



# **Awel y Môr Offshore Wind Farm**

## **Marine Ornithology Great Orme Assessment (Clean)**

### **Marine Licence Submission 1**

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# 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:

*"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."*

- 2 The Applicant has since engaged further with NRW following receipt of the Relevant Representations, through a consultation meeting held virtually on 6 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, 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.
- 3 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.

- 4 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.
- 5 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.
- 6 This version contains updates on the species-specific demographic parameters after a review of these values was requested by NRW after reviewing  
1.16\_D1\_AyM\_Marine\_Ornithology\_Great\_Orme\_Assessment\_RevA  
(planninginspectorate.gov.uk) (Email correspondence 16 November 2022 AyM: Great Orme SSSI Ornithology Assessment, from NRW). Additionally, the assessment period was changed from 2023-2053 to 2030-2065 to more closely match the operational period of AyM.

## 2 Methods

### 2.1 PVA Tool

- 7 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 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 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 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 For these reasons, the Seabird PVA Tool was set up to be run 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 with demographic stochasticity, which was therefore run with this option turned off. This is not expected to affect the results as published guidance indicates that for populations greater than 100 individuals there should be no difference in outputs with and without demographic stochasticity (Mobbs et al. 2020).
- 12 The model was run with 5,000 simulations from 2025 to 2065, with an impact period from 2030 to 2065, with a 10-year burn-in period 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 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 harvest values into the PVA tool to act as the impact parameters.

## 2.2 Species specific inputs

- 14 Details of the species-specific parameters used for running the Seabird PVA Tool are presented in Table 1. 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 (2,322) and razorbill (254) and counted as individuals, whilst kittiwake (780) 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.



Table 1: 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	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	780 <small>AON</small>	0.0023	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	254 <small>INDI</small>	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	2,322 <small>INDI</small>	0.0007	0.939 ± 0.015	0.560 ± 0.000	0.762 ± 0.000	0.917 ± 0.000	0.939 ± 0.015	0.939 ± 0.015

## 3 Results

- 15 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 2.
- 16 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.
- 17 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

- 18 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 accounting for the potential impact via collisions from AyM, which is not significant. The counterfactual of final population size shows a 10% decrease in population size relative to the unimpacted population size by 2065 (Table 2). Both populations remain in growth and end with significantly higher populations in comparison to the current level (Figure 1).
- 19 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.

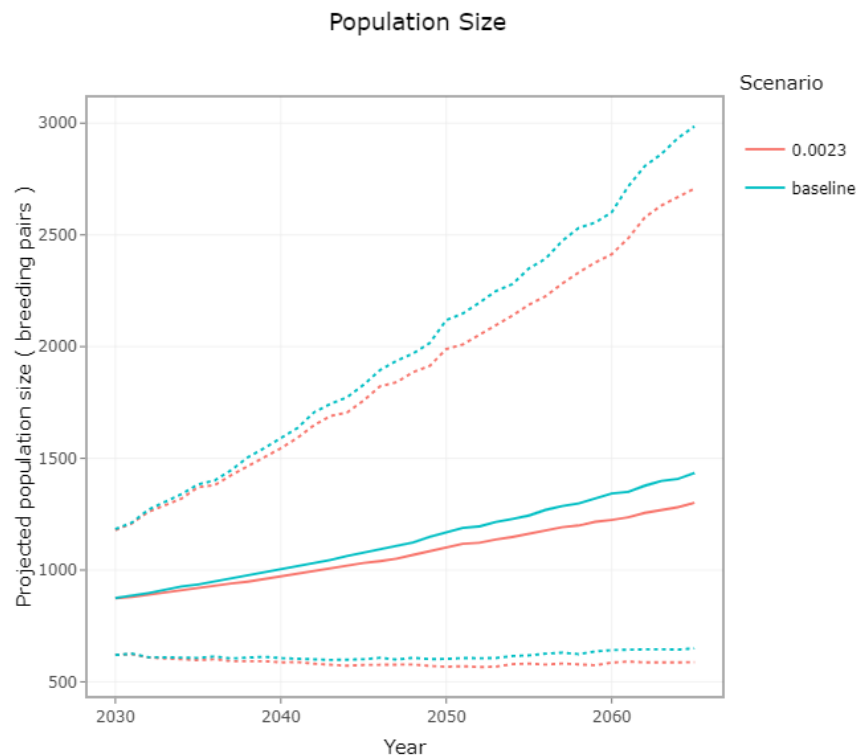


Figure 1: Population trajectory from the PVA model for Kittiwake showing the baseline and impacted population estimates over 35 years.

## 3.2 Razorbill

- 20 The PVA outputs show the unimpacted and impacted 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 which has the potential to be affected by AyM. Final counterfactual population size indicated a decrease of 2.6% (Table 2). 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).

- 21 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 another reason that it is recommended to focus on the difference in growth rate and population size between the impacted and counterfactual (unimpacted) scenario as the relevant metrics, rather than the overall population trend.

### 3.3 Guillemot

- 22 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 2.8% change between the counterfactual and impacted population (Table 2). Both populations showed continued exponential growth, increasing to number unlikely to be reflection of true population trends (Figure 3).
- 23 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 not included within the model.

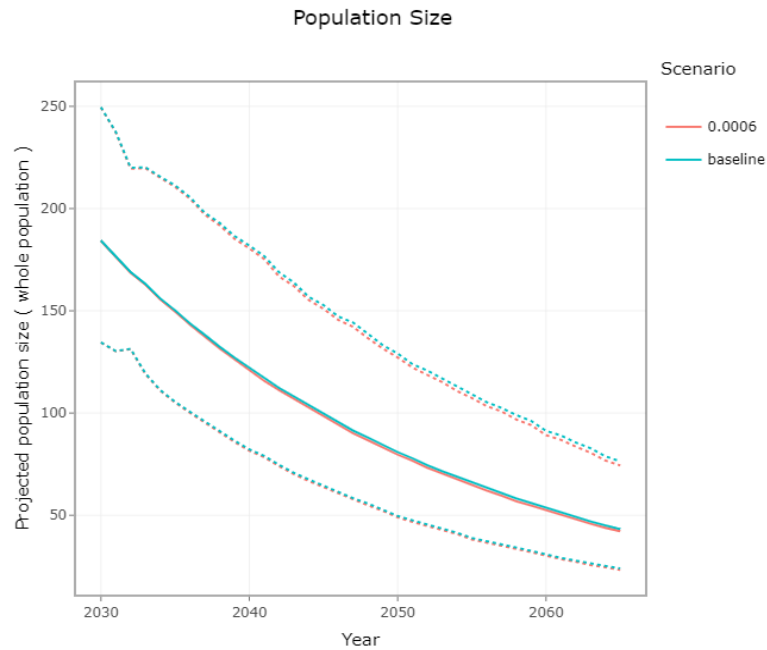


Figure 2: Population trajectory from the PVA model run for Razorbill showing the baseline and impacted population estimates over 35 years.

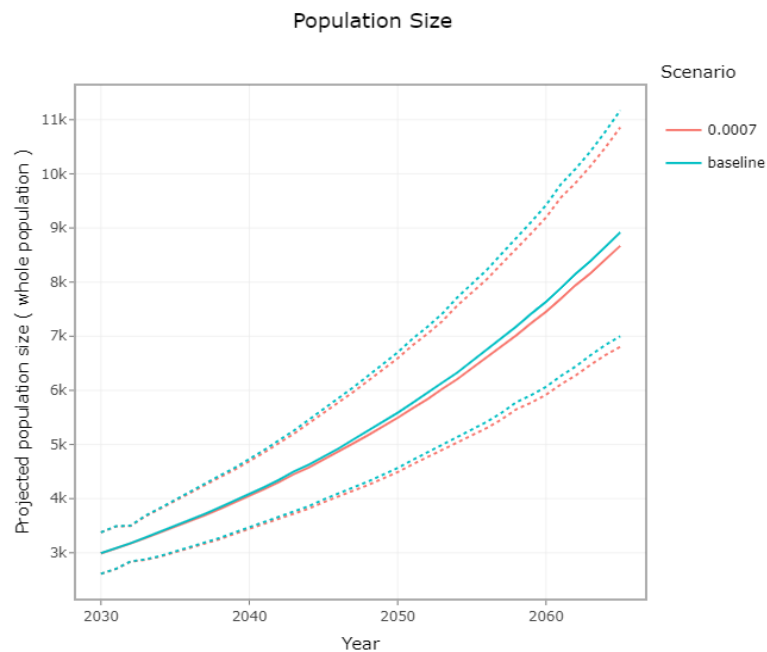


Figure 3: Population trajectory from the PVA model run for Guillemot showing the baseline and impacted population estimates over 35 years.

Table 2: 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	$0.998 \pm 0.017$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.998 \pm 0.033$	$0.999 \pm 0.001$	$0.999 \pm 0.000$
2031	$0.997 \pm 0.012$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.996 \pm 0.035$	$0.999 \pm 0.001$	$0.998 \pm 0.000$
2032	$0.997 \pm 0.009$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.993 \pm 0.037$	$0.998 \pm 0.001$	$0.997 \pm 0.000$
2033	$0.997 \pm 0.007$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.990 \pm 0.039$	$0.997 \pm 0.001$	$0.997 \pm 0.000$
2034	$0.997 \pm 0.006$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.987 \pm 0.040$	$0.996 \pm 0.002$	$0.996 \pm 0.000$
2035	$0.997 \pm 0.005$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.985 \pm 0.042$	$0.996 \pm 0.002$	$0.995 \pm 0.000$
2036	$0.997 \pm 0.005$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.982 \pm 0.043$	$0.995 \pm 0.002$	$0.994 \pm 0.000$
2037	$0.997 \pm 0.005$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.979 \pm 0.044$	$0.994 \pm 0.002$	$0.993 \pm 0.000$
2038	$0.997 \pm 0.004$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.976 \pm 0.045$	$0.994 \pm 0.003$	$0.993 \pm 0.000$
2039	$0.997 \pm 0.004$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.974 \pm 0.046$	$0.993 \pm 0.003$	$0.992 \pm 0.000$

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2040	0.994 ± 0.004	0.999 ± 0.000	0.999 ± 0.000	0.971 ± 0.048	0.992 ± 0.003	0.991 ± 0.000
2041	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.969 ± 0.048	0.991 ± 0.003	0.990 ± 0.000
2042	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.966 ± 0.050	0.991 ± 0.003	0.990 ± 0.000
2043	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.964 ± 0.051	0.990 ± 0.004	0.989 ± 0.000
2044	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.961 ± 0.052	0.989 ± 0.004	0.988 ± 0.000
2045	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.958 ± 0.052	0.989 ± 0.004	0.987 ± 0.000
2046	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.956 ± 0.053	0.988 ± 0.004	0.987 ± 0.000
2047	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.987 ± 0.054	0.987 ± 0.005	0.986 ± 0.000
2048	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.952 ± 0.055	0.986 ± 0.005	0.985 ± 0.000
2049	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.949 ± 0.056	0.985 ± 0.005	0.984 ± 0.000
2050	0.997 ± 0.003	0.999 ± 0.000	0.999 ± 0.000	0.946 ± 0.057	0.984 ± 0.006	0.983 ± 0.000
2051	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.943 ± 0.057	0.984 ± 0.006	0.983 ± 0.000

YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2052	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.941 ± 0.058	0.983 ± 0.006	0.982 ± 0.000
2053	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.938 ± 0.059	0.983 ± 0.007	0.981 ± 0.000
2054	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.936 ± 0.060	0.982 ± 0.007	0.980 ± 0.000
2055	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.933 ± 0.060	0.981 ± 0.007	0.980 ± 0.000
2056	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.931 ± 0.060	0.980 ± 0.008	0.979 ± 0.000
2057	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.928 ± 0.061	0.980 ± 0.008	0.978 ± 0.000
2058	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.926 ± 0.061	0.979 ± 0.008	0.977 ± 0.000
2059	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.923 ± 0.061	0.978 ± 0.008	0.977 ± 0.000
2060	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.921 ± 0.062	0.978 ± 0.009	0.976 ± 0.000
2061	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.919 ± 0.063	0.977 ± 0.009	0.975 ± 0.000
2062	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.916 ± 0.063	0.976 ± 0.009	0.974 ± 0.000
2063	0.997 ± 0.002	0.999 ± 0.000	0.999 ± 0.000	0.914 ± 0.064	0.976 ± 0.010	0.974 ± 0.000



YEAR	COUNTERFACTUAL GROWTH RATE MEAN (WITH SD)			COUNTERFACTUAL POPULATION SIZE (WITH SD)		
	KITTIWAKE	RAZORBILL	GUILLEMOT	KITTIWAKE	RAZORBILL	GUILLEMOT
2064	$0.997 \pm 0.002$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.912 \pm 0.064$	$0.975 \pm 0.011$	$0.973 \pm 0.000$
2065	$0.997 \pm 0.002$	$0.999 \pm 0.000$	$0.999 \pm 0.000$	$0.909 \pm 0.064$	$0.974 \pm 0.011$	$0.972 \pm 0.000$

## 4 Conclusions

- 24 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 comparison of final population size indicates there is a potential for kittiwake populations to be 10% lower by the end of the 35-year period in the impacted scenario compared to the unimpacted population size, and a 2.6% decrease in razorbill and 2.8% decrease in guillemot population size. Under both the impacted and unimpacted scenarios, populations of kittiwake and guillemot are expected to grow significantly compared to the current population, with both unimpacted and impacted populations of razorbill predicted to decline.
- 25 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.
- 26 The use of counterfactual of final population size within a density 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 0.003%, while the counterfactual of population size would only be 4.2% lower at that time point.

- 27 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.
- 28 Given that the counterfactual growth rate metric is the more robust assessment metric, the results indicate that the impact of AyM on the three 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 rates for kittiwake (0.003), razorbill (0.001) and guillemot (0.001).
- 29 Therefore, with regards to all three species 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.

## 5 References

- 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: [https://github.com/naturalengland/Seabird\\_PVA\\_Tool/blob/master/Documentation/PVA\\_Tool\\_UI\\_Guidance.pdf](https://github.com/naturalengland/Seabird_PVA_Tool/blob/master/Documentation/PVA_Tool_UI_Guidance.pdf) (Downloaded: 11 June 2020).
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- SMP (2020). JNCC UK Seabird Monitoring Programme. <https://jncc.gov.uk/news/smpdatabase-launch/> and <https://app.bto.org/seabirds/public/index.jsp>

## 6 Appendices

### 6.1 PVA Tool mode log – Kittiwake

#### ▲ Set up

The log file was created on: 2022-11-22 11:05:06 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 "GO\_KI\_rh\_v2\_2".

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: 4567.

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 780 in 2022

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?: 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

#### Impact on Demographic Rates

Scenario A - Name: 0.0023

#### All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0023 , 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: 2022-11-22 04:56:40 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 "GO\_RA\_rh\_v2".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: No.

Number of simulations: 5000.

Random seed: 6789.

Years for burn-in: 10.

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: all.individuals

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

### ▲ Population 1



Initial population values: Initial population 254 in 2022

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?: 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

#### ➤ Impact on Demographic Rates

Scenario A - Name: 0.0006

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6e-04 , 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?: whole.population

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: 2022-11-22 05:02:13 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 "GO\_GU\_rh\_v2".

PVA model run type: simplescenarios.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: No.

Number of simulations: 5000.

Random seed: 6543.

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: all.individuals

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

### 📌 Population 1

Initial population values: Initial population 2322 in 2022

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?: 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

#### ▲ Impact on Demographic Rates

##### ▲ Scenario A - Name: 0.0007

### **All subpopulations**

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-04 , 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?: whole.population

Target population size to use in calculating impact metrics: NA

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



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