Partners in UK offshore wind

MORGAN OFFSHORE WIND PROJECT GENERATION ASSETS

Preliminary Environmental Information Report

Volume 4, annex 10.6: Offshore ornithology population viability analysis

Image of an offshore wind farm

April 2023
FINAL

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev01	Draft for Client review	RPS	bpEnBW		23/11/22
Rev02	Addressing client comments	RPS	bpEnBW		10/12/22
Rev03	Final	RPS	bpEnBW	bpEnBW	16/12/22

Prepared by:	Prepared for:
RPS	**Morgan Offshore Wind Ltd.**

Contents

Tables

Appendices

Glossary

Term	Meaning
Breeding Adults	Adults at breeding age proportion of a population.
Counterfactual of Growth Rate	The ratio of impacted to unimpacted annual growth rate.
Counterfactual of Population Size	The ratio of impacted to unimpacted population size.
Cumulative Effects	The combined effect of the Mona Offshore Wind Project and Morgan Generation Assets in combination with the effects from a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Mona Offshore Wind Project and Morgan Generation Assets.
Demographic Parameter	A factor that determines the population size.
Population Viability Analysis	The process of determining the probability that a population will persist over a specified time period.
Productivity	The annual population estimate of number of chicks fledged per pair.
Shiny App	User-friendly graphical user interface accessible via a standard web-browser that uses underlying R code.
Stochasticity	The lack of any predictable order or plan.
Survival Rate	The probability of an individual to survive from one breeding season to the next.

Acronyms

Term	Meaning
BDMPS	Biologically Defined Minimum Population Scale
CPGR	Counterfactual of the Population Growth Rate
CPS	Counterfactual of Population Size
EIA	Environmental Impact Assessment
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
SD	Standard Deviation
SPA	Special Protection Area

Units

Unit	Description
%	Percentage

1 Offshore ornithology cumulative population viability analysis

1.1 Introduction

1.1.1 Background

1.1.1.1 Renewable energy projects in the marine environment, such as offshore wind farms, have the potential to impact seabirds through several processes such as collision with wind turbine blades resulting in mortality, or displacement from an area due to the presence of wind turbines. These processes affect individuals, but the cumulative effects (when the project alone effects are considered alongside any effects from other projects on the same receptor) have the potential to affect the productivity or elevate the baseline mortality of a population. The Environmental Impact Assessment (EIA) process provides for the assessment of such potential effects as a consequence of offshore wind farms at varying population scales, from a single Special Protection Area (SPA) colony to the wider biogeographic population.

1.1.1.2 One method to estimate the effect that offshore wind projects alone or cumulatively may have on a population is through Population Viability Analysis (PVA). PVA provides a robust framework using demographic parameters to predict changes in the population, using statistical population models to forecast future changes over a set period. Comparisons are made between ‘baseline’ conditions whereby conditions remain unimpacted and under ‘scenario’ conditions where an impact is applied to a population by the alteration of demographic parameters. Population metrics that are derived from comparisons of ‘baseline’ and ‘impacted’ predictions generated by PVAs can then be used to assess the significance of the anticipated additional mortality associated with planned developments; typically, causing a population to decline when it was otherwise increasing (the growth rate falls below 1) alongside decreasing the population size by more than 10% is seen as having an adverse effect.

1.1.1.3 As part of the Mona Offshore Wind Project and Morgan Offshore Wind Project Generation Assets (hereafter called the Morgan Generation Assets) alone and cumulative assessments (as detailed in volume 2, chapter 10; Offshore ornithology of the PEIR for each project), the species selected for further assessment were:

- Common guillemot *Uria aalge*
- Great black-backed gull *Larus marinus.*

These species were selected for further assessment of the predicted cumulative impacts only, due to the predicted cumulative increase in baseline mortality exceeding a 1% threshold in relation to the Biologically Defined Minimum Population Scale (BDMPS). A 1% increase is the level that is regarded as the threshold for undertaking further assessments such as PVA for their respective BDMPS regions. For the Mona Offshore Wind Project and Morgan Generation Assets in isolation, as detailed in volume 2, chapter 10; Offshore ornithology of the PEIR for each project, the assessments concluded no significant effect would occur at the BDMPS scale and so therefore, no project alone PVA was deemed necessary.

1.1.2 Aim of report

1.1.3 This technical report presents the cumulative PVA process conducted for the Mona Offshore Wind Project and the Morgan Generation Assets with wind farms in the surrounding area.

1.2 Methodology

1.2.1.1 PVA was undertaken using the Seabird PVA Tool developed by Natural England (Searle *et al*. 2019). The Seabird PVA Tool was accessed via the ‘Shiny App’ interface, which is a user-friendly graphical user interface accessible via a standard web-browser that uses the nepva R package to perform the modelling and analysis. The tool constructs a stochastic Leslie matrix and can assess any type of impact in terms of change to demographic parameters, or as a cull or harvest of a fixed size per year (Searle *et al*. 2019).

1.2.2 Modelling approach

1.2.2.1 All PVA models were undertaken using the ‘Simulation’ run type, which is used to simulate population trajectories based on the specified demographic parameters, initial population sizes and scenarios the user inputs into the model.

1.2.2.2 The tool includes an option to switch the model to run as either density independent, or density dependent. Density dependence is self-evident in the natural environment, as without density dependence, populations would grow exponentially. For seabird populations, the mechanisms as to how this operates are largely uncertain. If density dependence is mis-specified in an assessment, the modelled predictions may be unreliable. Therefore, it is more typical to use density independent models for seabird assessments, despite the lack of biologically necessary density dependence. As such, density independent models lack any means by which a population can recover once it has been reduced beyond a certain point, they are therefore appropriate for impact assessment purposes on the grounds of precaution (Ridge *et al*. 2019).

1.2.2.3 Environmental stochasticity, which accounts for the variation arising from environmental changes affecting individuals in the same group (e.g. between-year differences in weather conditions), was incorporated in the models at the level of productivity and survival rates. For each simulated year, a value for each demographic rate was randomly generated from a probability distribution defined by the mean and standard deviation estimates of that rate for the population under consideration.

1.2.2.4 Demographic stochasticity, which accounts for individual-level variation affecting transition probabilities between age-classes, was included in the models. For large populations, like the ones considered in this analysis, the effects of environmental stochasticity are deemed more important than those associated with demographic stochasticity (Morris and Doak, 2002). However, including demographic stochasticity will not cause any issues when simulating larger populations (WWT Consulting 2012) and hence has been included.

1.2.2.5 PVA outputs can either be expressed as the Counterfactual of Population Size (CPS) or the Counterfactual of the Population Growth Rate (CPGR) depending on if density dependence is included within the model. As models within this report have been run using density independence, the CPGR is considered more robust and informative, while if the PVA is density dependent then the CPS is more robust and informative.

While both CPS and CPGR are provided, the interpretation of the density independent PVA outputs focusses on the CPGR.

1.2.2.6 All PVA modelling in this technical report was undertaken with environmental and deterministic stochasticity. To ensure robust results, all simulations were set to run 5,000 times. All models were run for a 35 year time span (the lifetime of the Mona Offshore Wind Project and the Morgan Generation Assets).

1.2.2.7 Modelling has also been undertaken excluding 'burn in' within the model. It has been assumed that any impacts on populations commenced the year following latest population counts. If a 'burn in' period is applied, it allows for a stable age structure to form when starting to run the model. Within the guidance document for the model (Mobbs *et al*. 2020), the use of 'burn in' within the model is specified as future work, and so due to this reason the PVA modelling has been run excluding a 'burn in' period.

1.2.3 Demographic rates

1.2.3.1 For both species the initial population size inputted into all PVAs for the biogeographic scale were taken from the review undertaken by Furness (2015). The survival rates for common guillemot and great black-backed gull were derived from the national values presented in Horswill and Robinson (2015).

1.2.3.2 Due to the limited amount of data, Horswill and Robinson (2015) recommended using the survival rates of other large gull species when conducting population modelling for great black-backed gull. Therefore, the survival rates for great black-backed gull used for the PVA are based on adult and juvenile rates for herring gull as presented in Horswill & Robinson (2015); Table 1.1.

Table 1.1: Species demographic rates used in population viability analysis.

Species	Age first breeding	Final Age	Eggs/pair		Survival rates (per age class)						Productivity	
					0-1	1-2	2-3	3-4	4-5	5-6	A	
Guillemot	6	6	1	Mean	0.560	0.792	0.917	0.939	0.939	0.939	0.939	0.672
				SD	0.013	0.034	0.022	0.015	0.015	0.015	0.015	0.147
Great black-backed gull	5	6	1	Mean	0.798	0.834	0.834	0.834	0.834	n/a	0.834	1.139
				SD	0.092	0.034	0.034	0.034	0.034	n/a	0.034	0.533

1.2.3.3 As detailed in volume 2, chapter 10; Offshore ornithology of the PEIR the following BDMPS populations were used in PVA for each species:

- As the Mona Offshore Wind Project and the Morgan Generation Assets are close to both the UK Southwest & English Channel BDMPS and West of Scotland BDMPS regions, there is uncertainty regarding the most applicable BDMPS regions to use for the cumulative assessment of great black-backed gull. To account for this, both BDMPS populations have been used with a population of 17,742 individuals and 34,380 individuals respectively (Furness, 2015)
- UK Western waters for common guillemot with a population size of 1,139,200 individuals (Furness, 2015).

1.2.4 Input parameters

Common guillemot

1.2.4.1 The displacement values used in the PVA assessment for common guillemot are based on the multiple assessments presented in volume 2, chapter 10; Offshore ornithology of the PEIR. The displacement impacts assessed for the cumulative effects assessment followed a range-based approach, considering displacement values of 30 to 70% and a 1 to 10% mortality rate as advised via the Offshore Ornithology Expert Working Group, with meetings held in February 2022 and July 2022. The cumulative displacement values are presented in Table 1.2.

Table 1.2: Common guillemot PVA results for the UK Western waters BDMPS.

Scenario	Cumulative predicted mortality	Predicted mortality %
1. 30% displacement, 1% mortality	172	0.015%
2. 50% displacement, 1% mortality	287	0.025%
3. 70% displacement, 1% mortality	402	0.035%
4. 30% displacement, 2% mortality	345	0.030%
5. 50% displacement, 2% mortality	574	0.050%
6. 70% displacement, 2% mortality	804	0.071%
7. 30% displacement, 5% mortality	861	0.076%
8. 50% displacement, 5% mortality	1,436	0.126%
9. 70% displacement, 5% mortality	2,010	0.176%
10. 30% displacement, 10% mortality	1,723	0.151%
11. 50% displacement, 10% mortality	2,872	0.252%
12. 70% displacement, 10% mortality	4,020	0.353%

Great black-backed gull

1.2.4.2 The collision risk values used in the PVA assessment for great black-backed gull are based on the mean, Lower Confidence Interval (LCI) and Upper Confidence Interval (UCI) values presented in volume 2, chapter 10; Offshore ornithology of the PEIR. The approach taken to assessing cumulative collision risk is a quantitative one, drawing upon the published information produced by the other projects considered in the cumulative effects assessment. The cumulative values are presented in Table 1.3.

Table 1.3: Great black-backed gull PVA results for the differing BDMPS.

Scenario	Cumulative predicted mortality	Predicted mortality %
UK South-west & English Channel BDMPS		
1. Mean	49.2	0.277%
2. LCI	43.1	0.243%
3. UCI	60.8	0.343%
West of Scotland BDMPS		
1. Mean	49.2	0.143%
2. LCI	43.1	0.125%
3. UCI	60.8	0.177%
Combined BDMPS		
1. Mean	49.2	0.094%
2. LCI	43.1	0.083%
3. UCI	60.8	0.117%

1.2.5 Impact scenarios

1.2.5.1 Each simulation was paired with an impact scenario that included additional population-level mortality due to wind turbine collision or habitat displacement effects. This additional mortality was calculated as a proportion of the starting population and applied to the adult age class only. This way, the number of additional deaths scaled proportionately with changes to the simulated number of breeding adults in the population.

1.2.5.2 Due to uncertainty surrounding the level of impact, a range of displacement and mortality rates for common guillemot have been shown, with focus placed on the commonly used 50% displacement and 1% mortality rate for common guillemot, in line with values used by other offshore wind farm displacement assessments. Upper and lower collision risk estimates for great black-backed gull have been presented alongside the mean estimated value (Table 1.5 to Table 1.7).

1.2.5.3 All impact scenarios and input parameters for each run and for each species are presented in Appendix A.

1.3 Results

1.3.1 Common guillemot

1.3.1.1 The final counterfactual growth rate for guillemot remained below 0.4% across the 35-year model run with the counterfactual of final population size remaining below a 14% change between the baseline and impacted population (Table 1.4).

Table 1.4: Common guillemot PVA results for the UK Western waters BDMPS.

				Density-independence (after 35 years)			
Scale	Scenario	Predicted mortality	Growth rate	Mean CPGR	Mean CPS	Reduction in growth rate	Reduction in population size
	Baseline (unimpacted)	0	1.034	1.000	1.000	n/a	n/a
	1. 30% displacement, 1% mortality	172	1.034	1.000	0.994	0.017%	0.607%
	2. 50% displacement, 1% mortality	287	1.034	1.000	0.990	0.028%	1.004%
	3. 70% displacement, 1% mortality	402	1.034	1.000	0.986	0.039%	1.406%
BDMPS	4. 30% displacement, 2% mortality	345	1.034	1.000	0.988	0.034%	1.210%
	5. 50% displacement, 2% mortality	574	1.034	0.999	0.980	0.056%	1.999%
	6. 70% displacement, 2% mortality	804	1.034	0.999	0.972	0.079%	2.795%
	7. 30% displacement, 5% mortality	861	1.034	0.999	0.970	0.084%	2.990%
	8. 50% displacement, 5% mortality	1436	1.033	0.999	0.951	0.140%	4.934%
	9. 70% displacement, 5% mortality	2010	1.032	0.998	0.932	0.197%	6.837%
	10. 30% displacement, 10% mortality	1723	1.033	0.998	0.941	0.168%	5.888%
	11. 50% displacement, 10% mortality	2,872	1.032	0.997	0.904	0.281%	9.619%
	12. 70% displacement, 10% mortality	4,020	1.030	0.996	0.868	0.393%	13.208%

1.3.1.2 When considering the scenario of 50% displacement and 1% mortality rate, growth rate was reduced by 0.028% resulting in a 1.004% decrease in population size over a 35 year timeframe.

1.3.1.3 When considering the most extreme scenario of 70% displacement and 10% mortality rate, growth rate was reduced by 0.393% resulting in a maximum decrease in population size by 13.208% over a 35 year timeframe. However, the maximum scenario is unlikely.

1.3.1.4 Regardless of if the most likely displacement and mortality scenario (50% and 1%) or the maximum scenario (70% and 10%) is utilised, the common guillemot population in the UK Western waters BDMPS is observed to be growing. The model predicts a positive rate of growth for the population based on a median growth rate of 1.034 to 1.030 (or 3.4% to 3.0%) per annum at that level of impact, compared to 1.034 (or 3.4%) within the unimpacted population. It is assumed therefore that despite any additional mortality, the population is still expected to continue to grow and will be larger after 35 years than that what is currently recorded. The reduction in growth rate by between 0.017 to 0.393% (depending on the displacement and mortality rate used) would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population.

1.3.2 Great black-backed gull

1.3.2.1 The PVA outputs for great black-backed gull indicate a change less than 1% (range of 0.292 to 0.410%) in the final counterfactual of growth rate of the South-West and English Channel BDMPS. The counterfactual of final population size shows a maximum 13.727% decrease in population size relative to the unimpacted population size by the end of the 35 year model run (Table 1.5).

1.3.2.2 Against the West of Scotland BDMPS, PVA outputs show a change less than 0.3% (range of 0.151 to 0.212%) in the final counterfactual of growth rate and a maximum of 7.345% decrease in population size relative to the unimpacted population size after 35 years (Table 1.6).

1.3.2.3 When considering the combined great black-backed gull Western Waters BDMPS population (52,122 individuals), PVA results show a change of less than 0.2% (range of 0.099 to 0.139%) in the final counterfactual of growth rate. The counterfactual of final population size shows a maximum 4.881% decrease in population size relative to the unimpacted population size by the end of the 35-year model run (Table 1.7).

Table 1.5: Great black-backed gull PVA results for the South-West and English Channel BDMPS.

				Density-independence (after 35 years)			
Scale	Scenario	Predicted mortality	Growth rate	Mean CPGR	Mean CPS	Reduction in growth rate	Reduction in population size
BDMPS	Baseline (unimpacted)	0	1.028	1.000	1.000	n/a	n/a
	1. Mean collision mortality	49.2	1.024	0.997	0.887	0.334%	11.321%
	2. LCI collision mortality	43.1	1.025	0.997	0.900	0.292%	9.958%
	3. UCI collision mortality	60.8	1.024	0.996	0.863	0.410%	13.727%

Table 1.6: Great black-backed gull PVA results for the West of Scotland BDMPS region.

				Density-independence (after 35 years)			
Scale	Scenario	Predicted mortality	Growth rate	Mean CPGR	Mean CPS	Reduction in growth rate	Reduction in population size
BDMPS	Baseline (unimpacted)	0	1.028	1.000	1.000	n/a	n/a
	1. Mean collision mortality	49.2	1.026	0.998	0.940	0.172%	5.987%
	2. LCI collision mortality	43.1	1.026	0.998	0.947	0.151%	5.276%
	3. UCI collision mortality	60.8	1.026	0.998	0.927	0.212%	7.345%

Table 1.7: Great black-backed gull PVA results for the Combined Western Waters BDMPS.

				Density-independence (after 35 years)			
Scale	Scenario	Predicted mortality	Growth rate	Mean CPGR	Mean CPS	Reduction in growth rate	Reduction in population size
BDMPS	Baseline (unimpacted)	0	1.028	1.000	1.000	n/a	n/a
	1. Mean collision mortality	49.2	1.027	0.999	0.960	0.113%	3.966%
	2. LCI collision mortality	43.1	1.027	0.999	0.965	0.099%	3.488%
	3. UCI collision mortality	60.8	1.026	0.999	0.951	0.139%	4.881%

1.3.2.4 As noted above the CPS is considered a less reliable metric for density independent simulations and therefore should not be solely relied on. The addition of great black-backed gull collision impacts from the Mona Offshore Wind Project and the Morgan Generation Assets and with the impacts from other cumulative wind farms would reduce the growth rate of the smallest BDMPS population (UK South-West and English Channel BDMPS) by no more than 0.410% when using the largest collision risk estimate (60.8 individuals per annum). The model also predicts a positive rate of growth for the population based on growth rate of 1.026 per annum at that level of impact, compared to 1.028 within the unimpacted population.

1.3.2.5 For the purposes of this assessment, it is assumed therefore that despite any additional mortality, the population is still expected to continue to grow and will be larger after 35 years than that what is currently recorded. The reduction in growth rate by 0.334% (LCI; 0.292 to UCI; 0.410%) would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population.

1.4 References

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.

Ridge, K., Jones, C., Jones, G. & Kean, G. (2019) Norfolk Vanguard Offshore Wind Farm Examing Authority's Report of Findings and Conclusions and Recommendations to the Secretary of State for Business, Energy and Industrial Strategy.

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.

Morris, W.F. and Doak, D.F. (2002) Quantitative conservation biology: theory and practice of population viability analysis. Sinauer, MA.

WWT Consulting (2012) SOSS-04 Gannet Population Viability Analysis: Developing guidelines on the use of Population Viability Analysis for investigating bird impacts due to offshore wind farms. Report to The Crown Estate.

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.

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

Appendix A: Seabird PVA Parameter Log

A.1 Common guillemot

The log file was created on: 2022-10-28 10:01 using Tool version 2, nepva R package: v 4.18 Interface: v 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

Run had reference name “Guillemot UK Western waters BDMPS”

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: 5,000.

Random seed: 10.

Years for burn-in: 0.

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 1,139,200 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: 0.560 , sd: 0.013 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.034 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.022 , 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

Impact scenario inputs

Number of impact scenarios: 12.

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: 2023 to 2058

Impact scenario outputs

Scenario 1

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000151, se: N/A

Scenario 2

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000252, se: N/A

Scenario 3

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000353, se: N/A

Scenario 4

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000303, se: N/A

Scenario 5

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000504, se: N/A

Scenario 6

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000706, se: N/A

Scenario 7

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000756, se: N/A

Scenario 8

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001261, se: N/A

Scenario 9

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001764, se: N/A

Scenario 10

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001512, se: N/A

Scenario 11

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.002521, se: N/A

Scenario 12

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.003529, se: N/A

A.2 Great black-backed gull

UK South-west & English Channel

The log file was created on: 2022-10-28 13:18 using Tool version 2, nepva R package: v 4.18 Interface: v 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

Run had reference name “Great black-backed gull UK South-west & English Channel BDMPS”

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: 5,000.

Random seed: 10.

Years for burn-in: 0.

Case study selected: None.

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 3 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 17,742 in 2022

Productivity rate per pair: mean: 1.139 , sd: 0.533

Adult survival rate: mean: 0.834 , sd: 0.034

Immatures survival rates:

Age class 0 to 1 - mean: 0.789 , sd: 0.092 , DD: NA

Age class 1 to 2 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.034 , DD: NA

Impact scenario inputs

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: 2023 to 2058

Impact scenario outputs

Scenario Mean

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.002773, se: N/A

Scenario LCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.002429, se: N/A

Scenario UCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.003427, se: N/A

West of Scotland BDMPS

The log file was created on: 2022-10-28 14:48 using Tool version 2, nepva R package: v 4.18 Interface: v 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

Run had reference name "Great black-backed gull West of Scotland BDMPS"

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: 10.

Years for burn-in: 0.

Case study selected: None.

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 3 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 34,380 in 2022

Productivity rate per pair: mean: 1.139 , sd: 0.533

Adult survival rate: mean: 0.834 , sd: 0.034

Immatures survival rates:

Age class 0 to 1 - mean: 0.789 , sd: 0.092 , DD: NA

Age class 1 to 2 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.034 , DD: NA

Impact scenario inputs

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: 2023 to 2058

Impact scenario outputs

Scenario Mean

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001431, se: N/A

Scenario LCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001254, se: N/A

Scenario UCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001768, se: N/A

UK South-west & English Channel and West of Scotland combined BDMPS

The log file was created on: 2022-10-28 16:17 using Tool version 2, nepva R package: v 4.18 Interface: v 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

Run had reference name “Great black-backed gull combined BDMPS”

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: 5,000.

Random seed: 10.

Years for burn-in: 0.

Case study selected: None.

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 3 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 52,122 in 2022

Productivity rate per pair: mean: 1.139 , sd: 0.533

Adult survival rate: mean: 0.834 , sd: 0.034

Immatures survival rates:

Age class 0 to 1 - mean: 0.789 , sd: 0.092 , DD: NA

Age class 1 to 2 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.034 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.034 , DD: NA

Impact scenario inputs

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: 2023 to 2058

Impact scenario outputs

Scenario Mean

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000944, se: N/A

Scenario LCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.000827, se: N/A

Scenario UCI

All subpopulations

Impact on productivity rate mean: 0, se: N/A

Impact on adult survival rate mean: 0.001166, se: N/A