RWE

Awel y Môr Offshore Wind Farm

Marine Ornithology Great Orme Assessment (Tracked)

Deadline 3a

Date: 16 December 2022

Revision: C

Document Reference: 3a.6

PINS Reference: N/A

Fferm Wynt Alltraeth
AWEL Y MÔR
Offshore Wind Farm

REVISION	DATE	STATUS/ REASON FOR ISSUE	AUTHOR	CHECKED BY	APPROVED BY
A	October 2022	Issue to NRW	APEM	RWE	RWE
A	October 2022	Deadline 1	APEM	RWE	RWE
B	November 2022	ML Deadline 1	APEM	RWE	RWE
C	December 2022	Deadline 3a	APEM	RWE	RWE

[redacted]

RWE Renewables UK Swindon Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
T +44 (0)8456 720 090
[redacted]

Registered office:
RWE Renewables UK Swindon Limited
Windmill Hill Business Park
Whitehill Way
Swindon

Contents

Figures

Tables

1 Overview

1 This Clarification Note has been produced by the Applicant in response to the comments received from Natural Resource Wales (NRW) within their Relevant Representation (RR-015) in relation to ornithological matters associated with the Pen-y-Gogarth / Great Orme Site of Special Scientific Interest (SSSI). The specific response received from NRW on this matter being as follows:

2 "NRW advises that a detailed assessment of the potential impacts of the project on the breeding seabird features of Pen-y-Gogarth / Great Orme's Head SSSI (guillemots, razorbills and black-legged kittiwakes) should be undertaken, as currently this has not been done sufficiently to assess effects on these features."

3 The Applicant has since engaged further with NRW following receipt of the Relevant Representations, through a consultation meeting held virtually on 6th September 2022, to establish a way forward on this matter. The outcome of the consultation meeting was that both parties recognise that the existing assessments provided at the point of application within the Environmental Statement (ES) Document 6.2.4, Volume 2, Chapter 4: Offshore Ornithology of the ES Chapter (APP-050) did not consider birds specifically associated with the SSSI and that no bespoke assessment of the Pen-y-Gogarth / Great Orme's Head SSSI's colonies were undertaken (as the Environmental Impact Assessment (EIA) was undertaken at a larger scale linked to the relevant biologically defined minimum population scales (BDMPS) for each species). Notwithstanding this, and to enable NRW to have a better understanding of the potential impacts from Awel y Môr offshore wind farm (OWF) (here on in referred to as AyM) of features specifically associated with the Pen-y-Gogarth / Great Orme's Head SSSI, the Applicant has produced this Clarification Note that presents such an assessment.

4 This report focuses on those species from the Pen-y-Gogarth / Great Orme's Head SSSI that were identified by NRW within their Relevant Representation (RR-015), namely black-legged kittiwake (*Rissa tridactyla*) (here on in referred to as kittiwake), guillemot (*Uria aalge*) and razorbill (*Alca torda*). In order to ascertain the magnitude of any impacts on these seabirds and the significance of any potential effect from AyM on these species from the Pen-y-Gogarth / Great Orme's Head SSSI colonies a population viability assessment (PVA) was undertaken.

5 Natural England provide an online Seabird PVA Tool, which can be used for such studies (Searle *et al.,* 2019). The PVAs undertaken for AyM at the point of application (APP-100) were parameterised with agreed values from the Expert Technical Group (ETG) for offshore ornithology at the ES stage, with advice received from NRW, Natural England, and the Royal Society for the Protection of Birds (RSPB), for the assessment of certain ornithological effects on a number of sites designated at the European level. The same parameterisation approach is applied to the PVA for the assessments considered within this report, with some minor changes following consultation and agreement with NRW during a virtual meeting held on 6 September 2022.

6 Outputs of the Seabird PVA Tool are summarised within this report to indicate whether the model predicts significant changes in the counterfactual growth rate and counterfactual population size of the species associated with the Pen-y-Gogarth / Great Orme SSSI.

7 This version of the report has been revised following the Deadline 3 Written Submission from NRW (REP3-026). NRW requested full apportionment tables be provided for each species, which are now included in Section 2.2. Greater clarity on the values used for the apportioning of collision risk for Kittiwake and displacement for Guillemot and Razorbill has also been provided in Section 2.3. NRW also noted discrepancies in demographic parameters used and requested clarity on these values, which the Applicant subsequently reviewed and corrected, where applicable, before all PVA models were re-run accordingly. The corresponding full log files for these runs also included in the Appendix A of this document, which provides NRW with all parameters used in sufficient detail, in order to allow NRW to replicate the analysis as requested.

8 Additionally, the assessment period was changed from 2023-2053 to 2030-2065 to more closely match the anticipated operational period of AyM, along with other minor updates to ensure clarity and consistency.

2 Methods

2.1 PVA Tool

~~7~~9 The Seabird PVA Tool provides a method for running Leslie Matrix models on selected populations to compare how population predictions may vary between impacted and unimpacted populations (Searle *et al.*, 2019).

~~8~~10 The Seabird PVA Tool was parameterised using the same approach to that described in the AyM ES Document 6.4.4.6, Volume 4, Annex 4.6: Offshore Ornithology PVA (APP-100). Pre-set demographic values are available for a total of 15 different seabird species, including all three species considered in this report. The values are derived from previously reported national or colony specific demographic parameters sourced from the Joint Nature Conservation Committee (JNCC) Seabird Monitoring Programme (SMP, 2020), divided into eight regional classifications (further information on the eight regional classifications can be found in Mobbs et al. (2020)) for breeding success data or Horswill and Robinson (2015) for survival rate. Upon review and agreement with appropriate bodies, the national productivity values available within Horswill and Robinson (2015) were instead used for assessment, due to providing a more representative productivity rate of the populations assessed.

~~9~~11 The Seabird PVA Tool can optionally be run using density dependant or density independent models. Density dependant approaches are more likely to be biologically realistic as populations are constrained in their growth by environmental factors (food supply, space at colony etc.). However, this requires appropriate and careful specification of the biological mechanisms and therefore outputs may be present traits of specification rather than useful results. Density independent methods do not have this issue, and therefore are a slightly more robust approach for contrasting populations.

~~10~~12 The Seabird PVA Tool is also capable of utilising stochastic modelling approaches, which enable environmental and demographic stochasticity to produce estimates with associated confidence intervals for assessments.

~~11~~13 For these reasons, the Seabird PVA Tool was set up to be ran with environmental and demographic stochasticity~~,~~ but using a density independent approach. This approach is the same as detailed within the AyM ES, Document 6.4.4.6, Volume 4, Annex 4.6: Offshore Ornithology Population Viability Analysis (APP-100). Previous work with the PVA Tool has highlight stability issues (crashing due to unknown reason when running the model with burn-in), which affected running the tool for Razorbill, which was therefore run without a burn in period. This is not expected to affect the results significantly.

~~12~~14 The model was run with 5,000 simulations ~~for a~~from 2025 to 2065, with an impact period ~~of 30 years~~from 2030 to 2065, with a 10-year burn-in period (except for razorbill as noted above) to ensure a stable population matrix structure had been calculated by the model. Population sizes were obtained from the most recently available count data on the SMP online portal (SMP, 2020).

~~13~~15 Collision risk and displacement mortality impact assumptions from the AyM ES Document 6.2.4, Volume, Chapter 4: Offshore Ornithology of the ES Chapter (APP-050) were inputted as ~~absolute~~relative harvest values into the PVA tool to act as the impact parameters. These impacts were apportioned to the Pen-y-Gogarth / Great Orme SSSI using the approach set out in Section 2.2 Apportionment.

2.2 Apportionment

16 Impacts in the breeding season have been apportioned to colonies following the current best practice within the interim guidance from NatureScot (formally known as Scottish Natural Heritage) (2018). Further details, including a worked example using gannet, are provided in the Report to Inform Appropriate Assessment, Annex 5: Ornithology Apportioning Note. The apportionment tables are presented below for kittiwake (Table 1), guillemot (Table 2) and razorbill (Table 3).

17 Impacts in the non-breeding season have been apportioned using the "BDMPS Approach" based on information given within Furness (2015). The BDMPS approach relies on the proportion of adults from a given colony that remain within the BDMPS region and assumes birds within the BDMPS mix freely. The calculations for all species are presented in Table 4.

Table 1: Kittiwake breeding bio-season apportionment.

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
St Tudwal's Island East (2016)	620	122	0.481	2.077	0.019	0.003
Trwyn Cilan (2016)	56	117	0.448	2.233	0.002	0.000
Bardsey Island (SPA) (2019)	242	106	0.509	1.964	0.009	0.001
Carreg y Llam (2019)	1,254	74	0.524	1.908	0.094	0.015
Penlas, Anglesey (Gwyn.) (1992)	424	70	0.580	1.724	0.032	0.005
South Stack Cliffs RSPB (2019)	22	69	0.580	1.724	0.002	0.000
Middle Mouse (2002)	104	44	0.573	1.747	0.020	0.003
Ynys Moelfre (2016)	312	32	0.542	1.844	0.121	0.019

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Puffin Island (Wales) (SPA) (2019)	626	24	0.516	1.937	0.455	0.072
Great Orme (2019)	1,708	15	0.492	2.032	3.334	0.530
Little Orme (2019)	648	15	0.475	2.106	1.311	0.209
Morecambe Gas Platform (2020)	1,112	50	0.369	2.710	0.260	0.041
St Bees Head RSPB (2019/20)	1,365	115	0.353	2.830	0.063	0.010
Balcary Point 1 (2018)	228	152	0.319	3.138	0.007	0.001
Meikle Ross (2000)	14	148	0.366	2.729	0.000	0.000
Big Scar (2018)	38	147	0.467	2.139	0.001	0.000
Mull of Galloway RSPB (2019)	216	148	0.494	2.024	0.004	0.001

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Lythe Mead to Carrick-Kee (2015)	678	148	0.494	2.024	0.014	0.002
Port Mona (2000)	60	153	0.493	2.030	0.001	0.000
Rockabill (SPA) (2018)	266	149	0.458	2.182	0.006	0.001
Lambay (SPA) (2015)	6,640	148	0.466	2.144	0.140	0.022
Ireland's Eye (SPA) (2015)	3,220	152	0.458	2.183	0.066	0.010
Howth Head (SPA) (2015)	6,162	151	0.462	2.165	0.126	0.020
Bray Head (2010)	2,946	155	0.474	2.111	0.056	0.009
Wicklow Head (SPA) (2019)	1,546	162	0.372	2.690	0.034	0.005
Ramsey - Port Mooar (2017)	156	103	0.474	2.108	0.007	0.001

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Port St Mary - Sound (2017)	1,080	93	0.518	1.932	0.052	0.008
Calf of Man (2013)	26	95	0.522	1.917	0.001	0.000
Glen Maye - Peel (2017)	108	102	0.514	1.945	0.004	0.001
Ailsa Craig (2019)	600	231	0.357	2.801	0.007	0.001
Skomer (2018)	2,472	223	0.462	2.163	0.023	0.004
Great Saltee Island (NPWS 2015-2018)	2,076	253	0.491	2.038	0.014	0.002
SUM	37,025	3,766	15.104	69.300	6.288	1.000

Table 2: Guillemot breeding bio-season apportionment.

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Abraham's Bosom (2016)	315	70	0.766	1.306	0.004	0.002
South Stack Cliffs RSPB (2019)	6,292	69	0.668	1.498	0.097	0.047
Gogarth (2016)	7	68	0.776	1.288	0.000	0.000
Middle Mouse (2016)	5,550	44	0.741	1.349	0.189	0.093
Puffin Island (2019)	3,606	24	0.560	1.786	0.547	0.268
Great Orme (2019)	1,843	15	0.537	1.861	0.746	0.365
Little Orme (2019)	348	15	0.493	2.028	0.153	0.075
Lambay (2015)	59,983	148	0.467	2.142	0.287	0.140
Ireland's Eye (2015)	4,410	152	0.455	2.197	0.021	0.010
SUM	82,354	605	5.464	15.454	2.044	1.000

Table 3: Razorbill breeding bio-season apportionment.

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Carreg y Llam (2019)	519	74	0.637	1.569	0.041	0.028
Abraham's Bosom (2016)	83	70	0.784	1.275	0.006	0.004
South Stack Cliffs RSPB (2019)	1,192	69	0.398	2.515	0.174	0.116
Gogarth (2016)	18	68	0.794	1.260	0.001	0.001
Pant yr Eglwys (2001)	28	53	0.612	1.634	0.005	0.003
The Skerries RSPB (2017)	3	56	0.836	1.197	0.000	0.000
Porth Llanlleiana (2016)	2	45	0.538	1.859	0.001	0.000
Middle Mouse (2016)	455	44	0.772	1.296	0.084	0.056
Bwrdd Arthur to Fedw Fawr (2016)	14	29	0.556	1.797	0.008	0.006
Puffin Island (2019)	434	24	0.765	1.307	0.272	0.182

COLONY (DATE OF COUNT)	COUNT OF ADULT BIRDS ON COLONY	DISTANCE FROM COLONY TO DEVELOPMENT (KM)	PROPORTION OF FORAGE RANGE AS SEA	1/P(SEA)	RESULTING WEIGHT FOR COLONY	PROPORTIONAL WEIGHT OF COLONY
Great Orme (2019)	255	15	0.526	1.901	0.595	0.399
Little Orme (2019)	24	15	0.483	2.071	0.061	0.041
Marine Drive (2017)	56	88	0.762	1.313	0.003	0.002
Lambay (2015)	7,353	148	0.462	2.163	0.201	0.134
Ireland's Eye (2015)	1,600	152	0.458	2.183	0.042	0.028
SUM	12,036	950	9.383	25.340	1.494	1.000

Table 4: Calculation of non-breeding season apportionment for all species. Proportion remaining in region is from Furness (2015). Total BDMPS population is as described in the Environmental Statement (ES) Document 6.2.4, Volume 2, Chapter 4: Offshore Ornithology (APP-050).

SPECIES	BDMPS REGION	GREAT ORME COLONY SIZE	BIO-SEASON	PROPORTION REMAINING IN REGION	NUMBER REMAINING IN REGION	TOTAL BDMPS POPULATION	PROPORTIONAL WEIGHT OF COLONY
Kittiwake	UK Western Waters and Channel	1,708	Post-breeding migration	0.6	1,024.8	911,586	0.0011
			Return migration	0.8	1,366.4	691,526	0.0020
Guillemot	UK Western Waters	1,843	Non-breeding	0.95	1,750.9	1,139,220	0.0015
Razorbill	UK Western Waters	255	Post-breeding migration and Return migration	0.98	249.9	606,914	0.0004

SPECIES	BDMPS REGION	GREAT ORME COLONY SIZE	BIO-SEASON	PROPORTION REMAINING IN REGION	NUMBER REMAINING IN REGION	TOTAL BDMPS POPULATION	PROPORTIONAL WEIGHT OF COLONY
			Winter	0.3	76.5	341,422	0.0002

2.22.3 Species specific inputs

1418 Details of the species-specific parameters used for running the Seabird PVA Tool are presented in Table 1.Table 5. Use of generic national parameters available from Horswill & Robinson (2015) were agreed with the NRW. Species count data was obtained from the most recent population count data available for the Pen-y-Gogarth / Great Orme SSSI. For the correct interpretation of the PVA outputs, it is important to note that the species detailed in this report are counted using different methods. Guillemot (2,3221,843) and razorbill (254255) and counted as individuals, whilst kittiwake (780854) are recorded as the number of active nests which can be assumed to be multiplied by two to account for a breeding pair (or two individuals) being associated with each nest.

19 Note that for guillemot and razorbill, the number of individuals counted is likely to be an underestimate of the colony size, given that at any one time, a significant number of individuals may be away from the colony. However, given they breed at high densities on cliffs, it is difficult to identify nests or breeding pairs and therefore a count of the number of individuals is considered to be the most useful for providing reliable data from which to extract population trends (Walsh *et al.*, 1995). As a rough estimate, one individual is equivalent to 0.67 breeding pairs for both species (Walsh et al., 1995, Harris, 1989) – i.e. a count of 1,000 individuals sighted would correspond to an estimated colony size of 670 breeding pairs (or 1,340 breeding adults). For the purposes of a PVA with no density dependence, this is not expected to affect the conclusions.

20 The impact of AyM has been parametrised as a relative harvest, i.e. the increase in mortality rate as a result of the impact. Table 6 and Table 7 show the calculation to go from total collision rates and abundances (as per the Environmental Statement (ES) Document 6.2.4, Volume 2, Chapter 4: Offshore Ornithology (APP-050) through apportioned mortality (based on proportional colony weights given in Table 1, Table 2 and Table 3) to relative harvests. Note that for the purposes of the PVA model, specifying a relative harvest means the absolute number of birds that suffer mortality as a result of the project is proportional to the population size. This is in line with the assessment approach for both collision risk and displacement analysis.

Table 5: Species demographic parameter values obtained from Horswill & Robinson (2015), as agreed for use within the AyM assessment materials due to data reliability concerns. National average values were used as agreed to be the more robust values. Kittiwake populations are counted via Apparently Occupied Nests (AON) with Razorbill and Guillemot populations counted as total individuals (INDI).

SPECIES	PRODUCTIVITY RATE ± SD	SMP POPULATION COUNTS	IMPACT (RELATIVE HARVEST)	MEAN ADULT SURVIVAL RATE ± SD	MEAN IMMATURE AGE CLASS 0 – 1 SURVIVAL RATE ± SD	MEAN IMMATURE AGE CLASS 1 – 2 SURVIVAL RATE ± SD	MEAN IMMATURE AGE CLASS 2 – 3 SURVIVAL RATE ± SD	MEAN IMMATURE AGE CLASS 3 – 4 SURVIVAL RATE ± SD	MEAN IMMATURE AGE CLASS 4 – 5 SURVIVAL RATE ± SD
Kittiwake	0.690 ± 0.296	854 AON	0.0020	0.854 ± 0.051	0.790 ± 0.000	0.854 ± 0.051	0.854 ± 0.051	0.854 ± 0.051	0.854 ± 0.051
Razorbill	0.570 ± 0.247	255 INDI	0.0006	0.895 ± 0.006	0.630 ± 0.209	0.630 ± 0.209	0.630 ± 0.209	0.895 ± 0.006	0.895 ± 0.006
Guillemot	0.672 ± 0.147	1,843 INDI	0.0009	0.939 ± 0.015	0.560 ± 0.000	0.762 ± 0.000	0.917 ± 0.000	0.939 ± 0.015	0.939 ± 0.015

~~SPECIES~~	~~DEMOGRAPHIC PARAMETER~~	~~VALUE~~
~~Kittiwake~~	~~Productivity ± SD~~	~~0.690 ± 0.296~~
	~~Survival ± SD~~	~~0.870 ± 0.057~~
	~~Impact value~~	~~3.54~~
~~Razorbill~~	~~Productivity ± SD~~	~~0.570 ± 0.247~~
	~~Survival ± SD~~	~~0.895 ± 0.067~~
	~~Impact value~~	~~0.16~~
~~Guillemot~~	~~Productivity ± SD~~	~~0.672 ± 0.174~~
	~~Survival ± SD~~	~~0.939 ± 0.015~~

SPECIES	DEMOGRAPHIC PARAMETER	VALUE
	Impact value	1.63

Table 6: Calculation of relative harvest for collisions.

SPECIES	BIO-SEASON	SEASONAL COLLISION RATE (TOTAL)	PROPORTIONAL WEIGHT OF GREAT ORME COLONY	PROPORTION ADULTS	ADULT MORTALITY APPORTIONED TO GREAT ORME	ANNUAL TOTAL	COLONY SIZE	RELATIVE HARVEST
Kittiwake	Breeding	12.3	0.530	0.53	3.46	3.50	1,708	0.0020
	Post-breeding migration	13.1	0.001	0.53	0.01			
	Return migration	28.4	0.002	0.53	0.03			

Table 7: Calculation of relative harvest for displacement.

SPECIES	BIO-SEASON	SEASONAL ABUNDANCE (ARRAY AREA PLUS 2KM)	TOTAL MORTALITY (50% DISPLACEMENT, 1% MORTALITY)	PROPORTIONAL WEIGHT OF GREAT ORME COLONY	PROPORTION ADULTS	ADULT MORTALITY APPORTIONED TO GREAT ORME	ANNUAL TOTAL	COLONY SIZE	RELATIVE HARVEST
Guillemot	Breeding	1,569	7.9	0.365	0.57	1.63	1.64	1,843	0.0009
	Non-breeding	2,919	14.6	0.0015	0.57	0.01			
Razorbill	Breeding	140	0.7	0.399	0.57	0.159	0.160	255	0.0006
	Post-breeding migration	66	0.3	0.0004	0.57	0.000			
	Winter	150	0.8	0.0002	0.57	0.000			
	Return migration	336	1.7	0.0004	0.57	0.000			

3 Results

~~16~~21 Graphical outputs from the PVA analysis are presented here. Yearly break down of the PVA outputs of counterfactual growth rate and counterfactual population size for each of the three species are presented in Table 8 ~~Table 2.~~

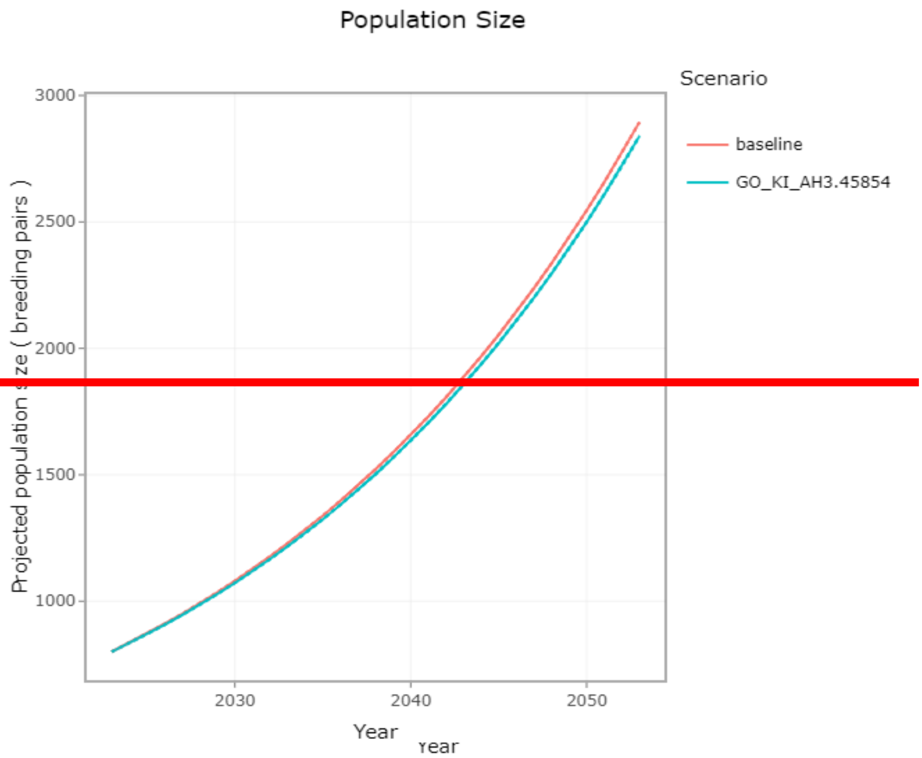
~~17~~22 The population trends presented are unlikely to be true reflections of reality as density independent models contain no constraints on population size or compensatory mechanisms. This means that density independent population model outputs are most likely to show exponential (positive or negative) trends, as demonstrated within the three species presented here.

~~18~~23 The use of counterfactual population size as metric to assess the outputs of density independent models is likely to produce outputs which are over-estimates of population impact as there is no method for populations to recover within the model. It is therefore considered appropriate for the assessments to prioritise the counterfactual growth rate as this population metric is less impacted by density independence in the model over time and therefore is likely more appropriate to consider what affect any potential impacts from a wind farm development may have.

3.1 Kittiwake

~~19~~24 The PVA outputs for kittiwake indicate a change less than 1% in the final counterfactual of growth rate of the Pen-y-Gogarth / Great Orme SSSI population after ~~the~~ accounting for the potential impact via collisions from AyM, which is not significant. The counterfactual of final population size shows a ~~1.9~~4.5% decrease in population size relative to the unimpacted population size by ~~the end of the 30-year lifespan of the AyM project, though both~~2065 (Table 8). Both populations remain in growth and end with significantly higher populations in comparison to the current level~~.~~ (Figure 1).

~~20~~25 The change in counterfactual of final population size is most likely a trait of the population model, with the relatively low number of estimated birds affected likely to recover through normal population dynamics, which are not included within the model.



~~Figure 1: Population trajectory from the PVA model run showing the baseline and impacted population estimates over 30 years.~~

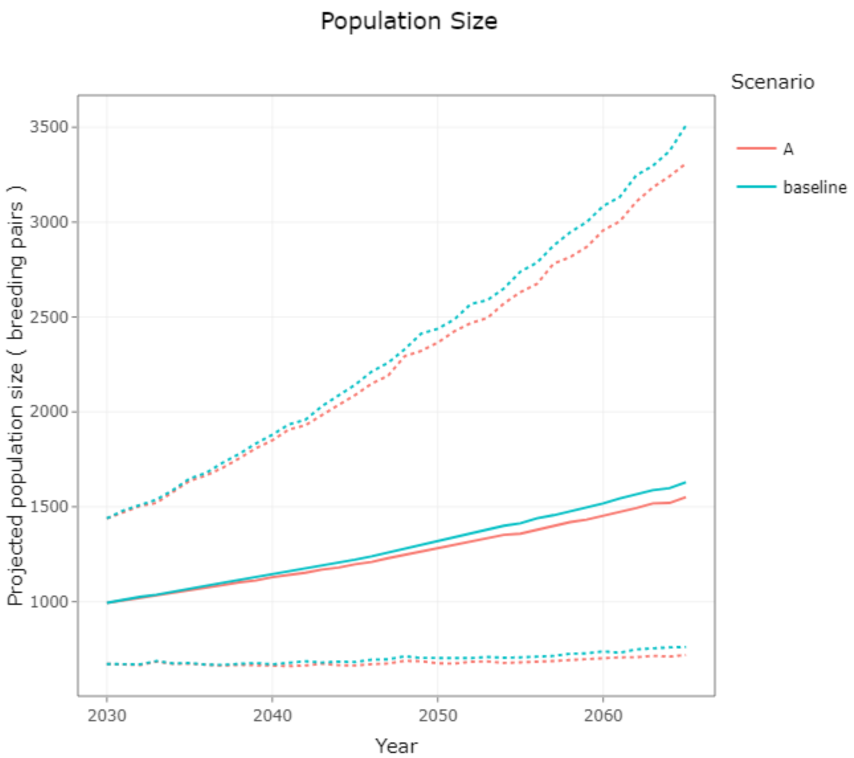


Figure 1: Population trajectory from the PVA model for Kittiwake showing the baseline and impacted population estimates over 35 years.

3.2 Razorbill

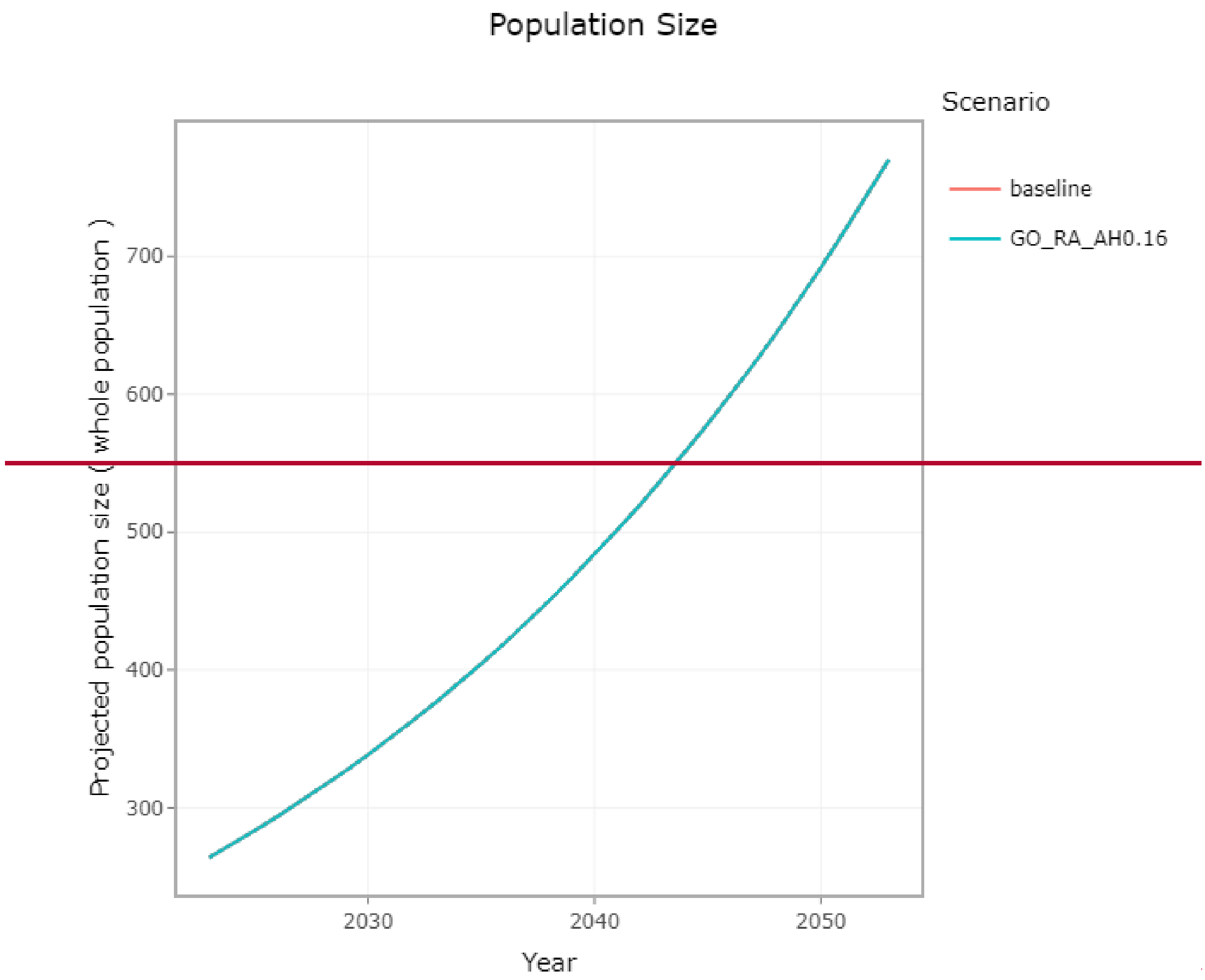
26 Razorbill The PVA outputs show no differences between the baseline population the unimpacted and the population affected by displacementimpacted populations from AyM at the Pen-y-Gogarth / Great Orme SSSI site show similar declines (Figure 2). There is less than 1% difference (0.001) in the final counterfactual growth rate for the Pen-y-Gogarth / Great Orme SSSI razorbill population in either final counterfactual of growth rate orwhich has the potential to be affected by AyM. Final counterfactual of final population size. indicated a mean increase of 1.5% (Table 8), which is assumed to be as a result of the demographic stochasticity included in the PVA. Due to the model approach used, final counterfactual growth rate is viewed as the more robust metric for assessment, this is expanded on further in Section 4 (Conclusion).

27 Model outputs indicated that using the Horswill & Robinson (2015) species-specific parameters produced exponentially declining population trends for both unimpacted and impacted populations (Figure 2). In reality, the population of Razorbill at the Pen-y-Gogarth / Great Orme SSSI site show fluctuating but on average consistent counts since 2000 (SMP 2022). However, with no robust localised estimates available, these parameters are considered the best available data for use within this assessment. This is likely due to the low percentage of affected birds that are apportioned to the Pen-y-Gogarth / Great Orme SSSIanother reason that it is recommended to focus on the difference in growth rate and population at the apportioning stage. Subsequently,size between the impacted and counterfactual (unimpacted) scenario as the relevant metrics, rather than the overall population trajectoriestrend.

3.3 Guillemot

28 The final difference between the counterfactual and impacted growth rate for guillemot remained below 1% (0.001) across the 35-year model run, with the final population size showing a 2.2% change between the counterfactual and impacted population (Table 8). Both populations showed continued exponential growth, increasing to number unlikely to be reflection of true population trends (Figure 3).

~~21~~29 The small difference between counterfactual and impacted final population size is most likely a trait of the population model, with the relatively low number of estimated birds affected likely to recover through normal population/metapopulation dynamics, which are ~~an exact match for each other (Figure 2).~~not included within the model.



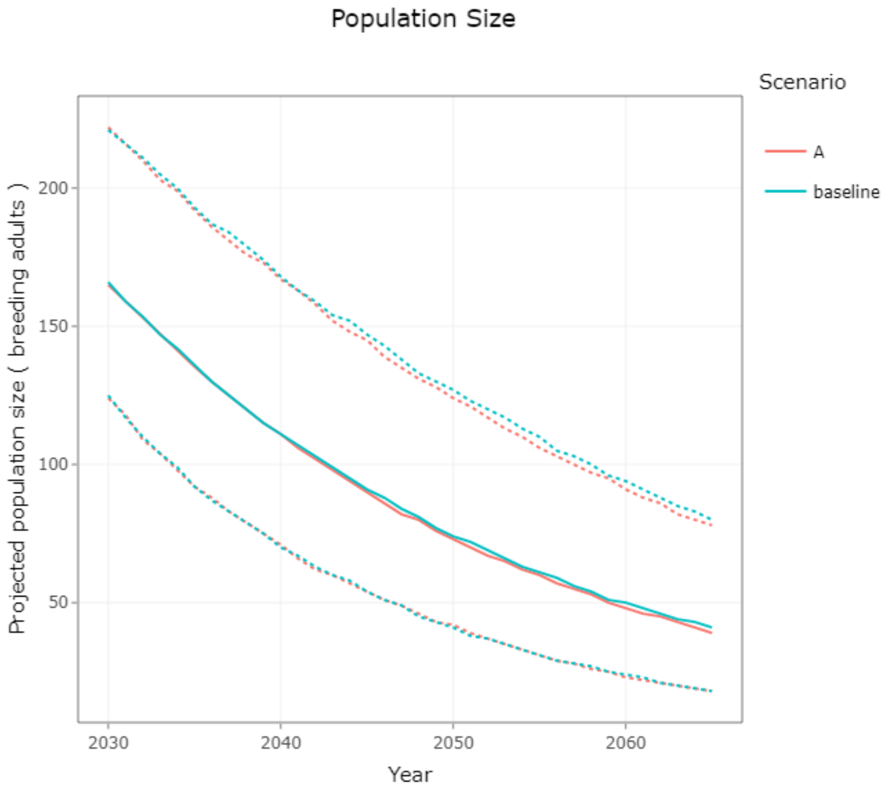
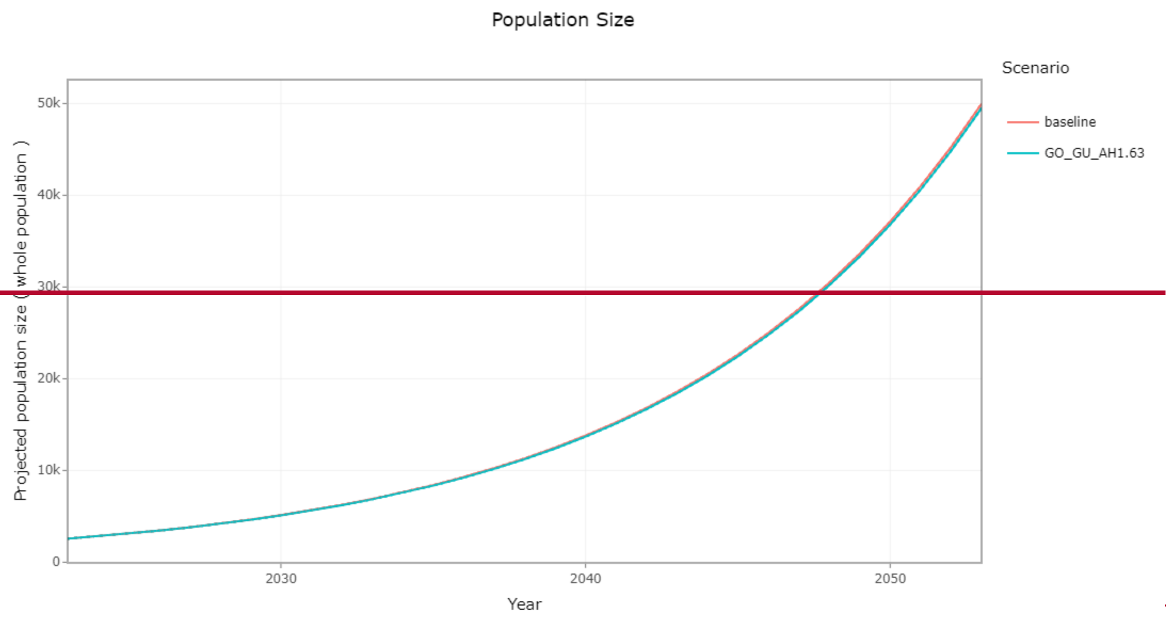


Figure 2: Population trajectory from the PVA model run for Razorbill showing the baseline and impacted population estimates over ~~30~~35 years.

~~3.3 Guillemot~~

~~1 The final counterfactual growth rate for guillemot remained below 0.1% across the 30-year model run with the counterfactual of final population size remaining below a 1% change between the baseline and impacted population. It is therefore expected that there will be no significant impact on the population of guillemot within the Pen-y-Gogarth / Great Orme SSSI.~~



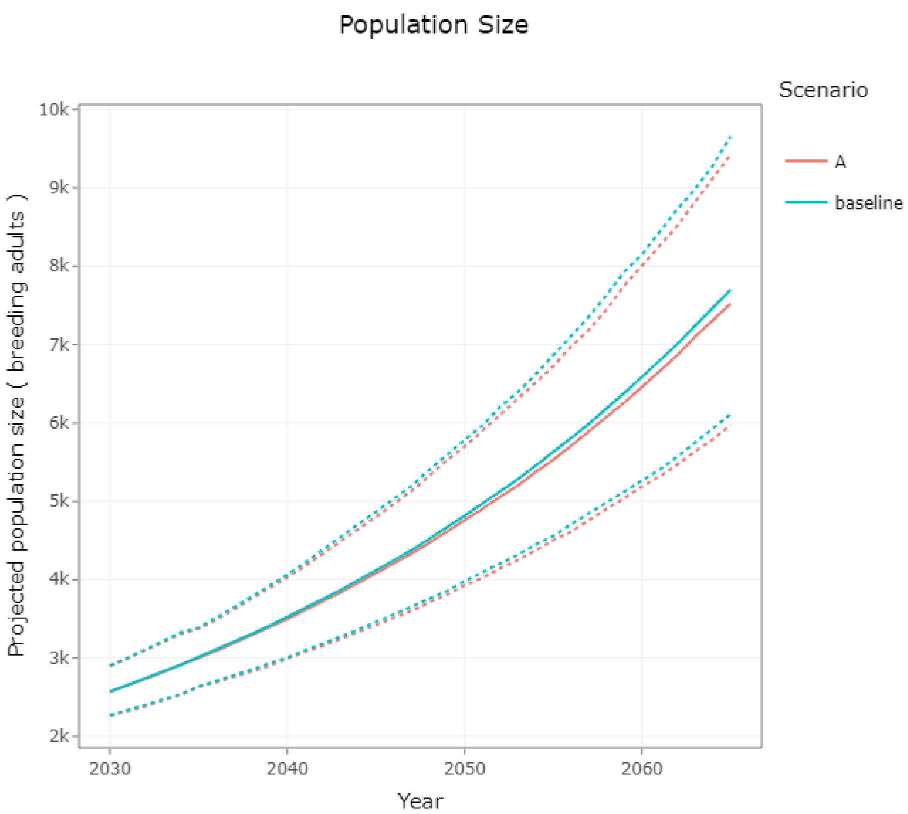


Figure 3.: Population trajectory from the PVA model run for Guillemot showing the baseline and impacted population estimates over 3035 years.

Table 8: Seabird PVA Tool outputs for the counterfactual of growth rate and counterfactual of population size for kittiwake, guillemot, and razorbill. Outputs are presented for the impact years of 2030 to 2065.

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2030	0.998 ± 0.017	1.000 ± 0.044	0.999 ± 0.010	0.999 ± 0.037	0.999 ± 0.001	1.000 ± 0.024
2031	0.998 ± 0.011	1.000 ± 0.030	0.999 ± 0.007	0.997 ± 0.039	0.999 ± 0.001	0.999 ± 0.025
2032	0.998 ± 0.008	1.000 ± 0.024	0.999 ± 0.005	0.996 ± 0.040	0.998 ± 0.001	0.998 ± 0.026
2033	0.999 ± 0.007	1.000 ± 0.021	0.999 ± 0.004	0.995 ± 0.041	0.997 ± 0.001	0.997 ± 0.027
2034	0.999 ± 0.006	1.000 ± 0.018	0.999 ± 0.004	0.994 ± 0.042	0.996 ± 0.002	0.997 ± 0.027
2035	0.999 ± 0.005	1.000 ± 0.017	0.999 ± 0.003	0.993 ± 0.043	0.996 ± 0.002	0.996 ± 0.028
2036	0.999 ± 0.005	1.000 ± 0.015	0.999 ± 0.003	0.992 ± 0.045	0.995 ± 0.002	0.996 ± 0.029
2037	0.999 ± 0.004	1.000 ± 0.014	0.999 ± 0.003	0.990 ± 0.046	0.994 ± 0.002	0.995 ± 0.029
2038	0.999 ± 0.004	1.000 ± 0.014	0.999 ± 0.002	0.988 ± 0.047	0.994 ± 0.003	0.995 ± 0.030
2039	0.999 ± 0.004	1.000 ± 0.013	0.999 ± 0.002	0.987 ± 0.048	0.993 ± 0.003	0.994 ± 0.030

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2040	0.999 ± 0.003	0.999 ± 0.012	0.999 ± 0.002	0.986 ± 0.050	0.992 ± 0.003	0.993 ± 0.031
2041	0.999 ± 0.003	0.999 ± 0.012	0.999 ± 0.002	0.985 ± 0.050	1.005 ± 0.106	0.993 ± 0.031
2042	0.999 ± 0.003	0.999 ± 0.012	0.999 ± 0.002	0.983 ± 0.051	1.006 ± 0.112	0.992 ± 0.032
2043	0.999 ± 0.003	0.999 ± 0.011	0.999 ± 0.002	0.982 ± 0.052	1.006 ± 0.119	0.991 ± 0.033
2044	0.999 ± 0.003	0.999 ± 0.011	0.999 ± 0.002	0.981 ± 0.053	1.005 ± 0.125	0.991 ± 0.033
2045	0.999 ± 0.003	0.999 ± 0.011	0.999 ± 0.002	0.980 ± 0.054	1.006 ± 0.132	0.990 ± 0.034
2046	0.999 ± 0.003	0.999 ± 0.010	0.999 ± 0.002	0.978 ± 0.055	1.006 ± 0.138	0.990 ± 0.034
2047	0.999 ± 0.003	0.999 ± 0.010	0.999 ± 0.002	0.977 ± 0.055	1.007 ± 0.145	0.989 ± 0.034
2048	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.976 ± 0.056	1.008 ± 0.152	0.989 ± 0.034
2049	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.975 ± 0.057	1.008 ± 0.157	0.988 ± 0.035
2050	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.973 ± 0.057	1.009 ± 0.164	0.987 ± 0.035
2051	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.972 ± 0.058	1.008 ± 0.169	0.987 ± 0.035

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2052	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.971 ± 0.058	1.008 ± 0.175	0.986 ± 0.036
2053	0.999 ± 0.002	0.999 ± 0.010	0.999 ± 0.001	0.970 ± 0.060	1.009 ± 0.182	0.986 ± 0.036
2054	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.969 ± 0.060	1.010 ± 0.187	0.985 ± 0.036
2055	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.967 ± 0.061	1.008 ± 0.193	0.985 ± 0.036
2056	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.966 ± 0.061	1.008 ± 0.198	0.984 ± 0.036
2057	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.965 ± 0.062	1.007 ± 0.205	0.984 ± 0.037
2058	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.964 ± 0.062	1.007 ± 0.211	0.983 ± 0.037
2059	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.962 ± 0.063	1.009 ± 0.220	0.982 ± 0.037
2060	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.961 ± 0.064	1.011 ± 0.228	0.982 ± 0.037
2061	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.960 ± 0.064	1.011 ± 0.236	0.981 ± 0.037
2062	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.959 ± 0.065	1.012 ± 0.243	0.980 ± 0.038
2063	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.958 ± 0.065	1.012 ± 0.250	0.980 ± 0.038

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2064	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.956 ± 0.066	1.013 ± 0.259	0.979 ± 0.038
2065	0.999 ± 0.002	0.999 ± 0.009	0.999 ± 0.001	0.955 ± 0.066	1.015 ± 0.263	0.978 ± 0.038

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2023	0.999 ± 0.0005	1.000 ± 0.000	0.999 ± 0.0001	0.999 ± 0.0005	1.000 ± 0.0000	0.999 ± 0.0001
2024	0.999 ± 0.0003	1.000 ± 0.000	0.999 ± 0.0001	0.998 ± 0.0006	1.000 ± 0.0000	0.998 ± 0.0002
2025	0.999 ± 0.0002	1.000 ± 0.000	0.999 ± 0.0001	0.997 ± 0.0007	1.000 ± 0.0000	0.997 ± 0.0002
2026	0.999 ± 0.0002	1.000 ± 0.000	0.999 ± 0.0001	0.996 ± 0.0007	1.000 ± 0.0000	0.996 ± 0.0003
2027	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0001	0.995 ± 0.0006	1.000 ± 0.0000	0.996 ± 0.0003
2028	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0001	0.994 ± 0.0006	1.000 ± 0.0000	0.995 ± 0.0003
2029	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0000	0.993 ± 0.0006	1.000 ± 0.0000	0.995 ± 0.0003

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2030	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0000	0.993 ± 0.0006	1.000 ± 0.0000	0.995 ± 0.0003
2031	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0000	0.992 ± 0.0006	1.000 ± 0.0000	0.994 ± 0.0003
2032	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0000	0.991 ± 0.0006	1.000 ± 0.0000	0.994 ± 0.0003
2033	0.999 ± 0.0001	1.000 ± 0.000	0.999 ± 0.0000	0.990 ± 0.0006	1.000 ± 0.0000	0.994 ± 0.0003
2034	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.990 ± 0.0006	1.000 ± 0.0000	0.993 ± 0.0003
2035	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.989 ± 0.0006	1.000 ± 0.0000	0.993 ± 0.0003
2036	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.988 ± 0.0006	1.000 ± 0.0000	0.993 ± 0.0003
2037	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.988 ± 0.0005	1.000 ± 0.0000	0.993 ± 0.0003
2038	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.987 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0003
2039	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.987 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0004
2040	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.986 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0004
2041	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.986 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0004

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2042	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.985 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0004
2043	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.985 ± 0.0005	1.000 ± 0.000	0.992 ± 0.0004
2044	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.984 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2045	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.984 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2046	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.983 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2047	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.983 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2048	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.983 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2049	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.982 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2050	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.982 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2051	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.982 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2052	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.981 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004
2053	0.999 ± 0.0000	1.000 ± 0.000	0.999 ± 0.0000	0.981 ± 0.0005	1.000 ± 0.000	0.991 ± 0.0004

4 Conclusions

~~22 The PVA outputs for guillemot and razorbill indicate that there is no risk to population status of those species at the Pen-y-Gogarth / Great Orme SSSI.~~

30 The PVA outputs for kittiwake, razorbill and guillemot indicate that there is limited effect when assessing using the final counterfactual of growth rate metric for assessing the Pen-y-Gogarth / Great Orme SSSI breeding birds. The ~~counterfactual~~comparison of final population size indicates ~~the~~ there is a potential for ~~the population~~kittiwake populations to be ~~1.9~~4.5% lower by the end of the ~~30~~35-year period in the impacted scenario compared to the unimpacted population size~~. However, under~~, and a 1.5% increase in razorbill and 2.2% decrease in guillemot population size. Under both the impacted and unimpacted scenarios, ~~the~~populations of kittiwake ~~population is still~~and guillemot are expected to grow significantly compared to the current population~~. –~~, with both unimpacted and impacted populations of razorbill predicted to decline.

31 The national average values available may not be most appropriate for modelling some localised populations, as the parameters don't generate stable population sizes, or population predictions that closely reflect reality. The population of Razorbill at the Pen-y-Gogarth / Great Orme SSSI site have shown fluctuating but relatively steady population counts since 2000 (SMP 2020), however model outputs predict a significant decline in both impacted and unimpacted populations. This highlights the effect limited localised data may have on model outputs, especially when assessing a single site in isolation.

2332 The use of counterfactual of final population size within a deterministicdensity independent model is problematic as the metric is time dependant and therefore not as robust as using the final counterfactual of growth rate. In a deterministic, density independent model, any slight reduction in survival or growth rate will lead to a divergence in the population sizes that increases constantly over time, with no mechanism that would constrain infinite growth, nor allow populations to recover once impacts have been removed. For example, if the outputs were assessed at the 15-year point for kittiwakes, the counterfactual of growth rate metric would report the same decrease of 0.1001%, while the counterfactual of population size would return a 1.3only be 2.0% lower population size. at that time point.

33 Therefore, the final counterfactual growth rate should be prioritised as main assessment metric used to consider population level effects. The use of final counterfactual population size outputs as the main assessment metric is less robust as the metric is strongly time and modelling approach sensitive, especially within density independent models and is therefore inappropriate to use as the sole metric for evaluating population level effects.

2434 Given that the counterfactual growth rate metric is the more robust assessment approachmetric, the results indicate that the impact of AyM on the kittiwake population atthree species scoped into this clarification note for the Pen-y-Gogarth / Great Orme SSSI is not a cause for concern, with only a small deviation from the predicted unimpacted population growth rate.rates for kittiwake (0.001), razorbill (0.001) and guillemot (0.001).

2535 Therefore, with regards to all three species assessed (kittiwake, guillemot and razorbill) from the Pen-y-Gogarth / Great Orme SSSI colonies there is no potential for a significant effect in relation to potential displacement or collision risk impacts from AyM and therefore, subject to natural change, all three species will be maintained as features in the long term with respect to the potential for adverse effects from displacement or collision risk.

26

5 References

Furness, R.W. 2015. Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Reports, Number 164.

Harris, M.P. 1989. Variation in the correction factor used for converting counts of individual guillemots *Uria aalge* into breeding pairs. Ibis, 131: 85-93.

Horswill, C. & Robinson R. A. (2015). Review of seabird demographic rates and density dependence. JNCC Report No. 552. Joint Nature Conservation Committee, Peterborough

Mobbs, D., Searle, K., Daunt, F. & Butler, A. (2020). A Population Viability Analysis Modelling Tool for Seabird Species: Guide for using the PVA tool (v2.0) user interface. Available at: [redacted] (Downloaded: 11 June 2020).

NatureScot (2018). Interim Guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs. [redacted]

Searle, K., Mobbs, D., Daunt, F., & Butler, A. 2019. A Population Viability Analysis Modelling Tool for Seabird Species. Centre for Ecology & Hydrology report for Natural England. Natural England Commissioned Report NECR274.

SMP (2020). JNCC UK Seabird Monitoring Programme. https://jncc.gov.uk/news/smpdatabase-launch/ and [redacted]

Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W., & Tasker, M.L. 1995. Seabird monitoring handbook for Britain and Ireland. JNCC / RSPB / ITE / Seabird Group, Peterborough.

6 Appendix A PVA Logs

6.1 PVA Tool mode log – Kittiwake

⅄ Set up

The log file was created on: 2022-12-12 17:22:16 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"

⅄ Basic information

This run had reference name “Great Orme Kittiwake”.
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: 1234.
Years for burn-in: 10.
Case study selected: None.

⅄ 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: 4.

Is there an upper constraint on productivity in the model?: Yes, constrained to 2 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: breeding.pairs
Are baseline demographic rates specified separately for immatures?: Yes.

- Population 1

Initial population values: Initial population 854 in 2019
Productivity rate per pair: mean: 0.69 , sd: 0.296
Adult survival rate: mean: 0.854 , sd: 0.051
Immatures survival rates:
Age class 0 to 1 - mean: 0.79 , sd: 1e-04 , DD: NA
Age class 1 to 2 - mean: 0.854 , sd: 0.051 , DD: NA
Age class 2 to 3 - mean: 0.854 , sd: 0.051 , DD: NA
Age class 3 to 4 - mean: 0.854 , sd: 0.051 , DD: NA

- Impacts

Number of impact scenarios: 1.
Are impacts applied separately to each subpopulation?: No
Are impacts of scenarios specified separately for immatures?: Yes
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

- Impact on Demographic Rates

Scenario A - Name: A
All subpopulations
Impact on productivity rate mean: 0 , se: NA
Impact on adult survival rate mean: 0.002 , se: NA
Impact on immature survival rate mean: 0 , se: NA

- Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065
How should outputs be produced, in terms of ages?: breeding.pairs
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA

6.2 PVA Tool mode log – Razorbill

- Set up

The log file was created on: 2022-12-12 18:01:45 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"

- Basic information

This run had reference name "Great Orme Razorbill".
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: 3456.
Years for burn-in: 0.
Case study selected: None.

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

⅄ Population 1

Initial population values: Initial population 255 in 2019
Productivity rate per pair: mean: 0.57 , sd: 0.247
Adult survival rate: mean: 0.895 , sd: 0.006
Immatures survival rates:
Age class 0 to 1 - mean: 0.63 , sd: 0.209 , DD: NA
Age class 1 to 2 - mean: 0.63 , sd: 0.209 , DD: NA
Age class 2 to 3 - mean: 0.63 , sd: 0.209 , DD: NA
Age class 3 to 4 - mean: 0.895 , sd: 0.006 , DD: NA
Age class 4 to 5 - mean: 0.895 , sd: 0.006 , DD: NA

⅄ Impacts

Number of impact scenarios: 1.
Are impacts applied separately to each subpopulation?: No
Are impacts of scenarios specified separately for immatures?: Yes
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

⅄ Impact on Demographic Rates

Scenario A - Name: A
All subpopulations
Impact on productivity rate mean: 0 , se: NA
Impact on adult survival rate mean: 6e-04 , se: NA
Impact on immature survival rate mean: 0 , se: NA

⅄ Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065
How should outputs be produced, in terms of ages?: breeding.adults
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA

6.3 PVA Tool mode log – Guillemot

- Set up

The log file was created on: 2022-12-12 17:36:42 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"

Basic information

This run had reference name "".
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: 2345.
Years for burn-in: 10.
Case study selected: None.

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

Population 1

Initial population values: Initial population 1843 in 2019
Productivity rate per pair: mean: 0.672 , sd: 0.147
Adult survival rate: mean: 0.939 , sd: 0.015
Immatures survival rates:
Age class 0 to 1 - mean: 0.56 , sd: 1e-04 , DD: NA
Age class 1 to 2 - mean: 0.762 , sd: 1e-04 , DD: NA
Age class 2 to 3 - mean: 0.917 , sd: 1e-04 , DD: NA
Age class 3 to 4 - mean: 0.939 , sd: 0.015 , DD: NA
Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA
Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 1.
Are impacts applied separately to each subpopulation?: No
Are impacts of scenarios specified separately for immatures?: Yes

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

- Impact on Demographic Rates
- Scenario A - Name:

All subpopulations
Impact on productivity rate mean: 0 , se: NA
Impact on adult survival rate mean: 9e-04 , se: NA
Impact on immature survival rate mean: 0 , se: NA

- Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065
How should outputs be produced, in terms of ages?: breeding.adults
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA

Fferm Wynt Alltraeth

AWEL Y MÔR

Offshore Wind Farm

RWE Renewables UK Swindon Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
T +44 (0)8456 720 090
[redacted]

Registered office:
RWE Renewables UK Swindon Limited
Windmill Hill Business Park
Whitehill Way
Swindon