



Morven South Offshore Wind Array Project

Environmental Impact Assessment Report

**Volume 3, Annex 11.6: Offshore Ornithology
Regional Population Viability Analysis**

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1 Introduction

1.1 Context

- 1.1.1.1 Seabirds can be impacted by offshore wind developments in a number of ways, including collision with wind turbine blades resulting in mortality, and 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 allows for evaluating the potential impacts of offshore wind farms on different population scales.
- 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 (i.e. the Morven South Offshore Wind Array Project (hereafter "Morven South") is not constructed) 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. Assessing the acceptability of the impact involves evaluating biological responses alongside statutory, policy, and other relevant considerations. There is no universally defined threshold for what constitutes an 'acceptable' level of impact; rather, determinations will be population-specific and guided by a comprehensive analysis of these factors.

1.2 Aim of report

- 1.2.1.1 This Technical Report presents the PVA process conducted for the species and associated populations in relation to impacts associated with Morven South alone, the Morven programme (for ornithological receptors this refers to impacts from Morven North Offshore Wind Array Project (hereafter "Morven North") and Morven South combined, , as set out in Volume 2, Chapter 11: Offshore Ornithology), and cumulatively with other plans and projects.

2 Methodology

2.1 Overview

2.1.1.1 PVA was undertaken using the Seabird PVA Tool developed by Natural England (Searle *et al.*, 2019). This software has a user-friendly interface (in the 'Shiny App' interface) and another series of code tools for direct use. Both are written within the computer software 'R' (R is a free software environment for statistical computing and graphics) and are intended to give the same fundamental calculations. The Seabird PVA Tool was accessed via the Shiny App 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).

2.2 Identification of species and populations for consideration

2.2.1.1 Species are selected for further assessment where the predicted increase in baseline mortality exceeds a 0.02 percentage point increase in the baseline mortality of the relevant regional population. A 0.02 percentage point increase is the level that is regarded as the threshold for undertaking further assessments such as PVA as recommended by NatureScot (2023a) in both project alone and cumulative assessments.

2.2.1.2 When applying this threshold as part of the assessments undertaken for Morven South in Volume 2, Chapter 11: Offshore Ornithology, the species and associated seasons included in Table 2.1 require PVA modelling.

Table 2.1: Species and associated seasons for which Population Viability Analysis is required based on the assessments presented in Volume 2, Chapter 11: Offshore Ornithology

Species	Season
Morven South alone	
Common guillemot (<i>Uria aalge</i>)	Post-breeding and non-breeding seasons
	Annual basis
Morven Programme assessment (Morven North and Morven South combined)	
Common guillemot	All seasons
	Annual basis
Razorbill (<i>Alca torda</i>)	Post-breeding season
	Annual basis
Cumulative assessment	
Kittiwake (<i>Rissa tridactyla</i>)	All seasons
	Annual basis
Great black-backed gull (<i>Larus marinus</i>)	Non-breeding
	Annual basis
Common guillemot	All seasons

Species	Season
	Annual basis
Razorbill	All seasons
	Annual basis
Puffin (<i>Fratercula arctica</i>)	All seasons
	Annual basis
Gannet (<i>Morus bassanus</i>)	All seasons
	Annual basis

2.2.1.3 Impacts in other seasons both for the species included in Table 2.1 and those for which assessments are included in Volume 2, Chapter 11: Offshore Ornithology but not included in Table 2.1 did not exceed the 0.02 percentage point threshold and therefore did not require PVA.

2.3 Modelling approach

2.3.1.1 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.

2.3.1.2 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).

2.3.1.3 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.

2.3.1.4 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.

2.3.1.5 PVA outputs can either be expressed as the counterfactual of population size (CPS) or the counterfactual of population growth rate (CGR). 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 outputs are presented in line with NatureScot's guidance (NatureScot, 2023a), the interpretation of results in Volume 2, Chapter 11 Offshore Ornithology focuses on CGR, as it provides a clearer indication of

potential long-term population-level effects in the absence of density regulation. This is in line with ecological modelling principles described by White (2016), where it is noted that the interpretation of the CGR is better suited to density-independent models, as it shows how a population responds to external pressures without the added complexity of feedback effects. In contrast, CPS is more appropriate metric when density dependence is explicitly included in the model, as it reflects how population size changes over time in response to natural constraints such as resource limitation and carrying capacity.

- 2.3.1.6 Additionally, the quantile from the unimpacted population that matched the 50% quantile for the impacted population ($U=50\%I$) and the quantile from the impacted population that matched the 50% quantile for the unimpacted population ($I=50\%U$) have been presented. These quantiles provide a baseline against which the impacted population can be evaluated, aiding in assessing the magnitude of impact and potential consequences.

2.4 Simulation parameterisation

- 2.4.1.1 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 (5,000 runs is regarded as the standard approach and has been utilised in several offshore wind applications such as Hornsea Four Offshore Wind Farm, Awel Y Mor Offshore Wind Farm, Mona and Morgan Offshore Wind Farms, Berwick Bank Offshore Wind Farm and Green Volt Offshore Wind Farm). All models were run for a 35-year time span (the anticipated lifetime of Morven South) with outputs for 25 and 50 impacted years also presented for all impact scenarios.
- 2.4.1.2 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 PVA model, impacts were set to commence the year Morven South is anticipated to start operating (2038) and were set to run for the lifetime of Morven South (35 years) until 2072 providing PVA models run for 35 impacted years.
- 2.4.1.3 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).
- 2.4.1.4 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.

2.5 Model parametrisation

2.5.1 Demographic rates

- 2.5.1.1 The survival rates for the species considered were derived from the national values presented in Horswill and Robinson (2015), with updated productivity values taken from the Joint Nature Conservation Committee (JNCC) and the British Trust for Ornithology (BTO) (JNCC, 2024) (Table 2.1). These values matched with those set out within the most recent version of the Seabird PVA Tool (Searle *et al.*, 2019).
- 2.5.1.2 Survival rates vary depending on age class, with 0 to 1 used to represent birds below the age of one, age class 1 to 2 used to represent birds aged one, age class 2 to 3 representing two years of age and so on. Adults are grouped together as survival rates are consistent between adult aged birds regardless of actual age (e.g. seven year olds have the same survival rate as eight year olds and so on) (Table 2.2:).

Table 2.2: Species demographic rates used in Population Viability Analysis

Species	Age first breeding (years)	No. of eggs/pair/annum	Metric	Survival rates (per age class)							Productivity	Source
				0-1	1-2	2-3	3-4	4-5	5-6	Adult		
Kittiwake	4	2	Mean	0.790	0.854	0.854	0.854	-	-	0.854	0.619	Survival: Horswill and Robinson (2015) Productivity: JNCC (2024)
			Standard deviation (SD)	0.001	0.077	0.077	0.077	-	-	0.077	0.127	
Great black-backed gull	5	3	Mean	0.798	0.834	0.834	0.834	0.834	-	0.834	1.061	Survival: Horswill and Robinson (2015) Productivity: JNCC (2024)
			SD	0.092	0.079	0.079	0.079	0.079	-	0.079	0.131	
Common guillemot	6	1	Mean	0.560	0.792	0.917	0.939	0.939	0.939	0.939	0.583	Survival: Horswill and Robinson (2015), standard deviations from nepva tool Productivity: JNCC (2024)
			SD	0.058	0.152	0.098	0.015	0.015	0.015	0.025	0.079	
Razorbill	5	1	Mean	0.630	0.630	0.895	0.895	0.895	-	0.895	0.532	Survival: Horswill and Robinson (2015) Productivity: JNCC (2024)
			SD	0.209	0.209	0.067	0.067	0.067	-	0.067	0.084	

Species	Age first breeding (years)	No. of eggs/pair/annum	Metric	Survival rates (per age class)							Productivity	Source
				0-1	1-2	2-3	3-4	4-5	5-6	Adult		
Puffin	5	1	Mean	0.709	0.709	0.709	0.760	0.805	-	0.907	0.557	Survival: Searle <i>et al.</i> (2019) derived from Horswill and Robinson (2015) Productivity: JNCC (2024)
			SD	0.108	0.108	0.108	0.093	0.083	-	0.083	0.115	
Gannet	5	1	Mean	0.424	0.829	0.891	0.895	0.919	-	0.919	0.766	Survival: Searle <i>et al.</i> (2019) derived from Horswill and Robinson (2015) Productivity: JNCC (2024)
			SD	0.045	0.026	0.019	0.019	0.042	-	0.042	0.054	

2.5.2 Populations

Morven South alone

- 2.5.2.1 During the breeding season, the population derived from Morven South alone assessment was utilised within the PVA modelling. Populations were derived using each species' foraging range as detailed within Volume 2, Chapter 11: Offshore Ornithology and Volume 3, Annex 11.1: Offshore Ornithology Baseline Characterisation Report. Breeding populations used within the PVAs are shown in Table 2.3.
- 2.5.2.2 During non-breeding seasons, impacts are put into the context of the Biologically Defined Minimum Population Scale (BDMPS) for each species (Table 2.3) based on the populations presented in Furness (2015). For common guillemot, and following consultation with NatureScot, the non-breeding season population is defined as the breeding population within a region delineated using tracking data from Buckingham *et al.* (2022). Baseline mortality was estimated using the respective demographic rates for each species, as detailed in Table 2.2.
- 2.5.2.3 For the annual assessment, the population is defined as the largest of the individual seasonal regional populations, as further detailed within Volume 2, Chapter 11: Offshore Ornithology.

Table 2.3: Biologically defined population scales for use in the Morven South alone assessment

Species	Season	Region	BDMPS (no. of birds)
Common guillemot	Non-breeding	Foraging range generated from Buckingham <i>et al.</i> (2022)	474,821
	Post-breeding		
	Annual		

Morven Programme and cumulative assessment

- 2.5.2.4 The populations used in the Morven Programme and cumulative assessments take into account the additional populations that may be affected by projects considered cumulatively. A full description of the methodology used to derive populations for use in associated PVA models is provided in Volume 2, Chapter 11: Offshore Ornithology. The populations used for PVA modelling for relevant species are provided in Table 2.4.

Table 2.4: Biologically defined population scales for use in the Morven Programme and cumulative assessments

Species	Season	Region	BDMPS (no. of birds)
Morven Programme assessment			
Common guillemot	Breeding	Foraging range + 1 SD	178,118
	Non-breeding	Foraging range generated from Buckingham <i>et al.</i> (2022)	474,821
	Post-breeding		
	Annual		
Razorbill	Post-breeding	Foraging range + 1 SD	591,874

Species	Season	Region	BDMPS (no. of birds)
	Annual		
Cumulative assessment			
Kittiwake	Breeding	Foraging range + 1 SD (156.1+144.5km; Woodward <i>et al.</i> , 2019)	576,167
	Post-breeding	UK North Sea BDMPS population (Furness, 2015)	829,937
	Pre-breeding		627,816
	Annual		829,937
Great black-backed gull	Non-breeding	UK North Sea BDMPS population (Furness, 2015)	91,399
	Annual		
Common guillemot	Breeding	Foraging range + 1 SD (55.5+39.7km; Woodward <i>et al.</i> , 2019)	178,118
	Non-breeding	Foraging range generated from Buckingham <i>et al.</i> (2022)	474,821
	Post-breeding		
	Annual		
Razorbill	Breeding	Foraging range + 1 SD (73.8+48.4km; Woodward <i>et al.</i> , 2019)	88,821
	Post-breeding	UK North Sea and Channel BDMPS population (Furness, 2015)	591,874
	Non-breeding		218,622
	Pre-breeding		591,874
	Annual		591,874
Puffin	Breeding	Foraging range + 1 SD (137.1+128.3km; Woodward <i>et al.</i> , 2019)	449,089
	Non-breeding	UK North Sea and Channel BDMPS population (Furness, 2015)	231,957
	Annual	Foraging range + 1 SD (137.1+128.3km; Woodward <i>et al.</i> , 2019)	449,089
Gannet	Breeding	Foraging range + 1 SD (315.2+194.2km; Woodward <i>et al.</i> , 2019)	559,963
	Post-breeding	UK North Sea and Channel BDMPS population (Furness, 2015)	456,298
	Pre-breeding		248,385
	Annual	Foraging range + 1 SD (315.2+194.2km; Woodward <i>et al.</i> , 2019)	559,963

2.5.3 Impact scenarios

2.5.3.1 The impact from Morven South alone, the Morven Programme assessment and cumulatively with other projects has been parameterised as a 'relative harvest' (i.e. additional mortality as a result of the impact).

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- 2.5.3.2 Note that for the purposes of the PVA model, specifying a relative harvest means that the absolute number of birds that could suffer mortality as a result of Morven South is proportional to the population size. This is in line with the assessment approach for both collision risk and displacement analysis as described in Volume 3, Annex 11.2: Offshore Ornithology Collision Risk Modelling Report and Volume 3, Annex 11.4: Offshore Ornithology Displacement Modelling Report (Matrix Approach).
- 2.5.3.3 Each simulation run within the PVA model was paired with an impact scenario that included additional population-level mortality due to wind turbine collision or displacement effects. This additional mortality was calculated as a proportion of the starting population and applied to the adult age class only. This way, the number of additional mortalities scaled proportionately with changes to the simulated number of breeding adults in the population.
- 2.5.3.4 For all species, a range of impact levels has been modelled based on the impact values estimated in Volume 2, Chapter 11: Offshore Ornithology. As explained in Section 2.2, only the impact scenarios that surpassed the 0.02 percentage point threshold have been taken forward to PVA modelling.
- 2.5.3.5 The impacts for all species used in population modelling are presented in Table 2.5 The impact values used in the PVA assessment for all species are based on the assessments presented in Volume 2, Chapter 11: Offshore Ornithology.

Table 2.5: Impacts modelled for all species from impacts predicted in Volume 2, Chapter 11: Offshore Ornithology

Key to scenario names: "PA" = Project alone, "MPA" = Morven Programme assessment, "GU" = Guillemot

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
Morven South alone						
Common guillemot	Displacement	PA_GU_3	Post-breeding	NatureScot: 60% displacement, 3% mortality	161.65	0.0003404384
		PA_GU_6	Annual	NatureScot: 60% displacement, 5% mortality (breeding), 3% mortality (non-breeding)	231.67	0.0004879075
Morven Programme assessment						
Common guillemot	Displacement	MPA_GU_1	Breeding	NatureScot: 60% displacement, 3% mortality	89.3	0.0005013230
		MPA_GU_2		NatureScot: 60% displacement, 5% mortality	148.8	0.0008355383
		MPA_GU_3	Post-breeding	NatureScot: 60% displacement, 1% mortality	192.4	0.0004051242
		MPA_GU_4		NatureScot: 60% displacement, 3% mortality	577.1	0.0012153727
		MPA_GU_5		Applicant: 50% displacement, 1% mortality	160.3	0.0003376035
		MPA_GU_6	Non-breeding	NatureScot: 60% displacement, 5% mortality	161.0	0.0003391036
		MPA_GU_7	Annual	NatureScot: 60% displacement, 3% mortality (breeding), 1% mortality (non-breeding)	335.3	0.0007062184
		MPA_GU_8		NatureScot: 60% displacement, 5% mortality (breeding), 3% mortality (non-breeding)	886.9	0.0018679090

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		MPA_GU_9		Applicant: 50% displacement, 1% mortality	229.8	0.0004840378
Razorbill	Displacement	MPA_RA_1	Post-breeding	NatureScot: 60% displacement, 3% mortality	170.4	0.0002879639
		MPA_RA_2	Annual	NatureScot: 60% displacement, 5% mortality (breeding), 3% mortality (non-breeding)	202.0197.5	0.0003412595
Cumulative assessment						
Kittiwake	Collision	CEA_KI_1	Breeding	NatureScot	1400.95	0.0023697110
		CEA_KI_2		Applicant	470.64	0.0007948953
		CEA_KI_3	Post-breeding	NatureScot	928.21	0.0011184122
		CEA_KI_4		Applicant	336.51	0.0004054636
		CEA_KI_5	Pre-breeding	NatureScot	1038.96	0.0016548835
		CEA_KI_6		Applicant	373.82	0.0005954303
		CEA_KI_7	Annual	NatureScot	3368.12	0.0040793586
		CEA_KI_8		Applicant	1180.96	0.0014291807
	Displacement	CEA_KI_9	Breeding	NatureScot/Applicant: 30% displacement, 1% mortality	285.21	0.0004487896
		CEA_KI_10		NatureScot: 30% displacement, 3% mortality	855.63	0.0013463689
		CEA_KI_11	Post-breeding	NatureScot/Applicant: 30% displacement, 1% mortality	222.88	0.0002685240
		CEA_KI_12		NatureScot: 30% displacement, 3% mortality	668.63	0.0008055720

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)	
		CEA_KI_13	Pre-breeding	NatureScot/Applicant: 30% displacement, 1% mortality	198.89	0.0003168029	
		CEA_KI_14		NatureScot: 30% displacement, 3% mortality	596.68	0.0009504087	
		CEA_KI_15	Annual	NatureScot/Applicant: 30% displacement, 1% mortality	709.98	0.0008318507	
		CEA_KI_16		NatureScot: 30% displacement, 3% mortality	2120.94	0.0024955522	
		Collision and displacement	CEA_KI_17	Breeding	NatureScot: 30% displacement, 1% mortality	1686.16	0.0028185007
			CEA_KI_18		NatureScot: 30% displacement, 3% mortality	2256.58	0.0037160799
			CEA_KI_19		Applicant	755.85	0.0012436849
			CEA_KI_20	Post-breeding	NatureScot: 30% displacement, 1% mortality	1151.09	0.0013869362
	CEA_KI_21		NatureScot: 30% displacement, 3% mortality		1596.84	0.0019239842	
	CEA_KI_22		Applicant		559.38	0.0006739876	
		CEA_KI_23	Pre-breeding	NatureScot: 30% displacement, 1% mortality	1237.86	0.0019716864	
		CEA_KI_24		NatureScot: 30% displacement, 3% mortality	1635.64	0.0026052922	
		CEA_KI_25		Applicant	572.71	0.0009122332	
		CEA_KI_26	Annual	NatureScot: 30% displacement, 1% mortality	4075.10	0.0049112093	

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		CEA_KI_27		NatureScot: 30% displacement, 3% mortality	5489.06	0.0065749107
		CEA_KI_28		Applicant	1887.95	0.0022610314
Great black-backed gull	Collision	CEA_GB_1	Non-breeding	NatureScot	868.9	0.0095069462
		CEA_GB_2		Applicant	123.1	0.0013465724
	CEA_GB_3	Annual	NatureScot	868.9	0.0095069462	
	CEA_GB_4		Applicant	123.1	0.0013465724	
Common guillemot	Displacement	CEA_GU_1	Breeding	NatureScot: 60% displacement, 3% mortality	2549.7	0.0143146678
		CEA_GU_2		NatureScot:60% displacement, 5% mortality	4249.5	0.0238577797
		CEA_GU_3		Applicant: 50% displacement, 1% mortality	708.3	0.0039765773
		CEA_GU_4	Post-breeding	NatureScot:60% displacement, 1% mortality	192.4	0.0004052028
		CEA_GU_5		NatureScot:60% displacement, 3% mortality	577.1	0.0012153977
		CEA_GU_6		Applicant: 50% displacement, 1% mortality	160.3	0.0003375988
		CEA_GU_7	Non-breeding	NatureScot:60% displacement, 1% mortality	835.3	0.0017591781
		CEA_GU_8		NatureScot:60% displacement, 3% mortality	2505.9	0.0052775344
		CEA_GU_9		Applicant: 50% displacement, 1% mortality	696.1	0.0014660169

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		CEA_GU_10	Annual	NatureScot:60% displacement, 3% mortality (breeding), 1% mortality (non-breeding)	3577.4	0.0075341600
		CEA_GU_11		NatureScot:60% displacement, 5% mortality (breeding), 3% mortality (non-breeding)	7332.5	0.0154425640
		CEA_GU_12		Applicant: 50% displacement, 1% mortality	1564.6	0.0032951157
Razorbill	Displacement	CEA_RA_1	Breeding	NatureScot:60% displacement, 3% mortality	443.0	0.0049880022
		CEA_RA_2		NatureScot:60% displacement, 5% mortality	738.4	0.0083133370
		CEA_RA_3		Applicant: 50% displacement, 1% mortality	123.1	0.0013855562
		CEA_RA_4	Post-breeding	NatureScot:60% displacement, 1% mortality	487.6	0.0008237439
		CEA_RA_5		NatureScot:60% displacement, 3% mortality	1462.7	0.0024712317
		CEA_RA_6		Applicant: 50% displacement, 1% mortality	406.3	0.0006864532
		CEA_RA_7	Non-breeding	NatureScot:60% displacement, 1% mortality	281.2	0.0012861440
		CEA_RA_8		NatureScot:60% displacement, 3% mortality	843.5	0.0038584319
		CEA_RA_9		Applicant: 50% displacement, 1% mortality	234.3	0.0010717866

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		CEA_RA_10	Pre-breeding	NatureScot:60% displacement, 1% mortality	406.9	0.0006874564
		CEA_RA_11		NatureScot:60% displacement, 3% mortality	1220.7	0.0020623693
		CEA_RA_12		Applicant: 50% displacement, 1% mortality	339.1	0.0005728804
		CEA_RA_13	Annual	NatureScot:60% displacement, 3% mortality (breeding), 1% mortality (non-breeding)	1618.7	0.0027348032
		CEA_RA_14		NatureScot:60% displacement, 5% mortality (breeding), 3% mortality (non-breeding)	4265.3	0.0072063608
		CEA_RA_15		Applicant: 50% displacement, 1% mortality	1102.7	0.0018631490
Puffin	Displacement	CEA_PU_1	Breeding	NatureScot:60% displacement, 3% mortality	715.6	0.0026556144
		CEA_PU_2		NatureScot:60% displacement, 5% mortality	1192.6	0.0004426024
		CEA_PU_3		Applicant: 50% displacement, 1% mortality	198.8	0.0011431728
		CEA_PU_4	Non-breeding	NatureScot:60% displacement, 1% mortality	265.2	0.0034295185
		CEA_PU_5		NatureScot:60% displacement, 3% mortality	795.5	0.0009526440
		CEA_PU_6		Applicant: 50% displacement, 1% mortality	221.0	0.0021838239

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		CEA_PU_7	Annual	NatureScot:60% displacement, 1% mortality	980.7	0.0044269801
		CEA_PU_8		NatureScot:60% displacement, 3% mortality	1988.1	0.0009346484
		CEA_PU_9		Applicant: 50% displacement, 1% mortality	419.7	0.0015933687
Gannet	Collision	CEA_GX_1	Breeding	NatureScot	872.8	0.0015587100
		CEA_GX_2		Applicant	856.6	0.0015296819
		CEA_GX_3	Post-breeding	NatureScot	124.7	0.0002731922
		CEA_GX_4		Applicant	124.6	0.0002730657
		CEA_GX_5	Annual	NatureScot	1039.7	0.0018567559
		CEA_GX_6		Applicant	1023.4	0.0018275714
	Displacement	CEA_GX_7	Breeding	NatureScot/Applicant: 70% displacement, 1% mortality	210.4	0.0003756766
		CEA_GX_8		NatureScot: 70% displacement, 3% mortality	631.1	0.0011270299
		CEA_GX_9	Post-breeding	NatureScot/Applicant: 70% displacement, 1% mortality	186.5	0.0004087272
		CEA_GX_10		NatureScot: 70% displacement, 3% mortality	559.5	0.0012261815
		CEA_GX_11	Pre-breeding	NatureScot/Applicant: 70% displacement, 1% mortality	50.1	0.0002015406
		CEA_GX_12		NatureScot: 70% displacement, 3% mortality	150.2	0.0006046219
		CEA_GX_13	Annual	NatureScot/Applicant: 70% displacement, 1% mortality	446.9	0.0007981350

Species	Impact	Scenario as used in this Technical Report	Season	Impact scenario	Predicted mortality (original impact) (no. of birds)	Predicted impact on adult survival rate (no. of absolute mortalities)
		CEA_GX_14		NatureScot: 70% displacement, 3% mortality	1340.8	0.0023944050
	Collision plus displacement	CEA_GX_15	Breeding	NatureScot: 70% displacement, 1% mortality	1083.2	0.0019343866
		CEA_GX_16		NatureScot: 70% displacement, 3% mortality	1503.9	0.0026857399
		CEA_GX_17		Applicant	1066.9	0.0019053586
		CEA_GX_18	Post-breeding	NatureScot: 70% displacement, 1% mortality	311.2	0.0006819193
		CEA_GX_19		NatureScot: 70% displacement, 3% mortality	684.2	0.0014993737
		CEA_GX_20		Applicant	311.1	0.0006817928
		CEA_GX_21	Pre-breeding	NatureScot: 70% displacement, 1% mortality	92.3	0.0003715899
		CEA_GX_22		NatureScot: 70% displacement, 3% mortality	192.4	0.0007746711
		CEA_GX_23		Applicant	92.3	0.0003714695
		CEA_GX_24	Annual	NatureScot: 70% displacement, 1% mortality	1486.6	0.0026548910
		CEA_GX_25		NatureScot: 70% displacement, 3% mortality	2380.5	0.0042511610
		CEA_GX_26		Applicant	1470.3	0.0026257064

3 Results

3.1 Overview

3.1.1.1 The results of the PVA runs for impacts from Morven South alone, the Morven Programme assessment and Morven South cumulatively with other offshore wind farms on each species outlined in Section 2.2 are presented in Sections 3.2 to 3.7. PVA outputs are presented at the start of the operation and maintenance phase (2038), for the expected lifespan of Morven South (35 impacted years) (2072) and 50 impacted years (2087). The baseline 'unimpacted' scenarios (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

3.2 Kittiwake

3.2.1 Cumulative assessment

3.2.1.1 The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of kittiwake are presented in Table 3.1.

Table 3.1: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of kittiwake

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	607,031	-	1.0088	0.8601	1.1269	-	-	-	-
	Post-breeding		-	887,522	-	1.0075	0.8641	1.1234	-	-	-	-
	Pre-breeding		-	671,315	-	1.0077	0.8640	1.1234	-	-	-	-
	Annual		-	887,522	-	1.0075	0.8641	1.1234	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	654,774	9.28	1.0025	0.9812	1.0235	-	-	-	-
		CEA_KI_1	1401.0	591,728	-1.32	0.9996	0.9784	1.0206	0.9971	0.9042	40.42	59.04
		CEA_KI_2	470.6	632,657	5.65	1.0016	0.9802	1.0225	0.9990	0.9667	46.74	53.24
		CEA_KI_9	285.2	642,470	7.08	1.0020	0.9807	1.0229	0.9994	0.9797	47.86	52.1
		CEA_KI_10	855.6	615,292	2.78	1.0008	0.9794	1.0216	0.9982	0.9401	43.96	55.54
		CEA_KI_17	1686.2	580,595	-3.19	0.9991	0.9777	1.0200	0.9965	0.8857	38.68	61
		CEA_KI_18	2256.6	556,894	-7.12	0.9979	0.9766	1.0187	0.9954	0.8499	35.46	64.24
	CEA_KI_19	755.9	620,499	3.47	1.0010	0.9797	1.0219	0.9985	0.9469	44.9	55.08	
	Post-breeding	Baseline (unimpacted)	-	965,263	10.66	1.0029	0.9814	1.0230	-	-	-	-
		CEA_KI_3	928.2	922,275	5.61	1.0016	0.9802	1.0217	0.9987	0.9546	46.22	54.02
		CEA_KI_4	336.5	950,074	8.71	1.0024	0.9811	1.0225	0.9995	0.9833	48.66	51.44
		CEA_KI_11	222.9	955,746	9.44	1.0026	0.9812	1.0228	0.9997	0.9888	49.16	50.86
		CEA_KI_12	668.6	933,213	7.02	1.0019	0.9807	1.0220	0.9990	0.9672	47.04	52.9
		CEA_KI_20	1151.1	910,334	4.55	1.0013	0.9799	1.0214	0.9984	0.9441	45.04	54.86
CEA_KI_21		1596.8	890,804	1.95	1.0006	0.9792	1.0207	0.9977	0.9231	43.44	56.46	

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
	Pre-breeding	CEA_KI_22	559.4	937,833	7.61	1.0021	0.9807	1.0223	0.9992	0.9723	47.52	52.56
		Baseline (unimpacted)	-	729,117	10.53	1.0029	0.9815	1.0231	-	-	-	-
		CEA_KI_5	1039.0	681,760	3.35	1.0009	0.9797	1.0211	0.9980	0.9335	44.22	55.54
		CEA_KI_6	373.8	712,186	8.08	1.0022	0.9807	1.0223	0.9993	0.9756	47.68	52.1
		CEA_KI_13	198.9	721,979	9.23	1.0025	0.9812	1.0227	0.9996	0.9867	49.1	50.86
		CEA_KI_14	596.7	702,092	6.30	1.0017	0.9804	1.0219	0.9989	0.9614	46.66	53.18
		CEA_KI_23	1237.9	671,965	1.90	1.0005	0.9791	1.0207	0.9977	0.9214	43.22	56.5
		CEA_KI_24	1635.6	654,813	-0.75	0.9998	0.9786	1.0199	0.9969	0.8975	41.28	58.74
	CEA_KI_25	572.7	702,591	6.46	1.0018	0.9805	1.0220	0.9989	0.9627	46.68	53.14	
	Annual	Baseline (unimpacted)	-	965,263	10.66	1.0029	0.9814	1.0230	-	-	-	-
		CEA_KI_7	3368.1	815,209	-6.44	0.9981	0.9768	1.0182	0.9952	0.8448	36.16	63.78
		CEA_KI_8	1181.0	910,026	4.36	1.0012	0.9799	1.0213	0.9983	0.9428	45.02	55.08
		CEA_KI_15	710.0	931,457	6.82	1.0019	0.9806	1.0220	0.9990	0.9653	46.86	52.92
		CEA_KI_16	2120.94	867,571	-0.59	0.9998	0.9785	1.0200	0.9970	0.8993	41.48	58.74
		CEA_KI_26	4075.1	786,374	-9.81	0.9971	0.9758	1.0172	0.9942	0.8155	33.52	66.52
CEA_KI_27		5489.1	732,990	-15.93	0.9951	0.9737	1.0151	0.9922	0.7593	28.28	72.62	
CEA_KI_28	1888.0	878,323	0.61	1.0002	0.9789	1.0203	0.9973	0.9098	42.42	57.70		
50 (2087)	Breeding	Baseline (unimpacted)	-	681,067	14.16	1.0027	0.9849	1.0194	-	-	-	-
		CEA_KI_1	1401.0	589,304	-1.31	0.9997	0.9820	1.0165	0.9971	0.8658	38.46	61.54
		CEA_KI_2	470.6	648,966	8.75	1.0017	0.9839	1.0184	0.9990	0.9528	46.02	53.82
		CEA_KI_9	285.2	661,998	10.82	1.0021	0.9842	1.0188	0.9994	0.9710	47.54	52.48

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U	
		CEA_KI_10	855.6	623,954	4.60	1.0009	0.9832	1.0176	0.9982	0.9156	42.94	57.4	
		CEA_KI_17	1686.2	573,470	-3.99	0.9992	0.9814	1.0159	0.9965	0.8406	36.06	63.62	
		CEA_KI_18	2256.6	540,268	-9.61	0.9980	0.9802	1.0147	0.9954	0.7925	31.72	67.5	
		CEA_KI_19	755.9	630,730	5.67	1.0011	0.9832	1.0178	0.9985	0.9253	43.66	56.5	
	Post-breeding	Baseline (unimpacted)	-	1,001,529	14.73	1.0028	0.9857	1.0198	-	-	-	-	-
		CEA_KI_3	928.2	935,966	7.33	1.0014	0.9844	1.0184	0.9987	0.9358	44.84	55.8	
		CEA_KI_4	336.5	976,075	11.98	1.0023	0.9852	1.0193	0.9995	0.9762	48.32	52.08	
		CEA_KI_11	222.9	984,932	12.73	1.0024	0.9854	1.0194	0.9997	0.9841	48.9	51.52	
		CEA_KI_12	668.6	953,169	9.18	1.0018	0.9847	1.0188	0.9990	0.9535	46.26	54.12	
		CEA_KI_20	1151.1	921,663	5.66	1.0011	0.9840	1.0181	0.9984	0.9210	43.88	57.02	
		CEA_KI_21	1596.8	892,409	2.26	1.0004	0.9834	1.0175	0.9977	0.8921	41.5	59.2	
		CEA_KI_22	559.4	961,265	10.22	1.0019	0.9849	1.0189	0.9992	0.9607	47.08	53.54	
	Pre-breeding	Baseline (unimpacted)	-	756,640	14.69	1.0027	0.9857	1.0198	-	-	-	-	-
		CEA_KI_5	1039.0	685,036	3.78	1.0007	0.9837	1.0178	0.9980	0.9064	42.46	57.94	
		CEA_KI_6	373.8	730,535	10.58	1.0020	0.9850	1.0191	0.9993	0.9652	47.62	52.88	
		CEA_KI_13	198.9	741,426	12.51	1.0024	0.9853	1.0194	0.9996	0.9812	48.48	51.62	
		CEA_KI_14	596.7	714,333	8.34	1.0016	0.9846	1.0186	0.9989	0.9452	45.5	54.64	
		CEA_KI_23	1237.9	672,439	1.99	1.0004	0.9834	1.0174	0.9977	0.8897	41.2	59.32	
		CEA_KI_24	1635.6	647,585	-1.66	0.9997	0.9825	1.0166	0.9969	0.8569	38.76	61.94	
		CEA_KI_25	572.7	716,204	8.66	1.0017	0.9846	1.0186	0.9989	0.9473	45.86	54.54	
	Annual	Baseline (unimpacted)	-	1,001,529	14.73	1.0028	0.9857	1.0198	-	-	-	-	-

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		CEA_KI_7	3368.1	785,645	-9.89	0.9979	0.9809	1.0150	0.9952	0.7860	32.8	67.88
		CEA_KI_8	1181.0	920,915	5.34	1.0010	0.9840	1.0181	0.9983	0.9192	43.82	57.18
		CEA_KI_15	710.0	950,353	8.95	1.0017	0.9846	1.0187	0.9990	0.9507	46.06	54.22
		CEA_KI_16	2120.94	859,793	-1.46	0.9997	0.9827	1.0168	0.9970	0.8594	39.18	61.92
		CEA_KI_26	4075.1	747,987	-14.48	0.9969	0.9798	1.0140	0.9942	0.7472	29.88	71.26
		CEA_KI_27	5489.1	673,937	-22.57	0.9949	0.9778	1.0118	0.9922	0.6749	23.36	77.42
		CEA_KI_28	1888.0	873,857	0.17	1.0000	0.9830	1.0171	0.9973	0.8737	40.12	60.64

3.3 Great black-backed gull

3.3.1 Cumulative assessment

- 3.3.1.1 The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of great black-backed gull are presented in Table 3.2.

Table 3.2: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of great black-backed gull

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Non-breeding	Baseline (unimpacted)	-	146,242	-	1.0237	0.9019	1.1286	-	-	-	-
	Annual		-	146,242	-	1.0237	0.9019	1.1286	-	-	-	-
35 (2072)	Non-breeding	Baseline (unimpacted)	-	290,103	105.39	1.0208	1.0024	1.0383	-	-	-	-
		CEA_GB_1	868.9	193,680	37.00	1.0090	0.9907	1.0267	0.9885	0.6675	15.50	84.22
		CEA_GB_2	123.1	274,084	94.10	1.0191	1.0007	1.0368	0.9984	0.9447	44.18	55.38
	Annual	Baseline (unimpacted)	-	290,103	105.39	1.0208	1.0019	1.0383	-	-	-	-
		CEA_GB_3	868.9	193,680	37.00	1.0090	0.9907	1.0267	0.9885	0.6675	15.50	84.22
		CEA_GB_4	123.1	274,084	94.10	1.0191	1.0007	1.0368	0.9984	0.9447	44.18	55.38
50 (2087)	Non-breeding	Baseline (unimpacted)	-	395,866	176.71	1.0206	1.0052	1.0359	-	-	-	-
		CEA_GB_1	868.9	222,007	55.10	1.0088	0.9936	1.0242	0.9885	0.5614	9.86	89.90
		CEA_GB_2	123.1	365,457	154.76	1.0189	1.0035	1.0342	0.9984	0.9216	43.32	57.56
	Annual	Baseline (unimpacted)	-	395,866		1.021	1.005	1.036	-	-	-	-
		CEA_GB_3	868.9	222,007	55.10	1.0088	0.9936	1.0242	0.9885	0.5614	9.86	89.90
		CEA_GB_4	123.1	365,457	154.76	1.0189	1.0035	1.0342	0.9984	0.9216	43.32	57.56

3.4 Common guillemot

- 3.4.1.1 The PVA outputs for impacts from Morven South alone on the regional populations of common guillemot are presented in Table 3.3. The PVA outputs for impacts from the Morven Programme assessment on the regional populations of common guillemot are presented in Table 3.4. The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of common guillemot are presented in Table 3.5.

3.4.2 Project alone assessment

Table 3.3: Population Viability Analysis results for Morven South alone in relation to impacts on regional populations of common guillemot

Key to scenario names: "PA" = Project alone, "GU" = Guillemot

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Post-breeding	Baseline (unimpacted)	-	728,253	-	1.0267	0.9551	1.0907				
	Annual		-	728,253	-	1.0267	0.9551	1.0907	-	-	-	-
35 (2072)	Post-breeding	Baseline (unimpacted)	-	1,707,774	140.62	1.0254	1.0163	1.0342	-	-	-	-
		PA_GU_3	161.65	1,685,094	137.43	1.0250	1.0159	1.0338	0.9996	0.9867	46.94	53.30
	Annual	Baseline (unimpacted)	-	1,707,774	140.62	1.0254	1.0163	1.0342	-	-	-	-
		PA_GU_6	231.67	1,676,127	135.97	1.0248	1.0157	1.0336	0.9995	0.9810	45.82	54.96
50 (2087)	Post-breeding	Baseline (unimpacted)	-	2,485,465	251.23	1.0254	1.0177	1.0325	-	-	-	-
		PA_GU_3	161.65	2,436,603	244.62	1.0251	1.0174	1.0321	0.9996	0.9811	46.24	53.38
	Annual	Baseline (unimpacted)	-	2,485,465	247.76	1.0254	1.0177	1.0325	-	-	-	-
		PA_GU_6	231.67	2,416,126	241.71	1.0249	1.0172	1.0319	0.9995	0.9730	44.44	55.16

3.4.3 Morven Programme assessment

Table 3.4: Common guillemot Population Viability Analysis results for the Morven Programme in relation to impacts on regional populations of common guillemot

Key to scenario names: "MPA" = Morven Programme assessment, "GU" = Guillemot

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	384,606	-	1.0268	0.9547	1.0897	-	-	-	-
	Non-breeding		-	729,995	-	1.0269	0.9549	1.0892	-	-	-	-
	Post-breeding		-	729,748	-	1.0269	0.9548	1.0897	-	-	-	-
	Annual		-	729,995	-	1.0269	0.9549	1.0892	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	640,917	140.69	1.0254	1.0162	1.0342	-	-	-	-
		MPA_GU_1	89.3	628,183	135.81	1.0248	1.0157	1.0336	0.9994	0.9804	45.62	55.12
		MPA_GU_2	148.8	620,012	132.86	1.0244	1.0153	1.0332	0.9991	0.9677	42.88	57.62
	Post-breeding	Baseline (unimpacted)	-	1,703,305	139.93	1.0253	1.0166	1.0336	-	-	-	-
		MPA_GU_3	192.4	1,675,648	136.26	1.0249	1.0160	1.0331	0.9995	0.9842	46.48	53.68
		MPA_GU_4	577.1	1,623,583	128.86	1.0239	1.0151	1.0322	0.9986	0.9533	39.80	60.48
		MPA_GU_5	160.3	1,681,684	136.77	1.0249	1.0161	1.0333	0.9996	0.9868	47.22	53.12
	Non-breeding	Baseline (unimpacted)	-	1,704,529	139.91	1.0253	1.0166	1.0336	-	-	-	-
		MPA_GU_6	161.0	1,681,566	136.88	1.0249	1.0161	1.0332	0.9996	0.9866	47.10	53.22
	Annual	Baseline (unimpacted)	-	1,703,305	139.93	1.0253	1.0166	1.0336	-	-	-	-
		MPA_GU_7	335.3	1,655,595	133.32	1.0245	1.0157	1.0328	0.9992	0.9726	44.04	56.22
		MPA_GU_8	886.9	1,582,489	122.92	1.0232	1.0144	1.0315	0.9979	0.9292	34.56	66.08

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		MPA_GU_9	229.8	1,671,314	135.38	1.0248	1.0160	1.0331	0.9995	0.9812	45.90	54.10
50 (2087)	Breeding	Baseline (unimpacted)	-	1,305,755	249.82	1.0254	1.0179	1.0322	-	-	-	-
		MPA_GU_1	89.3	1,278,850	242.99	1.0250	1.0175	1.0318	0.9996	0.9800	46.26	53.68
		MPA_GU_2	148.8	1,263,651	238.10	1.0247	1.0172	1.0315	0.9993	0.9670	43.86	56.46
	Post-breeding	Baseline (unimpacted)	-	2,481,321	249.80	1.0254	1.0179	1.0322	-	-	-	-
		MPA_GU_3	192.4	2,422,673	241.83	1.0249	1.0174	1.0317	0.9995	0.9774	45.82	54.64
		MPA_GU_4	577.1	2,316,341	226.49	1.0239	1.0165	1.0308	0.9986	0.9341	37.06	63.20
		MPA_GU_5	160.3	2,432,781	243.11	1.0250	1.0175	1.0318	0.9996	0.9812	46.68	53.84
	Non-breeding	Baseline (unimpacted)	-	2,479,951	249.55	1.0253	1.0179	1.0322	-	-	-	-
		MPA_GU_6	161.0	2,432,119	243.14	1.0250	1.0175	1.0318	0.9996	0.9810	46.60	53.66
	Annual	Baseline (unimpacted)	-	2,481,321	249.80	1.0254	1.0179	1.0322	-	-	-	-
		MPA_GU_7	335.3	2,383,112	236.27	1.0246	1.0171	1.0314	0.9992	0.9611	42.68	58.08
		MPA_GU_8	886.9	2,233,025	214.90	1.0232	1.0157	1.0301	0.9979	0.9003	30.32	69.78
		MPA_GU_9	229.8	2,413,718	240.30	1.0248	1.0173	1.0317	0.9995	0.9732	45.20	55.38

3.4.4 Cumulative assessment

Table 3.5: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of common guillemot

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	274,219	-	1.0271	0.9952	1.0906	-	-	-	-
	Post-breeding		-	731,025	-	1.0267	0.9551	1.0907	-	-	-	-
	Non-breeding		-	731,025	-	1.0267	0.9551	1.0907	-	-	-	-
	Annual		-	731,025	-	1.0267	0.9551	1.0907	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	640,354	140.54	1.0254	1.0162	1.0342	-	-	-	-
		CEA_GU_1	2549.7	363,557	36.45	1.0089	1.004	1.022	0.9839	0.5674	0.10	100.00
		CEA_GU_2	4249.5	247,800	-6.90	0.9980	0.996	1.014	0.9732	0.3870	0.00	100.00
		CEA_GU_3	708.3	547,172	105.80	1.0208	1.013	1.031	0.9955	0.8551	20.18	80.66
	Post-breeding	Baseline (unimpacted)	-	1,704,529	139.91	1.0253	1.0166	1.0336	-	-	-	-
		CEA_GU_4	192.4	1,677,167	136.14	1.0249	1.0161	1.0331	0.9995	0.9842	46.64	53.60
		CEA_GU_5	577.1	1,624,581	128.89	1.0239	1.0151	1.0322	0.9986	0.9533	40.00	60.64
		CEA_GU_6	160.3	1,680,867	136.78	1.0249	1.0162	1.0332	0.9996	0.9867	47.00	53.20
	Non-breeding	Baseline (unimpacted)	-	1,704,529	139.91	1.0253	1.0166	1.0336	-	-	-	-
		CEA_GU_7	907.3	1,580,621	122.59	1.0231	1.0143	1.0314	0.9979	0.9277	34.28	66.76
		CEA_GU_8	2,721.8	1,359,041	91.36	1.0187	1.0100	1.0270	0.9936	0.7979	10.46	90.08
		CEA_GU_9	756.1	1,599,641	125.40	1.0235	1.0147	1.0318	0.9982	0.9393	36.74	64.16
	Annual	Baseline (unimpacted)	-	1,704,529	139.91	1.0253	1.0166	1.0336	-	-	-	-

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
50 (2087)		CEA_GU_10	3724.5	1,250,536	76.03	1.0163	1.0075	1.0246	0.9912	0.7340	4.44	95.98
		CEA_GU_11	7673.6	898,236	26.46	1.0067	0.9980	1.0150	0.9819	0.5271	0.00	100.00
		CEA_GU_12	1645.5	1,486,401	109.30	1.0213	1.0126	1.0296	0.9961	0.8725	22.60	78.98
	Breeding	Baseline (unimpacted)	-	1,306,249	249.75	1.0254	1.0178	1.0322	-	-	-	-
		CEA_GU_1	2624.8	722,920	93.47	1.0133	1.0058	1.0201	0.9882	0.5533	0.34	99.96
		CEA_GU_2	4374.7	485,182	29.88	1.0052	0.9978	1.0121	0.9804	0.3713	0.00	100.00
		CEA_GU_3	729.1	1,108,194	196.86	1.0220	1.0145	1.0289	0.9967	0.8489	20.94	78.60
	Post-breeding	Baseline (unimpacted)	-	2,479,951	249.55	1.0253	1.0179	1.0322	-	-	-	-
		CEA_GU_4	192.4	2,423,707	241.77	1.0249	1.0174	1.0317	0.9995	0.9775	45.80	54.38
		CEA_GU_5	577.1	2,316,419	226.72	1.0240	1.0165	1.0308	0.9986	0.9340	37.06	63.04
		CEA_GU_6	160.3	2,432,587	243.13	1.0250	1.0175	1.0318	0.9996	0.9812	46.60	53.68
	Non-breeding	Baseline (unimpacted)	-	2,479,951	249.55	1.0253	1.0179	1.0322	-	-	-	-
CEA_GU_7		907.3	2,229,774	214.26	1.0232	1.0157	1.0300	0.9979	0.8983	30.06	70.06	
CEA_GU_8		2,721.8	1,795,670	153.31	1.0188	1.0113	1.0256	0.9936	0.7243	5.88	94.86	
CEA_GU_9		756.1	2,266,405	219.77	1.0235	1.0161	1.0304	0.9982	0.9144	33.10	67.16	
Annual	Baseline (unimpacted)	-	2,479,951	249.55	1.0253	1.0179	1.0322	-	-	-	-	
	CEA_GU_10	3724.5	1,594,222	124.92	1.0163	1.0088	1.0232	0.9912	0.6429	1.82	98.72	
	CEA_GU_11	7673.6	993,808	40.10	1.0068	0.9993	1.0136	0.9819	0.4006	0.00	100.00	
	CEA_GU_12	1645.5	2,041,483	187.80	1.0214	1.0139	1.0282	0.9961	0.8230	16.88	82.90	

3.5 Razorbill

- 3.5.1.1 The PVA outputs for impacts from the Morven Programme assessment on the regional populations of razorbill are presented in Table 3.6. The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of razorbill are presented in Table 3.7.

3.5.2 Morven Programme assessment

Table 3.6: Population Viability Analysis results for the Morven programme in relation to impacts on regional populations of razorbill

Key to scenario names: "MPA" = Morven Programme assessment, "RA" = Razorbill

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Post-breeding	Baseline (unimpacted)	-	341,066	-	0.9832	0.8305	1.1003	-	-	-	-
	Annual		-	340,779	-	0.9834	0.8301	1.1005	-	-	-	-
35 (2072)	Post-breeding	Baseline (unimpacted)	-	148,341	-56.72	0.9764	0.9549	0.9955	-	-	-	-
		MPA_RA_1	170.4	146,672	-57.28	0.9760	0.9544	0.9950	0.9997	0.9879	48.94	50.98
	Annual	Baseline (unimpacted)	-	148,324	-56.77	0.9763	0.9546	0.9954	-	-	-	-
		MPA_RA_2	202.0	146,365	-57.38	0.9759	0.9544	0.9951	0.9996	0.9861	48.90	51.22
50 (2087)	Post-breeding	Baseline (unimpacted)	-	103,476	-70.20	0.9761	0.9586	0.9929	-	-	-	-
		MPA_RA_1	170.4	101,801	-70.70	0.9757	0.9584	0.9926	0.9997	0.9830	48.64	51.72
	Annual	Baseline (unimpacted)	-	103,775	-70.15	0.9761	0.9587	0.9929	-	-	-	-
		MPA_RA_2	202.0	101,557	-70.79	0.9757	0.9583	0.9925	0.9996	0.9801	48.84	51.20

3.5.3 Cumulative assessment

Table 3.7: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of razorbill

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	59,827	-	0.9834	0.8490	1.0791	-	-	-	-
	Post-breeding		-	342,925	-	0.9826	0.8523	1.0777	-	-	-	-
	Non-breeding		-	126,594	-	0.9827	0.8516	1.0776	-	-	-	-
	Pre-breeding		-	342,925	-	0.9826	0.8523	1.0777	-	-	-	-
	Annual		-	342,925	-	0.9826	0.8523	1.0777	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	26,253	-56.85	0.9763	0.9574	0.9945				
		CEA_RA_1	443.0	21,360	-64.93	0.9705	0.9518	0.9887	0.9941	0.8133	30.56	69.70
		CEA_RA_2	738.4	18,578	-69.43	0.9667	0.9478	0.9849	0.9902	0.7083	19.70	80.70
		CEA_RA_3	123.1	24,811	-59.25	0.9747	0.9558	0.9928	0.9984	0.9441	44.52	55.72
	Post-breeding	Baseline (unimpacted)	-	152,688	-56.00	0.9768	0.9582	0.9936	-	-	-	-
		CEA_RA_4	487.6	147,602	-57.51	0.9758	0.9574	0.9927	0.9990	0.9663	46.56	53.24
		CEA_RA_5	1462.7	138,115	-60.23	0.9740	0.9555	0.9909	0.9971	0.9028	40.32	59.66
		CEA_RA_6	406.3	148,537	-57.22	0.9760	0.9575	0.9930	0.9992	0.9719	47.22	52.78
	Non-breeding	Baseline (unimpacted)	-	56,483	-56.02	0.9768	0.9583	0.9936	-	-	-	-
		CEA_RA_7	281.2	53,501	-58.34	0.9753	0.9569	0.9922	0.9985	0.9985	0.9480	44.80
		CEA_RA_8	843.5	48,040	-62.48	0.9724	0.9538	0.9894	0.9954	0.9954	0.8523	35.16

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U	
		CEA_RA_9	234.3	53,954	-57.95	0.9755	0.9571	0.9925	0.9987	0.9987	0.9565	45.62	
	Pre-breeding	Baseline (unimpacted)	-	152,688	-56.00	0.9768	0.9582	0.9936	-	-	-	-	
		CEA_RA_10	406.9	148,338	-57.27	0.9760	0.9575	0.9929	0.9992	0.9720	47.10	52.64	
		CEA_RA_11	1220.7	140,270	-59.66	0.9744	0.9559	0.9912	0.9976	0.9183	41.82	58.26	
		CEA_RA_12	339.0	149,441	-57.09	0.9761	0.9577	0.9931	0.9993	0.9765	47.80	52.22	
	Annual	Baseline (unimpacted)	-	152,688	-56.00	0.9768	0.9582	0.9936	-	-	-	-	
		CEA_RA_13	1618.7	136,396	-60.69	0.9737	0.9551	0.9905	0.9968	0.8931	39.30	60.72	
		CEA_RA_14	4265.3	113,247	-67.41	0.9685	0.9500	0.9854	0.9915	0.7415	23.62	76.30	
		CEA_RA_15	1102.7	141,362	-59.27	0.9747	0.9562	0.9916	0.9978	0.9257	42.34	57.22	
	50 (2087)	Breeding	Baseline (unimpacted)	-	18,314	-69.80	0.9763	0.9608	0.9910	-	-	-	-
			CEA_RA_1	443.0	13,668	-77.50	0.9706	0.9551	0.9854	0.9941	0.7447	26.22	73.54
CEA_RA_2			738.4	11,203	-81.57	0.9667	0.9511	0.9816	0.9902	0.6107	14.62	85.92	
CEA_RA_3			123.1	16,910	-72.17	0.9747	0.9591	0.9895	0.9984	0.9215	43.04	56.66	
Post-breeding		Baseline (unimpacted)	-	106,798	-69.34	0.9766	0.9612	0.9914	-	-	-	-	
		CEA_RA_4	487.6	101,936	-70.80	0.9757	0.9603	0.9904	0.9990	0.9527	45.54	54.00	
		CEA_RA_5	1462.7	92,417	-73.49	0.9738	0.9585	0.9886	0.9971	0.8640	37.06	62.30	
		CEA_RA_6	406.3	102,787	-70.61	0.9758	0.9605	0.9906	0.9992	0.9603	46.46	53.30	
Non-breeding		Baseline (unimpacted)	-	39,531	-69.35	0.9766	0.9613	0.9914	-	-	-	-	
		CEA_RA_7	281.2	36,599	-71.58	0.9752	0.9597	0.9899	0.9985	0.9266	43.06	56.84	
		CEA_RA_8	843.5	31,427	-75.53	0.9722	0.9568	0.9870	0.9954	0.7958	30.84	69.00	

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		CEA_RA_9	234.3	37,082	-71.17	0.9754	0.9602	0.9902	0.9987	0.9385	44.30	55.58
	Pre-breeding	Baseline (unimpacted)	-	106,798	-69.34	0.9766	0.9612	0.9914	-	-	-	-
		CEA_RA_10	406.9	102,692	-70.55	0.9758	0.9606	0.9906	0.9992	0.9602	46.36	53.46
		CEA_RA_11	1220.7	94,554	-72.87	0.9742	0.9589	0.9890	0.9976	0.8851	39.00	60.38
		CEA_RA_12	339.0	103,507	-70.35	0.9760	0.9605	0.9908	0.9993	0.9668	47.06	52.92
	Annual	Baseline (unimpacted)	-	106,798	-69.34	0.9766	0.9612	0.9914	-	-	-	-
		CEA_RA_13	1618.7	91,053	-73.91	0.9735	0.9582	0.9882	0.9968	0.8509	36.08	63.54
		CEA_RA_14	4265.3	69,720	-80.01	0.9683	0.9530	0.9831	0.9915	0.6525	18.36	81.46
		CEA_RA_15	1102.7	95,675	-72.55	0.9745	0.9592	0.9893	0.9978	0.8954	40.00	59.54

3.6 Puffin

3.6.1 Cumulative assessment

3.6.1.1 The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of puffin are presented in Table 3.8.

Table 3.8: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of puffin

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	281,112	-	0.9822	0.8108	1.0972	-	-	-	-
	Non-breeding		-	121,749	-	0.9816	0.8109	1.0947	-	-	-	-
	Annual		-	281,112	-	0.9822	0.8108	1.0972	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	105,405	-63.32	0.9718	0.9470	0.9952	-	-	-	-
		CEA_PU_1	715.6	98,744	-65.62	0.9700	0.9450	0.9934	0.9981	0.9365	45.08	55.06
		CEA_PU_2	1192.6	94,422	-66.99	0.9688	0.9438	0.9922	0.9969	0.8962	42.06	58.24
		CEA_PU_3	198.8	103,471	-63.97	0.9713	0.9464	0.9947	0.9995	0.9820	48.58	51.34
	Non-breeding	Baseline (unimpacted)	-	46,502	-62.26	0.9725	0.9473	0.9943	-	-	-	-
		CEA_PU_4	265.2	44,325	-64.00	0.9712	0.9458	0.9931	0.9986	0.9533	46.82	53.52
		CEA_PU_5	795.5	40,276	-67.32	0.9685	0.9432	0.9905	0.9959	0.8674	39.62	59.74
		CEA_PU_6	221.0	44,644	-63.78	0.9714	0.9461	0.9932	0.9989	0.9611	47.46	52.76
	Annual	Baseline (unimpacted)	-	105,405	-63.32	0.9718	0.9470	0.9952	-	-	-	-
		CEA_PU_7	980.7	96,258	-66.45	0.9693	0.9442	0.9928	0.9974	0.9138	43.4	56.92
		CEA_PU_8	1988.1	87,863	-69.40	0.9667	0.9416	0.9901	0.9948	0.8332	37.1	63.5
CEA_PU_9		419.7	101,504	-64.66	0.9707	0.9456	0.9942	0.9989	0.9621	47.08	53.2	
50 (2087)	Breeding	Baseline (unimpacted)	-	68,315	-75.99	0.9719	0.9513	0.9911	-	-	-	-
		CEA_PU_1	715.6	62,192	-78.14	0.9701	0.9494	0.9893	0.9981	0.9103	43.68	55.82
		CEA_PU_2	1192.6	58,456	-79.46	0.9688	0.9482	0.9881	0.9969	0.8549	40	59.44

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		CEA_PU_3	198.8	66,765	-76.52	0.9714	0.9508	0.9906	0.9995	0.9748	48.22	51.44
	Non-breeding	Baseline (unimpacted)	-	30,534	-75.22	0.9725	0.9515	0.9914	-	-	-	-
		CEA_PU_4	265.2	28,497	-76.85	0.9712	0.9505	0.9901	0.9986	0.9346	45.54	54.84
		CEA_PU_5	795.5	24,909	-79.70	0.9686	0.9476	0.9875	0.9960	0.8169	37.08	63.36
		CEA_PU_6	221.0	28,850	-76.60	0.9714	0.9504	0.9903	0.9989	0.9450	46.52	54.26
	Annual	Baseline (unimpacted)	-	68,315	-75.99	0.9719	0.9513	0.9911	-	-	-	-
		CEA_PU_7	980.7	60,092	-78.85	0.9694	0.9486	0.9886	0.9974	0.8792	41.56	57.98
		CEA_PU_8	1988.1	52,573	-81.48	0.9668	0.9462	0.9860	0.9948	0.7702	33.06	65.8
		CEA_PU_9	419.7	64,610	-77.23	0.9708	0.9502	0.9901	0.9989	0.9465	46.32	53.32

3.7 Gannet

3.7.1 Cumulative assessment

- 3.7.1.1 The PVA outputs for impacts from Morven South cumulatively with other plans and projects on the regional populations of gannet are presented in Table 3.9.

Table 3.9: Population Viability Analysis results for Morven South cumulatively with other plans and projects in relation to impacts on regional populations of gannet

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
1 (2038)	Breeding	Baseline (unimpacted)	-	693,155	-	1.0159	0.9322	1.0769	-	-	-	-
	Post-breeding		-	605,905	-	1.0157	0.9339	1.0751	-	-	-	-
	Pre-breeding		-	329,922	-	1.0157	0.9332	1.0753	-	-	-	-
	Annual		-	693,155	-	1.0159	0.9322	1.0769	-	-	-	-
35 (2072)	Breeding	Baseline (unimpacted)	-	1,044,862	52.66	1.0122	1.0009	1.0232	-	-	-	-
		CEA_GX_1	872.8	979,413	43.04	1.0103	0.9990	1.0213	0.9982	0.9373	39.20	61.38
		CEA_GX_2	856.6	979,665	43.31	1.0103	0.9990	1.0213	0.9982	0.9383	39.22	61.02
		CEA_GX_7	210.4	1,028,205	50.42	1.0117	1.0005	1.0228	0.9996	0.9844	47.40	52.62
		CEA_GX_8	631.1	996,555	45.59	1.0108	0.9996	1.0218	0.9987	0.9542	42.14	58.26
		CEA_GX_15	1083.2	962,378	40.85	1.0098	0.9985	1.0208	0.9977	0.9226	36.44	63.74
		CEA_GX_16	1503.9	934,216	36.52	1.0089	0.9976	1.0200	0.9968	0.8942	32.06	69.18
	CEA_GX_17	1066.9	964,410	41.08	1.0099	0.9986	1.0209	0.9977	0.9237	36.80	63.54	
	Post-breeding	Baseline (unimpacted)	-	919,044	54.42	1.0125	1.0014	1.0230	-	-	-	-
		CEA_GX_3	124.7	910,112	52.64	1.0122	1.0010	1.0227	0.9997	0.9888	48.56	51.66
		CEA_GX_4	124.6	909,171	52.58	1.0121	1.0011	1.0226	0.9997	0.9889	48.40	51.58
		CEA_GX_9	186.5	904,269	51.76	1.0120	1.0009	1.0225	0.9995	0.9832	47.54	52.88
		CEA_GX_10	559.5	874,148	46.72	1.0110	0.9999	1.0215	0.9985	0.9503	42.22	58.32
		CEA_GX_18	311.2	894,189	50.09	1.0117	1.0006	1.0222	0.9992	0.9722	45.82	54.70
CEA_GX_19		684.2	864,064	45.07	1.0107	0.9995	1.0212	0.9982	0.9396	40.04	60.04	

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U	
		CEA_GX_20	311.1	894,028	50.08	1.0117	1.0006	1.0222	0.9992	0.9721	45.78	54.62	
	Pre-breeding	Baseline (unimpacted)	-	500,331	54.40	1.0125	1.0014	1.0229	-	-	-	-	-
		CEA_GX_11	50.1	496,472	53.12	1.0122	1.0011	1.0227	0.9998	0.9915	48.90	51.44	
		CEA_GX_12	150.2	488,102	50.53	1.0118	1.0006	1.0223	0.9993	0.9752	46.30	54.06	
		CEA_GX_21	92.3	492,726	51.98	1.0120	1.0009	1.0225	0.9996	0.9844	47.74	52.50	
		CEA_GX_22	192.4	484,980	49.37	1.0115	1.0004	1.0221	0.9991	0.9683	44.98	55.40	
		CEA_GX_23	92.3	493,723	52.06	1.0120	1.0009	1.0226	0.9996	0.9847	47.98	52.54	
	Annual	Baseline (unimpacted)	-	1,044,862	52.66	1.0122	1.0009	1.0232	-	-	-	-	-
		CEA_GX_5	1039.7	966,194	41.41	1.0099	0.9986	1.0209	0.9978	0.9257	37.08	63.32	
		CEA_GX_6	1023.4	967,812	41.42	1.0100	0.9987	1.0210	0.9978	0.9268	37.24	63.06	
		CEA_GX_13	446.9	1,010,052	47.73	1.0112	0.9999	1.0222	0.9991	0.9673	44.48	55.80	
		CEA_GX_14	1340.8	945,551	38.18	1.0093	0.9980	1.0203	0.9972	0.9051	33.92	67.30	
		CEA_GX_24	1486.6	935,632	36.74	1.0090	0.9977	1.0200	0.9968	0.8953	32.30	69.04	
		CEA_GX_25	2380.5	874,487	27.92	1.0071	0.9958	1.0181	0.9949	0.8375	22.68	77.90	
CEA_GX_26		1470.3	937,054	36.80	1.0090	0.9978	1.0201	0.9969	0.8965	32.64	68.92		
50 (2087)	Breeding	Baseline (unimpacted)	-	1,252,098	83.26	1.0122	1.0029	1.0212	-	-	-	-	
		CEA_GX_1	872.8	1,141,529	66.94	1.0103	1.0011	1.0194	0.9982	0.9116	36.08	63.62	
		CEA_GX_2	856.6	1,143,555	67.28	1.0103	1.0011	1.0194	0.9982	0.9131	36.22	63.30	
		CEA_GX_7	210.4	1,224,315	79.23	1.0117	1.0025	1.0208	0.9996	0.9779	46.48	53.52	
		CEA_GX_8	631.1	1,171,953	71.35	1.0108	1.0016	1.0199	0.9987	0.9353	39.96	60.24	
		CEA_GX_15	1083.2	1,116,345	63.41	1.0099	1.0006	1.0189	0.9977	0.8912	32.82	66.64	

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		CEA_GX_16	1503.9	1,067,967	56.22	1.0090	0.9997	1.0179	0.9968	0.8523	27.26	72.34
		CEA_GX_17	1066.9	1,118,163	63.76	1.0099	1.0007	1.0189	0.9977	0.8929	33.18	66.48
	Post-breeding	Baseline (unimpacted)	-	1,103,466	85.68	1.0125	1.0032	1.0214	-	-	-	-
		CEA_GX_3	124.7	1,085,471	82.74	1.0121	1.0029	1.0210	0.9997	0.9838	47.44	52.20
		CEA_GX_4	124.6	1,086,316	82.62	1.0121	1.0029	1.0210	0.9997	0.9840	47.56	52.34
		CEA_GX_9	186.5	1,076,380	81.31	1.0120	1.0028	1.0209	0.9995	0.9761	45.94	53.56
		CEA_GX_10	559.5	1,027,880	72.59	1.0110	1.0017	1.0199	0.9985	0.9297	39.54	60.52
		CEA_GX_18	311.2	1,060,204	78.22	1.0116	1.0024	1.0205	0.9992	0.9604	43.86	55.96
		CEA_GX_19	684.2	1,009,986	69.73	1.0106	1.0014	1.0196	0.9982	0.9149	36.82	62.84
		CEA_GX_20	311.1	1,060,647	78.34	1.0116	1.0024	1.0205	0.9992	0.9604	43.90	55.92
		Pre-breeding	Baseline (unimpacted)	-	601,056	83.26	1.0125	1.0033	1.0213	-	-	-
	CEA_GX_11		50.1	593,639	64.19	1.0122	1.0030	1.0211	0.9998	0.9880	48.02	51.74
	CEA_GX_12		150.2	579,423	64.37	1.0117	1.0025	1.0206	0.9993	0.9648	44.44	55.32
	CEA_GX_21		92.3	587,979	74.73	1.0120	1.0027	1.0209	0.9996	0.9779	46.62	53.34
	CEA_GX_22		192.4	574,044	58.92	1.0115	1.0023	1.0204	0.9991	0.9550	42.94	57.00
	CEA_GX_23		92.3	587,905	56.55	1.0120	1.0028	1.0209	0.9996	0.9781	46.60	53.24
	Annual	Baseline (unimpacted)	-	1,252,098	85.75	1.0122	1.0029	1.0212	-	-	-	-
		CEA_GX_5	1039.7	1,121,332	83.36	1.0100	1.0007	1.0190	0.9978	0.8955	33.62	66.02
		CEA_GX_6	1023.4	1,124,269	79.16	1.0100	1.0008	1.0190	0.9978	0.8971	33.96	65.82
		CEA_GX_13	446.9	1,194,376	81.42	1.0112	1.0020	1.0202	0.9991	0.9536	42.78	57.22
		CEA_GX_14	1340.8	1,085,787	77.39	1.0093	1.0001	1.0183	0.9972	0.8673	29.10	70.30

Impacted year (Year)	Simulated season	Impact scenario	Impact (no. of birds)	Simulated population size	Change in population size (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS	Quantile U=50 %I	Quantile I=50 %U
		CEA_GX_24	1486.6	1,070,867	81.52	1.0090	0.9998	1.0180	0.9968	0.8540	27.54	72.18
		CEA_GX_25	2380.5	972,093	85.75	1.0071	0.9978	1.0161	0.9950	0.7763	17.48	82.62
		CEA_GX_26	1470.3	1,070,881	83.36	1.0090	0.9998	1.0181	0.9969	0.8555	27.54	71.84

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