LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

Volume 6: Appendix 22C – Marine Ornithology Collision Risk Modelling

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Prepared by: Llŷr Floating Wind Ltd

FLOVENTIS ENERGY

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Acronyms and abbreviations

Acronym or abbreviation	Definition	Unit	Definition
BDMPS	Biologically Defined Minimum Population Scales	SNCB	Statutory Nature Conservation Body
CRM	Collision Risk Model	SPA	Special Protection Area
DAS	Digital Aerial Survey	SSSI	Special Site of Scientific Interest
EIA	Environmental Impact Assessment	SSSP	Skomer, Skokholm and the Seas off Pembrokeshire
HRA	Habitats Regulation Assessment	%	Percentage
JNCC	Joint Nature Conservation Committee	km	Kilometre
Llŷr	Llŷr Offshore Wind Demonstration Project	m	Metre
NRW	Natural Resources Wales	m^2	Metre square
NRW (A)	Natural Resources Wales Advisory	ms-1	Metre per second
RIAA	Report to Inform Appropriate Assessment	MW	Megawatt
sCRM	Stochastic Collision Risk Model	rpm	Rotation per minute
SD	Standard Deviation		

Glossary of project terms

Term	Definition
The Applicant	The developer of the Project, Llŷr Floating Wind Limited
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located
Avoidance rate	A species-specific rate that quantifies active avoidance behaviour of seabirds in response to wind farms. It is calculated by comparing the number of birds that collide with turbines, corrected for imperfect detection, with the number of birds predicted to collide in the absence of any avoidance rate. A high avoidance rate (e.g. 0.99) represents high avoidance and thus low mortality rate.
BDMPS	'Biologically defined minimum population scales' are spatially distinct biogeographic populations of seabirds that are present in UK waters during the non-breeding period, as defined by Furness (2015).
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.

Term	Definition
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
proposed Project	All aspects of the Llŷr 1 development (i.e. the onshore and offshore components).
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.

Contents

22. Appendix 22C: Marine Ornithology Collision Risk Modelling 7
22.1 Introduction 7
22.2 Methods 8
22.2.1. Stochastic Collision Risk Model (sCRM) 8
22.2.2. Input Parameters 8
Turbine Scenarios 8
Turbine Operation 8
Seabird Parameters 8
Seabird Monthly Mean Densities 9
Model Options 9
Avoidance Rates 9
Seasons 10
22.3 Results 10
22.3.1. Kittiwake 11
22.3.2. Lesser Black-Backed Gull 12
22.3.3. Gannet 13
22.4 Summary of Collision Risk Impacts 14
22.4.4. Consideration of Collision Risk Impacts Against the 'Thresholds of Concern' 14
22.1 Annex A. Monthly Collision Risk Figures 15
22.5.1 Kittiwake 15
22.5.2 Lesser Black-Backed Gull 16
22.5.3 Gannet 17
22.5.4 Great Black-Backed Gull 18
22.6 Annex B. CRM Input / Output Logs 19
22.7 References 20

List of Tables

Table 22C-1. Turbine scenarios for collision risk modelling.....8
Table 22C-2. Biometric / behavioural input parameters for each species (standard deviation in brackets) 9
Table 22C-3. CRM avoidance rates (standard deviation) for each species modelled 10
Table 22C-4. Seasons used in analysis (adapted from Furness, 2015) 10
Table 22C-5. Kittiwake seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2.....11
Table 22C-6. Kittiwake seasonal collision mortalities (number of birds) each year as apportioned to Skomer, Skokholm and the seas off Pembrokeshire SPA 11
Table 22C-7. Lesser black-backed gull seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2.....12
Table 22C-8. Lesser black-backed gull seasonal collision mortalities (number of birds) each year as apportioned to Skomer, Skokholm and the seas off Pembrokeshire SPA.....12
Table 22C-9. Gannet seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2.....13
Table 22C-10. Gannet seasonal collision mortalities (number of birds) each year as apportioned to Grassholm SPA 13
Table 22C-11. 1% annual baseline mortality of relevant populations used as 'threshold of concern' 14
Table 22C-A1. Kittiwake monthly mean input flying bird densities for the array area 15
Table 22C-A2. Kittiwake sCRM model option 2 mortality estimates for the array area 15
Table 22C-A3. Lesser black-backed gull monthly mean input flying bird densities for the array area 16
Table 22C-A4. Lesser black-backed gull sCRM model option 2 mortality estimates for the array area 16
Table 22C-A5. Gannet monthly mean input flying bird densities for the array area (reduced to account for 70% macro-avoidance rate) 17
Table 22C-A6. Gannet sCRM model option 2 mortality estimates for the array area.....17
Table 22C-A7. Great black-backed gull monthly mean input flying bird densities for the array area .18
Table 22C-A8. Great black-backed gull sCRM model option 2 mortality estimates for the array area 18

22. APPENDIX 22C: MARINE ORNITHOLOGY COLLISION RISK MODELLING

22.1 Introduction

1. This **Appendix 22C: Marine Ornithology Collision Risk Modelling** provides a quantification of collision risk impact for key seabird species within the Llŷr 1 Floating Offshore Wind Farm (hereafter referred to as the proposed Project), for consideration in the **Environmental Statement (ES) Volume 3, Chapter 22 Marine Ornithology** and in **Appendix 8E: Habitats Regulations Assessment (HRA) Report to Inform Appropriate Assessment (RIAA)**.
2. **Chapter 22: Marine Ornithology** includes a summary of the statutory advice and pre-application liaison carried out with Natural Resources Wales Advisory (NRW (A)) and the Joint Nature Conservation Committee (JNCC) as well as the wider stakeholder liaison (including with the Royal Society for the Protection of Birds and the Wildlife Trusts) for this receptor group (**Table 22-4**, scoping and **Table 22-5**, pre-application consultation, as presented in **Chapter 22: Marine Ornithology**).
3. Furness *et al.* (2013) consider the sensitivity of key seabird species to collision with turbines, ranking them in order of species most at risk. These sensitivity rankings were used in conjunction with the abundance of species observed during digital aerial surveys (DAS) to identify the species of concern at the proposed Project with regards to collision risk. These species are:
    - black-legged kittiwake (*Rissa tridactyla*), hereafter 'kittiwake';
    - lesser black-backed gull (*Larus fuscus*); and
    - northern gannet (*Morus bassanus*), hereafter 'gannet'.
4. At the request of NRW (A) it was agreed that collision mortality estimates would also be presented for two other species: great black-backed gull (*Larus marinus*) and herring gull (*Larus argentatus*) (**Chapter 22: Marine Ornithology, Table 22-5**). With subsequent project revisions, there are no longer any observations of herring gull within the Array Area and so this species is not considered further. However, great black-backed gull were recorded in low numbers and are therefore still included (**Appendix 22A: Marine Ornithology Baseline**).
5. Collision risk modelling (CRM) provides a consistent and quantitative method for estimating the risk that a bird entering the 'risk window', the sweep of the turbine blades, could be struck. The calculation within CRM assumes that birds do not take avoiding action, and instead, this is factored in by subsequently applying an agreed avoidance rate. The avoidance rate takes into account action birds will take to avoid being struck, whether this is avoiding the wind farm completely (macro-avoidance) or altering their flight path in proximity to the turbine blades (meso- and micro-avoidance).
6. This **Appendix 22C: Marine Ornithology Collision Risk Modelling** presents the collision risk modelling – methods, input parameters, assumptions adopted and outputs – for the three focal species – kittiwake, lesser black-backed gull and gannet – as well as great black-backed gull for information. Seasonal CRM outputs are presented for these three focal species **Section 22.3** with the underpinning monthly collision estimates (including those for great black-backed gull) provided in **Appendix 22C: Annex A - Monthly Collision Risk Figures..**
7. **Section 22.3** also presents the apportioning of impacts against the focal breeding colonies of concern in assessment; Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro (SSSP) Special Protection Area (SPA) for kittiwake and lesser black-backed gull, and Grassholm SPA for gannet.

22.2 Methods

22.2.1. Stochastic Collision Risk Model (sCRM)

8. As per the NRW (A) advice note dated 05 April 2023, the original sCRM shiny app has been used for the modelling presented in this **Appendix 22C: Marine Ornithology Collision Risk Modelling**. The sCRM (McGregor *et al.*, 2018) builds on the previous Band model (2012) for offshore wind farms and incorporates a measure of uncertainty and variability within the input parameters. It estimates the risk of birds entering the proposed wind farm site and colliding with the turbine blades.

22.2.2. Input Parameters

9. The turbine scenario and turbine operation parameters are those provided by the Applicant, while the seabird biometric information, sCRM model choice and associated input parameters are those advised by NRW (A) in their note of 17 February 2023. Input densities for each species recorded during DAS work are taken from **Appendix 22A: Marine Ornithology Baseline** as discussed in more detail below.

Turbine Scenarios

10. The Applicant has provided two scenarios for modelling: a seven turbine (7x20 MW) and a ten turbine (10x20 MW) scenario. The same parameters are being modelled for each scenario with just the number of turbines changing as presented in **Table 22C-1**.

Table 22C-1. Turbine scenarios for collision risk modelling

Parameter	Measurement
Latitude (degrees)	51.338
Windfarm width (km)	7.5 (east-west)
Tidal offset (m)	NA
No. turbines	7 or 10
No. blades	3
Rotor radius (m)	142.5
Air gap (m)	22
Max. blade width (m)	7
Rotation speed (rpm)	8
Pitch (degrees)	5
Rotor swept area (7X20 MW) (m^2)	446,557.8
Rotor swept area (10X20 MW) (m^2)	637,939.7

Turbine Operation

11. Although turbines are not operational 100% of the time, this has been used for the purposes of obtaining a worst-case scenario estimate. Similarly, the turbine downtime due to maintenance activities (either scheduled or unscheduled), has been modelled as zero to provide a worst-case estimate.

Seabird Parameters

12. The seabird parameters presented in **Table 22C-2** are those advised by NRW (A) in their note dated 17 February 2023 (Table 3 of that note), based on Pennycuick (1997); Alerstam *et al.* (2007) and Furness *et al.* (2018). Flight speed was recorded via tracking data at Grassholm SPA

and reported in Langlay and Votier (2021). The resulting flight speed of this study was modelled for information only and was not brought forward for assessment.

Table 22C-2. Biometric / behavioural input parameters for each species (standard deviation in brackets)

Species	Body length (m)	Wingspan (m)	Flight speed (ms-1)	Nocturnal activity	Flight type
Kittiwake	0.39 (0.005)	1.08 (0.0625)	13.1 (0.4)	0.375 (0.0637)	Flapping
Lesser black-backed gull	0.58 (0.03)	1.42 (0.0375)	13.1 (1.9)	0.375 (0.0637)	Flapping
Gannet	0.94 (0.0325)	1.72 (0.0375)	14.9 (0) *13.1 (0)**	0.08 (0.1)	Gliding
Great black-backed gull	0.71 (0.035)	1.58 (0.0375)	13.7 (1.2)	0.375 (0.0637)	Flapping

**13.1 ms^{-1} is also modelled for information, as derived from Grassholm tracking data (Langley and Votier, 2021)*

Seabird Monthly Mean Densities

13. The sCRM requires monthly mean densities of flying seabirds within the Array Area as an input parameter. The densities are calculated as the monthly means across the two years of survey work. **Appendix 22C: Annex A – Monthly Collision Risk Figures** presents the values used in assessment for each species. The estimates include a measure of uncertainty, the standard deviation (SD), which is input into the model. The values presented in **Appendix 22C: Annex A – Monthly Collision Risk Figures** are calculated from the full list of monthly densities and SDs for each species given in **Appendix 22A: Marine Ornithology Baseline.**

14. It is noted that the density of flying gannets was reduced by 70% before being input into the sCRM to account for macro-avoidance, following NRW (A) advice in their note dated 17 February 2023.

Model Options

15. Option 2 of the sCRM model has been used for assessment which adopts the generic flight height distributions that are given in Johnston *et al.* (2014a; 2014b).

Avoidance Rates

16. The avoidance rates used in the sCRM for each species are presented in **Table 22C-3** below, and taken from Table 3 of the NRW (A) advice note dated 17 February 2023, derived from Ozsanlev-Harris *et al*. (2023). For sCRM, variance around the choice of avoidance rate is captured by the model and reported in the measure of the SD (as given in brackets in **Table 22C-3**).

Table 22C-3. CRM avoidance rates (standard deviation) for each species modelled

Species	Option 2
Kittiwake	0.993 (0.0003)
Lesser black-backed gull	0.994 (0.0004)
Gannet	0.993 (0.0003)
Great black-backed gull	0.994 (0.0004)

Seasons

17. The sCRM realistic worst-case mortality estimates were calculated per season. Seasonal definitions were agreed during pre-application consultation with NRW (A) and JNCC and are based on Furness (2015) (**Table 22C-4**). The full UK breeding season was used, with the non-breeding seasons (Biologically Defined Minimum Population Scale, 'BDMPS'; Furness, 2015) adjusted accordingly to avoid overlapping months with the breeding seasons.

Table 22C-4. Seasons used in analysis (adapted from Furness, 2015)

Species	UK breeding season	Adjusted BDMPS		
		Autumn migration	Non-breeding	Spring migration
Kittiwake	Mar – Aug	Sep – Dec	-	Jan – Feb
Lesser black-backed gull	Apr – Aug	Sep – Oct	Nov – Feb	Mar
Gannet	Mar – Sep	Oct – Nov	-	Dec – Feb
Great black-backed gull	Mar – Aug	-	Sep – Feb	-

18. Seasonal SDs are calculated by squaring the monthly estimates of SD (as presented in **Appendix 22C: Annex A – Monthly Collision Risk Figures** for each species) to obtain the variance, summing these variances together and then taking the square root of the summed total.

22.3 Results

19. For all species, seasonal collision mortalities using sCRM are presented for the two modelled turbine scenarios (7x20 MW and 10x20 MW) (**Table 22C-5**, **Table 22C-7** and **Table 22C-9**).

20. The sCRM data are presented as seasonal totals (the sum of the monthly mortality estimates) with the associated SD. This provides an indication of the uncertainty around the estimates and can be used for any population modelling required. Full monthly collision risk outputs are presented in **Appendix 22C: Annex A – Monthly Collision Risk Figures** for each turbine scenario and model option.

21. Apportioning of impacts against the focal breeding colonies of concern in assessment; the SSSP SPA for kittiwake and lesser black-backed gull, and Grassholm SPA for gannet is provided in **Table 22C-6**, **Table 22C-8** and **Table 22C-10**.

22. **Appendix 22C: Annex A – Monthly Collision Risk Figures** also includes the collision mortality estimates for great black-backed gull (**Table 22C-A7** and **Table 22C-A8**) using design-based density inputs, as requested by NRW (A).

23. All input and output logs for this sCRM are provided separately as **Appendix 22C: Annex B - CRM Input / Output Logs**.

22.3.1. Kittiwake

Table 22C-5. Kittiwake seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2

Kittiwake collision mortalities	Migration-free breeding season	BDMPS Autumn migration	Non-breeding	Spring migration	Annual total
	Mar – Aug	Sep – Dec	NA	Jan – Feb	
7 turbines					
Seasonal mortality	0.8	14.5	N/A	1.5	16.7
SD	0.2	1.9	N/A	0.3	2.6
10 turbines					
Seasonal mortality	1.1	20.6	N/A	2.1	23.9
SD	0.3	2.8	N/A	0.4	3.8

Table 22C-6. Kittiwake seasonal collision mortalities (number of birds) each year as apportioned to Skomer, Skokholm and the seas off Pembrokeshire SPA

Kittiwake apportioned collision mortalities	Migration-free breeding season	BDMPS Autumn migration	Non-breeding	Spring migration	Annual total
	Mar - Aug	Sep - Dec	NA	Jan - Feb	
7 turbines					
Total mortality	0.8	14.5	N/A	1.5	16.7
Apportioning weighting	0.636	0.001	N/A	0.002	N/A
SPA apportioned mortality	0.509	0.015	N/A	0.003	0.5
10 turbines					
Seasonal mortality	1.1	20.6	N/A	2.1	23.9
Apportioning weighting	0.636	0.001	N/A	0.002	N/A
SPA apportioned mortality	0.700	0.021	N/A	0.004	0.7

22.3.2. *Lesser Black-Backed Gull*

Table 22C-7. Lesser black-backed gull seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2

Lesser black-backed gull collision mortalities	Migration-free breeding season	BDMPS			
		Autumn migration	Non-breeding	Spring migration	
	Apr - Aug	Sep - Oct	Nov - Feb	Mar	Annual total
7 turbines					
Seasonal mortality	0.8	0.2	0.2	0.3	1.3
SD	0.2	0.1	0.1	0.1	0.4
10 turbines					
Seasonal mortality	1.1	0.2	0.2	0.4	1.9
SD	0.2	0.1	0.1	0.2	0.6

Table 22C-8. Lesser black-backed gull seasonal collision mortalities (number of birds) each year as apportioned to Skomer, Skokholm and the seas off Pembrokeshire SPA

Lesser black-backed gull apportioned collision mortalities	Migration-free breeding season	BDMPS			
		Autumn migration	Non-breeding	Spring migration	
	Apr - Aug	Sep - Oct	Nov - Feb	Mar	Annual total
7 turbines					
Total mortality	0.8	0.2	0.2	0.3	1.3
Apportioning weighting	0.951	0.083	0.094	0.083	NA
SPA apportioned mortality	0.761	0.017	0.019	0.025	0.8
10 turbines					
Seasonal mortality	1.1	0.2	0.2	0.4	1.9
Apportioning weighting	0.951	0.083	0.094	0.083	NA
SPA apportioned mortality	1.046	0.017	0.019	0.033	1.1

22.3.3. *Gannet*

Table 22C-9. Gannet seasonal collision mortalities (number of birds) each year and associated SD for the array area using sCRM option 2

Gannet collision mortalities	Migration-free breeding season	BDMPS			
		Autumn migration	Non-breeding	Spring migration	
	Mar - Sep	Oct - Nov	NA	Dec - Feb	Annual total
7 turbines					
Seasonal mortality	2.1	0.3	N/A	0.2	2.7
SD	0.5	0.2	N/A	0.1	1.0
7 turbines (Grassholm flight speed, for information)					
Seasonal mortality	*2.0*	*0.3*	*N/A*	*0.2*	*2.5*
SD	*0.4*	*0.2*	*N/A*	*0.1*	*1.0*
10 turbines					
Seasonal mortality	3.0	0.5	N/A	0.3	3.7
SD	0.6	0.3	N/A	0.1	1.5
10 turbines (Grassholm flight speed, for information)					
Seasonal mortality	*2.8*	*0.4*	*N/A*	*0.3*	*3.5*
SD	*0.6*	*0.2*	*N/A*	*0.1*	*1.4*

Table 22C-10. Gannet seasonal collision mortalities (number of birds) each year as apportioned to Grassholm SPA

Gannet apportioned collision mortalities	Migration-free breeding season	BDMPS			
		Autumn migration	Non-breeding	Spring migration	
	Mar - Sep	Oct - Nov	NA	Dec - Feb	Annual total
7 turbines					
Total mortality	2.1	0.3	N/A	0.2	2.7
Apportioning weighting	0.969	0.144	N/A	0.119	NA
SPA apportioned mortality	2.035	0.043	N/A	0.024	2.1
10 turbines					
Seasonal mortality	3.0	0.5	N/A	0.3	3.7
Apportioning weighting	0.969	0.144	N/A	0.119	NA
SPA apportioned mortality	2.907	0.072	N/A	0.036	3.0

22.4 Summary of Collision Risk Impacts

24. When comparing the results for each of the seven and ten turbine scenarios, the number of estimated collisions are higher for the latter scenario (which is unsurprising given that all other parameters are the same).

22.4.4. Consideration of Collision Risk Impacts Against the 'Thresholds of Concern'.

25. **Table 22C-11** gives the 'threshold of concern' for whether or not the population consequence of a predicted impact will require further investigation via population modelling. It can be clearly seen from this that all predicted collision mortality estimates for the proposed Project alone are well below these thresholds. It will only be gannet which may need further consideration in respect of the combined impacts of collision risk and displacement. This matter is addressed in **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios**.

Table 22C-11. 1% annual baseline mortality of relevant populations used as 'threshold of concern'

Species	EIA[1]	SSSP SPA	Grassholm SPA
Kittiwake	1,331	4	N/A
Gannet	536	N/A	58
Lesser black-backed gull	277	19	N/A

[1] *These EIA thresholds are based on adult mortality rather than that across all age-classes. This has been done for simplicity as the adult mortality threshold is more stringent than the one that would be derived from mortality across all age-classes. If predicted mortalities do not exceed the former, more stringent threshold then they will not be exceeding the all age-class one either.*

22.1 Annex A. Monthly Collision Risk Figures

Table 22C-A1 to **Table 22C-A8** provide the monthly mean input densities and collision risk outputs for each species, model option and turbine scenario.

22.5.1 Kittiwake

Table 22C-A1. Kittiwake monthly mean input flying bird densities for the array area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.947	0.279	0.446	0.000	0.000	0.023	0.011	0.056	0.022	6.147	4.677	0.590
SD	0.182	0.120	0.110	0.000	0.000	0.017	0.009	0.031	0.011	0.792	0.747	0.220

Table 22C-A2. Kittiwake sCRM model option 2 mortality estimates for the array area

Turbine scenario		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7 turbines	Mean	1.150	0.323	0.611	0.000	0.000	0.040	0.021	0.090	0.032	8.135	5.628	0.704
7 turbines	SD	0.277	0.137	0.168	0.000	0.000	0.023	0.013	0.046	0.015	1.487	1.133	0.281
10 turbines	Mean	1.635	0.473	0.877	0.000	0.000	0.060	0.030	0.128	0.045	11.621	7.980	1.003
10 turbines	SD	0.390	0.204	0.242	0.000	0.000	0.034	0.018	0.064	0.022	2.191	1.661	0.391

22.5.2 Lesser Black-Backed Gull

Table 22C-A3. Lesser black-backed gull monthly mean input flying bird densities for the array area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.011	0.045	0.090	0.056	0.078	0.067	0.022	0.011	0.000	0.056	0.000	0.011
SD	0.007	0.018	0.032	0.023	0.029	0.021	0.009	0.012	0.000	0.019	0.000	0.010

Table 22C-A4. Lesser black-backed gull sCRM model option 2 mortality estimates for the array area

Turbine scenario		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7 turbines	Mean	0.030	0.109	0.255	0.167	0.256	0.217	0.071	0.046	0.000	0.153	0.000	0.032
7 turbines	SD	0.018	0.051	0.111	0.083	0.114	0.089	0.036	0.032	0.000	0.063	0.000	0.022
10 turbines	Mean	0.041	0.152	0.364	0.239	0.363	0.307	0.105	0.065	0.000	0.217	0.000	0.047
10 turbines	SD	0.023	0.075	0.171	0.116	0.166	0.127	0.051	0.044	0.000	0.094	0.000	0.032

22.5.3 Gannet

Table 22C-A5. Gannet monthly mean input flying bird densities for the array area (reduced to account for 70% macro-avoidance rate)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.014	0.164	0.191	0.204	0.104	0.107	0.184	0.351	0.127	0.247	0.017	0.000
SD	0.006	0.061	0.034	0.077	0.080	0.037	0.080	0.101	0.064	0.095	0.008	0.000

Table 22C-A6. Gannet sCRM model option 2 mortality estimates for the array area

Turbine scenario		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7 turbines*	Mean	0.015	0.181	0.268	0.323	0.223	0.195	0.344	0.588	0.184	0.323	0.019	0.000
7 turbines*	SD	0.009	0.099	0.112	0.178	0.157	0.100	0.194	0.272	0.114	0.181	0.011	0.000
7 turbines †	*Mean*	*0.014*	*0.170*	*0.245*	*0.295*	*0.198*	*0.179*	*0.313*	*0.545*	*0.175*	*0.302*	*0.017*	*0.000*
7 turbines †	*SD*	*0.008*	*0.092*	*0.104*	*0.162*	*0.141*	*0.091*	*0.182*	*0.266*	*0.108*	*0.163*	*0.01*	*0.000*
10 turbines*	Mean	0.020	0.248	0.379	0.446	0.294	0.268	0.483	0.826	0.266	0.461	0.026	0.000
10 turbines*	SD	0.013	0.137	0.159	0.245	0.218	0.141	0.274	0.398	0.164	0.259	0.016	0.000
10 turbines †	*Mean*	*0.020*	*0.232*	*0.349*	*0.412*	*0.280*	*0.258*	*0.445*	*0.774*	*0.241*	*0.413*	*0.025*	*0.000*
10 turbines †	*SD*	*0.012*	*0.129*	*0.147*	*0.215*	*0.197*	*0.137*	*0.264*	*0.381*	*0.149*	*0.226*	*0.016*	*0.000*

** Using 14.9 ms-1 flight speed provided in sCRM (McGregor et al., 2018) – these figures are taken forward into the assessment.*

† Using 13.1 ms-1 flight speed derived from Grassholm tracking data (Langley and Votier, 2021) – these figures are provided for information and context.

22.5.4 Great Black-Backed Gull

Table 22C-A7. Great black-backed gull monthly mean input flying bird densities for the array area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	0.000	0.000	0.000	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.090	0.090
SD	0.000	0.000	0.000	0.089	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.067

Table 22C-A8. Great black-backed gull sCRM model option 2 mortality estimates for the array area

Turbine scenario		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7 turbines	Mean	0.000	0.000	0.000	0.484	0.000	0.000	0.000	0.000	0.000	0.000	0.346	0.334
7 turbines	SD	0.000	0.000	0.000	0.311	0.000	0.000	0.000	0.000	0.000	0.000	0.198	0.202
10 turbines	Mean	0.000	0.000	0.000	0.653	0.000	0.000	0.000	0.000	0.000	0.000	0.482	0.478
10 turbines	SD	0.000	0.000	0.000	0.422	0.000	0.000	0.000	0.000	0.000	0.000	0.287	0.272

22.6 ANNEX B. CRM INPUT / OUTPUT LOGS

Annex provided as a separate document.

22.7 References

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