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Volume 7B Proposed Development (Offshore) Appendices

Appendix 6-5 Migratory Collision Risk Modelling Technical Report
Annex 1 Migratory Collision Risk Modelling Results (Caledonia OWF)

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Volume 7B Appendix 6-5 Annex 1 Migratory Collision Risk Modelling Results (Caledonia OWF)

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Acronyms and Abbreviations

mCRM	Migratory Collision Risk Modelling
OWF	Offshore Wind Farm
SD	Standard Deviation
WCS	Worst-case Scenario
WTG	Wind Turbine Generator

1 Introduction

1.1.1.1 The results of the migratory Collision Risk Modelling (mCRM) for the Caledonia Offshore Wind Farm (OWF) (i.e., the Caledonia North Site and Caledonia South Site) are presented within this annex. Three Wind Turbine Generator (WTG) options have been modelled using the Marine Scotland Avian Migration Collision Risk Model Shiny Application ("mCRM Application"; HiDef Aerial Surveying Ltd., 2024¹). The full mCRM methodology is outlined in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report.

1.1.1.2 The WTG parameters used within the mCRM for the Caledonia OWF are presented in (Table 1-1). Scoping results are presented in Section 2, and estimated seasonal collisions presented in Section 3.

Table 1-1: OWF and WTG parameters used for CRM for the Caledonia OWF.

Parameter	WTG 1	WTG 2		WTG 3
	Fixed	Fixed	Floating	Fixed
Number of WTGs	140	62	29	84
Latitude (degrees)	58.19	58.19	58.19	58.19
Width (km)	44.0	44.0	44.0	44.0
Number of blades	3	3	3	3
Rotor radius (m)	118	155	145	155
Blade width (m)	7.50	7.50	7.50	7.50
Average pitch (°)	2	2	2	2
Average pitch SD (°)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)
Rotation speed (rpm)	8.4	8.4	8.4	8.4
Rotation speed SD (rpm)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)	No data (assumed 0)

2 Scoping Results

- 2.1.1.1 The results from the scoping process (methodology described in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report) are presented in Table 2-1 to Table 2-4. For each table, the species UK Population estimate (and corresponding Standard Deviation (SD)) predicted to intersect Caledonia OWF on migration, based on the default UK population sizes within the model are presented. The population estimate predicted to intersect Caledonia OWF is calculated based on the proportion of randomly generated migration lines which intersect Caledonia OWF within the species defined migratory corridor. Further detail on population estimation can be found within the mCRM Application github repository (HiDef Aerial Surveying Ltd., 2024¹).
- 2.1.1.2 The percentage of the UK population predicted to intersect Caledonia OWF (and thus at potential risk of collision) on migration is also provided within Table 2-1 to Table 2-4. In accordance with the Scoping methodology (described in Volume 7B, Appendix 6-5: Migratory Collision Risk Modelling Technical Report) where less than 1% of the UK population is predicted to intersect Caledonia OWF, the species has been scoped out of further modelling. The species that have been scoped in have been carried through into Section 3.

Table 2-1: Caledonia OWF scenario WTG 1 initial scoping results.

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Bar-tailed godwit (<i>Limosa lapponica</i>)	12,829	2,074	1.90	In
Bean goose (<i>Anser fabalis</i>)	24	4	2.40	In
Bittern (<i>Botaurus stellaris</i>)	-	-	0.00	Out
Black-tailed godwit (<i>Limosa limosa</i>)	-	-	0.00	Out
Black-throated Diver (<i>Gavia arctica</i>)	27	4	2.20	In
Canadian Light-bellied brent goose (<i>Branta bernicla hrota</i>)	-	-	0.00	Out
Common scoter (<i>Melanitta nigra</i>)	1,880	340	1.40	In
Corncrake (<i>Crex crex</i>)	270	55	1.60	In
Curlew (<i>Numenius arquata</i>)	2,764	423	2.00	In
Dotterel (<i>Charadrius morinellus</i>)	11	2	2.70	In
Dunlin (<i>Calidris alpina</i>)	31,804	5,938	1.60	In
Eider (<i>Somateria mollissima</i>)	1,941	296	1.80	In
Golden plover (<i>Pluvialis apricaria</i>)	53,437	8,506	1.60	In
Goldeneye (<i>Bucephala clangula</i>)	719	117	1.90	In
Goosander (<i>Mergus merganser</i>)	599	65	3.40	In
Great crested grebe (<i>Podiceps cristatus</i>)	-	-	0.00	Out
Great northern diver (<i>Gavia immer</i>)	188	32	1.70	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Greenshank (<i>Tringa nebularia</i>)	123	24	1.70	In
Grey plover (<i>Pluvialis squatarola</i>)	1,976	402	1.60	In
Hen harrier (<i>Circus cyaneus</i>)	37	6	1.70	In
Icelandic greylag goose (<i>Anser anser</i>)	161	76	0.20	Out
Knot (<i>Calidris canutus</i>)	5,131	1,099	1.40	In
Lapwing (<i>Vanellus vanellus</i>)	59,611	10,292	1.50	In
Long-tailed duck (<i>Clangula hyemalis</i>)	275	44	2.10	In
Mallard (<i>Anas platyrhynchos</i>)	17,741	2,752	2.20	In
Marsh harrier (<i>Circus aeruginosus</i>)	52	8	2.00	In
Merlin (<i>Falco columbarius</i>)	46	15	0.60	Out
Nightjar (<i>Caprimulgus europaeus</i>)	82	19	1.10	In
Osprey (<i>Pandion haliaetus</i>)	16	3	2.40	In
Oystercatcher (<i>Haematopus ostralegus</i>)	6,160	1,141	1.70	In
Pink-footed goose (<i>Anser brachyrhynchus</i>)	908	485	0.20	Out
Pintail (<i>Anas acuta</i>)	331	57	1.60	In
Purple sandpiper (<i>Calidris maritima</i>)	465	72	1.90	In
Red-breasted merganser (<i>Mergus serrator</i>)	293	51	1.80	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Redshank (<i>Tringa totanus</i>)	5,383	1,054	1.30	In
Red-throated diver (<i>Gavia stellata</i>)	726	109	2.10	In
Ringed plover (<i>Charadrius hiaticula</i>)	4,001	679	1.40	In
Ruff (<i>Calidris pugnax</i>)	537	98	1.70	In
Sanderling (<i>Calidris alba</i>)	3,460	593	1.70	In
Scaup (<i>Aythya marila</i>)	77	17	1.10	In
Shelduck (<i>Tadorna tadorna</i>)	922	182	1.50	In
Short-eared owl (<i>Asio flammeus</i>)	258	47	1.70	In
Shoveler (<i>Anas clypeata</i>)	251	49	1.10	In
Slavonian grebe (<i>Podiceps auritus</i>)	18	4	1.70	In
Snipe (<i>Gallinago gallinago</i>)	92,767	16,401	1.50	In
Spotted crake (<i>Porzana porzana</i>)	1	-	3.80	In
Svalbard barnacle goose (<i>Branta leucopsis</i>)	1,862	185	4.30	In
Svalbard light-bellied brent goose (<i>Branta bernicla hrota</i>)	331	40	3.30	In
Teal (<i>Anas crecca</i>)	704	378	0.20	Out
Tufted duck (<i>Aythya fuligula</i>)	2,421	413	1.60	In
Turnstone (<i>Arenaria interpres</i>)	6,205	964	1.80	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Velvet scoter (<i>Melanitta fusca</i>)	58	10	1.70	In
Whimbrel (<i>Numenius phaeopus</i>)	72	13	1.50	In
White-tailed eagle (<i>Haliaeetus albicilla</i>)	2	1	1.30	In
Whooper swan (<i>Cygnus cygnus</i>)	1,043	135	2.60	In
Wigeon (<i>Anas penelope</i>)	8,197	1,477	1.70	In
Wood sandpiper (<i>Tringa glareola</i>)	1	-	1.90	In

Table 2-2: Caledonia OWF scenario WTG 2a initial scoping results.

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Bar-tailed godwit	12,955	2,136	1.90	In
Bean goose	24	4	2.50	In
Bittern	-	-	0.00	Out
Black-tailed godwit	-	-	0.00	Out
Black-throated Diver	28	4	2.30	In
Canadian light-bellied brent goose	-	-	0.00	Out
Common scoter	1,856	357	1.40	In
Corncrake	265	42	1.60	In
Curlew	2,616	387	1.90	In
Dotterel	11	2	2.80	In
Dunlin	32,380	5,497	1.60	In
Eider	1,951	311	1.80	In
Golden plover	53,256	9,003	1.60	In
Goldeneye	687	113	1.80	In
Goosander	605	73	3.50	In
Great crested Grebe	-	-	0.00	Out
Great northern diver	183	34	1.70	In
Greenshank	116	20	1.60	In
Grey plover	2,027	334	1.60	In
Hen harrier	37	6	1.70	In
Icelandic greylag goose	169	77	0.20	Out
Knot	5,230	1,004	1.50	In
Lapwing	59,395	11,439	1.50	In
Long-tailed duck	269	36	2.10	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Mallard	18,104	2,800	2.20	In
Marsh harrier	53	8	2.00	In
Merlin	46	13	0.60	Out
Nightjar	84	19	1.10	In
Osprey	16	3	2.40	In
Oystercatcher	6,172	1,066	1.70	In
Pink-footed goose	898	417	0.20	Out
Pintail	339	62	1.60	In
Purple sandpiper	459	70	1.90	In
Red-breasted merganser	302	45	1.90	In
Redshank	5,490	977	1.30	In
Red-throated diver	732	110	2.20	In
Ringed plover	4,096	762	1.40	In
Ruff	532	86	1.70	In
Sanderling	3,404	576	1.70	In
Scaup	81	18	1.10	In
Shelduck	932	185	1.50	In
Short-eared owl	256	43	1.70	In
Shoveler	248	55	1.10	In
Slavonian grebe	18	3	1.70	In
Snipe	92,919	16,352	1.50	In
Spotted crake	1	-	3.80	In
Svalbard barnacle goose	1,873	214	4.30	In
Svalbard light-bellied brent goose	335	39	3.30	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Teal	739	348	0.20	Out
Tufted duck	2,431	502	1.60	In
Turnstone	6,099	897	1.80	In
Velvet scoter	59	12	1.70	In
Whimbrel	74	12	1.60	In
White-tailed eagle	2	1	1.30	In
Whooper swan	1,051	141	2.60	In
Wigeon	7,885	1,200	1.60	In
Wood sandpiper	1	-	1.90	In

Table 2-3: Caledonia OWF scenario WTG 2b initial scoping results.

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Bar-tailed godwit	12,941	2,263	1.9	In
Bean goose	24	4	2.5	In
Bittern	-	-	0	Out
Black-tailed godwit	-	-	0	Out
Black-throated Diver	28	4	2.3	In
Canadian light-bellied brent goose	-	-	0	Out
Common scoter	1,868	334	1.4	In
Corncrake	264	45	1.6	In
Curlew	2,636	415	1.9	In
Dotterel	11	2	2.8	In
Dunlin	32,542	5,162	1.6	In
Eider	1,953	275	1.8	In
Golden plover	53,388	8,521	1.6	In
Goldeneye	687	124	1.8	In
Goosander	606	75	3.5	In
Great crested Grebe	-	-	0	Out
Great northern diver	183	31	1.7	In
Greenshank	116	18	1.6	In
Grey plover	2,020	320	1.6	In
Hen harrier	37	6	1.7	In
Icelandic greylag goose	169	75	0.2	Out
Knot	5,212	899	1.4	In
Lapwing	59,276	11,379	1.5	In
Long-tailed duck	269	34	2.1	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Mallard	18,058	2,844	2.2	In
Marsh harrier	53	8	2	In
Merlin	46	14	0.6	Out
Nightjar	85	20	1.1	In
Osprey	16	3	2.4	In
Oystercatcher	6,170	1,022	1.7	In
Pink-footed goose	893	427	0.2	Out
Pintail	339	62	1.6	In
Purple sandpiper	459	71	1.9	In
Red-breasted merganser	300	50	1.9	In
Redshank	5,484	1,004	1.3	In
Red-throated diver	727	100	2.1	In
Ringed plover	4,093	738	1.4	In
Ruff	532	94	1.7	In
Sanderling	3,412	633	1.7	In
Scaup	81	18	1.1	In
Shelduck	932	162	1.5	In
Short-eared owl	256	45	1.7	In
Shoveler	247	54	1.1	In
Slavonian grebe	18	4	1.7	In
Snipe	93,133	15,778	1.5	In
Spotted crake	1	-	3.8	In
Svalbard barnacle goose	1,868	220	4.3	In
Svalbard light-bellied brent goose	334	39	3.3	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Teal	739	365	0.2	Out
Tufted duck	2,427	470	1.6	In
Turnstone	6,089	977	1.8	In
Velvet scoter	59	11	1.7	In
Whimbrel	74	15	1.6	In
White-tailed eagle	2	1	1.3	In
Whooper swan	1,054	133	2.6	In
Wigeon	7,839	1,421	1.6	In
Wood sandpiper	1	-	1.9	In

Table 2-4: Caledonia OWF scenario WTG 3 initial scoping results.

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Bar-tailed godwit	12,941	2,263	1.90	In
Bean goose	24	4	2.50	In
Bittern	-	-	0.00	Out
Black-tailed godwit	-	-	0.00	Out
Black-throated diver	28	4	2.30	In
Canadian light-bellied brent goose	-	-	0.00	Out
Common scoter	1,868	334	1.40	In
Corncrake	264	45	1.60	In
Curlew	2,636	415	1.90	In
Dotterel	11	2	2.80	In
Dunlin	32,542	5,162	1.60	In
Eider	1,953	275	1.80	In
Golden plover	53,388	8,521	1.60	In
Goldeneye	687	124	1.80	In
Goosander	606	75	3.50	In
Great crested Grebe	-	-	0.00	Out
Great northern diver	183	31	1.70	In
Greenshank	116	18	1.60	In
Grey plover	2,020	320	1.60	In
Hen harrier	37	6	1.70	In
Icelandic greylag goose	169	75	0.20	Out
Knot	5,212	899	1.40	In
Lapwing	59,276	11,379	1.50	In
Long-tailed duck	269	34	2.10	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Mallard	18,058	2,844	2.20	In
Marsh harrier	53	8	2.00	In
Merlin	46	14	0.60	Out
Nightjar	85	20	1.10	In
Osprey	16	3	2.40	In
Oystercatcher	6,170	1,022	1.70	In
Pink-footed goose	893	427	0.20	Out
Pintail	339	62	1.60	In
Purple sandpiper	459	71	1.90	In
Red-breasted merganser	300	50	1.90	In
Redshank	5,484	1,004	1.30	In
Red-throated diver	727	100	2.10	In
Ringed plover	4,093	738	1.40	In
Ruff	532	94	1.70	In
Sanderling	3,412	633	1.70	In
Scaup	81	18	1.10	In
Shelduck	932	162	1.50	In
Short-eared owl	256	45	1.70	In
Shoveler	247	54	1.10	In
Slavonian grebe	18	4	1.70	In
Snipe	93,133	15,778	1.50	In
Spotted crake	1	-	3.80	In
Svalbard barnacle goose	1,868	220	4.30	In
Svalbard light-bellied brent goose	334	39	3.30	In

Species	Population Estimate	SD	% at Collision Risk	Scoped In/Out
Teal	739	365	0.20	Out
Tufted duck	2,427	470	1.60	In
Turnstone	6,089	977	1.80	In
Velvet scoter	59	11	1.70	In
Whimbrel	74	15	1.60	In
White-tailed eagle	2	1	1.30	In
Whooper swan	1,054	133	2.60	In
Wigeon	7,839	1,421	1.60	In
Wood sandpiper	1	-	1.90	In

3 Results

- 3.1.1.1 The mCRM results for Scenarios 1, 2 and 3 for the Caledonia OWF are presented below in Table 3-1 to Table 3-3.
- 3.1.1.2 Scenario 2 results are presented as a combination of WTG 2 (bottom-fixed) and WTG 2 (floating). The same species were scoped out (Section 2); therefore, the predicted collisions have been combined to present one total for the WTG 2 scenario for the Caledonia OWF (Table 3-1). The worst-case scenario (WCS) for the Caledonia OWF, determined by comparing scenarios for the highest estimated annual collision rate, is WTG 1.

Table 3-1: Summary of estimated seasonal migratory collisions for the Caledonia OWF scenario WTG 1 (WCS).

Species	Pre-breeding	Post-breeding	Other	Total
Bar-tailed godwit	0.357 ± 0.057	0.35 ± 0.056	0 ± 0	0.707 ± 0.08
Bean goose	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Black-throated diver	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Common scoter	0.786 ± 0.148	0.779 ± 0.147	0 ± 0	1.565 ± 0.209
Corncrake	0.037 ± 0.007	0.036 ± 0.007	0 ± 0	0.073 ± 0.01
Curlew	0.087 ± 0.014	0.085 ± 0.014	0 ± 0	0.172 ± 0.02
Dotterel	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dunlin	0.802 ± 0.149	0.790 ± 0.147	0 ± 0	1.592 ± 0.209
Eider	0.226 ± 0.036	0.230 ± 0.037	0 ± 0	0.456 ± 0.052
Golden plover	1.438 ± 0.228	1.413 ± 0.224	0 ± 0	2.851 ± 0.32
Goldeneye	0.304 ± 0.053	0.305 ± 0.053	0 ± 0	0.609 ± 0.075
Goosander	0.269 ± 0.032	0.263 ± 0.032	0 ± 0	0.532 ± 0.045
Great northern diver	0.008 ± 0.001	0.008 ± 0.001	0 ± 0	0.016 ± 0.001
Greenshank	0.004 ± 0.001	0.004 ± 0.001	0 ± 0	0.008 ± 0.001
Grey plover	0.053 ± 0.011	0.052 ± 0.011	0 ± 0	0.105 ± 0.016
Hen Harrier	0.006 ± 0.001	0.006 ± 0.001	0 ± 0	0.012 ± 0.001
Knot	0.13 ± 0.028	0.128 ± 0.027	0 ± 0	0.258 ± 0.039
Lapwing	1.706 ± 0.289	1.729 ± 0.293	0 ± 0	3.435 ± 0.412
Long-tailed duck	0.115 ± 0.019	0.115 ± 0.019	0 ± 0	0.230 ± 0.027
Mallard	8.135 ± 1.348	8.288 ± 1.373	8.401 ± 1.392	24.824 ± 2.375
Marsh harrier	0.004 ± 0.001	0.004 ± 0.001	0 ± 0	0.008 ± 0.001
Nightjar	0.012 ± 0.004	0.012 ± 0.004	0 ± 0	0.024 ± 0.006
Osprey	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Oystercatcher	0.192 ± 0.036	0.187 ± 0.035	0 ± 0	0.379 ± 0.05

Species	Pre-breeding	Post-breeding	Other	Total
Pintail	0.143 ± 0.025	0.144 ± 0.026	0 ± 0	0.287 ± 0.036
Purple sandpiper	0.012 ± 0.002	0.012 ± 0.002	0 ± 0	0.024 ± 0.003
Red-breasted merganser	0.123 ± 0.023	0.126 ± 0.023	0 ± 0	0.249 ± 0.033
Redshank	0.147 ± 0.03	0.143 ± 0.029	0 ± 0	0.29 ± 0.042
Red-throated diver	0.028 ± 0.004	0.027 ± 0.004	0 ± 0	0.055 ± 0.006
Ringed plover	0.102 ± 0.017	0.101 ± 0.017	0 ± 0	0.203 ± 0.024
Ruff	0.014 ± 0.003	0.014 ± 0.003	0 ± 0	0.028 ± 0.004
Sanderling	0.084 ± 0.014	0.084 ± 0.014	0 ± 0	0.168 ± 0.02
Scaup	0.032 ± 0.007	0.033 ± 0.007	0 ± 0	0.065 ± 0.01
Shelduck	0.219 ± 0.047	0.207 ± 0.044	0.216 ± 0.046	0.642 ± 0.079
Short-eared owl	0.042 ± 0.008	0.041 ± 0.008	0 ± 0	0.083 ± 0.011
Shoveler	0.106 ± 0.021	0.104 ± 0.021	0.109 ± 0.022	0.319 ± 0.037
Slavonian grebe	0.002 ± 0.001	0.002 ± 0.001	0 ± 0	0.004 ± 0.001
Snipe	2.407 ± 0.415	2.397 ± 0.413	2.467 ± 0.425	7.271 ± 0.723
Spotted crake	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Svalbard barnacle goose	0.059 ± 0.008	0.059 ± 0.008	0 ± 0	0.118 ± 0.011
Svalbard light-bellied brent goose	0.005 ± 0.002	0.005 ± 0.001	0 ± 0	0.01 ± 0.002
Tufted duck	0.983 ± 0.171	1.001 ± 0.174	0 ± 0	1.984 ± 0.244
Turnstone	0.179 ± 0.038	0.173 ± 0.037	0 ± 0	0.352 ± 0.053
Velvet scoter	0.026 ± 0.005	0.025 ± 0.005	0 ± 0	0.051 ± 0.007
Whimbrel	0.002 ± 0	0.002 ± 0	0 ± 0	0.004 ± 0
White-tailed eagle	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Whooper swan	0.284 ± 0.056	0.285 ± 0.057	0 ± 0	0.569 ± 0.08

Species	Pre-breeding	Post-breeding	Other	Total
Wigeon	3.559 ± 0.66	3.549 ± 0.658	0 ± 0	7.108 ± 0.932
Wood sandpiper	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 3-2: Summary of estimated seasonal migratory collisions for the Caledonia OWF scenario WTG 2.

Species	Pre-breeding	Post-breeding	Other	Total
Bar-tailed godwit	0.240 ± 0.041	0.236 ± 0.04	0 ± 0	0.476 ± 0.057
Bean Goose	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Black-throated diver	0 ± 0	0.001 ± 0	0 ± 0	0.001 ± 0
Common scoter	0.543 ± 0.105	0.538 ± 0.104	0 ± 0	1.081 ± 0.148
Corncrake	0.025 ± 0.005	0.025 ± 0.005	0 ± 0	0.05 ± 0.007
Curlew	0.060 ± 0.01	0.06 ± 0.01	0 ± 0	0.120 ± 0.014
Dotterel	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dunlin	0.538 ± 0.097	0.530 ± 0.096	0 ± 0	1.068 ± 0.137
Eider	0.157 ± 0.027	0.160 ± 0.027	0 ± 0	0.317 ± 0.038
Golden plover	0.959 ± 0.185	0.942 ± 0.181	0 ± 0	1.901 ± 0.259
Goldeneye	0.203 ± 0.035	0.203 ± 0.035	0 ± 0	0.406 ± 0.049
Goosander	0.186 ± 0.024	0.182 ± 0.022	0 ± 0	0.368 ± 0.033
Great northern diver	0.006 ± 0.001	0.006 ± 0.001	0 ± 0	0.012 ± 0.001
Greenshank	0.003 ± 0	0.003 ± 0	0 ± 0	0.006 ± 0
Grey plover	0.037 ± 0.006	0.035 ± 0.006	0 ± 0	0.072 ± 0.009
Hen harrier	0.004 ± 0	0.004 ± 0	0 ± 0	0.008 ± 0
Knot	0.092 ± 0.015	0.091 ± 0.015	0 ± 0	0.183 ± 0.021
Lapwing	1.200 ± 0.200	1.217 ± 0.203	0 ± 0	2.417 ± 0.285
Long-tailed duck	0.077 ± 0.012	0.078 ± 0.012	0 ± 0	0.155 ± 0.017
Mallard	5.787 ± 0.924	5.896 ± 0.942	5.975 ± 0.955	17.658 ± 1.629
Marsh harrier	0.003 ± 0	0.003 ± 0	0 ± 0	0.006 ± 0
Nightjar	0.009 ± 0.003	0.009 ± 0.003	0 ± 0	0.018 ± 0.004
Osprey	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Oystercatcher	0.138 ± 0.024	0.134 ± 0.024	0 ± 0	0.272 ± 0.034

Species	Pre-breeding	Post-breeding	Other	Total
Pintail	0.100 ± 0.018	0.100 ± 0.018	0 ± 0	0.200 ± 0.025
Purple sandpiper	0.008 ± 0.001	0.008 ± 0.001	0 ± 0	0.016 ± 0.001
Red-breasted merganser	0.084 ± 0.016	0.085 ± 0.016	0 ± 0	0.169 ± 0.023
Redshank	0.104 ± 0.022	0.102 ± 0.022	0 ± 0	0.206 ± 0.031
Red-throated diver	0.020 ± 0.003	0.019 ± 0.003	0 ± 0	0.039 ± 0.004
Ringed plover	0.068 ± 0.013	0.068 ± 0.013	0 ± 0	0.136 ± 0.019
Ruff	0.009 ± 0.002	0.009 ± 0.002	0 ± 0	0.018 ± 0.002
Sanderling	0.055 ± 0.011	0.055 ± 0.011	0 ± 0	0.110 ± 0.015
Scaup	0.023 ± 0.004	0.023 ± 0.004	0 ± 0	0.046 ± 0.005
Shelduck	0.152 ± 0.031	0.143 ± 0.029	0.149 ± 0.03	0.444 ± 0.052
Short-eared owl	0.029 ± 0.006	0.028 ± 0.006	0 ± 0	0.057 ± 0.009
Shoveler	0.077 ± 0.015	0.074 ± 0.015	0.079 ± 0.016	0.23 ± 0.027
Slavonian grebe	0.002 ± 0	0.002 ± 0	0 ± 0	0.004 ± 0
Snipe	1.688 ± 0.296	1.68 ± 0.294	1.73 ± 0.303	5.098 ± 0.516
Spotted crake	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Svalbard barnacle goose	0.042 ± 0.006	0.042 ± 0.006	0 ± 0	0.084 ± 0.009
Svalbard light-bellied brent goose	0.004 ± 0.001	0.003 ± 0.001	0 ± 0	0.007 ± 0.001
Tufted duck	0.673 ± 0.129	0.685 ± 0.130	0 ± 0	1.358 ± 0.183
Turnstone	0.120 ± 0.033	0.116 ± 0.032	0 ± 0	0.236 ± 0.046
Velvet scoter	0.017 ± 0.004	0.017 ± 0.003	0 ± 0	0.034 ± 0.005
Whimbrel	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
White-tailed eagle	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Whooper swan	0.209 ± 0.046	0.21 ± 0.046	0 ± 0	0.419 ± 0.065

Species	Pre-breeding	Post-breeding	Other	Total
Wigeon	2.359 ± 0.408	2.351 ± 0.407	0 ± 0	4.710 ± 0.576
Wood sandpiper	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Table 3-3: Summary of estimated seasonal migratory collisions for the Caledonia OWF scenario WTG 3.

Species	Pre-breeding	Post-breeding	Other	Total
Bar-tailed godwit	0.227 ± 0.04	0.223 ± 0.039	0 ± 0	0.450 ± 0.056
Bean goose	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Black-throated diver	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Common scoter	0.494 ± 0.093	0.490 ± 0.093	0 ± 0	0.984 ± 0.132
Corncrake	0.023 ± 0.004	0.022 ± 0.004	0 ± 0	0.045 ± 0.006
Curlew	0.054 ± 0.01	0.053 ± 0.009	0 ± 0	0.107 ± 0.013
Dotterel	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dunlin	0.508 ± 0.081	0.500 ± 0.079	0 ± 0	1.008 ± 0.113
Eider	0.147 ± 0.023	0.15 ± 0.023	0 ± 0	0.297 ± 0.033
Golden plover	0.898 ± 0.143	0.882 ± 0.141	0 ± 0	1.780 ± 0.201
Goldeneye	0.184 ± 0.036	0.185 ± 0.036	0 ± 0	0.369 ± 0.051
Goosander	0.175 ± 0.024	0.171 ± 0.023	0 ± 0	0.346 ± 0.033
Great northern diver	0.005 ± 0.001	0.005 ± 0.001	0 ± 0	0.010 ± 0.001
Greenshank	0.002 ± 0	0.002 ± 0	0 ± 0	0.004 ± 0
Grey plover	0.034 ± 0.005	0.033 ± 0.005	0 ± 0	0.067 ± 0.007
Hen harrier	0.004 ± 0.001	0.004 ± 0.001	0 ± 0	0.008 ± 0.001
Knot	0.081 ± 0.014	0.079 ± 0.014	0 ± 0	0.160 ± 0.02
Lapwing	1.076 ± 0.203	1.091 ± 0.206	0 ± 0	2.167 ± 0.289
Long-tailed duck	0.071 ± 0.010	0.071 ± 0.010	0 ± 0	0.142 ± 0.014
Mallard	5.388 ± 0.917	5.489 ± 0.934	5.564 ± 0.947	16.441 ± 1.616
Marsh Harrier	0.003 ± 0.001	0.003 ± 0.001	0 ± 0	0.006 ± 0.001
Nightjar	0.008 ± 0.003	0.008 ± 0.003	0 ± 0	0.016 ± 0.004
Osprey	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Oystercatcher	0.124 ± 0.022	0.121 ± 0.021	0 ± 0	0.245 ± 0.03

Species	Pre-breeding	Post-breeding	Other	Total
Pintail	0.094 ± 0.018	0.094 ± 0.018	0 ± 0	0.188 ± 0.025
Purple Sandpiper	0.007 ± 0.001	0.007 ± 0.001	0 ± 0	0.014 ± 0.001
Red-breasted Merganser	0.080 ± 0.014	0.082 ± 0.015	0 ± 0	0.162 ± 0.021
Redshank	0.094 ± 0.019	0.092 ± 0.018	0 ± 0	0.186 ± 0.026
Red-throated Diver	0.018 ± 0.003	0.018 ± 0.003	0 ± 0	0.036 ± 0.004
Ringed Plover	0.064 ± 0.011	0.064 ± 0.011	0 ± 0	0.128 ± 0.016
Ruff	0.009 ± 0.002	0.009 ± 0.002	0 ± 0	0.018 ± 0.003
Sanderling	0.051 ± 0.009	0.051 ± 0.009	0 ± 0	0.102 ± 0.013
Scaup	0.021 ± 0.005	0.022 ± 0.005	0 ± 0	0.043 ± 0.007
Shelduck	0.144 ± 0.029	0.136 ± 0.027	0.142 ± 0.028	0.422 ± 0.049
Short-eared Owl	0.027 ± 0.005	0.027 ± 0.005	0 ± 0	0.054 ± 0.007
Shoveler	0.067 ± 0.015	0.065 ± 0.015	0.068 ± 0.015	0.200 ± 0.026
Slavonian Grebe	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Snipe	1.510 ± 0.251	1.504 ± 0.25	1.547 ± 0.257	4.561 ± 0.438
Spotted Crake	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Svalbard Barnacle Goose	0.038 ± 0.006	0.039 ± 0.006	0 ± 0	0.077 ± 0.008
Svalbard Light-Bellied Brent Goose	0.004 ± 0.001	0.003 ± 0.001	0 ± 0	0.007 ± 0.001
Tufted Duck	0.622 ± 0.122	0.634 ± 0.124	0 ± 0	1.256 ± 0.174
Turnstone	0.113 ± 0.028	0.109 ± 0.027	0 ± 0	0.222 ± 0.039
Velvet Scoter	0.017 ± 0.003	0.016 ± 0.003	0 ± 0	0.033 ± 0.004
Whimbrel	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
White-tailed Eagle	0.001 ± 0	0.001 ± 0	0 ± 0	0.002 ± 0
Whooper Swan	0.198 ± 0.042	0.198 ± 0.042	0 ± 0	0.396 ± 0.059

Species	Pre-breeding	Post-breeding	Other	Total
Wigeon	2.172 ± 0.408	2.165 ± 0.407	0 ± 0	4.337 ± 0.576
Wood Sandpiper	0 ± 0	0 ± 0	0 ± 0	0 ± 0

4 References

¹ HiDef Aerial Surveying Ltd. (2024) 'mCRM: Avian Migration Collision Risk Model'. R package version f0.4.1. Available at: <https://hidefdevo.shinyapps.io/mCRM/> (Accessed 13/05/2024)

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