Hornsea Project Four: Environmental Statement (ES)

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Volume A5, Annex 5.2: Offshore Ornithology Displacement Analysis

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Glossary

Term	Definition
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons. Separate bio-seasons are recognised in this technical report in order to establish the level of importance any seabird species has within the study area during any particular period of time.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
the Hornsea Four array area	The proposed area for Hornsea Four within which the Wind Turbine Generators (WTGs) would be installed (at PEIR stage).
SeaMaST	Seabird densities from the predicted density maps and the underlying dataset of the SeaMaST project (Seabird Mapping and Sensitivity Tool) described in Bradbury et al. (2014) was identified by Natural England, through the Evidence Plan Process (Technical Panel Meeting Three, 10.04.19), as the most appropriate data set for the purpose of estimating the density and abundances of red-throated divers within the ECC. The SeaMaST data were compiled from offshore boat and aerial observer surveys spanning the period 1979–2012.
Statutory Nature Conservation Bodies (SNCBs)	Comprised of JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage, these agencies provide advice in relation to nature conservation to government.

Acronyms

Acronym	Definition
AfL	Agreement for Lease
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
EP	Evidence Plan
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SeaMaST	Seabird Mapping and Sensitivity Tool
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
WTG	Wind Turbine Generator

Units

Unit	Definition
km	Kilometre (distance)
km^2	Kilometre squared (area)

1 Introduction

1.1 Project Background

1.1.1.1 Orsted Hornsea Project Four Limited, (hereafter 'the Applicant') is proposing to develop the Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four is located approximately 69 km offshore from the coastline of the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume A1, Chapter 4: Project Description** for full details on the Project Design).

1.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 846 km^2 at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project has given due consideration to the size and location (within the existing AfL area) of the final project that is being taken forward to Development Consent Order (DCO) application. This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction.

1.1.1.3 The combination of Hornsea Four's Proportionality in EIA and Developable Area Process has resulted in a marked reduction in the array area taken forward at the point of DCO application. Hornsea Four adopted a major site reduction from the array area presented at Scoping (846 km^2) to the Preliminary Environmental Information Report (PEIR) boundary (600 km^2), with a further reduction adopted for the Environmental Statement (ES) and DCO application (468 km^2) due to the results of the PEIR, technical considerations and stakeholder feedback. The evolution of the Hornsea Four Order Limits is detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**.

1.1.1.4 APEM Ltd (hereafter APEM) was commissioned by the Applicant to undertake a study of the offshore and intertidal ornithology that characterises the area that may be influenced by Hornsea Four. As part of this study, APEM was commissioned to undertake a displacement analysis on the ornithological receptors identified. This technical annex has been produced to support the ES for **Volume A5, Chapter 5: Offshore and Intertidal Ornithology**.

1.1.1.5 The consideration of offshore and intertidal ornithology for Hornsea Four has been discussed with consultees through the Hornsea Four Evidence Plan (EP) process; specifically with the Offshore and Intertidal Ornithology Evidence Plan Technical Panel (hereafter EP Technical Panel) of which Natural England and the Royal Society for the Protection of Birds (RSPB) are members. Agreements made with consultees within the EP process are set out in the topic specific EP Logs which are appended to the Hornsea Four EP (**B1.1.1: Evidence Plan**), an annex of the Hornsea Four Consultation Report (**B1.1: Consultation Report**). All agreements within the EP Logs have unique identifier codes which have been used throughout this document to signpost to the specific agreements made (e.g. OFF-ORN-2.1).

1.2 Displacement

1.2.1.1 The presence of wind turbine generators (WTGs) has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where Hornsea Four is proposed. This in effect represents indirect habitat loss, potentially reducing

the area available for those seabirds sensitive to disturbance to forage, loaf and / or moult in the way that they are currently able to within and around the Hornsea Four area. There is also the potential for the construction and decommissioning of WTGs, substations and cable laying to directly disturb and displace seabirds, though the nature of such potential impacts is more restricted spatially and temporally by virtue of the nature of those phases of the development.

1.3 Species of Interest

1.3.1.1 Following consultation with Natural England and the RSPB through the EP process, the following five species were identified as the 'key' species for inclusion in this Hornsea Four disturbance and displacement assessment (OFF-ORN-2.10 & OFF-ORN-2.12):

- Red-throated diver (*Gavia stellata*);
- Gannet (*Morus bassanus*);
- Guillemot (*Uria aalge*);
- Razorbill (*Alca torda*); and
- Puffin (*Fratacula arctica*).

1.3.1.2 The data contributing to this annex are from 24 months of digital aerial video surveys (April 2016 to March 2018) of the Hornsea Four AfL plus a 4 km buffer. Data from these site-specific surveys are used for four species of interest; gannet, guillemot, razorbill and puffin. A different approach was adopted for red-throated diver, as outlined in **Sections 1.4.2** and **1.4.3**.

1.4 Changes to Displacement Analysis since Preliminary Environmental Information Report (PEIR)

1.4.1.1 A number of changes have been made to the displacement analysis for Hornsea Four for the DCO Application in response to comments received from Natural England and the RSPB through the formal Section 42 responses and engagement through the EP process since the PEIR stage. Further details of the EP meetings are presented in **B1.1.1: Evidence Plan**.

1.4.1.2 Following consideration of the Section 42 responses and discussions at EP meetings, the following changes have been made to the displacement analysis that was presented at PEIR:

- For the PEIR stage, a decision was taken to present as many different variations of displacement matrices for gannet, guillemot, razorbill and puffin as possible in order to be able to consider a range of potential impacts associated with displacement. These included matrices for the array area alone and separately for differing buffers (1 km, 2 km and 4 km) surrounding the array area. Following Natural England's advice through their formal Section 42 responses and engagement through the EP process, this report presents simply the array area and array area plus a 2 km buffer for these species (OFF-ORN-2.10);
- For the PEIR stage, a decision was also taken to present as many different variations of bio-seasons for gannet, guillemot, razorbill and puffin as possible in order to be able to consider a range of potential impacts associated with displacement. These included three separate wider bio-seasons (all non-breeding, breeding and non-breeding) as well as four more standard bio-seasons (return migration, migration-free breeding, post-breeding migration/dispersal and migration-free winter). Following Natural England's advice through their formal Section 42 responses and engagement through the EP process (at Technical Panel Meeting Five on 29th October 2019), this report presents a reduced number of bio-seasons more akin to those presented in Furness (2015), with three to four

standard bio-seasons considered for all species and non-breeding bio-seasons considered for guillemot and puffin;

- For the PEIR stage, a decision was also taken to present a range of data points for red-throated diver within the array area and a 2 km buffer, populated using densities from the predicted density map and the underlying dataset of the SeaMaST project (Seabird Mapping and Sensitivity Tool) described in Bradbury et al. (2014). Following Natural England's advice through their formal Section 42 responses and engagement through the EP process, and through further individual discussions with Natural England's marine ornithologists, a 'benchmark' approach has now been applied to the SeaMaST data to quantify and assess red-throated diver density and abundance within the Hornsea Four offshore Export Cable Corridor (ECC). The final 'benchmark' approach was agreed with Natural England as being fit for the purpose of assessing the potential impacts on red-throated diver for Hornsea Four (OFF-ORN-2.25); and
- After further consultation on predicted guillemot displacement impacts from Hornsea Four though the EP process (at Technical Panel Meeting 14 on 4th March 2021) and due to the unique location of Hornsea being closer to the Flamborough and Filey Coast SPA colony (although should be noted that Hornsea Four is still a considerable distance away at 63 km offshore from the colony) in comparison to other English North Sea offshore wind farms (OWFs), it was decided that calculating the non-breeding bio-season abundance using the standard mean peak method caused inflationary bias. In order to reduce this bias for guillemot and provide more representative, yet still precautionary, abundance and density estimates for the non-breeding bio-season, a weighted-mean approach has been used for the displacement matrices presented in the main body of this report (**Section 4**). The weighted-mean approach takes into account the three-component bio-seasons mean peaks and the number of months which each component bio-season contributes to the wider non-breeding bio-season for each year. Displacement matrices using the standard mean peak method for the non-breeding bio-season have also been produced for comparison and are presented in **Appendix A**: Guillemot displacement matrices using the mean peak abundance estimates.

1.4.2 Displacement Buffers

1.4.2.1 The main assessment on disturbance and displacement is found within **Volume A2, Chapter 5: Offshore and Intertidal Ornithology**. The scale of the potential displacement applied in this report is in response to guidance in the literature (Statutory Nature Conservation Bodies (SNCBs) 2017), comments received from Natural England and the RSPB through the EP process and formal Section 42 responses.

1.4.2.2 Following the generic guidance (SNCBs 2017), and at the request of Natural England and the RPSB, this report presents displacement matrices that consider red-throated diver within a 2 km buffer surrounding a cable laying vessel in the offshore ECC. Red-throated diver are not considered for displacement within the Hornsea Four array area (or respective buffers), as this species was only recorded within the 4 km buffer of the array area in a single month (with a raw count of one and an abundance estimate of 10 individuals) during the 24 month baseline digital aerial survey programme (**Annex 5.1: Offshore and Intertidal Ornithology Baseline Characterisation Report**).

1.4.2.3 Following the same generic guidance (SNCBs 2017), and at the request of Natural England and the RSPB, this report also presents displacement matrices that consider gannet and the auk species (guillemot, razorbill and puffin) (OFF-ORN-2.10). These matrices present abundances for gannet and auk species within the Hornsea Four array area as well as

separately for the Hornsea Four array area plus a 2 km buffer, in response to Natural England's request in their Section 42 consultation response.

1.4.3 Red-throated Diver 'Benchmark' Approach

1.4.3.1 The SeaMaST project described in Bradbury et al. (2014), identified by Natural England as the most appropriate dataset through the EP process (OFF-ORN-1.11), was used to identify where red-throated divers may occur within the offshore ECC. As the SeaMaST data does not provide absolute densities of birds, a 'benchmark' approach, as agreed with Natural England (OFF-ORN-2.25), using an alternate data source with known density and abundance estimates from datasets collected from further south in the Southern North Sea was undertaken. This provided suitable data and was used to produce a scaled density factor, which was applied to the relative densities of the offshore ECC.

1.4.3.2 The most suitable alternative data source for the benchmark approach was identified as that from the 2013 aerial digital surveys (APEM 2013) and described in Goodship et al. (2015), under contract to Natural England, of the Outer Thames Estuary Special Protection Area (SPA). The entire area of the Outer Thames Estuary SPA surveyed is covered by the SeaMaST datasets and was therefore suitable to acquire a scaled density factor. The upper and lower abundance estimate confidence intervals from the Outer Thames data were selected applied to create two scaling factors, to represent a range of density values for this species within the offshore ECC and 2 km buffer surrounding cable laying activities during the migration-free winter bio-season.

1.4.4 Guillemot 'Weighted-Mean' Approach

1.4.4.1 When considering the abundance and density of seabird species within individual bio-seasons, it has been common practice to calculate the mean peak from several years of data covering the same bio-season in each year (e.g. SNCBs 2017). This method accounts for any variation between years and between the months within the individual bio-season, typically covering a two to four-month period. This method provides a precautionary account of the abundance of birds potentially present within a given area.

1.4.4.2 Following advice received from Natural England on the Hornsea Four PEIR (OFF-ORN-2.2), a much wider non-breeding bio-season has been considered for guillemot following Furness (2015), with the mean peak abundance estimate calculated across a seven-month period (Aug-Feb). This seven-month non-breeding period encapsulates a range of behaviours which may affect abundance and density of guillemot within Hornsea Four, including post-breeding dispersal (**Table 1**). Baseline survey data from Hornsea Four suggest that this post-breeding dispersal occurs within two of these seven months (Aug-Sep), with birds quickly passing out of the area as they migrate (**Figure 1**; **Table 1**). This relatively rapid movement away from breeding colonies has been observed at other North Sea breeding colonies (e.g. van Katwijk & Camphuysen; Dunn et al. 2020). The inclusion of these post-breeding season data inflate the mean peak estimate for the non-breeding bio-season beyond that which is representative for the remaining five months of the non-breeding bio-season, leading to over-precaution in assessing potential displacement.

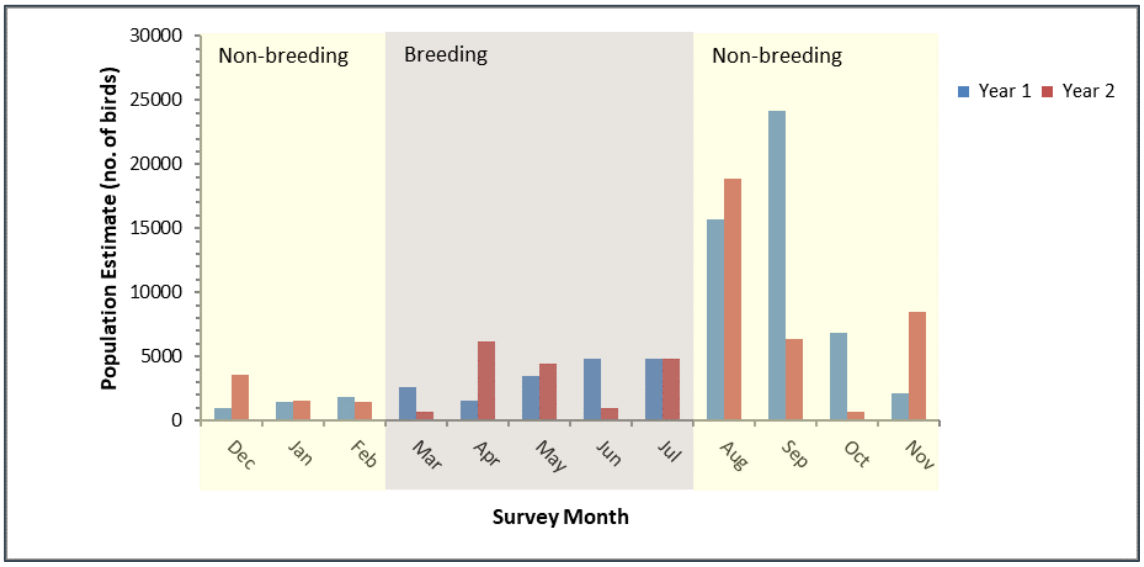

Figure 1: Monthly guillemot abundance within Hornsea Four across two-years of baseline survey. Bio-seasons (breeding and non-breeding) are defined by Furness (2015).

1.4.4.3 In order to reduce this bias and to provide a more representative abundance and density estimate for the seven-month non-breeding bio-season, a weighted mean peak method was used for guillemot.

1.4.4.4 This involved calculating the mean of the three-component bio-season peaks (post-breeding, migration free winter, and return migration) which contribute to the non-breeding bio-season for year one and year two separately, factoring in the number of months which contribute to each component bio-season peak, and then calculating the mean of these two weighted abundances as outlined in the equation below:

$$\frac{\left(\left(\text{Year 1}\ \frac{\sum(PBr \times t_{PBr},\ W \times t_W,\ M \times t_M)}{\sum t_{PBr}, t_W, t_M}\right) + \left(\text{Year 2}\ \frac{\sum(PBr \times t_{PBr},\ W \times t_W,\ M \times t_M)}{\sum t_{PBr}, t_W, t_M}\right)\right)}{2}$$

Where:
PBr = predicted abundance in the post-breeding bio-season
W = predicted abundance in the migration-free winter bio-season
M = predicted abundance in the return migration bio-season
t_{PBr} = number of component months contributing to the post-breeding bio-season
t_W = number of component months contributing to the migration-free winter bio-season
t_M = number of component months contributing to the return migration bio-season

1.5 Data Limitations

1.5.1.1 The data within this report for gannet, guillemot, razorbill and puffin are reliant upon site-specific aerial digital video surveys undertaken over the Hornsea Four AfL and a 4 km buffer surrounding it for a period of 24 months, collected between April 2016 to March 2018, inclusive. These data are considered to be the most reliable source for characterising the baseline environment for offshore ornithology. However, using these data to characterise the abundance for each species within individual bio-seasons (as described in Section 1.6) is subject to interpretation, given variation in migratory movements between species and between years, the age classification of birds within each bio-season, connectivity to breeding colonies and other factors. Therefore, these data may be used for the assessments accompanying the DCO application (i.e. within the ES Chapter and the Report to Inform

Appropriate Assessment (RIAA)) in differing manners, depending upon additional factors considered when assessing the potential impacts and / or effects of displacement on these species.

1.5.1.2 The data within this report for red-throated diver within the offshore ECC are reliant upon the underlying dataset of the SeaMaST project described in Bradbury et al. (2014) and benchmarked against data from aerial digital surveys (APEM 2013; as described in **paragraph 1.4.3.2**). Although this benchmarking approach is agreed by Natural England as the most appropriate method for this purpose through the EP process (OFF-ORN-2.25) and provides a precautionary approach, the limitations of these data are that they are two modelled datasets, and therefore predictions rather than empirical counts. However, these data are agreed as fit for the purpose of generic displacement assessments within offshore ECCs, ensuring a consistent approach across OWF impact assessments (OFF-ORN-2.25).

1.6 Presentation of Displacement for each Bio-Season

1.6.1.1 In order to provide a more visual approach to presenting data on the species considered for disturbance and displacement within the tables contained in this report, colour-coding has been used to represent different bio-seasons. For each species, the months defining each bio-season are different, based upon Furness (2015) and site-specific data presented in **Annex 5.1: Offshore and Intertidal Ornithology Baseline Characterisation Report**.

1.6.1.2 The colours used to define the six main bio-seasons are presented in **Table 1**.

Table 1: Bio-season colour coding.

Bio-season	Red-throated diver	Gannet	Guillemot	Razorbill	Puffin
Return Migration (Green)	N/A	Dec – Mar	N/A	Jan – Mar	N/A
Migration-free Breeding (Purple)	N/A	Apr – Aug	N/A	Apr – Jul	N/A
Post-breeding Migration (Red)	N/A	Sept – Nov	N/A	Aug – Oct	N/A
Migration-free Winter (Grey/Blue)	Dec - Jan	N/A	N/A	Nov – Dec	N/A
Breeding (Brown)	N/A	N/A	Mar - Jul	N/A	Apr - Jul
Non-breeding (Yellow)	N/A	N/A	Aug – Feb	N/A	Aug – Mar

1.6.1.3 As described in **Section 1.3**, the data used to underpin abundance and density estimates for gannet and the three auk species (guillemot, razorbill and puffin) were collected through 24 months of aerial digital video surveys completed for the Hornsea Four AfL plus an area that extended 4 km around this area. For displacement analysis, gannets recorded as either sitting or flying were included, whilst for guillemot, razorbill and puffin only sitting birds were included, given the species foraging behaviours. As described above, estimated abundance / density for red-throated diver within the offshore ECC were from an alternate source agreed as appropriate with Natural England and the RSPB (OFF-ORN-2.25). Bio-season mean peak abundance and density estimates are presented in **Table 2**.

1.6.1.4 Species-specific displacement matrices for the areas described in **Section 1.3** covering separate bio-seasons for each of the five species are presented in **Sections 2** to **6** of this document.

Table 2: Bio-season mean peak abundance and density estimates of key bird species for Hornsea Four disturbance and displacement assessment (sitting birds). Data highlighted in bold represent the bio-season with peak abundance for each species.

Bio-season	Survey Area	Red-throated diver		Gannet		Guillemot		Razorbill		Puffin	
		Abundance estimate	Density estimate (birds / km²)	Abundance estimate	Density estimate (birds / km²)	Abundance estimate	Density estimate (birds / km²)	Abundance estimate	Density estimate (birds / km²)	Abundance estimate	Density estimate (birds / km²)
Return Migration	Array Area	N/A		163	0.35	N/A	N/A	234	0.50	N/A	N/A
	Array & 2 km Buffer			235	0.35	N/A	N/A	371	0.56	N/A	N/A
Migration-free Breeding	Array Area	N/A		549	1.17	N/A	N/A	192	0.41	N/A	N/A
	Array & 2 km Buffer			791	1.18	N/A	N/A	276	0.41	N/A	N/A
Post-breeding Migration	Array Area	N/A		**593**	**1.26**	N/A	N/A	**2,367**	**5.03**	N/A	N/A
	Array & 2km Buffer			**854**	**1.28**	N/A	N/A	**3,590**	**5.38**	N/A	N/A
Migration-free Winter	Array Area	N/A		N/A		N/A	N/A	305	0.65	N/A	N/A
	Array & 2 km Buffer					N/A	N/A	474	0.71	N/A	N/A
	ECC & 2 km Buffer	**2-3**	**0.004 – 0.005**			N/A	N/A	N/A	N/A	N/A	N/A
Breeding	Array Area	N/A		N/A		5,479	11.65	N/A		104	0.22
	Array & 2 km Buffer					8,553	12.82			153	0.23
Non-breeding	Array Area	N/A		N/A		**11,150***	**23.71***	N/A		**245**	**0.52**
	Array & 2 km Buffer					**17,062***	**25.57***			**353**	**0.53**

*Table Note: Bio-season abundance and density estimates for guillemot represent weighted-mean peaks as described in Section 1.4.4.

2 Red-Throated Diver Displacement Matrices

Table 3: Displacement matrix presenting the minimum number of red-throated divers in the ECC plus a 2 km buffer surrounding the cable laying vessel only, during the migration-free winter bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
40	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
50	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
60	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
70	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2
80	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
90	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
100	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2

Table 4: Displacement matrix presenting the maximum number of red-throated divers in the offshore ECC plus a 2 km buffer only surrounding the cable laying vessel only, during the migration-free winter bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
30	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
40	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
50	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
60	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2
70	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
80	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
90	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	3
100	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3

3 Gannet Displacement Matrices

Table 5: Displacement matrix presenting the number of gannets in the array area only, during the return migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2
10	0	0	0	0	1	1	2	3	5	7	8	10	11	13	15	16
20	0	0	1	1	1	2	3	7	10	13	16	20	23	26	29	33
30	0	0	1	1	2	2	5	10	15	20	24	29	34	39	44	49
40	0	1	1	2	3	3	7	13	20	26	33	39	46	52	59	65
50	0	1	2	2	3	4	8	16	24	33	41	49	57	65	73	82
60	0	1	2	3	4	5	10	20	29	39	49	59	69	78	88	98
70	0	1	2	3	5	6	11	23	34	46	57	69	80	91	103	114
80	0	1	3	4	5	7	13	26	39	52	65	78	91	105	118	131
90	0	1	3	4	6	7	15	29	44	59	73	88	103	118	132	147
100	0	2	3	5	7	8	16	33	49	65	82	98	114	131	147	163

Table 6: Displacement matrix presenting the number of gannets in the array area plus 2 km buffer, during the return migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	5	7	9	12	14	16	19	21	24
20	0	0	1	1	2	2	5	9	14	19	24	28	33	38	42	47
30	0	1	1	2	3	4	7	14	21	28	35	42	49	56	64	71
40	0	1	2	3	4	5	9	19	28	38	47	56	66	75	85	94
50	0	1	2	4	5	6	12	24	35	47	59	71	82	94	106	118
60	0	1	3	4	6	7	14	28	42	56	71	85	99	113	127	141
70	0	2	3	5	7	8	16	33	49	66	82	99	115	132	148	165
80	0	2	4	6	8	9	19	38	56	75	94	113	132	151	169	188
90	0	2	4	6	8	11	21	42	64	85	106	127	148	169	191	212
100	0	2	5	7	9	12	24	47	71	94	118	141	165	188	212	235

Table 7: Displacement matrix presenting the number of gannets in the array area only, during the migration-free breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5
10	0	1	1	2	2	3	5	11	16	22	27	33	38	44	49	55
20	0	1	2	3	4	5	11	22	33	44	55	66	77	88	99	110
30	0	2	3	5	7	8	16	33	49	66	82	99	115	132	148	165
40	0	2	4	7	9	11	22	44	66	88	110	132	154	176	198	219
50	0	3	5	8	11	14	27	55	82	110	137	165	192	219	247	274
60	0	3	7	10	13	16	33	66	99	132	165	198	230	263	296	329
70	0	4	8	12	15	19	38	77	115	154	192	230	269	307	346	384
80	0	4	9	13	18	22	44	88	132	176	219	263	307	351	395	439
90	0	5	10	15	20	25	49	99	148	198	247	296	346	395	444	494
100	0	5	11	16	22	27	55	110	165	219	274	329	384	439	494	549

Table 8: Displacement matrix presenting the number of gannets in the array area plus 2 km buffer, during the migration-free breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	2	2	3	4	5	6	6	7	8
10	0	1	2	2	3	4	8	16	24	32	40	47	55	63	71	79
20	0	2	3	5	6	8	16	32	47	63	79	95	111	127	142	158
30	0	2	5	7	9	12	24	47	71	95	119	142	166	190	214	237
40	0	3	6	9	13	16	32	63	95	127	158	190	221	253	285	316
50	0	4	8	12	16	20	40	79	119	158	198	237	277	316	356	395
60	0	5	9	14	19	24	47	95	142	190	237	285	332	380	427	474
70	0	6	11	17	22	28	55	111	166	221	277	332	387	443	498	554
80	0	6	13	19	25	32	63	127	190	253	316	380	443	506	569	633
90	0	7	14	21	28	36	71	142	214	285	356	427	498	569	641	712
100	0	8	16	24	32	40	79	158	237	316	395	474	554	633	712	791

Table 9: Displacement matrix presenting the number of gannets in the array area only, during the post-breeding migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	1	2	2	3	4	4	5	5	6
10	0	1	1	2	2	3	6	12	18	24	30	36	42	47	53	59
20	0	1	2	4	5	6	12	24	36	47	59	71	83	95	107	119
30	0	2	4	5	7	9	18	36	53	71	89	107	125	142	160	178
40	0	2	5	7	9	12	24	47	71	95	119	142	166	190	213	237
50	0	3	6	9	12	15	30	59	89	119	148	178	208	237	267	296
60	0	4	7	11	14	18	36	71	107	142	178	213	249	285	320	356
70	0	4	8	12	17	21	42	83	125	166	208	249	291	332	374	415
80	0	5	9	14	19	24	47	95	142	190	237	285	332	379	427	474
90	0	5	11	16	21	27	53	107	160	213	267	320	374	427	480	534
100	0	6	12	18	24	30	59	119	178	237	296	356	415	474	534	593

Table 10: Displacement matrix presenting the number of gannets in the array area plus 2 km buffer, during the post-breeding migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	2	3	3	4	5	6	7	8	9
10	0	1	2	3	3	4	9	17	26	34	43	51	60	68	77	85
20	0	2	3	5	7	9	17	34	51	68	85	103	120	137	154	171
30	0	3	5	8	10	13	26	51	77	103	128	154	179	205	231	256
40	0	3	7	10	14	17	34	68	103	137	171	205	239	273	308	342
50	0	4	9	13	17	21	43	85	128	171	214	256	299	342	384	427
60	0	5	10	15	21	26	51	103	154	205	256	308	359	410	461	513
70	0	6	12	18	24	30	60	120	179	239	299	359	419	478	538	598
80	0	7	14	21	27	34	68	137	205	273	342	410	478	547	615	684
90	0	8	15	23	31	38	77	154	231	308	384	461	538	615	692	769
100	0	9	17	26	34	43	85	171	256	342	427	513	598	684	769	854

4 Guillemot Displacement Matrices

Table 11: Displacement matrix presenting the number of guillemots in the array area only, during the breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	2	3	5	11	16	22	27	33	38	44	49	55
10	0	5	11	16	22	27	55	110	164	219	274	329	384	438	493	548
20	0	11	22	33	44	55	110	219	329	438	548	657	767	877	986	1,096
30	0	16	33	49	66	82	164	329	493	657	822	986	1,151	1,315	1,479	1,644
40	0	22	44	66	88	110	219	438	657	877	1,096	1,315	1,534	1,753	1,972	2,192
50	0	27	55	82	110	137	274	548	822	1,096	1,370	1,644	1,918	2,192	2,465	2,739
60	0	33	66	99	131	164	329	657	986	1,315	1,644	1,972	2,301	2,630	2,959	3,287
70	0	38	77	115	153	192	384	767	1,151	1,534	1,918	2,301	2,685	3,068	3,452	3,835
80	0	44	88	131	175	219	438	877	1,315	1,753	2,192	2,630	3,068	3,506	3,945	4,383
90	0	49	99	148	197	247	493	986	1,479	1,972	2,465	2,959	3,452	3,945	4,438	4,931
100	0	55	110	164	219	274	548	1,096	1,644	2,192	2,739	3,287	3,835	4,383	4,931	5,479

Table 12: Displacement matrix presenting the number of guillemots in the array area plus 2 km buffer, during the breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	3	4	9	17	26	34	43	51	60	68	77	86
10	0	9	17	26	34	43	86	171	257	342	428	513	599	684	770	855
20	0	17	34	51	68	86	171	342	513	684	855	1,026	1,197	1,369	1,540	1,711
30	0	26	51	77	103	128	257	513	770	1,026	1,283	1,540	1,796	2,053	2,309	2,566
40	0	34	68	103	137	171	342	684	1,026	1,369	1,711	2,053	2,395	2,737	3,079	3,421
50	0	43	86	128	171	214	428	855	1,283	1,711	2,138	2,566	2,994	3,421	3,849	4,277
60	0	51	103	154	205	257	513	1,026	1,540	2,053	2,566	3,079	3,592	4,106	4,619	5,132
70	0	60	120	180	239	299	599	1,197	1,796	2,395	2,994	3,592	4,191	4,790	5,389	5,987
80	0	68	137	205	274	342	684	1,369	2,053	2,737	3,421	4,106	4,790	5,474	6,158	6,843
90	0	77	154	231	308	385	770	1,540	2,309	3,079	3,849	4,619	5,389	6,158	6,928	7,698
100	0	86	171	257	342	428	855	1,711	2,566	3,421	4,277	5,132	5,987	6,843	7,698	8,553

Table 13: Displacement matrix presenting the number of guillemots in the array area only, during the non-breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	6	11	22	33	45	56	67	78	89	100	112
10	0	11	22	33	45	56	112	223	335	446	558	669	781	892	1,004	1,115
20	0	22	45	67	89	112	223	446	669	892	1,115	1,338	1,561	1,784	2,007	2,230
30	0	33	67	100	134	167	335	669	1,004	1,338	1,673	2,007	2,342	2,676	3,011	3,345
40	0	45	89	134	178	223	446	892	1,338	1,784	2,230	2,676	3,122	3,568	4,014	4,460
50	0	56	112	167	223	279	558	1,115	1,673	2,230	2,788	3,345	3,903	4,460	5,018	5,575
60	0	67	134	201	268	335	669	1,338	2,007	2,676	3,345	4,014	4,683	5,352	6,021	6,690
70	0	78	156	234	312	390	781	1,561	2,342	3,122	3,903	4,683	5,464	6,244	7,025	7,805
80	0	89	178	268	357	446	892	1,784	2,676	3,568	4,460	5,352	6,244	7,136	8,028	8,920
90	0	100	201	301	401	502	1,004	2,007	3,011	4,014	5,018	6,021	7,025	8,028	9,032	10,035
100	0	112	223	335	446	558	1,115	2,230	3,345	4,460	5,575	6,690	7,805	8,920	10,035	11,150

Table 14: Displacement matrix presenting the number of guillemots in the array area plus 2 km buffer, during the non-breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	3	5	7	9	17	34	51	68	85	102	119	136	154	171
10	0	17	34	51	68	85	171	341	512	682	853	1,024	1,194	1,365	1,536	1,706
20	0	34	68	102	136	171	341	682	1,024	1,365	1,706	2,047	2,389	2,730	3,071	3,412
30	0	51	102	154	205	256	512	1,024	1,536	2,047	2,559	3,071	3,583	4,095	4,607	5,119
40	0	68	136	205	273	341	682	1,365	2,047	2,730	3,412	4,095	4,777	5,460	6,142	6,825
50	0	85	171	256	341	427	853	1,706	2,559	3,412	4,265	5,119	5,972	6,825	7,678	8,531
60	0	102	205	307	409	512	1,024	2,047	3,071	4,095	5,119	6,142	7,166	8,190	9,213	10,237
70	0	119	239	358	478	597	1,194	2,389	3,583	4,777	5,972	7,166	8,360	9,555	10,749	11,943
80	0	136	273	409	546	682	1,365	2,730	4,095	5,460	6,825	8,190	9,555	10,920	12,284	13,649
90	0	154	307	461	614	768	1,536	3,071	4,607	6,142	7,678	9,213	10,749	12,284	13,820	15,356
100	0	171	341	512	682	853	1,706	3,412	5,119	6,825	8,531	10,237	11,943	13,649	15,356	17,062

5 Razorbill Displacement Matrices

Table 15: Displacement matrix presenting the number of razorbills in the array area only, during the return migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	5	7	9	12	14	16	19	21	23
20	0	0	1	1	2	2	5	9	14	19	23	28	33	37	42	47
30	0	1	1	2	3	4	7	14	21	28	35	42	49	56	63	70
40	0	1	2	3	4	5	9	19	28	37	47	56	66	75	84	94
50	0	1	2	4	5	6	12	23	35	47	59	70	82	94	105	117
60	0	1	3	4	6	7	14	28	42	56	70	84	98	112	126	140
70	0	2	3	5	7	8	16	33	49	66	82	98	115	131	148	164
80	0	2	4	6	7	9	19	37	56	75	94	112	131	150	169	187
90	0	2	4	6	8	11	21	42	63	84	105	126	148	169	190	211
100	0	2	5	7	9	12	23	47	70	94	117	140	164	187	211	234

Table 16: Displacement matrix presenting the number of razorbills in the array area plus 2 km buffer, during the return migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	2	2	3	3	3	4
10	0	0	1	1	1	2	4	7	11	15	19	22	26	30	33	37
20	0	1	1	2	3	4	7	15	22	30	37	45	52	59	67	74
30	0	1	2	3	4	6	11	22	33	45	56	67	78	89	100	111
40	0	1	3	4	6	7	15	30	45	59	74	89	104	119	134	148
50	0	2	4	6	7	9	19	37	56	74	93	111	130	148	167	186
60	0	2	4	7	9	11	22	45	67	89	111	134	156	178	200	223
70	0	3	5	8	10	13	26	52	78	104	130	156	182	208	234	260
80	0	3	6	9	12	15	30	59	89	119	148	178	208	237	267	297
90	0	3	7	10	13	17	33	67	100	134	167	200	234	267	301	334
100	0	4	7	11	15	19	37	74	111	148	186	223	260	297	334	371

Table 17: Displacement matrix presenting the number of razorbills in the array area only, during the migration-free breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
10	0	0	0	1	1	1	2	4	6	8	10	12	13	15	17	19
20	0	0	1	1	2	2	4	8	12	15	19	23	27	31	35	38
30	0	1	1	2	2	3	6	12	17	23	29	35	40	46	52	58
40	0	1	2	2	3	4	8	15	23	31	38	46	54	61	69	77
50	0	1	2	3	4	5	10	19	29	38	48	58	67	77	86	96
60	0	1	2	3	5	6	12	23	35	46	58	69	81	92	104	115
70	0	1	3	4	5	7	13	27	40	54	67	81	94	107	121	134
80	0	2	3	5	6	8	15	31	46	61	77	92	107	123	138	153
90	0	2	3	5	7	9	17	35	52	69	86	104	121	138	155	173
100	0	2	4	6	8	10	19	38	58	77	96	115	134	153	173	192

Table 18: Displacement matrix presenting the number of razorbills in the array area plus 2 km buffer, during the migration-free breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	3
10	0	0	1	1	1	1	3	6	8	11	14	17	19	22	25	28
20	0	1	1	2	2	3	6	11	17	22	28	33	39	44	50	55
30	0	1	2	2	3	4	8	17	25	33	41	50	58	66	75	83
40	0	1	2	3	4	6	11	22	33	44	55	66	77	88	99	110
50	0	1	3	4	6	7	14	28	41	55	69	83	97	110	124	138
60	0	2	3	5	7	8	17	33	50	66	83	99	116	133	149	166
70	0	2	4	6	8	10	19	39	58	77	97	116	135	155	174	193
80	0	2	4	7	9	11	22	44	66	88	110	133	155	177	199	221
90	0	2	5	7	10	12	25	50	75	99	124	149	174	199	224	249
100	0	3	6	8	11	14	28	55	83	110	138	166	193	221	249	276

Table 19: Displacement matrix presenting the number of razorbills in the array area only, during the post-breeding migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	2	5	7	9	12	14	17	19	21	24
10	0	2	5	7	9	12	24	47	71	95	118	142	166	189	213	237
20	0	5	9	14	19	24	47	95	142	189	237	284	331	379	426	473
30	0	7	14	21	28	36	71	142	213	284	355	426	497	568	639	710
40	0	9	19	28	38	47	95	189	284	379	473	568	663	757	852	947
50	0	12	24	36	47	59	118	237	355	473	592	710	828	947	1,065	1,183
60	0	14	28	43	57	71	142	284	426	568	710	852	994	1,136	1,278	1,420
70	0	17	33	50	66	83	166	331	497	663	828	994	1,160	1,325	1,491	1,657
80	0	19	38	57	76	95	189	379	568	757	947	1,136	1,325	1,515	1,704	1,893
90	0	21	43	64	85	107	213	426	639	852	1,065	1,278	1,491	1,704	1,917	2,130
100	0	24	47	71	95	118	237	473	710	947	1,183	1,420	1,657	1,893	2,130	2,367

Table 20: Displacement matrix presenting the number of razorbills in the array area plus 2 km buffer, during the post-breeding migration bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	2	4	7	11	14	18	22	25	29	32	36
10	0	4	7	11	14	18	36	72	108	144	179	215	251	287	323	359
20	0	7	14	22	29	36	72	144	215	287	359	431	503	574	646	718
30	0	11	22	32	43	54	108	215	323	431	538	646	754	862	969	1,077
40	0	14	29	43	57	72	144	287	431	574	718	862	1,005	1,149	1,292	1,436
50	0	18	36	54	72	90	179	359	538	718	897	1,077	1,256	1,436	1,615	1,795
60	0	22	43	65	86	108	215	431	646	862	1,077	1,292	1,508	1,723	1,939	2,154
70	0	25	50	75	101	126	251	503	754	1,005	1,256	1,508	1,759	2,010	2,262	2,513
80	0	29	57	86	115	144	287	574	862	1,149	1,436	1,723	2,010	2,298	2,585	2,872
90	0	32	65	97	129	162	323	646	969	1,292	1,615	1,939	2,262	2,585	2,908	3,231
100	0	36	72	108	144	179	359	718	1,077	1,436	1,795	2,154	2,513	2,872	3,231	3,590

Table 21: Displacement matrix presenting the number of razorbills in the array area only, during the migration-free winter bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	2	2	2	2	3	3
10	0	0	1	1	1	2	3	6	9	12	15	18	21	24	27	30
20	0	1	1	2	2	3	6	12	18	24	30	37	43	49	55	61
30	0	1	2	3	4	5	9	18	27	37	46	55	64	73	82	91
40	0	1	2	4	5	6	12	24	37	49	61	73	85	97	110	122
50	0	2	3	5	6	8	15	30	46	61	76	91	107	122	137	152
60	0	2	4	5	7	9	18	37	55	73	91	110	128	146	164	183
70	0	2	4	6	9	11	21	43	64	85	107	128	149	171	192	213
80	0	2	5	7	10	12	24	49	73	97	122	146	171	195	219	244
90	0	3	5	8	11	14	27	55	82	110	137	164	192	219	247	274
100	0	3	6	9	12	15	30	61	91	122	152	183	213	244	274	305

Table 22: Displacement matrix presenting the number of razorbills in the array area plus 2 km buffer, during the migration-free winter bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5
10	0	0	1	1	2	2	5	9	14	19	24	28	33	38	43	47
20	0	1	2	3	4	5	9	19	28	38	47	57	66	76	85	95
30	0	1	3	4	6	7	14	28	43	57	71	85	100	114	128	142
40	0	2	4	6	8	9	19	38	57	76	95	114	133	152	171	190
50	0	2	5	7	9	12	24	47	71	95	119	142	166	190	213	237
60	0	3	6	9	11	14	28	57	85	114	142	171	199	228	256	284
70	0	3	7	10	13	17	33	66	100	133	166	199	232	266	299	332
80	0	4	8	11	15	19	38	76	114	152	190	228	266	303	341	379
90	0	4	9	13	17	21	43	85	128	171	213	256	299	341	384	427
100	0	5	9	14	19	24	47	95	142	190	237	284	332	379	427	474

6 Puffin Displacement Matrices

Table 23: Displacement matrix presenting the number of puffins in the array area only, during the breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	0	0	0	1	1	2	3	4	5	6	7	8	9	10
20	0	0	0	1	1	1	2	4	6	8	10	12	14	17	19	21
30	0	0	1	1	1	2	3	6	9	12	16	19	22	25	28	31
40	0	0	1	1	2	2	4	8	12	17	21	25	29	33	37	41
50	0	1	1	2	2	3	5	10	16	21	26	31	36	41	47	52
60	0	1	1	2	2	3	6	12	19	25	31	37	43	50	56	62
70	0	1	1	2	3	4	7	14	22	29	36	43	51	58	65	72
80	0	1	2	2	3	4	8	17	25	33	41	50	58	66	75	83
90	0	1	2	3	4	5	9	19	28	37	47	56	65	75	84	93
100	0	1	2	3	4	5	10	21	31	41	52	62	72	83	93	104

Table 24: Displacement matrix presenting the number of puffins in the array area plus 2 km buffer, during the breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2
10	0	0	0	0	1	1	2	3	5	6	8	9	11	12	14	15
20	0	0	1	1	1	2	3	6	9	12	15	18	21	25	28	31
30	0	0	1	1	2	2	5	9	14	18	23	28	32	37	41	46
40	0	1	1	2	2	3	6	12	18	25	31	37	43	49	55	61
50	0	1	2	2	3	4	8	15	23	31	38	46	54	61	69	77
60	0	1	2	3	4	5	9	18	28	37	46	55	64	74	83	92
70	0	1	2	3	4	5	11	21	32	43	54	64	75	86	97	107
80	0	1	2	4	5	6	12	25	37	49	61	74	86	98	110	123
90	0	1	3	4	6	7	14	28	41	55	69	83	97	110	124	138
100	0	2	3	5	6	8	15	31	46	61	77	92	107	123	138	153

Table 25: Displacement matrix presenting the number of puffins in the array area only, during the non-breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	5	7	10	12	15	17	20	22	24
20	0	0	1	1	2	2	5	10	15	20	24	29	34	39	44	49
30	0	1	1	2	3	4	7	15	22	29	37	44	51	59	66	73
40	0	1	2	3	4	5	10	20	29	39	49	59	68	78	88	98
50	0	1	2	4	5	6	12	24	37	49	61	73	86	98	110	122
60	0	1	3	4	6	7	15	29	44	59	73	88	103	117	132	147
70	0	2	3	5	7	9	17	34	51	68	86	103	120	137	154	171
80	0	2	4	6	8	10	20	39	59	78	98	117	137	157	176	196
90	0	2	4	7	9	11	22	44	66	88	110	132	154	176	198	220
100	0	2	5	7	10	12	24	49	73	98	122	147	171	196	220	245

Table 26: Displacement matrix presenting the number of puffins in the array area plus 2 km buffer, during the non-breeding bio-season.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	4
10	0	0	1	1	1	2	4	7	11	14	18	21	25	28	32	35
20	0	1	1	2	3	4	7	14	21	28	35	42	49	56	64	71
30	0	1	2	3	4	5	11	21	32	42	53	64	74	85	95	106
40	0	1	3	4	6	7	14	28	42	56	71	85	99	113	127	141
50	0	2	4	5	7	9	18	35	53	71	88	106	123	141	159	176
60	0	2	4	6	8	11	21	42	64	85	106	127	148	169	191	212
70	0	2	5	7	10	12	25	49	74	99	123	148	173	198	222	247
80	0	3	6	8	11	14	28	56	85	113	141	169	198	226	254	282
90	0	3	6	10	13	16	32	64	95	127	159	191	222	254	286	318
100	0	4	7	11	14	18	35	71	106	141	176	212	247	282	318	353

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Appendix A: Guillemot displacement matrices using the mean peak abundance estimates

Table A 1: Displacement matrix presenting the number of guillemots in the array area only, during the breeding bio-season based on the mean peak abundance.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	2	2	3	5	11	16	22	27	33	38	44	49	55
10	0	5	11	16	22	27	55	110	164	219	274	329	384	438	493	548
20	0	11	22	33	44	55	110	219	329	438	548	657	767	877	986	1,096
30	0	16	33	49	66	82	164	329	493	657	822	986	1,151	1,315	1,479	1,644
40	0	22	44	66	88	110	219	438	657	877	1,096	1,315	1,534	1,753	1,972	2,192
50	0	27	55	82	110	137	274	548	822	1,096	1,370	1,644	1,918	2,192	2,465	2,739
60	0	33	66	99	131	164	329	657	986	1,315	1,644	1,972	2,301	2,630	2,959	3,287
70	0	38	77	115	153	192	384	767	1,151	1,534	1,918	2,301	2,685	3,068	3,452	3,835
80	0	44	88	131	175	219	438	877	1,315	1,753	2,192	2,630	3,068	3,506	3,945	4,383
90	0	49	99	148	197	247	493	986	1,479	1,972	2,465	2,959	3,452	3,945	4,438	4,931
100	0	55	110	164	219	274	548	1,096	1,644	2,192	2,739	3,287	3,835	4,383	4,931	5,479

Table A 2: Displacement matrix presenting the number of guillemots in the array area plus 2 km buffer, during the breeding bio-season based on the mean peak abundance.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	3	4	9	17	26	34	43	51	60	68	77	86
10	0	9	17	26	34	43	86	171	257	342	428	513	599	684	770	855
20	0	17	34	51	68	86	171	342	513	684	855	1,026	1,197	1,369	1,540	1,711
30	0	26	51	77	103	128	257	513	770	1,026	1,283	1,540	1,796	2,053	2,309	2,566
40	0	34	68	103	137	171	342	684	1,026	1,369	1,711	2,053	2,395	2,737	3,079	3,421
50	0	43	86	128	171	214	428	855	1,283	1,711	2,138	2,566	2,994	3,421	3,849	4,277
60	0	51	103	154	205	257	513	1,026	1,540	2,053	2,566	3,079	3,592	4,106	4,619	5,132
70	0	60	120	180	239	299	599	1,197	1,796	2,395	2,994	3,592	4,191	4,790	5,389	5,987
80	0	68	137	205	274	342	684	1,369	2,053	2,737	3,421	4,106	4,790	5,474	6,158	6,843
90	0	77	154	231	308	385	770	1,540	2,309	3,079	3,849	4,619	5,389	6,158	6,928	7,698
100	0	86	171	257	342	428	855	1,711	2,566	3,421	4,277	5,132	5,987	6,843	7,698	8,553

Table A 3: Displacement matrix presenting the number of guillemots in the array area only, during the non-breeding bio-season based on the mean peak abundance.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	4	6	9	11	22	43	65	86	108	129	151	172	194	215
10	0	22	43	65	86	108	215	430	645	861	1,076	1,291	1,506	1,721	1,936	2,152
20	0	43	86	129	172	215	430	861	1,291	1,721	2,152	2,582	3,012	3,443	3,873	4,303
30	0	65	129	194	258	323	645	1,291	1,936	2,582	3,227	3,873	4,518	5,164	5,809	6,455
40	0	86	172	258	344	430	861	1,721	2,582	3,443	4,303	5,164	6,025	6,885	7,746	8,606
50	0	108	215	323	430	538	1,076	2,152	3,227	4,303	5,379	6,455	7,531	8,606	9,682	10,758
60	0	129	258	387	516	645	1,291	2,582	3,873	5,164	6,455	7,746	9,037	10,328	11,619	12,910
70	0	151	301	452	602	753	1,506	3,012	4,518	6,025	7,531	9,037	10,543	12,049	13,555	15,061
80	0	172	344	516	689	861	1,721	3,443	5,164	6,885	8,606	10,328	12,049	13,770	15,492	17,213
90	0	194	387	581	775	968	1,936	3,873	5,809	7,746	9,682	11,619	13,555	15,492	17,428	19,365
100	0	215	430	645	861	1,076	2,152	4,303	6,455	8,606	10,758	12,910	15,061	17,213	19,365	21,516

Table A 4: Displacement matrix presenting the number of guillemots in the array area plus 2 km buffer, during the non-breeding bio-season based on the mean peak abundance.

Displacement (%)	Mortality Rates (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	3	7	10	13	16	33	66	99	131	164	197	230	263	296	328
10	0	33	66	99	131	164	328	657	985	1,314	1,642	1,970	2,299	2,627	2,955	3,284
20	0	66	131	197	263	328	657	1,314	1,970	2,627	3,284	3,941	4,597	5,254	5,911	6,568
30	0	99	197	296	394	493	985	1,970	2,955	3,941	4,926	5,911	6,896	7,881	8,866	9,852
40	0	131	263	394	525	657	1,314	2,627	3,941	5,254	6,568	7,881	9,195	10,508	11,822	13,135
50	0	164	328	493	657	821	1,642	3,284	4,926	6,568	8,210	9,852	11,493	13,135	14,777	16,419
60	0	197	394	591	788	985	1,970	3,941	5,911	7,881	9,852	11,822	13,792	15,762	17,733	19,703
70	0	230	460	690	919	1,149	2,299	4,597	6,896	9,195	11,493	13,792	16,091	18,390	20,688	22,987
80	0	263	525	788	1,051	1,314	2,627	5,254	7,881	10,508	13,135	15,762	18,390	21,017	23,644	26,271
90	0	296	591	887	1,182	1,478	2,955	5,911	8,866	11,822	14,777	17,733	20,688	23,644	26,599	29,555
100	0	328	657	985	1,314	1,642	3,284	6,568	9,852	13,135	16,419	19,703	22,987	26,271	29,555	32,838