Outer Dowsing Offshore Wind

Preliminary Environmental Information Report

Volume 2, Appendix 7.2: Offshore Ornithology Collision Risk Modelling

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OUTER DOWSING OFFSHORE WIND

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Abbreviations

Acronym	Expanded name
BEIS	Department for Business, Energy & Industrial Strategy (now the Department for Energy Security and Net Zero (DESNZ))
CI	Confidence Interval
CRM	Collision Risk Model
DAS	Digital Aerial Survey
DCO	Development Consent Order
DESNZ	Department for Energy Security and Net Zero, formerly Department of Business, Energy and Industrial Strategy (BEIS), which was previously Department of Energy & Climate Change (DECC).
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (a wholly owned Green Investment Group portfolio company), Gulf Energy Development and TotalEnergies.
HAT	Highest Astronomical Tide
JNCC	Joint Nature Conservation Committee
MDS	Maximum Design Scenario
MSL	Mean Sea Level
NAF	Nocturnal Activity Factors
NSIP	Nationally Significant Infrastructure Project
OWF	Offshore Windfarm
PCH	Potential Collision Height
PEIR	Preliminary Environmental Information Report
RIAA	Report to Inform Appropriate Assessment
RPM	Revolutions per minute
RSPB	Royal Society for the Protection of Birds
sCRM	Stochastic Collison Risk Model
SD	Standard Deviations
SNCB	Statutory Nature Conservation Bodies
SoS	Secretary of State
WTG	Wind Turbine Generator

Terminology

Term	Definition
Array area	The area offshore within the PEIR Boundary within which the generating stations (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling are positioned.
Baseline	The status of the environment at the time of assessment without the development in place.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Department for Energy Security and Net Zero (DESNZ).
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the Environmental Impact Assessment (EIA) Regulations, including the publication of an Environmental Statement (ES).
EIA Directive	European Union 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU)
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Environmental Statement (ES)	The suite of documents that detail the processes and results of the Environmental Impact Assessment (EIA).
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Inter-array	Cable which connects the wind turbines to each other and to the offshore substation(s).
Intertidal	Area where the ocean meets the land between high and low tides.
Landfall	The location at the land-sea interface where the offshore export cable will come ashore.
Maximum Design Scenario	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed
Outer Dowsing Offshore Wind	The Project.
Preliminary Environmental Information Report (PEIR)	The PEIR is written in the style of a draft Environmental Statement (ES) and provides information to support and inform the statutory consultation process in the pre-application phase. Following that consultation, the PEIR documentation will be updated to produce the Project's ES that will accompany the application for the Development Consent Order (DCO).
Pre-construction and post-construction	The phases of the Project before and after construction takes place.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as

Term	Definition
	'residential' or those using areas for amenity or recreation), watercourses etc.
PEIR Boundary	The PEIR Boundary is outlined in Figure 3.1 of Volume 1, Chapter 3: Project Description and comprises the extent of the land and/or seabed for which the PEIR assessments are based upon.
Project Design envelope	A description of the range of possible elements that make up the Project's design options under consideration, as set out in detail in the project description. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
The Applicant	GT R4 Ltd. The Applicant making the application for a DCO. The Applicant is GT R4 Limited (a joint venture between Corio Generation, TotalEnergies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company), TotalEnergies and GULF.
The Project	Outer Dowsing Offshore Wind including proposed onshore and offshore infrastructure
Wind turbine generator (WTG)	All the components of a wind turbine, including the tower, nacelle, and rotor.

12 Introduction

12.1 Overview

Project Background

12.1.1 GT R4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (hereafter "the Project"). The Project will be located approximately 54km from the Lincolnshire coastline in the southern North Sea. The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, onshore cables, and connection to the electricity transmission network, and ancillary and associated development (see Volume 1, Chapter 3: Project Description for full details).

12.1.2 This technical annex has been produced to provide the methodology and results of the collision risk modelling that forms part of the ornithological assessment completed to date, and supports Volume 2, Chapter 12: Offshore and Intertidal Ornithology. A separate report (Volume 2, Appendix 12.1: Offshore and Intertidal Ornithology Technical Baseline) provides the findings from offshore and intertidal ornithology data to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from the Project.

12.1.3 The consideration of offshore and intertidal ornithology for the Project has been discussed with consultees (Natural England and the Royal Society for the Protection of Birds [RSPB]) through the Project Evidence Plan Process (EPP). The latest Natural England advice has been followed (Parker *et al.,* 2022; Natural England, 2022). Where there is deviation from this guidance, any agreements made with consultees during the EPP regarding the CRM methodology can be found within Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3.

Collision Risk Modelling

12.1.4 There is a potential risk that birds flying through the Project array area could collide with the operational wind turbine generators (WTGs). The risk of potential collision with WTG blades is increased if they are located in areas of higher bird densities and in areas in which there is a high level of flight activity. High levels of flight activity can be associated with locations where food supplies are concentrated or with areas where there is a high turnover of individuals (possibly commuting daily between nesting and feeding areas or passing through the area on seasonal migrations). The potential collision risk can be estimated using collision risk modelling (CRM).

12.1.5 Investigation of the site-specific survey data identified six seabird species as needing consideration for collision risk. These species are also highlighted within current guidance and have been agreed with relevant stakeholders through the EPP (Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3). These species are:

- Kittiwake, *Rissa tridactyla*;
- Greater black-backed gull, *Larus marinus*;
- Herring gull, *Larus argentatus*;

- Lesser black-backed gull, *Larus fuscus*;
- Sandwich tern *Sterna sandvicensis*; and
- Gannet, *Morus bassanus*.

12.1.6 Other species were recorded during the first 18 months of digital aerial survey (DAS) data collected within the array area and the buffer area but have not been considered within the CRM assessment as they were either observed at lower numbers deemed to be insignificant, or were not considered to be a collision risk species because their flight height distribution does not overlap with the area of collision risk (i.e. they fly below the rotor swept area) (Johnston *et al.,* 2014). These species have not been included within the CRM assessment completed to inform the assessments presented in the Preliminary Environmental Information Report (PEIR), since predicted mortality would be expected to be so low as to be of no significance. However, the status of each species will be reassessed on review of the complete set of data collected over the full 24 months of DAS data and the CRM will be updated to inform the Environmental Statement submitted a spart of the DCO application. For a detailed account of species inclusion within CRM see the screening table which presents a rationale on a species-by-species basis (Volume 2, Chapter 12: Offshore and Intertidal Ornithology).

12.1.7 The results presented in the main body of this annex are calculated for the Maximum Design Scenario (MDS) (i.e. the project design scenario giving rise to the greatest level of collision risk) and are used to subsequently inform the worst case assessment within Volume 2, Chapter 12: Offshore and Intertidal Ornithology. However, a range of WTG are being considered for the Project (in terms of size and number) at this stage. The collision estimates across a range of four WTG options are therefore also presented in the annex to this appendix (Annex A) to provide an indication of the range of collision mortalities that might occur. It should be noted that technical feasibility and availability of these turbine types are not fully understood at this stage and therefore the whole range of turbine options may not be available to the project. The MDS will ensure that an appropriate project design envelope is consented which allows for future procurement and delivery of the Project.

12.1.8 In addition, the results across two minimum tip heights, 30m and 40m relative to mean sea level (MSL), are also presented within Annex A to provide the full range of potential impacts predicted for the Project. The MDS using a 30m minimum tip height is presented in the main body of this appendix, the results of which have been carried through to the assessment within Volume 2, Chapter 12: Offshore and Intertidal Ornithology and Part 7, Document 7.1: Draft Report to Inform Appropriate Assessment (RIAA).

12.2 Methodology

Guidance and Models

12.2.1 CRM was undertaken using the Marine Science Scotland Stochastic Collision Risk Model Shiny Application ("sCRM App"; Donovan, 2018), as recommended by the latest Natural England guidance (Parker *et al.,* 2022). The sCRM builds on the Band (2012) offshore CRM, together with code written by Masden (2015) to incorporate variation or uncertainty surrounding the input parameters into calculations of collision frequency. The sCRM was accessed via the "Shiny App" interface, which is a user-friendly graphical interface accessible

via a standard web-browser or within R statistical software (R Core Team, 2021) that uses an R code to estimate collision risk (Donovan, 2018). For this assessment the latest version of the model was downloaded and run locally within R. The advantage of the sCRM over the Band (2012) model is that it provides a clear and transparent audit trail for all modelling runs, which enables regulators and stakeholders to easily access and reproduce the results of any modelling scenario. A full report on the sCRM was published by Marine Scotland in 2018 to accompany the User Guide (McGregor *et al*., 2018).

12.2.2 The sCRM, as with Band (2012), can generate collision estimates using two different methods (basic and extended models), with both methods having two further options based on flight height data. The basic model assumes the flight height distribution across the rotor swept heights is uniform, whilst the extended model accounts for variation in flight height distributions by using species-specific modelled flight height distributions (Band, 2012; Johnston *et al*., 2014). Since seabird flight height distributions tend to be skewed towards lower rotor swept heights where collision risk is lower, Option 3 gives rise to considerably lower collision estimates than Option 2 (Band, 2012).

12.2.3 Both the basic and extended models can also be run using either site-specific flight height data (i.e. collected from the proposed array area), or generic flight height data derived from pre-construction surveys for windfarm developments across 32 sites in the UK and Europe (Johnston *et al.*, 2014). This produces four model options: Option 1 (site-specific flight height data) and 2 (generic flight height data) for the basic model, and Option 3 (generic flight height data) and 4 (site-specific flight height data) for the extended model (Band, 2012).

12.2.4 Due to the lack of sufficient site-specific flight height data for all species, and the lack of guidance on using Option 3 within the latest tool, results are only presented for Option 2 at this stage as agreed at Expert Topic Groups (ETG) (Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3).

CRM Input Parameters

12.2.5 Models were run stochastically for each species. Uncertainty in each relevant parameter was incorporated into the model using distributions set by standard deviations (SD). A total of 1000 simulations were run for each scenario to ensure that any outputs were robust. The Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards (Parker *et al*., 2022), was used to determine model input parameters for each species. The mean density of flying birds within the Project array area formed the basis of the modelling. SNCB advocated seabird parameters, including biometrics, nocturnal activity factors (NAF) and avoidance rates, were used throughout based on the latest interim guidance (Natural England, 2022).

12.2.6 The stochastic model output provides a mean and an upper and lower 95% Confidence intervals (CI) as a measure of variance in the outputs.

Turbine Parameters

12.2.7 The WTG and windfarm parameters used within the CRM are summarised in Table 12.1 and Table 12.2. These values are based on the MDS parameter values, as described in Volume 1, Chapter 3: Project Description. The values for revolutions per minute (RPM) and pitch have a standard deviation (SD) associated with them.

Table 12.1: Maximum design scenario offshore windfarm and WTG parameters used for CRM. HAT = Highest Astronomical Tide.

Parameter	Mean (SD)
No. WTGs	93
Windfarm width (km)	34.3
Latitude (deg)	53.6
Rotor radius (m)	121
No. Blades	3
Max Chord (m)	7.5
Min Tip Clearance HAT (m)	27.67 (30m MSL)
Hub height relative to HAT (m)	148.67
Tidal offset (HAT – MSL) (m)	2.33
Rated RPM (SD)	7.91 (0.39)
Average Pitch (^{o}) (SD)	6.5 (1.75)

Table 12.2: Maximum design scenario operational parameters used within the CRM.

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind availability (%)	92.1	91.1	90.7	87.7	86.7	83.1	83.6	84.7	87.7	91.4	92.8	91.7
Mean downtime (%)	2.8	2.7	2.7	2.6	2.6	2.5	2.5	2.5	2.6	2.7	2.8	2.8
SD downtime (%)	0	0	0	0	0	0	0	0	0	0	0	0

Density of Birds in Flight

12.2.8 Density estimates of birds in flight (birds per km^2) and the associated SD were determined for the Project using average monthly densities within the array area based on the currently available data collected over the first 18 months of the DAS campaign. For months when two surveys were conducted (i.e. March – August 2022), the mean of the two surveys was calculated for those months. The mean across the same month between years was then subsequently calculated.

12.2.9 The SD of density was calculated using a "rule of thumb" that one SD is approximately one quarter of the range, where the range is estimated as the highest upper 95% confidence limit minus the smallest lower 2.5% confidence limit. Density estimates for each species used for CRM are presented in Table 12.3. A mean density estimate is provided for each species, and associated SD.

Table 12.3: Monthly values for the mean density (birds per km^2) and standard deviation (SD) of flying birds used in the Project CRM for six key species.

Species	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gannet	Mean	0.01	0.03	0.15	0.48	0.23	0.08	0.21	0.11	0.04	0.09	0.06	0.00
	SD	0.01	0.01	0.06	0.14	0.14	0.03	0.10	0.03	0.01	0.03	0.02	0.00
Kittiwake	Mean	0.11	0.61	1.95	4.09	1.42	0.79	1.19	0.95	0.90	0.10	0.18	0.32
	SD	0.02	0.09	0.53	0.76	0.61	0.33	0.53	0.31	0.22	0.03	0.03	0.06
Herring gull	Mean	0.01	0.00	0.01	0.01	0.01	0.04	0.02	0.00	0.00	0.00	0.00	0.00
	SD	0.01	0.00	0.02	0.01	0.01	0.04	0.02	0.00	0.00	0.00	0.00	0.00
Greater black-backed gull	Mean	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.04	0.01	0.05	0.02
	SD	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.01
Lesser black-backed gull	Mean	0.00	0.00	0.01	0.03	0.01	0.02	0.02	0.03	0.00	0.01	0.01	0.00
	SD	0.00	0.00	0.01	0.02	0.01	0.03	0.01	0.03	0.00	0.01	0.01	0.00
Sandwich tern	Mean	0.00	0.00	0.00	0.06	0.24	0.10	0.00	0.00	0.03	0.00	0.00	0.00
	SD	0.00	0.00	0.00	0.05	0.09	0.08	0.00	0.00	0.02	0.00	0.00	0.00

Avoidance Rates

12.2.10 Most birds exhibit avoidance behaviour towards WTGs, and the inclusion of this behaviour is a key element of CRM. Avoidance behaviour can occur at three scales (Cook *et al.,* 2014); macro-avoidance (avoiding the whole windfarm array and buffer area), meso-avoidance (avoiding WTGs but not the rotor-swept area), and micro-avoidance (last-second changes to avoid collision with WTG blades). Different species exhibit varying degrees of avoidance behaviours towards offshore windfarms and therefore species-specific avoidance rates are used within the CRM (Table 12.4). The most recent interim guidance on avoidance rates, provided by Natural England (Natural England, 2022) based on a review of the latest evidence bases (Cook, 2021), and a re-analysis of avoidance rates (Ozsanlev-Harris *et al*., 2023), were used within the CRM as agreed through the ETGs (Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3). However, there is further evidence that the standard CRM avoidance rates used within assessments are overly precautionary; for example the findings from the recent Vattenfall (2023) study indicated that seabirds were exposed to very low risks of collision and no collisions or narrow escapes were recorded.

Table 12.4: Species-specific mean avoidance rates and associated standard deviation (SD) used for CRM.

Parameter	Species	Mean	SD	Source
Avoidance Rate for basic model option 2	Kittiwake	0.993	0.0003	Natural England, 2022
	Greater black-backed gull	0.994	0.0004	
	Herring gull	0.994	0.0004	
	Lesser black-backed gull	0.994	0.0004	
	Sandwich tern	0.991	0.0004	
	Gannet	0.993	0.0003	

Species Biometrics

12.2.11 Physical and behavioural biometric input parameters were determined for each species and used to inform the CRM (Table 12.5). Biometric data (bird length and wingspan) were derived from Snow & Perrins (1987) for each species as displayed in the latest guidance (Natural England, 2022). SDs have been considered within the model as advised by the latest Natural England guidance (Natural England, 2022).

Table 12.5: Species-specific mean biometrics parameters and associated standard deviations (SD) used for CRM of anticipated key species.

Parameter	Species	Body Length (m)	Wingspan (m)	Source
Species Biometrics	Gannet	0.94 (0.0325)	1.72 (0.0375)	Natural England, (2022) Snow & Perrins (1987)
	Kittiwake	0.39 (0.005)	1.08 (0.0625)	
	Herring gull	0.60 (0.0225)	1.44 (0.03)	
	Great black-backed gull	0.71 (0.035)	1.58 (0.0375)	
	Lesser black-backed gull	0.58 (0.03)	1.42 (0.0375)	
	Sandwich tern	0.38 (0.005)	1.00 (0.04)	

Nocturnal Activity

12.2.12 Nocturnal Activity factors (NAFs) are applied in the CRM to allow the calculation of collision risk during the night. NAF values are derived from daytime survey data and extrapolated to include activity at night. Nocturnal activity levels are based on a review by Garthe and Hüppop (2004) which ranks species from 1 (low) to 5 (high) to indicate % nocturnal activity levels in relation to daytime activity (1 = 0%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 100%).

12.2.13 Since the publication of these NAF values, Furness *et al*. (2005) have reviewed gannet studies and recommended, using the available evidence-base, considerably lower relative nocturnal activity rate estimates. Similarly, a review of nocturnal activity in large gulls (MacArthur Green, 2015) indicated that the 50% rate was more than double the realistic level for these species.

12.2.14 The NAF used within the models followed the latest Natural England guidance (Table 12.6; Natural England, 2022) and were agreed at ETG (Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3). For kittiwake and gull species the SDs are designed to incorporate the 0.25 and 0.5 within the 95% confidence intervals.

Table 12.6: Mean nocturnal activity factor and associated standard deviation (SD) used within the CRM assessment.

Parameter	Species	Mean	SD	Source
Nocturnal Activity (%)	Gannet	0.080	0.1000	Furness et al. (2018) Natural England, (2022) Garth and Huppop (2004)
	Kittiwake	0.375	0.0637	
	Herring gull	0.375	0.0637	
	Great black-backed gull	0.375	0.0637	
	Lesser black-backed gull	0.375	0.0637	
	Sandwich tern	0.000	0.0000	

Seabird Flight Speeds

12.2.15 Mean flight speeds for species included in the CRM were taken from the latest Natural England (2022) guidance (Table 12.7) and were agreed with Natural England at ETG (Volume 2, Chapter 12: Offshore and Intertidal Ornithology, Section 12.3). The guidance uses flight speeds derived from Pennycuick (1997) for gannet, Fijn and Gyimesi (2018) for sandwich tern and Alerstam et al. (2007) for all other species.

Table 12.7: Species-specific mean flight speeds and associated standard deviations (SD) used for CRM.

Parameter	Species	Mean	SD	Source
Flight Speed (ms^{-1})	Gannet	14.9	0.00	Pennycuick (1987)
	Kittiwake	13.1	0.40	Alerstam et al. (1997)
	Herring gull	12.8	1.80	
	Great black-backed gull	13.7	1.20	
	Lesser black-backed gull	13.1	1.90	
	Sandwich tern	10.3	3.40	Fijn and Gyimesi, (2018)

Other Parameters

12.2.16 Following the interim Natural England (2022) guidance it was assumed that all birds were flapping while flying and that an even proportion (50%) of flights occurred in the upwind and downwind direction.

12.3 Results

12.3.1 This section presents the outputs from the CRM analysis for each of the six seabird species considered. A summary of the monthly breakdown of collisions for each species is presented in Table 12.8. The 95% CIs provide an indication of the level of certainty or uncertainty in the results. The results from the other WTG options and from scenarios with an increased minimum tip height are presented within Annex A – Results from a Range of WTG Options.

Table 12.8: Summary of average monthly collisions by species based on the maximum design scenario.

Option 2	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.69	3.78	14.67	31.22	12.01	6.27	9.81	7.56	6.58	0.74	1.18	2.01	**96.56**
	2.5% CI	0.34	2.29	6.22	16.34	2.37	1.24	2.37	2.68	3.33	0.28	0.66	1.13	**39.25**
	97.5% CI	1.12	5.41	25.20	48.07	22.87	11.99	18.76	12.95	10.48	1.29	1.77	3.13	**163.06**
Gannet	Mean	0.07	0.16	1.16	3.84	2.21	0.70	1.93	0.96	0.26	0.63	0.33	0.00	**12.25**
	2.5% CI	0.00	0.02	0.16	0.84	0.16	0.09	0.18	0.21	0.07	0.13	0.08	0.00	**1.94**
	97.5% CI	0.23	0.42	2.96	8.92	6.00	1.88	5.35	2.18	0.58	1.45	0.77	0.00	**30.74**
Herring gull	Mean	0.23	0.00	0.37	0.36	0.33	1.17	0.52	0.00	0.00	0.00	0.00	0.00	**2.97**
	2.5% CI	0.02	0.00	0.02	0.02	0.02	0.07	0.05	0.00	0.00	0.00	0.00	0.00	**0.19**
	97.5% CI	0.58	0.00	1.01	0.91	0.88	2.84	1.34	0.00	0.00	0.00	0.00	0.00	**7.56**
Great black-backed gull	Mean	0.33	0.00	0.47	0.00	0.16	0.12	0.00	0.23	1.23	0.37	1.25	0.57	**4.73**
	2.5% CI	0.08	0.00	0.02	0.00	0.01	0.01	0.00	0.02	0.45	0.03	0.18	0.20	**1.00**
	97.5% CI	0.65	0.00	1.29	0.00	0.44	0.29	0.00	0.61	2.21	0.87	2.68	1.05	**10.08**
Lesser black-backed gull	Mean	0.00	0.00	0.24	0.71	0.21	0.71	0.54	0.78	0.00	0.25	0.23	0.00	**3.66**
	2.5% CI	0.00	0.00	0.01	0.08	0.01	0.04	0.05	0.04	0.00	0.01	0.02	0.00	**0.26**
	97.5% CI	0.00	0.00	0.68	1.90	0.60	2.08	1.37	2.35	0.00	0.71	0.61	0.00	**10.31**
Sandwich tern	Mean	0.00	0.00	0.00	0.20	0.79	0.39	0.02	0.00	0.08	0.00	0.00	0.00	**1.49**
	2.5% CI	0.00	0.00	0.00	0.01	0.15	0.03	0.00	0.00	0.01	0.00	0.00	0.00	**0.20**
	97.5% CI	0.00	0.00	0.00	0.72	2.38	1.30	0.06	0.00	0.29	0.00	0.00	0.00	**4.74**

Gannet

12.3.2 The gannet collision rate for Band Option 2 estimated a mean of 12.25 annual collisions (Table 12.9). The monthly distribution of collision estimates for gannet are displayed in Figure 12.1, with the error bars displaying the upper and lower 95% CIs.

Table 12.9: Summary of annual gannet collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Gannet	12.25	1.94	30.74

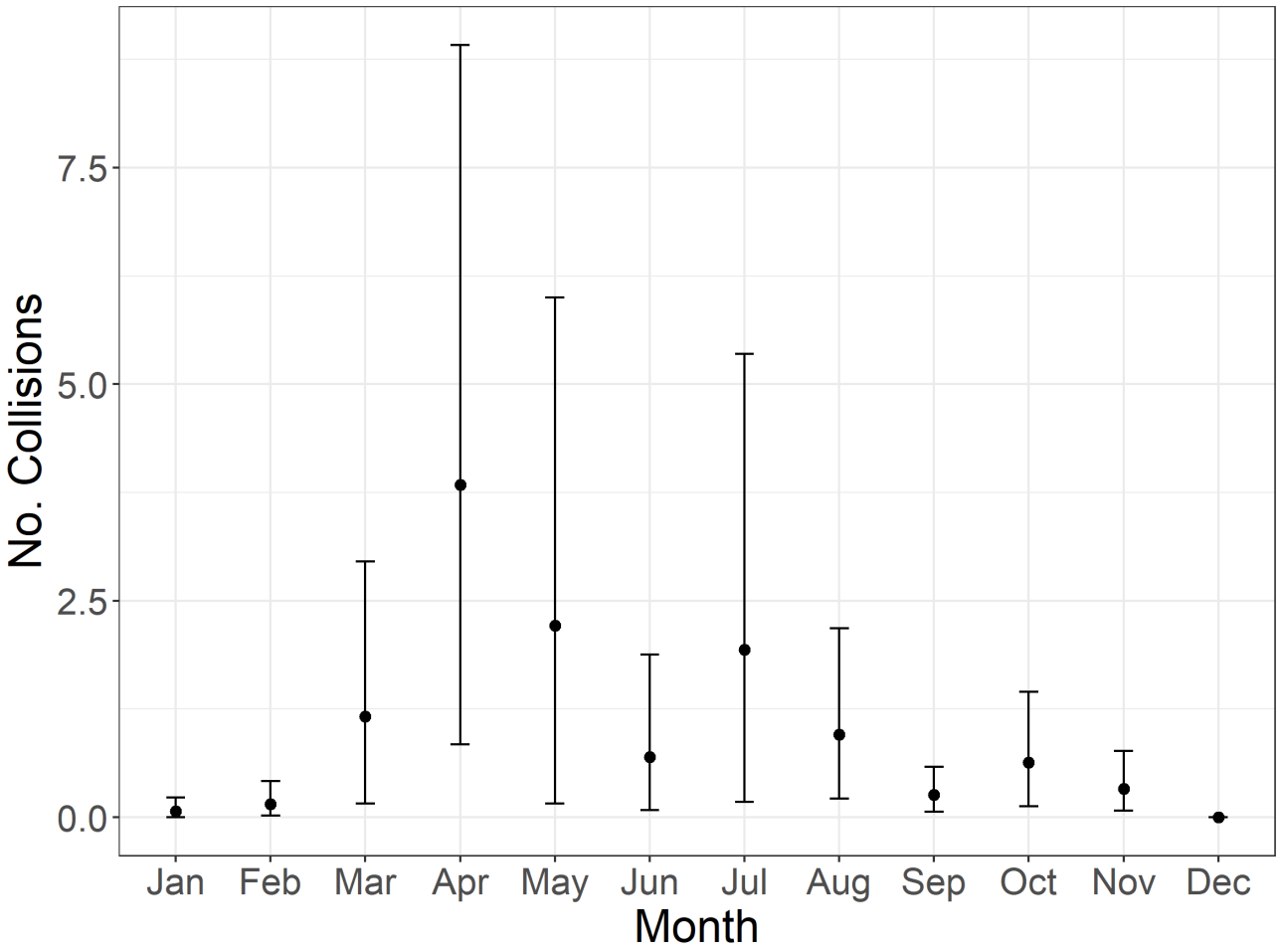

Figure 12.1: Mean monthly collisions predicted for northern gannet using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

Kittiwake

12.3.3 The kittiwake collision rate for Band Option 2 estimated a mean of 96.56 annual collisions (Table 12.10). The monthly distribution of collision estimates for kittiwake are displayed in Figure 12.2, with the error bars displaying the upper and lower 95% CIs.

Table 12.10: Summary of annual collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Kittiwake	96.56	39.25	163.06

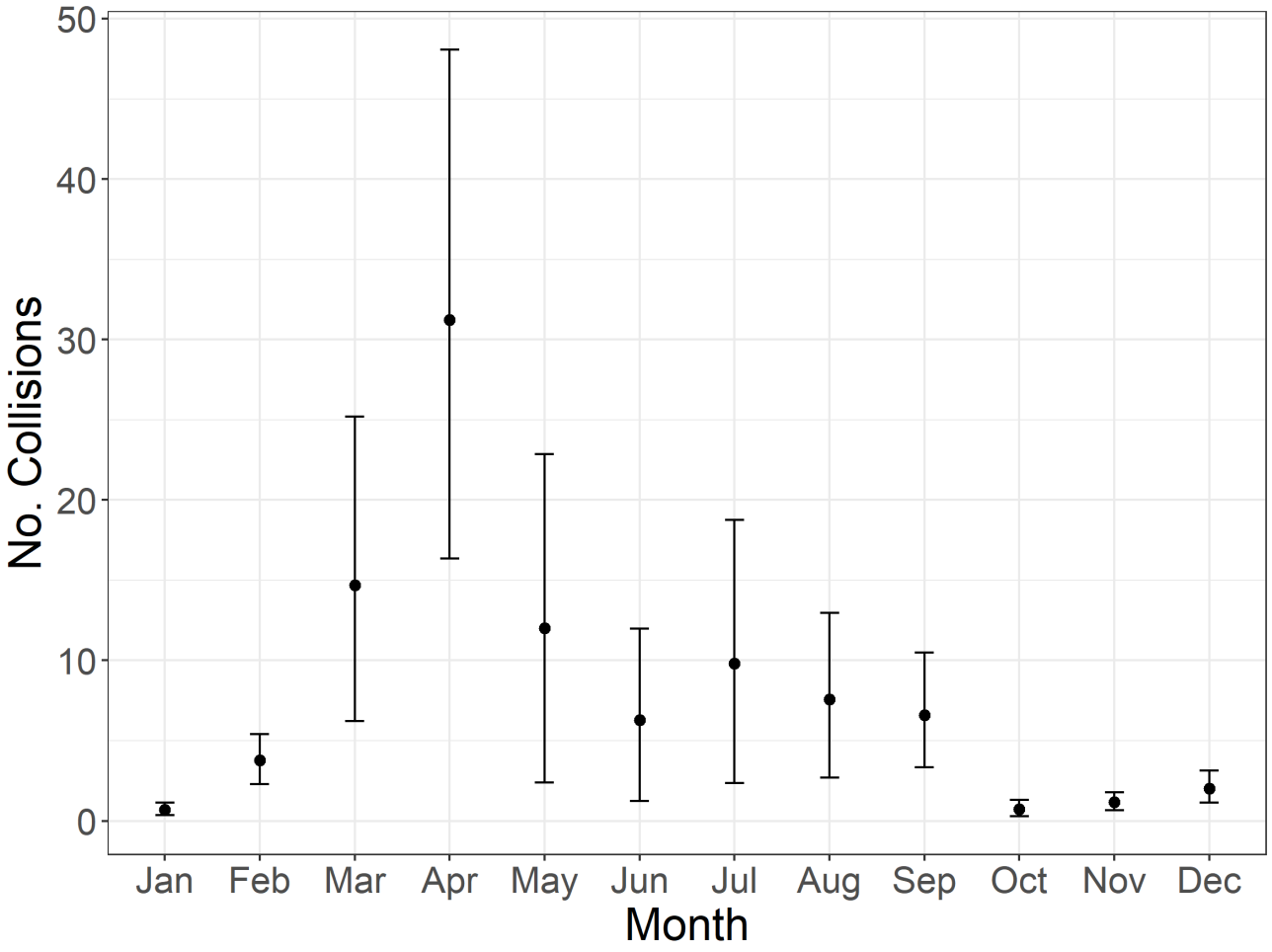

Figure 12.2: Mean monthly collisions predicted for black-legged kittiwake using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

Herring Gull

12.3.4 The herring gull collision rate for Band Option 2 estimated a mean of 2.97 annual collisions (Table 12.11). The monthly distribution of collision estimates for herring gull are displayed in Figure 12.3, with the error bars displaying the upper and lower 95% CIs.

Table 12.11: Summary of annual collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Herring gull	2.97	0.19	7.56

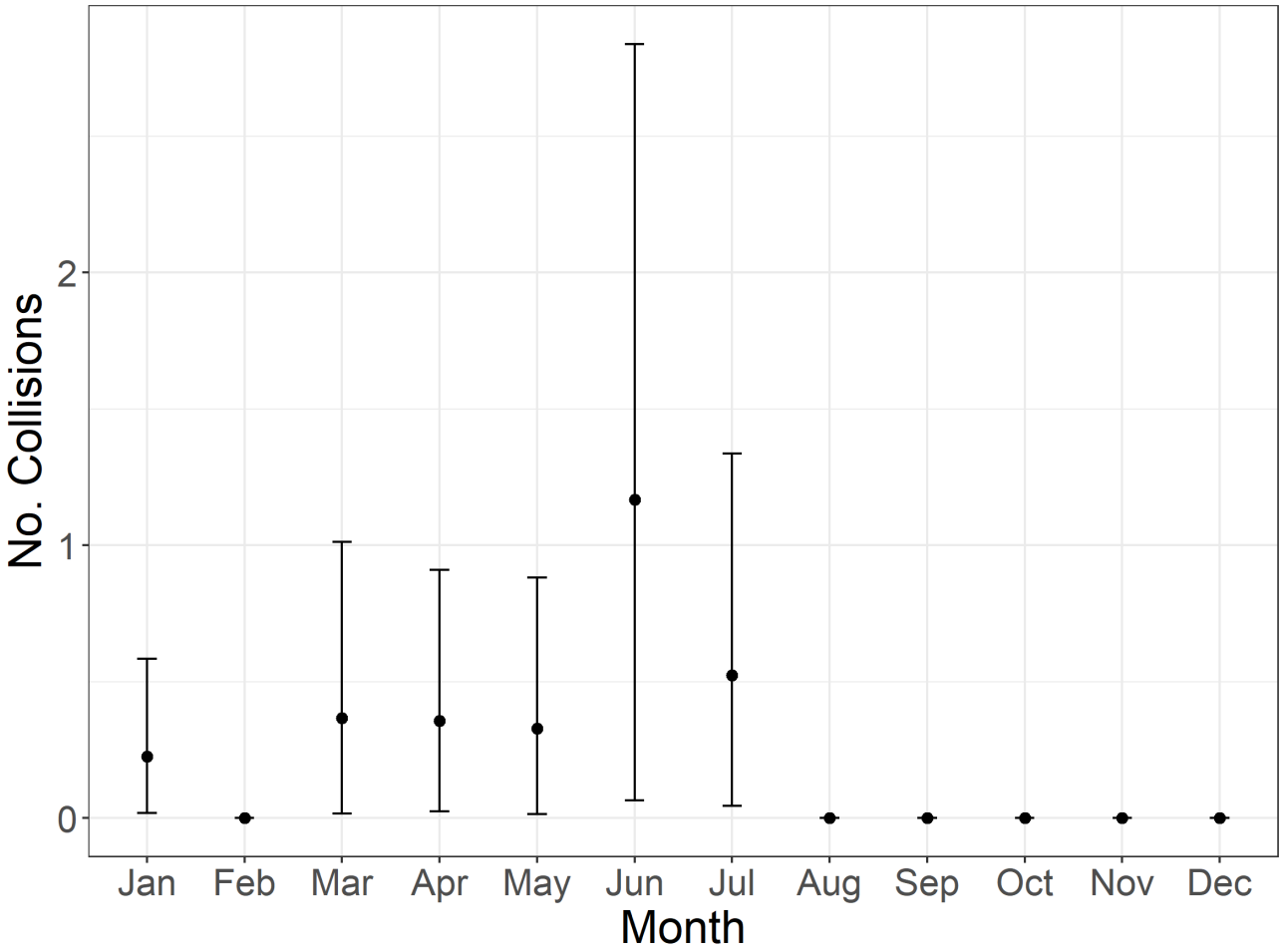

Figure 12.3: Mean monthly collisions predicted for herring gull using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

Greater Black-Backed Gull

12.3.5 The greater black-backed gull collision rate for Band Option 2 estimated a mean of 4.73 annual collisions (Table 12.12). The monthly distribution of collision estimates for greater black-backed gull are displayed in Figure 12.4, with the error bars displaying the upper and lower 95% CIs.

Table 12.12: Summary of annual collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Greater black-backed gull	4.73	1.00	10.08

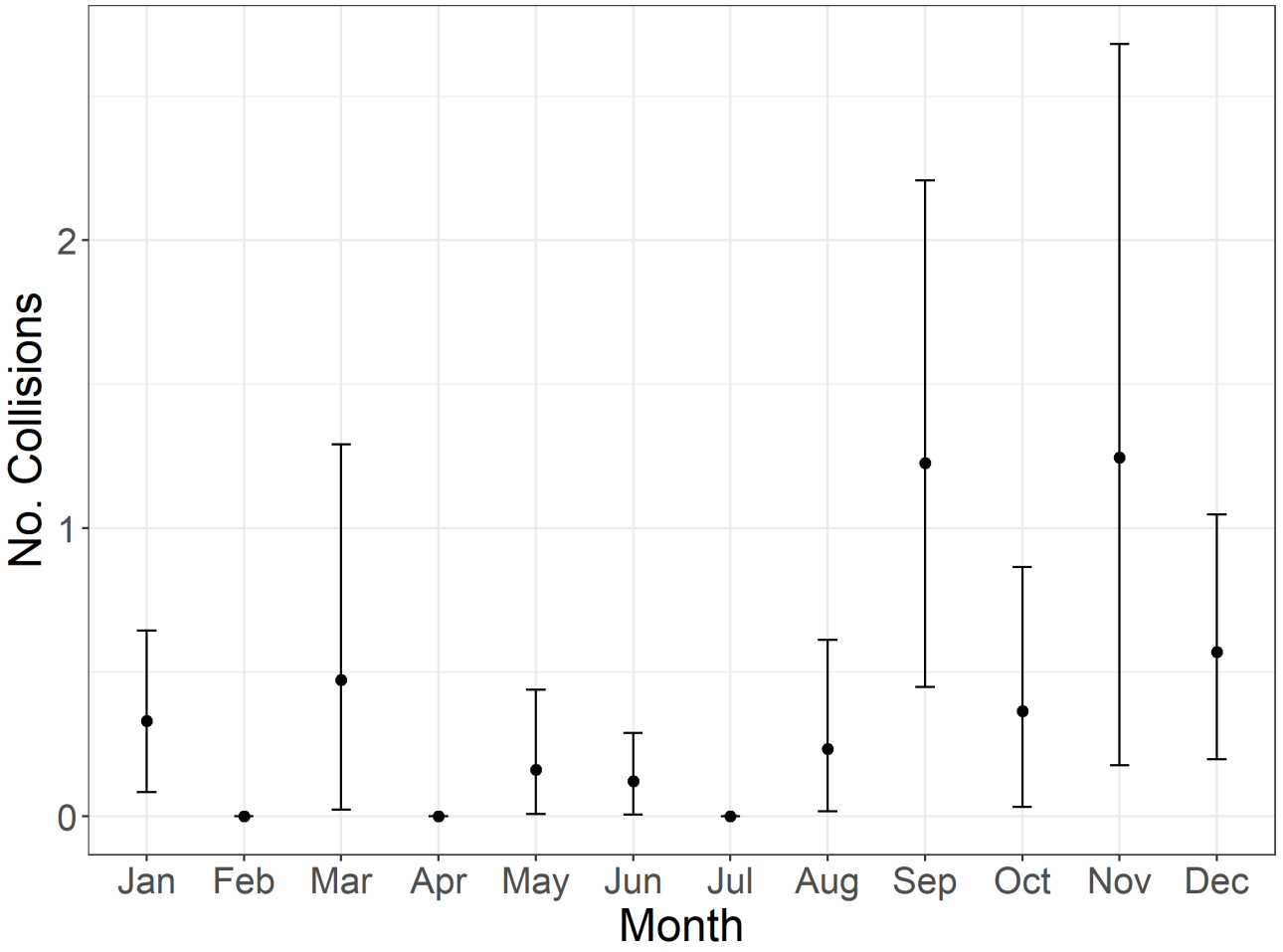

Figure 12.4: Mean monthly collisions predicted for greater black-backed gull using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

Lesser Black-Backed Gull

12.3.6 The lesser black-backed gull collision rate for Band Option 2 estimated a mean of 3.66 annual collisions (Table 12.13). The average monthly collision rates for the MDS are presented in Figure 12.5, with the error bars displaying the upper and lower 95% CIs.

Table 12.13: Summary of annual collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Lesser black-backed gull	3.66	0.26	10.31

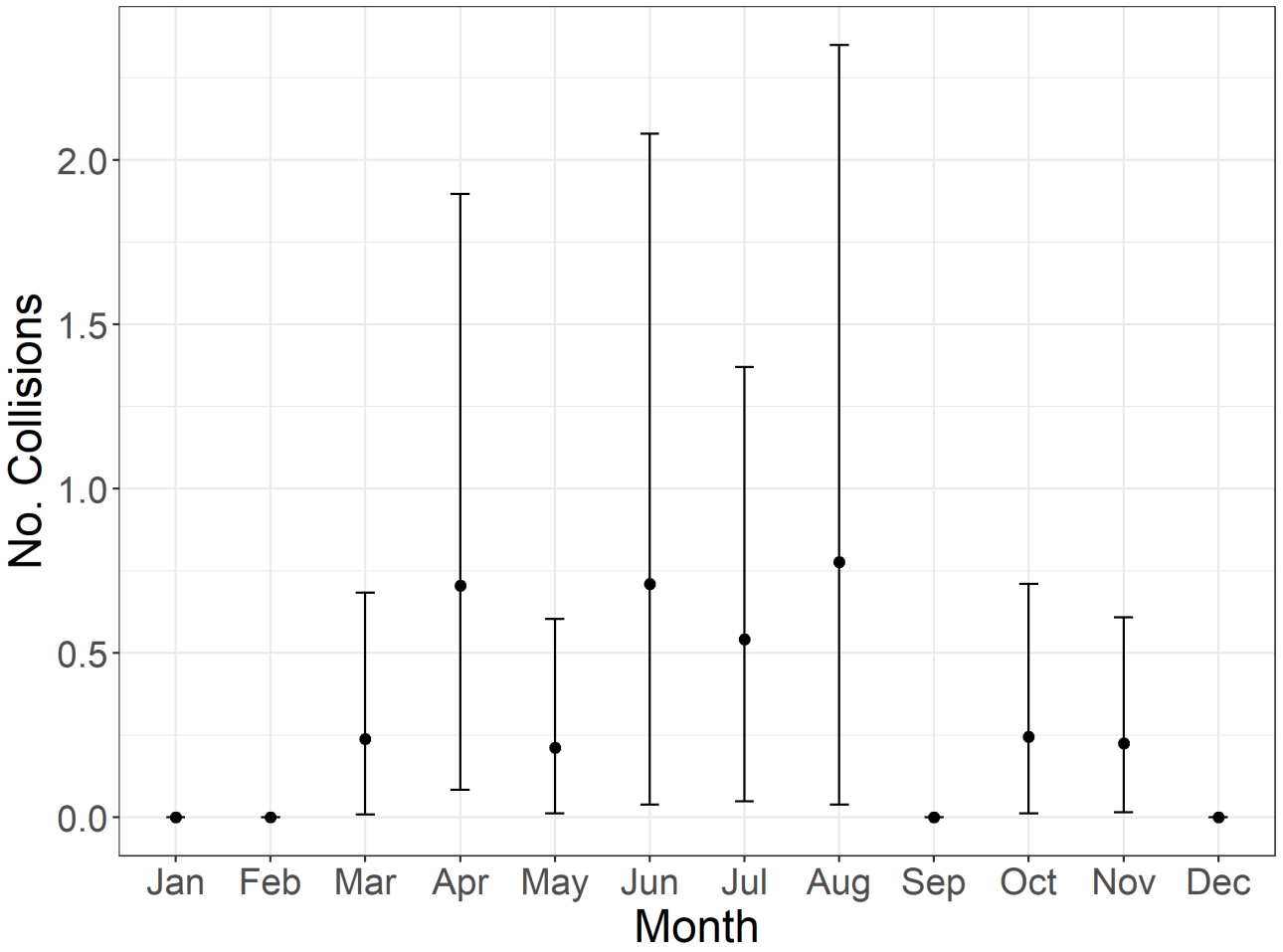

Figure 12.5: Mean monthly collisions predicted for lesser black-backed gull using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

Sandwich Tern

12.3.7 The sandwich tern collision rate for Band Option 2 estimated a mean of 1.49 annual collisions (Table 12.14). The monthly distribution of collision estimates for sandwich tern are displayed in Figure 12.6, with the error bars displaying the upper and lower 95% CIs.

Table 12.14: Summary of annual collisions following SNCB guidance for Option 2.

Species	Mean estimate	2.5% CI	97.5% CI
Sandwich tern	1.49	0.20	4.74

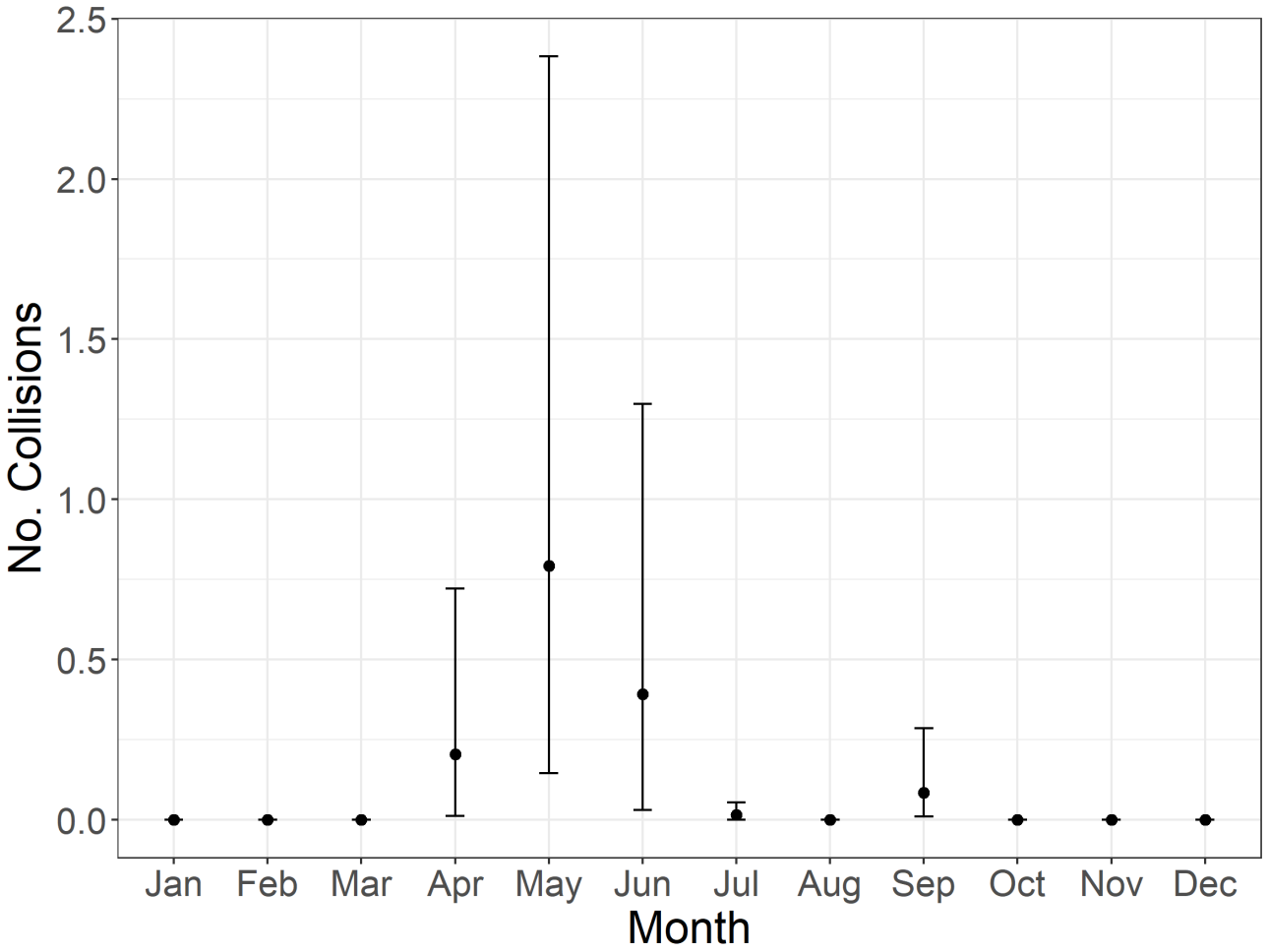

Figure 12.6: Mean monthly collisions predicted for sandwich tern using the project approach for Band Option 2. Error bars display the 2.5% and 97.5% confidence intervals of the monthly collisions.

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Annex A – Results from a Range of WTG Options

Introduction

12.4.1 This Annex provides the results of CRM for four different WTG options currently being considered by the Project. This presents the full range of impacts on collision risk species that the project may contribute. In addition, results for a minimum tip height of 30m and 40m relative to Mean Sea Level (MSL) each WTG option is presented to provide the full range of potential impacts. The same species parameters are used within the scenarios within this appendix as presented within the main Appendix.

Results

12.4.2 The monthly collision estimates using Natural England advocated parameters in Band Option 2 are presented for all eight scenarios in Table 12.16 to Table 12.23.

Table 12.15: WTG parameters for the four windfarm options currently being considered.

Parameter	WTG 1	WTG 2	WTG 3	WTG 4
No. WTGs	93	75	60	50
Rotor diameter (m)	242	265	300	340
Blade length (m)	118	129	146	166
Rated RPM	7.91	7.23	6.38	5.63
Rated RPM SD	0.39	0.36	0.32	0.28
No. Blades	3	3	3	3
Latitude (deg)	53.6	53.6	53.6	53.6
Windfarm width (km)	34.3	34.3	34.3	34.3
Max Chord (m)	7.5	8.5	8.5	9
Average Pitch (^{o})	6.5	6.5	6.5	6.5
Average Pitch SD	1.75	1.75	1.75	1.75
Min Tip Clearance HAT (m)	27.67	27.67	27.67	27.67
Hub height relative to HAT (m)	148.67	159.67	173.67	193.67
Tidal offset (HAT-MSL) (m)	2.33	2.33	2.33	2.33

Table 12.16: Summary of average monthly collisions by species based on WTG 1 scenario (30m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.69	3.78	14.67	31.22	12.01	6.27	9.81	7.56	6.58	0.74	1.18	2.01	**96.56**
	2.5% CI	0.34	2.29	6.22	16.34	2.37	1.24	2.37	2.68	3.33	0.28	0.66	1.13	**39.25**
	97.5% CI	1.12	5.41	25.20	48.07	22.87	11.99	18.76	12.95	10.48	1.29	1.77	3.13	**163.06**
Gannet	Mean	0.07	0.16	1.16	3.84	2.21	0.70	1.93	0.96	0.26	0.63	0.33	0.00	**12.25**
	2.5% CI	0.00	0.02	0.16	0.84	0.16	0.09	0.18	0.21	0.07	0.13	0.08	0.00	**1.94**
	97.5% CI	0.23	0.42	2.96	8.92	6.00	1.88	5.35	2.18	0.58	1.45	0.77	0.00	**30.74**
Herring gull	Mean	0.23	0.00	0.37	0.36	0.33	1.17	0.52	0.00	0.00	0.00	0.00	0.00	**2.97**
	2.5% CI	0.02	0.00	0.02	0.02	0.02	0.07	0.05	0.00	0.00	0.00	0.00	0.00	**0.19**
	97.5% CI	0.58	0.00	1.01	0.91	0.88	2.84	1.34	0.00	0.00	0.00	0.00	0.00	**7.56**
Great black-backed gull	Mean	0.33	0.00	0.47	0.00	0.16	0.12	0.00	0.23	1.23	0.37	1.25	0.57	**4.73**
	2.5% CI	0.08	0.00	0.02	0.00	0.01	0.01	0.00	0.02	0.45	0.03	0.18	0.20	**1.00**
	97.5% CI	0.65	0.00	1.29	0.00	0.44	0.29	0.00	0.61	2.21	0.87	2.68	1.05	**10.08**
Lesser black-backed gull	Mean	0.00	0.00	0.24	0.71	0.21	0.71	0.54	0.78	0.00	0.25	0.23	0.00	**3.66**
	2.5% CI	0.00	0.00	0.01	0.08	0.01	0.04	0.05	0.04	0.00	0.01	0.02	0.00	**0.26**
	97.5% CI	0.00	0.00	0.68	1.90	0.60	2.08	1.37	2.35	0.00	0.71	0.61	0.00	**10.31**
Sandwich tern	Mean	0.00	0.00	0.00	0.20	0.79	0.39	0.02	0.00	0.08	0.00	0.00	0.00	**1.49**
	2.5% CI	0.00	0.00	0.00	0.01	0.15	0.03	0.00	0.00	0.01	0.00	0.00	0.00	**0.20**
	97.5% CI	0.00	0.00	0.00	0.72	2.38	1.30	0.06	0.00	0.29	0.00	0.00	0.00	**4.74**

Table 12.17: Summary of average monthly collisions by species based on WTG 2 scenario (30m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.61	3.35	12.95	27.33	10.40	5.71	8.58	6.55	5.78	0.64	1.05	1.74	**84.70**
	2.5% CI	0.29	1.92	5.63	15.70	2.17	1.34	1.85	2.33	2.71	0.21	0.58	0.95	**35.69**
	97.5% CI	0.95	5.03	21.20	42.18	19.04	11.06	17.21	11.50	9.20	1.11	1.62	2.65	**142.76**
Gannet	Mean	0.06	0.13	0.98	3.33	1.91	0.61	1.60	0.81	0.23	0.54	0.28	0.00	**10.48**
	2.5% CI	0.00	0.02	0.13	0.73	0.14	0.11	0.15	0.19	0.05	0.12	0.07	0.00	**1.72**
	97.5% CI	0.19	0.34	2.48	7.58	5.41	1.56	4.73	1.89	0.51	1.33	0.66	0.00	**26.68**
Herring gull	Mean	0.20	0.00	0.33	0.32	0.33	1.03	0.47	0.00	0.00	0.00	0.00	0.00	**2.68**
	2.5% CI	0.02	0.00	0.01	0.02	0.02	0.07	0.04	0.00	0.00	0.00	0.00	0.00	**0.18**
	97.5% CI	0.51	0.00	0.87	0.80	0.87	2.65	1.20	0.00	0.00	0.00	0.00	0.00	**6.90**
Great black-backed gull	Mean	0.29	0.00	0.41	0.00	0.15	0.11	0.00	0.21	1.09	0.32	1.07	0.49	**4.14**
	2.5% CI	0.08	0.00	0.02	0.00	0.01	0.01	0.00	0.02	0.36	0.03	0.15	0.17	**0.84**
	97.5% CI	0.57	0.00	1.12	0.00	0.39	0.28	0.00	0.53	2.06	0.75	2.30	0.93	**8.92**
Lesser black-backed gull	Mean	0.00	0.00	0.21	0.63	0.19	0.61	0.48	0.69	0.00	0.22	0.20	0.00	**3.23**
	2.5% CI	0.00	0.00	0.01	0.06	0.01	0.03	0.06	0.04	0.00	0.01	0.01	0.00	**0.22**
	97.5% CI	0.00	0.00	0.61	1.65	0.57	1.66	1.19	1.92	0.00	0.61	0.55	0.00	**8.74**
Sandwich tern	Mean	0.00	0.00	0.00	0.16	0.69	0.34	0.01	0.00	0.07	0.00	0.00	0.00	**1.27**
	2.5% CI	0.00	0.00	0.00	0.01	0.12	0.02	0.00	0.00	0.01	0.00	0.00	0.00	**0.15**
	97.5% CI	0.00	0.00	0.00	0.56	2.08	1.11	0.05	0.00	0.21	0.00	0.00	0.00	**4.01**

Table 12.18: Summary of average monthly collisions by species based on WTG 3 scenario (30m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.51	2.72	10.43	21.86	8.34	4.61	7.21	5.31	4.71	0.52	0.84	1.43	**68.49**
	2.5% CI	0.26	1.57	4.62	11.83	1.75	0.95	1.34	1.80	2.40	0.18	0.48	0.81	**27.98**
	97.5% CI	0.81	3.95	17.22	32.92	15.97	9.16	14.07	9.49	7.79	0.93	1.32	2.27	**115.90**
Gannet	Mean	0.05	0.10	0.76	2.62	1.50	0.49	1.30	0.65	0.18	0.43	0.22	0.00	**8.29**
	2.5% CI	0.00	0.02	0.10	0.60	0.15	0.06	0.18	0.15	0.05	0.09	0.05	0.00	**1.45**
	97.5% CI	0.16	0.27	1.99	6.13	4.34	1.27	3.60	1.56	0.42	1.06	0.54	0.00	**21.33**
Herring gull	Mean	0.17	0.00	0.27	0.24	0.25	0.84	0.37	0.00	0.00	0.00	0.00	0.00	**2.13**
	2.5% CI	0.01	0.00	0.01	0.02	0.01	0.04	0.04	0.00	0.00	0.00	0.00	0.00	**0.13**
	97.5% CI	0.39	0.00	0.71	0.65	0.67	2.16	0.94	0.00	0.00	0.00	0.00	0.00	**5.51**
Great black-backed gull	Mean	0.23	0.00	0.33	0.00	0.11	0.09	0.00	0.16	0.85	0.25	0.83	0.41	**3.26**
	2.5% CI	0.07	0.00	0.02	0.00	0.00	0.01	0.00	0.01	0.29	0.02	0.11	0.15	**0.67**
	97.5% CI	0.43	0.00	0.90	0.00	0.32	0.20	0.00	0.39	1.51	0.59	1.79	0.75	**6.87**
Lesser black-backed gull	Mean	0.00	0.00	0.16	0.48	0.15	0.48	0.38	0.53	0.00	0.17	0.16	0.00	**2.50**
	2.5% CI	0.00	0.00	0.01	0.02	0.01	0.02	0.04	0.03	0.00	0.01	0.01	0.00	**0.18**
	97.5% CI	0.00	0.00	0.46	1.40	0.40	1.40	0.91	1.44	0.00	0.48	0.42	0.00	**6.64**
Sandwich tern	Mean	0.00	0.00	0.00	0.14	0.59	0.28	0.01	0.00	0.06	0.00	0.00	0.00	**1.07**
	2.5% CI	0.00	0.00	0.00	0.01	0.10	0.02	0.00	0.00	0.01	0.00	0.00	0.00	**0.13**
	97.5% CI	0.00	0.00	0.00	0.50	1.78	0.98	0.04	0.00	0.18	0.00	0.00	0.00	**3.48**

Table 12.19: Summary of average monthly collisions by species based on WTG 4 scenario (30m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.43	2.39	9.18	19.47	7.39	4.00	6.13	4.73	4.08	0.46	0.74	1.25	**60.23**
	2.5% CI	0.21	1.41	3.78	10.61	1.41	0.80	1.07	1.61	1.98	0.15	0.43	0.71	**24.15**
	97.5% CI	0.70	3.57	15.18	29.00	14.97	7.46	12.61	8.24	6.53	0.82	1.14	1.92	**101.12**
Gannet	Mean	0.04	0.09	0.69	2.33	1.31	0.43	1.15	0.57	0.16	0.38	0.19	0.00	**7.33**
	2.5% CI	0.00	0.01	0.10	0.53	0.10	0.06	0.14	0.13	0.04	0.09	0.05	0.00	**1.24**
	97.5% CI	0.13	0.25	1.81	5.27	3.78	1.13	3.35	1.29	0.37	0.96	0.46	0.00	**18.81**
Herring gull	Mean	0.14	0.00	0.23	0.21	0.20	0.72	0.33	0.00	0.00	0.00	0.00	0.00	**1.82**
	2.5% CI	0.01	0.00	0.01	0.01	0.01	0.04	0.03	0.00	0.00	0.00	0.00	0.00	**0.12**
	97.5% CI	0.32	0.00	0.61	0.57	0.55	1.75	0.85	0.00	0.00	0.00	0.00	0.00	**4.64**
Great black-backed gull	Mean	0.20	0.00	0.29	0.00	0.10	0.08	0.00	0.14	0.75	0.22	0.76	0.35	**2.88**
	2.5% CI	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.26	0.02	0.15	0.12	**0.62**
	97.5% CI	0.39	0.00	0.81	0.00	0.27	0.19	0.00	0.36	1.38	0.51	1.58	0.68	**6.17**
Lesser black-backed gull	Mean	0.00	0.00	0.14	0.43	0.13	0.41	0.33	0.46	0.00	0.15	0.14	0.00	**2.19**
	2.5% CI	0.00	0.00	0.01	0.03	0.01	0.03	0.04	0.02	0.00	0.01	0.01	0.00	**0.16**
	97.5% CI	0.00	0.00	0.43	1.08	0.38	1.12	0.80	1.33	0.00	0.45	0.40	0.00	**5.99**
Sandwich tern	Mean	0.00	0.00	0.00	0.13	0.53	0.25	0.01	0.00	0.05	0.00	0.00	0.00	**0.98**
	2.5% CI	0.00	0.00	0.00	0.01	0.10	0.01	0.00	0.00	0.01	0.00	0.00	0.00	**0.12**
	97.5% CI	0.00	0.00	0.00	0.46	1.60	0.84	0.04	0.00	0.17	0.00	0.00	0.00	**3.09**

Table 12.20: Summary of average monthly collisions by species based on WTG 1 scenario (40m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.27	1.48	5.62	12.05	4.60	2.51	3.93	2.94	2.54	0.29	0.46	0.79	**37.46**
	2.5% CI	0.13	0.86	2.46	6.34	0.94	0.52	0.75	0.99	1.15	0.11	0.23	0.40	**14.88**
	97.5% CI	0.47	2.32	9.58	20.05	9.22	5.16	7.94	5.64	4.33	0.53	0.74	1.29	**67.26**
Gannet	Mean	0.03	0.06	0.45	1.48	0.85	0.27	0.73	0.37	0.10	0.24	0.13	0.00	**4.70**
	2.5% CI	0.00	0.01	0.05	0.22	0.05	0.02	0.08	0.06	0.02	0.03	0.02	0.00	**0.55**
	97.5% CI	0.10	0.17	1.26	3.96	2.73	0.81	2.12	0.93	0.26	0.65	0.34	0.00	**13.31**
Herring gull	Mean	0.13	0.00	0.21	0.20	0.20	0.68	0.30	0.00	0.00	0.00	0.00	0.00	**1.73**
	2.5% CI	0.01	0.00	0.01	0.01	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	**0.10**
	97.5% CI	0.34	0.00	0.62	0.57	0.55	1.77	0.78	0.00	0.00	0.00	0.00	0.00	**4.62**
Great black-backed gull	Mean	0.20	0.00	0.28	0.00	0.09	0.07	0.00	0.14	0.72	0.21	0.71	0.33	**2.75**
	2.5% CI	0.05	0.00	0.02	0.00	0.01	0.01	0.00	0.01	0.25	0.02	0.11	0.12	**0.58**
	97.5% CI	0.38	0.00	0.73	0.00	0.27	0.19	0.00	0.35	1.39	0.50	1.59	0.63	**6.03**
Lesser black-backed gull	Mean	0.00	0.00	0.24	0.71	0.21	0.71	0.54	0.78	0.00	0.25	0.23	0.00	**3.66**
	2.5% CI	0.00	0.00	0.01	0.08	0.01	0.04	0.05	0.04	0.00	0.01	0.02	0.00	**0.26**
	97.5% CI	0.00	0.00	0.68	1.90	0.60	2.08	1.37	2.35	0.00	0.71	0.61	0.00	**10.31**
Sandwich tern	Mean	0.00	0.00	0.00	0.06	0.24	0.12	0.00	0.00	0.03	0.00	0.00	0.00	**0.45**
	2.5% CI	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**
	97.5% CI	0.00	0.00	0.00	0.24	0.90	0.44	0.02	0.00	0.10	0.00	0.00	0.00	**1.70**

Table 12.21: Summary of average monthly collisions by species based on WTG 2 scenario (40m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.24	1.29	4.93	10.54	3.98	2.11	3.33	2.52	2.20	0.25	0.40	0.68	**32.44**
	2.5% CI	0.11	0.68	2.14	5.41	0.66	0.35	0.66	0.93	1.01	0.09	0.21	0.33	**12.56**
	97.5% CI	0.40	2.04	8.70	17.39	8.28	4.16	7.10	4.81	3.73	0.45	0.65	1.11	**58.81**
Gannet	Mean	0.02	0.04	0.32	1.04	0.59	0.19	0.52	0.26	0.07	0.17	0.09	0.00	**3.31**
	2.5% CI	0.00	0.00	0.03	0.16	0.03	0.02	0.05	0.04	0.01	0.02	0.01	0.00	**0.37**
	97.5% CI	0.07	0.13	0.92	2.70	1.88	0.54	1.55	0.67	0.18	0.47	0.24	0.00	**9.35**
Herring gull	Mean	0.12	0.00	0.19	0.19	0.17	0.58	0.27	0.00	0.00	0.00	0.00	0.00	**1.52**
	2.5% CI	0.01	0.00	0.01	0.01	0.01	0.04	0.02	0.00	0.00	0.00	0.00	0.00	**0.10**
	97.5% CI	0.30	0.00	0.53	0.51	0.48	1.55	0.73	0.00	0.00	0.00	0.00	0.00	**4.09**
Great black-backed gull	Mean	0.18	0.00	0.25	0.00	0.09	0.07	0.00	0.12	0.64	0.19	0.64	0.30	**2.46**
	2.5% CI	0.05	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.22	0.02	0.09	0.10	**0.51**
	97.5% CI	0.34	0.00	0.67	0.00	0.24	0.16	0.00	0.31	1.22	0.46	1.44	0.60	**5.42**
Lesser black-backed gull	Mean	0.00	0.00	0.12	0.34	0.10	0.34	0.26	0.39	0.00	0.12	0.11	0.00	**1.77**
	2.5% CI	0.00	0.00	0.01	0.03	0.01	0.02	0.03	0.02	0.00	0.01	0.01	0.00	**0.12**
	97.5% CI	0.00	0.00	0.37	1.04	0.31	1.13	0.72	1.19	0.00	0.36	0.34	0.00	**5.46**
Sandwich tern	Mean	0.00	0.00	0.00	0.05	0.21	0.10	0.00	0.00	0.02	0.00	0.00	0.00	**0.40**
	2.5% CI	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**
	97.5% CI	0.00	0.00	0.00	0.22	0.72	0.44	0.02	0.00	0.08	0.00	0.00	0.00	**1.48**

Table 12.22: Summary of average monthly collisions by species based on WTG 3 scenario (40m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.19	1.05	4.01	8.61	3.27	1.72	2.74	2.03	1.80	0.20	0.33	0.55	**26.50**
	2.5% CI	0.09	0.55	1.57	4.17	0.48	0.33	0.62	0.60	0.82	0.07	0.17	0.29	**9.75**
	97.5% CI	0.33	1.66	6.93	13.84	6.73	3.57	5.70	3.83	3.06	0.37	0.53	0.91	**47.44**
Gannet	Mean	0.02	0.04	0.32	1.04	0.59	0.19	0.52	0.26	0.07	0.17	0.09	0.00	**3.31**
	2.5% CI	0.00	0.00	0.03	0.16	0.03	0.02	0.05	0.04	0.01	0.02	0.01	0.00	**0.37**
	97.5% CI	0.07	0.13	0.92	2.70	1.88	0.54	1.55	0.67	0.18	0.47	0.24	0.00	**9.35**
Herring gull	Mean	0.09	0.00	0.16	0.14	0.13	0.50	0.21	0.00	0.00	0.00	0.00	0.00	**1.24**
	2.5% CI	0.01	0.00	0.01	0.01	0.01	0.04	0.02	0.00	0.00	0.00	0.00	0.00	**0.09**
	97.5% CI	0.23	0.00	0.44	0.37	0.38	1.31	0.57	0.00	0.00	0.00	0.00	0.00	**3.29**
Great black-backed gull	Mean	0.14	0.00	0.21	0.00	0.07	0.05	0.00	0.10	0.51	0.15	0.51	0.24	**1.98**
	2.5% CI	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.16	0.01	0.10	0.08	**0.42**
	97.5% CI	0.29	0.00	0.57	0.00	0.19	0.13	0.00	0.25	1.00	0.36	1.07	0.45	**4.32**
Lesser black-backed gull	Mean	0.00	0.00	0.09	0.27	0.08	0.26	0.21	0.29	0.00	0.09	0.09	0.00	**1.37**
	2.5% CI	0.00	0.00	0.00	0.03	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.00	**0.09**
	97.5% CI	0.00	0.00	0.29	0.76	0.25	0.84	0.55	0.90	0.00	0.29	0.28	0.00	**4.15**
Sandwich tern	Mean	0.00	0.00	0.00	0.04	0.18	0.09	0.00	0.00	0.02	0.00	0.00	0.00	**0.33**
	2.5% CI	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**
	97.5% CI	0.00	0.00	0.00	0.18	0.62	0.37	0.01	0.00	0.07	0.00	0.00	0.00	**1.25**

Table 12.23: Summary of average monthly collisions by species based on WTG 4 scenario (40m minimum tip height).

Option 2	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kittiwake	Mean	0.17	0.92	3.50	7.42	2.86	1.47	2.34	1.80	1.56	0.18	0.28	0.47	**22.98**
	2.5% CI	0.08	0.49	1.45	3.93	0.54	0.27	0.47	0.63	0.71	0.05	0.14	0.24	**9.00**
	97.5% CI	0.28	1.46	6.11	12.06	5.91	2.93	4.82	3.57	2.69	0.32	0.45	0.78	**41.37**
Gannet	Mean	0.02	0.04	0.28	0.91	0.51	0.17	0.45	0.23	0.06	0.15	0.08	0.00	**2.88**
	2.5% CI	0.00	0.00	0.03	0.14	0.03	0.02	0.04	0.03	0.01	0.02	0.01	0.00	**0.34**
	97.5% CI	0.06	0.11	0.77	2.33	1.66	0.48	1.36	0.61	0.16	0.39	0.20	0.00	**8.13**
Herring gull	Mean	0.08	0.00	0.13	0.13	0.11	0.42	0.19	0.00	0.00	0.00	0.00	0.00	**1.06**
	2.5% CI	0.00	0.00	0.01	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	**0.06**
	97.5% CI	0.20	0.00	0.39	0.35	0.33	1.07	0.51	0.00	0.00	0.00	0.00	0.00	**2.86**
Great black-backed gull	Mean	0.13	0.00	0.17	0.00	0.06	0.04	0.00	0.09	0.44	0.13	0.44	0.21	**1.71**
	2.5% CI	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.14	0.01	0.07	0.07	**0.35**
	97.5% CI	0.26	0.00	0.48	0.00	0.17	0.11	0.00	0.22	0.84	0.31	1.03	0.40	**3.81**
Lesser black-backed gull	Mean	0.00	0.00	0.08	0.24	0.07	0.23	0.18	0.26	0.00	0.08	0.07	0.00	**1.21**
	2.5% CI	0.00	0.00	0.00	0.03	0.00	0.01	0.02	0.01	0.00	0.01	0.00	0.00	**0.08**
	97.5% CI	0.00	0.00	0.23	0.68	0.21	0.74	0.52	0.81	0.00	0.24	0.21	0.00	**3.63**
Sandwich tern	Mean	0.00	0.00	0.00	0.04	0.15	0.07	0.00	0.00	0.02	0.00	0.00	0.00	**0.28**
	2.5% CI	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**
	97.5% CI	0.00	0.00	0.00	0.14	0.52	0.30	0.01	0.00	0.06	0.00	0.00	0.00	**1.03**