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Volume 7B Proposed Development (Offshore) Appendices

Appendix 6-2 Offshore Ornithology Distributional Responses Technical Report
Annex 1 Distributional Responses Results (Caledonia OWF)

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Volume 7B Appendix 6-2 Annex 1 Distributional Responses Results (Caledonia OWF)

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Acronyms and Abbreviations

BDMPS	Biologically Defined Minimum Population Scales
OWF	Offshore Wind Farm
SNCB	Statutory Nature Conservation Body

1 Introduction

- 1.1.1.1 The results of the distributional response assessment for the Caledonia Offshore Wind Farm (OWF) (i.e., the Caledonia North Site and Caledonia South Site combined) are provided within this annex. Displacement matrices for key species as per the NatureScot (2020¹) guidance defined seasons are presented in Section 2.1, followed by non-breeding displacement matrices as per the seasonal definitions presented in Furness (2015²) in Section 2.2. The full distributional response assessment methodology is outlined in Section 2 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.
- 1.1.1.2 Monthly apportioned abundance estimates of birds (in flight and on sea, and accounting for availability bias of birds on the water in the case of guillemot, razorbill and puffin) within the boundaries of the Caledonia OWF (+2km buffer) were used within the distributional response assessment, derived from the 24 months of Digital Aerial Survey data. For further information see Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report and Volume 7B, Appendix 6-1: Offshore Ornithology Baseline Characterisation Report.
- 1.1.1.3 Each cell in the matrices represents the potential mortality of birds following displacement from the Caledonia OWF during a defined season by considering the following:
- The seasonal mean peak population within the impacted area;
 - The assumed percentage of birds displaced from the impacted area; and
 - The assumed percentage mortality amongst the displaced birds.
- 1.1.1.4 The values highlighted within the matrices are based on displacement and mortality rates considered the 'most realistic' mortality estimates as advised by the following:
- Guidance Approach (highlighted in dark blue); and
 - Applicant Approach (highlighted in yellow), which is being proposed by Caledonia Offshore Wind Farm Limited (i.e., the Applicant).
- 1.1.1.5 Cells highlighted in light blue represent overlapping estimates from both the Guidance Approach and Applicant Approach, as advised by the Statutory Nature Conservation Bodies (SNCB, 2022³) guidance regarding matrix presentation.
- 1.1.1.6 For a detailed justification of the displacement and mortality rates selected for the Applicant Approach, see Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report and Volume 7B, Appendix 6-2, Annex 4: Review of Relevant Evidence.

2 Results

2.1 Displacement Matrices: NatureScot Seasonal Definitions

2.1.1 Overview

2.1.1.1 Displacement matrices as per the defined seasons in the NatureScot Guidance Note 9 (NatureScot, 2020¹) within the Caledonia OWF plus a 2km buffer are provided in the following sections for the following species:

- Kittiwake (*Rissa tridactyla*);
- Common guillemot (*Uria aalge*), hereafter 'guillemot';
- Razorbill (*Alca torda*);
- Puffin (*Fratercula arctica*); and
- Gannet (*Morus bassanus*).

2.1.1.2 It should be noted the Applicant included the Year 1 August count for puffin in the non-breeding season rather than during the breeding season as part of the Applicant Approach. This is due to the monthly abundance data suggesting the August abundance reflecting the potential migration of puffin, rather than individuals present in the breeding season. Matrices for puffin have also been presented with the Year 1 August count included in the breeding season as per the Guidance Approach, meaning that for this species, there are two separate sets of matrices.

2.1.1.3 For further information regarding the seasonal considerations within the distributional response assessment see Section 2.6 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.1.2 Kittiwake

Table 2-1: Kittiwake breeding season (Mid-April to August) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	2	4	6	10	20	41	61	82	102	122	143	163	183	204
20	4	8	12	20	41	82	122	163	204	245	285	326	367	408
30	6	12	18	31	61	122	183	245	306	367	428	489	550	612
40	8	16	24	41	82	163	245	326	408	489	571	652	734	815
50	10	20	31	51	102	204	306	408	510	612	714	815	917	1,019
60	12	24	37	61	122	245	367	489	612	734	856	979	1,101	1,223
70	14	29	43	71	143	285	428	571	714	856	999	1,142	1,284	1,427
80	16	33	49	82	163	326	489	652	815	979	1,142	1,305	1,468	1,631
90	18	37	55	92	183	367	550	734	917	1,101	1,284	1,468	1,651	1,835
100	20	41	61	102	204	408	612	815	1,019	1,223	1,427	1,631	1,835	2,039

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach. The Applicant remains of the view that kittiwake do not require assessment for distributional response and thus no Applicant Approach is presented. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-2: Kittiwake non-breeding season (September to early-April) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Non-Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	2	5	10	14	19	24	29	34	39	43	48
20	1	2	3	5	10	19	29	39	48	58	68	77	87	97
30	1	3	4	7	14	29	43	58	72	87	101	116	130	145
40	2	4	6	10	19	39	58	77	97	116	135	155	174	193
50	2	5	7	12	24	48	72	97	121	145	169	193	217	242
60	3	6	9	14	29	58	87	116	145	174	203	232	261	290
70	3	7	10	17	34	68	101	135	169	203	237	270	304	338
80	4	8	12	19	39	77	116	155	193	232	270	309	348	386
90	4	9	13	22	43	87	130	174	217	261	304	348	391	435
100	5	10	14	24	48	97	145	193	242	290	338	386	435	483

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach. The Applicant remains of the view that kittiwake do not require assessment for distributional response and thus no Applicant Approach is presented. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.1.3 Guillemot

Table 2-3: Guillemot breeding season (April to mid-August) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Breeding Season		Mortality Rate (%)													
Displacement Rate (%)	1	2	3	5	10	20	30	40	50	60	70	80	90	100	
10	16	32	48	80	161	322	483	644	805	966	1,126	1,287	1,448	1,609	
20	32	64	97	161	322	644	966	1,287	1,609	1,931	2,253	2,575	2,897	3,218	
30	48	97	145	241	483	966	1,448	1,931	2,414	2,897	3,379	3,862	4,345	4,828	
40	64	129	193	322	644	1,287	1,931	2,575	3,218	3,862	4,506	5,149	5,793	6,437	
50	80	161	241	402	805	1,609	2,414	3,218	4,023	4,828	5,632	6,437	7,241	8,046	
60	97	193	290	483	966	1,931	2,897	3,862	4,828	5,793	6,759	7,724	8,690	9,655	
70	113	225	338	563	1,126	2,253	3,379	4,506	5,632	6,759	7,885	9,011	10,138	11,264	
80	129	257	386	644	1,287	2,575	3,862	5,149	6,437	7,724	9,011	10,299	11,586	12,873	
90	145	290	434	724	1,448	2,897	4,345	5,793	7,241	8,690	10,138	11,586	13,034	14,483	
100	161	322	483	805	1,609	3,218	4,828	6,437	8,046	9,655	11,264	12,873	14,483	16,092	

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-4: Guillemot non-breeding season (Late-August to March) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Non-breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	7	13	20	34	67	134	201	268	335	403	470	537	604	671
20	13	27	40	67	134	268	403	537	671	805	939	1,074	1,208	1,342
30	20	40	60	101	201	403	604	805	1,006	1,208	1,409	1,610	1,812	2,013
40	27	54	81	134	268	537	805	1,074	1,342	1,610	1,879	2,147	2,416	2,684
50	34	67	101	168	335	671	1,006	1,342	1,677	2,013	2,348	2,684	3,019	3,355
60	40	81	121	201	403	805	1,208	1,610	2,013	2,416	2,818	3,221	3,623	4,026
70	47	94	141	235	470	939	1,409	1,879	2,348	2,818	3,288	3,758	4,227	4,697
80	54	107	161	268	537	1,074	1,610	2,147	2,684	3,221	3,758	4,294	4,831	5,368
90	60	121	181	302	604	1,208	1,812	2,416	3,019	3,623	4,227	4,831	5,435	6,039
100	67	134	201	335	671	1,342	2,013	2,684	3,355	4,026	4,697	5,368	6,039	6,710

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.1.4 Razorbill

Table 2-5: Razorbill breeding season (April to mid-August) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	2	4	5	9	18	35	53	70	88	106	123	141	159	176
20	4	7	11	18	35	70	106	141	176	211	247	282	317	352
30	5	11	16	26	53	106	159	211	264	317	370	423	476	529
40	7	14	21	35	70	141	211	282	352	423	493	564	634	705
50	9	18	26	44	88	176	264	352	440	529	617	705	793	881
60	11	21	32	53	106	211	317	423	529	634	740	846	951	1,057
70	12	25	37	62	123	247	370	493	617	740	863	987	1,110	1,233
80	14	28	42	70	141	282	423	564	705	846	987	1,128	1,269	1,409
90	16	32	48	79	159	317	476	634	793	951	1,110	1,269	1,427	1,586
100	18	35	53	88	176	352	529	705	881	1,057	1,233	1,409	1,586	1,762

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-6: Razorbill non-breeding season (Late-August to March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Non-breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	2	4	6	10	19	39	58	77	96	116	135	154	174	193
20	4	8	12	19	39	77	116	154	193	232	270	309	347	386
30	6	12	17	29	58	116	174	232	289	347	405	463	521	579
40	8	15	23	39	77	154	232	309	386	463	540	617	695	772
50	10	19	29	48	96	193	289	386	482	579	675	772	868	965
60	12	23	35	58	116	232	347	463	579	695	810	926	1,042	1,158
70	14	27	41	68	135	270	405	540	675	810	945	1,081	1,216	1,351
80	15	31	46	77	154	309	463	617	772	926	1,081	1,235	1,389	1,544
90	17	35	52	87	174	347	521	695	868	1,042	1,216	1,389	1,563	1,737
100	19	39	58	96	193	386	579	772	965	1,158	1,351	1,544	1,737	1,930

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.1.5 Puffin

Guidance Approach

Table 2-7: Puffin breeding season (April to mid-March) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	2	4	6	10	21	41	62	82	103	124	144	165	185	206
20	4	8	12	21	41	82	124	165	206	247	289	330	371	412
30	6	12	19	31	62	124	185	247	309	371	433	495	556	618
40	8	16	25	41	82	165	247	330	412	495	577	659	742	824
50	10	21	31	52	103	206	309	412	515	618	721	824	927	1,030
60	12	25	37	62	124	247	371	495	618	742	866	989	1,113	1,236
70	14	29	43	72	144	289	433	577	721	866	1,010	1,154	1,298	1,443
80	16	33	49	82	165	330	495	659	824	989	1,154	1,319	1,484	1,649
90	19	37	56	93	185	371	556	742	927	1,113	1,298	1,484	1,669	1,855
100	21	41	62	103	206	412	618	824	1,030	1,236	1,443	1,649	1,855	2,061

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach (though the final Applicant Approach outputs are presented in Table 2-9 and Table 2-10). For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-8: Puffin non-breeding season (Late-August to March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Non-breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	1	3	4	7	13	27	40	53	67	80	93	107	120	134
20	3	5	8	13	27	53	80	107	134	160	187	214	240	267
30	4	8	12	20	40	80	120	160	200	240	280	321	361	401
40	5	11	16	27	53	107	160	214	267	321	374	427	481	534
50	7	13	20	33	67	134	200	267	334	401	467	534	601	668
60	8	16	24	40	80	160	240	321	401	481	561	641	721	801
70	9	19	28	47	93	187	280	374	467	561	654	748	841	935
80	11	21	32	53	107	214	321	427	534	641	748	855	962	1,068
90	12	24	36	60	120	240	361	481	601	721	841	962	1,082	1,202
100	13	27	40	67	134	267	401	534	668	801	935	1,068	1,202	1,336

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach (though the final Applicant Approach outputs are presented in Table 2-9 and Table 2-10). For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Applicant Approach

Table 2-9: Puffin breeding season (April to mid-March) displacement matrix (Caledonia OWF + 2km buffer) (Model-based).

Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	1	1	2	3	7	14	21	28	35	42	49	56	63	70
20	1	3	4	7	14	28	42	56	70	84	98	112	126	140
30	2	4	6	10	21	42	63	84	105	126	147	168	188	209
40	3	6	8	14	28	56	84	112	140	168	195	223	251	279
50	3	7	10	17	35	70	105	140	175	209	244	279	314	349
60	4	8	13	21	42	84	126	168	209	251	293	335	377	419
70	5	10	15	24	49	98	147	195	244	293	342	391	440	489
80	6	11	17	28	56	112	168	223	279	335	391	447	503	558
90	6	13	19	31	63	126	188	251	314	377	440	503	565	628
100	7	14	21	35	70	140	209	279	349	419	489	558	628	698

Note, this table presents the Applicant Approach for puffin, whereby the Year 1 August abundance has been incorporated as part of the non-breeding season (see Table 2-10). Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-10: Puffin non-breeding season (Late-August to March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Non-breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	3	6	9	15	30	60	90	120	150	180	210	240	270	300
20	6	12	18	30	60	120	180	240	300	361	421	481	541	601
30	9	18	27	45	90	180	270	361	451	541	631	721	811	901
40	12	24	36	60	120	240	361	481	601	721	841	961	1,082	1,202
50	15	30	45	75	150	300	451	601	751	901	1,052	1,202	1,352	1,502
60	18	36	54	90	180	361	541	721	901	1,082	1,262	1,442	1,622	1,803
70	21	42	63	105	210	421	631	841	1,052	1,262	1,472	1,683	1,893	2,103
80	24	48	72	120	240	481	721	961	1,202	1,442	1,683	1,923	2,163	2,404
90	27	54	81	135	270	541	811	1,082	1,352	1,622	1,893	2,163	2,434	2,704
100	30	60	90	150	300	601	901	1,202	1,502	1,803	2,103	2,404	2,704	3,005

Note, this table presents the Applicant Approach for puffin, whereby the Year 1 August abundance has been incorporated as part of the non-breeding season. Outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.1.6 Gannet

Table 2-11: Gannet breeding season displacement (Mid-March to September) matrix (Caledonia OWF + 2km buffer) (Design-based).

Breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	1	2	3	5	9	18	27	36	45	55	64	73	82	91
20	2	4	5	9	18	36	55	73	91	109	127	145	164	182
30	3	5	8	14	27	55	82	109	136	164	191	218	245	273
40	4	7	11	18	36	73	109	145	182	218	254	291	327	363
50	5	9	14	23	45	91	136	182	227	273	318	363	409	454
60	5	11	16	27	55	109	164	218	273	327	382	436	491	545
70	6	13	19	32	64	127	191	254	318	382	445	509	572	636
80	7	15	22	36	73	145	218	291	363	436	509	581	654	727
90	8	16	25	41	82	164	245	327	409	491	572	654	736	818
100	9	18	27	45	91	182	273	363	454	545	636	727	818	909

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in light blue represent the overlapping predicted annual mortality estimates from both the Guidance Approach and Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-12: Gannet non-breeding season (October to early-March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Non-breeding Season Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	2	3	6	9	13	16	19	22	25	28	32
20	1	1	2	3	6	13	19	25	32	38	44	50	57	63
30	1	2	3	5	9	19	28	38	47	57	66	76	85	95
40	1	3	4	6	13	25	38	50	63	76	88	101	113	126
50	2	3	5	8	16	32	47	63	79	95	110	126	142	158
60	2	4	6	9	19	38	57	76	95	113	132	151	170	189
70	2	4	7	11	22	44	66	88	110	132	154	176	198	221
80	3	5	8	13	25	50	76	101	126	151	176	202	227	252
90	3	6	9	14	28	57	85	113	142	170	198	227	255	284
100	3	6	9	16	32	63	95	126	158	189	221	252	284	315

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in light blue represent the overlapping predicted annual mortality estimates from both the Guidance Approach and Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.2 Displacement Matrices: Furness (2015) Seasonal Definitions

2.2.1 Overview

2.2.1.1 Non-breeding displacement matrices as per the defined seasons Furness (2015²) for species with defined autumn passage, spring passage and winter periods are provided in the following sections for the following species:

- Kittiwake;
- Razorbill; and
- Gannet.

2.2.1.2 The Furness (2015²) seasons have been adapted and shortened to align with the NatureScot breeding seasons. For further information regarding the seasonal considerations within the distributional response assessment see Section 2.6 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.2.1.3 It should be noted that for kittiwake, the Applicant has decided to include the Year 3 April count (04 April 2023) in the breeding season rather than during the spring migration breeding season. This is due to the April 2023 abundance being considered to reflect nest site attendance rather than individuals present in the spring migration.

2.2.2 Kittiwake

Table 2-13: Kittiwake autumn migration (September to December) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Autumn Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	2	5	10	14	19	24	29	34	39	43	48
20	1	2	3	5	10	19	29	39	48	58	68	77	87	97
30	1	3	4	7	14	29	43	58	72	87	101	116	130	145
40	2	4	6	10	19	39	58	77	97	116	135	155	174	193
50	2	5	7	12	24	48	72	97	121	145	169	193	217	242
60	3	6	9	14	29	58	87	116	145	174	203	232	261	290
70	3	7	10	17	34	68	101	135	169	203	237	270	304	338
80	4	8	12	19	39	77	116	155	193	232	270	309	348	386
90	4	9	13	22	43	87	130	174	217	261	304	348	391	435
100	5	10	14	24	48	97	145	193	242	290	338	386	435	483

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach. The Applicant remains of the view that kittiwake do not require assessment for distributional response and thus no Applicant Approach is presented. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-14: Kittiwake spring migration (January to mid-April) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Spring Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	1	1	2	3	5	6	7	8	9	10	11
20	0	0	1	1	2	5	7	9	11	14	16	18	21	23
30	0	1	1	2	3	7	10	14	17	21	24	27	31	34
40	0	1	1	2	5	9	14	18	23	27	32	37	41	46
50	1	1	2	3	6	11	17	23	29	34	40	46	52	57
60	1	1	2	3	7	14	21	27	34	41	48	55	62	69
70	1	2	2	4	8	16	24	32	40	48	56	64	72	80
80	1	2	3	5	9	18	27	37	46	55	64	73	82	92
90	1	2	3	5	10	21	31	41	52	62	72	82	93	103
100	1	2	3	6	11	23	34	46	57	69	80	92	103	115

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach. The Applicant remains of the view that kittiwake do not require assessment for distributional response and thus no Applicant Approach is presented. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.2.3 Razorbill

Table 2-15: Razorbill autumn migration (Late-August to October) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Autumn Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	2	4	6	9	18	37	55	74	92	110	129	147	166	184
20	4	7	11	18	37	74	110	147	184	221	258	294	331	368
30	6	11	17	28	55	110	166	221	276	331	387	442	497	552
40	7	15	22	37	74	147	221	294	368	442	515	589	663	736
50	9	18	28	46	92	184	276	368	460	552	644	736	828	920
60	11	22	33	55	110	221	331	442	552	663	773	883	994	1,104
70	13	26	39	64	129	258	387	515	644	773	902	1,031	1,160	1,288
80	15	29	44	74	147	294	442	589	736	883	1,031	1,178	1,325	1,472
90	17	33	50	83	166	331	497	663	828	994	1,160	1,325	1,491	1,656
100	18	37	55	92	184	368	552	736	920	1,104	1,288	1,472	1,656	1,841

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-16: Razorbill winter period (November to December) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Winter Period Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	1	3	5	8	10	13	15	18	20	23	25
20	1	1	2	3	5	10	15	20	25	30	35	40	45	51
30	1	2	2	4	8	15	23	30	38	45	53	61	68	76
40	1	2	3	5	10	20	30	40	51	61	71	81	91	101
50	1	3	4	6	13	25	38	51	63	76	88	101	114	126
60	2	3	5	8	15	30	45	61	76	91	106	121	136	152
70	2	4	5	9	18	35	53	71	88	106	124	141	159	177
80	2	4	6	10	20	40	61	81	101	121	141	162	182	202
90	2	5	7	11	23	45	68	91	114	136	159	182	205	227
100	3	5	8	13	25	51	76	101	126	152	177	202	227	253

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-17: Razorbill spring migration (January to March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Spring Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	1	1	2	3	5	11	16	21	26	32	37	42	48	53
20	1	2	3	5	11	21	32	42	53	64	74	85	95	106
30	2	3	5	8	16	32	48	64	79	95	111	127	143	159
40	2	4	6	11	21	42	64	85	106	127	148	169	191	212
50	3	5	8	13	26	53	79	106	132	159	185	212	238	265
60	3	6	10	16	32	64	95	127	159	191	222	254	286	318
70	4	7	11	19	37	74	111	148	185	222	259	297	334	371
80	4	8	13	21	42	85	127	169	212	254	297	339	381	424
90	5	10	14	24	48	95	143	191	238	286	334	381	429	477
100	5	11	16	26	53	106	159	212	265	318	371	424	477	530

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in yellow represent the predicted annual mortality estimates as per the Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

2.2.4 Gannet

Table 2-18: Gannet autumn migration (October to November) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Autumn Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	1	1	2	3	6	9	13	16	19	22	25	28	32
20	1	1	2	3	6	13	19	25	32	38	44	50	57	63
30	1	2	3	5	9	19	28	38	47	57	66	76	85	95
40	1	3	4	6	13	25	38	50	63	76	88	101	113	126
50	2	3	5	8	16	32	47	63	79	95	110	126	142	158
60	2	4	6	9	19	38	57	76	95	113	132	151	170	189
70	2	4	7	11	22	44	66	88	110	132	154	176	198	221
80	3	5	8	13	25	50	76	101	126	151	176	202	227	252
90	3	6	9	14	28	57	85	113	142	170	198	227	255	284
100	3	6	9	16	32	63	95	126	158	189	221	252	284	315

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in light blue represent the overlapping predicted annual mortality estimates from both the Guidance Approach and Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

Table 2-19: Gannet spring migration (December to mid-March) displacement matrix (Caledonia OWF + 2km buffer) (Design-based).

Spring Migration Displacement Rate (%)	Mortality Rate (%)													
	1	2	3	5	10	20	30	40	50	60	70	80	90	100
10	0	0	0	0	0	1	1	1	1	2	2	2	3	3
20	0	0	0	0	1	1	2	2	3	3	4	5	5	6
30	0	0	0	0	1	2	3	3	4	5	6	7	8	9
40	0	0	0	1	1	2	3	5	6	7	8	9	10	11
50	0	0	0	1	1	3	4	6	7	9	10	11	13	14
60	0	0	1	1	2	3	5	7	9	10	12	14	15	17
70	0	0	1	1	2	4	6	8	10	12	14	16	18	20
80	0	0	1	1	2	5	7	9	11	14	16	18	21	23
90	0	1	1	1	3	5	8	10	13	15	18	21	23	26
100	0	1	1	1	3	6	9	11	14	17	20	23	26	29

Note, outputs highlighted in dark blue represent the predicted annual mortality estimates as per the Guidance Approach and those highlighted in light blue represent the overlapping predicted annual mortality estimates from both the Guidance Approach and Applicant Approach. For further information regarding the Guidance and Applicant Approaches see Section 2.5 of Volume 7B, Appendix 6-2: Offshore Ornithology Distributional Responses Technical Report.

3 References

¹ NatureScot (2020) 'Guidance Note 9 - Guidance to support Offshore Wind Applications: Seasonal periods for Birds in the Scottish Marine Environment'. Available at: <https://www.nature.scot/doc/guidance-note-9-guidance-support-offshore-wind-applications-seasonal-periods-birds-scottish-marine> (Accessed 15/05/2024)

² Furness, R.W. (2015) 'Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)'. Natural England Commissioned Reports, Number 164

³ Statutory Nature Conservation Bodies (SNCB) (2022) 'Joint SNCB Interim Displacement Advice Note'. Statutory Nature Conservation Bodies in this case comprising Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England, Scottish Natural Heritage (NatureScot) and Joint Nature Conservation Committee. Available at: <https://data.jncc.gov.uk/data/9aecb87c-80c5-4cfb-9102-39f0228dcc9a/joint-sncb-interim-displacement-advice-note-2022.pdf> (Accessed 15/05/2024)

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