Awel y Môr Offshore Wind Farm

Category 6: Environmental Statement

Volume 4, Annex 4.6: Offshore Ornithology Population Viability Analysis

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1. Introduction

1.1 Project Background

Awel y Môr Offshore Wind Farm Limited ('the Applicant') is proposing to develop the Awel y Môr Offshore Wind Farm (AyM) as a proposed sister project to the operational Gwynt y Môr (GyM) Offshore Wind Farm (OWF). AyM is located approximately 10.5 km offshore from the north-east coast of Wales at its closest point, with the array covering an area of approximately 78 km^2. AyM will comprise both offshore and onshore infrastructure, including an offshore generating station (wind farm), export cables to landfall, and an onshore substation for connection to the electricity transmission network (please see **Volume 2, Chapter 1: Offshore Project Description (application ref: 6.2.1)** and **Volume 3, Chapter 1: Onshore Project Description (application ref: 6.3.1)** for full details on the Project Design).

APEM Ltd (hereafter APEM) was commissioned by the Applicant to undertake impact assessments of offshore ornithology, including the characterisation within the area that may be influenced by AyM. A separate report (**Volume 4, Annex 4.1: Offshore Ornithology; Baseline Characterisation Report (application ref: 6.4.4.1)**) provides the findings from offshore ornithology data to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from AyM. This technical annex has been produced to support the findings in the impact assessments in **Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.2.4)**.

The consideration of offshore ornithology for AyM has been discussed with consultees through the Expert Technical Group (ETG) meetings; of which Natural Resources Wales, The Joint Nature Conservation Committee (JNCC), Natural England and the Royal Society for the Protection of Birds (RSPB) are members. Agreements made with consultees within the ETG process are set out in the **Evidence Plan Report (application ref: 8.2.)** and **Volume 4, Annex 4.5: Offshore Ornithology Scoping & Consultation Responses (application ref: 6.4.4.5)**.

1.2 Population Viability Analysis

Renewable energy projects in the marine environment, such as OWFs, have the potential to impact on seabirds through a number of processes such as collision with turbine blades resulting in mortality, or displacement from an area due to the presence of Wind Turbine Generators (WTGs). 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 EIA process provides the assessment of such potential effects as a consequence of OWFs at varying population scales.

One method to estimate the effect that developments 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.

This report provides PVAs modelled on BDMPS to aid the analysis of the following species, based on Section 42 responses and agreement with stakeholders through the ETGs:

- Great black-backed gull, *Larus marinus*;

This species was selected to further assess the predicted cumulative impacts only, due to the predicted impacts at a cumulative scale exceeding a 1% increase relative to baseline mortality at the BDMPS scale, with a 1% increase being the level which is regarded as the threshold for undertaking further assessments such as PVA for their respective BDMPS regions. For the project alone, as detailed in **Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.2.4)** the assessments concluded no significant effect.

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 advantages of using an online platform for modelling and analysis purposes are that users are not required to use any R code, users are not required to install or maintain R, and updates to the model are made directly to the server. The tool is capable of assessing 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).

2. Methods

2.1 Guidance and Models

2.1.1 Overview

The user guide for the Seabird PVA Tool provided by Natural England (Mobbs et al. 2020) has been followed for modelling and assessment of potential impacts.

The demographic parameters used for the PVA are presented in **Section 2.2**, whilst the input log and outputs from the Shiny App are included in **Appendix 1** of this report.

2.2 PVA demographic parameters

2.2.1 Modelling approach

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.

The Seabird PVA Tool uses a Leslie matrix to construct a PVA model (Caswell 2000) based on the parameters provided by the user. Users can specify whether they wish the model to include demographic stochasticity, environmental stochasticity, density dependence, density independence or whether they want the model to run an entirely deterministic model.

A deterministic model translates the demographic parameters provided into actual numbers and provides a simplistic model, which can be used to generate average trends. Due to the lack of stochasticity, a deterministic model will produce the same result every time the simulation is run. In situations where little is known about how the population size has varied, or how the scale of impact may vary, running a deterministic model might provide a more candid assessment of the population and how it may be impacted.

A stochastic model produces probabilistic outputs to account for the impact of environmental and demographic stochasticity. Environmental stochasticity describes the effects random variation in factors such as weather can have on a population and is modelled by the incorporation of randomly generated values for the probability of survival from one-time step to the next. Demographic stochasticity refers to the effect of random variation in population structure on demographic rates and is modelled by generating random numbers of surviving individuals for any given survival probability. Demographic stochasticity can usually be ignored for populations greater than 100 individuals, however including demographic stochasticity will not cause any penalty when simulating larger populations (WWT Consulting 2012).

All PVA modelling in this 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 30-year time span, representing the likely lifespan of AyM.

Modelling has been undertaken including and excluding 'burn in' within the model. The inclusion of 'burn in' allows for a stable age structure when starting to run the model. A burn in period of 10 years was applied, it should be noted that within the guidance document for

the model (Mobbs et al. 2020), the use of 'burn in' within the model is specified as future work, due to this reason the PVA modelling has been run including and excluding 'burn in'.

Demographic processes such as growth, survival, productivity and recruitment are density-dependent, as their rates change in relation to the number of individuals in a population. Density dependence can be described as being either compensatory or depensatory (Begon, Townsend & Harper 2005). Compensation is characterised by demographic changes that cause a stabilising effect on a populations long-term average. Depensation acts to further decrease the rate of population growth in declining populations and can delay the rate of recovery. This is typically exhibited in populations that have been significantly depleted in size and is caused by a reduction in the benefits associated with conspecific presence.

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 (i.e. another source of precaution in the assessment process) (Ridge et al. 2019).

2.2.2 Species demographics

The Shiny App offers the users the choice of using pre-set demographic parameters or the ability to enter custom values. The pre-set demographic values are available for a total of 15 different species. 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. **Table 1** summarises the species-specific values selected for great black-backed gull.

After reviewing the pre formulated productivity rates within the tool for the eight regional classifications, due to the age of the data (productivity data spanning over 50 years in some instances) feeding into the productivity rates, none of the pre formulated values for productivity were representative of the populations assessed within this report. The national productivity values presented within Horswill and Robinson (2015) was instead used for assessment, due to providing a more representative productivity rate of the populations assessed.

As detailed in **Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.2.4**), there is uncertainty regarding the most applicable BDMPS region (Furness, 2015) for assessment due to AyMs location. To account for this uncertainty the Applicant has modelled PVA predicted impacts against the following populations:

- UK South-west & English Channel BDMPS with a population size of 17,742 individuals;
- UK West of Scotland BDMPS with a population size of 34,380 individuals; and
- Both above regions combined into the 'Combined Western Waters BDMPS' with a population size of 52,122 individuals.

The survival rates for great black-backed gull presented in Horswill and Robinson (2015) are limited and are based on a relatively old study by Glutz von Blotzheim & Bauer (1982). 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).

For age at first breeding and maximum brood size per pair parameters, the pre formulated values within the tool were selected.

Table 1 Demographic parameters selected for great-black backed gull.

Demographic parameter	Value
Productivity rate + SD	1.139 ± 0.533
Mean immature age class 0-1 survival rate + SD	0.798 ± 0.092
Mean immature age class 1-2 survival rate + SD	0.834 ± 0.034
Mean immature age class 2-3 survival rate + SD	0.834 ± 0.034
Mean immature age class 3-4 survival rate + SD	0.834 ± 0.034
Mean immature age class 4-5 survival rate + SD	0.834 ± 0.034

2.3 Impact values assessed

For the PVA presented within this report, generic impact levels have been modelled only. The reason for using generic impact levels rather than the predicted cumulative totals presented in Volume 2, Chapter 4: Offshore Ornithology (application ref: 6.4.2), is to account for the uncertainty in project totals for developments which have yet to gain consent future proofing the results and due to SNCBs preferring a range-based approach to assessment, over a single impact value.

3. Results

3.1 Introduction

The outputs of the Seabird PVA Tool are set out in **Table 2**, **Table 3** and **Table 4** below for the three different great black-backed gull BDMPS regions considered. The metrics used to summarise the PVA results are based on the counterfactual of population growth and counterfactual of population size.

3.1.1 South-West and English Channel BDMPS

Table 2 presents the PVA results for great black-backed gull when considering the South-West and English Channel BDMPS.

Table 2 Great black-backed gull PVA results using the Seabird PVA Tool for the South-West and English Channel BDMPS.

Increase in Mortality	'Burn In' Excluded				'Burn In'' Included			
	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size
	Growth rate	Population size			Growth rate	Population size		
50	0.997	0.899	0.34%	10.12%	0.997	0.900	0.34%	10.04%
55	0.996	0.890	0.37%	10.96%	0.996	0.890	0.37%	10.96%
60	0.996	0.880	0.41%	11.99%	0.996	0.881	0.41%	11.93%
65	0.996	0.871	0.44%	12.89%	0.996	0.872	0.44%	12.82%
70	0.995	0.862	0.48%	13.80%	0.995	0.863	0.47%	13.68%
75	0.995	0.853	0.51%	14.73%	0.995	0.854	0.51%	14.64%
80	0.995	0.844	0.54%	15.55%	0.995	0.844	0.54%	15.56%
85	0.994	0.835	0.58%	16.49%	0.994	0.835	0.58%	16.46%
90	0.994	0.827	0.61%	17.33%	0.994	0.827	0.61%	17.26%
95	0.994	0.818	0.65%	18.21%	0.994	0.818	0.65%	18.24%

3.1.2 West of Scotland BDMPS

Table 3 presents the PVA results for great black-backed gull when considering the West of Scotland BDMPS.

Table 3 Great black-backed gull PVA results using the Seabird PVA Tool for the West of Scotland BDMPS region.

Increase in Mortality	'Burn In' Excluded				'Burn In'' Included			
	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size
	Growth rate	Population size			Growth rate	Population size		
50	0.998	0.947	0.18%	5.32%	0.998	0.947	0.18%	5.35%
55	0.998	0.942	0.19%	5.79%	0.998	0.942	0.19%	5.80%
60	0.998	0.936	0.21%	6.35%	0.998	0.936	0.21%	6.36%
65	0.998	0.931	0.23%	6.87%	0.998	0.932	0.23%	6.83%
70	0.998	0.926	0.25%	7.35%	0.998	0.927	0.25%	7.33%
75	0.997	0.921	0.26%	7.86%	0.997	0.922	0.26%	7.81%
80	0.997	0.916	0.28%	8.37%	0.997	0.917	0.28%	8.33%
85	0.997	0.911	0.30%	8.90%	0.997	0.912	0.30%	8.82%
90	0.997	0.906	0.32%	9.38%	0.997	0.907	0.32%	9.34%
95	0.997	0.901	0.33%	9.86%	0.997	0.902	0.33%	9.83%

3.1.3 Combined Western Waters BDMPS

Table 4 presents the PVA results for great black-backed gull when considering the Combined Western Waters BDMPS region.

Table 4 Great black-backed gull PVA results using the seabird PVA Tool for the Combined Western Waters BDMPS.

Increase in Mortality	'Burn In' Excluded				'Burn In'' Included			
	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size	Density independent counterfactual metric (after 35 years)		Reduction in growth rate	Reduction in population size
	Growth rate	Population size			Growth rate	Population size		
50	0.999	0.964	0.12%	3.58%	0.999	0.965	0.12%	3.55%
55	0.999	0.960	0.13%	3.96%	0.999	0.961	0.13%	3.89%
60	0.999	0.957	0.14%	4.29%	0.999	0.958	0.14%	4.23%
65	0.998	0.954	0.15%	4.60%	0.998	0.954	0.15%	4.58%
70	0.998	0.951	0.16%	4.95%	0.998	0.951	0.16%	4.91%
75	0.998	0.947	0.18%	5.32%	0.998	0.947	0.17%	5.26%
80	0.998	0.943	0.19%	5.66%	0.998	0.945	0.18%	5.54%
85	0.998	0.940	0.20%	5.96%	0.998	0.940	0.20%	5.98%
90	0.998	0.937	0.21%	6.33%	0.998	0.937	0.21%	6.25%
95	0.998	0.933	0.22%	6.65%	0.998	0.933	0.22%	6.66%

4. References

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Appendix 1 Seabird PVA Tool Input Log

South-West and English Channel BDMPS log

Set up

The log file was created on: 2022-02-18 15:18:02 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA South-Western”.

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: 275.

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 17742 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002818 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0031 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003382 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003664 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003945 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004227 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004509 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004791 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005073 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005355 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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

South-West and English Channel BDMPS with Burn In log

Set up

The log file was created on: 2022-02-18 13:11:05 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA south-west”.

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: 7831.

Years for burn-in: 10.

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 17742 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002818 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0031 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003382 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003664 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003945 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004227 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004509 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004791 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005073 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005355 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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

West of Scotland BDMPS log

Set up

The log file was created on: 2022-02-18 13:58:08 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA Western Scotland”.

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: 9158.

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 34380 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001454 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0016 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001745 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001891 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002036 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002182 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002327 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002472 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002618 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002763 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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

West of Scotland BDMPS with Burn In log

Set up

The log file was created on: 2022-02-18 14:10:20 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA Western Scotland Burn In”.

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: 9158.

Years for burn-in: 10.

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 34380 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001454 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0016 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001745 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001891 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002036 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002182 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002327 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002472 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002618 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002763 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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

Combined Western Waters BDMPS regions log

Set up

The log file was created on: 2022-02-18 14:25:54 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA Western Combined”.

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: 2361.

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 52122 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000959 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001055 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001151 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001247 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001343 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001439 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001525 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001631 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001727 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001823 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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

Combined Western Waters BDMPS regions with Burn In log

Set up

The log file was created on: 2022-02-18 14:44:34 using Tool version 2, with R version 3.5.1, PVA package version: 4.17 (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 “GB EIA Western Combined Burn In”.

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: 7923.

Years for burn-in: 10.

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 52122 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

Impacts

Number of impact scenarios: 10.

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 2053

Impact on Demographic Rates

Scenario A - Name: 50

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000959 , se: NA

Scenario B - Name: 55

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001055 , se: NA

Scenario C - Name: 60

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001151 , se: NA

Scenario D - Name: 65

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001247 , se: NA

Scenario E - Name: 70

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001343 , se: NA

Scenario F - Name: 75

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001439 , se: NA

Scenario G - Name: 80

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001525 , se: NA

Scenario H - Name: 85

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001631 , se: NA

Scenario I - Name: 90

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001727 , se: NA

Scenario J - Name: 95

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001823 , se: NA

Output:

First year to include in outputs: 2023

Final year to include in outputs: 2053

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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