



Marubeni



Appendix 11.2, Annex A: Offshore Ornithology Deterministic Collision Risk Model Estimates

Array EIA Report

2024

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1. DETERMINISTIC COLLISION RISK MODEL ESTIMATE TABLES

Table 1.1: Kittiwake Expected Collisions from Deterministic CRMs Across Months

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 2	0.998	13.1	2	Expected collisions	0.13	0.28	1.00	0.17	4.35	1.69	1.31	0.12	0.13	0.19	0.71	0.23	10.31
Option 2	0.998	13.1	3	Expected collisions	0.17	0.35	1.20	0.19	4.81	1.83	1.43	0.14	0.15	0.23	0.94	0.32	11.78
Option 2	0.998	8.71	2	Expected collisions	0.10	0.22	0.81	0.14	3.52	1.37	1.06	0.10	0.11	0.15	0.58	0.19	8.35
Option 2	0.998	8.71	3	Expected collisions	0.14	0.29	0.97	0.16	3.89	1.48	1.15	0.11	0.12	0.19	0.76	0.26	9.53
Option 2	0.993	13.1	2	Expected collisions	0.45	0.97	3.48	0.59	15.24	5.91	4.58	0.43	0.46	0.66	2.49	0.82	36.08
Option 2	0.993	13.1	3	Expected collisions	0.61	1.24	4.20	0.68	16.82	6.40	4.99	0.49	0.54	0.82	3.30	1.13	41.21
Option 2	0.993	8.71	2	Expected collisions	0.37	0.79	2.82	0.48	12.34	4.79	3.70	0.35	0.37	0.53	2.02	0.66	29.21
Option 2	0.993	8.71	3	Expected collisions	0.49	1.00	3.40	0.55	13.62	5.18	4.04	0.39	0.44	0.66	2.67	0.92	33.36
Option 2	0.994	13.1	2	Expected collisions	0.39	0.83	2.99	0.51	13.06	5.07	3.92	0.37	0.39	0.56	2.13	0.70	30.93
Option 2	0.994	13.1	3	Expected collisions	0.52	1.06	3.60	0.58	14.42	5.48	4.28	0.42	0.46	0.70	2.83	0.97	35.33
Option 2	0.994	8.71	2	Expected collisions	0.31	0.67	2.42	0.41	10.57	4.10	3.18	0.30	0.32	0.45	1.73	0.57	25.04
Option 2	0.994	8.71	3	Expected collisions	0.42	0.86	2.91	0.47	11.67	4.44	3.46	0.34	0.37	0.57	2.29	0.79	28.60
Option 3	0.995	13.1	2	Expected collisions	0.06	0.13	0.45	0.08	1.98	0.77	0.59	0.06	0.06	0.09	0.32	0.11	4.68
Option 3	0.995	13.1	3	Expected collisions	0.08	0.16	0.54	0.09	2.18	0.83	0.65	0.06	0.07	0.11	0.43	0.15	5.34
Option 3	0.995	8.71	2	Expected collisions	0.06	0.13	0.45	0.08	1.97	0.76	0.59	0.06	0.06	0.08	0.32	0.11	4.66
Option 3	0.995	8.71	3	Expected collisions	0.08	0.16	0.54	0.09	2.17	0.83	0.64	0.06	0.07	0.11	0.43	0.15	5.32
Option 3	0.980	13.1	2	Expected collisions	0.23	0.50	1.81	0.31	7.90	3.07	2.37	0.22	0.24	0.34	1.29	0.43	18.71
Option 3	0.980	13.1	3	Expected collisions	0.32	0.64	2.18	0.35	8.72	3.32	2.59	0.25	0.28	0.42	1.71	0.59	21.38
Option 3	0.980	8.71	2	Expected collisions	0.23	0.50	1.80	0.31	7.86	3.05	2.36	0.22	0.24	0.34	1.28	0.42	18.62
Option 3	0.980	8.71	3	Expected collisions	0.32	0.64	2.17	0.35	8.68	3.30	2.58	0.25	0.28	0.42	1.70	0.58	21.27

Table 1.2: Kittiwake Expected Collisions from Deterministic CRMs Across Seasons

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Pre-Breeding (Jan to mid-Apr)	Breeding (Apr to Aug)	Post-Breeding (Sep to Dec)	Total
Option 2	0.998	13.1	2	Expected collisions	1.49	7.56	1.26	10.31
Option 2	0.998	13.1	3	Expected collisions	1.83	8.30	1.65	11.78
Option 2	0.998	8.71	2	Expected collisions	1.20	6.12	1.02	8.35
Option 2	0.998	8.71	3	Expected collisions	1.48	6.72	1.34	9.53
Option 2	0.993	13.1	2	Expected collisions	5.20	26.46	4.42	36.08
Option 2	0.993	13.1	3	Expected collisions	6.39	29.04	5.78	41.21
Option 2	0.993	8.71	2	Expected collisions	4.21	21.42	3.58	29.21
Option 2	0.993	8.71	3	Expected collisions	5.17	23.51	4.68	33.36
Option 2	0.994	13.1	2	Expected collisions	4.46	22.68	3.79	30.93
Option 2	0.994	13.1	3	Expected collisions	5.48	24.89	4.96	35.33
Option 2	0.994	8.71	2	Expected collisions	3.61	18.36	3.07	25.04
Option 2	0.994	8.71	3	Expected collisions	4.44	20.15	4.01	28.60
Option 3	0.995	13.1	2	Expected collisions	0.67	3.43	0.57	4.68
Option 3	0.995	13.1	3	Expected collisions	0.83	3.77	0.75	5.34
Option 3	0.995	8.71	2	Expected collisions	0.67	3.41	0.57	4.66
Option 3	0.995	8.71	3	Expected collisions	0.82	3.75	0.75	5.32
Option 3	0.980	13.1	2	Expected collisions	2.70	13.72	2.29	18.71
Option 3	0.980	13.1	3	Expected collisions	3.32	15.06	3.00	21.38
Option 3	0.980	8.71	2	Expected collisions	2.68	13.65	2.28	18.62
Option 3	0.980	8.71	3	Expected collisions	3.30	14.99	2.98	21.27

Table 1.3: Herring Gull Expected Collisions from Deterministic CRMs Across Months

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 2	0.997	12.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.15
Option 2	0.997	12.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.20
Option 2	0.997	9.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.13
Option 2	0.997	9.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.17
Option 2	0.995	12.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.18
Option 2	0.995	12.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.24
Option 2	0.995	9.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.16
Option 2	0.995	9.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.21
Option 2	0.994	12.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.09
Option 2	0.994	12.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.12
Option 2	0.994	9.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.08
Option 2	0.994	9.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Option 3	0.990	12.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.46
Option 3	0.990	12.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.61
Option 3	0.990	9.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.46
Option 3	0.990	9.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.60
Option 3	0.950	12.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.09
Option 3	0.950	12.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.12
Option 3	0.950	9.8	2	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.09
Option 3	0.950	9.8	3	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.12

Table 1.4: Herring Gull Expected Collisions from Deterministic CRMs Across Seasons

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Breeding (Apr to Aug)	Non-Breeding (Sep to Mar)	Total
Option 2	0.997	12.8	2	Expected collisions	0.00	0.15	0.15
Option 2	0.997	12.8	3	Expected collisions	0.00	0.20	0.20
Option 2	0.997	9.8	2	Expected collisions	0.00	0.13	0.13
Option 2	0.997	9.8	3	Expected collisions	0.00	0.17	0.17
Option 2	0.995	12.8	2	Expected collisions	0.00	0.18	0.18
Option 2	0.995	12.8	3	Expected collisions	0.00	0.24	0.24
Option 2	0.995	9.8	2	Expected collisions	0.00	0.16	0.16

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Breeding (Apr to Aug)	Non-Breeding (Sep to Mar)	Total
Option 2	0.995	9.8	3	Expected collisions	0.00	0.21	0.21
Option 2	0.994	12.8	2	Expected collisions	0.00	0.09	0.09
Option 2	0.994	12.8	3	Expected collisions	0.00	0.12	0.12
Option 2	0.994	9.8	2	Expected collisions	0.00	0.08	0.08
Option 2	0.994	9.8	3	Expected collisions	0.00	0.10	0.10
Option 3	0.990	12.8	2	Expected collisions	0.00	0.46	0.46
Option 3	0.990	12.8	3	Expected collisions	0.00	0.61	0.61
Option 3	0.990	9.8	2	Expected collisions	0.00	0.46	0.46
Option 3	0.990	9.8	3	Expected collisions	0.00	0.60	0.60
Option 3	0.950	12.8	2	Expected collisions	0.00	0.09	0.09
Option 3	0.950	12.8	3	Expected collisions	0.00	0.12	0.12
Option 3	0.950	9.8	2	Expected collisions	0.00	0.09	0.09
Option 3	0.950	9.8	3	Expected collisions	0.00	0.12	0.12

Table 1.5: Lesser Black-Backed Gull Expected Collisions from Deterministic CRMs Across Months

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 2	0.997	13.1	2	Expected collisions	0.000	0.000	0.000	0.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.166
Option 2	0.997	13.1	3	Expected collisions	0.000	0.000	0.000	0.190	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.190
Option 2	0.997	9.8	2	Expected collisions	0.000	0.000	0.000	0.143	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.143
Option 2	0.997	9.8	3	Expected collisions	0.000	0.000	0.000	0.165	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.165
Option 2	0.995	13.1	2	Expected collisions	0.000	0.000	0.000	0.199	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.199
Option 2	0.995	13.1	3	Expected collisions	0.000	0.000	0.000	0.228	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.228
Option 2	0.995	9.8	2	Expected collisions	0.000	0.000	0.000	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.172
Option 2	0.995	9.8	3	Expected collisions	0.000	0.000	0.000	0.197	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.197
Option 2	0.994	13.1	2	Expected collisions	0.000	0.000	0.000	0.099	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099
Option 2	0.994	13.1	3	Expected collisions	0.000	0.000	0.000	0.114	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.114
Option 2	0.994	9.8	2	Expected collisions	0.000	0.000	0.000	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086
Option 2	0.994	9.8	3	Expected collisions	0.000	0.000	0.000	0.099	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099
Option 3	0.990	13.1	2	Expected collisions	0.000	0.000	0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177
Option 3	0.990	13.1	3	Expected collisions	0.000	0.000	0.000	0.203	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.203

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 3	0.990	9.8	2	Expected collisions	0.000	0.000	0.000	0.175	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.175
Option 3	0.990	9.8	3	Expected collisions	0.000	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200
Option 3	0.981	13.1	2	Expected collisions	0.000	0.000	0.000	0.093	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.093
Option 3	0.981	13.1	3	Expected collisions	0.000	0.000	0.000	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.107
Option 3	0.981	9.8	2	Expected collisions	0.000	0.000	0.000	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
Option 3	0.981	9.8	3	Expected collisions	0.000	0.000	0.000	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105

Table 1.6: Lesser Black-Backed Gull Expected Collisions from Deterministic CRMs Across Seasons

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Breeding (mid-Mar to Aug)	Post-Breeding (Sep to Oct)	Non-Breeding (Nov to Feb)	Total
Option 2	0.997	13.1	2	Expected collisions	0.166	0.00	0.00	0.166
Option 2	0.997	13.1	3	Expected collisions	0.190	0.00	0.00	0.190
Option 2	0.997	9.8	2	Expected collisions	0.143	0.00	0.00	0.143
Option 2	0.997	9.8	3	Expected collisions	0.165	0.00	0.00	0.165
Option 2	0.995	13.1	2	Expected collisions	0.199	0.00	0.00	0.199
Option 2	0.995	13.1	3	Expected collisions	0.228	0.00	0.00	0.228
Option 2	0.995	9.8	2	Expected collisions	0.172	0.00	0.00	0.172
Option 2	0.995	9.8	3	Expected collisions	0.197	0.00	0.00	0.197
Option 2	0.994	13.1	2	Expected collisions	0.099	0.00	0.00	0.099
Option 2	0.994	13.1	3	Expected collisions	0.114	0.00	0.00	0.114
Option 2	0.994	9.8	2	Expected collisions	0.086	0.00	0.00	0.086
Option 2	0.994	9.8	3	Expected collisions	0.099	0.00	0.00	0.099
Option 3	0.990	13.1	2	Expected collisions	0.177	0.00	0.00	0.177
Option 3	0.990	13.1	3	Expected collisions	0.203	0.00	0.00	0.203
Option 3	0.990	9.8	2	Expected collisions	0.175	0.00	0.00	0.175
Option 3	0.990	9.8	3	Expected collisions	0.200	0.00	0.00	0.200
Option 3	0.981	13.1	2	Expected collisions	0.093	0.00	0.00	0.093
Option 3	0.981	13.1	3	Expected collisions	0.107	0.00	0.00	0.107
Option 3	0.981	9.8	2	Expected collisions	0.092	0.00	0.00	0.092
Option 3	0.981	9.8	3	Expected collisions	0.105	0.00	0.00	0.105

Table 1.7: Gannet Expected Collisions from Deterministic CRMs Across Months

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 2	0.993	14.9	1.32	Expected collisions	0.00	0.07	0.28	4.98	10.40	5.60	11.63	2.18	2.87	4.83	0.20	0.06	43.09
Option 2	0.993	13.33	1.32	Expected collisions	0.00	0.07	0.26	4.72	9.85	5.30	11.03	2.07	2.72	4.58	0.19	0.06	40.83
Option 3	0.953	14.9	1.32	Expected collisions	0.00	0.06	0.25	4.57	9.55	5.14	10.68	2.00	2.63	4.43	0.18	0.05	39.56
Option 3	0.953	13.33	1.32	Expected collisions	0.00	0.06	0.25	4.56	9.51	5.12	10.64	1.99	2.62	4.42	0.18	0.05	39.42

Table 1.8: Gannet Expected Collisions from Deterministic CRMs Across Seasons

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM Output	Pre-Breeding (Dec to mid-Mar)	Breeding (mid-Mar to Sep)	Post-Breeding (Oct to Nov)	Total
Option 2	0.993	14.9	1.32	Expected collisions	0.27	37.79	5.03	43.09
Option 2	0.993	13.33	1.32	Expected collisions	0.25	35.82	4.76	40.83
Option 3	0.953	14.9	1.32	Expected collisions	0.25	34.70	4.61	39.56
Option 3	0.953	13.33	1.32	Expected collisions	0.24	34.58	4.60	39.42

Table 1.9: Fulmar Expected Collisions from Deterministic CRMs Across Months

Model Option	Avoidance Rate (out of 1.000)	Flight speed (m/s)	NAF	CRM output	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Option 2	0.99	13.0	4	Expected collisions	0.04	0.03	0.00	0.01	0.02	0.09	0.07	0.03	0.03	0.00	0.05	0.12	0.48
Option 3	0.99	13.0	4	Expected collisions	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.04

Table 1.10: Fulmar Expected Collisions from Deterministic CRMs Across Seasons

Model Option	Avoidance Rate (out of 1.000)	Flight Speed (m/s)	NAF	CRM output	Pre-Breeding (Dec to Mar)	Breeding (Apr to mid-Sep)	Post-Breeding (mid-Sep to Oct)	Non-Breeding (Nov)	Total
Option 2	0.99	13.0	4	Expected collisions	0.19	0.23	0.02	0.05	0.48
Option 3	0.99	13.0	4	Expected collisions	0.02	0.02	0.00	0.00	0.04

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