Outer Dowsing Offshore Wind

Examination

Appendix 12.4: Offshore Ornithology Population Viability Assessment

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Change Log

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Acronyms & Definitions

Abbreviations / Acronyms

Abbreviation / Acronym	Description
AfL	Area for Lease
ANS	Artificial Nesting Structure
BDMPS	Biologically Defined Minimum Population Scale
BTO	British Trust for Ornithology
CGR	Counterfactual of Population Growth
CPS	Counterfactual Population Size
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
GR	Growth Rate
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (a wholly owned Green Investment Group portfolio company), Gulf Energy Development and TotalEnergies.
GULF	Total Energies and Gulf Energy Development
HRA	Habitats Regulations Assessments
MCA	Maritime and Coastguard Agency
MMO	Marine Management Organisation
MRSea	Marine Renewables Strategic environment assessment
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind (The Project)
ORBA	Offshore Restricted Build Area
ORCP	Offshore Reactive Compensation Platforms
OWF	Offshore wind farm
OP	Offshore Platform
PS	Population Size
PVA	Population Viability Analysis
RSPB	Royal Society for the Protection of Birds
SD	Standard deviation
SNCB	Statutory Nature Conservation Body
SPA	Special Protected Area
TCE	The Crown Estate
UKHO	United Kingdom Hydrographic Office
WTGs	Wind turbine generators

Terminology

Term	Definition
Array area	The area offshore within which the generating station (including Wind Turbine Generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling will be positioned, including the ORBA.

Term	Definition
Cumulative impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with the Project.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of an impact with the sensitivity of a receptor, in accordance with defined significance criteria.
EIA Directive	European Union 2011/92/EU (as amended by Directive 2014/52/EU).
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the EIA.
Evidence Plan	A voluntary process of stakeholder consultation with appropriate Expert Topic Groups (ETGs) that discusses and, where possible, agrees the detailed approach to the Environmental Impact Assessment (EIA) and information to support Habitats Regulations Assessment (HRA) for those relevant topics included in the process, undertaken during the pre-application period.
GT R4 Ltd	The Applicant making the application for a DCO. Refer to as GT R4 Ltd on first introduction, then “the Applicant” thereafter. The Applicant is GTR4 Limited (a joint venture between Corio Generation and Total Energies), trading as Outer Dowsing Offshore Wind. The project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company) and TotalEnergies.
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Intertidal	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS)
NSIP Reform Action Plan	An Action Plan launched in February 2023 by Department for Levelling Up, Housing & Communities to reform the NSIP regime to ensure the effectiveness and resilience of the planning regime for the growing pipeline of critical infrastructure projects.
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the Order Limits within which the export cable running from the array to landfall will be situated.
Offshore Reactive Compensation Platform (ORCP)	A structure attached to the seabed by means of a foundation, with one or more decks (including bird deterrents) housing electrical reactors and

Term	Definition
	switchgear for the purpose of the efficient transfer of power in the course of HVAC transmission by providing reactive compensation.
Offshore Restricted Build Area (ORBA)	The area within the array area, where no wind turbine generator, offshore transformer substation or offshore accommodation platform shall be erected.
Outer Dowsing Offshore Wind (ODOW)	The Project.
Onshore Infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
The Applicant	GTR4 Limited (a joint venture between Corio Generation (and its affiliates), TotalEnergies and Gulf Energy Development), trading as Outer Dowsing Offshore Wind.
The Project	Outer Dowsing Offshore Wind including proposed onshore and offshore infrastructure.
Wind turbine generator (WTG)	A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems, fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation
WTG area	Following the introduction of the offshore restricted build area, the WTG area is a reduced area within the array area within which WTG and offshore platforms may be constructed.

Reference Documentation

Document Number	Title
6.1.3	Project Description
6.1.12	Intertidal and Offshore Ornithology

12 Offshore Ornithology Population Viability Assessment

12.1 Introduction

12.1.1 Overview

12.1.1.1 Project Background

1. GTR4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (hereafter 'The Project'). The Project array area will be located approximately 54km from the Lincolnshire coastline in the southern North Sea. The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, Offshore Reactive Compensation Platforms (ORCPs), onshore cables, connection to the electricity transmission network, ancillary and associated development and areas for the delivery of up to two Artificial Nesting Structures (ANS) and the creation and recreation of a biogenic reef (if these compensation measures are deemed to be required by the Secretary of State) (see Volume 1, Chapter 3: Project Description (document reference 6.1.3) for full details).
2. This technical annex has been produced to support the assessment of potential project impacts on seabirds identified in Volume 1, Chapter 12: Intertidal and Offshore Ornithology (document reference 6.1.12).
3. The consideration of offshore and intertidal ornithology for The Project has been discussed with consultees (Natural England and the Royal Society for the Protection of Birds (RSPB)) through The Project Evidence Plan Process (EPP). The latest Natural England and Statutory Nature Conservation Bodies (SNCB) advice has been followed (Parker *et al.*, 2022c; MIG-Birds, 2022). Where there is deviation from this guidance, any agreements made with consultees during the EPP regarding the displacement methodology can be found within document 6.1.12, Section 12.3.
4. This document has been updated to incorporate two changes which have been made by the Applicant to The Project:
   - the introduction of an Offshore Restricted Build Area (ORBA) over the northern section of the Project array area; and
   - the removal of the northern section of the offshore Export Cable Corridor (ECC).

5. Additionally, the results incorporate updates to the assessment methodology made in response to consultation feedback from relevant stakeholders following the submission of the Environmental Statement (ES). A summary of the main updates can be found in Section 12.5 of Volume 1, Chapter 12: Intertidal and Offshore Ornithology (document reference 6.1.12).As a result of continuing engagement with stakeholders, and enabled by progress on engineering design, the area within which the Wind Turbine Generators (WTGs) and Offshore Platforms (OPs) will be positioned has been refined. The ORBA has been introduced to reduce the impact from the presence of the WTGs on auk species (specifically common guillemot), informed by a consideration of geophysical and geotechnical data. The ORBA also supports progress towards the required energy density for the final Project design, as set out within the Agreement for Lease (AfL).
6. The ORBA was introduced during examination and covers the northern section of the array area, restricting the installation of WTGs and OPs. For the avoidance of doubt, the ORBA may still be used for cable installation and ancillary operations during construction, operations and maintenance and decommissioning. Additionally, Project parameters including number of structures, foundation types, and cable parameters will remain unchanged. As such, no change has been made to the extent of the array area, as defined within the draft Development Consent Order (DCO).
7. Further engineering design and procurement work, informed by additional geophysical, geotechnical and environmental survey work, undertaken post-consent (if granted), will confirm the final layout of infrastructure. Final details will be set out in a design plan to be submitted to and approved by the MMO, following consultation with Trinity House, the Maritime and Coastguard Agency (MCA) and United Kingdom Hydrographic Office (UKHO) prior to commencement of the licensed works, in line deemed Marine Licence condition 13 (see condition 13(1)(a), Part 2, Schedule 10 of the dDCO [document 3.1].
8. The location and size of the ORBA was decided using various factors. MRSea based analysis was used to generate estimates of distribution and abundance, underpinned by observations of guillemot recorded in the Digital Aerial Survey (DAS) imagery (Scott -Hayward et al., 2014). This produced month by month density distribution mapping for the period March 2021 to August 2023 that identified hotspots within the array area plus 2 km buffer.
9. There were some commonality in the hotspots between the 2021 and 2022 surveys with denser concentrations of guillemots recorded in the north and east of the area of interest (Figures 3.1 - 3.4 Appendix 12.6) particularly within the months of April and August both in 2021 and 2022.
10. The MRSea data (Appendix 12.6) strongly agreed with the design based density estimates, which also show a general pattern of higher densities of guillemot and razorbill to the north of the array area (see Figures 3.31 – 3.33 and 3.37 – 3.39 Appendix 12.1 Intertidal and Offshore Ornithology Technical Baseline (document reference 6.3.12.1)).

11. The introduction and size of the ORBA has been made possible through continued engagement with the relevant oil and gas operators who have interests which overlap with the Project, i.e. due to the presence of oil and gas platforms within or adjacent to the array area. Since the Application, the Applicant has been able to agree the principles for co-existence between the Project and access arrangements to the Malory platform with Perenco, specifically for helicopter transfers to and from this platform. Confidence in the likely final protective provisions for this operator within the DCO for the Project has therefore allowed further engineering work to be undertaken to support additional mitigation of the impact to auk species through a reduction in the area within which WTGs and OPs may be placed.
12. The introduction of the ORBA has resulted in a reduction in the summed mean seasonal peak abundance of guillemot from 27,653.3 birds in the array area plus 2 km buffer (Appendix 12.1 Offshore and Intertidal Ornithology Technical Baseline AS1-064 Version 1) to a summed mean seasonal peak abundance of 23,586 guillemot in the array area minus the ORBA, hereafter known as the WTG area, plus 2 km buffer (Appendix 12.1 Offshore and Intertidal Ornithology Technical Baseline, Version 2).

12.1.1.2 Population Viability Analysis

13. Renewable energy projects in the marine environment, such as Offshore Wind Farms (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.
14. The Environmental Impact Assessment (EIA) and Habitats Regulations Assessments (HRA) processes provides the assessment of such potential effects as a consequence of OWFs at varying population scales, from a single Special Protection Area (SPA) colony to the wider biogeographic population.
15. 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' scenario whereby conditions remain unimpacted and under an 'impacted' scenario where an impact is applied to a population by the alteration of demographic parameters.
16. This report provides PVAs modelled population impacts to the North Sea and English Channel Biologically Defined Minimum Population Scale (BDMPS) and wider biogeographic population scales. The eight species selected for modelling were:
    - Black-legged kittiwake (hereafter 'kittiwake');
    - Northern gannet (hereafter 'gannet');

- Common guillemot (hereafter ‘guillemot’);
- Razorbill;
- Atlantic Puffin (hereafter ‘puffin’);
- Lesser black-backed gull;
- Herring gull; and
- Great black-backed gull.

17. These species were selected to further assess the predicted cumulative impacts, where the predicted impacts at a cumulative scale exceeding, or being close to exceeding, a 1% increase relative to baseline mortality relative to the BDMPS or biogeographic population for that species. A 1% increase to baseline mortality is generally regarded as the threshold for undertaking further assessments such as PVA (Parker *et al.*, 2022c).
18. 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 the approach is consistent across projects, 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 many different types of impact to a population. For example, it can model impacts as changes to demographic parameters (e.g. survival or productivity), or as a cull or harvest of a fixed size per year (Searle *et al*. 2019).

12.2 Methodology

12.2.1 Guidance and Models

19. 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 12.2.2, whilst the input log and outputs from the Shiny App are included in Annex A of this report.
20. The Seabird PVA Tool uses a Leslie matrix to construct a PVA model (Caswell, 2000) based on the parameters provided by the user. Two broad types of population models are available: (a) deterministic Leslie matrix models, and (b) stochastic Leslie matrix models. Users are able to specify whether the model is run using environmental stochasticity (as opposed to a deterministic model), demographic stochasticity, and whether it incorporates density dependence.
21. PVA for The Project was run using stochasticity, as this option incorporates uncertainty into inputs and outputs, and therefore provides more ecologically realistic values compared to deterministic models.

22. 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 selecting the survival probability from a distribution. 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). Demographic stochasticity was therefore included in PVA models.
23. All PVA modelling in this report was undertaken with the Beta/Gamma model for environmental stochasticity and was run with no density dependence. To ensure robust results, all simulations were set to run 5,000 times. All models were run for a 35-year time span (2030 to 2065), representing the likely lifespan of The Project.
24. Modelling has been undertaken including 'burn in' within the model. The inclusion of 'burn in' allows for a stable age structure to be generated before the impacts are applied. A burn in period of five years was used as per Natural England guidance (Parker *et al.,* 2022c; Mobbs *et al.* 2020), with the exception of lesser black-backed gull for which no burn in was included.
25. Demographic processes, such as growth, survival, productivity and recruitment, change relative to the number of individuals in a population, and are therefore density dependent. Density dependence regulates population size by adjusting demographic rates to maintain a population around a carrying capacity. If impacts form OWFs decrease survival, reduced competition for resources could cause a subsequent increase in survival and/or productivity and consequently an increase in population growth rate. Density dependence is self-evident in the natural environment, as without density dependence, populations would grow exponentially. However, the mechanisms as to how this operates in seabird populations are largely uncertain. If density dependence is mis-specified in an assessment, the modelled predictions will be unreliable. Therefore, it is more typical to use more precautionary density independent models for seabird assessments, despite the ecological evidence suggesting that density dependence acts on large populations (Horswill *et al.* 2017). 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 as it represents a precautionary approach (Ridge *et al.* 2019).
26. The demographic rates used in the analyses are presented in Table 12.1, Table 12.2 and Table 12.3.

12.2.2 Species-specific input parameters

27. 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 British Trust for Ornithology (BTO) Seabird Monitoring Program (BTO, 2023), divided into eight regional classifications for breeding success data (further information on the eight regional classifications can be found in Mobbs *et al.* (2020)) or Horswill and Robinson (2015) for survival rate.

12.2.2.1 Population size

28. The initial population size used in PVA was the relevant peak annual BDMPS population and biogeographic populations as defined in Volume 1, Chapter 12: Intertidal and Offshore Ornithology (document reference 6.1.12).

Table 12.1:Initial population sizes used in PVA.

Species	BDMPS population	Biogeographic population
Kittiwake	829,937	5,100,000
Lesser black-backed gull	209,007	864,000
Herring gull	466,510	1,098,000
Great black-backed gull	91,398	235,000
Guillemot	2,045,078	4,125,000
Razorbill	591,875	1,707,000
Puffin	868,689	11,840,000
Gannet	456,299	1,180,000

12.2.2.2 Breeding success data

29. The input value used for mean productivity and Standard Deviation (SD) was selected as the default values in the PVA tool for the Greater North Sea region.

Table 12.2: Breeding success parameters used in PVA.

Species	Productivity rate +/- SD
Kittiwake	0.70 (± 0.32)
Gannet	0.69 (± 0.07)
Guillemot	0.69 (± 0.12)
Razorbill	0.56 (± 0.16)
Puffin	1.40 (± 0.46)
Lesser black-backed gull	0.47 (± 0.58)
Herring gull	1.03 (± 0.66)
Great black-backed gull	1.40 (± 0.46)

12.2.2.3 Survival rate

30. Survival rates used were based on the “National” values in the PVA tool, which are based on Horswill and Robinson (2015).

Table 12.3 Survival rates used in PVA.

Species	Survival rate (+/- SD)						
	Adult	Immature 0 to 1	Immature 1 to 2	Immature 2 to 3	Immature 3 to 4	Immature 4 to 5	Immature 5 to 6
Kittiwake	0.85 (± 0.08)	0.79 (± 0.08)	0.85 (± 0.08)	0.85 (± 0.08)	0.85 (± 0.08)	0.85 (± 0.08)	-
Gannet	0.92 (± 0.04)	0.42 (± 0.05)	0.83 (± 0.03)	0.89 (± 0.02)	0.90 (± 0.02)	0.92 (± 0.04)	-
Guillemot	0.94 (± 0.03)	0.56 (± 0.06)	0.79 (± 0.15)	0.92 (± 0.10)	0.94 (± 0.11)	0.94 (± 0.03)	0.94 (±0.03)
Razorbill	0.90 (± 0.07)	0.63 (± 0.07)	0.63 (± 0.07)	0.90 (± 0.07)	0.90 (± 0.07)	0.90 (± 0.07)	-
Puffin	0.91 (± 0.08)	0.71 (± 0.11)	0.71 (± 0.11)	0.71 (± 0.11)	0.76 (± 0.09)	0.81 (± 0.08)	-
Lesser black-backed gull	0.89 (± 0.06)	0.82 (± 0.06)	0.89 (± 0.06)	0.89 (± 0.06)	0.89 (± 0.06)	0.89 (± 0.06)	-
Herring gull	0.83 (± 0.08)	0.80 (± 0.08)	0.83 (± 0.08)	0.80 (± 0.08)	0.80 (± 0.08)	0.80 (± 0.08)	-
Great black-backed gull	0.93 (± 0.00)	0.93 (± 0.00)	0.93 (± 0.00)	0.93 (± 0.00)	0.93 (± 0.00)	0.93 (± 0.00)	-

12.3 PVA Scenarios assessed

31. This section outlines the different PVA scenarios assessed for each species. Key scenarios include assessment of impacts from The Project alone, and cumulatively with other projects, though further scenarios (e.g., different displacement rates) are described on a species-by-species basis below. Table 12.4 to Table 12.11 present the relevant mortalities for each species scenario and the extent to which those mortalities reduce the population survival rates. It is these reduction in survival rates that are inputted into the model to inform the 'impacted' scenario. As PVA was only carried out on populations showing a potential impact of >1% increase in baseline mortality, the biogeographic population was not always assessed.

12.3.1 Kittiwake

32. For kittiwake, two main scenarios are assessed (Project alone and cumulatively) against both BDMPS and biogeographic populations.

Table 12.4: PVA scenarios assessed for kittiwake.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone	33.2	<0.001	-
Cumulative	3,755.3	0.004	-

12.3.2 Gannet

33. As gannet is assessed for both collision and displacement impacts, the PVA analysis for this species considers the combined impacts only (i.e., collision impacts plus displacement impacts). Within this, only a displacement rate of 70% was assessed as presented in 6.1.12 Offshore and Intertidal Ornithology.

Table 12.5: PVA scenarios assessed for gannet.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone			
70% displacement, 1% mortality	9.5	<0.001	-
Cumulative			
70% displacement, 1% mortality	935.2	0.002	-

12.3.3 Guillemot

34. Guillemot scenarios assessed incorporate a range of different displacement and mortality results as presented in 6.1.12 Offshore and Intertidal Ornithology, ranging from 30% displacement and 1% mortality to 70% displacement and 10% mortality. Based on this, eight scenarios are assessed.

Table 12.6: PVA scenarios assessed for guillemot.

Scenario		Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone				
Applicant	50% displacement, 1% mortality	102.2	<0.001	<0.001
	70% displacement, 2% mortality	286.0	<0.001	<0.001
Natural England	50% displacement, 1% mortality	123.5	<0.001	<0.001
	70% displacement, 2% mortality	345.9	<0.001	<0.001
Cumulative				
Applicant	50% displacement, 1% mortality	3,686.5	0.002	0.001

Scenario		Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
	70% displacement, 2% mortality	10,322.3	0.005	0.003
Natural England	50% displacement, 1% mortality	3,707.9	0.002	0.001
	70% displacement, 2% mortality	10,382.2	0.005	0.003

12.3.4 Razorbill

35. Razorbill scenarios assessed incorporate a range of different displacement and mortality results as presented in 6.1.12 Offshore and Intertidal Ornithology, ranging from 30% displacement and 1% mortality to 70% displacement and 10% mortality. Based on this, eight scenarios are assessed.

Table 12.7: PVA scenarios assessed for razorbill.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone			
50% displacement, 1% mortality	61.3	<0.001	<0.001
70% displacement, 2% mortality	171.6	<0.001	<0.001
Cumulative			
50% displacement, 1% mortality	1,083.1	0.002	<0.001
70% displacement, 2% mortality	3,032.7	0.005	0.002

12.3.5 Puffin

36. Razorbill scenarios assessed incorporate a range of different displacement and mortality results as resented in 6.1.12 Offshore and Intertidal Ornithology, ranging from 30% displacement and 1% mortality to 70% displacement and 10% mortality. Based on this, six scenarios are assessed.

Table 12.8: PVA scenarios assessed for puffin.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone			
50% displacement, 1% mortality	5.4	<0.001	-
70% displacement, 2% mortality	15.1	<0.001	-
Cumulative			
50% displacement, 1% mortality	335.7	<0.001	-
70% displacement, 2% mortality	939.9	0.001	-

12.3.6 Lesser black-backed gull

37. For lesser black-backed gull, two main scenarios are assessed (Project alone and cumulatively, both assessed against the BDMPS).

Table 12.9: PVA scenarios assessed for lesser black-backed gull.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone	2.4	<0.001	-
Cumulative	689.3	0.003	-

12.3.7 Herring gull

38. For herring gull, two main scenarios are assessed (Project alone and cumulatively, assessed against the BDMPS).

Table 12.10: PVA scenarios assessed for herring gull.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone	2.9	<0.001	-
Cumulative	1018.5	0.003	-

12.3.8 Great black-backed gull.

39. For great black-backed gull, two main scenarios are assessed (Project alone and Project cumulatively, assessed against the BDMPS).

Table 12.11: PVA scenarios assessed for great black-backed gull.

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Project alone	4.0	<0.001	-

Scenario	Mortalities per annum	Impact on survival rate (BDMPS)	Impact on survival rate (biogeographic)
Cumulative	1420.0	0.006	-

12.4 PVA Results

40. For each scenario (Table 12.4), Counterfactual of Population Growth (CGR) and Counterfactual Population Size (CPS) have been presented from the model outputs, measuring the changes in annual growth rate and population size, respectively relative to a baseline scenario. The resulting median percentage difference/reduction in growth rate (GR) and population size (PS) in relation to a baseline population at the end of the impacted period of 35 years.

12.4.1 Kittiwake

Table 12.12: PVA results for kittiwake for the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone	33.2	1.000	0.998	0.004%	0.163%
Cumulative	3,755.3	0.995	0.826	0.530%	17.399%

12.4.2 Gannet

Table 12.13: PVA results for gannet in relation to the BDMPS, for combined collision and displacement including macro-avoidance (70% displacement, 1% mortality).

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project Alone	9.48	1.000	0.999	0.002%	0.095%
Cumulative	935.15	0.998	0.916	0.242%	8.364%

12.4.3 Guillemot

Table 12.14: PVA results for guillemot in relation to the BDMPS.

Scenario		Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone						
Applicant	50% displacement, 1% mortality	102.2	1.000	0.998	0.006%	0.205%
	70% displacement, 2% mortality	286.0	1.000	0.994	0.016%	0.562%
Natural England	50% displacement,	123.5	1.000	0.998	0.007%	0.243%

Scenario		Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
	1% mortality					
	70% displacement, 2% mortality	345.9	1.000	0.993	0.019%	0.683%
Cumulative						
Applicant	50% displacement, 1% mortality	3,686.5	0.998	0.929	0.203%	7.050%
	70% displacement, 2% mortality	10,322.3	0.994	0.815	0.568%	18.537%
Natural England	50% displacement, 1% mortality	3,707.9	0.998	0.929	0.204%	7.090%
	70% displacement, 2% mortality	10,382.2	0.994	0.814	0.571%	18.638%

Table 12.15: PVA results for guillemot in relation to the biogeographic population.

Scenario		Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone						
Applicant	50% displacement, 1% mortality	102.2	1.000	0.999	0.003%	0.104%
	70% displacement, 2% mortality	286.0	1.000	0.997	0.008%	0.275%
Natural England	50% displacement, 1% mortality	123.5	1.000	0.999	0.003%	0.125%
	70% displacement, 2% mortality	345.9	1.000	0.997	0.010%	0.340%
Cumulative						
Applicant	50% displacement, 1% mortality	3,686.5	0.999	0.964	0.101%	3.559%
	70% displacement, 2% mortality	10,322.3	0.997	0.903	0.282%	9.652%
Natural England	50% displacement, 1% mortality	3,707.9	0.999	0.964	0.101%	3.576%
	70% displacement, 2% mortality	10,382.2	0.997	0.903	0.283%	9.706%

12.4.4 Razorbill

Table 12.16: PVA results for razorbill in relation to the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone					
50% displacement, 1% mortality	61.3	1.000	0.996	0.012%	0.417%
70% displacement, 2% mortality	171.6	1.000	0.988	0.034%	1.219%
Cumulative					

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
50% displacement, 1% mortality	1,083.1	0.998	0.925	0.216%	7.491%
70% displacement, 2% mortality	3,032.7	0.994	0.804	0.605%	19.624%

Table 12.17: PVA results for razorbill in relation to the biogeographic.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone					
50% displacement, 1% mortality	61.3	1.000	0.999	0.004%	0.150%
70% displacement, 2% mortality	171.6	1.000	0.996	0.012%	0.427%
Cumulative					
50% displacement, 1% mortality	1,083.1	0.999	0.973	0.075%	2.668%
70% displacement, 2% mortality	3,032.7	0.998	0.927	0.210%	7.283%

12.4.5 Puffin

Table 12.18: PVA results for puffin in relation to the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone					
50% displacement, 1% mortality	5.4	1.000	1.000	0.000%	0.014%
70% displacement, 2% mortality	15.1	1.000	0.999	0.002%	0.061%
Cumulative					
50% displacement, 1% mortality	335.7	1.000	0.984	0.045%	1.608%
70% displacement, 2% mortality	939.9	0.999	0.955	0.127%	4.476%

12.4.6 Lesser black-backed gull

Table 12.19: PVA results for lesser black-backed gull in relation to the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone	2.4	1.000	1.000	0.001%	0.037%
Cumulative	689.3	0.996	0.873	0.375%	12.661%

12.4.7 Herring gull

Table 12.20: PVA results for herring gull in relation to the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone	2.9	1.000	1.000	0.001%	0.018%
Cumulative	1,018.5	0.997	0.909	0.264%	9.076%

12.4.8 Great black-backed gull

Table 12.21: PVA results for great black-backed gull in relation to the BDMPS.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone	4.0	1.000	0.998	0.005%	0.162%
Cumulative	1,420.0	0.983	0.545	1.671%	45.473%

Table 12.22: PVA results for great black-backed gull in relation to the biogeographic population.

Scenario	Mortalities per annum	CGR	CPS	Difference in GR	Difference in PS
Project alone	4.0	1.000	0.999	0.002%	0.065%
Cumulative	1,420.0	0.994	0.791	0.650%	20.914%

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Annex A - Population Viability Analysis Parameter log

Set up

The log file was created on: 2025-02-13 14:26:59.777441 using Tool version 2, with R version 4.4.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package         Version
## popbio         "popbio"        "2.8"
## shiny          "shiny"         "1.9.1"
## shinyjs        "shinyjs"       "2.1.0"
## shinydashboard "shinydashboard" "0.7.2"
## shinyWidgets   "shinyWidgets"  "0.8.7"
## DT             "DT"            "0.33"
## plotly         "plotly"        "4.10.4"
## rmarkdown      "rmarkdown"     "2.28"
## dplyr          "dplyr"         "1.1.4"
## tidyr          "tidyr"         "1.3.1"
```

Gannet Combined (BDMPS)

Basic information

This run had reference name "Gannet 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: 5000.
Random seed: 11.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Northern Gannet.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 456299 in 2015

Productivity rate per pair: mean: 0.6948221 , sd: 0.07298986

Adult survival rate: mean: 0.919 , sd: 0.042

Immatures survival rates:

Age class 0 to 1 - mean: 0.424 , sd: 0.045 , DD: NA

Age class 1 to 2 - mean: 0.829 , sd: 0.026 , DD: NA

Age class 2 to 3 - mean: 0.891 , sd: 0.019 , DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.019 , DD: NA

Age class 4 to 5 - mean: 0.919 , sd: 0.042 , DD: NA

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2.1e-05 , se: NA

Scenario B - Name: Cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002049 , 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

Great black-backed gull (BDMPS)

Basic information

This run had reference name “GBBG (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: 9.
Years for burn-in: 5.
Case study selected: None.

~~14.5~~12.5 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 91398 in 2015

Productivity rate per pair: mean: 1.400163 , sd: 0.4642731

Adult survival rate: mean: 0.93 , sd: 1e-06

Immatures survival rates:

Age class 0 to 1 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 1 to 2 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 1e-06 , DD: NA

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 4.4e-05 , se: NA

Scenario B - Name: Cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.015537 , 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

Great black-backed gull (Biogeographic)

Basic information

This run had reference name "GBBG (Biogeo)".
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: 5.
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: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 235000 in 2015

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

Adult survival rate: mean: 0.93 , sd: 1e-06

Immatures survival rates:

Age class 0 to 1 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 1 to 2 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 2 to 3 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 3 to 4 - mean: 0.93 , sd: 1e-06 , DD: NA

Age class 4 to 5 - mean: 0.93 , sd: 1e-06 , DD: NA

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 1.7e-05 , se: NA

Scenario B - Name: Cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.006043 , 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

Guillemot (BDMPS)

Basic information

This run had reference name "Guillemot (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: 2.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 2045078 in 2015

Productivity rate per pair: mean: 0.6940442 , sd: 0.1195933

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

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

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

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

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

Impacts

Number of impact scenarios: 8.

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?: Yes

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: 50,1 project alone_Applicant
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 5e-05 , se: NA

Scenario B - Name: 70,2 project alone_Applicant
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00014 , se: NA

Scenario C - Name: 50,1 cumulative_Applicant
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001803 , se: NA

Scenario D - Name: 70,2 cumulative_Applicant
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005047 , se: NA

Scenario E - Name: 50,1 project alone_NE
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6e-05 , se: NA

Scenario F - Name: 70,2 project alone_NE

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000169 , se: NA

Scenario G - Name: 50,1 cumulative_NE
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001813 , se: NA

Scenario H - Name: 70,2 cumulative_NE
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005077 , 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

Guillemot (Biogeographic)

Basic information

This run had reference name “Guillemot (Biogeo)”.
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: 3.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 4125000 in 2015

Productivity rate per pair: mean: 0.6940442 , sd: 0.1195933

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

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

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

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

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

Impacts

Number of impact scenarios: 8.

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?: Yes

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: 50,1 project alone_Applicant

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 2.5e-05 , se: NA

Scenario B - Name: 70,2 project alone_Applicant

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6.9e-05 , se: NA

Scenario C - Name: 50,1 cumulative_Applicant

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000894 , se: NA

Scenario D - Name: 70,2 cumulative_Applicant

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002502 , se: NA

Scenario E - Name: 50,1 project alone_NE

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 3e-05 , se: NA

Scenario F - Name: 70,2 project alone_NE

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8.4e-05 , se: NA

Scenario G - Name: 50,1 cumulative_NE
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000899 , se: NA

Scenario H - Name: 70,2 cumulative_NE
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002517 , 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

Herring gull (BDMPS)

Basic information

This run had reference name “HG(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: 8.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Herring Gull.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 466510 in 2015

Productivity rate per pair: mean: 1.033303 , sd: 0.6585291

Adult survival rate: mean: 0.834 , sd: 0.079

Immatures survival rates:

Age class 0 to 1 - mean: 0.794 , sd: 0.079 , DD: NA

Age class 1 to 2 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 2 to 3 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 3 to 4 - mean: 0.834 , sd: 0.079 , DD: NA

Age class 4 to 5 - mean: 0.834 , sd: 0.079 , DD: NA

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Project alone
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6e-06 , se: NA

Scenario B - Name: Cumulative
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002183 , 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

Kittiwake (BDMPS)

Basic information

This run had reference name “KI”.
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: 23545634.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Black-Legged Kittiwake.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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.adults
Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 839456 in 2015

Productivity rate per pair: mean: 0.6994274 , sd: 0.3249545

Adult survival rate: mean: 0.854 , sd: 0.077

Immatures survival rates:

Age class 0 to 1 - mean: 0.79 , sd: 0.078 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 4e-05 , se: NA

Scenario B - Name: In-combo

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.004473 , 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

Lesser black-backed gull (BDMPS)

Basic information

This run had reference name "LBBG (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: 7.
Years for burn-in: 0.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Lesser Black-Backed Gull.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 209006 in 2015

Productivity rate per pair: mean: 0.4694737 , sd: 0.579858

Adult survival rate: mean: 0.885 , sd: 0.056

Immatures survival rates:

Age class 0 to 1 - mean: 0.82 , sd: 0.056 , DD: NA

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

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

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

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

Impacts

Number of impact scenarios: 2.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: Yes

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: Project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 1.2e-05 , se: NA

Scenario B - Name: Cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.003298 , 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

Puffin (BDMPS)

Basic information

This run had reference name “Pu 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: 4554.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Atlantic Puffin.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
Age at first breeding: 5.
Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.
Number of subpopulations: 1.
Are demographic rates applied separately to each subpopulation?: No.
Units for initial population size: breeding.adults
Are baseline demographic rates specified separately for immatures?: Yes.

Population 1

Initial population values: Initial population 868689 in 2015

Productivity rate per pair: mean: 0.5760227 , sd: 0.3308661

Adult survival rate: mean: 0.907 , sd: 0.083

Immatures survival rates:

Age class 0 to 1 - mean: 0.709 , sd: 0.108 , DD: NA

Age class 1 to 2 - mean: 0.709 , sd: 0.108 , DD: NA

Age class 2 to 3 - mean: 0.709 , sd: 0.108 , DD: NA

Age class 3 to 4 - mean: 0.76 , sd: 0.093 , DD: NA

Age class 4 to 5 - mean: 0.805 , sd: 0.083 , 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?: Yes

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: 50, 1 Alone
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6e-06 , se: NA

Scenario A - Name: 70, 2 Alone
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 1.7e-05 , se: NA

Scenario A - Name: 50, 1 Cumulative
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000386 , se: NA

Scenario B - Name: 70,2 Cumulative
All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001082 , 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

Razorbill (BDMPS)

Basic information

This run had reference name “Razorbill (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: 4.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 591875 in 2015

Productivity rate per pair: mean: 0.5604778 , sd: 0.1619291

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.07 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.07 , DD: NA

Age class 2 to 3 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 4 to 5 - mean: 0.895 , sd: 0.067 , DD: NA

Impacts

Number of impact scenarios: 4.

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?: Yes

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: 50,1 project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000104 , se: NA

Scenario B - Name: 70,2 project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00029 , se: NA

Scenario C - Name: 50,1 cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00183 , se: NA

Scenario D - Name: 70,2 cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005124 , 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

Razorbill (Biogeographic)

Basic information

This run had reference name “Razorbill (Biogeo)”.
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: 5.
Years for burn-in: 5.
Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.
Region type to use for breeding success data: MSFD.
Available colony-specific survival rate: National. Sector to use within breeding success region: Greater North Sea.
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 1707000 in 2015

Productivity rate per pair: mean: 0.5604778 , sd: 0.1619291

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.07 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.07 , DD: NA

Age class 2 to 3 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 3 to 4 - mean: 0.895 , sd: 0.067 , DD: NA

Age class 4 to 5 - mean: 0.895 , sd: 0.067 , DD: NA

Impacts

Number of impact scenarios: 4.

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?: Yes

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: 50,1 project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 3.6e-05 , se: NA

Scenario B - Name: 70,2 project alone

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000101 , se: NA

Scenario C - Name: 50,1 cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.000635 , se: NA

Scenario D - Name: 70,2 cumulative

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001777 , 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