codling wind park

Environmental Impact Assessment Report

Volume 4

Appendix 10.12 Ornithological receptor tolerance – offshore construction phase prey effects


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Table of contents

1 Introduction 5

2 Receptor tolerance 5

3 References 24

List of tables

Table 2-1 Determination of receptor tolerance to construction phase impacts upon prey availability in offshore areas 6

Abbreviations

Abbreviation	Term in Full
ABP	An Bord Pleanála
CWP	Codling Wind Park
EIAR	Environmental Impact Assessment Report
OECC	Offshore Export Cable Corridor
SD	Standard Deviation
spp	Species (plural)
NA	Not Applicable

APPENDIX 10.12: ORNITHOLOGICAL RECEPTOR TOLERANCE: OFFSHORE CONSTRUCTION PHASE PREY EFFECTS

1 Introduction

1. Codling Wind Park Limited (hereafter 'the Applicant') is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish sea approximately 13 - 22 km off the east coast of Ireland, at County Wicklow.

2. This appendix forms part of Chapter 10: Ornithology of the Environmental Impact Assessment Report (EIAR) for the CWP Project. Specifically, this appendix relates to **Chapter 10 Ornithology; Section 10.10** Impact assessment; Construction phase; Impact 3: Changes in prey availability; Offshore; Receptor sensitivity.

2 Receptor tolerance

3. Full considerations used to arrive at designated species-specific receptor tolerances are presented herein. Tolerances of offshore ornithological receptors in relation to changes in prey availability are assessed by considering four factors, namely;

   - Dietary specificity;
   - Impact magnitudes to key prey groups;
   - Species use of project areas; and
   - Species foraging range.

4. Receptor tolerances have the potential to range from very low through to very high (See **Chapter 10 Ornithology**). Receptor tolerances in relation to changes in prey availability range from high to very high, and are summarised in **Table 2-1**, below.

Table 2-1 Determination of receptor tolerance to construction phase impacts upon prey availability in offshore areas

<table>
<tr><th>Receptor</th><th>Receptor tolerance factors and assessed tolerance</th></tr>
<tr><td>Common scoter</td><td>
1. Dietary specificity: Primarily bivalve molluscs with other prey items (e.g. crabs, small fishes and gastropods) incorporated less frequently (Kaiser et al., 2006)
2. Impact magnitudes to key prey groups:
<table>
<tr><td rowspan="2">Key marine prey species / species groups</td><td colspan="4">Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
<tr><td rowspan="2">Habitat disturbance / loss</td><td colspan="2">Noise and vibration</td><td rowspan="2">Increased suspended sediment concentration</td></tr>
<tr><td>Mortality or injury</td><td>Behavioural change</td></tr>
<tr><td>Bivalve molluscs [shellfish group as proxy]</td><td>low</td><td>very low</td><td>very low</td><td>very low</td></tr>
</table>
3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0 individuals per km^2 (Very low)
OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = Medium
4. Foraging range: NA – non-breeding species
Assessed tolerance: Common scoter is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the magnitude of impacts to the key prey species are low to very low, foraging scoter were absent from the array site and surrounding 2 km buffer and that the OECC does not appear to represent an area of high importance for this receptor in the context of the wider western Irish Sea area.
</td></tr>
<tr><td>Kittiwake</td><td>
1. Dietary specificity: Primarily piscivorous (e.g. sandeels, herring, gadoids) with some invertebrates (e.g. euphausids, amphipods) in the diet also recorded (Hatch et al., 2020)
2. Impact magnitudes to key prey groups:
<table>
<tr><td rowspan="2">Key marine prey species / species groups</td><td colspan="4">Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
<tr><td rowspan="2">Habitat disturbance / loss</td><td colspan="2">Noise and vibration</td><td rowspan="2">Increased suspended sediment concentration</td></tr>
<tr><td>Mortality or injury</td><td>Behavioural change</td></tr>
<tr><td>Sandeel</td><td>very low</td><td>very low</td><td>low</td><td>low</td></tr>
<tr><td>Herring</td><td>very low</td><td>very low</td><td>very low</td><td>very low</td></tr>
</table>
</td></tr>
</table>

	Gadoids	very low	very low	low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 5.936 individuals per km^2 (High)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = High

4. **Foraging range**: Mean-max + 1 SD = 300.6 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 141,938 km^2.

Assessed tolerance: Kittiwake is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Although high densities of kittiwake utilise the array site and surrounding 2 km buffer and the OECC appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, these areas constitute only a small proportion of the sea area utilised by this wide ranging receptor.

Black-headed gull

1. **Dietary specificity**: Diet varies by location and season. Birds foraging in marine environments feed on fish and marine invertebrates (Moskoff *et al*., 2021). The diet of black-headed gull is extremely broad and opportunistic. Coastal birds may feed on marine invertebrates and to lesser extent on fish, sometimes following fishing vessels (Burger *et al*., 2020).
2. **Impact magnitudes to key prey groups**:

   Generalist forager – no particular key marine prey species

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.051 individuals per km^2 (Very low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = High

4. **Foraging range**: NA – non-breeding species

Assessed tolerance: Black-headed gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Although the OECC appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, densities of black-headed gull utilising the array site and surrounding 2 km buffer are very low.

Little gull

1. **Dietary specificity**: A primarily aquatic forager that feeds on flying insects, small fish and aquatic invertebrates typically at the water surface (Ewins and Weseloh, 2020). Little is known of the winter diet of this species
2. **Impact magnitudes to key prey groups**:

Key marine prey species	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)		
		Noise and vibration	

/ species groups	Habitat disturbance / loss	Mortality or injury	Behavioural change	Increased suspended sediment concentration
Flying insects	No impact			
Aquatic invertebrates [Shellfish group as proxy]	low	very low	very low	very low
Small fish species near water surface [worst-case benthic fish species, sandeel as proxy]	very low	very low	low	low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.255 individuals per km^2 (Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = High

4. **Foraging range**: NA – non-breeding species

Assessed tolerance: Little gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that this receptor forages upon a wide range of prey groups and that the magnitude of impacts to the key prey groups are zero to low (with the exception of potential behavioural change effects to sandeel, which are assessed as medium). Maximum little gull densities within the array site are low and although the OECC area appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, overall numbers of this species occurring within the Irish Sea constitute only a small part at the edge of wider biogeographic migratory population (123,000 individuals, Stroud *et al*., 2016).

Great black-backed gull

1. **Dietary specificity**: generalist predator that feeds on fish, both pelagic and intertidal marine invertebrates, mammals, insects, seabirds and waterfowl as well as their eggs and chicks. Great black-backed gulls also scavenge on fish, carrion, human refuse and will follow fishing vessels in search of fisheries discard (Good, 2020).
2. **Impact magnitudes to key prey groups**:

   Generalist forager – no particular key marine prey species

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.291 individuals per km^2 (Low)

	OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium 4. **Foraging range**: Mean-max (no SD available) = 73 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 8,371 km^2. Assessed tolerance: Great black-backed gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Although the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, densities of great black-backed gull utilising the array site and surrounding 2 km buffer are low and these areas constitute only a small proportion of the sea area utilised by this moderately wide ranging receptor.
Common gull	1. **Dietary specificity**: Diet varies by location and season. Birds foraging in marine environments feed on fish and marine invertebrates (Moskoff *et al*., 2021). The diet of black-headed gull is extremely broad and opportunistic. Coastal birds may feed on marine invertebrates and to lesser extent on fish, sometimes following fishing vessels (Burger *et al*., 2020). 2. **Impact magnitudes** to key prey groups: Generalist forager – no particular key marine prey species 3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.231 individuals per km2 (Very low) OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = Medium 4. **Foraging range**: NA – non-breeding species Assessed tolerance: Common gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Although the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, densities of common gull utilising the array site and surrounding 2 km buffer are low.
Herring gull	1. **Dietary specificity**: Generalist and opportunistic feeder and can forage over both terrestrial and aquatic habitats. Its diet includes fish, fish offal, bivalves, gastropods, crustaceans, squid, insects, other seabirds, small landbirds, small mammals, terrestrial insects, earthworms, berries, carrion, and a wide variety of human refuse (Weseloh *et al*., 2020). 2. **Impact magnitudes to key prey groups**: Generalist forager – no particular key marine prey species 3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 1.231 individuals per km^2 (Moderate) OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

<table>
<tr><td></td><td>4. Foraging range: Mean-max + 1 SD = 85.6 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 11,510 km^2.

Assessed tolerance: Herring gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Although densities of herring gull utilising the array site and surrounding 2 km buffer are moderate and the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, these areas constitute only a small proportion of the sea area utilised by this moderately wide ranging receptor.</td></tr>
<tr><td>Lesser black-backed gull</td><td>1. Dietary specificity: Diet diverse and opportunistic feeder. This species can forage over both terrestrial and aquatic habitats. Frequent prey items include small fish, aquatic invertebrates, birds' eggs and chicks, trawler discards, rodents and berries (Burger et al., 2020).

2. Impact magnitudes to key prey groups:

Generalist forager – no particular key marine prey species

3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.040 individuals per km^2 (Very Low)

OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = Medium

4. Foraging range: Mean-max + 1 SD = 236 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 87,487 km^2.

Assessed tolerance: Lesser black-backed gull is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Although the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, densities of lesser black-backed gull utilising the array site and surrounding 2 km buffer are very low and these areas constitute only a small proportion of the sea area utilised by this wide ranging receptor.</td></tr>
<tr><td>Sandwich tern</td><td>1. Dietary specificity: Largely piscivorous; surveys from the southern North Sea show that Clupeidae (herrings) and sandeels (Ammodytes spp) along with Nereis-worms (Nereididae spp) can form important prey bases (Courtens et al., 2017).

2. Impact magnitudes to key prey groups:

<table>
<tr><td>Key marine prey species / species groups</td><td>Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
</table>
</td></tr>
</table>

	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Nereis-worms [Shellfish group as proxy]	low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.035 individuals per km^2 (Very Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Low

4. **Foraging range**: Mean-max + 1 SD = 57.5 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 5,193 km^2. However – there are no colonies within foraging range of the Array Site or OECC.

Assessed tolerance: Sandwich tern is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of Sandwich tern utilising the array site and surrounding 2 km buffer are very low and the OECC also appears to represent an area of low importance for this receptor in the context of the wider western Irish Sea area. Furthermore, there are no Sandwich tern breeding colonies within foraging range of the array site or OECC.

Roseate tern

1. **Dietary specificity**: Largely piscivorous; studies from Rockabill SPA show that sandeels (Ammodytes spp) along with clupeids and, to a lesser extent, gadoids can form important prey bases (e.g. Allbrook *et al*., 2022).
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	

Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Gadoids	very low	very low	low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.013 individuals per km^2 (Very Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: Mean-max + 1 SD = 23.2 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 845 km^2. However – there are no colonies within foraging range of the Array Site or OECC.

Assessed tolerance: Roseate tern is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of roseate tern utilising the array site and surrounding 2 km buffer are very low and the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area. Furthermore, there are no roseate tern breeding colonies within foraging range of the array site or OECC.

Common tern

1. **Dietary specificity**: Largely piscivorous; studies from Rockabill SPA show that sandeels (Ammodytes spp) along with clupeids and, to a lesser extent, gadoids can form important prey bases (e.g. Allbrook *et al*., 2022).

2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Gadoids	very low	very low	low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 2.922 individuals per km^2 (Medium)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: Mean-max + 1 SD = 26.9 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 1,137 km^2.

Assessed tolerance: Common tern is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of common tern utilising the array site and surrounding 2 km buffer are moderate and the OECC also appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area and these areas constitute a moderate proportion of the sea area utilised by this receptor.

Arctic tern

1. **Dietary specificity**: largely piscivorous. Most frequent fish prey are small, schooling species commonly caught in open water, at tide rips, and over predators (e.g. jellyfish and marine mammals). These are usually 1- or 2-year-old fish, including from the Clupeidae (herrings), Gadidae (cods, pollocks) and Ammodytidae (sandeels) families (Hatch *et al*., 2020).
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Gadoids	very low	very low	low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 1.126 individuals per km^2 (Medium)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium
4. **Foraging range**: Mean-max + 1 SD = 40.5 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 2,576 km^2.

Assessed tolerance: Arctic tern is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of Arctic tern utilising the array site and surrounding 2 km buffer are moderate and the OECC also appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area and these areas constitute a moderate proportion of the sea area utilised by this receptor.

Little tern

1. **Dietary specificity**: largely piscivorous. Studies from a more southerly Irish colony show that sandeels (Ammodytes spp.) along with clupeids and, to a lesser extent, gadoids can form important prey bases (Johnson *et al*., 2022).
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Gadoids	very low	very low	low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0 individuals per km^2 (Very Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium
4. **Foraging range**: Max = 5 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 39 km^2.

Assessed tolerance: Little tern is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates several key species and the magnitude of impacts to those key prey species are generally low to very low. Although two visual aerial surveys undertaken in summer and autumn 2016 (ObSERVE – Jessopp *et al*., 2018) indicate that the array site and OECC appear to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, little tern were observed only once (one record of two individuals) during 24 baseline digital aerial surveys of the array site and surrounding 2 km buffer. Furthermore, breeding birds are considered to forage over marine and brackish waters quite close (<5 km) to breeding colonies (Power *et al*., 2021; Power *et al*., 2022) and as such there is no potential for overlap with the array site plus a 2 km buffer, or the OECC.

Guillemot

1. **Dietary specificity**: a wide variety of fish species, euphausiids, large copepods, and squid. In summer mainly fish (particularly sandeel and sprat – Harris *et al*., 2022), especially when feeding chicks, in contrast to a more diverse diet during non-breeding period, with euphausiids in particular more important (Ainley *et al*., 2021).
2. **Impact magnitudes to key prey groups**:

Key marine prey species /	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)

species groups				
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Sprat	very low	very low	low	very low
Euphausiids [Shellfish group as proxy]	low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 58.100 individuals per km^2 (Very High)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = High

4. **Foraging range**: Mean-max + 1 SD = 153.7 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 37,108 km^2.

Assessed tolerance: Guillemot is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of fish and invertebrate species. This includes several key species and the magnitude of impacts to those key prey species are generally low to very low. Although densities of guillemot utilising the array site and surrounding 2 km buffer are very high at times and the OECC also appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, these areas constitute only a small proportion of the sea area utilised by this receptor.

Razorbill

1. **Dietary specificity**: Range of schooling fish including herring and sandeel. Crustaceans and polychaetes may also be important in adult diets (Lavers *et al.*, 2020).
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	

Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low
Crustaceans and polychaetes [Shellfish group as proxy]	low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 18.990 individuals per km^2 (Very High)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = High

4. **Foraging range**: Mean-max + 1 SD = 164.6km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 42,558 km^2.

Assessed tolerance: Razorbill is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of fish and invertebrate species. This includes several key species and the magnitude of impacts to those key prey species are generally low to very low. Although densities of razorbill utilising the array site and surrounding 2 km buffer are very high at times and the OECC also appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, these areas constitute only a small proportion of the sea area utilised by this receptor.

Black guillemot

1. **Dietary specificity**: a wide range of benthic fish and invertebrate species. Based on a study from Shetland, Scotland, chicks were provisioned predominantly a diet of sandeels and butterfish (Ewins, 1990).
2. **Impact magnitudes to key receptor groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sandeel	very low	very low	low	low
Butterfish [worst-case benthic fish species, sandeel as proxy]	very low	very low	low	low
Benthic invertebrates	low	very low	very low	very low

[Shellfish group as proxy]				

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.076 individuals per km^2 (Very low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Low

4. **Foraging range**: Mean-max + 1 SD = 9.1 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 130 km^2. Although there are no colonies within foraging range of the Array Site, breeding individuals from sites between Wicklow and Dublin may forage within the OECC area.

Assessed tolerance: Black guillemot is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that, although the magnitude of impacts to key prey species are moderate to very low, levels of black guillemot usage of the array site were very low and the OECC appears also to represent an area of low importance for this receptor in the context of the wider western Irish Sea area.

Puffin

1. **Dietary specificity**: Predominately small to mid-sized (5 – 15cm) schooling midwater fish including sprat (Sprattus sprattus) sandeel (Ammodytes spp) and herring (Clupea harengus) (Lowther *et al*., 2020).
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sprat	very low	very low	low	very low
Sandeel	very low	very low	low	low
Herring	very low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.408 individuals per km^2 (Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: Mean-max + 1 SD = 265.4 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 110,642 km^2.

Assessed tolerance: Puffin is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a range of fish species. This includes several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of puffin utilising the array site and surrounding 2 km buffer are low and, although the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea, these areas constitute only a small proportion of the sea area utilised by this wide ranging receptor.

Red-throated diver

1. **Dietary specificity**: Piscivorous, but poorly known outside of the breeding season. One study from the German Bight indicates that red-throated diver is a generalist opportunistic feeder but pelagic schooling fish that have a high energetic value might be favoured (Kleinschmidt *et al.*, 2019)
2. **Impact magnitudes to key prey groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Sprat [example of high energetic value pelagic schooling fish]	very low	very low	low	very low
Herring [example of high energetic value pelagic schooling fish]	very low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 4 km buffer): Maximal bio-seasonal mean peak density = 0.577 individuals per km^2 (Medium)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: NA – non-breeding species

Assessed tolerance: Red-throated diver is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore development areas. This is on the basis that the receptor depredates a range of fish species. This includes several key species and the magnitude of impacts to those key prey species are generally very low. Densities of red-throated diver utilising the array site and surrounding 4 km buffer are moderate, the array site and OECC do not appear to represent an area of high Importance for this receptor in the context of the wider western Irish Sea area.

Great northern diver

1. **Dietary specificity**: Largely piscivorous, foraging over the benthos as well as throughout the water column, but will also frequently eat marine invertebrates (Paruk *et al*., 2021)

2. **Impact magnitudes to key prey group**s:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Invertebrates [Shellfish group as proxy]	low	very low	very low	very low

3. **Use of project areas**: Array Site (+ 4 km buffer): Maximal bio-seasonal mean peak density = 0.051 individuals per km^2 (Very Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: NA – non-breeding species

Assessed tolerance: Great northern diver is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of benthic and pelagic fish species. This includes one potentially particularly important broad prey group (marine invertebrates), for which the magnitude of impacts is low / very low. Densities of great-northern diver utilising the array site and surrounding 4 km buffer are very low, and the OECC does not appear to represent an area of high importance for this receptor in the context of the wider western Irish Sea area.

<table>
<tr>
<td>Fulmar</td>
<td>
1. Dietary specificity: The colonisation of Ireland and Britain by fulmar over the last two centuries has been largely attributed to their close association with fisheries, but contemporary dietary studies indicate they also feed on a wide variety of prey including sandeels, crustaceans and squid (Philips I., 1999)
2. Impact magnitudes to key receptor groups:
Generalist forager – no particular key marine prey species
3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.114 individuals per km^2 (Very low)
OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = Low
4. Foraging range: Mean-max + 1 SD = 1,200.2 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 2,262,700 km^2.
Assessed tolerance: Fulmar is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor is a generalist forager, with a high level of dietary flexibility should the availability of one or more of its prey species alter in response to construction phase activities. Densities of fulmar utilising the array site and surrounding 2 km buffer are low, the OECC also appears to represent an area of low importance for this receptor in the context of the wider western Irish Sea area and these areas constitute only a very small proportion of the sea area utilised by this very wide ranging receptor.
</td>
</tr>
<tr>
<td>Manx shearwater</td>
<td>
1. Dietary specificity: Primarily clupeiform fish (i.e. herring and sprat, during the chick rearing period; outside of this period squid and other marine invertebrates may form a larger part of the manx shearwater's diet (Brooke, 1990).
2. Impact magnitudes to key receptor groups:
<table>
<tr><td>Key marine prey species / species groups</td><td colspan="4">Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
<tr><td></td><td>Habitat disturbance / loss</td><td colspan="2">Noise and vibration</td><td>Increased suspended sediment concentration</td></tr>
<tr><td></td><td></td><td>Mortality or injury</td><td>Behavioural change</td><td></td></tr>
<tr><td>Sprat</td><td>very low</td><td>very low</td><td>low</td><td>very low</td></tr>
<tr><td>Herring</td><td>very low</td><td>very low</td><td>very low</td><td>very low</td></tr>
<tr><td>Invertebrates [Shellfish group as proxy]</td><td>low</td><td>very low</td><td>very low</td><td>very low</td></tr>
</table>
3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 4.900 individuals per km^2 (Medium)
</td>
</tr>
</table>

OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al*., 2018) = Medium

4. **Foraging range**: Mean-max + 1 SD = 2,365.5 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 8,789,532 km^2.

Assessed tolerance: Manx shearwater is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of fish and invertebrate species. This includes several key species and the magnitude of impacts to those key prey species are generally low to very low. Although densities of Manx shearwater utilising the array site and surrounding 2 km buffer are moderate at times and the OECC also appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area, these areas constitute only a very small proportion of the sea area utilised by this very wide ranging receptor.

Gannet

1. **Dietary specificity**: Depredates a wide range of pelagic fish species, usually including including Clupeidae (herrings) mackerel and sandeels (Ammodytes spp) (Hamer *et al*., 2000), supplemented by locally available prey items (Barrett *et al*., 2015).
2. **Impact magnitudes to key receptor groups**:

Key marine prey species / species groups	Magnitude of construction phase impact (**Chapter 9: Fish, Shellfish and Turtle Ecology**)			
	Habitat disturbance / loss	Noise and vibration		Increased suspended sediment concentration
		Mortality or injury	Behavioural change	
Herring	very low	very low	very low	very low
Mackerel	very low	very low	low	very low
Sandeel	very low	very low	low	low

3. **Use of project areas**: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.457 individuals per km^2 (Low)

   OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop *et al.,* 2018) = Medium

4. **Foraging range**: Mean-max + 1 SD = 509.4 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 407,603 km^2.

Assessed tolerance: Gannet is considered to have a very high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of pelagic fish species. This includes

<table>
<tr><td></td><td>several key species and the magnitude of impacts to those key prey species are generally low to very low. Densities of gannet utilising the array site and surrounding 2 km buffer are low and the OECC appears to represent an area of moderate importance for this receptor in the context of the wider western Irish Sea area. array site and OECC areas constitute only a very small proportion of the sea area utilised by this very wide ranging receptor..</td></tr>
<tr><td>Cormorant</td><td>
1. Dietary specificity: diet consists predominantly of small benthic and pelagic fish which are captured by pursuit diving, typically over shallow (<10 m) freshwater, estuarine and marine environments (Gremillet et al., 1998; Hatch et al., 2020). In marine environments cormorant diet has been observed to comprise of large components of wrasse, gadoids and sandeel, dependant on local availability (West et al., 1975; Barrett et al., 1990)
2. Impact magnitudes to key receptor groups:
<table>
<tr><td>Key marine prey species / species groups</td><td colspan="4">Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
<tr><td></td><td>Habitat disturbance / loss</td><td colspan="2">Noise and vibration</td><td>Increased suspended sediment concentration</td></tr>
<tr><td></td><td></td><td>Mortality or injury</td><td>Behavioural change</td><td></td></tr>
<tr><td>Wrasse [worst-case benthic fish species, sandeel as proxy]</td><td>very low</td><td>very low</td><td>low</td><td>low</td></tr>
<tr><td>Gadoids</td><td>very low</td><td>very low</td><td>low</td><td>very low</td></tr>
<tr><td>Sandeel</td><td>very low</td><td>very low</td><td>low</td><td>low</td></tr>
</table>
3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.055 individuals per km^2 (Very Low)

OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = High
4. Foraging range: Mean-max + 1 SD = 33.9 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 1,805 km^2.

Assessed tolerance: Cormorant is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of benthic and pelagic fish species. This includes several key species and the magnitude of impacts to those key prey species are generally moderate to very low. Although the OECC appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, densities of cormorant utilising the array site and surrounding 2 km buffer are very low
</td></tr>
</table>

<table>
<tr><td></td><td>array site and OECC areas constitute only a very small proportion of the sea area utilised by this very wide ranging receptor.</td></tr>
<tr><td>Shag</td><td>
1. Dietary specificity: almost exclusively piscivorous, with prey taken chiefly near sea bed or at intermediate depths, and principally of the families Ammodytidae (sandeels), Gadidae (cod), Clupeidae (herring), Cottidae (sculpins) and Labridae (wrasse), but a wide range of species taken, perhaps opportunistically (Orta et al., 2021).
2. Impact magnitudes to key receptor groups:
<table>
<tr><td>Key marine prey species / species groups</td><td colspan="4">Magnitude of construction phase impact (Chapter 9: Fish, Shellfish and Turtle Ecology)</td></tr>
<tr><td></td><td>Habitat disturbance / loss</td><td colspan="2">Noise and vibration</td><td>Increased suspended sediment concentration</td></tr>
<tr><td></td><td></td><td>Mortality or injury</td><td>Behavioural change</td><td></td></tr>
<tr><td>Wrasse and sculpins [worst-case benthic fish species, sandeel as proxy]</td><td>very low</td><td>very low</td><td>low</td><td>low</td></tr>
<tr><td>Gadoids</td><td>very low</td><td>very low</td><td>low</td><td>very low</td></tr>
<tr><td>Sandeel</td><td>very low</td><td>very low</td><td>low</td><td>low</td></tr>
<tr><td>Herring</td><td>very low</td><td>very low</td><td>very low</td><td>very low</td></tr>
</table>
3. Use of project areas: Array Site (+ 2 km buffer): Maximal bio-seasonal mean peak density = 0.190 individuals per km^2 (Very Low)

OECC: Area use relative to wider western Irish Sea (from ObSERVE data – Jessop et al., 2018) = High
4. Foraging range: Mean-max + 1 SD = 23.7 km. Marine area within foraging range (assuming 50% of area within foraging range radius is marine) = 882 km^2.

Assessed tolerance: Shag is considered to have a high tolerance to impacts to prey species in relation to construction phase activity within offshore areas. This is on the basis that the receptor depredates a wide range of benthic and pelagic fish species. This includes several key species and the magnitude of impacts to those key prey species are generally moderate to very low. Although the OECC appears to represent an area of high importance for this receptor in the context of the wider western Irish Sea area, densities of shag utilising the array site and surrounding 2 km buffer are very low array site and OECC areas constitute only a very small proportion of the sea area utilised by this very wide ranging receptor.
</td></tr>
</table>

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