MONA OFFSHORE WIND PROJECT

Revised Assessment for Northern Gannet at Grassholm SPA

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Image of an offshore wind farm

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Glossary

Term	Meaning
Applicant	Mona Offshore Wind Limited.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Mona Offshore Wind Project	The Mona Offshore Wind Project is comprised of both the generation assets, offshore and onshore transmission assets, and associated activities.
The Planning Inspectorate	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects.

Acronyms

Acronym	Description
AEoSI	Adverse Effect on Site Integrity
BDMPS	Biologically Defined Minimum Population Scales
CGR	Counterfactual of growth rate
CPS	Counterfactual of population size.
EIA	Environmental Impact Assessment
ExA	Examining Authority
HRA	Habitats Regulations Assessment
JNCC	Joint Nature Conservation Committee
LCI	Lower confidence interval
NRW(A)	Natural Resources Wales (Advisory)
NRW	Natural Resources Wales
PVA	Population Viability Analysis
SNCB	Statutory Nature Conservation Body
SPAs	Special Protection Areas
SSSI	Site of Special Scientific Interest
UCI	Upper confidence interval
UK	United Kingdom

Units

Unit	Description
%	Percentage
km^2	Square kilometres
km	Kilometres
m	Metres

1 REVISED ASSESSMENT FOR NORTHERN GANNET AT GRASSHOLM SPA

1.1 Summary and Introduction

1.1.1.1 Following submission of the Offshore Ornithology Additional Supporting in-combination Assessment Information in line with SNCB Advice (REP5-074) at Deadline 5, the Applicant has undertaken further engagement with Natural Resources Wales (Advisory) (NRW (A)), which have outstanding concerns for Grassholm Special Protection Area (SPA) for northern gannet *Morus bassanus* and the level of precaution considered within the assessment.

1.1.1.2 The Applicant had updated the population count used within the Offshore Ornithology Additional Supporting in-combination Assessment Information in line with SNCB Advice (REP5-074) to 19,199 pairs based on the most recent count undertaken in 2024. However, NRW (A) has since advised (in a meeting on 16 December 2024) to use the 2015 count of 36,011 pairs, as this population is more contemporaneous with the site-specific baseline surveys carried out between March 2020 and February 2022. NRW (A) also advised the implications of macro-avoidance of northern gannet be considered within the in-combination collision assessment alongside qualitative consideration of this species' foraging range and the degree of connectivity between the Grassholm SPA and the Mona Array Area.

1.1.1.3 This updated assessment for northern gannet from Grassholm SPA has been prepared in accordance with NRW (A)'s most recent advice received on 16 December 2024 and supersedes the assessment presented in the Offshore Ornithology Additional Supporting in-combination Assessment Information in line with SNCB Advice (REP5-074) at Deadline 5. It includes an assessment both with and without macro-avoidance taken into account in the collision estimates. Two macro-avoidance scenarios have been presented, one where 70% macro-avoidance is applied year-round and one where 70% macro-avoidance is applied during the non-breeding season. Both are considered noting there is contrasting SNCB advice as to the appropriateness of year-round vs non-breeding only macro-avoidance (D.3.13 and D.7.3 of Technical Engagement Plan Appendices - Part 1 (A to E) (APP-042) and the Joint SNCB Advice Note, 2024[1]). The review by Pavat *et al*. (2023) commissioned by Natural England stated a year-round mean macro-avoidance should be applied; however, there is some expert opinion that during the breeding season birds are more likely to get closer to turbines and less likely to be displaced due to the need to provision chicks (Pavat *et al*, 2023).

1.1.1.4 In addition, the assessments include indicative estimates for two additional historical wind farms, Barrow and North Hoyle – see the Applicant's Update on Offshore Ornithology Principal Matters (S_D6_20) for the rationale for undertaking a gap-fill exercise for these projects. The indicative estimates for these two projects will be incorporated into the updated Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) submitted at Deadline 7 and are not anticipated to alter the EIA and HRA conclusions reached by the Applicant or the Statutory Nature Conservation Bodies (SNCBs).

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[1] Within the 'Joint advice note from the Statutory Nature Conservation Bodies (SNCBs) regarding bird collision risk modelling for offshore wind developments' note there is acknowledgment that consultation with the respective SNCB is required if macro-avoidance is undertaken or not and for which season.

1.1.1.5　　When using the 2015 population estimate, the resulting PVA indicates that the in-combination impact results in >30,000 pairs[2] and an increasing population size after 35 years. Therefore, the Applicant concludes that the Mona Offshore Wind Project alone and in-combination does not result in an Adverse Effect on Site Integrity (AEoSI) beyond reasonable scientific doubt on northern gannet from the Grassholm SPA.

1.2　　Mona Offshore Wind Project alone assessment

1.2.1.1　　The Applicant has provided the alone assessment for Grassholm SPA within Table 1.20 of HRA Stage 2 Information to Support an Appropriate Assessment (ISAA) Part Three: SPAs and Ramsar sites Assessments (REP2-010) and Table 1-11 (displacement), Table 1-18 (collisions) and Table 1-55 (displacement and collisions combined), as part of the in-combination assessment) within the Offshore Ornithology Supporting Information in line with SNCB Advice (REP4-030) note.

1.2.1.2　　Within the HRA Stage 2 ISAA Part Three: SPAs and Ramsar sites Assessments (REP2-010), the combined predicted impact from both displacement and collision impacts was 0.6 birds from the Mona Offshore Wind Project alone which equated to an increase in the baseline mortality of 0.01%. This used site-specific age-class data throughout the year, a 70% displacement and 1% mortality rate and 70% macro-avoidance was applied to the collision impacts. As the impact was predicted to increase the baseline mortality by <0.05%, no in-combination assessment was presented within HRA Stage 2 ISAA Part Three: SPAs and Ramsar sites Assessments (REP2-010).

1.2.1.3　　Within Offshore Ornithology Supporting Information in line with SNCB Advice (REP4-030), the predicted combined impact from both displacement and collisions to northern gannet from Grassholm SPA was 0.39 to 5.68 birds which equated to an increase in baseline mortality of 0.01 to 0.10% (combined total from Tables 1-11 and 1-18 of Offshore Ornithology Supporting Information in line with SNCB Advice (REP4-030). This used site-specific age-class data throughout the year, 60-80% displacement and 1-10% mortality rate, the lower and upper confidence interval of collisions and 70% macro-avoidance was applied to the collision impacts (as advised by the SNCBs during the Expert Working Groups (EWGs); Technical Engagement Plan Appendices - Part 1 (A to E) (APP-042)). As the impact was predicted to increase the baseline mortality by >0.05%, an in-combination assessment was presented in Table 1-55 of Offshore Ornithology Supporting Information in line with SNCB Advice (REP4-030).

1.2.1.4　　Given the multiple potential over-precautionary elements to the Applicant's in-combination assessment that NRW (A) highlighted during the meeting on the 16 December 2024, the Applicant has provided a matrix table for the Mona Offshore Wind Project alone to determine whether an in-combination assessment is required. The impact presented within the matrix table (Table 1-1 showing mortalities and Table 1-2 showing the increase in baseline mortality) uses the site-specific age-class data for the whole year, mean collision estimate (0.30 birds annually) and accounts for 70% macro-avoidance in the collision estimates. The information presented here replicates the numbers provided in previous submissions.

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[2] Countryside Council for Wales (CCW) (now part of NRW) Core Management Plan for Grassholm SPA (See Appendix O in REP3-068): CCW's aim for the gannet colony is to see it contribute towards maintaining the North Atlantic gannet population in ensure favourable conservation status. The population on Grassholm should not fall below 30,000 pairs in three consecutive years, nor should it drop by more than 25% of the previous year's figures in any one year. There should be no decline in the Grassholm/Ynys Gwales population which is significantly more than any decline in the North Atlantic population as a whole.

Table 1-1: Matrix table showing the predicted mortalities (adult birds) from mean collisions (0.30 birds) and displacement for the Mona Offshore Wind Project alone using the SNCBs-advised range of displacement and mortality rates

Northern gannet (Annual Mortality rate (%) – predicted mortalities)	1%	2%	3%	4%	5%	10%
Displacement 60%	0.59	0.91	1.23	1.54	1.86	3.45
rate (%) 70%	0.64	1.01	1.38	1.76	2.13	3.98
80%	0.70	1.12	1.54	1.97	2.39	4.51

Table 1-2: Matrix table showing the predicted increase in baseline mortality from mean collisions (0.30 birds) and displacement for the Mona Offshore Wind Project alone using the SNCBs-advised range of displacement and mortality rates

Northern gannet (Annual – increase in baseline mortality)	Mortality rate (%)					
	1%	2%	3%	4%	5%	10%
Displacement 60%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%
rate (%) 70%	0.01%	0.01%	0.02%	0.03%	0.03%	0.06%
80%	0.01%	0.01%	0.02%	0.03%	0.04%	0.07%

1.2.1.5 Considering the >0.05% increase in baseline mortality threshold adopted for the Mona Offshore Wind Project, an in-combination assessment is not required when considering the lower range of mortality rates. An in-combination assessment is required when considering the highest mortality rate of >5% mortality which is considered precautionary by the Applicant and NRW (A).

1.2.1.6 In addition to the low potential for an in-combination assessment (due to the to the small predicted increase in baseline mortality as a result of the Mona Offshore Wind Project alone), the work by Wakefield *et al*. (2013) highlighted that there is strong partitioning between breeding colonies and indicated that northern gannet from Grassholm do not forage within the area of the Irish Sea in which Mona Offshore Wind Project is proposed. Furthermore, there is no evidence from this study of gannet from Grassholm foraging within the northern part of the Irish Sea (limited movement to the north of the Llyn peninsula). Therefore, the results from the apportioning work (using the NatureScot approach, which is in line with best practice) that predicted 17.6% of the birds within the Array Area during the breeding period were from Grassholm SPA is not supported by evidence from tracking data (see Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report (REP2-022) for apportioning calculations) and is therefore likely to be overly precautionary.
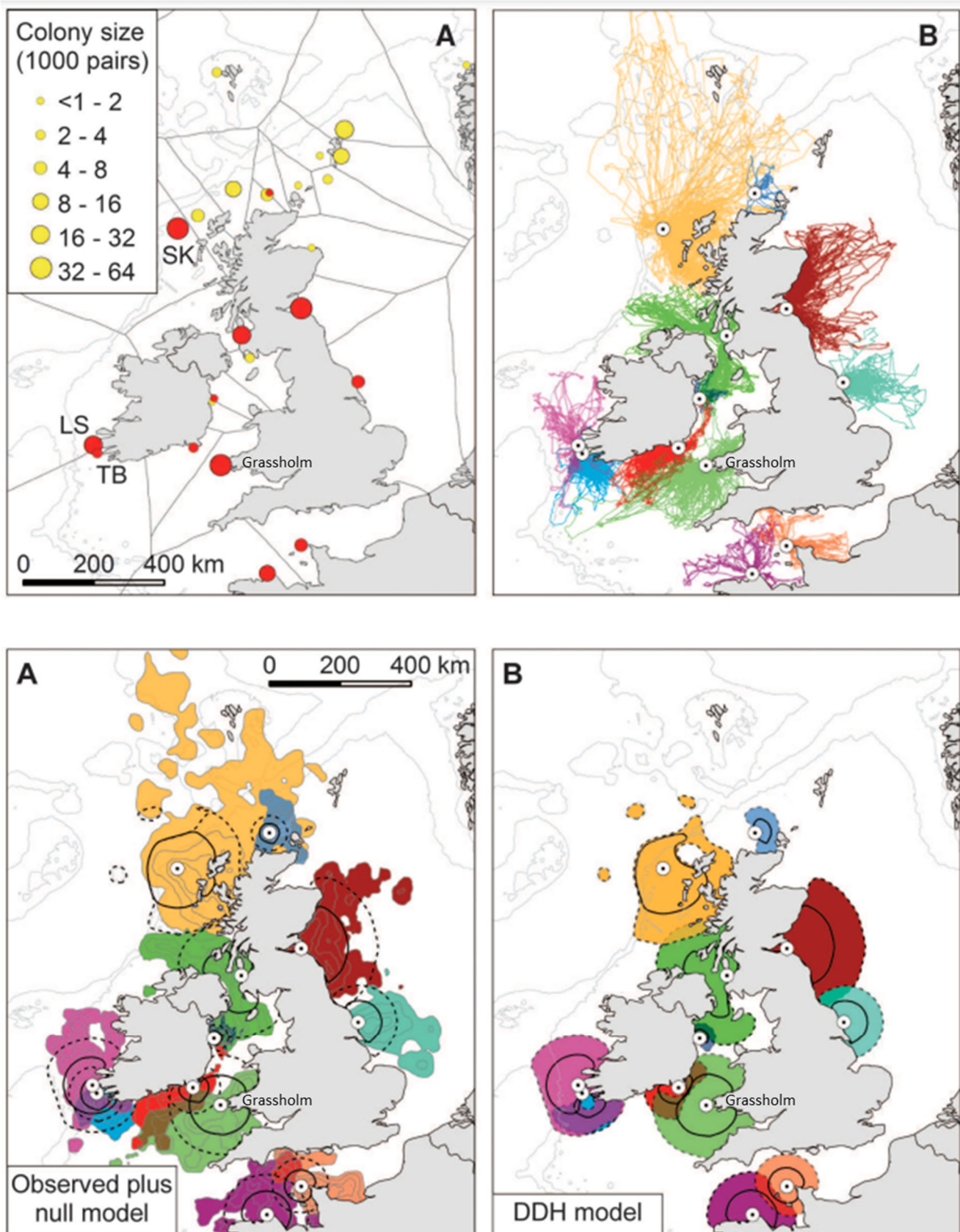
Figure 1.1: Spatial partitioning between northern gannet breeding colonies in the breeding season. Grassholm is indicated on the figure (source: Wakefield *et al.* (2013))

1.2.1.7   More recent tracking studies by Stephen Votier (unpublished but available on seabirdtracking.org), replicated the earlier results of the Wakefield *et al.* (2013) from Grassholm which showed no overlap with northern gannet from Grassholm and the Mona Offshore Wind Project location (Figure 1.2). The mean maximum foraging

distance from Grassholm was 116.8 ± 7.4 km for the 304 birds tracked from Grassholm, as part of Clark *et al.*'s (2024) review. The Mona Offshore Wind Project is 232.5 km (straight line) from Grassholm and therefore not within foraging range of northern gannet from Grassholm.
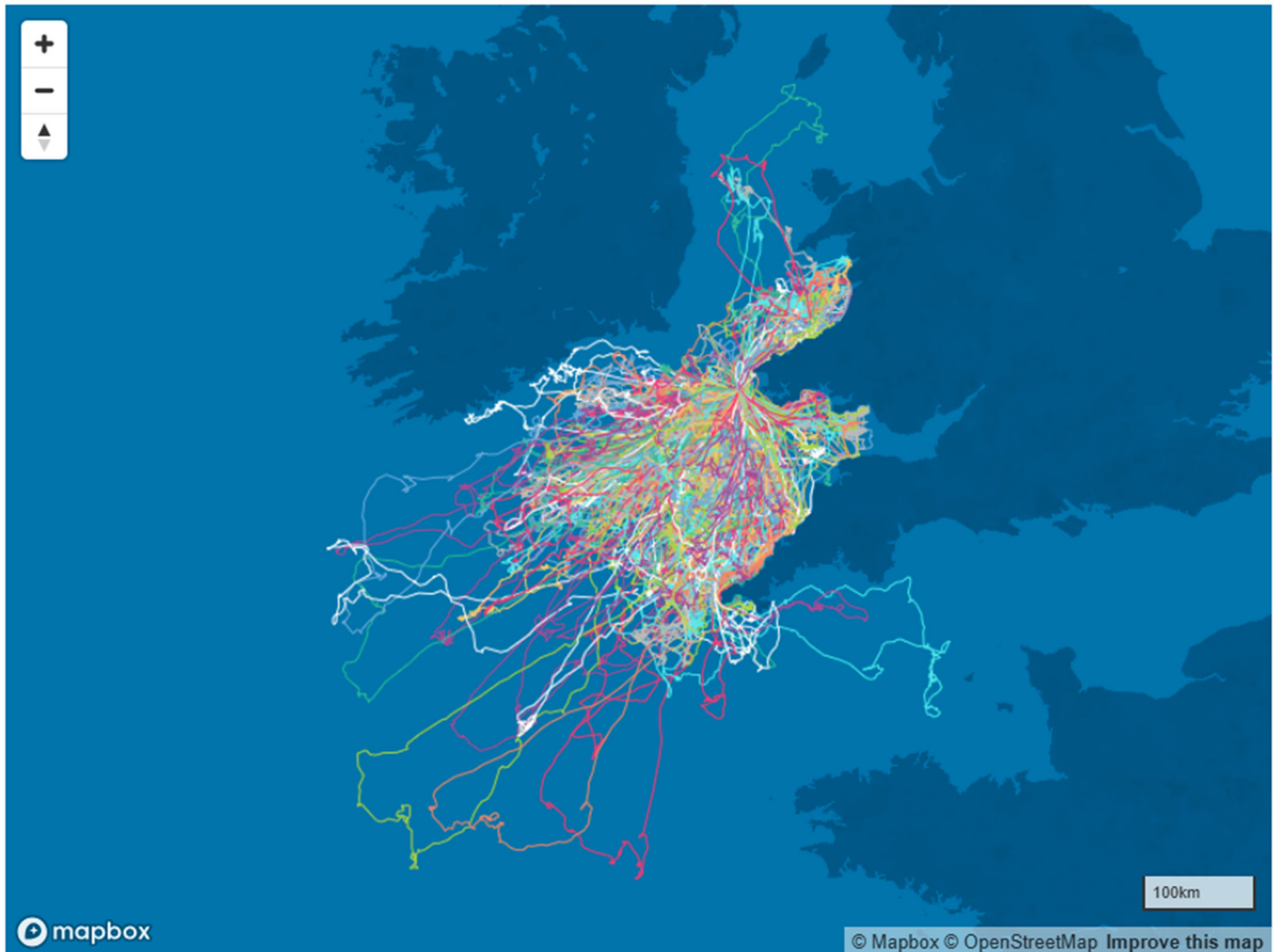
Figure 1.2: Foraging tracks of adult gannet from Grassholm during the breeding season (source: Seabirdtracking.org)

1.3   In-combination assessment

1.3.1.1   Despite there being little evidence for a potential in-combination impact due to the Mona Offshore Wind Project's alone impact being <0.05% increase in baseline mortality under several of the SNCB advised displacement and mortality rates and there being no empirically evidenced connectivity, the Applicant has provided the assessment below.

1.3.1.2   Within the in-combination assessment the Applicant has presented the gap-filled projects as part of the in-combination totals. The full method for how gap-filling was done and for which sites, species and seasons gap-filling was undertaken for, is presented in Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028).

1.3.2 Northern gannet from Grassholm SPA – without any macro-avoidance

1.3.2.1 As the impact from the Mona Offshore Wind Project alone was predicted to result in a >0.05% increase in northern gannet baseline mortality from Grassholm SPA when considering a 10% morality rate (see Table 1-1), an in-combination assessment is presented within Table 1-9 (the values presented represent 60-80% displacement and 1-10% mortality and for CRM the species-group avoidance rate of 0.9928). The displacement (60-80%) and mortality (1-10%) rates were requested during the EWGs.

1.3.2.2 Table 1-11 provides a matrix table showing the percentage increase in baseline mortality for the full range of JNCC and NRW (A) advised displacement (60-80%) and mortality (1-10%) rates. Table 1-11 also includes the predicted collision impacts.

Table 1-3:   In-combination assessment for northern gannet from the Grassholm SPA.

a – During the breeding season site-specific age-class values have been used for Awel y Mor (93.5%), Erebus Floating Wind Project (99.0%), Llŷr Floating Offshore Wind Project (95.99%), Mona Offshore Wind Project (93.58%), Morecambe Generation Assets (73.3%) and Morgan Generation Assets (94.94%) or where no site-specific data was available, 100% of birds are assumed to be adults. During the non-breeding season the age-class proportions are derived from the adult/immature proportion from the Appendix tables of (Furness, 2015) which are 59.16% of birds are adults in the pre-breeding period and 58.25% of birds are adults in the post-breeding season.

b – the apportioning value during the breeding season was taken from project specific documentation (Awel y Môr, 2022; Erebus, 2021b; Llŷr 1 Floating Offshore Wind Farm, 2024b; Morgan Generation Assets, 2024b; Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report (REP2-022); Morecambe Generation Assets, 2024b)

c – the apportioning value during the breeding season has used that of Morgan Offshore Wind Project Generation Assets, specifically 0.258.

d – the apportioning value during the breeding season has used that of Awel y Môr Offshore Wind Farm, specifically 0.367.

e – the apportioning value during the breeding seas has used that of Llŷr 1 Floating Offshore Wind Farm, specifically 0.969.

f – the Applicant has presented the collision impacts using a 99.28% avoidance rate, therefore some of the numbers presented have been corrected from the original application documents for some sites.

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) [f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Awel y Môr Offshore Wind Farm	0	307	117	0.00	10.17	1.40	0.2007	0.367[b]	0.2471	0.00 to 0.00	0.68 to 9.00	0.17 to 2.31	0.00	3.73	0.36	0.00 to 0.00	4.41 to 12.74	0.54 to 2.68	4.95 to 15.42
Burbo Bank Extension Offshore Wind Farm	15	648	13	0.00	12.44	0.00	0.2007	0.367[d]	0.2471	0.02 to 0.24	1.43 to 19.03	0.02 to 0.25	0.00	4.56	0.00	0.02 to 0.24	5.99 to 23.59	0.02 to 0.25	6.03 to 24.08
Erebus Floating Wind Project	59	222	195	0.34	3.34	0.34	0.2007	0.995[b]	0.2471	0.07 to 0.95	1.32 to 17.65	0.29 to 3.85	0.07	3.32	0.09	0.14 to 1.02	4.64 to 20.97	0.38 to 3.93	5.16 to 25.93
TwinHub (Wave Hub Floating Wind Farm)	0	244	89	0.00	26.12	0.00	0.2007	0.969[e]	0.2471	0.00 to 0.00	1.46 to 18.91	0.13 to 1.76	0.00	25.31	0.00	0.00 to 0.00	27.45 to 44.23	0.13 to 1.76	26.86 to 45.99
Llŷr 1 Floating Offshore Wind Farm	38	236	416	0.18	2.88	0.29	0.2007	0.969[b]	0.2471	0.05 to 0.62	1.37 to 18.31	0.62 to 8.23	0.04	2.79	0.07	0.08 to 0.65	4.16 to 21.10	0.69 to 8.31	4.93 to 30.05
Mona Offshore Wind Project	17	235	34	0.23	4.43	0.28	0.2007	0.176[b]	0.2471	0.02 to 0.27	0.25 to 3.31	0.05 to 0.67	0.05	0.78	0.07	0.07 to 0.31	1.03 o 4.09	0.12 to 0.74	1.22 to 5.14
Morecambe Offshore Windfarm Generation Assets	5	397	72	0.00	0.91	0.01	0.2007	0.3141[b]	0.2471	0.01 to 0.08	0.75 to 9.96	0.11 to 1.43	0.00	0.29	0.00	0.01 to 0.08	1.03 to 10.25	0.11 to 1.43	1.15 to 11.76
Morgan Offshore Wind Project Generation Assets	21	139	38	0.00	1.08	0.12	0.2007	0.258[b]	0.2471	0.02 to 0.33	0.21 to 2.86	0.06 to 0.75	0.00	0.28	0.03	0.02 to 0.33	0.49 to 3.14	0.08 to 0.78	0.60 to 4.25
Ormonde Wind Farm	2	199	3	0.00	6.72	0.00	0.2007	0.258[c]	0.2471	0.00 to 0.03	0.31 to 4.11	0.01 to 0.07	0.00	1.73	0.00	0.00 to 0.03	2.04 to 5.84	0.01 to 0.07	2.05 to 5.94
Walney (3 and 4) Extension Offshore Wind Farm	14	150	151	0.51	16.30	9.15	0.2007	0.258[c]	0.2471	0.02 to 0.23	0.23 to 3.10	0.22 to 2.98	0.11	4.20	2.38	0.13 to 0.34	4.44 to 7.30	2.61 to 5.37	7.17 to 13.00
West of Duddon Sands Offshore Wind Farm	7	431	10	0.14	1.96	0.18	0.2007	0.258[c]	0.2471	0.01 to 0.10	0.67 to 8.90	0.02 to 0.21	0.03	0.51	0.05	0.04 to 0.14	1.17 to 9.40	0.06 to 0.25	1.27 to 9.79
West of Orkney Windfarm	35	958	682	1.16	33.80	7.14	0.2007	No connectivity	0.2471	0.04 to 0.56	-	1.01 to 13.48	0.25	-	1.86	0.29 to 0.81	-	2.87 to 15.34	3.16 to 16.15
White Cross Offshore Windfarm	83	239	44	0.00	4.42	0.93	0.2007	0.5208[b]	0.2471	0.10 to 1.34	0.75 to 9.96	0.07 to 0.88	0.00	2.30	0.24	0.10 to 1.34	3.05 to 12.26	0.31 to 1.12	3.46 to 14.72
Gap-filled projects																			
Barrow Offshore Wind Farm	0	2	1	0.04	0.36	0.03	0.2007	0.258[b]	0.2471	0.00 to 0.03	0.01 to 0.17	0.01 to 0.07	0.01	0.09	0.01	0.01 to 0.04	0.11 to 0.26	0.01 to 0.08	0.13 to 0.37

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) [f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Burbo Bank	2	6	3	0.03	0.36	0.03	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.01 to 0.18	0.00 to 0.06	0.01	0.13	0.01	0.01 to 0.04	0.15 to 0.31	0.01 to 0.07	0.17 to 0.41
Gwynt y Môr Offshore Wind Farm	8	27	12	0.56	7.30	0.69	0.2007	0.367[d]	0.2471	0.01 to 0.12	0.06 to 0.79	0.02 to 0.23	0.12	2.68	0.18	0.13 to 0.24	2.74 to 3.47	0.20 to 0.41	3.06 to 4.13
North Hoyle Offshore Wind Farm	0	3	1	0.06	0.74	0.08	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.02 to 0.20	0.00 to 0.06	0.01	0.27	0.02	0.01 to 0.04	0.29 to 0.47	0.02 to 0.08	0.32 to 0.58
Robin Rigg	2	11	4	0.05	0.70	0.07	0.2007	0.258[c]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.08	0.01	0.18	0.02	0.01 to 0.05	0.20 to 0.41	0.02 to 0.10	0.23 to 0.55
Rhyl Flats Offshore Wind Farm	2	8	3	0.22	1.04	0.10	0.2007	0.367[d]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.07	0.05	0.38	0.03	0.05 to 0.09	0.40 to 0.62	0.03 to 0.09	0.48 to 0.80
Walney 1 and 2	9	36	15	0.14	1.91	0.18	0.2007	0.258[c]	0.2471	0.01 to 0.14	0.06 to 0.74	0.02 to 0.30	0.03	0.49	0.05	0.04 to 0.17	0.55 to 1.24	0.07 to 0.35	0.66 to 1.75
Total predicted impact (adult birds)										0.39 to 5.17	9.58 to 127.78	2.83 to 37.73	0.78	53.86	5.44	1.17 to 5.95	63.44 to 181.64	8.27 to 43.18	72.89 to 230.77
Increase in baseline mortality (%) (baseline mortality of 5,834)										0.01% to 0.09%	0.16% to 2.19%	0.05% to 0.65%	0.01%	0.93%	0.09%	0.02% to 0.10%	1.09% to 3.11%	0.14% to 0.74%	1.25% to 3.96%

Table 1-4: Matrix table showing the predicted mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%), without any macro-avoidance.

Northern gannet (Annual)		Mortality rate (%)					
		1%	2%	3%	4%	5%	10%
Displacement rate (%)	60%	72.89	85.69	98.49	111.29	124.10	188.11
	70%	75.02	89.96	104.89	119.83	134.76	209.44
	80%	77.15	94.22	111.29	128.36	145.43	230.78

Table 1-5: Matrix table showing the percentage increase in baseline mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%), without any macro-avoidance.

Northern gannet (Annual)		Mortality rate (%)					
		1%	2%	3%	4%	5%	10%
Displacement rate (%)	60%	1.25%	1.47%	1.69%	1.91%	2.13%	3.23%
	70%	1.29%	1.55%	1.80%	2.06%	2.31%	3.59%
	80%	1.33%	1.62%	1.91%	2.20%	2.50%	3.96%

1.3.2.3 As the predicted impact on northern gannet from Grasholm SPA is predicted to be >1% increase in baseline mortality, the impact is further investigated by a PVA (see section 1.4.2) to determine whether AEoSI can be ruled out beyond reasonable scientific doubt.

1.3.3 Northern gannet from Grassholm SPA – with 70% macro-avoidance during the non-breeding season

1.3.3.1 As the impact from the Mona Offshore Wind Project alone was predicted to result in a >0.05% increase in northern gannet baseline mortality from Grassholm SPA when considering a 10% mortality rate (see Table 1-1), an in-combination assessment is presented within Table 1-9 (the values presented represent 60-80% displacement and 1-10% mortality and the species-group avoidance rate). The displacement (60-80%) and mortality (1-10%) rates were requested during the EWGs. The collision estimates have been reduced to account for 70% macro-avoidance, as a bird cannot be displaced and also susceptible to collision at the same time. Macro-avoidance has been applied during the non-breeding season only.

1.3.3.2   Table 1-11 provides a matrix table showing the percentage increase in baseline mortality for the full range of JNCC and NRW (A) advised displacement (60-80) and mortality (1-10%) rates. Table 1-11 also includes the predicted collision impacts.

Table 1-6:   In-combination assessment for northern gannet from the Grassholm SPA.

a – During the breeding season site-specific age-class values have been used for Awel y Mor (93.5%), Erebus Floating Wind Project (99.0%), Llŷr Floating Offshore Wind Project (95.99%), Mona Offshore Wind Project (93.58%), Morecambe Generation Assets (73.3%) and Morgan Generation Assets (94.94%) or where no site-specific data was available, 100% of birds are assumed to be adults. During the non-breeding season the age-class proportions are derived from the adult/immature proportion from the Appendix tables of (Furness, 2015) which are 59.16% of birds are adults in the pre-breeding period and 58.25% of birds are adults in the post-breeding season.

b – the apportioning value during the breeding season was taken from project specific documentation (Awel y Môr, 2022; Erebus, 2021b; Llŷr 1 Floating Offshore Wind Farm, 2024b; Morgan Generation Assets, 2024b; Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report (REP2-022); Morecambe Generation Assets, 2024b)

c – the apportioning value during the breeding season has used that of Morgan Offshore Wind Project Generation Assets, specifically 0.258.

d – the apportioning value during the breeding season has used that of Awel y Môr Offshore Wind Farm, specifically 0.367.

e – the apportioning value during the breeding seas has used that of Llŷr 1 Floating Offshore Wind Farm, specifically 0.969.

f – the Applicant has presented the collision impacts using a 99.28% avoidance rate and a 70% macro-avoidance, therefore some of the numbers presented have been corrected from the original application documents for some sites.

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) (species-group avoidance rate 0.9928 and 70% macro-avoidance during the non-breeding season)[f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928 and 70% macro-avoidance during the non-breeding season)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Awel y Môr Offshore Wind Farm	0	307	117	0.00	10.17	0.44	0.2007	0.367[b]	0.2471	0.00 to 0.00	0.68 to 9.00	0.17 to 2.31	0.00	3.73	0.11	0.00 to 0.00	4.41 to 12.74	0.28 to 2.43	4.69 to 15.16
Burbo Bank Extension Offshore Wind Farm	15	648	13	0.00	12.44	0.00	0.2007	0.367[d]	0.2471	0.02 to 0.24	1.43 to 19.03	0.02 to 0.25	0.00	4.56	0.00	0.02 to 0.24	5.99 to 23.59	0.02 to 0.25	6.03 to 24.08
Erebus Floating Wind Project	59	222	195	0.36	3.34	0.35	0.2007	0.995[b]	0.2471	0.07 to 0.95	1.32 to 17.65	0.29 to 3.85	0.07	3.32	0.09	0.14 to 1.02	4.64 to 20.97	0.38 to 3.93	5.10 to 25.87
TwinHub (Wave Hub Floating Wind Farm)	0	244	89	0.00	26.12	0.00	0.2007	0.969[e]	0.2471	0.00 to 0.00	1.46 to 18.91	0.13 to 1.76	0.00	25.31	0.00	0.00 to 0.00	26.73 to 44.23	0.13 to 1.76	26.86 to 45.99
Llŷr 1 Floating Offshore Wind Farm	38	236	416	0.05	2.88	0.09	0.2007	0.969[b]	0.2471	0.05 to 0.62	1.37 to 18.31	0.62 to 8.23	0.01	2.79	0.02	0.06 to 0.63	4.16 to 21.10	0.64 to 8.26	4.86 to 29.98
Mona Offshore Wind Project	17	235	34	0.07	4.43	0.09	0.2007	0.176[b]	0.2471	0.02 to 0.27	0.25 to 3.31	0.05 to 0.67	0.01	0.78	0.02	0.03 to 0.28	1.03 to 4.09	0.07 to 0.69	1.13 to 5.06
Morecambe Generation Assets	5	397	72	0.00	0.91	0.00	0.2007	0.3141[b]	0.2471	0.01 to 0.08	0.75 to 9.96	0.11 to 1.43	0.00	0.29	0.00	0.01 to 0.08	1.03 to 10.25	0.11 to 1.43	1.15 to 11.76
Morgan Generation Assets	21	139	38	0.00	0.37	0.01	0.2007	0.258[b]	0.2471	0.02 to 0.33	0.21 to 2.86	0.06 to 0.75	0.00	0.10	0.01	0.02 to 0.33	0.32 to 3.11	0.06 to 0.76	0.41 to 4.20
Ormonde Wind Farm	2	199	3	0.00	6.72	0.00	0.2007	0.258[c]	0.2471	0.00 to 0.03	0.31 to 4.11	0.01 to 0.07	0.00	1.73	0.00	0.00 to 0.03	2.04 to 5.84	0.01 to 0.07	2.05 to 5.94
Walney (3 and 4) Extension Offshore Wind Farm	14	150	151	0.16	16.30	2.89	0.2007	0.258[c]	0.2471	0.02 to 0.23	0.23 to 3.10	0.22 to 2.98	0.03	4.20	0.73	0.05 to 0.26	4.44 to 7.30	0.95 to 3.71	5.43 to 11.26
West of Duddon Sands Offshore Wind Farm	7	431	10	0.05	1.96	0.06	0.2007	0.258[c]	0.2471	0.01 to 0.10	0.67 to 8.90	0.02 to 0.21	0.01	0.51	0.01	0.02 to 0.11	1.17 to 9.40	0.03 to 0.22	1.22 to 9.74
West of Orkney Windfarm	35	958	682	0.37	33.80	2.26	0.2007	No connectivity	0.2471	0.04 to 0.56	-	1.01 to 13.48	0.07	-	0.57	0.12 to 0.64	N/A	1.58 to 14.05	1.69 to 14.68
White Cross Offshore Windfarm	83	239	44	0.00	4.42	0.30	0.2007	0.5208[b]	0.2471	0.10 to 1.34	0.75 to 9.96	0.07 to 0.88	0.00	2.30	0.07	0.10 to 1.34	3.05 to 12.26	0.14 to 0.95	3.29 to 14.55
Gap-filled projects																			
Barrow Offshore Wind Farm	0	2	1	0.01	0.36	0.01	0.2007	0.258[b]	0.2471	0.00 to 0.03	0.01 to 0.17	0.01 to 0.07	0.00	0.09	0.00	0.00 to 0.03	0.11 to 0.26	0.01 to 0.07	0.12 to 0.36
Burbo Bank	2	6	3	0.01	0.36	0.01	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.01 to 0.18	0.00 to 0.06	0.00	0.13	0.00	0.00 to 0.03	0.15 to 0.31	0.01 to 0.06	0.16 to 0.40
Gwynt y Môr Offshore Wind Farm	8	27	12	0.18	7.30	0.22	0.2007	0.367[d]	0.2471	0.01 to 0.12	0.06 to 0.79	0.02 to 0.23	0.04	2.68	0.05	0.05 to 0.16	2.74 to 3.47	0.07 to 0.28	2.85 to 3.92
North Hoyle Offshore Wind Farm	0	3	1	0.02	0.74	0.02	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.02 to 0.20	0.00 to 0.06	0.00	0.27	0.01	0.01 to 0.03	0.29 to 0.47	0.01 to 0.06	0.30 to 0.56

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) (species-group avoidance rate 0.9928 and 70% macro-avoidance during the non-breeding season)[f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928 and 70% macro-avoidance during the non-breeding season)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Robin Rigg	2	11	4	0.02	0.70	0.02	0.2007	0.258[c]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.08	0.00	0.18	0.01	0.01 to 0.04	0.20 to 0.41	0.01 to 0.09	0.21 to 0.53
Rhyl Flats Offshore Wind Farm	2	8	3	0.07	1.04	0.03	0.2007	0.367[d]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.07	0.01	0.38	0.01	0.02 to 0.05	0.40 to 0.62	0.01 to 0.08	0.43 to 0.75
Walney 1 and 2	9	36	15	0.05	1.91	0.06	0.2007	0.258[c]	0.2471	0.01 to 0.14	0.06 to 0.74	0.02 to 0.30	0.01	0.49	0.01	0.02 to 0.15	0.55 to 1.24	0.04 to 0.31	0.60 to 1.70
Total predicted impact (adult birds)										0.38 to 5.11	9.56 to 127.42	2.82 to 37.61	0.29	53.86	1.73	0.68 to 5.45	63.44 to 181.64	4.56 to 39.46	68.58 to 226.46
Increase in baseline mortality (%) (baseline mortality of 5,834)										0.01% to 0.16%	0.31% to 4.10%	0.09% to 1.21%	0.00%	0.92%	0.03%	0.01% to 0.09%	1.09% to 3.11%	0.08% to 0.68%	1.18% to 3.88%

Table 1-7: Matrix table showing the predicted mortalities in baseline mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%).

Northern gannet (Annual)	Mortality rate (%)					
	1%	2%	3%	4%	5%	10%
Displacement rate (%) 60%	68.58	81.38	94.18	106.99	119.79	183.80
70%	70.71	85.65	100.58	115.52	130.46	205.13
80%	72.85	89.92	106.99	124.05	141.12	226.47

Table 1-8: Matrix table showing the percentage increase in baseline mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%).

Northern gannet (Annual)	Mortality rate (%)					
	1%	2%	3%	4%	5%	10%
Displacement rate (%) 60%	1.18%	1.39%	1.61%	1.83%	2.05%	3.15%
70%	1.21%	1.47%	1.72%	1.98%	2.24%	3.52%
80%	1.25%	1.54%	1.83%	2.13%	2.42%	3.88%

As the predicted impact on northern gannet from Grasholm SPA is predicted to be >1% increase in baseline mortality under several scenarios, the impact is further investigated by a PVA (see section 1.4.3) to determine whether AEoSI can be ruled out beyond reasonable scientific doubt.

1.3.4 Northern gannet from Grassholm SPA – with 70% macro-avoidance annually

1.3.4.1 As the impact from the Mona Offshore Wind Project alone was predicted to result in a >0.05% increase in northern gannet baseline mortality from Grassholm SPA when considering a 10% mortality rate (see Table 1-1), an in-combination assessment is presented within Table 1-9 (the values presented represent 60-80% displacement and 1-10% mortality and the species-group avoidance rate). The displacement (60-80%) and mortality (1-10%) rates were requested during the EWGs. The collision estimates have been reduced to account for 70% macro-avoidance, as a bird can not be displaced and also susceptible to collision at the same time. Macro-avoidance has been applied year round.

1.3.4.2 Table 1-11 provides a matrix table showing the percentage increase in baseline mortality for the full range of JNCC and NRW (A) advised displacement (60-80) and mortality (1-10%) rates. Table 1-11 also includes the predicted collision impacts.

Table 1-9: In-combination assessment for northern gannet from the Grassholm SPA.

a – During the breeding season site-specific age-class values have been used for Awel y Mor (93.5%), Erebus Floating Wind Project (99.0%), Llŷr Floating Offshore Wind Project (95.99%), Mona Offshore Wind Project (93.58%), Morecambe Generation Assets (73.3%) and Morgan Generation Assets (94.94%) or where no site-specific data was available, 100% of birds are assumed to be adults. During the non-breeding season the age-class proportions are derived from the adult/immature proportion from the Appendix tables of (Furness, 2015) which are 59.16% of birds are adults in the pre-breeding period and 58.25% of birds are adults in the post-breeding season.

b – the apportioning value during the breeding season was taken from project specific documentation (Awel y Môr, 2022; Erebus, 2021b; Llŷr 1 Floating Offshore Wind Farm, 2024b; Morgan Generation Assets, 2024b; Volume 6, Annex 5.5: Offshore Ornithology Apportioning Technical Report (REP2-022); Morecambe Generation Assets, 2024b)

c – the apportioning value during the breeding season has used that of Morgan Offshore Wind Project Generation Assets, specifically 0.258.

d – the apportioning value during the breeding season has used that of Awel y Môr Offshore Wind Farm, specifically 0.367.

e – the apportioning value during the breeding seas has used that of Llŷr 1 Floating Offshore Wind Farm, specifically 0.969.

f – the Applicant has presented the collision impacts using a 99.28% avoidance rate and a 70% macro-avoidance, therefore some of the numbers presented have been corrected from the original application documents for some sites.

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) (species-group avoidance rate 0.9928 and 70% macro-avoidance annually)[f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928 and 70% macro-avoidance annually)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Awel y Môr Offshore Wind Farm	0	307	117	0.00	3.05	0.44	0.2007	0.367[b]	0.2471	0.00 to 0.00	0.68 to 9.00	0.17 to 2.31	0.00	1.12	0.11	0.00 to 0.00	1.38 to 9.71	0.28 to 2.43	1.67 to 12.14
Burbo Bank Extension Offshore Wind Farm	15	648	13	0.00	3.73	0.00	0.2007	0.367[d]	0.2471	0.02 to 0.24	1.43 to 19.03	0.02 to 0.25	0.00	1.37	0.00	0.02 to 0.24	2.24 to 19.84	0.02 to 0.25	2.27 to 20.33
Erebus Floating Wind Project	59	222	195	0.36	3.34	0.35	0.2007	0.995[b]	0.2471	0.07 to 0.95	1.32 to 17.65	0.29 to 3.85	0.07	3.32	0.09	0.14 to 1.02	4.64 to 20.97	0.38 to 3.93	5.16 to 25.93
TwinHub (Wave Hub Floating Wind Farm)	0	244	89	0.00	7.84	0.00	0.2007	0.969[e]	0.2471	0.00 to 0.00	1.46 to 18.91	0.13 to 1.76	0.00	7.59	0.00	0.00 to 0.00	5.91 to 23.41	0.13 to 1.76	6.04 to 25.17
Llŷr 1 Floating Offshore Wind Farm	38	236	416	0.05	0.86	0.09	0.2007	0.969[b]	0.2471	0.05 to 0.62	1.37 to 18.31	0.62 to 8.23	0.01	0.84	0.02	0.06 to 0.63	1.89 to 18.82	0.64 to 8.26	2.59 to 27.70
Mona Offshore Wind Project	17	235	34	0.07	1.33	0.09	0.2007	0.176[b]	0.2471	0.02 to 0.27	0.25 to 3.31	0.05 to 0.67	0.01	0.23	0.02	0.03 to 0.28	0.40 to 3.45	0.07 to 0.69	0.50 to 4.43
Morecambe Generation Assets	5	397	72	0.00	0.91	0.00	0.2007	0.3141[b]	0.2471	0.01 to 0.08	0.75 to 9.96	0.11 to 1.43	0.00	0.29	0.00	0.01 to 0.08	1.03 to 10.25	0.11 to 1.43	1.15 to 11.76
Morgan Generation Assets	21	139	38	0.00	0.37	0.01	0.2007	0.258[b]	0.2471	0.02 to 0.33	0.21 to 2.86	0.06 to 0.75	0.00	0.10	0.01	0.02 to 0.33	0.32 to 3.11	0.06 to 0.76	0.41 to 4.20
Ormonde Wind Farm	2	199	3	0.00	2.02	0.00	0.2007	0.258[c]	0.2471	0.00 to 0.03	0.31 to 4.11	0.01 to 0.07	0.00	0.52	0.00	0.00 to 0.03	0.62 to 4.42	0.01 to 0.07	0.62 to 4.51
Walney (3 and 4) Extension Offshore Wind Farm	14	150	151	0.16	4.89	2.89	0.2007	0.258[c]	0.2471	0.02 to 0.23	0.23 to 3.10	0.22 to 2.98	0.03	1.26	0.73	0.05 to 0.26	0.98 to 3.84	0.95 to 3.71	1.98 to 7.81
West of Duddon Sands Offshore Wind Farm	7	431	10	0.05	0.59	0.06	0.2007	0.258[c]	0.2471	0.01 to 0.10	0.67 to 8.90	0.02 to 0.21	0.01	0.15	0.01	0.02 to 0.11	0.76 to 8.99	0.03 to 0.22	0.80 to 9.32
West of Orkney Windfarm	35	958	682	0.37	10.14	2.26	0.2007	No connectivity	0.2471	0.04 to 0.56	-	1.01 to 13.48	0.07	-	0.57	0.12 to 0.64	-	1.58 to 14.05	1.69 to 14.69
White Cross Offshore Windfarm	83	239	44	0.00	1.33	0.30	0.2007	0.5208[b]	0.2471	0.10 to 1.34	0.75 to 9.96	0.07 to 0.88	0.00	0.69	0.07	0.10 to 1.34	1.16 to 10.37	0.14 to 0.95	1.40 to 12.65
Gap-filled projects																			
Barrow Offshore Wind Farm	0	2	1	0.01	0.11	0.01	0.2007	0.258[b]	0.2471	0.00 to 0.03	0.01 to 0.17	0.01 to 0.07	0.00	0.03	0.00	0.00 to 0.03	0.03 to 0.18	0.01 to 0.07	0.04 to 0.28

Project	Un-apportioned abundances (adult birds [a])			Un-apportioned collision impacts (adult birds [a]) (species-group avoidance rate 0.9928 and 70% macro-avoidance annually)[f]			Apportioning values			Apportioned displacement impact values (60-80% displacement and 1-10% mortality)			Apportioned collision (species-group avoidance rate 0.9928 and 70% macro-avoidance annually)			Combined impact			
	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Pre-breeding	Breeding	Post-breeding	Annual
Burbo Bank	2	6	3	0.01	0.11	0.01	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.01 to 0.18	0.00 to 0.06	0.00	0.04	0.00	0.00 to 0.03	0.04 to 0.20	0.01 to 0.06	0.05 to 0.29
Gwynt y Môr Offshore Wind Farm	8	27	12	0.18	2.19	0.22	0.2007	0.367[d]	0.2471	0.01 to 0.12	0.06 to 0.79	0.02 to 0.23	0.04	0.80	0.05	0.05 to 0.16	0.53 to 1.27	0.07 to 0.28	0.65 to 1.71
North Hoyle Offshore Wind Farm	0	3	1	0.02	0.22	0.02	0.2007	0.367[d]	0.2471	0.00 to 0.03	0.02 to 0.20	0.00 to 0.06	0.00	0.08	0.01	0.01 to 0.03	0.06 to 0.24	0.01 to 0.06	0.08 to 0.34
Robin Rigg	2	11	4	0.02	0.21	0.02	0.2007	0.258[c]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.08	0.00	0.05	0.01	0.01 to 0.04	0.05 to 0.26	0.01 to 0.09	0.07 to 0.39
Rhyl Flats Offshore Wind Farm	2	8	3	0.07	0.31	0.03	0.2007	0.367[d]	0.2471	0.00 to 0.04	0.02 to 0.23	0.01 to 0.07	0.01	0.11	0.01	0.02 to 0.05	0.09 to 0.30	0.01 to 0.08	0.12 to 0.43
Walney 1 and 2	9	36	15	0.05	0.57	0.06	0.2007	0.258[c]	0.2471	0.01 to 0.14	0.06 to 0.74	0.02 to 0.30	0.01	0.15	0.01	0.02 to 0.15	0.14 to 0.83	0.04 to 0.31	0.20 to 1.30
Total predicted impact (adult birds)										**0.38 to 5.11**	**9.56 to 127.42**	**2.82 to 37.61**	**0.29**	**18.75**	**1.73**	**0.68 to 5.45**	**28.33 to 146.53**	**4.46 to 39.37**	**33.47 to 191.35**
Increase in baseline mortality (%) (baseline mortality of 5,834)										**0.01% to 0.16%**	**0.31% to 4.10%**	**0.09% to 1.21%**	**0.00%**	**0.32%**	**0.03%**	**0.01% to 0.09%**	**0.49% to 2.51%**	**0.08% to 0.67%**	**0.57% to 3.28%**

Table 1-10: Matrix table showing the predicted mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%).

Northern gannet (Annual)		Mortality rate (%)					
		1%	2%	3%	4%	5%	10%
Displacement rate (%)	60%	33.47	46.27	59.07	71.88	84.68	148.69
	70%	35.60	50.54	65.48	80.41	95.35	170.03
	80%	37.74	54.81	71.88	88.95	106.02	191.36

Table 1-11: Matrix table showing the percentage increase in baseline mortality for the range of potential annual in-combination impacts from displacement and collisions on northern gannet from the Grassholm SPA (red text indicates >1%).

Northern gannet (Annual)		Mortality rate (%)					
		1%	2%	3%	4%	5%	10%
Displacement rate (%)	60%	0.57%	0.79%	1.01%	1.23%	1.45%	2.55%
	70%	0.61%	0.87%	1.12%	1.38%	1.63%	2.91%
	80%	0.65%	0.94%	1.23%	1.52%	1.82%	3.28%

1.3.4.3   As the predicted impact on northern gannet from Grasholm SPA is predicted to be >1% increase in baseline mortality under several scenarios, the impact is further investigated by a PVA (see section 1.4.3) to determine whether AEoSI can be ruled out beyond reasonable scientific doubt.

1.4 Population Viability Analysis

1.4.1.1 A PVA has been undertaken for northern gannet from Grassholm SPA which exceeds a >1% increase in baseline mortality for the upper displacement and mortality range as advised by the SNCBs during the EWGs.

1.4.1.2 The full methodology for running the PVA is presented in Volume 6, Annex 5.6: Offshore ornithology Population Viability Analysis Technical Report (REP2-024). All PVAs were run density independently which is in line with best practice (Parker *et al*., 2022; NatureScot, 2023), and therefore, the counterfactual of growth rate (CGR) is a more useful metric than counterfactual of population size (CPS). Full input parameters are presented in Appendix A:.

1.4.2 Northern gannet from Grassholm SPA – without macro-avoidance

1.4.2.1 Four scenarios were modelled within the PVA for northern gannet from Grassholm SPA, considering the lowest and highest advised scenarios of 60-80% displacement and 1-10% mortality plus collisions in line with NRW (A) advice during the EWGs (scenario A & D), the Applicant's HRA approach (70% displacement and 1% mortality plus collisions) (scenario B), and assuming 80% displacement and 1% mortality (scenario D).

1.4.2.2 The Applicant has presented three scenarios using 1% mortality as this is deemed an appropriate mortality rate to present (alongside the range of impacts). Northern gannet have a larger foraging range (517.7km when using the mean maximum plus one standard deviation from Woodward *et al*, 2019), which means each foraging trip a northern gannet can travel a great distance before returning to provision it's chick. Therefore, being displaced over 10s of km to avoid windfarm is potentially not a large detour for a bird which can travel over 500 km on a foraging trip. The likelihood that this detour would result in an energetic increase resulting in 10% mortality is highly unlikely and has not been empirically recorded. Whilst the Applicant has presented an assessment based on 80% displacement and 10% mortality in line with the advice received during the EWGs, it is considered that a mortality rate of 1% is sufficiently precautionary.

Table 1-12: Summary of the annual in-combination impacts used in the PVA for northern gannet from Grassholm SPA.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 60% displacement and 1% mortality plus predicted collisions	72.89	1.25%	0.001012008
B: 70% displacement and 1% mortality plus predicted collisions	75.02	1.29%	0.001041633
C: 80% displacement and 1% mortality plus predicted collisions	77.37	1.32%	0.001071259
D: 80% displacement and 10% mortality plus predicted collisions	230.78	3.96%	0.003204282

1.4.2.3   The PVA resulted in a predicted impact, which indicates that median growth rate (and 95% confidence intervals) continues to be >1 and, therefore indicates that the population is predicted to increase in size under these modelled parameters (Table 1-13; Figure 1.3). The CGR also indicates the impact scenario is close to the baseline or the non-impacted predicted growth rate (between 0.1%- 0.4% difference).

Table 1-13: PVA outputs for northern gannet from Grassholm SPA.

| Year	Impact scenario	Median adult population size	Population change (%) since 2015	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	86,267	1.76%	1.018	0.905	1.083	-	-
	Scenario A	86,096	1.57%	1.016	0.903	1.083	0.998	0.999
	Scenario B	86,024	1.59%	1.016	0.902	1.084	0.999	0.999
	Scenario C	86,301	1.62%	1.016	0.903	1.083	0.999	0.999
	Scenario D	86,030	1.35%	1.013	0.901	1.079	0.996	0.996
2065	Baseline	130,687	54.89%	1.012	1.001	1.023	-	-
	Scenario A	125,102	48.37%	1.011	1.000	1.021	0.958	0.999
	Scenario B	125,250	48.22%	1.011	1.000	1.021	0.956	0.999
	Scenario C	124,970	47.98%	1.011	1.000	1.021	0.955	0.999
	Scenario D	114,005	34.96%	1.008	0.997	1.019	0.872	0.996
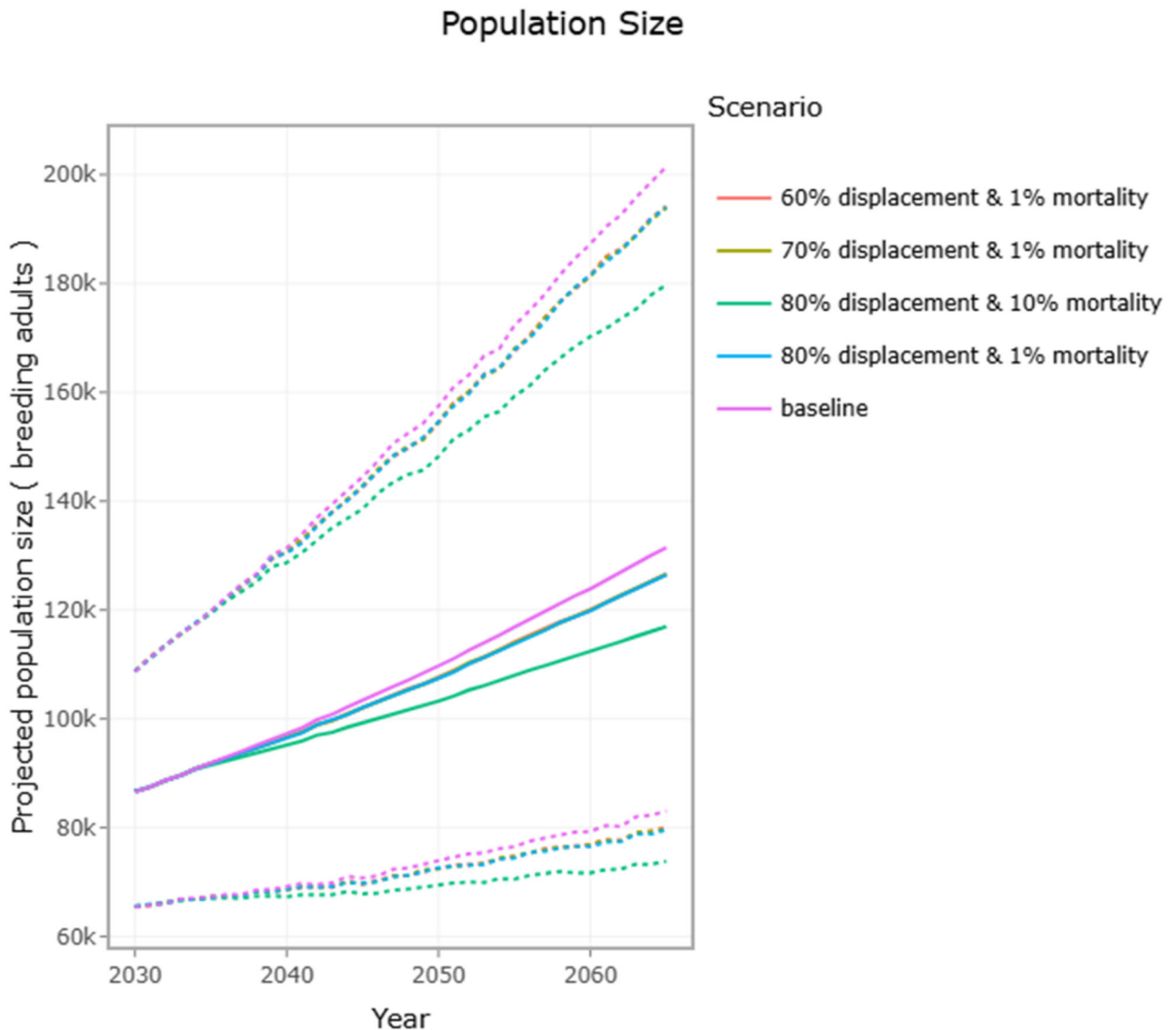
Figure 1.3: PVA output graph for northern gannet from Grassholm SPA (dashed lines represent the 95% LCI and UCI)

1.4.2.4   As the results of the PVA undertaken for northern gannet from Grassholm SPA indicate an increasing population size with and without the predicted impacts, it can be concluded beyond reasonable scientific doubt, that there is no AEoSI, when considering the Mona Offshore Wind Project in-combination with other plans and projects. In reaching this conclusion, the Applicant has considered the site's conservation objectives (Appendix to ExQ1 Q1.10.6 Part B Conservation objectives for SPAs screened in for Likely Significant Effects (REP3-068)), specifically the requirement for the Grassholm SPA population to remain >30,000 pairs. This conclusion replicates what was previously presented in HRA Stage 2 ISAA Part Three: Special Protection Areas and Ramsar sites Assessments (REP2-010) and the Offshore ornithology additional supporting in-combination assessment information in line with SNCB advice (REP4-030) note.

1.4.3 Northern gannet from Grassholm SPA – with 70% macro-avoidance during the non-breeding season

1.4.3.1 Four scenarios were modelled within the PVA for northern gannet from Grassholm SPA, considering the lowest and highest advised scenarios of 60-80% displacement and 1-10% mortality plus collisions in line with NRW (A) advice during the EWGs (scenario A & D), the Applicant's HRA approach (70% displacement and 1% mortality plus collisions) (scenario B), and assuming 80% displacement and 1%mortality (scenario D).

Table 1-14: Summary of the annual in-combination impacts used in the PVA for northern gannet from Grassholm SPA.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 60% displacement and 1% mortality plus predicted collisions	68.58	1.18%	0.000952195
B: 70% displacement and 1% mortality plus predicted collisions	70.71	1.21%	0.000981821
C: 80% displacement and 1% mortality plus predicted collisions	72.85	1.25%	0.001011446
D: 80% displacement and 10% mortality plus predicted collisions	226.47	3.88%	0.003144469

1.4.3.2 The PVA resulted in a predicted impact, which indicates that median growth rate (and 95% confidence intervals) continues to be >1 and, therefore indicates that the population is predicted to increase in size under these modelled parameters (Table 1-13;Figure 1.5). The CGR also indicates the impact scenario is close to the baseline or the non-impacted predicted growth rate (between 0.1%- 0.4% difference).

Table 1-15: PVA outputs for northern gannet from Grassholm SPA.

Year	Impact scenario	Median adult population size	Population change (%) since 2015	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	86,267	1.76	1.018	0.905	1.083		
	Scenario A	86,181	1.64	1.016	0.903	1.083	0.999	0.999
	Scenario B	86,103	1.61	1.016	0.902	1.083	0.999	0.999
	Scenario C	86,268	1.58	1.016	0.904	1.083	0.999	0.999
	Scenario D	86,047	1.34	1.013	0.903	1.081	0.996	0.997
2065	Baseline	130,687	54.89	1.012	1.001	1.023		
	Scenario A	125,663	48.77	1.011	1.000	1.022	0.960	0.999

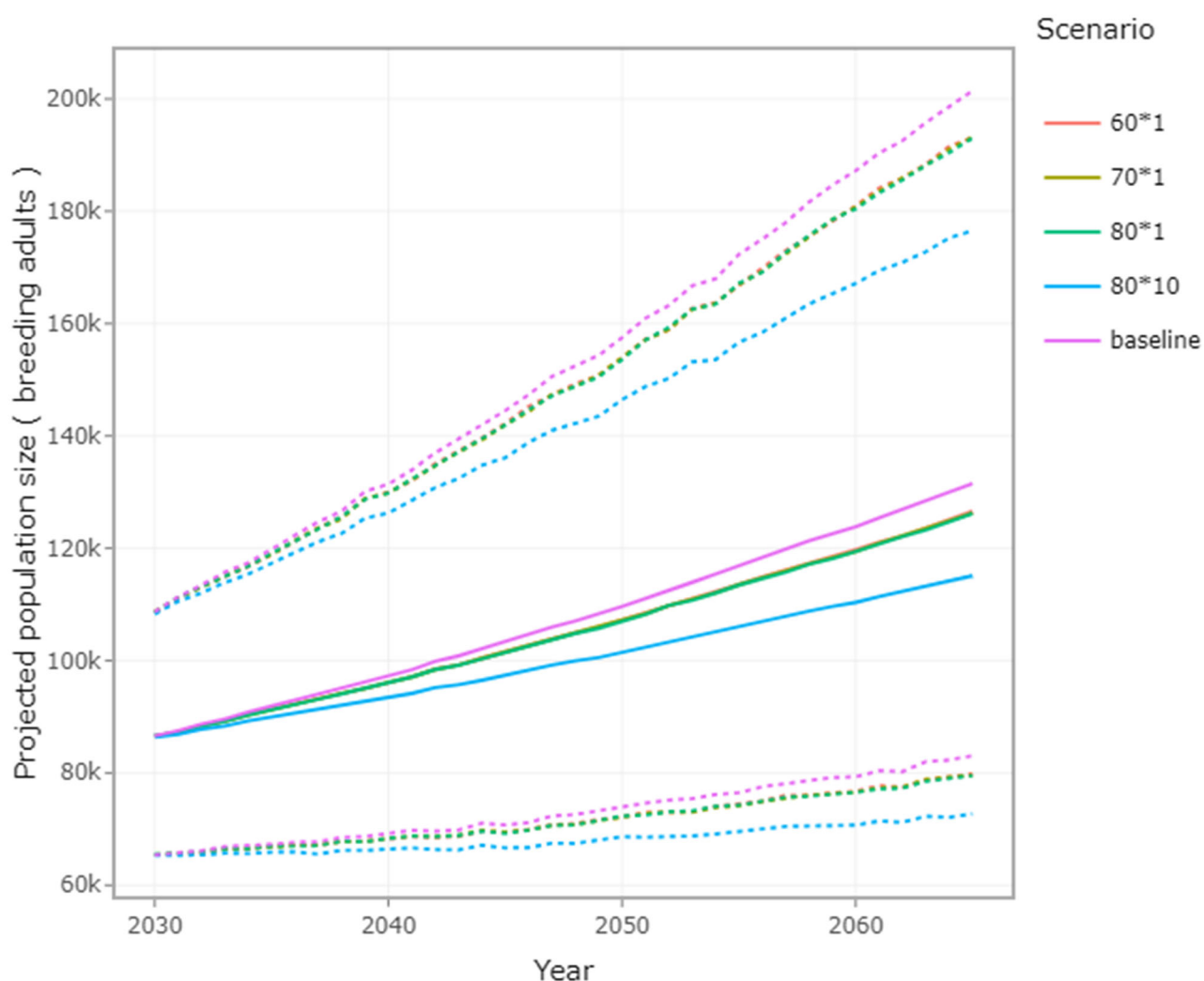| Year	Impact scenario	Median adult population size	Population change (%) since 2015	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
	Scenario B	125,520	48.02	1.011	1.000	1.022	0.958	0.999
	Scenario C	125,339	48.21	1.011	1.000	1.021	0.957	0.999
	Scenario D	114,506	35.33	1.008	0.997	1.019	0.875	0.996

Figure 1.4: PVA output graph for northern gannet from Grassholm SPA (dashed lines represent the 95% LCI and UCI)

1.4.3.3   As the results of the PVA undertaken for northern gannet from Grassholm SPA indicate an increasing population size with and without the predicted impacts, it can be concluded beyond reasonable scientific doubt, that there is no AEoSI when considering the Mona Offshore Wind Project in-combination with other plans and projects. In reaching this conclusion, the Applicant has considered the site's conservation objectives (Appendix to ExQ1 Q1.10.6 Part B Conservation objectives

for SPAs screened in for Likely Significant Effects (REP3-068)), specifically the requirement for the Grassholm SPA population to remain >30,000 pairs. This conclusion replicates what was previously presented in HRA Stage 2 ISAA Part Three: Special Protection Areas and Ramsar sites Assessments (REP2-010) and the Offshore ornithology additional supporting in-combination assessment information in line with SNCB advice (REP4-030) note.

1.4.4 Northern gannet from Grassholm SPA – with 70% macro-avoidance annually

1.4.4.1 Five scenarios were modelled within the PVA for northern gannet from Grassholm SPA, considering the same four scenarios as presented without macro-avoidance (Table 1-12 and Table 1-13) and an additional one where the impact increased the baseline mortality by >1% (which was when assuming 60% displacement and 3% mortality; Table 1-11).

Table 1-16: Summary of the annual in-combination impacts used in the PVA gannet from Grassholm SPA.

Scenario	Predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 60% displacement and 1% mortality plus predicted collisions	33.47	0.57%	0.000464730
B: 70% displacement and 1% mortality plus predicted collisions	35.60	0.61%	0.000494356
C: 80% displacement and 1% mortality plus predicted collisions	37.74	0.65%	0.000523981
D: 60% displacement and 3% mortality plus predicted collisions (the first impact within matrix Table 1-11which is >1%)	59.07	1.01%	0.000820234
E: 80% displacement and 10% mortality plus predicted collisions	191.36	3.28%	0.002657004

1.4.4.2 The PVA resulted in a predicted impact, which indicates that median growth rate continues to be >1 and, therefore indicates that the population is predicted to increase in size under these modelled parameters (Table 1-17; Figure 1.5). The CGR also indicates the impact scenario is close to the baseline or the non-impacted predicted growth rate (between 0.0%- 0.3% difference).

Table 1-17: PVA outputs for northern gannet from Grassholm SPA.

| Year	Impact scenario	Median adult population size	Population change (%) since 2015	Median growth rate	2.5 percentile of growth rate	97.5 percentile of growth rate	Median CPS	Median CGR
2030	Baseline	86,587	2.03%	1.020	0.912	1.085		
	Scenario A	86,576	1.99%	1.020	0.912	1.085	0.999	0.999
	Scenario B	86,602	1.98%	1.020	0.911	1.084	1.000	0.999
	Scenario C	86,508	1.96%	1.020	0.912	1.085	0.999	0.999
	Scenario D	86,582	1.92%	1.019	0.911	1.084	0.999	0.999
	Scenario E	86,389	1.75%	1.018	0.909	1.082	0.997	0.997
2065	Baseline	131,548	55.19%	1.012	1.001	1.023		
	Scenario A	128,927	52.45%	1.012	1.000	1.022	0.980	0.999
	Scenario B	128,786	52.11%	1.012	1.000	1.022	0.979	0.999
	Scenario C	128,692	51.84%	1.012	1.000	1.022	0.978	0.999
	Scenario D	127,028	50.09%	1.011	1.000	1.022	0.966	0.999
	Scenario E	117,501	38.60%	1.009	0.998	1.019	0.893	0.997
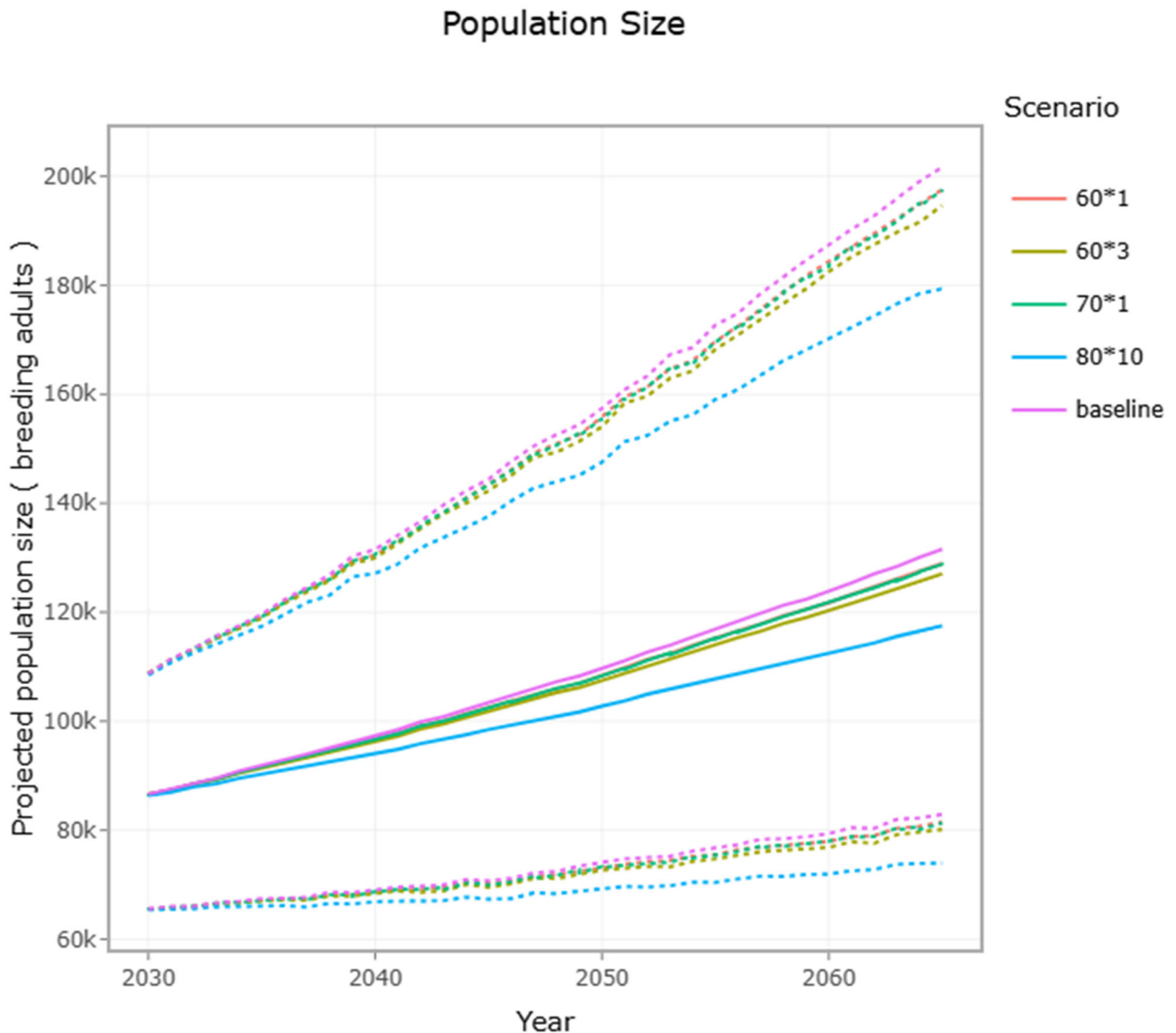
Figure 1.5: PVA output graph for northern gannet from Grassholm SPA (dashed lines represent the 95% LCI and UCI)

1.4.4.3   As the results of the PVA undertaken for northern gannet from Grassholm SPA indicate an increasing population size with and without the predicted impacts concluded beyond reasonable scientific doubt, that there is no AEoSI, when considering the Mona Offshore Wind Project in-combination with other plans and projects. Through the process of reaching this conclusion, the Applicant has considered the sites conservation objectives (Appendix to ExQ1 Q1.10.6 Part B Conservation objectives for SPAs screened in for Likely Significant Effects (REP3-068)), specifically the requirement for the Grassholm SPA population to remain >30,000 pairs). This conclusion replicates what was previously presented in HRA Stage 2 ISAA Part Three: SPAs and Ramsar sites Assessments (REP2-010) and the Offshore ornithology additional supporting in-combination assessment information in line with SNCB advice (REP4-030) note.

1.5   Discussion and conclusions

1.5.1.1   The Applicant maintains its conclusion that AEoSI can be ruled out beyond reasonable scientific doubt for northern gannet from Grassholm SPA from the Mona Offshore Wind Project alone due to lack of connectivity and the small predicted impact. NRW (A) agreed at Deadline 5 that the Mona Offshore Wind Project alone would not result in an AEoSI for this site and feature.

1.5.1.2   This updated assessment presented in this note uses the 2015 northern gannet population count from Grassholm, which is contemporaneous with the site-specific baseline surveys carried out between March 2020 and February 2022, in that they were undertaken prior to the impact HPAI had on the breeding population and is consistent with that assessed in the HRA Stage 2 Information to Support an Appropriate Assessment (ISAA) Part Three: SPAs and Ramsar sites Assessments (REP2-010). The assessment has examined a range of displacement, mortality rate and macro-avoidance scenarios in accordance with NRW (A)'s recent advice to enable a suitably robust review of the potential lower and upper worst-case predicted in-combination impacts on northern gannet from Grassholm SPA against the site conservation objectives.

1.5.1.3   The PVAs have shown that the predicted in-combination impact would decrease the median counterfactual growth rate by between 0.01 - 0.4% under the range of scenarios modelled (assuming 60-80% displacement, 1-10% mortality and with and out any macro-avoidance applied). Under all other modelled scenarios the predicted decrease in the counterfactual of the growth rate is no greater than 1%. The northern gannet population at Grassholm SPA is predicted increase in size and to remain >30,000 pairs under all modelled scenarios, and therefore, the conservation objectives for the site can be met under all impact scenarios.

1.5.1.4   The Applicant would highlight that the PVA outputs should be considered in the context of the level of precaution captured within the PVAs themselves and the input parameters. These include:

- Tracking data suggests a lack of connectivity between Grassholm SPA and the Mona Array Area and, indeed, other projects located in the Irish Sea (see paragraphs 1.2.1.6 to 1.2.1.7) and therefore, breeding season apportionment and subsequent predicted impacts are likely to be overestimated;

- The displacement rates considered include those at the upper end of the range advised by the SNCBs for use in assessments, which are likely to overestimate mortality due to the species large foraging range and low habitat specialisation;

- Mortality rates in excess of 1% are likely to be overly precautionary (see paragraph 1.3.2.1 for further justification);

- The latest scientific evidence shows gannet to display a high level of macro-avoidance (Peschko *et al*., 2021, Pavat *et al*, 2023) and so scenarios which assume no macro-avoidance should be regarded as precautionary; and

- The use of consented offshore wind farm design parameters in the CRM is likely to overestimate collision impacts as offshore wind farms are rarely built out to their fully consented design and therefore the collision risk associated with constructed wind farms is often lower than predicted.

1.5.1.5   The Applicant acknowledges that northern gannet suffered from HPAI during the 2022 breeding season, resulting in a decline in the population at Grassholm (Tremlett et al. 2024). Initial guidance from Natural England on the consideration of HPAI Natural

England, 2022) states that (in paragraph 4): "*We expect seabird data collected prior to summer 2022 (approx. June) to remain a valid representation of 'typical' seabird distribution and density, as this was before mass mortality events began to take place*". The Applicant considers that this supports the use of a population count that is contemporaneous with the site-specific baseline surveys for the Mona Offshore Wind Project (as has been used in this assessment). This guidance also sets an expectation that at a broad level, the resultant declines in colony populations will be associated with proportionate reductions in the abundance of birds from such colonies in at-sea surveys, with the consequence that the scale of impact is likely to remain in proportion to the size of the colony. Thus, the Applicant considers that the assessment presented to be sufficiently robust.

1.5.1.6   Overall, the Applicant considers that the updated assessment presented in this note demonstrates beyond reasonable scientific doubt that AEoSI on the northern gannet feature of the Grassholm SPA can be ruled for the Mona Offshore Wind Project in combination with other plans and projects. This conclusion is consistent with that reached in the HRA Stage 2 Information to Support an Appropriate Assessment (ISAA) Part Three: SPAs and Ramsar sites Assessments (REP2-010).

1.6   References

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Llŷr 1 Floating Offshore Wind Farm (2024a). Volume 6: Appendix 22A – Marine Ornithology Baseline

Llŷr 1 Floating Offshore Wind Farm (2024b). Volume 6: Appendix 22B – Marine Ornithology Colony Apportioning

Morecambe Generation Assets (2024a) Appendix 12.2 Aerial Survey Two Year Report March 2021 to February 2023

Morecambe Generation Assets (2024b) Volume 5 - Appendix 12.1 - Offshore Ornithology Technical Report

Morgan Generation Assets (2024a). Volume 4, Annex 5.5: Offshore Ornithology Apportioning Technical Report

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Tremlett, C.J., Morley, N., and Wilson, L.J. (2024). UK seabird colony counts in 2023 following the 2021- 22 outbreak of Highly Pathogenic Avian Influenza. RSPB Research Report 76. RSPB Centre for Conservation Science, RSPB, The Lodge, Sandy, Bedfordshire, SG19 2DL.

Trevail, A. (2019). Environmental drivers of variability in population and individual foraging strategies. PhD Thesis University of Liverpool.

Trevail, A. M., Green, J. A., Sharples, J., Polton, J. A., Arnould, J. P., & Patrick, S. C. (2019). Environmental heterogeneity amplifies behavioural response to a temporal cycle. Oikos, 128(4), 517-528.

Appendix A: PVA modelling parameters

A.1.1 PVA input parameters for northern gannet from Grassholm SPA – without macro-avoidance

A.1.1.1 Set up

The log file was created on: 2024-12-16 10:05:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                   Package            Version
## popbio           "popbio"           "2.4.4"
## shiny            "shiny"            "1.1.0"
## shinyjs          "shinyjs"          "1.0"
## shinydashboard   "shinydashboard"   "0.7.1"
## shinyWidgets     "shinyWidgets"     "0.4.5"
## DT               "DT"               "0.5"
## plotly           "plotly"           "4.8.0"
## rmarkdown        "rmarkdown"        "1.10"
## dplyr            "dplyr"            "0.7.6"
## tidyr            "tidyr"            "0.8.1"
```

A.1.1.2 Basic information

This run had reference name "Grassholm_GX_In-comb_100Adult".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

A.1.1.3 Baseline demographic rates

Species chosen to set initial values: Northern gannet.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

A.1.1.4   Population 1

Initial population values: Initial population 72,022 in 2015

Productivity rate per pair: mean: 0.766 , sd: 0.051

Adult survival rate: mean: 0.919 , sd: 0.042

Immatures survival rates:

Age class 0 to 1 - mean: 0.424 , sd: 0.045 , DD: NA

Age class 1 to 2 - mean: 0.829 , sd: 0.026, DD: NA

Age class 2 to 3 - mean: 0.891 , sd: 0.019, DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.019, DD: NA

Age class 4 to 5 - mean: 0.919 , sd: 0.042 , DD: NA

A.1.1.5   Impacts

Number of impact scenarios: 4.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2065

A.1.1.6   Impact on Demographic Rates

Scenario A - Name: 60*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001041633, se: NA

Scenario B - Name: 70*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001044675, se: NA

Scenario C - Name: 80*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001071259, se: NA

Scenario D - Name: 80*10 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003204282, se: NA

A.1.1.7   Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: breeding.adults

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

A.1.2   PVA input parameters for northern gannet from Grassholm SPA – with macro-avoidance annually

A.1.2.1   Set up

The log file was created on: 2024-12-16 10:05:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                     Package          Version
## popbio           "popbio"          "2.4.4"
## shiny            "shiny"           "1.1.0"
## shinyjs          "shinyjs"         "1.0"
## shinydashboard   "shinydashboard"  "0.7.1"
## shinyWidgets     "shinyWidgets"    "0.4.5"
## DT               "DT"              "0.5"
## plotly           "plotly"          "4.8.0"
## rmarkdown        "rmarkdown"       "1.10"
## dplyr            "dplyr"           "0.7.6"
## tidyr            "tidyr"           "0.8.1"
```

A.1.2.2   Basic information

This run had reference name "Grassholm_GX_In-comb_Macro".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

A.1.2.3   Baseline demographic rates

Species chosen to set initial values: Northern gannet.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

A.1.2.4   Population 1

Initial population values: Initial population 72,022 in 2015

Productivity rate per pair: mean: 0.766 , sd: 0.051

Adult survival rate: mean: 0.919 , sd: 0.042

Immatures survival rates:

Age class 0 to 1 - mean: 0.424 , sd: 0.045 , DD: NA

Age class 1 to 2 - mean: 0.829 , sd: 0.026, DD: NA

Age class 2 to 3 - mean: 0.891 , sd: 0.019, DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.019, DD: NA

Age class 4 to 5 - mean: 0.919 , sd: 0.042 , DD: NA

A.1.2.5   Impacts

Number of impact scenarios: 5.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2065

A.1.2.6   Impact on Demographic Rates

Scenario A - Name: 60*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000464730, se: NA

Scenario B - Name: 70*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000494356, se: NA

Scenario C - Name: 80*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000523981, se: NA

Scenario D - Name: 60*3 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000820234, se: NA

Scenario E - Name: 80*10 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002657004, se: NA

A.1.2.7   Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: breeding.adults

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA

A.1.3   PVA input parameters for northern gannet from Grassholm SPA – with macro-avoidance during the non-breeding season

A.1.3.1   Set up

The log file was created on: 2024-12-16 10:05:25 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                   Package           Version
## popbio            "popbio"          "2.4.4"
## shiny             "shiny"           "1.1.0"
## shinyjs           "shinyjs"         "1.0"
## shinydashboard    "shinydashboard"  "0.7.1"
## shinyWidgets      "shinyWidgets"    "0.4.5"
## DT                "DT"              "0.5"
## plotly            "plotly"          "4.8.0"
## rmarkdown         "rmarkdown"       "1.10"
## dplyr             "dplyr"           "0.7.6"
## tidyr             "tidyr"           "0.8.1"
```

A.1.3.2   Basic information

This run had reference name "Grassholm_GX_In-comb_MacroNB".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 15.

Years for burn-in: 5.

Case study selected: None.

A.1.3.3   Baseline demographic rates

Species chosen to set initial values: Northern gannet.

Region type to use for breeding success data: Global.

Available colony-specific survival rate: National. Sector to use within breeding success region: Global.

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

Are baseline demographic rates specified separately for immatures?: Yes.

A.1.3.4   Population 1

Initial population values: Initial population 72,022 in 2015

Productivity rate per pair: mean: 0.766 , sd: 0.051

Adult survival rate: mean: 0.919 , sd: 0.042

Immatures survival rates:

Age class 0 to 1 - mean: 0.424 , sd: 0.045 , DD: NA

Age class 1 to 2 - mean: 0.829 , sd: 0.026, DD: NA

Age class 2 to 3 - mean: 0.891 , sd: 0.019, DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.019, DD: NA

Age class 4 to 5 - mean: 0.919 , sd: 0.042 , DD: NA

A.1.3.5   Impacts

Number of impact scenarios: 5.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2065

A.1.3.6   Impact on Demographic Rates

Scenario A - Name: 60*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000952195, se: NA

Scenario B - Name: 70*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000981821, se: NA

Scenario C - Name: 80*1 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001011446, se: NA

Scenario D - Name: 80*10 plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003144469, se: NA

A.1.3.7   Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: breeding.adults

Target population size to use in calculating impact metrics: NA

Quasi-extinction threshold to use in calculating impact metrics: NA