MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Environmental Statement

Volume 4, Annex 5.6: Offshore ornithology PVA technical report

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Image of an offshore wind farm

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Glossary

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

Acronyms

Term	Meaning
BDMPS	Biologically Defined Minimum Population Scale
CGR	Counterfactual of Growth Rate
CPS	Counterfactual of Population Size
DCO	Development Consent Order
EIA	Environmental Impact Assessment
HRA	Habitats Regulations Assessment
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
SD	Standard Deviation
SNCB	Statutory Nature Conservation Bodies
SSSI	Site of Special Scientific Interest
SPA	Special Protection Area
TSC	Territorial Sea Committee

Units

Unit	Description
%	Percentage

1 Offshore ornithology PVA technical report

1.1 Introduction

1.1.1 Background

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

1.1.1.2 One method to estimate the effect that offshore wind projects alone or cumulatively may have on a population is through Population Viability Analysis (PVA). PVA provides a robust framework using demographic parameters to predict changes in the population, using statistical population models to forecast future changes over a set period. Comparisons are made between 'baseline' conditions whereby conditions remain unimpacted and under 'scenario' conditions where an impact is applied to a population by the alteration of demographic parameters. Population metrics that are derived from comparisons of 'baseline' and 'impacted' predictions generated by PVAs can then be used to assess the significance of the anticipated additional mortality associated with planned developments.

1.1.1.3 As part of the assessments undertaken for the Morgan Offshore Wind Project Generation Assets (hereafter called the Morgan Generation Assets) in the ISAA Part 3: Special Protection Areas (SPAs) and Ramsar Site Assessments (Document Reference E1.3), the species and associated populations selected for further assessment were:

- Great black-backed gull *Larus marinus* at the Isles of Scilly SPA.

1.1.1.4 This feature was selected for further assessment of the predicted in-combination impacts only, due to the predicted increase in baseline mortality considered to exceed 1% of the baseline mortality of the SPA population. A 1% increase is the level that is regarded as the threshold for undertaking further assessments such as PVA (Natural England, 2022). Impacts attributed to other designated sites were not considered to exceed this threshold based on the information provided in ISAA Part 3: Special Protection Areas (SPAs) and Ramsar Site Assessments (Document Reference E1.3) and Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement (Document Reference F2.5).

1.1.2 Aim of report

1.1.2.1 This technical report presents the PVA process conducted for the species and associated populations identified above in relation to impacts associated with the Morgan Generation Assets and other projects considered in-combination.

1.2 Consultation

1.2.1 Overview

1.2.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to offshore ornithology and the use of population viability analysis, is presented in Table 1.1 below, together with how these issues have been considered in the production of this technical report as part of the Environmental Statement and ISAA (Document Reference E1.3).

1.2.2 Evidence plan process

1.2.2.1 The purpose of the Evidence Plan process is to agree the information the Morgan Generation Assets needs to supply to the Secretary of State, as part of the Development Consent Order (DCO) application for the Morgan Generation Assets. The Evidence Plan seeks to ensure compliance with the process for undertaking a Habitats Regulations Assessment. The development and monitoring of the Evidence Plan and its subsequent progress is being undertaken by the Steering Group. The Steering Group is comprised of the Planning Inspectorate, the Applicant, NRW, Natural England, JNCC and the MMO as the key regulatory and Statutory Nature Conservation Bodies (SNCBs). To inform the EIA and HRA process during the pre-application stage of the Morgan Generation Assets, Expert Working Groups (EWGs) were also set up to discuss and agree topic specific issues with the relevant stakeholders. Consultation was undertaken via the Offshore Ornithology EWG, with meetings held in February 2022, July 2022, November 2022, February 2023, June 2023, October 2023, December 2023 and March 2024.

1.2.2.2 The responses provided and changes suggested by the stakeholders through the EWG are summarized in Table 1.1, together with changes implemented in this technical report.

1.2.3 Section 42 Consultation

1.2.3.1 A number of comments were received during the S42 consultation following submission of the Preliminary Environmental Information Report (PEIR) chapter. All the responses provided, and changes suggested by the stakeholders are presented in the consultation report (Document Reference E.3) together with changes implemented in the technical reports underpinning the Environmental Statement.

1.2.3.2 A summary of the key responses with changes implemented in this technical report of the Environmental Statement are presented in Table 1.1.

Table 1.1: Summary of key topics and issues raised during consultation activities undertaken for the Morgan Offshore Wind Project relevant to offshore ornithology population viability analysis technical report of the Environmental Statement.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this report
June 2023	**S42 Consultation** Natural Resources Wales	Whilst Special Protection Areas (SPAs)/Ramsars are assessed within the Habitats Regulation Assessment (HRA) related reports, where there is potential connectivity (for example, within foraging range etc.) and potential impact pathway of seabird features of SSSIs that are not already assessed in the HRA reports as they are also features of SPAs/Ramsars, these SSSIs and features need to be assessed within the Environmental Statement. For example, the Pen y Gogarth/Great Orme's Head SSSI is designated for breeding kittiwake, guillemot and razorbill and the Morgan project is located within foraging range of all three of these species. Hence quantitative assessments of displacement for guillemot and razorbill and collision for kittiwake should be undertaken for this site.	Predicted mortalities from collisions and displacement of the Morgan Generation Assets to seabird colonies designated as SSSIs, including the Pen y Gogarth/Great Orme's Head SSSI have been presented in Volume 6, Annex 5.5: Offshore ornithology apportioning technical report of the Environmental Statement. Furthermore, Population Viability Analysis (PVA) has been undertaken for common guillemot at the Pen y Gogarth/Great Orme's Head SSSI and presented in Volume 6, Annex 5.6: Offshore ornithology population viability analysis technical report of the Environmental Statement. This was undertaken as only the guillemot colony impacts went above 1% with the other species well below the 1% threshold and therefore it was not deemed necessary to carry out further investigation of these species and sites.
		Population Viability Analyses (PVAs) have been undertaken where predicted cumulative impacts equate to more than 1% of baseline mortality of the relevant populations, and that these have been undertaken using the Natural England (NE)/Joint Nature Conservation Committee (JNCC) PVA tool. Based on the current figures this has been undertaken for annual cumulative (EIA scale) displacement impacts for guillemot and operational collision impacts for great black-backed gull. Given the lack of evidence for how density dependence acts on the populations for which PVAs have been undertaken, Natural Resources Wales (NRW) (A) agree that these have been run as density independent models.	Noted, PVAs have been conducted using density independent models (see Section 1.3.2).
		NRW (A) welcome that the models have been run for 5,000 simulations and that the tool input parameter log files have been included. However, all results of the PVA, including graphs of Counterfactual of Population Size (CPS) and	Counterfactual Population Size (CPS), Counterfactual of Growth Rate (CGR) and population size under baseline and impacted condition are presented in Section 1.4 as well as graphs and output logs.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this report
		Counterfactual of Growth Rate (CGR) and population size under baseline and impacted conditions should also be presented.	
		NRW (A) note that the PVAs have been run excluding a 'burn in' and it has been assumed that any impacts on populations commenced the year following latest population counts, which for all models appears to be 2023. NRW (A) advise that the PVAs are parameterised using a 5-year burn-in period, with the impacts set to commence when the project is anticipated to start operating and to run for the lifetime of the project, and with the starting population being the latest count for the site in question. NRW (A) therefore advise that the models are updated to account for this.	PVAs have been parameterized with a 5-year burn-in period to include age structure from burn-in run period (see Section 1.3).
		Volume 6, Annex 5.6: Offshore ornithology population viability analysis technical report of the Environmental Statement. We welcome that that the models have been run for 5,000 simulations and that the tool input parameter log files have been included. We recommend providing all results of the PVA, including CPS and CGR and graphs of population size under baseline and impacted conditions.	Counterfactual Population Size (CPS), Counterfactual of Growth Rate (CGR) and population size under baseline and impacted condition are presented in Section 1.4 as well as the graphic outputs.
		Given the comments made regarding calculation of the breeding Biologically Defined Minimum Population Scale (BDMPS) population (Furness, 2015), apportioning impacts to adults, immatures, and sabbaticals, lack of calculation of annual impacts, and multiple unknown quantitative in-combination impacts from other projects, we cannot agree that a PVA is required for solely common guillemot and great black-backed gull.	Rationale for taking forward species to PVA is presented in Volume 2, Chapter 5: Offshore Ornithology of the Environmental Statement and the ISAA Part 3: Special Protection Areas (SPAs) and Ramsar Site Assessments (Document Reference E1.3)
June 2023	**S42 Consultation** Natural England	Natural England advise following our Phase III Best practice guidance which states: 'PVAs should estimate the impacted and unimpacted populations over the lifetime of the project and include a 'burn-in' period (5 years) to allow the model to reach stability prior the projection period beginning'	PVAs have been parameterized with a 5-year burn-in period to include age structure from burn-in run period (see Section 1.3).

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this report
June 2023	**S42 Consultation** IOM Gov Detailed response	The Territorial Sea Committee (TSC) believe that this follows accepted practice with respect to great black-backed gull. There are known problems defining the regional population here but it makes a comparison with both west coast regional populations, as it lies between the two. Of concern here is that the result of the methodology is that there is a slight reduction in the positive growth of the (smaller) southwest population, but the Isle of Man data shows, not a positive growth, but a very severe decline in the breeding population (breeding population reduction 78.5% in 15 years and reduction 70.6% in 30 years) which begs a question as to whether the accepted regional population comparisons provide appropriate data as background, when there are clearly very different effects occurring in areas within that population, and much of it lies far from the study site, whereas the Isle of Man is close. At the expert working group, it was noted that Horswill and Robinson (2015) had been referenced and we ask whether the latest JNCC-held SMP data can be used, which the applicant has stated they will look at (the guidance apparently just recommends a 'custom approach'). Assurances are sought that the Manx population of great black-backed gulls will not be affected significantly, noting the threat that this population is already under, on the Isle of Man.	The great black-backed gull population on the Isle of Man has been specifically considered within Volume 2, Chapter 5: Offshore Ornithology of the Environmental Statement. The associated impact has been estimated at less than one bird/ Population modelling for great black-backed gull has not been undertaken at an EIA level as the threshold for undertaking PVA has not been breached within Volume 2, Chapter 5: Offshore Ornithology of the Environmental Statement.

1.3 Methodology

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

1.3.2 Modelling approach

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

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

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

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

1.3.2.5 PVA outputs can either be expressed as the CPS or the CGR depending on if density dependence is included within the model. As models within this report have been run using density independence, the CGR is considered more robust and informative, while if the PVA is density dependent then the CPS is more robust and informative. While both CPS and CGR are provided, the interpretation of the density independent PVA outputs focusses on the CGR.

1.3.3 Simulation parameterisation

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

1.3.3.2 Modelling has also been undertaken including a five year 'burn in' period within the model. Applying a 'burn in' period allows for a stable age structure to form when starting to run the model. Within the model, impacts were set to commence the year the project was anticipated to start operating (2030) and run for the lifetime of the project (35 years).

1.3.3.3 Although impacts are only reported with respect to the adult numbers, impacts within the simulations were also applied proportionally to immature age-classes (based upon the stable age distribution from eigen-decomposition of the Leslie matrix; Searle *et al.,* 2019).

1.3.3.4 Impacted vs unimpacted comparisons were based on a matched runs approach, whereby stochasticity is applied to the population before impacts are applied (i.e. survival and productivity rates simulated at each time step are the same for the unimpacted and impacted populations, before additional impact mortalities are deducted from simulated survivals for the impacted populations). This approach is used as previous analyses demonstrated that stochastic models using a matched runs approach were likely the most precautionary (Cook and Robinson, 2017). Productivity rates were assumed to be unaffected by wind farm effects.

1.3.4 Model parameterisation

Demographic rates

1.3.4.1 If available, and if considered to adequately reflect the productivity of the population, site-specific productivity values should be used to parameterise PVA. For great black-backed gull, site-specific productivity values are not available and as such productivity values associated with JNCC's Seabird Monitoring Programme Report 1986-2019 have been used (provided by JNCC as part of the Evidence Plan process). Productivity values between 2010 and 2019 have been averaged to provide a value to inform the PVAs in this technical report.

1.3.4.2 Two sources have been used to parameterise the survival rate of great black-backed gull within the models conducted. The first was derived from the national values presented in Horswill and Robinson (2015). Due to the limited amount of data, Horswill and Robinson (2015) recommended using the survival rates of other large gull species when conducting population modelling for great black-backed gull. Therefore, the survival rates for great black-backed gull used for the PVA are based on adult and juvenile rates for herring gull as presented in Horswill & Robinson (2015) (Table 1.2). The second rate represents survival data reported as part of the BTO's Retrap Adult Survival project which has been collected subsequent to the publication of Horswill and Robinson (2015) which is considered to be of moderate quality and providing a relatively accurate survival trend (BTO, 2024).

Table 1.2: Species demographic rates used in population viability analysis.

Population	Species	Age first breeding	Eggs/pair	Metric	Survival rates (per age class) 0-1	1-2	2-3	3-4	4-5	5-6	Adult	Productivity	Source
Isles of Scilly SPA	Great black-backed gull	5	3	Mean	0.798	0.834	0.834	0.834	0.834	n/a	0.834	1.061	Survival: Horswill and Robinson (2015) Productivity: provided by JNCC
				Standard deviation (sd)	0.092	0.034	0.034	0.034	0.034	n/a	0.034	0.132	
				Mean	0.85	0.85	0.85	0.85	0.85	0.85	0.85	1.061	Survival: BTO (2024) Productivity: provided by JNCC
				Standard deviation (sd)	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.132	

Populations

Special Protection Areas

1.3.4.3 The initial population size for great black-backed gull at the Isles of Scilly SPA was taken from the Seabirds Count database (Burnell *et al.,* 2023), representing the most recent complete count available. This is presented in Table 1.3.

Table 1.3: SPA populations.

SPA	Feature	Population (breeding adults)
Isles of Scilly	Great black-backed gull	1,618

1.3.5 Impact scenarios

1.3.5.1 The impact from the Morgan Generation Assets in-combination/cumulatively with other projects has been parametrised as a 'relative harvest' (i.e. additional mortality as a result of the impact).

1.3.5.2 Note that for the purposes of the PVA model, specifying a relative harvest means the absolute number of birds that could suffer mortality as a result of the project is proportional to the population size. This is in line with the assessment approach for both collision risk and displacement analysis.

1.3.5.3 All impact scenarios and input parameters for each run and for great black-backed gull at the Isles of Scilly SPA are presented in Appendix A.

Special Protection Areas

Isles of Scilly SPA

1.3.5.4 The impacts for great black-backed gull at the Isles of Scilly SPA used in population modelling are presented in Table 1.4. The scenarios included reflect the values calculated when applying the avoidance rate recommended by the EWG (99.3%) and those used by the Applicant (99.91%).

Table 1.4: Impacts modelled for great black-backed gull at the Isles of Scilly SPA.

Scenario	Total mortality	Impact on survival rate (%)
Avoidance rate = 99.3%	8.8	7.80
Avoidance rate = 99.91%	1.3	1.14

1.4 Results

1.4.1 Special Protection Areas

Isles of Scilly

1.4.1.1 The results of the PVA for impacts on the great black-backed gull population at the Isles of Scilly SPA at the start of operation (2030) and for the duration of the Morgan Generation Assets (35 years) are presented in Table 1.5 below using the survival rate from Horswill and Robinson (2015). The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes. Graphs relating to population size, Counterfactual of Population Size (CPS) and Counterfactual of Growth Rate (CGR) for each impact scenario are also presented (Figure 1.1 to Figure 1.3). Consideration of the outputs presented below is provided in ISAA Part 3: Special Protection Areas (SPAs) (Document Reference E1.3).

Table 1.5: Great black-backed gull PVA results for the Isles of Scilly SPA (survival rate = Horswill and Robinson, 2015).

Year	Impact scenario	Simulated population size	Median population change (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS
2030	Baseline (unimpacted)	1,862	+ 2.22	1.022	0.915	1.132	-	-
2030	Avoidance rate = 99.3%	1,690	- 7.24	0.928	0.826	1.028	0.907	0.906
2030	Avoidance rate = 99.91%	1,839	+ 0.82	1.008	0.903	1.120	0.986	0.986
2065	Baseline (unimpacted)	3,969	+ 114.76	1.021	1.011	1.032	-	-
2065	Avoidance rate = 99.3%	113	- 93.91	0.925	0.913	0.937	0.906	0.028
2065	Avoidance rate = 99.91%	2,409	+ 30.43	1.007	0.997	1.017	0.986	0.606

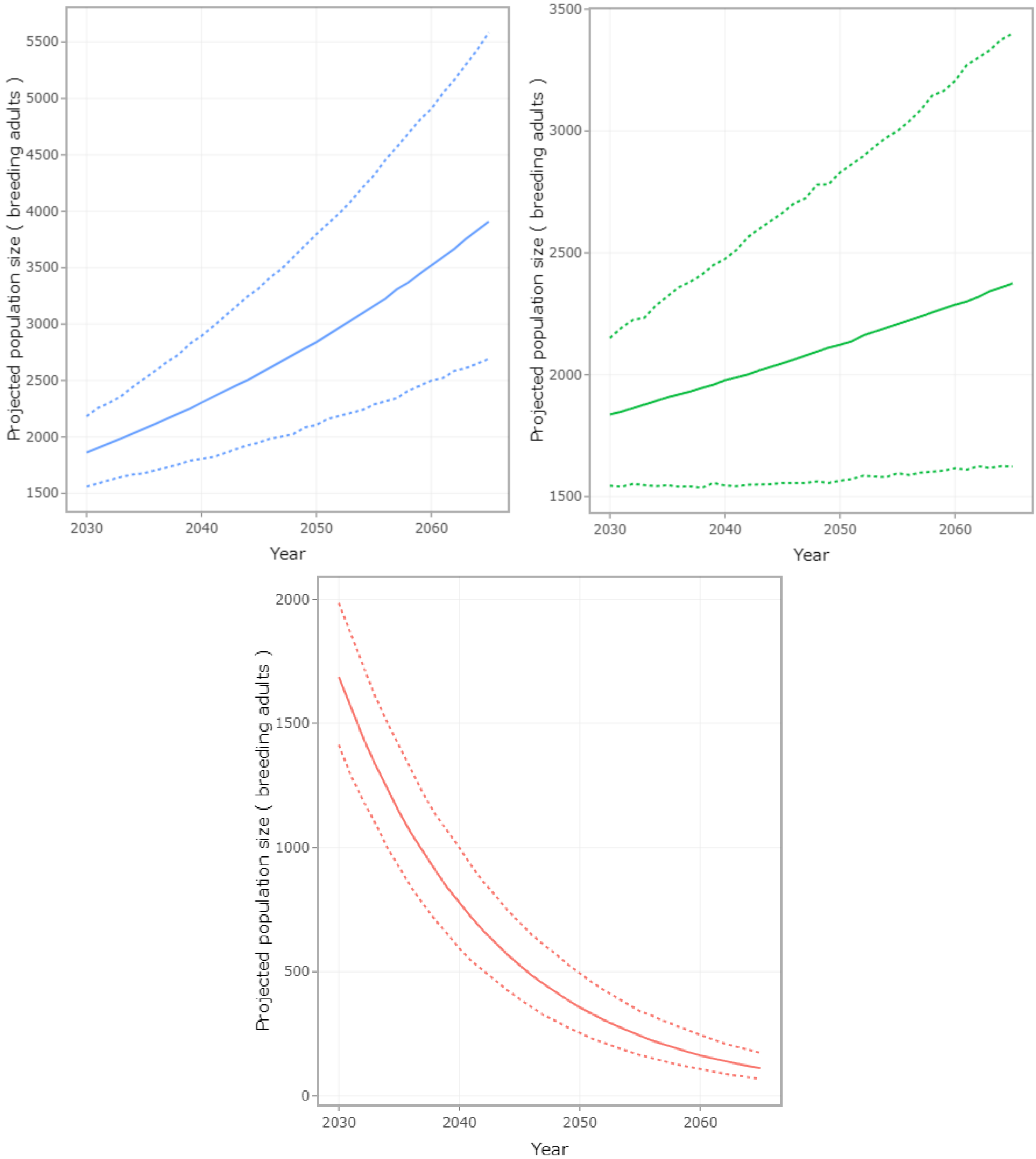

Figure 1.1: Projections of population sizes over a 35-year time-frame for the great black-backed gull population at the Isles of Scilly SPA. Each plot represents a different impact scenario in terms of additional adult mortalities (starting at baseline (i.e. unimpacted)). Blue = Baseline, Red = Impact calculated using an avoidance rate of 99.3%, Green = Impact calculated using an avoidance rate of 99.91%.

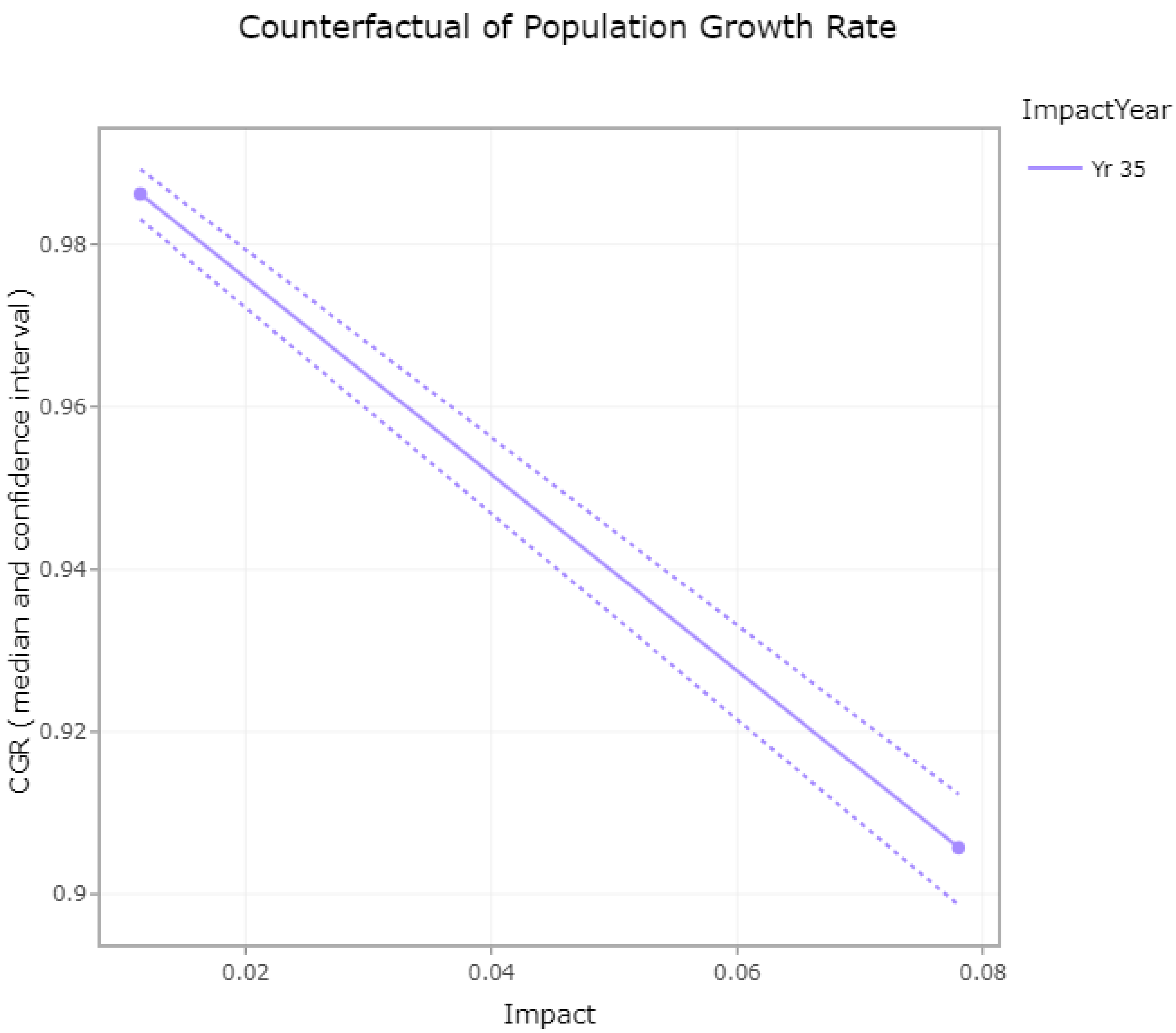

Figure 1.2: Ratio of impacted growth rates after 35 years for the great black-backed gull population at the Isles of Scilly SPA under a range of impact scenarios (impact from additional mortalities shown on x-axis). The two points on the line relate to the impact scenario modelled.

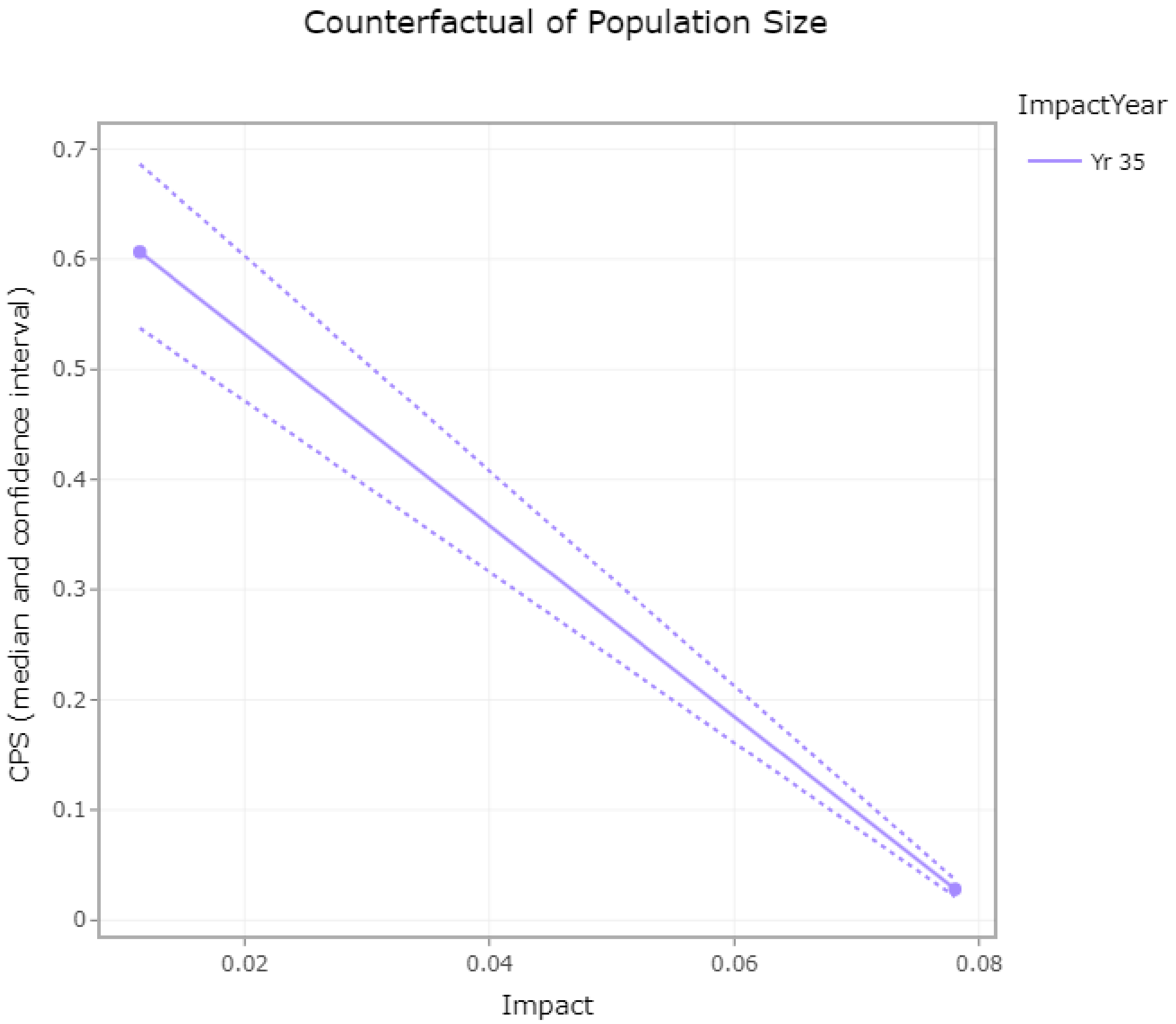

Figure 1.3: The ratio of the median impacted population sizes for the great black-backed gull population at the Isles of Scilly SPA from the simulations after 35 years under a range of impact scenarios (impact from additional mortalities shown on x-axis). The two points on the line relate to the impact scenario modelled.

1.4.1.2 The results of the PVA for impacts on the great black-backed gull population at the Isles of Scilly SPA at the start of operation (2030) and for the duration of the Morgan Generation Assets (35 years) are presented in Table 1.5 below using the survival rate from BTO (2024). The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes. Graphs relating to population size, Counterfactual of Population Size (CPS) and Counterfactual of Growth Rate (CGR) for each impact scenario are also presented (see Figure 1.4 to Figure 1.6). Consideration of the outputs presented below is provided in ISAA Part 3: Special Protection Areas (SPAs) and Ramsar Site Assessments (Document Reference E1.3).

Table 1.6: Great black-backed gull PVA results for the Isles of Scilly SPA (survival rate = BTO, 2024).

Year	Impact scenario	Simulated population size	Median population change (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS
2030	Baseline (unimpacted)	2,180	+ 6.76	1.068	0.736	1.317	-	--
2030	Avoidance rate = 99.3%	1,980	- 3.02	0.970	0.644	1.207	0.910	0.909
2030	Avoidance rate = 99.91%	2,150	+ 5.09	1.051	0.722	1.306	0.986	0.986
2065	Baseline (unimpacted)	10,633	+ 369.31	1.044	1.016	1.069	-	-
2065	Avoidance rate = 99.3%	332	- 85.59	0.948	0.919	0.973	0.908	0.031
2065	Avoidance rate = 99.91%	6,531	+ 187.97	1.030	1.002	1.055	0.986	0.612

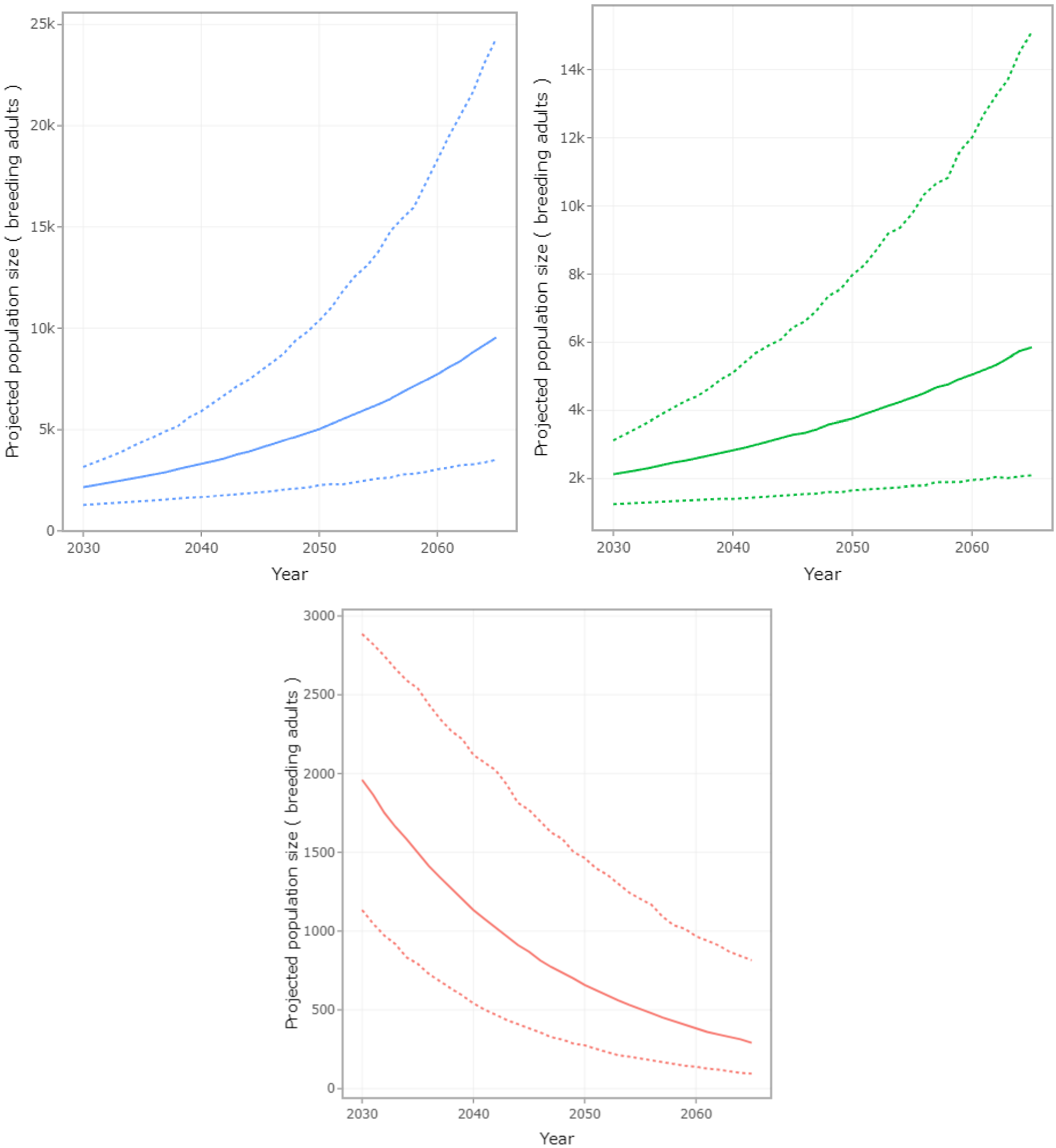

Figure 1.4: Projections of population sizes over a 35-year time-frame for the great black-backed gull population at the Isles of Scilly SPA. Each plot represents a different impact scenario in terms of additional adult mortalities (starting at baseline (i.e. unimpacted)). Blue = Baseline, Red = Impact calculated using an avoidance rate of 99.3%, Green = Impact calculated using an avoidance rate of 99.91%.

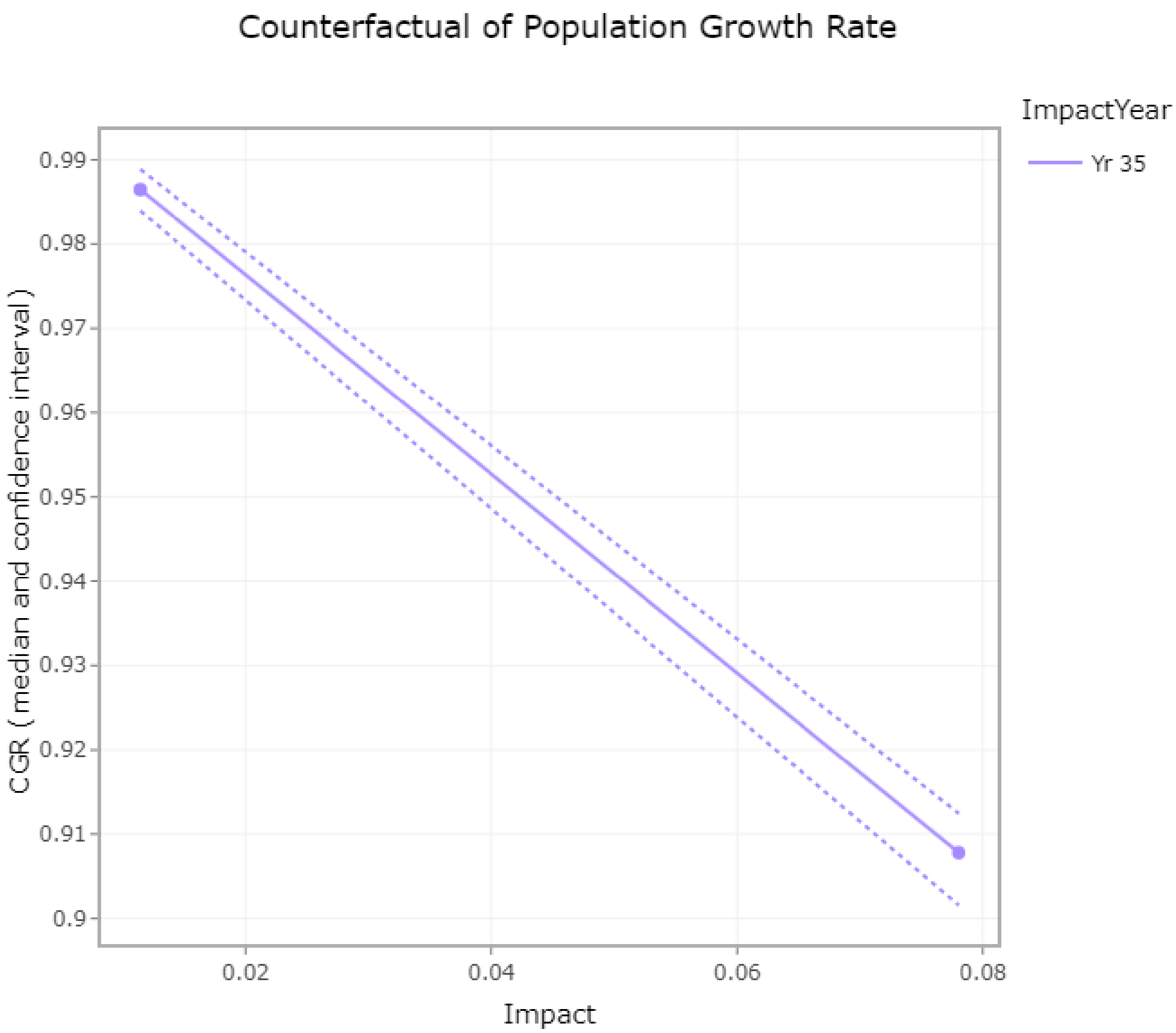

Figure 1.5: Ratio of impacted growth rates after 35 years for the great black-backed gull population at the Isles of Scilly SPA under a range of impact scenarios (impact from additional mortalities shown on x-axis). The two points on the line relate to the impact scenario modelled.

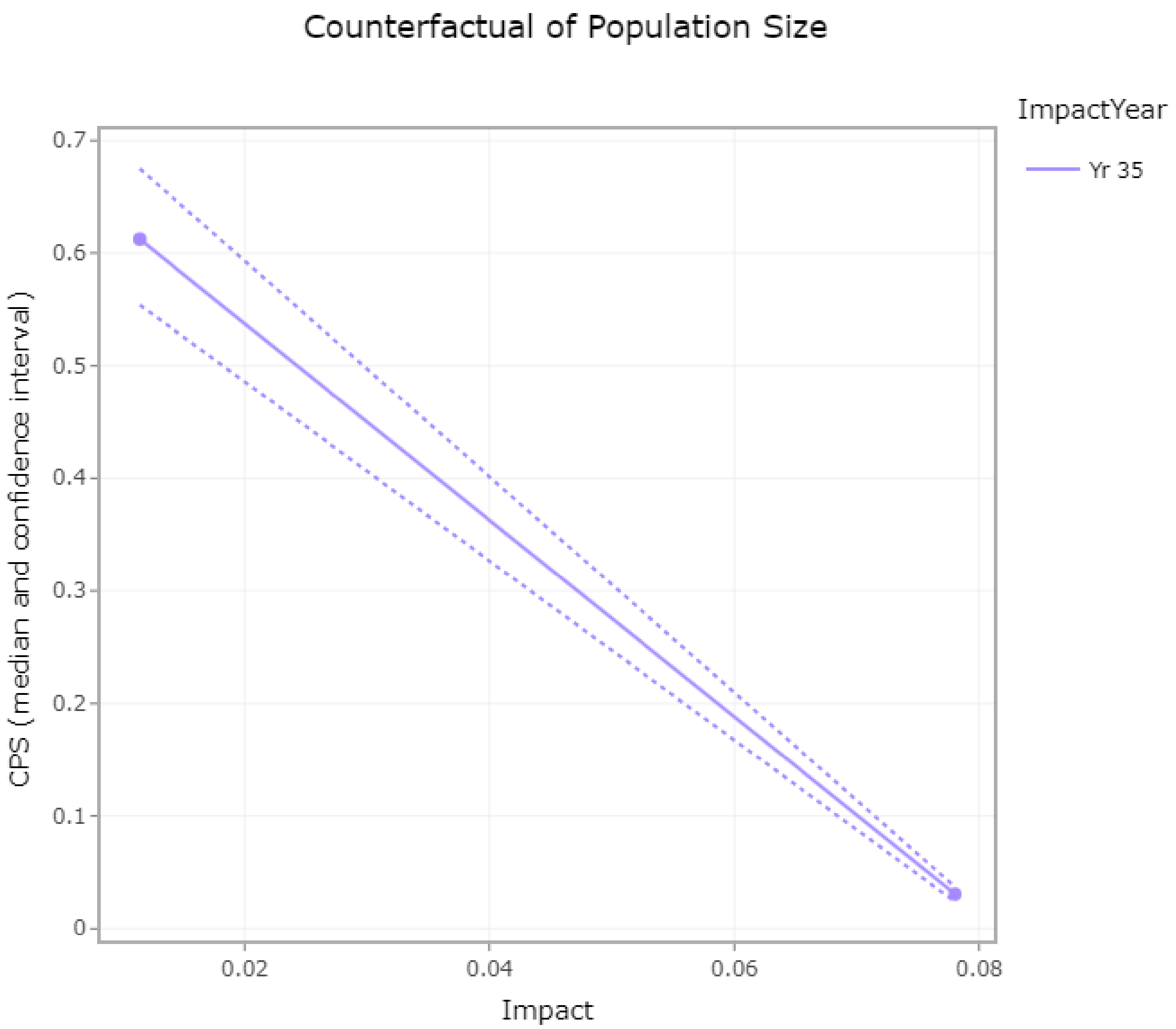

Figure 1.6: The ratio of the median impacted population sizes for the great black-backed gull population at the Isles of Scilly SPA from the simulations after 35 years under a range of impact scenarios (impact from additional mortalities shown on x-axis). The two points on the line relate to the impact scenario modelled.

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Appendix A: Seabird PVA Parameter Log

A.1.1 Great black-backed gull

A.1.2 Isles of Scilly

A.1.2.1 Set up

The log file was created on: 2024-02-23 17:15:12 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                  Package          Version
## popbio           "popbio"         "2.4.4"
## shiny            "shiny"          "1.1.0"
## shinyjs          "shinyjs"        "1.0"
## shinydashboard   "shinydashboard" "0.7.1"
## shinyWidgets     "shinyWidgets"   "0.4.5"
## DT               "DT"             "0.5"
## plotly           "plotly"         "4.8.0"
## rmarkdown        "rmarkdown"      "1.10"
## dplyr            "dplyr"          "0.7.6"
## tidyr            "tidyr"          "0.8.1"
```

A.1.2.2 Basic Information

This run had reference name “GB_IslesofScilly_HW”.

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: 15.

Years for burn-in: 5.

Case study selected: None.

A.1.2.3 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.

Region type to use for breeding success data: .

Available colony-specific survival rate: . Sector to use within breeding success region: .

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: breeding.adults

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

Population 1

Initial population values: Initial population 1618 in 2023

Productivity rate per pair: mean: 1.06052 , sd: 0.1319869

Adult survival rate: mean: 0.834 , sd: 0.034

Immatures survival rates:

Age class 0 to 1 - mean: 0.798 , 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

A.1.2.4 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: Avoidance_rate_99.91

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.01142422 , se: NA

Scenario B - Name: 0.834

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.07802339 , se: NA

A.1.2.5 Output

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: breeding.adults

Target population size to use in calculating impact metrics: NA

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

Appendix B: Seabird PVA Parameter Log

B.1. Great black-backed gull (BTO, 2024 survival rate)

B.1.1 Isles of Scilly

B.1.1.1 Set up

The log file was created on: 2024-02-23 17:06:35 using Tool version 2, with R version 3.5.1, PVA package version: 4.18 (with UI version 1.7)

```
##                Package          Version
## popbio         "popbio"         "2.4.4"
## shiny          "shiny"          "1.1.0"
## shinyjs        "shinyjs"        "1.0"
## shinydashboard "shinydashboard" "0.7.1"
## shinyWidgets   "shinyWidgets"   "0.4.5"
## DT             "DT"             "0.5"
## plotly         "plotly"         "4.8.0"
## rmarkdown      "rmarkdown"      "1.10"
## dplyr          "dplyr"          "0.7.6"
## tidyr          "tidyr"          "0.8.1"
```

B.1.1.2 Basic Information

This run had reference name “GB_IslesofScilly_RAS”.

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: 15.

Years for burn-in: 5.

Case study selected: None.

B.1.1.3 Baseline demographic rates

Species chosen to set initial values: Great Black-Backed Gull.

Region type to use for breeding success data: .

Available colony-specific survival rate: . Sector to use within breeding success region: .

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: breeding.adults

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

Population 1

Initial population values: Initial population 1618 in 2023

Productivity rate per pair: mean: 1.06052 , sd: 0.1319869

Adult survival rate: mean: 0.85 , sd: 0.1111755

Immatures survival rates:

Age class 0 to 1 - mean: 0.85 , sd: 0.1111755 , DD: NA

Age class 1 to 2 - mean: 0.85 , sd: 0.1111755 , DD: NA

Age class 2 to 3 - mean: 0.85 , sd: 0.1111755 , DD: NA

Age class 3 to 4 - mean: 0.85 , sd: 0.1111755 , DD: NA

Age class 4 to 5 - mean: 0.85 , sd: 0.1111755 , DD: NA

B.1.1.4 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: Avoidance_rate_99.91

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.01142422, se: NA

Scenario B - Name: 0.834

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.07802339, se: NA

B.1.1.5 Output

First year to include in outputs: 2030

Final year to include in outputs: 2065

How should outputs be produced, in terms of ages?: breeding.adults

Target population size to use in calculating impact metrics: NA

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