



Hornsea Project Four

Comparative Gannet Assessment

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Glossary

Term	Definition
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons.
Collision	An instance of one moving object or individual striking violently against another.
Collision Risk Model (CRM)	General term to describe the method of estimating the collision risk of seabirds (estimated mortality) to operational turbines, which could be either deterministic or stochastic.
MRSea	Statistical package to model spatial count data and predict spatial abundances; developed by the Centre for Research into Ecological and Environmental Modelling (CREEM) specifically for dealing with data collected for offshore wind farm projects.

Acronyms

Term	Definition
CRM	Collision Risk Model
EIA	Environmental Impact Assessment
FFC	Flamborough and Filey Coast
HRA	Habitats Regulations Assessment
MRSea	Marine Renewables Strategic environmental assessment
sCRM	stochastic Collision Risk Model
SPA	Special Protection Area

1 Introduction

- 1.1.1.1 On the 20th April 2022 the Applicant held a consultation meeting with Natural England to present the results of the revised MRSea modelling undertaken by the Applicant as detailed in [G2.10 MRSea Baseline Sensitivity Report \(REP03-029\)](#). Natural England welcomed the revised modelling undertaken by the Applicant and agreed that the MRSea v2 was the best model fit that provided a good spatial fit also. The results of the best fit MRSea model produced outputs including 12 monthly abundance and density estimates from the 24 months of survey data. This was due to the best model fit making use of the input parameter of calendar month rather than individual survey months to model the data. The resulting data set therefore provide a smoothed modelled set of monthly abundance and density estimates to define the baseline and for use in impact assessments.
- 1.1.1.2 In order to understand the differences from the use of the MRSea v1 data used to define the baseline and underpin the assessments in the DCO application at the EIA and HRA levels the Applicant was asked by the examining authority in Issue Specific Hearings 5 and 6 ([EV-028A](#)) to provide a worked example of any changes that would result from using the MRSea v2 for gannet. This report, therefore, provides a fully worked example of EIA and HRA level assessments of gannet using both the MRSea_V1 and MRSea_V2 to provide a comparison between using both datasets and identify any differences from using either dataset. For the purpose of this worked example the potential impacts from collision risk and displacement (operational) are presented as well as both of these impacts combined.
- 1.1.1.3 The derivation and presentation of the monthly and seasonal abundance for the MRSea_V2 datasets used within the assessments presented within this report are provided in [G2.10 MRSea Baseline Sensitivity Report \(REP03-029\)](#).

2 Collision Risk Modelling

- 2.1.1.1 Collision risk modelling was undertaken for both datasets using the stochastic Collision Risk Model (sCRM) ([Donovan, 2018](#)). The input parameters used were based on the central/mean collision risk modelling parameters as detailed in [A5.5.3 ES Volume A5 Annex 5.3 Offshore Ornithology Collision Risk Modelling \(APP-076\)](#), which the assessment of gannet within [Volume A2 Chapter 5 Offshore and Intertidal Ornithology \(APP-017\)](#) was based upon. For reference a summary of the wind turbine generators and biotic input parameters modelled are also presented within [Appendix A](#) of this report.
- 2.1.1.2 The collision risk results using both the MRSea_V1 and MRSea_V2 datasets are presented in [Table 1](#) with both the monthly and annual difference between the two assessments calculated.

Table 1: Gannet collision risk results using the MRSea_V2 and MRSea_V1 datasets.

Month	MRSea_V2 (mortality rate)	MRSea_V1 (mortality rate)	Difference (mortality rate and percentage change)
January	0.00	0.50	-0.5 (NA%)
February	0.163	0.17	-0.01 (-4%)
March	0.908	0.68	+0.23 (+25%)
April	0.222	1.69	-1.46 (-659%)
May	0.445	1.67	-1.23 (-276%)
June	6.185	2.59	+3.6 (+58%)
July	3.801	3.71	+0.09 (+2%)
August	3.085	3.72	-0.63 (-20%)
September	1.081	1.57	-0.49 (-45%)
October	1.354	1.22	+0.13 (+10%)
November	2.083	2.15	-0.07 (-3%)
December	0.065	0.50	-0.43 (-665%)
Annual	19.39	20.15	-0.76 (-4%)

3 Displacement Analysis

3.1.1.1 The assessment of displacement for gannet using both MRSea datasets is based on a displacement rate of 60-80% and a mortality rate of 1%, as used for assessment of gannet within [Volume A2 Chapter 5 Offshore and Intertidal Ornithology \(APP-017\)](#). The seasonal abundance, predicted displacement impact and difference between the two MRSea datasets are presented in [Table 2](#) below.

Table 2: Gannet displacement analysis using the MRSea_V2 and MRSea_V1 datasets for the Hornsea Four array area Plus 2 km Buffer.

Bio-season	MRSea_V2 (mortality rate)		MRSea_V1 (mortality rate)		Difference (mortality rate and percentage change)	
	<i>Abundance (All Behaviours)</i>	<i>60-80% Displacement; 1% Mortality</i>	<i>Abundance (All Behaviours)</i>	<i>60-80% Displacement; 1% Mortality</i>	<i>Abundance (All Behaviours)</i>	<i>60-80% Displacement; 1% Mortality</i>
Return Migration	270.57	1.62 – 2.16	235.34	1.41 – 1.88	35.23 (13%)	+0.21 – 0.28 (+13%)
Migration-free breeding	742.69	4.46 – 5.94	790.79	4.74 – 6.33	-48.10 (-6%)	-0.29 – -0.38 (-6%)
Post-breeding migration	667.42	4.00 – 5.34	854.42	5.13 – 6.84	-187.00 (-28%)	-1.12 – -1.50 (-28%)
Annual	1,680.69	10.08 – 13.45	1,880.55	11.28 – 15.04	-199.86 (-12%)	-1.20 – -1.60 (-12%)

4 Apportionment of Impacts to the Flamborough and Filey Coast (FFC) Special Protection Area (SPA)

4.1.1.1 Following the calculation of predicted collision and displacement impacts as presented in [Table 1](#) and [Table 2](#), predicted impacts were apportioned to the FFC SPA using the Applicant’s calculated apportionment rates. The apportionment rates used included of 61.20% of gannet being breeding adults from FFC SPA in the migration-free breeding bio-season, 4.85% in the post-breeding migration bio-season and 6.23% in the return migration bio-season. The details of how these rates were derived and calculated are provided in [B2.2 Report to Inform Appropriate Assessment Part 11: Appendix H: Offshore Ornithology Flamborough and Filey Coast \(FFC\) Special Protection Area \(SPA\) Population Viability Analysis \(APP-177\)](#). Apportioned collision risk, displacement and combined collision and displacement impacts using the MRSea_V2 and MRSea_V1 datasets are presented in [Table 3](#), [Table 4](#) and [Table 5](#), respectively.

Table 3: Gannet collision impacts apportioned to the FFC SPA using the MRSea_V2 and MRSea_V1 datasets.

Bio-season	MRSea_V2 (mortality rate)	MRSea_V1 (mortality rate)	Difference (mortality rate and percentage change)
Return Migration	8.41	8.18	+0.23 (+2.7%)
Migration-free breeding	0.07	0.11	-0.04 (-62.1%)
Post-breeding migration	0.22	0.24	-0.02 (-9.4%)
Annual	8.70	8.53	+0.16 (+1.9%)

Table 4: Gannet displacement impacts apportioned to the FFC SPA using the MRSea_V2 and MRSea_V1 datasets.

Bi-season	MRSea_V2	MRSea_V1	Difference
	<i>60-80% Displacement; 1% Mortality</i>	<i>60-80% Displacement; 1% Mortality</i>	
Return Migration	0.10 – 0.13	0.09 – 0.12	+0.01 – 0.02 (+6.5%)
Migration-free breeding	2.73 – 3.64	2.90 – 3.87	-0.18 – -0.24 (13%)
Post-breeding migration	0.19 – 0.26	0.25 – 0.33	-0.05 – -0.07 (-28%)
Annual	3.02 – 4.03	3.24 – 4.32	-0.22 – -0.29 (-7.2)

Table 5: Gannet combined collision and displacement impacts apportioned to the FFC SPA using the MRSea_V2 and MRSea_V1 datasets.

Bio-season	MRSea_V2	MRSea_V1	Difference
Combined annual total (CRM + 60% Displacement; 1% Mortality)	11.72	11.77	-0.05 (-0.5%)
Combined annual total (CRM + 80% Displacement; 1% Mortality)	12.73	12.85	-0.13 (-1.0%)

5 Conclusion

- 5.1.1.1 At an EIA level, the difference between the predicted impacts for the two versions of MRSea equates to a reduction of less than a bird per annum ([Table 1](#)) for collision risk (-0.76 birds) and less than two birds per annum ([Table 2](#)) for displacement (-1.2 to -1.6 birds) at the EIA level. This level of difference between the two datasets would not make a material difference to the Applicant's assessments undertaken within [A5.5.3 ES Volume A5 Annex 5.3 Offshore Ornithology Collision Risk Modelling \(APP-076\)](#) and therefore no amendments are considered necessary to the conclusions of predicted impacts on gannet from collision risk or displacement at an EIA level from Hornsea Four dependent upon the application of MRSea_v2. Stakeholders and the Examining Authority can therefore take comfort that the DCO Application documents for ornithology present a robust and suitably precautionary assessment.
- 5.1.1.2 For impacts apportioned to the FFC SPA at the HRA level, the difference between the predicted impacts for the two versions of MRSea equates to an increase of significantly less than one breeding adult ([Table 3](#)) for collision risk (+0.16) and a decrease of significantly less than a breeding adult ([Table 4](#)) for displacement (-0.22 to -0.29). When both impacts apportioned to the FFC SPA are combined together the difference between the two versions of MRSea remains a decrease of significantly less than a single breeding adult, with a difference of 1% ([Table 5](#)) at most between the predicted impacts (-0.05 to -0.13). This level of difference between the impacts derived from the two datasets would not make a material difference to the Applicant's assessments undertaken within [2.2: Report to Inform Appropriate Assessment \(APP-167 & APP-178\)](#) and therefore no amendments are considered necessary to the conclusions of predicted impacts on gannets from collision risk or displacement at the HRA level apportioned to the FFC SPA from Hornsea Four.

6 Reference

Donovan, C. (2018) Stochastic Band CRM – GUI User Manual, Draft V1.0, 31/03/2017.

Appendix A Collision Risk Modelling Input Parameters

Table A 1: Turbine and wind farm parameters modelled. Values derived from A5.5.3 ES Volume A5 Annex 5.3 Offshore Ornithology Collision Risk Modelling (APP-076)

Parameter	Value
Maximum number of turbines	180
Number of blades	3
Wind farm width (km)	37.75
Latitude (degrees)	54.11
Air Gap (m; HAT)	
Tidal offset (m)	2.28
Rotor Radius (m)	152.5
Hub Height (m)	190.22
Blade Width (m)	6
Wind Speed (ms ⁻¹)	11.2
Rotor Speed (rpm)	6.5
Pitch (°)	4.6
Jan Operational (%)	92.15
Feb Operational (%)	92.58
Mar Operational (%)	92.42
Apr Operational (%)	91.46
May Operational (%)	91.25
Jun Operational (%)	90.04
Jul Operational (%)	89.87
Aug Operational (%)	90.49
Sep Operational (%)	91.75
Oct Operational (%)	92.61
Nov Operational (%)	92.60
Dec Operational (%)	92.45

Table A 2: Gannet biotic parameters modelled. Values derived from A5.5.3 ES Volume A5 Annex 5.3 Offshore Ornithology Collision Risk Modelling (APP-076)

Parameter	Value
Avoidance Basic	0.989
Avoidance Extended	N/A
Wingspan (m)	1.72
Body Length (m)	0.94
PCH	N/A
Flight Speed (ms ⁻¹)	13.33
Nocturnal Activity	0.00

Table A 3: Gannet MRSea_V2 and MRSea_V1 monthly flying density.

Month	MRSea_V2 (birds/km ²)*	MRSea_V1 (birds/km ²)**
January	0.00	0.13
February	0.04	0.04
March	0.16	0.12
April	0.03	0.26
May	0.06	0.22
June	0.79	0.33
July	0.48	0.47
August	0.44	0.52
September	0.18	0.26
October	0.26	0.24
November	0.51	0.53
December	0.02	0.14

Table Note: *MRSea_V2 density estimates derived from [G2.10 MRSea Baseline Sensitivity Report \(REP03-029\)](#).
 **MRSea_V1 density estimates derived from [A5.5.3 ES Volume A5 Annex 5.3 Offshore Ornithology Collision Risk Modelling \(APP-076\)](#).