Appendix 11-7:
Offshore Ornithology Apportioning Impacts to Individual Colonies

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ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Appendix 11-7: Offshore Ornithology Apportioning Impacts to Individual Colonies

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ORIEL WIND FARM PROJECT – OFFSHORE ORNITHOLOGY APPORTIONING IMPACTS TO INDIVIDUAL COLONIES

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1 INTRODUCTION

1.1 Project background

Oriel Windfarm Limited ('the Applicant') is proposing to develop the Oriel Wind Farm Project, an offshore wind farm, hereafter referred to as 'the Project'. The Project is located in the western Irish Sea and is located within the territorial waters of the Republic of Ireland. The Project will comprise both offshore and onshore infrastructure including 25 offshore wind turbines generators (WTGs), associated foundations and inter-array cabling, offshore substation, offshore export cable within a defined offshore cable corridor, a landfall, onshore cable and an onshore substation for connection to the electricity transmission network.

1.2 Background to apportioning

When assessing the impact of a proposed offshore wind farm, it is crucial to determine the impact that such development will have on breeding seabird populations. Seabirds nest in colonies of variable sizes around the coastline (Mitchell *et al*., 2004) and most species have large foraging ranges at sea (Woodward *et al*., 2019). Establishing the connectivity between marine renewable sites and colonies, which are often protected as Special Protection Areas (SPAs), is a key element of the assessment of impact. A theoretical approach was developed by Scottish Natural Heritage (SNH, 2018) (now known as NatureScot) to determine the proportion of birds from SPA sites which use proposed development areas. The tools allow to 'apportion' the impact of a marine renewable site to multiple SPAs.

1.3 Purpose of the report

The *primary purpose* of this report is to apportion predicted mortalities from collisions and displacement of the Project to seabird colonies designated as SPAs (i.e. qualifying as an individual species and/or assemblage of species). As there are no defined seabird colonies for marine SPA's (i.e. those designated to protect foraging areas), they have not been included in the apportioning of potential impacts (e.g. North-west Irish Sea SPA).

This report presents the method used and apportions the potential impacts of the Project, on SPAs that support qualifying species deemed to be adversely impacted by the Project. It utilises outcomes from other reports, including the collision risk and displacement analyses (appendix 11-4: Offshore Ornithology Collision Risk Modelling and appendix 11-5: Offshore Ornithology Displacement Modelling).

The species presented within this report are limited to the species for which an impact assessment was undertaken in chapter 11: Offshore Ornithology for either displacement or collision. In the EIAR, displacement as a result of the construction, operational and maintenance or decommissioning phases was considered for common guillemot (*Uria aalge*) (hereafter referred to as guillemot), great northern diver (*Gavia immer*), northern gannet (*Morus bassanus*) (hereafter, referred to as gannet) and razorbill (*Alca torda*). The risk of collision as a result of the Project was assessed for black-legged kittiwake (*Rissa tridactyla*) (hereafter referred to as kittiwake), common gull (*Larus canus*), gannet, great black-backed gull (*Larus marinus*) and herring gull (L*arus argentatus*).

There are no SPAs designated for breeding great northern diver within the Cumulative Offshore Ornithology Study Area and the species is not considered further in this report. Similarly, there are no breeding common gull nor great black-backed gull SPAs within 50 km and 73 km of the Project, the mean-maximum foraging range (MMFR) of common gull and great black-backed gull, respectively. The Cumulative Offshore Ornithology Study Area is defined as the MMFR plus one standard deviation (SD) of gannet (Woodward *et al.,* 2019) as the theoretical maximal zone of influence of the Project.

2 METHODOLOGY

Apportioning undertaken for the Project is based on the NatureScot 'theoretical approach' method for the breeding season (SNH, 2018). Apportioning during the non-breeding season utilises elements from within Furness (2015) but is adapted to include the abundance estimates for the entire Irish Sea.

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For apportioning estimated mortalities associated with an offshore wind farm that may occur in the breeding season to seabirds from those SPAs within a species' MMFR of the Project, there is a two-step approach as outlined in the NatureScot method:

- Apportion estimated mortalities between SPA and non-SPA breeding colonies within foraging range of the wind farm. This is done using the most recent counts for each colony; and

- The estimated mortalities assigned to the SPA component are further apportioned between the individual SPAs within foraging range. This is done by using the Seabird 2000 counts as a reference point.

In this report, the choice was made to base the apportioning on the most recent counts, given that many colony counts have been updated since the NatureScot method was published. Colony counts were extracted from the Seabird Monitoring Programme (SMP) online database (available online at: https://app.bto.org/seabirds/public/index.jsp).

2.1 Identification of designated sites

All SPAs that have connectivity to the Project, defined by the MMFR (plus one SD) of that SPA's qualifying ornithological interest features were identified. Connectivity between an SPA and the Project was defined by the MMFR of each species as shown in Table 2-1 from Woodward *et al*. (2019). A total of 12 different SPAs were identified and included within this apportioning report.

Table 2-1: MMFR for each species and associated SPAs.

Species	Mean max foraging range (km) + SD (sample size – number of studies)	SPA(s) within MMFR of each species
Gannet	315.2 ± 194.2 (31)	- Ailsa Craig - Grassholm - Ireland's Eye - Saltee Islands - Lambay Island
Guillemot	73.2 ± 80.5 (7)	- Howth Head Coast - Ireland's Eye - Lambay Island - Rathlin Island - Wicklow Head
Herring gull	58.8 ± 26.8 (7)	- Howth Head Coast - Ireland's Eye - Lambay Island - Skerries Islands
Kittiwake	156.1 ± 144.5 (19)	- Ailsa Craig - Helvick Head to Ballyquin - Horn Head to Fanad Head - Howth Head Coast - Ireland's Eye - Lambay Island - North Colonsay and Western Cliffs - Rathlin Island - Saltee Islands - Wicklow Head
Razorbill	88.7 ± 75.9 (8)	- Howth Head Coast - Ireland's Eye

Species	Mean max foraging range (km) + SD (sample size – number of studies)	SPA(s) within MMFR of each species
		• Lambay Island • Rathlin Island • Wicklow Head

2.2 Defining bio-seasons

Bio-seasons used within the assessment were defined according to the breeding, non-breeding and migratory season (autumn and spring migration) based on Furness (2015) (Table 2-2). Colour-coding has been used to define the four main bio-seasons presented in Table 2-2.

Table 2-2: Seasonal definitions as the basis for assessment.

Species	Pre-breeding season/spring migration	Breeding season (migration free if provided in Furness, 2015)	Post breeding season/autumn migration	Non-breeding/winter season
Gannet	December to March	April to August (migration free)	September to November	N/A
Guillemot	N/A	March to July	N/A	August to February
Herring gull	N/A	March to August	N/A	September to February
Kittiwake	January to April	May to July (migration free	September to December	N/A
Razorbill	January to March	April to July	August to October	November to December

2.3 Mortality estimates

The mortality estimates are provided in Table 2-3 from collision and displacement. There were up to three estimates provided for the number of birds that might collide or be displaced due to the varying methodologies of the surveys that took place and analysis undertaken.

For collisions, within the Band (2012) model, both site specific and generic flight heights can be used providing different estimates of collision. Option 1 uses site specific flight heights (obtained from the boat based surveys), whereas Option 2 uses flight heights from Johnston *et al.* (2014). Both the Natural England avoidance rates (ARs) and the JNCC ARs are presented. Natural England interim avoidance is not species specific, whereas the JNCC AR are. See appendix 11-4: Offshore Ornithology Collision Risk Modelling for full methods of the CRM.

Within the results section below (section 3), only the maximum and minimum of the three estimates is presented within the assessment to reduce repetition and for precaution.

Table 2-3: Estimated mortalities per species and seasons from collision risk and/or displacement.

Species	Season	Survey technique (Band Model Option)	Estimated mortality collisions		Estimated mortality displacement	Estimated mortality combined
			Natural England AR	JNCC AR		
Gannet (70% macro-avoidance included in collisions)	Pre-breeding	Boat (BM1)	1.74	1.54	0	1.54 to 1.74
		Boat (BM2)	0.86	0.75	0	0.75 to 0.86
	Breeding	Boat (BM1)	10.31	8.96	1 to 2	9.96 to 12.31
		Boat (BM2)	5.08	4.34	1 to 2	5.34 to 7.08

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Species	Season	Survey technique (Band Model Option)	Estimated mortality collisions		Estimated mortality displacement	Estimated mortality combined
			Natural England AR	JNCC AR		
		Aerial (BM2)	4.10	3.61	1	4.61 to 5.10
	Post-breeding	Boat (BM1)	8.65	7.47	2 to 3	9.47 to 11.63
		Boat (BM2)	4.25	3.63	2 to 3	5.63 to 7.25
Guillemot	Breeding	Boat	-		2 to 29	2 to 29
		Aerial	-		5 to 56	5 to 56
	Non-breeding	Boat	-		8 to 93	8 to 93
		Aerial	-		15 to 173	15 to 173
Herring gull	Breeding	Boat (BM1)	26.32	20.99	-	20.99 to 26.32
		Boat (BM2)	31.34	25.12	-	25.12 to 31.34
	Non-breeding	Boat (BM1)	50.79	40.64	-	40.64 to 50.79
		Boat (BM2)	60.46	48.38	-	48.38 to 60.46
Kittiwake	Pre-breeding	Boat (BM1)	23.02	7.05	-	7.05 to 23.02
		Boat (BM2)	26.5	8.06	-	8.06 to 26.5
	Breeding	Boat (BM1)	3.99	1.52	-	1.52 to 3.99
		Boat (BM2)	5.83	1.74	-	1.74 to 5.83
		Aerial (BM2)	4.1	3.61	-	3.61 to 4.1
	Post-breeding	Boat (BM1)	20.81	6.4	-	6.4 to 20.81
		Boat (BM2)	23.95	7.31	-	7.31 to 23.95
Razorbill	Pre-breeding	Boat	-		3 to 30	3 to 30
	Breeding	Boat	-		0	0
		Aerial	-		1 to 12	1 to 12
	Post-breeding	Boat	-		3 to 34	3 to 34
		Aerial	-		2 to 20	2 to 20
	Non-breeding	Boat	-		2 to 18	2 to 18

2.4 Age composition

Specific additional mortalities for a set of impact scenarios representing bird deaths due to turbine collisions and habitat displacement effects, or their combined effect, were provided for two population groups based on age-class breeding ability: adults (i.e. breeding age-classes) and sub-adults (i.e. immature age-classes). Demographic rates from Horswill and Robinson (2015) were used to calculate the expected stable proportions in each age class for each species during the breeding season. Non-breeding age class proportions were taken from Furness (2015).

Every breeding season, a proportion of adult birds will be taking a sabbatical from breeding. Therefore, these birds need to be removed from assessment as overestimation of potential effects to SPA populations would occur if sabbatical impacts were not removed. The proportion of adults taking sabbatical from breeding each year for each species also presented within

Table 2-4; these have been taken from The Crown Estate's Plan Level Habitat Regulation Assessment document (Niras, 2021). These sabbatical rates are applied to impacts assigned to adult birds after age-class apportioning.

Table 2-4: Age class percentages used in apportioning impacts.

Species	Season	Adult %	Immatures %	Sabbaticals (% of adult birds)
Gannet	Breeding	56.8	43.2	10
	Non-breeding	55.2	44.8	-
Guillemot	Breeding	52.2	47.8	7
	Non-breeding	57.5	42.5	-
Herring gull	Breeding	42.2	57.8	35
	Non-breeding	47.8	52.2	-
Kittiwake	Breeding	52.7	47.3	10
	Non-breeding	53.2	46.8	-
Razorbill	Breeding	53.3	46.7	7
	Non-breeding	57.1	42.9	-

2.5 Apportioning impacts during the breeding season

NatureScot guidance (SNH, 2018) was followed to apportion impacts to seabirds from the SPAs within a species' foraging range of the Project. Impacts were apportioned between all breeding colonies (both SPA and non-SPA) within the foraging range of each species using the most recent colony counts (obtained from the SMP). The centroid of the Project was determined in QGIS and buffer zones equating to the species' home range (Table 2-1) were produced. As recommended by SNH (2018), the mean-max foraging range from Woodward *et al.* (2019) was used. Each seabird colony located within the species' foraging range of the Project were selected. In the SMP, a 'Master Site' can be made up of several sites along the coastline. Where a 'Master Site' in the SMP was made up of several nesting sites (i.e. sub-colonies), a centroid was generated for each 'Master Site' and the distance between the 'Master Site' centroid and the Project centroid was calculated. For each 'Master Site', the proportion of the species' foraging range at sea was calculated. Finally, the parameters were inputted into Excel to calculate the apportioning value for each colony. The calculations are based on foraging range and three colony-specific parameters:

i.   Colony size (in individuals);

ii. Distance of colony – measured from the central point of the Project to the central point of the colony; and

iii. Sea area (the extent of the open sea within the foraging range of the relevant species).

The parameters are combined to produce an overall weighting factor and the calculation is made as follows:

$$\text{Colony Weight} = \frac{\text{Colony Population}}{\text{Sum of Populations}} \times \frac{\text{Sum of Distance\textasciicircum2}}{\text{Colony Distance\textasciicircum2}} \times \frac{1/\text{Colony Sea Proportion}}{\text{Sum of} \left(\frac{1}{\text{Colony Sea Propotions}}\right)}$$

Each colony weight is then used to calculate the proportion of birds attributed to each SPA by calculating (*colony weight / sum of all colony weights*). This proportion is then used to calculate the estimated number of mortalities from the project that can be apportioned to each colony.

2.6 Apportioning impacts during the non-breeding season

To apportion non-breeding season effects from the Project between relevant SPAs, the contribution of adult and immature birds from an individual SPA was calculated as a proportion of the BDMPS defined in Furness (2015). The number of induvial birds within each BDMPS has been adapted from Furness (2015) to increase the representation of Irish colonies. Therefore an "adapted Furness" approach has been used in defining the

BDMPS of the Irish Sea. Model estimates of the proportion of adults or immatures in spatially distinct BDMPS were used to calculate the contribution of each breeding colony SPAs to the Irish Sea.

3 RESULTS

3.1 Gannet

3.1.1 Colony weighted proportions

Using the NatureScot apportioning tool, 46 % of the birds recorded in the Project in the breeding season would be predicted to originate from the Ailsa Craig SPA. The Grassholm SPA which is the largest colony within the species foraging range of the Project is predicted to contribute to ~24 % of the birds within the offshore wind farm area (Table 3-1).

Table 3-1: Breeding gannet colony weighting factors used for apportioning impacts on colonies.

Colony	Gannet is a qualifying feature of the site	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Ailsa Craig SPA	Yes	64,452	160.7	0.39	0.46
Grassholm SPA	Yes	72,022	246.6	0.20	0.24
Saltee Islands SPA	Yes	9,444	203.7	0.03	0.04
Ireland's Eye SPA	No	700	56.8	0.04	0.04
Lambay Ireland SPA	No	1,852	47.1	0.14	0.16
Combined non-SPA	N/A	2,427	N/A	0.06	0.07

3.1.2 Apportioned breeding impacts

Table 3-2 shows the minimum and maximum mortality resulting from collision (when using the Natural England AR) and displacement. The minimum and maximum variation occurs within the density estimate presented (boat-based or DAS), the Band Model option (Band Option 1 and Band Option 2) and the range of displacement mortality estimates. The largest estimate of mortality was from Ailsa Craig SPA, with up to 2.86 adult birds. The highest increase in baseline mortality of adult birds was at Lambay Island SPA, where a 0.68 % increase was predicted when taking the maximum impact.

Table 3-3 shows the minimum and maximum mortality resulting from collision (when using the JNCC AR) and displacement. The largest estimate of mortality was from Ailsa Craig SPA, with up to 2.55 adult birds. The highest increase in baseline mortality of adult birds was at Lambay Island SPA, where a 0.60 % increase was predicted when taking the maximum impact.

Table 3-2: Apportioned mortality of gannet resulting from collision and displacement during the breeding season when using the Natural England AR (Sab = sabbatical, Ad = adult, Im = immature).

Colony	Estimated mortality from collision and displacement			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ailsa Craig SPA	0.13 to 0.32	1.19 to 2.86	1.00 to 2.42	5,221	15,318	0.02 to 0.05	0.01 to 0.02
Grassholm SPA	0.07 to 0.16	0.61 to 1.48	0.52 to 1.25	5,834	17,117	0.01 to 0.03	<0.01 to 0.01
Saltee Islands SPA	0.01 to 0.03	0.11 to 0.25	0.09 to 0.22	765	2,244	0.01 to 0.03	<0.01 to 0.01
Ireland's Eye SPA	0.01 to 0.03	0.11 to 0.26	0.09 to 0.22	57	166	0.19 to 0.46	0.06 to 0.13
Lambay Island SPA	0.05 to 0.11	0.42 to 1.01	0.36 to 0.86	150	440	0.28 to 0.68	0.08 to 0.19
Combined non-SPA	0.02 to 0.05	0.17 to 0.41	0.14 to 0.35	197	577	0.09 to 0.21	0.03 to 0.06

Table 3-3: Apportioned mortality of gannet resulting from collision and displacement during the breeding season when using the JNCC AR (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from collision and displacement			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ailsa Craig	0.12 to 0.28	1.07 to 2.55	0.91 to 2.16	5,221	15,318	0.02 to 0.05	0.01 to 0.01
Grassholm	0.06 to 0.15	0.56 to 1.32	0.47 to 1.12	5,834	17,117	0.01 to 0.02	0.00 to 0.01
Saltee Islands	0.01 to 0.03	0.10 to 0.23	0.08 to 0.19	765	2,244	0.01 to 0.03	0.00 to 0.01
Ireland's Eye	0.01 to 0.03	0.10 to 0.23	0.08 to 0.20	57	166	0.17 to 0.41	0.05 to 0.12
Lambay Island	0.04 to 0.10	0.38 to 0.90	0.32 to 0.76	150	440	0.25 to 0.60	0.07 to 0.17
Combined non-SPA	0.02 to 0.04	0.15 to 0.37	0.13 to 0.31	197	577	0.08 to 0.19	0.02 to 0.05

3.1.3 Apportioned non-breeding impacts

Apportioned mortality for gannet during the non-breeding season is presented in Table 3-4 when using the Natural England AR and Table 3-5 when using the JNCC AR. Estimated number of collisions range from <0.01 to 1.48 (Natural England AR) and <0.01 to 1.33 (JNCC AR), depending on the colony. This increased baseline mortality between < 0.01 and 0.03 % (Natural England AR) and <0.01 and 0.02 % (JNCC AR), depending on colony.

Table 3-4: Apportioned mortality of gannet resulting from collision and displacement during the non-breeding season when using the Natural England AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Post-breeding	Ailsa craig	312,206	0.206	0.71 to 1.33	0.01 to 0.03
		Saltee Islands	312,206	0.023	0.08 to 0.15	0.01 to 0.02
		Ireland's Eye	312,206	0.002	0.01 to 0.01	0.01 to 0.03
		Grassholm	312,206	0.231	0.80 to 1.48	0.01 to 0.03
		Lambay Island	312,206	0.006	0.02 to 0.04	0.01 to 0.03
	Pre-breeding	Ailsa craig	312,206	0.172	0.08 to 0.16	<0.01 to <0.01
		Saltee Islands	375,540	0.025	0.01 to 0.02	<0.01 to <0.01
		Ireland's Eye	375,540	0.002	<0.01 to <0.01	<0.01 to <0.01
		Grassholm	375,540	0.192	0.09 to 0.18	<0.01 to <0.01
		Lambay Island	375,540	0.006	0.02 to 0.04	0.01 to 0.03
Immature	Post-breeding	Ailsa craig	375,540	0.187	0.52 to 0.97	<0.01 to 0.01
		Saltee Islands	223,799	0.021	0.06 to 0.11	<0.01 to <0.01
		Ireland's Eye	223,799	0.002	0.01 to 0.01	<0.01 to 0.01
		Grassholm	223,799	0.209	0.58 to 1.09	<0.01 to 0.01
		Lambay Island	223,799	0.007	0.02 to 0.03	<0.01 to 0.01
	Pre-breeding	Ailsa craig	269,199	0.155	0.06 to 0.12	<0.01 to <0.01
		Saltee Islands	269,199	0.023	0.01 to 0.01	<0.01 to <0.01
		Ireland's Eye	269,199	0.002	<0.01 to <0.01	<0.01 to <0.01
		Grassholm	269,199	0.173	0.07 to 0.14	<0.01 to <0.01
		Lambay Island	269,199	0.004	<0.01 to <0.01	<0.01 to <0.01

Table 3-5: Apportioned mortality of gannet resulting from collision and displacement during the non-breeding season when using the JNCC AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Post-breeding	Ailsa craig	312,206	0.206	0.64 to 1.19	0.01 to 0.02
		Saltee Islands	312,206	0.023	0.07 to 0.13	0.01 to 0.02
		Ireland's Eye	312,206	0.002	0.01 to 0.01	0.01 to 0.02
		Grassholm	312,206	0.231	0.72 to 1.33	0.01 to 0.02
		Lambay Island	312,206	0.006	0.02 to 0.03	0.01 to 0.02
	Pre-breeding	Ailsa craig	312,206	0.172	0.07 to 0.15	<0.01 to <0.01
		Saltee Islands	375,540	0.025	0.01 to 0.02	<0.01 to <0.01
		Ireland's Eye	375,540	0.002	<0.01 to <0.01	<0.01 to <0.01
		Grassholm	375,540	0.192	0.08 to 0.16	<0.01 to <0.01
		Lambay Island	375,540	0.006	0.02 to 0.03	0.01 to 0.02
Immature	Post-breeding	Ailsa craig	375,540	0.187	0.47 to 0.88	<0.01 to 0.01
		Saltee Islands	223,799	0.021	0.05 to 0.10	<0.01 to <0.01
		Ireland's Eye	223,799	0.002	0.01 to 0.01	<0.01 to 0.01
		Grassholm	223,799	0.209	0.53 to 0.98	<0.01 to 0.01
		Lambay Island	223,799	0.007	0.02 to 0.03	<0.01 to 0.01
	Pre-breeding	Ailsa craig	269,199	0.155	0.05 to 0.11	<0.01 to <0.01
		Saltee Islands	269,199	0.023	0.01 to 0.02	<0.01 to <0.01
		Ireland's Eye	269,199	0.002	<0.01 to <0.01	<0.01 to <0.01
		Grassholm	269,199	0.173	0.06 to 0.12	<0.01 to <0.01
		Lambay Island	269,199	0.004	<0.01 to <0.01	<0.01 to <0.01

3.2 Guillemot

3.2.1 SPA weighted proportions

Using the NatureScot apportioning tool, 72 % of the birds recorded in the Project in the breeding season would be predicted to originate from the Lambay Island SPA. The Rathlin Island SPA which is the largest colony within the species foraging range of the Project is predicted to contribute to 16 % of the birds within the offshore wind farm area (Table 3-6).

Table 3-6: Breeding guillemot colony weighting factors used for apportioning impacts on SPAs.

SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Howth Head Coast	1,167	60	0.01	0.01
Ireland's Eye	5,909	57	0.08	0.04
Lambay Island	80,377	48	1.61	0.72

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SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Rathlin Island	200,343	154	0.36	0.16
Wicklow Head	811	106	<0.01	<0.01
Combined non-SPA	64,639	N/A	0.17	0.08

3.2.2 Apportioned breeding impacts

Apportioned mortality for guillemot during the breeding season is presented in Table 3-7. Estimated number of mortalities from displacement range from <0.1 to 19.17 adult birds, depending on the colony. This increased baseline mortality between < 0.01 and 0.40 % in adult birds when considered a 70 % displacement and a 5 % mortality.

Table 3-7: Apportioned mortality of guillemot resulting from displacement during the breeding season (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from displacement			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Howth Head Coast	<0.01 to 0.02	0.01 to 0.17	0.01 to 0.18	71	233	0.01 to 0.24	<0.01 to 0.08
Ireland's Eye	<0.01 to 0.11	0.03 to 0.98	0.04 to 1.00	360	1,179	0.01 to 0.27	<0.01 to 0.08
Lambay Island	0.07 to 2.09	0.67 to 18.85	0.68 to 19.17	4,903	16,038	0.01 to 0.38	<0.01 to 0.12
Rathlin Island	0.02 to 0.47	0.15 to 4.26	0.15 to 4.33	12,221	39,976	<0.01 to 0.03	<0.01 to 0.01
Wicklow Head	<0.01 to <0.01	<0.01 to 0.03	<0.01 to 0.03	49	162	<0.01 to 0.07	<0.01 to 0.02
Combined non-SPA	0.01 to 0.22	0.07 to 2.02	0.07 to 2.06	3,844	12,576	<0.01 to 0.05	<0.01 to 0.02

3.2.3 Apportioned non-breeding impacts

Apportioned mortality for guillemot during the non-breeding season is presented in Table 3-8. Estimated number of mortalities from displacement range from <0.01 to 22.08 birds, depending on the colony. This increased baseline mortality between < 0.01 and 0.18 %.

Table 3-8: Apportioned mortality of guillemot resulting from displacement during the non-breeding season.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Non-breeding	Howth Head Coast	902,773	0.001	0.01 to 0.13	0.01 to 0.18
		Ireland's Eye	902,773	0.007	0.03 to 0.65	0.01 to 0.18
		Lambay Island	902,773	0.089	0.41 to 8.86	0.01 to 0.18
		Rathlin Island	902,773	0.222	1.02 to 22.08	0.01 to 0.18
		Wicklow Head	902,773	0.001	<0.01 to 0.09	0.01 to 0.18
Immature		Howth Head Coast	664,625	0.001	<0.01 to 0.09	<0.01 to 0.05
		Ireland's Eye	664,625	0.006	0.02 to 0.46	<0.01 to 0.05
		Lambay Island	664,625	0.085	0.29 to 6.25	<0.01 to 0.05
		Rathlin Island	664,625	0.212	0.72 to 15.58	<0.01 to 0.05
		Wicklow Head	664,625	0.001	<0.01 to 0.06	<0.01 to 0.05

3.3 Herring gull

3.3.1 SPA weighted proportions

Using the NatureScot apportioning tool, 22 % of the birds recorded in the Project in the breeding season would be predicted to originate from the Lambay Island SPA. The largest number of breeding herring gull are associated with the coastal urban areas within Dublin, Balbriggan and Howth (72 %).

Table 3-9: Breeding herring gull colony weighting factors used for apportioning impacts on SPAs.

SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Ireland's Eye	636	57	0.06	0.06
Lambay Island	1,812	48	0.25	0.22
Skerries Islands	34	39	0.01	0.01
Combined non-SPA	7,184	N/A	0.81	0.72

3.3.2 Apportioned breeding impacts

Table 3-10 shows the minimum and maximum mortality resulting from collision (when using the Natural England AR) and displacement. The minimum and maximum variation occurs within the density estimate presented (boat-based or DAS), the Band Model option (Band Option 1 and Band Option 2) and the range of displacement mortality estimates. The largest estimate of mortality was from Lambay Island SPA, with up to 1.90 adult birds. The highest increase in baseline mortality for adult birds was at Skerries Islands SPA, where a 1.07% increase was predicted when taking the maximum impact.

Table 3-11Table 3-11 shows the minimum and maximum mortality resulting from collision (when using the JNCC AR) and displacement. The largest estimate of mortality was from Lambay Island SPA, with up to 1.52 adult birds. The highest increase in baseline mortality for adult birds was at Skerries Islands SPA, where a 0.86% increase was predicted when taking the maximum impact.

Table 3-10: Apportioned mortality of herring gull resulting from collision during the breeding season using the Natural England AR (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from collision			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ireland's Eye	0.22 to 0.26	0.41 to 0.49	0.86 to 1.03	106	154	0.39 to 0.46	0.56 to 0.67
Lambay Island	0.86 to 1.02	1.59 to 1.90	3.36 to 4.00	301	438	0.53 to 0.63	0.77 to 0.91
Skerries Islands	0.03 to 0.03	0.05 to 0.06	0.11 to 0.13	6	8	0.90 to 1.07	1.30 to 1.55
Combined non-SPA	2.78 to 3.31	5.17 to 6.15	10.89 to 12.96	1,193	1,736	0.43 to 0.52	0.63 to 0.75

Table 3-11: Apportioned mortality of herring gull resulting from collision during the breeding season using the JNCC AR (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from collision			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ireland's Eye	0.18 to 0.21	0.33 to 0.39	0.69 to 0.82	106	154	0.31 to 0.37	0.45 to 0.54
Lambay Island	0.68 to 0.82	1.27 to 1.52	2.68 to 3.21	301	438	0.42 to 0.51	0.61 to 0.73
Skerries Islands	0.02 to 0.03	0.04 to 0.05	0.09 to 0.10	6	8	0.72 to 0.86	1.04 to 1.24

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Combined non-SPA	2.22 to 2.65	4.12 to 4.93	8.68 to 10.39	1,193	1,736	0.35 to 0.41	0.50 to 0.60

3.3.3 Apportioned non-breeding impacts

Apportioned mortality for herring gull during the non-breeding season is presented in Table 3-12 when using the Natural England AR and Table 3-13 when using the JNCC AR. Estimated number of collisions range from <0.1 to 0.5 (Natural England AR) and <0.1 to 0.4 (JNCC AR), depending on the colony. This increased baseline mortality between 0.13 and 0.16 % (Natural England AR) and 0.10 and 0.13 % (JNCC AR), depending on colony.

Table 3-12: Apportioned mortality of herring gull resulting from collision during the non-breeding season when using the Natural England AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Non-breeding	Ireland's Eye	98,946	0.0050	0.1 to 0.1	0.13 to 0.16
		Lambay Island	98,946	0.0165	0.4 to 0.5	0.13 to 0.16
		Skerries Islands	98,946	0.0005	<0.1	0.13 to 0.16
Immature		Ireland's Eye	97,845	0.0049	0.1 to 0.2	0.12 to 0.15
		Lambay Island	97,845	0.0161	0.4 to 0.5	0.12 to 0.15
		Skerries Islands	97,845	0.0005	<0.1	0.12 to 0.15

Table 3-13: Apportioned mortality of herring gull resulting from collision during the non-breeding season when using the JNCC AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Non-breeding	Ireland's Eye	98,946	0.0050	0.1 to 0.1	0.11 to 0.13
		Lambay Island	98,946	0.0165	0.3 to 0.4	0.11 to 0.13
		Skerries Islands	98,946	0.0005	<0.1	0.11 to 0.13
Immature		Ireland's Eye	97,845	0.0049	0.1 to 0.1	0.10 to 0.12
		Lambay Island	97,845	0.0161	0.3 to 0.4	0.10 to 0.12
		Skerries Islands	97,845	0.0005	<0.1	0.10 to 0.12

3.4 Kittiwake

3.4.1 SPA weighted proportions

Using the NatureScot apportioning tool, 35 % of the birds recorded in the Project in the breeding season would be predicted to originate from the Lambay Island SPA (Table 3-14).

Table 3-14: Breeding kittiwake colony weighting factors used for apportioning impacts on SPAs.

SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Ailsa Craig	980	161	0.01	0.00

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SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Helvick Head to Ballyquin	260	230	0.00	0.00
Horn Head to Fanad Head	3,640	190	0.02	0.01
Howth Head Coast	3,546	59	0.36	0.12
Ireland's Eye	910	57	0.10	0.03
Lambay Island	6,640	48	1.05	0.35
North Colonsay and Western Cliffs	6,694	242	0.03	0.01
Rathlin Island	27,412	155	0.33	0.11
Saltee Islands	2,076	204	0.01	0.00
Wicklow Head	1,546	106	0.05	0.02
Combined non-SPA	24570	N/A	1.05	0.35

3.4.2 Apportioned breeding impacts

Table 3-15 shows the minimum and maximum mortality resulting from collision (when using the Natural England AR) and displacement. The minimum and maximum variation occurs within the density estimate presented (boat-based or DAS), the Band Model option (Band Option 1 and Band Option 2) and the range of displacement mortality estimates. The largest estimate of mortality was from Lambay Island SPA, with up to 0.99 adult birds. The highest increase in baseline mortality for adult birds was at Lambay Island SPA, where a 0.10 % increase was predicted when taking the maximum impact.

Table 3-16 shows the minimum and maximum mortality resulting from collision (when using the JNCC AR) and displacement. The largest estimate of mortality was from Lambay Island SPA, with up to 0.61 adult birds. The highest increase in baseline mortality for adult birds was at Lambay Island SPA, where a 0.06 % increase was predicted when taking the maximum impact.

Table 3-15: Apportioned mortality of kittiwake resulting from collision during the breeding season using the Natural England AR (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from collision			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ailsa Craig	<0.01 to <0.01	0.01 to 0.01	0.01 to 0.01	143	148	0.01 to 0.01	0.01 to 0.01
Helvick Head to Ballyquin	<0.01 to <0.01	<0.01 to <0.01	<0.01 to <0.01	38	39	<0.01 to <0.01	<0.01 to <0.01
Horn Head to Fanad Head	<0.01 to <0.01	0.02 to 0.02	0.01 to 0.02	531	549	<0.01 to <0.01	<0.01 to <0.01
Howth Head Coast	0.02 to 0.03	0.23 to 0.34	0.22 to 0.33	518	535	0.05 to 0.07	0.04 to 0.06
Ireland's Eye	<0.01 to 0.01	0.07 to 0.10	0.06 to 0.09	133	137	0.05 to 0.07	0.05 to 0.07
Lambay Island	0.05 to 0.07	0.68 to 0.99	0.65 to 0.96	969	1,001	0.07 to 0.10	0.07 to 0.10
North Colonsay and Western Cliffs	<0.01 to <0.01	0.02 to 0.03	0.02 to 0.03	977	1,009	<0.01 to <0.01	<0.01 to <0.01
Rathlin Island	0.02 to 0.02	0.21 to 0.31	0.20 to 0.30	4,002	4,133	0.01 to 0.01	<0.01 to 0.01
Saltee Islands	<0.01 to <0.01	0.01 to 0.01	0.01 to 0.01	303	313	<0.01 to <0.01	<0.01 to <0.01
Wicklow Head	<0.01 to <0.01	0.03 to 0.05	0.03 to 0.05	226	233	0.01 to 0.02	0.01 to 0.02
Combined non-SPA	0.05 to 0.07	0.68 to 1.00	0.66 to 0.96	3,587	3,705	0.02 to 0.03	0.02 to 0.03

Table 3-16: Apportioned mortality of kittiwake resulting from collision during the breeding season using the JNCC AR (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from collision			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Ailsa Craig	<0.01 to <0.01	<0.01 to 0.01	<0.01 to 0.01	143	148	<0.01 to 0.01	<0.01 to 0.01
Helvick Head to Ballyquin	<0.01 to <0.01	<0.01 to <0.01	<0.01 to <0.01	38	39	<0.01 to <0.01	<0.01 to <0.01
Horn Head to Fanad Head	<0.01 to <0.01	0.01 to 0.01	0.01 to 0.01	531	549	<0.01 to <0.01	<0.01 to <0.01
Howth Head Coast	0.01 to 0.02	0.09 to 0.21	0.09 to 0.20	518	535	0.02 to 0.04	0.02 to 0.04
Ireland's Eye	<0.01 to <0.01	0.02 to 0.06	0.02 to 0.06	133	137	0.02 to 0.04	0.02 to 0.04
Lambay Island	0.02 to 0.05	0.26 to 0.61	0.25 to 0.59	969	1,001	0.03 to 0.06	0.02 to 0.06
North Colonsay and Western Cliffs	<0.01 to <0.01	0.01 to 0.02	0.01 to 0.02	977	1,009	<0.01 to <0.01	<0.01 to <0.01
Rathlin Island	0.01 to 0.01	0.08 to 0.19	0.08 to 0.18	4,002	4,133	<0.01 to <0.01	<0.01 to <0.01
Saltee Islands	<0.01 to <0.01	<0.01 to 0.01	<0.01 to 0.01	303	313	<0.01 to <0.01	<0.01 to <0.01
Wicklow Head	<0.01 to <0.01	0.01 to 0.03	0.01 to 0.03	226	233	0.01 to 0.01	0.01 to 0.01
Combined non-SPA	0.02 to 0.05	0.26 to 0.62	0.25 to 0.60	3,587	3,705	0.01 to 0.02	0.01 to 0.02

3.4.3 Apportioned non-breeding impacts

Apportioned mortality for gannet during the non-breeding season is presented in Table 3-17 when using the Natural England AR and Table 3-18 when using the JNCC AR. Estimated number of collisions range from <0.1 to 0.9 (Natural England AR) and <0.1 to 0.3 (JNCC AR), depending on the colony. This increased baseline mortality between 0.01 and 0.02 % (Natural England AR) and <0.01 and 0.01 % (JNCC AR), depending on colony.

Table 3-17: Apportioned mortality of kittiwake resulting from collision during the non-breeding season when using the Natural England AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Post-breeding	Ailsa Craig	508,068	0.002	0.02 to 0.02	0.01 to 0.02
		Helvick Head to Ballyquin	508,068	<0.001	0.01 to 0.01	0.01 to 0.02
		Horn Head to Fanad Head	508,068	0.006	0.07 to 0.08	0.01 to 0.02
		Howth Head Coast	508,068	0.006	0.07 to 0.08	0.01 to 0.02
		Ireland's Eye	508,068	0.002	0.02 to 0.02	0.01 to 0.02
		Lambay Island	508,068	0.013	0.14 to 0.17	0.01 to 0.02
		North Colonsay and Western Cliffs	508,068	0.012	0.13 to 0.15	0.01 to 0.02

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Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
		Rathlin Island	508,068	0.054	0.60 to 0.69	0.01 to 0.02
		Saltee Islands	508,068	0.002	0.02 to 0.03	0.01 to 0.01
		Wicklow Head	508,068	0.002	0.02 to 0.02	0.01 to 0.01
	Pre-breeding	Ailsa Craig	420,138	0.002	0.02 to 0.03	0.02 to 0.02
		Helvick Head to Ballyquin	420,138	<0.001	0.01 to 0.01	0.02 to 0.02
		Horn Head to Fanad Head	420,138	0.007	0.08 to 0.10	0.02 to 0.02
		Howth Head Coast	420,138	0.007	0.08 to 0.10	0.02 to 0.02
		Ireland's Eye	420,138	0.002	0.03 to 0.03	0.02 to 0.02
		Lambay Island	420,138	0.016	0.19 to 0.22	0.02 to 0.02
		North Colonsay and Western Cliffs	420,138	0.013	0.16 to 0.18	0.02 to 0.02
		Rathlin Island	420,138	0.065	0.80 to 0.92	0.02 to 0.02
		Saltee Islands	420,138	0.002	0.03 to 0.03	0.01 to 0.01
		Wicklow Head	420,138	0.002	0.02 to 0.03	0.01 to 0.01
Immature	Post-breeding	Ailsa Craig	387,615	0.002	0.02 to 0.02	0.01 to 0.01
		Helvick Head to Ballyquin	387,615	<0.001	<0.01 to <0.01	0.01 to 0.01
		Horn Head to Fanad Head	387,615	0.006	0.06 to 0.06	0.01 to 0.01
		Howth Head Coast	387,615	0.006	0.05 to 0.06	0.01 to 0.01
		Ireland's Eye	387,615	0.002	0.02 to 0.02	0.01 to 0.02
		Lambay Island	387,615	0.014	0.13 to 0.15	0.01 to 0.02
		North Colonsay and Western Cliffs	387,615	0.011	0.10 to 0.12	0.01 to 0.01
		Rathlin Island	387,615	0.056	0.55 to 0.63	0.01 to 0.02
		Saltee Islands	387,615	0.002	0.02 to 0.03	0.01 to 0.01
		Wicklow Head	387,615	0.002	0.02 to 0.02	0.01 to 0.01
	Pre-breeding	Ailsa Craig	320,532	0.002	0.02 to 0.02	0.01 to 0.01
		Helvick Head to Ballyquin	320,532	<0.001	<0.01 to 0.01	0.01 to 0.01
		Horn Head to Fanad Head	320,532	0.006	0.06 to 0.07	0.01 to 0.01
		Howth Head Coast	320,532	0.006	0.06 to 0.07	0.01 to 0.01
		Ireland's Eye	320,532	0.002	0.02 to 0.02	0.01 to 0.02
		Lambay Island	320,532	0.013	0.14 to 0.16	0.01 to 0.02
		North Colonsay and Western Cliffs	320,532	0.011	0.12 to 0.14	0.01 to 0.01
		Rathlin Island	320,532	0.053	0.57 to 0.65	0.01 to 0.02
		Saltee Islands	320,532	0.002	0.02 to 0.03	0.01 to 0.01
		Wicklow Head	320,532	0.002	0.02 to 0.02	0.01 to 0.01

Table 3-18: Apportioned mortality of kittiwake resulting from collision during the non-breeding season when using the JNCC AR.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Post-breeding	Ailsa Craig	508,068	0.002	0.01 to 0.01	<0.01 to <0.01
		Helvick Head to Ballyquin	508,068	<0.001	<0.01 to <0.01	<0.01 to <0.01
		Horn Head to Fanad Head	508,068	0.006	0.02 to 0.03	<0.01 to <0.01
		Howth Head Coast	508,068	0.006	0.02 to 0.02	<0.01 to <0.01
		Ireland's Eye	508,068	0.002	0.01 to 0.01	<0.01 to 0.01
		Lambay Island	508,068	0.013	0.04 to 0.05	<0.01 to 0.01
		North Colonsay and Western Cliffs	508,068	0.012	0.04 to 0.05	<0.01 to <0.01
		Rathlin Island	508,068	0.054	0.18 to 0.21	<0.01 to 0.01
		Saltee Islands	508,068	0.002	0.01 to 0.01	<0.01 to <0.01
		Wicklow Head	508,068	0.002	0.01 to 0.01	<0.01 to <0.01
	Pre-breeding	Ailsa Craig	420,138	0.006	0.01 to 0.01	<0.01 to 0.01
		Helvick Head to Ballyquin	420,138	0.002	<0.01 to <0.01	<0.01 to 0.01
		Horn Head to Fanad Head	420,138	<0.001	0.03 to 0.03	<0.01 to 0.01
		Howth Head Coast	420,138	0.008	0.04 to 0.05	<0.01 to 0.01
		Ireland's Eye	420,138	0.012	0.03 to 0.03	0.01 to 0.01
		Lambay Island	420,138	0.008	0.06 to 0.07	0.01 to 0.01
		North Colonsay and Western Cliffs	420,138	0.016	0.05 to 0.05	<0.01 to 0.01
		Rathlin Island	420,138	0.013	0.24 to 0.28	0.01 to 0.01
		Saltee Islands	420,138	0.065	0.01 to 0.01	<0.01 to <0.01
		Wicklow Head	420,138	0.002	0.01 to 0.01	<0.01 to <0.01
Immature	Post-breeding	Ailsa Craig	387,615	0.002	<0.01 to 0.01	<0.01 to <0.01
		Helvick Head to Ballyquin	387,615	0.002	<0.01 to <0.01	<0.01 to <0.01
		Horn Head to Fanad Head	387,615	0.002	0.02 to 0.02	<0.01 to <0.01
		Howth Head Coast	387,615	<0.001	0.02 to 0.02	<0.01 to <0.01
		Ireland's Eye	387,615	0.006	0.01 to 0.01	<0.01 to <0.01
		Lambay Island	387,615	0.006	0.04 to 0.05	<0.01 to <0.01
		North Colonsay and Western Cliffs	387,615	0.002	0.03 to 0.04	<0.01 to <0.01
		Rathlin Island	387,615	0.014	0.17 to 0.19	<0.01 to <0.01
		Saltee Islands	387,615	0.011	0.01 to 0.01	<0.01 to <0.01
		Wicklow Head	387,615	0.056	0.01 to 0.01	<0.01 to <0.01
	Pre-breeding	Ailsa Craig	320,532	0.002	0.01 to 0.01	<0.01 to <0.01
		Helvick Head to Ballyquin	320,532	0.002	<0.01 to <0.01	<0.01 to <0.01
		Horn Head to Fanad Head	320,532	0.002	0.02 to 0.03	<0.01 to <0.01
		Howth Head Coast	320,532	<0.001	0.03 to 0.04	<0.01 to <0.01

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Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
		Ireland's Eye	320,532	0.007	0.02 to 0.02	<0.01 to <0.01
		Lambay Island	320,532	0.010	0.04 to 0.05	<0.01 to <0.01
		North Colonsay and Western Cliffs	320,532	0.006	0.04 to 0.04	<0.01 to <0.01
		Rathlin Island	320,532	0.013	0.17 to 0.20	<0.01 to <0.01
		Saltee Islands	320,532	0.011	0.01 to 0.01	<0.01 to <0.01
		Wicklow Head	320,532	0.053	0.01 to 0.01	<0.01 to <0.01

3.5 Razorbill

3.5.1 SPA weighted proportions

Using the NatureScot apportioning tool, 60 % of the birds recorded in the Project in the breeding season would be predicted to originate from the Lambay Island SPA. Rathlin Island SPA which is the largest colony within the species foraging of the Project is predicted to contribute to 17 % of the birds within the offshore wind farm area (Table 3-19).

Table 3-19: Breeding razorbill colony weighting factors used for apportioning impacts on SPAs.

SPA Colony	Colony size (individuals)	Distance to the Project centre (km)	NatureScot colony weight	Proportional weight
Howth Head Coast	374	60	0.03	0.01
Ireland's Eye	2,144	57	0.20	0.09
Lambay Island	9,853	48	1.33	0.60
Rathlin Island	30,044	154	0.39	0.18
Wicklow Head	247	106	0.01	<0.01
Combined non-SPA	13,224	N/A	0.24	0.11

3.5.2 Apportioned breeding impacts

Apportioned mortality for razorbill during the breeding season is presented in Table 3-20. Estimated number of mortalities from displacement range from 0 to 3.48 adult birds, depending on the colony. This increased baseline mortality between 0 and 0.34 % in adult birds when considered a 70 % displacement and a 5 % mortality.

Table 3-20: Apportioned mortality of razorbill resulting from displacement during the breeding season (Sab = sabbatical, Ad = adult, Im = immature).

SPA colony	Estimated mortality from displacement			Baseline mortality		Increase in baseline mortality (%)	
	Sab	Ad	Im	Ad	Im	Ad	Im
Howth Head Coast	0 to 0.01	0 to 0.08	0 to 0.08	39	51	0 to 0.21	0 to 0.16
Ireland's Eye	0 to 0.06	0 to 0.53	0 to 0.52	225	294	0 to 0.24	0 to 0.18
Lambay Island	0 to 0.39	0 to 3.48	0 to 3.39	1,035	1,350	0 to 0.34	0 to 0.25
Rathlin Island	0 to 0.11	0 to 1.02	0 to 0.99	3,155	4,117	0 to 0.03	0 to 0.02
Wicklow Head	0 to <0.01	0 to 0.02	0 to 0.02	26	34	0 to 0.06	0 to 0.05

| Combined non-SPA | 0 to 0.07 | 0 to 0.62 | 0 to 0.60 | 1,389 | 1,812 | 0 to 0.04 | 0 to 0.03 |

3.5.3 Apportioned non-breeding impacts

Apportioned mortality for razorbill during the non-breeding season is presented in Table 3-21. Estimated number of mortalities from displacement range from <0.1 to 1.8 birds, depending on the colony. This increased baseline mortality between < 0.01 and 0.06 % in adult birds considered a 70 % displacement and a 5 % mortality.

Table 3-21: Apportioned mortality of razorbill resulting from displacement during the non-breeding season.

Age	Bio-season	SPA colony	BDMPS	Proportion SPA / BDRMS	Estimated mortality	Increase in baseline mortality (%)
Adult	Post-breeding	Howth Head Coast	316,928	0.001	<0.01 to 0.02	<0.01 to 0.06
		Ireland's Eye	316,928	0.007	0.01 to 0.13	<0.01 to 0.06
		Lambay Island	316,928	0.031	0.04 to 0.60	<0.01 to 0.06
		Rathlin Island	316,928	0.095	0.11 to 1.84	<0.01 to 0.06
		Wicklow Head	316,928	0.001	<0.01 to 0.02	<0.01 to 0.06
	Pre-breeding	Howth Head Coast	316,928	0.001	<0.01 to 0.02	0.01 to 0.05
		Ireland's Eye	316,928	0.007	0.01 to 0.12	0.01 to 0.05
		Lambay Island	316,928	0.031	0.05 to 0.53	0.01 to 0.05
		Rathlin Island	316,928	0.095	0.16 to 1.62	0.01 to 0.05
		Wicklow Head	316,928	0.001	<0.01 to 0.01	0.01 to 0.05
	Non-breeding	Howth Head Coast	178,289	0.001	<0.01 to 0.01	<0.01 to 0.02
		Ireland's Eye	178,289	0.005	0.01 to 0.05	<0.01 to 0.02
		Lambay Island	178,289	0.022	0.03 to 0.23	<0.01 to 0.02
		Rathlin Island	178,289	0.067	0.08 to 0.69	<0.01 to 0.02
		Wicklow Head	178,289	0.001	<0.01 to 0.01	<0.01 to 0.02
Immature	Post-breeding	Howth Head Coast	289,986	0.001	<0.01 to 0.01	<0.01 to 0.03
		Ireland's Eye	289,986	0.005	<0.01 to 0.08	<0.01 to 0.03
		Lambay Island	289,986	0.025	0.02 to 0.37	<0.01 to 0.03
		Rathlin Island	289,986	0.077	0.07 to 1.12	<0.01 to 0.03
		Wicklow Head	289,986	0.001	<0.01 to 0.01	<0.01 to 0.03
	Pre-breeding	Howth Head Coast	289,986	0.001	<0.01 to 0.01	<0.01 to 0.03
		Ireland's Eye	289,986	0.006	0.01 to 0.07	<0.01 to 0.03
		Lambay Island	289,986	0.025	0.03 to 0.33	<0.01 to 0.03
		Rathlin Island	289,986	0.078	0.10 to 1.00	<0.01 to 0.03
		Wicklow Head	289,986	0.001	<0.01 to 0.01	<0.01 to 0.03
	Non-breeding	Howth Head Coast	163,133	<0.001	<0.01 to <0.01	<0.01 to <0.01
		Ireland's Eye	163,133	0.001	<0.01 to 0.01	<0.01 to <0.01
		Wicklow Head	163,133	0.005	<0.01 to 0.03	<0.01 to <0.01
		Lambay Island	163,133	0.014	0.01 to 0.11	<0.01 to <0.01
		Rathlin Island	163,133	<0.001	<0.01 to <0.01	<0.01 to <0.01
		Wicklow Head	316,928	0.001	<0.01 to 0.02	<0.01 to 0.06

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Annex 1: Parameters used to calculate colony and proportional weighting

Table A.1: Parameters used to calculate colony weighting and proportional weighting for gannet during the breeding season.

Gannet colonies	Pop.[1]	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
Ailsa Craig SPA	64452	160.7	25820.02	0.65	0.35	0.42	7.59	0.12	0.39	0.455
Grassholm SPA	72022	246.6	60835.27	0.62	0.38	0.47	3.22	0.13	0.20	0.236
Saltee Islands SPA	9444	203.7	41501.77	0.66	0.34	0.06	4.72	0.12	0.03	0.040
Ireland's Eye SPA	700	56.8	3227.25	0.63	0.37	0.00	60.74	0.13	0.04	0.042
Lambay Island SPA	1852	47	2217.59	0.63	0.37	0.01	88.39	0.13	0.14	0.161
SPA Total	**148470**									**0.934**
Monreith Cliffs and Scar Rocks	4752	122	14803.10	0.62	0.38	0.03	13.24	0.13	0.06	0.065
Porth Llanlleiana to Porth Eilian	42	120	14492.85	0.62	0.38	0.00	13.52	0.13	0.00	0.001
Garvan Islands	60	182	33115.16	0.70	0.30	0.00	5.92	0.10	0.00	0.000
Non-SPA Total	**4854**								**0.06**	**0.066**
Sum	**153324**	**1139**	**196013**	**5.14**	**2.86**	**1.00**	**197.35**	**1.00**	**0.85**	**1.00**

1: Pop. = No. of individuals.

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Table A.2: Parameters used to calculate colony weighting and proportional weighting for guillemot during the breeding season.

Guillemot colonies	Pop.	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
Howth Head Coast SPA	871	60	3551.81	0.47	0.53	0.00	93.74	0.05	0.015	0.007
Ireland's Eye SPA	4410	57	3231.52	0.47	0.53	0.02	103.04	0.05	0.084	0.037
Lambay Island SPA	59983	48	2271.25	0.47	0.53	0.23	146.60	0.05	1.612	0.716
Rathlin Island SPA	149510	154	23674.78	0.50	0.50	0.57	14.06	0.05	0.364	0.162
Wicklow Head SPA	605	106	11237.29	0.53	0.47	0.00	29.63	0.04	0.003	0.001
SPA Total	**215379**									**0.923**
Aberdaron Coast and Bardsey Island SPA	1112	155	23916.79	0.57	0.43	0.00	13.92	0.04	0.00	0.00
Aberdaron Coast not in SPA	94	154	23644.43	0.57	0.43	0.00	14.08	0.04	0.00	0.00
Bray Head	1413	81	6523.31	0.50	0.50	0.01	51.04	0.05	0.01	0.01
Causeway Coast	278	148	21950.03	0.51	0.49	0.00	15.17	0.04	0.00	0.00
Larne Lough to Portmuck	2617	103	10522.08	0.49	0.51	0.01	31.64	0.05	0.01	0.01
Lleyn Peninsula	3295	163	26591.10	0.55	0.45	0.01	12.52	0.04	0.01	0.00
Lleyn Peninsula (Carreg y Llam)	11000	150	22374.63	0.55	0.45	0.04	14.88	0.04	0.03	0.01
Monreith Cliffs and Scar Rocks	350	122	14803.10	0.49	0.51	0.00	22.49	0.05	0.00	0.00
Muck Island	2782	106	11213.23	0.49	0.51	0.01	29.69	0.05	0.01	0.01
Mull of Galloway	277	112	12519.97	0.51	0.49	0.00	26.59	0.04	0.00	0.00
North Island (Isle of Man)	471	119	14221.41	0.51	0.49	0.00	23.41	0.04	0.00	0.00
Port Mona, Devil's Bridge, Laggantalluch Head	229	110	12087.68	0.51	0.49	0.00	27.55	0.05	0.00	0.00
Porth Llanlleiana to Porth Eilian	5550	120	14508.99	0.59	0.41	0.02	22.95	0.04	0.02	0.01
Puffin Island SPA	4200	151	22702.96	0.55	0.45	0.02	14.67	0.04	0.01	0.00
Sheep Island SPA	703	149	22252.85	0.51	0.49	0.00	14.96	0.04	0.00	0.00

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Guillemot colonies	Pop.	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
South Island (Isle of Man)	4085	86	7478.72	0.55	0.45	0.02	44.52	0.04	0.03	0.01
South Stack	7914	114	13031.53	0.60	0.40	0.03	25.55	0.04	0.03	0.01
West Island (Isle of Man)	663	93	8654.62	0.54	0.46	0.00	38.47	0.04	0.00	0.00
Non-SPA Total	**47033**	**124**							**0.173**	**0.077**
Sum	**262412**	**2659**	**332964.06**	**12.00**	**11.00**	**1.00**	**831.20**	**1.00**	**2.25**	**1.00**

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Table A.3: Parameters used to calculate colony weighting and proportional weighting for razorbill during the breeding season.

Razorbill colonies	Pop.	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
Howth Head Coast SPA	279	60	3551.81	0.47	0.53	0.01	138.30	0.03	0.032	0.015
Ireland's Eye SPA	1600	57	3231.52	0.47	0.53	0.04	152.00	0.04	0.205	0.093
Lambay Island SPA	7353	48	2271.25	0.47	0.53	0.18	216.27	0.03	1.332	0.605
Rathlin Island SPA	22421	154	23674.78	0.47	0.53	0.54	20.75	0.03	0.390	0.177
Wicklow Head SPA	184	106	11237.29	0.51	0.49	0.00	43.71	0.03	0.006	0.003
SPA Total	**31837**									**0.89**
Aberdaron Coast and Bardsey Island SPA	1972	155	23916.79	0.56	0.44	0.05	20.54	0.03	0.03	0.01
Aberdaron Coast not in SPA	134	154	23644.43	0.55	0.45	0.00	20.77	0.03	0.00	0.00
Ailsa Craig SPA	1161	161	25820.02	0.42	0.58	0.03	19.02	0.04	0.02	0.01
Bray	150	81	6523.31	0.48	0.52	0.00	75.30	0.03	0.01	0.00
Carmel Head South	0	114	13054.73	0.55	0.45	0.00	37.63	0.03	0.00	0.00
Causeway Coast	361	147	21585.42	0.50	0.50	0.01	22.76	0.03	0.01	0.00
East Island (Isle of Man)	100	108	11643.19	0.49	0.51	0.00	42.19	0.03	0.00	0.00
Great Orme and Little Orme	168	159	25245.42	0.50	0.50	0.00	19.46	0.03	0.00	0.00
Larne Lough to Portmuck	679	103	10522.08	0.48	0.52	0.02	46.68	0.03	0.03	0.01
Lleyn Peninsula	292	163	26591.10	0.54	0.46	0.01	18.47	0.03	0.00	0.00
Lleyn Peninsula (Carreg y Llam)	519	150	22374.63	0.53	0.47	0.01	21.95	0.03	0.01	0.00
Meikle Ross & Little Ross	3	159	25308.29	0.41	0.59	0.00	19.41	0.04	0.00	0.00
Muck Island	1048	106	11213.23	0.48	0.52	0.03	43.81	0.03	0.04	0.02
Mull of Galloway	44	112	12519.97	0.48	0.52	0.00	39.23	0.03	0.00	0.00
North Island (Isle of Man)	36	119	14221.41	0.47	0.53	0.00	34.54	0.04	0.00	0.00
Point Lynas to Trwyn Du	9	144	20835.50	0.52	0.48	0.00	23.58	0.03	0.00	0.00
Port Mona, Devil's Bridge, Laggantalluch Head	37	111	12241.52	0.48	0.52	0.00	40.13	0.03	0.00	0.00
Puffin Island (Gwynedd)	457	151	22702.96	0.51	0.49	0.01	21.64	0.03	0.01	0.00
Sanda Islands - Kintyre	430	155	24002.02	0.45	0.55	0.01	20.47	0.04	0.01	0.00
Sheep Island SPA	221	149	22252.85	0.51	0.49	0.01	22.07	0.03	0.00	0.00

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Razorbill colonies	Pop.	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
Skerry Islands	15	150	22447.09	0.54	0.46	0.00	21.88	0.03	0.00	0.00
South Island (Isle of Man)	389	86	7478.72	0.51	0.49	0.01	65.68	0.03	0.02	0.01
South Stack	1479	114	13031.53	0.55	0.45	0.04	37.69	0.03	0.04	0.02
Starling Knowe to Downan Point	64	139	19409.84	0.44	0.56	0.00	25.31	0.04	0.00	0.00
West Island (Isle of Man)	101	93	8654.62	0.49	0.51	0.00	56.76	0.03	0.00	0.00
Non-SPA Total	**9869**								**0.237**	**0.108**
Sum	**41706**	**3706**	**491207.31**	**14.82**	**15.18**	**1.00**	**1388.00**	**1.00**	**2.20**	**1.00**

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Table A.4: Parameters used to calculate colony weighting and proportional weighting for herring gull during the breeding season.

Herring gull colonies	Pop.	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	Weighting	Proportion
Ireland's Eye SPA	636	57	3227.25	0.54	0.46	0.07	14.69	0.07	0.064	0.057
Lambay Island SPA	1812	48	2302.30	0.55	0.45	0.19	20.60	0.07	0.251	0.221
Skerries Islands SPA	34	39	1487.79	0.51	0.49	0.00	31.87	0.07	0.008	0.007
SPA Total	**2482**									**0.284**
Belfast	86	76	5777.05	0.13	0.87	0.01	8.21	0.13	0.009	0.008
Bray Head	4	81	6523.31	0.54	0.46	0.00	7.27	0.07	0.000	0.000
Dublin City Centre, Skerries and Balbriggan	3468	50	2486.31	0.46	0.54	0.36	19.07	0.08	0.536	0.472
Dun Laoghaire (Urban Area)	2	70	4945.51	0.51	0.49	0.00	9.59	0.07	0.000	0.000
Howth Head Coast SPA	18	60	3605.49	0.55	0.45	0.00	13.15	0.07	0.002	0.001
Howth village	920	59	3514.64	0.54	0.46	0.10	13.49	0.07	0.086	0.076
Loughshinny to Killiney	86	36	3514.64	0.54	0.46	0.01	13.49	0.07	0.008	0.007
Loughshinny to Killiney (Dalkey Island)	38	72	2552.83	0.54	0.46	0.00	18.57	0.07	0.005	0.004
Monaghan Lakes	16	51	2552.83	0.13	0.87	0.00	18.57	0.13	0.004	0.003
Strangford Lough	2546	70	4926.68	0.55	0.45	0.26	9.62	0.06	0.163	0.144
Non-SPA Total	**7184**								**0.814**	**0.716**
Sum	**9666**	**768**	**47416.61**	**6.08**	**6.92**	**1.00**	**198.20**	**1.00**	**1.14**	**1.00**

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Table A.5: Parameters used to calculate colony weighting and proportional weighting for kittiwake during the breeding season.

Kittiwake Colonies - SMP master site	Pop	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	NatureScot Weighting	NatureScot prop
Ailsa Craig SPA	490	161	25820.0	0.471	0.529	0.013	53.459	0.020	0.013	0.004
Helvick Head to Ballyquin SPA	130	230	52778.9	0.650	0.350	0.003	26.153	0.013	0.001	0.000
Horn Head to Fanad Head SPA	1820	190	36174.2	0.643	0.357	0.047	38.158	0.013	0.024	0.008
Howth Head Coast SPA	1773	59	3532.7	0.462	0.538	0.045	390.731	0.020	0.361	0.119
Ireland's Eye SPA	455	57	3236.0	0.463	0.537	0.012	426.547	0.020	0.101	0.033
Lambay Island SPA	3320	48	2264.8	0.463	0.537	0.085	609.471	0.020	1.050	0.347
North Colonsay and Western Cliffs SPA	3347	242	58767.6	0.572	0.428	0.086	23.488	0.016	0.033	0.011
Rathlin Island SPA	13706	155	24042.5	0.572	0.428	0.350	57.412	0.016	0.325	0.108
Saltee Island SPA	1038	204	41501.8	0.576	0.424	0.027	33.259	0.016	0.014	0.005
Wicklow Head SPA	773	106	11236.0	0.462	0.538	0.020	122.849	0.020	0.049	0.016
SPA Total	**26852**									**0.651**
Aberdaron Coast and Bardsey Island SPA	90	155	23916.8	0.381	0.619	0.002	57.714	0.023	0.003	0.001
Ardmore to Whiting Bay	226	247	60836.6	0.650	0.350	0.006	22.689	0.013	0.002	0.001
Balcary Point	114	177	31427.2	0.438	0.562	0.003	43.921	0.021	0.003	0.001
Bishop & Clerks and Ramsey	83	234	54924.2	0.570	0.430	0.002	25.131	0.016	0.001	0.000
Bray Head	873	81	6523.3	0.470	0.530	0.022	211.599	0.020	0.095	0.031
Caldey Island	271	269	72572.9	0.570	0.430	0.007	19.020	0.016	0.002	0.001
Causeway Coast	562	148	21950.0	0.510	0.490	0.014	62.885	0.019	0.017	0.006
Creadan Head to Foilakipeen	26	205	41820.8	0.598	0.402	0.001	33.006	0.015	0.000	0.000

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Kittiwake Colonies - SMP master site	Pop	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	NatureScot Weighting	NatureScot prop
Downhill	92	147	21548.6	0.542	0.458	0.002	64.056	0.017	0.003	0.001
Dunmore East to Red Head	401	207	42645.6	0.600	0.400	0.010	32.367	0.015	0.005	0.002
Giants Causeway Coast	13	148	21964.4	0.526	0.474	0.000	62.844	0.018	0.000	0.000
Grassholm	30	247	60835.3	0.547	0.453	0.001	22.690	0.017	0.000	0.000
Great Orme and Little Orme	992	159	25245.4	0.346	0.654	0.025	54.676	0.025	0.034	0.011
Inishtrahull Island SPA (assemblage)	7	185	34078.3	0.586	0.414	0.000	40.505	0.016	0.000	0.000
Islay - East (Port Askaig to Bowmore)	59	186	34542.5	0.533	0.467	0.002	39.960	0.018	0.001	0.000
Islay - West (Port Askaig to Bruichladdich)	246	217	47136.3	0.559	0.441	0.006	29.284	0.017	0.003	0.001
Larne Lough to Portmuck	1145	103	10592.1	0.450	0.550	0.029	130.317	0.021	0.079	0.026
Lleyn Peninsula	965	163	26600.0	0.370	0.630	0.025	51.892	0.024	0.030	0.010
Loughshinny to Killiney (Rockabill)	165	36	1292.6	0.452	0.548	0.004	1067.867	0.021	0.093	0.031
Maggy's Leap	656	32	1040.1	0.426	0.574	0.017	1327.064	0.022	0.484	0.160
Meikle Ross & Little Ross	0	159	25308.3	0.427	0.573	0.000	54.540	0.022	0.000	0.000
Monreith Cliffs and Scar Rocks	19	122	14803.1	0.417	0.583	0.000	93.246	0.022	0.001	0.000
Morecambe Central Gas Platform	220	179	31929.5	0.390	0.610	0.006	43.230	0.023	0.006	0.002
Muck Island	519	106	11213.2	0.453	0.547	0.013	123.098	0.021	0.034	0.011
Mull of Galloway	61	112	12483.6	0.416	0.584	0.002	110.571	0.022	0.004	0.001
New Quay to Lochtyn	332	221	48739.0	0.463	0.537	0.008	28.321	0.020	0.005	0.002
North Antrim coast	242	148	21794.9	0.533	0.467	0.006	63.332	0.018	0.007	0.002

ORIEL WIND FARM PROJECT – OFFSHORE ORNITHOLOGY APPORTIONING IMPACTS TO INDIVIDUAL COLONIES

Kittiwake Colonies - SMP master site	Pop	Distance	Distance ^2	Proportion at Sea	1 - Psea	Colpop/ sumpop	Sum dist2/ col dist2	Colsea/ sumsea	NatureScot Weighting	NatureScot prop
North Island (Isle of Man)	78	119	14221.4	0.381	0.619	0.002	97.060	0.023	0.005	0.001
Point Lynas to Trwyn Du	156	131	17136.2	0.338	0.662	0.004	80.550	0.025	0.008	0.003
Port Mona, Devil's Bridge, Laggantalluch Head	25	110	12087.7	0.418	0.582	0.001	114.193	0.022	0.002	0.001
Portally to Benlea Head	100	208	43299.0	0.603	0.397	0.003	31.879	0.015	0.001	0.000
Porth Llanlleiana to Porth Eilian	0	120	14509.0	0.339	0.661	0.000	95.136	0.025	0.000	0.000
Puffin Island, Anglesey	313	151	22703.0	0.341	0.659	0.008	60.799	0.025	0.012	0.004
Sanda Islands - Kintyre	33	156	24303.5	0.483	0.517	0.001	56.795	0.020	0.001	0.000
Sheep Islands SPA	230	149	22252.9	0.512	0.488	0.006	62.029	0.018	0.007	0.002
Skerry Islands	76	150	22447.1	0.532	0.468	0.002	61.492	0.018	0.002	0.001
Skomer SPA (assemblage)	1439	248	61663.9	0.565	0.435	0.037	22.385	0.016	0.014	0.004
South Island (Isle of Man)	553	85	7151.7	0.370	0.630	0.014	193.007	0.024	0.065	0.021
South Stack	10	114	13031.5	0.344	0.656	0.000	105.922	0.025	0.001	0.000
St Bees Head and Town	809	172	29744.0	0.417	0.583	0.021	46.407	0.022	0.021	0.007
West Island (Isle of Man)	54	93	8654.6	0.375	0.625	0.001	159.490	0.024	0.005	0.002
Non-SPA Total	**12285**								**1.055**	**0.349**
Sum	**39137**	**7848.523**	**1380324.5**	**24.576**	**26.424**	**1.000**	**6884.494**	**1.000**	**3.026**	**1.000**