

Appendix 9.2 CRM for Merlin

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WIND FARM PARAMETERS	
Size of windfarm envelope*	795 ha
Number of turbines	19
Rotor diameter	136 m
Hub height	82 m
Max. rotor depth in metres	2.7 m
Max. chord	4.10 m
Pitch	6.0 degrees
Rotation period	4.30 s
Turbine operation time	96 %

WATCH DATA		
VP	Area (ha)	Time (hrs)
1	142.0	84.0
2	308.0	180.0
3	113.0	94.0
4	192.0	96.0
5	0.0	0.0
6	0.0	0.0
Totals	755.0	454.0

BIRD PARAMETERS	
Length	0.28 m
Wingspan	0.6 m
Assumed flight speed	13 ms ⁻¹
Number of days birds potentially present	365 per year
Number of hours birds potentially present	13 per day
Assumed avoidance rate	98 %

BIRD FLIGHT DATA		
VP	Total (s)	'Risk height' (s)
1	15	15
2	0	0
3	60	60
4	0	0
5	0	0
6	0	0
Totals	75	75

BAND USED TO DEFINE 'RISK HEIGHT'	
Max height	220 m
Min height	0 m

Optional inputs

*note that a value of 1 or more must be entered in Cell B3

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		Calculation of alpha and p(collision) as a function of radius								
K: [1D or [3D] (0 or 1)	1				Upwind:			Downwind:		
NoBlades	3				collide	contribution	collide	contribution		
MaxChord	4.10 m	r/R	c/C	α	length	p(collision)	from radius r	length	p(collision)	from radius r
Pitch (degrees)	6.0	radius	chord	alpha						
BirdLength	0.28 m	0.025	0.575	5.03	14.86	0.83	0.00104	14.37	0.80	0.00100
Wingspan	0.56 m	0.075	0.575	1.68	5.12	0.29	0.00214	4.63	0.26	0.00194
F: Flapping (0) or gliding (+1)	0	0.125	0.702	1.01	3.74	0.21	0.00261	3.14	0.18	0.00219
		0.175	0.860	0.72	3.29	0.18	0.00322	2.56	0.14	0.00250
Bird speed	13 m/sec	0.225	0.994	0.56	3.01	0.17	0.00378	2.15	0.12	0.00270
RotorDiam	136 m	0.275	0.947	0.46	2.45	0.14	0.00376	1.64	0.09	0.00252
RotationPeriod	4.30 sec	0.325	0.899	0.39	2.08	0.12	0.00378	1.31	0.07	0.00238
		0.375	0.851	0.34	1.81	0.10	0.00379	1.08	0.06	0.00226
		0.425	0.804	0.30	1.59	0.09	0.00378	0.91	0.05	0.00215
		0.475	0.756	0.26	1.42	0.08	0.00377	0.77	0.04	0.00205
Bird aspect ratio: β	0.50	0.525	0.708	0.24	1.28	0.07	0.00374	0.67	0.04	0.00196
		0.575	0.660	0.22	1.15	0.06	0.00370	0.59	0.03	0.00188
		0.625	0.613	0.20	1.05	0.06	0.00365	0.52	0.03	0.00182
		0.675	0.565	0.19	0.95	0.05	0.00358	0.47	0.03	0.00176
		0.725	0.517	0.17	0.87	0.05	0.00351	0.42	0.02	0.00172
		0.775	0.470	0.16	0.79	0.04	0.00343	0.39	0.02	0.00169
		0.825	0.422	0.15	0.72	0.04	0.00333	0.36	0.02	0.00166
		0.875	0.374	0.14	0.66	0.04	0.00322	0.34	0.02	0.00166
		0.925	0.327	0.14	0.60	0.03	0.00310	0.32	0.02	0.00166
		0.975	0.279	0.13	0.55	0.03	0.00297	0.31	0.02	0.00167
Overall p(collision) =					Upwind	6.6%	Downwind	3.9%		
					Average	5.3%				

FLIGHT ACTIVITY PER UNIT TIME & AREA		
VP	Observation effort (HaHr)	Flying time at 'risk height' (Hahr ⁻¹)
1	11928.00	3.49318E-07
2	55440.00	0
3	10622.00	1.56907E-06
4	18432.00	0
5	0.00	FALSE
6	0.00	FALSE
<i>Totals</i>	<i>96422.00</i>	<i>4.79597E-07</i>

WEIGHTED BY OBSERVATION EFFORT		
VP	Weighting	Ajusted time at 'risk height' (Hahr ⁻¹)
1	0.124	4.32128E-08
2	0.575	0
3	0.110	1.72851E-07
4	0.191	0
5	0.000	0
6	0.000	0
<i>Totals</i>	<i>1.000</i>	<i>2.16064E-07</i>
Mean activity hr⁻¹ in wind farm		
	Risk height	0.01717%
	Rotor height	0.01061%

MORTALITY ESTIMATE	
Flight risk volume (Vw)	1.081E+09 m ³
Rotor radius	4624 m ²
Combined rotor swept volume (Vr)	276008 m ³
Vr * (d + l)	822503 m ³
Bird occupancy (n)	0.52 hrs / yr
Bird occupancy of rotor swept vol (b)	1.42 bird-secs
Bird transit time (t)	0.24 secs
No. of transits through rotors	5.97 per year
Estimated no. of collisions	0.30 per year
After allowing for avoidance	0.00602 per year
i.e. equivalent to one bird every	166.2 years

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