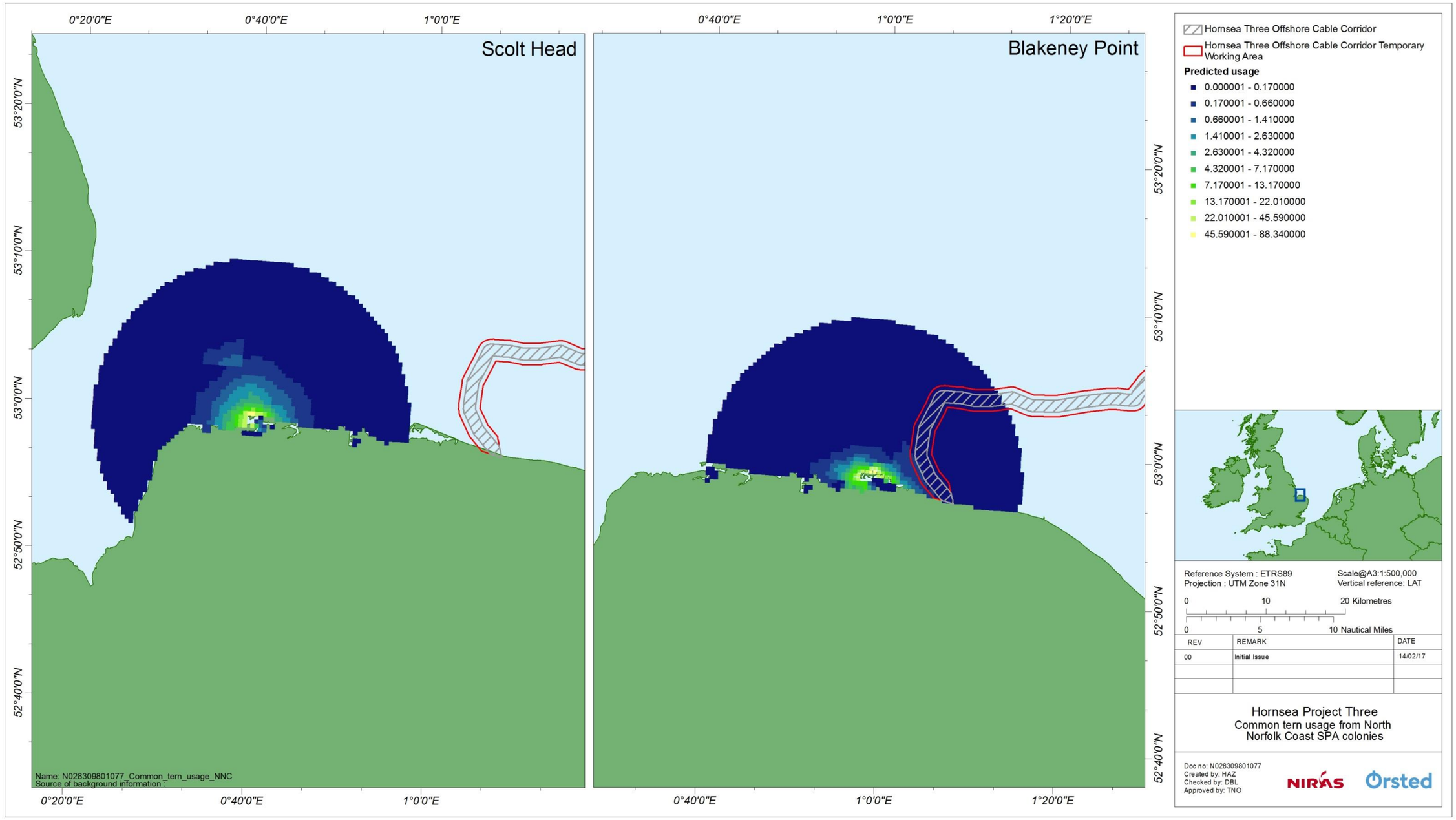


Figure 1.24: Predicted usage of offshore areas along the North Norfolk Coast by common terns from the breeding colonies at Scolt Head and Blakeney Point (data obtained from Natural England).

1.6.17 Arctic tern (*Sterna paradisaea*)

Status overview

1.6.17.1 Arctic tern is listed on Annex I of the EU Birds Directive, and the species is currently amber-listed on the UK Birds of Conservation Concern list (Eaton *et al*., 2015).

1.6.17.2 Arctic terns are summer visitors to Britain, breeding in coastal colonies, predominantly in the north. Seabird 2000 recorded 52,621 pairs in Britain (Mitchell *et al*., 2004). In autumn, Arctic terns migrate down the west coast of Europe and Africa to the Antarctic seas for the winter, returning the following spring (Wernham *et al*., 2002). The closest large colonies to Hornsea Three are the Farne Islands, Coquet Island and Long Nanny, (all Northumberland). Sandeels are the major prey species (Mitchell *et al*., 2004). The highest predicted densities of the species in the summer (April to September) correlate with the location of breeding colonies (Figure 1.47) and, due to the generic seasons used in the modelling process, also likely capture passage movements of the species along the east coast of England.

1.6.17.3 Arctic tern is listed as a qualifying interest species in the breeding season for fifteen SPAs and one pSPA on the UK east coast (Table 1.32). These SPAs are designated for 15,398 breeding pairs representing approximately 29% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004). Hornsea Three lies beyond the maximum known foraging range of Arctic terns from these SPAs (30 km) (Thaxter *et al*., 2012) Table 1.32).

1.6.17.4 Wade *et al*. (2016) assessed Arctic tern as being at low risk of displacement from wind farms and moderate risk of habitat loss due to the species moderate ability to utilise alternative habitats. The species was also considered to be at moderate risk of collision with turbines due to the high proportion of time the species spends in flight. Maclean *et al*. (2009) assessed terns as being at very low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.32: SPAs for breeding Arctic tern on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Auskerry	632	780
Coquet Island	283	1,230
Fair Isle	654	1,100
Farne Islands	304	2,003
Fetlar	751	1,065
Forth Islands	384	540
Foula	725	1,500
Mousa	699	1,000
Northumberland Marine	268	9,564 individuals
Outer Firth of Forth and St Andrews Bay Complex pSPA	345	-
Papa Stour	743	850
Papa Westray (North Hill and Holm)	672	1,700
Pentland Firth Islands	611	1,000
Rousay	657	790
Sumburgh Head	683	700
West Westray	667	1,140
Total		15,398*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA or the Northumberland Marine SPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

Seasonal abundance and distribution

1.6.17.5 Arctic terns were recorded in two of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. A total of seven birds were recorded during the May 2016 survey with a further 44 recorded in the May 2017 survey. These counts translate to population estimates of 399 and 1,578 birds, respectively (Table 1.33; Figure 1.25). These birds are migratory individuals with neither population surpassing the 1% threshold for regional importance of the migratory population (1% threshold = 1,639 individuals).

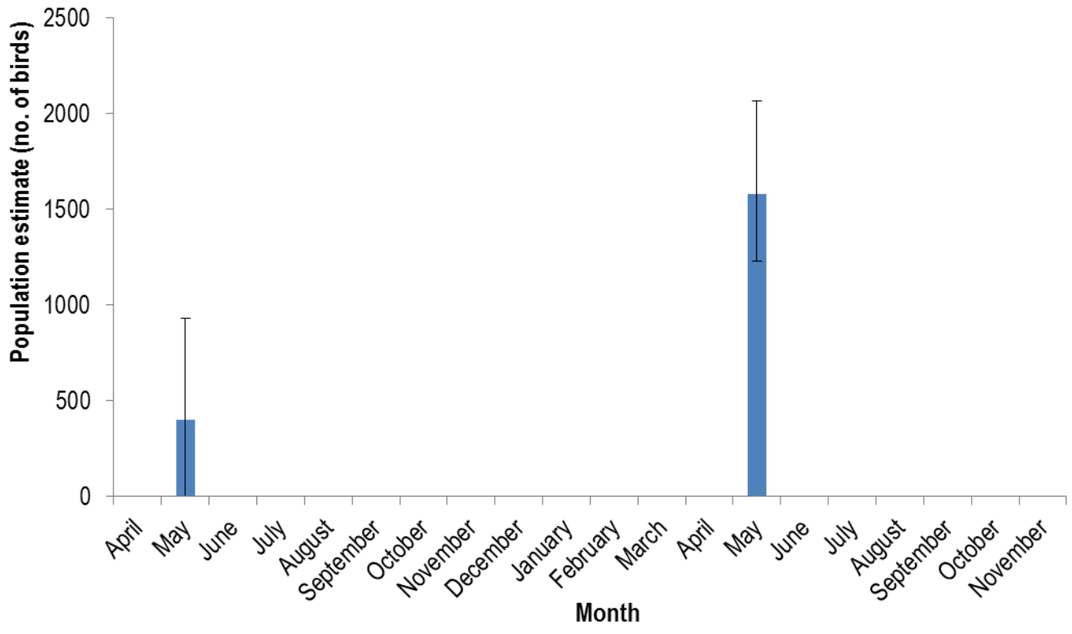


Figure 1.25: Population estimates of Arctic tern (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.17.6 Arctic tern is listed on Annex 1 of the EU Birds Directive and therefore the species is considered to have a National conservation status. The peak population of Arctic tern estimated at Hornsea Three was 1,578 birds in May (Table 1.33). Traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three due to the ephemeral nature of such movements. Thereforethe criteria in Table 1.8 relating to population importance cannot be applied for Arctic tern. As such, on a precautionary basis common tern is identified as a VOR and is considered for further assessment, where it is considered to be of International conservation value as the population that interacts with Hornsea Three is unknown and may include birds from breeding UK SPA colonies.

Table 1.33: Monthly population estimates and densities of Arctic tern in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	290	110	399	928	0	0.24	0.09	0.32	0.75	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	0	0	0	0	0	0	0	0	0	0
October 2016	0	0	0	0	0	0	0	0	0	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	546	739	1578	2064	1229	0.44	0.6	1.28	1.68	1
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.18 Kittiwake (*Rissa tridactyla*)

Status overview

1.6.18.1 Kittiwake is currently red-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015). The species is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

1.6.18.2 Kittiwake is one of the commonest seabirds in the UK, breeding in large colonies on coastal cliff habitat. Seabird 2000 recorded 366,835 pairs in the UK, with the largest numbers on the east coast (Mitchell *et al*., 2004). The nearest large colony to Hornsea Three is at Flamborough Head and Bempton Cliffs. Kittiwakes mostly prey on small fish such as sandeels, crustaceans and fishery discards (Coulson, 2011).

1.6.18.3 Between April and July, kittiwakes are dispersed widely around the coast of Britain, with the highest densities located in inshore areas along the North Sea coast of the UK (Stone *et al*., 1995). In eastern England, particularly south of Flamborough Head, kittiwake colonies are few, due to the lack of suitable cliff-face breeding habitats. However, predicted densities (WWT Consulting and MacArthur Green, 2013) are high in offshore areas to the east of the colony at Flamborough Head, however such high densities do not extend as far as Hornsea Three (Figure 1.48). From August to October, kittiwakes begin to disperse across the North Sea, although the predominant distribution still reflects the location of breeding colonies. From November to March, birds are dispersed over much larger areas of the North Sea, and in the southern parts, numbers peak during this period (Stone *et al.,* 1995). This reflects the kittiwake's preference for pelagic habitats in winter. The highest predicted densities in the winter (October to March) occur offshore of the Yorkshire and Lincolnshire coast and also in the Dogger Bank area. Predicted densities at Hornsea Three during this period are relatively low (Figure 1.48).

1.6.18.4 DECC (2009) shows kittiwake numbers in the Greater Wash survey blocks GW2, GW9 and GW10, peaked during chick-rearing (July) with a mean of 1,162 birds recorded in GW9 and GW10. The second highest peak occurred during incubation (May) with a mean of 722 birds. Lower numbers were recorded between August and February.

1.6.18.5 Kittiwake is listed as a qualifying interest species in the breeding season for 21 SPAs and 2 pSPAs on the UK east coast (Table 1.34). These SPAs are designated for 256,160 breeding pairs representing nearly 70% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004).

1.6.18.6 Flamborough and Filey Coast pSPA is the closest SPA/pSPA to Hornsea Three. However, Hornsea Three is outside of the mean-maximum and maximum foraging ranges of kittiwake (60 ±23.3 km and 120 km, respectively) from the pSPA as reported by Thaxter *et al*. (2012). Preliminary results from the FAME project which has tracked breeding kittiwake from the Flamborough and Filey Coast pSPA colony do however suggest that there may be connectivity between the Flamborough and Filey Coast pSPA and Hornsea Three (Figure 1.37).

Table 1.34: SPAs for breeding kittiwake on the UK east coast. There is possible connectivity between Hornsea Three and those sites in bold

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Buchan Ness to Collieston Coast	453	30,452
Calf of Eday	654	1,717
Copinsay	620	9,550
Coquet Island (non-listed assemblage)	283	213
East Caithness Cliffs	583	32,500
Fair Isle	654	18,160
Farne Islands	304	8,241 breeding adults
Forth Islands	384	8,400
Flamborough and Filey Coast pSPA	149	44,520
Foula	725	3,840
Fowlsheugh	425	36,650
Hermaness, Saxa Vord and Valla Field	773	922
Hoy	628	3,000
Marwick Head	662	7,700
North Caithness Cliffs	604	13,100
Northumberland Marine	268	4,334
Noss	708	7,020
Outer Firth of Forth and St Andrews Bay Complex pSPA (breeding)	345	12,020 individuals
Rousay	657	4,900
St Abb's Head to Fast Castle	348	21,170
Sumburgh Head	683	1,366
Troup, Pennan and Lion's Heads	493	31,600
West Westray	667	23,900
Total		304,801*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

1.6.18.7 Wade *et al*. (2016) assessed kittiwake as being at low risk of displacement from wind farms and habitat loss due to the ability of the species to utilise alternative habitats. Kittiwake is however considered to be at high risk of collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects at offshore wind farms (Table 1.6).

Seasonal abundance and distribution

1.6.18.8 Kittiwakes were recorded in all of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. Population estimates derived from aerial survey data during all breeding months surpass the 1% threshold for regional importance (1,020 individuals). The population estimates calculated for April (8,451 birds) and July 2016 (12,551 birds) also exceed the 1% threshold for national importance (1% threshold = 7,600 individuals).

1.6.18.9 Populations estimated during the post-breeding season (August to December) do not surpass the 1% importance threshold of the post-breeding regional BDMPS population for kittiwake (8,299 individuals). The peak population estimated during the post-breeding season was in December with 3,591 birds estimated to be present (Table 1.35; Figure 1.26). Populations estimated during surveys undertaken in the pre-breeding season (January to March) also do not surpass the 1% threshold for regional importance (1% threshold = 6,278 individuals) with the peak population occurring in the March survey (2,812 birds) (Table 1.35; Figure 1.26).

Behaviour

1.6.18.10 A total of 510 kittiwakes were recorded in flight within Hornsea Three plus a 4 km buffer during boat-based surveys of the former Hornsea Zone. Of these, only four were recorded flying above 32.5 m giving a PCH value of 0.78%. When the generic flight height data from Johnston *et al.* (2014) is analysed to calculate a PCH value based on the turbine parameters for Hornsea Three, 4.1% (2.7-5.4%) of kittiwakes are at potential risk height.

1.6.18.11 Flight direction was recorded for 1,858 kittiwakes with 885 in the breeding season, 768 in the post-breeding season and 205 in the pre-breeding season. In the breeding season, birds were recorded flying in all directions however, there was a stronger bias towards north-westerly, westerly and south-westerly flights (Figure 1.27). In the post-breeding season (Figure 1.28), the majority of birds were recorded flying in a north-easterly direction (21%) with large proportions also recorded flying in north-westerly, westerly and south-westerly directions (40%). In the pre-breeding season, the majority of birds were recorded flying in southerly and south-easterly directions (47%).

Conclusion

1.6.18.12 Kittiwake is considered to have an International conservation status as, although the foraging ranges reported by Thaxter *et al.* (2012) suggest no connectivity between Hornsea Three and any breeding colony, preliminary evidence from tracking studies (FAME project) do suggest possible (albeit limited) connectivity (Figure 1.37). Population estimates of kittiwake at Hornsea Three plus a 4 km buffer exceed the 1% importance threshold of the regional population in all breeding season months (Table 1.35; Table 1.5) with the populations estimated in April and July 2016 also surpassing the 1% threshold for national importance. Therefore based on potential SPA connectivity and the national importance of kittiwake populations at Hornsea Three, kittiwake is identified as a VOR and considered for further assessment as a receptor with an International conservation value.

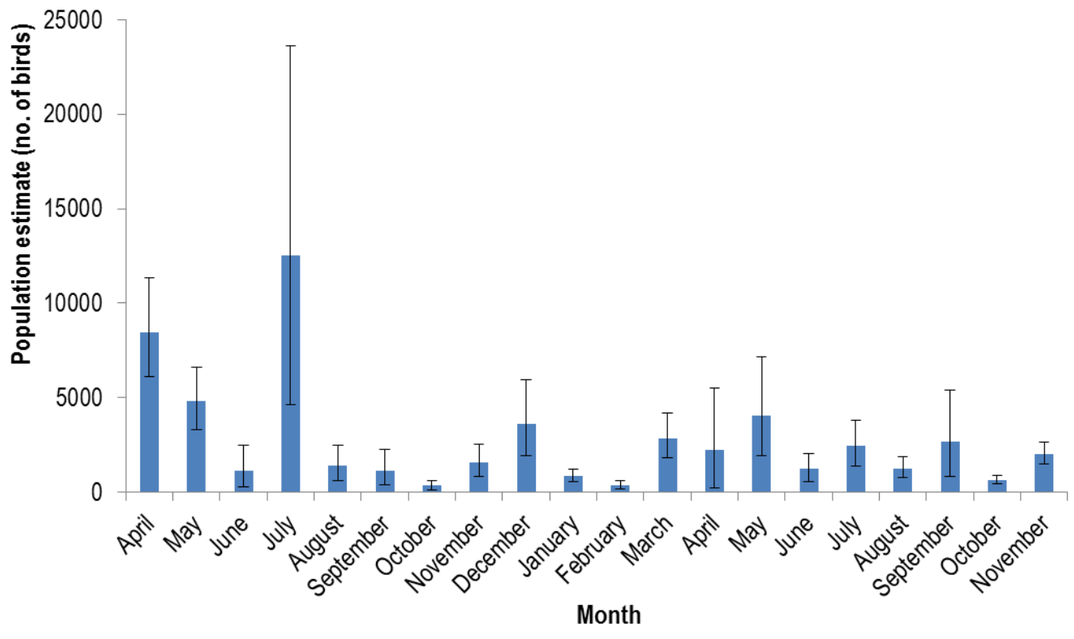


Figure 1.26: Population estimates of kittiwake (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

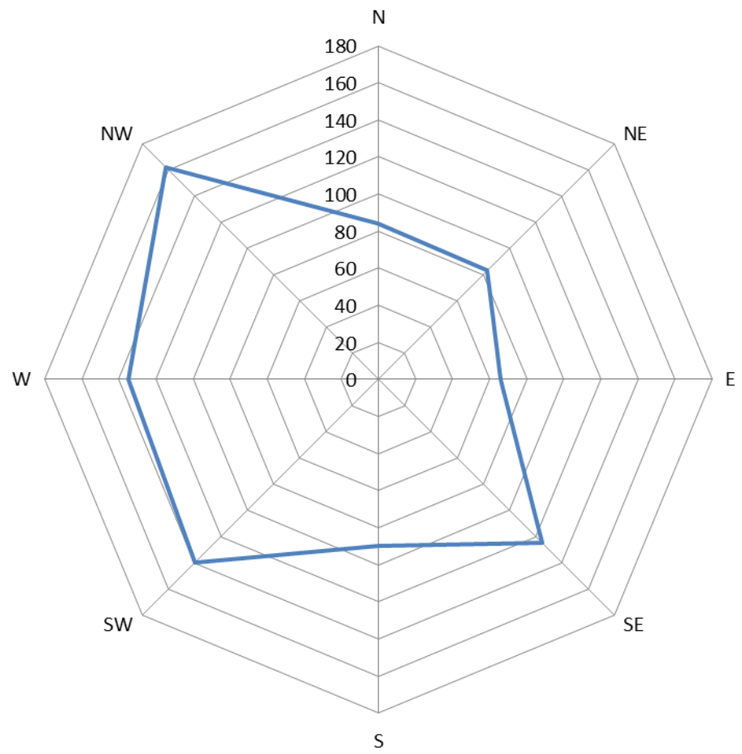


Figure 1.27: Flight directions of kittiwakes recorded during the breeding season and across all aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

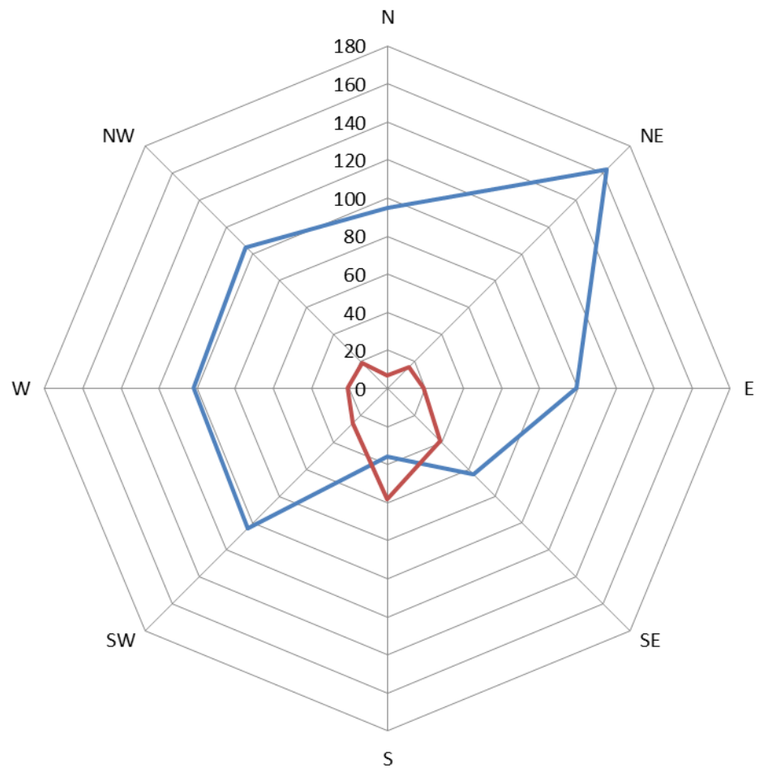


Figure 1.28: Flight directions of kittiwakes recorded during the post- and pre-breeding season and across all aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

Table 1.35: Monthly population estimates and densities of kittiwake in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	2881	5553	8451	11331	6126	2.34	4.51	6.87	9.21	4.98
May 2016	2031	2827	4842	6605	3332	1.65	2.3	3.93	5.37	2.71
June 2016	260	895	1152	2498	303	0.21	0.73	0.94	2.03	0.25
July 2016	2214	10331	12551	23622	4642	1.8	8.39	10.2	19.19	3.77
August 2016	321	1093	1415	2476	601	0.26	0.89	1.15	2.01	0.49
September 2016	716	411	1145	2266	364	0.58	0.33	0.93	1.84	0.3
October 2016	142	192	334	614	120	0.12	0.16	0.27	0.5	0.1
November 2016	740	847	1594	2544	841	0.6	0.69	1.29	2.07	0.68
December 2016	2631	919	3592	5948	1955	2.14	0.75	2.92	4.83	1.59
January 2017	585	267	871	1217	551	0.48	0.22	0.71	0.99	0.45
February 2017	182	187	387	626	186	0.15	0.15	0.31	0.51	0.15
March 2017	1403	1405	2812	4198	1811	1.14	1.14	2.29	3.41	1.47
April 2017	923	1306	2239	5503	220	0.75	1.06	1.82	4.47	0.18
May 2017	758	3272	4038	7172	1939	0.62	2.66	3.28	5.83	1.58
June 2017	369	849	1222	2033	544	0.3	0.69	0.99	1.65	0.44
July 2017	1163	1265	2434	3818	1398	0.95	1.03	1.98	3.1	1.14
August 2017	852	329	1254	1892	760	0.69	0.27	1.02	1.54	0.62
September 2017	1282	1369	2653	5421	817	1.04	1.11	2.16	4.4	0.66
October 2017	562	59	627	880	418	0.46	0.05	0.51	0.72	0.34
November 2017	1616	419	2028	2652	1488	1.31	0.34	1.65	2.15	1.21

1.6.19 Black-headed gull (*Chroicocephalus ridibundus*)

Status overview

1.6.19.1 Black-headed gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Black-headed gull is amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.19.2 Black-headed gulls are common and widespread in the UK and occur both inland and on the coast, although they are rarely found far offshore. In summer, birds breed at inland and coastal colonies, with 127,907 pairs recorded in Britain during Seabird 2000 (Mitchell *et al*., 2004). The UK wintering population of black-headed gull has been estimated at nearly 2,200,000 individuals (Burton *et al*., 2012).

1.6.19.3 Predicted densities of black-headed gull in the North Sea during both the summer (April to September) and winter (October to March) as derived from data collected between 1979 and 2011 indicate that the species is not abundant in the North Sea ((WWT Consulting and MacArthur Green, 2013)).

1.6.19.4 Black-headed gull is listed as a qualifying interest species in the breeding season for four SPAs and one pSPA on the UK east coast (Table 1.36). These SPAs support 6,441 breeding pairs representing approximately 5% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004). Since designation, the population at Coquet Island SPA has increased whereas the population at Alde-Ore Estuary SPA has decreased. However, there is now a very large breeding colony at the nearby Hamford Water SPA (3,700 pairs in 2012) although the species is not listed as a qualifying feature (JNCC, 2017). Hornsea Three is outside the maximum known foraging range of this species from any SPA where it is a designated feature (40 km) (Thaxter *et al*., 2012).

1.6.19.5 Wade *et al*. (2016) assessed black-headed gull as being at low risk of displacement from wind farms and habitat loss due to the species ability to use a wide range of habitats. The species was assessed as being at high risk of collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects with offshore wind farms (Table 1.6).

Table 1.36: SPAs for breeding black-headed gull on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Alde-Ore Estuary	189	1,582[26]
Coquet Island	283	3,886
Farne Islands (non-listed assemblage)	304	973 breeding adults
Northumberland Marine	268	4,373
Outer Firth of Forth and St Andrews Bay Complex pSPA	345	26,835 individuals
Total		6,441*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

Seasonal abundance and distribution

1.6.19.6 Black-headed gulls were recorded in only one of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. One bird was recorded during the October survey translating into a population estimate of 12 birds (Table 1.37). A regional population is not defined for black-headed gull with this population estimate therefore compared to national population thresholds which it does not exceed (2,800 individuals) (Table 1.5).

Conclusion

1.6.19.7 Black-headed gull is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015). The peak population of black-headed gull estimated at Hornsea Three plus a 4 km buffer was 78 birds in October 2017 (Table 1.37). This peak population estimate does not exceed relevant 1% importance thresholds of the international or national populations (Table 1.5) for black-headed gull. The number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect. Therefore, black-headed gull is not considered for further assessment.

[26] Population in 1990

Table 1.37: Monthly population estimates and densities of black-headed gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	0	0	0	0	0	0	0	0	0	0
October 2016	11	0	12	33	0	0.01	0	0.01	0.03	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	78	0	78	161	11	0.06	0	0.06	0.13	0.01
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.20 Little gull (Hydrocoloeus minutus)

Status overview

1.6.20.1 Little gull is listed on Annex I of the EU Birds Directive and Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). It is currently green-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.20.2 Little gull occurs on passage in the North Sea where it is fairly common off the Flamborough (East Yorkshire) coast with the highest numbers occurring in autumn (Thomas, 2011; Stone *et al*., 1995). The generic seasonal definitions used in WWT Consulting and MacArthur Green (2013), potentially lead to an overlap between the breeding season and post-breeding passage movements of little gull through the North Sea. This may therefore lead to certain areas appearing to support high densities of little gull throughout the summer when these high densities only actually occur during the post-breeding season. The predicted high densities off the Yorkshire coast south of Flamborough presented in Figure 1.49 are therefore considered to reflect the population of little gull present at that location in the post-breeding season. In winter months the highest predicted densities of the species are located off the north Norfolk coast and Lincolnshire coast around The Wash, in the area covered by the Greater Wash pSPA.

1.6.20.3 DECC (2009) shows that almost no little gulls were recorded during aerial surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with only three birds recorded during November.

1.6.20.4 Large numbers of little gull occur at Hornsea Mere, on the East Yorkshire coast in late summer, with up to 21,500 birds present in 2007 for example although in recent years numbers have been lower (Frost *et al.*, 2017). There are no terrestrial UK SPAs for little gull, (JNCC, 2013), although the species was considered for marine SPAs in a recent JNCC report (Kober *et al*., 2010) and is included as a qualifying feature for two pSPAs on the east coast of the UK: the Greater Wash pSPA (1,303 individuals) and the Outer Firth of Forth and St Andrews Bay Complex pSPA (126 individuals).

1.6.20.5 Garthe and Hüppop (2004) assessed little gull as being at low risk of collision with turbines and displacement due to the moderate proportion of birds at turbine height and the moderate ability of the species to use alternative habitats. The species was considered to be at moderate risk of habitat loss. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects from offshore wind farms. (Table 1.6).

Seasonal abundance and distribution

Hornsea Three array area

1.6.20.6 Little gulls were recorded during five of the aerial surveys conducted across Hornsea Three plus a 4 km buffer. These birds were recorded during the April 2016, September 2016, October 2016, February 2017 and October 2017 surveys with populations of 34, 13, 24, 12 and 78 birds estimated for each month respectively (Table 1.38; Figure 1.29). These population estimates do not surpass the 1% threshold for regional importance (1% threshold = 720 – 1,740 individuals).

Hornsea Three export cable route

1.6.20.7 Lawson *et al.* (2015), which presents survey data collected across the Greater Wash, indicates that a mean-peak population of 2,153 little gull occurs (Figure 1.7). The Greater Wash for which the distribution of little gull was calculated in Lawson *et al.* (2015) incorporates approximately 25 km of the export cable route. However, the main concentrations of little gull occur in the mouth of the Wash extending in a north-easterly direction offshore (Figure 1.30), with densities of up to 0.89 birds/km^2 occurring in these areas. Figure 1.30 suggests however, that low densities (0.09 birds/km^2) of little gull may occur along the export cable route.

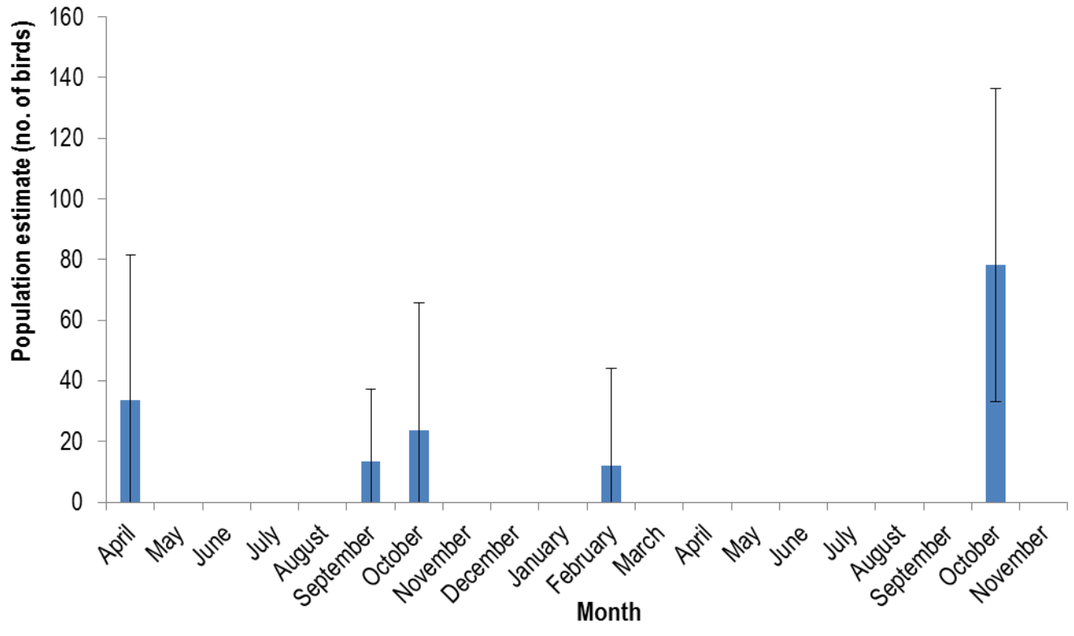


Figure 1.29: Population estimates of little gull (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.20.8 Little gull is listed on Annex 1 of the EU Birds Directive and as such is considered to have a National conservation status. The peak population of little gull estimated at Hornsea Three plus a 4 km buffer was 78 birds in October 2017 (Table 1.38). However, traditional boat-based and aerial surveys are considered unlikely to accurately quantify the migratory movements of this species that may pass through Hornsea Three due to the ephemeral nature of such movements. Thereforethe criteria in Table 1.8 relating to population importance cannot be applied for little gull. As such, on a precautionary basis little gull is identified as a VOR and considered for further assessment, where it is considered to be of International conservation value as the population that interacts with Hornsea Three is unknown.

1.6.20.9 The Hornsea Three export cable route passes through the Greater Wash pSPA at which little gull is a qualifying feature. The predicted usage of the area in which the Hornsea Three export cable is located is negligible. In addition, little gull are not considered vulnerable to the impacts that may arise during the installation of the Hornsea Three export cable (Table 1.6). As such, little gull is not considered for further assessment.

1.6.20.10 Little gull is, therefore, considered for further assessment for impacts associated with the Hornsea Three array area only.

Table 1.38: Monthly population estimates and densities of little gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	34	0	34	81	0	0.03	0	0.03	0.07	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	12	0	13	37	0	0.01	0	0.01	0.03	0
October 2016	22	0	24	66	0	0.02	0	0.02	0.05	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	12	0	12	44	0	0.01	0	0.01	0.04	0
March 2017	0	0	0	0	0	0	0	0	0	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	65	12	78	136	33	0.05	0.01	0.06	0.11	0.03
November 2017	0	0	0	0	0	0	0	0	0	0

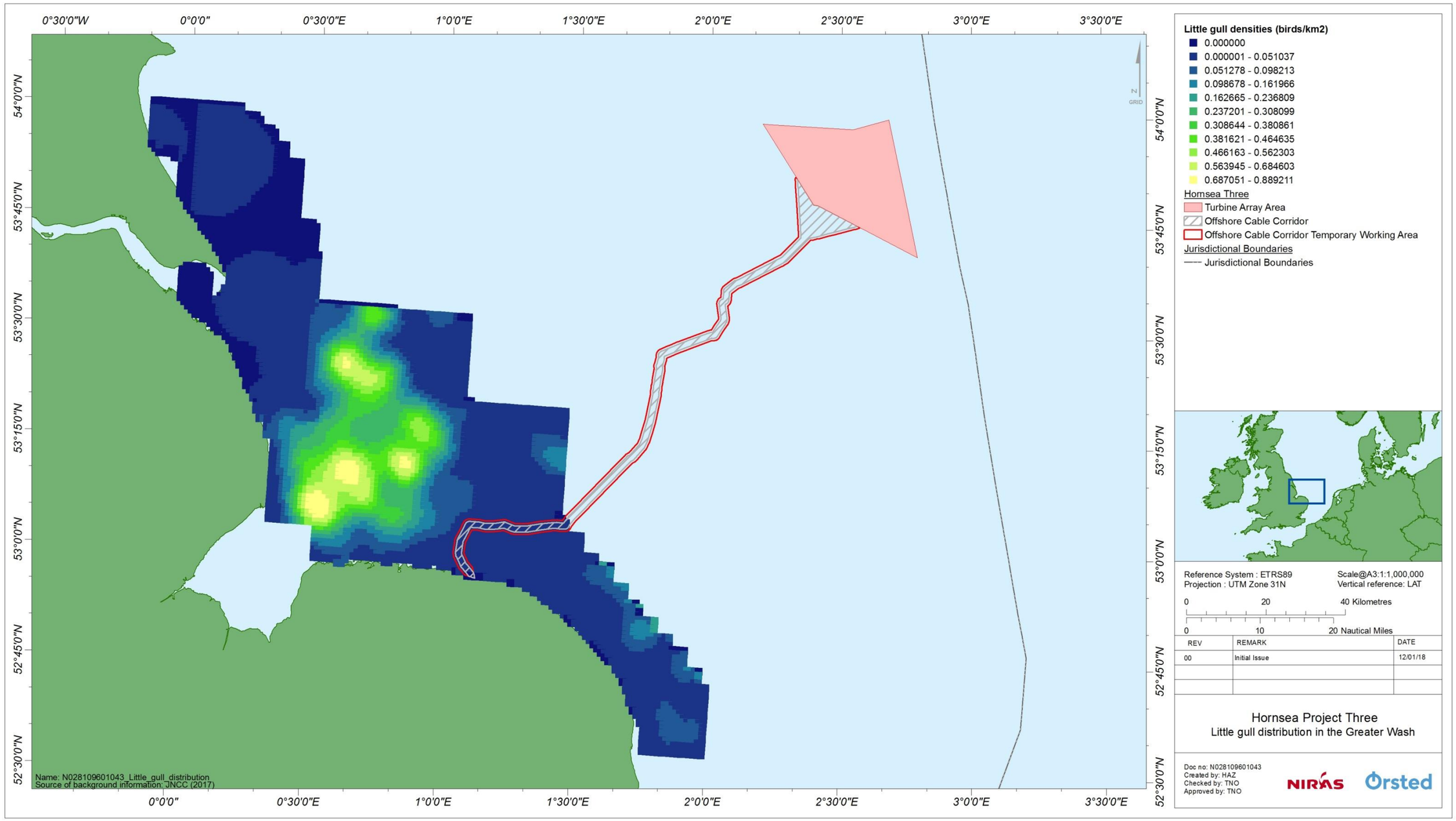


Figure 1.30: Distribution of little gull in the Greater Wash, calculated from data collected between 2002 and 2008 (Lawson *et al.*, 2015).

1.6.21 Common gull (*Larus canus*)

Status overview

1.6.21.1 Common gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.21.2 Common gulls are common and widespread in the UK in lowland, urban and coastal areas in winter, and at breeding colonies in coastal and inland locations in summer. Seabird 2000 recorded 48,163 pairs of common gulls breeding in Britain (Mitchell *et al*., 2004). Common gulls typically feed on farmland, playing fields, estuaries and in coastal waters, and are comparatively uncommon offshore (Forrester *et al*., 2007; Stone *et al*., 1995). The UK wintering population of common gull has been estimated at over 700,000 individuals (Burton *et al*., 2012).

1.6.21.3 Predicted densities of common gull as calculated from boat-based and aerial survey data collected between 1979 and 2011 (WWT Consulting and MacArthur Green, 2013) suggest that the species is not abundant at Hornsea Three (Figure 1.50) The highest predicted densities in the summer (April to September) occur far to the north-west of Hornsea Three along the North Yorkshire and Durham coastlines. In the winter (October to March), the distribution of common gull shifts further south with the highest densities along the English coast between East Yorkshire and Suffolk.

1.6.21.4 Common gull is listed as a qualifying interest species in the breeding season for one SPA in the UK: Tips of Corsemaul and Tom Mor SPA. This inland SPA, located in Aberdeenshire, held 15,870 pairs at the time of designation. A larger population (18,136 pairs) was recorded in 1998 however more recent data indicates a decline at this site, with 6,240 pairs in 2007 (4,156 pairs at Tom Mor) and 2008 (2,084 pairs at Tips of Corsemaul) (JNCC, 2017). The distance between this SPA and Hornsea Three is beyond the maximum known foraging range for this species (50 km) (Thaxter *et al*., 2012). Common gull is also included as part of the proposed designation of the Outer Firth of Forth and St Andrews Bay Complex pSPA (14,647 individuals) in the non-breeding season.

1.6.21.5 Wade *et al*. (2016) assessed common gull as being at low risk of displacement from wind farms and habitat loss due to the species ability to use a wide range of habitats. However, the species is assessed as being at very high risk from collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects at offshore wind farms (Table 1.6).

Seasonal abundance and distribution

1.6.21.6 Common gulls were recorded in nine of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. A population of 46 birds was estimated to be present at Hornsea Three during the July 2016 survey. Although this is within the breeding season defined for common gull (Table 1.4) these birds are unlikely to be breeding birds with Hornsea Three located beyond the maximum foraging range reported for this species from any UK breeding colony (Thaxter *et al.* 2012) with the nearest large colony of this species located in eastern Scotland (Mitchell *et al.,* 2004).

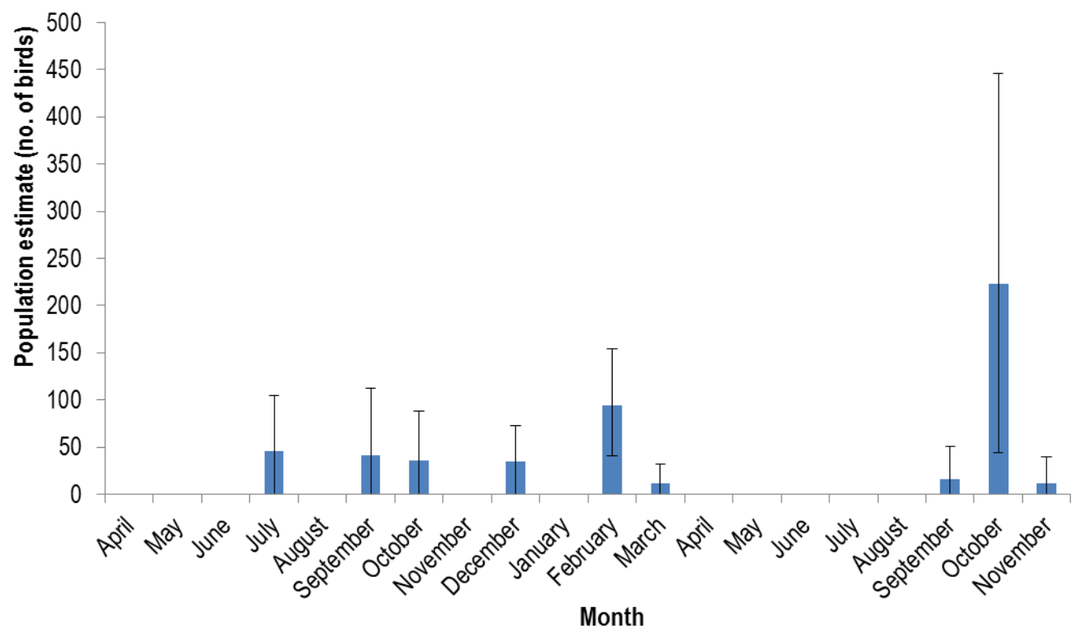


Figure 1.31: Population estimates of common gull (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

1.6.21.7 In the non-breeding season (September to March) a peak population of 223 birds was estimated in October 2017 (Table 1.39; Figure 1.31). This population does not surpass the 1% threshold for national importance (1% threshold = 980 individuals).

Conclusion

1.6.21.8 Common gull is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015). The peak population of common gull estimated at Hornsea Three plus a 4 km buffer was 223 birds in October 2017 (Table 1.39). This peak population estimate does not exceed relevant 1% importance thresholds of the international or national populations (Table 1.5) of common gull. The number of individuals potentially impacted by Hornsea Three is considered to be negligible and there is no potential for a significant effect. Therefore, common gull is not considered for further assessment.

Table 1.39: Monthly population estimates and densities of common gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	0	0	0	0	0	0	0	0	0
June 2016	0	0	0	0	0	0	0	0	0	0
July 2016	46	0	46	104	0	0.04	0	0.04	0.08	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	36	0	41	112	0	0.03	0	0.03	0.09	0
October 2016	22	13	36	88	0	0.02	0.01	0.03	0.07	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	33	0	34	73	0	0.03	0	0.03	0.06	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	92	0	95	154	41	0.07	0	0.08	0.12	0.03
March 2017	12	0	11	32	0	0.01	0	0.01	0.03	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	0	0	0	0	0	0	0	0	0	0
July 2017	0	0	0	0	0	0	0	0	0	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	26	16	51	0	0	0.02	0.01	0.04	0
October 2017	222	0	223	446	44	0.18	0	0.18	0.36	0.04
November 2017	0	11	11	40	0	0	0.01	0.01	0.03	0

1.6.22 Lesser black-backed gull (*Larus fuscus*)

Status overview

1.6.22.1 Lesser black-backed gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.22.2 Lesser black-backed gulls are common and widespread in the UK in summer, and breed in colonies in coastal and inland locations. Seabird 2000 recorded 111,835 pairs in Britain (Mitchell *et al*., 2004). In winter, many birds leave northern areas between November and March, although some remain all year, particularly in the south-west (Forrester *et al*., 2007). The UK wintering population of lesser black-backed gull has been estimated at over 125,000 individuals (Burton *et al*., 2012). Lesser black-backed gulls take a wide variety of prey and scavenged food, both at sea, and on farmland and refuse sites (Forrester *et al*., 2007).

1.6.22.3 Predicted densities of lesser black-backed gull (WWT Consulting and MacArthur Green, 2013) suggest that the species is not abundant in the North Sea in either the summer (April to September) or winter (October to March) (Figure 1.51). The highest predicted densities in the summer occur to the south of Hornsea Three, associated with breeding colonies on the Suffolk and Norfolk coasts.

1.6.22.4 Lesser black-backed gull is listed as a qualifying interest species in the breeding season for five SPAs on the UK east coast (Table 1.40).. These SPAs are designated for 24,626 breeding pairs representing approximately 22% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004). Since designation, the population at some of these SPAs has decreased significantly. The distance between Hornsea Three and all SPAs is beyond the maximum known foraging range of lesser black-backed gull (181 km) (Thaxter *et al*., 2012). There is also a large breeding colony at Outer Trial Bank within The Wash SPA (1,457 pairs in 2009) (JNCC, 2017), which is within the maximum foraging range for this species, though they are not a qualifying feature of the SPA.

1.6.22.5 Wade *et al*. (2016) assessed lesser black-backed gull as being at low risk of displacement from wind farms and very low risk of habitat loss due to the species ability to use a wide range of habitats. However, the species is assessed as being at very high risk of collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.40: SPAs for breeding lesser black-backed gull on the UK east coast. Hornsea Three lies within the mean-maximum foraging range of lesser black-backed gull from those sites in bold.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Alde-Ore Estuary	189	21,700[27]
Coquet Island (non-listed assemblage)	283	26
Farne Islands (non-listed assemblage)	304	1,400 breeding adults
Forth Islands	384	1,500
Northumberland Marine	268	726
Total		24,626

Seasonal abundance and distribution

1.6.22.6 Lesser black-backed gulls were recorded in twelve of the aerial surveys conducted across Hornsea Three plus a 4 km buffer. The peak population in the breeding season (May to July) was recorded in June 2016 with an estimate of 1,002 birds (Table 1.41; Figure 1.32). This population and those estimated in July 2016 and May 2017 exceed the 1% threshold for regional importance (1% threshold = 50 individuals). However, none of these populations exceed the 1% importance threshold of the national breeding population (1% threshold = 2,200 individuals).

1.6.22.7 In the post-breeding season (August to October) a peak population of 343 birds estimated in August 2017 (343 individuals) (Table 1.41; Figure 1.32). In the pre-breeding season (March to April), the peak population occurred in April 2016 (133 birds). The population estimates calculated in the post-breeding and pre-breeding seasons do not surpass the respective 1% thresholds for regional importance (1% threshold = 2,090 and 1,975 individuals respectively). No birds were recorded in the non-breeding season as defined for lesser black-backed gull (November to February).

[27] Population in 1990

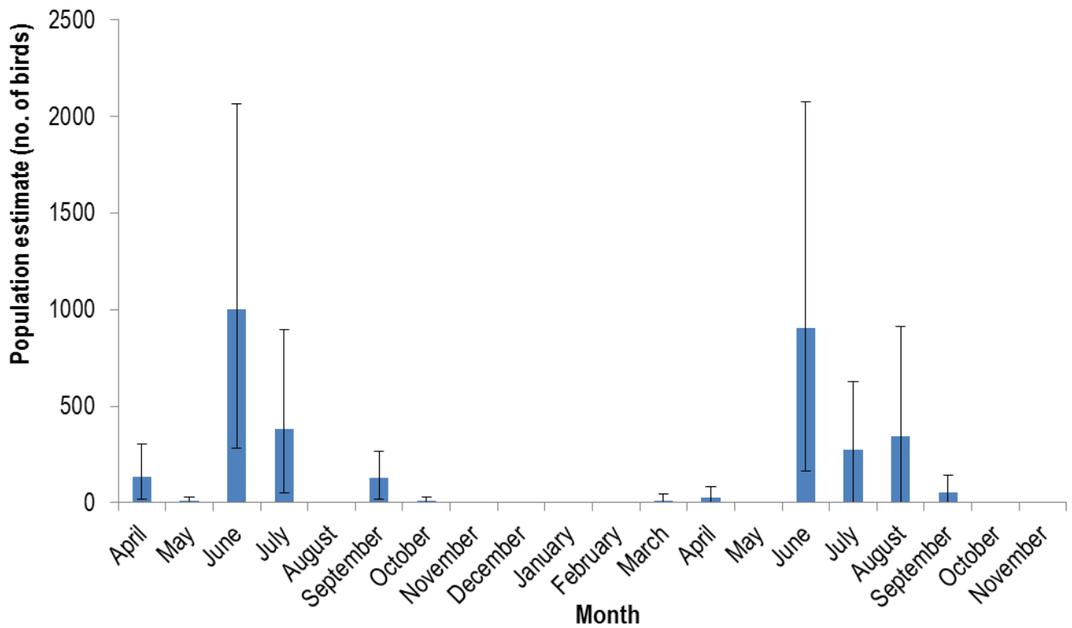


Figure 1.32: Population estimates of lesser black-backed gull (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Behaviour

1.6.22.8 A total of 123 lesser black-backed gulls were recorded in flight within Hornsea Three plus a 4 km buffer during boat-based surveys of the former Hornsea Zone. Of these, twelve were recorded flying above 32.5 m giving a PCH value of 9.8%. When the generic flight height data from Johnston *et al.* (2014) is analysed to calculate a PCH value based on the turbine parameters for Hornsea Three, 11.9% (6.8-25.2%) of lesser black-backed gulls are at potential risk height.

1.6.22.9 A total of 229 lesser black-backed gulls were recorded during aerial surveys of Hornsea Three plus a 4 km buffer. Seventy-six birds were recorded in flight with remaining birds on the sea surface. The majority of these birds (nearly 62%) were recorded flying in either a south-westerly, westerly or north-westerly direction.

Conclusion

1.6.22.10 Lesser black-backed gull is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015). The peak population of lesser black-backed gull estimated at Hornsea Three plus a 4 km buffer was 1,002 birds in June 2016 (Table 1.41). This peak population estimate along with the population estimated in July 2016 and June and July 2017 exceed the 1% importance threshold of the regional population of lesser black-backed gull (Table 1.5). The 1% importance thresholds of the national and international populations for lesser black-backed gull are not surpassed in any month. Therefore based on the conservation status of lesser black-backed gull and the regional importance of lesser black-backed gull populations present at Hornsea Three, lesser black-backed gull is identified as a VOR and considered for further assessment as a species of Regional conservation value.

Table 1.41: Monthly population estimates and densities of lesser black-backed gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	132	0	133	304	20	0.11	0	0.11	0.25	0.02
May 2016	11	0	11	31	0	0.01	0	0.01	0.02	0
June 2016	276	725	1002	2065	281	0.22	0.59	0.81	1.68	0.23
July 2016	96	284	381	896	52	0.08	0.23	0.31	0.73	0.04
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	31	99	127	264	17	0.03	0.08	0.1	0.21	0.01
October 2016	0	11	11	31	0	0	0.01	0.01	0.02	0
November 2016	0	0	0	0	0	0	0	0	0	0
December 2016	0	0	0	0	0	0	0	0	0	0
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	0	0	0	0	0	0	0	0	0	0
March 2017	0	13	13	46	0	0	0.01	0.01	0.04	0
April 2017	31	0	26	82	0	0.03	0	0.02	0.07	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	209	702	907	2073	164	0.17	0.57	0.74	1.68	0.13
July 2017	140	134	276	629	0	0.11	0.11	0.22	0.51	0
August 2017	66	285	343	910	0	0.05	0.23	0.28	0.74	0
September 2017	29	24	55	143	0	0.02	0.02	0.04	0.12	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.23 Herring gull (*Larus argentatus*)

Status overview

1.6.23.1 Herring gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently red-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.23.2 Herring gulls are resident, common and widespread, breeding in colonies in coastal and inland locations. Seabird 2000 recorded 142,942 pairs in Britain (Mitchell *et al*., 2004). There is a general movement southwards in winter months (Forrester *et al*., 2007) with the UK wintering population estimated at over 740,000 individuals (Burton *et al*., 2012). Herring gulls exploit a wide range of food sources, including scraps and offal from trawlers, as well as on land at refuse dumps and farm land (Forrester *et al*., 2007).

1.6.23.3 Predicted densities of herring gull (WWT Consulting and MacArthur Green, 2013) suggest that the species is not abundant at Hornsea Three in either the summer (April to September) or winter (October to March) (Figure 1.52). The highest predicted densities of the species during both periods occur in inshore areas between Northumberland and Yorkshire in the summer and between Northumberland and Norfolk in the winter, especially in The Wash.

1.6.23.4 Herring gull is listed as a qualifying interest species in the breeding season for ten SPAs and two pSPAs on the UK east coast (Table 1.42). These SPAs were designated for 37,159 pairs representing approximately 26% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al.,* 2004). Since designation, the populations at all ten SPAs have decreased. The population at the closest SPA to Hornsea Three, Flamborough and Filey Coast pSPA, has decreased from 1,110 pairs at citation in 1993 to 495 pairs in 2010. The distance between Hornsea Three and all of these SPAs is greater than the mean-maximum foraging range for herring gull (61.1 km ± 44 km), (Thaxter *et al*., 2012). There is also a large breeding colony at Outer Trial Bank within The Wash SPA (1,056 pairs in 2009) (JNCC, 2017), which is also outside of foraging range.

1.6.23.5 Wade *et al*. (2016) has assessed herring gull as being low risk from displacement from wind farms and very low risk of habitat loss due to the species ability to use a wide range of habitats. The species is considered to be at very high risk of collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.42: SPAs for breeding herring gull on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Alde-Ore Estuary	189	6,050[28]
Buchan Ness to Collieston Coast	453	4,292
Coquet Island (non-listed assemblage)	283	4 breeding adults
East Caithness Cliffs	583	9,400
Farne Islands (non-listed assemblage)	304	1,688 breeding adults
Forth Islands	384	6,600
Flamborough and Filey Coast pSPA	149	1,421
Fowlsheugh	425	3,190
Northumberland Marine	268	836
Outer Firth of Forth and St Andrews Bay Complex pSPA (breeding)	345	3,044 individuals
St Abb's Head to Fast Castle	348	1,160
Troup, Pennan and Lion's Heads	493	4,200
Total		37,159*

*Total does not include the Outer Firth of Forth and St Andrews Bay Complex pSPA as the designation relates to birds utilising a foraging resource which are accounted for elsewhere.

[28] Population in 1990

Seasonal abundance and distribution

1.6.23.6 Herring gulls were recorded during ten of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. The peak population recorded in the breeding season (May to July) occurred in June 2017 when 221 birds were estimated to be present at Hornsea Three (Table 1.43; Figure 1.33). There is not considered to be any connectivity between herring gull breeding colonies and Hornsea Three and therefore any birds recorded at Hornsea Three are considered to be non-breeding or immature birds.

1.6.23.7 In the non-breeding season (August to April), a peak population of 318 birds was estimated in December (Table 1.43; Figure 1.33). This population does not surpass the 1% threshold for regional importance (1% threshold = 4,665 individuals).

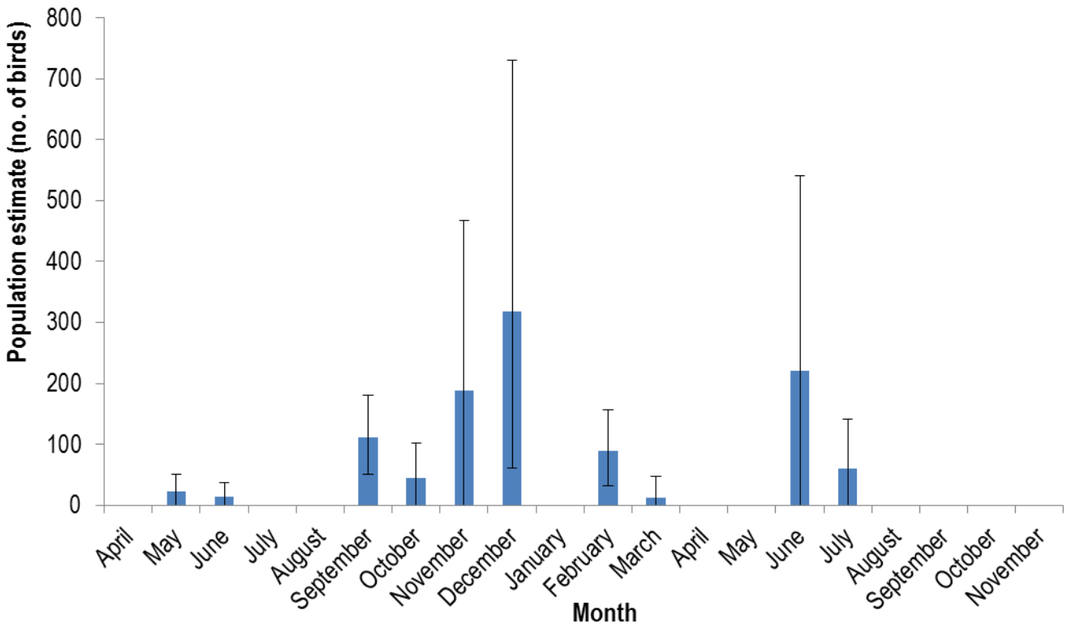


Figure 1.33: Population estimates of herring gull (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

Conclusion

1.6.23.8 Herring gull is currently red-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015). Hornsea Three is not within the mean-maximum or maximum foraging ranges of herring gull from any breeding colony with only low numbers of the species recorded at Hornsea Three during the breeding season. The peak population of herring gull estimated at Hornsea Three plus a 4 km buffer was 318 birds in December (Table 1.43). This peak population estimate does not exceed relevant 1% importance thresholds of the international or national populations (Table 1.5) for herring gull and as such the species is not considered for further assessment.

Table 1.43: Monthly population estimates and densities of herring gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	0	0	0	0	0	0	0	0	0	0
May 2016	0	22	22	51	0	0	0.02	0.02	0.04	0
June 2016	13	0	13	38	0	0.01	0	0.01	0.03	0
July 2016	0	0	0	0	0	0	0	0	0	0
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	77	33	111	180	50	0.06	0.03	0.09	0.15	0.04
October 2016	0	45	45	102	0	0	0.04	0.04	0.08	0
November 2016	0	181	188	467	0	0	0.15	0.15	0.38	0
December 2016	100	225	318	730	60	0.08	0.18	0.26	0.59	0.05
January 2017	0	0	0	0	0	0	0	0	0	0
February 2017	58	22	90	156	31	0.05	0.02	0.07	0.13	0.03
March 2017	0	13	13	46	0	0	0.01	0.01	0.04	0
April 2017	0	0	0	0	0	0	0	0	0	0
May 2017	0	0	0	0	0	0	0	0	0	0
June 2017	12	212	221	541	0	0.01	0.17	0.18	0.44	0
July 2017	12	49	60	141	0	0.01	0.04	0.05	0.11	0
August 2017	0	0	0	0	0	0	0	0	0	0
September 2017	0	0	0	0	0	0	0	0	0	0
October 2017	0	0	0	0	0	0	0	0	0	0
November 2017	0	0	0	0	0	0	0	0	0	0

1.6.24 Great black-backed gull (*Larus marinus*)

Status overview

1.6.24.1 Great black-backed gull is not listed under Annex I of the EU Birds Directive (2009/147/EEC) or Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The species is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al*., 2015).

1.6.24.2 Great black-backed gull is a common resident species in the UK, occurring in coastal areas. Seabird 2000 recorded 17,394 pairs in Britain, with largest numbers on western coasts (Mitchell *et al*., 2004). Great black-backed gulls are omnivorous, foraging at sea, on estuaries and beaches, and less commonly at rubbish dumps (Forrester *et al*., 2007).

1.6.24.3 Great black-backed gull is a relatively common breeding species in Great Britain. During the pre-breeding and breeding season their distribution tends to be limited to coastal areas. During the winter they are a much more widely dispersed species and often travel long distances in pursuit of discards from fishing vessels (Stone *et al*., 1995). The UK wintering population of great black-backed gull has been estimated at over 76,000 individuals (Burton *et al.,* 2012). The flyway population in the North Sea is estimated at 480,000 birds with 5.2% of the biogeographic population flying over the southernmost part of this area (Stienen *et al*., 2007).

1.6.24.4 During March and April the highest densities within the UK are found in the northern isles of Scotland with overwintering birds in UK waters returning to breeding grounds in Fennoscandia and Iceland during this time (Furness, 2015), leaving lower densities along the east coast. Predicted densities of great black-backed gull in the English North Sea during the summer (April to September) (WWT Consulting and MacArthur Green, 2013) are highest in inshore areas between Northumberland and East Yorkshire. At Hornsea Three densities of the species are relatively low.

1.6.24.5 During the post-breeding period of August to October, distribution is more widespread along the east coast with densities of five birds/km^2 recorded to the north of the Humber estuary (Stone *et al*., 1995). In the winter (October to March) the species is more widespread with the highest predicted densities occurring off the East Yorkshire coast at Flamborough, off the eastern Norfolk coast and in the north-eastern part of Hornsea Three, extending outside of UK territorial waters (Figure 1.53).

1.6.24.6 DECC (2009) shows that small numbers of great black-backed gulls were recorded throughout the year during surveys of the Greater Wash survey blocks GW2, GW9 and GW10, with the average number of birds peaking in December (11 birds). A similar number of the species group 'black-backed gulls' was also recorded with highest average also occurring in December (14 birds). Another species group defined as 'large gull spp.' also showed similar numbers, but this time average numbers peaked in March (24 birds). Much more frequent was the species group 'gull spp.' with a mean peak of 166 birds in March.

1.6.24.7 Great black-backed gull is listed as a qualifying interest species in the breeding season for six SPAs on the east coast of the UK. These SPAs held 2,812 pairs at time of designation representing approximately 16% of the national breeding population as recorded during Seabird 2000 (Mitchell *et al*., 2004*)*. However, Hornsea Three is well outside of foraging range (60 km; Seys *et al.,* 2001) of great black-backed gull from these colonies (Table 1.44).

1.6.24.8 Wade *et al*. (2016) assessed great black-backed gull as being at low risk of displacement from wind farms and very low risk of habitat loss due to the species ability to use a wide range of habitats. The species is considered to be at very high risk of collision with turbines due to the relatively high proportion of birds at turbine height. Maclean *et al*. (2009) assessed gulls as being at low risk of barrier effects at offshore wind farms (Table 1.6).

Table 1.44: SPAs for breeding great black-backed gull on the UK east coast.

SPA	Distance to Hornsea Three (km)	Cited SPA population (pairs) (unless otherwise stated)
Calf of Eday	654	938
Copinsay	620	490
East Caithness Cliffs	583	800
Farne Islands (non-listed assemblage)	304	27 breeding adults
Hoy	628	570
Northumberland Marine	268	13
Total		2,812

Seasonal abundance and distribution

1.6.24.9 Great black-backed gulls were recorded in nineteen of the aerial surveys undertaken across Hornsea Three plus a 4 km buffer. Great black-backed gulls were recorded in all surveys covering the breeding season defined for the species (May to July) with the peak population of 399 birds estimated for the July 2017 survey (Table 1.45; Figure 1.34). There is not considered to be any connectivity between great black-backed gull breeding colonies and Hornsea Three and therefore any birds recorded at Hornsea Three are considered to be non-breeding or immature birds.

1.6.24.10 In the non-breeding season (August to March) the peak population was recorded during the February survey (1,455 birds) (Table 1.45; Figure 1.34). This population, and those estimated in the November and December 2016 and October 2017 surveys surpass the 1% threshold for regional importance (1% threshold = 914 individuals) with the population in February also considered to be of national importance (1% threshold = 1,435 individuals).

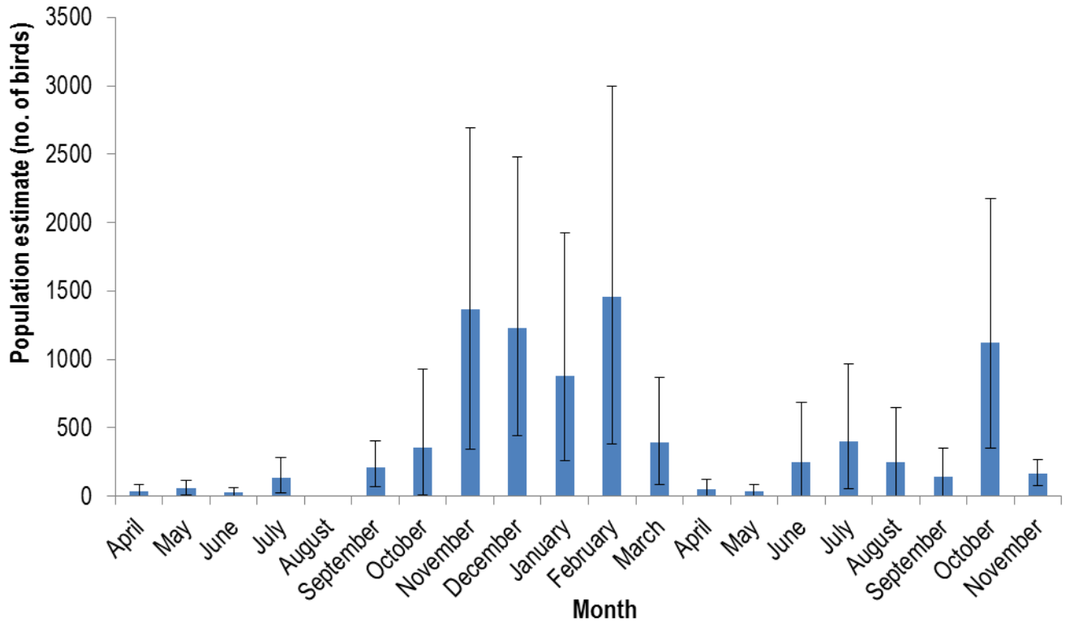


Figure 1.34: Population estimates of great black-backed gull (with 95% confidence intervals) estimated from aerial surveys undertaken across Hornsea Three plus a 4 km buffer between April 2016 and November 2017.

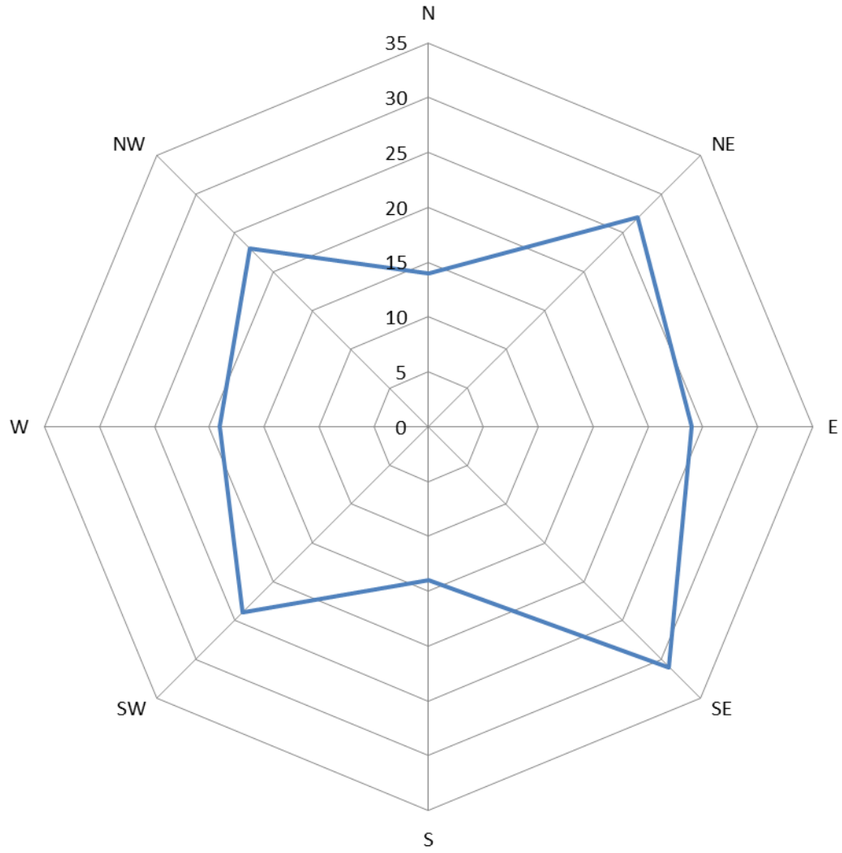


Figure 1.35: Flight directions of great black-backed gulls in the non-breeding season recorded during aerial surveys of Hornsea Three plus a 4 km buffer undertaken between April 2016 and November 2017.

Behaviour

1.6.24.11 A total of 177 great black-backed gulls were recorded in flight within Hornsea Three plus a 4 km buffer during boat-based surveys of the former Hornsea Zone. Of these, thirteen were recorded flying above 32.5 m giving a PCH value of 7.3%. When the generic flight height data from Johnston *et al.* (2014) is analysed to calculate a PCH value based on the turbine parameters for Hornsea Three, 15.3% (12.0-26.3%) of great black-backed gulls are at potential risk height.

1.6.24.12 A total of 722 great black-backed gulls were recorded during aerial surveys of Hornsea Three plus a 4 km buffer. The majority were associated with the sea surface (nearly 70%) with remaining birds in flight. Of these 46 were in the breeding season and 176 in the non-breeding season. In the non-breeding season there was a trend towards easterly directions with nearly 47% recorded flying in either a north-easterly, easterly or south-easterly direction (Figure 1.35) although large proportions were also recorded flying in north-westerly (13%) and south-westerly directions (14%).

Conclusion

1.6.24.13 Great black-backed gull is currently amber-listed on the UK Birds of Conservation Concern (Eaton *et al.,* 2015) meaning the species has a Local conservation status in the context of Hornsea Three. The peak population of great black-backed gull estimated at Hornsea Three plus a 4 km buffer was 1,455 birds in February (Table 1.45). This peak population estimate exceeds the 1% threshold of national importance with the populations estimated in November and December surpassing the threshold for regional importance (Table 1.5). Therefore based on the conservation status of great black-backed gull and the national importance of great black-backed gull populations present at Hornsea Three, great black-backed gull is identified as a VOR and considered for further assessment as a species of National conservation value.

Table 1.45: Monthly population estimates and densities of great black-backed gull in Hornsea Three plus a 4 km buffer.

Month	Population estimates (Hornsea Three + 4 km buffer) (no. of birds)					Densities (Hornsea Three + 4 km buffer) (birds/km²)				
	Flying	On water	Combined	Upper confidence limit	Lower confidence limit	Flying	On water	Combined	Upper confidence limit	Lower confidence limit
April 2016	11	23	33	81	0	0.01	0.02	0.03	0.07	0
May 2016	22	34	55	112	10	0.02	0.03	0.04	0.09	0.01
June 2016	26	0	27	63	0	0.02	0	0.02	0.05	0
July 2016	71	59	130	281	21	0.06	0.05	0.11	0.23	0.02
August 2016	0	0	0	0	0	0	0	0	0	0
September 2016	127	83	210	403	67	0.1	0.07	0.17	0.33	0.05
October 2016	33	327	357	931	10	0.03	0.27	0.29	0.76	0.01
November 2016	232	1143	1362	2690	341	0.19	0.93	1.11	2.19	0.28
December 2016	558	675	1227	2481	443	0.45	0.55	1	2.02	0.36
January 2017	244	653	882	1923	260	0.2	0.53	0.72	1.56	0.21
February 2017	164	1110	1455	2995	382	0.13	0.9	1.18	2.43	0.31
March 2017	57	339	394	871	81	0.05	0.28	0.32	0.71	0.07
April 2017	0	45	50	123	0	0	0.04	0.04	0.1	0
May 2017	34	0	34	82	0	0.03	0	0.03	0.07	0
June 2017	70	176	247	687	0	0.06	0.14	0.2	0.56	0
July 2017	339	49	399	966	50	0.28	0.04	0.32	0.78	0.04
August 2017	44	207	245	644	0	0.04	0.17	0.2	0.52	0
September 2017	129	11	138	347	0	0.1	0.01	0.11	0.28	0
October 2017	318	801	1120	2176	348	0.26	0.65	0.91	1.77	0.28
November 2017	144	22	165	269	80	0.12	0.02	0.13	0.22	0.06

1.7 Identification of Valued Ornithological Receptors

1.7.1.1 Table 1.8 outlines the criteria used to determine the conservation value of all species relevant to Hornsea Three. Based on the information in Section 1.4 regarding the sensitivity of different species' to recognised offshore wind farm impacts, and the results presented in each species account in Section 1.6, a group of key species has been identified for Impact Assessment in Volume 2, Chapter 5: Offshore Ornithology for the Hornsea Three array area:

- Fulmar;
- Gannet;
- Arctic skua;
- Great skua;
- Puffin;
- Razorbill;
- Guillemot;
- Common tern;
- Arctic tern;
- Kittiwake;
- Little gull;
- Lesser black-backed gull; and
- Great black-backed gull.

1.7.1.2 Therefore of the species recorded at Hornsea Three during aerial surveys, red-throated diver, Cory's shearwater, Manx shearwater, storm petrel, Sandwich tern, black-headed gull, common gull and herring gull are not considered for further assessment in relation to impacts associated with the Hornsea Three array area.

1.7.1.3 In addition to the impacts that may affect birds at the Hornsea Three array area, consideration has also been given to impacts associated with the installation and maintenance of the Hornsea Three export cable and supporting infrastructure such as offshore transformer substations located along the export cable route. Based on the vulnerability of species to impacts associated with offshore wind farms (Table 1.6) and the overlap between the Greater Wash pSPA and the Hornsea Three export cable route (Table 1.7), red-throated diver, common scoter and Sandwich tern are also included in Volume 2, Chapter 5: Offshore Ornithology and assigned an International conservation value in relation to impacts from these aspects of Hornsea Three (Table 1.46).

Table 1.46: Summary of the conservation importance and peak populations of all seabird species identified for consideration as part of the Hornsea Three assessment in relation to national and regional thresholds. (Grey cells indicate seasons which are not applicable to the relevant species)[29].

Species	Conservation status	SPA connectivity	Breeding season		Post-breeding/Pre-breeding season		Non-breeding season		Conservation value	Taken forward to impact assessment?
			Peak population estimate at Hornsea Three	Population importance	Peak population estimate at Hornsea Three	Population importance	Peak population estimate at Hornsea Three	Population importance		
Common scoter	Schedule 1	Yes	Not recorded during aerial surveys of the Hornsea Three array area but may occur along the export cable route						International	Yes – SPA connectivity (direct overlap with export cable)
Red-throated diver	Annex 1	Yes	66 (May 2016)	Local	Not recorded during aerial surveys of the Hornsea Three array area but may occur along the export cable route				International	Yes – SPA connectivity (direct overlap with export cable)
Fulmar	Amber list	Yes	1,554 (August 2017)	Regional	1,347 (September 2016)	Local	450 (November 2017)	Local	International	Yes – SPA connectivity (mean-maximum foraging range). Breeding season population estimates of regional importance
Cory's shearwater	Annex 1	No			11 (July 2017)	Local	0	-	International	No - very low peak estimates, population importance thresholds unlikely to be met in any season
Manx shearwater	Amber list	No	11 (July 2016 and July 2017)	Local	179 (August 2016)	Regional	0	-	Regional	No - low peak estimates in comparison with UK breeding and wider migratory population.
European storm petrel	Annex 1	No	11 (September 2016)	Local			0	-	National	No - very low peak estimates, population importance thresholds unlikely to be met in any season
Gannet	Amber list	Yes	2,207 (August 2017)	Regional	2,638 (October 2017)	Local			International	Yes – SPA connectivity (mean-maximum foraging range). Breeding season population estimates of regional importance
Arctic skua	Red list	No	11 (July 2016 and July 2017)	Local	55 (September 2016)	Local	0	-	International	Yes - International conservation value. Migratory species with large proportion in SPAs
Great skua	Amber list	No	0	-	17 (September 2017)	Local	22 (December)	Local	International	Yes - International conservation value. Migratory species with large proportion in SPAs
Puffin	Red list	Yes	352 (May 2016)	Regional			266 (April 2016)	Local	International	Yes – SPA connectivity (maximum foraging range). Breeding season population estimates of regional importance
Razorbill	Amber list	No	736 (April 2017)	Local	4,021 (October 2017)	Local	4,976 (November 2016)	Regional	Regional	Yes – Non-breeding season population estimates of regional importance
Guillemot	Amber list	No	19,360 (June 2016)	National			26,561 (November 2017)	Regional	National	Yes – Breeding season population estimates of national importance
Little tern	Annex 1	Yes	Not recorded during aerial surveys of the Hornsea Three array area						International	No – not recorded at the array area and unlikely to occur in notable numbers along the export cable route. In addition the species is not vulnerable to impacts associated with the export cable route
Sandwich tern	Annex 1	Yes			162 (September 2017)	Local			International	Yes – SPA connectivity (direct overlap with export cable)

[29] Grey cells indicate not relevant for the species.

Species	Conservation	SPA	Breeding season		Post-breeding/Pre-breeding season		Non-breeding season		Conservation	Taken forward to impact assessment?
Common tern	Annex 1	No	0	-	1,184 (May 2017)	Local	0	-	International	Yes - International conservation value. Migratory species
Arctic tern	Annex 1	No	0	-	1,578 (May 2017)	Local	0	-	International	Yes - International conservation value. Migratory species
Kittiwake	Red list	Yes	12,551 (July 2016)	National	3,592 (December)	Local			International	Yes – SPA connectivity (tracking data). Breeding season population estimates of national importance.
Black-headed gull	Amber list	No	0	-			78 (October 2017)	Local	Local	No - peak estimates unlikely to surpass population importance thresholds
Little gull	Annex 1	No					78 (October 2017)	Local	International	Yes - International conservation value. Migratory species.
Common gull	Amber list	No	46 (July 2016)	Local			223 (October 2017)	Local	Local	No - peak estimates unlikely to surpass population importance thresholds
Lesser black-backed gull	Amber list	Yes	1,002 (June 2016)	Regional	343 (August 2017)	Local	0	-	Regional	Yes - Breeding season population estimates of regional importance
Herring gull	Red list	No	221 (June 2017)	Local			318 (December)	Local	Regional	No - peak estimates unlikely to surpass population importance thresholds
Great black-backed gull	Amber list	No	399 (July 2017)	Local			1,455 (February)	National	National	Yes – Non-breeding season population estimates of national importance

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A.1 Foraging range maps

Figure 1.36: Alongshore and seaward foraging extents of little tern from the breeding colony at Blakeney Point as presented in Parsons *et al.* (2015)

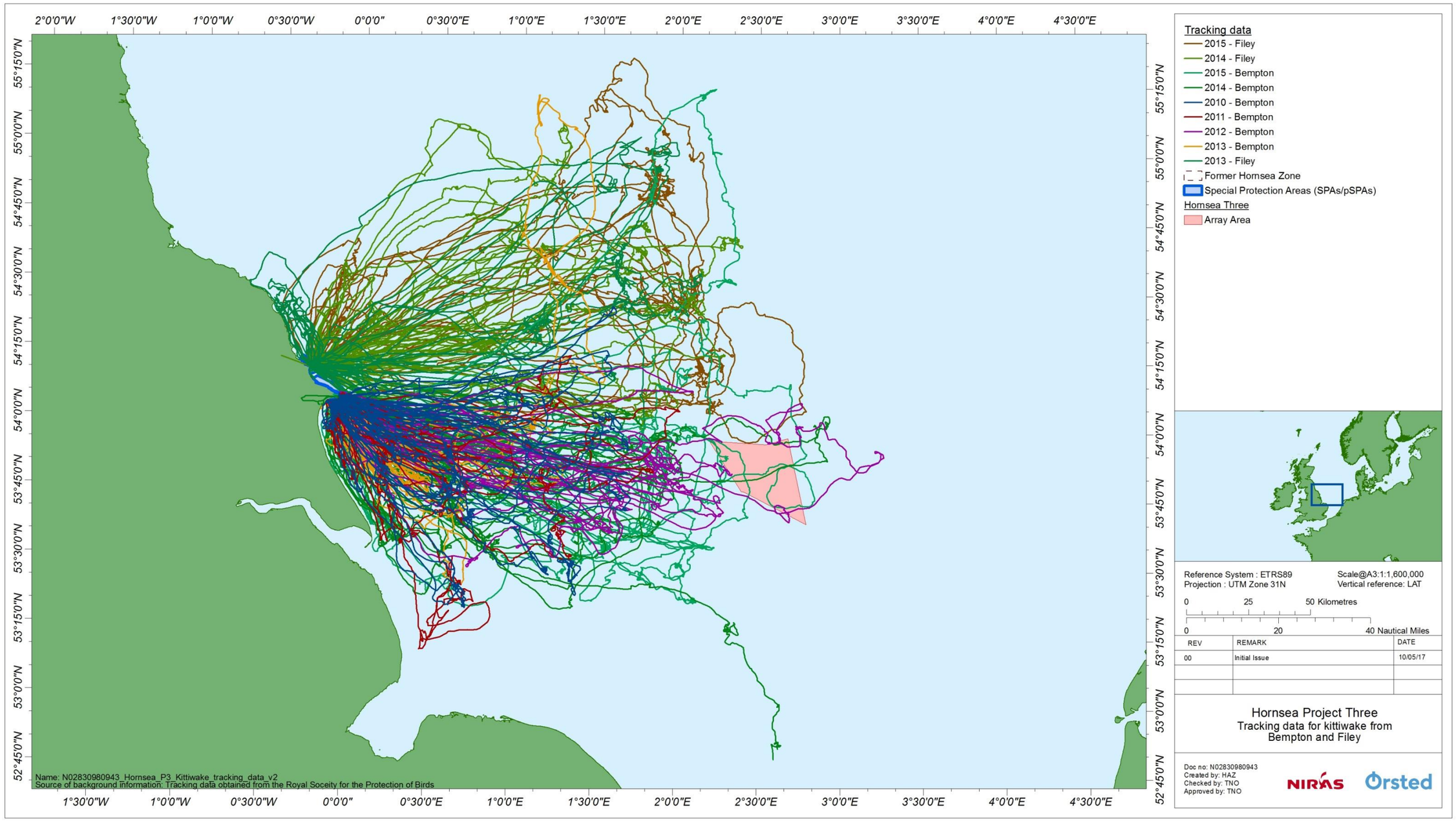

Figure 1.37: Kittiwake tracking data from the Flamborough and Filey Coast pSPA.

A.2 Predicted densities of seabirds in the North Sea (WWT Consulting and MacArthur Green, 2013)

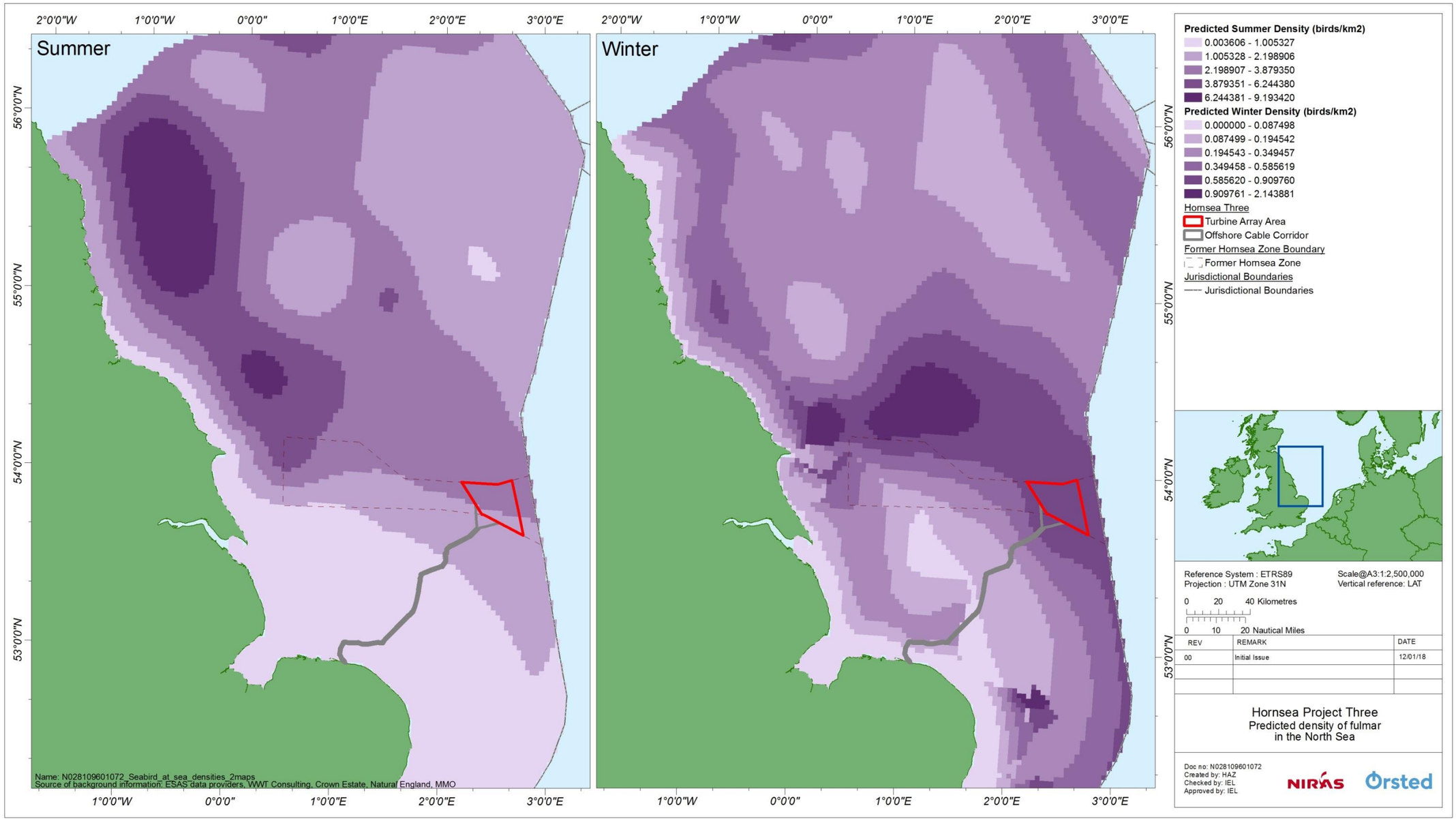

Figure 1.38: Predicted density of fulmar in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

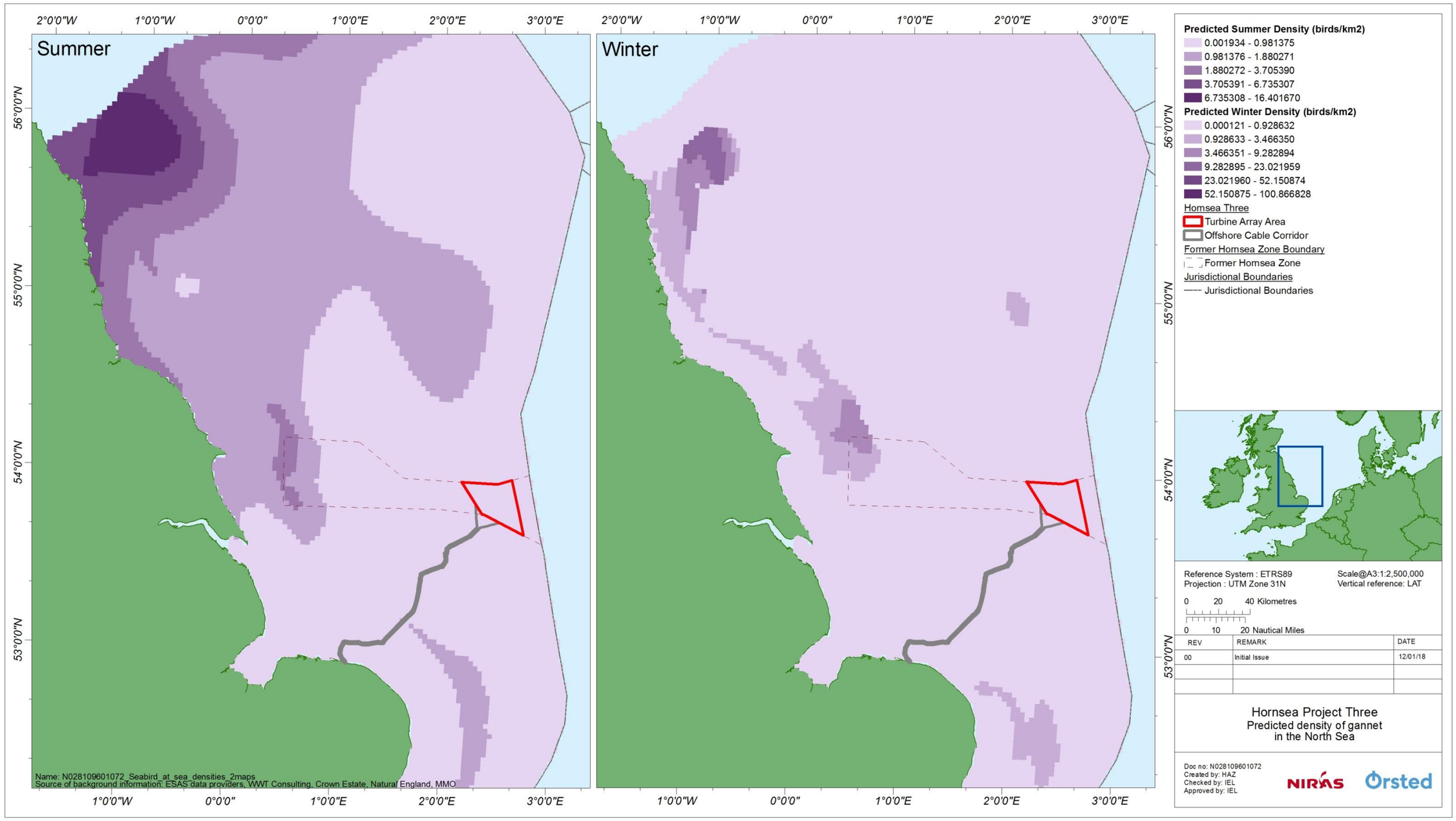

Figure 1.39: Predicted density of gannet in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

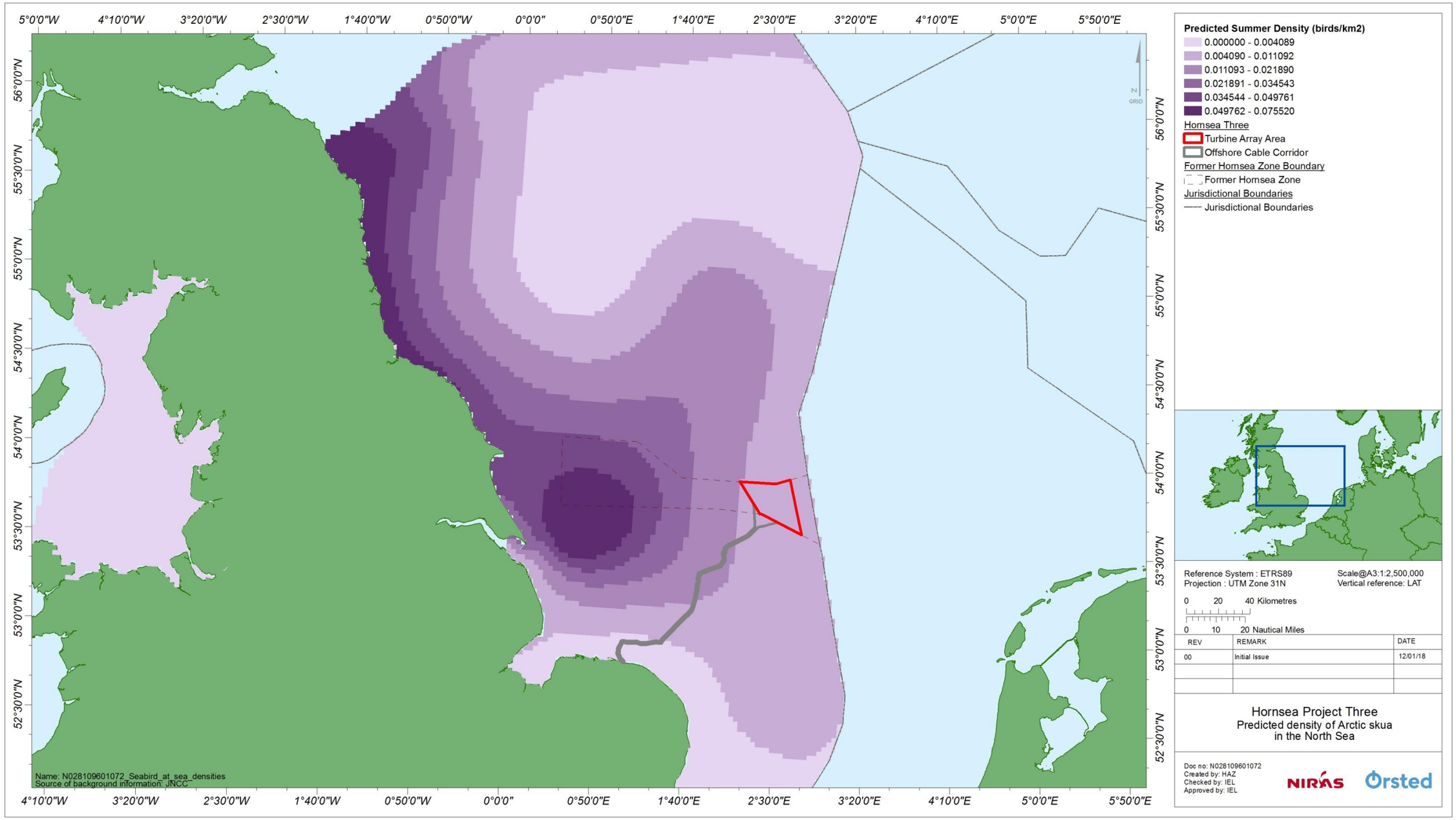

Figure 1.40: Predicted density of Arctic skua in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

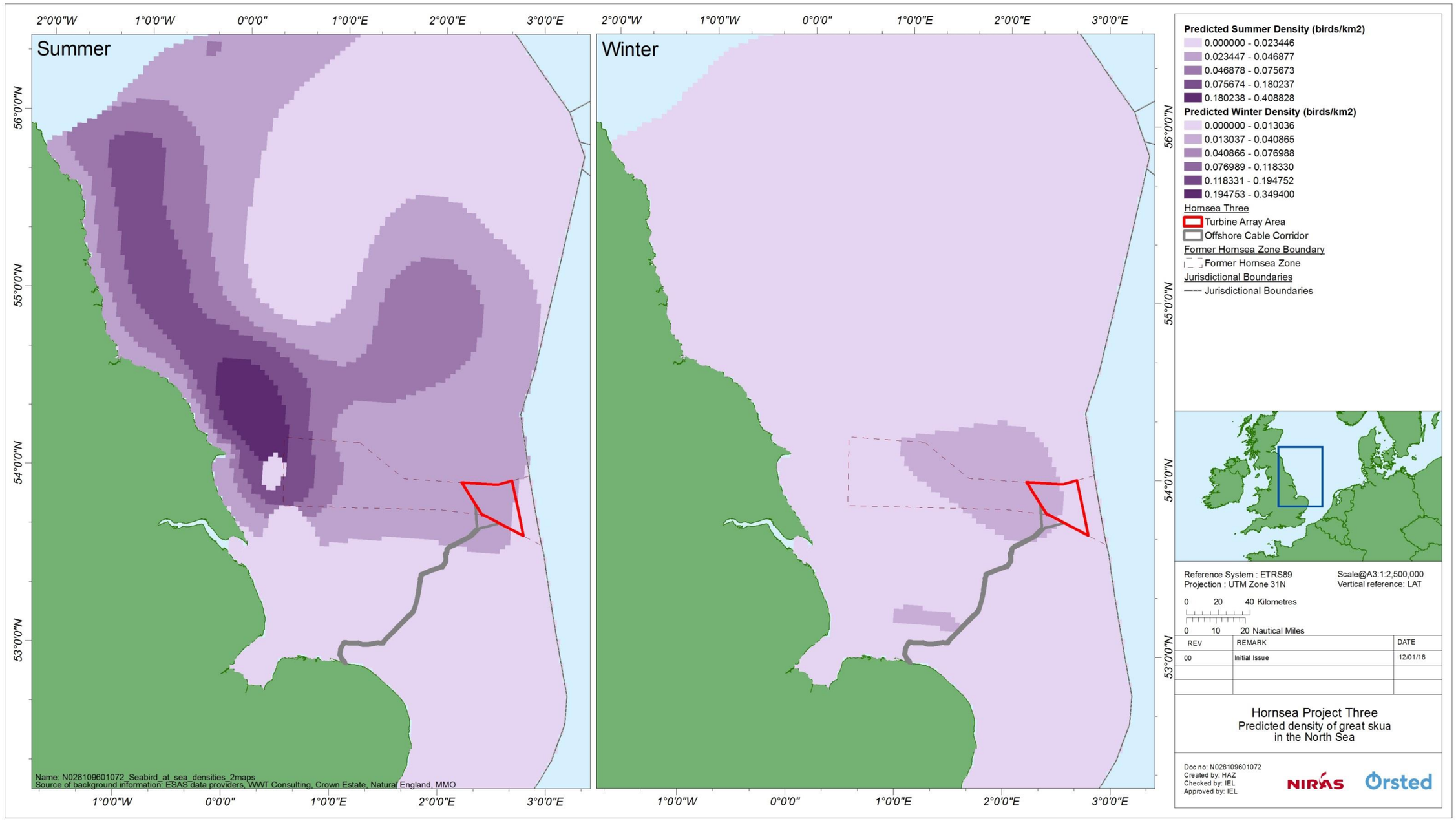

Figure 1.41: Predicted density of great skua in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

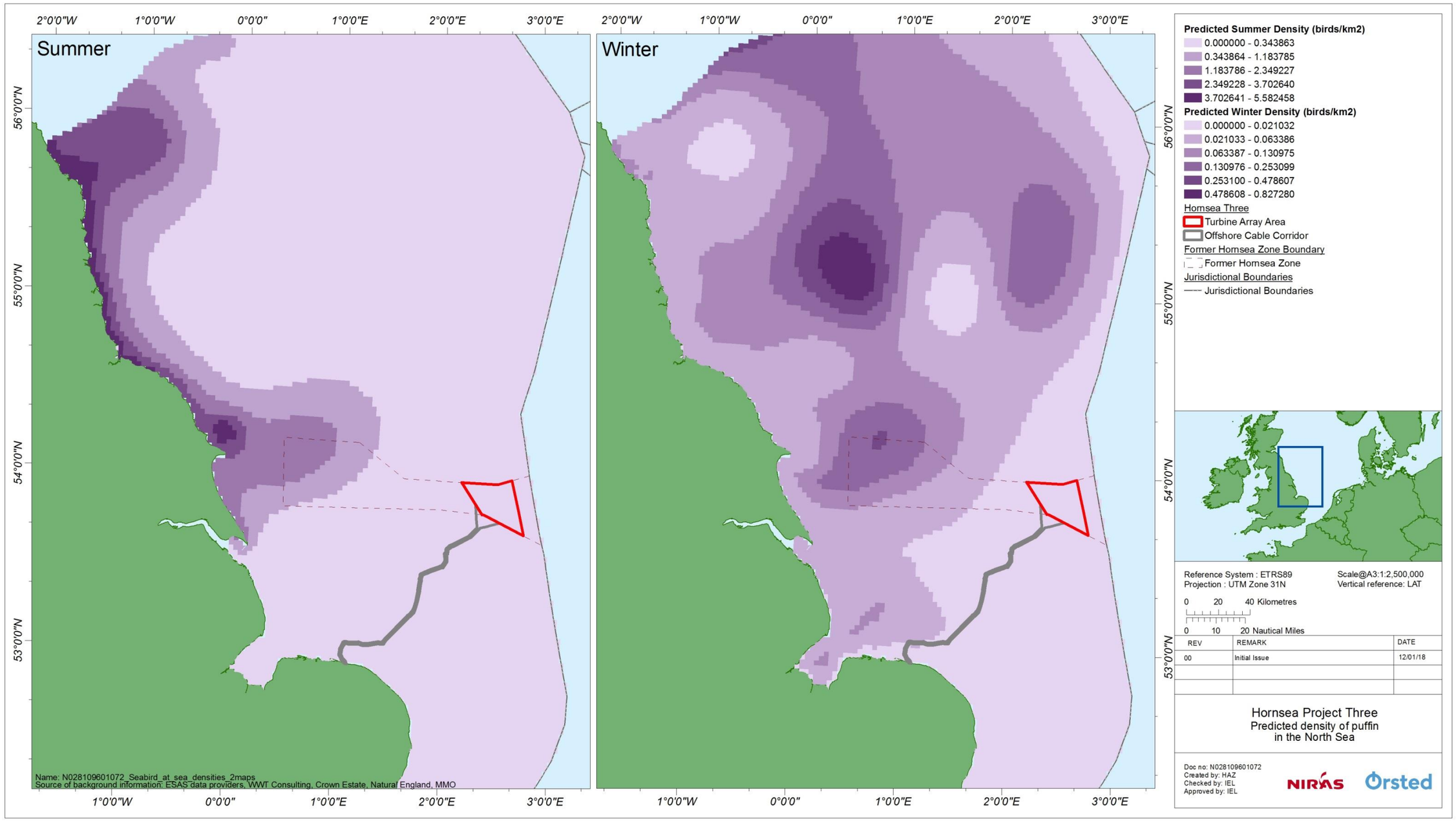

Figure 1.42: Predicted density of puffin in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

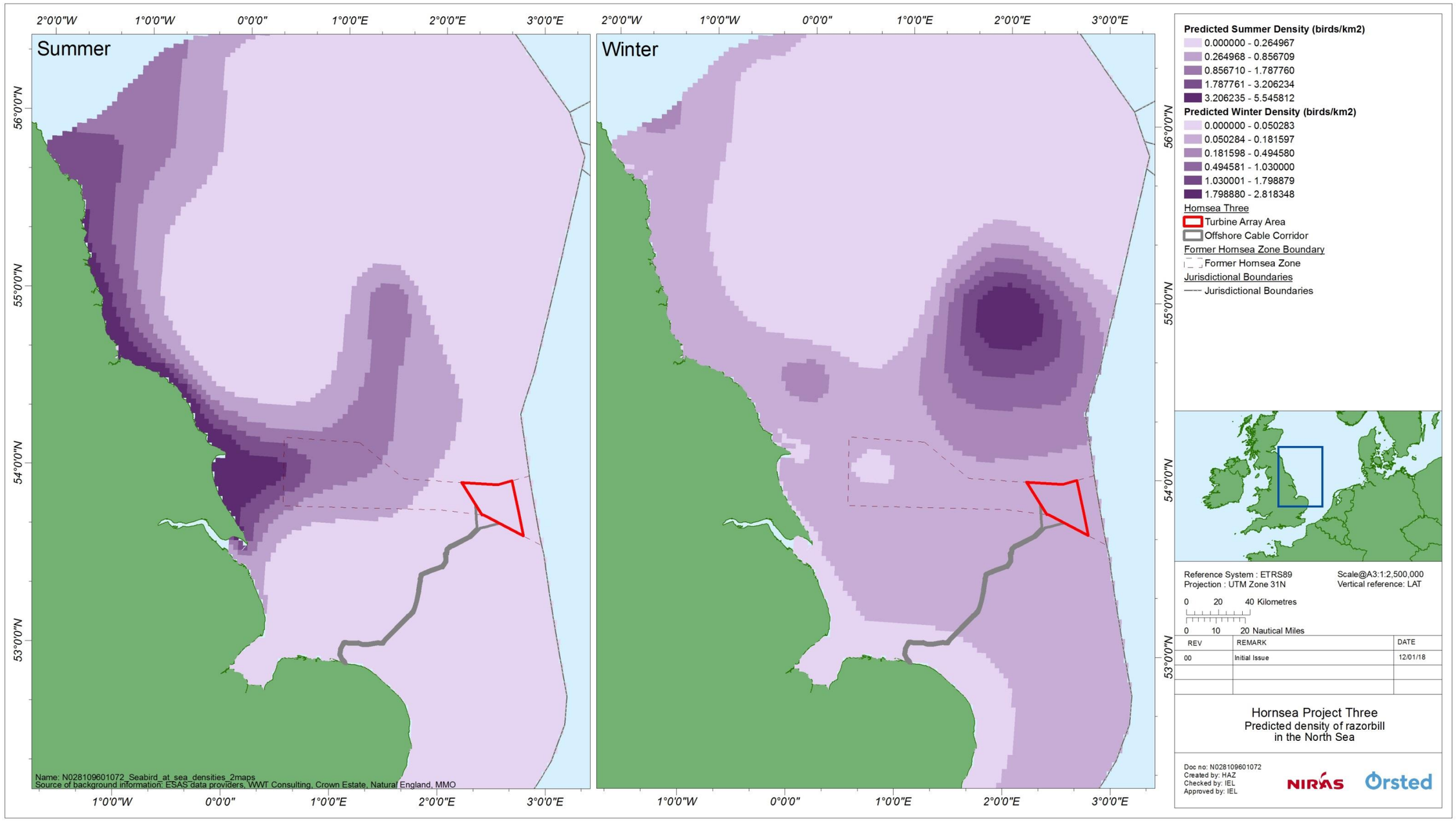

Figure 1.43: Predicted density of razorbill in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

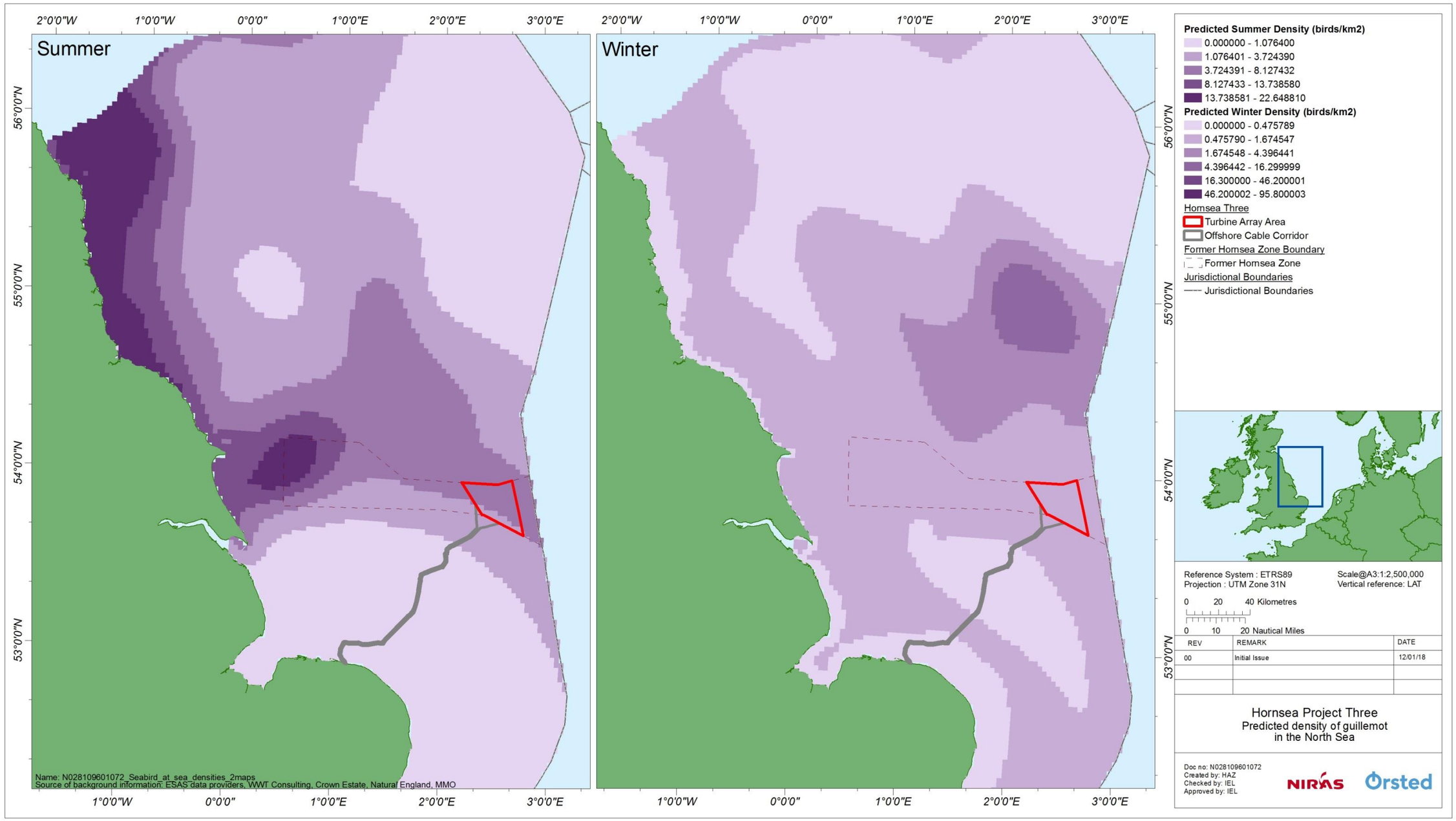

Figure 1.44: Predicted density of guillemot in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

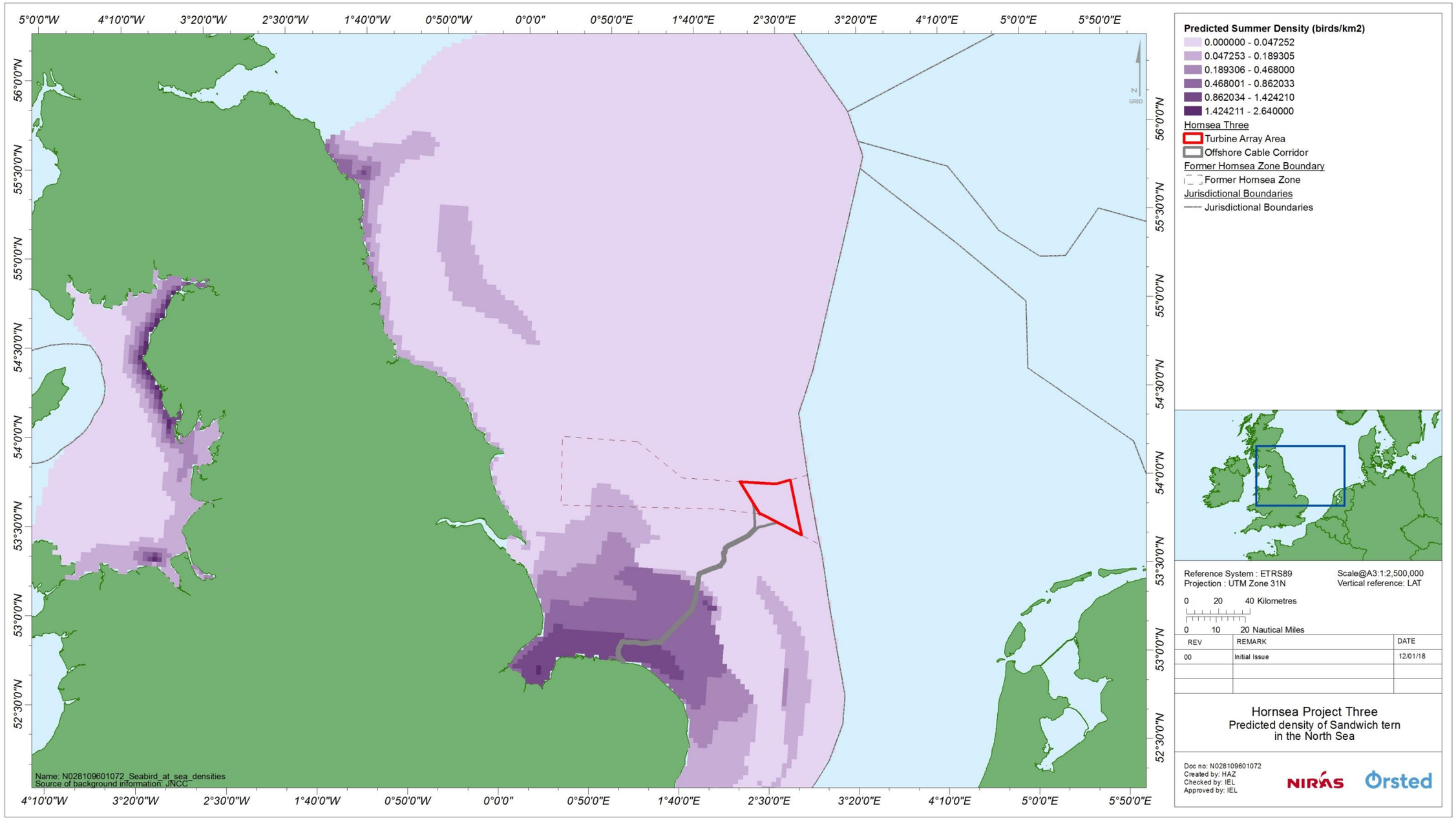

Figure 1.45: Predicted density of Sandwich tern in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

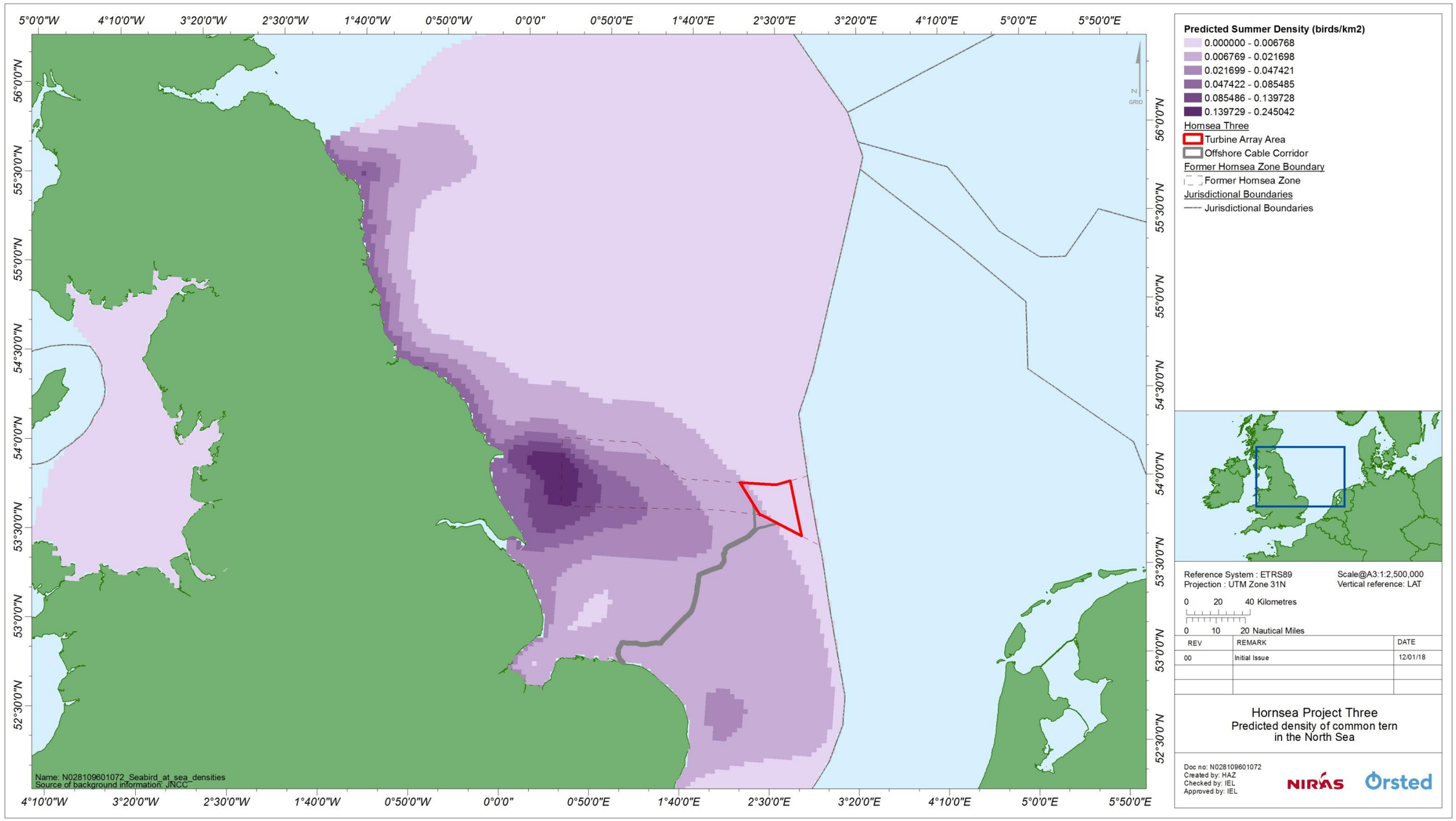

Figure 1.46: Predicted density of common tern in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

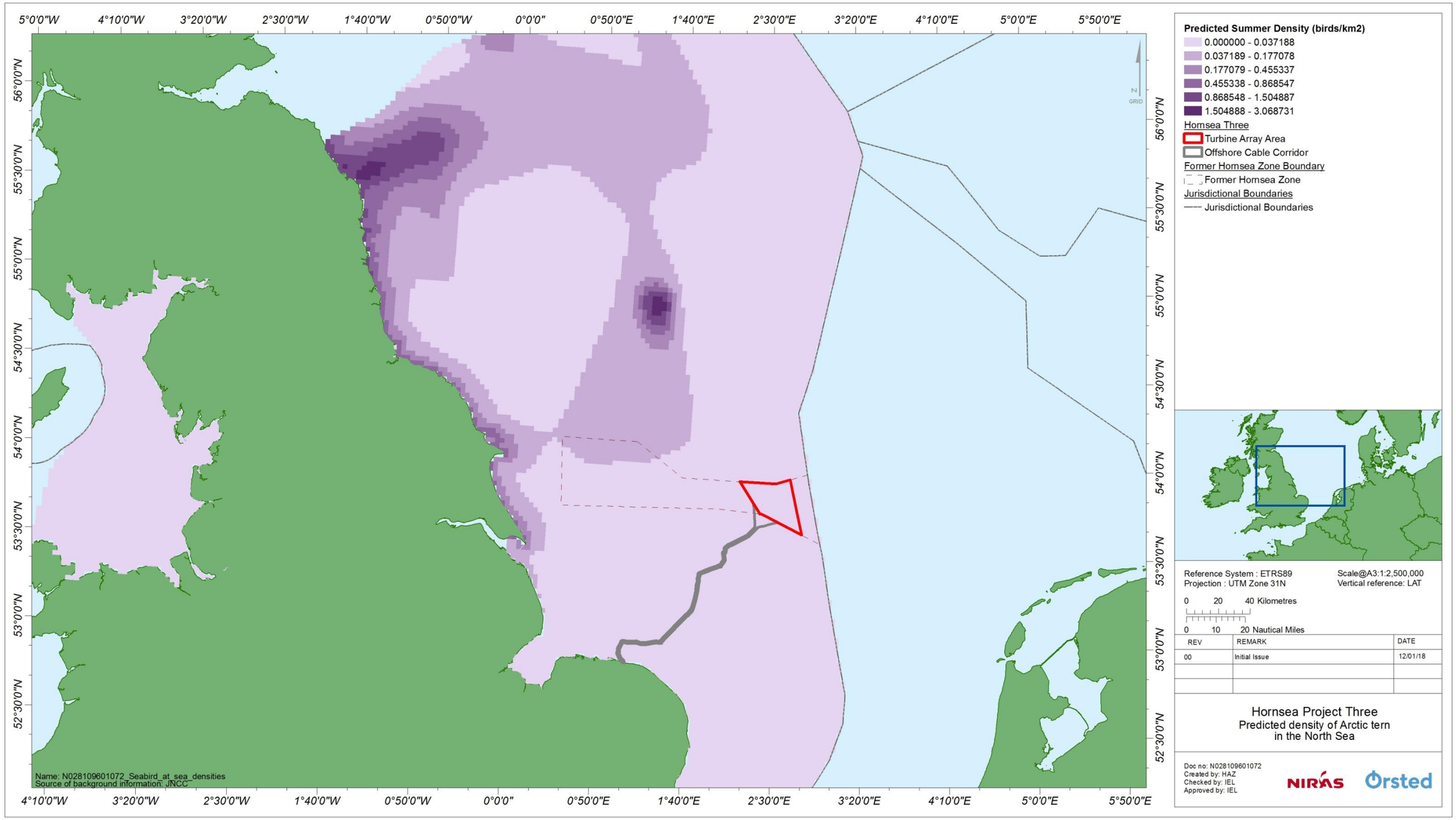

Figure 1.47: Predicted density of Arctic tern in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

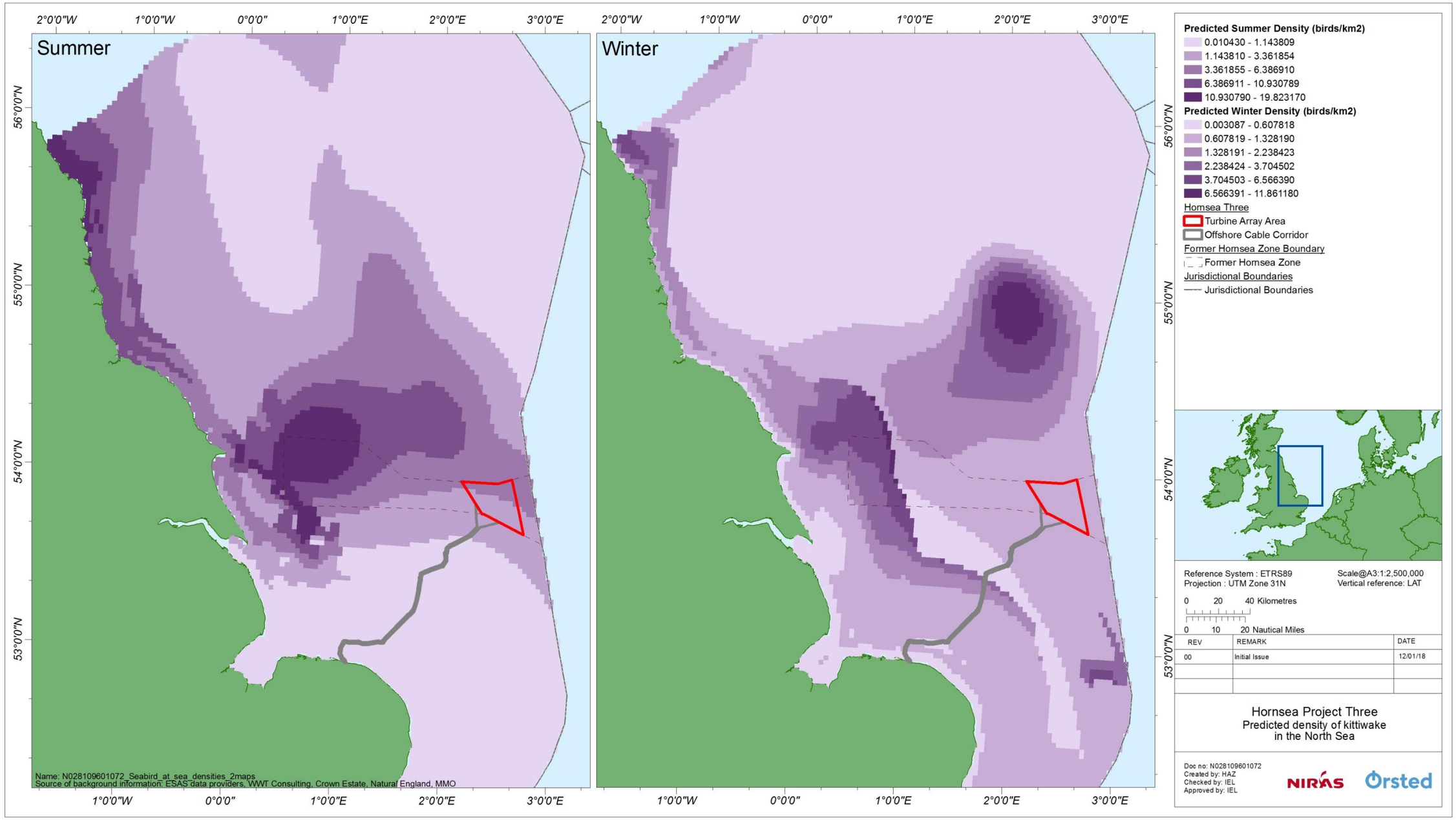

Figure 1.48: Predicted density of kittiwake in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

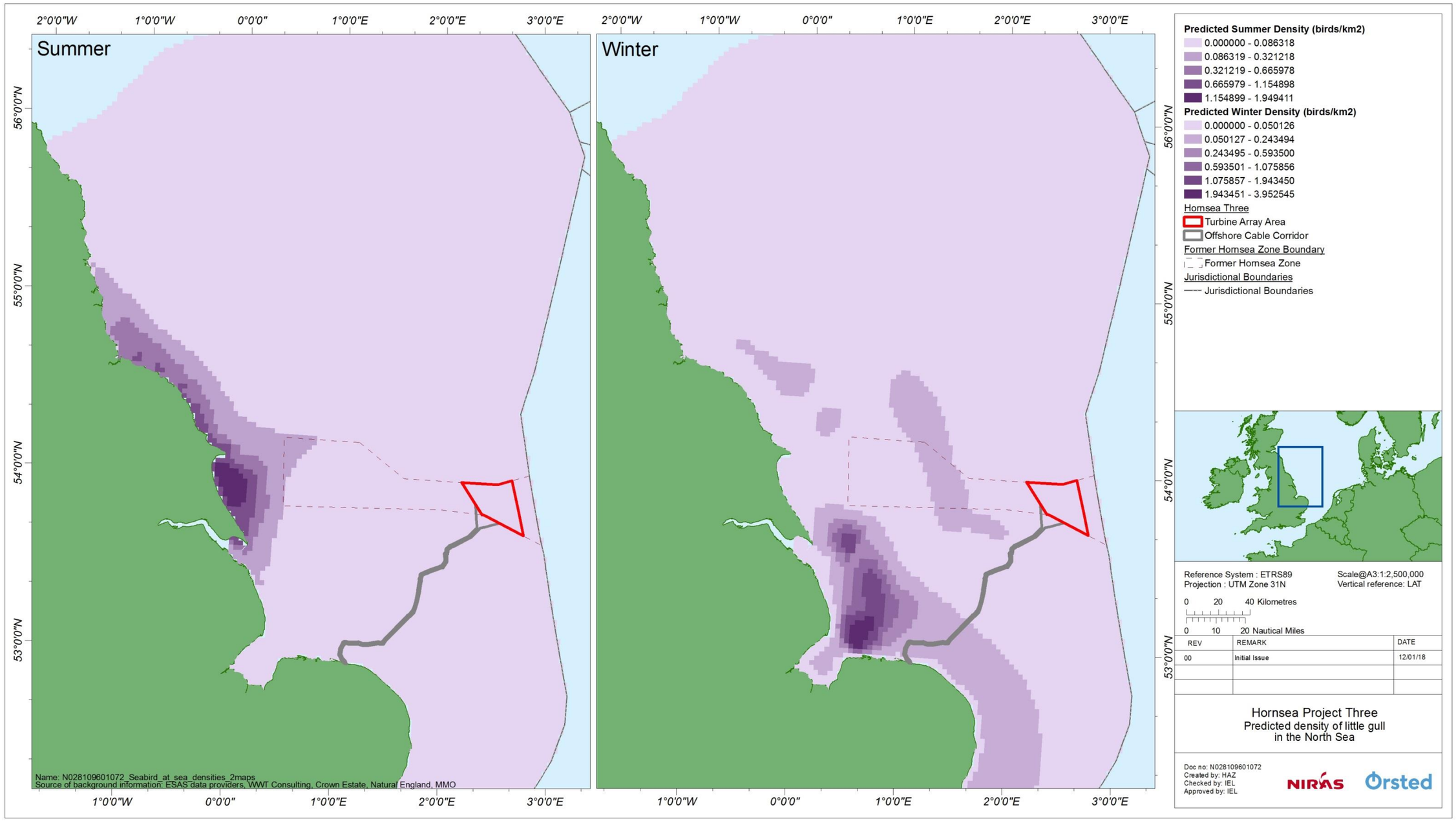

Figure 1.49: Predicted density of little gull in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

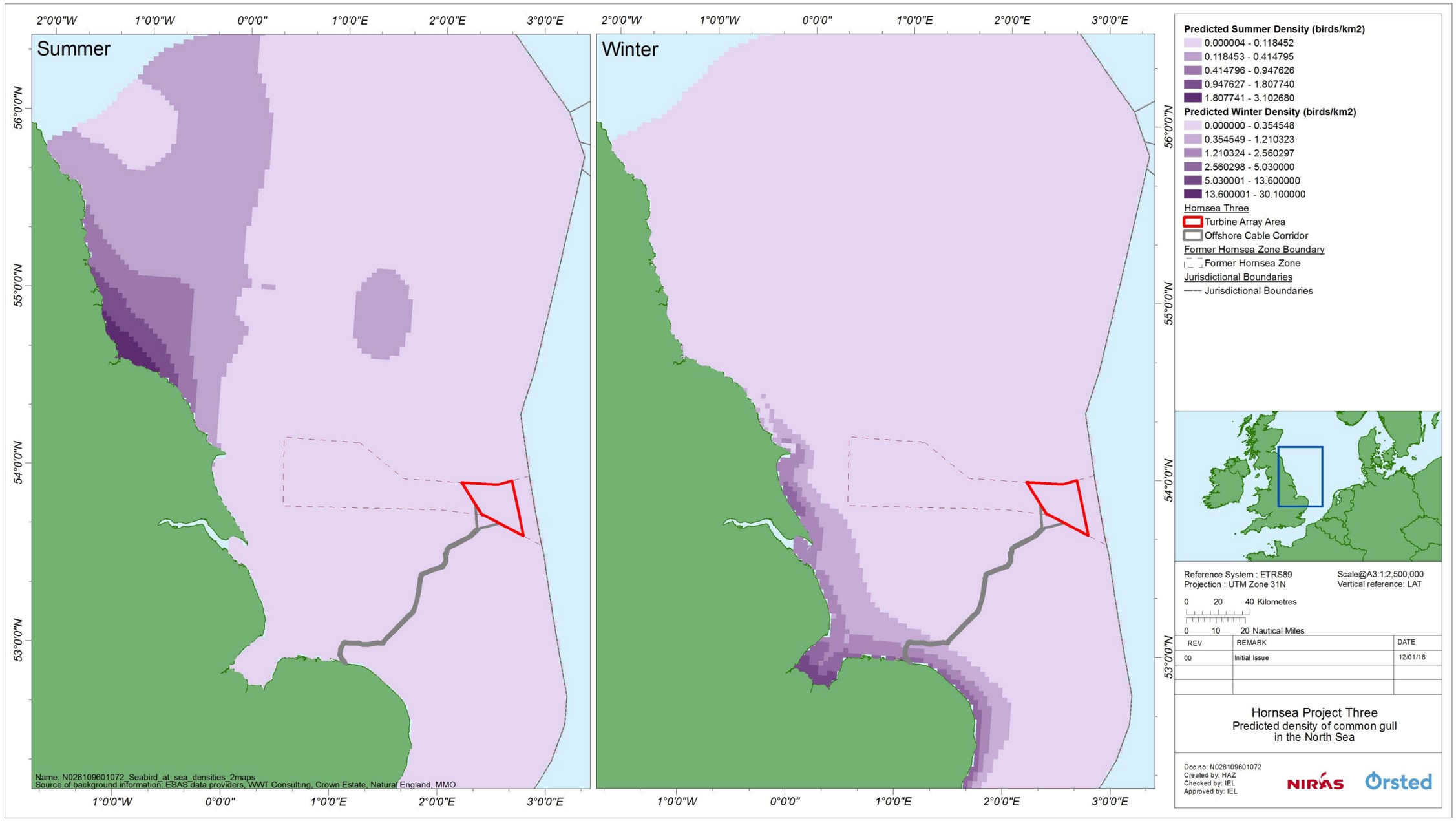

Figure 1.50: Predicted density of common gull in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

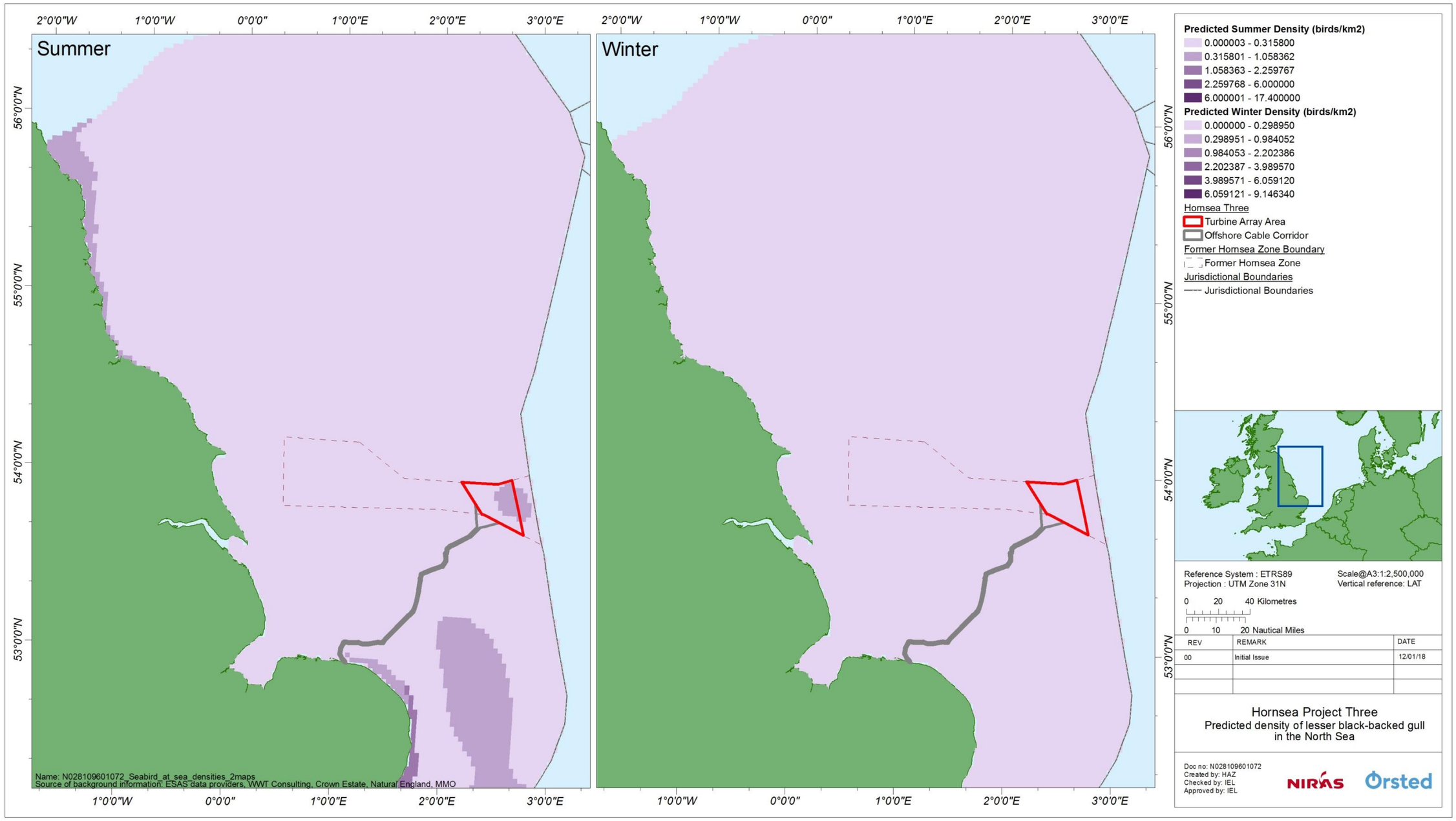

Figure 1.51: Predicted density of lesser black-backed gull in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

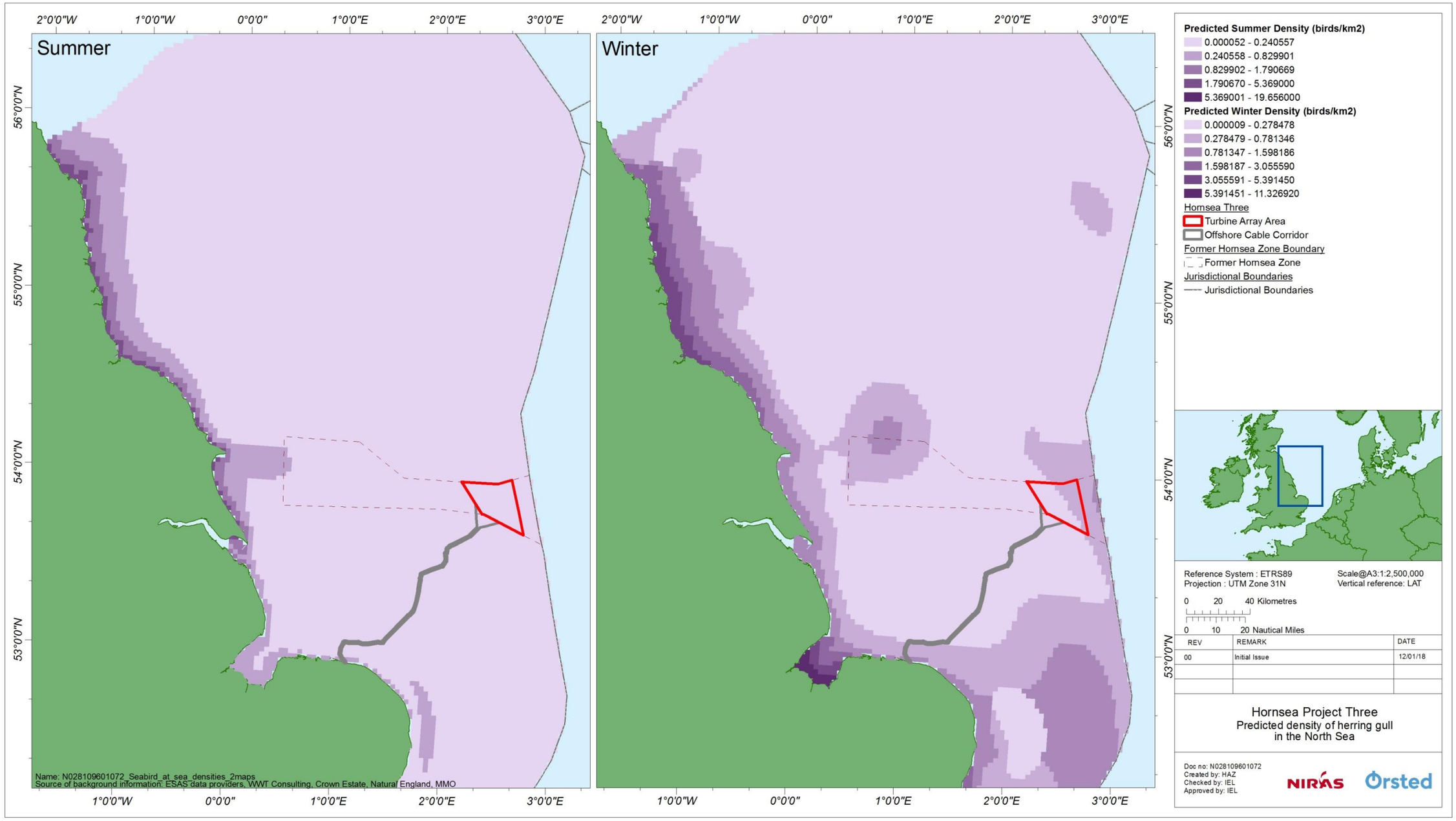

Figure 1.52: Predicted density of herring gull in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)

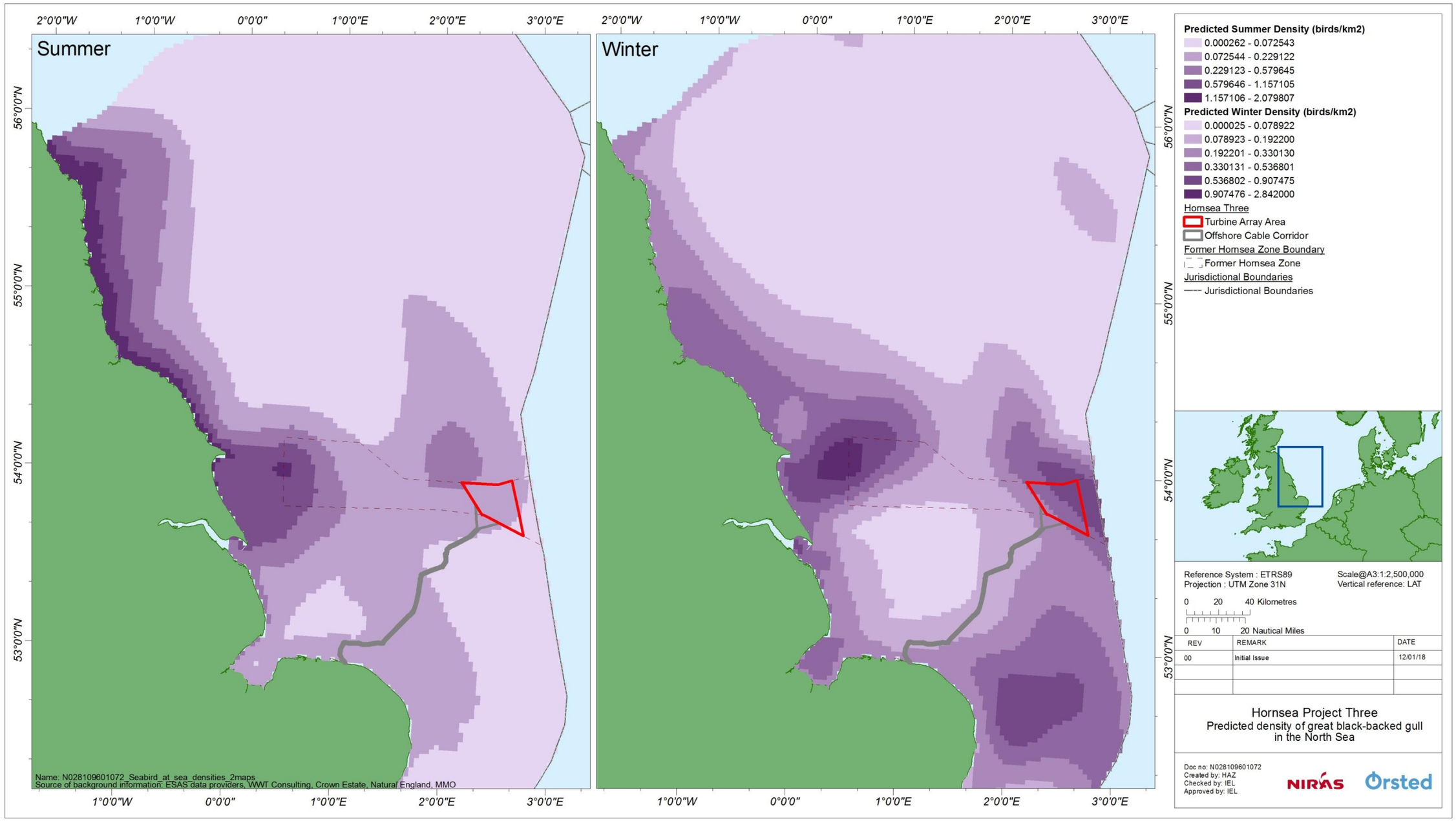

Figure 1.53: Predicted density of great black-backed gull in the summer (Apr-Sep) and winter (Oct-Mar) derived using boat-based and aerial survey data collected between 1979 and 2011 (source: data associated with WWT Consulting and MacArthur Green, 2013)