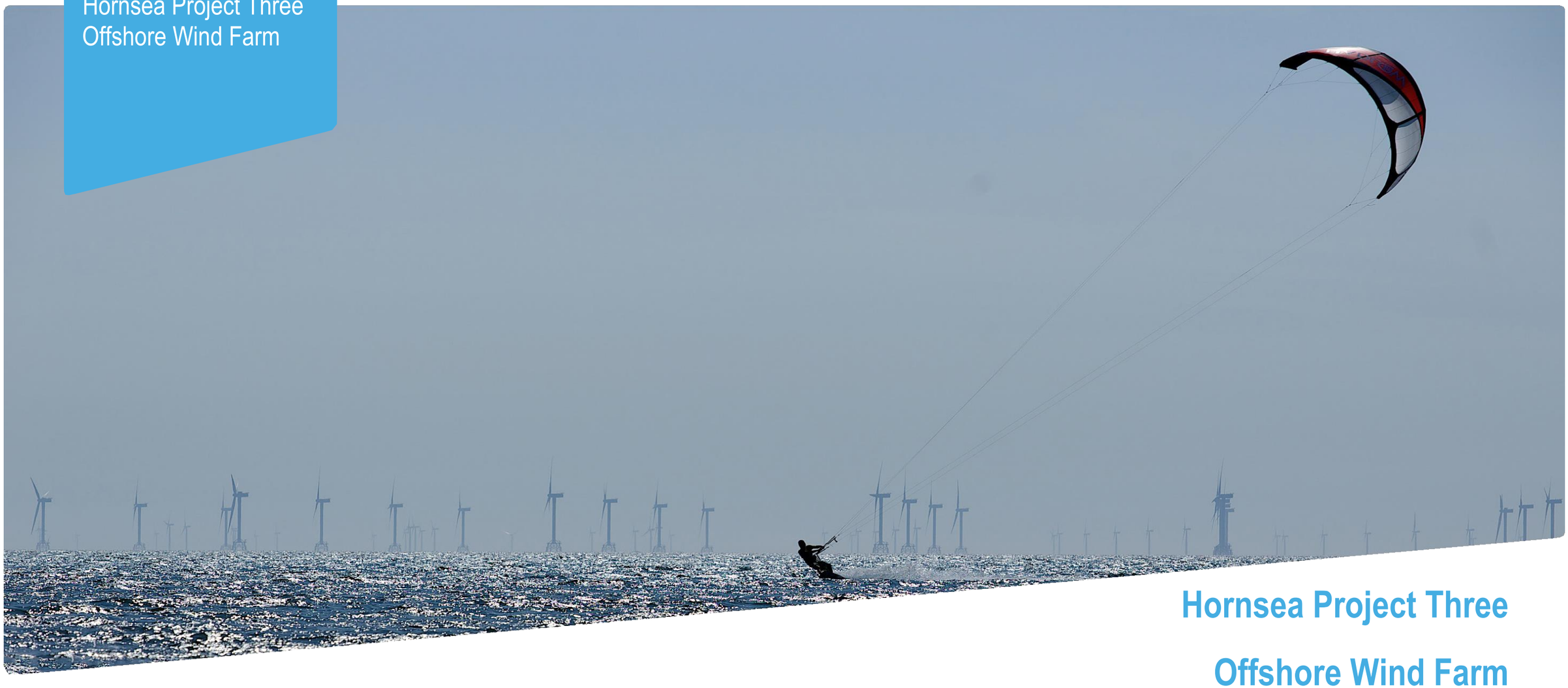
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Preliminary Environmental Information Report:
Annex 5.2 - Analysis of Displacement Impacts on Seabirds

Date: July 2017

Hornsea 3
Offshore Wind Farm

DONG energy

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 5

Annex 5.2 - Analysis of displacement impacts on seabirds

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Front cover picture: Kite surfer near one of DONG Energy's UK offshore wind farms © DONG Energy Hornsea Project Three (UK) Ltd., 2016.

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1. Analysis of displacement impacts on seabirds

1.1 Introduction

1.1.1.1 The presence of wind turbines has the potential to directly disturb and displace birds from within and around Hornsea Three. This indirect habitat loss would reduce the area available for feeding, loafing and moulting for seabird species that may occur at Hornsea Three.

1.1.1.2 This Annex presents data to inform assessments presented in Volume 2, Chapter 5: Offshore Ornithology which determine the significance of displacement impacts. The analyses presented in this Annex have been informed by recent guidance published jointly by the UK Statutory Nature Conservation Bodies (SNCBs)[1] (JNCC *et al.,* 2017). Only displacement impacts associated with the wind farm array area are considered in this Annex. For disturbance/displacement impacts associated with the export cable, including those on red-throated diver and common scoter, see Volume 2, Chapter 5: Offshore Ornithology.

1.2 Background

1.2.1.1 Many groups of seabirds exhibit species-specific behavioural responses to operational offshore wind farms. These responses generally constitute an avoidance reaction in response to rotating turbines or vessel movements. Such a response can result in indirect habitat loss as species avoid areas in which operational wind farms are present (Maclean *et al.,* 2009; Langston, 2010). The vulnerability of a number of species/species groups to displacement effects is shown in Table 1.1 with this information derived from Wade *et al.* (2016) or Garthe and Hüppop (2004).

Table 1.1: Vulnerability of selected seabird species to displacement from structures (Wade *et al.,* 2016; Garthe and Hüppop, 2004)[2].

Vulnerability[1]	Species / species group
Very High	Divers, scoters
High	Guillemot, razorbill, gannet
Medium	Puffin
Low	Terns, all gulls (excl. little gull)
Very Low	Cormorants, fulmar, little gull, skuas, shearwaters

1.2.1.2 Displacement may impact bird populations by affecting site usage which may be for foraging, resting or moulting purposes. As a result of displacement an individual bird may experience a decrease in fitness, due to the effect of re-locating to alternative foraging grounds and/or changes to energy budgets due to the increased energy expenditure when avoiding a wind farm. These impacts, in turn, may have indirect effects on birds at areas that may be some distance from the wind farm including reduced energy acquisition as a result of increased competition at other foraging sites which can result in further reductions in fitness affecting reproductive success. However, due to limited empirical evidence quantifying the likely energetic consequences of displacement, Statutory Nature Conservation Bodies advice is to consider displacement impacts in terms of direct mortality on bird populations (JNCC *et al.,* 2017), with this considered to be a precautionary approach for the purposes of this assessment.

1.2.1.3 In addition to the vulnerability of seabird species to displacement, recent advice published by UK SNCBs (JNCC *et al.,* 2017) suggests that the habitat use flexibility can, in-combination with other factors including expert opinion, be used to propose an appropriate rate of mortality that occurs as a result of displacement. The habitat use flexibility of a number of species/species groups is presented in Table 1.2.

[1] Comprising Natural Resources Wales, Department of Agriculture Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England, Scottish Natural Heritage and the Joint Nature Conservation Committee.

[2] Wade *et al.* (2016) use a numerical scale (1-5) to define vulnerability consistent with that used in Furness (2013). In Table 1.1, scores of 1 are considered to be very low vulnerability with scores of 5 considered to be very high vulnerability

Table 1.2: Habitat use flexibility of selected seabird species (Wade *et al.,* 2016).

Habitat use flexibility	Species / species group
Very High	Gannet, lesser black-backed gull, herring gull, shearwaters, petrels, fulmar
High	All other gull species, skuas
Medium	Great northern diver, guillemot, razorbill, puffin, terns, cormorants
Low	Red-throated diver, black-throated diver, scoters, little tern
Very Low	None

1.2.1.4 Due to the evidence relating to the disturbance distances of divers and seaducks (Fox and Petersen, 2006; Petersen *et al*., 2006; Percival, 2010) the assessments for these species would be conducted using site-specific data incorporating a 4 km buffer. For all other species a buffer of 2 km would be applied. This approach is consistent with the guidance from JNCC *et al.* (2017).

1.3 Methodology

1.3.1 Species for consideration

1.3.1.1 The selection of species for consideration in the displacement assessment was informed using the following criteria:

- The population of the species at the development site plus a 4 km buffer which was compared against a relevant population scale (regional, national or international);
- The vulnerability to displacement and habitat use flexibility of a species (Wade *et al.,* 2016; Bradbury *et al.,* 2014).

1.3.1.2 These criteria were considered conjointly and not individually, i.e. a species with a high vulnerability but small population may not be included but conversely a species with a large population but low vulnerability may be included. For example, a species occurring in low numbers at Hornsea Three or those species that have a low vulnerability to displacement impacts are unlikely to be impacted to the extent whereby population level effects may occur; a small number of displaced birds are likely to be able to re-distribute to other areas unaffected by the effect, with this especially relevant to those species with a high habitat flexibility (Table 1.2). The full process applied to identify species that may be impacted by displacement effects is documented in the Baseline Characterisation Report (Annex 5.1: Offshore Ornithology Baseline Characterisation Report).

1.3.1.3 The following species were identified for inclusion in the displacement assessment:

- Fulmar;
- Gannet;
- Guillemot;
- Razorbill; and
- Puffin.

1.3.2 Population estimates

1.3.2.1 Project-specific data for Hornsea Three has, to date, been collected by eleven digital aerial surveys carried out between April 2016 and February 2017 encompassing the wind farm array area plus a 4 km buffer. This data collection is ongoing. The primary data that informs the basis for the assessment are monthly population estimates (corrected for survey coverage and availability bias) including birds both on the water and in flight. Further information on the aerial surveys undertaken for Hornsea Three and the methodologies used to derive population estimates is provided in the Annex 5.1: Offshore Ornithology Baseline Characterisation Report.

1.3.2.2 For those species identified in Section 1.3.1, a 2 km buffer is applied with monthly population estimates in the wind farm plus a 2 km buffer are presented in Table 1.3. No species for which a 4 km displacement buffer around the wind farm would be used (i.e. those with a Very High vulnerability to displacement) were selected for inclusion in the analyses presented in this Annex due to insignificant observations (less than 10 birds) of these species during aerial surveys at Hornsea Three.

1.3.2.3 Using the population estimates in Table 1.3, peak population estimates have been calculated for each season relevant for each species with these presented in Table 1.4. The seasonal extents for each species are defined in Annex 5.1: Offshore Ornithology Baseline Characterisation Report and included alongside the peak population estimates in Table 1.4. Joint SNCB advice recommends the use of mean-peak population estimates for displacement analysis (JNCC *et al.,* 2017), however, as only one year of data is currently available for Hornsea Three, a peak population estimate has been used for all species on a precautionary basis. This will be amended for the final EIA. The use of seasonal peak population estimates follows recently published SNCB advice (JNCC *et al.,* 2017).

Table 1.3: Monthly population estimates (birds on the water and birds in flight) for species considered for displacement effects at Hornsea Three plus a 2 km buffer.

Survey	Fulmar	Gannet	Guillemot	Razorbill	Puffin
Apr	642	790	3,928	474	187
May	91	206	4,725	285	252
Jun	1,146	234	12,140	577	13
Jul	1,375	642	11,843	239	12
Aug	0	136	8,168	0	0
Sep	1,096	113	9,958	46	11
Oct	262	178	4,465	398	0
Nov	273	90	11,929	3,782	0
Dec	778	429	13,795	2,682	11
Jan	211	0	750	206	0
Feb	69	136	2,684	576	0

Table 1.4: Peak seasonal population estimates for species under consideration.[3]

Species	Breeding	Post-breeding	Non-breeding	Pre-breeding
Fulmar	1,375 (Apr – Aug)	1,096 (Sep-Oct)	273 (Dec)	778 (Jan – Mar)
Gannet	790 (Apr – Aug)	178 (Sep – Nov)		429 (Dec- Mar)
Guillemot	12,140 (Mar – Jul)		13,795 (Aug – Feb)	
Razorbill	577 (Apr – Jul)	398 (Sep – Oct)	3,782 (Nov – Dec)	576 (Jan – Mar)
Puffin	252 (Apr – Jul)		11 (Aug – Mar)	

1.3.3 Displacement and mortality rates

1.3.3.1 Displacement matrices are presented in Section 1.4 for each species and associated seasons identified in Section 1.3. Potential displacement impacts for each species are presented here based on a wide range of potential displacement (0-100%) and mortality rates (0-100%) following recent SNCB guidance (JNCC *et al.,* 2017). Consideration of the appropriate displacement and mortality rates to apply for assessment is provided in Volume 2, Chapter 5: Offshore Ornithology.

1.3.3.2 In Chapter 5: Offshore Ornithology the degree of change predicted to occur at the population level for a species is further explored by comparing the predicted displacement mortality to the relevant 1% threshold of baseline mortality for each species (as advised by Natural England for Hornsea Project Two in July 2014 (Natural England, 2014). This approach is that used at other offshore wind farm projects (e.g. Hornsea Project Two) and is therefore considered applicable to the assessments conducted for Hornsea Three. As such, each matrix in the following species-specific sections is shaded to indicate where the displacement mortality surpasses the 1% threshold of baseline mortality of the relevant regional or national population for each species. The relevant population against which displacement mortality is compared and the baseline mortality for each species (inverse of adult survival from Horswill and Robinson (2015) are presented in each matrix.

1.4 Results

1.4.1 Fulmar

1.4.1.1 Four seasons were defined for fulmar in Annex 5.1: Offshore Ornithology Baseline Characterisation Report. Displacement matrices for each of these seasons, using the peak populations presented in Table 1.4 are presented in Table 1.5 to Table 1.8. The potential level of displacement mortality for fulmar is assessed in Volume 2, Chapter 5: Offshore Ornithology.

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

Table 1.5: Predicted fulmar mortality as a result of displacement from Hornsea Three and 2 km buffer during the breeding season.

Peak month = July	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	14	28	41	55	69	83	96	110	124	138
20	3	6	14	28	55	83	110	138	165	193	220	248	275
30	4	8	21	41	83	124	165	206	248	289	330	371	413
40	6	11	28	55	110	165	220	275	330	385	440	495	550
50	7	14	34	69	138	206	275	344	413	481	550	619	688
60	8	17	41	83	165	248	330	413	495	578	660	743	825
70	10	19	48	96	193	289	385	481	578	674	770	866	963
80	11	22	55	110	220	330	440	550	660	770	880	990	1100
90	12	25	62	124	248	371	495	619	743	866	990	1114	1238
100	14	28	69	138	275	413	550	688	825	963	1100	1238	1375
Regional BDMPS population = 11,745 breeding individuals Baseline mortality = 0.064					< 1% background mortality					> 1% background mortality			

Table 1.6: Predicted fulmar mortality as a result of displacement from Hornsea Three and 2 km buffer during the post-breeding season.

Peak month = September	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	11	22	33	44	55	66	77	88	99	110
20	2	4	11	22	44	66	88	110	132	153	175	197	219
30	3	7	16	33	66	99	132	164	197	230	263	296	329
40	4	9	22	44	88	132	175	219	263	307	351	395	438
50	5	11	27	55	110	164	219	274	329	384	438	493	548
60	7	13	33	66	132	197	263	329	395	460	526	592	658
70	8	15	38	77	153	230	307	384	460	537	614	691	767
80	9	18	44	88	175	263	351	438	526	614	701	789	877
90	10	20	49	99	197	296	395	493	592	691	789	888	986
100	11	22	55	110	219	329	438	548	658	767	877	986	1096
Regional BDMPS population = 957,502 individuals Baseline mortality = 0.064					< 1% background mortality					> 1% background mortality			

Table 1.7: Predicted fulmar mortality as a result of displacement from Hornsea Three and 2 km buffer during the non-breeding season.

Peak month = November	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	3	5	8	11	14	16	19	22	25	27
20	1	1	3	5	11	16	22	27	33	38	44	49	55
30	1	2	4	8	16	25	33	41	49	57	65	74	82
40	1	2	5	11	22	33	44	55	65	76	87	98	109
50	1	3	7	14	27	41	55	68	82	96	109	123	136
60	2	3	8	16	33	49	65	82	98	115	131	147	164
70	2	4	10	19	38	57	76	96	115	134	153	172	191
80	2	4	11	22	44	65	87	109	131	153	175	196	218
90	2	5	12	25	49	74	98	123	147	172	196	221	246
100	3	5	14	27	55	82	109	136	164	191	218	246	273
Regional BDMPS population = 568,736 Baseline mortality = 0.064					< 1% background mortality					> 1% background mortality			

Table 1.8: Predicted fulmar mortality as a result of displacement from Hornsea Three and 2 km buffer during the pre-breeding season.

Peak month = December	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	4	8	16	23	31	39	47	54	62	70	78
20	2	3	8	16	31	47	62	78	93	109	125	140	156
30	2	5	12	23	47	70	93	117	140	163	187	210	233
40	3	6	16	31	62	93	125	156	187	218	249	280	311
50	4	8	19	39	78	117	156	195	233	272	311	350	389
60	5	9	23	47	93	140	187	233	280	327	374	420	467
70	5	11	27	54	109	163	218	272	327	381	436	490	545
80	6	12	31	62	125	187	249	311	374	436	498	560	623
90	7	14	35	70	140	210	280	350	420	490	560	630	700
100	8	16	39	78	156	233	311	389	467	545	623	700	778
Regional BDMPS population = 957,502 individuals Baseline mortality = 0.064					< 1% background mortality					> 1% background mortality			

1.4.2 Gannet

1.4.2.1 Three seasons were defined for gannet in Annex 5.1: Offshore Ornithology Baseline Characterisation Report. Displacement matrices for each of these seasons, using the peak populations presented in Table 1.4 are presented in Table 1.9 to Table 1.11. The potential level of displacement mortality for gannet is assessed in Volume 2, Chapter 5: Offshore Ornithology.

Table 1.9: Predicted gannet mortality as a result of displacement from Hornsea Three and 2 km buffer during the breeding season.

Peak month = April	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	9	19	28	37	46	56	65	74	84	93
20	2	4	9	19	37	56	74	93	111	130	148	167	186
30	3	6	14	28	56	84	111	139	167	195	223	251	278
40	4	7	19	37	74	111	148	186	223	260	297	334	371
50	5	9	23	46	93	139	186	232	278	325	371	418	464
60	6	11	28	56	111	167	223	278	334	390	445	501	557
70	6	13	32	65	130	195	260	325	390	455	520	585	650
80	7	15	37	74	148	223	297	371	445	520	594	668	742
90	8	17	42	84	167	251	334	418	501	585	668	752	835
100	9	19	46	93	186	278	371	464	557	650	742	835	928
Regional BDMPS population = 24,998 breeding individuals Baseline mortality = 0.081					< 1% background mortality					> 1% background mortality			

Table 1.10: Predicted gannet mortality as a result of displacement from Hornsea Three and 2 km buffer during the post-breeding season.

Peak month = October	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	3	6	8	11	14	17	19	22	25	28
20	1	1	3	6	11	17	22	28	33	39	44	50	55
30	1	2	4	8	17	25	33	42	50	58	67	75	83
40	1	2	6	11	22	33	44	55	67	78	89	100	111
50	1	3	7	14	28	42	55	69	83	97	111	125	139
60	2	3	8	17	33	50	67	83	100	116	133	150	166
70	2	4	10	19	39	58	78	97	116	136	155	175	194
80	2	4	11	22	44	67	89	111	133	155	177	200	222
90	2	5	12	25	50	75	100	125	150	175	200	225	250
100	3	6	14	28	55	83	111	139	166	194	222	250	277
Regional BDMPS population = 456,298 individuals Baseline mortality = 0.081					< 1% background mortality					> 1% background mortality			

Table 1.11: Predicted gannet mortality as a result of displacement from Hornsea Three and 2 km buffer during the pre-breeding season.

Peak month = December	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	5	9	19	28	37	47	56	66	75	84	94
20	2	4	9	19	37	56	75	94	112	131	150	169	187
30	3	6	14	28	56	84	112	140	169	197	225	253	281
40	4	7	19	37	75	112	150	187	225	262	300	337	375
50	5	9	23	47	94	140	187	234	281	328	375	421	468
60	6	11	28	56	112	169	225	281	337	393	450	506	562
70	7	13	33	66	131	197	262	328	393	459	524	590	656
80	7	15	37	75	150	225	300	375	450	524	599	674	749
90	8	17	42	84	169	253	337	421	506	590	674	759	843
100	9	19	47	94	187	281	375	468	562	656	749	843	936
Regional BDMPS population = 248,385 individuals Baseline mortality = 0.081					< 1% background mortality					> 1% background mortality			

1.4.3 Puffin

1.4.3.1 Two seasons were defined for puffin in Annex 5.1: Offshore Ornithology Baseline Characterisation Report. Displacement matrices for each of these seasons, using the peak populations presented in Table 1.4 are presented in Table 1.12 and Table 1.13. The potential level of displacement mortality for puffin is assessed in Volume 2, Chapter 5: Offshore Ornithology.

Table 1.12: Predicted puffin mortality as a result of displacement from Hornsea Three and 2 km buffer during the breeding season.

Peak month = May	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	3	5	8	10	13	15	18	20	23	25
20	1	1	3	5	10	15	20	25	30	35	40	45	50
30	1	2	4	8	15	23	30	38	45	53	61	68	76
40	1	2	5	10	20	30	40	50	61	71	81	91	101
50	1	3	6	13	25	38	50	63	76	88	101	114	126
60	2	3	8	15	30	45	61	76	91	106	121	136	151
70	2	4	9	18	35	53	71	88	106	124	141	159	177
80	2	4	10	20	40	61	81	101	121	141	162	182	202
90	2	5	11	23	45	68	91	114	136	159	182	204	227
100	3	5	13	25	50	76	101	126	151	177	202	227	252
Regional BDMPS population = 1,960 breeding individuals Baseline mortality = 0.094					< 1% background mortality					> 1% background mortality			

Table 1.13: Predicted puffin mortality as a result of displacement from Hornsea Three and 2 km buffer during the non-breeding season.

Peak month = September	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	0	0	0	1	1	1	1	1	1
20	0	0	0	0	0	1	1	1	1	2	2	2	2
30	0	0	0	0	1	1	1	2	2	2	3	3	3
40	0	0	0	0	1	1	2	2	3	3	4	4	5
50	0	0	0	1	1	2	2	3	3	4	5	5	6
60	0	0	0	1	1	2	3	3	4	5	5	6	7
70	0	0	0	1	2	2	3	4	5	6	6	7	8
80	0	0	0	1	2	3	4	5	5	6	7	8	9
90	0	0	1	1	2	3	4	5	6	7	8	9	10
100	0	0	1	1	2	3	5	6	7	8	9	10	11
Regional BDMPS population = 231,957 individuals Baseline mortality = 0.094					< 1% background mortality					> 1% background mortality			

1.4.4 Razorbill

1.4.4.1 Four seasons were defined for razorbill in Annex 5.1: Offshore Ornithology Baseline Characterisation Report. Displacement matrices for each of these seasons, using the peak populations presented in Table 1.4 are presented in Table 1.14 to Table 1.17. The potential level of displacement mortality for razorbill is assessed in Volume 2, Chapter 5: Offshore Ornithology.

Table 1.14: Predicted razorbill mortality as a result of displacement from Hornsea Three and 2 km buffer during the breeding season.

Peak month = June	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	1	3	6	12	17	23	29	35	40	46	52	58
20	1	2	6	12	23	35	46	58	69	81	92	104	115
30	2	3	9	17	35	52	69	87	104	121	139	156	173
40	2	5	12	23	46	69	92	115	139	162	185	208	231
50	3	6	14	29	58	87	115	144	173	202	231	260	289
60	3	7	17	35	69	104	139	173	208	243	277	312	346
70	4	8	20	40	81	121	162	202	243	283	323	364	404
80	5	9	23	46	92	139	185	231	277	323	370	416	462
90	5	10	26	52	104	156	208	260	312	364	416	468	520
100	6	12	29	58	115	173	231	289	346	404	462	520	577
National breeding population = 260,000 breeding individuals Baseline mortality = 0.105					< 1% background mortality					> 1% background mortality			

Table 1.15: Predicted razorbill mortality as a result of displacement from Hornsea Three and 2 km buffer during the post-breeding season.

Peak month = October	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	1	2	4	8	12	16	20	24	28	32	36	40
20	1	2	4	8	16	24	32	40	48	56	64	72	80
30	1	2	6	12	24	36	48	60	72	84	96	107	119
40	2	3	8	16	32	48	64	80	96	111	127	143	159
50	2	4	10	20	40	60	80	99	119	139	159	179	199
60	2	5	12	24	48	72	96	119	143	167	191	215	239
70	3	6	14	28	56	84	111	139	167	195	223	251	279
80	3	6	16	32	64	96	127	159	191	223	255	287	318
90	4	7	18	36	72	107	143	179	215	251	287	322	358
100	4	8	20	40	80	119	159	199	239	279	318	358	398
Regional BDMPS population = 591,874 individuals Baseline mortality = 0.105					< 1% background mortality					> 1% background mortality			

Table 1.16: Predicted razorbill mortality as a result of displacement from Hornsea Three and 2 km buffer during the non-breeding season.

Peak month = November	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	8	19	38	76	113	151	189	227	265	303	340	378
20	8	15	38	76	151	227	303	378	454	529	605	681	756
30	11	23	57	113	227	340	454	567	681	794	908	1021	1135
40	15	30	76	151	303	454	605	756	908	1059	1210	1362	1513
50	19	38	95	189	378	567	756	945	1135	1324	1513	1702	1891
60	23	45	113	227	454	681	908	1135	1362	1588	1815	2042	2269
70	26	53	132	265	529	794	1059	1324	1588	1853	2118	2383	2647
80	30	61	151	303	605	908	1210	1513	1815	2118	2420	2723	3026
90	34	68	170	340	681	1021	1362	1702	2042	2383	2723	3063	3404
100	38	76	189	378	756	1135	1513	1891	2269	2647	3026	3404	3782
Regional BDMPS population = 218,622 individuals Baseline mortality = 0.105					< 1% background mortality					> 1% background mortality			

Table 1.17: Predicted razorbill mortality as a result of displacement from Hornsea Three and 2 km buffer during the pre-breeding season.

Peak month = January	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	1	3	6	12	17	23	29	35	40	46	52	58
20	1	2	6	12	23	35	46	58	69	81	92	104	115
30	2	3	9	17	35	52	69	86	104	121	138	156	173
40	2	5	12	23	46	69	92	115	138	161	184	207	230
50	3	6	14	29	58	86	115	144	173	202	230	259	288
60	3	7	17	35	69	104	138	173	207	242	276	311	346
70	4	8	20	40	81	121	161	202	242	282	323	363	403
80	5	9	23	46	92	138	184	230	276	323	369	415	461
90	5	10	26	52	104	156	207	259	311	363	415	467	518
100	6	12	29	58	115	173	230	288	346	403	461	518	576
Regional BDMPS population = 591,874 individuals Baseline mortality = 0.105					< 1% background mortality					> 1% background mortality			

1.4.5 Guillemot

1.4.5.1 Two seasons were defined for guillemot in Annex 5.1: Offshore Ornithology Baseline Characterisation Report. Displacement matrices for each of these seasons, using the peak populations presented in Table 1.4 are presented in Table 1.18 and Table 1.19. The potential level of displacement mortality for guillemot is assessed in Volume 2, Chapter 5: Offshore Ornithology.

Table 1.18: Predicted guillemot mortality as a result of displacement from Hornsea Three and 2 km buffer during the breeding season.

Peak month = June	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	12	24	61	121	243	364	486	607	728	850	971	1093	1214
20	24	49	121	243	486	728	971	1214	1457	1700	1942	2185	2428
30	36	73	182	364	728	1093	1457	1821	2185	2549	2913	3278	3642
40	49	97	243	486	971	1457	1942	2428	2913	3399	3885	4370	4856
50	61	121	303	607	1214	1821	2428	3035	3642	4249	4856	5463	6070
60	73	146	364	728	1457	2185	2913	3642	4370	5099	5827	6555	7284
70	85	170	425	850	1700	2549	3399	4249	5099	5948	6798	7648	8498
80	97	194	486	971	1942	2913	3885	4856	5827	6798	7769	8740	9712
90	109	219	546	1093	2185	3278	4370	5463	6555	7648	8740	9833	10926
100	121	243	607	1214	2428	3642	4856	6070	7284	8498	9712	10926	12140
National breeding population = 1,900,000 breeding individuals Baseline mortality = 0.061					< 1% background mortality					> 1% background mortality			

Table 1.19: Predicted guillemot mortality as a result of displacement from Hornsea Three and 2 km buffer during the non-breeding season.

Peak month = December	Mortality rate (%)												
Displaced (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	14	28	69	138	276	414	552	690	828	966	1104	1242	1380
20	28	55	138	276	552	828	1104	1380	1655	1931	2207	2483	2759
30	41	83	207	414	828	1242	1655	2069	2483	2897	3311	3725	4139
40	55	110	276	552	1104	1655	2207	2759	3311	3863	4414	4966	5518
50	69	138	345	690	1380	2069	2759	3449	4139	4828	5518	6208	6898
60	83	166	414	828	1655	2483	3311	4139	4966	5794	6622	7449	8277
70	97	193	483	966	1931	2897	3863	4828	5794	6760	7725	8691	9657
80	110	221	552	1104	2207	3311	4414	5518	6622	7725	8829	9932	11036
90	124	248	621	1242	2483	3725	4966	6208	7449	8691	9932	11174	12416
100	138	276	690	1380	2759	4139	5518	6898	8277	9657	11036	12416	13795
Regional BDMPS population = 1,617,306 individuals Baseline mortality = 0.061					< 1% background mortality					> 1% background mortality			

1.5 References

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