



codling
wind park



Environmental Impact Assessment Report

Volume 4

Appendix 10.7 Collision Risk
Modelling of Kittiwake





IE200091 Codling Collision Risk Modelling of Kittiwake

21 March 2024

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Document history

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Issue	Date	Revision Details
A	10 January 2024	First issue to client
B	2 February 2024	Second issue to client
C	21 March 2024	Final for issue

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1. Background

Stochastic Collision Risk Models (sCRM) have been previously conducted for two design scenarios of Codling Offshore windfarm. In previously presented results (Appendix 10.3), kittiwake models had been parameterized using a mean flight speed of 13.1 m/s (with a standard deviation of 0.4). This Appendix has been drafted following feedback received from National Parks and Wildlife Service (NPWS) feedback with regards the use of alternative flight speeds for kittiwake. The document therefore parameterizes the models for kittiwake only, with a flight speed of 8.71 m/s (with a standard deviation of 3.16), rather than the mean flight speed of 13.1 m/s. This flight speed value originates from Skov *et al.*, 2018.

2. Methodology

Collision risk models were parameterized identically to the previous iteration, with the exception of flight speed. The full methodology is presented in the **Appendix 10.3: Ornithology Collision Risk Modelling**. Here the inputs required for the collision risk parameterisation for kittiwake alone are presented for reproducibility.

2.1. Biometrics

Table 2.1: Kittiwake inputs used for sCRM

	Flight speed	Avoidance rate	Body length	Wingspan	Nocturnal activity	% CRH at 36m - 250m	% CRH at 36m - 276m	flap or glide
mean	8.71	0.993	0.39	1.08	0.375	0.0145	0.0145	flap
sd	3.16	0.0003	0.005	0.0625	0.0637	0.005	0.005	

2.2. Animal densities

Table 2.2: In-flight densities of kittiwake for use in sCRM

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
mean	1.101	0.801	0.767	0.576	1.401	0.676	0.841	1.11	0.223	0.926	2.024	3.773
sd	0	0.849	0.226	0.177	0.283	0.035	0.128	0.326	0.315	0.318	0.393	1.601

2.3. Turbine specifications

Table 2.3: Turbine specifications for use in sCRM

	250m rotor diameter	276m rotor diameter
Scenario	Scenario A	Scenario B
Rotor radius	125	138
No of turbines	75	60
Latitude	53.1	
Tidal offset	0	

	250m rotor diameter	276m rotor diameter
Scenario	Scenario A	Scenario B
Chart datum relative to	Mean sea level (MSL)	
No of blades	3	
Max blade width	7	7.9
Airgap	36	

Table 2.4: Rotor speed and pitch values used for parameterisation of sCRM

Rotor diameter	Pitch		RPM	
	mean	SD	mean	SD
250m (Scenario A)	6.738	5.044	6.804	1.246
276m (Scenario B)	7.248	6.923	5.591	1.402

Table 2.5: Wind availability and downtime

	Rotor diameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind availability (%)	250m	89.4	89.8	86.5	83.6	82.5	81.5	81.1	82.7	85.3	88.7	89.5	90.6
Mean downtime (%)		0	0	0	0	0	0	0	0	0	0	0	0
SD downtime (%)		0	0	0	0	0	0	0	0	0	0	0	0
Wind availability (%)	276 m	89.5	89.7	86.8	84.1	83	82	81.6	83.2	85.8	89	89.4	90.5
Mean downtime (%)		0	0	0	0	0	0	0	0	0	0	0	0
SD downtime (%)		0	0	0	0	0	0	0	0	0	0	0	0

3. Results

Collision risk estimates using the slower mean flight speed of 8.71 m/s are provided in Table 3.1. This table also presents seasonal and annual summaries, where the median and 95% confidence interval are calculated from the summarized distribution of 1,000 collision estimates from the stochastic collision risk models. As a result of the creation of annual and seasonal distributions, the median and 95% confidence interval may be slightly different from the sum of monthly medians and 95% confidence intervals presented in monthly tables. The number of predicted collisions in each month of the year are presented in Table 3.2 for Scenario B (75 turbines with 250m rotor diameter), and Table 3.3 for Scenario A (60 turbines with 276m rotor diameter).

Table 3.1: Summary table of kittiwake collision estimates using the flight speed of 8.71 m/s, for two windfarm scenarios and two Band Option models. Values are seasonal and annual estimates of the median and 95% confidence intervals derived from 1,000 collision risk estimates

Band Option	Flight speed (m/s)	Windfarm scenario	Breeding	Post-breeding migration	Return migration	Annual
Option 1	8.71	Scenario A	3.243 (1.251 - 7.241)	7.624 (2.801 - 17.958)	3.221 (1.202 - 8.165)	14.07 (5.382 - 32.535)
Option 2	8.71	Scenario A	7.498 (3.64 - 12.849)	17.195 (8.01 - 33.711)	7.256 (3.638 - 14.492)	32.549 (16.693 - 58.551)
Option 1	8.71	Scenario B	2.849 (1.041 - 6.445)	6.55 (2.278 - 16.234)	2.775 (0.999 - 7.152)	12.255 (4.577 - 29.197)
Option 2	8.71	Scenario B	6.525 (2.956 - 11.755)	14.947 (6.584 - 30.301)	6.321 (3.03 - 13.062)	28.121 (13.572 - 53.118)

3.1. 250m rotor diameter

Table 3.2: Scenario A sCRM results

Flight speed	Model	Metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8.71 m/s	BO1	Lower 95th%ile	0.386	0.041	0.222	0.167	0.531	0.29	0.357	0.335	0.014	0.249	0.641	0.549
		Median	0.981	0.829	0.771	0.559	1.536	0.744	0.943	1.176	0.287	0.885	1.78	3.291
		Upper 95th %ile	2.239	3.212	2.107	1.491	3.736	1.639	2.137	2.901	1.221	2.392	4.25	9.433
	BO2	Lower 95th%ile	1.14	0.113	0.67	0.469	1.535	0.888	0.986	0.846	0.035	0.598	1.704	1.407
		Median	2.302	1.932	1.782	1.268	3.526	1.723	2.125	2.737	0.665	2.012	4.108	7.428
		Upper 95th %ile	3.895	6.34	3.733	2.725	6.686	2.907	3.773	5.662	2.394	4.617	7.761	18.251

3.2. 276m rotor diameter

Table 3.3: Scenario B sCRM results

Flight speed	Model	Metric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8.71 m/s	BO1	Lower 95th%ile	0.331	0.035	0.185	0.14	0.444	0.248	0.305	0.287	0.012	0.209	0.557	0.474
		Median	0.86	0.712	0.674	0.483	1.337	0.65	0.815	1.024	0.252	0.777	1.542	2.84
		Upper 95th %ile	1.964	2.777	1.826	1.316	3.318	1.452	1.883	2.567	1.093	2.067	3.76	8.501
	BO2	Lower 95th%ile	0.935	0.095	0.566	0.389	1.27	0.741	0.812	0.766	0.029	0.498	1.444	1.261
		Median	2.001	1.65	1.54	1.116	3.086	1.505	1.873	2.392	0.586	1.748	3.565	6.443
		Upper 95th %ile	3.53	5.637	3.32	2.543	5.915	2.656	3.423	5.044	2.134	4.125	6.946	16.03

4. References

Skov, H., Heinänen, S., Norman, T., Ward, R.M., Mendez-Roldan, S. & Ellis, I. (2018). ORJIP Bird Collision and Avoidance Study. Final report – April 2018. The Carbon Trust, UK.



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