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MONA OFFSHORE WIND PROJECT

Offshore Ornithology Additional Supporting Cumulative Assessment Information in line with SNCB Advice

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Image of an offshore wind farm

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Term	Meaning
The Applicant	Mona Offshore Wind Limited. Mona Offshore Wind Limited is a joint venture between two leading energy companies (bp Alternative Energy Investments (hereafter referred to as bp) and Energie Baden-Württemberg AG (hereafter referred to as EnBW)).
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
AEoI	Adverse Effect on Integrity
BDMPS	Biologically Defined Minimum Population Scales
CEA	Cumulative Effects Assessment
CRM	Collision Risk Model
DAS	Digital Aerial Surveys
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EWG	Expert Working Group
HRA	Habitats Regulations Assessment
ISAA	Information to Support Appropriate Assessment
JNCC	Joint Nature Conservation Committee
MERP	Marine Ecosystems Research Programme
NRW	Natural Resources Wales
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
SeaMaST	Seabird Mapping and Sensitivity Tool
SNCB	Statutory Nature Conservation Body
SPAs	Special Protection Areas
UK	United Kingdom

Units

Unit	Description
%	Percentage
kJ	Kilojoules
km^2	Square kilometres
km	Kilometres
m	Metres
MW	Megawatts
nm	Nautical mile

1 OFFSHORE ORNITHOLOGY ADDITIONAL SUPPORTING CUMULATIVE ASSESSMENT INFORMATION IN LINE WITH SNCB ADVICE

1.1 Summary

1.1.1.1 Following Deadline 4, Natural Resources Wales (Advisory) (NRW (A)) and the Joint Nature Conservation Committee (JNCC) requested further cumulative effects assessments (CEA) to take account of the publication of the Llŷr 1 Floating Offshore Wind Farm, Morgan Offshore Wind Project: Generation Assets and Morecambe Offshore Wind Farm: Generation Assets applications since the submission of the Mona Offshore Wind Project Development Consent Order (DCO) application, in order to confirm no significant effects cumulatively with other projects.

1.1.1.2 The additional supporting cumulative assessment information presented within this technical note includes the total impact presented in Volume 2, Chapter 5: Offshore Ornithology and consideration of the historical projects for which the Applicant has 'gap-filled' where data was unavailable (Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028)). Matrix tables have been presented to indicate the range of displacement and mortality rates requested by the Statutory Nature Conservation Bodies (namely NRW (A) and the JNCC). Population Viability Analyses have been carried out where the revised impact results in a >1% increase in baseline mortality. This review of new and updated information identified no changes to the conclusions of the Environmental Statement and has determined that there would be no significant cumulative effects in EIA terms on offshore ornithological receptors.

1.2 Introduction

1.2.1 Background and context

1.2.1.1 Following representations from Natural Resources Wales (Advisory) (NRW (A)) and the Joint Nature Conservation Committee (JNCC) in the Mona Offshore Wind Project Examination, the Applicant provided the Offshore ornithology supporting information in line with SNCB advice (REP4-030) note at Deadline 4. That supporting information note provided supplementary assessment information in accordance with the Statutory Nature Conservation Bodies (SNCBs) advice to provide confidence that the Applicant's Environmental Impact Assessment (see Volume 2, Chapter 5: Offshore ornithology (REP4-007)) and Habitats Regulations Assessment (HRA) (see HRA Stage 2 Information to Support an Appropriate Assessment Part Three: Special Protection Areas (SPAs) and Ramsar sites Assessments (REP2-010)) conclusions are robust.

1.2.1.2 Following Deadline 4, NRW (A) and the JNCC requested further cumulative effects assessments (CEA) to take account of several changes that have occurred since the submission of the Mona Offshore Wind Project Development Consent Order (DCO) application, in order to confirm no significant effects cumulatively with other projects. This request came following the Applicant's submission of the Review of Offshore ornithology CEA and In-Combination Assessment (REP4-027), which reviewed the CEA projects which had been submitted post November 2023 (which is when the CEA was undertaken). However, NRW (A) and the JNCC specifically requested the following two updates:

- incorporation of the Llŷr 1 Floating Offshore Wind Farm in the CEA following publication of the application reports (Llŷr 1 Floating Offshore Wind Farm, 2024a and 2024b); and
- updated abundance and collision estimates for the Morgan Offshore Wind Project: Generation Assets (hereafter referred to as the Morgan Generation Assets) and Morecambe Offshore Wind Farm: Generation Assets (hereafter referred to as the Morecambe Generation Assets) from the numbers presented at Preliminary Environmental Impact Report (PEIR) to those within the Environmental Statements (Morecambe Generation Assets, 2024a and 2024b; Morgan Generation Assets, 2024a).

1.2.1.3 The additional supporting CEA information presented within this technical note includes the total impact presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007) and also impact estimates for historical offshore wind projects for which the Applicant has ‘gap-filled’ where data were unavailable (presented in Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028)). The CEAs presented in this document provide an updated total abundance or collision estimate that includes the two additions detailed above.

1.2.1.4 The Applicant has also included an update in this note to account for amendments to the predicted impact for herring gull and lesser black-backed gull from Burbo Bank Extension and TwinHub, respectively (this was in light of an alignment task on CEA abundances/impacts used between the Mona Offshore Wind Project and Morgan Generation Assets). An avoidance rate used to calculate the predicted impact in Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for these two species required updating and therefore, the CEAs presented for herring gull and lesser black-backed gull (section 1.4.3 and 1.4.4, respectively) include this update with an overall increase in the cumulative total. A further amendment from Volume 2, Chapter 5: Offshore Ornithology (REP4-007) is that the predicted collision risk from West of Orkney Offshore Wind Project on great black-backed gull has been removed (which aligns with the assessment for Morgan Generation Assets). There is no connectivity during any of the bioseasons for this site and species, this is detailed in section 1.4.2. As stated by the Applicant in Hearing Summary (ISH4) Offshore Matters (REP4-034) this amendment will also be considered as an errata for the certified version of the Volume 2, Chapter 5: Offshore Ornithology.

1.2.1.5 See the Applicant’s Summary of Principal Offshore Ornithological Matters (S_D5_21) (section 1.6.4) submitted at Deadline 5 for further information on differences between the abundance estimates used in the CEA between Mona Offshore Wind Project and Morgan Generation Assets.

1.2.2 Updated impact estimates for Morgan and Morecambe

1.2.2.1 The Mona Offshore Wind Project submitted a DCO application in February 2024. The Application CEA considered information up to November 2023 (as set out in - Volume 1, Chapter 5: Environmental Impact Assessment Methodology (APP-052)). In November 2023, the only publicly available documents for the Morgan Generation Assets and Morecambe Generation Assets were the PEIRs (Morgan Generation Assets, 2023; Morecambe Generation Assets, 2023). Both PEIRs reported only one year of site-specific survey data, compared to the two years included within the projects’ application documents. Therefore, the predicted populations and impacts presented in the application documents for both projects supersede those presented at PEIR as they account for two years of survey data and several project description changes.

1.2.2.2 Morgan Generation Assets was accepted for examination in May 2024, followed by Morecambe Generation Assets in June 2024.

1.2.2.3 The resulting application documents (Morecambe Generation Assets, 2024a and 2024b; Morgan Generation Assets, 2024a) have been reviewed and the abundance and collision estimates updated to reflect the updated submitted documents (Table 1-1 and Table 1-2, respectively).

Table 1-1: Comparison of the annual abundance estimates for Morgan Generation Assets and Morecambe Generation Assets between the PEIR and application documents.

Species	Annual abundances (taken from PEIR documentation)			Annual abundances (taken from ES documentation)			
	Morgan	Morecambe	Morgan and Morecambe	Morgan	Morecambe	Morgan and Morecambe	Difference
Atlantic puffin	18	67	85	15	58	73	-12
Black-legged kittiwake	2,724	9,106	11,830	2,477	3,522	5,969	-5,861
Common guillemot	8,994	11,697	20,691	7,834	14,689	22,523	1,832
Manx shearwater	993	7,583	8,576	1,638	8,972	10,610	2,034
Northern gannet	454	912	1,366	254	673	927	-439
Razorbill	622	1,881	2,503	1,787	1,979	3,766	1,263

Table 1-2: Comparison of the annual collision estimates for Morgan Generation Assets and Morecambe Generation Assets between the PEIR and application documents.

Species	Annual collisions (taken from PEIR documentation)			Annual collisions (taken from ES documentation)			
	Morgan	Morecambe	Morgan and Morecambe	Morgan	Morecambe	Morgan and Morecambe	Difference
Black-legged kittiwake	40	32	72	40.00	25.45	65.45	-6.55
Great black-backed gull	0.98	2.81	3.79	5.70	1.75	7.45	3.67
Herring gull	11.82	3.42	15.24	10.10	4.15	14.25	-0.99
Lesser black-backed gull	0.99	4.36	5.35	1.20	3.57	4.77	-0.58
Northern gannet	2.15	0.08	2.23	0.45	1.26	1.71	-0.52

1.3 Displacement during operation and maintenance

1.3.1 Atlantic puffin

1.3.1.1 The CEA for Atlantic puffin is presented within Table 1-3 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.1.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant's preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-3: Atlantic puffin cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance
Total abundance presented in table 5.93 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	8,514
Total abundance presented in table A. 1 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	8,523
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	-12
Inclusion of Llŷr 1 Floating Offshore Wind Farm	744
Cumulative abundance total	**9,255**

Table 1-4: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	9	19	46	93	231	463	926
20%	19	37	93	185	463	926	1,851
30%	28	56	139	278	694	1,388	2,777
40%	37	74	185	370	926	1,851	3,702
50%	46	93	231	463	1,157	2,314	4,628
60%	56	111	278	555	1,388	2,777	5,553
70%	65	130	324	648	1,620	3,239	6,479
80%	74	148	370	740	1,851	3,702	7,404
90%	83	167	416	833	2,082	4,165	8,330
100%	93	185	463	926	2,314	4,628	9,255

1.3.1.3 The annual estimated mortality resulting from displacement during operation is 46 (28 to 648) individuals (Table 1-4). Using the largest population of 1,482,791 birds and average baseline mortality rate of 0.176, the background predicted mortality would be 260,971 individuals (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 46 (28 to 648) mortalities would increase the baseline mortality rate by 0.018% (0.011% to 0.248%).

1.3.1.4 Two tidal projects also predict an impact on Atlantic puffin (Holyhead Deep and West Anglesey Demonstration Zone) underwater collisions. This is predicted to result in an additional one bird per annum. This results in an increase in baseline mortality of

0.018% (0.011 to 0.249%). The annual predicted mortality from the CEA is below the 1% threshold increase in baseline mortality for further consideration with a PVA.

1.3.1.5 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in an increase in baseline mortality of up to 0.249% the magnitude is considered to be **negligible**.

1.3.1.6 Evidence of Atlantic puffin sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.75 onwards of Volume 2, Chapter 5: Offshore ornithology (REP4-007). Overall, based on evidence from post-construction studies and reviews, Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is, therefore, considered to be **high**.

1.3.1.7 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a negligible magnitude impact on a species of high sensitivity results in a **minor adverse** impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.3.2 Black-legged kittiwake

1.3.2.1 The CEA for black-legged kittiwake is presented within Table 1-5 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.2.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant’s preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-5: Black-legged kittiwake cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance
Total abundance presented table 5.104 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007))	26,665
Total abundance presented in table A. 5 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	28,070
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	-5,861
Inclusion of Llŷr 1 Floating Offshore Wind Farm	2,238
Cumulative abundance total	**24,447**

Table 1-6: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	24	49	122	244	611	1,222	2,445
20%	49	98	244	489	1,222	2,445	4,889
30%	73	147	367	733	1,834	3,667	7,334
40%	98	196	489	978	2,445	4,889	9,779
50%	122	244	611	1,222	3,056	6,112	12,224
60%	147	293	733	1,467	3,667	7,334	14,668
70%	171	342	856	1,711	4,278	8,556	17,113
80%	196	391	978	1,956	4,889	9,779	19,558
90%	220	440	1,100	2,200	5,501	11,001	22,002
100%	244	489	1,222	2,445	6,112	12,224	24,447

1.3.2.3 The annual estimated mortality resulting from displacement during the operational phase is 122 (73 to 1,711) individuals (Table 1-6). Using the largest population of 911,586 individuals, with an average baseline mortality rate of 0.156, the background predicted mortality would be 142,207 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 122 (73 to 1,711) mortalities would increase the baseline mortality rate by 0.086% (0.052 to 1.203%).

1.3.2.4 Black-legged kittiwake is also susceptible to collision, and therefore, a combined displacement and collision impact is presented in section 1.5. A conclusion of the magnitude of impact, sensitivity of the species and significance is presented as part of the combined assessment (section 1.5).

1.3.3 Common guillemot

1.3.3.1 The CEA for common guillemot is presented within Table 1-7 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.3.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant's preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-7: Common guillemot cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase

Project	Annual Abundance
Total abundance presented in table 5.81 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	93,278
Total abundance presented in table A. 10 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	94,545
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	1,832
Inclusion of Llŷr 1 Floating Offshore Wind Farm	15,035
Cumulative abundance total	**111,412**

Table 1-8: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	111	223	557	1,114	2,785	5,571	11,141
20%	223	446	1,114	2,228	5,571	11,141	22,282
30%	334	668	1,671	3,342	8,356	16,712	33,424
40%	446	891	2,228	4,456	11,141	22,282	44,565
50%	557	1,114	2,785	5,571	13,927	27,853	55,706
60%	668	1,337	3,342	6,685	16,712	33,424	66,847
70%	780	1,560	3,899	7,799	19,497	38,994	77,988
80%	891	1,783	4,456	8,913	22,282	44,565	89,130
90%	1,003	2,005	5,014	10,027	25,068	50,135	100,271
100%	1,114	2,228	5,571	11,141	27,853	55,706	111,412

1.3.3.3 The annual estimated mortality resulting from displacement during the operational phase is 557 (334 to 7,799) individuals (Table 1-8). Using the largest population of 1,145,528 individuals and the average baseline mortality rate of 0.133, the annual background predicted mortality would be 152,355 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 557 (334 to 7,799) mortalities would increase the baseline mortality rate by 0.366% (0.219% to 5.119%).

1.3.3.4 Two tidal projects also predict an impact on common guillemot (Holyhead Deep and West Anglesey Demonstration Zone) through underwater collisions. This is predicted to result in an additional 54 birds per annum (total cumulative impact of 611 (388 to 7,853)). This results in an increase in baseline mortality of 0.401% (0.255 to 5.154%).

1.3.3.5 As the impact is >1% in increase in baseline mortality (when considering at least 5% mortality for the SNCBs advised displacement rates; Table 1-8), a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.3.4 Manx shearwater

1.3.4.1 The CEA for Manx shearwater is presented within Table 1-9 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.4.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant's preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality, with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-9: Manx shearwater cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase

Project	Annual Abundance
Total abundance presented in table 5.110 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	28,774
Total abundance presented in table A. 14 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	28,827
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	2,034
Inclusion of Llŷr 1 Floating Offshore Wind Farm	4,728
Cumulative abundance total	**35,589**

Table 1-10: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	36	71	178	356	890	1,779	3,559
20%	71	142	356	712	1,779	3,559	7,118
30%	107	214	534	1,068	2,669	5,338	10,677
40%	142	285	712	1,424	3,559	7,118	14,236
50%	178	356	890	1,779	4,449	8,897	17,795
60%	214	427	1,068	2,135	5,338	10,677	21,353
70%	249	498	1,246	2,491	6,228	12,456	24,912
80%	285	569	1,424	2,847	7,118	14,236	28,471
90%	320	641	1,602	3,203	8,008	16,015	32,030
100%	356	712	1,779	3,559	8,897	17,795	35,589

1.3.4.3 The annual estimated mortality resulting from displacement during the operational phase is 178 (107 to 2,491) individuals (Table 1-10). Using the largest population of 1,821,544 individuals, with an average baseline mortality rate of 0.130, the background predicted mortality would be 236,801 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 178 (107 to 2,491) mortalities would increase the baseline mortality rate by 0.075% (0.045 to 1.052%).

1.3.4.4 As the impact is >1% in increase in baseline mortality when considering the upper range of the displacement and mortality rates (70% displacement and 10% mortality; Table 1-10), a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.3.5 Northern gannet

1.3.5.1 The CEA for northern gannet is presented within Table 1-11 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.5.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant's preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-11: Northern gannet cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance
Total abundance presented in table 5.98 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	7,689
Total abundance presented in table A. 19 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	7,918
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	-439
Inclusion of Llŷr 1 Floating Offshore Wind Farm	1,026
Cumulative abundance total	**8,505**

Table 1-12: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
10%	9	17	43	85	213	425	851
20%	17	34	85	170	425	851	1,701
30%	26	51	128	255	638	1,276	2,552
40%	34	68	170	340	851	1,701	3,402
50%	43	85	213	425	1,063	2,126	4,253
60%	51	102	255	510	1,276	2,552	5,103
70%	60	119	298	595	1,488	2,977	5,954
80%	68	136	340	680	1,701	3,402	6,804
90%	77	153	383	765	1,914	3,827	7,655
100%	85	170	425	851	2,126	4,253	8,505

1.3.5.3 The annual estimated mortality resulting from displacement during the operational phase is 60 (51 to 680) individuals (Table 1-12). Using the largest population of 661,888 individuals, with an average baseline mortality rate of 0.193, the background predicted mortality would be 127,744 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 60 (51 to 680) mortalities would increase the baseline mortality rate by 0.047% (0.040 to 0.533%).

1.3.5.4 Two tidal projects also predict an impact on northern gannet (Holyhead Deep and West Anglesey Demonstration Zone) through underwater collisions. This is predicted to result in an additional one bird per annum (total cumulative impact of 61 (52 to 680)). This results in an increase in baseline mortality of 0.047% (0.041 to 0.533%)

1.3.5.5 Northern gannet is also susceptible to collision, and therefore, a combined displacement and collision impact is presented in section 1.5. A conclusion of the magnitude of impact, sensitivity of the species and significance is presented as part of the combined assessment (section 1.5).

1.3.6 Razorbill

1.3.6.1 The CEA for razorbill is presented within Table 1-13 to account for the publication of new and updated information as outlined in section 1.2.2 above.

1.3.6.2 Within the matrix tables, the blue cells indicate the range of displacement and mortality rates requested by the SNCBs. The orange cell is the Applicant's preferred mortality and displacement rate. The red line indicates the 1% threshold of increase in baseline mortality with cells to the right of the red line indicating a >1% increase in baseline mortality.

Table 1-13: Razorbill cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Abundance
Total abundance presented in table 5.86 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	15,306
Total abundance presented in table A. 24 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	15,647
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-1 for details.	1,263
Inclusion of Llŷr 1 Floating Offshore Wind Farm	2,659
Cumulative abundance total	**19,569**

Table 1-14: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms annually.

Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality)						
	1%	2%	5%	10%	25%	50%	100%
10%	20	39	98	196	489	978	1,957
20%	39	78	196	391	978	1,957	3,914
30%	59	117	294	587	1,468	2,935	5,871
40%	78	157	391	783	1,957	3,914	7,828
50%	98	196	489	978	2,446	4,892	9,785
60%	117	235	587	1,174	2,935	5,871	11,741
70%	137	274	685	1,370	3,425	6,849	13,698
80%	157	313	783	1,566	3,914	7,828	15,655
90%	176	352	881	1,761	4,403	8,806	17,612
100%	196	391	978	1,957	4,892	9,785	19,569

1.3.6.3 The annual estimated mortality resulting from displacement during the operational phase is 98 (59 to 1,370) individuals (Table 1-14). Using the largest population of 606,914 individuals and the average baseline mortality rate of 0.172, the annual background predicted mortality would be 104,389 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The additional 98 (59 to 1,370) mortalities would increase the baseline mortality rate by 0.094% (0.056% to 1.312%).

1.3.6.4 Several tidal projects also predict a collision impact underwater, which cumulatively predicts an additional 24 birds per annum. This results in an increase in baseline mortality of 0.117% (0.079 to 1.335%).

1.3.6.5 As the impact is >1% in increase in baseline mortality (when consider a displacement rate of ≥60% and a mortality rate of ≥10%), a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.4 Collision risk

1.4.1 Black-legged kittiwake

1.4.1.1 The CEA for black-legged kittiwake is presented in Table 1-15 to account for the publication of new and updated information as outlined in section 1.2.2 above.

Table 1-15: Expected annual collision mortality estimates for black-legged kittiwake across relevant offshore wind farm projects using the species-group avoidance rate of 0.9928.

Project	Annual Collisions
Total predicted collisions presented in table 5.117 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	559.24
Total collisions presented in table A. 33 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects.– largest impact assuming consented parameters of historical gap-filled projects.	617.17
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-2 for details.	-6.55
Inclusion of Llŷr 1 Floating Offshore Wind Farm	24.48
Cumulative collisions total	**635.10**

1.4.1.2 The annual estimated mortality resulting from collisions during the operational phase is 635.10 individuals (Table 1-15). Using the largest population of 911,586 individuals, with an average baseline mortality rate of 0.156, the background predicted mortality would be 142,207 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population used and the demographic rates, respectively). The addition of up to 635.10 mortalities would increase the baseline mortality rate by 0.447%. The annual predicted mortality from the CEA is below the 1% threshold increase in baseline mortality for further consideration with a PVA.

1.4.1.3 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in an increase in baseline mortality of up to 0.447%, the magnitude is considered to be **low**.

1.4.1.4 Evidence of black-legged kittiwake sensitivity to collisions from offshore wind farms is summarised from paragraph 5.9.3.36 onwards in Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, black-legged kittiwakes are deemed to be of high vulnerability, low recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **high**.

1.4.1.5 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of high sensitivity results in a minor or moderate adverse impact which is not significant in EIA terms. This conclusion is consistent with that the presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.4.1.6 The JNCC also considers black-legged kittiwake to be susceptible to displacement and therefore, the Applicant has also provided a combined displacement and collision impact in section 1.5. A conclusion of the magnitude of impact, sensitivity of the species and significance is presented as part of the combined assessment is also presented section 1.5.

1.4.2 Great black-backed gull

1.4.2.1 The CEA for great black-backed gull is presented within Table 1-16 to account for the publication of new and updated information as outlined in section 1.2.2 above.

Table 1-16: Expected annual collision mortality estimates for great black-backed gull across relevant offshore wind farm projects using the species-group avoidance rate of 0.9939.

Project	Annual Collisions
Total predicted collisions presented in table 5.119 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	129.36
Total collisions presented in table A. 37 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects – largest impact when considering consented parameters of historical gap-filled projects.	171.41
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-2 for details.	3.67
Inclusion of Llŷr 1 Floating Offshore Wind Farm	1.61
Removal of the predicted impact from West of Orkney Wind Project as this project is not within the same BDMPS as Mona Offshore Wind Project (South West & Channel BDMPS). West of Orkney Wind Project has no connectivity throughout the whole year with the South West & Channel BDMPS.	-13.18
Cumulative collisions total	**163.51**

1.4.2.2 The annual estimated mortality resulting from collisions during the operational phase is up to 163.51 individuals (Table 1-16). Using the largest population of 17,742 individuals, with an average baseline mortality rate of 0.095, the background predicted mortality would be 1,685 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population and the demographic rates used, respectively). The addition of up to 163.51 mortalities would increase the baseline mortality rate by 9.710%. This is considering a species group avoidance rate of 0.9939. If the species-specific avoidance rate of 0.9991 were used, the impact would be up to 24.12 mortalities or an increase in baseline mortality of 1.431%.

1.4.2.3 As the impact is >1% increase in baseline mortality, a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.4.3 Herring gull

1.4.3.1 The CEA for herring gull is presented within Table 1-17 to account for the publication of new and updated information as outlined in section 1.2.2 above.

Table 1-17: Expected annual collision mortality estimates for herring gull across relevant offshore wind farm projects using the species-group avoidance rate of 0.9939.

Project	Annual Collisions
Total predicted collisions presented in table 5.122 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	148.07
Total collisions presented in table A. 41 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects – largest impact when considering consented parameters of historical gap-filled projects.	278.43
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-2 for details.	-0.99
Inclusion of Llŷr 1 Floating Offshore Wind Farm	0 (no recorded birds within Array Area)
Amendments to the predicted impact of Burbo Bank Extension following corrected avoidance rate	15.80
Cumulative collisions total	**293.24**

1.4.3.2 The annual estimated mortality resulting from collisions during the operational phase is up to 293.24 individuals (Table 1-17). Using the largest population of 217,167 individuals, with an average baseline mortality rate of 0.171, the background predicted mortality would be 37,136 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population used and the demographic rates, respectively). The addition of up to 293.24 mortalities would increase the baseline mortality rate by 0.790%. This is considering a species group avoidance rate of 0.9939. If the species-specific avoidance rate of 0.9952 was used, the impact would be up to 230.75 mortalities or an increase in baseline mortality of 0.621%. The annual predicted mortality from the CEA is below the 1% threshold increase in baseline mortality for further consideration with a PVA.

1.4.3.3 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007); the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in an increase in baseline mortality of up to 0.790% the magnitude is considered to be **low**.

1.4.3.4 Evidence of herring gull sensitivity to collisions from offshore wind farms is summarised from paragraph 5.9.3.44 onwards in Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, herring gull are deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

1.4.3.5 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a **minor adverse impact** which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.4.4 Lesser black-backed gull

1.4.4.1 The CEA for lesser black-backed gull is presented within Table 1-18 to account for the publication of new and updated information as outlined in section 1.2.2 above.

Table 1-18: Expected annual collision mortality estimates for lesser black-backed gull across relevant offshore wind farm projects using the species-group avoidance rate of 0.9939.

Project	Annual Collisions
Total predicted collisions presented in table 5.125 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	275.76
Total collisions presented in table A. 44 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects	285.29
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-2 for details.	-0.58
Inclusion of Llŷr 1 Floating Offshore Wind Farm	1.93
Amendments to the predicted impact of TwinHub following corrected avoidance rate	4.53
Cumulative collisions total	**291.17**

1.4.4.2 The annual estimated mortality resulting from collisions during the operational phase is up to 291.17 individuals (Table 1-18). Using the largest population of 240,750 individuals, with an average baseline mortality rate of 0.121, the background predicted mortality would be 29,130 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population used and the demographic rates, respectively). The addition of up to 291.17 mortalities would increase the baseline mortality rate by 1.000% (0.9995%). This is considering a species group avoidance rate of 0.9939. If the species-specific avoidance rate of 0.9954 was used, the impact would be up to 219.57 mortalities or an increase in baseline mortality of 0.754%.

1.4.4.3 As the predicted impact represents a 1% increase in baseline mortality when considering the species-group avoidance rate, a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.4.5 Northern gannet

1.4.5.1 The CEA for northern gannet is presented within Table 1-19 to account for the publication of as outlined in section 1.2.2 above.

Table 1-19: Expected annual collision mortality estimates for northern gannet across relevant offshore wind farm projects using species group avoidance rate of 0.9928.

Project	Annual Collisions
Total predicted collisions presented in table 5.128 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007)	159.87
Total collisions presented in table A. 48 of Offshore Ornithology Cumulative Effects Assessment and In-combination Gap-filling Historical Projects Technical Note (REP4-028) to account for gap-filled projects – largest impact when considering consented parameters of historical gap-filled projects.	177.48
Amendments and rationale	
Change in Morecambe Generation Assets and Morgan Generation Assets numbers from PEIR to those in application. See Table 1-2 for details.	-0.52
Inclusion of Llŷr 1 Floating Offshore Wind Farm	3.91
Cumulative collisions total	**180.87**

1.4.5.2 The annual estimated mortality resulting from collisions during the operational phase is 180.87 individuals (Table 1-19). Using the largest population of 661,888 individuals, with an average baseline mortality rate of 0.193, the background predicted mortality would be 127,744 (see Table 5.14 and 5.15 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for details on the population used and the demographic rates, respectively). The addition of up to 180.87 mortalities would increase the baseline mortality rate by 0.142%.

1.4.5.3 Northern gannet is also susceptible to displacement, and therefore, a combined displacement and collision impact is presented in section 1.5. A conclusion of the magnitude of impact, sensitivity of the species and significance is presented as part of the combined assessment (section 1.5).

1.5 Combined displacement and collision impacts

1.5.1.1 For species such as black-legged kittiwake and northern gannet that are both adversely affected by displacement and collision during the operations and maintenance phase, impacts must be combined in order for the true magnitude of impact to be understood. This is, however, a highly precautionary approach, as if a bird is displaced it cannot then collide with the rotating blades of a wind turbine, and if it collides, it is then not available to be displaced.

Table 1-20: Combined collision and displacement impacts on black-legged kittiwake and northern gannet across relevant offshore wind farm projects.

Impact	Predicted mortalities
Black-legged kittiwake	
Displacement (Table 1-6) – 50% displacement and 1% mortality (30% displacement and 1% mortality to 70% displacement and 10% mortality)	122 (73 to 1, 711)
Collisions (Table 1-15)	635.10
Combined impact	757.10 (708.10 to 2,346.10)
Increase in baseline mortality	0.532% (0.498% to 1.650%)
Northern gannet	
Displacement (Table 1-12) – 70% displacement and 1% mortality (60% displacement and 1% mortality to 80% displacement and 10% mortality) plus tidal collisions	61 (52 to 681)
Collisions (Table 1-19)	180.87
Combined impact	241.87 (232.87 to 861.87)
Increase in baseline mortality	0.189% (0.182% to 0.675%)

1.5.1.2 The worst-case predicted combined collision and displacement impact could result in up to 2,346.1 black-legged kittiwake being impacted (when considering the highest displacement rate of 70% and 10% mortality, as advised by the JNCC, plus collisions); this could result in an increase in the baseline mortality of 1.650%. As the largest impact is >1% in increase in baseline mortality, a PVA has been undertaken in section 1.6 to aid the conclusion on the significance of the predicted impact.

1.5.1.3 The worst-case predicted combined collision and displacement impact could result in up to 861.87 northern gannet being impacted (when considering the highest displacement rate of 80% and 10% mortality plus collisions); this could result in an increase in the baseline mortality of 0.675%. The annual predicted mortality from the CEA is below the 1% threshold increase in baseline mortality for further consideration with a PVA.

1.5.1.4 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the combined cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in an increase in baseline mortality of up to 0.675% the magnitude is considered to be **low**.

1.5.1.5 Evidence of northern gannet sensitivity to displacement and collisions from offshore wind farms is summarised in paragraph 5.9.3.12 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, northern gannet are deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

1.5.1.6 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6 Cumulative PVAs

1.6.1.1 Following this review of new and updated information as outlined in section 1.2.2 above, the increase in baseline mortality for the cumulative impacts on black-legged kittiwake, common guillemot, great-black backed gull, Manx shearwater and razorbill exceeded the threshold for undertaking PVA, and therefore, PVAs have been presented below. All input parameters are presented in Appendix A:.

1.6.2 Black-legged kittiwake

1.6.2.1 As described in section 1.5, the combined cumulative displacement and collision impact on black-legged kittiwake surpasses the 1% threshold for further assessment when considering the worst-case scenario as advised by the JNCC. A PVA was run considering the annual cumulative impact and subsequent change in baseline mortality on the largest regional population (911,586 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.1.

Table 1-21: Annual increases in black-legged kittiwake baseline mortality rate as a result of displacement and collision mortality from cumulative projects.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality plus predicted collisions	708.10	0.498%	0.000776778
B: 50% displacement and 1% mortality plus predicted collisions	757.10	0.532%	0.000830531
C: 70% displacement and 10% mortality plus predicted collisions	2,346.10	1.650%	0.002573646

1.6.2.2 The results of the PVA for the annual impacts from the Mona Offshore Wind Project cumulatively with other plans and projects to the black-legged kittiwake population at the start of operation (2030) and for the duration of the project (35 years), when considering a range-based approach of displacement impact scenarios, are presented in Table 1-22. The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

1.6.2.3 The counterfactual of growth rate (CGR) is a more realistic metric than counterfactual of population size (CPS) to review the impact when undertaking density independent PVAs. When considering all three impact scenarios, there is a marginal change in the CGR (0.997 to 1.000) compared to the baseline (unimpacted) scenario. Even when considering the worst-case impact (70% displacement and 10% mortality plus collisions), the predicted median growth rate of the black-legged kittiwake population is 1.000. Therefore, the modelled population is predicted to be stable or increasing under all impact scenarios after 35 years.

Table 1-22: Black-legged kittiwake PVA results for the three impact scenarios presented in Table 1-21

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	949,619	0.75%	1.008	0.870	1.116	-	-
2030	A (708.1 annual mortalities)	948,892	0.66%	1.007	0.869	1.116	0.999	0.999
2030	B (757.1 annual mortalities)	949,114	0.65%	1.007	0.869	1.115	0.999	0.999
2030	C (2,346.1 annual mortalities)	946,782	0.45%	1.004	0.867	1.113	0.997	0.997
2065	Baseline	1,047,929	10.48%	1.003	0.982	1.022	-	-
2065	A (708.1 annual mortalities)	1,012,715	6.98%	1.002	0.981	1.021	0.967	0.999
2065	B (757.1 annual mortalities)	1,010,979	6.64%	1.002	0.981	1.021	0.965	0.999
2065	C (2,346.1 annual mortalities)	938,932	-0.94%	1.000	0.979	1.019	0.896	0.997

1.6.2.4 The results of the PVA (Table 1-22) for the combined displacement and collision impact when compared to the cumulative displacement impacts presented in the CEA in Volume 2, Chapter 5: Offshore ornithology (REP4-007). result in the same conclusions.

1.6.2.5 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under most of the predicted impacts and only reducing the growth rate by 0.3% under the worst-case scenario of 70% displacement and 10% mortality (which is only requested by one of four UK SNCBs) the magnitude is considered to be **low**.

1.6.2.6 Evidence of black-legged kittiwake sensitivity to collisions and displacement from offshore wind farms is summarised in paragraph 5.9.3.11 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, black-legged kittiwakes are deemed to be of medium vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

1.6.2.7 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6.3 Common guillemot

1.6.3.1 As described in section 1.3.3, the cumulative displacement impact on common guillemot surpasses the 1% threshold for further assessment when considering the worst case scenario as advised by the SNCBs. A PVA was run considering the annual cumulative impact (including the predicted collisions from tidal projects) and subsequent change in baseline mortality on the largest regional population (1,145,528 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.2.

Table 1-23: Annual increases in common guillemot baseline mortality rate as a result of displacement mortality (and tidal project collisions) from cumulative projects.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality (plus predicted collisions from tidal projects)	388	0.25%	0.00033891
B: 50% displacement and 1% mortality (plus predicted collisions from tidal projects)	611	0.40%	0.00053343
C: 70% displacement and 10% mortality (plus predicted collisions from tidal projects)	7,853	5.15%	0.00685521

1.6.3.2 The results of the PVA for the annual impacts from the Mona Offshore Wind Project cumulatively with other plans and projects to the common guillemot population at the start of operation (2030) and for the duration of the project (35 years), when considering a range-based approach of displacement impact scenarios, are presented in Table 1-24. The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

1.6.3.3 The CGR is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering all three impact scenarios, there is a marginal change in the CGR (0.992 to 1.000) compared to the baseline (unimpacted) scenario. Even when considering the larger impact (70% displacement and 10% mortality plus the collision impact from tidal projects), the predicted median growth rate of the common guillemot population is >1. Therefore, the modelled population is predicted to grow under all impact scenarios. Similarly, the upper and lower confidence intervals indicate that after 35 years and under all impact scenarios the population is predicted to increase in size (>1 median growth rate).

Table 1-24: Common guillemot PVA results for the three impact scenarios presented in Table 1-23

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	1,685,359	2.72	1.027	0.955	1.092	-	-
2030	A (388 annual mortalities)	1,685,172	2.67	1.027	0.955	1.091	1.000	1.000
2030	B (611 annual mortalities)	1,684,820	2.65	1.027	0.955	1.091	0.999	0.999
2030	C (7,853 annual mortalities)	1,672,538	1.90	1.019	0.948	1.083	0.992	0.992
2065	Baseline	4,138,135	151.65	1.026	1.017	1.034	-	-
2065	A (388 annual mortalities)	4,083,333	148.16	1.026	1.017	1.034	0.986	1.000
2065	B (611 annual mortalities)	4,050,514	146.22	1.025	1.017	1.033	0.979	0.999
2065	C (7,853 annual mortalities)	3,135,667	90.60	1.018	1.009	1.026	0.757	0.992

1.6.3.4 The results of the PVA (Table 1-24) for the displacement impact when compared to the cumulative displacement impacts presented in the CEA in Volume 2, Chapter 5: Offshore ornithology (REP4-007) results in the same conclusions.

1.6.3.5 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under all of the predicted impacts and only reducing the growth rate by 0.8% under the worst-case scenario of 70% displacement and 10% mortality the magnitude is considered to be **low**.

1.6.3.6 Evidence of common guillemot sensitivity to displacement from offshore wind farms is summarised in paragraphs 5.9.2.56 onwards of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, common guillemot are deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

1.6.3.7 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6.4 Great black-backed gull

1.6.4.1 As described in section 1.4.2, the cumulative collision impact on great black-backed gull surpasses the 1% threshold for further assessment. A PVA was run considering the annual cumulative impact and subsequent change in baseline mortality on the largest regional population (17,742 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.3.

Table 1-25: Annual increases in great black-backed gull baseline mortality rate as a result of collision mortality from cumulative projects using species-group (99.39) and species-specific (99.91) avoidance rates.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality %	Decrease in survival rate
Avoidance rate 99.39	163.51	9.701%	0.0092161
Avoidance rate 99.91	24.12	1.431%	0.0013598

1.6.4.2 The results of the PVAs for predicted impacts from the Mona Offshore Wind Project cumulatively with other offshore wind farms to the great black-backed gull population at the start of operation (2030) and for the duration of the project (35 years) are presented in Table 1-26 using the species-group and species-specific avoidance rates. The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality) is also shown for comparison purposes.

1.6.4.3 In line with best practice, the annual impact is assessed against the largest population (Parker *et al*, 2022), which in the case of the great black-backed gull is the non-breeding population (17,742 birds)).

1.6.4.4 The CGR is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering the species-specific avoidance rate (99.91%), there is a marginal change in the CGR (0.999) when compared to the baseline (unimpacted) scenario. Similarly, when considering the species-group avoidance rate (99.39%), the counterfactual growth rate is 0.990. Even when considering the larger impact (when using the species-group avoidance rate of 99.39), the median growth rate of the great black-backed gull population is >1 and therefore, the modelled population is predicted to grow under the two impact scenarios.

Table 1-26: Annual great black-backed gull PVA results using species-group (99.39) and species-specific (99.91) avoidance rates.

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	106,348	12.72%	1.127	1.058	1.195	-	-
2030	Avoidance rate 99.91	106,179	12.55%	1.126	1.056	1.193	0.999	0.998
2030	Avoidance rate 99.39	105,251	11.59%	1.116	1.046	1.184	0.990	0.990
2065	Baseline	6,830,545	7151.07%	1.126	1.120	1.133	-	-
2065	Avoidance rate 99.91	6,474,649	6777.91%	1.125	1.118	1.131	0.948	0.999
2065	Avoidance rate 99.39	4,748,887	4933.64%	1.115	1.108	1.122	0.694	0.990

1.6.4.5 Based on the updated PVA, amendments to the CEA will have no effect on the conclusions of the CEA presented in Volume 2, Chapter 5: Offshore ornithology (REP4-007), which concluded a minor adverse effect.

1.6.4.6 The PVA presented considers the consented wind farm parameters from the original environmental statements (as presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007)) and the consented and as-built parameters of the historical projects as a greater impact. If as-built wind farm parameters were used for all wind farms within the CEA, the impact would be reduced from that presented here. Using the as-built parameters is considered a more realistic assessment than using the worst-case consented parameters, as it is highly unlikely that developments will be modified more than a decade into the operational phase (as is the case with many of the historical projects). The Applicant is not currently aware of any offshore wind projects that, following completion of construction and energisation, have added further wind turbines without additional consents being required.

1.6.4.7 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007) the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under all of the predicted impacts and only reducing the growth rate by 1% the magnitude is considered to be **low**.

1.6.4.8 Evidence of great black-backed gull sensitivity to collisions from offshore wind farms is summarised from paragraphs 5.9.2.40 onwards of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, great black-backed gull are deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

1.6.4.9 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6.5 Lesser black-backed gull

1.6.5.1 As described in section 1.4.4, the cumulative collision impact on lesser black-backed gull is at the 1% threshold for further assessment when considering the species-group avoidance rate. A PVA was run considering the annual cumulative impact and subsequent change in baseline mortality on the largest regional population (240,750 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.4.

Table 1-27: Annual increases in lesser black-backed gull baseline mortality rate as a result of collision mortality from cumulative projects using species-group (99.39) and species-specific (99.54) avoidance rates.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality %	Decrease in survival rate
Avoidance rate 99.39	291.17	1.000%	0.0012094289
Avoidance rate 99.54	219.57	0.754%	0.0009120249

1.6.5.2 The results of the PVAs for predicted impacts from the Mona Offshore Wind Project cumulatively with other offshore wind farms to the lesser black-backed gull population at the start of operation (2030) and for the duration of the project (35 years) are presented in Table 1-28 using the species-group and species-specific avoidance rates. The baseline ‘unimpacted’ scenario (i.e. assuming no additional mortality other than baseline mortality) is also shown for comparison purposes.

1.6.5.3 The CGR is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering the species-specific avoidance rate (99.54%) and species-group avoidance rate (99.39%), there is a marginal change in the CGR (0.999 or 0.1% difference) when compared to the baseline (unimpacted) scenario. The annual growth rate is <1 for all scenarios and therefore using the demographic rates currently advised indicate a reducing population without any impact. Therefore, as the impact results in an 0.1% difference (see CGR in Table 1-28Table 1-28) in this is considered minimal.

Table 1-28: Annual lesser black-backed gull PVA results using species-group (99.39) and species-specific (99.91) avoidance rates.

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	223,566	-1.54	0.985	0.859	1.206	-	-
2030	Avoidance rate 99.54	223,140	-1.65	0.984	0.858	1.205	0.999	0.999
2030	Avoidance rate 99.39	223,232	-1.67	0.983	0.857	1.205	0.999	0.999
2065	Baseline	183,729	-17.88	0.995	0.972	1.017	-	-
2065	Avoidance rate 99.54	177,317	-20.88	0.994	0.971	1.016	0.963	0.999
2065	Avoidance rate 99.39	174,852	-21.82	0.993	0.971	1.015	0.952	0.999

1.6.5.4 Based on the updated PVA, amendments to the CEA will have no effect on the conclusions of the CEA presented in Volume 2, Chapter 5: Offshore ornithology (REP4-007), which concluded a minor adverse effect.

1.6.5.5 The PVA presented considers the consented wind farm parameters from the original environmental statements (as presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007)) and the consented and as-built parameters of the historical projects as a greater impact. If as-built wind farm parameters were used for all wind farms within the CEA, the impact would be reduced from that presented here. Using the as-built parameters is considered a more realistic assessment than using the worst-case consented parameters, as it is highly unlikely that developments will be modified more than a decade into the operational phase (as is the case with many of the historical projects). The Applicant is not currently aware of any offshore wind projects that, following completion of construction and energisation, have added further wind turbines without additional consents being required.

1.6.5.6 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in an increase in baseline mortality of up to 1.000%, the magnitude is considered to be **low**.

1.6.5.7 Evidence of lesser-black backed gull sensitivity to collisions from offshore wind farms is summarised from paragraph 5.9.3.48 onwards in Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, lesser-black backed gull are deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

1.6.5.8 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6.6 Manx shearwater

1.6.6.1 As described in section 1.3.4, the cumulative displacement impact on Manx shearwater surpasses the 1% threshold for further assessment when considering the worst-case scenario as advised by the SNCBs. A PVA was run considering the annual cumulative impact and subsequent change in baseline mortality on the largest regional population (1,821,544 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.5.

Table 1-29: Annual increases in Manx shearwater baseline mortality rate as a result of displacement mortality (and tidal project collisions) from cumulative projects.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality	107	0.045%	0.000097690
B: 50% displacement and 1% mortality	178	0.075%	0.000058614
C: 70% displacement and 10% mortality	2,491	1.052%	0.001367662

1.6.6.2 The results of the PVA for the annual impacts from the Mona Offshore Wind Project cumulatively with other plans and projects to the Manx shearwater population at the start of operation (2030) and for the duration of the project (35 years), when considering a range-based approach of displacement impact scenarios, are presented in Table 1-30. The baseline ‘unimpacted’ scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

1.6.6.3 The CGR is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering all three impact scenarios, there is a marginal change in the CGR (0.997 to 1.000) compared to the baseline (unimpacted) scenario. Even when considering the larger impact (70% displacement and 10% mortality plus the collision impact from tidal projects), the predicted median growth rate of the common guillemot population is >1. Therefore, the modelled population is predicted to grow under all impact scenarios. Similarly, the upper and lower confidence intervals indicate that after 35 years and under all impact scenarios, the population is predicted to increase in size (>1 median growth rate).

Table 1-30: Manx shearwater PVA results for the three impact scenarios presented in Table 1-23

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	2,159,789	1.84	1.018	0.887	1.103	-	-
2030	A (107 annual mortalities)	2,158,816	1.76	1.018	0.886	1.102	0.999	0.999
2030	B (178 annual mortalities)	2,158,665	1.75	1.018	0.886	1.102	0.999	0.999
2030	C (2,491 annual mortalities)	2,153,524	1.56	1.016	0.884	1.100	0.997	0.997
2065	Baseline	3,108,055	46.86	1.011	0.992	1.028	-	-
2065	A (107 annual mortalities)	3,010,246	42.00	1.010	0.991	1.028	0.968	0.999
2065	B (178 annual mortalities)	3,004,360	41.79	1.010	0.991	1.027	0.966	0.999
2065	C (2,491 annual mortalities)	2,794,774	31.82	1.008	0.989	1.025	0.899	0.997

1.6.6.4 The results of the PVA (Table 1-30) for the displacement impact when compared to the cumulative displacement impacts presented in the CEA in Volume 2, Chapter 5: Offshore ornithology (REP4-007) results in the same conclusions.

1.6.6.5 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007); the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under all of the predicted impacts and only reducing the growth rate by 0.3% under the worst-case scenario of 70% displacement and 10% mortality the magnitude is considered to be **low**.

1.6.6.6 Evidence of Manx shearwater sensitivity to displacement from offshore wind farms is summarised in paragraph 5.9.2.109 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, Manx shearwater are deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

1.6.6.7 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.6.7 Razorbill

1.6.7.1 As described in section 1.3.6, the cumulative displacement impact on razorbill surpasses the 1% threshold for further assessment when considering the worst-case scenario as advised by the SNCBs. A PVA was run considering the annual cumulative impact (including the predicted collisions from tidal projects) and subsequent change in baseline mortality on the largest regional population (606,914 individuals) as defined by the SNCBs and derived from Furness (2015). The PVA input parameters are presented in A.1.6.

Table 1-31: Annual increases in razorbill baseline mortality rate as a result of displacement mortality (and tidal project collisions) from cumulative projects.

Scenario	Cumulative predicted adult mortalities	Increase in baseline mortality (%)	Decrease in survival rate
A: 30% displacement and 1% mortality (plus predicted collisions from tidal projects)	83	0.079%	0.00013660
B: 50% displacement and 1% mortality (plus predicted collisions from tidal projects)	122	0.117%	0.00020109
C: 70% displacement and 10% mortality (plus predicted collisions from tidal projects)	1,394	1.335%	0.00229692

1.6.7.2 The results of the PVA for the annual impacts from the Mona Offshore Wind Project cumulatively with other plans and projects to the razorbill population at the start of operation (2030) and for the duration of the project (35 years), when considering a range-based approach of displacement impact scenarios, are presented in Table 1-32. The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

1.6.7.3 The CGR is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering all three impact scenarios, there is a marginal change in the CGR (0.997 to 1.000) compared to the baseline (unimpacted) scenario. Even when considering the larger impact (70% displacement and 10% mortality plus the collision impact from tidal projects), the predicted median growth rate of the razorbill population is >1. Therefore, the modelled population is predicted to grow under all impact scenarios.

Table 1-32: Razorbill PVA results for the three impact scenarios presented in Table 1-31

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	701,018	1.63	1.016	0.896	1.096	-	-
2030	A (83 annual mortalities)	700,899	1.60	1.016	0.896	1.095	1.000	1.000
2030	B (122 annual mortalities)	701,143	1.59	1.016	0.895	1.095	1.000	1.000
2030	C (1,394 annual mortalities)	699,237	1.36	1.014	0.893	1.093	0.997	0.997
2065	Baseline	957,341	38.64	1.009	0.992	1.025	-	-
2065	A (83 annual mortalities)	952,996	37.86	1.009	0.992	1.025	0.994	1.000
2065	B (122 annual mortalities)	950,177	37.51	1.009	0.992	1.025	0.992	1.000
2065	C (1,394 annual mortalities)	872,098	26.10	1.006	0.989	1.022	0.910	0.997

1.6.7.4 The results of the PVA (Table 1-32) for the displacement impact when compared to the cumulative displacement impacts presented in the CEA in Volume 2, Chapter 5: Offshore ornithology (REP4-007) results in the same conclusions.

1.6.7.5 As stated within Volume 2, Chapter 5: Offshore Ornithology (REP4-007); the cumulative effect is predicted to be of national spatial extent, long term duration and continuous but with high reversibility. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under all of the predicted impacts and only reducing the growth rate by 0.3% under the worst-case scenario of 70% displacement and 10% mortality the magnitude is considered to be **low**.

1.6.7.6 Evidence of razorbill sensitivity to displacement from offshore wind farms is summarised from paragraph 5.9.2.66 onwards of Volume 2, Chapter 5: Offshore Ornithology (REP4-007). Overall, razorbill are deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

1.6.7.7 As set out in Table 5.20 of Volume 2, Chapter 5: Offshore Ornithology (REP4-007), the assessment of significance, a low magnitude impact on a species of medium sensitivity results in a minor adverse impact, which is not significant in EIA terms. This conclusion is consistent with that presented in Volume 2, Chapter 5: Offshore Ornithology (REP4-007).

1.7 Conclusion and summary

1.7.1.1 The Applicant has presented a review of new and updated information following the advice of the SNCBs as outlined in section 1.2.1.

1.7.1.2 This technical note has reached the same conclusions as presented within Volume 2, Chapter 5: Offshore Ornithology (REP4-007) for all species, including those for which PVAs have been undertaken (Table 1-33). The full rationale for the conclusions is presented under each of the species-specific assessments and summarised in Table 1-33 below.

Table 1-33: Summary of the conclusions on the significance of effect and comparison to previously presented statement

Species	Impact(s) assessed	Presented within Volume 2, Chapter 5: Offshore Ornithology (REP4-007)		Presented within this document	
		Magnitude of impact	Significance	Magnitude of impact	Significance
Atlantic puffin	Displacement	Negligible	Minor adverse	Negligible	Minor adverse
Black-legged kittiwake	Displacement and collision	Low	Minor adverse	Low	Minor adverse
Common guillemot	Displacement	Low	Minor adverse	Low	Minor adverse
Great black-backed gull	Collisions	Low	Minor adverse	Low	Minor adverse
Herring gull	Collisions	Low	Minor adverse	Low	Minor adverse
Lesser black-backed gull	Collisions	Low	Minor adverse	Low	Minor adverse
Manx shearwater	Displacement	Low	Negligible	Low	Negligible
Northern gannet	Displacement and collision	Low	Minor adverse	Low	Minor adverse
Razorbill	Displacement	Low	Minor adverse	Low	Minor adverse

1.7.1.3 The Applicant considers that this further cumulative supporting information is sufficient to enable the SNCBs to confirm their position on the significance of the CEA for all species assessed.

1.8 References

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Skokholm Bird Observatory, 2023. Seabird Report 2022. Available at: https://www.welshwildlife.org/sites/default/files/2023-07/Skokholm%20Seabird%20Report%202022.pdf

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Appendix A: PVA modelling parameters

A.1.1 PVA input parameters for black-legged kittiwake CEA

A.1.1.1 Set up

The log file was created on: 2024-11-28 14:54:25 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 “Kittiwake_Cumulative_Rerun”.

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: Black-legged kittiwake.

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: whole.population

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

A.1.1.4 Population 1

Initial population values: Initial population 911,586 in 2015

Productivity rate per pair: mean: 0.619 , sd: 0.121

Adult survival rate: mean: 0.854 , sd: 0.077

Immatures survival rates:

Age class 0 to 1 - mean: 0.79 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.854 , sd: 0.077, DD: NA

Age class 2 to 3 - mean: 0.854 , sd: 0.077, DD: NA

Age class 3 to 4 - mean: 0.854 , sd: 0.077, DD: NA

Age class 4 to 5 - mean: 0.854 , sd: 0.077 , DD: NA

A.1.1.1 Impacts

Number of impact scenarios: 3.

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.1.1.2 Impact on Demographic Rates

Scenario A - Name: 30% displacement, 1% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000776778, se: NA

Scenario B - Name: 50% displacement, 1% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000830531, se: NA

Scenario C - Name: 70% displacement, 10% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0. 002573646, se: NA

A.1.1.3 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

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 common guillemot CEA

A.1.2.1 Set up

The log file was created on: 2024-11-28 14:54:25 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 “Guillemot_Cumulative_Rerun”.

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: Common guillemot.

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: 6.

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: whole.population

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

A.1.2.4 Population 1

Initial population values: Initial population 1,145,528 in 2015

Productivity rate per pair: mean: 0.583, sd: 0.075

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.152 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.077, DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098, DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107, DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

A.1.2.5 Impacts

Number of impact scenarios: 3.

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: 30% displacement, 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00033891, se: NA

Scenario B - Name: 50% displacement, 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00053343, se: NA

Scenario C - Name: 70% displacement, 10% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00685521, 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?: whole.population

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 great black-backed gull CEA

A.1.3.1 Set up

The log file was created on: 2024-11-28 14:54:25 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 “Great black-backed gull_Cumulative_Rerun”.

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: Great black-backed gull.

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: whole.population

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

A.1.3.4 Population 1

Initial population values: Initial population 17,742 in 2015

Productivity rate per pair: mean: 1.061 , sd: 0.132

Adult survival rate: mean: 0.93 , sd: 0.001

Immatures survival rates:

Age class 0 to 1 - mean: 0.798 , sd: 0.092 , DD: NA

Age class 1 to 2 - mean: 0.93 , sd: 0.001, DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 0.001, DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 0.001, DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 0.001, DD: NA

A.1.1.4 Impacts

Number of impact scenarios: 2.

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.1.1.5 Impact on Demographic Rates

Scenario A - Name: 99.39 Avoidance Rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0092161, se: NA

Scenario B - Name: 99.91 Avoidance Rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0013598, se: NA

A.1.1.6 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

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

A.1.4 PVA input parameters for lesser black-backed gull CEA

A.1.4.1 Set up

The log file was created on: 2024-12-01 14:54:25 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.1.4.2 Basic information

This run had reference name “LB_Cumulative_Rerun”.

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.1.4.3 Baseline demographic rates

Species chosen to set initial values: Lesser black-backed gull.

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 3 per pair.

Number of subpopulations: 1.

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

Units for initial population size: whole.population

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

A.1.4.4 Population 1

Initial population values: Initial population 240,750 in 2015

Productivity rate per pair: mean: 0.438, sd: 0.282

Adult survival rate: mean: 0.885 , sd: 0.056

Immatures survival rates:

Age class 0 to 1 - mean: 0.82 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.885 , sd: 0.056, DD: NA

Age class 2 to 3 - mean: 0.885 , sd: 0.056, DD: NA

Age class 3 to 4 - mean: 0.885 , sd: 0.056, DD: NA

Age class 4 to 5 - mean: 0.885, sd: 0.056 , DD: NA

A.1.4.5 Impacts

Number of impact scenarios: 2.

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.1.4.6 Impact on Demographic Rates

Scenario A - Name: 99.39 Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0012094289, se: NA

Scenario B - Name: 99.54 Avoidance rate

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0009120249, se: NA

A.1.4.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

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

A.1.5 PVA input parameters for Manx shearwater CEA

A.1.5.1 Set up

The log file was created on: 2024-11-28 14:54:25 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.1.5.2 Basic information

This run had reference name “Manx_Cumulative_Rerun”.

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.1.5.3 Baseline demographic rates

Species chosen to set initial values: None.

Region type to use for breeding success data: None.

Available colony-specific survival rate: National. Sector to use within breeding success region: None.

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: whole.population

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

A.1.5.4 Population 1

Initial population values: Initial population 1,821,544 in 2015

Productivity rate per pair: mean: 0.600 , sd: 0.066

Adult survival rate: mean: 0.87 , sd: 0.080

Immatures survival rates:

Age class 0 to 1 - mean: 0.79 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.854 , sd: 0.077, DD: NA

Age class 2 to 3 - mean: 0.854 , sd: 0.077, DD: NA

Age class 3 to 4 - mean: 0.854 , sd: 0.077, DD: NA

Age class 4 to 5 - mean: 0.854 , sd: 0.077 , DD: NA

A.1.1.7 Impacts

Number of impact scenarios: 3.

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.1.1.8 Impact on Demographic Rates

Scenario A - Name: 30% displacement, 1% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000776778, se: NA

Scenario B - Name: 50% displacement, 1% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000830531, se: NA

Scenario C - Name: 70% displacement, 10% mortality plus collisions

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002573646, se: NA

A.1.1.9 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

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

A.1.6 PVA input parameters for razorbill CEA

A.1.6.1 Set up

The log file was created on: 2024-11-28 14:54:25 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.1.6.2 Basic information

This run had reference name “Razorbill_Cumulative_Rerun”.

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.1.6.3 Baseline demographic rates

Species chosen to set initial values: Razorbill.

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: whole.population

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

A.1.6.4 Population 1

Initial population values: Initial population 606,914 in 2015

Productivity rate per pair: mean: 0.532, sd: 0.084

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.794 , sd: 0.001, DD: NA

Age class 2 to 3 - mean: 0.895 , sd: 0.084, DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.084, DD: NA

Age class 4 to 5 - mean: 0.895, sd: 0.084 , DD: NA

A.1.6.5 Impacts

Number of impact scenarios: 3.

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.1.6.6 Impact on Demographic Rates

Scenario A - Name: 30% displacement, 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00013660, se: NA

Scenario B - Name: 50% displacement, 1% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00020109, se: NA

Scenario C - Name: 70% displacement, 10% mortality

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00229692, se: NA

A.1.6.7 Output:

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: whole.population

Target population size to use in calculating impact metrics: NA

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