Environmental Impact Assessment Report - Volume 2B

# Appendix 11-1:
# Offshore Ornithology Technical Report

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

A TETRA TECH COMPANY

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Energy for generations

# ORIEL WIND FARM PROJECT

## Environmental Impact Assessment Report
## Appendix 11-1: Offshore Ornithology Technical Report

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# Glossary

| Term | Meaning |
|---|---|
| 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. |
| Cumulative Impacts | Impacts that result from incremental changes caused by other reasonably foreseeable actions alongside the project in question. This includes the impact of all other developments that were not present at the time of data collection. |
| Cumulative Offshore Ornithology Study Area | The Cumulative Offshore Ornithology Study Area extends up to 509.4 km around the offshore wind farm area, based on gannet mean-maximum plus one standard deviation foraging distances. The mean-maximum foraging range for gannet is the greatest of all the Annex I species selected for assessment as part of this Technical Report. |
| Displacement | In relation to offshore wind farm development, displacement refers to a reduced number of birds occurring within or immediately adjacent to an offshore wind farm. |
| Disturbance | Disturbance occurs when a bird's normal pattern of activity is interrupted by an anthropogenic activity. Individuals may choose to avoid sources of disturbance (e.g. swimming or flying away) and may not return until sometime later. |
| Habitat | The natural home or environment of an animal, plant, or other organism. |
| Louth CDP | Louth County Development Plan. |
| Migration | The regular seasonal movement, often north and south along a flyway, between breeding and wintering grounds. |
| Non-statutory stakeholder | Organisations with whom the regulatory authorities may choose to engage who are not designated in law but are likely to have an interest in a proposed development. |
| Offshore Ornithology Study Area | Defined as the extent of the Survey Area for the site-specific boat-based ornithology surveys which covers a total area of 319.85 $km^2$ and encompasses the marine habitats within the offshore wind farm area, offshore cable corridor and an additional buffer of varying extent. |
| On transect | On transect records refer to records of birds made perpendicular to the direction of travel on one side of the boat, out to 300 m. A scan surveys an arc of 90° from directly in front to one side of the vessel, recording all birds within a quadrat with sides 300 m to the front and side of the observer. Also, a "snapshot" was used for flying birds, whereby all birds in flight were recorded every minute within the 300 m quadrat, along with their estimated flight height and direction. |
| Ornithology | Ornithology is a branch of zoology that concerns the study of birds. |
| Off Transect | Records of all birds observed outside the on transect boundary as defined above for *on transect*. |
| Ramsar | International convention on wetlands of international importance. |
| Sensitivity | Vulnerability of a sensitive receptor to change. |
| Special Protection Area | A designation under the European Union Directive on the Conservation of Wild Birds. Under this Directive, Member States of the European Union (EU) have a duty to safeguard the habitats of migratory birds and threatened birds. |

# Acronyms

| Term | Meaning |
|---|---|
| AA | Appropriate Assessment |
| AIC | Akaike Information Criterion |
| ACF | Autocorrelation Function |
| AON | Apparently Occupied Nests |
| AOS | Apparently Occupied Sites |
| BoCCI | Birds of Conservation Concern in Ireland |
| BTO | British Trust for Ornithology |
| CDS/MCDS | Conventional distance sampling/ Multiple covariate distance sampling |
| CDP | County Development Plan |
| CReSS | Complex Region Spatial Smoother |
| CV | Cross Validation |
| DAERA | The Department of Agriculture, Environment and Rural Affairs |
| DAS | Digital aerial surveys |
| DCCAE | Department of Communications, Climate Action and Environment |
| DCENR | Department of Communications, Energy and Natural Resources |
| DECC | Department of the Environment, Climate and Communications |
| DEFRA | Department for Environment, Food and Rural Affairs |
| DHLGH | Department of Housing, Local Government and Heritage |
| ECHA | East Canadian High Arctic |
| EIAR | Environmental Impact Assessment Report |
| EPS | European Protected Species |
| ESAS | European Seabirds at Sea |
| EU | European Union |
| EUNIS | European Nature Information System |
| FCS | Favourable Conservation Status |
| GEE | Generalised Estimating Equations |
| GLM | General Linear Model |
| GPS | Global Positioning System |
| GSD | Ground Sample Distance |
| IND | Individuals |
| IUCN | International Union for Conservation of Nature (IUCN) |
| I-WeBS | Irish Wetland Bird Survey |
| JNCC | Joint Nature Conservation Committee |
| LCL | Lower Confidence Limit |
| LWM | Low water mark |
| MAGIC | Multi-Agency Geographic Information for the Countryside |
| MRSea | Marine Renewables Strategic Environmental Assessment R Package |
| MSL | Mean Sea Level |
| NBAP | National Biodiversity Action Plan |
| NGO | Non-government Organisation |
| NIS | Natura Impact Statement |
| NMPF | National Marine Planning Framework |
| NPWS | National Parks and Wildlife Service |
| NRW | Natural Resources Wales |

| Term | Meaning |
|---|---|
| OREDP | Offshore Renewable Energy Development Plan |
| PVA | Population Viability Analysis |
| RSPB | Royal Society for the Protection of Birds |
| QAIC | Quasi-Akaike Information Criterion |
| SAC | Special Area of Conservation |
| SALSA | Spatially Adaptive Local Smoothing Algorithm |
| SCR | Seabird Colony Register |
| SD | Standard Deviation |
| SMP | Seabird Monitoring Programme |
| SNCB | Statutory Nature Conservation Body |
| SNH | Scottish Natural Heritage, now known as NatureScot |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| UCL | Upper Confidence Limit |
| VIF | Variance Inflation Factor |
| VP | Vantage Point |
| ZoI | Zone of Impact |

## Units

| Unit | Description |
|---|---|
| cm | Centimetre (distance) |
| ° | Degrees |
| °C | Degrees Centigrade |
| ha | Hectare (area) |
| km | Kilometres (distance) |
| kph | Kilometres per hour (speed) |
| m | Metres (distance) |
| m/s | Metres per second (wind speed) |
| MW | Megawatt (power; equal to one million watts) |
| NM | Nautical Mile (distance; equal to 1.852 km) |

# 1 INTRODUCTION

## 1.1 Context

This Offshore Ornithology Technical Report provides the baseline characterisation of offshore ornithological features for the Oriel Wind Farm Project (hereafter referred to as "the Project"). This characterisation informs the baseline against which potential impacts of the Project are assessed. The remit of this report covers offshore ornithological receptors up to the Low Water Mark (LWM). Intertidal and onshore ornithology is presented in volume 2C, chapter 19: Onshore Biodiversity.

Key desktop data sources and site-specific surveys have been drawn upon to support the development of this report. A detailed desktop study of existing data sources relating to offshore ornithology interest features was conducted to provide an overview of historic datasets, allowing for identification of species populations and distributions. A review of designated nature conservation sites aided identification of areas and species of conservation importance.

This report includes data collected from the site-specific offshore boat-based seabird surveys (undertaken between May 2018 and May 2020), digital aerial bird surveys undertaken between April and September 2020 and migratory geese vantage point (VP) surveys undertaken in November 2019, December 2019 and April 2020.

The information presented here underpins the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). It is recommended that this Technical Report is read in-conjunction with chapter 11: Offshore Ornithology.

## 1.2 Project location

The offshore wind farm area is located in the Irish Sea, off the coast of County Louth (approximately 22 km east of Dundalk town centre and 18 km east of Blackrock) (Figure 1-1). The closest wind turbine will be approximately 6 km from the closest shore on the Cooley Peninsula. The offshore cable corridor extends approximately 11 km southwest from the offshore wind farm area to the landfall south of Dunany Point. The onshore cable route extends for approximately 20.1 km to a substation location east of Ardee.

## 1.3 Aim and structure

This report provides the baseline characterisation of ornithological features within the defined Offshore Ornithology Study Area (as described in section 3) with the results of both the desk-based data review and site-specific surveys. This report aims to:

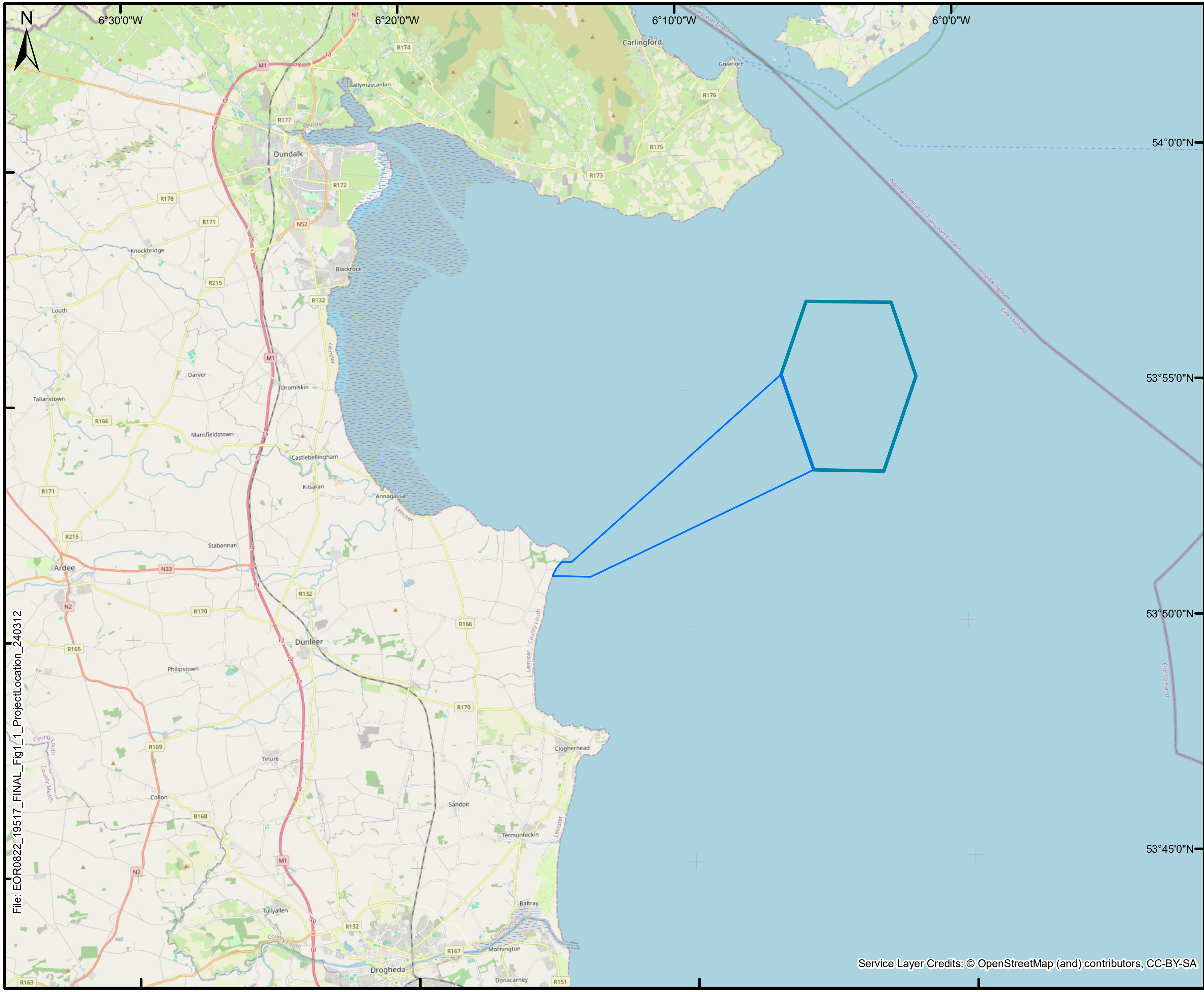
- Collate all available ornithological data to date for the Project, and provide a baseline description of the ornithological features present within the offshore wind farm area and offshore cable corridor; and
- Establish the ornithological importance of the offshore wind farm area for breeding, wintering and migratory birds through analysis of site survey data and other available data sources identified through consultation (as discussed in section 5).

This report is structured as follows:

1. Introduction;
2. Relevant Legislation and Guidance;
3. Study Area;
4. Methodology: including desk-based, site survey methods and data interpretation methods;

5. Baseline environment: including regional review, identification of designated sites, description of desk-based data and recent seabird population trends, site-specific survey data and modelling, and individual species accounts; and

6. References.

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**Legend**

- Offshore Wind Farm Area
- Offshore Cable Corridor

**Data Sources:** Client,

Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

## Oriel Wind Farm Project

Title

# Figure 1-1
# Project Location


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*Issue Details*

| | |
|---|---|
| **Drawn By:** NG | **Project No.** EOR0822 (MDR1520B) |
| **Checked By:** NG | **File Ref:** |
| **Approved By:** AOS | EOR0822_ORN_T_19517_FINAL |
| **Scale:** 1:200,000 @ A4 | **Projection:** |
| **Date:** 12/03/2024 | ITM (IRENET95) Geographic Co-ordinates: ETRS89 |

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# 2 RELEVANT LEGISLATION AND GUIDANCE

The following section provides an overview of the relevant legislation and guidance in Ireland in relation to assessing potential impacts on offshore ornithology receptors. Planning policy on renewable energy infrastructure is presented in volume 2A, chapter 2: Policy and Legislation of the EIAR.

## 2.1 European legislation and policy

### Habitats Directive

The Council Directive 92/43/EEC (the Habitats Directive) was adopted in 1992, providing a means for the European Union (EU) to meet its obligations under the Bern Convention. The aim of the Directive is to maintain or restore natural habitats and wild species listed on the Annexes at a favourable conservation status.

This protection is granted through the designation of European Sites and European Protected Species (EPS). In Ireland, the Habitats Directives were adopted in 1992, came into force in 1994 and were transposed into Irish law in 1997 as the Wildlife Act 1976 (as amended) and the European Communities (Natural Habitats) Regulations 1997. There have been several amendments to both the 1976 Act and the 1997 Regulations. This includes the European Communities (Birds and Natural Habitats) Regulations 2011 (which has also been amended, most recently in 2021). There are other related regulations including, the European Communities (Water Policy) Regulations 2003 (as amended in 2005), the European Communities (Birds and Natural Habitats) (Restrictions of the Use of Poison Bait) Regulations 2010 and the European Communities (Birds and Natural Habitats) (Control of Recreational Activities) Regulations 2010. Collectively these regulations can be referred to as the “Birds and Natural Habitats Regulations”.

Articles 6(3) and 6(4) of the Habitats Directive set out the decision-making tests for plans and projects likely to have a significant effect on or to adversely affect the integrity of European sites (Annex 1.1). Article 6(3) establishes the requirement for Appropriate Assessment (AA):

“*Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site’s conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public*.”

Article 6(4) states:

“*If, in spite of a negative assessment of the implications for the [European] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted*.”

### Birds Directive

The European Directive (2009/147/EC) on the conservation of wild birds (The Birds Directive) provides a framework for the conservation and management of wild birds within Europe. The Directive affords rare and vulnerable species listed under Annex I of the Directive, and regularly occurring migratory species, protection through the identification and designation of Special Protection Areas (SPAs). The Birds Directive is transposed into Irish law by the Birds and Natural Habitats Regulations. Sites which have been proposed by National Parks and Wildlife Service (NPWS) to be SPAs but are not officially designated are known as Candidate SPA (cSPA), these sites have the same protection as officially designated SPAs.

A programme to identify and designate SPA sites under Article 4 of the Birds Directive has been in place in Ireland since 1985, supporting the identification and classification of 167 SPAs, covering a total area of approximately 5,971 km$^2$ (NPWS, 2022). As of October 2022, 154 of these 167 SPAs have been protected by Statutory Instrument, which is the final step of the designation process.

**Table 2-1: Summary of European policy provisions relevant to offshore ornithology.**

| Policy | Summary |
|---|---|
| **Ornithology** | |
| Birds and Habitats Directive | The Birds Directive provides a general level of protection for all wild bird species which naturally occur in the EU. The most relevant provisions of the Directive to the Project are the identification and classification of SPAs for those species listed under Annex I of the Directive and for all regularly occurring migratory species (Article 4). The Directive also provides a general level of protection for all wild bird species in the EU (Article 5). The Directive requires national Governments to establish SPAs for the conservation of species where the Directive applies. |

### Ramsar Convention

The Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (also known as the Convention on Wetlands or Ramsar Convention) is an intergovernmental treaty which provides a framework for wetland conservation and wise use. Ramsar sites are designated under this convention for their international importance for containing representative, rare or unique wetland types or due to their importance in conserving biological diversity.

The Convention covers three main 'pillars' of activity:

- Designation of wetlands of international importance as Ramsar sites;
- Promotion of wise use of all wetlands in the territory of each country; and
- International co-operation to support wise use of wetlands and their resources.

A key criterion for 'international importance' is if the site regularly (period of five years) holds 1% of the biogeographic population of a species or 20,000 individuals. There are currently 45 Ramsar sites covering an area of 670 km$^2$ within Ireland (Ramsar, 2022).

## 2.2 National policy

National biodiversity policy is contained within the National Biodiversity Action Plan (NBAP). Ireland's fourth iteration of the action plan (2023-2030) was published in January 2024 and provides the policy basis to biodiversity objectives/targets (Government of Ireland, 2024).

National planning policy, specifically in relation to offshore ornithology, is contained in the National Marine Planning Framework (NMPF) (Department of Housing, Local Government and Heritage (DHLGH), 2021), Ireland's first national marine spatial plan. The NMPF is supported and further developed by a sectoral spatial plan for offshore renewables; the Offshore Renewable Energy Development Plan II (OREDP II) (Department of the Environment, Climate and Communications (DECC, 2022)). OREDP II follows on from the OREDP I, which primarily focused on fixed-bottom wind turbines in relatively shallow waters (< 70 m) (Department of the Communications, Energy and Natural Resources (DCENR), 2014).

In February 2023, the 'OREDP II - National Spatial Strategy for the transition to the Enduring Regime' was published in draft and subject to consultation. The draft OREDP II does not define specific provision similar to OREDP I. The key objectives of OREDP II are:

- *"Assess the resource potential for ORE in Ireland's maritime area.*
- *Provide an evidence base to facilitate the future identification of Broad Areas of Interest most suitable for the sustainable deployment of ORE in Ireland's maritime area*
- *Identify critical gaps in marine data or knowledge and recommend prioritised actions to close these gaps"*

When published, the OREDP II will update the original OREDP published in 2014, therefore the policy framework proposed within OREDP I is still relevant at the time of writing. A summary of the national policy provisions relevant to offshore ornithology are provided in Table 2-2 and Table 2-3.

**Table 2-2: Summary of OREDP I policy framework provisions relevant to offshore ornithology.**

| Policy | Summary |
|---|---|
| **Marine ornithology** | |
| Physical disturbance and displacement | Site-specific surveys to identify key breeding and foraging sites, moulting and migration. Avoid sensitive sites where possible and avoid undertaking potentially disturbing activities during sensitive seasons. |
| Collision risk | Reduce risks through appropriate siting of developments and orientation of turbine rows. |
| Barrier to movement | Avoid large installations in migration corridors. |

**Table 2-3: Summary of overarching marine plan policies from the NMPF relevant to offshore ornithology.**

| Policy | Summary |
|---|---|
| **Biodiversity** | |
| Policy 1 | Proposals incorporating features that enhance or facilitate species adaptation or migration, or natural native habitat connectivity will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals that may have significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity must demonstrate that they will, in order of preference and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate<br>significant adverse impacts on species adaptation or migration, or on natural native habitat connectivity. |
| Policy 2 | Proposals that protect, maintain, restore and enhance the distribution and net extent of important habitats and distribution of important species will be supported, subject to the outcome of statutory environmental assessment processes and subsequent decision by the competent authority, and where they contribute to the policies and objectives of this NMPF. Proposals must avoid significant reduction in the distribution and net extent of important habitats and other habitats that important species depend on, including avoidance of activity that may result in disturbance or displacement of habitats. |
| Policy 3 | Where marine or coastal natural capital assets are recognised by Government:<br>• Proposals must seek to enhance marine or coastal natural capital assets where possible.<br>• Proposals must demonstrate that they will in order of preference, and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate<br>significant adverse impacts on marine or coastal natural capital assets, or<br>d) if it is not possible to mitigate significant adverse impacts on marine or coastal natural capital assets proposals must set out the reasons for proceeding. |
| Policy 4 | Proposals must demonstrate that they will, in order of preference and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate significant disturbance to, or displacement of, highly mobile species. |
| **Protected Marine Sites** | |
| Policy 1 | Proposals must demonstrate that they can be implemented without adverse effects on the integrity of Special Areas of Conservation (SACs) or Special Protection Areas (SPAs). Where adverse effects from proposals remain following mitigation, in line with Habitats Directive Article 6(3), consent for the proposals cannot be granted unless the prerequisites set by Article 6(4) are met. |

| Policy | Summary |
|---|---|
| Policy 2 | Proposals supporting the objectives of protected marine sites should be supported and:<br>• be informed by appropriate guidance<br>• must demonstrate that they are in accordance with legal requirements, including statutory advice provided by authorities relevant to protected marine sites. |
| Policy 4 | Until the ecological coherence of the network of protected marine sites is examined and understood, proposals should identify, by review of best available evidence (including consultation with the competent authority with responsibility for designating such areas as required), the features, under consideration at the time the application is made, that may be required to develop and further establish the network. Based upon identified features that may be required to develop and further establish the network, proposals should demonstrate that they will, in order of preference, and in accordance with legal requirements:<br>a) avoid,<br>b) minimise, or<br>c) mitigate<br>significant impacts on features that may be required to develop and further establish the network, or<br>d) if it is not possible to mitigate significant impacts, proposals should set out the reasons for proceeding. |
| **Non-indigenous Species** | |
| Policy 1 | Reducing the risk of the introduction and / or spread of non-indigenous species is a requirement of all proposals. Proposals must demonstrate a risk management approach to prevent the introduction of and / or spread of non-indigenous species, particularly when:<br>a) moving equipment, boats or livestock (for example fish or shellfish) from one water body to another,<br>b) introducing structures suitable for settlement of non-indigenous species, or the spread of non-indigenous species known to exist in the area of the proposal. |

## 2.3 Regional policy

Louth County Council adopted the local development plan in November 2021. Relevant policies to the protection of biodiversity within Chapter 8 (natural heritage, biodiversity and green infrastructure) of the Louth County Development Plan (CDP) (2021-2027) are listed in Table 2-4.

**Table 2-4: Summary of Louth CDP (2021-2027) policies relevant to biodiversity.**

| Policy | Summary |
|---|---|
| **International, EU and Irish Policy on Biodiversity** | |
| Policy NBG2 | To promote and implement the objectives of the *Louth Biodiversity Action Plan 2021-2026* and any subsequent Biodiversity Action Plan adopted during the lifetime of this Plan. |
| **European Sites in County Louth** | |
| Policy NBG3 | To protect and conserve Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated under the EU Habitats and Birds Directives. |
| Policy NGB4 | To ensure that all proposed developments comply with the requirements set out in the DECLG "*Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities 2010*" |
| Policy NGB5 | To ensure that no plan, programme, or project giving rise to significant cumulative, direct, indirect or secondary impacts on European sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan, either individually or in combination with other plans, programmes or projects. |
| Policy NGB6 | To ensure a screening for Appropriate Assessment (AA) on all plans and projects and or Stage 2 Appropriate Assessment (Natura Impact Report/ Natura Impact Assessment) where appropriate, is undertaken to make a determination. European Sites located outside of the County but within 15 km of the proposed development site shall be included in such screenings as should those to which there are pathways, for example, hydrological links for potential effects. |
| Policy NGB7 | To co-operate with the Regional Planning Assembly and adjoining local authorities, public agencies and community interests to protect regionally significant heritage assets, environmental quality, and to identify threats to existing environmental quality in a transboundary context throughout the region including Northern Ireland. |

| Policy | Summary |
|---|---|
| **Protected Species** | |
| Policy NGB8 | To consult with the National Parks and Wildlife Service, taking account of their views and any licensing requirements, when undertaking, approving or authorising development, which is likely to affect plant, bird or other animal species protected by law. |
| **Protecting Biodiversity Value in Non-Designated Sites** | |
| Policy NGB9 | To ensure that proposals for development, where appropriate, protect and conserve biodiversity sites outside designated sites and require an appropriate level of ecological assessment by suitably qualified professionals to accompany development proposals likely to impact on such sites. |
| Policy NGB10 | To ensure that development proposals, where relevant, improve the ecological coherence of the Natura 2000 Network of European Sites and encourage the retention and management of landscape features as per Article 10 of the Habitats Directive. |
| Policy NGB11 | Where feasible, ensure that no ecological networks, or parts thereof, which provide significant connectivity between areas of local biodiversity, are lost without remediation as a result of implementation of this Plan. |

## 2.4 Relevant guidance

The Irish Government adopted the OREDP I in February 2014, which aims to 'harness market opportunities, increase awareness of the benefits of offshore renewable energy and ensure that development does not unacceptably impact Ireland's rich marine environment' (DCENR, 2014). An update, OREDP II, was published in draft in February 2023 and is subject to consultation at the time of writing. The currently available documentation on OREDP II does not present any new guidance on how to undertake surveys, assessment or mitigation, therefore guidance within OREDP I is still relevant.

The guidance outlined in Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects (DCCAE, 2018) supports the Guidance on EIS and NIS Preparation for Offshore Renewable Energy Projects (DCCAE, 2016). A summary of the guidance relevant to offshore ornithology is presented in Table 2-5.

There is additional guidance available for the UK's government and Statutory Nature Conservation Bodies (SNCB), the recent advice published was by Natural England in July 2022 (Natural England, 2022) and NatureScot in January 2023 (NatureScot, 2023a). These documents have been reviewed considering this application.

**Table 2-5: Guidance on marine baseline ecological assessments and monitoring activities for offshore renewable energy projects.**

| Guidance area | Summary |
|---|---|
| **Pre-construction baseline survey methods** | **Offshore surveys (>2 km from shore):** Via boat/aerial/high-definition videography transect surveys (line/point/strip) following European Seabirds at Sea (ESAS) survey methodology and conventional distance sampling (CDS/MCDS) using recommended software (Distance, MRSea, GLM, design-based methods) and recording additional data (e.g. behaviour, flight height) as appropriate.<br>**Near shore (<2 km from shore):** Vantage point watches with timed scans of defined count units (no standard methodology available) and recording additional data (e.g. behaviour, flight height, dive direction and location) as appropriate. Record radial distance and angle to observations (analysis with R package nupoint) where possible.<br>**Extent:** Impact area and buffer zone around this area.<br>**Duration:** If no previous data available for the area, a minimum of three years of baseline data should be collected; reduced survey years (2 years) depending on sensitivity of site and availability of existing data.<br>**Boat/aerial surveys:** Monthly as weather allows otherwise covering each "marine bird survey period". |
| **Potential impacts** | Direct impacts are disturbance, displacement, attraction, collision (above and below water), entrapment and barrier effects. Indirect impacts are changes in sedimentary process, pollution, |

| Guidance area | Summary |
|---|---|
| | predation (use of devices as land bridges by predators) and displaced fishing effort with implications for foraging resources (positive and negative). |
| **Cumulative effects** | To support development of cumulative effects for seabirds, developing a population viability analysis (PVA) that assesses concurrent impacts (e.g. collision mortality, decreased breeding success, etc.) is currently the most likely feasible approach. Analysis should be run over a range of plausible impact scenarios (e.g. high mortality/low reproductive success through to low mortality/high reproductive success) to generate a plausible range of impacts rather than a single estimate of impact. Cumulative effects must also consider the presence of other stressors in the area (e.g. mortality from fishing entanglement) or in other parts of the species’ range (e.g. wintering grounds for breeding migrants) and how these might change with the introduction of energy development. Cumulative effects should be addressed across projects rather than simply at the project level. |

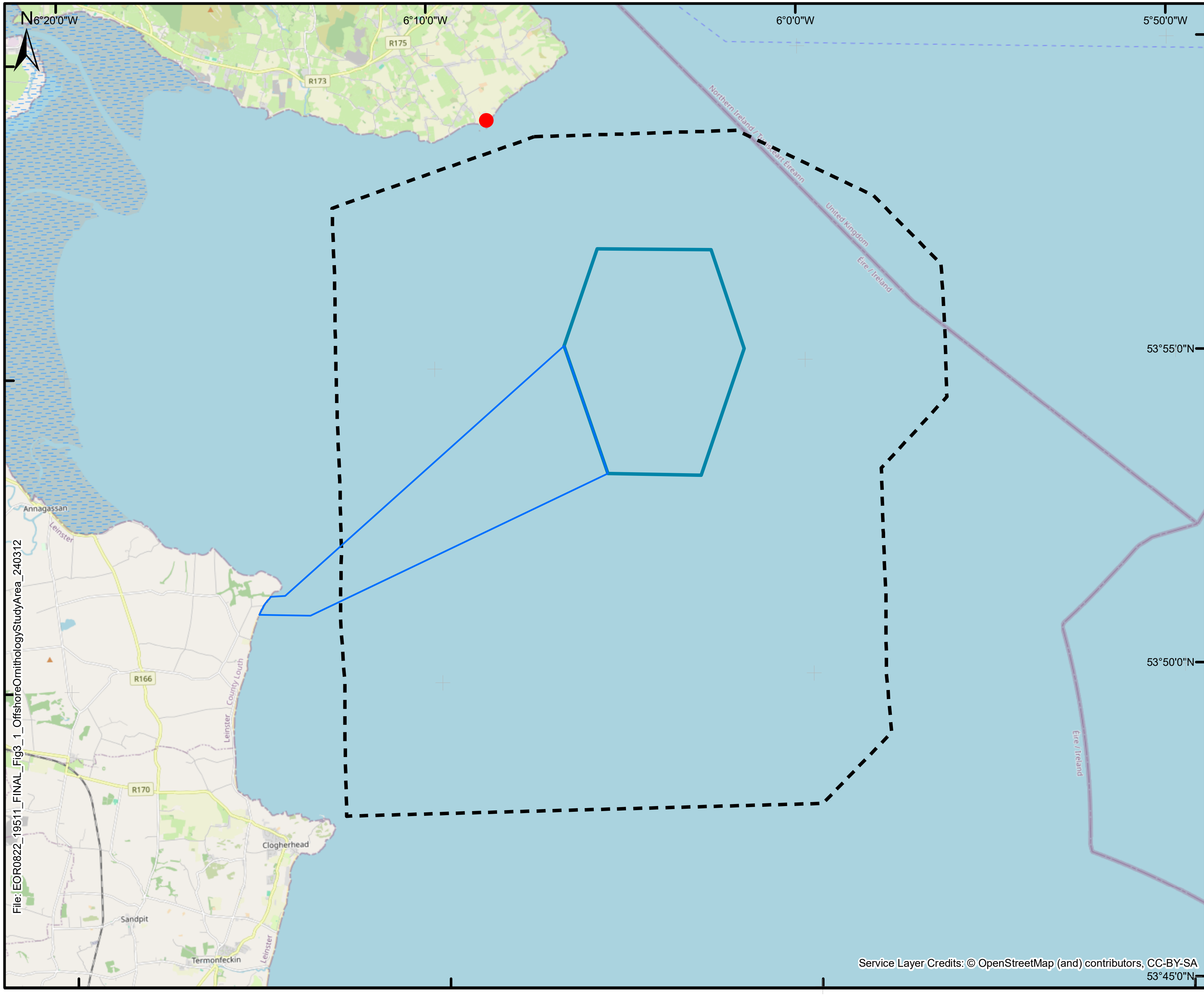
# 3 STUDY AREA

Two appropriate study areas have been defined for the development of this technical report, as illustrated within Figure 3-1 and Figure 3-2 and defined as follows:

- **The Offshore Ornithology Study Area:** defined as the extent of the area surveyed during the site-specific boat-based ornithology surveys (Aquafact, 2019) and digital aerial surveys (DAS) (APEM, 2020) and the extent of the offshore cable corridor up to the LWM. The boat and aerial surveys cover a total area of 319.85 $km^2$ and encompasses the marine habitats within the offshore wind farm area, offshore cable corridor and an additional buffer of varying extent, as illustrated Figure 3-1. The closest distance from the offshore wind farm area to the boundary of the Offshore Ornithology Study Area (i.e. the extent of the survey buffer around the offshore wind farm area) is 3.37 km, with the furthest distance approximately 12.74 km;

- **The Cumulative Offshore Ornithology Study Area:** where Annex I species under the Birds Directive were identified within the Offshore Ornithology Study Area, mean-maximum foraging ranges (based on those presented in Woodward *et al.* (2019)) of these species have been used to identify potentially connected designated sites for which they are qualifying features. The Cumulative Offshore Ornithology Study Area extends up to 509.4 km around the wind farm area and is based on the northern gannet *Morus bassanus* (hereafter referred to as gannet) mean-maximum plus one standard deviation (SD) foraging distances (Woodward *et al.*, 2019). The mean-maximum foraging range for gannet is the greatest of all the Annex I species selected for assessment as part of this Technical Report, therefore this extent encompasses the foraging ranges from SPAs of all other relevant seabird species for which the Project potentially has more than a negligible impact, as illustrated on Figure 3-2; and

- **Brent Goose Survey Area:** The migratory geese VP surveys were undertaken from a single coastal VP at Cooley Point, County Louth (see appendix 11-3: Migratory Geese Survey Report).

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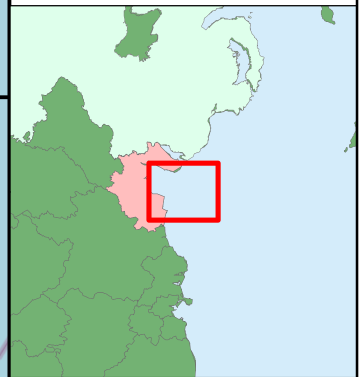
**Legend**

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Offshore Ornithology Study Area / Boat-based and Aerial Survey Area
- Vantage Point Survey Location
- Teritorial Waters Boundary

**Data Sources:** Client,



**Client**

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

**Project**

**Oriel Wind Farm Project**

**Title**

# Figure 3-1 Offshore Ornithology Study Area

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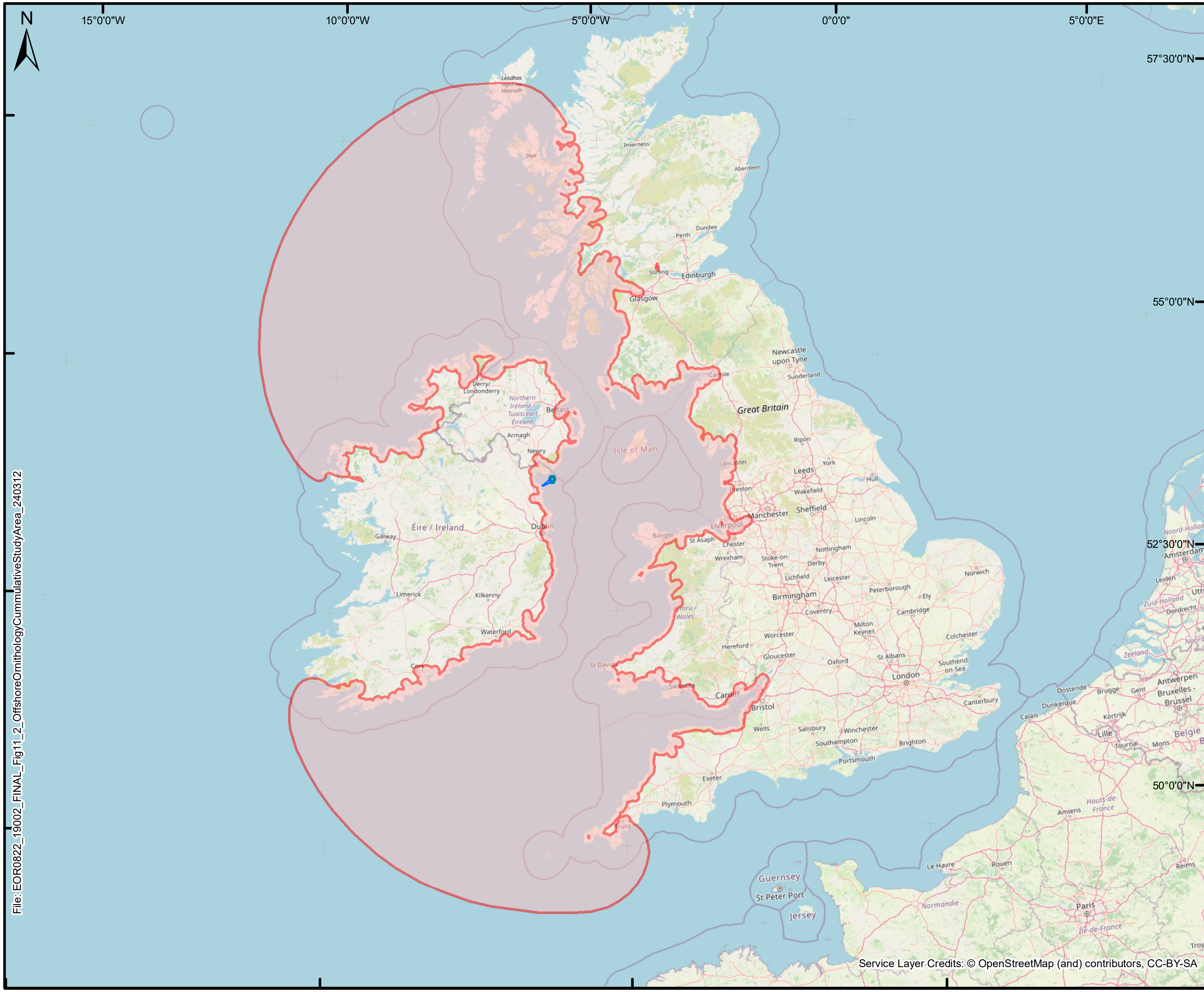


## Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Cumulative Offshore Ornithology Study Area

**Data Sources:** Client,


**Client**

**Oriel Windfarm Ltd.**

**Project**

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

**Title** **Figure 3-2**
**Cumulative Offshore Ornithology Study Area**


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# 4 METHODOLOGY

## 4.1 Desk-based review

Information on offshore ornithology within both the Offshore Ornithology Study Area and Cumulative Offshore Ornithology Study Area was collected through a detailed desktop review of existing studies and datasets relevant to the Project. Data was gathered from various sources, including those listed within Table 4-1, while Table 4-2 describes the specific data reports or databases utilised for the development of this report.

**Table 4-1: Desk-based data sources and data provisions.**

| Data Source | Data Provision |
|---|---|
| Ireland’s Marine Atlas | Ireland’s Marine Atlas provides an overview of protected sites in Ireland’s marine environment, as well as a resource to identify other marine developments for cumulative assessment. |
| NPWS | NPWS provide data on protected species, sites and conservation objectives in Ireland, including site boundaries and an overview of designated sites (SPAs) seabird feature populations and colonies. |
| The Department of Agriculture, Environment and Rural Affairs (DAERA) | DAERA provides an overview of designated sites (SPAs) in Northern Ireland and details of their seabird feature populations and colonies. |
| Natural England | Natural England provides an overview of designated sites (SPAs) in England and details of their seabird feature populations and colonies. |
| Natural Resources Wales (NRW) | NRW provides an overview of designated sites (SPAs) in Wales and details of their seabird feature populations and colonies. |
| NatureScot (formerly Scottish Natural Heritage) | NatureScot provides an overview of designated sites (SPAs) in Scotland and details of their seabird feature populations and colonies. |
| European Environment Agency | The European Environment Agency provides detail of species, habitats and protected sites across Europe through the European Nature Information System (EUNIS). This system provides detailed accounts of Natura 2000 sites, including features and population demographics of seabird features. |
| Seabird distribution and model outputs from ObSERVE | The ObSERVE programme was established by the Department of Communications, Climate Action and Environment (DCCAE) in partnership with the Department of Culture, Heritage and the Gaeltacht with the aim to improve the current knowledge and understanding of protected offshore species and habitats to support sustainable management of offshore activities and the development of appropriate marine conservation strategies. In 2016, an output of the programme ‘The seasonal distribution and abundance of Seabirds in the western Irish Sea, 2016’ was made available. |
| Irish Wetland Bird Survey (I-WeBS) | I-WeBS is a joint scheme of BirdWatch Ireland and NPWS which aims to monitor the numbers and distribution of waterbird populations wintering in the Republic of Ireland to enable identification of long-term spatio-temporal trends. |
| ESAS | ESAS data were amalgamated from a long-running programme of survey and research work on seabirds in the marine environment in the northeast Atlantic since 1979, and in the southwest Atlantic between 1998 and 2002. This data set recorded a wide range of seabirds, divers and seaducks, presented as grid cell densities of each species. |
| Seabird Monitoring Programme (SMP) | An ongoing annual monitoring programme of 25 species of seabird that regularly breed in Britain and Ireland. Established in 1986, the SMP was led and co-ordinated by the Joint Nature Conservation Committee (JNCC) in partnership with multiple organisations. As of July 2022, the annual monitoring scheme is organised by the British Trust for Ornithology (BTO) in partnership with JNCC, and RSPB as an associate partner. It is supported by a wider advisory group which includes Natural England, NRW, NatureScot and DAERA. |

The data collated from these sources provides an overview of seabird populations at both a localised Project level and a regional level. The ESAS database was reviewed for an area comprising the offshore wind farm area and offshore cable corridor plus 5 km buffer zone to provide an overview of the seabird populations within the immediate vicinity of the Project. Likewise, the I-WeBS accounts provide a localised overview of the Dundalk Bay area. The ObSERVE programme provides an overview of seabird populations and densities at a regional level, spanning from Dundalk Bay in the north, to south of Wexford harbour in the south. Further detail of these programmes is presented within section 5.5.

**Table 4-2: Summary of key desktop reports or databases considered in this report.**

| Title | Author | Year |
|---|---|---|
| ESAS | Joint Nature Conservation Committee | 2012 |
| ObSERVE programme 'The seasonal distribution and abundance of seabirds in the western Irish Sea' | Department of Communications, Climate Action and Environment, National Parks and Wildlife Service and Department of Culture, Heritage and the Gaeltacht | 2018 |
| Dundalk Bay (site 0Z401) I-WeBS Database | BirdWatch Ireland and National Parks and Wildlife Service | 2022 |
| Monthly 10 km grid square species distribution models of seabird abundance | Waggit *et al.* (2019) Distribution maps of cetacean and seabird populations in the North-East Atlantic | 2019 |

## 4.2 Identification of designated sites

All designated sites and qualifying features within the Cumulative Offshore Ornithology Study Area that have qualifying features which could be affected by the construction, operation and maintenance, and decommissioning of the Project were identified using the three-step process described below:

- Step 1: All designated sites of international importance within the Cumulative Offshore Ornithology Study Area, and within 100 km for designated sites of national importance were identified from various sources, including Ireland's Marine Atlas interactive map application (http://atlas.marine.ie/), National Parks and Wildlife Service (NPWS) website, the European Nature Information System (EUNIS) designated site database, and for sites in Northern Ireland, the JNCC website and the Department for Environment, Food and Rural Affairs (DEFRA) MAGIC interactive map applications (http://magic.defra.gov.uk/).
- Step 2: Information was compiled on the relevant features for each of these sites, based on known species occurrences from the desktop review; and
- Step 3: Using the above information and expert judgement, sites were included for further consideration if:
  - A designated site directly overlaps with the Project;
  - The ecology of a feature of an internationally designated site (i.e. species foraging range) directly overlaps with the Project; and
  - Sites and associated notified interest features are located within the potential Zone of Impact (ZoI) for impacts associated with the Project.

This high-level screening process aided the identification of designated sites where there is the potential for birds to be affected by the Project, specifically through overlap/impact to a species':

- Foraging ranges (Woodward *et al.*, 2019) with a 5 km inland buffer to account for coastal colonies;
- Resource dependencies;
- Breeding habitat; and
- Migratory routes.

A review of the status of any international and national protected sites designated for waders, wildfowl and seabird features that have the potential to be affected by the Project (NPWS, 2008) was also conducted. This included a review of the favourable conservation status (FCS) of the designated bird feature(s) for each site.

Where national designated sites (NHAs, pNHAs, wildfowl sanctuaries and ASSI) fall within the boundaries of an internationally designated site (a Ramsar site or SPA), only the international site has been presented in the tables below, except when a national site forms a component of an international site, but the designation does not list a qualifying interest (QI) that is present as part of the international site.

## 4.3 Site-specific surveys

An initial programme of baseline boat-based site-specific seabird surveys was carried out between 2006 and 2008. In order to inform the EIAR, an updated programme of boat-based seabird surveys was commissioned to take place between May 2018 and May 2020. In response to the Covid-19 pandemic and associated difficulties in continuation of the boat-based surveys in 2020, a program of six monthly aerial digital surveys of the Offshore Ornithology Study Area were also undertaken between April 2020 and September 2020 by APEM Ltd., with the aim of complementing the pre-existing boat-based surveys and providing an additional breeding season of seabird distribution and abundance data.

Vantage point surveys targeting migratory geese and swans were undertaken in the autumn period between November and December 2019 with spring migration surveys undertaken in April 2020. The main objective of these surveys was to record movements of primary target species (brent geese and other large wildfowl) between the VP location at Cooley Point and out across Dundalk Bay to the Offshore Ornithology Study Area, between 5-10 km offshore.

The field survey methods for each survey campaign are presented below.

### 4.3.1 Field survey methods (2018 to 2020)

#### Boat-based surveys

This section presents the methodology followed for the 2018 to 2020 boat-based survey programme. The survey schedule is provided in Table 4-3. The surveys are also shown in relation to the eight periods in the annual cycle in Table 4-4. The survey date(s), start and end times and weather conditions are provided for each of the boat-based surveys in Table 4-5.

**Table 4-3: Breakdown of the monthly coverage of the boat-based surveys between May 2018 and May 2020.**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓* | ✓ |
| 2019 | ✓ | ✓ | ✓ | ✓ | × | ✓ | ✓ | ✓ | × | ✓* | × | ✓ |
| 2020 | ✓ | × | × | × | ✓* | | | | | | | |

* Partial coverage – not all transects completed,

✓ Survey complete

× Survey not completed

**Table 4-4: Breakdown of the periods of the annual cycle covered during the boat-based surveys.**

| Period of annual cycle | Period Months | 2018 | 2019 | 2020 | No. of Surveys | No. of Years |
|---|---|---|---|---|---|---|
| Mid winter | Jan-Feb | | ✓ | ✓ | 2 | 2 |
| Late winter | Feb-Mar | | ✓✓ | | 2 | 1 |
| Early breeding season | Apr-mid May | ✓ | ✓ | | 2 | 2 |
| Mid breeding season | Mid May-mid Jun | ✓ | | ✓* | 2* | 2* |
| Late breeding season | Mid Jun-Jul | ✓ | ✓✓ | | 3 | 2 |
| Post breeding / moult | Aug-mid Sep | ✓✓ | ✓ | | 3 | 2 |
| Autumn | Mid Sep-Oct | ✓ | ✓* | | 2* | 2* |
| Early winter | Nov-Dec | ✓*✓ | ✓ | | 3* | 2* |

* Partial coverage – not all transects completed.

**Table 4-5: Summary of the boat-based surveys undertaken between May 2018 and May 2020.**

| Date | Transect Numbers | Start Time | End Time | Sea State at 5 km | Wind (Beaufort) / Direction | Cloud (Oktas) | Sea Swell | Precipitation | Visibility |
|---|---|---|---|---|---|---|---|---|---|
| 04/05/2018 | 1 to 11 | 07:18 | 17:21 | 3 to 4 | 4 / SW | 3 to 8 | Low | Nil | Good |
| 08/06/2018 | 2, 4, 6, 8, 10, 11 | 07:21 | 13:43 | 3 to 4 | 2 to 3 / NE | 3 to 6 | Low | Nil | Good |
| 09/06/2018 | 1, 3, 5, 7, 9 | 07:10 | 12:14 | 1 | 1 / E | 1 to 4 | Low | Nil | Good |
| 06/07/2018 | 1, 3, 5, 7, 9, 11 | 09:54 | 15:30 | 2 to 3 | 3 / SE | 1 to 8 | Low | Nil | Good |
| 07/07/2018 | 2, 4, 6, 8, 10 | 07:02 | 11:47 | 0 to 2 | 1 to 2 / SE | 1 to 6 | Slight / low | Nil | Good |
| 30/08/2018 | 1, 3, 5, 7, 9, 11 | 10:14 | 16:01 | 1 to 2 | 1 / NW | 5 to 8 | Low | Nil | Good |
| 31/08/2018 | 2, 4, 6, 8, 10 | 07:24 | 12:11 | 3 to 5 | 4 to 5 / SE | 1 to 7 | Low | Nil | Good |
| 01/09/2018 | 2, 3, 6 to 11 | 10:47 | 18:20 | 1 to 2 | 2 / SW | 2 to 7 | Low / moderate | Nil | Moderate / Good |
| 02/09/2018 | 1, 4, 5 | 08:58 | 11:32 | 3 | 3 / S | 8 | Low | Nil | Moderate / Good |
| 20/10/2018 | 1, 3, 5, 7, 9, 10, 11 | 10:19 | 16:11 | 3 to 4 | 3 to 4 / SW | 7 to 8 | Low | Nil | Good |
| 21/10/2018 | 2, 4, 6, 8 | 08:39 | 12:14 | 3 to 5 | 3 to 5 / SW | 8 | Low | Light / moderate | Moderate / Good |
| 26/11/2018 | 2, 4, 6, 7, 8, 9 | 08:06 | 13:41 | 4 | 4 / E to SE | 6 to 8 | Low / moderate | Nil / light | Good |
| 04/12/2018 | 4 to 11 | 08:39 | 14:31 | 3 | 3 / SW | 8 | Moderate | Nil | Good |
| 05/12/2018 | 1 to 3 | 11:50 | 15:00 | 2 to 4 | 3 to 4 / SW | 4 to 8 | Low | Nil | Good |
| 10/01/2019 | 5 to 11 | 09:33 | 15:05 | 2 to 3 | 3 / W | 6 to 8 | Low | Nil | Good |
| 11/01/2019 | 1 to 4 | 08:25 | 11:32 | 3 | 2 to 3 / NW | 8 | Low | Nil | Good |
| 26/02/2019 | 2, 4, 6, 8, 10 | 09:10 | 14:22 | 2 to 3 | 2 to 3 / SE | 1 | Low | Nil | Good |
| 27/02/2019 | 1, 3, 5, 7, 9, 11 | 08:58 | 13:24 | 2 to 3 | 2 to 3 / SW | 1 to 8 to | Low | Nil | Moderate / Good |
| 27/03/2019 | 6 to 11 | 11:31 | 16:30 | 2 to 3 | 2 to 3 / W | 7 to 8 to | Low | Nil | Very good |
| 28/03/2019 | 1 to 5 | 08:47 | 12:53 | 2 to 4 | 3 / SW to SE to S | 1 to 2 to | Low | Nil | Good |
| 20/04/2019 | 6 to 11 | 11:57 | 17:05 | 1 to 2 | 2 / SE | 1 to 4 to | Low | Nil | Low / moderate |
| 21/04/2019 | 1 to 5 | 09:31 | 14:11 | 1 to 3 | 2 to 3 / W | 2 to 7 to | Low | Nil | Good |
| 19/06/2019 | 4 to 11 | 08:30 | 16:20 | 2 | 2 to 3 / SW to W to NW | N/A | Low | Nil | Good |
| 20/06/2019 | 1 to 3 | 09:49 | 12:15 | 3 to 4 | 3 / W | N/A | Low | Nil | Good |
| 17/07/2019 | 7 to 11 | 09:00 | 13:44 | 4 | 4 / SW | N/A | Moderate | Moderate / heavy | Moderate |
| 18/07/2019 | 1 to 6 | 09:25 | 14:20 | 4 | 4 to 6 / SW | N/A | Low | Nil | Good |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 01/08/2019 | 4 to 11 | 10:55 | 18:20 | 2 | 1 | N/A | Low | Nil | Good |
| 02/08/2019 | 1 to 3 | 08:00 | 10:30 | 2 to 3 | 01 to Feb | N/A | Low | Nil | Good |
| 02/10/2019 | 6 to 11 | 10:00 | 15:35 | 2 to 3 | 2 to 3 / W | N/A | Low | Nil | Good |
| 01/12/2019 | 7 to 11 | 10:20 | 15:00 | 2 | 2 / N to NW | N/A | Low | Nil | Good |
| 02/12/2019 | 1 to 6 | 08:50 | 14:30 | 2 | 2 to 3 / W | N/A | Low | Nil | Good |
| 21/01/2020 | 5 to 11 | 09:38 | 15:35 | 1 to 3 | N/A | N/A | N/A | N/A | N/A |
| 22/01/2020 | 1 to 4 | 09:00 | 12:06 | 1 | N/A | N/A | N/A | N/A | N/A |
| 20/05/2020 | 3 to 10 | 07:56 | 13:55 | N/A | N/A | N/A | N/A | N/A | N/A |

Baseline boat-based surveys were carried out within the Offshore Ornithology Study Area comprising the marine habitats within the offshore wind farm area, offshore cable corridor and an additional buffer of varying extent. Transects were spaced at 2 km intervals in compliance with best practice guidelines for surveying (Camphuysen *et al.*, 2004)[1], and were numbered from one in the south to 11 in the north (Figure 4-1).

Weather and sea conditions were recorded for all survey visits. The November 2018, October 2019 and May 2020 surveys were only partially completed due to weather or other logistical constraints, with a single survey visit undertaken in each of those months. In November 2018, alternate transects were covered to achieve representative sampling coverage across the Survey Area. In October 2019, coverage was only achieved of transects 6-11 in the northern half of the Survey Area and in May 2020 transects 3-10 were covered. Surveys were not completed in May 2019, September 2019, November 2019, February 2020 and March 2020 due to adverse weather constraints during planned survey windows.

ESAS census techniques (described within Camphuysen *et al.*, 2004; Johansen *et al.*, 2014) were employed within the survey methods. Surveys were conducted in suitable weather conditions (less than sea state 5), from a ship deck height of 5 m, travelling between 5 and 15 knots (typically 10-11 knots). Observations and notes were recorded by two trained ESAS surveyors.

Records of birds were made perpendicular to the direction of travel on one side of the boat, out to 300 m. A scan surveys an arc of 90° from directly in front to one side of the vessel, recording all birds within a quadrat with sides 300 m to the front and side of the observer. Also, a “snapshot” was used for flying birds, whereby all birds in flight were recorded every minute within the 300 m quadrat, along with their estimated flight height and direction.

Each bird record was allocated to five distance bands:

- A: 0-50 m;
- B: 50-100 m;
- C: 100-200 m;
- D: 200-300 m; and
- E: 300 m+.

Where feasible, the following details were recorded for all bird sightings:

- Species;
- Sex, age and plumage characteristics (species dependent);

[1] Line-transects spaced across the Survey Area, a minimum of 0.5 nm (0.9 km) apart up to a maximum spacing of 2 nm (3.7 km).

- Behaviour; and
- Flight height with direction (for flying birds).

Monthly data for each species recorded 'on transect' (i.e. within 300 m of one side of the transect) are presented in section 5.5.1. Additional observations of birds recorded during surveys, but not allocated to the transect, are also discussed within section 5.5.1 as 'All Records' which includes all birds observed (whether present on the transect or recorded incidentally). Further, records were made of total observations of both individuals and the number of sightings.

## Digital aerial surveys

This section summarises the information collected following the completion of the six DAS of the Offshore Ornithology Study Area between April 2020 and September 2020. Full details of the survey methods are provided in appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The date(s), start and end times and weather conditions are provided for each of the DAS in Table 4-6.

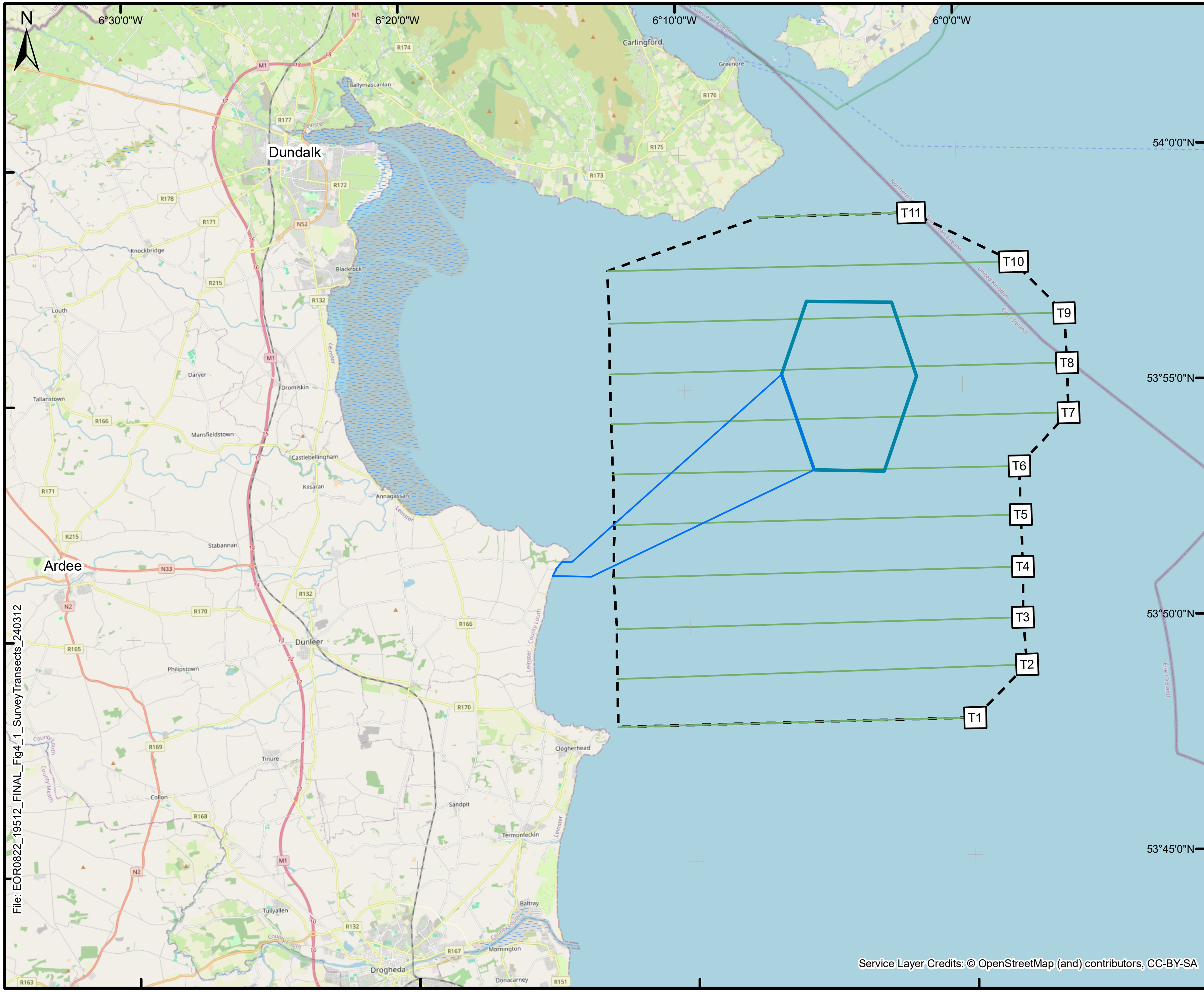
**Table 4-6: Survey dates and weather conditions recorded for completed surveys: April 2019 to September 2020.**

| Survey Number | Date | Start Time | End Time | Sea State at 5 km | Wind (Beaufort) / Direction | Cloud (Oktas) | Visibility | Air Temp (°C) |
|---|---|---|---|---|---|---|---|---|
| 1 | 24/04/20 | 08:00 | 10:09 | 1 | 3 to 4 / W | 4 | Very good | 18 |
| 2 | 02/06/20 | 12:04 | 13:58 | 1 | 3 / NE | 4 | Very good | 19 |
| 3 | 21/06/20 | 16:21 | 17:48 | 3 | 4 to 5 / W | 2 to 4 | Very good | 15 |
| 4 | 18/07/20 | 16:07 | 17:31 | 2 | 3 / NW | 4 to 8 | Very good | 15 |
| 5 | 08/08/20 | 13:41 | 14:55 | 1 | 3 / NE | 0 to 7 | Very good | 16 to 18 |
| 6 | 03/09/20 | 07:45 | 09:19 | 3 | 5 / W | 4 to 8 | Very good | 16 to 17 |

The DAS method was designed to complement the pre-existing boat-based surveys which had already been undertaken, with the same aims and objectives.

The bespoke camera system was fitted into a twin-engine aircraft, data collected were 1.5 cm ground sample distance (GSD) digital still images, using a GPS-linked bespoke flight management system to ensure the tracks were flown with a high degree of accuracy; at least 25% coverage of the sea surface was collected to be analysed. The camera system captured abutting still imagery along the same transect routes used for the boat-based surveys. The aircraft collected the data at an altitude of approximately 395 m, and a speed of approximately 120 knots. The aircraft's internal Global Positioning System (GPS) and inertial measurement unit (IMU) systems record to an accuracy of +/- 3 to 5 m as standard.

The weather conditions during all surveys were conducive to collecting and analysing imagery for the purpose of providing data on the identification, distribution and abundance of bird species within the Study Area.




**Legend**

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Survey Transects
- Offshore Ornithology Study Area / Boat-based and Aerial Survey Area

**Data Sources:** Client,

**Client**

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**Project**

## Oriel Wind Farm Project

**Title**

## Figure 4-1 Boat-based and Aerial Survey Transects


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**Issue Details**

| | |
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| Checked By: NG | File Ref: |
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| Date: 12/03/2024 | |

## Migratory geese vantage point surveys

This section presents the VP methodology followed for the autumn migration (November 2019 and December 2019) and spring migration (April 2020) survey programme. The survey date(s), start and end times and weather conditions are provided for each of the VP surveys in Table 4-7.

**Table 4-7: Survey dates and weather conditions recorded for completed surveys: November / December 2019 and April 2020.**

| Date | Start Time | End Time | Sea State at 5 km | Wind (Beaufort) / Direction | Cloud (Oktas) | Temp (°C) | Precipitation | Sunset / Sunrise | Visibility |
|---|---|---|---|---|---|---|---|---|---|
| 12/11/19 | 08:00 | 15:00 | 3-4 | 3-4 / W-NW | 6 | 3 | None | 07:47 | Good |
| 25/11/19 | 09:00 | 15:30 | 2-3 | 2-3 / SE | 8 | 9 | Drizzle at times | 08:05 | Good |
| 26/11/19 | 08:15 | 14:45 | 3 | 3-4 / SE | 8 | 9 | Light showers | 08:05 | Good |
| 30/11/19 | 07:50 | 14:20 | 3-4 | 3-4 / ESE | 6 | 6 | None | 08:20 | Good |
| 02/12/19 | 09:00 | 15:30 | 1-2 | 1-2 / W | 4 | 1 | None | 08:23 | Good |
| 12/12/19 | 08:40 | 15:40 | 2 | 2 / SW | 8 | 7 | None | 08:36 / 16:04 | Good |
| 20/12/19 | 10:05 | 16:35 | 2-3 | 2-3 / WSW-W | 7 | 5 | Light drizzle at start | 08:43 / 16:05 | Good |
| 10/04/20 | 17:30 | 20:30 | 2 | 2 / SW | 0 | N/A | None | 06:33 / 20:20 | Good |
| 11/04/20 | 06:20 | 09:30 | 2 | 2 / SW | 8 | N/A | None | 06:33 / 20:20 | Good |
| 11/04/20 | 17:30 | 20:30 | 2 | 0 | 8 | N/A | None | 06:33 / 20:20 | Good |
| 12/04/20 | 11:00 | 14:00 | 2 | 3 / NE | 8 | N/A | None | 06:33 / 20:20 | Good |
| 12/04/20 | 18:30 | 21:30 | 2 | 3 / NE | 8 | N/A | None | 06:33 / 20:20 | Good |
| 13/04/20 | 18:00 | 21:30 | 3 | 3 / NE | 8 | N/A | None | 06:20 / 20:40 | Good |
| 14/04/20 | 18:00 | 21:00 | 3 | 2-3 / NE | 0 | N/A | None | 06:20 / 20:40 | Good |
| 15/04/20 | 16:00 | 19:00 | 1 | 0 | 0 | N/A | None | 06:20 / 20:40 | Good |
| 16/04/20 | 06:00 | 09:00 | 1 | 0 | 0 | N/A | None | 06:21 / 21:00 | Good |
| 16/04/20 | 18:00 | 21:00 | 1 | 2 / NE | 0 | N/A | None | 06:21 / 21:00 | Good |
| 20/04/20 | 18:00 | 21:00 | 1 | 2 / E | 0 | N/A | None | 06:19 / 20:40 | Good |
| 23/04/20 | 18:30 | 21:30 | 2 | 1 / NE | 8 | N/A | None | 06:19 / 20:40 | Good |
| 24/04/20 | 14:00 | 17:00 | 2 | 1 / NE | 1 | N/A | None | 06:18 / 20:42 | Good |

Since there is no guidance on VP survey protocols for the Republic of Ireland, guidance developed by Scottish Natural Heritage (SNH) for onshore wind farm ornithology surveys was followed (SNH, 2017).

Surveys to record movements of migratory waterfowl during the 2019/20 autumn and spring migration periods were conducted from a single coastal VP at Cooley Point, County Louth.

The protocol followed during coastal migration surveys was a systematic 180° scan (including overhead) for birds in flight. The primary target species were geese and swans, with secondary target species being ducks, divers, waders, raptors and passerines. Surveys were not undertaken in weather conditions which were likely to preclude migration. Data collected for each observation included:

- Time of observation;
- Species;
- Flock size;
- Flight height bands (1 = 0-20 m, 2 = 20-250 m, 3 = 250-300 m, 4 = > 300 m);

- Flight direction;
- Distance from observer (to the nearest 100 m); and
- Flight lines drawn onto maps, which were later digitised in GIS.

During the autumn migration period, seven surveys totalling 42 hours of observation were undertaken between November and December 2019. Spring migration surveys totalling 40 hours of observation were undertaken in April 2020. Timing of surveys are based on data provided in Fox *et al.* (2017); but these timings are also considered suitable for recording migrating brent geese which were the primary target species.

Full details of the survey methods are provided in appendix 11-3: Migratory Geese Survey Report.

### 4.3.2 Field survey methods (2006 to 2008)

The 2006 to 2008 survey programme followed a similar field methodology to those described above for the 2018 to 2020 surveys.

A programme of baseline boat-based site-specific seabird surveys was carried out between 2006 and 2008 (Table 4-8). The methods employed for these surveys followed the JNCC Seabirds at Sea survey methods, as described in Walsh *et al.* (1995).

The methodology recorded all birds in a 90º scan from ahead out to 300 m on one side of the boat. Within the transect, most or all of the birds were identified with the naked eye, with binoculars of 7x or 8x magnification also used. Within the JNCC methods, it is noted that the inclusion of all flying birds may lead to significant overestimates. Therefore, scans for flying birds were made every minute (using a timer) and only those seen during the scan and within the 300 m transect were recorded as ‘in transect’.

A robust baseline was gathered in 2006-2008 with two years of survey data. Due to the age of the data, it has not been included in the development of species accounts within this report. However, the 2006-2008 data may be referred to within the EIAR assessment chapter for context, particularly in months which have low or no data in recent surveys.

**Table 4-8: Boat-based surveys for the Project 2006-2008.**

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | × | × | × | ✓ | × | ✓ | ✓ | × | × | × | × | × |
| 2007 | ✓ | × | ✓ | ✓ | × | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2008 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | × |

✓ Survey complete

× Survey not completed

## 4.4 Data interpretation methods

### 4.4.1 Distance analysis

Surveying animals by eye carries the potential for decreases in detectability with distance, resulting in negatively biased population estimates (e.g. Skov *et al.* 1995, Ronconi and Burger 2009). This is especially likely for relatively small species on the water, such as auks. Detection is also likely to change according to sea state amongst other factors. Distance analysis can be used to analyse variations in the detectability of birds and correct density estimates accordingly. Buckland *et al.* (2001) define the central concept of distance analysis as the modelling of the detection function, g(x), which is the probability of detecting an object (a bird or group of birds), given that it is at distance x from a transect line or point (see Buckland *et al.* 2001, 2004).

Distance correction analysis makes several important assumptions about the nature of the data: 1) the distribution of birds is random with respect to the transect line, 2) birds are non-aggregated and are evenly distributed across all distance bands and 3) all birds on the transect line at distance 0 (band A in this case) are detected (Thomas *et al.* 2010). As Distance Analysis was only applied to birds on the water, there was limited scope for birds to be attracted to, or be associated, with the vessel. It was also assumed that birds were identified and located in distance bands prior to any response (flushing, swimming or diving) to the vessel, which might violate the assumptions of Distance correction (Buckland *et al.* 2001).

Where sufficient species observations were available models were fitted using various key functions (uniform, half-normal, hazard-rate or gamma), with or without adjustment terms (e.g. cosine, simple polynomial or hermite polynomial). Sea state and cluster / flock size were also investigated as model covariates in determining detection probability. Goodness of fit of potential detection functions can be assessed using chi-square tests, however as the degrees of freedom of the chi-square test is defined as the number of bins minus the number of parameters in the detection function minus 1 (e.g. df =bins-parameters-1). With only four bins, we are can therefore only consider detection functions containing two or less parameters if we are to assess fit in this manner. As we also have a relatively large sample size for some of the species of interest this means that, the chi-square test tends to indicate significant discrepancies between candidate detection functions and the data in any case. As such, visual assessment in combination with Akaike Information Criterion (AIC) values has been used to identify the 'best' model to assess the goodness of fit in the following sections.

Distance analysis was undertaken with all data pooled to maximise the data informing the detection functions and produce a single detection function for each species, where sufficient observations were available to allow this approach.

### 4.4.2 Spatial abundance mapping – boat-based surveys

The methods described in this section were used to meet the following analyses objectives for those species where sufficient observations were available:

- Spatial abundance maps of each species on the sea within the season and / or month (where appropriate);
- Spatial abundance confidence interval maps for each map produced above; and
- Densities (and associated error) estimated from spatial abundance maps.

Where possible, the bird survey data was analysed using the CReSS approach in a GEE framework with a Spatially Adaptive Local Smoothing Algorithm (SALSA) for model selection (Mackenzie *et al.* 2013). Environmental data was used to predict the density and distribution of species across a defined grid covering the Survey Area. The following environmental covariates were used to predict the species' distributions:

- Bathymetry;
- X and Y coordinates; and
- Distance to coast.

The CReSS modelling technique was developed to deal with spatial smoothing in geographically complex regions (i.e. coastal waters) it has been further developed as part of the MRSea (Scott-Hayward, 2017) R package specifically to deal with data collected for offshore wind farm projects. The modelling technique allowed both spatially auto-correlated and zero-inflated data to be modelled in a robust method. The confidence intervals generated using CReSS incorporate both the uncertainty in the detection function fitting (where applicable) and in the spatial model fitting process (Mackenzie *et al.,* 2013). Using a CReSS modelling method also enabled any spatial autocorrelation within the dataset to be incorporated providing more robust confidence intervals. Autocorrelation Function (ACF) plots allowed detection of spatial autocorrelation, and an appropriate blocking structure was specified within the model to account for any autocorrelation detected this method was appropriate for analysing zero-inflated count data through specification of an appropriate family (quasipoisson) within the modelling process. The MRSea package in R allowed the data to be modelled using regression splines and CReSS smoothing with a SALSA for model selection.

Mapping was undertaken for all boat-based data collected during the survey period; the data were collected along transect lines over the entire survey area, but in some months, some transects were not surveyed resulting in partial spatial coverage (i.e. May 2020 and November 2019). The presence of these missing data means that standard methods for analysing surveys through transforming point data to a smoothed surface (e.g. kernel density estimation) could not be used. As such, we used a SALSA (Walker *et al.,* 2010) within the R package MRSea (Scott-Hayward, 2017). This approach allows for the presence of missing data by exploiting empirical relationships between abundance and other variables (depth and distance to coast) and exploiting commonalities between distributions in different months.

Due to small numbers of observations over several months information was pooled into broad seasons including breeding, non-breeding and pre-breeding seasons and models fitted to each of these for each species of interest with sufficient observations for model convergence (~80). Since there are known differences between spatial distributions across species between breeding, non-breeding and pre-breeding seasons, we only pooled information across months within each of these seasons, and not between seasons. Months were classified by their relationship with the species' breeding behaviours defined as pre-breeding, breeding or non-breeding for each species. Three separate models based on season were fit to each species to allow for differences in the relationships of distance to coast and/or depth, and different levels of smoothness depending on the time of year.

Due to the structure of the data, the gaps in spatial and temporal coverage it has not been possible to fit a density surface that allows the estimate to vary by survey visit (i.e. month and year). Instead we have fitted surfaces that interact with month (data pooled across years where available) allowing estimates to vary spatially across the site by month. We have also fitted year as a fixed term in the model allowing the model surface to rise or fall overall based on the average effect of year on estimates. This has allowed us to produce estimates by month and year but means that in general estimates between years for months in similar seasons can be very similar and, in some cases, the same especially where between year variation (across all months) is not significant.

Crucially, these assumptions do not imply that the distribution of birds across the Offshore Ornithology Study Area needs to be the same. The degree of smoothing for each species and season was determined within the MRSea software using tenfold cross validation in the majority of cases. However, in one instance the cross validation (CV) approach led to unreliable estimates of the upper 95% confidence limit due to external edge effects. In this case the results are presented using Quasi AIC (QAIC) for model fitting. Within each of the models, separate maps with associated 95% lower and upper confidence intervals (LCL and UCL, respectively) were produced for each species and month, where possible.

## Availability bias

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).

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).

All available data for seabirds relate to diving behaviour obtained by direct observation, or in the case of common guillemot *Uria aalge* (hereafter, referred to as guillemot) and razorbill *Alca torda*, to data obtained during the breeding season using data loggers. Thaxter *et al.* (2010) gives 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 guillemot and razorbill 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 guillemot is 23.75% and for razorbill of 17.4%. To account for this bias scaling factors of 1.2375 and 1.174 have been applied to guillemot and razorbill estimates respectively.

### 4.4.3 Species abundance estimates – DAS

For each monthly aerial digital survey of the Offshore Ornithology Study Area, geo-referenced locations of seabirds, contained within each individual digital still image, were used to generate raw counts. Seabird locations contained within the boundaries of the two areas: the Offshore Ornithology Study area (which contains the offshore wind farm area), and the offshore wind farm area alone were then extracted using QGIS, providing raw count data. APEM preformed all elements of the DAS analysis.

The raw counts were then divided by the number of images collected to give the mean number of animals per image (i). Population estimates (N) for each survey month were then generated by multiplying the mean number of animals per image by the total number of images required to cover the entire study area (A):

$$N = i\,A$$

Non-parametric bootstrap methods were used for variance estimation. A variability statistic was generated by re-sampling 999 times with replacement from the raw count data. The statistic was evaluated from each of these 999 bootstrap samples and upper and lower 95% confidence intervals of these 999 values were taken as the variability of the statistic over the population (Efron & Tibshirani, 1993). This results in species-specific monthly abundance estimates being calculated from the raw count data, with upper and lower confidence limits.

# 5 BASELINE ENVIRONMENT

## 5.1 Regional review: seabirds in the Irish sea

Ireland has one of the largest marine areas in Europe, around ten times its land area, and a wealth of marine biodiversity as a result (Burke, 2018). Ireland's marine areas offer productive intertidal zones with bays and estuaries which provide vital food resources and essential habitat to many species of birds throughout the year, including non-breeding and passage migrants. To date, 52 species of seabirds have been recorded in Irish waters, 24 of which habitually forage and breed. Of the 24 habitually occulting species, ten are Annex I listed species of the Birds Directive, with nine of these species are listed as Birds of Conservation Concern in Ireland 4 (BoCCI) (Gilbert *et al.,* 2021).

Many seabird species within Ireland are present in numbers of regional, continental or global importance. Ireland supports several species of internationally important numbers, such as the largest European population of roseate tern *Sterna dougallii* at Rockabill (Dublin), or key clusters of European storm-petrel (hereafter, referred to as storm petrel) at Blasket Islands in Kerry (BirdWatch Ireland, 2020a). The Irish Sea supports both truly pelagic seabirds such as northern gannet (hereafter, referred to as gannet), northern fulmar *Fulmarus glacialis* (hereafter, referred to as fulmar) and auks, and other species which spend part of their annual life cycle at sea, such as divers, gulls (including black-legged kittiwake *Rissa tridactyla*, hereafter referred to as kittiwake) and seaducks. Additionally, non-seabird migrants are also present within the Irish Sea region such as wildfowl and waders.

Recent surveys of the Irish Sea identified 97,326 seabirds during the 2016 breeding season, 299,122 seabirds during the autumn of 2016, and 87,180 seabirds during the 2016 winter period. The most frequently sighted and most abundant species within the surveys were razorbill/guillemot, with frequent sightings of gannet, fulmar and gull species (Jessop *et al.*, 2018). The Irish Sea provides important foraging, breeding and wintering grounds for seabird species.

## 5.2 Designated sites

The Project intersects one European site, namely the North-west Irish Sea SPA[2] for approximately 2 km of the offshore cable corridor. The next closest European site, Carlingford Lough SPA, is located 5.7 km north of the Project. The Project also intersects one pNHA – Dunany Point at the landfall location and for approximately 0.25 km of the offshore cable corridor.

Individuals from local SPA populations are likely to use or travel through the offshore wind farm area and offshore cable corridor. For seabird species with particularly large foraging ranges (such as gannet) there is the potential for connectivity between the Project and more distant SPAs.

As discussed in section 3, international designated sites within the Cumulative Offshore Ornithology Study Area, and nationally designated sites within 100 km of the Project were identified.. If a nationally designated site overlaps with an internationally designated site with the same qualifying features only the international designated site is presented in Table 5-1 except when a national site forms a component of an international site, but the designation does not list a qualifying interest (QI) that is present as part of the international site.

Designated sites and/or foraging ranges of qualifying species which do not overlap with the offshore wind farm area have been identified by "greying out". The closest distance between the offshore wind farm area and the SPA boundary in Table 5-1 is via marine pathway. During the breeding season, seabirds are highly unlikely to commute across land and will stay in the marine environment, therefore, to calculate the distance between the SPA and the project a marine pathway measurement is required and not a straight line distance.

[2] Candidate and proposed sites, and European sites are collectively referred to as "SACs" and "SPAs". There is no distinction made between candidate/proposed sites and European sites as they have the same level of protection as a matter of domestic law. For the purpose of the report, they are considered one and the same.

Each of the SPA buffer areas presented within Figure 5-1 relate to the largest of the mean-maximum foraging ranges of the species associated with that SPA, for example, if there are three qualifying feature seabird species associated with a SPA, then the buffer shown is for the species with the largest foraging range (and for which there is considered to be potential for more than a negligible impact of the Project).

Although other designated sites have been identified within the larger foraging range of the fulmar, these sites beyond the extent defined by the foraging range of gannet are not considered further due to low abundances of fulmar observed within the Offshore Ornithology Study Area resulting in absence of likely significant impacts.

The designated sites within Table 5-1 include transboundary sites within the jurisdiction of Northern Ireland which fall under responsibility of the DAERA; sites within Scotland, Wales and England fall under the responsibility of NatureScot, NRW and Natural England respectively.

**Table 5-1: Designated sites and relevant offshore ornithology qualifying features.**

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| North-west Irish Sea cSPA | NPWS | Common scoter *Melanitta nigra* | N/A* | The cable corridor goes through the SPA. |
| | | Red-throated diver *Gavia stellata* | N/A* | |
| | | Great northern diver *Gavia immer* | N/A* | |
| | | Fulmar | 1,200.2 | |
| | | Manx shearwater *Puffinus puffinus* | 2,364.7 | |
| | | Shag *Phalacrocorax aristotelis* | 23.7 | |
| | | Cormorant *Phalacrocorax carbo* | 33.9 | |
| | | Little gull *Hydrocoloeus minutus* | N/A* | |
| | | Kittiwake | 300.6 | |
| | | Black-headed gull *Chroicocephalus ridibundus* | N/A* | |
| | | Common gull *Larus canus* | N/A* | |
| | | Lesser black-backed gull *Larus fucus* | 236 | |
| | | Herring gull *Larus argentatus* | 236 | |
| | | Great black-backed gull *Larus marinus* | N/A* | |
| | | Little tern *Sterna albifrons* | 5 | |
| | | Roseate tern | 23.2 | |
| | | Common tern *Sterna hirundo* | 26.9 | |
| | | Arctic tern *Sterna paradisaea* | 40.5 | |
| | | Puffin | 265.4 | |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| | | *Fratercula arctica* | | |
| | | Razorbill | 164.6 | |
| | | Guillemot | 153.7 | |
| Dunay Point pNHA | NPWS | Cormorant | N/A* | The cable corridor and landfall location intersect with the pNHA |
| | | Red-breasted merganser *Mergus serrator* | N/A* | |
| Carlingford Lough SPA | DAERA and NPWS | Sandwich tern *Sterna sandvicensis* | 57.5 | 5.7 |
| | | Common tern | 26.9 | |
| | | Light-bellied brent goose *Branta bernicla hrota* | N/A* | |
| Dundalk Bay SPA | NPWS | Common gull | N/A* | 8.0 |
| | | Red-breasted merganser | N/A* | |
| | | Common scoter | N/A* | |
| | | Black-headed gull | N/A* | |
| | | Herring Gull | N/A* | |
| | | Light-bellied brent goose | N/A* | |
| River Nanny Estuary and Shore SPA | NPWS | Herring Gull | N/A* | 24.2 |
| Mourne Coast ASSI | DAERA | Kittiwake | 300.6 | 21.2 |
| Rockabill SPA | NPWS | Arctic tern | 40.5 | 28.5 |
| | | Roseate tern | 23.2 | |
| | | Common tern | 26.9 | |
| Skerries Islands SPA | NPWS | Herring gull | 85.6 | 33.1 |
| | | Cormorant | 33.9 | |
| | | Shag | 23.7 | |
| | | Light-bellied brent goose | N/A* | |
| Lambay Island SPA | NPWS | Fulmar | 1,200.2 | 42.7 |
| | | Guillemot | 153.7 | |
| | | Herring Gull | 85.6 | |
| | | Kittiwake | 300.6 | |
| | | Razorbill | 164.6 | |
| | | Lesser black-backed gull | 236 | |
| | | Puffin | 265.4 | |
| | | Shag | 23.7 | |
| | | Cormorant | 33.9 | |
| Strangford Lough SPA | DAERA | Sandwich tern | 57.5 | 49.4 |
| | | Common tern | 26.9 | |
| | | Arctic tern | 40.5 | |
| | | Light-bellied brent goose | N/A* | |
| Ireland's Eye SPA | NPWS | Herring gull | 85.6 | 52.7 |
| | | Guillemot | 153.7 | |
| | | Kittiwake | 300.6 | |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| | | Razorbill | 164.6 | |
| | | Cormorant | 33.9 | |
| Howth Head Coast SPA | NPWS | Kittiwake | 300.6 | 55.2 |
| Irish Sea Front SPA | JNCC | Manx shearwater | 2,364.7 | 56.8 |
| Dalkey Coastal Zone and Kiliney Hill pNHA | NPWS | Herring gull | 85.6 | 68.8 |
| | | Great black-backed gull | 70 | |
| | | Lesser black-backed gull | 236 | |
| | | Manx shearwater | 2,364.7 | |
| | | Arctic tern | 40.5 | |
| | | Roseate tern | 23.2 | |
| | | Common tern | 26.9 | |
| | | Cormorant | N/A* | |
| Copeland Islands SPA | DAERA | Manx shearwater | 2,364.7 | 86.8 |
| | | Arctic tern | 40.5 | |
| Baie ny Carrickey MNR | Isle of Man Government | Kittiwake | 300.6 | 83.7 |
| | | Guillemot | 153.7 | |
| | | Puffin | 265.4 | |
| | | Razorbill | 164.6 | |
| Little Ness MNR | Isle of Man Government | Fulmar | 1,200.2 | 102.4 |
| | | Black guillemot | 9.1 | |
| Niarbyl Bay MNR | Isle of Man Government | Fulmar | 1,200.2 | 85.4 |
| | | Lesser black-backed gull | 236 | |
| | | Shag | 23.7 | |
| Port Erin Bay MNR | Isle of Man Government | Fulmar | 1,200.2 | 82.3 |
| | | Herring gull | 85.6 | |
| | | Shag | 23.7 | |
| Calf and Wart Bank MNR | Isle of Man Government | Puffin | 265.4 | 78.9 |
| | | Manx shearwater | 2,364.7 | |
| Wicklow Head SPA | NPWS | Kittiwake | 300.6 | 101.2 |
| Glannau Aberdaron ac Ynys Enlli SPA | NRW | Manx shearwater | 2,364.7 | 139.6 |
| Rathin Island SPA | DAERA | Kittiwake | 300.6 | 145.6 |
| | | Guillemot | 153.7 | |
| | | Razorbill | 164.6 | |
| Ailsa Craig SPA | NatureScot | Gannet | 509.4 | 158.6 |
| | | Kittiwake | 300.6 | |
| | | Lesser black-backed gull | 236 | |
| | | Guillemot | 153.7 | |
| | | Herring gull | 85.6 | |
| Seas off Wexford cSPA | NPWS | Red-throated diver | 9 | 149.97 |
| | | Fulmar | 1,200.2 | |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| | | Manx shearwater | 2,364.7 | |
| | | Gannet | 509.4 | |
| | | Cormorant | 33.9 | |
| | | Shag | 23.7 | |
| | | Common scoter | N/A* | |
| | | Mediterranean Gull *Larus melanocephalus* | 20 | |
| | | Black-headed gull | 18.5 | |
| | | Lesser black-backed gull | 236 | |
| | | Herring gull | 85.6 | |
| | | Kittiwake | 300.6 | |
| | | Sandwich tern | 57.5 | |
| | | Roseate tern | 23.2 | |
| | | Common tern | 26.9 | |
| | | Arctic tern | 40.5 | |
| | | Little tern | 5 | |
| | | Guillemot | 153.7 | |
| | | Razorbill | 164.6 | |
| | | Puffin | 265.4 | |
| Ribble and Alt Estuaries SPA | Natural England | Lesser black-backed gull | 236 | 194.5 |
| | | Common tern | 26.9 | |
| Saltee Islands SPA | NPWS | Fulmar | 1,200.2 | 209.7 |
| | | Gannet | 509.4 | |
| | | Lesser black-backed gull | 236 | |
| | | Kittiwake | 300.6 | |
| | | Puffin | 265.4 | |
| | | Cormorant | 33.9 | |
| | | Shag | 23.7 | |
| | | Herring gull | 85.6 | |
| | | Guillemot | 153.7 | |
| | | Razorbill | 164.6 | |
| Skomer, Skokhom and the Seas off Pembrokeshire SPA | NRW | Manx shearwater | 2,364.7 | 238.9 |
| | | Puffin | 265.4 | |
| | | Storm petrel | 336** | |
| | | Lesser black-backed gull | 236 | |
| Grassholm SPA | NRW | Gannet | 509.4 | 240.5 |
| North Colonsay and Western Cliffs SPA | NatureScot | Kittiwake | 300.6 | 257.1 |
| | | Guillemot | 153.7 | |
| Horn Head to Fanad Head SPA | NPWS | Fulmar | 1,200.2 | 269.4 |
| | | Kittiwake | 300.6 | |
| | | Cormorant | 33.9 | |
| | | Shag | 23.7 | |
| | | Guillemot | 153.7 | |
| | | Razorbill | 164.6 | |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| Helvick Head to Ballyquin SPA | NPWS | Kittiwake | 300.6 | 275.6 |
| | | Cormorant | 33.9 | |
| | | Herring gull | 85.6 | |
| Tory Island SPA | NPWS | Fulmar | 1,200.2 | 301.8 |
| | | Puffin | 265.4 | |
| | | Razorbill | 164.6 | |
| West Donegal Coast SPA | NPWS | Fulmar | 1,200.2 | 317.8 |
| | | Kittiwake | 300.6 | |
| | | Cormorant | 33.9 | |
| | | Shag | 23.7 | |
| | | Razorbill | 164.6 | |
| | | Herring gull | 85.6 | |
| Rum SPA | NatureScot | Manx shearwater | 2,364.7 | 354.7 |
| | | Kittiwake | 300.6 | |
| | | Guillemot | 153.7 | |
| | | Red-throated diver | 9 | |
| Mingulay and Berneray SPA | NatureScot | Fulmar | 1,200.2 | 360.9 |
| | | Kittiwake | 300.6 | |
| | | Guillemot | 153.7 | |
| | | Shag | 23.7 | |
| | | Razorbill | 164.6 | |
| | | Puffin | 265.4 | |
| Beara Peninsula SPA | NPWS | Fulmar | 1,200.2 | 466.7 |
| Shiant Isles SPA | NatureScot | Fulmar | 1,200.2 | 471.0 |
| | | Guillemot | 153.7 | |
| | | Shag | 23.7 | |
| | | Kittiwake | 300.6 | |
| | | Puffin | 265.4 | |
| | | Razorbill | 164.6 | |
| The Bull and The Cow Rocks SPA | NPWS | Gannet | 509.4 | 482.4 |
| | | Puffin | 265.4 | |
| St Kilda SPA | NatureScot | Fulmar | 1,200.2 | 483.2 |
| | | Gannet | 509.4 | |
| | | Manx shearwater | 2,364.7 | |
| | | Leach's storm petrel *Oceanodroma leucorhoa* | 657*** | |
| | | Storm petrel | 336 | |
| | | Guillemot | 153.7 | |
| | | Kittiwake | 300.6 | |
| | | Puffin | 265.4 | |
| | | Razorbill | 164.6 | |
| Duvillaun Islands SPA | NPWS | Fulmar | 1,200.2 | 484.8 |
| | | Storm petrel | 336 | |
| | NPWS | Fulmar | 1,200.2 | 493.2 |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| Deenish Island and Scariff Island SPA | | Manx shearwater | 2,364.7 | |
| | | Storm petrel | 336 | |
| | | Lesser black-backed gull | 236 | |
| | | Arctic tern | 40.5 | |
| Iveragh Peninsula SPA | NPWS | Fulmar | 1,200.2 | 493.6 |
| | | Kittiwake | 300.6 | |
| | | Guillemot | 153.7 | |
| Skelligs SPA | NPWS | Fulmar | 1,200.2 | 509.0 |
| | | Manx shearwater | 2,364.7 | |
| | | Gannet | 509.4 | |
| | | Storm petrel | 336 | |
| | | Guillemot | 153.7 | |
| | | Kittiwake | 300.6 | |
| | | Puffin | 265.4 | |
| Boyne Estuary SPA | NPWS | Little tern | 5 | 18.5 |
| Outer Ards SPA | DAERA | Arctic tern | 40.5 | 56.1 |
| | | Light-bellied brent goose | N/A* | |
| South Dublin Bay and Tolka Estuary SPA | NPWS | Arctic tern | 40.5 | 59.0 |
| | | Common tern | 26.9 | |
| | | Roseate tern | 23.2 | |
| | | Light-bellied brent goose | N/A* | |
| Dalkey Islands SPA | NPWS | Arctic tern | 40.5 | 67.6 |
| | | Common tern | 26.9 | |
| | | Roseate tern | 23.2 | |
| The Murrough SPA | NPWS | Little tern | 5 | 86.8 |
| | | Light-bellied brent goose | N/A* | |
| | | Herring gull | N/A* | |
| | | Red-throated diver | N/A* | |
| Ramsey Bay MNR | Isle of Man Government | Arctic tern | 40.5 | 129.7 |
| Anglesey Terns SPA | JNCC | Arctic tern | 40.5 | 95.1 |
| | | Common tern | 26.9 | |
| | | Roseate tern | 23.2 | |
| | | Sandwich tern | 57.5 | |
| Larne Lough SPA | DAERA | Common tern | 26.9 | 125.2 |
| | | Roseate tern | 23.2 | |
| | | Sandwich tern | 57.5 | |
| | | Light-bellied brent goose | N/A* | |
| Liverpool Bay SPA | JNCC | Little tern | 5 | 127.7 |
| | | Common tern | 26.9 | |
| | | Red-throated diver | N/A* | |
| | | Common scoter | N/A* | |
| Puffin Island SPA | NRW | Cormorant | 33.9 | 147.8 |
| The Raven SPA | NPWS | Red-throated diver | N/A* | 162.9 |

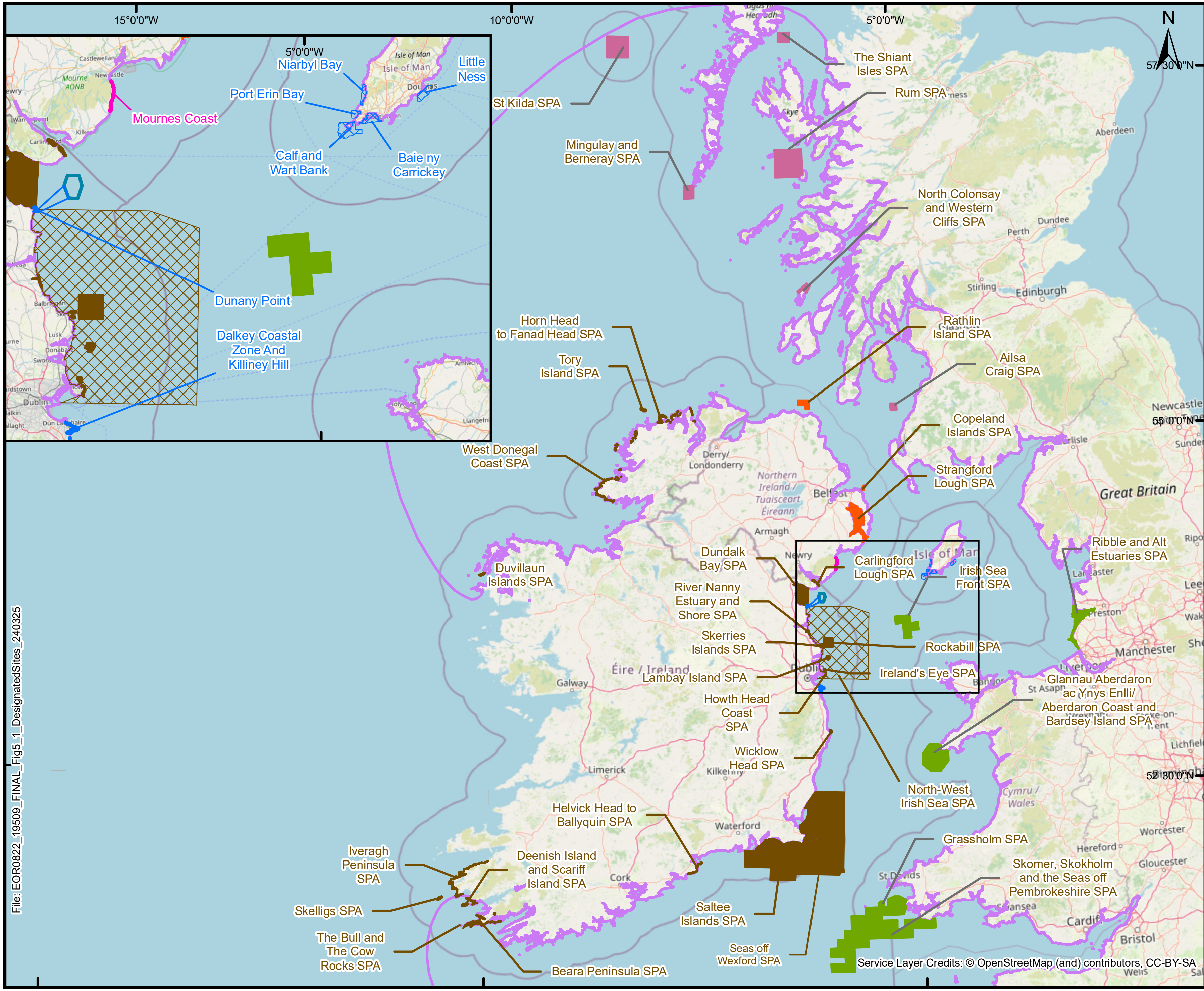
| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| | | Common scoter | N/A* | |
| | | Cormorant | N/A* | |
| Morecombe Bay and Duddon Estuary SPA | Natural England | Little tern | 5 | 170.8 |
| | | Common tern | 26.9 | |
| | | Sandwich tern | 57.5 | |
| Wexford Harbour and Slobs SPA | NPWS | Cormorant | N/A* | 177.7 |
| | | Light-bellied brent goose | N/A* | |
| | | Red-breasted merganser | N/A* | |
| | | Black-headed gull | N/A* | |
| | | Lesser black-backed gull | N/A* | |
| | | Little tern | 5 | |
| Sheep Island SPA | DAERA | Cormorant | 33.9 | 182.4 |
| The Dee Estuary SPA | Natural England | Little tern | 5 | 184.9 |
| | | Common tern | 26.9 | |
| | | Sandwich tern | 57.5 | |
| Lady's Island Lake SPA | DAERA | Arctic tern | 40.5 | 192.7 |
| | | Common tern | 26.9 | |
| | | Roseate tern | 23.2 | |
| | | Sandwich tern | 57.5 | |
| | | Black-headed gull | 18.5 | |
| Mersey Narrows and North Wirral Foreshore SPA | Natural England | Common tern | 26.9 | 194.7 |
| Keeragh Islands SPA | NPWS | Cormorant | 33.9 | 220.7 |
| Lough Foyle SPA | DAERA | Light-bellied brent goose | N/A* | 234.9 |
| Inishtrahull SPA | NPWS | Shag | 23.7 | 240.7 |
| | | Common gull | 50** | |
| Mid-Waterford Coast SPA | NPWS | Cormorant | 33.9 | 250.8 |
| | | Herring gull | 85.6 | |
| Lough Swilly SPA | NPWS | Black-headed gull | 18.5 | 283.1 |
| | | Common tern | 26.9 | |
| | | Sandwich tern | 57.5 | |
| | | Red-breasted merganser | N/A* | |
| | | Common gull | N/A* | |
| Greers Isle SPA | NPWS | Black-headed gull | 18.5 | 295.2 |
| | | Sandwich tern | 57.5 | |
| | | Common gull | 50 | |
| Ballymacoda Bay SPA | NPWS | Black-headed gull | N/A* | 301.8 |
| | | Common gull | N/A* | |
| | | Lesser black-backed gull | N/A* | |
| Inishbofin, Inishdooey and Inishbeg SPA | NPWS | Lesser black-backed gull | 236 | 302.2 |
| | | Common gull | 50** | |
| | | Arctic tern | 40.5 | |

| Designated Site | Agency | Relevant qualifying marine bird interest features | Mean Max foraging range + 1 SD (km) | Closest distance to offshore wind farm area (km) (marine pathway) |
|---|---|---|---|---|
| Glas Eileanan SPA | NatureScot | Common tern | 26.9 | 303.2 |
| West Donegal Islands SPA | NPWS | Shag | 23.7 | 312.2 |
| | | Common gull | 50** | |
| | | Herring gull | 85.6 | |
| Illancrone and Inishkeeragh SPA | NPWS | Common gull | 50** | 338.0 |
| | | Arctic tern | 40.5 | |
| | | Little tern | 5 | |
| Roaninish SPA | NPWS | Herring gull | 85.6 | 348.1 |
| Sovereign Islands SPA | NPWS | Cormorant | 33.9 | 348.2 |
| Old Head of Kinsale SPA | NPWS | Kittiwake | 300.6 | 357.7 |
| | | Guillemot | 153.7 | |
| Canna and Sanday SPA | NatureScot | Guillemot | 153.7 | 369.6 |
| | | Herring gull | 85.6 | |
| | | Kittiwake | 300.6 | |
| | | Puffin | 265.4 | |
| | | Shag | 23.7 | |
| Inishduff SPA | NPWS | Shag | 23.7 | 395.1 |
| Inishmurray SPA | NPWS | Shag | 23.7 | 404.3 |
| | | Herring gull | 85.6 | |
| | | Arctic tern | 40.5 | |
| Ardboline Island and Horse Island SPA | NPWS | Cormorant | 33.9 | 413.5 |
| Aughris Head SPA | NPWS | Kittiwake | 300.6 | 420.5 |
| Isles of Scilly SPA | Natural England | Shag | 23.7 | 437.1 |
| | | Lesser black-backed gull | 236 | |
| | | Storm petrel | 336 | |
| | | Great black-backed gull | 73 | |
| Blacksod Bay/Broad Haven SPA | NPWS | Arctic tern | 40.5 | 453.4 |
| Inishglora and Inishkeeragh SPA | NPWS | Cormorant | 33.9 | 471.0 |
| | | Shag | 23.7 | |
| | | Lesser black-backed gull | 236 | |
| | | Herring gull | 85.6 | |
| | | Arctic tern | 40.5 | |
| Inishkea Islands SPA | NPWS | Shag | 23.7 | 477.9 |
| | | Herring gull | 85.6 | |
| | | Common gull | 50** | |
| | | Arctic tern | 40.5 | |
| | | Little tern | 5 | |

* Qualifying feature is for wintering population therefore professional judgement is required to determine likely impact.

** The foraging distance presented for storm petrel and common gull is the maximum from a single colony, therefore no mean nor SD.

*** Leach's storm petrel is a mean value from a single colony (11 birds).




## Legend

- Project Offshore Wind Farm Area
- Project Offshore Cable Corridor
- Cumulative Offshore Ornithology Study Area
- Irish SPA
- Irish cSPA
- Northern Irish SPA
- Scottish SPA
- English and Welsh SPA
- Isle of Man MNR
- Northern Irish ASSI
- Irish pNHA

**Data Sources:** Client, NPWS, JNCC

**Client**

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

**Project**

## Oriel Wind Farm Project

**Title** **Figure 5-1**
**Designated Sites within mean-maximum foraging ranges of their qualifying interest features located within Cumulative Offshore Ornithology Study Area**

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*Issue Details*

| | | | |
|---|---|---|---|
| Drawn By: | MJ | Project No. | EOR0822 (MDR1520B) |
| Checked By: | MJ | File Ref: | |
| Approved By: | AOS | | EOR0822_ORN_T_19509_FINAL |
| Scale: | 1:4,000,000@ A4 | Projection: | ITM (IRENET95) Geographic Co-ordinates: ETRS89 |
| Date: | 25/03/2024 | | |

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
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## 5.3 Recent seabird population trends

### 5.3.1 Overview

The following sections provide an overview of the current pressures and data trends on seabird populations based on the long-term Seabird Monitoring Programme (SMP) coordinated by the JNCC.

### 5.3.2 Current pressures

Seabird species are generally long-lived, with delayed breeding and low annual reproductive outputs. Seabird and coastal bird populations are subject to natural variation in population size and distributions, largely as a result of year to year variation in recruitment success. Therefore, influencing factors to adult survival in seabird species can greatly impact population dynamics but may however be unrecognised for several years (Stienen *et al.*, 2007).

A recent study suggests that, in terms of number of species affected and the average impact, the top three threats to seabird populations globally are invasive species (165 species across all the most threatened groups), bycatch in fisheries (100 species but with the greatest average impact) and climate change (96 species affected) (Dias *et al.*, 2019). Furthermore, it was estimated that more than 170 million individual birds (over 20% of all seabirds) are exposed to the combined impacts of bycatch, invasive alien species and climate change, and over 380 million (45% of all seabirds) are exposed to at least one of these three threats (Dias *et al.*, 2019).

It is estimated that 89% of seabirds affected by climate change are also affected by other threats, such as overfishing. Recent studies have described the greatest threat to fish stocks upon which seabirds forage is the combined effect of climate change and overfishing (Brander, 2007). Consequently, climate change and removal of prey items through overfishing can impact seabird breeding success and survival and, ultimately, population stability (Frederiksen *et al.*, 2004; Ainley and Blight, 2009). Increasing loss of breeding habitat and food resources are noted as key factors for seabird declines, further amplified by overfishing and rising ocean temperatures relating to climate change (Burke, 2018).

Sandeels, which make up a significant component of many of the seabirds' diet, is less likely to be able to adapt to increasing temperatures due to their specific habitat requirements for coarse sandy sediment. Declining recruitment in sandeel in parts of the UK has been correlated with increasing sea temperature (Heath *et al.*, 2012). A study by the BTO also suggested that during the years when a greater proportion of the North Sea's sandeel was fished; the rates of seabird breeding failure increased (Cook *et al.*, 2014). More recent research suggests that a closure of sandeel fishery correlated with an increase in breeding success for kittiwake, but no correlation with razorbill or guillemot (Searle *et al*., 2023).

Seabirds are more threatened globally than any other comparable group of birds with over 25% of species threatened and five percent of species critically endangered (Croxall *et al.*, 2012; Dias *et al*., 2019). Many of the seabirds of Ireland are listed as vulnerable or endangered at a European or global level, owing to their natural lifecycle traits and increasing pressures on marine environments (Burke, 2018).

During the summer of 2022 there were large-scale outbreaks of avian flu across multiple seabird colonies within Ireland, the UK and throughout Europe. The exact number of birds that died and of which species is not known but any previous population estimates will not have taken account of this potentially reduced population. Colonies were impacted in different ways, with some reporting 100% chick mortality with fewer adult birds impacted, whereas others had large-scale adult die offs (Adlhoch *et al.,* 2022; NatureScot, 2023b; RSPB, 2024).The populations at different colonies provide an understanding of the impact, with a large variation compared to the "baseline" (RPSB, 2024). RSPB coordinated a UK wide study at important seabird colonies to understand the impact, it concluded that, on average there was a reduction in population. Great skua declined that most (-76% decrease) followed by tern species (common tern declined by -42% and sandwich tern declined by -35%) at the monitored colonies. Other species, such as guillemot (-7% decrease) did not seem as impacted).

All of the survey data and population estimates presented within this report precede the HPAI impacts and therefore there is no specific change to the assessment presented. However where an issue to be highlighted at a specific colony, the specific pressures on that colony would be further investigated.

### 5.3.3 Seabird Monitoring Programme data trends

The Seabird Monitoring Programme (SMP) is an ongoing annual monitoring programme of 25 species that regularly breed in Britain and Ireland. Established in 1986, the SMP was led and co-ordinated by JNCC in partnership with multiple organisations.

From July 2022, the annual monitoring scheme is organised by the BTO in partnership with JNCC, and with the RSPB as an associate partner. It is supported by Natural England, NRW, NatureScot, DAERA, DCCAE and BirdWatch Ireland, alongside a wider advisory group. Close collaboration with organisations in the Republic of Ireland enables all-Ireland interpretation of seabird trends.

Seabird population trends are a key indicator for the marine environment, providing an insight into local fisheries, climatic changes and impact of human activity. A summary of the recent JNCC SMP results are presented within Table 5-2 for the whole of UK and Ireland. Several species have illustrated declines between 2000 and 2019, including fulmar, shag, kittiwake, great black-backed gull, common tern, little tern and Arctic tern. However, several species have presented positive population trend changes between 2000 and 2019, including cormorant, gannet, black-headed gull, Sandwich tern, guillemot, and razorbill (JNCC, 2021).

**Table 5-2: Recent seabird population trends, based on the results of the JNCC Seabird Monitoring Programme.**

| Species | Population Trend Change (%) | | |
|---|---|---|---|
| | 1969-70 to 1985-88 | 1985-88 to 1998-2002 | 2000-2019 |
| Fulmar | 77 | -3 | -33 |
| Manx shearwater | N/A | N/A | N/A |
| Gannet | 39 | 39 | 34 |
| Shag | 21 | -27 | -40 |
| Cormorant | 9 | 10 | 16 |
| Kittiwake | 24 | -25 | -29 |
| Black-headed gull | 5 | 0 | 26 |
| Common gull | 25 | 36 | N/A |
| Great black-backed gull | -7 | -4 | -23 |
| Lesser black-backed gull | 29 | 40 | N/A |
| Herring gull | -48 | -13 | N/A |
| Great skua | 148 | 26 | N/A |
| Little tern | 58 | -23 | -28 |
| Common tern | 9 | -9 | -3 |
| Arctic tern | 50 | -31 | -5 |
| Sandwich tern | 33 | -15 | 5 |
| Guillemot | 77 | 31 | 60 |
| Black guillemot | N/A | 3 | N/A |
| Razorbill | 19 | 21 | 37 |
| Puffin | 15 | 19 | N/A |

## 5.4 Desk-based species data

### 5.4.1 Overview

This section provides an overview of the data collated from various sources, to provide a summary of seabird populations in the vicinity of the Project. A summary of the data sources from which this section has been developed is illustrated within Table 5-3.

**Table 5-3: Summary of key desktop reports or databases considered in this section.**

| Title | Author | Year |
|---|---|---|
| ESAS | Joint Nature Conservation Committee | 2012 |
| ObSERVE programme 'The seasonal distribution and abundance of seabirds in the western Irish Sea' | Department of Communications, Climate Action and Environment, National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht. | 2018 |
| Dundalk Bay (site 0Z401) I-WeBS Database | BirdWatch Ireland and National Parks and Wildlife Service | 2022 |

### 5.4.2 European Seabirds at Sea (ESAS)

ESAS data provide the abundance and distribution of seabirds in Irish waters (Dunn, 2012). The datasets consist of the observations of all seabirds and derived grids, showing the density of flying and sitting species on a 3 km grid scale within the area covered. ESAS data were amalgamated from a long-running programme of survey and research work on seabirds in the marine environment in the northeast Atlantic since 1979, and in the southwest Atlantic between 1998 and 2002.

ESAS data was reviewed for an area comprising the offshore wind farm area and offshore cable corridor plus a 5 km buffer zone (see section 4.1). A total of 202 observations of 482 individuals from 10 species were recorded. Data were collected in either January, July or September in 1984, 1988, 1989 and 1995. Data collected provided total observation data and total counts for several species, including fulmar, gannet, great black-backed gull, herring gull, kittiwake, lesser black-backed gull, Manx shearwater, guillemot, guillemot/razorbill, razorbill and shag. A summary of the ESAS data is presented below within Table 5-4.

**Table 5-4: Summary of ESAS data within the Offshore Ornithology Study Area.**

| Species | Year | Month | Total Observations | Total Individuals Recorded |
|---|---|---|---|---|
| Fulmar | 1988 | September | 4 | 4 |
| | 1989 | July | 1 | 1 |
| | 1995 | January | 9 | 12 |
| Gannet | 1988 | September | 8 | 11 |
| | 1989 | July | 1 | 1 |
| | 1995 | January | 2 | 2 |
| Great black-backed gull | 1988 | September | 2 | 3 |
| | 1995 | January | 7 | 18 |
| Herring gull | 1995 | January | 25 | 47 |
| Kittiwake | 1988 | September | 9 | 22 |
| | 1995 | January | 32 | 88 |
| Lesser black-backed gull | 1988 | September | 1 | 1 |
| | 1995 | January | 4 | 4 |
| Manx shearwater | 1988 | September | 9 | 15 |

| Species | Year | Month | Total Observations | Total Individuals Recorded |
|---|---|---|---|---|
| Guillemot | 1984 | January | 1 | 1 |
| | 1988 | September | 24 | 52 |
| | 1989 | July | 4 | 10 |
| | 1995 | January | 44 | 168 |
| Guillemot/Razorbill | 1988 | September | 2 | 4 |
| | 1995 | January | 6 | 7 |
| Razorbill | 1988 | September | 2 | 5 |
| | 1995 | January | 3 | 4 |
| Shag | 1995 | January | 2 | 2 |
| **Totals** | | | **202** | **482** |

### 5.4.3 ObSERVE Programme – The seasonal distribution and abundance of seabirds in the western Irish Sea

In 2016 and early 2017, the ObSERVE programme supported fine-scale aerial surveys to assess the occurrence and distribution of seabird species in the Irish Sea. This section provides a summary of the reported outputs of these surveys (Jessopp *et al.*, 2018).

The surveys gathered data on sightings, density distributions, habitat associations, and abundance estimates for the ObSERVE western Irish Sea survey area. The survey was conducted during the breeding season (June to early July 2016), the post-breeding season (late August to September 2016) and winter (late November 2016 to early January 2017) via 55 parallel survey transects spaced approximately 2 nautical miles (3.7 km) apart, and between 20-30 nautical miles in length covering the east coast of Ireland in the Irish Sea. Surveys covered an area spanning from Dundalk in the north, to south of Wexford harbour in the south. The northern area of the survey region studied within the ObSERVE survey area encompasses the offshore wind farm area.

Across the survey period, there were 13,492 sightings of 45,409 seabirds, representing 29 seabird species or species groups (Jessopp *et al.*, 2018) within the entire ObSERVE survey area. Analysis of this data suggests the western Irish Sea supported 97,326 seabirds during the 2016 breeding season, 299,122 seabirds during the autumn of 2016, and 87,180 seabirds during the 2016 winter period. The most frequently sighted and most abundant species within the surveys were razorbill/guillemot, with frequent sightings of gannet, fulmar and gull species. A summary of the total sightings and individuals across the summer, autumn and winter periods is presented in Table 5-5.

The second phase of ObSERVE (ObSERVE II) is currently being undertaken between summer 2021 until summer 2025. The data gathered thus far is not currently available for inclusion.

**Table 5-5: Seabird sightings summary from aerial surveys in the Irish Sea in summer, autumn and winter 2016. 'Sightings' indicates the number of sightings, 'Individuals' indicates the total number of individuals counted (extracted from Jessopp *et al.*, 2018).**

| Species | Summer | | Autumn | | Winter | |
|---|---|---|---|---|---|---|
| | Sightings | Individuals | Sightings | Individuals | Sightings | Individuals |
| Gannet | 194 | 331 | 445 | 828 | 27 | 33 |
| Cormorant/shag | 53 | 255 | 50 | 182 | 71 | 106 |
| Fulmar | 41 | 59 | 571 | 1,337 | 75 | 137 |
| Great skua | - | - | 3 | 4 | 1 | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Herring/common gull | 207 | 568 | 145 | 890 | 412 | 1,268 |
| Black-headed gull | 6 | 17 | 12 | 67 | 79 | 214 |
| Lesser black-backed gull | - | - | 25 | 31 | 8 | 8 |
| Great black-backed gull | - | - | 74 | 95 | 34 | 48 |
| Black-backed gull species | 55 | 77 | 42 | 88 | 72 | 171 |
| Little gull | - | - | - | - | 37 | 80 |
| Kittiwake | 309 | 499 | 326 | 1,355 | 310 | 567 |
| Large gull spp. | 9 | 43 | 41 | 724 | 62 | 579 |
| Small gull spp. | 38 | 63 | 31 | 763 | 97 | 144 |
| Manx shearwater | 790 | 3,669 | 80 | 1,062 | 2 | 5 |
| Shearwater spp. | 3 | 7 | - | - | 2 | 4 |
| Petrel spp. | 1 | 1 | 7 | 9 | - | - |
| Puffin | 23 | 26 | 1 | 1 | - | - |
| Black guillemot | 5 | 6 | 2 | 6 | - | - |
| Razorbill/Guillemot | 1,800 | 3,849 | 3,496 | 16,444 | 2,245 | 4,470 |
| Auk spp. | 20 | 135 | 2 | 31 | - | - |
| Arctic/Common tern | 299 | 498 | 144 | 737 | - | - |
| Roseate tern | 66 | 131 | 13 | 34 | - | - |
| Sandwich tern | 39 | 60 | 21 | 30 | - | - |
| Little tern | 52 | 72 | 23 | 65 | - | - |
| Tern spp. | 7 | 8 | 1 | 4 | - | - |
| Common scoter | - | - | 31 | 855 | 41 | 328 |
| Velvet scoter | - | - | 6 | 9 | 9 | 30 |
| Scoter spp. | - | - | 6 | 45 | 4 | 11 |
| Diver spp. | 4 | 4 | 115 | 879 | 170 | 252 |

### 5.4.4 Irish Wetland Bird Survey (I-WeBS) Data

I-WeBS is a joint scheme of BirdWatch Ireland and NPWS which aims to monitor the numbers and distribution of waterbird populations wintering in the Republic of Ireland to enable identification of long-term spatio-temporal trends. To allow for efficient management of data and observation of populations, data records are clustered within ‘sites’. The Dundalk Bay I-WeBS sites (site 0Z401) database was reviewed to support the development of the baseline information for the Project offshore ornithology features (I-WeBS, 2022).

A total of 227 counts of 50 species were recorded within the I-WeBS Dundalk Bay database, with data provided for the most recently available five-year survey reporting period (2015/16 to 2019/20). The species five-year peak counts and five-year mean counts (2015/16 to 2019/20) have been considered within the development of the species accounts presented within section 5.5.1. Data collected provided total counts for several species, including golden plover, oystercatcher, knot, black-tailed godwit, lapwing, bar-tailed godwit, dunlin, redshank and curlew. Additionally, total counts were also available for several seabirds and divers including black-headed gull, common gull, herring gull, red-throated diver, great northern diver, common scoter and red-breasted merganser.

## 5.5 Site-specific survey data

This section provides a summary of the analysed site-specific boat-based survey data for the period May 2018 to May 2020 and DAS for the period April 2020 to September 2020 (APEM, 2020).

Table 5-6 presents total numbers of birds recorded for each species encountered 'on transect' during fieldwork within the Offshore Ornithology Study Area. "On transect" is only applicable to the boat-based survey data, all DAS data is included. Monthly data for each species recorded on transect are presented in section 5.5.1. Additional observations of birds recorded during the surveys, but not counted while on transect, are also discussed within section 5.5.1 as 'All Records' which includes all birds observed (whether present on transect or recorded incidentally).

It is important to note that these numbers should not be taken as absolute; some birds may be recorded multiple times in the same month or even multiple times during one transect during a single survey day. Model derived abundance and density estimates for the most common species, and species for which an impact assessment has been undertaken are presented alongside the raw data within the individual species accounts (section 5.6). The model derived abundance and density estimates were only produced for the offshore wind farm area and associated buffer (2 km).

**Table 5-6: Total numbers of birds recorded 'on transect' during the monthly boat-based surveys between May 2018 and May 2020 and aerial surveys between April 2020 to September 2020 with associated mean max foraging range.**

| Species | Transect records | Mean maximum foraging range (±1 SD) (km) (Woodward *et al*., 2019) |
|---|---|---|
| **Numbers in excess of 500 individuals** | | |
| Guillemot | 23,878 | 73.2 ± 80.5 |
| Manx shearwater | 8,043 | 1,346.8 ± 1,018.7 |
| Razorbill | 2,955 | 88.7 ± 75.9 |
| Common scoter | 2,222 | N/A |
| Guillemot / razorbill | 2,213 | N/A |
| Gannet | 1,216 | 315.2 ± 194.2 |
| Black guillemot | 1,135 | 4.8 ± 4.3 |
| Great northern diver | 837 | N/A |
| Kittiwake | 742 | 156.1 ± 144.5 |
| **Numbers in excess of 200 individuals and less than 500 individuals** | | |
| Great black-backed gull | 414 | 73 |
| Herring gull | 359 | 58.8 ± 26.8 |
| Common gull | 323 | 50 |
| **Numbers in excess of 100 individuals and less than 200 individuals** | | |
| Shag | 183 | 13.2 ± 10.5 |
| Red-throated diver | 106 | 9 |
| **Between 10-100 individuals** | | |
| Puffin | 68 | 137.1 ± 128.3 |
| Auk spp. | 61 | N/A |
| Common tern | 55 | 18.0 ± 8.9 |
| Gull spp. | 56 | N/A |

| | | |
|---|---|---|
| Cormorant | 47 | 25.6 ± 8.3 |
| Fulmar | 43 | 542.3 ± 657.9 |
| Arctic / common tern (comic tern) | 26 | N/A |
| Roseate tern | 22 | 12.6 ± 10.6 |
| Sandwich Tern | 19 | 34.3 ± 23.2 |
| Lesser black-backed gull | 16 | 127 ± 109 |
| Small gull spp. | 11 | N/A |
| Tern spp. | 11 | N/A |
| **Less than 10 individuals** | | |
| Diver spp. | 9 | N/A |
| Red-breasted merganser | 8 | N/A |
| Black-headed gull | 7 | 18.5 |
| Arctic skua | 7 | N/A |
| Storm petrel | 6 | 336 |
| Cormorant / shag | 6 | N/A |
| Great skua | 3 | 443.3 ± 44.6 |
| Meadow pipit | 3 | N/A |
| Duck spp. | 3 | N/A |
| Dunlin | 2 | N/A |
| Arctic tern | 1 | 25.7 ± 14.8 |
| Little gull | 1 | N/A |
| Large gull spp. | 1 | N/A |
| Great shearwater | 1 | N/A |
| Curlew | 1 | N/A |

It was not possible to identify 2,336 individuals (5.2% of all bird records) to species level; these individuals were therefore attributed to a high-level species group which included: guillemot / razorbill, auk species, gull species, small gull species, large gull species, arctic / common tern, tern spp., diver species, cormorant / shag and duck species.

The most commonly observed species recorded on transect was guillemot, comprising over half of all bird records (23,878 guillemot records out of a total of 45,059 birds sighted). Manx shearwater was the second most frequently recorded species (8,043 individuals), followed by razorbill (2,955 individuals), common scoter (2,222 individuals), gannet (1,216 individuals) and black guillemot (1,135 individuals). Over 2,000 individuals were identified as being either guillemot or razorbill.

Several species were observed in numbers in excess of 200 individuals (but less than 500 individuals) including great black-backed gull (414), herring gull (359) and common gull (323), and two species were observed in numbers in excess of 100 individuals (shag (183) and red-throated diver (106)). Puffin, common tern, cormorant, fulmar, roseate tern, Sandwich tern and lesser black-backed gull were observed in numbers between 10 and 100 individuals, while the remaining species had less than ten individuals recorded.

In terms of flight heights, most of the birds observed flying at heights of over 20 m were gulls, with herring gull most likely to be encountered flying over 20 m. The most commonly observed species (guillemot, Manx shearwater and razorbill) were all observed to fly at heights which would typically be below rotor swept height (i.e. < 20 m).

### 5.5.1 Biological seasons of species recorded on site-specific surveys

Species that were recorded during the boat-based surveys between May 2018 and May 2020 and DAS between April 2020 and September 2020 are shown in Table 5-7, together with an overview of relevant seasons for each species based on information from Furness (2015). Where species seasonality is not included in Furness (2015), seasons are defined with reference to *Birds of the Western Palearctic* (Snow and Perrins, 1998) or NatureScot guidance (NatureScot, 2017). The breeding period presented is the "migration-free breeding period" (Furness, 2015), whereby the species will be incubating or rearing the eggs/young and therefore will not move away from the nesting location. Non-breeding season is not specified for each species, but includes the autumn migration, winter and spring migration periods. These months are provided as a guide, but individual birds may breed earlier or later and therefore impact the migration timings.

**Table 5-7: Species recorded during site-specific surveys and definitions of biological seasons (from Furness *et al.,* 2015, unless otherwise stated).**

| Species | Migration-free Breeding | Autumn migration | Migration-free Winter | Spring migration | Non-breeding |
|---|---|---|---|---|---|
| Arctic skua | May-Jul | Aug-Oct | - | Apr-May | - |
| Arctic tern | May-Aug | Jul-Sep | - | Apr-May | - |
| Black-headed gull* | May-Aug | - | - | - | Sep-Mar |
| Black guillemot | Apr-Aug | - | Sep-Mar | - | - |
| Common gull* | May-Aug | - | - | - | Sep-Apr |
| Common scoter* | May-Aug | Sep-Dec | - | Jan-Apr | - |
| Common tern | May-Aug | Jul-Sep | - | Apr-May | - |
| Cormorant | Apr-Jul | Aug-Oct | Nov-Jan | Feb-Mar | - |
| Fulmar | Apr-Aug | Sep-Oct | Nov | Dec-Mar | - |
| Gannet | Apr-Aug | Sep-Nov | - | Dec-Mar | - |
| Great black-backed gull | May-Jul | Aug-Nov | Dec | Jan-Apr | - |
| Great northern diver | - | Sep-Nov | Dec-Feb | Mar-May | - |
| Great skua | May-Aug | Aug-Oct | Nov-Feb | Mar-Apr | - |
| Guillemot | Mar-Jun | Jul-Oct | Nov | Dec-Feb | - |
| Herring gull | May-Jul | Aug-Nov | Dec | Jan-Apr | - |
| Kittiwake | May-Jul | Aug-Dec | - | Jan-Apr | - |
| Lesser black-backed gull | May-Jul | Aug-Oct | Nov-Feb | Mar-Apr | - |
| Little gull* | Apr-Jul | - | - | - | Aug-Apr |
| Manx shearwater | Apr-Aug | Aug-Oct | Nov-Feb | Mar-May | - |
| Puffin | May-Jun | Jul-Aug | Sep-Feb | Mar-Apr | - |
| Razorbill | Apr-Jul | Aug-Oct | Nov-Dec | Jan-Mar | - |
| Red-throated diver | Mar-Aug | Sep-Nov | Dec-Jan | Feb-Apr | - |
| Roseate tern | May-Aug | Aug-Sep | - | Apr-May | - |
| Sandwich tern | Apr-Aug | Jul-Sep | - | Mar-May | - |
| Shag | Mar-Aug | Sep-Oct | Nov | Dec-Feb | - |
| Storm petrel** | May-Sep | - | - | - | - |

* Information taken from Bird breeding season dates in Scotland (NatureScot, 2017).

** Information taken from Birds of the Western Palearctic (Snow and Perrins, 1998).

## 5.6 Species Accounts

This section provides an overview of each of the species identified within the Offshore Ornithology Study Area from the desktop data review and/or site-specific surveys. Desk-based data is based on the species accounts presented in Jessopp *et al.*, (2018), which provides a summary of the findings of aerial seabird surveys conducted along the east coast of Ireland in the summer, autumn and winter of 2016/2017 (ObSERVE), and I-WeBS accounts. The desk-based data also draws upon the findings from the National Seabird Monitoring Programme undertaken between 2013 and 2018 (Cummins *et al.,* 2019).

Where available, recent (within the last five summers, 2017 – 2022) SMP colony data is provided for each species. The recent colony counts presented within this section do not represent the colonies used in the apportioning technical report (see appendix 11-7: Apportioning Impacts to Individual Colonies; for full methodologies for which colonies are included within the apportioning task. The colonies included are those which are located within the maximum search area from the Cumulative Offshore Ornithology Study Area (see section 3) and the mean max foraging range of the specific species. The counts provided within each species table has a specific unit, either apparently occupied nests (AON), apparently occupied sites (AOS) or individuals (IND), see column headings for detail.

Site-specific data is based on the boat and digital aerial seabird surveys which have been conducted to support the development of this report (Aquafact, 2019 and APEM, 2020). Boat-based data collected up to 2020, analysed by RPS, are also included within this report. In the case of light-bellied brent geese, the site-specific data is based on the VP surveys undertaken during the late autumn (November to December 2019) and spring migration (April 2020) survey programmes which are provided in appendix 11-3: Migratory Geese Survey Report.

### 5.6.1 Common scoter

#### Ecology

With an estimated 50 pairs and long-term population declines, common scoter are scarce breeders in Ireland (Gilbert *et al*., 2021) and the UK. This species favours large inland water bodies with tree or shrub cover to aid nesting, however they flock in offshore areas during winter. Common scoter have a preference for shallow waters of less than 20 m depth (optimally 5-15 m) over sandy substrates, generally between 500 m and approximately 2 km from the shore (BirdLife International, 2020). Their diet consists predominantly of molluscs, especially during the winter, although it occasionally forages on other aquatic invertebrates such as crustaceans (e.g. barnacles and shrimps), worms (del Hoyo *et al.*, 1992), echinoderms, isopods, amphipods (Kear, 2005) and insects (e.g. midges and caddisflies) as well as small fish (del Hoyo *et al.*, 1992) and fish eggs (BirdLife International, 2020).

The common scoter is Red-listed as a Bird of High Conservation Concern in the UK and Ireland due to long term (25 year) population declines (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021).

#### Desk-based data

The 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) recorded a total of 72 sightings representing 1,183 individuals within the ObSERVE western Irish Sea survey area, with no sightings in the summer surveys. Sightings were concentrated along the coastline around Dundalk Bay within autumn surveys. Dundalk Bay was observed as an important area for common scoter during winter surveys, although sightings also occurred to the east of Dublin Bay and further from the coast. Observations of common scoter were concentrated around coastal and nearshore waters, illustrating a preference for water depths of 10 m. Mean density of common scoter across the ObSERVE survey area ranged from 0.94 birds/ km$^2$ in autumn surveys and 0.34 birds/ km$^2$ in winter surveys (Jessopp *et al.*, 2018).

Within the Dundalk Bay I-WeBS site area, common scoter was recorded at levels which exceed National Importance (1% level of 110 birds) with a five-year peak-mean count of 945 individuals (2015/16 to 2019/20). However, populations of common scoter did not exceed levels of International Importance (1% level of 7,500 birds) (Table 5-8).

**Table 5-8: Summary of I-WeBS survey counts for common scoter within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 90 | 11 | 2,121 | 945 | 110 | 7,500 |

## Site-specific data

Common scoter was present in varying numbers in the Study Area throughout the survey period, with a maximum record of 106 birds recorded (247 total records) during the boat-based transect in January 2019 (Aquafact, 2019) and 2,005 individuals recorded during the DAS in April 2020 (APEM, 2020).

Observations of common scoter were concentrated around the western and northwestern extent of the Study Area, although one flock of birds was also observed at the southern edge of the Study Area in October 2018 and again in November 2018 (Aquafact, 2019). In April 2020, the large flock of common scoter were recorded in the west of the Study Area. There were few birds recorded within the wind farm area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-9.

Table **5-10** shows the seasonal variation between 2018 and 2020 for all records, which are based on the definitions taken from Snow and Perrins (1998). Figure 5-2 shows the spatial distribution of common scoter during the survey period.

**Table 5-9: Transect records and total observations of common scoter from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 10 | - | 880 |
| June 2018 | 4 | - | 8 |
| July 2018 | 0 | - | 0 |
| August 2018 | 0 | - | 42 |
| September 2018 | 0 | - | 0 |
| October 2018 | 2 | - | 31 |
| November 2018 | 8 | - | 49 |
| December 2018 | 0 | - | 43 |
| January 2019 | 106 | - | 247 |
| February 2019 | 0 | - | 39 |
| March 2019 | 50 | - | 86 |
| April 2019 | 0 | - | 5 |
| June 2019 | 0 | - | 0 |
| July 2019 | 0 | - | 0 |
| August 2019 | 0 | - | 0 |
| October 2019 | 3 | - | 3 |
| December 2019 | 0 | - | 0 |
| January 2020 | 1 | - | 1 |
| April 2020 | - | 2,005 | 2,005 |
| May 2020 | 0 | 0 | 0 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 4 | 4 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| August 2020 | - | 0 | 0 |
| September 2020 | - | 29 | 29 |
| **Total** | **184** | **2,038** | **3,472** |

**Table 5-10: Biological seasonal variation of common scoter recorded between May 2018 and September 2020.**

| Year | Spring Migration Jan – Apr | Breeding May – Aug | Autumn Migration Sep – Dec | Winter | Non-breeding |
|---|---|---|---|---|---|
| 2018 | - | 934 | 123 | - | - |
| 2019 | 377 | 0 | 3 | - | - |
| 2020 | 2,006 | 4 | 29 | - | - |

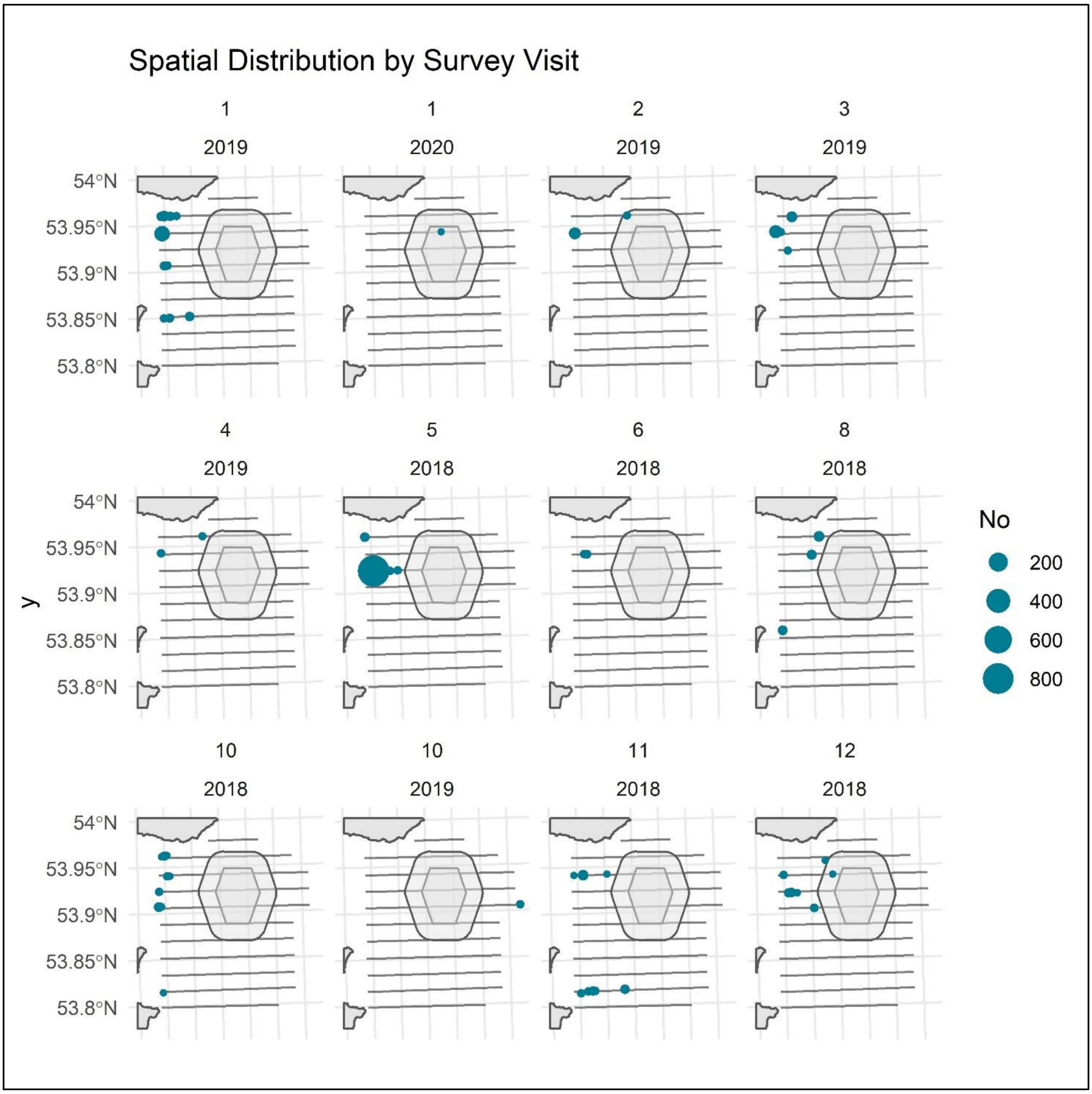


**Figure 5-2: Spatial distribution of common scoter records during boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

The peak levels of activity were recorded during the spring migration (up to 2,006 birds), with smaller numbers recorded in the breeding (up to 934 birds) and autumn migration (up to 123 birds) periods.

During the boat-based transect surveys, the majority of birds observed were in flight (flying) (172 individuals, 93.5%) compared to sitting on the sea surface ('sitting') (12 individuals, 6.5%). Off transect, a higher proportion of birds were recorded sitting (943 individuals, 75.4%) compared to flying (307 individuals, 24.6%). Flight heights on and off transect were observed between 5 m and 10 m; 20 individuals were observed flying at a height of 20 m off transect.

During the DAS undertaken between April 2020 and September 2020 (APEM, 2020), a total of 2,038 common scoter were identified, of which 2,031 were observed sitting and 7 were recorded flying. Flight heights were not calculated during the DAS.

Table 5-11 below shows the proportion of individuals observed sitting and flying throughout the Study Area between May 2018 and September 2020. Figure 5-3 shows the recorded flight heights of common scoter during the boat-based surveys.

**Table 5-11: Proportion of common scoter recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 10 | 100 | 0 | 0 | 20 | 2.3 | 850 | 97.7 |
| June 2018 | 4 | 100 | 0 | 0 | 4 | 100 | 0 | 0 |
| July 2018 | No birds recorded | | | | | | | |
| August 2018 | 0 | 0 | 0 | 0 | 42 | 100 | 0 | 0 |
| September 2018 | No birds recorded | | | | | | | |
| October 2018 | 2 | 100 | 0 | 0 | 29 | 100 | 0 | 0 |
| November 2018 | 0 | 0 | 8 | 100 | 41 | 100 | 0 | 0 |
| December 2018 | 0 | 0 | 0 | 0 | 30 | 69.8 | 13 | 30.2 |
| January 2019 | 106 | 100 | 0 | 0 | 61 | 43.2 | 80 | 56.7 |
| February 2019 | 0 | 0 | 0 | 0 | 39 | 100 | 0 | 0 |
| March 2019 | 50 | 100 | 0 | 0 | 36 | 100 | 0 | 0 |
| April 2019 | 0 | 0 | 0 | 0 | 5 | 100 | 0 | 0 |
| June 2019 | No birds recorded | | | | | | | |
| July 2019 | | | | | | | | |
| August 2019 | | | | | | | | |
| October 2019 | 0 | 0 | 3 | 100 | 0 | 0 | 0 | 0 |
| December 2019 | No birds recorded | | | | | | | |
| January 2020 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| April 2020 | 3 | 0.1 | 2002 | 99.9 | N/A | | | |
| May 2020 | No birds recorded | | | | | | | |
| June 2020 | | | | | | | | |
| July 2020 | 4 | 100 | 0 | 0 | N/A | | | |
| August 2020 | No birds recorded | | | | | | | |
| September 2020 | 0 | 0 | 29 | 0 | N/A | | | |
| **Total** | **172** | **93.5** | **12** | **6.5** | **307** | **24.6** | **943** | **75.4** |

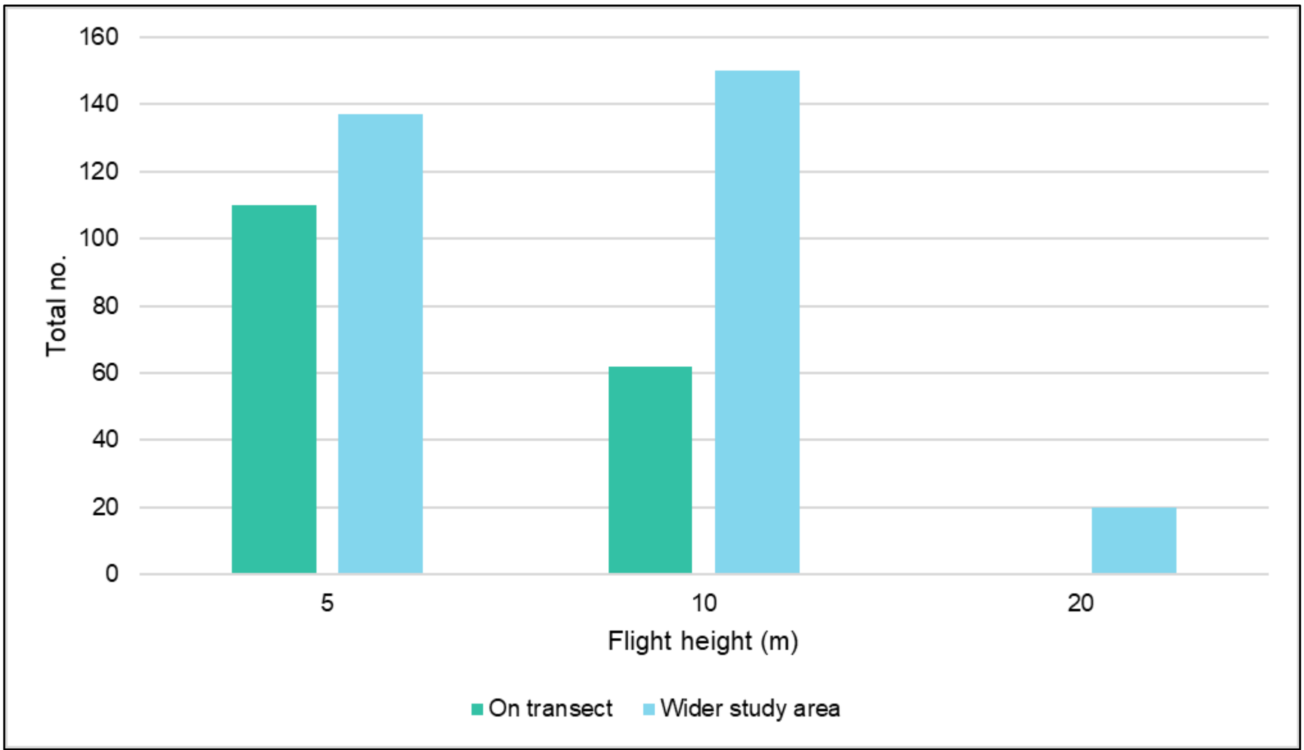


**Figure 5-3: Common scoter flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-2), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.2 Red-breasted merganser

### Ecology

Red-breasted merganser is both a resident species and winter visitor, present in greater numbers during winter months following an influx in individuals from northern and eastern breeding areas (Stone *et al.*, 1995). This species breeds from April in single pairs or colonies (del Hoyo *et al.*, 1992), on islands, small islets, sheltered rivers and lakes in the north and west of Ireland (Balmer *et al.*, 2013). It is gregarious during the winter and on migration, and flocks of up to a hundred or more may be observed in suitable sites during the autumn (BirdLife International, 2019).

Red-breasted merganser are frequent in shallow coastal marine habitats as well as offshore areas (Crowe, 2005), with a preference for clear, shallow waters not affected by heavy wave action. Their diet consists predominantly of small, shoaling marine or freshwater fish, as well as small amounts of plant material and aquatic invertebrates (del Hoyo *et al.*, 1992).

This species is Green-listed Ireland but is Amber-listed in the UK due to declines in non-breeding populations (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021).

### Desk-based data

Although no red-breasted merganser were recorded or presented within the ObSERVE 2016/2017 western Irish Sea survey results, I-WeBS surveys within the Dundalk Bay site recorded a five year peak count of 132 between 2015/16 and 2019/20 (Table 5-12). A five-year peak-mean count of 72 between 2015/16 and 2019/20 suggests the population within Dundalk Bay exceeds the National Importance threshold of 25 birds (I-WeBS, 2022). The population of red-breasted merganser within the Dundalk Bay I-WeBS site does not exceed International Importance thresholds (860 birds).

**Table 5-12: Summary of I-WeBS survey counts for red-breasted merganser within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 83 | 28 | 132 | 72 | 25 | 860 |

## Site-specific data

Site-specific surveys recorded red-breasted merganser within the Study Area in January and February 2019 and in January 2020; transect recordings in all three months were concentrated in the northwest of the Study Area. There were no red-breasted merganser recorded during the DAS undertaken between April 2020 to September 2020.

During the boat-based transect surveys, two individuals were observed flying at a height of 20 m, although generally the majority of birds were observed flying at a height of 5 m.

A summary of the monthly records from the boat-based surveys is presented in Table 5-13. Figure 5-4 shows the spatial distribution of red-breasted merganser during the survey period.

**Table 5-13: Transect records and total observations of red-breasted merganser from boat-based surveys in the Study Area.**

| Month / Year | Boat-based Transect Records | All Records |
|---|---|---|
| May 2018 | 0 | 0 |
| June 2018 | 0 | 0 |
| July 2018 | 0 | 0 |
| August 2018 | 0 | 0 |
| September 2018 | 0 | 0 |
| October 2018 | 0 | 0 |
| November 2018 | 0 | 0 |
| December 2018 | 0 | 0 |
| January 2019 | 0 | 4 |
| February 2019 | 3 | 14 |
| March 2019 | 0 | 0 |
| April 2019 | 0 | 0 |
| June 2019 | 0 | 0 |
| July 2019 | 0 | 0 |
| August 2019 | 0 | 0 |
| October 2019 | 0 | 0 |
| December 2019 | 0 | 0 |
| January 2020 | 5 | 5 |
| May 2020 | 0 | 0 |
| **Total** | **8** | **23** |

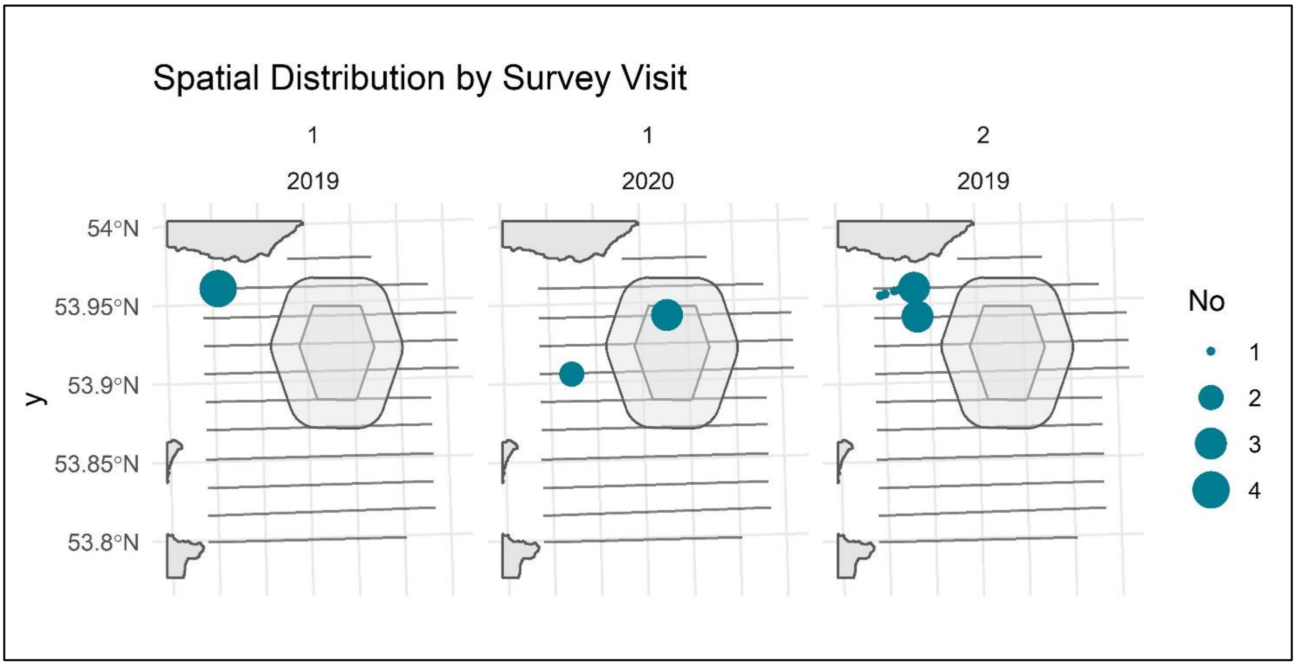


**Figure 5-4: Spatial distribution of red-breasted merganser records during boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

#### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-4), it is not possible to undertake any detailed spatial analysis for this species.

### 5.6.3 Red-throated diver

#### Ecology

Red-throated diver are rare breeders in Ireland, with only six known pairs in County Donegal (BirdWatch Ireland, 2020b). However, this species is present in large numbers around the coastal areas of Ireland for the wintering period and is most commonly observed singly, in pairs or in small, scattered flocks during migration and winter (BirdWatch Ireland, 2020b).

Outside of the breeding season, the species frequents inshore waters along sheltered coasts occasionally occurring inland on lakes, pools, reservoirs and rivers with sandy substrates (del Hoyo *et al.*, 1992). These habitats support their foraging ecology and their diet consists predominantly of fish as well as crustaceans, molluscs, frogs, fish spawn, aquatic insects, annelid worms and plant matter (del Hoyo *et al.*, 1992, BirdLife International, 2020).

The red-throated diver is Amber-listed in Ireland due to its rare breeding ecology and its status as a Species of European Conservation Concern (Gilbert *et al*, 2021).

#### Desk-based data

The ObSERVE surveys recorded three diver species within the 2016/2017 surveys: red-throated diver, great northern diver and black-throated diver (Jessopp *et al.*, 2018). Due to difficulties with distinguishing between the diver species during aerial surveys, observations were recorded as red-throated diver or great northern diver. A total of 289 observations of 1,135 individuals were recorded within the ObSERVE western Irish Sea survey area. Apart from four summer sightings, observations were made within the autumn and winter surveys with highest densities during the autumn surveys (Jessopp *et al.*, 2018). Observations of divers were concentrated around coastal and nearshore waters, illustrating a preference for water depths of 5-20 m. Further, the distribution of diver observations was concentrated around Dundalk Bay, illustrating the importance of this area to diving species in autumn and winter months. Mean density of all divers across the

ObSERVE western Irish Sea survey area ranged from 0.01 birds/km$^2$ in summer surveys, 0.97 birds/km$^2$ during autumn surveys and 0.32 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018).

Observations of red-throated diver were also recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-14. A five-year peak observation of 39 birds was recorded in the 2016/2017 season, along with a five-year peak-mean count of 23 birds between 2015/16 and 2019/20. The National Importance threshold for red-throated diver is 20 birds, and the International Importance threshold is 3,000 birds. Therefore, red-throated diver numbers in the Dundalk Bay I-WeBS site occasionally exceed levels of National Importance based on the 2016/17 peak count (I-WebS, 2022), but the most recent five-year peak-mean count is well below levels of International Importance.

**Table 5-14: Summary of I-WeBS survey counts for red-throated diver within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 31 | 13 | 39 | 23 | 20 | 3,000 |

## Site-specific data

During the boat-based transect surveys conducted, there were 87 records of red-throated diver on transect throughout the survey period, with records in all months except between June and July 2018 and between June and September 2019. In 2018, there was an increase in records in August post the breeding period, reflecting the passage of birds from the northwestern breeding areas (Crowe, 2005).

The greatest peak was observed in the spring migration period (February to April) in both 2019 and 2020, with a maximum of 18 birds recorded on transect in February 2019 and 15 birds recorded in April 2020.

The red-throated diver were mainly distributed along the western and northern sides of the Study Area, with the exception of October 2019, where birds were more frequently recorded in the north and east of the area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-15. Table 5-16 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-5 shows the spatial distribution of red-throated diver during the survey period.

**Table 5-15: Transect records and total observations of red-throated diver from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 2 |
| June 2018 | 0 | - | 0 |
| July 2018 | 0 | - | 0 |
| August 2018 | 6 | - | 7 |
| September 2018 | 2 | - | 4 |
| October 2018 | 5 | - | 5 |
| November 2018 | 3 | - | 4 |
| December 2018 | 5 | - | 12 |
| January 2019 | 9 | - | 12 |
| February 2019 | 18 | - | 27 |
| March 2019 | 6 | - | 9 |
| April 2019 | 10 | - | 10 |
| June 2019 | 0 | - | 0 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| July 2019 | 0 | - | 0 |
| August 2019 | 0 | - | 0 |
| October 2019 | 11 | - | 11 |
| December 2019 | 1 | - | 1 |
| January 2020 | 10 | - | 10 |
| April 2020 | - | 15 | 15 |
| May 2020 | 1 | 0 | 1 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 0 | 0 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 4 | 4 |
| **Total** | **87** | **19** | **134** |

**Table 5-16: Biological seasonal variation of red-throated diver recorded between May 2018 and September 2020.**

| Year | Spring Migration Feb – Apr | Breeding Mar – Aug | Autumn Migration Sep – Nov | Winter Dec – Jan | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | 0 | 9 | 13 | 24 | - |
| 2019 / 2020 | 27 | 19 | 11 | 11 | - |
| 2020 | 0 | 15 | 4 | - | - |

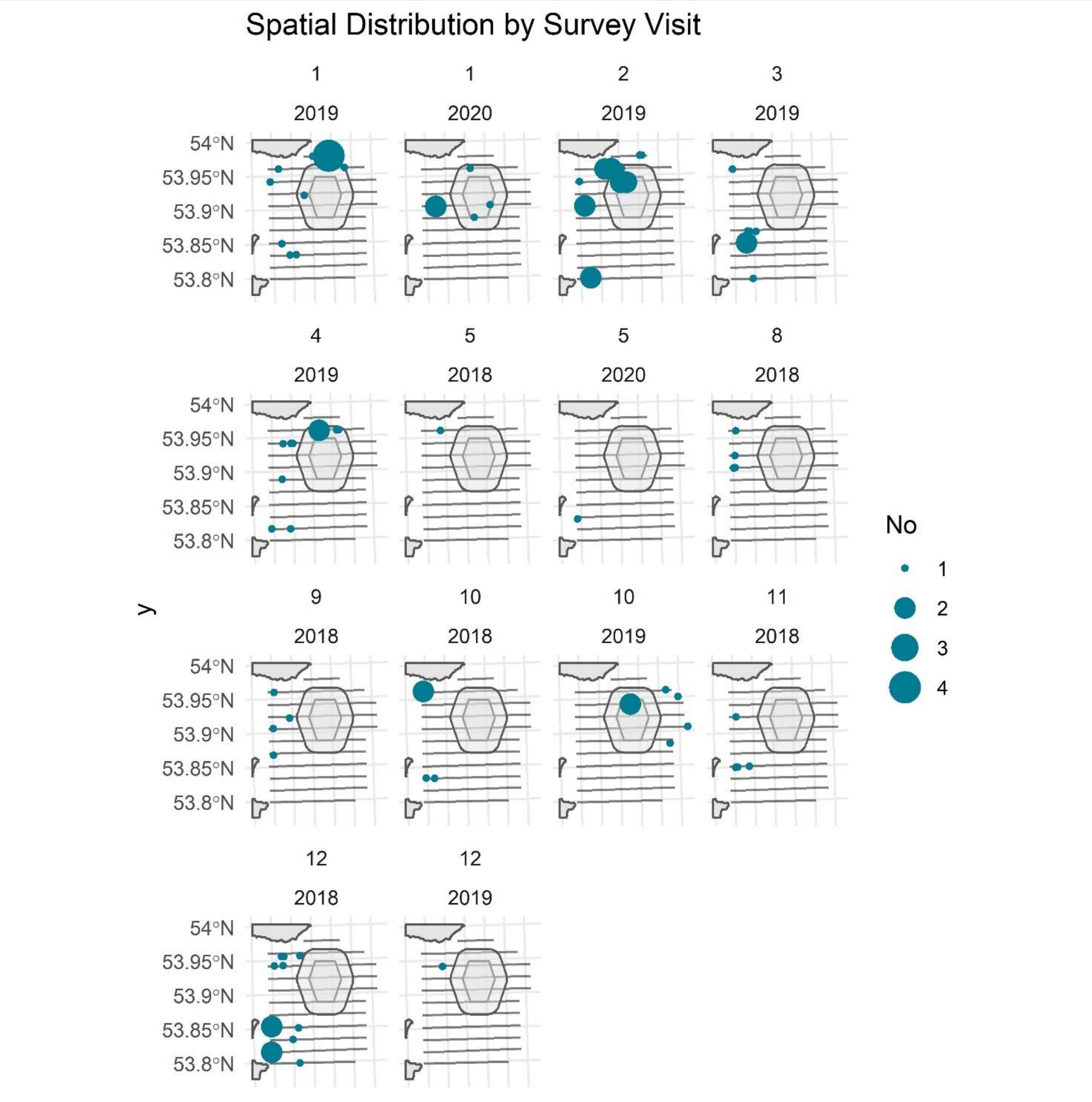


**Figure 5-5: Spatial distribution red-throated diver records during boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

Similar levels of activity were recorded during the survey period, with a peak count of up to 19 birds recorded during the breeding season, up to24 birds during the winter period and 13 to 27 birds recorded during the autumn and spring migration periods respectively.

During the boat-based transect surveys, the majority of birds observed were sitting (84 individuals, 96.5%); whereas off transect, a higher proportion of birds were recorded in flight (27 individuals, 96.4%). Flight heights along the transect route were recorded between 5 m and 10 m, with a small number of birds flying between 20 m and 30 m off transect.

During the DAS undertaken between April 2020 and September 2020 (APEM, 2020), a total of 19 red-throated diver were recorded, of which two were observed in flight and 17 were recorded sitting. One red-throated diver was recorded flying in a northeasterly direction in the April survey and one red-throated diver was recorded flying in a southwesterly direction in the September survey. The red-throated diver were mainly distributed along the western side of the Ornithology Study Area, with only two located in the southeastern area. There were no calculated flight heights for red-throated diver from the APEM surveys.

Table 5-17 below shows the proportion of individuals observed sitting and flying over the transect route and Study Area between May 2018 and September 2020. Figure 5-6 shows the recorded flight heights of red-throated diver during the boat-based surveys.

**Table 5-17: Proportion of red-throated diver recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 |
| June 2018 | No birds recorded | | | | | | | |
| July 2018 | | | | | | | | |
| August 2018 | 0 | 0 | 6 | 100 | 1 | 100 | 0 | 0 |
| September 2018 | 0 | 0 | 2 | 100 | 2 | 100 | 0 | 0 |
| October 2018 | 0 | 0 | 5 | 100 | 0 | 0 | 0 | 0 |
| November 2018 | 0 | 0 | 3 | 100 | 1 | 100 | 0 | 0 |
| December 2018 | 0 | 0 | 5 | 100 | 7 | 100 | 0 | 0 |
| January 2019 | 2 | 22.2 | 7 | 77.8 | 3 | 100 | 0 | 0 |
| February 2019 | 0 | 0 | 18 | 100 | 9 | 100 | 0 | 0 |
| March 2019 | 0 | 0 | 6 | 100 | 2 | 66.7 | 1 | 33.3 |
| April 2019 | 0 | 0 | 10 | 100 | 0 | 0 | 0 | 0 |
| June 2019 | No birds recorded | | | | | | | |
| July 2019 | | | | | | | | |
| August 2019 | | | | | | | | |
| October 2019 | 0 | 0 | 11 | 100 | 0 | 0 | 0 | 0 |
| December 2019 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| January 2020 | 0 | 0 | 10 | 100 | 0 | 0 | 0 | 0 |
| April 2020 | 1 | 6.7 | 14 | 93.3 | N/A | | | |
| May 2020 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 2020 | No birds recorded | | | | | | | |
| July 2020 | | | | | | | | |
| August 2020 | | | | | | | | |
| September 2020 | 1 | 25 | 3 | 75 | | | | |
| **Total** | **3** | **3.5** | **84** | **96.5** | **27** | **96.4** | **1** | **3.6** |

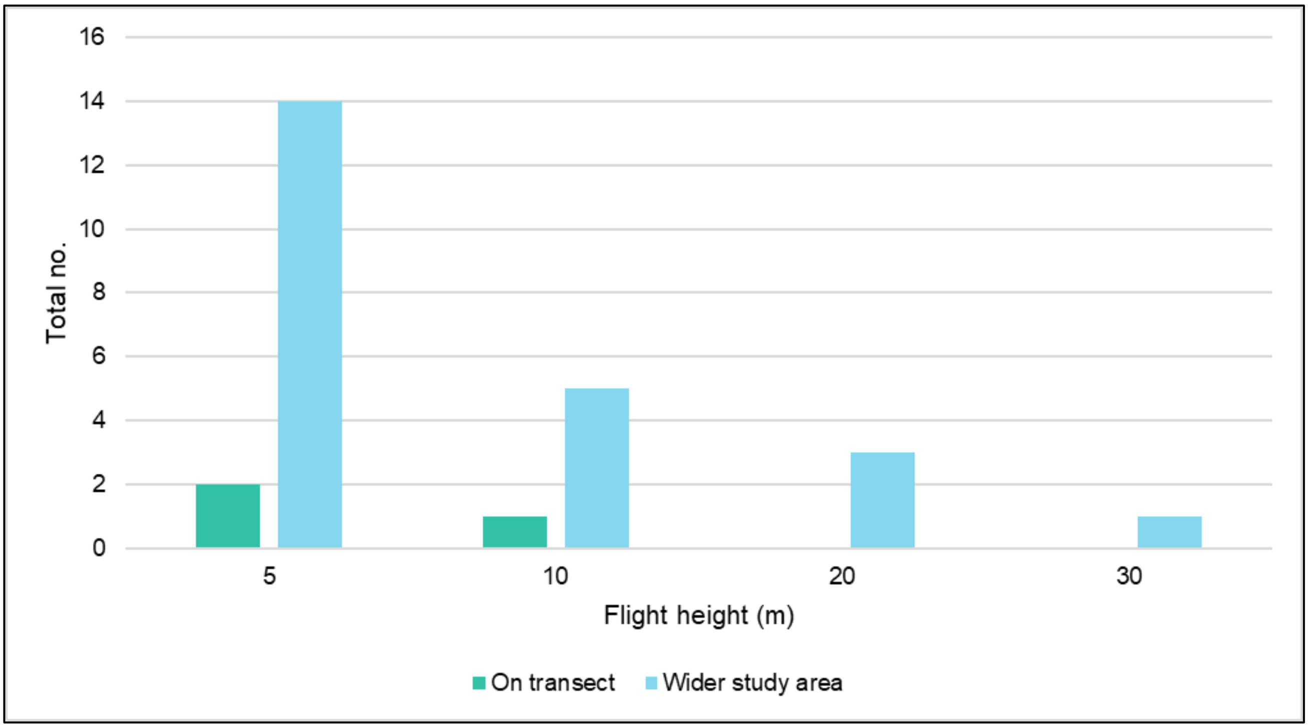


**Figure 5-6: Red-throated diver flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-5), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.4 Great northern diver

### Ecology

Great northern diver are a winter visitor to Ireland and are mainly observed between September to April in offshore regions of the coast (Crowe, 2005; Stone *et al.*, 1995). The closest breeding colonies are in Iceland. Unlike red-throated diver, great northern diver are capable of feeding in deeper waters and are thus observed offshore utilising deeper bays and inlets. Their diet consists predominantly of fish as well as crustaceans, molluscs, aquatic insects, annelid worms, frogs, other amphibians and plant matter (e.g. *Potamogeton* spp., willow *Salix* spp., shoots, roots, seeds, moss and algae) (del Hoyo *et al.*, 1992).

The great northern diver is Amber-listed in the UK and Ireland due to an internationally important wintering population (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021).

### Desk-based data

The ObSERVE western Irish Sea surveys recorded three diver species within the 2016/2017 surveys: red-throated diver, great northern diver and black-throated diver (Jessopp *et al.*, 2018). Due to difficulties with distinguishing between the diver species during aerial surveys, observations were recorded as red-throated diver or great northern diver. A total of 289 observations of 1,135 individuals were recorded within the ObSERVE western Irish Sea survey area. Apart from four summer sightings, observations were made within the autumn and winter surveys with highest densities during the autumn surveys (Jessopp *et al.*, 2018). Observations of divers were concentrated around coastal and nearshore waters, illustrating a preference of water depths of 5-20 m. Further, the distribution of diver observations was concentrated around Dundalk Bay, illustrating the importance of this area to diving species in autumn and winter months. Mean density of all divers across the ObSERVE western Irish Sea survey area ranged from 0.01 birds/km$^2$ in summer surveys, 0.97 birds/km$^2$ during autumn surveys and 0.32 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018).

Observations of great northern diver were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-18. A five-year peak count observation of 33 birds was recorded in the 2016/17 season, along with a five-year peak-mean count of 27 birds between 2015/16 and 2019/20. The National Importance threshold for great northern diver is 20 birds, and the International Importance threshold is 50 birds. Therefore, great northern diver in the Dundalk Bay I-WeBS site are currently exceeding levels of National Importance based on the most recent five-year peak-mean count (2015/16 to 2019/20; I-WeBS, 2022), but do not exceed levels of International Importance.

**Table 5-18: Summary of I-WeBS survey counts for great northern diver within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 31 | 15 | 33 | 27 | 20 | 50 |

## Site-specific data

Site-specific surveys conducted in 2018 and 2019 recorded great northern diver on transect in all months except July 2018, July 2019 to August 2019 and August 2020 to September 2020. Peak occurrences were observed in January 2020 with 127 birds in the Study Area, and in January 2019 with 61 birds within the Study Area and 76 birds on transect (Aquafact, 2019). Large numbers of individuals were also recorded in May 2018 (49 birds on transect and 83 within the Study Area); this peak in May 2018 is notable as this species typically vacates Irish waters from April (Crowe, 2005; Stone *et al.*, 1995), and is related to poor weather events occurring in spring 2018 which led to delays in departures of birds to their more northerly summer areas (e.g. Iceland and Greenland).

Birds were observed in the northern and western areas of the Study Area throughout winter, although observations were also made of birds in the southern extent of the Study Area in January 2019, December 2019 and January 2020. During the DAS undertaken between April 2020 and September 2020 (APEM, 2020), the distribution of great northern diver was mainly concentrated in the east to north of the Study Area. There were no great northern diver were recorded in the southwest of the Study Area during these surveys.

A summary of the monthly records from the boat-based surveys and DAS is presented in Table 5-19. Table 5-20 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-7 shows the spatial distribution of great northern diver during the boat-based survey period.

**Table 5-19: Transect records and total observations of great northern diver from boat-based surveys in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 49 | - | 83 |
| June 2018 | 9 | - | 9 |
| July 2018 | 0 | - | 0 |
| August 2018 | 0 | - | 1 |
| September 2018 | 2 | - | 2 |
| October 2018 | 60 | - | 63 |
| November 2018 | 20 | - | 25 |
| December 2018 | 30 | - | 38 |
| January 2019 | 61 | - | 76 |
| February 2019 | 21 | - | 24 |
| March 2019 | 31 | - | 55 |
| April 2019 | 53 | - | 68 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| June 2019 | 2 | - | 2 |
| July 2019 | 0 | - | 0 |
| August 2019 | 0 | - | 0 |
| October 2019 | 4 | - | 4 |
| December 2019 | 54 | - | 54 |
| January 2020 | 127 | - | 127 |
| April 2020 | - | 285 | 285 |
| May 2020 | 12 | 9 | 21 |
| June 2020 | - | 4 | 4 |
| July 2020 | - | 4 | 4 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 0 | 0 |
| **Total** | **535** | **302** | **945** |

**Table 5-20: Biological seasonal variation of great northern diver recorded between May 2018 and September 2020.**

| Year | Spring Migration Mar – May | Breeding Jun – Aug | Autumn Migration Sep – Nov | Winter Dec – Feb | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | 83 | 10 | 90 | 138 | - |
| 2019 / 2020 | 123 | 2 | 4 | 181 | - |
| 2020 | 306 | 8 | 0 | - | - |

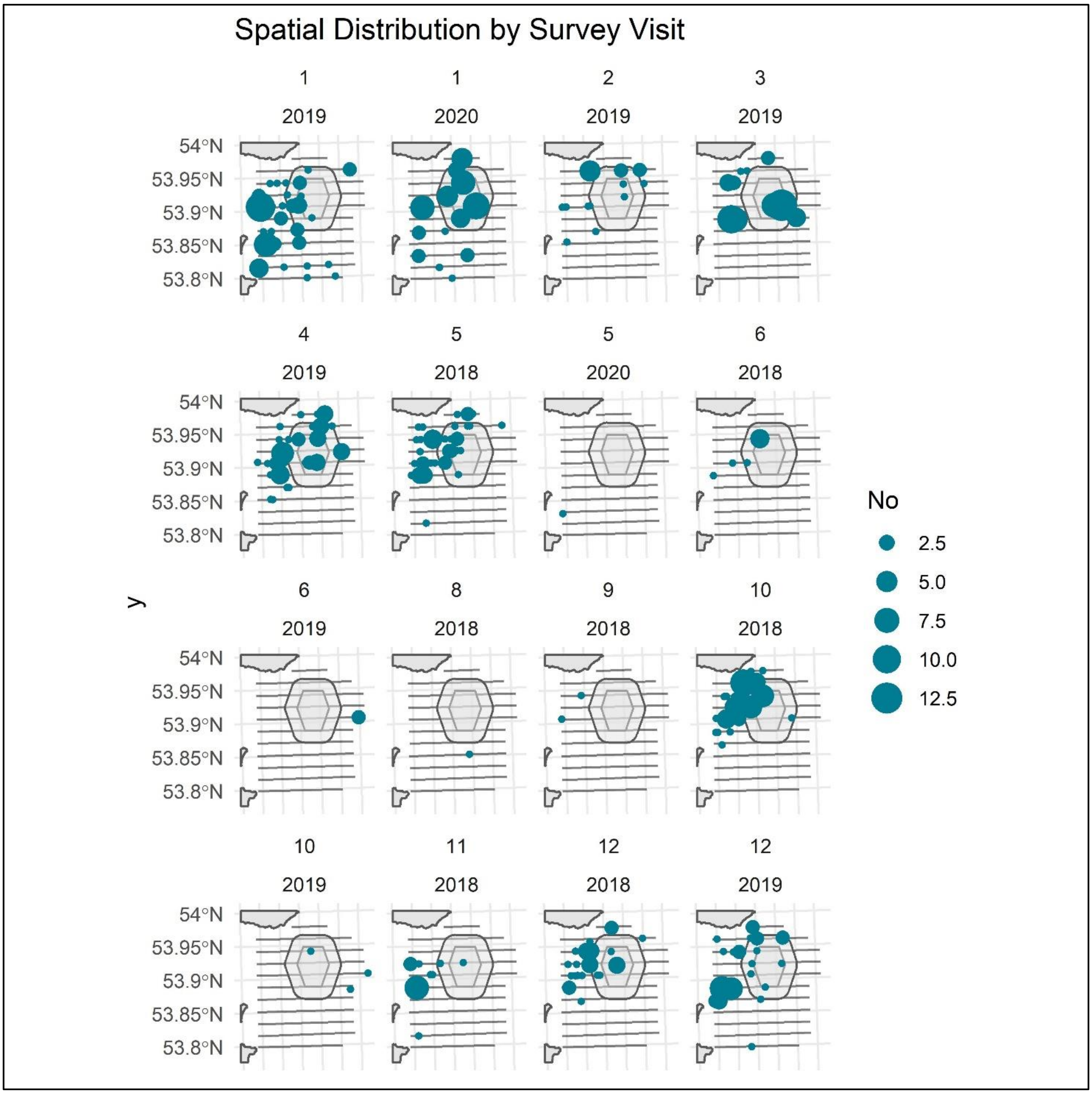


**Figure 5-7: Spatial Distribution of great northern diver records during boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

The peak levels of activity were recorded during the spring migration (up to 306 birds) and winter periods (up to 181 birds), with smaller numbers recorded in the migration periods.

During the boat-based transect surveys, over 98% of birds (527 individuals) were observed sitting; between May 2018 and June 2019, there were no records of birds in flight on transect. A higher proportion of birds were observed in flight off transect (24 individuals, 22.2%). Of those birds recorded in flight in the Study Area, flight heights were most frequently observed between 10 m and 20 m.

During the DAS undertaken between April 2020 and September 2020 (APEM, 2020), a total of 302 great northern diver were identified, of which all were observed sitting.

Table 5-21 below shows the proportion of individuals observed sitting and flying over the transect route and Study Area between May 2018 and September 2020. Figure 5-8 shows the recorded flight heights of great northern diver during the boat-based surveys.

**Table 5-21: Proportion of great northern diver recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 49 | 100 | 3 | 8.8 | 31 | 91.2 |
| June 2018 | 0 | 0 | 9 | 100 | 0 | 0 | 0 | 0 |
| July 2018 | No birds recorded | | | | | | | |
| August 2018 | 0 | 0 | 0 | 0 | 1 | 100 | 0 | 0 |
| September 2018 | 0 | 0 | 2 | 100 | 0 | 0 | 0 | 0 |
| October 2018 | 0 | 0 | 60 | 100 | 2 | 66.7 | 1 | 33.3 |
| November 2018 | 0 | 0 | 20 | 100 | 4 | 80 | 1 | 20 |
| December 2018 | 0 | 0 | 30 | 100 | 6 | 75 | 2 | 25 |
| January 2019 | 0 | 0 | 61 | 100 | 2 | 13.3 | 13 | 86.7 |
| February 2019 | 0 | 0 | 21 | 100 | 3 | 100 | 0 | 0 |
| March 2019 | 0 | 0 | 31 | 100 | 0 | 0 | 24 | 100 |
| April 2019 | 0 | 0 | 53 | 100 | 3 | 20 | 12 | 80 |
| June 2019 | 0 | 0 | 2 | 100 | 0 | 0 | 0 | 0 |
| July 2019 | No birds recorded | | | | | | | |
| August 2019 | | | | | | | | |
| October 2019 | 1 | 25 | 3 | 75 | 0 | 0 | 0 | 0 |
| December 2019 | 4 | 7.4 | 50 | 92.6 | 0 | 0 | 0 | 0 |
| January 2020 | 2 | 1.6 | 125 | 98.4 | 0 | 0 | 0 | 0 |
| April 2020 | 0 | 0 | 285 | 100 | N/A | | | |
| May 2020 | 1 | 5 | 20 | 95 | 0 | 0 | 0 | 0 |
| June 2020 | 0 | 0 | 4 | 100 | N/A | | | |
| July 2020 | 0 | 0 | 4 | 100 | | | | |
| August 2020 | No birds recorded | | | | | | | |
| September 2020 | | | | | | | | |
| **Total** | **9** | **1.5** | **527** | **98.5** | **24** | **22.2** | **84** | **77.8** |

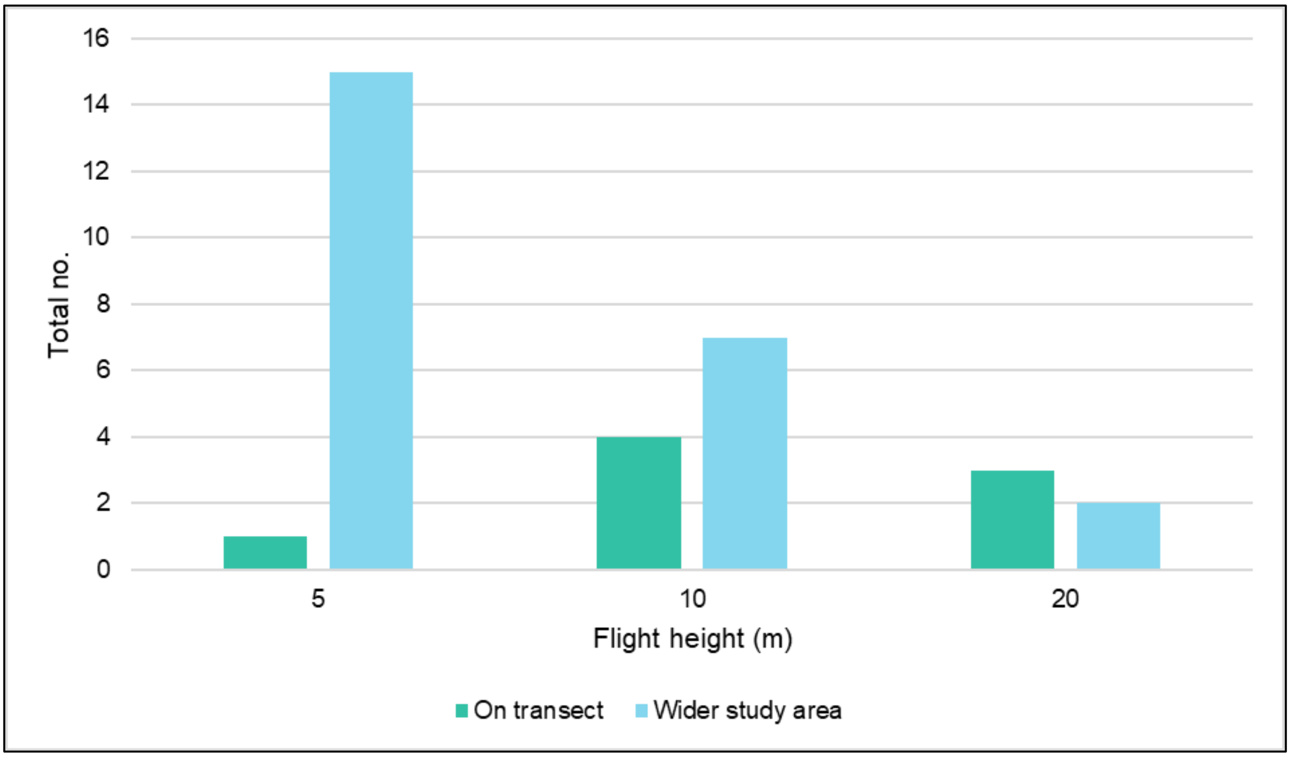


**Figure 5-8: Great northern diver flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates from the boat-based surveys

During initial data exploration and model fitting a high co-linearity / correlation between Bathymetry and distance to coast was identified resulting in a prohibitively high variance inflation factor (VIF) for these parameters. Because of this distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CreSS:

- Bathymetry;
- Year; and
- X and Y coordinates.

In addition to the co-linearity identified above a low number of observations were also identified in some months for great northern diver and this also inhibited model convergence when using month as an interaction to term. As such seasonal periods were used in place of month for this analysis.

To prepare for the GEE-CreSS analyses, a complete grid of abutting cells based on the survey grid and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinates were included in the one-dimensional SALSA model selection method (Walker *et al.,* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Period was fitted as a factor term. This provided the base model for assessment of the 2D spatial smoother.

CreSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CreSS grid knot locations are included in annex 1 of this report. An interaction with month was included to allow the density surface to vary between survey months. Following predictions, bootstrapping was used to generate 95% confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CreSS method.

### All behaviours (both sitting and flying birds)

Table 5-22, Table 5-23 and Table 5-24 below present the great northern diver modelled abundance estimates for the offshore wind farm area, offshore wind farm area plus 2 km buffer and the Offshore Ornithology Study Area during the boat-based survey data. Both sitting and flying birds are included within the estimate below.

**Table 5-22: Great northern diver offshore wind farm area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 12 | 7 | 21 |
| June 2018 | 4 | 1 | 11 |
| July 2018 | No birds recorded | | |
| August 2018 | 0 | 0 | N/A |
| September 2018 | 0 | 0 | N/A |
| October 2018 | 12 | 5 | 30 |
| November 2018 | 1 | 0 | 36 |
| December 2018 | 8 | 3 | 24 |
| January 2019 | 43 | 28 | 63 |
| February 2019 | 10 | 2 | 52 |
| March 2019 | 45 | 20 | 107 |
| April 2019 | 38 | 22 | 63 |
| June 2019 | 4 | 1 | 11 |
| July 2019 | No birds recorded | | |
| August 2019 | | | |
| October 2019 | 12 | 5 | 30 |
| December 2019 | 8 | 3 | 24 |
| January 2020 | 43 | 28 | 63 |
| May 2020 | 12 | 7 | 21 |

**Table 5-23: Great northern diver offshore wind farm area plus 2 km modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 31 | 18 | 55 |
| June 2018 | 7 | 2 | 22 |
| July 2018 | No birds recorded | | |
| August 2018 | 0 | 0 | NA |
| September 2018 | 0 | 0 | NA |
| October 2018 | 43 | 21 | 89 |
| November 2018 | 5 | 1 | 109 |
| December 2018 | 31 | 15 | 76 |
| January 2019 | 115 | 76 | 168 |
| February 2019 | 25 | 5 | 112 |
| March 2019 | 95 | 43 | 215 |
| April 2019 | 102 | 56 | 184 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| June 2019 | 7 | 2 | 22 |
| July 2019 | No birds recorded | | |
| August 2019 | | | |
| October 2019 | 43 | 21 | 89 |
| December 2019 | 31 | 15 | 76 |
| January 2020 | 115 | 76 | 168 |
| May 2020 | 31 | 18 | 55 |

**Table 5-24: Great northern diver Offshore Ornithology Study Area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 143 | 74 | 300 |
| June 2018 | 21 | 6 | 91 |
| July 2018 | No birds recorded | | |
| August 2018 | 0 | 0 | 0 |
| September 2018 | 7 | 0 | NA |
| October 2018 | 112 | 57 | 259 |
| November 2018 | 122 | 36 | 779 |
| December 2018 | 139 | 76 | 294 |
| January 2019 | 326 | 208 | 505 |
| February 2019 | 73 | 17 | 328 |
| March 2019 | 175 | 77 | 417 |
| April 2019 | 374 | 196 | 711 |
| June 2019 | 21 | 6 | 91 |
| July 2019 | No birds recorded | | |
| August 2019 | | | |
| October 2019 | 112 | 57 | 259 |
| December 2019 | 139 | 76 | 294 |
| January 2020 | 326 | 208 | 505 |
| May 2020 | 143 | 74 | 300 |

## Flying birds only

There were 32 records of flying great northern diver during the boat-based surveys. Densities of flying birds were derived from the total numbers seen in radial snapshots, divided by the total area surveyed by snapshots (survey effort); that is the number of snapshots multiplied by the snapshot area of 0.09 $km^2$.

Non-parametric bootstrap intervals have been used to calculate the standard error and 95% confidence intervals around the observed counts and densities per $km^2$. The offshore wind farm area has then been used to calculate simple abundances based on density results (Table 5-25 and Table 5-26).

**Table 5-25: Great northern diver flying bird offshore wind farm area simple abundance estimates.**

| Season | Estimate | LCL | UCL |
|---|---|---|---|
| Mid winter | 2 | 0 | 4 |
| Late winter | 2 | 0 | 4 |
| Early breeding season | 6 | 0 | 12 |
| Mid breeding season | 4 | 0 | 10 |
| Late breeding season | 0 | 0 | 0 |
| Post breeding / moult | 1 | 0 | 2 |
| Autumn | 2 | 0 | 4 |
| Early winter | 8 | 3 | 13 |

**Table 5-26: Great northern diver flying bird offshore wind farm area plus 2 km simple abundance estimates.**

| Season | Estimate | LCL | UCL |
|---|---|---|---|
| Mid winter | 6 | 0 | 12 |
| Late winter | 6 | 0 | 12 |
| Early breeding season | 17 | 0 | 35 |
| Mid breeding season | 12 | 0 | 29 |
| Late breeding season | 0 | 0 | 0 |
| Post breeding / moult | 3 | 0 | 6 |
| Autumn | 6 | 0 | 12 |
| Early winter | 23 | 9 | 38 |

## Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for great northern diver (all behaviours) at the different spatial scales (Table 5-27). Detailed methods on calculation of the abundance estimates are presented in section 4.4.3.

**Table 5-27: Abundance estimates of great northern diver within the different study areas.**

| Month / Year | Offshore wind farm area | Offshore wind farm area plus 2 km buffer | Offshore wind farm area plus 4 km buffer |
|---|---|---|---|
| April 2020 | 102 | 222 | 412 |
| May 2020 | 5 | 10 | 21 |
| June 2020 | 3 | 6 | 6 |
| July 2020 | 6 | 8 | 8 |
| August 2020 | 0 | 0 | 0 |
| September 2020 | 0 | 0 | 0 |

### 5.6.5 Fulmar

#### Ecology

Fulmar is a widespread breeding species around the Irish coast, typically breeding on cliffs and rock faces but also occasionally on flatter ground up to 1 km inland (BirdLife International, 2020). The diet of this species comprises of fish, squid and zooplankton (especially amphipods), and they will also scavenge on commercial fishing discards (Phillips *et al.*, 1999). Fulmar are typically surface seizing foragers; however, they also forage through plunge feeding methods (del Hoyo *et al.*, 1992).

Ireland's fulmar population has been increasing in recent years, and therefore this species is Green-listed in Ireland (Gilbert *et al.,* 2021), however Amber-listed for the UK as a whole (Stanbury *et al.,* 2021). To support the SMP, fulmar was one of four priority species counted in 2015 at 31 colonies in the Republic of Ireland. A total of 21,937 AOS were counted which was 33% fewer than the 32,918 AOS recorded during Seabird 2007 (JNCC, 2016).

The Seabirds Count census which was undertaken across Ireland between 2015 and 2018 estimated that the breeding population of fulmar was 32,899 pairs, an increase of 68% over the long term (1985/87 – 2015/18) (Cummins *et al.,* 2019). Colonies at the Cliffs of Moher and Clare Island (two of the most important colonies identified during Seabird 2000) had both undergone significant changes in their site estimates (+36% and -31% respectively). A summary of the population trends of fulmar at a selection of Irish colonies since Seabird 2000 is summarised in Table 5-28 below.

**Table 5-28: Population trends of breeding fulmar (AOS) at a selection or Irish colonies since Seabird 2000 (Cummins *et al*., 2019).**

| Site | Seabird 2000 1998 / 2002 | 2015 – 2018 | % Change Since Seabird 2000 |
|---|---|---|---|
| Inishshark Island | 603 | 1,160 | + 92% |
| Puffin Island | 447 | 670 | + 50% |
| Cliffs of Moher | 3,566 | 4,842 | + 36% |
| Cape Clear Island | 466 | 527 | + 13% |
| Inishturk Island | 2,897 | 2,881 | - 1% |
| Great Skellig | 761 | 725 | - 5% |
| Duvillaun Islands | 638 | 547 | - 14% |
| Little Saltee | 205 | 167 | - 19% |
| Inishvikillane | 672 | 517 | - 23% |
| Clare Island | 4,029 | 2,789 | - 31% |
| Lambay | 585 | 375 | - 36% |
| Great Saltee | 315 | 190 | - 40% |
| Aran Island – Aranmore | 1,535 | 768 | - 50% |

Within the UK, numbers of fulmar have fallen in all areas, although the greatest declines appear to be at colonies in the north and west of the UK.

A summary of recent (within the last five summers) colony data for fulmar within the Cumulative Offshore Ornithology Study Area is provided in Table 5-29 below. If multiple years are provided, then the mean count is presented. Colonies which recorded zero birds are not included.

**Table 5-29: Summary of most recent colony data for fulmar between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Blackhead | 2017 – 2019 | 30 ± 0.8 |
| | Causeway Coast | 2021 | 880 |
| | East Antrim Coast | 2017 – 2019 | 44.7 ± 11.1 |
| | Giants Causeway Coast | 2018 – 2022 | 133.3 ± 38.5 |
| | Larne Lough to Portmuck | 2017 – 2019 | 282.7 ± 59.9 |
| | Muck Island | 2017 – 2019 | 65 ± 15.9 |
| | North Antrim coast | 2017 – 2019 | 10 ± 9.9 |
| | Rathlin Island SPA | 2021 | 1,038 |
| | Sheep Island SPA | 2021 | 61 |
| | Whitehead | 2017 – 2019 | 6 ± 0.9 |
| Argyll and Bute | Coll | 2018 | 55 |
| | Gigha | 2021 | 16 |
| | Islay – East (Port Askaig to Bowmore) | 2017 – 2021 | 124.3 ± 32.7 |
| | Islay – West (Port Askaig to Bruichladdich) | 2017 – 2021 | 165.5 ± 127.2 |
| | Isle of Colonsay | 2017 – 2021 | 11.8 ± 1.8 |
| | Keil Point to Kilmanshennachan | 2021 | 21 |
| | North Colonsay and Western Cliffs SPA | 2017 – 2022 | 270 ± 147.8 |
| | North West Iona | 2021 | 10 |
| | Sanda Islands – Kintyre | 2019 | 43 |
| | Sound of Luing | 2019 | 28 |
| | South West Iona and Soa | 2017 and 2021 | 41.5 ± 14.5 |
| | Stac Mhic Mhurchaidh, Reidh Eilean, Eilean Annraidh, Eilean Chalba | 2021 | 38 |
| | Staffa | 2018 – 2021 | 40.7 ± 11.9 |
| | Tiree | 2018 | 1,054 |
| | Treshnish Isles SPA | 2017 – 2021 | 301.5 ± 38.7 |
| Clwyd | Llanddulas Quarries | 2017 | 25 |
| Cork | Baltimore to Glandore Harbour | 2017 | 58 |
| | Beara Peninsula – North | 2018 | 12 |
| | Cork Harbour to Youghal Harbour | 2018 | 91 |
| | Galley Head | 2017 | 19 |
| | Ringabella to Kinsale | 2017 | 100 |
| Cornwall | Bounds Cliff – North Cornwall | 2017 | 74 |
| | Carnweather Point, North Cornwall | 2017 | 25 |
| | Chapel Porth to Perranporth | 2017 and 2018 | 57 ± 38 |
| | Com Head – North Cornwall | 2017 | 23 |
| | Delabole Point – North Cornwall | 2017 | 19 |
| | Godrevy Head to St Agnes SSSI | 2020 | 62 |
| | Gunwallor Fishing Cove to Kynance Cove | 2017 | 39 |
| | Ligger Point to Porth | 2017 | 97 |
| | Mount’s Bay, Cornwall | 2021 | 10 |
| | North Cornwall Coast | 2017 | 113 |
| | Penally to Cornakey | 2018 | 57 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS) ± SD (if applicable) |
|---|---|---|---|
| | Pine Haven, North Cornwall | 2018 | 10 |
| | Port Isaac, North Cornwall | 2017 | 60 |
| | Reedy Cliff, North Cornwall | 2017 | 17 |
| | Trerubies Cove – North Cornwall | 2017 | 15 |
| | Tresungers Point, North Cornwall | 2017 | 96 |
| | Trevan Point, North Cornwall | 2017 | 13 |
| | Trevelgue Head to Merope Rocks | 2017 and 2019 | 145.5 ± 2.5 |
| | Varley Head, North Cornwall | 2018 | 8 |
| | West Penwith | 2017 | 93 |
| Cumbria | Parton Bay | 2017 – 2021 | 5.5 ± 3.4 |
| | St Bees Head and Town | 2017 – 2021 | 45 ± 5.7 |
| Devon | Clovelly to Hartland Quay | 2017 | 22 |
| | Lundy | 2017 and 2019 | 246 ± 19 |
| | North Devon Coast | 2017 | 46 |
| | West Exmoor Coast and Woods SSSI | 2018 | 62 |
| Donegal | Gweedore Bay Islands | 2018 | 33 |
| | Inishdooey, Inishbofin, Inishbeg | 2018 | 89 |
| | Malin Peninsula | 2018 | 607 |
| | North Donegal | 2018 | 16 |
| | Rathlin O’Birne Island | 2018 | 5 |
| | Slieve League | 2018 | 31 |
| | Tory Island and Bloody Foreland | 2018 | 3 |
| Down | Maggy’s Leap 1/Donnard Cove | 2017 and 2019 | 1.5 ± 0.5 |
| Dyfed | Aber Bach – Ynys Barry | 2018 | 104 |
| | Abereiddy – Treginnnis, St Davids | 2018 | 27 |
| | Barafundle to Giltar Point | 2017 and 2018 | 86.5 ± 5.5 |
| | Bishop and Clerks and Ramsey | 2017 – 2019 | 272 ± 38.8 |
| | Caldey Island | 2017 – 2019 | 105 ± 4.8 |
| | Cardigan Island and Mwnt to Carreg Lydan | 2018 | 78 |
| | Castlemartin Coast (Berryslade to Barafundle Bay) | 2017 – 2019, 2021 and 2022 | 67.8 ± 11.0 |
| | Dinas Fach, Solva – Newgale (Pen-y-Cwm) | 2018 | 6 |
| | Freshwater West to West Angle Bay | 2017 | 2 |
| | Gilfach yr halen | 2018 | 10 |
| | Little Haven to Newgale | 2017 | 90 |
| | Llangrannog to Penpeles (includes Tresaith SSSI and Aberporth) | 2018 | 24 |
| | Llanrhyslud – Llansanffraed | 2018 | 14 |
| | New Quay to Lochtyn | 2018 | 37 |
| | Newport to Poppit | 2018 | 155 |
| | Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA | 2018 and 2021 | 799 ± 2 |
| | St Anne’s Head (Renny Slip to Dale) | 2017 | 8 |
| | St Bride’s Bay (S and SE) | 2017 and 2018 | 35.5 ± 0.5 |
| | Strumble Head – Pwll Deri | 2018 | 38 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS) ± SD (if applicable) |
|---|---|---|---|
| | Strumble Head to Fishguard to Newport | 2018 | 61 |
| | Tenby to Amroth | 2017 | 19 |
| | Treginnis – Dinas Fawr, Solva | 2018 | 41 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | 2017 – 2019 | 16 ± 2.8 |
| | Friog | 2018 | 13 |
| | Great Orme and Little Orme | 2017 – 2022 | 28.6 ± 6.1 |
| | Lleyn Peninsula | 2018, 2019 and 2021 | 2.7 ± 0.9 |
| | Puffin Island SPA | 2017 – 2019 and 2021 | 34.3 ± 12.7 |
| | South Stack | 2017 – 2019 | 16.7 ± 6 |
| Isle of Man | East Island | 2017 | 408 |
| | North Island | 2017 | 162 |
| | South Island | 2017 | 423 |
| | West Island | 2017 | 56 |
| Isles of Scilly | Isle of Scilly SPA | 2017 – 2021 | 45.5 ± 2.62 |
| | St Agnes | 2017 – 2021 | 7 ± 1.6 |
| Kyle and Carrick | Ailsa Craig SPA | 2017 – 2019 and 2021 | 115.8 ± 17.3 |
| | Bennane Lea to Games Loup | 2018 | 6 |
| | Culzean Country Park – Sea cliffs | 2018 | 9 |
| | Drumshang to Heads of Ayr | 2018 | 4 |
| | Starling Knowe to Downan Point | 2018, 2019 and 2021 | 5.7 ± 0.9 |
| Lochaber | Canna and Sanday SPA | 2017 – 2019, 2021 and 2022 | 133.3 ± 38.5 |
| | Muck | 2018 and 2021 | 155.5 ± 19.5 |
| | Rum SPA | 2021 | 12 |
| Londonderry | Downhill | 2017 – 2019 | 92 ± 8 |
| | North Antrim coast | | 14 ± 2.4 |
| Mayo | Downpatrick to Creevagh Heads | 2018 | 71 |
| Skye and Lochalsh | Rubha Hunish | 2021 | 1,045 |
| | Skye | 2021 | 22 |
| | Skye – Strathaird | 2021 | 2 |
| | Skye: Hoe Point to Meanish | 2021 | 234 |
| Sligo | Sligo Bay | 2018 | 2,018 |
| Somerset | Glenthorne to Ivy Stone | 2017 and 2018 | 5 ± 1 |
| South Glamorgan | Nash Point | 2018 | 16 |
| Stewartry | Balcary Point | 2018 | 7 |
| | Barlocco | 2021 | 9 |
| | Meikle Ross and Little Ross | 2021 | 2 |
| | Port O'Warren | 2019 | 9 |
| Waterford | Annestown to Kilmurrin | 2018 | |
| | Ardmore to Whiting Bay | 2018 | 13 |
| | Bally Voorey to Stradbally | 2018 | 48 |
| | Bunmahon to Stradbally | 2018 | 52 |
| | Creadan Head to Foilakipeen | | 54 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS) ± SD (if applicable) |
|---|---|---|---|
| | Dungarvan to Ardmore | 2018 | 28 |
| | Illaunglass to Annestown | 2018 | 72 |
| | Kilmurrin Cove to Bunmahon | 2018 | 32 |
| | Portally to Benlea Head | 2018 | 5 |
| | Stradbally to Ballyvoile | 2018 | 21 |
| | Tramore to Illaunglass | 2018 | 42 |
| West Glamorgan | Gower | 2018 | 3 |
| Wicklow | Mizen Head | 2018, 2019, 2021 and 2022 | 38.7 ± 20.8 |
| Wigtown | Castle Point to Portankill (Mull of Galloway) – Tysties | 2021 | 6 |
| | Loch Ryan | 2021 | 3 |
| | Monreith Cliffs and Scar Rocks | 2021 | 4 |
| | Mull of Galloway | 2019 | 1 |
| | Port Mona, Devil's Bridge, Laggantalluch Head | 2017 | 15 |
| | Portpatrick | 2021 | 88 |
| | Rigg Bay + Cruggleton | 2020 | 4 |
| | Sheddock Cliffs – Burrow Head | 2020 | 6 |
| | West Coast Wigtownshire | 2021 | 5 |

## Desk-based data

The 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) recorded a total of 687 sightings of 1,533 individuals within the ObSERVE western Irish Sea survey area across the three survey periods, with 87% of these sightings recorded during the autumn surveys. Observations of fulmar were recorded throughout the ObSERVE western Irish Sea survey area, with a high aggregation in the northeastern extent which is located to the east of the Project. The natural foraging behaviour within deep waters was illustrated, with the majority of sightings made within water depths exceeding 60 m. Mean density of fulmar across the ObSERVE western Irish Sea survey area ranged from 0.07 birds/km$^2$ in summer surveys, 1.52 birds/km$^2$ in autumn surveys and 0.16 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018). No records of fulmar were presented within the I-WeBS database.

## Site-specific data

Observations of fulmar were recorded during eight of the 19 survey months of boat-based transects, with peak counts of 18 birds recorded on transect from a total of 20 birds across the Study Area in July 2018 (Aquafact, 2019). During the DAS two fulmar were identified, one each during April and September 2020. In general, fulmar observations were distributed in the south of the Study Area, both within the offshore wind farm area and buffer.

Although there are no breeding sites within the immediate vicinity of the Project, summer records of fulmar from the site surveys are likely to be birds from breeding colonies around the Irish Sea, reflecting the fulmar's large foraging range.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-30.

Table 5-31 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-9 shows the spatial distribution of fulmar over the survey period.

**Table 5-30: Transect records and total observations of fulmar from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 0 |
| June 2018 | 3 | - | 6 |
| July 2018 | 18 | - | 20 |
| August 2018 | 2 | - | 11 |
| September 2018 | 2 | - | 5 |
| October 2018 | 0 | - | 0 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 0 | - | 0 |
| February 2019 | 6 | - | 6 |
| March 2019 | 0 | - | 0 |
| April 2019 | 0 | - | 1 |
| June 2019 | 0 | - | 0 |
| July 2019 | 0 | - | 0 |
| August 2019 | 7 | - | 7 |
| October 2019 | 2 | - | 2 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 1 | 1 |
| May 2020 | 1 | 0 | 1 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 0 | 0 |
| August 2020 | - | 1 | 1 |
| September 2020 | - | 0 | 0 |
| **Total** | **41** | **2** | **61** |

**Table 5-31: Seasonal variation of fulmar recorded between May 2018 and September 2020**

| Year | Spring Migration Dec – Mar | Breeding Apr – Aug | Autumn Migration Sep – October | Winter Nov | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 37 | 5 | 0 | - |
| 2019 / 2020 | 0 | 14 | 2 | 0 | - |
| 2020 | 0 | 3 | 0 | - | - |

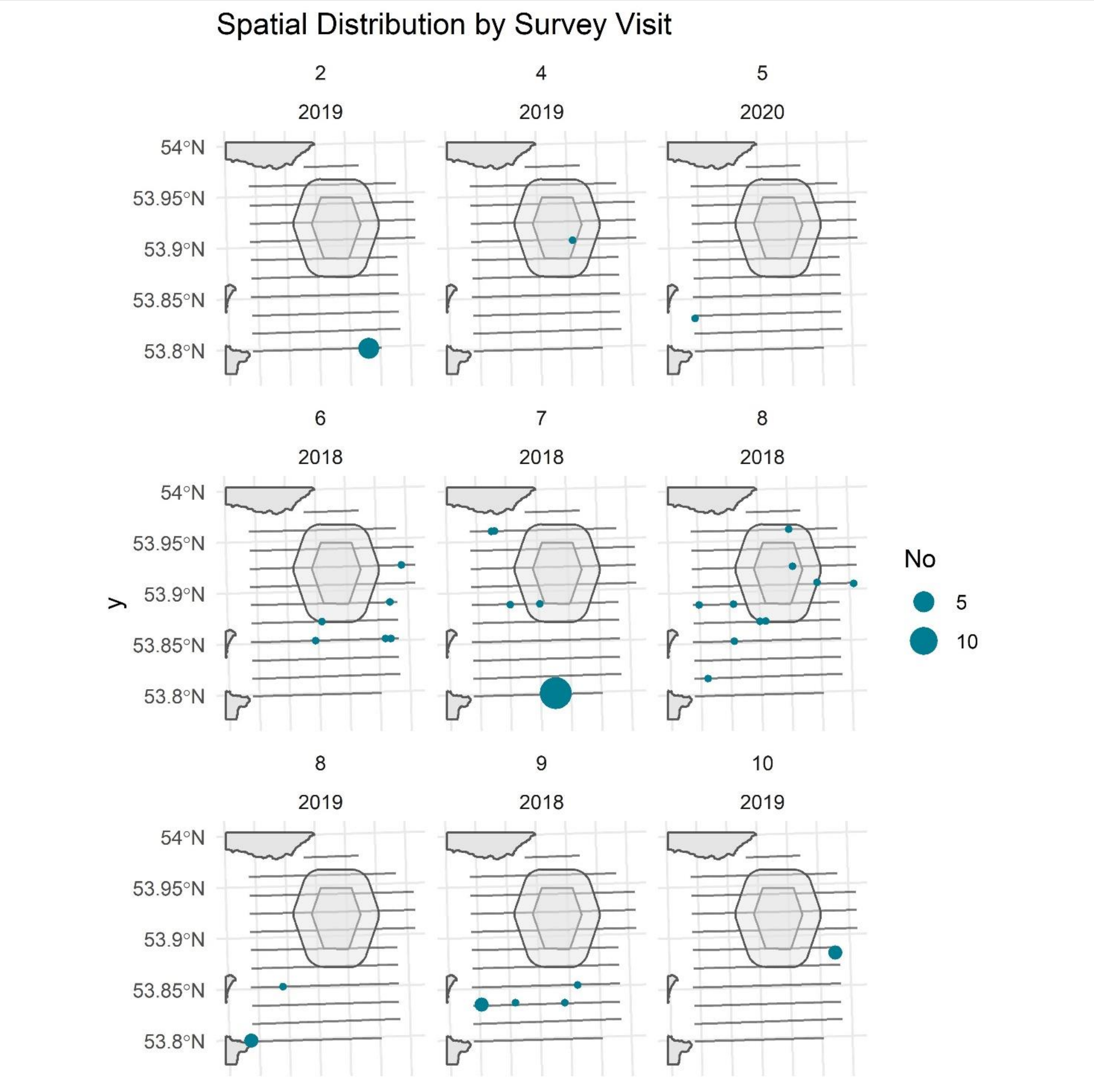


**Figure 5-9: Spatial distribution of Fulmar records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

The peak levels of activity were recorded during the breeding season (up to 37 birds), with low numbers of birds recorded during the autumn migration period (up to 5 birds). Fulmar were not recorded during the spring migration or winter periods.

During the boat-based transect surveys, the majority of birds observed were sitting (37 individuals, 90.2%) compared to in flight (4 individuals, 9.8%). Off transect, a higher proportion of birds were recorded in flight (16 individuals, 88.9%) compared to sitting (2 individuals, 11.1%).

Flight heights of fulmar on transect were recorded at 5 m. Off transect, flight heights were observed between 5 m and 10 m.

Table 5-32 below shows the proportion of individuals observed sitting and flying throughout the Study Area between May 2018 and May 2020.

**Table 5-32: Proportion of fulmar recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | No birds recorded | | | | | | | |
| June 2018 | 1 | 33.3 | 2 | 66.7 | 3 | 100.0 | 0 | 0 |
| July 2018 | 0 | 0 | 18 | 100.0 | 0 | 0 | 2 | 100.0 |
| August 2018 | 2 | 100.0 | 0 | 0 | 9 | 100.0 | 0 | 0 |
| September 2018 | 0 | 0 | 2 | 100.0 | 3 | 100.0 | 0 | 0 |
| October 2018 | No birds recorded | | | | | | | |
| November 2018 | | | | | | | | |
| December 2018 | | | | | | | | |
| January 2019 | | | | | | | | |
| February 2019 | 0 | 0 | 6 | 100.0 | 0 | 0 | 0 | 0 |
| March 2019 | No birds recorded | | | | | | | |
| April 2019 | 0 | 0 | 0 | 0 | 1 | 100.0 | 0 | 0 |
| June 2019 | No birds recorded | | | | | | | |
| July 2019 | | | | | | | | |
| August 2019 | 0 | 0 | 7 | 100.0 | 0 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 2 | 100.0 | 0 | 0 | 0 | 0 |
| December 2019 | No birds recorded | | | | | | | |
| January 2020 | | | | | | | | |
| April 2020 | 0 | 0 | 1 | 100 | N/A | | | |
| May 2020 | 1 | 100.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 2020 | No birds recorded | | | | | | | |
| July 2020 | | | | | | | | |
| August 2020 | 1 | 100 | 0 | 0 | N/A | | | |
| September 2020 | No birds recorded | | | | | | | |
| **Total** | **5** | **11.6** | **38** | **88.4** | **16** | **88.9** | **2** | **11.1** |

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-5), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.6 Manx shearwater

### Ecology

Manx shearwater are summer visitors to the Irish Sea (Stone *et al.*, 1995) and they tend to have localised, very large breeding colonies on coastal or offshore islands, with nesting occurring in burrows (Mitchell *et al.*, 2004; del Hoyo *et al.*, 1992).

Most of the estimated world population of approximately 340,000–410,000 pairs of Manx shearwater breed in Britain and Ireland. Of the UK population, 40% breed on Rum, and 50% in Pembrokeshire on the adjacent islands of Skomer, Skokholm and Middleholm.

Two colonies (Copeland Islands, Co. Down and Lambay Island, Co. Dublin) are located to the north and south of the Study Area. Big Copeland was estimated to hold 1,766 AOS, with a further 2,867 AOS on nearby Lighthouse Island (total 4,633 individuals). The islands were re-surveyed in 2007, when 1,406 AOS were recorded on Big Copeland and 3,444 AOS on Lighthouse Island (total 4,850) indicating that numbers had changed little overall. Changes at the respective islands between these two censuses (-20% on Big Island and +20% on Lighthouse) may be associated with logistical difficulties in surveying this nocturnal, burrow-nesting species.

It is likely that birds observed foraging within the Irish Sea are from further afield colonies within Scotland (Rum) or Wales (Skomer/Skokholm) (Stone *et al.*, 1994). Manx shearwater forage through pursuit-plunging or pursuit diving, and their diet consists of small fish, crustaceans and plankton. Manx shearwater is an Amber-listed species in the UK and Ireland due to their distribution of more than 50% of the Irish population occurring at fewer than ten sites and a decline in breeding ranges across the UK (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021).

A summary of the recent (within the last five summers) colony data for Manx shearwater within the Cumulative Offshore Ornithology Study Area is provided in Table 5-33 below. If multiple years are provided then the mean count is presented. Colonies which recorded zero birds are not included.

**Table 5-33: Summary of most recent colony data for Manx shearwater between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS) ± SD (if applicable) |
|---|---|---|---|
| Argyll and Bute | Treshnish Isles SPA | 2018 | 1,992 |
| Devon | Lundy | 2017 | 5,504 |
| Dyfed | Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA | 2018 | 455,156 |
| Isles of Scilly | Isle of Scilly SPA | 2017 – 2021 | 67.5 ± 26.9 |
| | St Agnes Island | | 27.3 ± 5.3 |
| | St Helen's | | 56 |
| Kyle and Carrick | Ailsa Craig SPA | 2018 | 20 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) observed Manx shearwater as one of the more commonly sighted species within the ObSERVE western Irish Sea survey area. A total of 872 sightings of 4,736 individuals were recorded across the three surveys, the vast majority of which (3,669 individuals) occurred during the breeding season. Observations of Manx shearwater were recorded throughout the ObSERVE western Irish Sea survey area, apart from nearshore areas, and were generally observed 4 km from shore. The natural foraging behaviour within deep waters was illustrated in the records with most sightings made within water depths exceeding 20 m. Mean density of Manx shearwater across the ObSERVE western Irish Sea survey area ranged from 3.37 birds/km$^2$ in summer surveys, 1.15 birds/km$^2$ in autumn surveys and 0.01 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018). No records of Manx shearwater were presented within the I-WeBS database.

## Site-specific data

As summer visitors to Ireland, observations of Manx shearwater were recorded during only the summer survey months (April to September) during site-specific surveys, although two and six observations were made in March and April 2018 respectively, and a further 80 in October 2019.

During the boat-based transects, peak counts were observed towards the end of the nesting period in August 2018, with a total of 1,593 birds recorded of which 990 were recorded on transect (Aquafact, 2019), and again in August 2019, with a total of 2,094 birds recorded on transect.

During the Digital Aerials, 2,377 Manx shearwater were identified across the Study Area, with larger concentrations in the east to southeast of the area. Similar to the observations during the boat-based surveys, a peak count of 1,317 birds was recorded towards the end of the breeding period in August 2020.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-34. Table 5-35 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-10 shows the spatial distribution of Manx shearwater during the survey period.

**Table 5-34: Transect records and total observations of Manx shearwater from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 7 | - | 31 |
| June 2018 | 150 | - | 404 |
| July 2018 | 285 | - | 630 |
| August 2018 | 990 | - | 1,593 |
| September 2018 | 957 | - | 1,419 |
| October 2018 | 0 | - | 0 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 0 | - | 0 |
| February 2019 | 0 | - | 0 |
| March 2019 | 0 | - | 2 |
| April 2019 | 1 | - | 4 |
| June 2019 | 304 | - | 304 |
| July 2019 | 575 | - | 575 |
| August 2019 | 2,094 | - | 2,094 |
| October 2019 | 80 | - | 80 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 6 | 6 |
| May 2020 | 223 | 547 | 770 |
| June 2020 | - | 90 | 90 |
| July 2020 | - | 280 | 280 |
| August 2020 | - | 1,317 | 1,317 |
| September 2020 | - | 137 | 137 |
| **Total** | **5,666** | **2,377** | **9,736** |

**Table 5-35: Seasonal variation of Manx shearwater recorded between May 2018 and September 2020.**

| Year | Spring Migration Mar – May | Breeding Apr – Aug | Autumn Migration Sep – Oct | Winter Nov – Feb | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | 31 | 2,627 | 1,419 | 0 | - |
| 2019 / 2020 | 6 | 2,973 | 80 | 0 | - |

| Year | Spring Migration Mar – May | Breeding Apr – Aug | Autumn Migration Sep – Oct | Winter Nov – Feb | Non-breeding |
|---|---|---|---|---|---|
| 2020 | - | 2,463 | 137 | - | - |

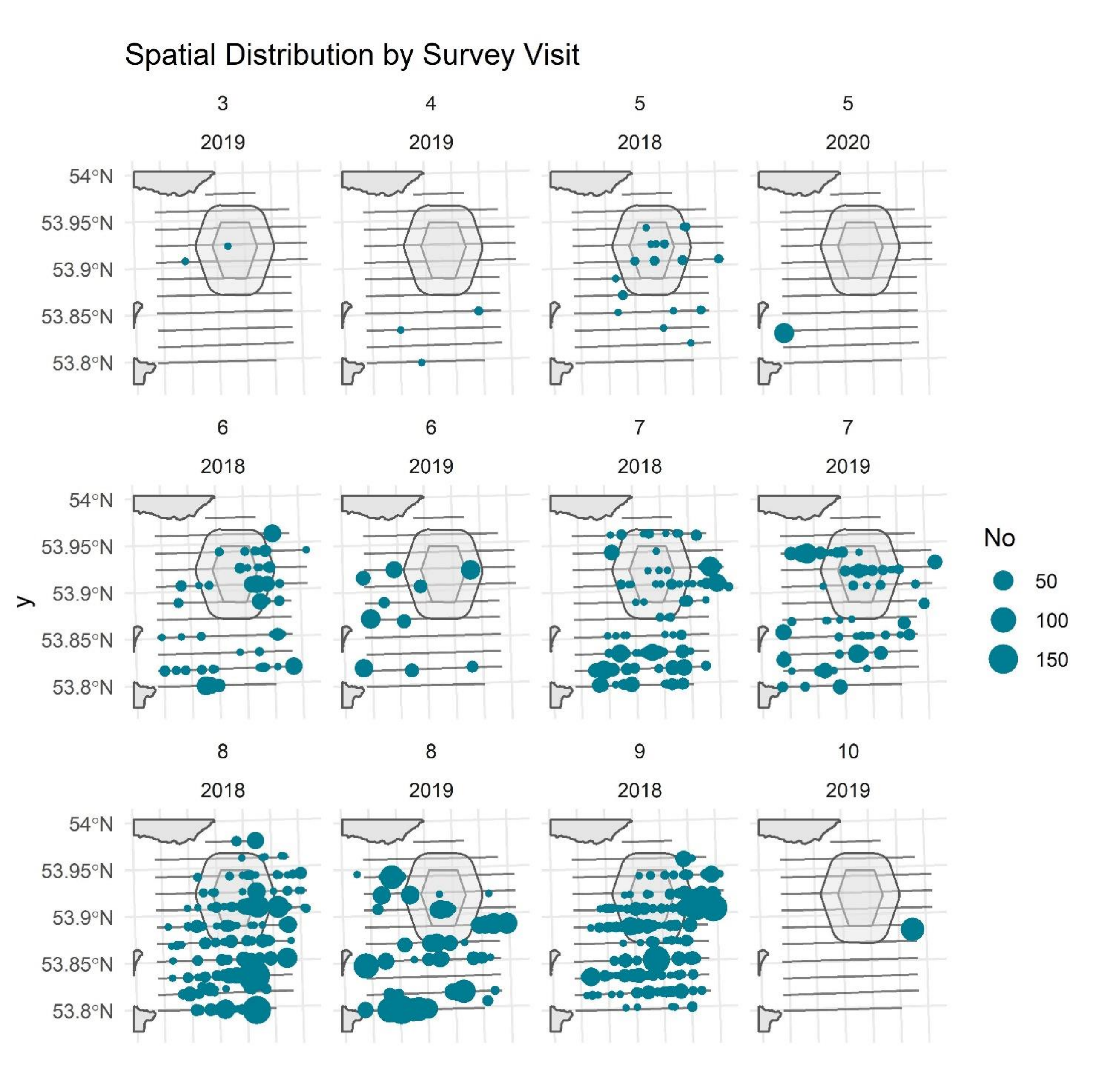


**Figure 5-10: Spatial distribution Manx shearwater records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

The peak levels of activity were recorded during the breeding season (up to 2,973 birds), with lower activity recorded during the autumn migration period (up to 1,419 birds). Single numbers of Manx shearwater were recorded during spring migration (up to six birds). No birds were recorded during the winter period (November to February).

During the boat-based transect surveys, the majority of birds observed were observed sitting (5,278 individuals, 93.2%) compared to in flight (388 individuals, 6.8%), whereas off transect, a higher proportion of birds were recorded in flight (1,370 individuals, 80.9%). Flight heights of Manx shearwater were most frequently recorded at 5 m, with only a small number of individuals flying at 10 m.

During the Digital Aerial, flying Manx shearwater were recorded in all six surveys with significant orientations recorded in five surveys. The flying Manx shearwater were significantly orientated around the mean of 126° in May 2020, 221° in June 2020, 112° in July 2020, 32° in August 2020 and 267° in September 2020. Flight heights were recorded for 133 individuals which resulted in a median altitude of 27 m above mean sea level (MSL).

Table 5-36 below shows the proportion of individuals observed sitting and flying throughout the Study Area between May 2018 and September 2020. Figure 5-11 shows the recorded flight heights of Manx shearwater during the boat-based surveys.

**Table 5-36: Proportion of Manx shearwater recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 4 | 57.1 | 3 | 42.9 | 24 | 100 | 0 | 0 |
| June 2018 | 13 | 8.7 | 137 | 91.3 | 184 | 72.4 | 70 | 27.6 |
| July 2018 | 76 | 26.7 | 209 | 73.3 | 345 | 100 | 0 | 0 |
| August 2018 | 45 | 4.5 | 945 | 95.5 | 390 | 64.7 | 213 | 35.3 |
| September 2018 | 56 | 5.9 | 901 | 94.1 | 422 | 91.3 | 40 | 8.7 |
| October 2018 | No birds recorded | | | | | | | |
| November 2018 | | | | | | | | |
| December 2018 | | | | | | | | |
| January 2019 | | | | | | | | |
| February 2019 | | | | | | | | |
| March 2019 | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 |
| April 2019 | 0 | 0 | 1 | 100 | 3 | 100 | 0 | 0 |
| June 2019 | 22 | 7.2 | 282 | 92.8 | 0 | 0 | 0 | 0 |
| July 2019 | 60 | 10.4 | 515 | 89.6 | 0 | 0 | 0 | 0 |
| August 2019 | 64 | 3.1 | 2,030 | 96.9 | 0 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 80 | 100 | 0 | 0 | 0 | 0 |
| December 2019 | No birds recorded | | | | | | | |
| January 2020 | | | | | | | | |
| April 2020 | 2 | 33.3 | 4 | 66.7 | N/A | | | |
| May 2020 | 366 | 21.5 | 404 | 78.5 | 0 | 0 | 0 | 0 |
| June 2020 | 67 | 83.8 | 13 | 16.2 | N/A | | | |
| July 2020 | 188 | 67.1 | 92 | 32.9 | | | | |
| August 2020 | 707 | 53.7 | 610 | 46.3 | | | | |
| September 2020 | 88 | 64.2 | 49 | 35.8 | | | | |
| **Total** | **1758** | **21.9** | **6,275** | **78.1** | **1,370** | **80.9** | **323** | **19.1** |

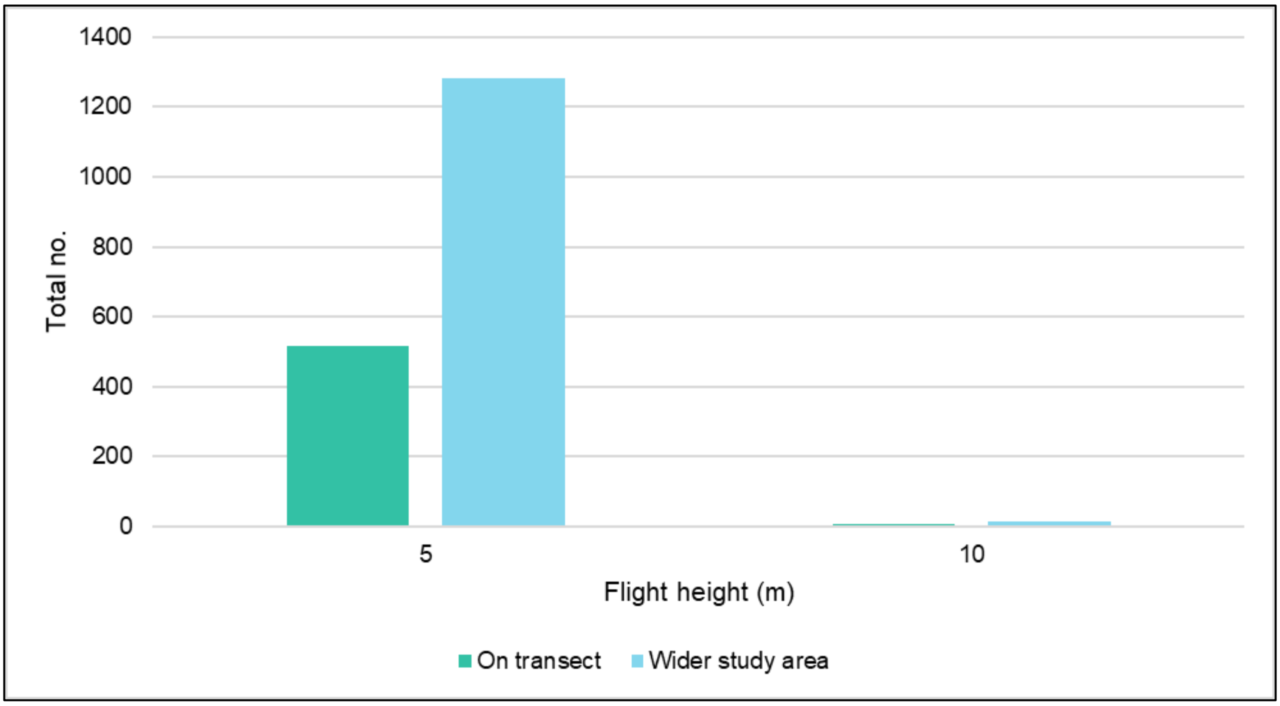


**Figure 5-11: Manx shearwater flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates from the boat-based surveys

During initial data exploration and model fitting a high co-linearity / correlation between Bathymetry and distance to coast was identified resulting in a prohibitively high VIF for these parameters. Because of this, distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CreSS:

- Bathymetry;
- Year; and
- X and Y coordinates.

To prepare for the GEE-CreSS analyses, a complete grid of abutting cells based on the survey grid and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinate were included in the one-dimensional SALSA model selection method (Walker *et al.,* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Period was fitted as a factor term. This model failed to converge and as such depth / bathymetry was removed from the model parameters and a simple linear model with an area offset was used as the base model for assessment of the 2D spatial smoother.

CreSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CreSS grid knot locations are included in annex 1. of this report. An interaction with month was included to allow the density surface to vary between survey periods. Survey periods included in this modelling step were limited to those with greater than one observation occurrence of the species to prevent model convergence issues. This meant that modelled abundance estimates could only be produced for mid breeding, late breeding and post breeding periods only.

Following predictions, bootstrapping was used to generate 95 % confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CreSS method.

### All behaviours (both sitting and flying birds)

Table 5-37 to Table 5-39 below present the Manx shearwater modelled abundance estimates for the offshore wind farm area, offshore wind farm area plus 2 km buffer and Offshore Ornithology Study Area during breeding season periods. Due to model convergence issues it was not possible to include data from other periods and produce estimates for such periods. This is considered likely due to the low numbers of observations during these periods and the excessive number of zero counts present.

**Table 5-37: Manx shearwater offshore wind farm area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| June 2018 | 78 | 28 | 196 |
| July 2018 | 66 | 22 | 222 |
| August 2018 | 131 | 69 | 294 |
| September 2018 | 227 | 97 | 969 |
| June 2019 | 135 | 51 | 363 |
| July 2019 | 113 | 35 | 362 |
| August 2019 | 225 | 117 | 471 |

**Table 5-38: Manx shearwater offshore wind farm area plus 2 km buffer modelled abundance estimates by Period.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| June 2018 | 254 | 91 | 627 |
| July 2018 | 209 | 68 | 731 |
| August 2018 | 507 | 283 | 1,007 |
| September 2018 | 1,034 | 532 | 3,109 |
| June 2019 | 436 | 160 | 1,102 |
| July 2019 | 360 | 115 | 1,169 |
| August 2019 | 872 | 481 | 1,629 |

**Table 5-39: Manx shearwater Offshore Ornithology Study Area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| June 2018 | 2,173 | 812 | 5,579 |
| July 2018 | 1,751 | 638 | 5,718 |
| August 2018 | 7,037 | 4,037 | 12,825 |
| September 2018 | 5,504 | 2,382 | 14,913 |
| June 2019 | 3,738 | 1,400 | 9,745 |
| July 2019 | 3,012 | 1,124 | 9,527 |
| August 2019 | 12,102 | 6,970 | 21,241 |

### Flying birds only

There were 3,128 records of flying Manx Shearwater over the study period. Densities of flying birds were derived from the total numbers seen in radial snapshots, divided by the total area surveyed by snapshots (survey effort); that is the number of snapshots multiplied by the snapshot area of 0.09 $km^2$.

Non-parametric bootstrap intervals have been used to calculate the standard error and 95% confidence intervals around the observed counts and densities per km2. The area of the offshore wind farm area has then been used to calculate simple abundances based on density results (Table 5-40 and Table 5-41).

**Table 5-40: Manx shearwater flying bird offshore wind farm area simple abundance estimates.**

| Season | Estimate | LCL (95%) | UCL (95%) |
|---|---|---|---|
| Mid winter | 0 | 0 | 0 |
| Late winter | 0 | 0 | 0 |
| Early breeding season | 669 | 411 | 920 |
| Mid breeding season | 564 | 390 | 735 |
| Late breeding season | 242 | 175 | 308 |
| Post breeding / moult | 271 | 225 | 316 |
| Autumn | 0 | 0 | 0 |
| Early winter | 0 | 0 | 0 |

**Table 5-41: Manx shearwater flying bird offshore wind farm area plus 2 km buffer simple abundance estimates.**

| Season | Estimate | LCL (95%) | UCL (95%) |
|---|---|---|---|
| Mid winter | 0 | 0 | 0 |
| Late winter | 0 | 0 | 0 |
| Early breeding season | 1,946 | 1,195 | 2,676 |
| Mid breeding season | 1,640 | 1,134 | 2,138 |
| Late breeding season | 704 | 509 | 896 |
| Post breeding / moult | 788 | 654 | 919 |
| Autumn | 0 | 0 | 0 |
| Early winter | 0 | 0 | 0 |

## Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for Manx shearwater at the different spatial scales. Table 5-42 presents the abundance estimates for sitting birds only whereas, Table 5-43 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate.

**Table 5-42: Abundance estimates of sitting Manx shearwater within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 3 (1 - 8) | 2 (1 - 7) |
| May 2020 | 44 (16 - 88) | 44 (17 - 105) |
| June 2020 | 8 (3 - 16) | 10 (4 - 20) |
| July 2020 | 3 (1 - 8) | 5 (2 - 13) |
| August 2020 | 3 (1 - 8) | 10 (4 - 23) |
| September 2020 | No birds recorded | No birds recorded |

**Table 5-43: Abundance estimates of flying Manx shearwater within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | No birds recorded | No birds recorded |
| May 2020 | 8 (3 - 25) | 57 (22 - 162) |
| June 2020 | 8 (3 - 24) | 13 (5 - 28) |
| July 2020 | 3 (1 - 8) | 8 (3 - 18) |
| August 2020 | 63 (35 - 82) | 167 (114 - 227) |
| September 2020 | 11 (4 - 25) | 39 (21 - 60) |

## 5.6.7 Gannet

### Ecology

The gannet is the largest seabird in the North Atlantic, having a wingspan of up to 2 m (6.6 ft), and can be observed around the Irish coastline throughout the year (Balmer *et al.*, 2013) although in scarcer numbers during winter months. Gannet forage through plunge-diving to a depth of up to 35 m, diving at high speeds into the sea with their bodies straight and rigid, wings tucked close to the body but angled back. Gannet forage on a variety of prey species, and they appear to have diet plasticity with different prey recorded at different colonies. Herring and mackerel were the most common prey species at colonies in Shetland, the Firth of Forth and Quebec (Garthe *et al.*, 2007; Lewis *et al.*, 2003) whilst capelin dominated prey in a low Arctic colony in Newfoundland.

Gannet foraging behaviours are supported by their long and narrow wings which are positioned towards the front of the body, allowing efficient use of air currents when flying. This relatively high wing loading results in a fast flight speed (55-65 km/hr) with relatively low manoeuvrability (Nelson, 2010). They usually fly between 3 and 105 m above sea level with most time spent between 11 and 60 m (Thaxter *et al.,* 2015).

The gannet is an Amber-listed species in Ireland due to their distribution of more than 50% of the Irish population occurring at fewer than ten sites (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021). The main colonies in Ireland are located on islands off the coast and include Great Saltee, Bull Rock and Little Skellig. Smaller colonies are also found on Irelands Eye and Clare’s Island. A sixth colony on Lambay had established since the last census (in 2007). The most recent census of gannet in Ireland took place in the breeding seasons between 2013 and 2014 (Cummins *et al.,* 2019); the results were largely based on aerial photography and supplemented by land-based VP counts at smaller colonies. The census revealed that the Irish population had increased by an estimated 33% over the 10-year period from 36,111 AOS in 2004 to 47,946 AOS in 2014 (Table 6-41).

**Table 5-44: Census totals (AOS) of gannet at Irish colonies for the period 1969-70 to 2013-14 (Cummins *et al.*, 2019).**

| Site | 1969 – 1970 | 1984 – 1985 | 1995 | 2004 | 2013-2014 | % Change Since 2004 |
|---|---|---|---|---|---|---|
| Clare Island | 0 | 2 | 3 | 3 | 267 | + 8800% |
| Little Skellig | Approximately 22,000 | 22,500 | 26,436 | 29,600 | 35,294 | + 19% |
| Bull Rock | Approximately 1,500 | 1,511 | 1,815 | 3,694 | 6,388 | + 73% |
| Great Saltee | 155 | 710 | 1,250 | 2,446 | 4,722 | + 93% |
| Ireland's Eye | - | - | 45 | 285 | 547 | + 92% |
| Lambay | - | - | - | - | 728 | - |
| National Total | 23,655 | 24,723 | 29,549 | 36,111 | 47,946 | + 33% |

The last census to cover all UK gannetries was carried out over two breeding seasons in 2003 and 2004. In 2013 and 2014 all Scottish colonies were surveyed, while Grassholm (Wales) was counted again in 2015. Similarly Irish colonies (Ireland's Eye, Lambay Island, Bull Rock and Great Saltee) where last counted between 2014 and 2015 The last colony count of St Margaret's Island (Caldey Island, Pembrokeshire) was undertaken in 2019 and recorded no occupied nests. A small colony (< 50 birds) has been recorded for the first time in 2022 on Middle Mouse off the north coast of Anglesey.

A summary of the recent (within the last 10 summers) colony data for gannet within the Cumulative Offshore Ornithology Study Area and within the mean max foraging range of the species is provided in Table 5-46 below. If multiple years are provided then the mean count is presented.

**Table 5-45: Summary of most recent colony data for gannet between 2012 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AOS/AON) ± SD (if applicable) |
|---|---|---|---|
| Cork | Bull Rock | 2014 | 6,388 |
| Donegal | Garven Islands | 2016 | 30 |
| Dublin | Ireland's Eye | 2013 and 2015 | 448.5 ± 98.5 |
| | Lambay Island | 2013 and 2015 | 827 ± 99 |
| Dyfed | Grassholm SPA | 2015 | 36,011 |
| Gwynedd | Porth Llanlleiana to Porth Eilian | 2022 | 21 |
| Kyle and Carrick | Ailsa Craig SPA | 2014 | 33,226 |
| Wexford | Great Saltee | 2013 | 4,722 |
| Wigtown | Monreith Cliffs and Scar Rocks | 2014 | 2,376 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) provided a total of 666 sightings of 1,192 gannet across the three surveys within the ObSERVE western Irish Sea survey area. This species was observed predominately in the northern transects of the ObSERVE western Irish Sea survey area, which were located around the Dundalk Bay area. Observations of gannet were far more common in summer and autumn surveys, with sightings of individuals or small groups most frequently observed. Winter sightings were very sparse (27 sightings, 33 individuals) and were exclusively adult birds. Mean density of gannet across the ObSERVE western Irish Sea survey area ranged from 0.88 birds/km$^2$ in autumn surveys, 0.33 birds/km$^2$ in summer surveys and 0.03 birds/km$^2$ in winter (Jessopp *et al.*, 2018). No records of gannet were presented within the I-WeBS database.

### Site-specific data

Gannet observations were recorded in all months of the survey period except November 2018, January 2019, December 2019 and January 2020. The greatest abundances were in recorded in September 2018 (247 individuals), August 2018 (183 individuals) and August 2019 (183 individuals), with a total of 1,718 observations recorded within the entire Study Area.

A monthly breakdown of gannet records from the transect surveys and from within the entire Study Area are presented in Table 5-46. Table 5-47 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-12 shows the spatial distribution of gannet during the survey period.

**Table 5-46: Transect records and total observations of gannet from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 2 | - | 12 |
| June 2018 | 27 | - | 80 |
| July 2018 | 17 | - | 66 |
| August 2018 | 62 | - | 199 |
| September 2018 | 119 | - | 247 |
| October 2018 | 23 | - | 99 |
| November 2018 | 0 | - | 0 |
| December 2018 | 2 | - | 4 |
| January 2019 | 0 | - | 3 |
| February 2019 | 1 | - | 3 |
| March 2019 | 3 | - | 20 |
| April 2019 | 8 | - | 33 |
| June 2019 | 5 | - | 5 |
| July 2019 | 20 | - | 20 |
| August 2019 | 183 | - | 183 |
| October 2019 | 23 | - | 23 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 73 | 73 |
| May 2020 | 38 | 127 | 165 |
| June 2020 | - | 41 | 41 |
| July 2020 | - | 156 | 156 |
| August 2020 | - | 145 | 145 |
| September 2020 | - | 141 | 141 |
| **Total** | **533** | **683** | **1,718** |

**Table 5-47: Seasonal variation of gannet recorded between May 2018 and September 2020.**

| Year | Spring Migration Dec – Feb | Breeding Mar – Aug | Autumn Migration Sep – Nov | Winter | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | 10 | 357 | 346 | - | - |
| 2019 / 2020 | 0 | 261 | 23 | - | - |
| 2020 | - | 580 | 141 | - | - |

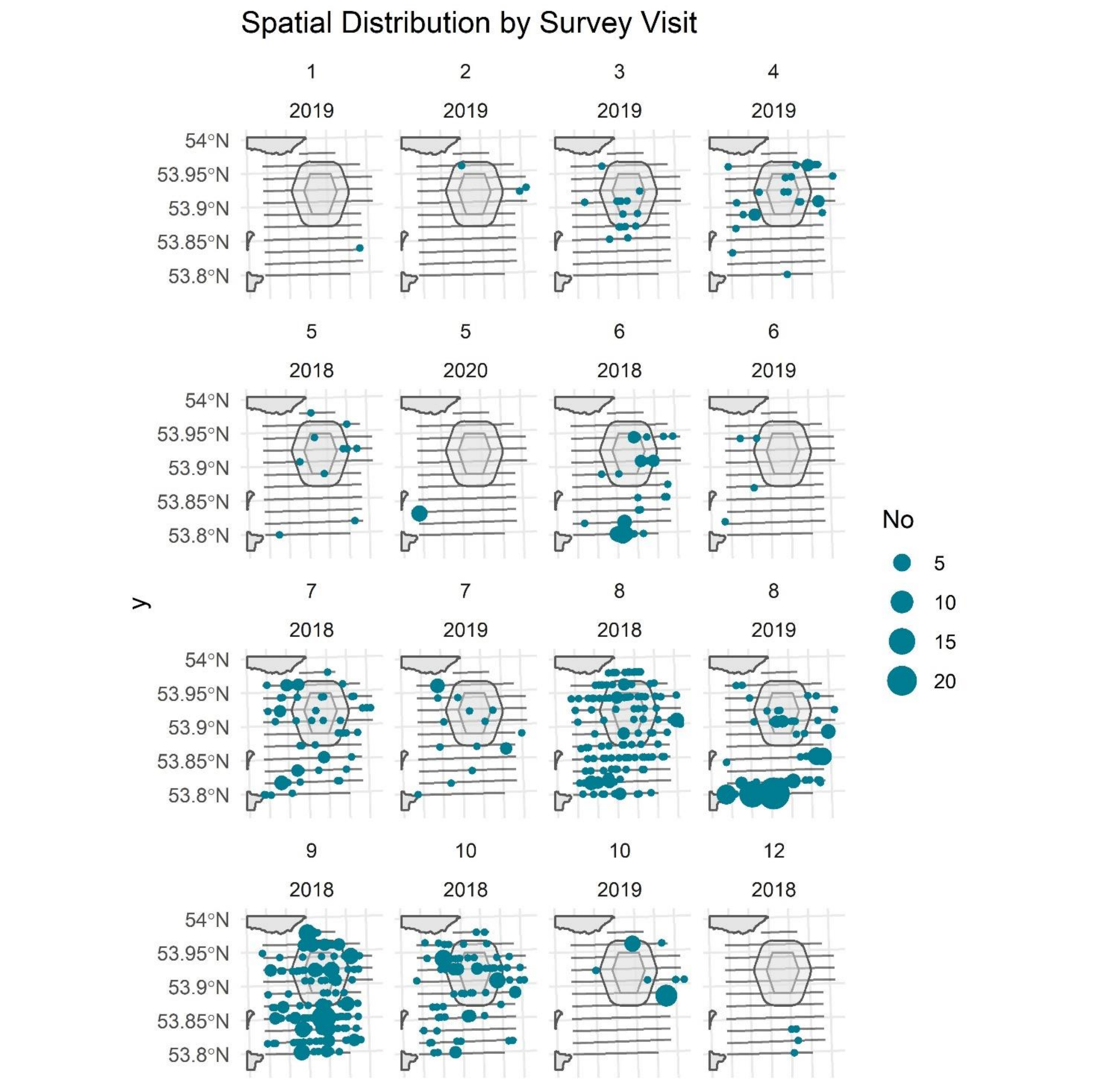


**Figure 5-12: Spatial distribution of gannet records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

The peak levels of activity were recorded during the breeding season (Mar-Sep) each year; outside the peak recording period, gannet was typically recorded further offshore (i.e. away from the west and northwest parts of the Study Area). However, during the peak recording months, birds were widespread throughout the Study Area. Single observations for gannet were recorded during the winter months.

During the boat-based transect surveys, the majority of birds (464 individuals, 87.1%) observed along the route were sitting; off transect, a higher proportion of birds (429 individuals, 85.5%) were recorded flying. Flight heights along the transect route were most frequently recorded between 5 m and 30 m with single observations of birds flying between 40 m and 50+ m. Off transect, a greater proportion of birds were recorded flying at 5 m, with a gradual decrease in numbers towards 50 m.

During the DAS (APEM, 2020), a total of 683 gannet were identified, of which 341 were observed sitting and 342 were recorded flying. Flying gannet were recorded in all six surveys and a significant orientation was observed in five of them; orientated around the mean of 99° in April, 108° in May, 225° in June, 88° in August and 233° in September. Flight heights were recorded for 64 individuals which resulted in a median altitude of 21 m above mean sea level (MSL).

Table 5-48 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-13 shows the recorded flight heights of gannet during the boat-based surveys.

**Table 5-48: Proportion of gannet recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 2 | 100.0 | 0 | 0 | 9 | 90.0 | 1 | 10.0 |
| June 2018 | 0 | 0 | 27 | 100.0 | 33 | 62.2 | 20 | 37.8 |
| July 2018 | 2 | 11.8 | 15 | 88.2 | 45 | 91.8 | 4 | 8.2 |
| August 2018 | 4 | 6.5 | 58 | 93.5 | 113 | 82.5 | 24 | 17.5 |
| September 2018 | 16 | 13.4 | 103 | 86.6 | 114 | 89.1 | 14 | 10.9 |
| October 2018 | 3 | 13.0 | 20 | 87.0 | 74 | 97.4 | 2 | 2.6 |
| November 2018 | No birds recorded | | | | | | | |
| December 2018 | 2 | 100.0 | 0 | 0 | 2 | 100.0 | 0 | 0 |
| January 2019 | 0 | 0 | 0 | 0 | 1 | 33.3 | 2 | 66.7 |
| February 2019 | 1 | 100.0 | 0 | 0 | 2 | 100.0 | 0 | 0 |
| March 2019 | 0 | 0 | 3 | 100.0 | 15 | 88.2 | 2 | 11.8 |
| April 2019 | 1 | 12.5 | 7 | 87.5 | 21 | 84.0 | 4 | 16.0 |
| June 2019 | 1 | 20.0 | 4 | 80.0 | 0 | 0 | 0 | 0 |
| July 2019 | 8 | 40.0 | 12 | 60.0 | 0 | 0 | 0 | 0 |
| August 2019 | 6 | 3.3 | 177 | 96.7 | 0 | 0 | 0 | 0 |
| October 2019 | 4 | 17.4 | 19 | 82.6 | 0 | 0 | 0 | 0 |
| December 2019 | No birds recorded | | | | | | | |
| January 2020 | | | | | | | | |
| April 2020 | 39 | 53.4 | 34 | 46.6 | N/A | | | |
| May 2020 | 61 | 37 | 104 | 63 | 0 | 0 | 0 | 0 |
| June 2020 | 32 | 78 | 9 | 22 | N/A | | | |
| July 2020 | 86 | 55.1 | 70 | 44.9 | | | | |
| August 2020 | 62 | 42.8 | 83 | 57.2 | | | | |
| September 2020 | 81 | 57.4 | 60 | 42.6 | | | | |
| **Total** | **411** | **33.8** | **805** | **66.2** | **429** | **85.5** | **73** | **14.5** |

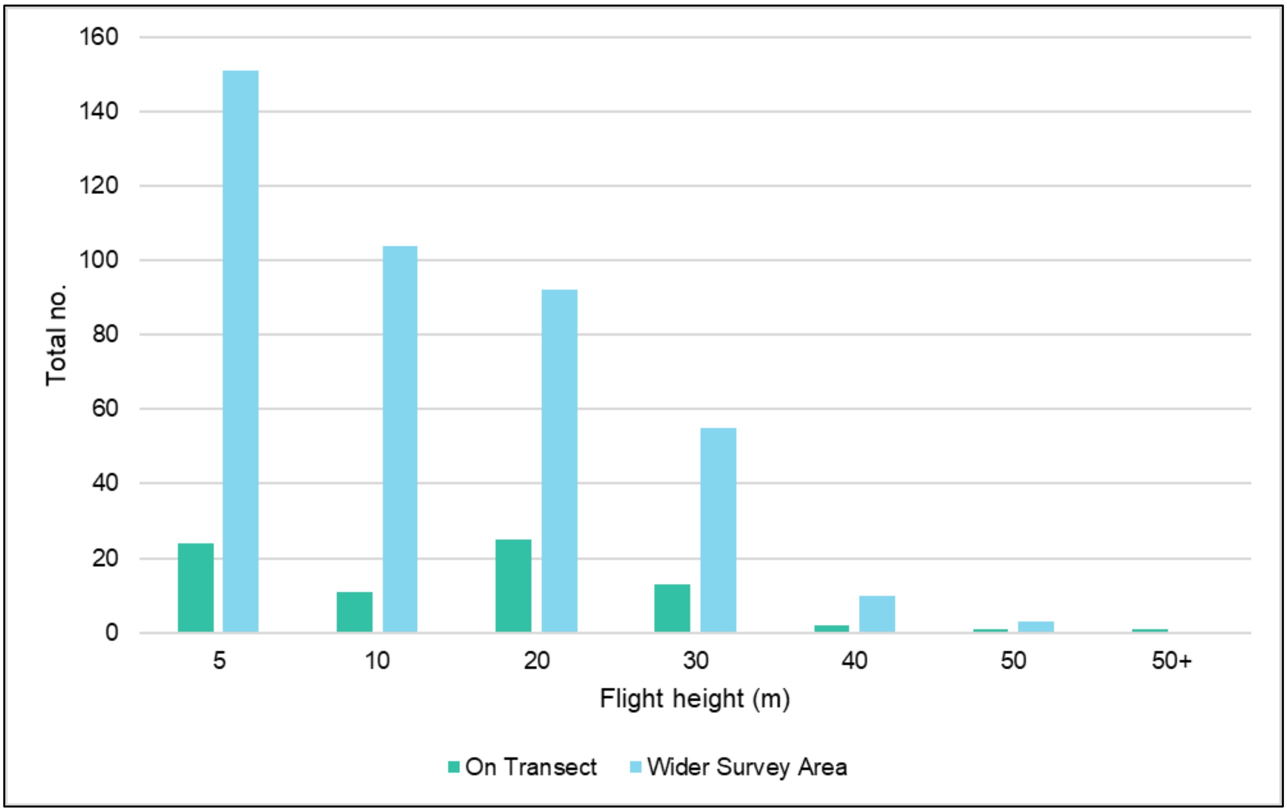


**Figure 5-13: Gannet flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during the boat-based surveys

During initial data exploration and model fitting a high co-linearity / correlation between Bathymetry and distance to coast was identified resulting in a prohibitively high VIF for these parameters. Because of this distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CreSS:

- Bathymetry;
- Year; and
- X and Y coordinates.

In addition to the co-linearity identified above a low number of observations were also identified in some months for gannet and this also inhibited model convergence when using month as an interaction to term. As such seasonal periods were used in place of month for this analysis.

To prepare for the GEE-CreSS analyses, a complete grid of abutting cells based on the survey grid and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinate were included in the one-dimensional SALSA model selection method (Walker *et al.,* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Period was fitted as a factor term. This provided the base model for assessment of the 2D spatial smoother.

CreSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CreSS grid knot locations are included in annex 1 of this report. An interaction with month was included to allow the density surface to vary between survey months. Following predictions, bootstrapping was used to generate 95 % confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CreSS method.

### All behaviours (both sitting and flying birds)

Table 5-49 to Table 5-51 below present the gannet modelled abundance estimates for the offshore wind farm area, the offshore wind farm area plus 2 km buffer and the Offshore Ornithology Study Area.

**Table 5-49: Gannet modelled sitting bird abundance estimates for offshore wind farm area by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 0 | 0 | NA |
| June 2018 | 0 | 0 | 6 |
| July 2018 | 7 | 3 | 16 |
| August 2018 | 7 | 4 | 3 |
| September 2018 | 28 | 18 | 51 |
| October 2018 | 5 | 2 | 10 |
| February 2019 | 0 | 0 | NA |
| March 2019 | 9 | 7 | 12 |
| April 2019 | 3 | 1 | 15 |
| June 2019 | 0 | 0 | 1 |
| July 2019 | 2 | 1 | 6 |
| August 2019 | 17 | 10 | 29 |
| October 2019 | 12 | 6 | 22 |
| May 2020 | 0 | 0 | NA |

**Table 5-50: Gannet modelled sitting bird abundance estimates for offshore wind farm area plus 2 km buffer by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 0 | 0 | NA |
| June 2018 | 2 | 0 | 7 |
| July 2018 | 16 | 7 | 40 |
| August 2018 | 21 | 12 | 38 |
| September 2018 | 79 | 48 | 150 |
| October 2018 | 13 | 6 | 32 |
| February 2019 | 0 | 0 | NA |
| March 2019 | 9 | 7 | 12 |
| April 2019 | 9 | 2 | 54 |
| June 2019 | 3 | 7 | 14 |
| July 2019 | 7 | 2 | 24 |
| August 2019 | 54 | 31 | 91 |
| October 2019 | 34 | 15 | 74 |
| May 2020 | 0 | 0 | NA |

**Table 5-51: Gannet modelled sitting bird abundance estimates for Offshore Ornithology Study Area by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 0 | 0 | NA |
| June 2018 | 57 | 25 | 172 |
| July 2018 | 66 | 26 | 189 |
| August 2018 | 219 | 122 | 404 |
| September 2018 | 369 | 196 | 773 |
| October 2018 | 61 | 19 | 293 |
| February 2019 | 0 | 0 | NA |
| March 2019 | 9 | 7 | 12 |
| April 2019 | 27 | 6 | NA |
| June 2019 | 23 | 9 | 70 |
| July 2019 | 27 | 9 | 87 |
| August 2019 | 579 | 35 | 928 |
| October 2019 | 162 | 47 | 714 |
| May 2020 | 0 | 0 | NA |

### Flying birds only

There are 478 records of flying gannet over the study period. Densities of flying birds were modelled using a similar approach to loafing birds described above where sufficient data was available to do so. For gannet sufficient observations were only available for the early breeding season, mid-breeding season, late breeding season, post breeding / moult and autumn periods to allow modelled estimation of flight densities. These data are presented in Table 5-52 and Table 5-53.

**Table 5-52: Gannet flying bird offshore wind farm area abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 1 | 0 | 6 |
| June 2018 | 10 | 5 | 28 |
| July 2018 | 22 | 12 | 40 |
| August 2018 | 127 | 99 | 162 |
| September 2018 | 85 | 66 | 110 |
| October 2018 | 60 | 47 | 76 |
| November 2018 | 0 | 0 | NA |
| December 2018 | 0 | 0 | 4 |
| January 2019 | 0 | 0 | NA |
| February 2019 | 0 | 0 | 10 |
| March 2019 | 23 | 14 | 37 |
| April 2019 | 21 | 10 | 44 |
| June 2019 | 2 | 0 | 10 |
| July 2019 | 5 | 1 | 15 |
| August 2019 | 3 | 2 | 5 |
| October 2019 | 2 | 1 | 3 |
| December 2019 | 0 | 0 | 0 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| January 2020 | 0 | 0 | NA |
| May 2020 | 4 | 1 | 13 |

**Table 5-53: Gannet flying offshore wind farm area plus 2 km buffer abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 3 | 0 | 21 |
| June 2018 | 31 | 14 | 87 |
| July 2018 | 64 | 35 | 122 |
| August 2018 | 405 | 321 | 512 |
| September 2018 | 257 | 198 | 335 |
| October 2018 | 168 | 131 | 217 |
| November 2018 | 0 | 0 | NA |
| December 2018 | 0 | 0 | 13 |
| January 2019 | 1 | 0 | NA |
| February 2019 | 39 | 5 | 39 |
| March 2019 | 76 | 47 | 134 |
| April 2019 | 56 | 26 | 126 |
| June 2019 | 7 | 1 | 32 |
| July 2019 | 13 | 4 | 45 |
| August 2019 | 11 | 6 | 17 |
| October 2019 | 4 | 2 | 8 |
| December 2019 | 0 | 0 | 0 |
| January 2020 | 0 | 0 | NA |
| May 2020 | 13 | 4 | 50 |

## Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for gannet at the different spatial scales. Table 5-54 presents the abundance estimates for sitting birds only whereas, Table 5-55 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate.

**Table 5-54: Abundance estimates of sitting gannet within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 13 (5 - 29) | 40 (16 - 87) |
| May 2020 | 96 (35 - 256) | 100 (39 - 234) |
| June 2020 | No birds recorded | |
| July 2020 | 25 (14 - 39) | 58 (33 - 89) |
| August 2020 | 16 (6 - 33) | 58 (35 - 86) |
| September 2020 | 11 (4 - 19) | 39 (21 - 62) |

**Table 5-55: Abundance estimates of flying gannet within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | No birds recorded | 22 (9 - 42) |
| May 2020 | 38 (14 - 71) | 49 (19 - 85) |
| June 2020 | 3 (1 - 8) | 10 (4 - 20) |
| July 2020 | 30 (11 - 61) | 81 (46 - 124) |
| August 2020 | 16 (6 - 33) | 40 (20 - 63) |
| September 2020 | 22 (8 - 66) | 81 (34 - 146) |

## 5.6.8 Shag

### Ecology

Shag is a coastal, piscivorous seabird that obtains prey by pursuit-diving (Watanuki *et al.,* 2008). Birds are widely dispersed around Ireland throughout the year (Stone *et al.*, 1995). The shag illustrates a strong preference for rocky coasts and islands, although they are also found over shallow, sandy sediments. Shag are almost exclusively benthic feeders, using two very distinct foraging habitats: sandy areas and rocky areas at depths of between 10 and 40 m.

Foraging behaviour differs markedly between habitats; in rocky areas birds travel along the bottom searching for bottom-living fish, whilst in sandy habitat they probe into the sand with their bill to catch lesser sandeels (Watanuki *et al.,* 2008). Long-term variability in the diet of this species has also been recorded (Howells *et al.*, 2018) with dramatic reductions in the frequency of lesser sandeel occurrence between 1984 and 2017 (especially during non-breeding).

The UK shag population increased slightly from 30,000 pairs in 1969-70 to 36,000 pairs in 1985-88, possibly as a result of better coverage of previously inaccessible coastlines through the use of inflatable boats, increased legal protection (e.g. under the Wildlife and Countryside Act 1981, as amended) and reduced persecution. However, numbers had fallen by 27% by the time of Seabird 2000. Severe events, such as those in the winters of 1993/1994 and 2004/2005, considerably affected populations on the east coast of the UK. These trends have resulted in the shag being Red-listed in the UK due to the sharp population declines over 25 years and over the longer term (Stanbury *et al.,* 2021).

In Ireland, the shag is an Amber-listed species due to their distribution of more than 50% of the Irish population occurring at fewer than ten sites (Gilbert *et al*., 2021). Table 5-56 below shows the population estimates of individual shag colonies over time (Cummins *et al*., 2019).

**Table 5-56: Census totals (AON) of shag at a selection of Irish colonies for the period since Seabird 2000 (Cummins *et al.,* 2019).**

| Site | Seabird 2000 | 2007 | 2015 – 2018 | Change (from Seabird 2000) |
|---|---|---|---|---|
| Inishmurray | 104 | - | 389 | + 274% |
| Howth | 12 | 55 | 41 | + 241% |
| Ireland's Eye | 32 | 64 | 81 | + 153% |
| Old Head of Kinsale | 30 | 25 | 46 | + 53% |
| Clare Island | 86 | - | 78 | - 9% |
| Lambay | 1,122 | 1670 | 469 | - 58% |
| Great Saltee | 2,687 | - | 112 | - 58% |

A summary of the recent (within the last five summers) colony data for shag within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-57 below. If multiple years are provided then the mean count is presented.

**Table 5-57: Summary of most recent colony data for shag between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Down | Maggy's Leap | 2017 and 2019 | 7 ± 2 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) did not differentiate between cormorant and shag and were grouped together. A total of 174 observations of 534 birds were recorded across the three survey periods, all of which were recorded within the coastal region of the ObSERVE western Irish Sea survey area. A preference for shallow waters was evident through a peak in the distribution of sightings over water depths of around 10 m, and very few sightings were observed in waters of depths of greater than 20 m. Mean density of cormorants/shags across the ObSERVE western Irish Sea survey area ranged from 0.31 birds/km$^2$ in summer surveys, 0.3 birds/km$^2$ in autumn surveys and 0.14 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018).

Several observations of shag were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-58. A five-year peak observation of 6 birds was recorded in the 2016/2017 season, along with a five-year peak-mean count of 2 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-58: Summary of I-WeBS survey counts for shag within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 1 | 0 | 6 | 2 | - | - |

## Site-specific data

Although shag was recorded during all survey months except March 2019 and July 2019, observations fluctuated throughout the 19 months surveyed, as presented within Table 5-59. Greater numbers were observed during post-breeding dispersal (August to October) and spring migration months (December to February). Peak counts on transect were recorded in December 2019 (25 individuals), October 2018 (24 individuals) and December 2018 (23 birds) (Aquafact, 2019).

A summary of the monthly records from the boat-based transect surveys is presented in Table 5-59. Table 5-60 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Specific counts for shag were not recorded during the Digital Aerials undertaken by APEM between April 2020 and September 2020 and are therefore not included in the tables below. Figure 5-14 shows the spatial distribution of shag during the survey period.

**Table 5-59: Transect records and total observations of shag from boat-based surveys in the Study Area.**

| Month / Year | Transect Records | All Records |
|---|---|---|
| May 2018 | 10 | 12 |
| June 2018 | 0 | 2 |
| July 2018 | 1 | 3 |
| August 2018 | 13 | 17 |
| September 2018 | 0 | 7 |

| Month / Year | Transect Records | All Records |
|---|---|---|
| October 2018 | 24 | 35 |
| November 2018 | 5 | 7 |
| December 2018 | 23 | 59 |
| January 2019 | 20 | 25 |
| February 2019 | 17 | 23 |
| March 2019 | 0 | 0 |
| April 2019 | 0 | 1 |
| June 2019 | 4 | 4 |
| July 2019 | 0 | 0 |
| August 2019 | 2 | 2 |
| October 2019 | 19 | 20 |
| December 2019 | 25 | 25 |
| January 2020 | 19 | 19 |
| May 2020 | 1 | 1 |
| **Total** | **183** | **262** |

**Table 5-60: Seasonal variation of shag recorded between May 2018 and September 2020.**

| Year | Spring Migration Dec – Feb | Breeding Mar – Aug | Autumn Migration Sep – Oct | Winter Nov | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | 107 | 34 | 42 | 7 | - |
| 2019 / 2020 | 44 | 7 | 20 | 0 | - |
| 2020 | - | 1 | - | - | - |

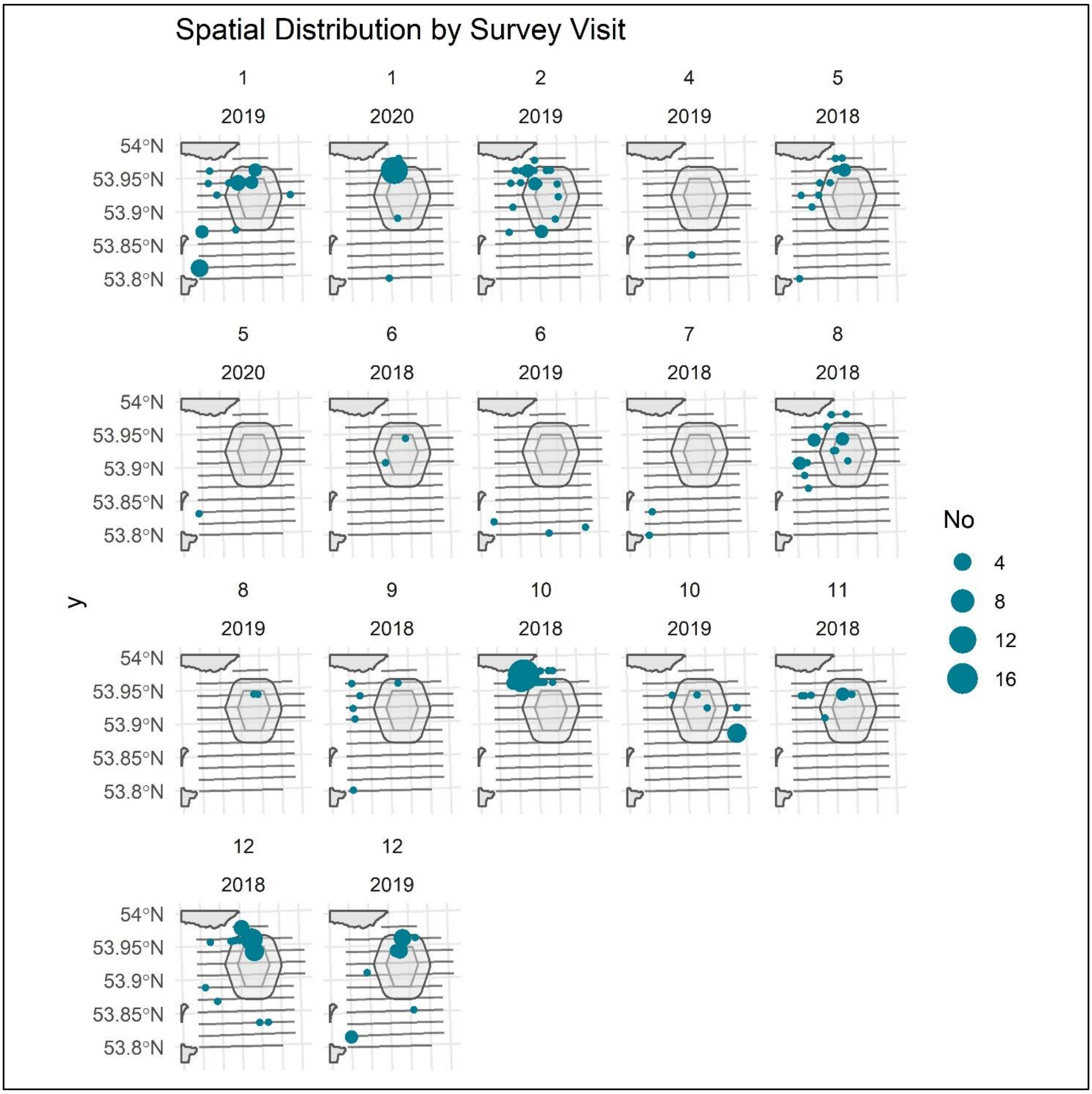


**Figure 5-14: Spatial distribution of shag records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, the majority of birds observed were observed sitting (176 individuals, 91.3%) compared to in flight (16 individuals, 8.7%), whereas off transect, a higher proportion of birds were recorded in flight (56 individuals, 70.9%). Flight heights of shag were most frequently recorded at 5 m on and off transect.

During the Digital Aerial, six cormorant / shag were identified: two each in April, May and September 2020. The cormorant / shag individuals were located in pairs, one pair in the southwest corner of the Ornithology Study area, just outside the boundary in April 2020 and the other two pairs located to the northwest of the area.

Table 5-61 below shows the proportion of individuals observed sitting and flying throughout the Study Area between May 2018 and May 2020 (Aquafact, 2019). Figure 5-15 shows the recorded flight heights of shag during the same period.

**Table 5-61: Proportion of shag recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 10 | 100.0 | 2 | 100.0 | 0 | 0 |
| June 2018 | 0 | 0 | 0 | 0 | 2 | 100.0 | 0 | 0 |
| July 2018 | 1 | 100.0 | 0 | 0 | 2 | 100.0 | 0 | 0 |
| August 2018 | 0 | 0 | 13 | 100.0 | 4 | 100.0 | 0 | 0 |
| September 2018 | 0 | 0 | 0 | 0 | 7 | 100.0 | 0 | 0 |
| October 2018 | 0 | 0 | 24 | 100.0 | 10 | 90.9 | 1 | 9.1 |
| November 2018 | 1 | 20.0 | 4 | 80.0 | 2 | 100.0 | 0 | 0 |
| December 2018 | 1 | 4.3 | 22 | 95.7 | 14 | 38.9 | 22 | 61.1 |
| January 2019 | 3 | 15.0 | 17 | 85.0 | 5 | 100.0 | 0 | 0 |
| February 2019 | 3 | 17.6 | 14 | 82.4 | 6 | 100.0 | 0 | 0 |
| March 2019 | No birds recorded | | | | | | | |
| April 2019 | 0 | 0 | 0 | 0 | 1 | 100.0 | 0 | 0 |
| June 2019 | 0 | 0 | 4 | 100.0 | 0 | 0 | 0 | 0 |
| July 2019 | No birds recorded | | | | | | | |
| August 2019 | 0 | 0 | 2 | 100.0 | 0 | 0 | 0 | 0 |
| October 2019 | 2 | 10.5 | 17 | 89.5 | 1 | 100.0 | 0 | 0 |
| December 2019 | 2 | 8.0 | 23 | 72.0 | 0 | 0 | 0 | 0 |
| January 2020 | 3 | 15.8 | 16 | 84.2 | 0 | 0 | 0 | 0 |
| May 2020 | 0 | 0 | 1 | 100.0 | 0 | 0 | 0 | 0 |
| **Total** | **16** | **8.7** | **167** | **91.3** | **56** | **70.9** | **23** | **29.1** |

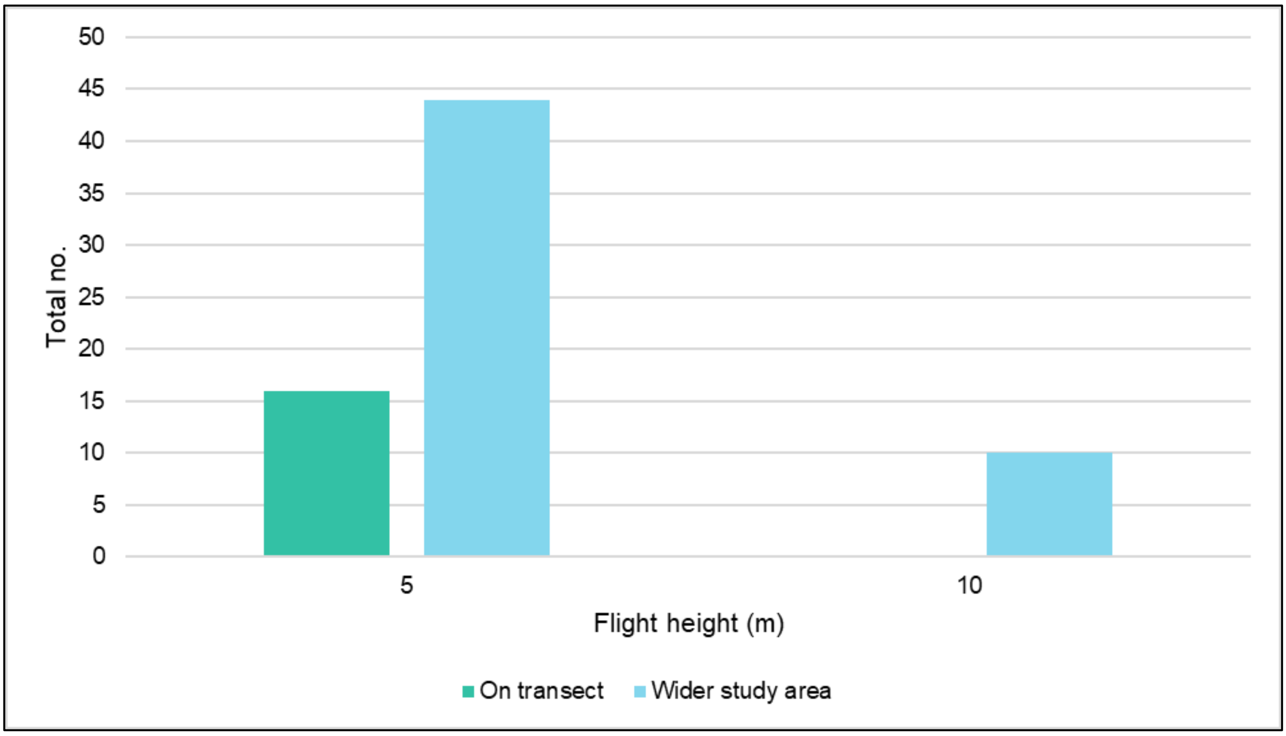


**Figure 5-15: Shag flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-14), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.9 Cormorant

### Ecology

Cormorant can occupy terrestrial and inland habitats and can be observed to nest within trees; however, it also inhabits marine environments such as sheltered coastal areas in estuaries, coastal bays and similar habitats and typically deeper waters and offshore areas (Balmer *et al.*, 2013; BirdLife International, 2020; Mitchell *et al.*, 2004).

Cormorants forage to depths of up to 10 m, and exceptionally down to 35 m (BirdLife International, 2020), up to 20-25 km from its wintering roosts or breeding colonies. As a generalist, cormorant is understood to feed on at least 22 different fish species (BirdLife International, 2019). Their diet consists of fish, including sculpins, capelin, gadids and flatfish (BirdLife International, 2019) as well as crustaceans, amphibians (del Hoyo *et al.*, 1992), molluscs and nestling birds (Brown *et al.*, 1982).

There is pronounced regional variation in the trends of abundance in great cormorant. Populations in northern Scotland have declined severely, whereas in England, inland colonies at least have increased with 2,362 pairs nesting in 2012. In Wales, numbers have been more stable. Increases in abundance up to 1995 are likely to have been facilitated by increased legal protection instigated under the Wildlife and Countryside Act 1981 (as amended). Factors responsible for recent declines are likely to include increased mortality from licensed and unlicensed shooting, as well as possible changes in food availability.

In Northern Ireland, there are only six known cormorant colonies. These held 663 AON during Seabird 2000, which was 10% fewer than that recorded during the SCR Census (736 AON) but six-times more than recorded by Operation Seafarer (108 AON). However, from 2017 to 2018, five colonies (Strangford Lough, Burial Island, Gobbins, Little Skerries and Sheep Island) held 673 AON, a very similar number to the Seabird 2000 count. Table 5-62 shows the census totals (AON) of cormorant at a selection of Irish colonies for the period 1985 – 1988 to 2015 – 2018 (Cummins *et al.,* 2019).

**Table 5-62: Census totals (AON) of cormorant at a selection of Irish colonies for the period 1985 – 1988 to 2015 – 2018 (Cummins *et al.,* 2019).**

| Site | SCR (1985 – 1988) | Seabird 2000 (1998 – 2002) | 2015 – 2018 | % Change (1998 – 2018) |
|---|---|---|---|---|
| Ballycotton Island | - | 46 | 75 | + 63% |
| Capel Island | - | 52 | 82 | + 58% |
| Ireland's Eye | 19 | 306 | 424 | + 39% |
| Lough Derg | 417 | 207 | 272 | + 31% |
| Inishowen Peninsula | - | 225 | 289 | + 28% |
| Ardboline and Horse Island | - | 156 | 191 | + 22% |
| Deer Island | - | 200 | 212 | + 6% |
| Keeragh Islands | 239 | 200 | 199 | - 1% |
| St. Patrick's Island | 0 | 558 | 544 | - 3% |
| Little Saltee | 234 | 273 | 208 | - 24% |
| Duvillaun Islands | 154 | 20 | 10 | - 50% |
| Sovereign Islands | - | 156 | 76 | - 51% |
| Lough Scannive | 218 | 160 | 71 | - 56% |
| Lambay Island | 1,027 | 675 | 299 | - 56% |
| Lough Cutra | 166 | 150 | 0 | - 100% |

Due to a moderate decline in their breeding populations, cormorant is Amber-listed in Ireland (Gilbert *et al*., 2021).

There is no colony data for cormorant within the Cumulative Offshore Ornithology Study Area and within the mean max foraging range of the species. The closest breeding colony is within Strangford Lough approximately 70 km away from the Project and outwith the mean max foraging range + 1 SD of 33.9 km for cormorant.

## Desk-based data

Data collected within the 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) did not differentiate between cormorant and shag and were grouped together. A total of 174 observations of 534 birds were recorded across the three survey periods, all of which were recorded within the coastal region of the ObSERVE western Irish Sea survey area. A preference for shallow waters was evident through a peak in the distribution of sightings over water depths of around 10 m, and very few sightings were observed in waters of depths of greater than 20 m. Mean density of cormorants/shags across the ObSERVE western Irish Sea survey area ranged from 0.31 birds/km$^2$ in summer surveys, 0.3 birds/km$^2$ in autumn surveys and 0.14 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018).

Observations of cormorant were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-63. A five-year peak observation of 171 birds was recorded in the 2017/18 season, along with a five-year peak-mean count of 105 birds between 2015/16 and 2019/20. The National Importance threshold for cormorant is 110 birds, and the International Importance threshold is 1,200 birds. Therefore, cormorant in the Dundalk Bay I-WeBS site are currently exceeding levels of National Importance (I-WeBS, 2022), but do not exceed levels of International Importance.

**Table 5-63: Summary of I-WeBS survey counts for cormorant within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 72 | 48 | 171 | 105 | 110 | 1,200 |

## Site-specific data

Observations of cormorant were recorded across all months of the survey period except for September 2018, June 2019, April 2020 and May 2020. Across all months, records of cormorant were generally low and were made on 20 of the 24 surveys.

Observations of cormorant were closer to shore, along the coastal areas of the western and northwestern extents of the Study Area, reflective of their foraging ecology.

A summary of the monthly records from the boat-based transect surveys and DAS is presented in Table 5-64.

Table 5-65 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-16 shows the spatial distribution of cormorant during the boat-based survey period.

**Table 5-64: Transect records and total observations of cormorant from boat-based surveys and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 1 | - | 4 |
| June 2018 | 1 | - | 1 |
| July 2018 | 0 | - | 1 |
| August 2018 | 1 | - | 9 |
| September 2018 | 0 | - | 0 |
| October 2018 | 12 | - | 18 |
| November 2018 | 0 | - | 1 |
| December 2018 | 3 | - | 4 |
| January 2019 | 0 | - | 2 |
| February 2019 | 2 | - | 3 |
| March 2019 | 0 | - | 8 |
| April 2019 | 1 | - | 3 |
| June 2019 | 0 | - | 0 |
| July 2019 | 2 | - | 2 |
| August 2019 | 1 | - | 1 |
| October 2019 | 3 | - | 3 |
| December 2019 | 3 | - | 3 |
| January 2020 | 1 | - | 1 |
| April 2020 | - | 0 | 0 |
| May 2020 | 0 | - | 0 |
| June 2020 | - | 9 | 9 |
| July 2020 | - | 3 | 3 |
| August 2020 | - | 1 | 1 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| September 2020 | - | 1 | 1 |
| **Total** | **31** | **14** | **78** |

**Table 5-65: Seasonal variation of cormorant recorded between May 2018 and September 2020.**

| Year | Spring Migration Feb – Mar | Breeding Apr – Jul | Autumn Migration Aug – Oct | Winter Nov – Jan | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 6 | 27 | 7 | - |
| 2019 / 2020 | 11 | 5 | 4 | 4 | - |
| 2020 | - | 12 | 2 | - | - |

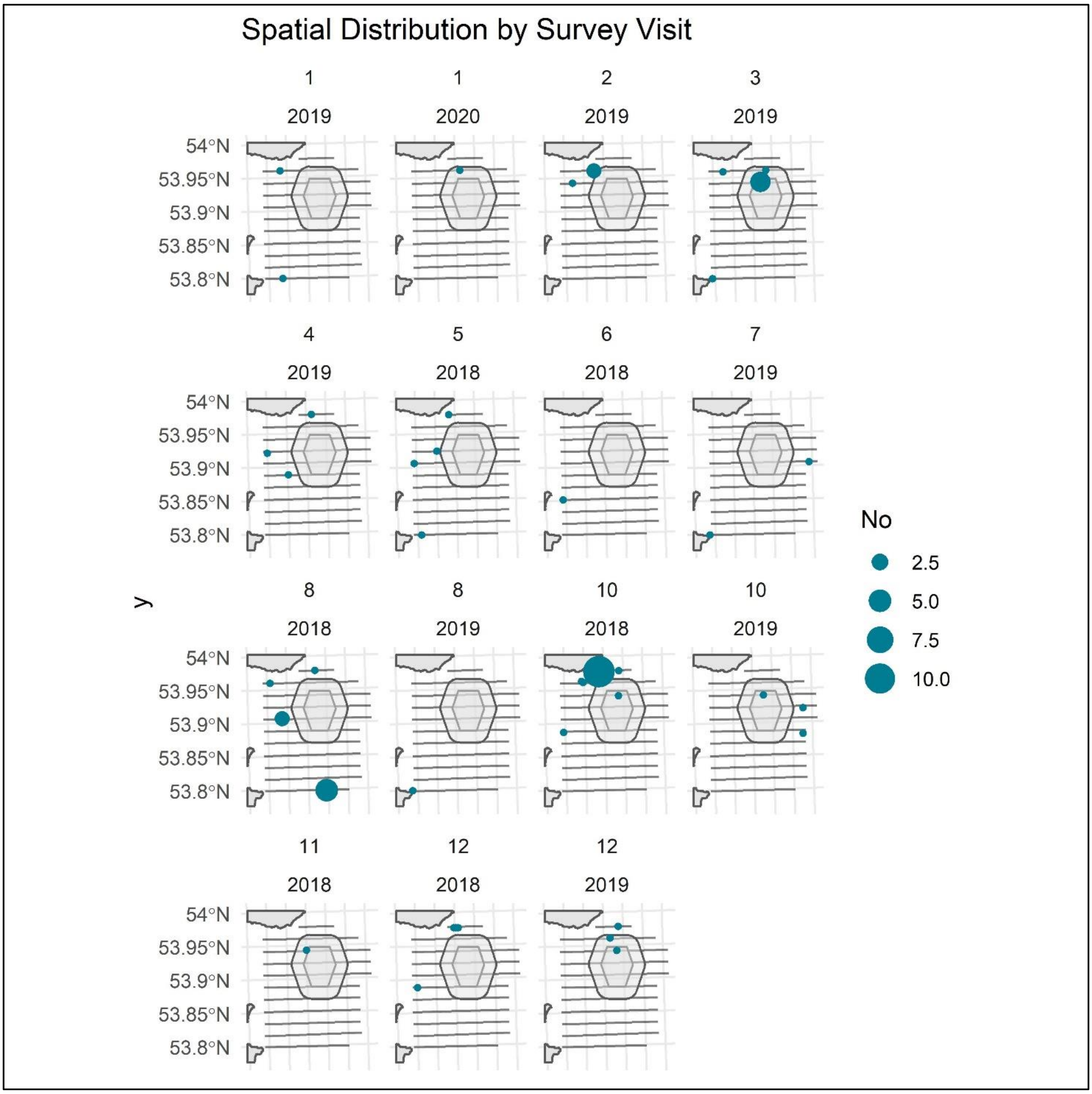


**Figure 5-16: Spatial distribution of cormorant records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, the majority of birds observed were observed flying through the Study Area (32 individuals, 94.1%) and on transect (20 individuals, 64.5%), compared to sitting (2 (5.9%) and 11 (35.5%) individuals respectively). Flight heights of cormorant were most frequently recorded at 5 m on and off transect.

Table 5-66 below shows the proportion of individuals observed sitting and flying throughout the Study Area between May 2018 and September 2020. Figure 5-17 shows the recorded flight heights of cormorant during the boat-based survey period.

**Table 5-66: Proportion of cormorant recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 1 | 100 | 4 | 100.0 | 0 | 0 |
| June 2018 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| July 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100.0 |
| August 2018 | 0 | 0 | 1 | 100 | 8 | 100.0 | 0 | 0 |
| September 2018 | No birds recorded | | | | | | | |
| October 2018 | 11 | 91.7 | 1 | 8.3 | 5 | 83.3 | 1 | 16.7 |
| November 2018 | 0 | 0 | 0 | 0 | 1 | 100.0 | 0 | 0 |
| December 2018 | 2 | 66.7 | 1 | 33.3 | 1 | 100.0 | 0 | 0 |
| January 2019 | 0 | 0 | 0 | 0 | 2 | 100.0 | 0 | 0 |
| February 2019 | 0 | 0 | 2 | 100 | 1 | 100.0 | 0 | 0 |
| March 2019 | 0 | 0 | 0 | 0 | 8 | 100.0 | 0 | 0 |
| April 2019 | 0 | 0 | 1 | 100 | 2 | 100.0 | 0 | 0 |
| June 2019 | No birds recorded | | | | | | | |
| July 2019 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| August 2019 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| October 2019 | 1 | 33.3 | 2 | 66.7 | 0 | 0 | 0 | 0 |
| December 2019 | 3 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| January 2020 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| April 2020 | 0 | 0 | 0 | 0 | N/A | | | |
| May 2020 | No birds recorded | | | | | | | |
| June 2020 | 4 | 44.4 | 5 | 56.6 | N/A | | | |
| July 2020 | 1 | 33.3 | 2 | 66.6 | | | | |
| August 2020 | 0 | 0 | 1 | 100 | | | | |
| September 2020 | 1 | 100 | 0 | 0 | | | | |
| **Total** | **27** | **58.7** | **19** | **41.3** | **32** | **94.1** | **2** | **5.9** |

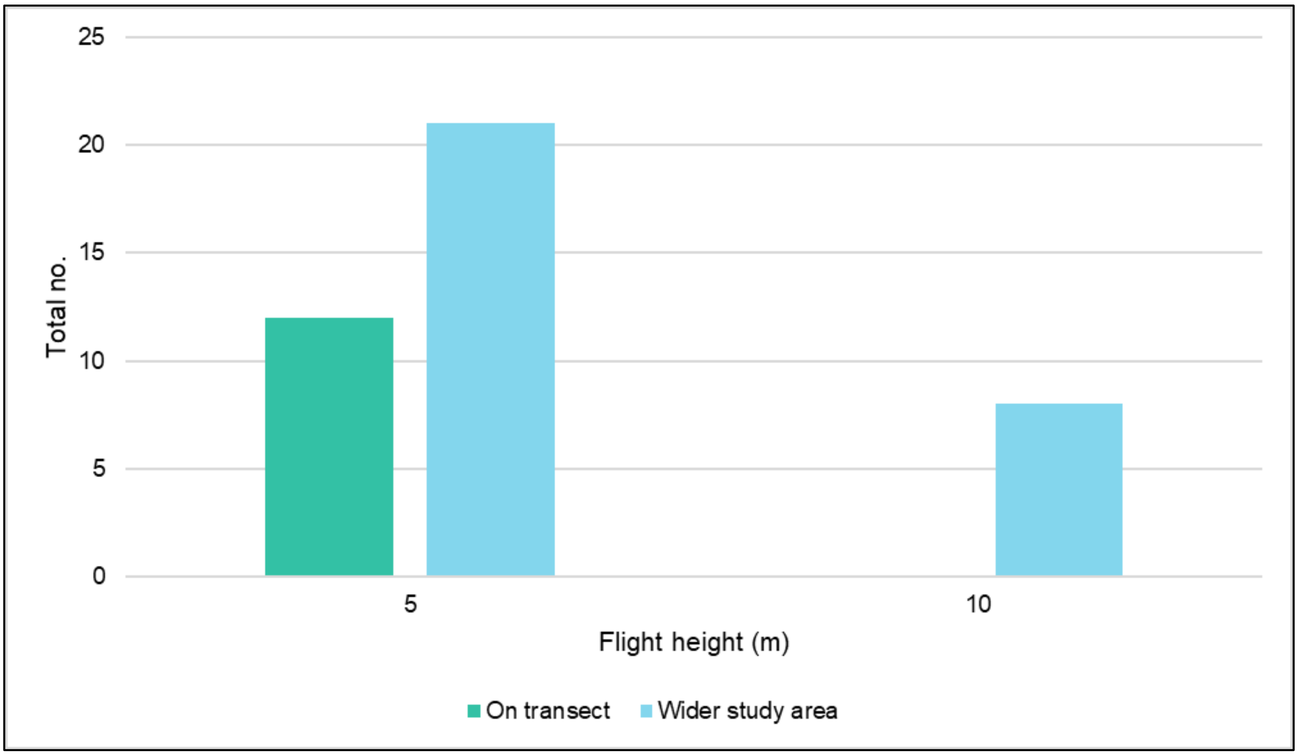


**Figure 5-17: Cormorant flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-16), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.10 Kittiwake

### Ecology

Kittiwake are one of Ireland's most common seabirds and are well distributed around the Irish coast and throughout the Irish sea, with a scattered breeding distribution at colonies at sea cliffs around the coast (Balmer *et al.*, 2013). Kittiwake are migratory and disperse after breeding from coastal areas to the open ocean (del Hoyo *et al.*, 1996). During the winter the species is highly pelagic, usually remaining on the wing out of sight of land (del Hoyo *et al.*, 1996). Kittiwake nest on high, steep, coastal cliffs with narrow ledges in areas with easy access to freshwater (del Hoyo *et al.*, 1996). Kittiwake are pelagic surface feeders feeding in the upper couple of metres of the water column. In the breeding season they feed mainly on small (15-20 cm) pelagic shoaling fish, such as sandeel, sprat and clupeids (del Hoyo *et al.*, 1996) but have been shown to have up to 40 different prey items in their diet (Soanes *et al.*, 2016). At sea during the winter, they will also take planktonic invertebrates and exploit sewage outfalls and fishing vessels (del Hoyo *et al.*, 1996). In the UK and Ireland, kittiwake is Red-listed due to severe declines in breeding population over 25 years and over the longer term (Gilbert *et al.,* 2021, Stanbury *et al.,* 2021).

The national population estimate for kittiwake is lower than that of Seabird 2000 and previous survey estimates, despite an increase in survey efforts (Cummins *et al.*, 2019). In Ireland, the declines are partly due to acute short-term population declines at some of the most important colonies, including Horn Head, Cliffs of Moher and Great Saltee. Table 5-67 shows a comparison of breeding kittiwake numbers between some of these colonies.

**Table 5-67: A comparison of breeding kittiwake numbers (AONs) between Seabird 2000 of kittiwake at a selection of Irish colonies for the period 1985 – 1988 to 2015 – 2018 (Cummins *et al.,* 2019).**

| Site | SCR (1985 – 1988) | Seabird 2000 (1998 – 2002) | 2015 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Great Skellig | - | 694 | 789 | + 14% |
| Howth Head | - | 1,906 | 1,773 | - 7% |
| Doulus Head | - | 1,150 | 994 | - 14% |
| Lambay Island | 3,005 | 4,091 | 3,320 | - 19% |
| Downpatrick Head to Creevagh Head | - | 1,653 | 1,163 | - 30% |
| Little Skellig | - | 250 | 173 | - 31% |
| Old Head of Kinsale | 2,059 | 1,188 | 711 | - 40.2% |
| Clare Island | - | 1,605 | 840 | - 47.7% |
| Cliffs of Moher | 4,313 | 7,698 | 3,981 | - 48.3% |
| Great Saltee | 2,908 | 2,125 | 1,038 | - 51.2% |
| Horn Head | 4,256 | 3,854 | 1,820 | - 52.8% |

A summary of the recent (within the last five summers) colony data for kittiwake within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-68 below. If multiple years are provided then the mean count is presented. Colonies which recorded zero birds are not included.

**Table 5-68: Summary of most recent colony data for kittiwake between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Causeway Coast | 2021 | 1,197 |
| | Larne Lough to Portmuck | 2017 – 2019 | 960.3 ± 199.7 |
| | Muck Island | 2017 – 2019 | 400.7 ± 86.6 |
| | North Antrim coast | 2017 – 2019 | 60±24.2 |
| | Rathlin Island SPA | 2021 | 13,706 |
| | Sheep Island SPA | 2021 | 305 |
| Argyll and Bute | Islay – East (Port Askaig to Bowmore) | 2017, 2018 and 2021 | 40.7 ± 17.6 |
| | Islay – West (Port Askaig to Bruichladdich) | 2018 | 123 |
| | Isle of Colonsay | 2019 | 143 |
| | North Colonsay and Western Cliffs SPA | 2018 | 2248 |
| | Sanda Islands – Kintyre | 2019 | 33 |
| | Tiree | 2018 | 233 |
| | Treshnish Isles SPA | 2017 – 2019 and 2021 | 654.3 ± 134.5 |
| Cumbria | St Bees Head and Town | 2017 – 2021 | 724.4 ± 121.4 |
| Donegal | Malin Peninsula | 2018 | 249 |
| Down | Maggy’s Leap | 2017 | 76 |
| | Maggy’s Leap to Newcastle | 2018 and 2019 | 546.5 ± 33.5 |
| Dublin | Loughshinny to Killiney | 2017 and 2018 | 146.5 ±1 3.5 |
| Dyfed | Bishop and Clerks and Ramsey | 2017 – 2019 | 88.7 ± 8.0 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| | Caldey Island | 2017 – 2019 and 2021 | 248.8 ±16.9 |
| | Castlemartin Coast (Berryslade to Barafundle Bay) | 2017 – 2019, 2021 and 2022 | 1.2 ± 1.2 |
| | Grassholm SPA | 2018 | 30 |
| | New Quay to Lochtyn | 2018 | 332 |
| | Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA | 2017, 2018 and 2021 | 1,337 ± 82.9 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | 2017 – 2019 | 112 ± 15.6 |
| | Great Orme and Little Orme | 2017 – 2019, 2021 and 2022 | 1,019.8 ± 102.1 |
| | Lleyn Peninsula | 2018, 2019 and 2021 | 519.3 ± 143.2 |
| | Puffin Island SPA | 2017 – 2019 and 2021 | 334.3 ± 116.4 |
| | South Stack | 2017 – 2019 and 2021 | 8.3 ± 2.4 |
| Isle of Man | North Island | 2017 | 78 |
| | South Island | 2017 | 540 |
| | West Island | 2017 | 54 |
| Kyle and Carrick | Ailsa Craig SPA | 2017 – 2019 and 2021 | 368.3 ± 86.3 |
| Lancashire | Morecambe Central Gas Platform | 2020 | 556 |
| Londonderry | North Antrim Coast | 2017 – 2019 | 204 ± 60.5 |
| Mayo | Downpatrick to Creevagh Heads | 2018 | 561 |
| Sligo | Sligo Bay | 2018 | 28 |
| Stewarty | Balcary Point | 2018 | 114 |
| Waterford | Ardmore to Whiting Bay | 2018 and 2019 | 181.5 ± 44.5 |
| | Creadan Head to Foilakipeen | 2018 and 2019 | 25.5 ± 0.5 |
| | Dungarvan to Ardmore | 2018 and 2019 | 68 ± 3 |
| | Portally to Benlea Head | 2018 and 2019 | 124 ± 24 |
| West Glamorgan | Gower | 2018 | 11 |
| | Mumbles Head | 2018 | 90 |
| Wicklow | Mizen Head | 2018, 2019, 2021 and 2022 | 915.5 ± 272.4 |
| Wigtown | Monreith Cliffs and Scar Rocks | 2018 | 19 |
| | Mull of Galloway | 2017 – 2019 | 83.3 ± 19.3 |
| | Port Mona, Devil's Bridge, Laggantalluch Head | 2019 | 25 |

## Desk-based data

The kittiwake was one of the most commonly sighted species within the ObSERVE 2016/2017 western Irish Sea surveys (Jessopp *et al.*, 2018), with 945 observations comprising a total of 2,421 individuals sighted across the three survey periods. In autumn, 1,355 individuals were recorded, with 567 in winter and 499 in summer. Although sightings were observed throughout the ObSERVE western Irish Sea survey area, there was a change in sightings distribution between the summer breeding season and the autumn and winter seasons. Sightings during the summer breeding survey period were concentrated in the central ObSERVE survey area around Dublin, spreading north and southwards during non-breeding seasons. Mean density of kittiwake across the ObSERVE western Irish Sea survey area ranged from 0.57 birds/km$^2$ in summer surveys, 1.47 birds/km$^2$ in autumn surveys, and 0.57 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018). No records of kittiwake were presented within the I-WeBS database.

## Site-specific data

Observations of kittiwake were recorded across all survey months, as shown within Table 5-69. Peak counts were recorded in October 2018, when a total of 125 birds were recorded on transect and a total of 238 birds recorded across the Survey Area (Aquafact, 2019). This peak count in October 2018 was attributed to relate to the autumn dispersal of individuals from breeding grounds, while observations of fewer birds during summer months was related to birds remaining within closer proximities to their breeding colonies (Aquafact, 2019). Throughout the remainder of the survey period, kittiwake numbers were consistent across the autumn and winter months. Seasonal variation of kittiwake recorded between May 2018 and September 2020 is shown in Table 5-70.

There were no areas of greater concentration of kittiwake observed within the site surveys, and birds were widely spread throughout the Study Area. Figure 5-18 shows the spatial distribution of birds during the survey period.

**Table 5-69: Transect records and total observations of kittiwake from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 23 | - | 48 |
| June 2018 | 17 | - | 65 |
| July 2018 | 6 | - | 13 |
| August 2018 | 7 | - | 18 |
| September 2018 | 24 | - | 45 |
| October 2018 | 125 | - | 238 |
| November 2018 | 14 | - | 70 |
| December 2018 | 17 | - | 87 |
| January 2019 | 18 | - | 45 |
| February 2019 | 85 | - | 146 |
| March 2019 | 45 | - | 62 |
| April 2019 | 1 | - | 3 |
| June 2019 | 14 | - | 14 |
| July 2019 | 3 | - | 3 |
| August 2019 | 74 | - | 74 |
| October 2019 | 35 | - | 36 |
| December 2019 | 13 | - | 13 |
| January 2020 | 83 | - | 83 |
| April 2020 | - | 41 | 41 |
| May 2020 | 5 | 31 | 36 |
| June 2020 | - | 2 | 2 |
| July 2020 | - | 15 | 15 |
| August 2020 | - | 18 | 18 |
| September 2020 | - | 24 | 24 |
| **Total** | **609** | **131** | **1,199** |

**Table 5-70: Seasonal variation of kittiwake recorded between May 2018 and September 2020.**

| Year | Spring Migration Jan – Apr | Breeding May – Jul | Autumn Migration Aug – Dec | Winter | Non-breeding |
|---|---|---|---|---|---|
| 2018 | - | 126 | 458 | - | - |
| 2019 | 256 | 17 | 123 | - | - |
| 2020 | 124 | 53 | 42 | - | - |

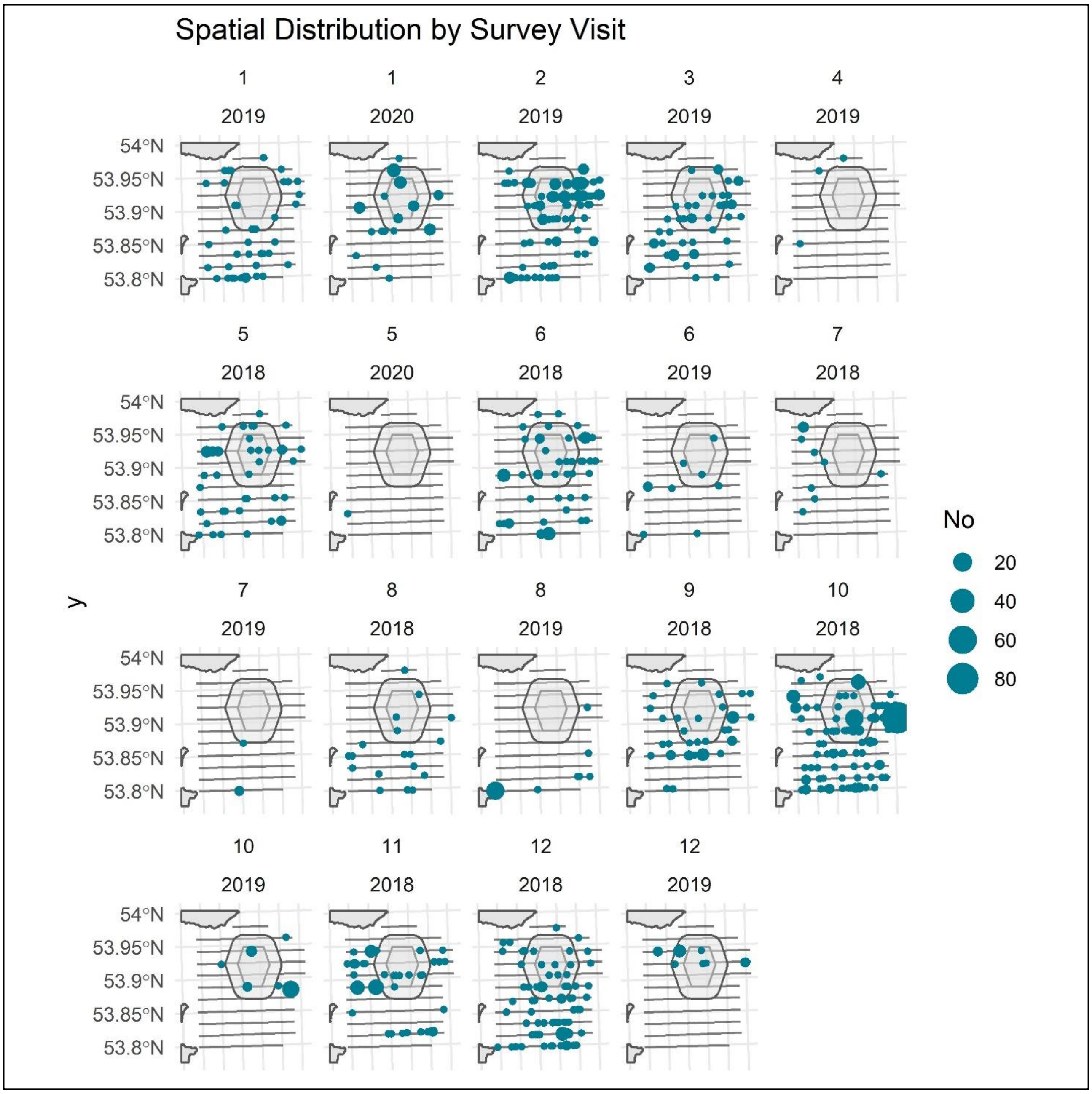


**Figure 5-18: Spatial distribution of kittiwake records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, the majority of birds (446 individuals, 73.2%) observed along the route were sitting compared to those observed in flight (163 individuals, 26.8%); off transect, a higher proportion of birds (452 individuals, 98.5%) were recorded flying. Flight heights on transect were recorded between 5 m and 30 m, with a few birds observed flying at 40 m off transect.

During the DAS (APEM, 2020), a total of 131 kittiwake were identified, of which 47 were observed sitting and 84 were recorded flying. Flying kittiwake were recorded in all six surveys; in April 2020, flying kittiwake were significantly orientated around the mean of 28°; in July 2020, flying kittiwake were significantly orientated around the mean of 316°; in September 2020, flying kittiwake were significantly orientated around the mean of 260°. Flight heights were recorded for 64 individuals which resulted in a median altitude of 43.95 m above MSL.

Table 5-71 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and May 2020. Figure 5-19 shows the recorded flight heights of kittiwake during the same period.

**Table 5-71: Proportion of kittiwake recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 4 | 17.4 | 19 | 82.6 | 25 | 100 | 0 | 0 |
| June 2018 | 4 | 23.5 | 13 | 76.5 | 46 | 95.8 | 2 | 4.2 |
| July 2018 | 0 | 0 | 6 | 100 | 7 | 100 | 0 | 0 |
| August 2018 | 4 | 57.1 | 3 | 42.9 | 11 | 100 | 0 | 0 |
| September 2018 | 8 | 33.3 | 16 | 66.7 | 21 | 100 | 0 | 0 |
| October 2018 | 89 | 71.2 | 36 | 28.8 | 113 | 100 | 0 | 0 |
| November 2018 | 3 | 21.4 | 11 | 78.6 | 56 | 100 | 0 | 0 |
| December 2018 | 6 | 35.3 | 11 | 64.7 | 70 | 100 | 0 | 0 |
| January 2019 | 8 | 44.4 | 10 | 55.6 | 27 | 100 | 0 | 0 |
| February 2019 | 13 | 15.3 | 72 | 84.7 | 59 | 96.7 | 2 | 3.3 |
| March 2019 | 3 | 6.7 | 42 | 93.3 | 14 | 82.4 | 3 | 17.6 |
| April 2019 | 1 | 100 | 0 | 0 | 2 | 100 | 0 | 0 |
| June 2019 | 4 | 28.6 | 10 | 71.4 | 0 | 0 | 0 | 0 |
| July 2019 | 0 | 0 | 3 | 100 | 0 | 0 | 0 | 0 |
| August 2019 | 3 | 4.1 | 71 | 95.9 | 0 | 0 | 0 | 0 |
| October 2019 | 5 | 14.3 | 30 | 85.7 | 1 | 100 | 0 | 0 |
| December 2019 | 1 | 7.7 | 12 | 92.3 | 0 | 0 | 0 | 0 |
| January 2020 | 3 | 3.6 | 80 | 96.4 | 0 | 0 | 0 | 0 |
| April 2020 | 21 | | 20 | | N/A | | | |
| May 2020 | 19 | 52.7 | 17 | 47.2 | 0 | 0 | 0 | 0 |
| June 2020 | 2 | 100 | 0 | 0 | N/A | | | |
| July 2020 | 14 | 92.3 | 1 | 6.7 | | | | |
| August 2020 | 13 | 72.2 | 5 | 27.8 | | | | |
| September 2020 | 19 | 79.2 | 5 | 20.8 | | | | |
| **Total** | **247** | **33.4** | **493** | **66.6** | **452** | **98.5** | **7** | **1.5** |

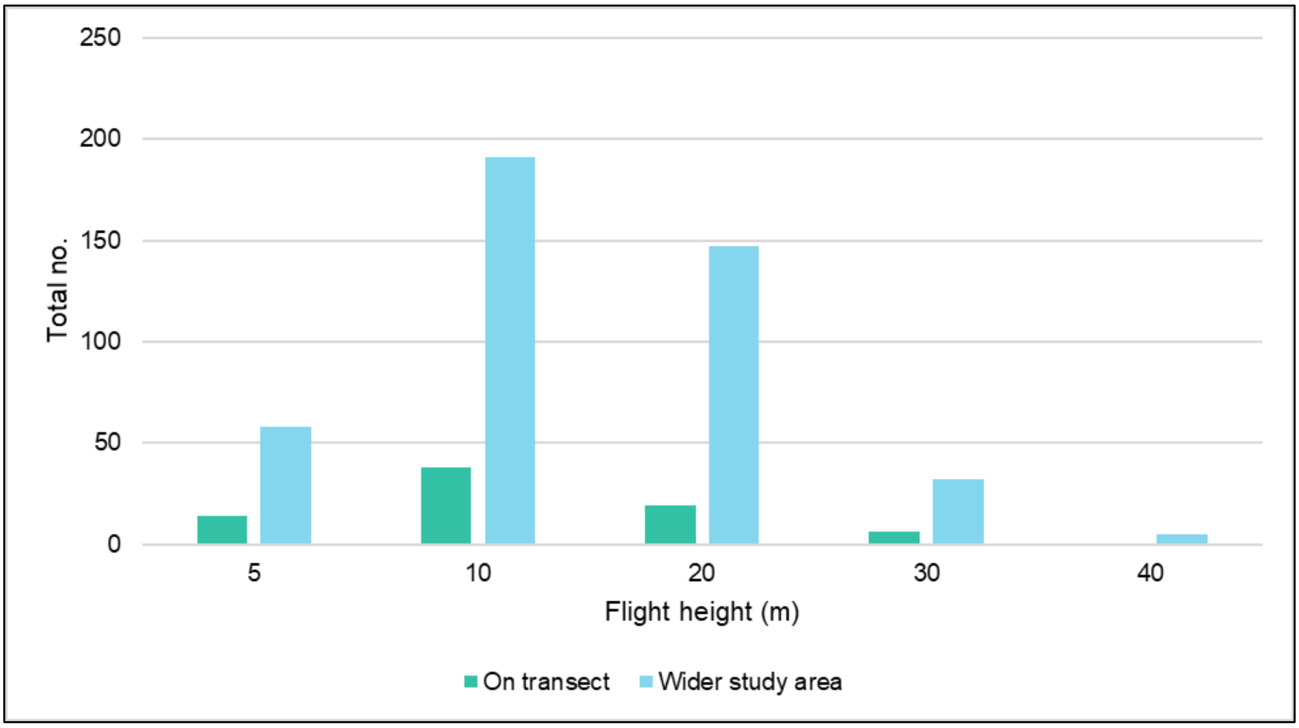


**Figure 5-19: Kittiwake flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during the boat-based surveys

During initial data exploration and model fitting a high co-linear / correlation between Bathymetry and distance to coast was identified resulting in a prohibitively high VIF for these parameters. Because of this distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CreSS:

- Bathymetry;
- Year; and
- X and Y coordinates.

To prepare for the GEE-CreSS analyses, a complete grid of abutting cells based on the survey grid and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinate were included in the one-dimensional SALSA model selection method (Walker *et al.,* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Month was fitted as a factor term. This provided the base model for assessment of the 2D spatial smoother.

CreSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CreSS grid knot locations are included in annex 1 of this report. An interaction with month was included to allow the density surface to vary between survey months. Following predictions, bootstrapping was used to generate 95 % confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CreSS method.

### All behaviours (both sitting and flying birds)

Table 5-72 to Table 5-74 below presents the kittiwake modelled abundance estimates for the offshore wind farm area, the offshore wind farm area plus 2 km and the Offshore Ornithology Study Area.

**Table 5-72: Kittiwake modelled offshore wind farm area abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 12 | 6 | 29 |
| June 2018 | 6 | 2 | 20 |
| July 2018 | 2 | 1 | 11 |
| August 2018 | 36 | 15 | 80 |
| September 2018 | 14 | 3 | 76 |
| October 2018 | 57 | 28 | 146 |
| November 2018 | 0 | 0 | NA |
| December 2018 | 6 | 1 | 67 |
| January 2019 | 23 | 8 | 63 |
| February 2019 | 63 | 39 | 100 |
| March 2019 | 45 | 26 | 90 |
| April 2019 | 0 | 0 | 0 |
| June 2019 | 7 | 3 | 24 |
| July 2019 | 3 | 1 | 11 |
| August 2019 | 36 | 15 | 80 |
| October 2019 | 57 | 28 | 146 |
| December 2019 | 6 | 1 | 67 |
| January 2020 | 23 | 8 | 63 |
| May 2020 | 2 | 1 | 10 |

**Table 5-73: Kittiwake modelled offshore wind farm area plus 2 km buffer abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 34 | 15 | 89 |
| June 2018 | 15 | 5 | 63 |
| July 2018 | 7 | 2 | 42 |
| August 2018 | 103 | 40 | 258 |
| September 2018 | 40 | 7 | 306 |
| October 2018 | 161 | 77 | 431 |
| November 2018 | 0 | 0 | NA |
| December 2018 | 16 | 1 | 289 |
| January 2019 | 69 | 23 | 197 |
| February 2019 | 187 | 111 | 309 |
| March 2019 | 139 | 77 | 281 |
| April 2019 | 0 | 0 | 0 |
| June 2019 | 19 | 6 | 71 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| July 2019 | 9 | 2 | 40 |
| August 2019 | 103 | 40 | 258 |
| October 2019 | 161 | 77 | 431 |
| December 2019 | 16 | 1 | 289 |
| January 2020 | 69 | 23 | 197 |
| May 2020 | 6 | 2 | 27 |

**Table 5-74: Kittiwake modelled Offshore Ornithology Study Area abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 197 | 84 | 537 |
| June 2018 | 64 | 19 | 293 |
| July 2018 | 34 | 7 | 289 |
| August 2018 | 0 | 0 | 0 |
| September 2018 | 0 | 0 | 0 |
| October 2018 | 0 | 0 | 0 |
| November 2018 | 0 | 0 | 0 |
| December 2018 | 0 | 0 | 0 |
| January 2019 | 0 | 0 | 0 |
| February 2019 | 902 | 482 | 1,716 |
| March 2019 | 611 | 335 | 1,412 |
| April 2019 | 0 | 0 | 0 |
| June 2019 | 81 | 23 | 348 |
| July 2019 | 43 | 9 | 263 |
| August 2019 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 0 |
| December 2019 | 0 | 0 | 0 |
| January 2020 | 0 | 0 | 0 |
| May 2020 | 35 | 9 | 163 |

### Flying birds

There were 427 records of flying kittiwake over the boat-based study period. Densities of flying birds were modelled using a similar approach to loafing birds described above where sufficient data was available to do so. For kittiwake sufficient observations were available for all months of study. These data are presented in Table 5-75 and Table 5-76.

**Table 5-75: Kittiwake flying bird offshore wind farm area modelled abundance estimates.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 14 | 7 | 27 |
| June 2018 | 34 | 23 | 55 |
| July 2018 | 1 | 0 | 17 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| August 2018 | 12 | 4 | 93 |
| September 2018 | 20 | 9 | 53 |
| October 2018 | 21 | 14 | 33 |
| November 2018 | 146 | 82 | 262 |
| December 2018 | 43 | 19 | 91 |
| January 2019 | 14 | 6 | 31 |
| February 2019 | 212 | 164 | 269 |
| March 2019 | 20 | 11 | 42 |
| April 2019 | 1 | 0 | 208 |
| June 2019 | 7 | 2 | 18 |
| July 2019 | 0 | 0 | 5 |
| August 2019 | 0 | 0 | 3 |
| October 2019 | 1 | 0 | 1 |
| December 2019 | 1 | 0 | 4 |
| January 2020 | 1 | 0 | 7 |
| May 2020 | 3 | 1 | 7 |

**Table 5-76: Kittiwake flying bird offshore wind farm area plus 2 km buffer modelled abundance estimates.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 39 | 20 | 75 |
| June 2018 | 95 | 65 | 156 |
| July 2018 | 5 | 2 | 50 |
| August 2018 | 42 | 13 | 284 |
| September 2018 | 62 | 29 | 165 |
| October 2018 | 86 | 58 | 136 |
| November 2018 | 446 | 264 | 759 |
| December 2018 | 130 | 65 | 251 |
| January 2019 | 46 | 21 | 97 |
| February 2019 | 581 | 435 | 760 |
| March 2019 | 54 | 27 | 125 |
| April 2019 | 5 | 1 | N/A |
| June 2019 | 19 | 5 | 51 |
| July 2019 | 1 | 0 | 14 |
| August 2019 | 1 | 0 | 9 |
| October 2019 | 2 | 1 | 6 |
| December 2019 | 3 | 1 | 10 |
| January 2020 | 4 | 1 | 20 |
| May 2020 | 8 | 3 | 19 |

### Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for kittiwake at the different spatial scales. Table 5-77 presents the abundance estimates for sitting birds only whereas, Table 5-78 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3.

**Table 5-77: Abundance estimates of sitting kittiwake within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 16 | 30 |
| May 2020 | 32 | 44 |
| June 2020 | 0 | 0 |
| July 2020 | 0 | 0 |
| August 2020 | 0 | 3 |
| September 2020 | 3 | 3 |

**Table 5-78: Abundance estimates of flying kittiwake within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 3 | 15 |
| May 2020 | 14 | 21 |
| June 2020 | 0 | 0 |
| July 2020 | 11 | 10 |
| August 2020 | 0 | 3 |
| September 2020 | 17 | 21 |

## 5.6.11 Black-headed gull

### Ecology

Black-headed gull are less reliant on marine habitats than other gull species, with approximately 44% of black-headed gulls breeding inland in Ireland and Britain (Mitchell *et al.*, 2004). During the breeding season, black-headed gull illustrates a preference for inland, shallow and calm wetland habitats and forms nesting colonies on lakes, lagoons, estuaries, upper zones of saltmarshes and coastal dunes (BirdLife International, 2020; del Hoyo *et al.*, 1996). Throughout the non-breeding winter period, black-headed gull frequents coastal habitats, tidal inshore waters, inlets and estuaries and presents a preference for sandy or muddy beaches (BirdLife International, 2020; del Hoyo *et al.*, 1996). Individuals may also occur inland in ploughed fields, urban parks, sewage farms, reservoirs, ponds and other ornamental water ways (BirdLife International, 2020). The diet of black-headed gulls consists predominantly of aquatic and terrestrial insects, earthworms and marine invertebrates (e.g. molluscs, crustaceans and marine worms) and fish (del Hoyo *et al.*, 1996).

National census data indicate the number of coastal nesting black-headed gulls in the United Kingdom was relatively stable between 1969-70 and 1998–2002. However, there are differences within the census data for the constituent countries of the UK. Over the monitoring period, black-headed gull productivity has fluctuated markedly and is likely to have been affected by predation by American mink, as well as changes in food supply and periods of inclement weather during breeding seasons. This fluctuating productivity trend is common to black-headed gull colonies throughout the UK.

In Ireland, the long-term breeding population trend estimates equate to a modest decline (10.9%) (Cummins *et al.,* 2019).

Table 5-79 below sets out population estimates for a number of sites, including inland breeding colonies.

**Table 5-79: Black-headed Gull population estimates for a selection of sites (Cummins *et al.*, 2019).**

| Site | 1977 – 1978 | 1985 – 1988 | 2000 – 2002 | 2007 – 2010 | 2016 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|---|---|
| Lough Carra | 1,670 | 1,668 | 100 | 854 | 656 | + 556% |
| Lady's Island Lake | - | 250 | 949 | - | 2,526 | + 166% |
| Inch Lough | - | - | 800 | - | 1,450 | + 81% |
| Lough Mask | 425 | 750 | 329 | 1041 | 535 | + 63% |
| Lough Corrib | 2,330 | 4,342 | 425 | 431 | 669 | + 57% |
| Lough Derg | - | 2,176 | - | - | 400 | - |

Due to the long-term declines in black-headed gull breeding populations and breeding ranges over the past 25 years, this species is Amber-listed and a species of high conservation concern in Ireland and the UK (Gilbert *et al*., 2021 and Stanbury *et al.,* 2021).

There is no colony data for black-headed gull within the Cumulative Offshore Ornithology Study Area and within the mean max foraging range of the species. The closest breeding colony is within Strangford Lough approximately 70 km away from the Project and out with the mean max foraging range of 18 km for black-headed gull.

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) recorded a total of 97 sightings of 298 black-headed gulls across all three survey seasons. Approximately 72% of these sightings occurred during winter surveys, followed by autumn and summer. Summer survey sightings were concentrated offshore, inshore in autumn and an even distribution was observed in winter. Mean density of black-headed gull across the ObSERVE western Irish Sea survey area ranged between 0.03 birds/km$^2$ in summer surveys, 0.15 birds/km$^2$ in autumn surveys, and 0.2 birds/km$^2$ in winter surveys.

Observations of black-headed gull were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-80. A five-year peak observation of 1,680 birds was recorded in the 2017/2018 season, along with a five-year peak-mean count of 946 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-80: Summary of I-WeBS survey counts for black-headed gull within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 1,170 | 706 | 1,680 | 946 | - | - |

## Site-specific data

During the boat-based surveys, black-headed gull was recorded in very low numbers on transect in only three months: October 2018, January 2019 and March 2019. Birds were also recorded within the Survey Area during July 2018 and December 2019. A total of 22 birds were observed within the Survey Area, with only 5 of these recorded on transect (Aquafact, 2019), as shown within Table 5-81.

Black-headed gull were only identified on two occasions during the Digital Aerials (April 2020). Black-headed Gull were not recorded in the May 2020, June 2020, July 2020, August 2020 and September surveys. The black-headed gulls were recorded flying in a northerly direction in the northeast of the Study Area.

The black-headed gull is a predominately coastal gull species, which reflects the low number of observations of the black-headed gull within the Study Area during these surveys.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-81.

Table 5-82 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Snow and Perrins (1998). Figure 5-20 shows the spatial distribution of black-headed gull during the survey period.

**Table 5-81: Transect records and total observations of black-headed gull from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 0 |
| June 2018 | 0 | - | 0 |
| July 2018 | 0 | - | 2 |
| August 2018 | 0 | - | 0 |
| September 2018 | 0 | - | 0 |
| October 2018 | 1 | - | 10 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 3 | - | 4 |
| February 2019 | 0 | - | 0 |
| March 2019 | 1 | - | 3 |
| April 2019 | 0 | - | 0 |
| June 2019 | 0 | - | 0 |
| July 2019 | 0 | - | 0 |
| August 2019 | 0 | - | 0 |
| October 2019 | 0 | - | 0 |
| December 2019 | 0 | - | 3 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 2 | 2 |
| May 2020 | 0 | 0 | 0 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 0 | 0 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 0 | 0 |
| **Total** | **5** | **2** | **24** |

**Table 5-82: Seasonal variation of black-headed gull recorded between May 2018 and September 2020.**

| Year | Spring Migration | Breeding May – Aug | Autumn Migration | Winter | Non-breeding Sep – Mar |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 2 | - | - | 17 |
| 2019 / 2020 | - | 0 | - | - | 5 |
| 2020 | - | 0 | - | - | 0 |

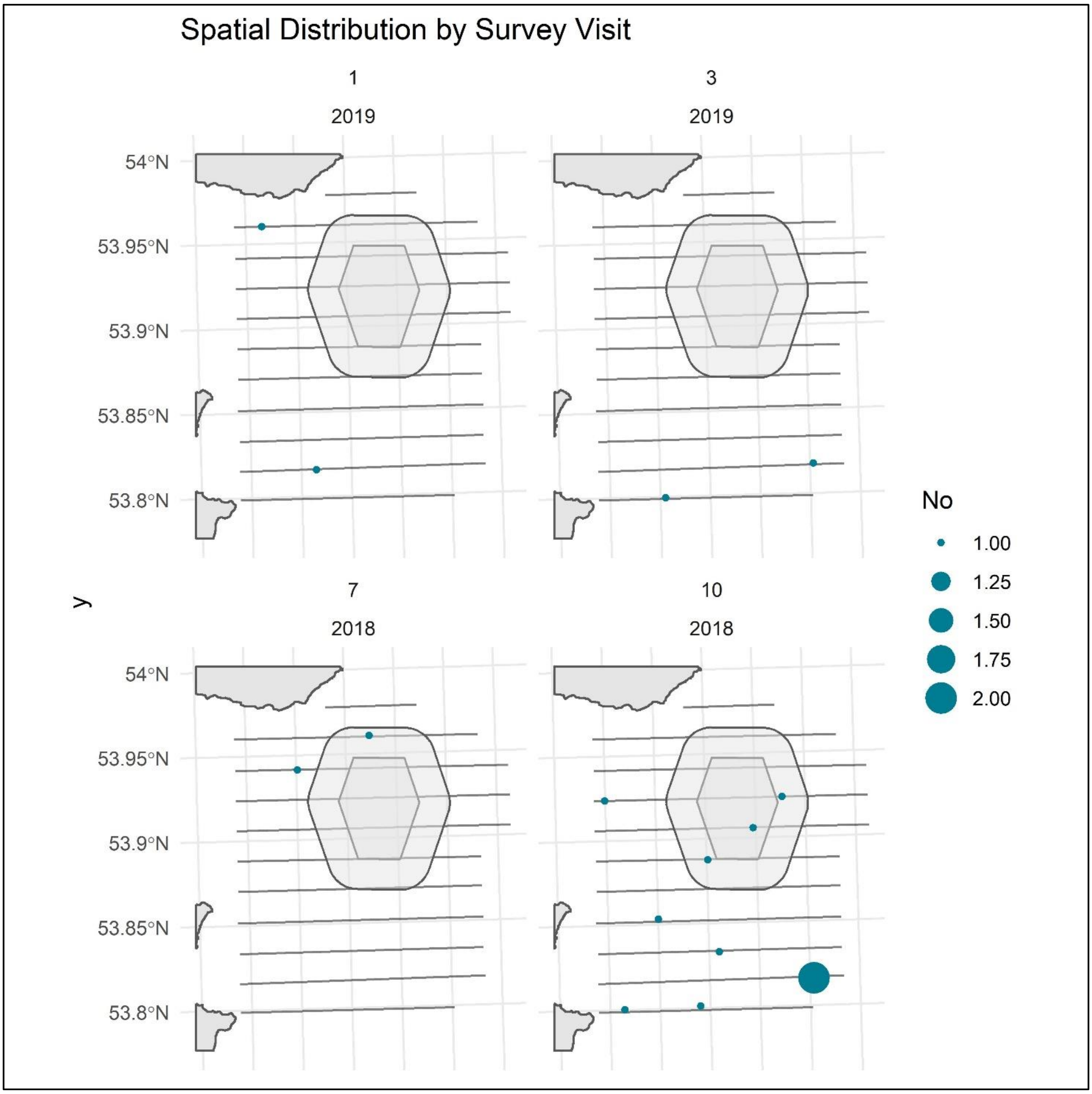


**Figure 5-20: Spatial distribution of black-headed gull records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygon.**

During the boat-based transect surveys, all birds recorded on transect were sitting compared to those recorded off transect which were observed in flight. Flight heights for black-headed gull off transect were recorded between 5 m and 20 m.

Table 5-83 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020.

**Table 5-83: Proportion of black-headed gull recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | No birds recorded | | | | | | | |
| June 2018 | | | | | | | | |
| July 2018 | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 |
| August 2018 | No birds recorded | | | | | | | |
| September 2018 | | | | | | | | |
| October 2018 | 0 | 0 | 1 | 100 | 9 | 100 | 0 | 0 |
| November 2018 | No birds recorded | | | | | | | |
| December 2018 | | | | | | | | |
| January 2019 | 0 | 0 | 3 | 100 | 1 | 100 | 0 | 0 |
| February 2019 | No birds recorded | | | | | | | |
| March 2019 | 0 | 0 | 1 | 100 | 2 | 100 | 0 | 0 |
| April 2019 | No birds recorded | | | | | | | |
| June 2019 | | | | | | | | |
| July 2019 | | | | | | | | |
| August 2019 | | | | | | | | |
| October 2019 | | | | | | | | |
| December 2019 | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 |
| January 2020 | No birds recorded | | | | | | | |
| April 2020 | 2 | 100 | 0 | 0 | N/A | | | |
| May 2020 | No birds recorded | | | | | | | |
| June 2020 | | | | | | | | |
| July 2020 | | | | | | | | |
| August 2020 | | | | | | | | |
| September 2020 | | | | | | | | |
| **Total** | **0** | **0** | **5** | **100.0** | **17** | **100.0** | **0** | **0** |

## Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-20), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.12 Common gull

### Ecology

Common gulls breed along the coast and inland in a variety of sites not necessarily close to wetland (del Hoyo *et al.*, 1996; BirdLife International, 2020), with approximately 57% of pairs breeding in non-coastal habitats (Mitchell *et al.*, 2004). Common gulls are more commonly observed in marine habitats outside of the breeding season, including along the east coast of Ireland (Balmer *et al.*, 2013).

The common gull diet consists of a variety of prey items including earthworms, insects, aquatic and terrestrial invertebrates, crayfish, molluscs and small fish (del Hoyo *et al.*, 1996). It is also an opportunistic forager and will exploit agricultural grain (del Hoyo *et al.*, 1996; Flint *et al.*, 1984).

In Ireland, common gull population estimates represent a significant increase from the Seabird estimate (Table 5-84), equating to an increase of 105% and 57% at coastal and inland sites respectively (Cummins *et al.,* 2019).

**Table 5-84: Common gull population estimates for a selection of sites (Cummins *et al.,* 2019).**

| Site | Seabird 2000 | 2006 – 2007 | 2010 | Seabird Census (2013 – 2018) | % Change since Seabird 2000 |
|---|---|---|---|---|---|
| Lough Mask | 124 | 271 | 230 | 191 | + 54% |
| Lough Conn | 40 | - | 15 | 43 | + 8% |
| Lough Corrib | 176 | 204 | 274 | 155 | - 12% |
| Connermara Lakes | 130 | - | 93 | 100 | - 26% |
| Lough Carra | 65 | - | 55 | 34 | - 47% |
| Lough Carrowmore | 59 | - | 55 | 10 | - 83% |

The common gull is an Amber-listed species in the UK and Ireland due to moderate declines in their breeding range, and as the species is also listed as a Species of European Conservation Concern (Gilbert *et al*., 2021 and Stanbury *et al*., 2021).

A summary of the recent (within the last five summers) colony data for common gull within the Cumulative Offshore Ornithology Study Area and within the mean max foraging range of the species is provided in Table 5-85 below. If multiple years are provided then the mean count is presented.

**Table 5-85: Summary of most recent colony data for common gull between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Down | Carlingford Lough SPA | 2017 – 2021 | 4.8 ± 2.9 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) did not differentiate between herring and common gull and were grouped together. A total of 764 sightings of 2,726 individuals were recorded over the three survey seasons, most commonly observed in the autumn surveys, then winter survey and least in summer surveys. Records were concentrated in the inshore coastal areas of the northern transects during the summer and autumn surveys, particularly along the Drogheda coastline. Mean density of herring/common gull across the ObSERVE western Irish Sea survey area ranged between 0.75 birds/km$^2$ in summer surveys, 3.82 birds/km$^2$ in autumn surveys, and 1.76 birds/km$^2$ in winter surveys.

Observations of common gull were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-76. A five-year peak observation of 957 birds was recorded in the 2017/2018 season, along with a five-year peak-mean count of 644 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-86: Summary of I-WeBS survey counts for common gull within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 671 | 440 | 957 | 644 | - | - |

## Site-specific data

Common gulls were observed in 14 of the 19 survey months of boat-based surveys, with birds recorded on transect in 13 of those months (Table 5-87). Observations of common gull on transect were not made during the summer breeding months (May to August), excluding a count of probable non-breeders during July 2018 and August 2018, August 2019 and June 2020. Peak counts on transect were recorded in December 2019 with a total of 112 birds observed, followed by April 2019 when 43 birds were recorded (Aquafact, 2019).

During the DAS, nine common gull were identified: six in April 2020, two in May 2020 and one in July 2020 surveys. Common gull were not recorded in the August or September 2020 survey.

Observations of common gull were widespread across the Study Area throughout the survey period.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-87. Table 5-88 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Snow and Perrins (1998). Figure 5-21 shows the spatial distribution of common gull over the survey period.

**Table 5-87: Transect records and total observations of common gull from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 0 |
| June 2018 | 0 | - | 0 |
| July 2018 | 12 | - | 26 |
| August 2018 | 0 | - | 3 |
| September 2018 | 0 | - | 0 |
| October 2018 | 13 | - | 75 |
| November 2018 | 3 | - | 18 |
| December 2018 | 20 | - | 57 |
| January 2019 | 22 | - | 45 |
| February 2019 | 31 | - | 64 |
| March 2019 | 8 | - | 26 |
| April 2019 | 43 | - | 59 |
| June 2019 | 0 | - | 0 |
| July 2019 | 0 | - | 0 |
| August 2019 | 6 | - | 6 |
| October 2019 | 4 | - | 5 |
| December 2019 | 112 | - | 137 |
| January 2020 | 49 | - | 49 |
| April 2020 | - | 6 | 6 |
| May 2020 | 1 | 2 | 3 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| June 2020 | - | 1 | 1 |
| July 2020 | - | 0 | 0 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 0 | 0 |
| **Total** | **324** | **9** | **580** |

**Table 5-88: Seasonal variation of common gull recorded between May 2018 and September 2020.**

| Year | Spring Migration | Breeding May – Aug | Autumn Migration | Winter | Non-breeding Sep – Apr |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 29 | - | - | 344 |
| 2019 / 2020 | - | 6 | - | - | 197 |
| 2020 | - | 4 | - | - | 0 |

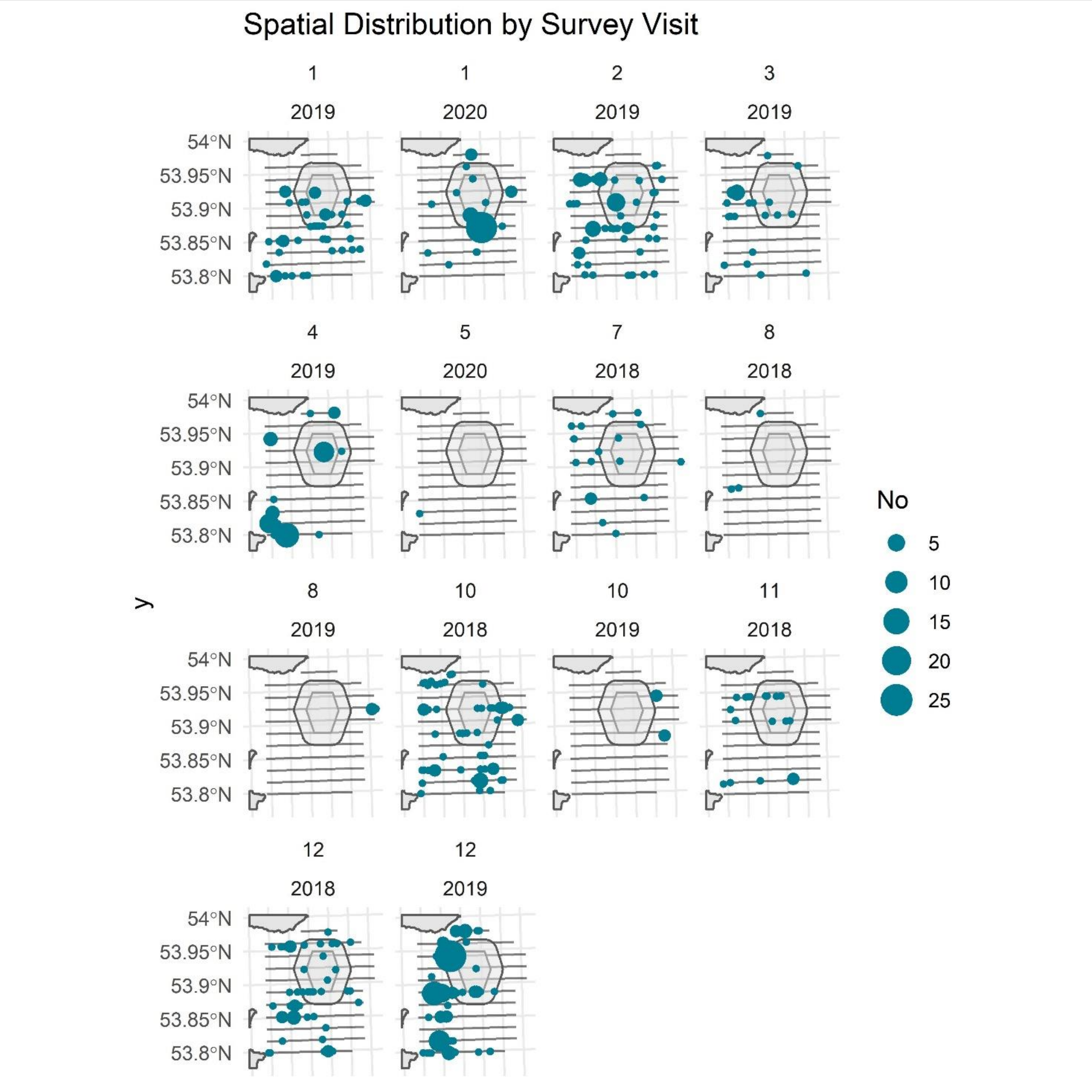


**Figure 5-21: Spatial distribution of common gull records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygon.**

During the boat-based transect surveys, 206 individuals (63.6%) were observed sitting. Off transect, the majority of birds (246 individuals, 99.6%) were observed in flight. Flight heights on transect were more frequently recorded between 5 m and 10 m, with 30 individuals recorded between 20 m and 30 m.

Table 5-89 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-22 shows the recorded flight heights of common gull during the boat-based surveys.

**Table 5-89: Proportion of common gull recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | No birds recorded | | | | | | | |
| June 2018 | | | | | | | | |
| July 2018 | 4 | 33.3 | 8 | 66.7 | 13 | 92.9 | 1 | 7.1 |
| August 2018 | 0 | 0 | 0 | 0 | 3 | 100 | 0 | 0 |
| September 2018 | No birds recorded | | | | | | | |
| October 2018 | 11 | 84.6 | 2 | 15.4 | 62 | 100 | 0 | 0 |
| November 2018 | 1 | 33.3 | 2 | 66.7 | 15 | 100 | 0 | 0 |
| December 2018 | 9 | 45 | 11 | 55 | 37 | 100 | 0 | 0 |
| January 2019 | 6 | 27.3 | 16 | 72.7 | 23 | 100 | 0 | 0 |
| February 2019 | 14 | 45.2 | 17 | 54.8 | 33 | 100 | 0 | 0 |
| March 2019 | 2 | 25 | 6 | 75 | 18 | 100 | 0 | 0 |
| April 2019 | 0 | 0 | 43 | 100 | 16 | 100 | 0 | 0 |
| June 2019 | No birds recorded | | | | | | | |
| July 2019 | | | | | | | | |
| August 2019 | 1 | 167 | 5 | 83.3 | 0 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 4 | 100 | 1 | 100 | 0 | 0 |
| December 2019 | 56 | 50 | 56 | 50 | 25 | 100 | 0 | 0 |
| January 2020 | 13 | 26.5 | 36 | 74.5 | 0 | 0 | 0 | 0 |
| April 2020 | 4 | 66.7 | 2 | 33.3 | N/A | | | |
| May 2020 | 2 | 66.7 | 1 | 33.3 | 0 | 0 | 0 | 0 |
| June 2020 | No birds recorded | | | | N/A | | | |
| July 2020 | 1 | 100 | 0 | 0 | | | | |
| August 2020 | No birds recorded | | | | | | | |
| September 2020 | | | | | | | | |
| **Total** | **143** | **39.6** | **218** | **61.4** | **246** | **99.6** | **1** | **0.4** |

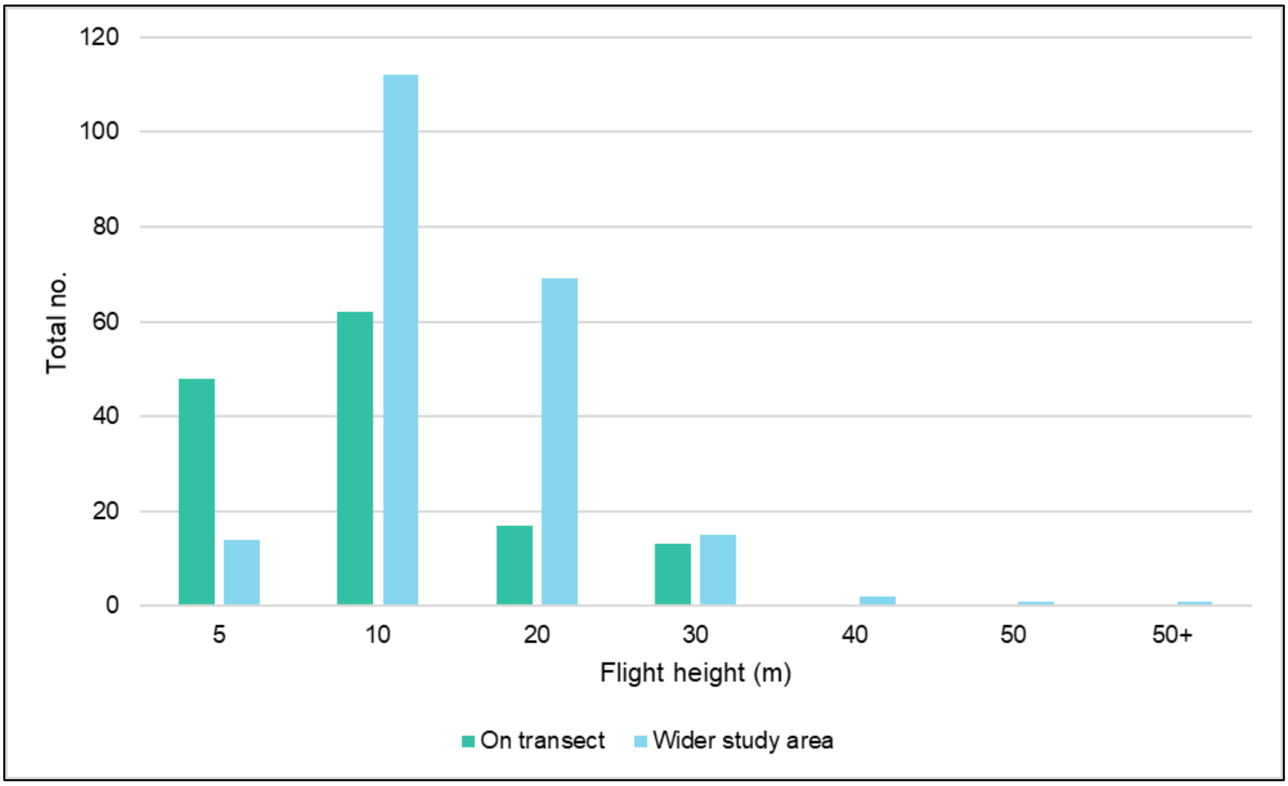


**Figure 5-22: Common gull flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during boat-based surveys

### Flying birds

There were 271 records of flying common gull over the study period. The majority of these records were single individuals with smaller numbers of groups of up to 12 birds recorded.

Table 5-90 and Table 5-91 below presents the common gull modelled flight abundance estimates for the offshore wind farm area plus a 2 km buffer during the non-breeding season. Due to model convergence issues it was not possible to include data from other periods and produce estimates for such periods. This is considered likely due to the low numbers of observations during these periods and the excessive number of zero counts present.

**Table 5-90: Common gull flying offshore wind farm area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| August 2018 | 0 | 0 | NA |
| September 2018 | 0 | 0 | NA |
| October 2018 | 32 | 25 | 44 |
| November 2018 | 7 | 4 | 11 |
| December 2018 | 27 | 19 | 37 |
| January 2019 | 15 | 9 | 24 |
| February 2019 | 71 | 51 | 101 |
| March 2019 | 8 | 4 | 19 |
| August 2019 | 0 | 0 | NA |
| October 2019 | 15 | 10 | 22 |
| December 2019 | 13 | 9 | 19 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| January 2020 | 7 | 4 | 11 |

**Table 5-91: Common gull flying offshore wind farm area plus 2 km modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| August 2018 | 1 | 0 | NA |
| September 2018 | 0 | 0 | NA |
| October 2018 | 93 | 69 | 136 |
| November 2018 | 20 | 11 | 36 |
| December 2018 | 98 | 71 | 141 |
| January 2019 | 45 | 27 | 79 |
| February 2019 | 225 | 149 | 349 |
| March 2019 | 31 | 14 | 69 |
| August 2019 | 0 | 0 | NA |
| October 2019 | 45 | 29 | 68 |
| December 2019 | 47 | 33 | 71 |
| January 2020 | 20 | 11 | 36 |

### Design-based spatial abundance estimates during the DAS

There were only two observations within the offshore wind farm area plus 2 km buffer during the DAS and therefore no abundance estimates have been produced.

## 5.6.13 Great black-backed gull

### Ecology

Great black-backed gulls are coastally distributed around Ireland and are observed in the Irish Sea (Stone *et al.*, 1995). The species is known to inhabit rocky or sandy coasts, estuaries, inshore and offshore waters and breeds on vegetated islands, dunes, flat-topped stacks, rocky shores, flat beaches and islands in saltmarsh (del Hoyo *et al.*, 1996). Great black-backed gulls also breed inland on islets in freshwater lakes and rivers, and in fields or moorland (BirdLife International, 2020). Similar to other gull species, great black-backed gulls are omnivorous and opportunistic foragers and feed on of fish, adult and young birds, bird eggs, small mammals (such as rabbits, rats and mice), insects, marine invertebrates (molluscs), carrion and refuse (del Hoyo *et al.*, 1996).

The Seabirds Count census undertaken between 2015 and 2018 estimated that the breeding population of great black-backed gull in Ireland was 3,081 pairs, an increase of 6% over the long term (1985/87 – 2015/18); 78% of this population is located within the SPA network (Cummins *et al.,* 2019). Table 5-92 sets out the population estimates of a selection of sites that were covered at least twice during the large survey initiatives since the 1980s.

**Table 5-92: Change in the recorded breeding great black-backed gull populations at a selection of Irish colonies (Cummins *et al.,* 2019).**

| Site | SCR 1985 – 1988 | Seabird 2000 1998 – 2002 | 2015 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Roaninish | 250 | 29 | 58 | + 100% |
| Inishmurray | 81 | 117 | 108 | - 8% |

| Site | SCR 1985 – 1988 | Seabird 2000 1998 – 2002 | 2015 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Lambay Islands | 145 | 193 | 99 | - 49% |
| Duvillaun Islands | 217 | 144 | 65 | - 55% |

The great black-backed gull is an Amber-listed species in the UK due to moderate declines in their population and range over the past 25 years (Stanbury *et al*., 2021). In Ireland, great black-backed gulls are Green-listed, however there is some uncertainty against the availability of data to confidently confirm their improved status (Gilbert *et al*., 2021).

A summary of the recent (within the last five summers) colony data for great black-backed gull within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-93 below. If multiple years are provided then the mean count is presented.

**Table 5-93: Summary of most recent colony data for great black-backed gull between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Down | Carlingford Lough SPA | 2017, 2018 and 2021 | 2 ± 1.6 |
| | Maggy's Leap | 2017 and 2019 | 1.5 ± 0.5 |
| | Strangford Lough SPA | 2017 – 2019 | 116.7 ± 9.2 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) did not differentiate between great and lesser black-backed gull during summer surveys, and these two species were grouped together. However, in autumn and winter surveys these species were recorded separately. There were 39 lesser black-backed gull individuals, 143 greater black-backed gull and 339 black-backed gulls that could not be differentiated to species level observed across the three survey seasons. Although sightings did occur across the ObSERVE western Irish Sea survey area, observations were predominantly in the northern part of the survey area.

Observations of great black-backed gull were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-94. A five-year peak observation of 113 birds was recorded in the 2015/2016 season, along with a five-year peak-mean count of 51 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-94: Summary of I-WeBS survey counts for great black-backed gull within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 34 | 11 | 113 | 51 | - | - |

## Site-specific data

Great black-backed gull was recorded on transect during all boat-based surveys (except in July 2019), as shown in Table 5-95. Observations were higher during the breeding season (March to August), however seasonal differences were not clearly apparent. Peak observations of great black-backed gull occurred in April 2019 with 74 individuals recorded on transect out of a total of 126 individuals observed within the Study Area (Aquafact, 2019).

During the DAS, 142 great black-backed gull were identified: 43 in April 2020, 35 in May 2020, one in June 2020, 10 in July 2020, 37 in August 2020 and 16 in the September 2020 surveys.

Observations of great black-backed gull were widespread across the Study Area throughout the survey period.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-95.

Table 5-96 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-23 shows the spatial distribution of great black-backed gull during the survey period.

**Table 5-95: Transect records and total observations of great black-backed gull from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 6 | - | 43 |
| June 2018 | 1 | - | 8 |
| July 2018 | 7 | - | 27 |
| August 2018 | 18 | - | 96 |
| September 2018 | 19 | - | 77 |
| October 2018 | 10 | - | 44 |
| November 2018 | 6 | - | 40 |
| December 2018 | 14 | - | 57 |
| January 2019 | 9 | - | 80 |
| February 2019 | 17 | - | 41 |
| March 2019 | 21 | - | 55 |
| April 2019 | 74 | - | 126 |
| June 2019 | 1 | - | 1 |
| July 2019 | 0 | - | 0 |
| August 2019 | 7 | - | 7 |
| October 2019 | 25 | - | 25 |
| December 2019 | 23 | - | 25 |
| January 2020 | 8 | - | 8 |
| April 2020 | - | 43 | 43 |
| May 2020 | 6 | 35 | 41 |
| June 2020 | - | 1 | 1 |
| July 2020 | - | 10 | 10 |
| August 2020 | - | 37 | 37 |
| September 2020 | - | 16 | 16 |
| **Total** | **272** | **142** | **908** |

**Table 5-96: Seasonal variation of great black-backed gull recorded between May 2018 and September 2020.**

| Year | Spring Migration Jan – Apr | Breeding May – July | Autumn Migration Aug – Nov | Winter Dec | Non-breeding |
|---|---|---|---|---|---|
| 2018 | - | 78 | 257 | 57 | - |
| 2019 | 302 | 1 | 32 | 25 | - |
| 2020 | 51 | 52 | 53 | - | - |

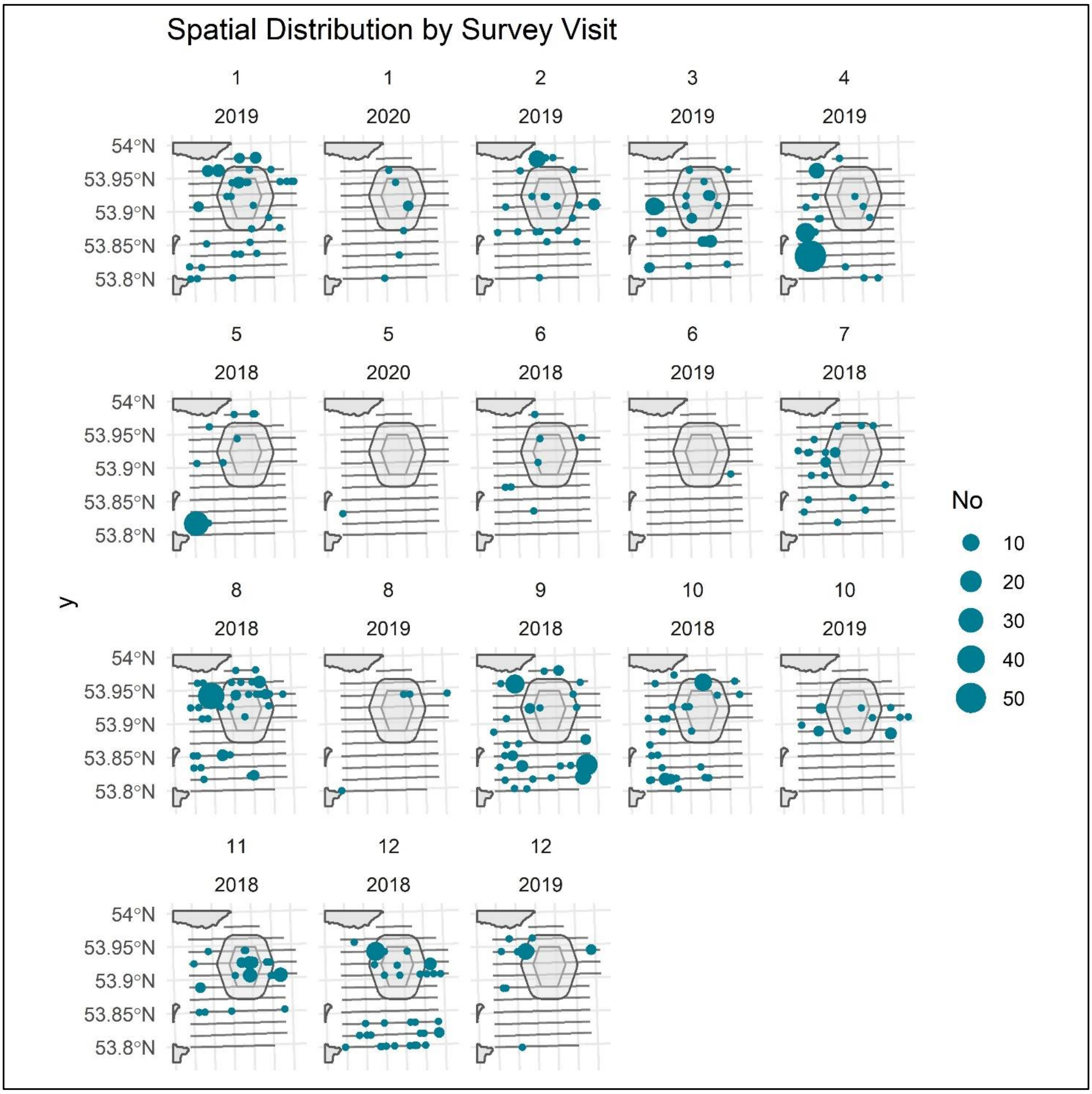


**Figure 5-23: Spatial distribution of great black-backed gull records on boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, 214 individuals (78.7%) were observed sitting compared to those in flight (58 individuals, 21.3%). Off Transect, the majority of birds (380 individuals, 76.9%) were observed in flight. Birds were more frequently observed flying at a height of 20 m on and off transect. Smaller numbers of birds were recorded at flight heights of 30 m to 50 m and 50+ m.

Of the 142 birds recorded during the DAS, 27 were observed in flight and 115 were observed sitting. Flying great black-backed gulls were recorded in April, May, June, August and September surveys. Significant orientations were recorded: in April 2020, flying great black-backed gulls were significantly orientated around the mean of 62°; in May 2020, they were orientated around the mean of 94°; and in September 2020, around the mean of 204°. One flying great black-backed gull deemed suitable for flight height determination was recorded, with an altitude of 4.5 m above MSL.

Table 5-97 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-24 shows the recorded flight heights of great black-backed gull during the boat-based surveys.

**Table 5-97: Proportion of great black-backed gull recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 1 | 16.7 | 5 | 83.3 | 7 | 18.9 | 30 | 81.1 |
| June 2018 | 0 | 0 | 1 | 100.0 | 6 | 85.7 | 1 | 14.3 |
| July 2018 | 6 | 85.7 | 1 | 14.3 | 15 | 75.0 | 5 | 25.0 |
| August 2018 | 4 | 22.2 | 14 | 78.8 | 69 | 88.5 | 9 | 11.5 |
| September 2018 | 2 | 10.5 | 17 | 89.5 | 58 | 100 | 0 | 0 |
| October 2018 | 3 | 30.0 | 7 | 70.0 | 34 | 100 | 0 | 0 |
| November 2018 | 1 | 16.7 | 5 | 89.3 | 34 | 100 | 0 | 0 |
| December 2018 | 4 | 28.6 | 10 | 71.4 | 42 | 97.7 | 1 | 2.3 |
| January 2019 | 2 | 22.2 | 7 | 78.8 | 41 | 57.7 | 30 | 42.3 |
| February 2019 | 12 | 70.6 | 5 | 29.4 | 16 | 66.7 | 8 | 33.3 |
| March 2019 | 7 | 33.3 | 14 | 66.7 | 34 | 100.0 | 0 | 0 |
| April 2019 | 0 | 0 | 74 | 100 | 24 | 46.2 | 28 | 53.8 |
| June 2019 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| July 2019 | No birds recorded | | | | | | | |
| August 2019 | 3 | 42.9 | 4 | 57.1 | 0 | 0 | 0 | 0 |
| October 2019 | 2 | 8.0 | 23 | 92.0 | 0 | 0 | 0 | 0 |
| December 2019 | 2 | 8.7 | 21 | 91.3 | 0 | 0 | 2 | 100 |
| January 2020 | 3 | 37.5 | 5 | 62.5 | 0 | 0 | 0 | 0 |
| April 2020 | 8 | 18.6 | 35 | 81.4 | N/A | | | |
| May 2020 | 16 | 39 | 25 | 61 | 0 | 0 | 0 | 0 |
| June 2020 | 1 | 100 | 0 | 0 | N/A | | | |
| July 2020 | 0 | 0 | 10 | 100 | | | | |
| August 2020 | 2 | 5.4 | 35 | 94.6 | | | | |
| September 2020 | 5 | 31.3 | 11 | 68.7 | | | | |
| **Total** | **85** | **20.5** | **329** | **79.5** | **380** | **76.9** | **114** | **23.1** |

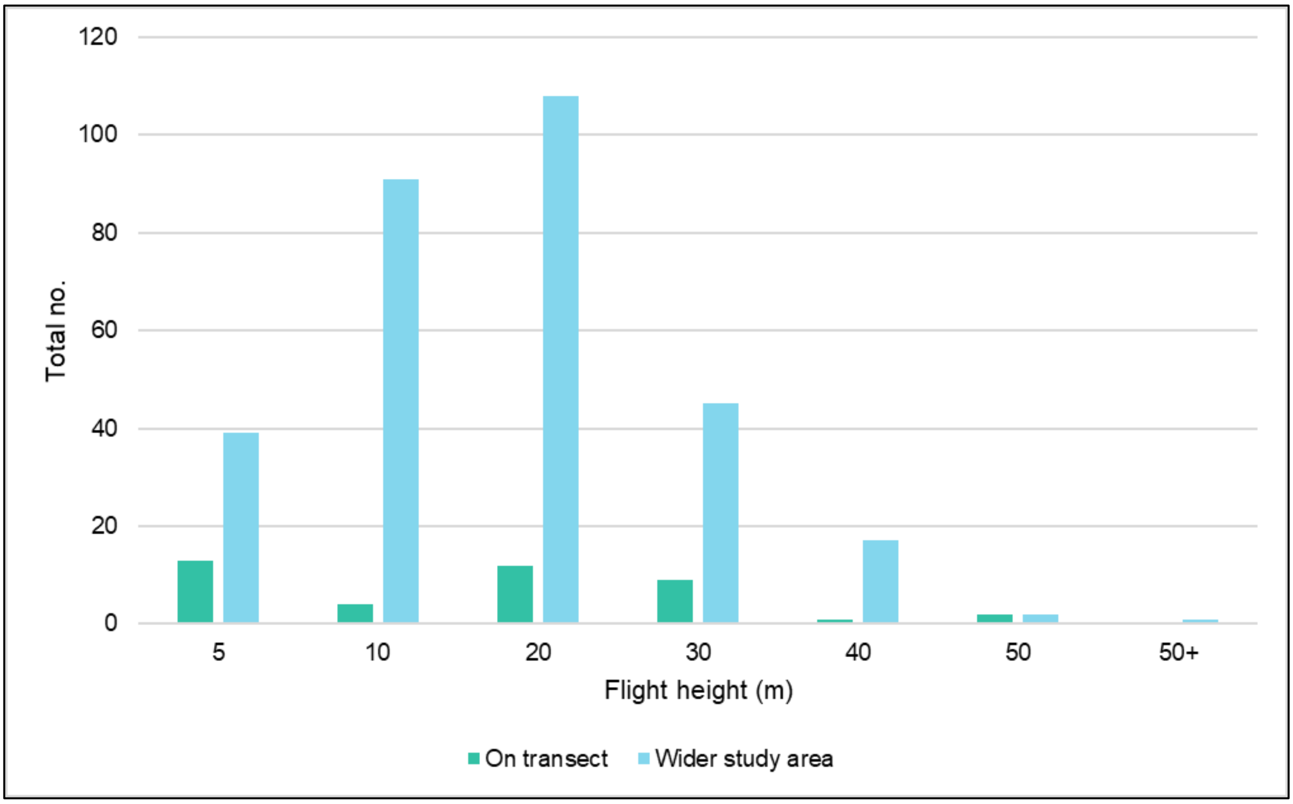


**Figure 5-24: Great black-backed gull flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during boat-based surveys

### Flying birds

Table 5-98 and Table 5-99 below presents the great black-backed gull modelled flight abundance estimates for the offshore wind farm area plus a 2 km buffer.

**Table 5-98: Great black-backed gull flying offshore wind farm area modelled abundance estimates by survey.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 3 | 1 | 6 |
| June 2018 | 2 | 1 | 6 |
| July 2018 | 5 | 3 | 11 |
| August 2018 | 41 | 9 | 150 |
| September 2018 | 3 | 0 | 91 |
| October 2018 | 22 | 4 | 141 |
| November 2018 | 2 | 0 | 28 |
| December 2018 | 74 | 20 | 416 |
| January 2019 | 34 | 6 | 168 |
| February 2019 | 48 | 22 | 130 |
| March 2019 | 11 | 3 | 33 |
| April 2019 | 3 | 1 | 9 |

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| June 2019 | 2 | 1 | 6 |
| July 2019 | 5 | 3 | 11 |
| August 2019 | 1 | 0 | 6 |
| October 2019 | 1 | 0 | 5 |
| December 2019 | 2 | 0 | 18 |
| January 2020 | 2 | 0 | 28 |
| May 2020 | 3 | 1 | 6 |

**Table 5-99: Great black-backed gull flying offshore wind farm area plus 2 km buffer modelled abundance estimates.**

| Month / Year | Estimate | LCL | UCL |
|---|---|---|---|
| May 2018 | 10 | 4 | 22 |
| June 2018 | 6 | 2 | 21 |
| July 2018 | 18 | 9 | 43 |
| August 2018 | 316 | 96 | 1116 |
| September 2018 | 39 | 5 | 428 |
| October 2018 | 76 | 14 | 515 |
| November 2018 | 7 | 1 | 74 |
| December 2018 | 170 | 51 | 905 |
| January 2019 | 95 | 21 | 420 |
| February 2019 | 117 | 49 | 362 |
| March 2019 | 39 | 13 | 125 |
| April 2019 | 9 | 3 | 29 |
| June 2019 | 6 | 2 | 21 |
| July 2019 | 18 | 9 | 43 |
| August 2019 | 8 | 1 | 41 |
| October 2019 | 2 | 0 | 17 |
| December 2019 | 4 | 1 | 36 |
| January 2020 | 7 | 1 | 74 |
| May 2020 | 10 | 4 | 22 |

## Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for great black-backed gull at the different spatial scales.

Table 5-100 presents the abundance estimates for sitting birds only whereas, Table 5-101 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate.

**Table 5-100: Abundance estimates of sitting great black-backed gull within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 13 (5 - 40) | 40 (16 - 75) |
| May 2020 | No birds recorded | No birds recorded |
| June 2020 | No birds recorded | No birds recorded |
| July 2020 | No birds recorded | No birds recorded |
| August 2020 | 93 (34 - 278) | 86 (34 - 250) |
| September 2020 | 28 (10 - 83) | 26 (10 - 78) |

**Table 5-101: Abundance estimates of flying great black-backed gull within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 5 (2 - 11) | 10 (4 - 22) |
| May 2020 | No birds recorded | No birds recorded |
| June 2020 | No birds recorded | No birds recorded |
| July 2020 | No birds recorded | No birds recorded |
| August 2020 | No birds recorded | No birds recorded |
| September 2020 | 3 (1 - 8) | 5 (2 - 13) |

## 5.6.14 Lesser black-backed gull

### Ecology

The majority of lesser black-backed gulls in Ireland nest at inland lakes in the west of the country, although they are known to nest on buildings around the Dublin area (Balmer *et al.*, 2013; Mitchell *et al.*, 2004). Lesser black-backed gulls inhabit level ground which is well covered with short vegetation, such as sand dunes, tops and ledges of coastal cliffs, rocky offshore islands, saltmarshes and inland on lake margins and rivers (BirdLife International, 2020).

Lesser black-backed gulls are omnivorous and opportunistic feeders that forage at sea and inland, with a diet which consists of small fish (Baltic herring *Clupea harengus*), aquatic and terrestrial invertebrates, bird eggs and nestlings, carrion, rodents, berries and grain (del Hoyo *et al.*, 1996; BirdLife International, 2020). Lesser black-backed gulls are also known to follow fishing fleets and forage on bycatch discards.

The lesser black-backed gull is an Amber-listed species in the UK and Ireland due to moderate declines in their breeding range over the past 20 years and over 50% of their breeding population occurring at ten or fewer sites (Gilbert *et al*., 2021 and Stanbury *et al*., 2021). During the Seabird Count census (Cummins *et al.,* 2019), the population estimate for lesser black-backed gulls was 7,112 pairs (of which 64% were within the SPA network). This was an increase of 145% over the long term (1985/87 – 2015/18). The short and long-term population trends at a coastal and national level indicate an expanding population, however there are some variable trends within more traditional sites, which have seen a marked decrease. Table 5-102 below shows a selection of Irish colonies for lesser black-backed gull (including inland colonies).

**Table 5-102: Change in the recorded breeding lesser black-backed gull populations at a selection of Irish colonies (Cummins *et al.*, 2019).**

| Site | SCR (1985 – 1988) | Seabird 2000 (1998 – 2002) | 2015 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Lough Corrib | 1,153 | 6 | 86 | 1,333% |
| Lough Conn – Gull Island | - | 10 | 35 | 250% |
| Inishkeas | - | 40 | 93 | 133% |
| Puffin Island | 55 | 139 | 291 | 109% |
| Great Saltee | 80 | 144 | 251 | 74% |
| Lough Mask | - | 286 | 422 | 48% |
| Lambay Island | 150 | 309 | 345 | 12% |
| Scariff Island | - | 97 | 97 | 0 |
| Cape Clear Island | 103 | 204 | 26 | -87% |
| Inishgoosk – Lough Derg, Donegal | - | 500 | 0 | -100% |

A summary of the recent (within the last five summers) colony data for lesser black-backed within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-103 below. If multiple years are provided then the mean count is presented. Colonies which recorded zero birds are not included.

**Table 5-103: Summary of most recent colony data for lesser black-backed gull between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Belfast | 2018 and 2019 | 161 ± 60 |
| | Belfast Harbour | 2017 and 2019 | 1 ± 0 |
| | Causeway Coast | 2021 | 3 |
| | East Antrim Coast | 2021 | 2 |
| | Lough Neagh and Lough Beg SPA | 2017, 2018 and 2021 | 768.7 ± 308.2 |
| | Rathlin Island SPA | 2021 | 519 |
| | Sheep Island SPA | 2021 | 88 |
| Argyll and Bute | Giga | 2021 | 1 |
| | Islay – East (Port Askaig to Bowmore) | 2017 and 2018 | 5.5 ± 4.5 |
| | Islay – West (Port Askaig to Bruichladdich) | 2017 – 2019 and 2021 | 10 ± 3.2 |
| | Jura (West) | 2017 – 2019 | 1.7 ± 0.5 |
| | Loch Fyne | 2021 | 18 |
| | Mull | 2021 | 3 |
| | Sanda Islands | 2019 | 23 |
| | Sound of Jura | 2021 | 14 |
| Clwyd | Kinmel Bay | 2019 | 1 |
| | Llanddulas Quarries | 2017 | 3 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| | Prestatyn | 2019 | 3 |
| | Rhyl | 2019 | 4 |
| Cumbria | Askam-in-Furness | 2019 | 42 |
| | Burrow-in-Furness | 2019 | 435 |
| | Flimby and Risehow | 2019 | 4 |
| | Haverigg and Millom | 2019 | 75 |
| | Siddick | 2019 | 1 |
| | South Solway | 2018 and 2019 | 286.5 ± 26.5 |
| | St Bees Head and Town | 2017 – 2020 | 0.8 ± 0.4 |
| | Walney Urban Gulls | 2019 | 11 |
| | Whitehaven (Buildings) | 2018 | 53 |
| | Workington | 2019 | 7 |
| Donegal | Aran Island | 2018 | 2 |
| | Inishdooey, Inishbofin, Inishbeg | 2018 | 20 |
| | North Donegal | 2018 | 1 |
| Down | Copeland Islands SPA | 2018 and 2019 | 456 ± 91 |
| | Gun’s Island – Northern Island | 2022 | 10 |
| | Strangford Lough SPA | 2017 – 2019 | 323 ± 14.4 |
| Dyed | Aber Bach – Ynys Barry | 2017 and 2018 | 4 ± 1 |
| | Abereiddy – Treginnis, St Davids | 2017 and 2018 | 4.5 ± 0.5 |
| | Bishop and Clerks and Ramsey | 2018 | 124 |
| | Newport to Poppit | 2018 | 39 |
| | Strumble Head – Pwll Deri | 2018 | 48 |
| | Strumble Head to Fishguard to Newport | 2017 and 2018 | 2.5 ± 1.5 |
| | Treginnis – Dinas Fawr, Solva | 2018 | 67 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | 2017 – 2019 | 168.3 ± 6.1 |
| | Aberdyfi | 2018 | 1 |
| | Anglesey Terns / Morwenoliaid Ynys MÃ´n SPA | 2017 – 2019 | 111 ± 14.2 |
| | Bangor and Caernarfon | 2019 | 17 |
| | Barmouth and Fairbourne | 2018 | 2 |
| | Bodorgan Head to Abermenai | 2018 | 4 |
| | Friog | 2018 | 1±0 |
| | Puffin Island SPA | 2017 | 526 |
| | South Stack | 2017 – 2019 and 2021 | 6.3 ± 1.8 |
| Isle of Man | East Island | 2017 | 5 |
| | North Island | 2017 | 2 |
| | South Island | 2017 | 28 |
| | West Island | 2017 | 1 |
| Kyle and Carrick | Ailsa Craig SPA | 2017 – 2019 | 153.3 ± 26.6 |
| | Lady Isle | 2018 | 246 |
| | Starling Knowe to Downan Point | 2018 | 3 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Lancashire | Fleetwood | 2019 | 9 |
| | Morecambe Bay and Duddon Estuary SPA (Lancashire) | 2017 – 2020 | 1,389 ± 1,040.6 |
| | Ribble and Alt Estuaries SPA | 2021 | 4,489 |
| Merseyside | Seaforth Nature Reserve and Liverpool City | 2019 | 15 |
| | The Dee Estuary SPA | 2019 | 3 |
| Stewarty | Almorness Point | 2021 | 373 |
| | Fleet Bay | 2018 | 8 |
| | Meikle Ross and Little Ross | 2018 | 6 |
| | Port O'Warren | 2020 | 1 |
| Waterford | Bally Voorey to Stradbally | 2018 | 2 |
| | Bunmahon to Stradbally | 2018 | 2 |
| | Dungarvan to Ardmore | 2018 | 2 |
| | Illaunglass to Annestown | 2018 | 2 |
| | Tramore to Illaunglass | 2018 | 5 |
| Wigtown | Loch Ryan | 2021 | 4 |
| | Wigtown Bay Merse and Baldoon | 2019 | 4 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) did not differentiate between great and lesser black-backed gulls during summer surveys, and these two species were grouped together. However, in autumn and winter surveys these species were recorded separately. There were 39 lesser black-backed gull individuals, 143 great black-backed gull and 339 black-backed gulls that could not be differentiated to species level observed across the three survey seasons. Although sightings did occur across the ObSERVE western Irish Sea survey area, observations were predominantly in the northern part of the survey area.

Observations of lesser black-backed gulls were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-104. A five-year peak observation of 56 birds was recorded in the 2015/2016 season, along with a five-year peak-mean count of 24 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-104: Summary of I-WeBS survey counts for lesser black-backed gull within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 8 | 2 | 56 | 24 | - | - |

## Site-specific data

Although in typically low numbers, lesser black-backed gulls were observed in the site Survey Area during 13 of the total survey months (Table 5-105). However, lesser black-backed gulls were only recorded on six boat-based transects (June 2018, April to August 2019 and December 2019) and on three Digital Aerials (June, July and September 2020).

The small number of observations recorded during the survey period may have been migrants from southern wintering areas to northern breeding sites in Northern Ireland or Scotland (Aquafact, 2019).

Observations of lesser black-backed gull were widespread across the Study Area throughout the survey period.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-105. Table 5-106 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-25 shows the spatial distribution of lesser black-backed gull over the survey period.

**Table 5-105: Transect records and total observations of lesser black-backed gull from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 4 |
| June 2018 | 5 | - | 20 |
| July 2018 | 0 | - | 8 |
| August 2018 | 0 | - | 5 |
| September 2018 | 0 | - | 2 |
| October 2018 | 0 | - | 0 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 0 | - | 0 |
| February 2019 | 0 | - | 1 |
| March 2019 | 0 | - | 0 |
| April 2019 | 2 | - | 3 |
| June 2019 | 1 | - | 1 |
| July 2019 | 1 | - | 1 |
| August 2019 | 2 | - | 2 |
| October 2019 | 0 | - | 0 |
| December 2019 | 1 | - | 1 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 0 | 0 |
| May 2020 | 0 | 0 | 0 |
| June 2020 | - | 2 | 2 |
| July 2020 | - | 1 | 1 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 1 | 1 |
| **Total** | **12** | **4** | **52** |

**Table 5-106: Seasonal variation of lesser black-backed gull recorded between May 2018 and September 2020.**

| Year | Spring Migration Mar – Apr | Breeding May – Jul | Autumn Migration Aug – Oct | Winter Nov – Feb | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 32 | 7 | 1 | - |
| 2019 / 2020 | 3 | 2 | 2 | 1 | - |
| 2020 | 0 | 3 | 1 | - | - |

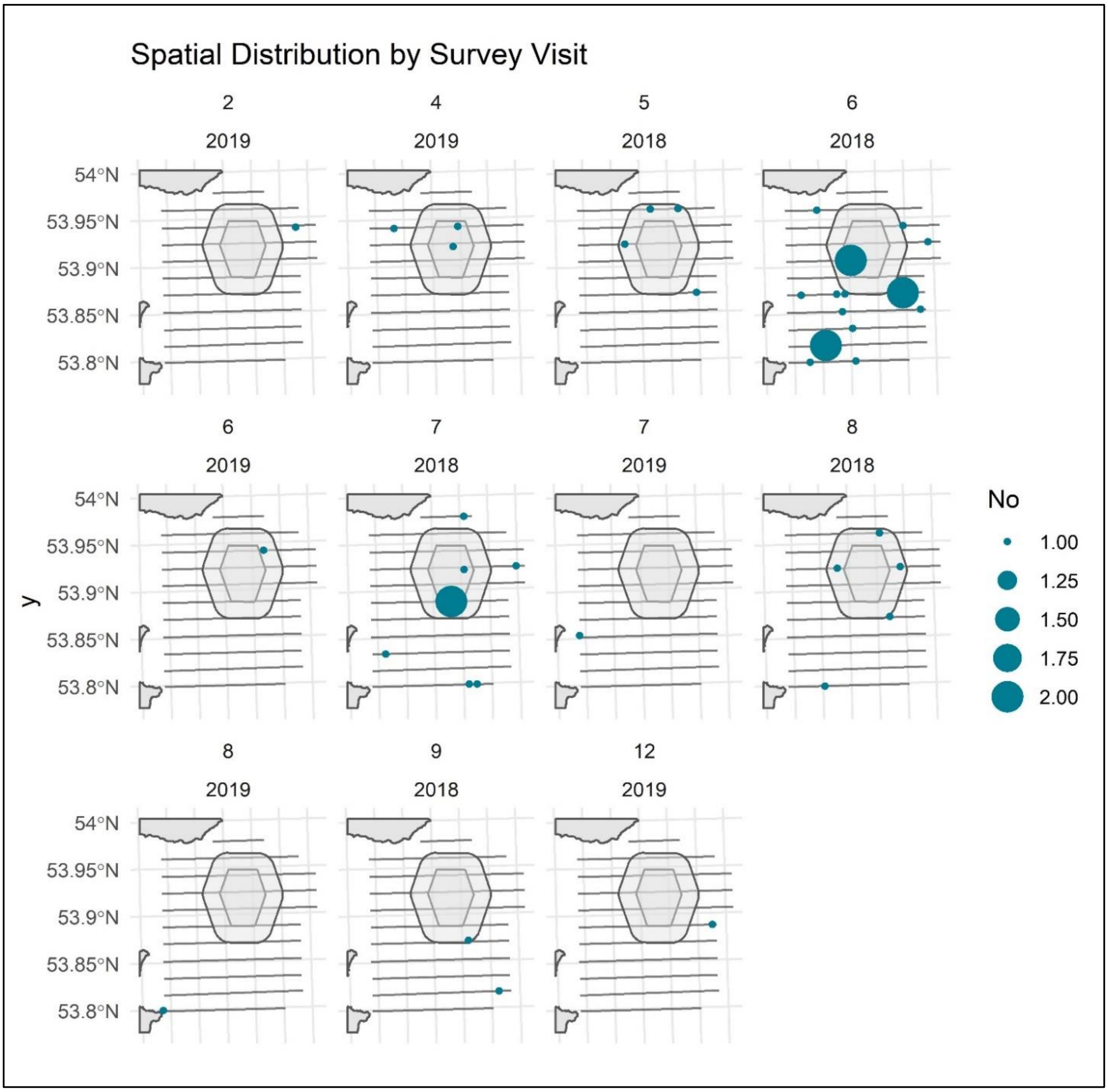


**Figure 5-25: Spatial distribution of lesser black-backed gull records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, 75% of individuals (9 birds) were observed flying on transect compared to 25% (3 individuals) sitting. Off transect, the majority of birds (40 individuals, 97.8%) were observed in flight. On transect, flight heights on transect were recorded between 10 m and 20 m. Off transect, lesser black-backed gulls were observed flying between 5 m and 50 m.

Of the 4 birds recorded during the DAS, 2 were observed in flight and 2 were observed sitting. One flying lesser black-backed gull deemed suitable for flight height determination was recorded, with an altitude of 13 m above MSL.

Table 5-107 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-26 shows the recorded flight heights of lesser black-backed gull during the boat-based surveys.

**Table 5-107: Proportion of lesser black-backed gull recorded flying or sitting during surveys undertaken between May 2018 and September 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 0 | 0 | 4 | 100 | 0 | 0 |
| June 2018 | 5 | 100 | 0 | 0 | 19 | 95.0 | 1 | 5.0 |
| July 2018 | 0 | 0 | 0 | 0 | 8 | 100 | 0 | 0 |
| August 2018 | 0 | 0 | 0 | 0 | 5 | 100 | 0 | 0 |
| September 2018 | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 |
| October 2018 | No birds recorded | | | | | | | |
| November 2018 | | | | | | | | |
| December 2018 | | | | | | | | |
| January 2019 | | | | | | | | |
| February 2019 | 0 | 0 | 0 | 0 | 1 | 100 | 0 | 0 |
| March 2019 | No birds recorded | | | | | | | |
| April 2019 | 0 | 0 | 2 | 100 | 1 | 100 | 0 | 0 |
| June 2019 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| July 2019 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| August 2019 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| October 2019 | No birds recorded | | | | | | | |
| December 2019 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| January 2020 | No birds recorded | | | | | | | |
| April 2020 | | | | | | | | |
| May 2020 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 2020 | No birds recorded | | | | | | | |
| July 2020 | 0 | 0 | 1 | 100 | N/A | | | |
| August 2020 | No birds recorded | | | | | | | |
| September 2020 | 0 | 0 | 1 | 100 | N/A | | | |
| **Total** | **11** | **68.7** | **5** | **31.3** | **40** | **97.8** | **1** | **2.2** |

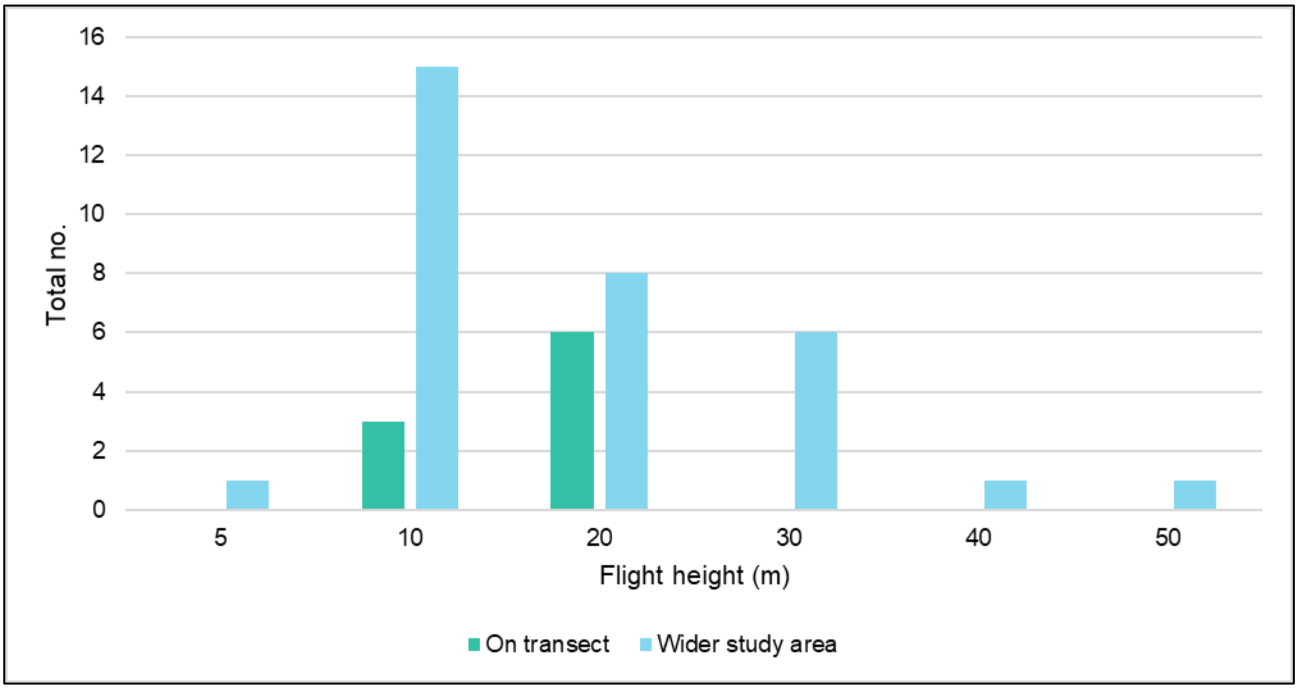


**Figure 5-26: Lesser black-backed gull flight heights observed between May 2018 and May 2020.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-25), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.15 Herring gull

### Ecology

Herring gulls are coastally distributed in Ireland and in recent years have been observed to move inland during the breeding season to breed on buildings and rooftops in addition to their cliff nest sites (Mitchell *et al.*, 2004). Although the herring gull has no specific breeding habitat, the species shows a preference for rocky shores with cliffs, outlying stacks or islets (del Hoyo *et al.*, 1996). The biggest colonies within Ireland are located on Lambay Island in Co. Dublin, which hosts over 1,800 nests (BirdWatch Ireland, 2020c). A smaller colony is located close to the Study Area at Wicklow Head.

Although herring gulls exploit refuse tips and agricultural areas, their breeding distribution is very coastal in comparison to other *Larus* gulls (excluding *L. marinus*) (Gibbons *et al.*, 1993). This species is a highly opportunistic forager and will exploit any superabundant food source such as fisheries, refuse dumps, sewage outfalls and wharves. The diet has been observed to consist of fish, crabs, earthworms, adult birds, eggs and young birds, rodents and insects (del Hoyo *et al.*, 1996).

Ireland supports internationally important numbers of herring gulls, however due to their long-term population declines over the past 25 years, the herring gull is a Amber-listed species in Ireland (Gilbert *et al*., 2021) and Red-listed in the UK (Stanbury *et al*., 2021). In Ireland, the Seabird Census recorded 10,333 pairs, a 33% decrease over the long term (1985/87 – 2015/18) (Cummins *et al.,* 2019), this is likely due to fluctuations at various sites and recording significant populations at previously unknown colonies.

Table 5-108 presents site population abundances as recorded over the SCR, Seabird 2000 and the Seabird Census period.

**Table 5-108: Change in the recorded breeding herring gull populations at a selection of Irish colonies (Cummins *et al.*, 2019).**

| Site | SCR (1985 – 1988) | Seabird 2000 (1998 – 2002) | 2015 – 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Great Saltee | 825 | 43 | 115 | 167% |
| Inishmurray | 200 | 111 | 246 | 119% |
| Glencolumbkille Peninsula | 339 | 236 | 389 | 65% |
| Ireland's Eye | 540 | 246 | 318 | 29% |
| Cape Clear Island | 176 | 46 | 29 | -37% |
| Lambay Island | 5,500 | 1,806 | 906 | -50% |

A summary of the recent (within the last five summers) colony data for herring gull within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-109 below. If multiple years are provided then the mean count is presented.

**Table 5-109: Summary of most recent colony data for herring gull between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Belfast | 2018 and 2019 | 27.5 ± 11.5 |
| Down | Carlingford Lough SPA | 2019 and 2021 | 6.5 ± 5.5 |
| | Gun's Island – Northern Island | 2022 | 5 |
| | Maggy's Leap | 2019 | 1 |
| | Outer Ards SPA | 2018 and 2019 | 193 ± 6 |
| | Strangford Lough SPA | 2017 – 2019 | 1,135 ± 97.6 |
| Isle of Man | South Island | 2017 | 536 |

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) did not differentiate between herring and common gull and were grouped together. A total of 764 sightings of 2,726 individuals were recorded over the three survey seasons, most commonly observed in the autumn surveys, then winter survey and least in summer surveys. Records were concentrated in the inshore coastal areas of the northern transects during the summer and autumn surveys, particularly along the Drogheda coastline. Mean density of herring/common gull across the ObSERVE western Irish Sea survey area ranged between 0.75 birds/km$^2$ in summer surveys, 3.82 birds/km$^2$ in autumn surveys, and 1.76 birds/km$^2$ in winter surveys.

Observations of herring gull were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-110.

A five-year peak observation of 9,245 birds was recorded in the 2017/2018 season, along with a five-year peak-mean count of 2,198 birds between 2015/16 and 2019/20 (I-WeBS, 2022).

**Table 5-110: Summary of I-WeBS survey counts for herring gull within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 – 2019/2020) | Five-year peak-mean count (2015/2016 – 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 379 | 165 | 9,245 | 2,198 | - | - |

## Site-specific data

Although herring gulls were observed in all twelve survey months, records were only made on transect during nine of these months Table 5-111. Transect records were low during the breeding season (March to August) which reflects local absence of breeding herring gull. The exception to this is in August 2019 when 165 birds were recorded on transect. On transect observations were generally higher in winter months, with peak counts recorded in December 2019 / January 2020 with 122 birds recorded (Aquafact, 2019).

Herring gulls showed no overall distribution pattern and were distributed across the Offshore Ornithology Study Area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-111.

Table 5-112 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-27 shows the spatial distribution of herring gull during the survey period.

**Table 5-111: Transect records and total observations of herring gull from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 14 |
| June 2018 | 4 | - | 51 |
| July 2018 | 2 | - | 20 |
| August 2018 | 2 | - | 17 |
| September 2018 | 0 | - | 18 |
| October 2018 | 10 | - | 75 |
| November 2018 | 6 | - | 21 |
| December 2018 | 5 | - | 69 |
| January 2019 | 3 | - | 47 |
| February 2019 | 17 | - | 33 |
| March 2019 | 15 | - | 48 |
| April 2019 | 0 | - | 20 |
| June 2019 | 2 | - | 2 |
| July 2019 | 4 | - | 4 |
| August 2019 | 165 | - | 165 |
| October 2019 | 8 | - | 8 |
| December 2019 | 52 | - | 52 |
| January 2020 | 20 | - | 20 |
| April 2020 | - | 2 | 2 |
| May 2020 | 0 | 17 | 17 |
| June 2020 | - | 1 | 1 |
| July 2020 | - | 24 | 24 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| August 2020 | - | 1 | 1 |
| September 2020 | - | 1 | 1 |
| **Total** | **315** | **46** | **730** |

**Table 5-112: Seasonal variation of herring gull recorded between May 2018 and September 2020.**

| Year | Spring Migration Jan – Apr | Breeding May – Jul | Autumn Migration Aug – Nov | Winter Dec | Non-breeding |
|---|---|---|---|---|---|
| 2018 | - | 102 | 114 | 69 | - |
| 2019 | 80 | 239 | 8 | 52 | - |
| 2020 | 22 | 43 | 1 | - | - |

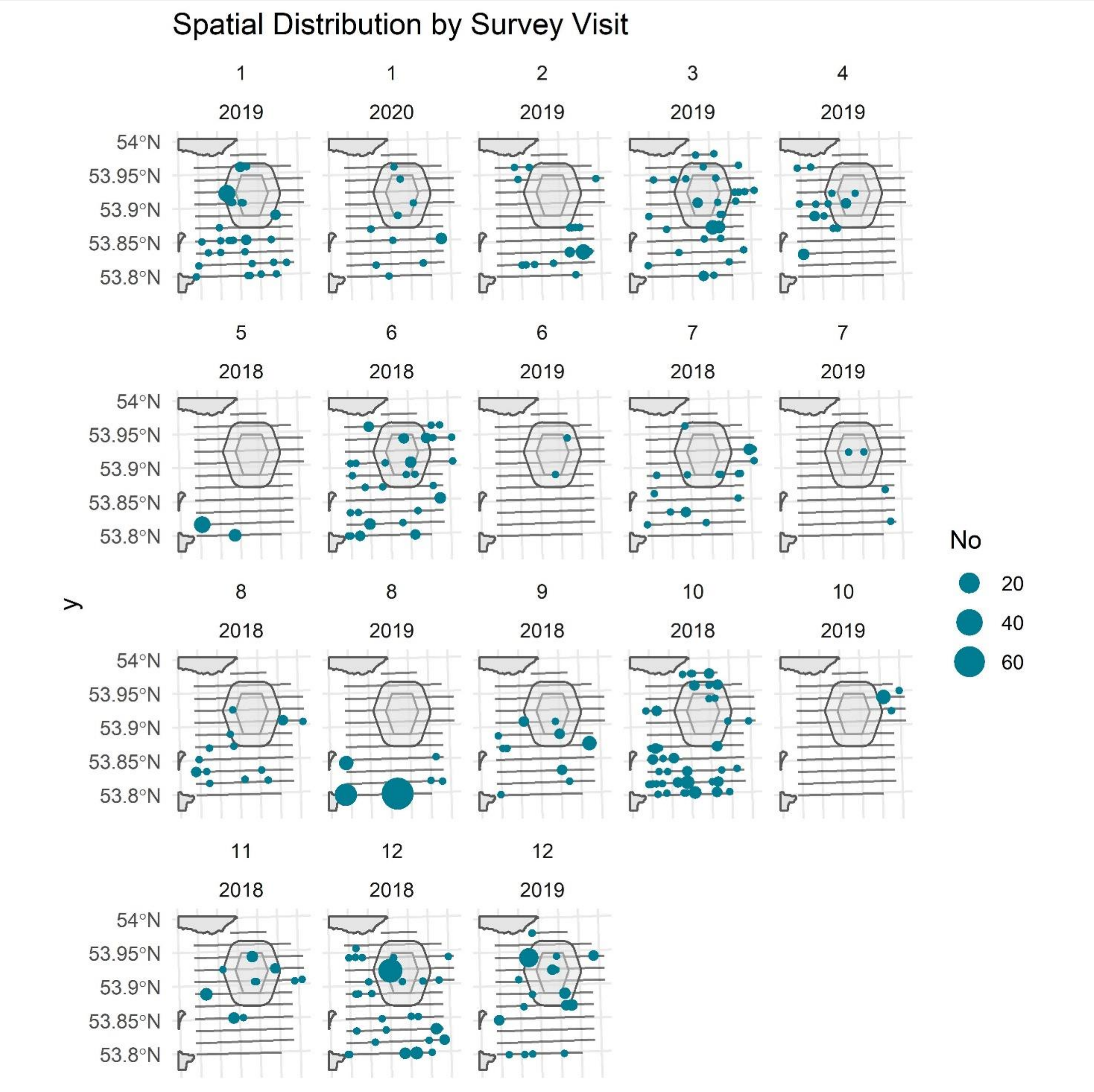


**Figure 5-27: Spatial distribution of herring gull records. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, 65.4% of individuals (206 birds) were observed sitting on transect compared to 34.6% (109 individuals) in flight. Off transect, the majority of birds (350 individuals, 94.9%) were observed in flight. On transect, the majority of observed flight heights were between 5 m and 20 m. with lower numbers of individuals recorded between 30 m and 40 m. Off transect, flight heights were observed between 5 m and 50+ m.

Of the 46 herring gull recorded during the DAS, 23 were observed in flight and 23 were observed sitting. Flight height calculations from three birds resulted in a median altitude of 46 m above MSL.

Table 5-113 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-28 shows the recorded flight heights of herring gull during the boat-based surveys.

**Table 5-113: Proportion of herring gull recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 0 | 0 | 4 | 28.6 | 10 | 71.4 |
| June 2018 | 4 | 100 | 0 | 0 | 44 | 93.6 | 3 | 6.3 |
| July 2018 | 2 | 100 | 0 | 0 | 18 | 100 | 0 | 0 |
| August 2018 | 0 | 0 | 2 | 100 | 15 | 100 | 0 | 0 |
| September 2018 | 0 | 0 | 0 | 0 | 18 | 100 | 0 | 0 |
| October 2018 | 6 | 60.0 | 4 | 40.0 | 65 | 100 | 0 | 0 |
| November 2018 | 2 | 33.3 | 4 | 66.7 | 15 | 100 | 0 | 0 |
| December 2018 | 5 | 100 | 0 | 0 | 64 | 100 | 0 | 0 |
| January 2019 | 2 | 66.7 | 1 | 33.3 | 44 | 100 | 0 | 0 |
| February 2019 | 14 | 82.4 | 3 | 17.6 | 15 | 93.8 | 1 | 6.2 |
| March 2019 | 13 | 86.7 | 2 | 13.3 | 31 | 93.9 | 2 | 6.1 |
| April 2019 | 0 | 0 | 0 | 0 | 17 | 85.0 | 3 | 15.0 |
| June 2019 | 1 | 50.0 | 1 | 50.0 | 0 | 0 | 0 | 0 |
| July 2019 | 2 | 50.0 | 2 | 50.0 | 0 | 0 | 0 | 0 |
| August 2019 | 25 | 15.2 | 140 | 74.8 | 0 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 8 | 100 | 0 | 0 | 0 | 0 |
| December 2019 | 18 | 34.6 | 34 | 65.4 | 0 | 0 | 0 | 0 |
| January 2020 | 15 | 75.0 | 5 | 25.0 | 0 | 0 | 0 | 0 |
| *April 2020* | 1 | 50.0 | 1 | 50.0 | N/A | | | |
| May 2020 | 2 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 2020 | 1 | 100 | 0 | 0 | N/A | | | |
| July 2020 | 16 | 66.7 | 8 | 33.3 | | | | |
| August 2020 | 1 | 100 | 0 | 0 | | | | |
| September 2020 | 1 | 100 | 0 | 0 | | | | |
| **Total** | **109** | **34.6** | **206** | **65.4** | **350** | **94.9** | **19** | **5.1** |

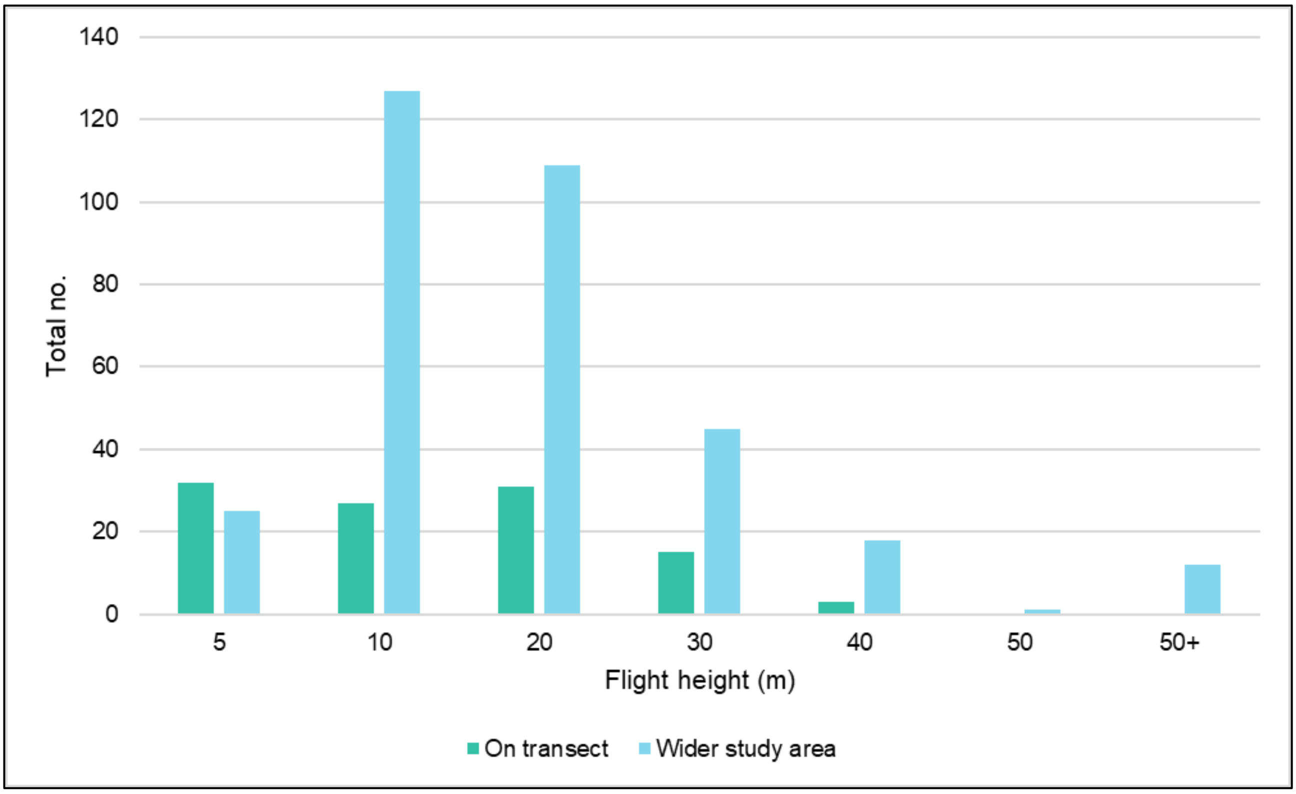


**Figure 5-28: Herring gull flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during boat-based surveys

### Flying birds

There were 303 records of flying herring gull over the study period. The majority of these records were single individuals with smaller numbers of groups up to 12 birds in size noted.

Table 5-114 and Table 5-115 below presents the herring gull modelled flight abundance estimates for the offshore wind farm area and the offshore wind farm area plus 2 km buffer.

**Table 5-114: Herring gull flying offshore wind farm area modelled abundance estimates by survey.**

| Month / Year | Offshore wind farm area estimate | Offshore wind farm area LCL | Offshore wind farm area UCL |
|---|---|---|---|
| May 2018 | 0 | 0 | NA |
| June 2018 | 20 | 16 | 27 |
| July 2018 | 7 | 4 | 12 |
| August 2018 | 14 | 1 | 204 |
| September 2018 | 11 | 2 | 132 |
| October 2018 | 6 | 1 | 52 |
| November 2018 | 12 | 4 | 40 |
| December 2018 | 224 | 126 | 403 |
| January 2019 | 38 | 14 | 106 |
| February 2019 | 12 | 12 | 44 |

| Month / Year | Offshore wind farm area estimate | Offshore wind farm area LCL | Offshore wind farm area UCL |
|---|---|---|---|
| March 2019 | 51 | 30 | 87 |
| April 2019 | 8 | 4 | 16 |
| June 2019 | 20 | 16 | 27 |
| July 2019 | 7 | 4 | 12 |
| August 2019 | 2 | 0 | 38 |
| Octpber 2019 | 1 | 0 | 9 |
| December 2019 | 33 | 16 | 67 |
| January 2020 | 12 | 4 | 40 |
| May 2020 | 0 | 0 | NA |

**Table 5-115: Herring gull flying offshore wind farm area plus 2 km buffer modelled abundance estimates by survey.**

| Month / Year | Offshore wind farm area estimate | Offshore wind farm area LCL | Offshore wind farm area UCL |
|---|---|---|---|
| May 2018 | 0 | 0 | NA |
| June 2018 | 27 | 15 | 61 |
| July 2018 | 12 | 4 | 20 |
| August 2018 | 24 | 3 | 293 |
| September 2018 | 28 | 5 | 234 |
| October 2018 | 34 | 12 | 138 |
| November 2018 | 30 | 11 | 86 |
| December 2018 | 337 | 183 | 650 |
| January 2019 | 91 | 35 | 249 |
| February 2019 | 159 | 37 | 159 |
| March 2019 | 163 | 93 | 299 |
| April 2019 | 16 | 4 | 24 |
| June 2019 | 27 | 15 | 61 |
| July 2019 | 12 | 4 | 20 |
| August 2019 | 4 | 0 | 23 |
| Octpber 2019 | 5 | 1 | 23 |
| December 2019 | 50 | 27 | 109 |
| January 2020 | 30 | 11 | 86 |
| May 2020 | 0 | 0 | NA |

## Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for herring gull at the different spatial scales. Table 5-116 presents the abundance estimates for sitting birds only whereas, Table 5-117 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate.

**Table 5-116: Abundance estimates of sitting herring gull within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | No birds recorded | No birds recorded |
| May 2020 | No birds recorded | No birds recorded |
| June 2020 | No birds recorded | No birds recorded |
| July 2020 | No birds recorded | 10 (4 - 20) |
| August 2020 | No birds recorded | No birds recorded |
| September 2020 | No birds recorded | No birds recorded |

**Table 5-117: Abundance estimates of flying herring gull within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | No birds recorded | No birds recorded |
| May 2020 | 3 (1 - 8) | 10 (4 - 26) |
| June 2020 | No birds recorded | No birds recorded |
| July 2020 | No birds recorded | No birds recorded |
| August 2020 | No birds recorded | No birds recorded |
| September 2020 | No birds recorded | No birds recorded |

## 5.6.16 Great skua

### Ecology

Recently, a small population of great skua have been observed breeding within Ireland, with approximately eight breeding pairs at four to five sites (Balmer *et al.*, 2013). Skuas are kleptoparasites (steal food items from other seabirds) and scavengers from fisheries, as well as predating eggs, chicks and other seabirds (Mitchell *et al.*, 2004).

Great skua is an Amber-listed species in the UK and Ireland due to their rare breeding population and localised distribution of breeding sites (Gilbert *et al*., 2021, Stanbury *et al.,* 2021). During the Seabird Census count between 2015 and 2018 great skua were recorded breeding on islands across four counties in Ireland; breeding was confirmed at 13 sites and individuals recorded at a further two occupied territories (Table 5-118). The Irish population was then estimated to be between 13 and 15 breeding pairs, an increase of between 1,200 and 1,400% since Seabird 2000 (Cummins *et al.,* 2019).

**Table 5-118: Great skuas breeding across Ireland during the period 2015 – 2018.**

| County | Confirmed Breeding | Possible / Probable Breeding |
|---|---|---|
| Donegal | 3 | 2 |
| Sligo | 1 | - |
| Mayo | 8 | - |
| Galway | 1 | - |
| **Total** | 13 | 2 |

A summary of the recent (within the last five summers) colony data for great skua within the Cumulative Offshore Ornithology Study Area is provided Table 5-119 below. If multiple years are provided then the mean count is presented.

**Table 5-119: Summary of most recent colony data for great skua between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AOT) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Rathlin Island SPA | 2017 and 2021 | 1.5 ± 0.5 |
| Argyll and Bute | Coll | 2018 | 3 |
| | Islay - West (Port Askaig to Bruichladdich) | 2017 – 2019 and 2021 | 1 ± 0.7 |
| | North Colonsay and Western Cliffs SPA | 2018 | 2 |
| | Oronsay | 2017 – 2019 | 3. 7 ± 0.9 |
| | South West Iona and Soa | 2021 | 1 |
| | Stac Mhic Mhurchaidh, Reidh Eilean, Eilean Annraidh, Eilean Chalba | 2021 | 1 |
| | Staffa | 2021 | 1 |
| | Tiree | 2018 and 2019 | 1±1 |
| | Treshnish Isles SPA | 2017 – 2019, 2021 and 2022 | 4 ± 2.1 |
| Lochaber | Canna and Sanday SPA | 2017 – 2019, 2021 and 2022 | 15.8 ± 5.2 |
| | Heisgeir | 2018 | 2 |
| | Muck | 2018 | 1 |
| Ross and Cromarty | Gruinard Bay | 2021 | 2 |
| | Loch Gairloch | 2019 | 6 |
| | Priest Island SPA | 2017, 2018 and 2021 | 6.7 ± 1.7 |
| | Rubha Reidh Peninsula | 2019 | 1 |
| | Summer Isles | 2019 | 8 |
| Skye and Lochalsh | East Trotternish | 2021 | 1 |
| | Kyleakin to Portree | 2021 | 1 |
| | Raasay | 2021 | 2 |
| | Rubha Hunish | 2018, 2019 and 2021 | 3.3 ± 0.5 |
| | Skye | 2021 | 2 |
| Sutherland | Assynt (Inland Lochs) | 2019 | 1 |
| | Glasleac Island, Soyea Island, Rubha Rodha, Loch Roe | 2021 | 2 |
| | Handa SPA | 2018 and 2022 | 178 ± 105 |
| | Loch Laxford | 2017 and 2019 | 1.5 ± 1.5 |
| | Stoer Headland | 2018 | 1 |
| Western Isles - Comhairle nan eilean | Barra and Vatersay | 2021 | 1 |
| | Bearasay - Lewis | 2021 | 1 |
| | Causamul, Haskeir, Boreray and Spuir | 2021 | 6 |
| | Druim Mor - Lewis | 2018 and 2021 | 18.5 ± 6.5 |
| | Flannan Isles SPA | 2021 | 11 |
| | Gilsay - Harris | 2021 | 1 |

| County (from SMP) | SMP Master Site | Year(s) | Count (AOT) ± SD (if applicable) |
|---|---|---|---|
| | Killegray - Harris | 2018 | 1 |
| | Lewis and Harris - Tysties | 2021 | 2 |
| | Lewis SKUA/GBBG squares | 2021 | 67 |
| | Liungaigh - Harris | 2018 | 1 |
| | Mingulay and Berneray SPA | 2021 | 17 |
| | North Rona and Sula Sgeir SPA | 2021 | 37 |
| | North Uist | 2021 | 2 |
| | Scaravay - Harris | 2021 | 1 |
| | Sound of Barra | 2021 | 1 |
| | Sound of Pabbay | 2021 | 8 |
| | South Uist | 2018 | 2 |
| | St Kilda SPA | 2019 | 211 |
| | Tolsta Head Moir - Lewis | 2018 and 2021 | 24.5 ± 15.5 |

## Desk-based data

The 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018) recorded a total of four sightings of five individuals within the ObSERVE western Irish Sea survey area across the three survey periods. Four individuals were recorded in autumn, and one individual was recorded in winter. Observations of great skua were concentrated in areas of water depths of between 30-60 m. No records of great skua were presented in the I-WeBS database.

## Site-specific data

During the boat-based surveys, observations of great skua were very sparse, with only two individuals recorded on transect in August 2018 and August 2019 (Table 5-120). Records of a further seven birds were made within the Study Area, in June 2018 (one individual), September 2018 (two individuals), October 2018 (two individuals), December 2018 (one individual) and April 2019 (one individual) (Aquafact, 2019). One great skua was identified during the aerial survey of the Study Area in July 2020, located in the southeast. All great skua records were of flying birds.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-120. Figure 5-29 shows the spatial distribution of great skua during the survey period.

**Table 5-120: Transect records and total observations of great skua from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 0 |
| June 2018 | 0 | - | 1 |
| July 2018 | 0 | - | 0 |
| August 2018 | 1 | - | 1 |
| September 2018 | 0 | - | 2 |
| October 2018 | 0 | - | 2 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 1 |
| January 2019 | 0 | - | 0 |

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| February 2019 | 0 | - | 0 |
| March 2019 | 0 | - | 0 |
| April 2019 | 0 | - | 1 |
| June 2019 | 0 | - | 0 |
| July 2019 | 0 | - | 0 |
| August 2019 | 1 | - | 1 |
| October 2019 | 0 | - | 0 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 0 | 0 |
| May 2020 | 0 | 0 | 0 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 1 | 1 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 0 | 0 |
| **Total** | **2** | **1** | **10** |

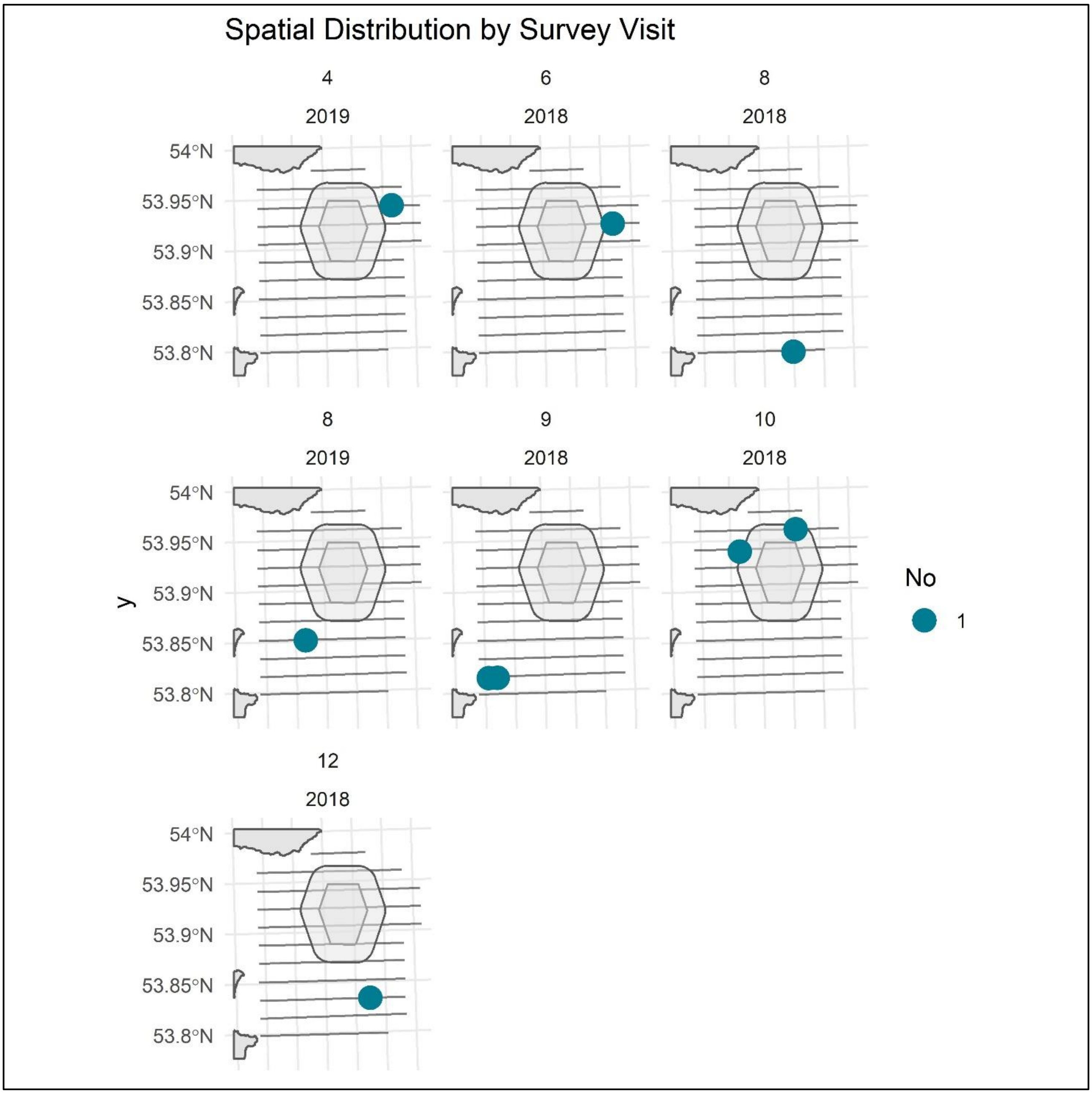


**Figure 5-29: Spatial distribution of great skua records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-29), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.17 Common tern

### Ecology

Common terns are summer visitors in Ireland with breeding colonies located throughout the country, including several located along the east coast of Ireland to the north and south of the offshore wind farm area (Balmer *et al.*, 2013), the closest being including Carlingford Lough. Although common tern is a strongly migratory coastal seabird, that breeds in a variety of habitats in coastal and inland areas, with a preference for nesting on flat rock surfaces on open shingle and sandy beaches, dunes and spits, vegetated dune areas, sandy, rocky islands in estuaries and coastal lagoons amongst others (BirdLife International, 2020; Snow and Perrins, 1998; del Hoyo *et al.*, 1996). When nesting inland, similar habitats are occupied such as sand or shingle lakes shores, shingle banks in rivers, sand- or gravel-pits, marshes, ponds, grassy areas and patches of dredged soil. The diet consists of small fish, planktonic crustaceans and insects (del Hoyo *et al.*, 1996).

In the UK and Ireland, common tern is Amber-listed due to recent moderate short- and long-term declines in their breeding range and localised nature of their breeding populations, with over 50% of their population found in ten or fewer sites (Gilbert *et al.*, 2021, Stanbury *et al.,* 2021). According to Cummins *et al.* (2019), the population of common tern in Ireland has increased by 185% since the All-Ireland Tern survey undertaken in 1995. The strong national increase of common tern was attributed to long-standing and ongoing conservation actions at Lady's Island Lake and Rockabill where near year on year increases have been recorded (Table 5-121) (Cummins *et al.,* 2019).

**Table 5-121: Common tern population growth at Rockabill and Lady's Island Lake (Cummins *et al.*, 2019).**

| Site | All-Ireland Tern Survey 1984 | All-Ireland Tern Survey 1995 | Seabird 2000 | Seabird Census (2013 – 2018) | % Change (since Seabird 2000) |
|---|---|---|---|---|---|
| Rockabill | 89 (5%) | 429 (24%) | 610 (25%) | 2,034 (40%) | + 233% |
| Lady's Island Lake[3] | <12 (<1%) | <401 (<23%) | 480 (19%) | 979 (19%) | + 104% |

A summary of the recent (within the last five summers) colony data for common tern within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-122 below. If multiple years are provided then the mean count is presented.

**Table 5-122: Summary of most recent colony data for common tern between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Down | Carlingford Lough SPA | 2017 – 2019 and 2021 | 120.4 ± 101.7 |
| Dublin | Loughshinny to Killiney | 2017 and 2018 | 2,037 ± 2 |

## Desk-based data

The surveys undertaken within the ObSERVE western Irish Sea survey did not differentiate between common tern and Arctic tern, and thus data were combined. A total of 443 observations of 1,235 individuals were recorded across the summer and autumn, with no sightings recorded during the winter surveys. Sightings were concentrated around Wexford harbour during summer surveys, and within the northern and southern sections of the ObSERVE western Irish Sea survey area during autumn. Mean density of Arctic and common tern across the ObSERVE survey area ranged from 0.49 birds/km$^2$ in summer surveys and 0.79 birds/km$^2$ in autumn surveys (Jessopp *et al.*, 2018). No records of common tern were presented in the I-WeBS database.

## Site-specific data

A total of 42 records of common tern were recorded on transect in only seven months during the boat-based surveys between August and September 2018 as June and October 2019, as shown in Table 5-123. A peak observation of 21 individuals on transect was recorded in August 2019. All transect records were of terns flying through the Study Area, suggested to be related to post-breeding site dispersals (Aquafact, 2019).

[3] Early surveys at this site did not distinguish between common and arctic terns.

Recorded flight heights during the boat-based surveys of birds observed within the Study Area were between 5 m and 20 m.

During the DAS, two common tern were observed in the centre and in the west of the Study Area. A summary of the monthly records from the boat-based and DAS is presented in Table 5-123. Figure 5-30 shows the spatial distribution of common tern during the boat-based survey period.

**Table 5-123: Transect records and total observations of common tern from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 1 |
| June 2018 | 0 | - | 0 |
| July 2018 | 0 | - | 0 |
| August 2018 | 1 | - | 9 |
| September 2018 | 2 | - | 21 |
| October 2018 | 0 | - | 0 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 0 | - | 0 |
| February 2019 | 0 | - | 0 |
| March 2019 | 0 | - | 0 |
| April 2019 | 0 | - | 0 |
| June 2019 | 4 | - | 4 |
| July 2019 | 4 | - | 4 |
| August 2019 | 21 | - | 21 |
| October 2019 | 4 | - | 4 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 0 | 0 |
| May 2020 | 6 | 0 | 6 |
| June 2020 | - | 0 | 0 |
| July 2020 | - | 0 | 0 |
| August 2020 | - | 0 | 0 |
| September 2020 | - | 7 | 7 |
| **Total** | **42** | **7** | **77** |

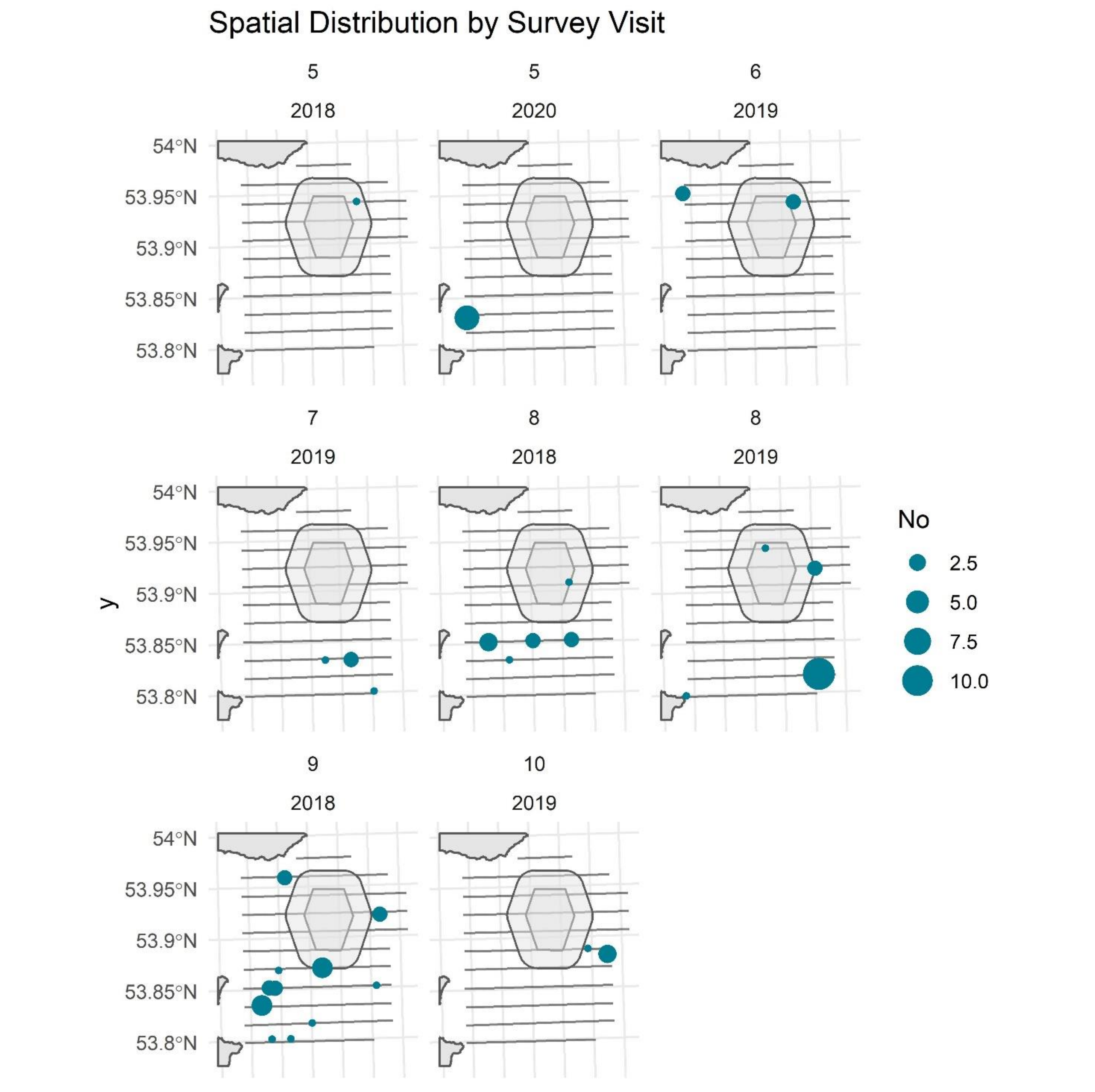


**Figure 5-30: Spatial distribution of common tern records. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-30), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.18 Roseate tern

### Ecology

Roseate tern is a migratory coastal seabird which breeds in large, dense, single or mixed species colonies which can contain up to several thousand pairs (del Hoyo *et al.*, 1996). Roseate terns nest on the ground in a scrape in sand, shingle or coral rubble (del Hoyo *et al.*, 1996) and are restricted to two main colonies in

Ireland which are monitored annually. The Seabird Census undertaken between 2013 – 2018 recorded 1,820 pairs, an increase of 192% since the All-Ireland Tern survey undertaken in 1995 (Cummins *et al.,* 2019); significant conservation management at the two colonies: Rockabill and Lady's Island Lake has contributed to this. Similar to sandwich terns, the national roseate tern population increase coincided with a decline in its breeding range, resulting in an extirpation of those breeding sites along Ireland's Atlantic coast. As indicated by Cummins *et al.* (2019), mortality in the tern's wintering grounds in Ghana is likely to be a key contributor to this species' overall decline.

Roseate terns roost in large groups throughout the year, and forage in either smaller loose groups or larger flocks of several hundred individuals (del Hoyo *et al.*, 1996). Roseate tern forage on small pelagic fish, particularly sandeel, clupeids, gadoids, insects and marine invertebrates (Birdlife International, 2020). Individuals forage through plunge diving, and typically plunge from greater heights than other terns. The roseate tern is Red-listed in the UK (Stanbury *et al*., 2021) and Amber-listed in Ireland (Gilbert *et al*., 2021).

There is no colony data for roseate tern within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species. The closest breeding colony is on Rockabill approximately 36 km away from the Project and outwith the mean max foraging range + 1 SD of 33.2 km for roseate tern. The latest colony data from Rockabill was 1704 nests in 2021 (BirdWatch Ireland, 2021).

## Desk-based data

Within the 2016/2017 ObSERVE surveys (Jessopp *et al.*, 2018), 79 observations of 165 roseate terns were made during the summer and autumn surveys, which were concentrated in the northern extent of the ObSERVE western Irish Sea survey area with several observations also recorded around Wexford harbour. Observations of roseate tern were also concentrated over water depths of between 20-50 m, illustrating no association between roseate terns and shallow water sandbanks. Mean density of roseate terns across the ObSERVE western Irish Sea survey area ranged from 0.14 birds/km$^2$ in summer surveys and 0.04 birds/km$^2$ in autumn surveys (Jessopp *et al.*, 2018). No records of roseate tern were presented in the I-WeBS database.

## Site-specific data

During the boat-based surveys, there was one observation of roseate tern in August 2019 (ten individuals), and an additional record of four roseate terns within the Study Area flying and foraging in July 2018.

During the DAS one roseate tern was identified in July 2020, flying in an easterly direction along the southern edge of the Study Area. A further 11 commic / roseate tern were identified between June 2020 and September 2020; the individuals showed no overall distributional pattern. Figure 5-31 shows the spatial distribution of roseate tern during the boat-based survey period.

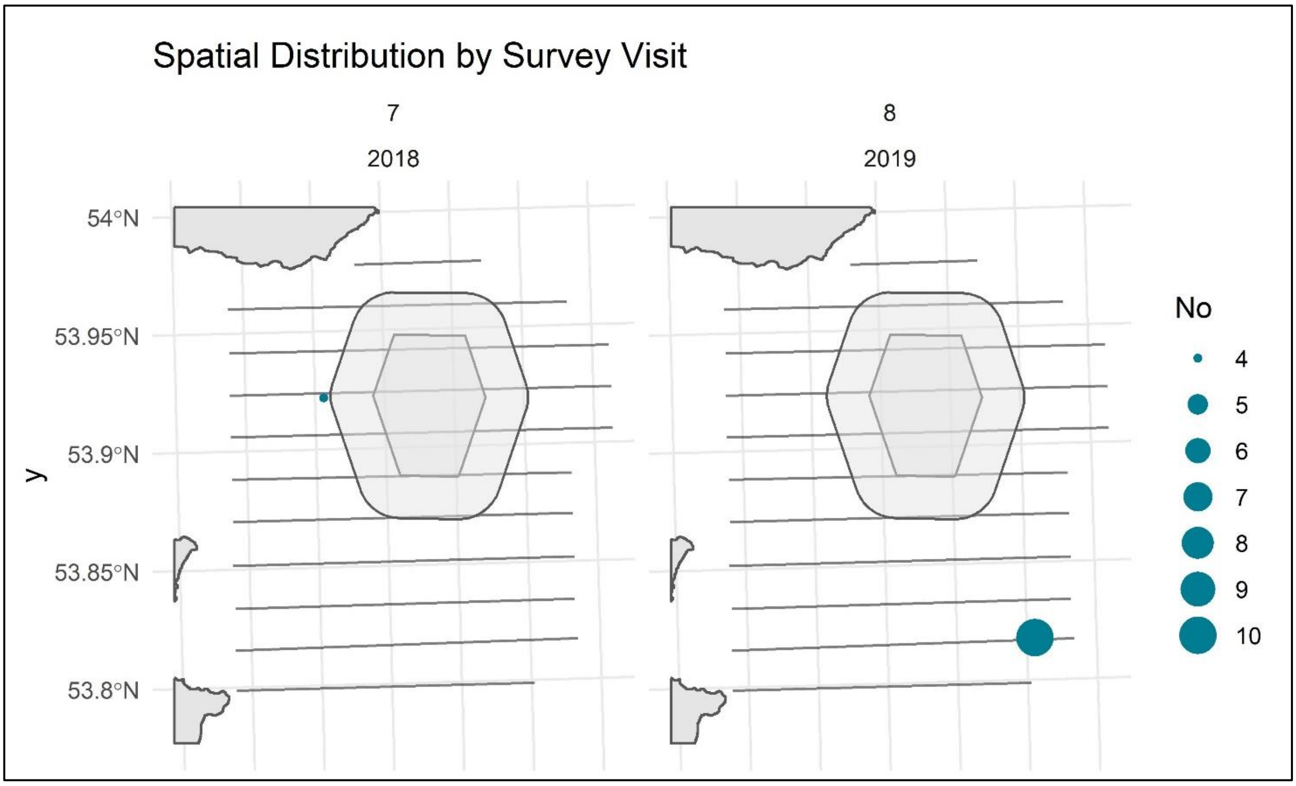


**Figure 5-31: Spatial distribution of roseate Tern records. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-31), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.19 Sandwich tern

### Ecology

The Sandwich tern is a summer visitor to all Irish coasts from March to September and is known to winter in small numbers in Galway Bay and Strangford Lough. Sandwich tern nest in shallow scrapes on open, unvegetated sand, gravel and mud substrates on sandy islands, rocky calcareous islets, sand-spits, sand-dunes and shingle beaches (del Hoyo *et al.*, 1996). Individuals breed in dense colonies with other tern species or black-headed gulls, and forage in large flocks in areas where prey is abundant or concentrated (del Hoyo *et al.*, 1996).

In Ireland, this species' colonies are confined to six counties, the closest of which is Carlingford Lough. Data recorded from seabird surveys during the period 2016 – 2018 of the Seabird Census (Cummins *et al.,* 2019) showed that Sandwich tern bred or attempted to breed at a small number of coastal locations, however the two main colonies at Lady's Island Lake and Inch Lough contribute most to the overall national population estimate (84%). According to Cummins *et al.* (2019), the changes in abundance or presence of Sandwich tern colonies may be driven, in part, by site-specific changes in conditions including recreational pressure, predation and availability of suitable prey during key periods of the breeding season.

Sandwich terns forage on surface-dwelling marine fish (between 9 and 15 cm in length), marine worms and small shrimp and forage through shallow surface dives. The Sandwich tern is Amber-listed in the UK and Ireland (Gilbert *et al*., 2021, Stanbury *et al*., 2021).

A summary of the recent (within the last five summers) colony data for sandwich tern within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-124 below. If multiple years are provided then the mean count is presented.

**Table 5-124: Summary of most recent colony data for sandwich tern between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (AON) ± SD (if applicable) |
|---|---|---|---|
| Down | Carlingford Lough SPA | 2017 – 2019 and 2021 | 120.4 ± 101.7 |

## Desk-based data

Approximately 60 observations of 90 Sandwich terns were recorded across the summer and autumn ObSERVE western Irish Sea surveys in 2016/2017 (Jessopp *et al.*, 2018). These observations were concentrated over shallow waters of approximately 10 m depth, and likely associated with sandbanks. Summer distributions were suggested to be influenced by the Lady's Island Lake colony in Wexford, and sightings in the northern area of the survey region were suggested to be non-breeders. Mean density of Sandwich terns across the ObSERVE western Irish Sea survey area ranged from 0.07 birds/km$^2$ in summer surveys and 0.04 birds/km$^2$ in autumn surveys (Jessopp *et al.*, 2018). No records of Sandwich tern were presented in the I-WeBS database.

## Site-specific data

There were six records of Sandwich tern made on transect during the boat-based surveys; three in July 2019, one in August 2019 and two in September 2019. Additional observations were made off transect in May 2018, July 2018 and two records in August 2018.

During the Digital Aerials, 13 Sandwich tern were identified across the surveys: three in April 2020, two in May 2020, three in June 2020, one in July 2020, one in August 2020 and three in the September surveys. Flying sandwich terns were recorded in all six of the surveys although there was not a significant orientation. In April and September 2020, one and one flying sandwich tern deemed suitable for flight height determination were recorded respectively, the altitude was 60 m above MSL in April and 7 m in September.

Sandwich tern were predominantly recorded along in the western edge and north-western corner of the Ornithology Study Area and in the northwest corner of the Ornithology Study Area, although a few observations were recorded in the east of the area between July and October 2019.

Figure 5-32 shows the spatial distribution of sandwich tern during the boat-based survey period.

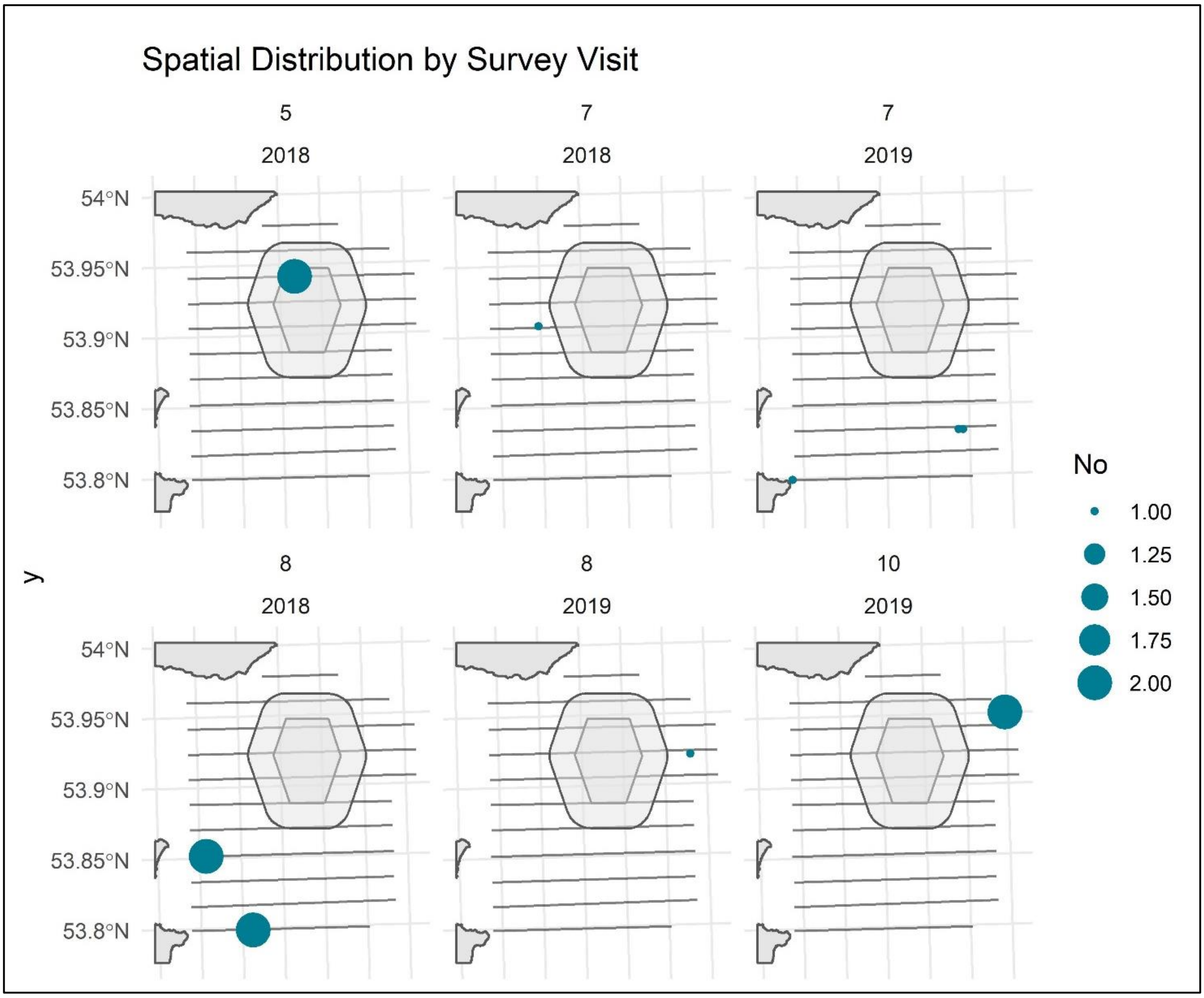


**Figure 5-32: Spatial distribution sandwich tern records. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-32), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.20 Guillemot

### Ecology

Britain and Ireland are home to internationally important populations of guillemot, with 13% of the global population (708,200 pairs) (Mitchell *et al.*, 2004), and a total estimated abundance of 236,654 of these pairs are located in Ireland. The closest breeding colony to the Study Area is on Lambay Island SPA, which recorded 59,983 individuals in 2017.

Guillemot spend most of their time at sea, only coming to land to breed on rocky cliff shores or islands. With extensive suitable habitats existing around Ireland’s coast, breeding sites are known to be located to the south of the Project along the east coast of Ireland.

Most foraging during the breeding season occurs within 10 to 20 km of the colony, although foraging distances of over 100 km have been recorded (BirdLife International, 2020). The main prey items of the adult guillemot are shoaling pelagic fish, mostly sandeel, herring and sprats as well as small gadoids, and they are capable of switching prey in response to availability. Prey are caught by pursuit diving, with birds diving from the surface, typically to depths of less than 50 m, but up to 200 m (BirdLife International, 2020). Guillemot catch prey from the bottom of the water column and carry single prey items back to the colony to provision chicks (Thaxter *et al.*, 2010).

The Seabird Census survey undertaken between 2015 and 2018 recorded guillemot at a total of 40 sites in Ireland, with an estimated 72% increase in the long-term trend (1985/87 – 2015/18) of this species. Approximately 97% of the Irish population are considered to be within the SPA network (Cummins *et al.,* 2019). Both the short- and long-term data trends suggested a strong increase in breeding guillemot in Ireland, with the largest colonies located at Cliffs of Moher, Loop Head, Doulus Head, Great Saltee and Lambay Island, with almost 40% of the national breeding population of guillemot occur on the east coast (Table 5-125). The regional variation in colony growth is likely due to food availability and abundance of preferred prey species.

**Table 5-125: Population estimates (individuals) of guillemot at a selection of Irish colonies for the period 1985 - 1988 to 2015 - 2018 (Cummins *et al.,* 2019).**

| Site | SCR 1985 - 1988 | Seabird 2000 1998 - 2002 | 2015 - 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Ireland's Eye | 1,458 | 2,191 | 4,410 | + 101% |
| Little Skellig | - | 1,129 | 2,069 | + 83% |
| Cliffs of Moher | 12,957 | 19,962 | 34,829 | + 75% |
| Great Skellig | - | 1,422 | 2,297 | + 62% |
| Doulus Head | 3,497 | 4,253 | 6,881 | + 62% |
| Loop Head | 4,010 | 5,000 | 7,709 | + 54% |
| Great Saltee | 16,329 | 21,436 | 25,851 | + 21% |
| Old Head of Kinsale | 4,179 | 3,610 | 4,157 | + 15% |
| Lambay Island | 44,495 | 60,754 | 59,983 | - 1% |
| Clare Island | - | 2,280 | 2,168 | - 5% |
| Horn Head | 4,806 | 6,548 | 5,442 | - 17% |

As more than 50% of their breeding population occurs at ten sites or fewer, guillemot is an Amber-listed species in Ireland (Gilbert *et al*., 2021).

A summary of the recent (within the last five summers) colony data for guillemot within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-126 below. If multiple years are provided then the mean count is presented.

**Table 5-126: Summary of most recent colony data for guillemot between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (IND) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Causeway Coast | 2021 | 278 |
| | Larne Lough to Portmuck | 2017 – 2019 | 2,409 ± 148.1 |
| | Muck Island | 2017 – 2019 | 2,604.7 ± 129.2 |
| | Rathlin Island SPA | 2021 | 149,510 |
| | Sheep Island SPA | 2021 | 703 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | 2017 – 2019 | 1,366.3 ± 191.5 |
| | Aberdaron Coast not in SPA | 2017 – 2019 | 54. 3 ± 23.9 |

| County (from SMP) | SMP Master Site | Year(s) | Count (IND) ± SD (if applicable) |
|---|---|---|---|
| | Lleyn Peninsula | 2018, 2019 and 2021 | 12,858.7 ± 1,318.3 |
| | Puffin Island SPA | 2017 – 2019 and 2021 | 3,672.3 ± 395.9 |
| | South Stack | 2017 – 2019 and 2021 | 6,365 ± 832.3 |
| Isle of Man | North Island | 2017 | 471 |
| | South Island | 2017 | 4,085 |
| | West Island | 2017 | 663 |
| Wicklow | Wicklow Head | 2018, 2019, 2021 and 2022 | 899 ± 262.6 |
| Wigtown | Mull Of Galloway | 2017 – 2019 | 359.3 ± 115.7 |
| | Port Mona, Devil's Bridge, Laggantalluch Head | 2021 | 229 |
| | Sheddock Cliffs - Burrow Head | 2020 | 6 |

## Desk-based data

The observations made within the ObSERVE western Irish Sea surveys did not differentiate between razorbill and guillemot, and therefore records were combined into a single group. There was a total of 7,541 sightings of 24,763 individuals across the ObSERVE western Irish Sea survey area, with the majority of these occurring within the autumn surveys. During the summer surveys, sightings were concentrated around the northern extent of the ObSERVE survey area, which includes Dundalk Bay and the offshore wind farm area. Data records did not illustrate a clear association between observations and water depths. Mean density of razorbill and guillemot across the ObSERVE western Irish Sea survey area ranged from 3.95 birds/km$^2$ in summer surveys, 17.4 birds/km$^2$ in autumn surveys and 4.61 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018). No records of guillemot were presented in the I-WeBS database.

## Site-specific data

During the boat-based surveys, guillemot was the most commonly recorded bird on transect, with over 10,000 individuals recorded across the survey period (Table 5-127). During periods of post-fledging dispersal of adults and juveniles from breeding sites between August and September 2018, peak counts were recorded of 1,274 and 1,640 individuals respectively (Table 5-127, Aquafact, 2019). Similar counts were observed in August 2019 and October 2019 with 2,114 and 1,203 birds respectively.

During the DAS, 13,458 guillemot were identified across the surveys, 247 in the April 2020, 529 in May 2020, 207 in June 2020, 3,235 in July 2020, 3,077 in August 2020 and 6,163 in September 2020 surveys. A peak count of 5,562 guillemot in the September 2020.

An additional 2,211 guillemot / razorbill were identified across the DAS: 217 in April 2020, 91 in May 2020, 245 in June 2020, 808 in July 2020, 54 in August 2020 and 796 in September 2020 surveys.

Guillemot were distributed across the Ornithology Study Area with the largest concentrations of individuals in the south to southeast of the area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-127. Table 5-128 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-33 shows the spatial distribution of guillemot during the boat-based survey period.

**Table 5-127: Transect records and total observations of guillemot from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 228 | - | 277 |
| June 2018 | 388 | - | 461 |
| July 2018 | 247 | - | 299 |
| August 2018 | 1,274 | - | 1,342 |
| September 2018 | 1,640 | - | 1,655 |
| October 2018 | 117 | - | 214 |
| November 2018 | 44 | - | 64 |
| December 2018 | 181 | - | 199 |
| January 2019 | 115 | - | 201 |
| February 2019 | 184 | - | 201 |
| March 2019 | 179 | - | 245 |
| April 2019 | 403 | - | 451 |
| June 2019 | 476 | - | 476 |
| July 2019 | 736 | - | 736 |
| August 2019 | 2,114 | - | 2,114 |
| October 2019 | 1,203 | - | 1,203 |
| December 2019 | 185 | - | 185 |
| January 2020 | 520 | - | 520 |
| April 2020 | - | 247 | 247 |
| May 2020 | 202 | 529 | 529 |
| June 2020 | - | 207 | 207 |
| July 2020 | - | 3,235 | 3,235 |
| August 2020 | - | 3,077 | 3,077 |
| September 2020 | - | 6,163 | 6,163 |
| **Total** | **10,436** | **13,458** | **24,301** |

**Table 5-128: Seasonal variation of guillemot recorded between May 2018 and September 2020.**

| Year | Spring Migration Dec – Feb | Breeding Mar - Jun | Autumn Migration Jul - Oct | Winter Nov | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 1,037 | 3,211 | 64 | - |
| 2019 / 2020 | 601 | 1,172 | 4,035 | - | - |
| 2020 | 705 | 983 | 12,475 | - | - |

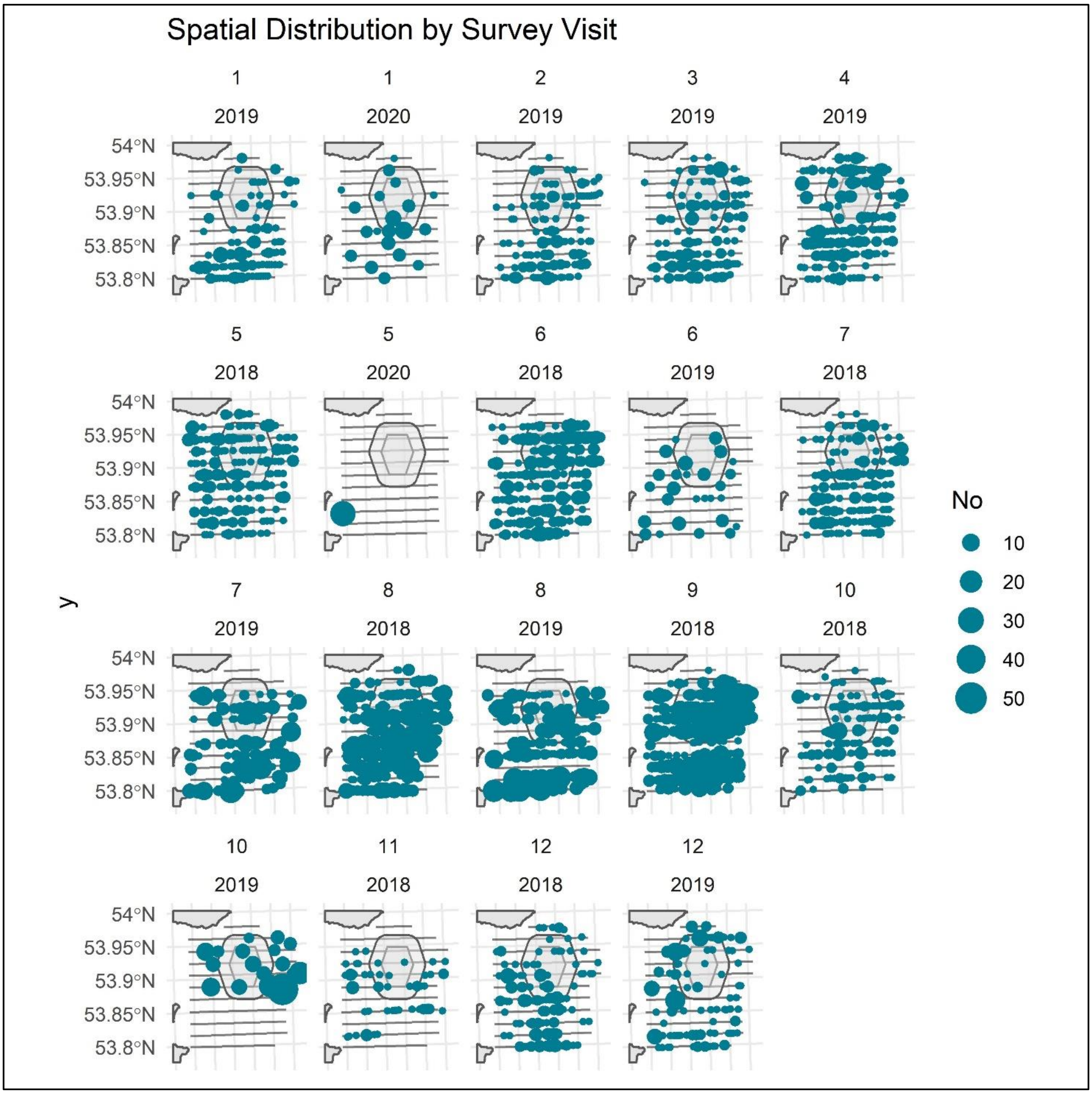


**Figure 5-33: Spatial distribution of guillemot records during the boat-based survey. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, 10,236 individuals (98.1%) were observed sitting compared to those in flight (200 individuals, 1.9%). Off transect, the majority of birds (417 individuals, 68.5%) were observed in flight. The majority of guillemot on transect and off transect had a flight height of 5 m; few birds were observed between 10 m and 30 m.

Of the 13,458 birds recorded during the DAS, 150 were observed in flight and 13,308 were observed sitting. Flying guillemot were recorded in the May, June and July surveys. In June guillemot flew in a significant orientation around the mean of 193° and in September guillemot flew in a significant orientation around the mean of 255°. The flight heights of guillemot recorded during the DAS resulted in a median altitude of 17 m above MSL.

Table 5-129 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and May. Figure 5-34 shows the recorded flight heights of guillemot during the same period.

**Table 5-129: Proportion of guillemot recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 12 | 5.3 | 216 | 94.7 | 44 | 89.8 | 5 | 10.5 |
| June 2018 | 6 | 1.5 | 382 | 98.5 | 42 | 57.5 | 31 | 42.5 |
| July 2018 | 7 | 2.8 | 240 | 97.2 | 23 | 44.2 | 29 | 55.8 |
| August 2018 | 5 | 0.4 | 1,269 | 99.6 | 3 | 4.4 | 65 | 95.6 |
| September 2018 | 7 | 0.4 | 1,633 | 99.6 | 6 | 33.3 | 9 | 66.7 |
| October 2018 | 6 | 5.1 | 111 | 94.9 | 96 | 99.0 | 1 | 1.0 |
| November 2018 | 0 | 0 | 44 | 100 | 20 | 100 | 0 | 0 |
| December 2018 | 1 | 0.6 | 180 | 99.4 | 18 | 100 | 0 | 0 |
| January 2019 | 9 | 7.3 | 106 | 92.2 | 78 | 90.1 | 8 | 9.9 |
| February 2019 | 2 | 1.1 | 182 | 98.9 | 16 | 94.1 | 1 | 5.9 |
| March 2019 | 16 | 8.9 | 163 | 91.1 | 45 | 68.2 | 21 | 31.8 |
| April 2019 | 4 | 1.0 | 399 | 99.0 | 26 | 54.2 | 22 | 45.8 |
| June 2019 | 25 | 5.3 | 451 | 94.7 | 0 | 0 | 0 | 0 |
| July 2019 | 2 | 0.3 | 734 | 99.7 | 0 | 0 | 0 | 0 |
| August 2019 | 0 | 0 | 2,114 | 100 | 0 | 0 | 0 | 0 |
| October 2019 | 2 | 0.2 | 1,201 | 99.8 | 0 | 0 | 0 | 0 |
| December 2019 | 11 | 5.9 | 174 | 94.1 | 0 | 0 | 0 | 0 |
| January 2020 | 42 | 8.1 | 478 | 91.9 | 0 | 0 | 0 | 0 |
| April 2020 | 46 | 18.6 | 201 | 81.4 | N/A | | | |
| May 2020 | 69 | 9.4 | 662 | 90.6 | 0 | 0 | 0 | 0 |
| June 2020 | 43 | 20.8 | 164 | 79.2 | N/A | | | |
| July 2020 | 26 | 0.9 | 3,209 | 99.1 | | | | |
| August 2020 | 0 | 0 | 3,077 | 100 | | | | |
| September 2020 | 9 | 0.1 | 6,154 | 99.9 | | | | |
| **Total** | **350** | **1.5** | **23,544** | **98.5** | **417** | **68.5** | **192** | **31.5** |

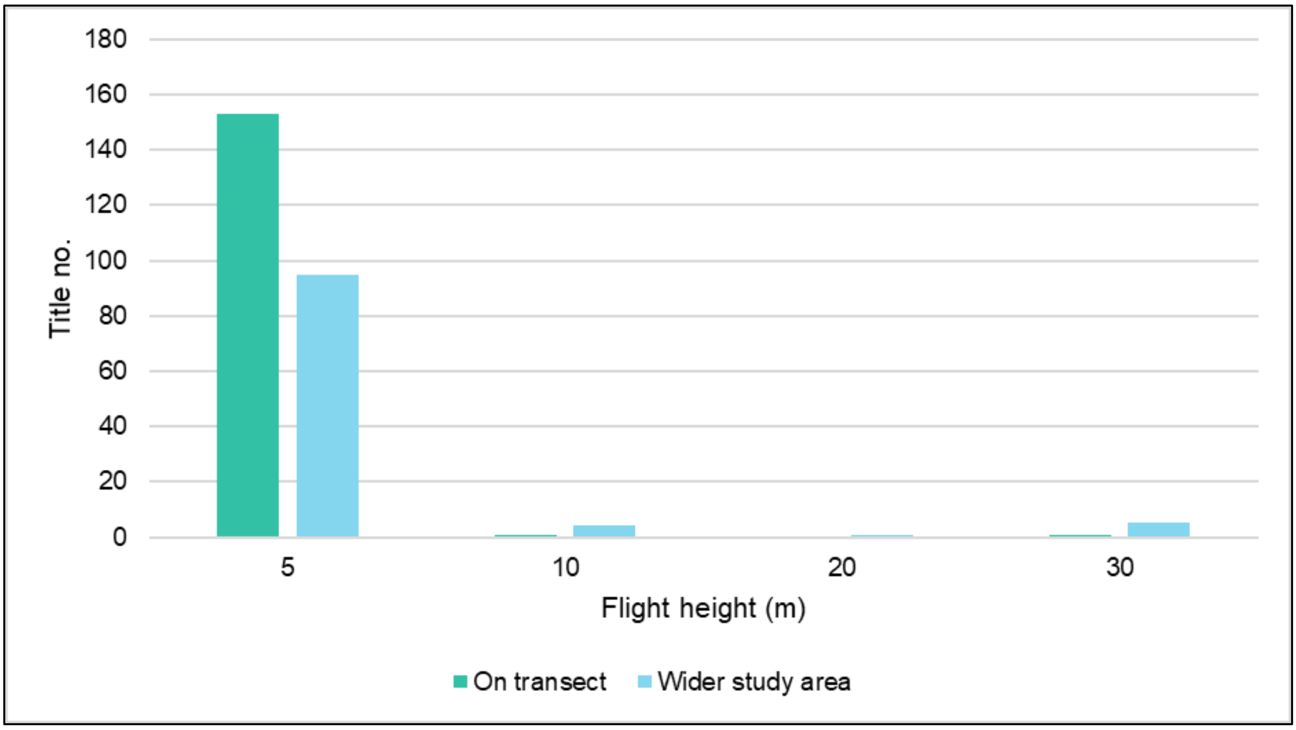


**Figure 5-34: Guillemot flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during boat-based surveys

During initial data exploration and model fitting a high co-linearity / correlation between Bathymetry and distance to coast was identified resulting in a prohibitively high VIF for these parameters. Because of this distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CReSS analysis:

- Bathymetry;
- Year; and
- X and Y coordinates.

To prepare for the GEE-CreSS analyses, a complete grid of abutting cells based on the survey grid and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinate were included in the one-dimensional SALSA model selection method (Walker *et al.* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Month was fitted as a factor term. This provided the base model for assessment of the 2D spatial smoother.

CReSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CReSS grid knot locations are included in annex 1 of this report. An interaction with month was included to allow the density surface to vary between survey months. Following predictions, bootstrapping was used to generate 95 % confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CReSS method.

### Sitting birds

Table 5-130 to Table 5-114 below present the guillemot modelled abundance estimates for sitting birds within the offshore wind farm area, the offshore wind farm area plus a 2 km buffer and Offshore Ornithology Study Area.

**Table 5-130: Guillemot modelled sitting bird abundance estimates for the offshore wind farm area by survey.**

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 67 | 22 to 263 | 83 | 27 to 325 |
| June 2018 | 156 | 89 to 335 | 193 | 110 to 415 |
| July 2018 | 78 | 42 to 153 | 97 | 52 to 189 |
| August 2018 | 266 | 183 to 405 | 329 | 226 to 501 |
| September 2018 | 669 | 456 to 985 | 828 | 564 to 1,219 |
| October 2018 | 128 | 84 to 203 | 158 | 104 to 251 |
| November 2018 | 18 | 1 to 823 | 22 | 1 to 1,018 |
| December 2018 | 43 | 21 to 103 | 53 | 26 to 127 |
| January 2019 | 30 | 10 to 110 | 37 | 12 to 136 |
| February 2019 | 65 | 44 to 94 | 80 | 54 to 116 |
| March 2019 | 109 | 82 to 138 | 135 | 101 to 171 |
| April 2019 | 189 | 75 to 456 | 234 | 93 to 564 |
| June 2019 | 306 | 171 to 646 | 379 | 212 to 799 |
| July 2019 | 154 | 88 to 285 | 191 | 109 to 353 |
| August 2019 | 697 | 498 to 1,016 | 863 | 616 to 1,257 |
| October 2019 | 334 | 222 to 544 | 413 | 275 to 673 |
| December 2019 | 111 | 51 to 264 | 137 | 63 to 327 |
| January 2020 | 179 | 89 to 354 | 222 | 110 to 438 |
| May 2020 | 51 | 16 to 156 | 63 | 20 to 193 |

**Table 5-131: Guillemot modelled sitting bird abundance for offshore wind farm area plus 2 km buffer by survey.**

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 231 | 95 to 753 | 286 | 118 to 932 |
| June 2018 | 447 | 262 to 892 | 553 | 324 to 1,104 |
| July 2018 | 261 | 142 to 488 | 323 | 176 to 604 |
| August 2018 | 857 | 587 to 1,317 | 1,061 | 726 to 1,630 |
| September 2018 | 2,071 | 1374 to 3,173 | 2,563 | 1,700 to 3,927 |
| October 2018 | 467 | 306 to 753 | 578 | 379 to 932 |
| November 2018 | 62 | 7 to 14,522 | 77 | 9 to 17,971 |
| December 2018 | 125 | 55 to 359 | 155 | 68 to 444 |

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| January 2019 | 91 | 28 to 377 | 113 | 35 to 467 |
| February 2019 | 207 | 143 to 297 | 256 | 177 to 368 |
| March 2019 | 312 | 234 to 414 | 386 | 290 to 512 |
| April 2019 | 554 | 241 to 1202 | 686 | 298 to 1,487 |
| June 2019 | 878 | 530 to 1716 | 1,087 | 656 to 2,124 |
| July 2019 | 512 | 307 to 902 | 634 | 380 to 1,116 |
| August 2019 | 2,243 | 1595 to 3,293 | 2,776 | 1974 to 4,075 |
| October 2019 | 1,223 | 809 to 2,062 | 1,513 | 1001 to 2,552 |
| December 2019 | 326 | 137 to 922 | 403 | 170 to 1,141 |
| January 2020 | 541 | 258 to 1,273 | 669 | 319 to 1,575 |
| May 2020 | 177 | 71 to 462 | 219 | 88 to 572 |

**Table 5-132: Guillemot modelled sitting bird abundance for the Offshore Ornithology Study Area by survey.**

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 1,799 | 835 to 4,279 | 2,226 | 1,033 to 5,295 |
| June 2018 | 1,984 | 1,130 to 3,682 | 2,455 | 1,398 to 4,556 |
| July 2018 | 2,054 | 1,214 to 3,692 | 2,542 | 1,502 to 4,569 |
| August 2018 | 7,029 | 4,945 to 10,472 | 8,698 | 6,119 to 12,959 |
| September 2018 | 11,391 | 7,432 to 18,354 | 14,096 | 9,197 to 22,713 |
| October 2018 | 4,840 | 2,892 to 8,624 | 5,990 | 3,579 to 10,672 |
| November 2018 | 498 | 42 to 187,413 | 616 | 52 to 231,924 |
| December 2018 | 632 | 266 to 1,942 | 782 | 329 to 2,403 |
| January 2019 | 564 | 183 to 2,567 | 698 | 226 to 3,177 |
| February 2019 | 1,558 | 1,136 to 2,122 | 1,928 | 1,406 to 2,626 |
| March 2019 | 1,400 | 1,038 to 1,988 | 1,733 | 1,285 to 2,460 |
| April 2019 | 2,585 | 1,168 to 5,619 | 3,199 | 1,445 to 6,954 |
| June 2019 | 3,899 | 2,279 to 6,994 | 4,825 | 2,820 to 8,655 |
| July 2019 | 4,036 | 2,506 to 6,638 | 4,995 | 3,101 to 8,215 |
| August 2019 | 18,397 | 13,754 to 24,970 | 22,766 | 17,021 to 30,900 |
| October 2019 | 12,667 | 7,834 to 23,029 | 15,675 | 9,695 to 28,498 |
| December 2019 | 1,653 | 705 to 4,792 | 2,046 | 872 to 5,930 |
| January 2020 | 3,357 | 1,707 to 7,949 | 4,154 | 2,112 to 9,837 |
| May 2020 | 1,381 | 646 to 3,183 | 1,709 | 799 to 3,939 |

### Flying Birds

There were 406 records of flying guillemot over the study period. Densities of flying birds were derived from the total numbers seen in radial snapshots, divided by the total area surveyed by snapshots (survey effort); that is the number of snapshots multiplied by the snapshot area of 0.09 km$^2$.

Non-parametric bootstrap intervals have been used to calculate the standard error and 95% confidence intervals around the observed counts and densities per km$^2$. The area of the offshore wind farm area has then been used to calculate simple abundances based on density results.

The results of these data are shown in Table 5-133 and Table 5-134.

**Table 5-133: Guillemot flying bird offshore wind farm area simple abundance estimates.**

| Month | Estimate | LCL (95%) | UCL (95%) |
|---|---|---|---|
| January | 161 | 119 | 205 |
| February | 10 | 3 | 17 |
| March | 38 | 25 | 53 |
| April | 17 | 5 | 28 |
| May | 198 | 76 | 321 |
| June | 53 | 35 | 69 |
| July | 20 | 12 | 27 |
| August | 4 | 0 | 8 |
| September | 7 | 0 | 15 |
| October | 76 | 46 | 105 |
| November | 14 | 5 | 22 |
| December | 16 | 9 | 23 |

**Table 5-134: Guillemot flying bird offshore wind farm area plus 2 km buffer simple abundance estimates.**

| Month | Estimate | LCL (95%) | UCL (95%) |
|---|---|---|---|
| January | 468 | 346 | 596 |
| February | 29 | 9 | 49 |
| March | 111 | 73 | 154 |
| April | 49 | 15 | 81 |
| May | 576 | 221 | 934 |
| June | 154 | 102 | 201 |
| July | 58 | 35 | 79 |
| August | 12 | 0 | 23 |
| September | 20 | 0 | 44 |
| October | 221 | 134 | 305 |
| November | 41 | 15 | 64 |
| December | 47 | 26 | 67 |

### Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for guillemot at the different spatial scales. Table 5-135 presents the abundance estimates for sitting birds only whereas, Table 5-117 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate. Availability biases have been applied to these numbers to account of birds under the water.

**Table 5-135: Abundance estimates of sitting guillemot within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 377 | 518 |
| May 2020 | 594 | 735 |
| June 2020 | 146 | 247 |
| July 2020 | 501 | 1,594 |
| August 2020 | 354 | 1,116 |
| September 2020 | 1,715 | 4,938 |

**Table 5-136: Abundance estimates of flying guillemot within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 13 | 26 |
| May 2020 | 5 | 21 |
| June 2020 | 3 | 12 |
| July 2020 | 6 | 8 |
| August 2020 | 0 | 0 |
| September 2020 | 0 | 0 |

## 5.6.21 Black guillemot

### Ecology

Black guillemot breed around the coastline of Ireland and are known to breed in areas in the vicinity of the Project with a known colony at Rockabill, Co. Dublin. As pursuit divers, black guillemot forage by propelling themselves through the water in pursuit of benthic fish and invertebrates, including crustaceans (BirdLife International, 2020; Ewins, 1990). Studies have observed sandeels and blennies (particularly butterfish *Pholis gunnellus*) to be the most important species for the black guillemot, however the contributions of these species to the overall diet varies (Ewins, 1990).

The Seabird Census survey undertaken in Ireland between 2017 and 2018 recorded over 3,917 individuals and formed part of an ongoing species-specific assessment; therefore this figure was considered to be a minimum estimate at the national population level (Cummins *et al.,* 2019).

This species is Amber listed in the UK and Ireland as it is a species of European Conservation Concern (Gilbert *et al.,* 2021, Stanbury *et al*., 2021).

## Desk-based data

Data collected within the 2016/2017 ObSERVE western Irish Sea surveys (Jessopp *et al.*, 2018) recorded a total of 12 individuals of black guillemot within the ObSERVE survey area during summer and autumn surveys, with an estimated mean density of 0.01 birds/km$^2$ in both periods (Jessopp *et al.*, 2018). No records of black guillemot were presented within the I-WeBS database.

## Site-specific data

During the site surveys, black guillemot was recorded on transect during every month across the survey period with peak counts observed during the aerial surveys in August 2020 (224 individuals) and September 2020 (217 individuals), as described in Table 5-137. Counts were fairly consistent in months outside the core breeding period of April to August when lower numbers were observed in the Survey Area.

Observations of black guillemot were typically recorded closer to the shore and were concentrated in the northwest corner of the Survey Area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-137. Table 5-138 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-35 shows the spatial distribution of black guillemot during the survey period.

**Table 5-137: Transect records and total observations of black guillemot from boat-based surveys and DAS in the Study Area.**

| Month / year | Boat-based transect records | DAS records | All records |
|---|---|---|---|
| May 2018 | 6 | - | 16 |
| June 2018 | 4 | - | 9 |
| July 2018 | 11 | - | 16 |
| August 2018 | 50 | - | 52 |
| September 2018 | 30 | - | 32 |
| October 2018 | 14 | - | 37 |
| November 2018 | 26 | - | 34 |
| December 2018 | 17 | - | 37 |
| January 2019 | 42 | - | 82 |
| February 2019 | 37 | - | 47 |
| March 2019 | 13 | - | 28 |
| April 2019 | 44 | - | 46 |
| June 2019 | 6 | - | 6 |
| July 2019 | 9 | - | 9 |
| August 2019 | 52 | - | 52 |
| October 2019 | 103 | - | 107 |
| December 2019 | 53 | - | 53 |
| January 2020 | 31 | - | 31 |
| April 2020 | - | 59 | 59 |
| May 2020 | 9 | 1 | 10 |
| June 2020 | - | 38 | 38 |
| July 2020 | - | 38 | 38 |
| August 2020 | - | 224 | 224 |
| September 2020 | - | 217 | 217 |
| **Total** | **557** | **577** | **1,280** |

**Table 5-138: Seasonal variation of black guillemot recorded between May 2018 and September 2020.**

| Year | Spring Migration | Breeding Apr - Aug | Autumn Migration | Winter Sep - Mar | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 93 | - | 297 | - |
| 2019 / 2020 | - | 113 | - | 191 | - |
| 2020 | - | 369 | - | 217 | - |

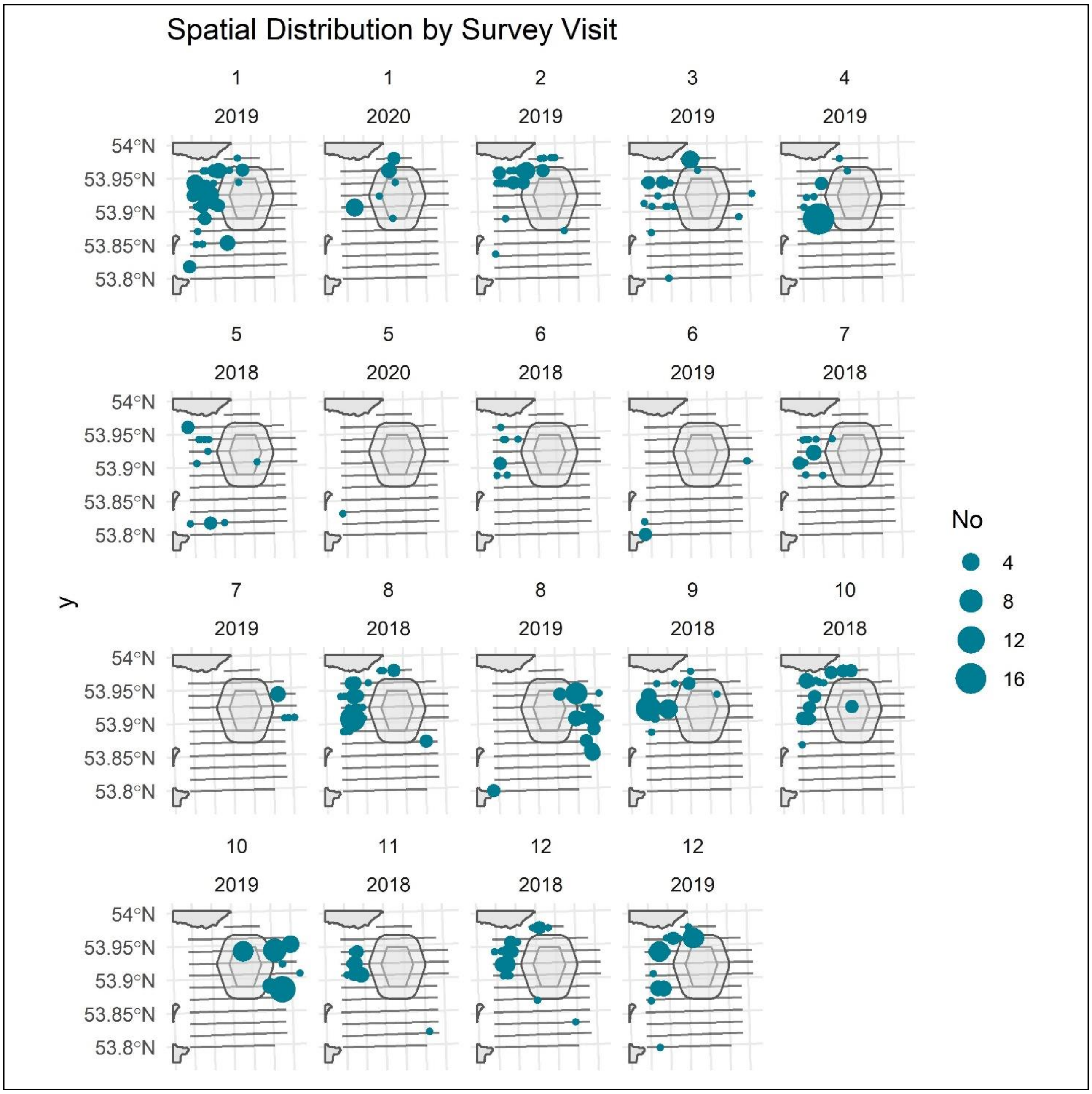


**Figure 5-35: Spatial distribution of black guillemot records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, more birds (518 individuals, 93%) were observed sitting compared to those in flight (39 individuals, 7%). Off transect, the majority of birds (143 individuals, 97.9%) were observed in flight. The majority of black guillemot on transect and off transect had a flight height of 5 m; one bird was recorded at a height of 10 m.

Of the 577 birds recorded during the DAS, four were observed in flight and 573 were observed sitting. Flying black guillemot were recorded in April 2020 and July 2020 and were found to have no significant direction of flight. The flight heights of black guillemot recorded during the DAS resulted in a median altitude of 3 m above MSL.

Table 5-139 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and May 2020.

**Table 5-139: Proportion of black guillemot recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / year | On transect | | | | Off transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 0 | 0 | 6 | 100 | 10 | 100 | 0 | 0 |
| June 2018 | 2 | 50 | 2 | 50 | 5 | 100 | 0 | 0 |
| July 2018 | 0 | 0 | 11 | 100 | 5 | 100 | 0 | 0 |
| August 2018 | 0 | 0 | 50 | 100 | 2 | 100 | 0 | 0 |
| September 2018 | 0 | 0 | 30 | 100 | 2 | 100 | 0 | 0 |
| October 2018 | 4 | 28.6 | 10 | 71.4 | 22 | 95.7 | 1 | 4.3 |
| November 2018 | 0 | 0 | 26 | 100 | 8 | 100 | 0 | 0 |
| December 2018 | 2 | 11.8 | 15 | 89.2 | 20 | 100 | 0 | 0 |
| January 2019 | 5 | 11.9 | 37 | 89.1 | 40 | 100 | 0 | 0 |
| February 2019 | 3 | 8.1 | 34 | 91.9 | 10 | 100 | 0 | 0 |
| March 2019 | 0 | 0 | 13 | 100 | 15 | 100 | 0 | 0 |
| April 2019 | 0 | 0 | 44 | 100 | 2 | 100 | 0 | 0 |
| June 2019 | 2 | 33.3 | 4 | 66.7 | 0 | 0 | 0 | 0 |
| July 2019 | 0 | 0 | 9 | 100 | 0 | 0 | 0 | 0 |
| August 2019 | 5 | 9.6 | 47 | 90.4 | 0 | 0 | 0 | 0 |
| October 2019 | 9 | 8.7 | 94 | 91.3 | 2 | 50 | 2 | 50 |
| December 2019 | 2 | 3.8 | 51 | 96.2 | 0 | 0 | 0 | 0 |
| January 2020 | 3 | 9.7 | 28 | 90.3 | 0 | 0 | 0 | 0 |
| April 2020 | 2 | 3.4 | 57 | 96.6 | N/A | | | |
| May 2020 | 2 | 20 | 8 | 80 | 0 | 0 | 0 | 0 |
| June 2020 | 0 | 0 | 38 | 100 | N/A | | | |
| July 2020 | 1 | 2.6 | 38 | 97.4 | | | | |
| August 2020 | 1 | 0.4 | 224 | 99.6 | | | | |
| September 2020 | 0 | 0 | 217 | 100 | | | | |
| **Total** | **43** | **3.8** | **1,093** | **96.2** | **143** | **97.9** | **3** | **2.1** |

## Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-35), it is not possible to undertake any detailed spatial analysis for this species.

### 5.6.22 Razorbill

#### Ecology

Britain and Ireland are home to internationally important populations of breeding razorbill and support up to 20% of the global population (93,600 pairs) (Mitchell *et al.*, 2004). Razorbill typically inhabit very similar habitats to guillemot, breeding on rocky cliff shores or islands. Razorbill feed mainly on shoaling fish; mostly sandeel for birds at breeding colonies in the British Isles, supplemented by herring, sprat, and rockling. Fish are caught by pursuit diving from the surface, typically to depths of 5 to 30 m, but possibly deeper than 100 m on occasions (BirdLife International, 2011).

Between 2015 and 2018, the population of razorbill in Ireland was estimated to be 33,689 individuals, an increase in the long-term trend by 45%. Over 95% of this population are associated with the SPA network (Cummins *et al.,* 2019). Although the overall trend is positive, site level changes continued to be variable (Table 5-140), such as the population changes at the Cliffs of Moher.

**Table 5-140: Ranked census totals (individuals) of razorbill at a selection of Irish colonies for the period 1985 - 1988 to 2015 - 2018 (Cummins *et al.,* 2019).**

| Site | SCR 1985 - 1988 | Seabird 2000 1998 - 2002 | 2015 - 2018 | % Change (since Seabird 2000) |
|---|---|---|---|---|
| Ireland’s Eye | 272 | 522 | 1,600 | + 207% |
| Inishnabro | 193 | 319 | 641 | + 101% |
| Great Saltee | 4,673 | 3,239 | 5,669 | + 75% |
| Lambay Island | 3,648 | 4,337 | 7,353 | + 70% |
| Little Saltee | 450 | 500 | 850 | + 70% |
| Clare island | - | 528 | 618 | + 17% |
| Horn Head | 5,628 | 6,739 | 6,812 | + 1% |
| Cliffs of Moher | 2,398 | 7,700 | 4,046 | - 48% |
| Tory Island | 614 | 1,002 | 951 | - 5% |

As more than 50% of their breeding population occurs at ten sites or fewer, razorbill is Red-listed species in Ireland (Gilbert *et al*., 2021), although Amber-listed in the UK (Stanbury *et al*., 2021).

A summary of the recent (within the last five summers) colony data for razorbill within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-141 below. If multiple years are provided then the mean count is presented.

**Table 5-141: Summary of most recent colony data for razorbill between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (IND) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Causeway Coast | 2021 | 361 |
| | Larne Lough to Portmuck | 2017 – 2019 | 707 ± 132.9 |
| | Muck Island | 2017 – 2019 | 866. 7 ± 183.9 |
| | Rathlin Island SPA | 2021 | 22,421 |
| | Sheep Island SPA | 2021 | 221 |
| Argyll and Bute | Sanda Islands - Kintyre | 2019 | 430 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | 2017 – 2019 | 1,877 ± 98.1 |
| | Aberdaron Coast not in SPA | 2017 – 2019 | 31.3 ± 13.3 |
| | Anglesey Terns / Morwenoliaid Ynys MÃ´n SPA | 2017 | 3 |

| County (from SMP) | SMP Master Site | Year(s) | Count (IND) ± SD (if applicable) |
|---|---|---|---|
| | Great Orme and Little Orme | 2017 – 2019, 2021 and 2022 | 250.6 ± 50.5 |
| | Lleyn Peninsula | 2018, 2019 and 2021 | 536.7 ± 88.7 |
| | Puffin Island SPA | 2017 – 2019 and 2021 | 514 ± 108 |
| | South Stack | 2017 – 2019 and 2021 | 1,184.3 ± 135.9 |
| Isle of Man | East Island | 2017 | 100 |
| | North Island | 2017 | 36 |
| | South Island | 2017 | 445 |
| | West Island | 2017 | 101 |
| Kyle and Carrick | Ailsa Craig SPA | 2017 – 2019 and 2021 | 863 ± 212.4 |
| | Finnarts Bay to Finnarts Hill (Finnarts Point) - Tysties | 2021 | 3 |
| | Starling Knowe to Downan Point | 2018, 2019 and 2021 | 22.3 ± 25.2 |
| Wicklow | Wicklow Head | 2018, 2019, 2021 and 2022 | 231.3 ± 74.7 |
| Wigtown | Mull of Galloway | 2017 – 2019 | 45.3 ± 0.9 |
| | Port Mona, Devil's Bridge, Laggantalluch Head | 2021 | 3 |
| | Sheddock Cliffs - Burrow Head | 2020 | 6 |

## Desk-based data

The observations made within the ObSERVE western Irish Sea surveys did not differentiate between razorbill and guillemot, and therefore records were combined into a single group. A total of 7,541 sightings of 24,763 individuals were recorded across the ObSERVE survey area, with the majority of these occurring during the autumn surveys. During the summer surveys, sightings were concentrated around the northern extent of the ObSERVE western Irish Sea survey area, which includes Dundalk Bay and the offshore wind farm area. Data records did not illustrate a clear association between observations and water depths. Mean density of razorbill and guillemot across the ObSERVE western Irish Sea survey area ranged from 3.95 birds/km$^2$ in summer surveys, 17.4 birds/km$^2$ in autumn surveys and 4.61 birds/km$^2$ in winter surveys (Jessopp *et al.*, 2018). No records of razorbill were presented in the I-WeBS database.

## Site-specific data

During the site surveys, razorbill was recorded on transect across the survey period with peak in counts observed in September 2020 (1,064 individuals). The peak in September 2020 is likely related to post-breeding dispersal of adults and juveniles from breeding sites. However, as there are no razorbill breeding colonies within the immediate vicinity of the Project, numbers during the breeding season (April to July) were relatively low.

An additional 2,211 guillemot / razorbill were identified across the DAS: 217 in April 2020, 91 in May 2020, 245 in June 2020, 808 in July 2020, 54 in August 2020 and 796 in September 2020 surveys.

Observations of razorbill were concentrated in offshore areas and away from the coastal areas within the west and north-west areas of the Survey Area.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-142. Table 5-143 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-36 shows the spatial distribution of razorbill during the boat-based survey period.

**Table 5-142: Transect records and total observations of razorbill from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 10 | - | 15 |
| June 2018 | 4 | - | 10 |
| July 2018 | 2 | - | 5 |
| August 2018 | 138 | - | 140 |
| September 2018 | 63 | - | 65 |
| October 2018 | 224 | - | 439 |
| November 2018 | 28 | - | 39 |
| December 2018 | 105 | - | 111 |
| January 2019 | 191 | - | 219 |
| February 2019 | 98 | - | 108 |
| March 2019 | 44 | - | 51 |
| April 2019 | 4 | - | 7 |
| June 2019 | 12 | - | 12 |
| July 2019 | 24 | - | 24 |
| August 2019 | 73 | - | 73 |
| October 2019 | 54 | - | 54 |
| December 2019 | 116 | - | 118 |
| January 2020 | 195 | - | 195 |
| April 2020 | - | 36 | 36 |
| May 2020 | 13 | 67 | 18 |
| June 2020 | - | 295 | 295 |
| July 2020 | - | 31 | 31 |
| August 2020 | - | 66 | 66 |
| September 2020 | - | 1,064 | 1,064 |
| **Total** | **1,398** | **1,559** | **3,195** |

**Table 5-143: Seasonal variation of razorbill recorded between May 2018 and September 2020.**

| Year | Spring Migration Jan – Mar | Breeding Apr - Jul | Autumn Migration Aug – Oct | Winter Nov - Dec | Non-breeding |
|---|---|---|---|---|---|
| 2018 | - | 30 | 644 | 150 | - |
| 2019 | 378 | 43 | 127 | 118 | - |
| 2020 | 195 | 380 | 1,130 | - | - |

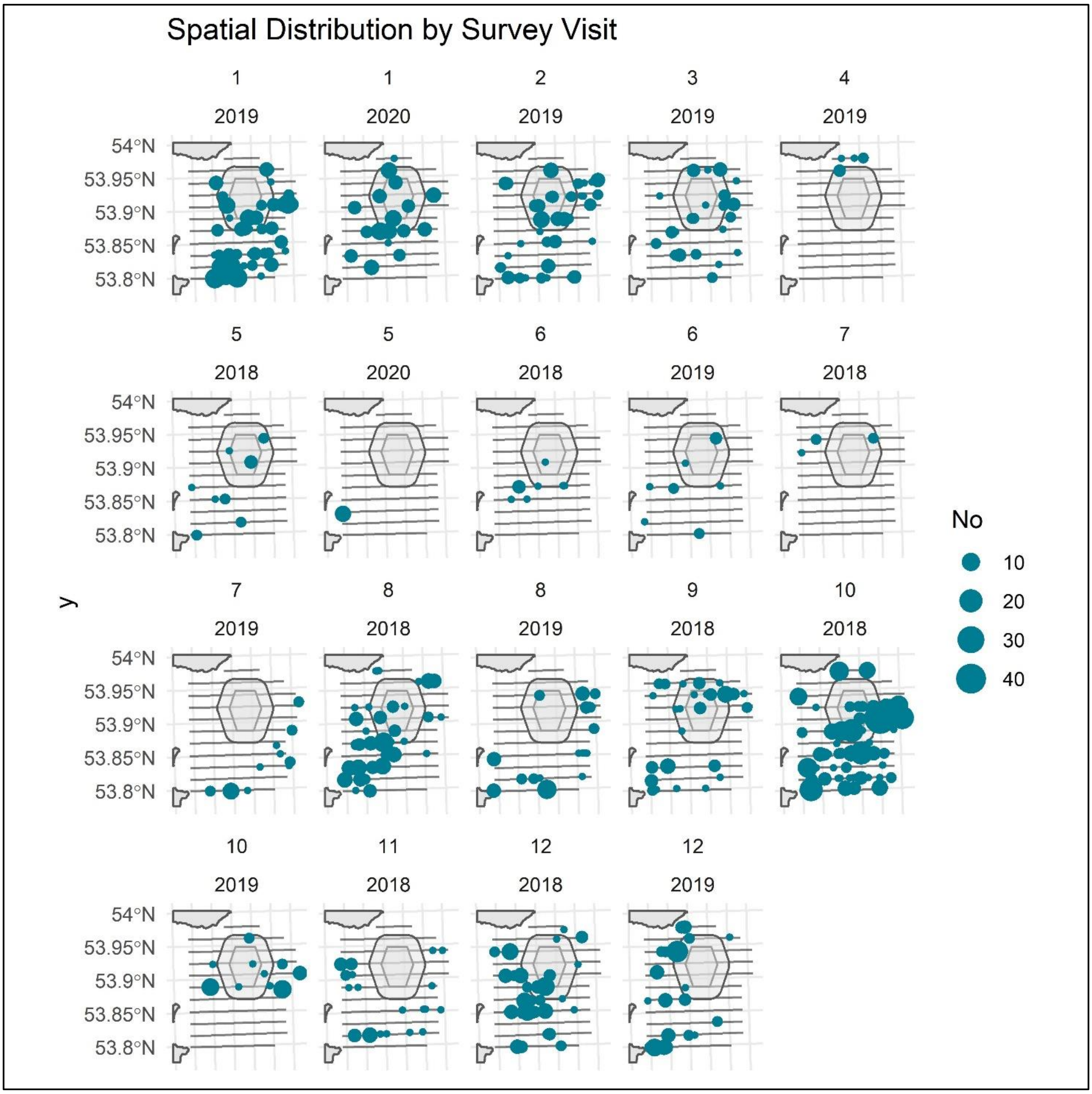


**Figure 5-36: Spatial distribution of razorbill records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, the majority of razorbill (1,349 individuals, 96.5%) were observed sitting compared to those in flight (49 individuals, 3.5%). Off transect, the majority of birds (289 individuals, 96.3%) were observed in flight. Razorbill flight heights were frequently recorded at 5 m both on transect and off transect. Sixteen individuals were observed flying between 10 m and 30 m Off transect.

Of the 1,559 razorbill recorded during the DAS, 32 were observed in flight and 1,527 were observed sitting. Flight heights for razorbill were not determined during the DAS.

Table 5-144 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020. Figure 5-37 shows the recorded flight heights of razorbill during the boat-based surveys.

**Table 5-144: Proportion of razorbill recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / Year | On Transect | | | | Off Transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | 3 | 30.0 | 7 | 70.0 | 5 | 100 | 0 | 0 |
| June 2018 | 1 | 25.0 | 3 | 75.0 | 6 | 100 | 0 | 0 |
| July 2018 | 2 | 100 | 0 | 0 | 3 | 100 | 0 | 0 |
| August 2018 | 0 | 0 | 138 | 100 | 2 | 100 | 0 | 0 |
| September 2018 | 2 | 3.2 | 61 | 96.8 | 2 | 100 | 0 | 0 |
| October 2018 | 25 | 11.2 | 199 | 88.8 | 213 | 99.1 | 2 | 0.9 |
| November 2018 | 0 | 0 | 28 | 100 | 11 | 100 | 0 | 0 |
| December 2018 | 0 | 0 | 105 | 100 | 3 | 50.0 | 3 | 50.0 |
| January 2019 | 0 | 0 | 191 | 100 | 28 | 100 | 0 | 0 |
| February 2019 | 5 | 5.1 | 93 | 94.9 | 4 | 40.0 | 6 | 60.0 |
| March 2019 | 4 | 9.1 | 40 | 90.9 | 7 | 100 | 0 | 0 |
| April 2019 | 0 | 0 | 4 | 100 | 3 | 100 | 0 | 0 |
| June 2019 | 1 | 8.3 | 11 | 91.7 | 0 | 0 | 0 | 0 |
| July 2019 | 0 | 0 | 24 | 100 | 0 | 0 | 0 | 0 |
| August 2019 | 0 | 0 | 73 | 100 | 0 | 0 | 0 | 0 |
| October 2019 | 2 | 3.7 | 52 | 96.3 | 0 | 0 | 0 | 0 |
| December 2019 | 1 | 0.9 | 115 | 99.1 | 2 | 100 | 0 | 0 |
| January 2020 | 3 | 1.5 | 192 | 98.5 | 0 | 0 | 0 | 0 |
| April 2020 | 23 | 63.9 | 13 | 36.1 | N/A | | | |
| May 2020 | 1 | 1.0 | 99 | 99.0 | 0 | 0 | 0 | 0 |
| June 2020 | 6 | 2.0 | 289 | 98.0 | N/A | | | |
| July 2020 | 0 | 0 | 31 | 100 | | | | |
| August 2020 | 0 | 0 | 66 | 100 | | | | |
| September 2020 | 2 | 0.2 | 1,064 | 99.8 | | | | |
| **Total** | **49** | **3.5** | **1,349** | **96.5** | **289** | **96.3** | **11** | **3.7** |

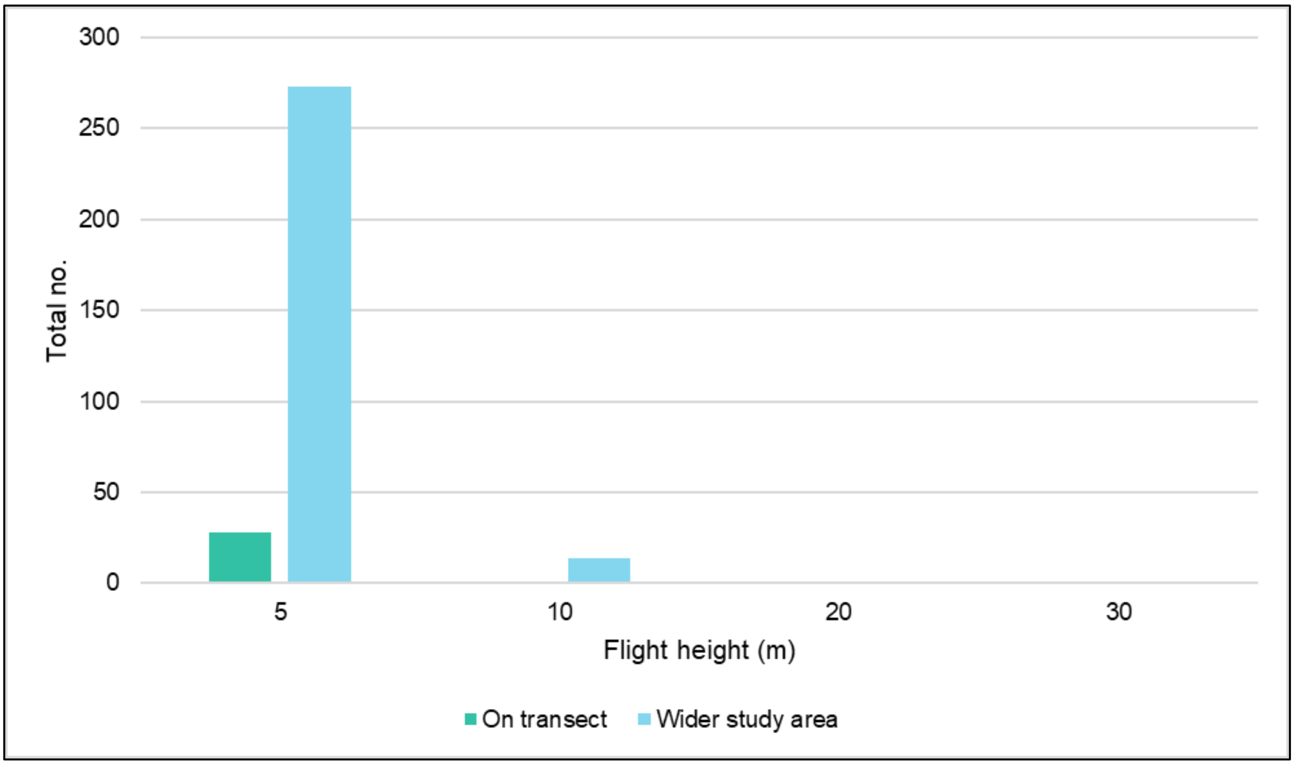


**Figure 5-37: Razorbill flight heights observed between May 2018 and May 2020.**

## Model derived spatial abundance and density estimates during boat-based surveys

During initial data exploration and model fitting a high co-linearity/ correlation between bathymetry and distance to coast was identified resulting in a prohibitively high VIF for these parameters. Because of this distance to coast was removed from the model. The following refined environmental and spatial covariates were used in the MRSea CReSS analysis:

- Bathymetry;
- Year; and
- X and Y coordinates.

To prepare for the GEE-CreSS analyses, a grid of abutting cells based on the transect routes and environmental covariates was constructed to cover the entire survey area. All variables except X and Y co-ordinate were included in the one-dimensional SALSA model selection method (Walker *et al.,* 2011) and automatic model simplification using non-significant p-values was carried out. An appropriate blocking structure using transect ID was included as there was evidence of autocorrelation. Month was fitted as a categorical or factor term. This provided the base model for assessment of the 2D spatial smoother.

CReSS was used to fit the spatial density surface and GEEs were used to provide realistic model-based estimates. The GEE-CReSS grid knot locations are included in annex 1 of this report. An interaction with month was included to allow the density surface to vary between survey months. Following predictions, bootstrapping was used to generate 95 % confidence intervals for each grid cell to allow for an assessment of uncertainty. The bootstrapping procedure incorporated any autocorrelation specified within the prediction model following the CReSS method.

### All behaviours (both sitting and flying birds)

Table 5-145 to Table 5-147 below presents the razorbill modelled abundance estimates for the offshore wind farm area, offshore wind farm area plus a 2 km buffer and Offshore Ornithology Study Area by survey.

**Table 5-145: Razorbill modelled abundance estimates for offshore wind farm area by survey.**

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 0 | 0 to 1,526 | 0 | 0 to 1,792 |
| June 2018 | 1 | 0 to 7 | 1 | 0 to 8 |
| July 2018 | 0 | 0 to 0 | 0 | 0 to 0 |
| August 2018 | 38 | 12 to 192 | 45 | 14 to 225 |
| September 2018 | 44 | 6 to 289 | 52 | 7 to 339 |
| October 2018 | 307 | 162 to 618 | 360 | 190 to 726 |
| November 2018 | 5 | 0 to 606 | 6 | 0 to 711 |
| December 2018 | 118 | 45 to 362 | 139 | 53 to 425 |
| January 2019 | 249 | 122 to 498 | 292 | 143 to 585 |
| February 2019 | 30 | 16 to 49 | 35 | 19 to 58 |
| March 2019 | 17 | 8 to 32 | 20 | 9 to 38 |
| April 2019 | 1 | 0 to 17 | 1 | 0 to 20 |
| June 2019 | 10 | 3 to 46 | 12 | 4 to 54 |
| July 2019 | 0 | 0 to 1 | 0 | 0 to 1 |
| August 2019 | 21 | 6 to 110 | 25 | 7 to 129 |
| October 2019 | 172 | 87 to 342 | 202 | 102 to 402 |
| December 2019 | 66 | 21 to 178 | 77 | 25 to 209 |
| January 2020 | 210 | 106 to 484 | 247 | 124 to 568 |
| May 2020 | 7 | 1 to 26 | 8 | 1 to 31 |

**Table 5-146: Razorbill modelled abundance estimates for offshore wind farm area plus 2 km by survey.**

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 1 | 0 to 2,444 | 1 | 0 to 2,869 |
| June 2018 | 2 | 0 to 14 | 2 | 0 to 16 |
| July 2018 | 0 | 0 to 0 | 0 | 0 to 0 |
| August 2018 | 155 | 55 to 596 | 182 | 65 to 700 |
| September 2018 | 151 | 28 to 818 | 177 | 33 to 960 |
| October 2018 | 1,049 | 552 to 2,030 | 1,232 | 648 to 2,383 |
| November 2018 | 36 | 3 to 1,545 | 42 | 4 to 1,814 |
| December 2018 | 436 | 197 to 1,164 | 512 | 231 to 1,367 |
| January 2019 | 732 | 360 to 1,484 | 859 | 423 to 1,742 |

| Month / Year | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| February 2019 | 340 | 185 to 597 | 399 | 217 to 701 |
| March 2019 | 186 | 82 to 395 | 218 | 96 to 464 |
| April 2019 | 3 | 0 to 97 | 4 | 0 to 114 |
| June 2019 | 19 | 7 to 79 | 22 | 8 to 93 |
| July 2019 | 0 | 0 to 4 | 0 | 0 to 5 |
| August 2019 | 87 | 29 to 345 | 102 | 34 to 405 |
| October 2019 | 589 | 290 to 1,131 | 691 | 340 to 1,328 |
| December 2019 | 245 | 92 to 625 | 288 | 108 to 734 |
| January 2020 | 617 | 316 to 1,335 | 724 | 371 to 1,567 |
| May 2020 | 14 | 4 to 46 | 16 | 5 to 54 |

**Table 5-147: Razorbill modelled abundance estimates for the Offshore Ornithology Study Area by survey.**

| Survey | Estimate | Estimate LCL to UCL | Availability Bias Corrected Estimate | Availability Bias Corrected Estimate LCL to UCL |
|---|---|---|---|---|
| May 2018 | 32 | 7 to 2,926 | 38 | 8 to 3,435 |
| June 2018 | 4 | 1 to 46 | 5 | 1 to 54 |
| July 2018 | 8 | 2 to 94 | 9 | 2 to 110 |
| August 2018 | 2,017 | 951 to 4,754 | 2,368 | 1,116 to 5,581 |
| September 2018 | 944 | 233 to 4,543 | 1,108 | 274 to 5,333 |
| October 2018 | 3,003 | 1,556 to 6,348 | 3,526 | 1,827 to 7,453 |
| November 2018 | 1,358 | 281 to 10,059 | 1,594 | 330 to 11,809 |
| December 2018 | 2,185 | 1,105 to 4,814 | 2,565 | 1,297 to 5,652 |
| January 2019 | 2,941 | 1,480 to 6,095 | 3,453 | 1,738 to 7,156 |
| February 2019 | 1,477 | 758 to 2,728 | 1,734 | 890 to 3,203 |
| March 2019 | 669 | 279 to 1,792 | 785 | 328 to 2,104 |
| April 2019 | 16 | 13 to 199 | 19 | 15 to 234 |
| June 2019 | 42 | 13 to 199 | 49 | 15 to 234 |
| July 2019 | 87 | 22 to 403 | 102 | 26 to 473 |
| August 2019 | 1,133 | 501 to 2,659 | 1,330 | 588 to 3,122 |
| October 2019 | 1,686 | 792 to 3,736 | 1,979 | 930 to 4,386 |
| December 2019 | 1,227 | 565 to 2,707 | 1,440 | 663 to 3,178 |
| January 2020 | 2,480 | 1,335 to 4,907 | 2,912 | 1,567 to 5,761 |
| May 2020 | 47 | 6 to 2,926 | 55 | 7 to 3,435 |

### Flying birds

There were 406 records of flying razorbill over the study period. Densities of flying birds were derived from the total numbers seen in radial snapshots, divided by the total area surveyed by snapshots (survey effort); that is the number of snapshots multiplied by the snapshot area of 0.09 $km^2$.

Non-parametric bootstrap intervals have been used to calculate the standard error and 95% confidence intervals around the observed counts and densities per $km^2$. The area of the offshore wind farm area has then been used to calculate simple abundances based on density results. These data are shown in Table 5-148 and Table 5-149.

**Table 5-148: Razorbill flying bird offshore wind farm area simple abundance estimates.**

| Month | Estimate | LCL | UCL |
|---|---|---|---|
| January | 9 | 4 | 14 |
| February | 5 | 0 | 11 |
| March | 6 | 1 | 12 |
| April | 2 | 0 | 4 |
| May | 2 | 0 | 4 |
| June | 2 | 0 | 5 |
| July | 1 | 0 | 3 |
| August | 1 | 0 | 1 |
| September | 2 | 0 | 5 |
| October | 78 | 48 | 108 |
| November | 14 | 6 | 23 |
| December | 1 | 0 | 2 |

**Table 5-149: Razorbill flying bird offshore wind farm area plus 2 km buffer simple abundance estimates.**

| Month | Estimate | LCL (95%) | UCL (95%) |
|---|---|---|---|
| January | 26 | 12 | 41 |
| February | 15 | 0 | 32 |
| March | 17 | 3 | 35 |
| April | 6 | 0 | 12 |
| May | 6 | 0 | 12 |
| June | 6 | 0 | 15 |
| July | 3 | 0 | 9 |
| August | 3 | 0 | 3 |
| September | 6 | 0 | 15 |
| October | 227 | 140 | 314 |
| November | 41 | 17 | 67 |
| December | 3 | 0 | 6 |

### Design-based spatial abundance estimates during the DAS

DAS abundance analysis was undertaken by APEM and summarised fully within appendix 11-2: Ornithological and Marine Megafauna Aerial Survey Results. The abundance estimates are presented below for razorbill at the different spatial scales. Table 5-150 presents the abundance estimates for sitting birds only whereas, Table 5-151 presents the abundance estimates for flying birds. Detailed methods on calculation of the abundance estimates are presented in section 4.4.3. When provided the LCL and UCL are presented within brackets after the estimate. Availability biases have been applied to these numbers to account of birds under the water.

**Table 5-150: Abundance estimates of sitting razorbill within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | 11 | 36 |
| May 2020 | 27 | 62 |
| June 2020 | 154 | 353 |
| July 2020 | 13 | 25 |
| August 2020 | No birds recorded | 10 |
| September 2020 | 26 | 566 |

**Table 5-151: Abundance estimates of flying razorbill within the different study areas.**

| Month / Year | Abudance estimate within the offshore wind farm area | Abudance estimate within the offshore wind farm area plus 2 km buffer |
|---|---|---|
| April 2020 | No birds recorded | 3 |
| May 2020 | No birds recorded | No birds recorded |
| June 2020 | No birds recorded | 4 |
| July 2020 | No birds recorded | No birds recorded |
| August 2020 | No birds recorded | No birds recorded |
| September 2020 | No birds recorded | No birds recorded |

## 5.6.23 Puffin

### Ecology

The puffin breeds in Iceland, Norway, Greenland, Newfoundland, and the Faroe Islands, and as far south as Maine in the west and the west coast of Ireland and parts of the UK in the north and east. The puffin is exclusively marine, found on rocky coasts and offshore islands nesting on grassy maritime slopes, sea cliffs and rocky slopes. Puffins are colonial nesters, excavating burrows on grassy clifftops or reusing existing holes, and on occasion may nest in crevices and among rocks and scree. During the winter it is wide-ranging and is found in offshore and pelagic habitats.

Similar to other auk species, the puffin is a poor flier due to its high wing loading and thus the bird's flight is direct and low over the surface of the water. As a pursuit-diver, puffin catch most of their prey within 30 m of the water surface but is capable of diving to 60 m (Piatt and Nettleship, 1985; Burger and Simpson, 1986). The puffin forages on juvenile pelagic fishes such as herring, juvenile and adult capelin *Mallotus villosus*, and sandeel (Barrett *et al.*, 1987). During chick rearing periods, birds generally forage within 10 km of their colony, but may range as far as 50 to 100 km or more (Thaxter *et al.*, 2012).

Due to rapid declines in its range since 2010, puffin is rated as vulnerable by the International Union for Conservation of Nature (IUCN) and are Red-listed in the UK and Ireland as a species of European Conservation Concern (Gilbert *et al.,* 2021, Stanbury *et al*., 2021).

A summary of the recent (within the last five summers) colony data for puffin within the Cumulative Offshore Ornithology Study Area and within the mean max (+1 SD) foraging range of the species is provided in Table 5-152 below. If multiple years are provided then the mean count is presented.

**Table 5-152: Summary of most recent colony data for puffin between 2017 and 2022.**

| County (from SMP) | SMP Master Site | Year(s) | Count (IND) ± SD (if applicable) |
|---|---|---|---|
| Antrim | Larne Lough to Portmuck | 2017 – 2019 | 55.3 ± 1.2 |
| | Muck Island | 2020 | 1 |
| | Rathlin Island SPA | 2021 | 407 |
| | Sheep Island SPA | 2021 | 2 |
| Argyll and Bute | Sanda Islands | 2019 | 54 |
| Down | Copeland Islands SPA | 2019 | 106 |
| Dyfed | Bishop and Clerks and Ramsey | 2018 | 120 |
| | Caldey Island | 2017 – 2019 and 2021 | 2.3 ± 1.1 |
| | Castlemartin Coast (Berryslade to Barafundle Bay) | 2017 – 2019 and 2021 | 5.3 ± 5.3 |
| | Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA | | 26,944.6 ± 16,018.9 |
| Gwynedd | Aberdaron Coast and Bardsey Island SPA | | 147.3 ± 15.8 |
| | Aberdaron Coast not in SPA | | 659.7 ± 31.9 |
| | Anglesey Terns / Morwenoliaid Ynys MÃ´n SPA | | 524 ± 249.2 |
| | Puffin Island SPA | | 10 ± 3.7 |
| | South Stack | | 21.3 ± 5.9 |
| Isle of Man | West Island | 2017 | 8 |
| Kyle and Carrick | Ailsa Craig SPA | 2017 – 2019 and 2021 | 147 ± 45.4 |
| Wigtown | Mull of Galloway | 2017 and 2018 | 0.5 ± 0.5 |

## Desk-based data

A total of 24 observations totalling 27 individuals were recorded within the ObSERVE western Irish Sea survey area during the summer survey. These sighting distributions were consistent with breeding colonies at Ireland's Eye and the Saltee Islands and illustrated an avoidance of sandbanks and very nearshore waters and preference for depths of between 30-60 m. Mean density of puffins across the ObSERVE survey area in summer was 0.02 birds/km$^2$ (Jessopp *et al.*, 2018). No records of puffin were presented in the I-WeBS database.

## Site-specific data

Observations of puffin during the boat-based surveys were sparse, with records of only single birds made on transect in both June 2018 and July 2018 (Table 5-153). During the DAS, a total of 51 puffin were recorded: two in the April 2020, one in May 2020 seven in June 2020, seven in July 2020, 10 in August 2020 and 24 in September 2020 surveys.

A summary of the monthly records from the boat-based and DAS is presented in Table 5-153. Table 5-154 shows the seasonal variation between 2018 and 2020 for all records and are based on the definitions taken from Furness (2015). Figure 5-38 shows the spatial distribution of puffin during the boat-based surveys.

**Table 5-153: Transect records and total observations of puffin from boat-based and DAS in the Study Area.**

| Month / Year | Boat-based Transect Records | DAS Records | All Records |
|---|---|---|---|
| May 2018 | 0 | - | 0 |
| June 2018 | 4 | - | 5 |
| July 2018 | 1 | - | 1 |
| August 2018 | 0 | - | 0 |
| September 2018 | 0 | - | 0 |
| October 2018 | 0 | - | 0 |
| November 2018 | 0 | - | 0 |
| December 2018 | 0 | - | 0 |
| January 2019 | 0 | - | 0 |
| February 2019 | 0 | - | 0 |
| March 2019 | 0 | - | 0 |
| April 2019 | 0 | - | 0 |
| June 2019 | 7 | - | 7 |
| July 2019 | 1 | - | 1 |
| August 2019 | 2 | - | 2 |
| October 2019 | 1 | - | 1 |
| December 2019 | 0 | - | 0 |
| January 2020 | 0 | - | 0 |
| April 2020 | - | 2 | 2 |
| May 2020 | 4 | 1 | 5 |
| June 2020 | - | 7 | 7 |
| July 2020 | - | 7 | 7 |
| August 2020 | - | 10 | 10 |
| September 2020 | - | 24 | 24 |
| **Total** | **20** | **51** | **72** |

**Table 5-154: Seasonal variation of puffin recorded between May 2018 and September 2020.**

| Year | Spring migration Mar - Apr | Breeding May - Jun | Autumn migration Jul - Aug | Winter Sep - Feb | Non-breeding |
|---|---|---|---|---|---|
| 2018 / 2019 | - | 5 | 1 | 0 | - |
| 2019 / 2020 | 0 | 7 | 3 | 1 | - |
| 2020 | 2 | 12 | 17 | 24 | - |

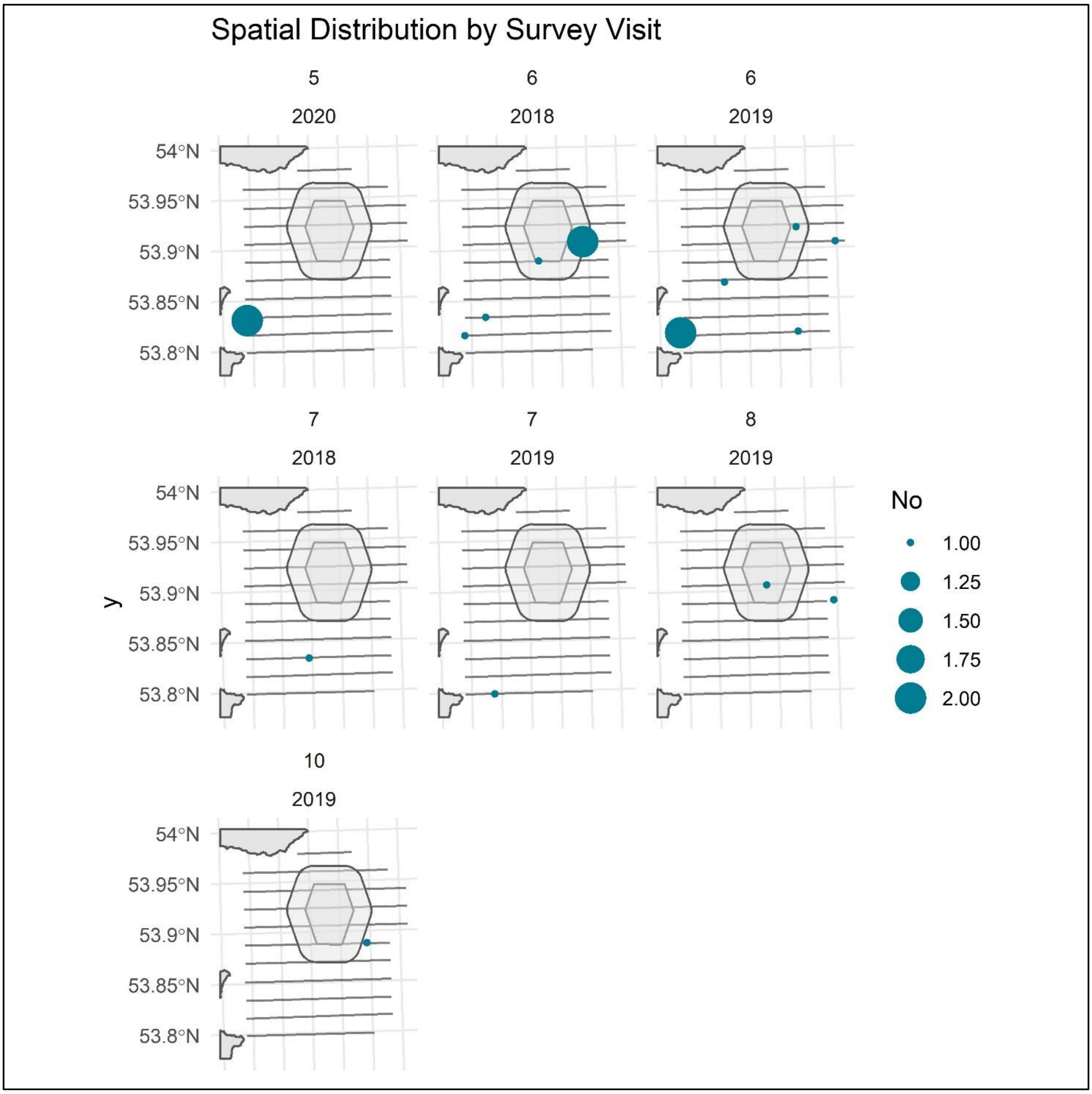


**Figure 5-38: Spatial distribution of Puffin records during the boat-based surveys. Transects shown as lines and offshore wind farm area and 2 km buffer shown as polygons.**

During the boat-based transect surveys, the majority of puffins (13 individuals, 69.2%) were observed sitting compared to those in flight (49 individuals, 3.5%). All birds off transect were observed in flight at heights of between 5 m and 10 m. All birds recorded during the DAS were observed sitting. Table 5-155 below shows the proportion of individuals observed in flight and sitting on and off transect between May 2018 and September 2020.

**Table 5-155: Proportion of puffin recorded flying or sitting during surveys undertaken between May 2018 and May 2020.**

| Month / year | On transect | | | | Off transect | | | |
|---|---|---|---|---|---|---|---|---|
| | Flying | | Sitting | | Flying | | Sitting | |
| | No. | % | No. | % | No. | % | No. | % |
| May 2018 | No birds recorded | | | | | | | |
| June 2018 | 0 | 0 | 1 | 100 | 4 | 100 | 0 | 0 |
| July 2018 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| August 2018 | No birds recorded | | | | | | | |
| September 2018 | | | | | | | | |
| October 2018 | | | | | | | | |
| November 2018 | | | | | | | | |
| December 2018 | | | | | | | | |
| January 2019 | | | | | | | | |
| February 2019 | | | | | | | | |
| March 2019 | | | | | | | | |
| April 2019 | | | | | | | | |
| June 2019 | 2 | 28.6 | 5 | 71.4 | 0 | 0 | 0 | 0 |
| July 2019 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| August 2019 | 0 | 0 | 2 | 100 | 0 | 0 | 0 | 0 |
| October 2019 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| December 2019 | No birds recorded | | | | | | | |
| January 2020 | | | | | | | | |
| April 2020 | 0 | 0 | 2 | 100 | N/A | | | |
| May 2020 | 1 | 20 | 4 | 80 | 0 | 0 | 0 | 0 |
| June 2020 | 0 | 0 | 7 | 100 | N/A | | | |
| July 2020 | 0 | 0 | 7 | 100 | | | | |
| August 2020 | 0 | 0 | 10 | 100 | | | | |
| September 2020 | 0 | 0 | 24 | 100 | | | | |
| **Total** | **4** | **5.9** | **64** | **94.1** | **4** | **100** | **0** | **0** |

### Model derived spatial abundance and density estimates

Given the small number of records and their general absence from the offshore wind farm area and its buffer (Figure 5-38), it is not possible to undertake any detailed spatial analysis for this species.

## 5.6.24 Light-bellied brent goose

### Ecology

The light-bellied brent goose is a fully migratory species, on breeding grounds in the Canadian Arctic between June and September. Individuals from that breeding population arrive at wintering grounds in Ireland from mid-September and remain until mid-March or early April. While the birds breed in either small loose colonies or in single pairs, they are highly gregarious during non-breeding periods and gather in groups of up to several thousand individuals (BirdLife International, 2020d; Snow and Perrins, 1998). Light-bellied brent geese are Amber listed in Ireland and UK as a species of European Conservation Concern (Gilbert *et al*., 2021, Stanbury *et al*., 2021).

Light-bellied brent geese breed in the Arctic tundra or close to wet coastal meadows with abundant grassy vegetation (Kear, 2005), or on tundra flats with tidal streams. The species is predominantly coastal outside of the breeding season and can be found in coastal estuaries during the autumn and early winter, and around grasslands from mid-winter until departure in late April for breeding grounds (BirdWatch Ireland, 2020d). Although a mainly herbivorous species, birds may forage on fish eggs, worms, snails and amphipods and is known to forage mostly on eel-grass during wintering months, as well as grass and winter crops.

### Desk-based data

No observations of light-bellied brent goose were recorded within the ObSERVE western Irish Sea data, or within the ESAS database. Engagement with key stakeholders from BirdWatch Ireland, the Brent Goose Research Group and a local birdwatching group member provided local information on light-bellied brent goose. Approximately 80-90% of the global population of East Canadian High Arctic (ECHA) brent geese migrate between Canada and Northern Ireland (Strangford Lough). Birds then re-distribute to other coastal sites in Northern Ireland and Ireland during the winter; whether they follow a coastal route, or a direct route is currently unknown. This migration tends to occur in two large pulses of geese passing through the Dundalk Bay area each year: 1 to 2 days in April on northward migration and likewise south in September. Therefore, there is not a daily commute across Dundalk Bay. Ornithological surveys have highlighted high counts of brent geese at Carlingford Lough, which was designated as a SPA.

Observations of light-bellied brent goose were recorded at the Dundalk Bay site within the I-WeBS database, as described within Table 5-156. A five-year peak observation of 2,752 birds was recorded in the 2018/2019 season, along with a five-year peak-mean count of 1,790 birds between 2015/16 and 2019/20. The National Importance threshold for light-bellied brent goose is 350 birds, and the International Importance threshold is 400 birds. Therefore, the light-bellied brent goose population in the Dundalk Bay I-WeBS site is currently exceeding the levels of National Importance and International Importance (I-WeBS, 2022).

**Table 5-156: Summary of I-WeBS survey counts for light bellied brent goose within Dundalk Bay site (site code 0Z401, I-WeBS, 2022).**

| 2018/19 count | 2019/20 count | Five-year peak count (2015/2016 - 2019/2020) | Five-year peak-mean count (2015/2016 - 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|
| 2752 | 675 | 2,752 | 1,790 | 350 | 400 |

### Site-specific data

There were no observations of light-bellied brent goose on transect during the site-specific surveys, but there were two records of light-bellied brent goose observed within the Survey Area; two individuals recorded together in November 2018 and a group of four individuals in January 2019. No goose were recorded during the DAS.

The full results of the migratory geese VP surveys are provided in appendix 11-3: Migratory Geese Survey Report.

## 5.6.25 Waterfowl and waders

### Ecology

Over 50 species of waterbird migrate to Ireland annually and the resource rich wetlands of Ireland support over 750,000 waterbirds each year. These waterbirds seek wetlands which provide resource rich feeding grounds and safe roosting, and the mild and wet winters of Ireland provide ice-free habitats for species such as light-bellied brent goose (see section 5.6.23 above), black-tailed godwit, whooper swan, Greenland white-fronted goose and ringed plover.

### Desk-based data

The I-WeBS database of surveys within the Dundalk Bay site provides an overview of the waterfowl and waders which are present within the wider Project region. A summary of the I-WeBS survey counts for the

Dundalk Bay site area (site code 0Z401) is presented within Table 5-157. Based on the most recently reported five-year period between 2015/16 and 2019/20, the following species were most commonly recorded (numbers in brackets are five-year peak-mean counts):

- Golden plover (8,250);
- Oystercatcher (5,942);
- Knot (5,264);
- Lapwing (4,776);
- Dunlin (4,612);
- Black-tailed godwit (3,262);
- Bar-tailed godwit (1,857);
- Redshank (1,469);
- Curlew (866); and
- Mallard (754).

Based on the recent five-year peak-mean counts, several of the above listed species exceed the 1% threshold of International Importance, including black-tailed godwit and bar-tailed godwit. All species listed above exceed the 1% threshold of National Importance based on recent five-year peak-mean counts (2013/14 to 2017/2018) (Table 5-157).

**Table 5-157: Summary of I-WeBS survey counts for Dundalk Bay site area (site code 0Z401, I-WeBS, 2022).**

| Species | 2018/19 Count | 2019/20 Count | Five-year peak count (2015/2016 - 2019/2020) | Five-year peak-mean count (2015/2016 - 2019/2020) | 1% National Importance Threshold | 1% International Importance Threshold |
|---|---|---|---|---|---|---|
| Golden plover | 6,964 | 10,560 | 11,200 | 8,250 | 920 | 9,300 |
| Oystercatcher | 5,586 | 3,976 | 9,660 | 5,942 | 610 | 8,200 |
| Knot | 7,856 | 1,057 | 7,856 | 5,264 | 160 | 5,300 |
| Lapwing | 4,281 | 5,545 | 6,732 | 4,776 | 850 | 72,300 |
| Dunlin | 6,890 | 3,575 | 6,890 | 4,612 | 460 | 13,300 |
| Black-tailed godwit | 2,235 | 2,447 | 4,227 | 3,262 | 200 | 1,100 |
| Bar-tailed godwit | 2,034 | 2,240 | 2,240 | 1,857 | 170 | 1,500 |
| Redshank | 2,025 | 856 | 2,057 | 1,469 | 240 | 2,400 |
| Curlew | 922 | 868 | 1,322 | 866 | 350 | 7,600 |
| Mallard | 454 | 415 | 1,281 | 754 | 280 | 53,000 |
| Wigeon | 661 | 572 | 1,215 | 745 | 560 | 14,000 |
| Teal | 667 | 687 | 687 | 586 | 360 | 5,000 |
| Greylag goose | 360 | 680 | 680 | 403 | 35 | 980 |
| Shelduck | 338 | 186 | 360 | 339 | 100 | 2,500 |
| Grey plover | 157 | 254 | 289 | 223 | 30 | 2,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ringed plover | 163 | 69 | 395 | 192 | 120 | 540 |
| Pintail | 111 | 91 | 302 | 175 | 20 | 600 |
| Pink-footed goose | 461 | - | 461 | 160 | - | - |
| Turnstone | 87 | 194 | 207 | 127 | 95 | 1,400 |
| Great crested grebe | 171 | 14 | 171 | 70 | 30 | 6,300 |
| Mute swan | 89 | 38 | 89 | 50 | 90 | 100 |
| Little egret | 37 | 37 | 61 | 48 | 20 | 1,100 |
| Goldeneye | 28 | 24 | 57 | 39 | 40 | 11,400 |
| Greenland white-fronted goose | 20 | - | 39 | 18 | 100 | 190 |
| Greenshank | 11 | 17 | 22 | 17 | 20 | 3,300 |
| Whimbrel | 55 | - | 55 | 12 | - | - |
| Snipe | 6 | 2 | 18 | 8 | - | - |
| Ruff | 5 | 6 | 11 | 8 | - | - |
| Whooper swan | 5 | - | 16 | 7 | 150 | 340 |
| Shoveler | 2 | - | 30 | 7 | 20 | 650 |
| Slavonian grebe | 6 | 2 | 6 | 4 | - | - |
| Scaup | - | - | 24 | 5 | 25 | 3,100 |
| Tufted duck | - | - | 2 | 1 | 270 | 8,900 |
| Little grebe | - | - | 3 | 1 | 20 | 4,700 |
| Moorhen | - | - | 2 | 1 | - | - |
| Sanderling | - | - | 4 | 1 | 85 | 2,000 |

## Site-specific data

Observations of waterfowl and waders were sparse within the site surveys; however, curlew dunlin, sanderling and turnstone were recorded in low counts during the boat-based and DAS. These records likely refer to migrating birds and indicates use of the Survey Area by birds on passage and migration along the east coast of Ireland, and between Ireland and Britain. A single flock of ten dunlin was recorded in May 2018, along with a flock of ten sanderling and a single turnstone. One curlew was observed during the DASin June 2020. No further observations were made.

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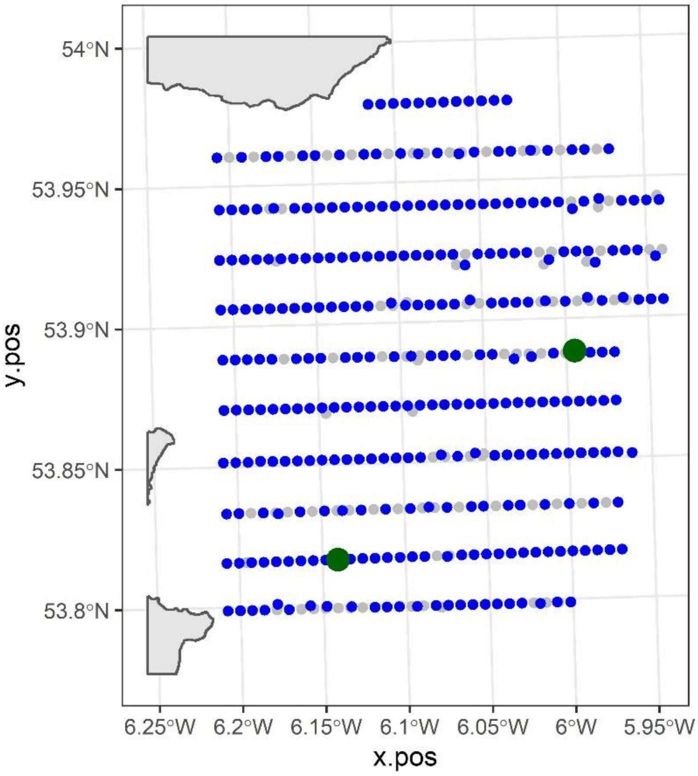
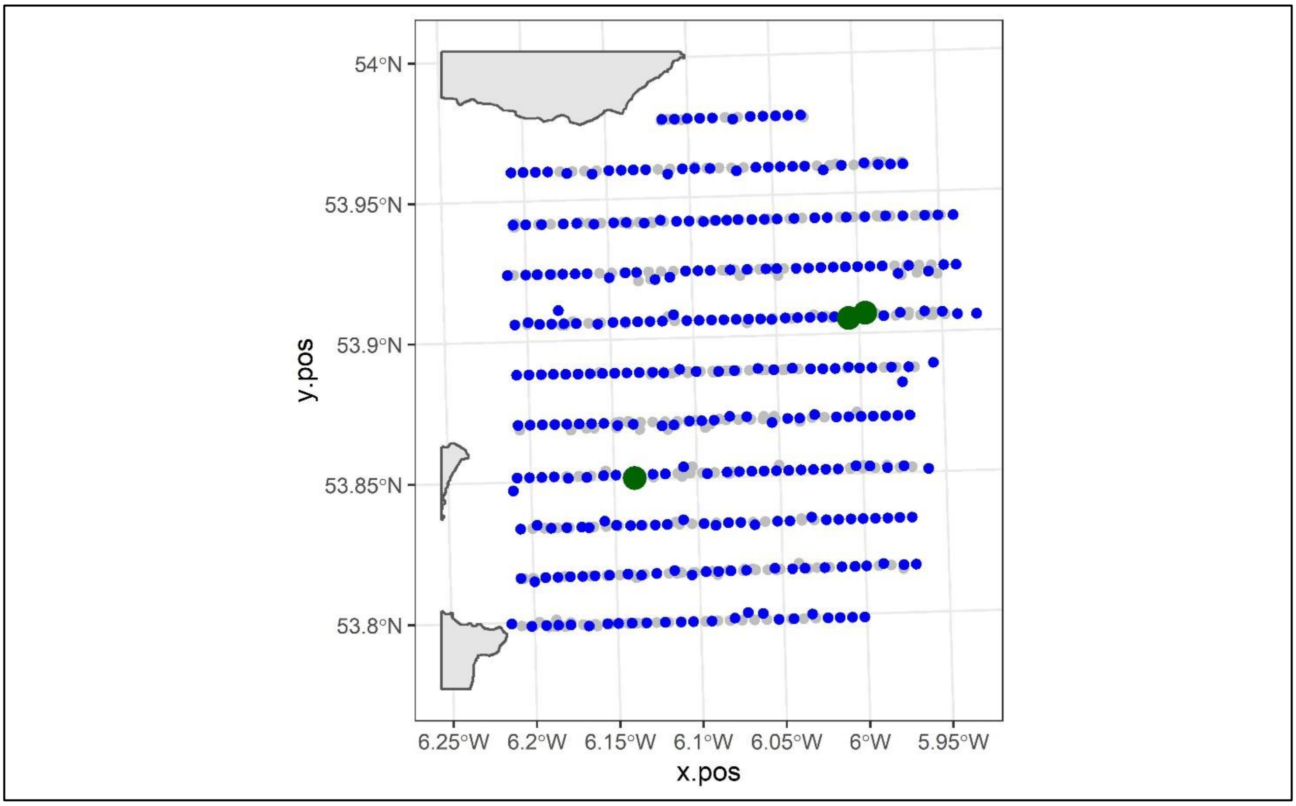
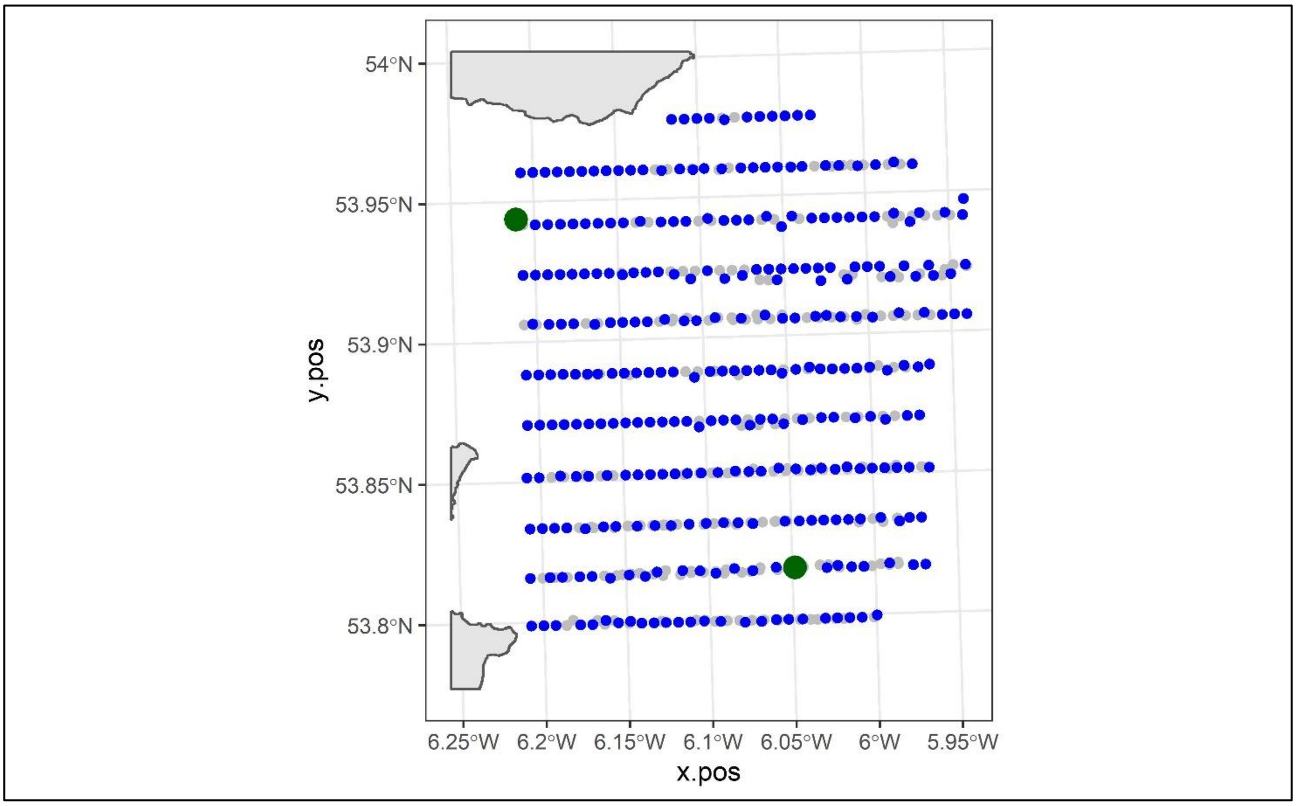
# Annex 1: MRSEA CRESS KNOT SELECTION – BOAT-BASED SURVEY ONLY



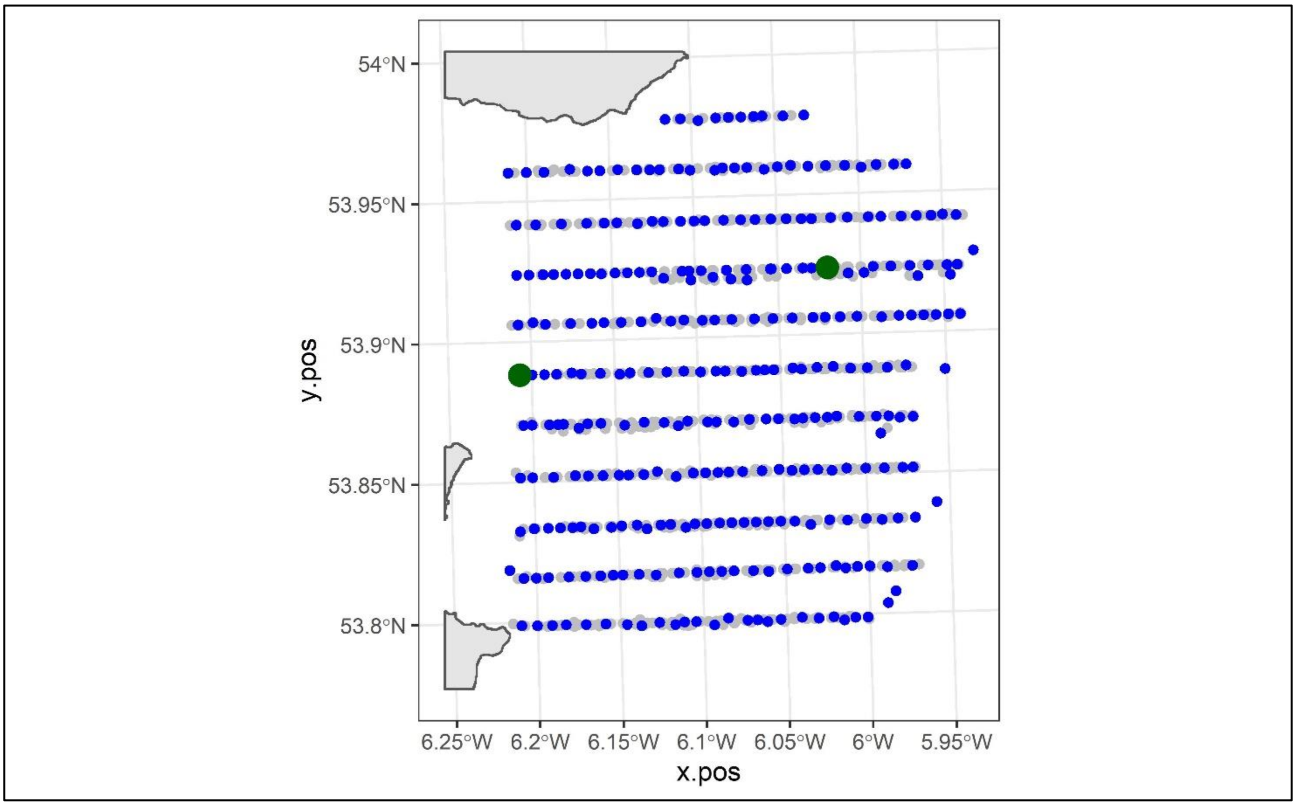

**A.1 1: Razorbill MRSea pre-breeding knot selection.**



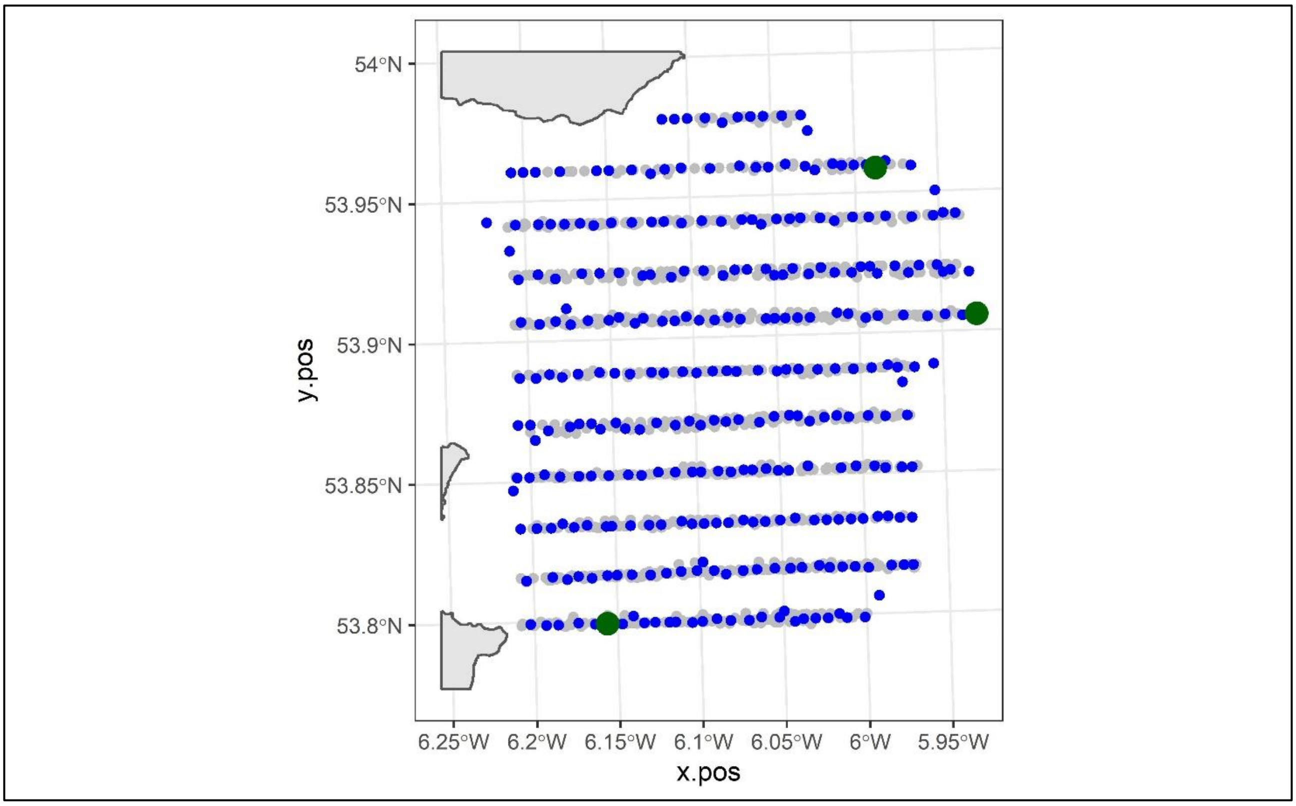

**A.1-2: Razorbill MRSea non- breeding knot selection.**



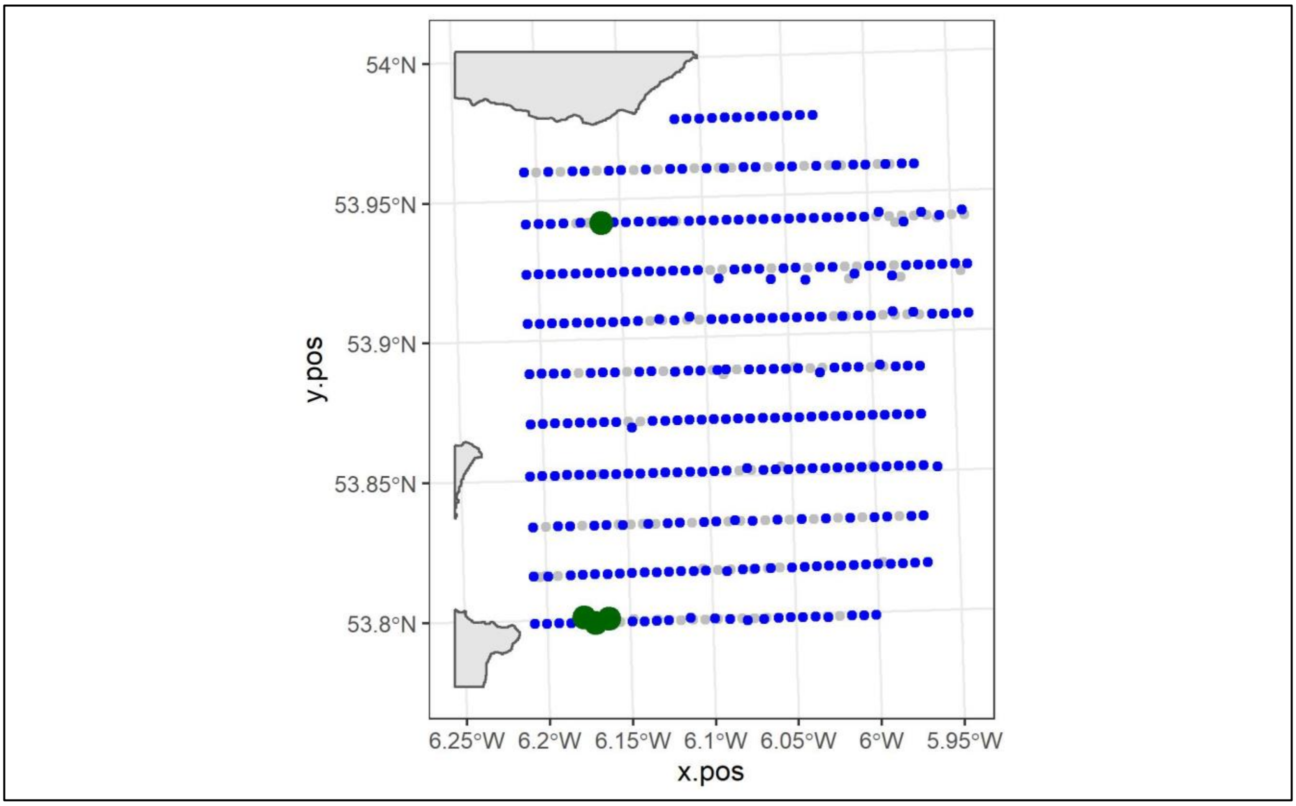

**A.1-3: Guillemot MRSea Pre-Breeding Season Knot selection.**



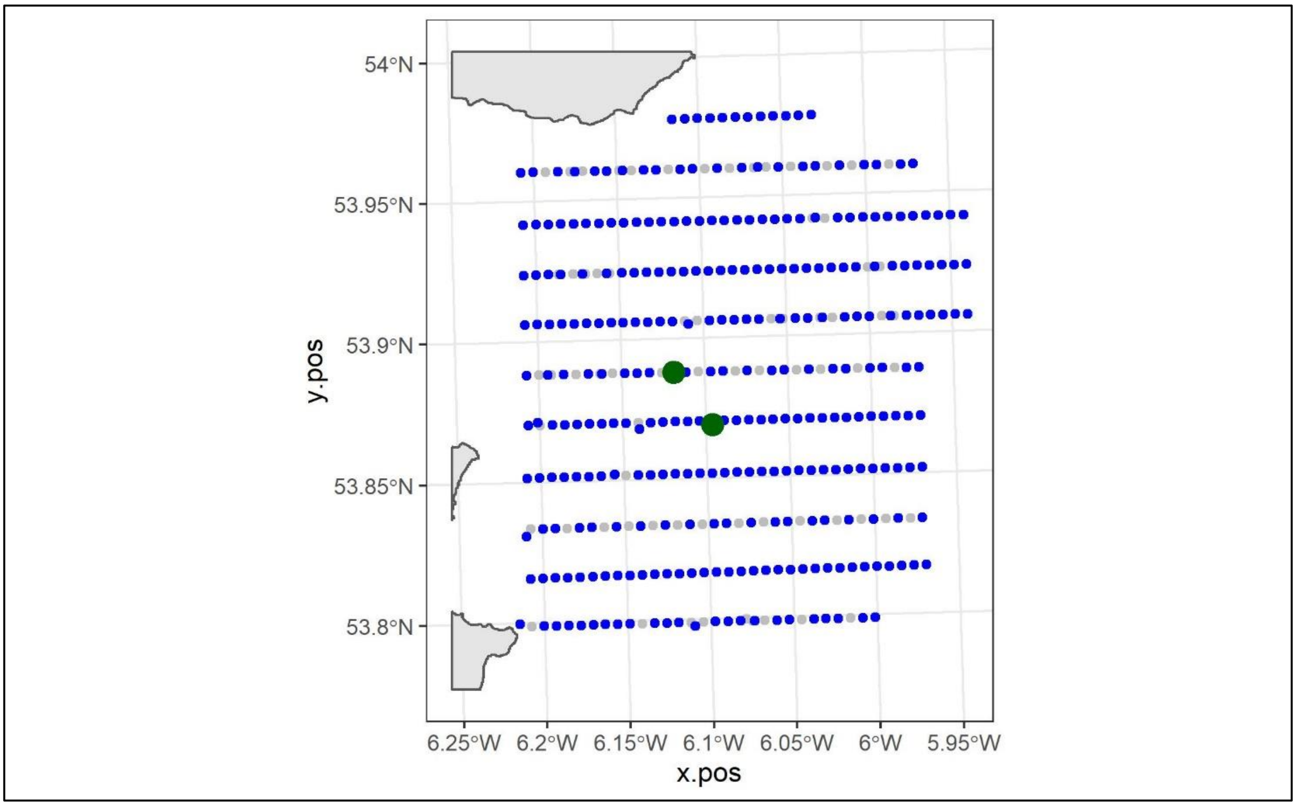

**A.1-4: Guillemot MRSea breeding season knot selection.**



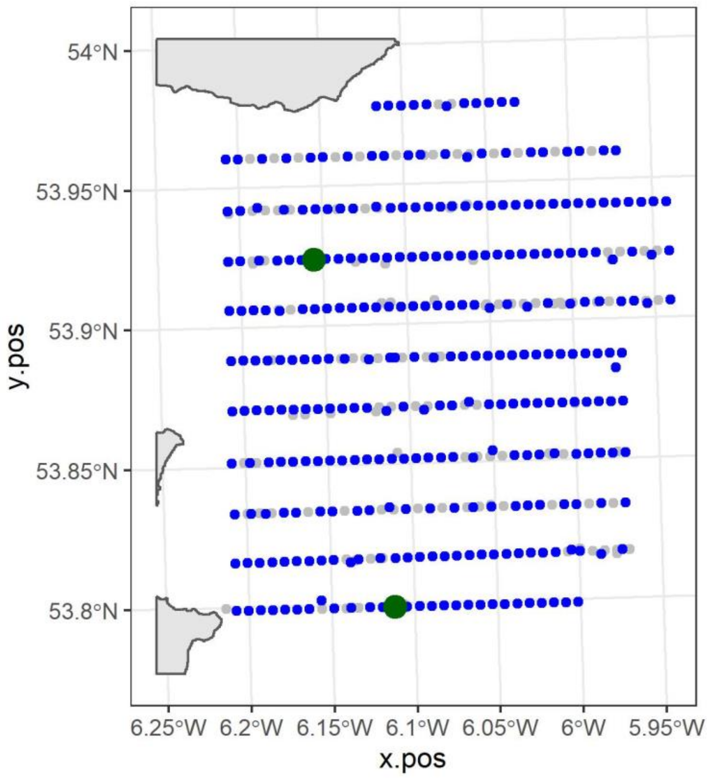

**A.1-5: Guillemot MRSea non-breeding season knot selection.**



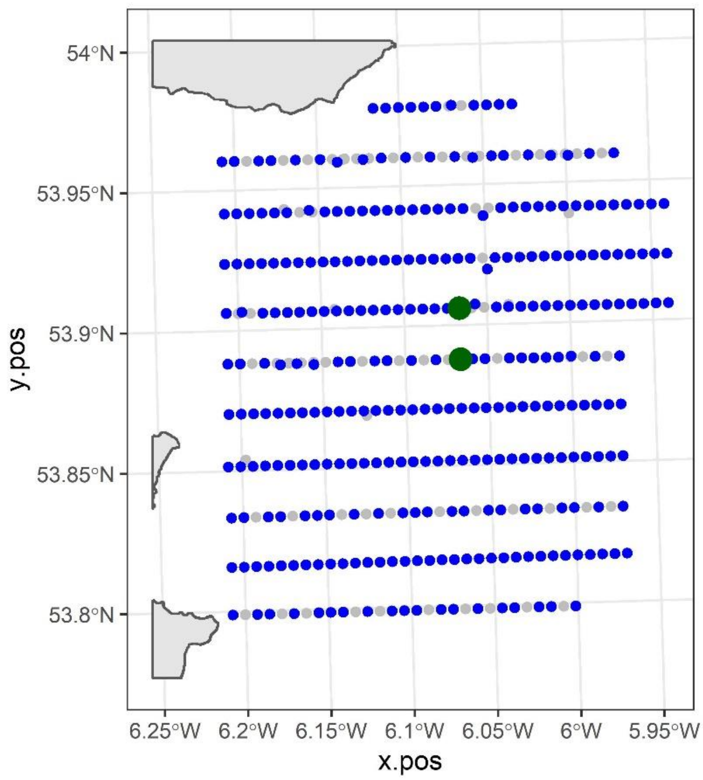

**A.1-6: Kittiwake MRSea pre-breeding season knot selection.**



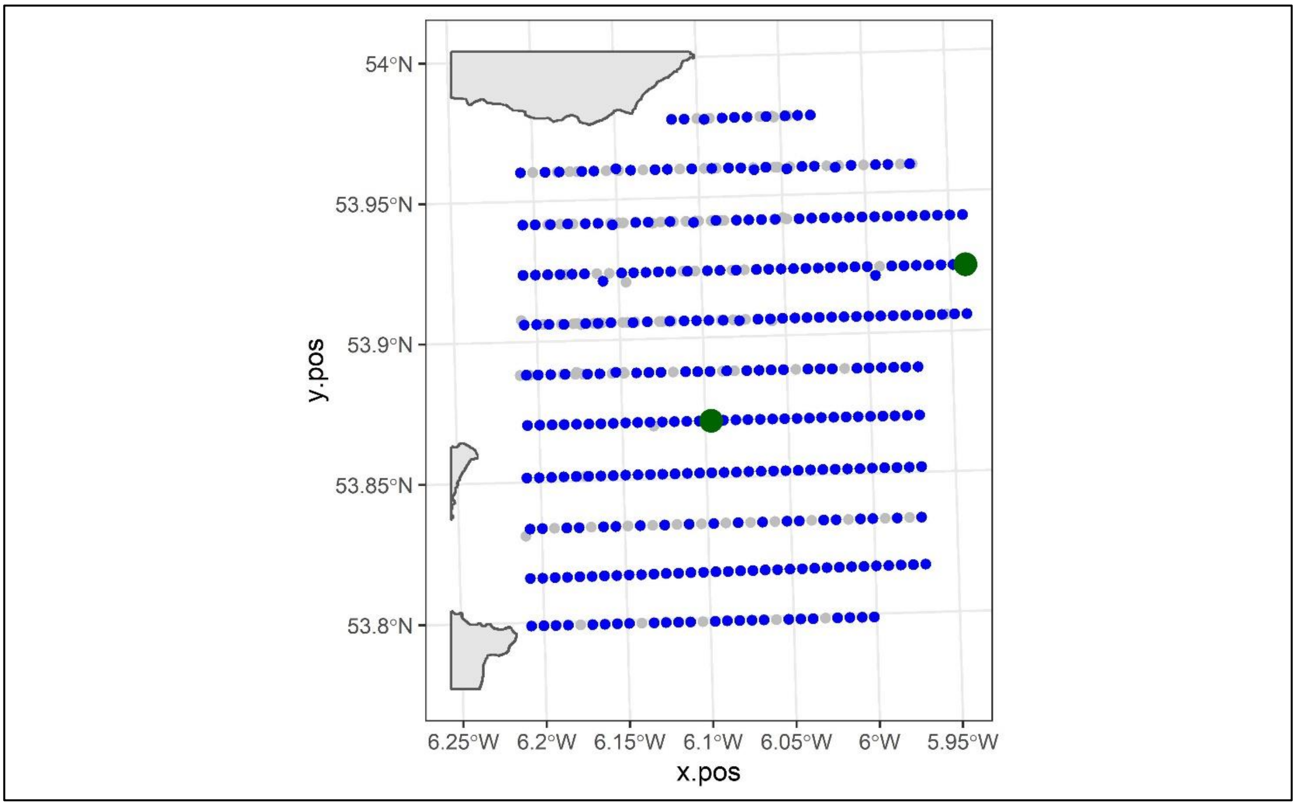

**A.1-7: Kittiwake MRSea breeding season knot selection.**



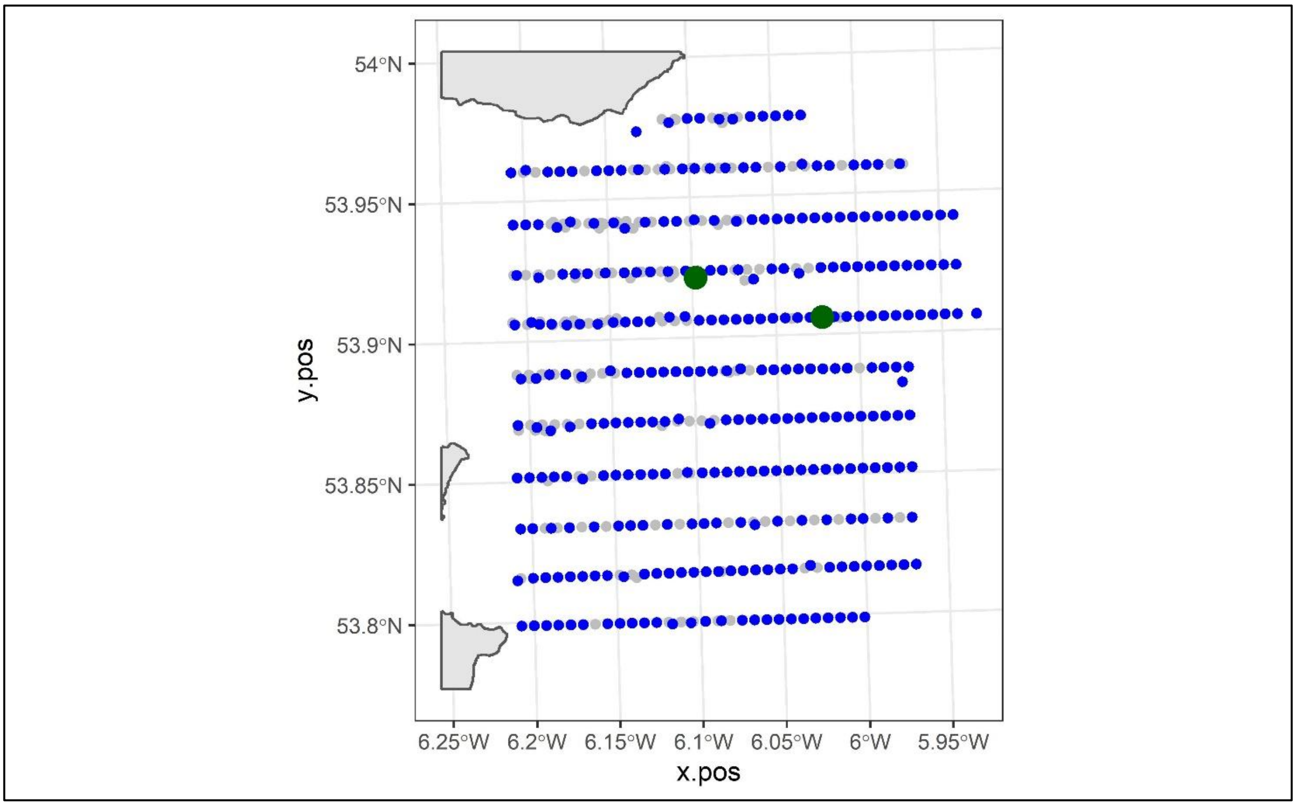

**A.1-8: Kittiwake MRSea non-breeding season knot selection.**



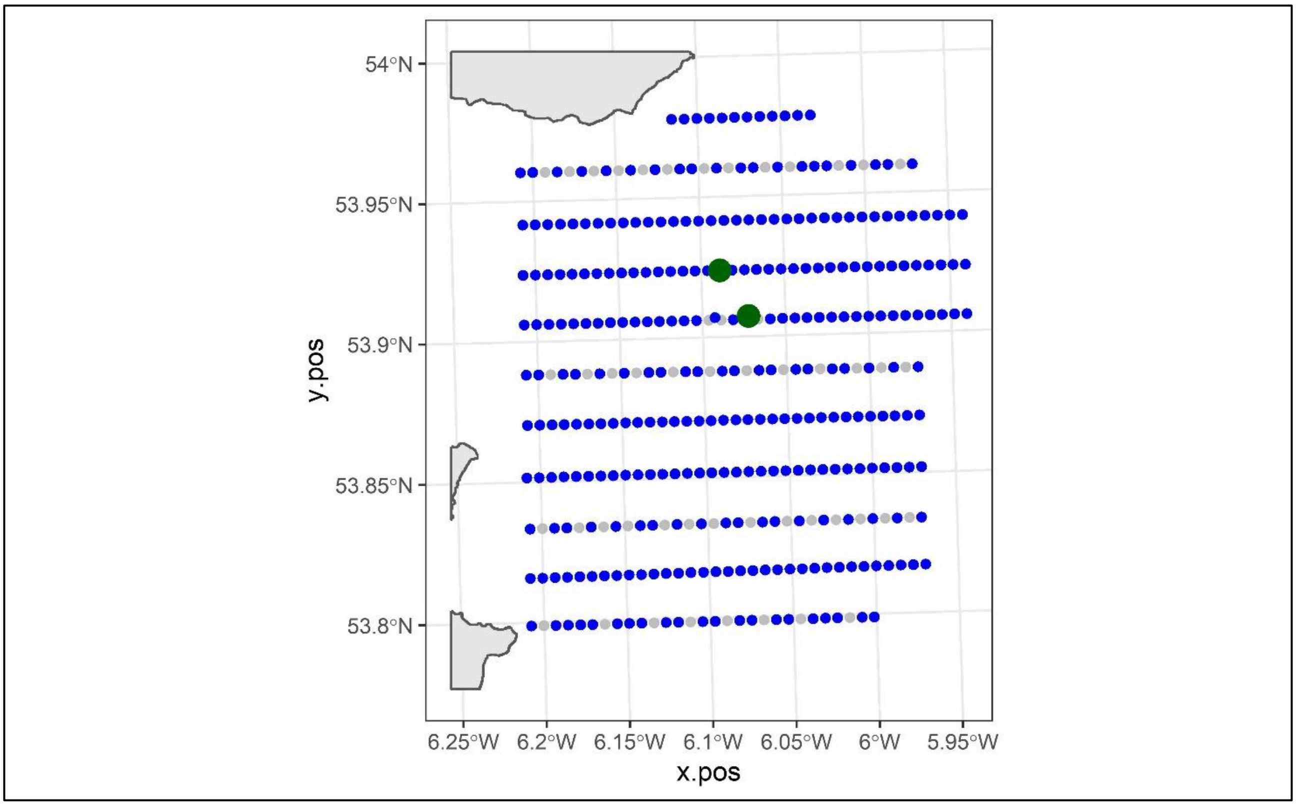

**A.1 9: Great Northern Diver MRSea pre-breeding season knot selection.**



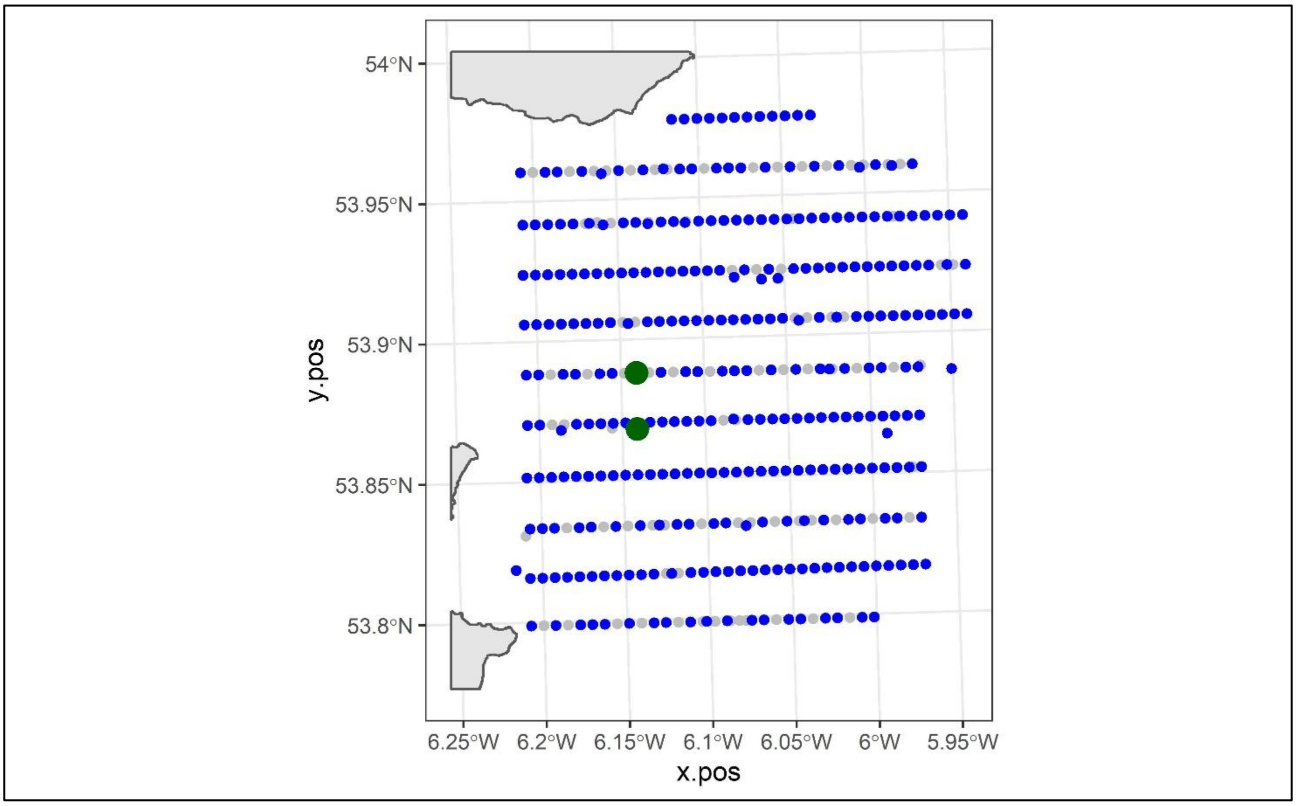

**A.1-10: Great Northern Diver MRSea breeding season knot selection.**



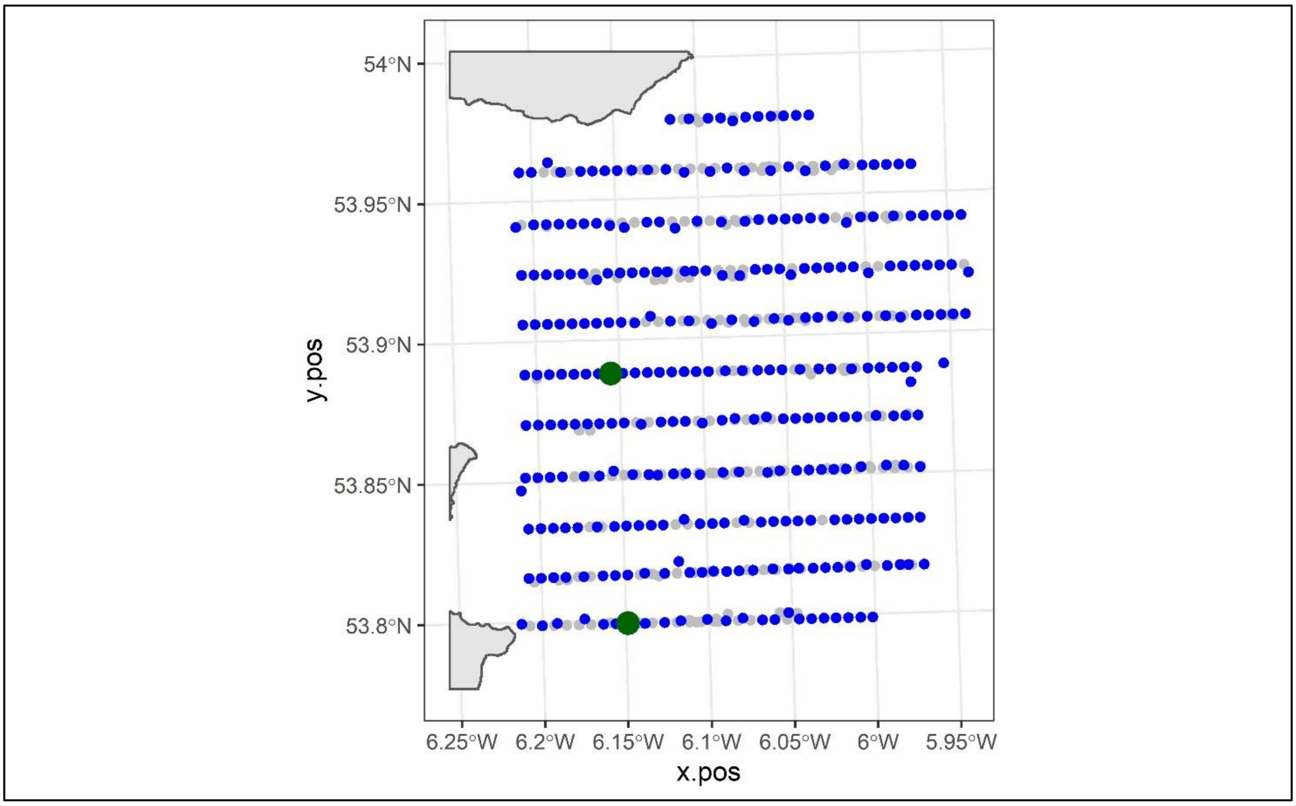

**A.1-11: Great Northern Diver MRSea non-breeding season knot selection.**



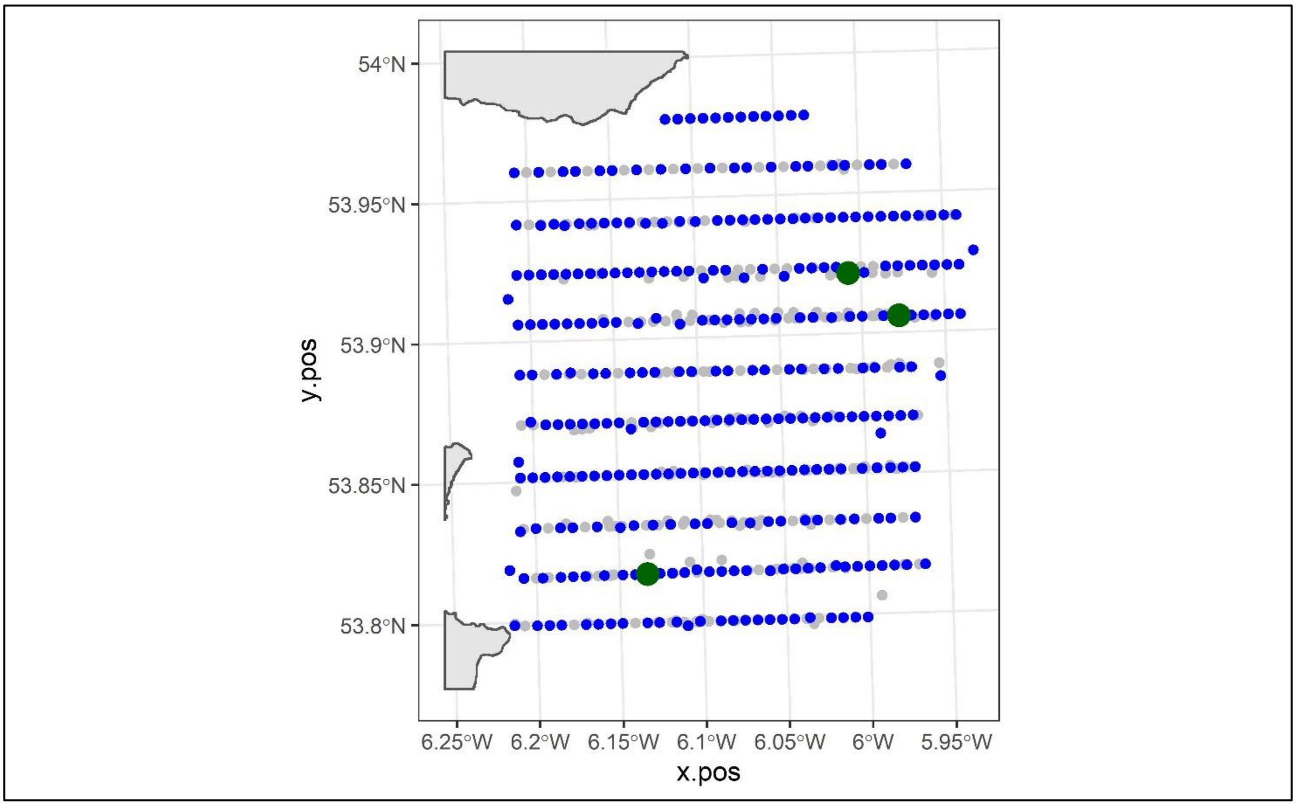

**A.1-12: Gannet MRSea pre-breeding season knot selection.**




**A.1-13: Gannet MRSea breeding season knot selection.**




**A.1-14: Gannet MRSea non-breeding season knot selection.**




**A.1-15: Manx shearwater MRSea breeding season knot selection.**