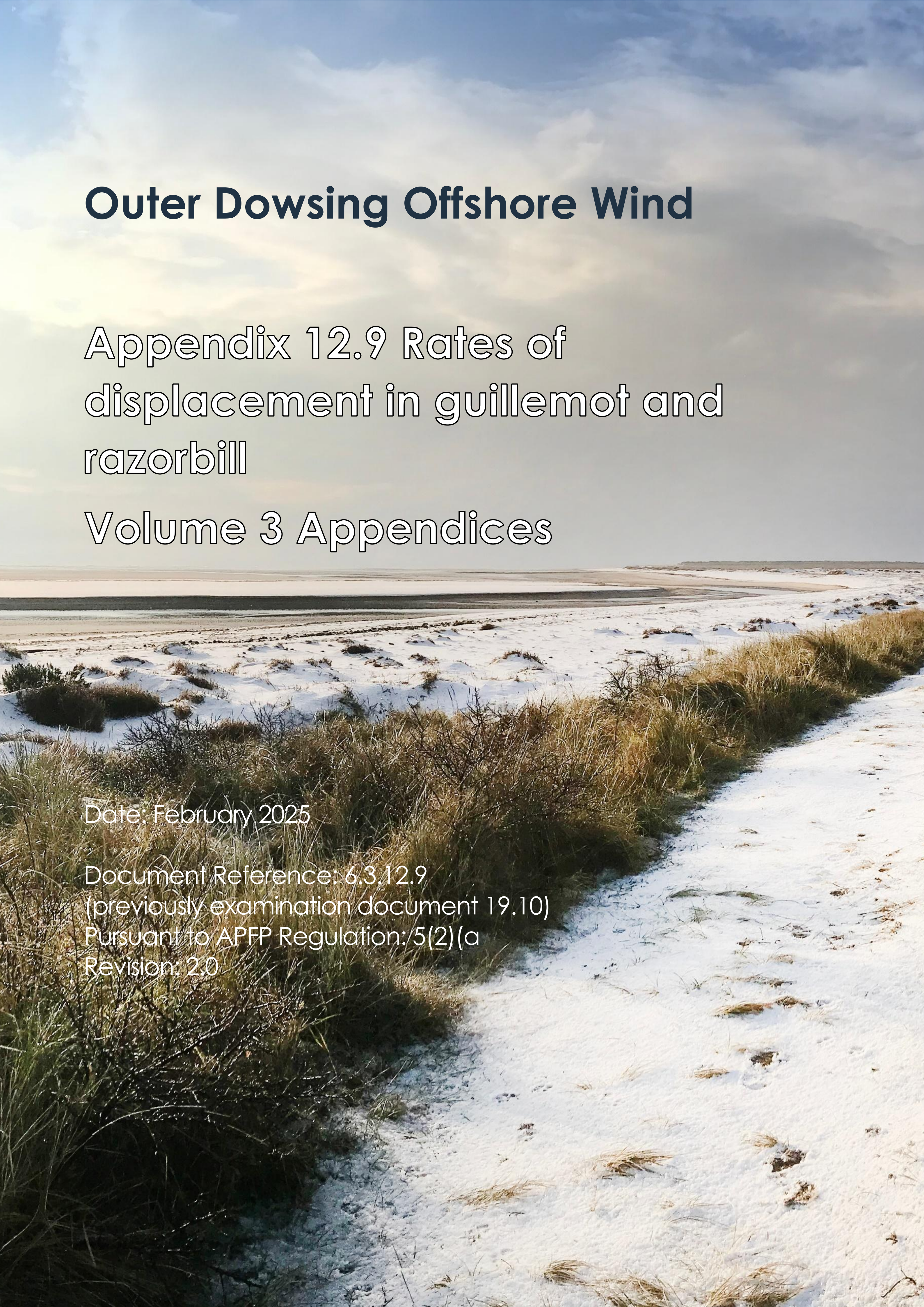

# Outer Dowsing Offshore Wind

## Appendix 12.9 Rates of displacement in guillemot and razorbill

## Volume 3 Appendices

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# Change Log

- Examination ES Update: This document is referred to in Chapter 12 and so has been included as an Appendix to that Chapter (with small amendments to Version 1 to update definitions).

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# Acronyms & Definitions

## Abbreviations / Acronyms

| Abbreviation / Acronym | Description |
|---|---|
| **AEoI** | Adverse Effect on Integrity |
| **ANS** | Artificial Nesting Structure |
| **BACI** | Before-After-Control-Impact |
| **DAS** | Digital Aerial Survey |
| **INLA** | Integrated Nested Laplace Approximations |
| **MMFR** | Mean Maximum Foraging Range |
| **ODOW** | Outer Dowsing Offshore Wind |
| **ORBA** | Offshore Restricted Build Area |
| **ORCP** | Offshore Reactive Compensation Platform |
| **OWF** | Offshore Wind farm |
| **RIAA** | Report to Inform Appropriate Assessment |
| **SNCB** | Statutory Nature Conservation Body |
| **UK** | United kingdom |
| **WTG** | Wind Turbine Generator |

## Terminology

| Term | Definition |
|---|---|
| **The Applicant** | GTR4 Limited (a joint venture between Corio Generation (and its affiliates), TotalEnergies and Gulf Energy Development), trading as Outer Dowsing Offshore Wind |
| **Array Area** | The area offshore within which the generating station (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling will be positioned, including the ORBA. |
| **Bioseason** | A biologically defined period of a bird's annual cycle based on the location and/or behaviour of the bird |
| **Effect** | Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the sensitivity of the receptor, in accordance with defined significance criteria. |
| **Environmental Impact Assessment (EIA)** | A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES). |
| **Environmental Statement** | The suite of documents that detail the processes and results of the EIA. |
| **Export Cables** | High voltage cables which transmit power from the Offshore Substations (OSS) to the Onshore Substation (OnSS) via an Offshore |

| Term | Definition |
|---|---|
| | Reactive Compensation Platform (ORCP) if required, which may include one or more auxiliary cables (normally fibre optic cables). |
| **Impact** | An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial. |
| **Landfall** | The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore. |
| **Offshore Reactive Compensation Platform (ORCP)** | A structure attached to the seabed by means of a foundation, with one or more decks (including bird deterrents) housing electrical reactors and switchgear for the purpose of the efficient transfer of power in the course of HVAC transmission by providing reactive compensation |
| **Offshore Restricted Build Area (ORBA)** | The area within the array area, where no wind turbine generator, offshore transformer substation or offshore accommodation platform shall be erected |
| **Onshore Infrastructure** | The combined name for all onshore infrastructure associated with the Project from landfall to grid connection. |
| **Outer Dowsing Offshore Wind (ODOW)** | The Project |
| **The Project** | Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure. |
| **Wind Turbine Generator (WTG)** | A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems, fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation |

## Reference Documentation

| Document Number | Title |
|---|---|
| Document Reference 6.3.12.7 (previously 19.8) | Levels of precaution in the assessment and compensation calculations for offshore ornithology |
| Document Reference 6.3.12.8 (previously 19.9) | Consideration of bioseasons in the assessment of guillemot |
| Document Reference 19.11 | Lead-in periods for kittiwake breeding on Artificial Nesting Structures |

# 1 Executive Summary

Following completion of the Report to Inform Appropriate Assessment for the Project (RIAA; AS1-095), with regard to guillemot and razorbill, the RIAA has concluded that there is no potential for an Adverse Effect on Integrity (AEoI) alone or in-combination. However, given the advice received from Natural England that they may not be able to rule out the potential for AEoI for these species, a 'without prejudice' derogation case and associated compensation measures have been developed for these species.

Impacts to seabird species known to be susceptible to displacement due to the presence of wind turbine generators (WTG) are assessed through the application of displacement and mortality rates which are applied to bioseasonal populations (typically defined by digital aerial survey (DAS)). For each species, matrices comprising displacement rates between 10 and 100% and mortality rates between 1 and 100% are presented, with projects and statutory advisors selecting the most appropriate displacement rates and mortality rates, incorporating a suitable level of precaution, on which to base assessments. The displacement and mortality rates are applied across each bioseason. Bioseasonal impacts are then summed to define an annual impact.

Evidence supporting the displacement and mortality rates selected when considering impacts on auk species has been historically sparse, with publication of data or results of windfarm displacement a relatively recent development.

Recently, collation of displacement monitoring outputs has allowed more in-depth investigation into the parameters influencing levels of displacement. Meta-analyses have been conducted, such as APEM (2022) and Lamb *et al*., (2024), to compare rates of displacement across sites, and analytical methods used, to better understand factors influencing displacement.

This document summarises the findings of these investigations and discusses their implications for the displacement rates to be used when considering impacts of the Project.

In Natural England's Relevant Representation (RR-045), Natural England commented that the Applicant had only presented the potential for the proposed compensation measures to deliver the full capacity of required compensation at the Applicant's preferred apportioning approach, using a 50% displacement rate, amongst other factors. In the Applicant's Responses to Relevant Representations (Document Reference 15.3) at pages 292 and 297, the Applicant commented that precaution is introduced at several stages of apportioning and assessment of guillemot and razorbill, including the displacement and mortality rates used in the assessment. This document provides further evidence confirming that the Applicant's use of a 50% displacement rate, as opposed to the 70% displacement rate as advised by Natural England, is appropriate.

Based on the information presented, the Applicant considers that a 70% displacement rate for guillemot and razorbill is not backed by evidence collated from existing displacement studies and is overly precautionary, and that a lower rate of 50% is more appropriate for the Project whilst maintaining a suitable level of precaution.

# 2 Introduction

## 2.1 Project Background

1. GT R4 Limited (trading as Outer Dowsing Offshore Wind (ODOW)) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (the Project). The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm) approximately 54km from the Lincolnshire coastline in the southern North Sea, export cables to landfall, Offshore Reactive Compensation Platforms (ORCPs), onshore cables, connection to the electricity transmission network, ancillary and associated development and areas for the delivery of up to two Artificial Nesting Structures (ANS) and the creation of a biogenic reef (see Volume 1, Chapter 3: Project Description (Document Reference 6.1.3) for full details).

## 2.2 Document Purpose

2. Following completion of the Report to Inform Appropriate Assessment for the Project (RIAA; Document Reference 7.1), with regard to guillemot and razorbills, the RIAA has concluded that there is no potential for an Adverse Effect on Integrity (AEoI) alone or in-combination. However, given the advice received from Natural England that they may not be able to rule out the potential for AEoI for these species, a 'without prejudice' derogation case and associated compensation measures have been developed for these species.
3. Impacts to seabird species known to be susceptible to displacement due to the presence of wind turbine generators (WTG) are assessed through the application of displacement and mortality rates which are applied to bioseasonal populations (typically defined by digital aerial survey (DAS)). For each species and each bioseason, matrices comprising displacement rates between 10 and 100% and mortality rates between 1 and 100% are presented, with projects and statutory advisors selecting the most appropriate or precautionary displacement and mortality rates, incorporating a suitable level of precaution, on which to base assessments. Bioseasonal impacts are then summed to define an annual impact.
4. Evidence supporting the displacement and mortality rates selected has been historically sparse, with publication of data or results of windfarm displacement a relatively recent development. As outputs from displacement monitoring have increased, the range of levels of displacement detected across different sites has become apparent, suggesting that the application of a single displacement rate across all projects and bioseasons is not appropriate. This is also evidenced by the lack of agreement between statutory bodies regarding the most appropriate rates to apply.

5. Recently, collation of displacement monitoring outputs has allowed more in-depth investigation into the parameters influencing levels of displacement. Meta-analyses have been conducted, such as APEM (2022) and Lamb *et al*., (2024), to compare rates of displacement across sites, and analytical methods used, to better understand factors influencing displacement. This report summarises the findings of these investigations and discusses their implications for the displacement rates to be used when considering the impacts of the Project.
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8. This report should be read in conjunction with the report on Lead-in periods for Kittiwake breeding on Artificial Nesting Structures (ANS)(Document Reference 19.11), Levels of Precaution in the assessment and confidence calculations for offshore ornithology (Document Reference 6.3.12.7) and SNCB guidance and bioseasons for guillemot (Document Reference 6.3.12.10).

# 3 Current Guidance and Rates used by the Applicant

9. At present there is not full agreement between UK statutory nature conservation bodies (SNCB) regarding the most appropriate displacement (and mortality) rates to use in displacement assessment for guillemot and razorbill. These rates are applicable across the annual cycle. The Applicant's approach is to assess displacement impacts for guillemot and razorbill using a displacement rate of 50%. Current rates advised for these species, and the rate used by the Applicant, are presented in Table 1.

Table 1. Displacement rates recommended by SNCBs and the rate used by the Applicant

| | Preferred displacement rate | | | |
|---|---|---|---|---|
| | Natural England | Nature Scot | NRW | Applicant |
| Guillemot | 70% | 60% | 70% | 50% |
| Razorbill | 70% | 60% | 70% | 50% |

# 4 Meta-analyses of Displacement

10. Two analyses collating displacement data have been carried out. In 2022, APEM undertook an analysis of all available displacement data on guillemot and razorbill (this work was commissioned for the Hornsea Four project). In 2024, Lamb *et al*., carried out a similar exercise with a larger pool of data and across a wider suite of species. The following sections summarise the findings of these analyses.

## 4.1 APEM 2022

11. In order to better understand levels of displacement, APEM collated information from the analysis of displacement effects on guillemot and razorbill at 21 offshore wind farms (OWFs) in UK and northwest European waters. Methods of data analysis were reviewed, and in some cases data were reanalysed, and levels of displacement measured were considered in relation to the key attributes for as built projects, i.e., density of turbines and levels of marine traffic, and ecological factors, i.e., bird density, season, distance from shore and geographical location.
12. This document provides a summary of the APEM (2022) report and provides clarificatory information to that information presented in the Environmental Statement (Document Reference 6.1.12). It further explains the statistical methods used in the APEM (2022) report and provides additional detail as to why the worst-case displacement rates in the APEM (2022) report are unsuitable for the Project.
13. In addition, this document considers the findings of the APEM (2022) study regarding the differences in observed displacement between breeding and non-breeding birds, which is pertinent to the conclusions reached as to the displacement rate which should be applied.

### 4.1.1 Key Findings

#### 4.1.1.1 Statistical analyses

14. The APEM (2022) review found that some of the statistical methods used to estimate levels of displacement at the OWFs were not appropriate for use with highly zero inflated datasets (i.e. datasets where a large proportion of observations are zero, as frequently happens with observations of seabirds at sea). Where possible, APEM re-analysed these datasets using the more appropriate approach of integrated nested Laplace approximations (INLA). The INLA approach has been recommended as a result of an international workshop (Leopold, 2018) and studies that have re-analysed data sets (Zuur, 2018).

15. The results of this re-analysis suggest that, where less suitable methods had been utilised, resultant displacement rates should be treated with caution as they are likely to be over-estimates. Zero inflated data sets are prone to greater variability in outputs than would be expected, therefore statistical methods that manage zero inflated datasets must be used. This in turn avoids the overestimation of results. For example, at two of the sites where re-analysis of the datasets was conducted, there was no evidence of significant displacement effects where previously displacement had been reported. At another site, where data were re-analysed using INLA, displacement levels were assessed as 45% where levels of 60% had previously been reported. As such, it can be assumed that many of the displacement rates that have to date informed SNCB guidance are likely to be overestimates or at least should be treated with a degree of caution.

#### 4.1.1.2 Design features

16. The APEM (2022) review found a correlation between the density of the windfarm and displacement, with higher densities of WTGs associated with higher displacement. It also found that high WTG density, and density of marine traffic, were shared attributes of sites with comparatively higher levels of displacement.
17. When considering the minimum spacing of 605m between turbines, the worst-case scenario for the Project regarding turbine density is 1.66 turbines per $km^2$. This is low within the context of the studies reviewed by APEM (2022), which have an average density of 2.48 turbines per $km^2$. As the WTG density for the Project will be low (lower than all but one project assessed as part of the APEM review), this means that a displacement rate of 70% is likely to be even less representative of actual displacement at the site.

#### 4.1.1.3 Ecological factors

18. The APEM (2022) review found associations between auk abundance and geographical region with sites of higher displacement. Sites with lower auk abundance, and which were located further south were found to exhibit greater displacement. As the Project has high abundance and is, from an ecological perspective, more aligned with the locations of the northern sites as defined and identified in APEM (2022) review (for example Westermost Rough), these factors suggest that a displacement rate of 70% would over-estimate displacement and that a rate of 50% would be more appropriate. be more appropriate.

#### 4.1.1.4 Displacement effects

19. Nine of the studies reviewed showed no displacement and, of these, six were originally analysed using INLA.
20. Displacement levels of 50% or above were reported by eight of the 21 OWFs assessed (displacement rates of 60%-75%); however all of these studies reported low auk abundance (compared with the Project, which had a mean peak density of 42.54 birds/km$^2$) and it is considered that, over the three years during which the data were collected, the small sample size was insufficient to support a reliable analysis. The study defines low auk abundance as ~5 to <1 birds/km$^2$. None of the assessments for the eight studies were carried out using INLA, with Zuur (2018) finding that, of the eight studies that published displacement effects over 50%, three had questionable confidence levels and two had not been published long enough to be independently assessed.
21. The studies of the remaining OWFs either showed no displacement effect (n=8), showed a displacement effect lower than 50% (n=1) or inferred displacement but did not report a displacement rate (n=4).

### 4.1.2 Discussion

22. The displacement assessments from the 21 OWFs collated by APEM (2022) present effects ranging from an attraction of 112% to a displacement of 75%, with displacement effects reported between 25 and 75%, which aligns with the 30 – 70% displacement range advocated by SNCBs, and an average displacement rate of 25.9%. The APEM (2022) review suggests that, for those sites which showed the greatest levels of displacement, levels are likely to have been overestimated due to the use of statistical methods that were not appropriate. These statistical models were unable to manage such zero-inflated data sets due to excess zeros causing over dispersion of data. Therefore, the previous models were not appropriate due to the assumption of normally distributed data. Some of the displacement assessments are also associated with low statistical confidence due to low sample sizes.
23. The APEM (2022) review also highlights many ways in which windfarm design or ecological factors affect the level of displacement shown. A key ecological factor appears to be bird abundance, with areas of low abundance having higher levels of displacement. However, it is unclear whether the high displacement rates are real and related to low densities, or whether the analysis techniques used were suitable for datasets with low densities of birds. Displacement may also be influenced by distance from shore and geographic location. This suggests that a single displacement rate would not be appropriate for use across all projects, and that projects with certain design features, densities of birds, or in certain locations, could be assessed using a lower displacement rate.
24. The results of the APEM meta-analysis also suggest that seasonality may be an important factor in displacement. Sites reporting high levels of displacement had many similar attributes that suggest that displacement in the breeding season may be lower than displacement in the non-breeding season. This is discussed further in Section 5.

## 4.2 Lamb *et al*., 2024

25. Lamb *et al*., (2024) reviewed outputs from 39 studies of displacement and attraction at offshore projects across a wide suite of species, including guillemot and razorbill. Of these, 15 studies were also reviewed during the APEM (2022) review, meaning a total of 45 projects in total contributed to the meta-analysis over the two reports.
26. Lamb *et al*., collated studies where empirical data informing displacement or attraction were presented alongside sufficient data to test for differences (i.e. means and measures of precision). From these data, information on whether an effect had been detected and the size of that effect was extracted. The study also collated data pertinent to the design of the array and the location.

### 4.2.1 Key Findings

27. When modelling the likelihood of a significant displacement effect from a constructed windfarm, and considering either biological parameters (taxa and season) study design (survey area, distance to effect and reference area) or wind farm design (turbine density, distance to shore, latitude) alone, biological parameters explained over half of the observed variance and fitted the model substantially better than study or windfarm design. The best model fit was achieved by combining all three sets of parameters, but as the biological parameters fitted best when assessed alone, it can be assumed that these parameters are key to whether a development has a displacement effect. The magnitude of the displacement effect was also best explained by biological parameters.
28. Variation between taxonomic groups explained more variation than any other covariate (i.e., different species are displaced at different rates), but season also affected the occurrence and magnitude of seabird distributional change following the installation of OWFs. Studies over the complete annual cycle were less likely to report change compared to those focussing on specific bioseasons, with increases (across most taxa) in distributional change most likely in the breeding season. In part, this may be related to a given project's power to detect a change. Breeding season aggregations are likely to be higher density and less variable in their location than aggregations in other seasons due to breeding birds being central place foragers and having less flexibility in their foraging strategies while breeding. Higher densities and lower spatial variation make detection of a change more likely. The Applicant considers that the displacement rates advised by SNCB's are based largely on non-breeding displacement but are being used to assess annual displacement, and in particular regarding the Project, annual displacement where the majority of interaction with the array area is in the breeding season. As a result, the displacement rates used are not representative of the displacement that the majority of the birds using the Project would demonstrate.

29. Conversely, the study found that auks showed greater displacement effects during the non-breeding season (compared to the breeding season) regardless of the kind of spatial comparison used.  Upper and lower confidence intervals of effect size, across the studies, were 69% and 49% respectively, suggesting that the mean level of displacement across all of the studies was somewhere within this range, and likely to be in the region of 60%. This is an annual displacement rate and is therefore less appropriate for the Project where the majority of displacement occurs in the breeding season, where displacement has been demonstrated to be lower.
30. As the effect of season on displacement was second only to the differences between species specific displacement in explaining variation within the model, the changes in displacement rates between seasons should not be considered trivial. Therefore 'single season', ie consideration of displacement rates during the non-breeding season only, should not be considered appropriate for determining the precautionary scenario for assessment of annual displacement, especially when the majority of displacement occurs in the breeding season. This, in combination with other factors such as the location of the Project (i.e. the relatively northern location), and the fact that the wind turbine density will be low (compared to other Projects in the APEM (2022) review), suggest that the Projects displacement will be substantially lower than 60%, and that therefore an assessment based on 50% is appropriately precautionary.

## 4.3 Trinder *et al.,* 2024

31. A novel method for studying displacement is presented by Trinder *et al.,* (2024). This study, based on data collected for pre and post construction monitoring surveys at the Beatrice windfarm, acknowledges that changes in bird distribution after construction of a wind farm can be difficult to disentangle from other potential causes of change such as changes in food distribution, especially given the high levels of variation in both time and space of seabird distribution. Trinder *et al*., (2024) examined bird distribution in relation to the Beatrice Windfarm WTGs, and compared the results with the density distribution around a simulation of an array layout. If birds were being displaced by WTGs, their distribution around the existing structures should be reduced when compared to the distribution around the simulated locations.

### 4.3.1 Key Findings

32. The study found that there was no difference between the observed density around the turbines when compared to the expected density (as informed by the densities around the simulated turbine locations). As such, no displacement was detected, resulting in a site-specific displacement rate of 0%.
33. The study noted that, for both guillemot and razorbill, densities around turbines were higher than expected, suggesting a weak attraction effect. There was no effect from rotor speed (i.e. birds showed no greater or less displacement depending on how fast the turbine blades were turning).

34. The results of this study give a clear indication of no displacement effect; the methods used mean that results are less likely to be obfuscated by the variations in bird distribution over the time periods involved in a standard Before-After-Control-Impact (BACI) study. As the study encompassed breeding birds interacting with OWF during the breeding season, its conclusion of 0% displacement is highly relevant to the Project. This should be considered as the best evidence with regard to the Project due to the similarities between the two projects. Specifically, the assessments for both are largely based on birds breeding at nearby colonies, with the greatest displacement potential on constrained birds during the breeding season, with birds from both projects potentially interacting with an array on a daily basis. In addition, both studies are from the ecological ‘north’ (within the context of observed displacement), and both projects have a low density of WTGs, when compared to those projects identified in APEM (2022). Likewise, both sites report high densities of birds, with a peak density of 52.83 guillemot per $km^2$ at the Beatrice OWF compared to the 42.54 birds per $km^2$ for the Project.  As such, the Beatrice study is considered a more appropriate representation of the likely displacement from the Project than using the precautionary end of the scale from a range of studies, many of which are not representative of the site or the birds at risk of displacement.  Therefore, the Project displacement rate of 50% is precautionary. The methods used to measure displacement from OWFs both pre-and post-construction by Trinder *et al*., (2024) should be seen as a benchmark for future studies monitoring displacement from offshore wind projects.

# 5 Reduced Displacement in the Breeding Season

35. Displacement rates may differ at different stages in a bird's annual cycle. A bird may be less likely to be displaced from an area where there is incentive for it to remain (such as the pressure to forage in good locations close to the colony in the breeding season) compared to an area where there is little pressure for it to remain (such as any given point along the transit of a bird's post-breeding migration).
36. Both the APEM (2022) and Lamb *et al*., 2024 studies (summarised in Section 4) provide evidence in support of lower levels of displacement of birds in the breeding season. The APEM (2022) review concluded that the abundance of auks, and geographical location all influenced displacement, with lower displacement rates at sites with high abundance, and at more northerly sites. Sites were identified as northerly within the context of observed displacement, as defined by APEM (2022) by comparison to others included in the study, i.e. those sites situated within the 'ecological' southern North Sea (in terms of displacement rates observed for auks). The idea that more southerly sites showed higher displacement rates is considered more likely to relate to the predominance of non-breeding birds at a site (either, those dispersing or dispersed from colonies, birds not mature enough to breed, or birds on sabbatical). Sites within the APEM (2022) review which reported a significant displacement effect were all within the southern North Sea (in UK, Dutch, Belgian and German waters); however, unlike the Project, these 'southern' sites are all beyond the mean maximum foraging range plus 1 standard deviation of all razorbill colonies and all guillemot colonies apart from the relatively small colony on Helgoland, Germany, and, as such, the vast majority of displacement at these sites occurred among non-breeding birds. As discussed, these non-breeding birds have fewer locational constraints than those birds engaged in incubation or chick rearing.
37. Lamb *et al*., (2024) also provided evidence that, across the suite of studies assessed, displacement rates in auks were lower in the breeding season than in the non-breeding season. Overall displacement figures from 49% to 69% were identified by Lamb *et al*. (2024) from 15 studies. These figures are likely to have been inflated by studies based in the southern North Sea that report on displacement effects almost exclusively from more readily displaced non-breeding birds. As the majority of displacement of the Project affects breeding birds , any displacement rate to be applied to the Project across the whole year should be below the levels suggested by Lamb *et al*., (2024).

38. By collating data presented in the APEM (2022) review based on whether the site is within mean maximum foraging range (MMFR) of breeding guillemots or razorbills, and whether studies focus on breeding or non-breeding birds, the differences seen between projects that are likely to have an interaction with breeding birds, and projects that are not, are highlighted. Table 2 to Table 4 show the average rates of guillemot displacement measured at projects within and beyond MMFR, whether the data collected refer to the breeding season, the non-breeding season, or at least contain a breeding season, and then a combination of these two factors. Table 5 and Table 6 present rates of razorbill displacement measured at projects within and beyond MMFR, whether the data collected refer to the breeding season, the non-breeding season, or at least contain a breeding season for razorbill.
39. All five tables indicate that displacement is much higher for birds either outside MMFR, in the non-breeding season, or both. Seasonality appears to have the strongest influence on displacement, with non-breeding birds showing a much higher average displacement than breeding birds (or studies that breeding birds contribute to) regardless of whether birds are within or beyond MMFR.

Table 2. Average guillemot displacement from APEM collated studies based on MMFR

| | n Projects | Average displacement effect % |
|---|---|---|
| Beyond MMFR | 8 | 35.96 |
| Within MMFR | 10 | 18.1 |

Table 3. Average guillemot displacement from APEM collated studies based on seasonality

| | n Projects | Average displacement effect |
|---|---|---|
| Only breeding birds | 2 | 22 |
| Full annual cycle | 8 | 5.4 |
| Only non-breeding birds | 10 | 42.6 |

Table 4. Average guillemot displacement from APEM collated studies based on MMFR and seasonality

| | n Projects | Average displacement effect |
|---|---|---|
| Breeders beyond MMFR | 2 | 0 |
| Breeders within MMFR | 6 | 7.1 |
| Non-breeders beyond MMFR | 6 | 47.9 |
| Non-breeders within MMFR | 4 | 35.4 |

40. Similar patterns can be seen in the displacement of razorbills, as presented in Table 5 and Table 6, although these results should be treated with more caution due to the small sample sizes.

Table 5. Average razorbill displacement from APEM collated studies based on MMFR

| | n Projects | Average displacement effect |
|---|---|---|
| Beyond MMFR | 5 | 42 |
| Within MMFR | 2 | 0 |

Table 6. Average razorbill displacement from APEM collated studies based on seasonality

| | n Projects | Average displacement effect |
|---|---|---|
| Full annual cycle | 2 | 0 |
| Only non-breeding birds | 5 | 42 |

41. Peschko *et al.,* 2020 showed high levels of guillemot displacement during the breeding season - avoidance of a windfarm (i.e. displacement) varied between 63% and 75% depending on whether the turbine blades were rotating or not - however, it is suggested that this is not the norm and that the findings should be treated with caution.
42. The Peschko study compared distributions of tracked birds to an expected distribution based on a range of covariates and assumed that, where birds do not occupy the space that they might be expected to, this is due to displacement. The covariates did not include any measure of food availability or suitable proxies for this (relying only on distance from shore, distance from breeding colony, water depth and slope); food availability is likely to be the biggest driver of guillemot distribution in an area (Bonn *et al.,* 2004).
43. The Peschko study was based on a relatively small sample size of only 12 tracked birds. The study included displacement from a collection of arrays 23 km north of a breeding site on Helgoland. This distance is likely to be beyond the mean foraging range of birds foraging from the Helgoland colony and, as birds were tagged during the egg laying stage, carried tags for two to three weeks and were re-trapped at the colony, at least some of the tracks collected would likely be from the chick rearing period when foraging trips are expected to be even more constrained. As such, overlap with the wind farms would be expected to be very small.
44. This study was published in 2020 and therefore will have been considered by both the APEM (2022) review and the Lamb *et al.,* (2024) review. It is suggested that this study should not take any precedence when informing displacement rates; it should also be noted that the displacement rates within Lamb *et al*., (2024) will have included those in Peschko *et al*, (2020)

# 6 Context for Outer Dowsing

45. The Applicant is assessing impacts on guillemot from displacement using a 50% displacement rate and is also presenting impacts using Natural England's preferred rate of 70%. These rates are being applied to populations calculated from means of peak monthly counts, per bioseason (as defined by Furness (2015), (breeding and non-breeding bioseasons using the Applicant's approach, and breeding, post breeding and non-breeding when presenting Natural England's preferred approach) derived from digital aerial survey data).
46. Both the APEM (2022) and Lamb et al., (2024) reviews suggest that the use of Natural England's preferred displacement rate of 70% would considerably over-estimate displacement impacts from the Project. Although the methods used in both reviews differed, APEM (2022) showed effects ranging from 112% attraction to displacement of 75%, with an average displacement rate of 25.9%; Lamb et al., (2024) suggest a mean displacement rate across all studies of 60%. Lamb et al., (2024) found that auks showed a greater displacement during the non-breeding season and so, as the majority of displacement resulting from the Project is likely to be of breeding, rather than non-breeding, birds, the average displacement rate of 60% suggested by Lamb et al., (2024) is considered very precautionary. The study by Trinder et al., (2024) showed a weak attraction effect of turbines and concluded 0% displacement.
47. The APEM (2022) review showed a statistically significant difference between the displacement shown by sites with high and low densities of auks. Sites containing a higher density of auks (such as the Project, with a mean peak of 42.54 birds/km2showed lower levels of displacement, and those sites with low densities of auks (~5 to <1 birds/km2) showed higher displacement. As such, a site such as the Project, with its very high densities of birds in April (within the Furness (2015) breeding season) and in August and September (forming the non-breeding season peak for the Project, and treated as a discreet 'post-breeding' bioseason by Natural England) is unlikely to show levels of displacement during these periods that would be comparable to displacement from a low density site, or an average taken of displacement from high and low density sites. Therefore, a displacement rate of 70% should be seen as highly precautionary for this site, especially when applied to peak counts and the Applicant considers that the displacement rate used in the assessment (50%) is appropriately precautionary.

48. The APEM (2022) review also demonstrated how projects with a smaller rotor swept area as a proportion of the whole array showed lower levels of displacement than those with higher proportions of the array being rotor swept. The Project (taking account of the Offshore Restricted Build Area (ORBA)) will have a worst-case scenario density of approximately 1.66 turbines/km2. This is lower than the average of all of the studies collated for the APEM (2022) review, and therefore the Project should be seen as having a low density, and therefore, it can be argued, less likely to displace birds compared with the other projects collated for the review. In addition, this worst-case scenario of density would lead to a reduced displacement impact as it would result in a substantially reduced array area from which birds could be displaced. The strong link between geographic location of a project and the levels of displacement detected discussed in APEM (2022), with increased effects more likely in projects in the southern North Sea, is highly likely to be a reflection of the breeding status of the bird populations being assessed, with southern North Sea populations likely to be comprised of non-breeding birds as the majority of the projects assessed were beyond MMFR from breeding colonies. As the Project's populations are made up of breeding birds during the breeding season, it is considered appropriate to use a displacement rate that reflects this.
49. In summary, a simple displacement rate of 70% should be seen as highly precautionary for non-breeding birds (as it adopts the worst-case scenario for non-breeding birds) and for assessments across the entire annual cycle, and even more precautionary for birds in the breeding season (especially those within MMFR from a likely source colony of colonies). This aligns with displacement rates seen at the Helgoland cluster in spring (Mar – May, i.e. before breeding commences) of 63%, and in summer (June and July) of 44%. The applicant considers that a displacement rate of 50% would be precautionary for birds during the breeding season and would therefore be precautionary across the whole annual cycle.
50. Whilst the findings in Lamb et al., (2024) suggest a 60% displacement rate would be appropriate for guillemot and razorbill, this is based on a suite of studies, many of which show higher displacement compared to the Project due to the specific ecological, location and design related factors present at the sites reviewed.
51. Given the mean displacement rate derived by the APEM (2022) study (a mean of 25.9%, which considered those projects with no displacement and those which showed attraction, and based on datasets that were re-assessed using more appropriate statistical approaches (as opposed to Lamb et al., (2024), which simply pooled studies)), a 50% displacement rate is considered to be appropriate and also precautionary.

# 7 Summary

52. Based on the information presented, the Applicant considers that a 70% displacement rate for guillemot and razorbill is not backed by evidence collated from existing displacement studies, and that the lower rate of 50% is more appropriate.
53. Both the APEM (2022) and Lamb *et al.,* (2024) studies highlight the difference in displacement between breeding and non-breeding birds. The Applicant considers that, given that the assessment is carried out using bioseasons that reflect this seasonal divide, the application of an overall rate that considers this difference is appropriate.
54. Taking the average rate of displacement from all studies collated for the APEM (2022) review (not including ones where an attraction was demonstrated), a displacement rate of 25% to 30% across all seasons is appropriate. A displacement rate of 50% has been used but remains precautionary for both the breeding season and across the annual cycle.

# 8 References


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