Rampion 2 Wind Farm

Category 8:

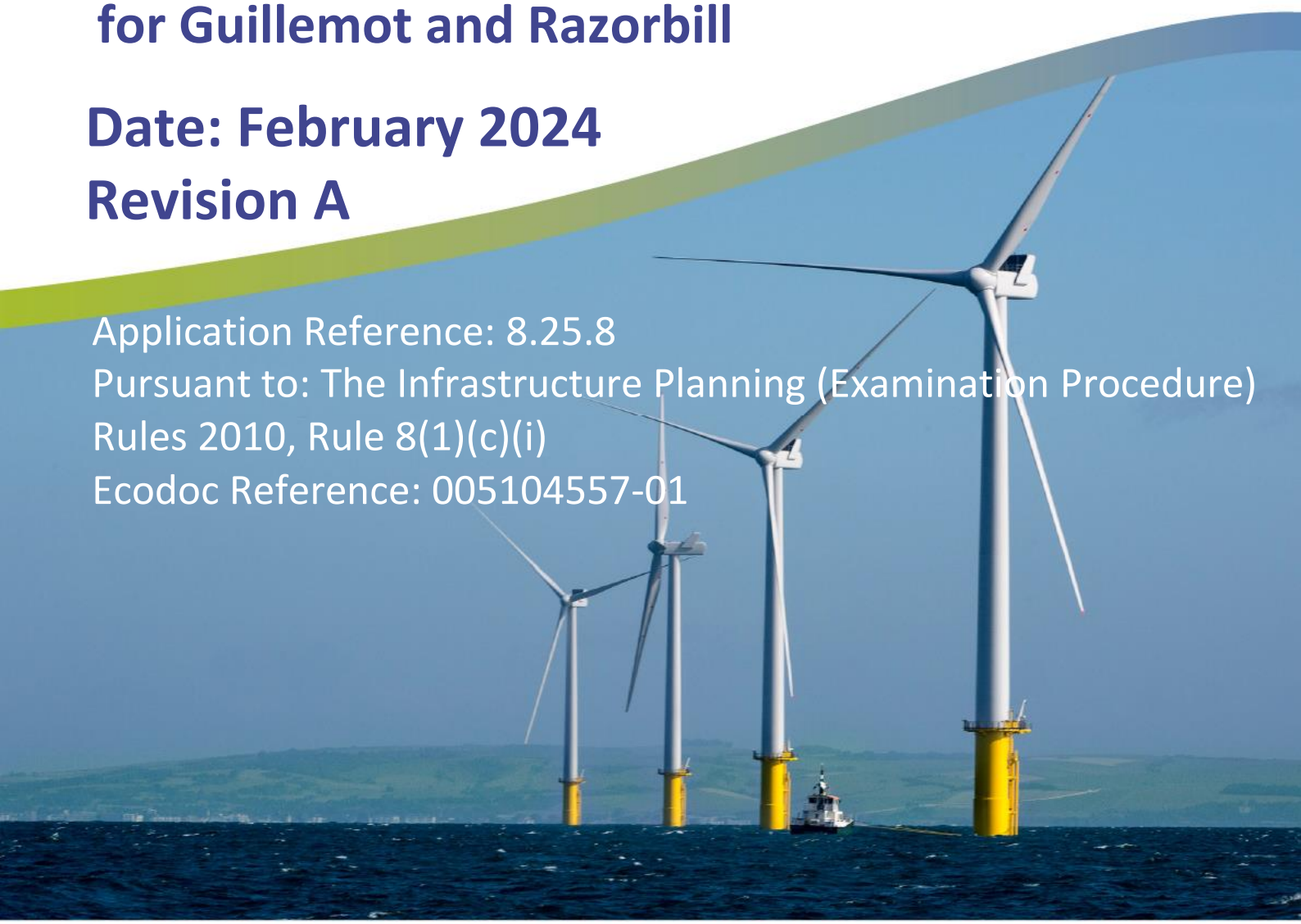
Examination Documents:

Applicant's Post Hearing Submission – Issue Specific Hearing 1

Appendix 8 – Further Information for Action Point 34 – In Combination Assessment Update for Guillemot and Razorbill

Date: February 2024

Revision A



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Contents

Tables

Figures

1. Introduction

1.1 Overview

1.1.1 Rampion Extension Development Limited (hereafter referred to as 'RED') (the 'Applicant') is developing the Rampion 2 Offshore Wind Farm Project ('Rampion 2') located adjacent to the existing Rampion Offshore Wind Farm Project ('Rampion 1') in the English Channel.

1.1.2 Rampion 2 will be located between 13km and 26km from the Sussex Coast in the English Channel and the offshore array area will occupy an area of approximately 160km^2. A detailed description of the Proposed Development is set out in **Chapter 4: The Proposed Development, Volume 2** of the Environmental Statement (ES) **[APP-045]**, submitted with the Development Consent Order (DCO) Application.

1.2 Purpose of this Document

1.2.1 As presented within Natural England's Relevant Representations [**RR-265**] the following additional assessment requests were made in relation to in-combination assessments:

- "*The Applicant should carry out a full in-combination assessment of impacts for guillemot and razorbill at FFC SPA, to allow NE to advice further regarding the risks of adverse effects in-combination*"; and
- "*The Applicant should carry out a full in-combination assessment of impacts of guillemot at the Farne Islands SPA, to allow NE to advise further regarding the risks of adverse effects in-combination*".

1.2.2 As reference, the Applicant's assessment of these qualifying features alone is presented in Table 7-10 of the **Report to Inform Appropriate Assessment [APP-038]**. For all three auk features, assessments concluded no Adverse Effect on Integrity (AEoI) with respect to the level of predicted impact from the Proposed Development alone. Due to the level of impact predicted for the Proposed Development alone apportioned to the three auk features being approximately a single breeding adult per annum, the Applicant concluded that such a level of effect would not materially contribute to any in-combination effect, hence why no in-combination assessments for these features were presented within the **Report to Inform Appropriate Assessment [APP-038]**.

1.2.3 Following review of the Natural England's Relevant Representations (**RR-265**), the Applicant has undertaken a full in-combination assessment for guillemot at both the Flamborough and Filey Coast Special Protected Area (FFC SPA) and the Farne Islands Special Protection Area (SPA) as well as an in-combination assessment for razorbill at FFC SPA, the results of which are presented within this report. This is inclusive of Population Viability Analysis (PVA) where any level of predicted impact exceeded a 1% increase in baseline mortality.

2. Methodology

2.1 Cumulative and In-combination Assessments

2.1.1 The criteria for identification of projects for inclusion within the in-combination assessments is described within the **Report to Inform Appropriate Assessment** [**APP-038**]. The Applicant has used the latest predicted impacts for projects included within the in-combination assessments presented, as informed from the latest documents submitted to the Planning Inspectorate. Developments within the same region are currently at varying stages of the planning process, with the final proposed project designs for some at the assessment and reporting stage, while others may not actually be taken forward or completed to their full maximum capacities. To incorporate this uncertainty, developments have been categorised into different tiers dependent on project status as described in **Table 2.1**.

Table 2.1 Description of Tiers of other developments

Tier	Sub-tier	Description
Tier 1	Tier 1a	Project in operation
	Tier 1b	Project under construction
	Tier 1c	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented
	Tier 1d	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined
Tier 2	N/A	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted
Tier 3	Tier 3a	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted
	Tier 3b	Identified in the relevant Development Plan (and emerging Development Plans with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited
	Tier 3c	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward

2.1.2 For both guillemot and razorbill, a regional in-combination assessment has been assessed based on projects within mean max plus one Standard Deviation (SD)

foraging distance (Woodward *et al.*, 2019) from the colony for the breeding season (**Table 2.2**). Within Woodward *et al.,* (2019), there are two foraging ranges provided for guillemot and razorbill, the first is inclusive of data from the Fair Isle colony and the other excludes these data. When considering the difference in foraging range between Northern Isle colonies and those located within the Southern North Sea, the Applicant considers the foraging range value that excludes Fair Isle data to be most appropriate for the FFC SPA, as recommended by the author (Woodward *et al.*, 2019). The use of this value has also been acknowledged by Natural England at the end of the Hornsea Four examination whereby they requested the exclusion of Hornsea Three from the guillemot and razorbill FFC SPA in-combination assessments due to the project being situated outside of the mean max plus one SD foraging range to the FFC SPA (Natural England, 2022). If the foraging range value inclusive of Fair Isle is used, Hornsea Three would still be considered to have partial connectivity during the breeding season.

Table 2.2 Mean max plus one SD foraging ranges for auk species derived from Woodward *et al.,* (2019)

Species	Value origin	Mean max plus one SD foraging range (km)
Guillemot	Including Fair Isle data	73.2±80.5
	Excluding Fair Isle data	55.5±39.7
Razorbill	Including Fair Isle data	88.7±75.9
	Excluding Fair Isle data	73.8±48.4

2.1.3 For non-breeding seasons, if values were not provided in project RIAAs the project alone values from the ES chapters were multiplied by the relevant non-breeding season apportionment values derived from the colony proportional splits presented within Appendix A of Furness (2015) as recommended within Natural England's best practice guidance (Parker *et al.,* 2022). For clarity these are provided in **Table 2.3**.

Table 2.3 Non-breeding season apportionment values for auk species derived from Furness (2015) for the North Sea and English.

Species	SPA	Apportionment values for non-breeding seasons (%)			
		Non-breeding	Post-breeding migration	Migration-free winter	Return migration
Guillemot	FFC SPA	4.41%	N/A	N/A	N/A
	Farne Islands SPA	3.73%	N/A	N/A	N/A
Razorbill	FFC SPA	N/A	3.38%	2.74%	3.38%

2.2 Displacement Rates

2.2.1 The SNCBs (2022) updated interim guidance recommends the following in relation to defining appropriate levels of displacement and mortality:

"developers are encouraged to seek and present emerging sources of empirical evidence to provide support for their displacement assessment".

2.2.2 Following this recommendation, the Applicant has referred to the APEM (2022) literature review on auk displacement and mortality rates, which is considered the most comprehensive study of seabird displacement to date. The auk displacement and mortality review critically appraised studies from a total of 21 offshore wind farms (OWFs) which included up to six years of post-consent monitoring for some OWFs. The recommended rates from this literature review concluded the most appropriate displacement rates to be up to 50% and a mortality rate of up to 1% being suitably precautionary, regardless of the bio-season. Corroboration of these rates can also be found in the Beatrice OWF Year 2 Post-construction Monitoring Report (MacArthur Green, 2023) whereby a displacement rate or 70% for both guillemot and razorbill is deemed as an over-estimate.

2.2.3 Assessments using Natural England's preferred range of 30-70% displacement and 1-10% mortality rate for auk species are also presented. Within this range, assessments for 70% displacement with either 2% or 5% mortality have also been considered. The value of 70% displacement and 2% mortality have previously been agreed upon by the Secretary of State as appropriate for other southern North Sea OWF projects including Hornsea Four and East Anglia one North (Secretary of State 2022 & 2023). In addition, Natural England have previously considered the rate of 70% displacement and 5% mortality as the upper worst case for concluding impacts for Hornsea Four (Natural England, 2022).

3. In-combination Impacts

3.1 Flamborough and Filey Coast SPA – Guillemot

3.1.1 The in-combination tables below (**Table 3.1** and **Table 3.2**) provide values from all consented and planned projects apportioned to the FFC SPA. Totals are provided for the following scenarios:

- Rampion 2 plus all consented projects
- Rampion 2, Dudgeon and Sheringham Shoal Extension Projects and all consented projects
- All projects
- Rampion 2 plus all consented projects (excluding Hornsea Four)
- Rampion 2 plus Dudgeon and Sheringham Shoal Extension Projects and all consented projects (excluding Hornsea Four)
- All projects (excluding Hornsea Four)

3.1.2 The consideration of Dudgeon and Sheringham Shoal Extension Projects is due to the similarity in timeline to the Proposed Development.

3.1.3 Following the latest conclusions from the Secretary of State in relation to the guillemot feature of the FFC SPA requiring compensation for predicted impacts from Hornsea Four, this project has been removed from the in-combination assessment of the guillemot in line with previous advice for consideration of projects whereby the commitment to compensation is required. Hence, scenarios including and excluding Hornsea Four impacts have been presented.

3.1.4 Due to the different values for mean max plus one SD foraging ranges for guillemot (Woodward *et al.*, 2019) two in-combination tables are provided as the use of the different foraging ranges will include or exclude different projects within the breeding season. The Applicant considers that as recommended by the author, the mean max plus one SD excluding Fair Isle data (95.2 km) is most appropriate for identifying theoretical breeding season connectivity (Woodward *et al*., 2019).

3.1.5 Displacement matrices for all displacement rate and mortality rate scenarios are provided for the annual totals in **Appendix A**.

Table 3.1 In-combination abundance totals for guillemot attributed to the Flamborough and Filey Coast SPA. (Using mean max plus one SD foraging range of 153.7 km)

Project	Breeding	Non-breeding	Annual	Tier
Beatrice	0	121	121	1a
Blyth Demonstration Site	0	58	58	1a
Dudgeon	0	24	24	1a
EOWDC	0	10	10	1a
Galloper	0	26	26	1a
Greater Gabbard	0	24	24	1a
Gunfleet Sands	0	16	16	1a
Humber Gateway	99	6	105	1a
Hywind 2 Demonstration	0	94	94	1a
Kentish Flats Extension	0	0	0	1a
Kentish Flats	0	0	0	1a
Lincs, Lynn & Inner Dowsing	0	36	36	1a
London Array	0	17	17	1a
Methil	0	0	0	1a
Race Bank	0	31	31	1a

Project	Breeding	Non-breeding	Annual	Tier
Rampion	0	684	684	1a
Scroby Sands	-	-	0	1a
Sheringham Shoal	0	32	32	1a
Teesside	267	40	307	1a
Thanet	0	6	6	1a
Westermost Rough	347	21	368	1a
East Anglia One	0	28	28	1a
Hornsea Project One	4,554	356	356	1a
Hornsea Project Two	3,581	579	579	1a
Moray East	0	24	24	1b
Triton Knoll	425	33	458	1b
Kincardine	0	0	0	1b
Dogger Bank A	1,893	270	270	1c
Dogger Bank B	3,318	467	467	1c
Dogger Bank C	0	100	100	1c
East Anglia Three	0	126	126	1c
Inch Cape	0	140	140	1c

Project	Breeding	Non-breeding	Annual	Tier
Moray West	0	1,680	1,680	1c
Neart na Gaoithe	0	166	166	1c
Seagreen Alpha	0	206	206	1c
Seagreen Bravo	0	181	181	1c
Sofia	0	163	163	1c
Hornsea Three	0	782	782	1c
Norfolk Boreas	0	606	606	1c
Norfolk Vanguard	0	210	210	1c
East Anglia ONE North	0	83	83	1c
East Anglia TWO	0	74	74	1c
Hornsea Four (Natural England's Bespoke Approach)	9,382	22,927	32,309	1c
Pentland	-	29	29	1c
Forth Wind	-	18	18	1c
Rampion 2	0	252	252	1d
Total (Rampion 2 plus all consented projects only)	**23,866**	**30,745**	**54,611**	

Project	Breeding	Non-breeding	Annual	Tier
Total (Rampion 2 plus all consented projects except Hornsea Four)	**14,484**	**7,818**	**22,302**	
Green Volt	0	710	710	1d
West of Orkney	-	189	189	1d
Dudgeon Extension Project (DEP)	0	655	655	1d
Sheringham Shoal Extension Project (SEP)	0	48	48	1d
Berwick Bank	-	1,948	1,948	1d
Dogger Bank South	0	0	0	2
Outer dowsing (PEIR)	12,284	982	13,266	2
Five Estuaries (PEIR)	0	163	163	2
North Falls (PEIR)	0	198	198	2
Total (All Projects)	**36,150**	**35,637**	**71,787**	
Total (All Projects except Hornsea Four)	**26,768**	**12,710**	**39,478**	
Total (Consented+ Rampion 2 + DEP&SEP)	**1,138**	**8,474**	**9,612**	
Total (Consented (Except Hornsea Four)+ Rampion 2 + DEP&SEP)	**14,484**	**8,520**	**23,004**	

Table 3.2 In-combination abundance totals for guillemot attributed to the Flamborough and Filey Coast SPA. (Using mean max plus one SD foraging range of 95.2 km)

Project	Breeding	Non-breeding	Annual	Tier
Beatrice	0	121	121	1a
Blyth Demonstration Site	0	58	58	1a
Dudgeon	0	24	24	1a
EOWDC	0	10	10	1a
Galloper	0	26	26	1a
Greater Gabbard	0	24	24	1a
Gunfleet Sands	0	16	16	1a
Humber Gateway	99	6	105	1a
Hywind 2 Demonstration	0	94	94	1a
Kentish Flats Extension	0	0	0	1a
Kentish Flats	0	0	0	1a
Lincs, Lynn & Inner Dowsing	0	36	36	1a
London Array	0	17	17	1a
Methil	0	0	0	1a
Race Bank	0	31	31	1a

Project	Breeding	Non-breeding	Annual	Tier
Rampion	0	684	684	1a
Scroby Sands	-	-	0	1a
Sheringham Shoal	0	32	32	1a
Teesside	267	40	307	1a
Thanet	0	6	6	1a
Westermost Rough	347	21	368	1a
East Anglia One	0	28	28	1a
Hornsea Project One	0	356	356	1a
Hornsea Project Two	0	579	579	1a
Moray East	0	24	24	1b
Triton Knoll	425	33	458	1b
Kincardine	0	0	0	1b
Dogger Bank A	0	270	270	1c
Dogger Bank B	0	467	467	1c
Dogger Bank C	0	100	100	1c
East Anglia Three	0	126	126	1c
Inch Cape	0	140	140	1c

Project	Breeding	Non-breeding	Annual	Tier
Moray West	0	1,680	1,680	1c
Neart na Gaoithe	0	166	166	1c
Seagreen Alpha	0	206	206	1c
Seagreen Bravo	0	181	181	1c
Sofia	0	163	163	1c
Hornsea Three	0	782	782	1c
Norfolk Boreas	0	606	606	1c
Norfolk Vanguard	0	210	210	1c
East Anglia ONE North	0	83	83	1c
East Anglia TWO	0	74	74	1c
Hornsea Four (Natural England's Bespoke Approach)	9,382	22,927	32,309	1c
Pentland	-	29	29	1c
Forth Wind	-	18	18	1c
Rampion 2	0	252	252	1d
Total (Rampion 2 plus all consented projects only)	**10,520**	**30,745**	**41,265**	

Project	Breeding	Non-breeding	Annual	Tier
Total (Rampion 2 plus all consented projects except Hornsea Four)	**1,138**	**7,818**	**8,956**	
Green Volt	0	710	710	1d
West of Orkney	-	189	189	1d
Dudgeon Extension Project (DEP)	0	655	655	1d
Sheringham Shoal Extension Project (SEP)	0	48	48	1d
Berwick Bank	-	1,948	1,948	1d
Dogger Bank South	0	0	0	2
Outer dowsing (PEIR)	12,284	982	13,266	2
Five Estuaries (PEIR)	0	163	163	2
North Falls (PEIR)	0	198	198	2
Total (All Projects)	**22,804**	**35,637**	**58,441**	
Total (All Projects except Hornsea Four)	**13,422**	**12,710**	**26,132**	
Total (Consented+ Rampion 2 + DEP&SEP)	**10,520**	**31,447**	**41,967**	
Total (Consented (Except Hornsea Four)+ Rampion 2 + DEP&SEP)	**1,138**	**8,520**	**9,568**	

Table 3.3 FFC SPA guillemot in-combination operation and maintenance phase displacement estimates using the 153.7 km mean max plus one SD foraging range (Applicant's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Breeding	Rampion 2 plus all consented projects only	23,866	83,214	5,076	119.3	2.35%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	14,484			72.4	1.43%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	23,866			119.3	2.35%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	14,484			72.4	1.43%
	All projects	36,150			180.8	3.56%
	All projects (excluding Hornsea Four)	26,768			133.8	2.64%
	Rampion 2 plus all consented projects only	23,866	141,815	8,651	119.3	1.38%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	14,484			72.4	0.84%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	23,866			119.3	1.38%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	14,484			72.4	0.84%
	All projects	36,150			180.8	2.09%
	All projects (excluding Hornsea Four)	26,768			133.8	1.55%
Non-breeding	Rampion 2 plus all consented projects only	30,745	83,214	5,076	153.7	3.03%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			39.1	0.77%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			157.2	3.10%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			42.6	0.84%
	All projects	35,637			178.2	3.51%
	All projects (excluding Hornsea Four)	12,710			63.6	1.25%
	Rampion 2 plus all consented projects only	30,745	141,815	8,651	153.7	1.78%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			39.1	0.45%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			157.2	1.82%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			42.6	0.49%
	All projects	35,637			178.2	2.06%
	All projects (excluding Hornsea Four)	12,710			63.6	0.73%
Annual	Rampion 2 plus all consented projects only	54,611	83,214	5,076	273.1	5.38%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	22,302			111.5	2.20%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	55,313			276.6	5.45%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	23,004			115.0	2.27%
	All projects	71,787			358.9	7.07%
	All projects (excluding Hornsea Four)	39,478			197.4	3.89%
	Rampion 2 plus all consented projects only	54,611	141,815	8,651	273.1	3.16%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	22,302			111.5	1.29%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	55,313			276.6	3.20%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	23,004			115.0	1.33%
	All projects	71,787			358.9	4.15%
	All projects (excluding Hornsea Four)	39,478			197.4	2.28%

Table 3.4 FFC SPA guillemot in-combination operation and maintenance phase displacement estimates using the 95.2 km mean max plus one SD foraging range (Applicant's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Breeding	Rampion 2 plus all consented projects only	10,520	83,214	5,076	52.6	1.04%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	1,138			5.7	0.11%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	10,520			52.6	1.04%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	1,138			5.7	0.11%
	All projects	22,804			114.0	2.25%
	All projects (excluding Hornsea Four)	13,422			67.1	1.32%
	Rampion 2 plus all consented projects only	10,520	141,815	8,651	52.6	0.61%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	1,138			5.7	0.07%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	10,520			52.6	0.61%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	1,138			5.7	0.07%
	All projects	22,804			114.0	1.32%
	All projects (excluding Hornsea Four)	13,422			67.1	0.78%
Non-breeding	Rampion 2 plus all consented projects only	30,745	83,214	5,076	153.7	3.03%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			39.1	0.77%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			157.2	3.10%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			42.6	0.84%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	All projects	35,637			178.2	3.51%
	All projects (excluding Hornsea Four)	12,710			63.6	1.25%
	Rampion 2 plus all consented projects only	30,745	141,815	8,651	153.7	1.78%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			39.1	0.45%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			157.2	1.82%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			42.6	0.49%
	All projects	35,637			178.2	2.06%
	All projects (excluding Hornsea Four)	12,710			63.6	0.73%
Annual	Rampion 2 plus all consented projects only	41,265	83,214	5,076	206.3	4.06%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	8,956			44.8	0.88%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	41,967			209.8	4.13%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	9,658			48.3	0.95%
	All projects	58,441			292.2	5.76%
	All projects (excluding Hornsea Four)	26,132			130.7	2.57%
	Rampion 2 plus all consented projects only	41,265	141,815	8,651	206.3	2.39%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	8,956			44.8	0.52%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	41,967			209.8	2.43%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	9,658			48.3	0.56%
	All projects	58,441			292.2	3.38%
	All projects (excluding Hornsea Four)	26,132			130.7	1.51%

Table 3.5 FFC SPA guillemot in-combination operation and maintenance phase displacement estimates using the 153.7 km mean max plus one SD foraging range (Natural England's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
Breeding	Rampion 2 plus all consented projects only	23,866	83,214	5,076	71.6 – 1,670.6	334.4	835.3	1.41 – 32.9%	6.58%	16.5%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	14,484			43.5 – 1,013.9	202.8	506.9	0.86 – 20.0%	4.00%	10.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	23,866			71.6 – 1,670.6	334.4	835.3	1.41 – 32.9%	6.58%	16.5%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	14,484			43.5 – 1,013.9	202.8	506.9	0.86 – 20.0%	4.00%	10.00%
	All projects	36,150			108.5 – 2,530.5	506.1	1,265.3	2.14 – 49.9%	10.00%	24.93%
	All projects (excluding Hornsea Four)	26,768			80.3 – 1,873.8	374.8	936.9	1.58 – 36.91%	7.38%	18.46%
	Rampion 2 plus all consented projects only	23,866	141,815	8,651	71.6 – 1,670.6	334.4	835.3	0.83 – 19.31%	3.86%	9.66%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	14,484			43.5 – 1,013.9	202.8	506.9	0.50 – 11.72%	2.34%	5.86%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	23,866			71.6 – 1,670.6	334.4	835.3	0.83 – 19.31%	3.86%	9.66%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	14,484			43.5 – 1,013.9	202.8	506.9	0.50 – 11.72%	2.34%	5.86%
	All projects	36,150			108.5 – 2,530.5	506.1	1,265.3	1.25 – 29.25%	5.85%	14.63%
	All projects (excluding Hornsea Four)	26,768			80.3 – 1,873.8	374.8	936.9	0.93 – 21.66%	4.33%	10.83%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
Non-breeding	Rampion 2 plus all consented projects only	30,745	83,214	5,076	92.2 – 2,152.1	430.4	1,076.1	1.82 – 42.4%	8.48%	21.20%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			23.5 – 547.2	109.5	273.6	0.46 – 10.78%	2.16%	5.39%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			94.3 – 2,201.3	440.3	1,100.7	1.86 – 43.37%	8.67%	21.68%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			25.6 – 596.4	119.3	298.2	0.50 – 11.75%	2.35%	5.87%
	All projects	35,637			106.9 – 2,494.6	498.9	1,247.3	2.11 – 49.14%	9.83%	24.57%
	All projects (excluding Hornsea Four)	12,710			38.1 – 889.7	177.9	444.8	0.75 – 17.53%	3.51%	8.76%
	Rampion 2 plus all consented projects only	30,745	141,815	8,651	92.2 – 2,152.1	430.4	1,076.1	1.07 – 24.88%	4.98%	12.44%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			23.5 – 547.2	109.5	273.6	0.27 – 6.33%	1.27%	3.16%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			94.3 – 2,201.3	440.3	1,100.7	1.09 – 25.45%	5.09%	12.72%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			25.6 – 596.4	119.3	298.2	0.80 – 18.61%	3.72%	9.31%
	All projects	35,637			106.9 – 2,494.6	498.9	1,247.3	1.24 – 28.84%	5.77%	14.42%
	All projects (excluding Hornsea Four)	12,710			38.1 – 889.7	177.9	444.8	0.44 – 10.28%	2.06%	5.14%
Annual	Rampion 2 plus all consented projects only	54,611	83,214	5,076	163.8 – 3,822.7	764.6	1,911.4	3.23 – 75.31%	15.06%	37.65%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 plus all consented projects (excluding Hornsea Four)	22,302			66.9 – 1,561.1	312.2	780.6	1.32 – 30.75%	6.15%	15.38%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	55,313			165.9 – 3,871.9	774.4	1,936.0	3.27 – 76.28%	15.26%	38.14%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	23,004			69.0 – 1.610.3	322.1	805.2	1.36 – 31.72%	6.34%	15.86%
	All projects	71,787			215.4 – 5,025.1	1,005.0	2,512.5	4.24 – 99.00%	19.80%	49.50%
	All projects (excluding Hornsea Four)	39,478			118.4 – 2,763.4	552.7	1,381.7	2.33 – 54.55%	10.89%	27.22%
	Rampion 2 plus all consented projects only	54,611	141,815	8,651	163.8 – 3,822.7	764.6	1,911.4	1.89 – 44.19%	4.98%	12.44%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	22,302			66.9 – 1,561.1	312.2	780.6	0.27 – 6.33%	1.27%	3.16%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	55,313			165.9 – 3,871.9	774.4	1,936.0	1.92 – 44.76%	8.95%	22.38%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	23,004			69.0 – 1.610.3	322.1	805.2	0.80 – 18.61%	3.72%	9.31%
	All projects	71,787			215.4 – 5,025.1	1,005.0	2,512.5	2.49 – 58.09%	11.62%	29.04%
	All projects (excluding Hornsea Four)	39,478			118.4 – 2,763.4	552.7	1,381.7	1.37 – 31.94%	6.39%	15.97%

Table 3.6 FFC SPA guillemot in-combination operation and maintenance phase displacement using the 95.2 km mean max plus one SD foraging range (Natural England's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
Breeding	Rampion 2 plus all consented projects only	10,520	83,214	5,076	31.6 – 736.4	147.3	368.2	0.62 – 14.51%	2.90%	7.25%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	1,138			3.4 – 79.7	15.9	39.8	0.07 – 1.57%	0.31%	0.78%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	10,520			31.6 – 736.4	147.3	368.2	0.62 – 14.51%	2.90%	7.25%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	1,138			3.4 – 79.7	15.9	39.8	0.07 – 1.57%	0.31%	0.78%
	All projects	22,804			68.4 – 1,596.3	319.3	798.1	1.35 – 31.45%	6.29%	15.72%
	All projects (excluding Hornsea Four)	13,422			78.4 – 1,829.2	365.8	914.6	1.54 – 36.04%	7.21%	18.02%
	Rampion 2 plus all consented projects only	10,520	141,815	8,651	31.6 – 736.4	147.3	368.2	0.36 – 8.51%	1.70%	4.26%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	1,138			3.4 – 79.7	15.9	39.8	0.04 – 0.92%	0.18%	0.46%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	10,520			31.6 – 736.4	147.3	368.2	0.36 – 8.51%	1.70%	4.26%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	1,138			3.4 – 79.7	15.9	39.8	0.04 – 0.92%	0.18%	0.46%
	All projects	22,804			68.4 – 1,596.3	319.3	798.1	0.79 – 18.45%	3.69%	9.23%
	All projects (excluding Hornsea Four)	13,422			78.4 – 1,829.2	365.8	914.6	0.47 – 10.86%	2.17%	5.43%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
Non-breeding	Rampion 2 plus all consented projects only	30,745	83,214	5,076	92.2 – 2,152.1	430.4	1,076.1	1.82 – 42.40%	8.48%	21.20%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			23.5 – 547.2	109.5	273.6	0.46 – 10.78%	2.16%	5.39%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			94.3 – 2,201.3	440.3	1,100.7	1.86 – 43.37%	8.67%	21.68%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			25.6 – 596.4	119.3	298.2	0.50 – 11.75%	2.35%	5.87%
	All projects	35,637			106.9 – 2,494.6	498.9	1,247.3	2.11 – 49.14%	9.83%	24.57%
	All projects (excluding Hornsea Four)	12,710			38.1 – 889.7	177.9	444.8	0.75 – 17.53%	3.51%	8.76%
	Rampion 2 plus all consented projects only	30,745	141,815	8,651	92.2 – 2,152.1	430.4	1,076.1	1.07 – 24.88%	4.98%	12.44%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	7,818			23.5 – 547.2	109.5	273.6	0.27 – 6.33%	1.27%	3.16%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	31,447			94.3 – 2,201.3	440.3	1,100.7	1.09 – 25.45%	5.09%	12.72%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	8,520			25.6 – 596.4	119.3	298.2	0.30 – 6.89%	1.38%	3.45%
	All projects	35,637			106.9 – 2,494.6	498.9	1,247.3	1.24 – 28.84%	5.77%	14.42%
	All projects (excluding Hornsea Four)	12,710			38.1 – 889.7	177.9	444.8	0.44 – 10.28%	2.06%	5.14%
Annual	Rampion 2 plus all consented projects only	41,265	83,214	5,076	123.8 – 2,888.5	577.7	1,444.3	2.44 – 56.90%	11.38%	28.45%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 – 70% Disp 1 – 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 plus all consented projects (excluding Hornsea Four)	8,956			3.4 – 79.7	15.9	39.8	0.07 – 1.57%	0.31%	0.78%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	41,967			125.9 – 2,937.7	587.5	1,468.9	2.48 – 57.87%	11.57%	28.94%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	9,658			29.0 – 676.1	135.2	338.0	0.57 – 13.32%	2.66%	6.66%
	All projects	58,441			175.3 – 4,090.8	818.2	2,045.4	3.45 – 80.59%	16.12%	40.30%
	All projects (excluding Hornsea Four)	26,132			78.4 – 1,829.2	365.8	914.6	01.54 – 36.04%	7.21%	18.02%
	Rampion 2 plus all consented projects only	41,265	141,815	8,651	123.8 – 2,888.5	577.7	1,444.3	1.43 – 33.39%	6.68%	16.70%
	Rampion 2 plus all consented projects (excluding Hornsea Four)	8,956			3.4 – 79.7	15.9	39.8	0.31 – 7.25%	1.45%	3.62%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	41,967			125.9 – 2,937.7	587.5	1,468.9	1.46 – 33.96%	6.79%	16.98%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	9,658			29.0 – 676.1	135.2	338.0	0.33 – 7.82%	1.56%	3.91%
	All projects	58,441			175.3 – 4,090.8	818.2	2,045.4	2.03 – 47.29%	9.46$	23.64%
	All projects (excluding Hornsea Four)	26,132			78.4 – 1,829.2	365.8	914.6	0.91 – 21.15%	4.23%	10.57%

3.2 Flamborough and Filey Coast SPA – Razorbill

3.2.1 The in-combination tables below (**Table 3.7** and **Table 3.8**) provide values from all consented and planned projects apportioned to the Flamborough and Filey Coast SPA. Totals are provided for the following scenarios:

- Rampion 2 plus all consented projects;
- Rampion 2 plus Dudgeon and Sheringham Shoal Extension Projects and all consented projects; and
- All projects.

3.2.2 The consideration of Dudgeon and Sheringham Shoal Extension Projects is due to the similarity in timeline to the Proposed Development.

3.2.3 Due to the different values for mean max plus one SD foraging range for razorbill (Woodward *et al.*, 2019) two in-combination tables are provided as the use of the different foraging ranges will include or exclude different projects within the breeding season.

3.2.4 Displacement matrices for all displacement rate and mortality rate scenarios are provided for the annual totals in **Appendix A**.

Table 3.7 In-combination abundance totals for razorbill attributed to the Flamborough and Filey Coast SPA. (Using mean max plus one SD foraging range of 164.6 km)

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Beatrice	0	28	15	28	72	1a
Blyth Demonstration Site	0	3	2	3	8	1a
Dudgeon	0	12	20	12	44	1a
EOWDC	0	2	0	1	3	1a
Galloper	0	2	3	13	18	1a
Greater Gabbard	0	0	11	3	13	1a
Gunfleet Sands	0	0	1	0	1	1a
Humber Gateway	0	1	0	1	2	1a
Hywind 2 Demonstration	0	24	0		25	1a
Kentish Flats	-	-	-	-	0	1a
Kentish Flats Extension	-	-	-	-	0	1a
Lincs, Lynn & Inner Dowsing	0	1	1	1	3	1a
London Array	0	1	0	1	2	1a
Methil	0	0	0	0	0	1a

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Race Bank	0	1	1	1	4	1a
Rampion	0	2	34	113	149	1a
Scroby Sands	-	-	-	-	0	1a
Sheringham Shoal	0	46	6	1	52	1a
Teesside	0	2	0	1	3	1a
Thanet	0	0	0	1	1	1a
Westermost Rough	91	4	4	3	102	1a
East Anglia One	0	1	4	11	17	1a
Hornsea Project One	535	164	41	61	800	1a
Hornsea Project Two	1,210	144	19	57	1,430	1a
Moray East	0	38	1	6	44	1b
Triton Knoll	0	9	23	4	36	1b
Kincardine	0	0	0	0	0	1b
Dogger Bank A	375	54	47	141	241	1c
Dogger Bank B	461	71	58	174	303	1c

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Dogger Bank C	250	11	26	65	102	1c
East Anglia Three	0	38	41	52	130	1c
Inch Cape	0	98	18	-	115	1c
Moray West	0	121	5	122	247	1c
Neart na Gaoithe	0	187	14	-	200	1c
Seagreen Alpha	0	0	30	-	30	1c
Seagreen Bravo	0	0	34	-	34	1c
Sofia	346	20	39	100	159	1c
Hornsea Three	0	69	99	72	240	1c
Norfolk Boreas	0	9	29	12	49	1c
Norfolk Vanguard	0	30	23	31	84	1c
East Anglia ONE North	0	3	2	7	11	1c
East Anglia TWO	0	2	4	8	13	1c
Pentland	0	1	1	1	3	1c
Hornsea Four (Natural England's Bespoke Approach)	386	2,845	13	15	3,259	1c

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Forth Wind	-	3	2	3	7	1c
Rampion 2	0	1	1	72	74	1d
Total (Rampion 2 plus all consented projects only)	**3,653**	**4,044**	**699**	**1,338**	**9,735**	
Green Volt	0	-	-2	-	2	1d
West of Orkney	0	-	5	-	5	1d
Dudgeon Extension Project (DEP)	0	31	23	11	65	1d
Sheringham Shoal Extension Project (SEP)	0	11	19	5	35	1d
Berwick Bank	0	301	38	254	593	1d
Dogger Bank South	-	-	-	-	-	2
Outer dowsing (PEIR)	2,737	80	23	178	3,017	2
Five Estuaries (PEIR)	0	10	10	26	46	2
North Falls (PEIR)	0	9	726	1,304	2,039	2
Total (All Projects)	**6,390**	**4,485**	**1,545**	**3,117**	**15,537**	
Total (Consented+ Rampion 2 + DEP&SEP)	**3,653**	**4,086**	**741**	**1,354**	**9,835**	

Table 3.8 In-combination abundance totals for razorbill attributed to the Flamborough and Filey Coast SPA. (Using mean max plus one SD foraging range of 122.2 km)

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Beatrice	0	28	15	28	72	1a
Blyth Demonstration Site	0	3	2	3	8	1a
Dudgeon	0	12	20	12	44	1a
EOWDC	0	2	0	1	3	1a
Galloper	0	2	3	13	18	1a
Greater Gabbard	0	0	11	3	13	1a
Gunfleet Sands	0	0	1	0	1	1a
Humber Gateway	0	1	0	1	2	1a
Hywind 2 Demonstration	0	24	0		25	1a
Kentish Flats	-	-	-	-	0	1a
Kentish Flats Extension	-	-	-	-	0	1a
Lincs, Lynn & Inner Dowsing	0	1	1	1	3	1a
London Array	0	1	0	1	2	1a
Methil	0	0	0	0	0	1a

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Race Bank	0	1	1	1	4	1a
Rampion	0	2	34	113	149	1a
Scroby Sands	-	-	-	-	0	1a
Sheringham Shoal	0	46	6	1	52	1a
Teesside	0	2	0	1	3	1a
Thanet	0	0	0	1	1	1a
Westermost Rough	91	4	4	3	102	1a
East Anglia One	0	1	4	11	17	1b
Hornsea Project One	535	164	41	61	800	1b
Hornsea Project Two	1,210	144	19	57	1,430	1b
Moray East	0	38	1	6	44	1b
Triton Knoll	0	9	23	4	36	1b
Kincardine	0	0	0	0	0	1b
Dogger Bank A	0	54	47	141	241	1c
Dogger Bank B	0	71	58	174	303	1c

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Dogger Bank C	0	11	26	65	102	1c
East Anglia Three	0	38	41	52	130	1c
Inch Cape	0	98	18	-	115	1c
Moray West	0	121	5	122	247	1c
Neart na Gaoithe	0	187	14	-	200	1c
Seagreen Alpha	0	0	30	-	30	1c
Seagreen Bravo	0	0	34	-	34	1c
Sofia	346	20	39	100	159	1c
Hornsea Three	0	69	99	72	240	1c
Norfolk Boreas	0	9	29	12	49	1c
Norfolk Vanguard	0	30	23	31	84	1c
East Anglia ONE North	0	3	2	7	11	1c
East Anglia TWO	0	2	4	8	13	1c
Pentland	0	1	1	1	3	1c
Hornsea Four (Natural England's Bespoke Approach)	386	2,845	13	15	3,259	1c

Project	Migration-free breeding	Post-breeding migration	Migration-free winter	Return migration	Annual	Tier
Forth Wind	-	3	2	3	7	1c
Rampion 2	0	1	1	72	74	1d
Total (Rampion 2 plus all consented projects only)	**2,221**	**4,044**	**699**	**1,338**	**8,303**	
Green Volt	0	-	2	-	2	1d
West of Orkney	0	-	5	-	5	1d
Dudgeon Extension Project (DEP)	0	31	23	11	65	1d
Sheringham Shoal Extension Project (SEP)	0	11	19	5	35	1d
Berwick Bank	0	301	38	254	593	1d
Dogger Bank South	-	-	-	-	-	2
Outer dowsing (PEIR)	2,737	80	23	178	3,017	2
Five Estuaries (PEIR)	0	10	10	26	46	2
North Falls (PEIR)	0	9	726	1,304	2,039	2
Total (All Projects)	**4,958**	**4,485**	**1,545**	**3,117**	**14,105**	
Total (Consented+ Rampion 2 + DEP&SEP)	**2,221**	**4,086**	**741**	**1,354**	**8,403**	

Table 3.9 FFC SPA razorbill in-combination operation and maintenance phase displacement estimates using the 164.6 km mean max plus one SD foraging range (Applicant's approach)

Bio-season	Projects included within seasonal totals	Seasonal abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Migration-free Breeding	Rampion 2 plus all consented projects only	3,653	21,140	2,220	18.3	0.82%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	3,653			18.3	0.82%
	All projects	6,390			32.0	1.44%
	Rampion 2 plus all consented projects only	3,653	59,055	6,201	18.3	0.29%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	3,653			18.3	0.29%
	All projects	6,390			32.0	0.52%
Post-breeding migration	Rampion 2 plus all consented projects only	4,044	21,140	2,220	20.2	0.91%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			20.4	0.92%
	All projects	4,485			22.4	1.01%
	Rampion 2 plus all consented projects only	4,044	59,055	6,201	20.2	0.33%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			20.4	0.33%
	All projects	4,485			22.4	0.36%
Migration-free winter	Rampion 2 plus all consented projects only	699	21,140	2,220	3.5	0.16%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			3.7	0.17%
	All projects	1,545			7.7	0.35%
	Rampion 2 plus all consented projects only	699	59,055	6,201	3.5	0.06%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			3.7	0.06%

Bio-season	Projects included within seasonal totals	Seasonal abundance (array area & 2km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	All projects	1,545			7.7	0.12%
Return migration	Rampion 2 plus all consented projects only	1,338	21,140	2,220	6.7	0.30%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			6.8	0.31%
	All projects	3,117			15.6	0.70%
	Rampion 2 plus all consented projects only	1,338	59,055	6,201	6.7	0.11%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			6.8	0.11%
	All projects	3,117			15.6	0.25%
Annual	Rampion 2 plus all consented projects only	9,735	21,140	2,220	48.7	2.19%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	9,835			49.2	2.22%
	All projects	15,537			77.7	3.50%
	Rampion 2 plus all consented projects only	9,735	59,055	6,201	48.7	0.78%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	9,835			49.2	0.79%
	All projects	15,537			77.7	1.25%

Table 3.10 FFC SPA razorbill in-combination operation and maintenance phase displacement estimates using the 122.2 km mean max plus one SD foraging range (Applicant's approach)

Bio-season	Projects included within seasonal totals	Seasonal abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Migration-free Breeding	Rampion 2 plus all consented projects only	2,221	21,140	2,220	11.1	0.50%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	2,221			11.1	0.50%
	All projects	4,958			24.8	1.12%
	Rampion 2 plus all consented projects only	2,221	59,055	6,201	11.1	0.18%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	2,221			11.1	0.18%
	All projects	4,958			24.8	0.40%
Post-breeding migration	Rampion 2 plus all consented projects only	4,044	21,140	2,220	20.2	0.91%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			20.4	0.92%
	All projects	4,485			22.4	1.01%
	Rampion 2 plus all consented projects only	4,044	59,055	6,201	20.2	0.33%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			20.4	0.33%
	All projects	4,485			22.4	0.36%
Migration-free winter	Rampion 2 plus all consented projects only	699	21,140	2,220	3.5	0.16%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			3.7	0.17%
	All projects	1,545			7.7	0.35%
	Rampion 2 plus all consented projects only	699	59,055	6,201	3.5	0.06%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			3.7	0.06%
	All projects	1,545			7.7	0.12%

Bio-season	Projects included within seasonal totals	Seasonal abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Return migration	Rampion 2 plus all consented projects only	1,338	21,140	2,220	6.7	0.30%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			6.8	0.31%
	All projects	3,117			15.6	0.70%
	Rampion 2 plus all consented projects only	1,338	59,055	6,201	6.7	0.11%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			6.8	0.11%
	All projects	3,117			15.6	0.25%
Annual	Rampion 2 plus all consented projects only	8,303	21,140	2,220	41.5	1.87%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,403			42.0	1.89%
	All projects	14,105			70.5	0.50%
	Rampion 2 plus all consented projects only	8,303	59,055	6,201	41.5	0.67%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,403			42.0	0.68%
	All projects	14,105			70.5	0.18%

Table 3.11 FFC SPA razorbill in-combination operation and maintenance phase displacement estimates using the mean max plus one SD foraging range of 164.6 km (Natural England's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
Migration-free Breeding	Rampion 2 plus all consented projects only	3,653	21,140	2,220	11.0 – 255.7	51.2	127.9	0.49 – 11.52%	2.30%	5.76%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	3,653			11.0 – 255.7	51.2	127.9	0.49 – 11.52%	2.30%	5.76%
	All projects	6,390			19.2 – 447.3	89.5	223.7	0.86 – 20.15%	4.03%	10.08%
	Rampion 2 plus all consented projects only	3,653	59,055	6,201	11.0 – 255.7	51.2	127.9	0.18 – 4.12%	0.82%	2.06%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	3,653			11.0 – 255.7	51.2	127.9	0.18 – 4.12%	0.82%	2.06%
	All projects	6,390			19.2 – 447.3	89.5	223.7	0.31 – 7.21%	1.44%	3.61%
Post-breeding migration	Rampion 2 plus all consented projects only	4,044	21,140	2,220	12.1 – 283.1	56.6	141.5	0.55 – 12.75%	2.55%	6.38%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			12.3 – 286.0	57.2	143.0	0.55 – 12.88%	2.58%	6.44%
	All projects	4,485			13.5 – 313.9	62.8	157.0	0.61 – 14.14%	2.83%	7.07%
	Rampion 2 plus all consented projects only	4,044	59,055	6,201	12.1 – 283.1	56.6	141.5	0.20 – 4.56%	0.91%	2.28%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			12.3 – 286.0	57.2	143.0	0.20 – 4.61%	0.92%	2.31%
	All projects	4,485			13.5 – 313.9	62.8	157.0	0.22 – 5.06%	1.01%	2.53%
Migration-free winter	Rampion 2 plus all consented projects only	699	21,140	2,220	2.1 – 49.0	9.8	24.5	0.09 – 2.21%	0.44%	1.10%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			2.2 – 51.9	10.4	25.9	0.10 – 2.34%	0.47%	1.17%
	All projects	1,545			4.6 – 108.2	21.6	54.1	0.21 – 4.87%	0.97%	2.44%
	Rampion 2 plus all consented projects only	699	59,055	6,201	2.1 – 49.0	9.8	24.5	0.03 – 0.79%	0.16%	0.39%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			2.2 – 51.9	10.4	25.9	0.04 – 0.84%	0.17%	0.42%
	All projects	1,545			4.6 – 108.2	21.6	54.1	0.07 – 1.74%	0.35%	0.87%
Return migration	Rampion 2 plus all consented projects only	1,338	21,140	2,220	4.0 – 93.7	18.7	46.8	0.18 – 4.22%	0.84%	2.11%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			4.1 – 94.8	19.0	47.4	0.18 – 4.27%	0.85%	2.14%
	All projects	3,117			9.4 – 218.2	43.6	109.1	0.42 – 9.83%	1.97%	4.91%
	Rampion 2 plus all consented projects only	1,338	59,055	6,201	4.0 – 93.7	18.7	46.8	0.06 – 1.51%	0.30%	0.76%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			4.1 – 94.8	19.0	47.4	0.07 – 1.53%	0.31%	0.76%
	All projects	3,117			9.4 – 218.2	43.6	109.1	0.15 – 3.52%	0.70%	1.76%
Annual	Rampion 2 plus all consented projects only	9,735	21,140	2,220	29,2 – 681.4	136.3	340.7	1.32 – 30.70%	6.14%	15.35%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	9,835			29.5 – 688.4	137.7	344.2	1.33 – 31.01%	6.20%	15.51%
	All projects	15,537			46.6 – 1,087.6	217.5	543.8	2.10 – 49.00%	9.80%	24.50%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 plus all consented projects only	9,735	59,055	6,201	29,2 – 681.4	136.3	340.7	0.47 – 10.99%	2.20%	5.49%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	9,835			29.5 – 688.4	137.7	344.2	0.48 – 11.10%	2.22%	5.55%
	All projects	15,537			46.6 – 1,087.6	217.5	543.8	0.75 – 17.54%	3.51%	8.77%

Table 3.12 FFC SPA razorbill in-combination operation and maintenance phase displacement estimates using the mean max plus one SD foraging range of 122.2 km (Natural England's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
Migration-free Breeding	Rampion 2 plus all consented projects only	2,221	21,140	2,220	6.7 – 155.5	31.1	77.7	0.30 – 7.01%	1.40%	3.50%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	2,221			6.7 – 155.5	31.1	77.7	0.30 – 7.01%	1.40%	3.50%
	All projects	4,958			14.9 – 347.1	69,4	173.5	0.67 – 15.64%	3.13%	7.82%
	Rampion 2 plus all consented projects only	2,221	59,055	6,201	6.7 – 155.5	31.1	77.7	0.11 – 2.51%	0.50%	1.25%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	2,221			6.7 – 155.5	31.1	77.7	0.11 – 2.51%	0.50%	1.25%
	All projects	4,958			14.9 – 347.1	69,4	173.5	0.24 – 5.60%	1.12%	2.80%
Post-breeding migration	Rampion 2 plus all consented projects only	4,044	21,140	2,220	12.1 – 283.1	56.6	141.5	0.55 – 12.75%	2.55%	6.38%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			12.3 – 286.0	57.2	142.2	0.55 – 12.88%	2.58%	6.44%
	All projects	4,485			13.5 – 314.0	62.8	157.0	0.61 – 14.14%	2.83%	7.07%
	Rampion 2 plus all consented projects only	4,044	59,055	6,201	12.1 – 283.1	56.6	141.5	0.20 – 4.56%	0.91%	2.28%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	4,086			12.3 – 286.0	57.2	142.2	0.20 – 4.61%	0.92%	2.31%
	All projects	4,485			13.5 – 314.0	62.8	157.0	0.22 – 5.06%	1.01%	2.53%
Migration-free winter	Rampion 2 plus all consented projects only	699	21,140	2,220	2.1 – 49.0	9.8	24.5	0.09 – 2.21%	0.44%	1.10%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			2.2 – 51.9	10.4	25.9	0.10 – 2.34%	0.47%	1.17%
	All projects	1,545			4.6 – 108.2	21.6	54.1	0.21 – 4.87%	0.97%	2.44%
	Rampion 2 plus all consented projects only	699	59,055	6,201	2.1 – 49.0	9.8	24.5	0.03 – 0.79%	0.16%	0.39%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	741			2.2 – 51.9	10.4	25.9	0.04 – 0.84%	0.17%	0.42%
	All projects	1,545			4.6 – 108.2	21.6	54.1	0.07 – 1.74%	0.35%	0.87%
Return migration	Rampion 2 plus all consented projects only	1,338	21,140	2,220	4.0 – 93.7	18.7	46.8	0.18 – 4.22%	0.84%	2.11%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			4.1 – 94.8	19.0	47.4	0.18 – 4.27%	0.85%	2.14%
	All projects	3,117			9.4 – 987.3	197.5	493.7	1.91 – 44.48%	8.90%	22.24%
	Rampion 2 plus all consented projects only	1,338	59,055	6,201	4.0 – 93.7	18.7	46.8	0.06 – 1.51%	0.30%	0.76%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,354			4.1 – 94.8	19.0	47.4	0.07 – 1.53%	0.31%	0.76%
	All projects	3,117			9.4 – 987.3	197.5	493.7	0.68 – 15.92%	3.18%	7.69%
Annual	Rampion 2 plus all consented projects only	8,303	21,140	2,220	24.9 – 581.2	116.2	290.6	1.12 – 26.18%	5.24%	13.09%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,403			25.2 – 588.2	117.6	294.1	1.14 – 26.50%	5.30%	13.25%
	All projects	14,105			42.3 – 987.3	197.5	493.7	1.91 – 44.48%	8.90%	22.24%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2 km buffer)	FFC SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of razorbills subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1% Mort - 10	70% Disp 2% Mort	70% Disp 5% Mort
	Rampion 2 plus all consented projects only	8,303	59,055	6,201	24.9 – 581.2	116.2	290.6	0.40 – 9.37%	1.87%	4.69%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,403			25.2 – 588.2	117.6	294.1	0.41 – 9.49%	1.90%	4.74%
	All projects	14,105			42.3 – 987.3	197.5	493.7	0.68 – 15.92%	3.18%	7.96%

3.3 Farne Islands SPA – Guillemot

3.3.1 The in-combination table below (**Table 3.13**) provides values from all consented and planned projects apportioned to the Farne Islands SPA. Totals are provided for the following scenarios:

- Rampion 2 plus all consented projects;
- Rampion 2 plus Dudgeon and Sheringham Shoal Extension Projects and all consented projects; and
- All projects.

3.3.2 The consideration of Dudgeon and Sheringham Shoal Extension Projects is due to the similarity in timeline to the Proposed Development.

3.3.3 Regardless of which of the two foraging ranges (95.2 km or 153.7 km) for guillemot is used (Woodward *et al.*, 2019) to identify theoretical breeding season connectivity, the overall in-combination abundance total apportioned the Farne Islands SPA remains the same.

3.3.4 It should be noted that despite a number of Scottish OWF projects (Inch Cape, Nearte na Gaoithe and Seagreen) being within foraging range, and so having theoretical connectivity during the breeding season, predicted impacts during the breeding season were instead entirely apportioned to Scottish SPAs closer to the projects. Therefore, no abundance for such projects were attributed to the Farne Islands SPA during the breeding season.

3.3.5 Additionally, no quantitative Farne Islands SPA assessment information was available for Teeside OWF to be able to apportion abundance from the project during the breeding season.

3.3.6 Displacement matrices for all displacement rate and mortality rate scenarios are provided for the annual totals in **Appendix A**.

Table 3.13 In-combination abundance totals for guillemot attributed to the Farne Islands SPA

Project	Breeding season	Non-breeding season	Annual	Tier
Beatrice	0	103	103	1a
Blyth Demonstration Site	-	49	49	1a
Dudgeon	0	20	20	1a
EOWDC	0	8	8	1a
Galloper	0	22	22	1a
Greater Gabbard	0	20	20	1a
Gunfleet Sands	0	14	14	1a
Humber Gateway	0	5	5	1a
Hywind 2 Demonstration	0	80	80	1a
Kentish Flats Extension	0	0	0	1a
Kentish Flats	0	0	0	1a
Lincs, Lynn & Inner Dowsing	0	30	30	1a
London Array	0	14	14	1a
Methil	0	0	0	1a
Race Bank	0	26	26	1a

Project	Breeding season	Non-breeding season	Annual	Tier
Rampion	0	579	579	1a
Scroby Sands	0	-	0	1a
Sheringham Shoal	0	27	27	1a
Teesside	0	34	34	1a
Thanet	0	5	5	1a
Westermost Rough	0	18	18	1a
East Anglia One	0	24	24	1b
Hornsea Project One	0	302	302	1b
Hornsea Project Two	0	491	491	1b
Moray East	0	20	20	1b
Triton Knoll	0	28	28	1b
Kincardine	0	0	0	1b
Dogger Bank A	0	229	229	1c
Dogger Bank B	0	396	396	1c
Dogger Bank C	0	85	85	1c
East Anglia Three	0	107	107	1c

Project	Breeding season	Non-breeding season	Annual	Tier
Inch Cape	0	119	119	1c
Moray West	0	1,424	1,424	1c
Neart na Gaoithe	0	140	140	1c
Seagreen Alpha	0	175	175	1c
Seagreen Bravo	0	153	153	1c
Sofia	0	138	138	1c
Hornsea Three	0	663	663	1c
Norfolk Boreas	0	514	514	1c
Norfolk Vanguard	0	178	178	1c
East Anglia ONE North	0	70	70	1c
East Anglia TWO	0	62	62	1c
Pentland	0	24	24	1c
Forth Wind	0	15	15	1c
Hornsea Four (Natural England's Standard Approach)	0	1,379	1,379	1c
Rampion 2	0	214	214	1d

Project	Breeding season	Non-breeding season	Annual	Tier
Total (Rampion 2 plus all consented projects only)	**0**	**8,005**	**8,005**	
Green Volt	0	601	601	1d
West of Orkney	0	160	160	1d
Dudgeon Extension Project (DEP)	-	555	555	1d
Sheringham Shoal Extension Project (SEP)	-	41	41	1d
Berwick Bank	2,949	1,648	4,597	1d
Dogger Bank South	0	-	-	2
Outer dowsing	0	830	830	2
Five Estuaries (PEIR)	-	138	138	2
North Falls (PEIR)	-	168	168	2
Total (All Projects)	**2,949**	**12,145**	**15,094**	
Total (Consented+ Rampion 2 + DEP&SEP)	**0**	**8,601**	**8,601**	

Table 3.14 Farne Islands SPA guillemot in-combination operation and maintenance phase displacement estimates (Applicant's approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	Farne Islands SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
Breeding	Rampion 2 plus all consented projects only	0	65,751	4,011	0	0.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	0			0	0.00%
	All projects	2,949			14.7	0.37%
	Rampion 2 plus all consented projects only	0	62,085	3,787	0	0.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	0			0	0.00%
	All projects	2,949			14.7	0.39%
Non-breeding	Rampion 2 plus all consented projects only	8,005	65,751	4,011	40.0	1.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			43.0	1.07%
	All projects	12,145			60.7	1.51%
	Rampion 2 plus all consented projects only	8,005	62,085	3,787	40.0	1.06%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			43.0	1.14%
	All projects	12,145			60.7	1.60%
Annual	Rampion 2 plus all consented projects only	8,005	65,751	4,011	40.0	1.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			43.0	1.07%
	All projects	15,094			75.5	1.88%
	Rampion 2 plus all consented projects only	8,005	62,085	3,787	40.0	1.06%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			43.0	1.14%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	Farne Islands SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)	Increase in baseline mortality (%)
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	50% Disp 1% Mort	50% Disp 1% Mort
	All projects	15,094			75.5	1.99%

Table 3.15 Farne Islands SPA guillemot in-combination operation and maintenance phase displacement estimates (Natural England's preferred approach)

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	Farne Islands SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
Breeding	Rampion 2 plus all consented projects only	0	65,751	4,011	0.0	0.0	0.0	0.00 – 0.00%	0.00%	0.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	0			0.0	0.0	0.0	0.00 – 0.00%	0.00%	0.00%
	All projects	2,949			8.8 – 206.5	41.3	103.2	0.22 – 5.15%	1.03%	2.57%
	Rampion 2 plus all consented projects only	0	62,085	3,787	0.0	0.0	0.0	0.00 – 0.00%	0.00%	0.00%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	0			0.0	0.0	0.0	0.00 – 0.00%	0.00%	0.00%
	All projects	2,949			8.8 – 206.5	41.3	103.2	0.23 – 5.45%	1.09%	2.73%
Non-breeding	Rampion 2 plus all consented projects only	8,005	65,751	4,011	24.0 – 560.4	112.1	280.2	0.60 – 13.97%	2.79%	6.99%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			25.8 – 602.1	120.4	301.0	0.64 – 15.01%	3.00%	7.51%
	All projects	12,145			36.4 – 850.1	170.0	425.1	0.91 – 21.20%	4.24%	10.60%
	Rampion 2 plus all consented projects only	8,005	62,085	3,787	24.0 – 560.4	112.1	280.2	0.63 – 14.80%	2.96%	7.40%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			25.8 – 602.1	120.4	301.0	0.68 – 15.90%	3.18%	7.95%
	All projects	12,145			36.4 – 850.1	170.0	425.1	0.96 – 22.45%	4.49%	11.22%
Annual	Rampion 2 plus all consented projects only	8,005	65,751	4,011	24.0 – 560.4	112.1	280.2	0.60 – 13.97%	2.79%	6.99%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			25.8 – 602.1	120.4	301.0	0.64 – 15.01%	3.00%	7.51%

Bio-season	Projects included within seasonal totals	Seasonal breeding adult abundance (array area & 2km buffer)	Farne Islands SPA citation and latest colony (2022) population and baseline mortality rate		Estimated number of guillemots subject to mortality (breeding adults per annum)			Increase in baseline mortality (%)		
			Population (breeding adults)	Baseline mortality (breeding adults per annum)	30 – 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort	30 - 70% Disp 1 - 10% Mort	70% Disp 2% Mort	70% Disp 5% Mort
	All projects	15,094			43.3 – 1,056.6	211.3	528.3	1.13 – 26.34%	5.27%	13.17%
	Rampion 2 plus all consented projects only	8,005	62,085	3,787	24.0 – 560.4	112.1	280.2	0.63 – 14.80%	2.96%	7.40%
	Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	8,601			25.8 – 602.1	120.4	301.0	0.68 – 15.90%	3.18%	7.95%
	All projects	15,094			43.3 – 1,056.6	211.3	528.3	1.20 – 27.90%	5.58%	13.95%

4. Population Viability Analysis

4.1.1 PVA was conducted where in-combination impacts presented in **Section 3** exceeded a 1% increase in baseline mortality at the SPA population scale. An overview of the PVA methodology is described below.

Modelling approach

4.1.2 The Seabird PVA Tool (Searle *et al*., 2019) uses a Leslie matrix to construct a PVA model (Caswell, 2000) based on the parameters provided by the user. Users can specify whether they wish the model to include demographic stochasticity, environmental stochasticity, and either use density dependent or independent methods, or whether they want the model to run as entirely deterministic model. Additionally, the model offers the user pre-set demographic rates which are based on generic parameters such as Horswill & Robinson (2015) or site-specific growth rates from previous studies. The selection of appropriate parameters is critical to producing justifiable PVA outputs, with the selection of demographic parameters details in **Table 4.1**.

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

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

4.1.5 Natural populations continually operate under density dependency, including nature mechanisms such as food resources which limit the growth rate and total size a population could obtain (theoretical carrying capacity). Demographic processes such as growth, survival, productivity and recruitment are density-dependent, as their rates change in relation to the number of individuals in a population. Density dependence can be described as being either compensatory or depensatory (Begon *et al.,* 2005). Compensation is characterised by demographic changes that cause a stabilising effect on a populations long-term average. Depensation acts to further decrease the rate of population growth in

declining populations and can delay the rate of recovery. This is typically exhibited in populations that have been significantly depleted in size and is caused by a reduction in the benefits associated with conspecific presence.

4.1.6 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, or where known is highly variable. Therefore, the more typical approach of using density independent models for seabird assessments, despite the lack of biologically realistic density dependence. Density independent models lack any means by which a population can recover once it has been reduced beyond a certain point or alternatively populations can grow exponentially, they are therefore appropriate for impact assessment purposes on the grounds of precaution (i.e., another source of precaution in the assessment process) as they are more likely to overestimate true impacts (Ridge *et al.,* 2019).

PVA demographic parameters

4.1.7 The Seabird PVA Tool (Searle *et al.,* 2019) has a Shiny App that offers the user the choice of using pre-set demographic parameters or the ability to enter custom values. The pre-set demographic values are available for a total of 15 different species. The values are derived from previously reported national or colony specific demographic parameters sourced from the Joint Nature Conservation Committee (JNCC) Seabird Monitoring Programme (SMP, 2020). This data is further divided into eight regional classifications (Mobbs *et al.,* 2020) for breeding success data or Horswill & Robinson (2015) for survival rate.

4.1.8 Following a review of the pre-formulated productivity rates within the Seabird PVA Tool (Searle *et al*., 2019) for the eight regional classifications, none of the pre-formulated values for productivity were representative of known population trends for those assessed within this report. This was due to the age of these data (productivity data spanning over 50 years in some instances) feeding into the productivity rates. Therefore, where possible, SPA-specific productivity values were calculated using breeding success from the SMP database (Seabird Monitoring Programme, 2023) and the associated colony count data. Average productivity rates (and associated standard deviations) were calculated using the datasets provided in the SMP database for the guillemot and razorbill feature for FFC SPA and the guillemot feature at Farne Islands SPA. **Table 4.1** summarises the species-specific values selected for the two species that are the focus of this report.

4.1.9 The overall productivity was calculated as the mean of each year's colony counts for all the years SPA colony count data available. Where specific years had multiple counts, these were subject to a weighted mean approach to avoid bias towards productivity for a certain year.

4.1.10 For the seabird colonies assessed there are currently no colony-specific survival rates available. In the absence of colony-specific survival rates all modelling relied on the pre-formulated national values presented within the Seabird PVA Tool (Searle *et al.,* 2019). These pre-formulated values were derived from Horswill and Robinson (2015) and are deemed to be the most appropriate values in the absence of colony-specifics. The age at first breeding and maximum brood size

per pair parameters were also selected from the pre-formulated values within the Seabird PVA Tool (Searle *et al.,* 2019).

Table 4.1 SPA population demographic parameters for guillemot and razorbill

Species	SPA	Population count	SPA population size (adults)	Productivity rate +SD	Mean adult survival rate + SD	Mean immature age class 0-1 survival rate +SD	Mean immature age class 1-2 survival rate +SD	Mean immature age class 2-3 survival rate +SD	Mean immature age class 3-4 survival rate +SD	Mean immature age class 5-6 survival rate +SD
Guillemot	FFC SPA	Citation	83,214	0.715 ± 0.075						
		Latest count	141,814							
	Farne Islands SPA	Citation	65,751	0.823 ± 0.164	0.939 ± 0.015	0.560 ± 0.001	0.792 ± 0.001	0.917 ± 0.001	0.917 ± 0.001)	0.939 ± 0.015
		Latest count	62,085							
Razorbill	FFC SPA	Citation	21,140	0.653 ± 0.099	0.895 ± 0.067	0.630 ± 0.209	0.630 ± 0.209	0.895 ± (0.067)	0.895 ± (0.067)	0.895 ± (0.067)
		Latest count	59,055							

4.1.11 The outputs of the Seabird PVA Tool are set out in **Table 4.4**, **Table 4.6** and **Table 4.8** below. The metrics used to summarise the PVA results are based on the counterfactual of population growth calculated as the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion.

4.1.12 Three different approaches were taken for the PVA as follows:

- Applicant's upper level of predicted impact using 50% Displacement and 1% Mortality;
- Secretary of States upper level of predicted impact using 70% Displacement and 2% Mortality;
- Natural England's upper level of predicted impact using 70% Displacement and 5% Mortality.

Validation results

4.1.13 Prior to running PVA validation modelling was undertaken to provide context as to whether the demographic rates used for modelling are representative of the trends naturally exhibited in the population or colony being analysed to ensure the PVA is as robust as possible (in the absence of density dependence). In order to validate the model, historic population / colony size data is required to compare the models baseline population against.

4.1.14 For PVA modelling at the HRA level, when assessing impacts against the relevant qualifying species' colony from designated sites such as the FFC SPA, the colony has been consistently monitored since 1969 which allows for validation to be undertaken. A summary of the historic colony counts for the qualifying features of the FFC SPA are presented in **Table 4.2** and count for Farne Islands SPA in **Table 4.3**. The starting, or initial, population was set to the 2000 colony count for each feature for the FFC SPA and 2004 for the Farne Islands SPA in order to allow for comparison with recent exhibited colony trends.

4.1.15 Summaries of the model logs presenting the input demographic rates for the validation analysis is provided in **Appendix B**. With the exception of productivity rate, the demographic values are the models preformulated values which are based on the literature review conducted by Horswill & Robinson (2015).

Table 4.2 Flamborough and Filey Coast SPA historic colony counts for guillemot and razorbill

Species	Year			
	2000	2008	2017	2022
Guillemot	63,268	80,155	113,427	141,815
Razorbill	11,340	20,041	37,473	59,055

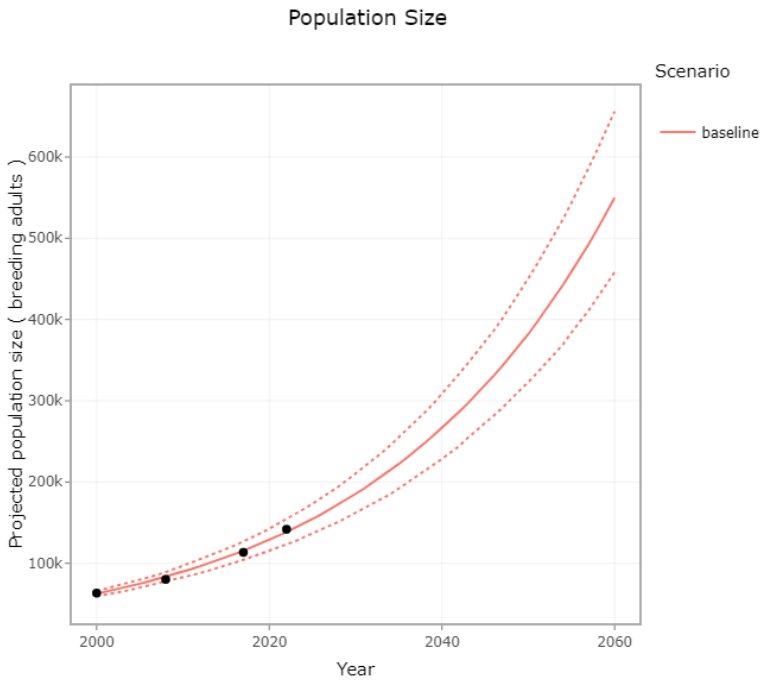
Table 4.3 Farne Islands SPA historic colony counts for guillemot and razorbill

Species	Year				
	2004	**2005**	**2006**	**2007**	**2008**
Guillemot	58,550	62,866	64,234	65,191	58,779
	2009	**2010**	**2011**	**2012**	**2013**
	64,489	62,116	64,289	65,762	67,064
	2014	**2015**	**2016**	**2017**	**2018**
	69,523	71,638	65,710	64,634	66,962
	2019	**2020**	**2021**	**2022**	**2023**
	85,816	84,973	84,334	79,285	62,085

Guillemot Validation for FFC SPA

4.1.16 As presented in **Figure 4.1**, the baseline population trend produced from the model matches closely with the actual exhibited colony growth trend. Therefore, the demographic rates used for guillemot (productivity rate of 0.715 and survival rate of 0.939) can be considered appropriate for analysis.

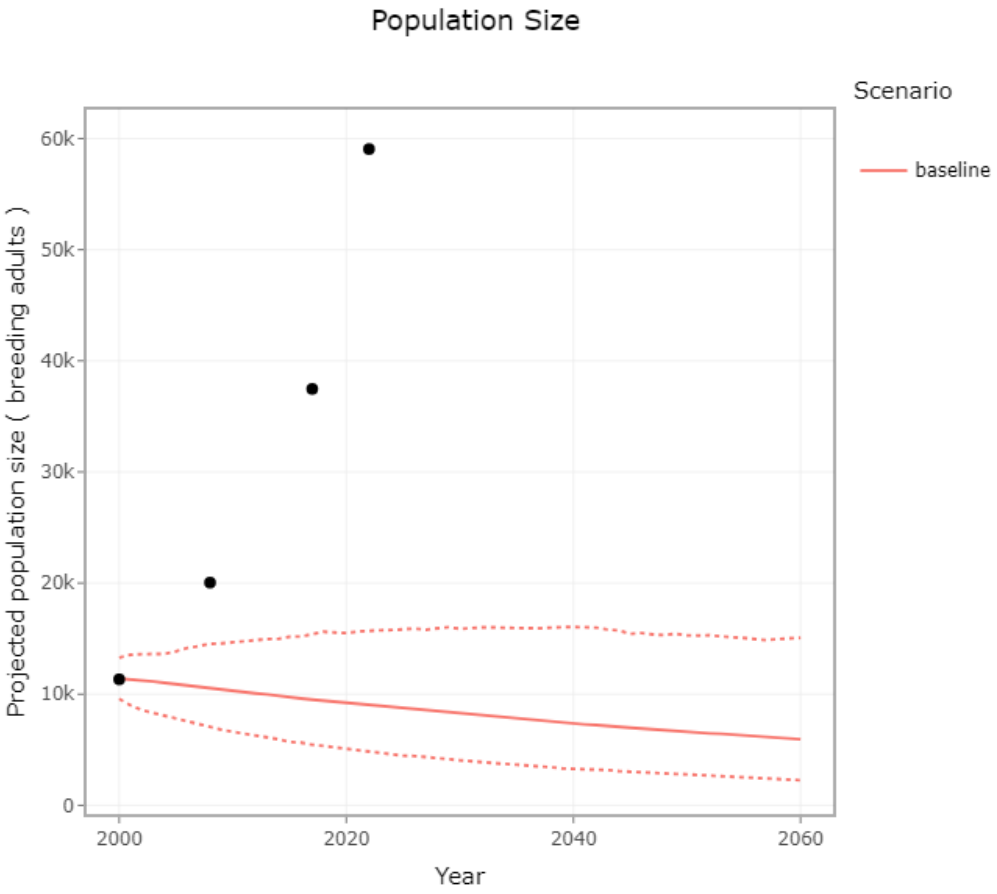
Figure 4.1 FFC SPA guillemot baseline PVA model validation



Razorbill Validation for FFC SPA

4.1.17 As presented in **Figure 4.2**, the baseline population trend produced from the PVA model when using the preformulated demographic rates, including productivity rate per pair of 0.653 results in a negative population decline. This is in complete contrast to observed counts where the colony trend shows a significant positive growth trend over a prolonged period of time at the FFC SPA colony (compound growth rate of +7.79% per annum between 2000 – 2022). This would suggest that there are other key variables that are not included within the current version of the PVA model that are having a significant effect on the population. Therefore, it is likely that the level of predicted impact from PVA modelling is overly precautionary.

Figure 4.2 FFC SPA razorbill baseline PVA model validation



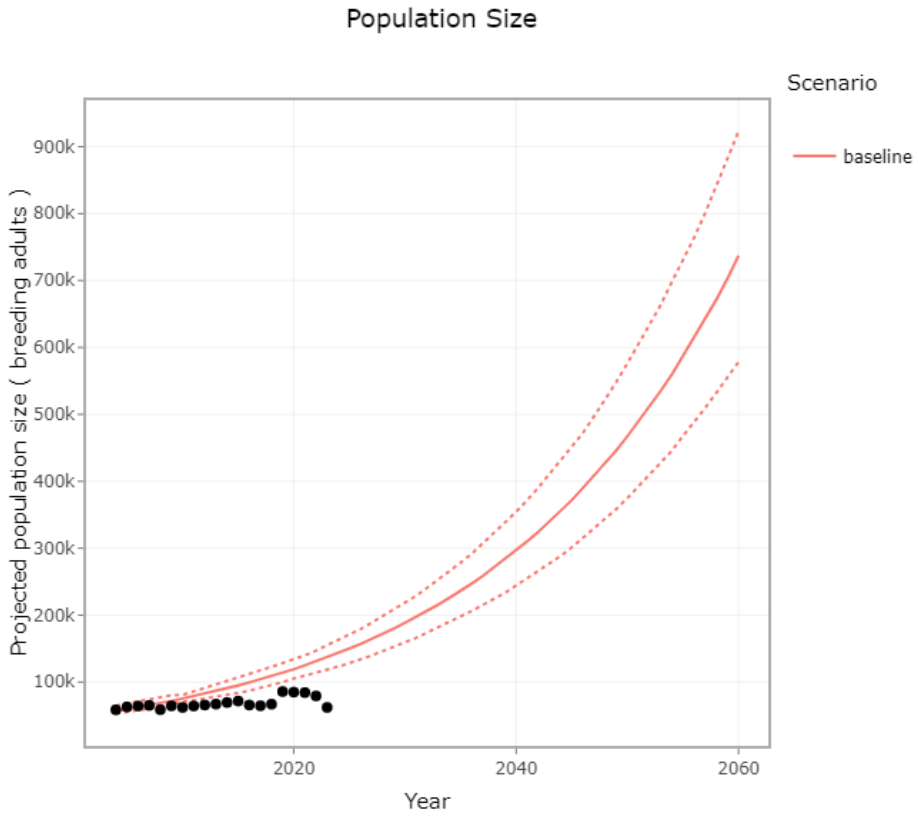
Guillemot Validation for Farne Islands SPA

4.1.18 As presented in **Figure 4.3**, the baseline population trend produced from the PVA model follows a positive exponential growth that differs from the colony data that stays relatively constant with no signs of exponential growth.

4.1.19 Potentially, the current data inputs within the density independent PVA model are not suitable for reflecting known population trends. It is possible that the local population dynamics lead to observed counts varying significantly from model

expectations, and therefore the current PVA methods cannot solely be relied upon for assessing likely population trends within the context of wind farm developments.

Figure 4.3 Farne Islands SPA guillemot baseline PVA model validation



Guillemot – Flamborough and Filey Coast SPA

Table 4.4 PVA results using Seabird PVA Tool for impacts apportioned to the Flamborough and Filey Coast SPA guillemot population showing displacement in-combination outputs for various scenarios

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
153.7	Applicant	Rampion 2 plus all consented projects only	273	0.998 (<0.001)	0.936 (0.004)	0.2%	6.4%
		Rampion 2 plus all consented projects (excluding Hornsea Four)	112	0.999 (<0.001)	0.973 (0.004)	0.1%	2.7%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	277	0.998 (<0.001)	0.933 (0.004)	0.2%	6.7%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	115	0.999 (<0.001)	0.973 (0.004)	0.1%	2.7%
		All projects	359	0.997 (<0.001)	0.917 (0.004)	0.3%	8.3%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
		All projects (excluding Hornsea Four)	197	0.998 (<0.001)	0.953 (0.004)	0.2%	4.7%
	Secretary of State	Rampion 2 plus all consented projects only	765	0.994 (<0.001)	0.829 (0.003)	0.6%	17.1%
		Rampion 2 plus all consented projects (excluding Hornsea Four)	312	0.998 (<0.001)	0.926 (0.004)	0.2%	7.4%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	774	0.994 (<0.001)	0.826 (0.003)	0.6%	17.4%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	322	0.997 (<0.001)	0.923 (0.004)	0.3%	7.7%
		All projects	1,005	0.992 (<0.001)	0.781 (0.003)	0.8%	21.9%
		All projects (excluding Hornsea Four)	553	0.996 (<0.001)	0.873 (0.004)	0.4%	12.7%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
	Natural England	Rampion 2 plus all consented projects only	1,911	0.985 (<0.001)	0.624 (0.003)	1.5%	37.6%
		Rampion 2 plus all consented projects (excluding Hornsea Four)	781	0.994 (<0.001)	0.826 (0.003)	0.6%	17.4%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,936	0.985 (<0.001)	0.619 (0.003)	1.5%	38.1%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	805	0.994 (<0.001)	0.820 (0.003)	0.6%	18.0%
		All projects	2,513	0.980 (<0.001)	0.538 (0.002)	2.0%	46.2%
		All projects (excluding Hornsea Four)	1,382	0.989 (<0.001)	0.713 (0.003)	1.1%	28.7%
95.2 km	Applicant	Rampion 2 plus all consented projects only	206	0.998 (<0.001)	0.949 (0.004)	0.2%	5.1%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
		Rampion 2 plus all consented projects (excluding Hornsea Four)	45	1.000 (<0.001)	0.990 (0.004)	0.0%	1.0%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	210	0.998 (<0.001)	0.949 (0.004)	0.2%	5.1%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	48	1.000 (<0.001)	0.990 (0.004)	0.0%	1.0%
		All projects	292	0.998 (<0.001)	0.930 (0.004)	0.2%	7.0%
		All projects (excluding Hornsea Four)	131	0.999 (<0.001)	0.969 (0.004)	0.1%	3.1%
	Secretary of State	Rampion 2 plus all consented projects only	578	0.995 (<0.001)	0.867 (0.004)	0.5%	13.3%
		Rampion 2 plus all consented projects (excluding Hornsea Four)	125	0.999 (<0.001)	0.969 (0.004)	0.1%	3.1%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	598	0.995 (<0.001)	0.867 (0.003)	0.5%	13.3%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	135	0.999 (<0.001)	0.966 (0.004)	0.1%	3.4%
		All projects	818	0.994 (<0.001)	0.817 (0.004)	0.6%	18.3%
		All projects (excluding Hornsea Four)	366	0.997 (<0.001)	0.913 (0.004)	0.3%	8.7%
	Natural England	Rampion 2 plus all consented projects only	1,444	0.989 (<0.001)	0.700 (0.003)	1.1%	30.0%
		Rampion 2 plus all consented projects (excluding Hornsea Four)	313	0.998 (<0.001)	0.926 (0.004)	0.2%	7.4%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	1,469	0.988 (<0.001)	0.695 (0.003)	1.2%	30.5%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric (30 years)		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four)	338	0.997 (<0.001)	0.920 (0.004)	0.3%	8.0%
		All projects	2,045	0.984 (<0.001)	0.604 (0.003)	1.6%	39.6%
		All projects (excluding Hornsea Four)	915	0.993 (<0.001)	0.800 (0.003)	0.7%	20.0%

4.1.20 Following analysis of the range of outputs from the in-combination PVAs for the guillemot feature of the Flamborough and Filey Coast SPA they are largely indicative of minimal reductions (**Table 4.4**). The maximum predicted impact is when Hornsea Four is included in the in-combination assessments (that incorporate the 153.7 km foraging range) following the 70% Displacement and 5% Mortality of Natural England's preferred approach. This PVA predicts a potential 46.2% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a decrease in growth rate of 2.0%. However, this uppermost prediction is viewed as highly precautionary, as evidence from operational OWFs indicate that displacement rates for auks are significantly lower than those advocated for use in Natural England's preferred approach (MacArthur Green, 2023 and APEM, 2022). Therefore, the Applicant considers the more realistic scenario following the Applicant's Approach, which predicts a maximum potential for all modelled scenarios of 8.3% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a reduction in growth rate of 0.3% to be most appropriate for concluding assessments.

4.1.21 Colony-specific population growth trends for guillemot show a high degree of variability, likely associated with prey resources (Wanless *et al.,* 2005) (**Table 4.5**). With the projected growth rate not expected to vary significantly from that of the baseline population in all modelling scenarios, the PVA model outputs fall within the high level of natural variation of population growth, indicating little to no true impact is likely.

Table 4.5 Average annual colony growth rate for guillemot colony for Flamborough and Filey Coast SPA between 2000 and 2022

Species	2000-2022	2008-2022	2017-2022
Guillemot	3.74%	4.16%	4.57%

4.1.22 When considering the displacement impacts from the Project in-combination with other plans and projects on the guillemot feature of the Flamborough to Filey Coast SPA, regardless of the impact scenario chosen the colony would still increase in size. This is due to the favourable condition of the colony as demonstrated by the consistent increasing growth rate from both historic and recent colony counts (**Table 4.5**). The favourable condition of the colony suggests strong resilience to any apparent change such as any potential displacement effect, and so the integrity of the guillemot feature of the FFC SPA will be maintained.

4.1.23 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Flamborough to Filey Coast SPA in relation to displacement effects in the operation and maintenance phase from the project in-combination and, therefore, subject to natural change guillemot will be maintained as a feature in the long term.

Razorbill – Flamborough and Filey Coast SPA

Table 4.6 PVA results using Seabird PVA Tool for impacts apportioned to the Flamborough and Filey Coast SPA guillemot population showing displacement in-combination outputs for various scenarios

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
164.6	Applicant	Rampion 2 plus all consented projects only	49	0.999 (<0.001)	0.971 (0.012)	0.1%	2.9%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	49	0.999 (<0.001)	0.971 (0.012)	0.1%	2.9%
		All projects	78	0.998 (<0.001)	0.953 (0.012)	0.2%	4.7%
	Secretary of State	Rampion 2 plus all consented projects only	136	0.997 (<0.001)	0.919 (0.012)	0.3%	8.1%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	138	0.997 (<0.001)	0.919 (0.012)	0.3%	8.1%
		All projects	218	0.996 (<0.001)	0.873 (0.011)	0.4%	12.7%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
122.2	Natural England	Rampion 2 plus all consented projects only	341	0.993 (<0.001)	0.808 (0.011)	0.7%	19.2%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	344	0.993 (<0.001)	0.808 (0.011)	0.7%	19.2%
		All projects	544	0.989 (<0.001)	0.713 (0.010)	1.1%	28.7%
	Applicant	Rampion 2 plus all consented projects only	42	0.999 (<0.001)	0.975 (0.012)	0.1%	2.5%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	42	0.999 (<0.001)	0.975 (0.012)	0.1%	2.5%
		All projects	71	0.999 (<0.001)	0.957 (0.012)	0.1%	4.3%
	Secretary of State	Rampion 2 plus all consented projects only	116	0.998 (<0.001)	0.930 (0.012)	0.2%	7.0%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	118	0.998 (<0.001)	0.930 (0.012)	0.2%	7.0%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
		All projects	198	0.996 (<0.001)	0.886 (0.011)	0.4%	11.4%
	Natural England	Rampion 2 plus all consented projects only	291	0.994 (<0.001)	0.836 (0.011)	0.6%	16.4%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	294	0.994 (<0.001)	0.833 (0.011)	0.6%	16.7%
		All projects	494	0.990 (<0.001)	0.734 (0.010)	1.0%	26.6%

4.1.24 Following analysis of the range of outputs from the in-combination PVAs for the razorbill feature of the Flamborough and Filey Coast SPA they are largely indicative of minimal reductions (**Table 4.6**). The maximum predicted impact is reached when a foraging range of 164.6 km is used to assess in-combination projects and the 70% Displacement and 5% Mortality of Natural England's preferred approach is used. This PVA predicts a potential 28.7% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a decrease in growth rate of 1.1%. However, this uppermost prediction is viewed as highly precautionary, as evidence from operational OWFs indicate that displacement rates for auks are significantly lower than those advocated for use in Natural England's preferred approach (MacArthur Green, 2023 and APEM, 2022). Therefore, the Applicant considers the more realistic scenario following the Applicant's Approach, which predicts a maximum potential for all modelled scenarios of 4.7% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a reduction in growth rate of 0.2% to be most appropriate for concluding assessments.

4.1.25 Colony-specific population growth trends for razorbill show a high degree of variability (**Table 4.7**). With the projected growth rate not expected to vary significantly from that of the baseline population in all modelling scenarios, the PVA model outputs fall within the high level of natural variation of population growth, indicating little to no true impact is likely.

Table 4.7 Average annual colony growth rate for razorbill colony for Flamborough and Filey Coast SPA between 2000 and 2022

Species	2000-2022	2008-2022	2017-2022
Razorbill	7.79%	8.02%	9.52%

4.1.26 Regardless of the impact scenario chosen the colony would still increase in size. This is due to the favourable condition of the colony as demonstrated by the consistent increasing growth rate from both historic and recent colony counts (**Table 4.7**). The favourable condition of the colony suggests strong resilience to any apparent change such as any potential displacement effect, and so the integrity of the razorbill feature of the FFC SPA will be maintained.

4.1.27 There is, therefore, no potential for an Adverse Effect on Site Integrity (AEoSI) to the conservation objectives of the razorbill feature of Flamborough to Filey Coast SPA in relation to displacement effects in the operation and maintenance phase from the Project in-combination and, therefore, subject to natural change razorbill will be maintained as a feature in the long term.

Guillemot – Farne Islands SPA

Table 4.8 PVA results using Seabird PVA Tool for impacts apportioned to the Farne Islands SPA guillemot population showing displacement in-combination outputs for various scenarios

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
153.7	Applicant	Rampion 2 plus all consented projects only	40	0.999 (<0.001)	0.979 (0.005)	0.1%	2.1%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	43	0.999 (<0.001)	0.976 (0.005)	0.1%	2.4%
		All projects	76	0.999 (<0.001)	0.959 (0.005)	0.1%	4.1%
	Secretary of State	Rampion 2 plus all consented projects only	112	0.998 (<0.001)	0.939 (0.005)	0.2%	6.1%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	120	0.998 (<0.001)	0.936 (0.005)	0.2%	6.4%
		All projects	211	0.996 (<0.001)	0.888 (0.005)	0.4%	11.2%

Foraging range (km)	Approach	Scenario	Additional mortality (breeding adult birds)	Density independent counterfactual metric		Reduction in growth rate	Reduction in population size
				Median growth rate (SD)	Median pop.size (SD)		
	Natural England	Rampion 2 plus all consented projects only	280	0.995 (<0.001)	0.855 (0.005)	0.5%	14.5%
		Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented	301	0.995 (<0.001)	0.846 (0.005)	0.5%	15.4%
		All projects	528	0.990 (<0.001)	0.743 (0.004)	1.0%	25.7%

4.1.28 Following analysis of the range of outputs from the in-combination PVAs for the guillemot feature of the Farne Islands SPA they are largely indicative of minimal reductions (**Table 4.8**). The maximum predicted impact is reached when using a 70% Displacement and 5% Mortality of Natural England's preferred approach. This PVA predicts a potential 23.6% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a decrease in growth rate of 0.9% per annum. However, this uppermost prediction is viewed as highly precautionary, as recent evidence from operational OWFs indicate that displacement rates for auks are significantly lower than those advocated for use in Natural England's preferred approach (MacArthur Green, 2023 and APEM, 2022 & 2023). Therefore, the Applicant considers the more realistic scenario following the Applicant's Approach, which predicts a maximum potential for all modelled scenarios of 4.1% reduction in population size after 30 years in contrast to the unimpacted baseline scenario, with a reduction in growth rate of 0.1% to be most appropriate for concluding assessments.

4.1.29 Colony-specific population growth trends for guillemot show a high degree of variability, likely associated with prey resources (Wanless *et al.,* 2005) (**Table 4.9**). With the projected growth rate not expected to vary significantly from that of the baseline population in all modelling scenarios, the PVA model outputs fall within the high level of natural variation of population growth, indicating little to no true impact is likely.

Table 4.9 Average annual colony growth rate for guillemot colony for Farne Islands SPA between 1990 and 2023

Species	1990-2023	1997-2023	2004-2023	2011-2023	2018-2023
Guillemot	3.01%	1.08%	0.31%	-0.29%	-1.50%

4.1.30 When considering the displacement impacts from the Project in-combination with other plans and projects on the guillemot feature of the Farne Islands SPA, the variability in colony growth and the Project's minimal contribution, it is not expected that any scenario would significantly affect the predicted population trend. When considering the annual colony growth rates (**Table 4.9**) the guillemot feature at the Farne Islands SPA has shown reductions since the early 2000's. The reductions in colony growth are a 'natural' occurrence in many guillemot colonies, with mass mortality events occurring sporadically within non-breeding seasons. This has been described in 2013 – 2014 and 2018 – 2019 (Burnell *et al.*, 2023). In addition, recent surveys on the effects of the Highly Pathogenic Avian Influenza (HPAI) on seabird colonies around the UK have shown declines in guillemots at the Farne Islands SPA since the outbreak of the virus (Tremlett *et al.*, 2024), further aiding in the represented colony growth reduction.

4.1.31 A consideration needs to be had for the in-combination results that are being modelled within the PVA tool. When considering only consented projects and the Proposed Development, there are currently no in-combination values apportioned to the Farne Islands SPA within the breeding season. It is expected that if the

presence of OWFs were to effect guillemots then the greatest level of effect would be expected during the breeding season where birds foraging is restricted, and birds are under additional stressors from breeding. As connectivity is therefore limited to the non-breeding season, the Applicant therefore considers a displacement rate of 50% displacement and 1% mortality to be most appropriate, which at most predicts a reduction in growth rate of 0.1% per annum. Regardless of the current status of the population such a reduction in growth rate would almost certainly be indistinguishable from natural fluctuations in the population. Furthermore the Applicant's maintains the position that the project's contribution to any in-combination effect can be considered non material given the highly limited connectivity and minimal level of predicted impact.

4.1.32 There is, therefore, no potential for an AEoI to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to displacement effects in the operation and maintenance phase from the Project in-combination and, therefore, subject to natural change guillemot will be maintained as a feature in the long term.

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Appendix A
Displacement matrices

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects (Using 153.7km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	5	11	16	22	27	55	109	164	218	273	328	382	437	491	546
10	55	109	164	218	273	546	1,092	1,638	2,184	2,731	3,277	3,823	4,369	4,915	5,461
15	82	164	246	328	410	819	1,638	2,457	3,277	4,096	4,915	5,734	6,553	7,372	8,192
20	109	218	328	437	546	1,092	2,184	3,277	4,369	5,461	6,553	7,645	8,738	9,830	10,922
25	137	273	410	546	683	1,365	2,731	4,096	5,461	6,826	8,192	9,557	10,922	12,287	13,653
30	164	328	491	655	819	1,638	3,277	4,915	6,553	8,192	9,830	11,468	13,107	14,745	16,383
35	191	382	573	765	956	1,911	3,823	5,734	7,645	9,557	11,468	13,380	15,291	17,202	19,114
40	218	437	655	874	1,092	2,184	4,369	6,553	8,738	10,922	13,107	15,291	17,475	19,660	21,844
50	273	546	819	1,092	1,365	2,731	5,461	8,192	10,922	13,653	16,383	19,114	21,844	24,575	27,305
60	328	655	983	1,311	1,638	3,277	6,553	9,830	13,107	16,383	19,660	22,936	26,213	29,490	32,766
70	382	765	1,147	1,529	1,911	3,823	7,645	11,468	15,291	19,114	22,936	26,759	30,582	34,405	38,227
80	437	874	1,311	1,748	2,184	4,369	8,738	13,107	17,475	21,844	26,213	30,582	34,951	39,320	43,688
90	491	983	1,474	1,966	2,457	4,915	9,830	14,745	19,660	24,575	29,490	34,405	39,320	44,235	49,149
100	546	1,092	1,638	2,184	2,731	5,461	10,922	16,383	21,844	27,305	32,766	38,227	43,688	49,149	54,611
		<1% increase in baseline mortality				>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects (Using 95.2km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	6	12	18	23	29	58	117	175	234	292	351	409	468	526	584
10	58	117	175	234	292	584	1,169	1,753	2,338	2,922	3,506	4,091	4,675	5,260	5,844
15	88	175	263	351	438	877	1,753	2,630	3,506	4,383	5,260	6,136	7,013	7,889	8,766
20	117	234	351	468	584	1,169	2,338	3,506	4,675	5,844	7,013	8,182	9,350	10,519	11,688
25	146	292	438	584	731	1,461	2,922	4,383	5,844	7,305	8,766	10,227	11,688	13,149	14,610
30	175	351	526	701	877	1,753	3,506	5,260	7,013	8,766	10,519	12,273	14,026	15,779	17,532
35	205	409	614	818	1,023	2,045	4,091	6,136	8,182	10,227	12,273	14,318	16,363	18,409	20,454
40	234	468	701	935	1,169	2,338	4,675	7,013	9,350	11,688	14,026	16,363	18,701	21,039	23,376
50	351	701	1,052	1,403	1,753	3,506	7,013	10,519	14,026	17,532	21,039	24,545	28,051	31,558	35,064
60	351	701	1,052	1,403	1,753	3,506	7,013	10,519	14,026	17,532	21,039	24,545	28,051	31,558	35,064
70	409	818	1,227	1,636	2,045	4,091	8,182	12,273	16,363	20,454	24,545	28,636	32,727	36,818	40,908
80	468	935	1,403	1,870	2,338	4,675	9,350	14,026	18,701	23,376	28,051	32,727	37,402	42,077	46,752
90	526	1,052	1,578	2,104	2,630	5,260	10,519	15,779	21,039	26,298	31,558	36,818	42,077	47,337	52,597
100	584	1,169	1,753	2,338	2,922	5,844	11,688	17,532	23,376	29,220	35,064	40,908	46,752	52,597	58,441

<1% increase in baseline mortality | >1% increase in baseline mortality | >1% threshold for citation population

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects excluding Hornsea Four (Using 153.7km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	2	4	7	9	11	22	45	67	89	112	134	156	178	201	223
10	22	45	67	89	112	223	446	669	892	1,115	1,338	1,561	1,784	2,007	2,230
15	33	67	100	134	167	335	669	1,004	1,338	1,673	2,007	2,342	2,676	3,011	3,345
20	45	89	134	178	223	446	892	1,338	1,784	2,230	2,676	3,122	3,568	4,014	4,460
25	56	112	167	223	279	558	1,115	1,673	2,230	2,788	3,345	3,903	4,460	5,018	5,575
30	67	134	201	268	335	669	1,338	2,007	2,676	3,345	4,014	4,683	5,352	6,021	6,690
35	78	156	234	312	390	781	1,561	2,342	3,122	3,903	4,683	5,464	6,244	7,025	7,806
40	89	178	268	357	446	892	1,784	2,676	3,568	4,460	5,352	6,244	7,136	8,029	8,921
50	112	223	335	446	558	1,115	2,230	3,345	4,460	5,575	6,690	7,806	8,921	10,036	11,151
60	134	268	401	535	669	1,338	2,676	4,014	5,352	6,690	8,029	9,367	10,705	12,043	13,381
70	156	312	468	624	781	1,561	3,122	4,683	6,244	7,806	9,367	10,928	12,489	14,050	15,611
80	178	357	535	714	892	1,784	3,568	5,352	7,136	8,921	10,705	12,489	14,273	16,057	17,841
90	201	401	602	803	1,004	2,007	4,014	6,021	8,029	10,036	12,043	14,050	16,057	18,064	20,071
100	223	446	669	892	1,115	2,230	4,460	6,690	8,921	11,151	13,381	15,611	17,841	20,071	22,302

<1% increase in baseline mortality	>1% increase in baseline mortality	>1% threshold for citation population

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects excluding Hornsea Four(Using 95.2km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	4	9	18	27	36	45	54	63	72	81	90
10	9	18	27	36	45	90	179	269	358	448	537	627	716	806	896
15	13	27	40	54	67	134	269	403	537	672	806	940	1,075	1,209	1,343
20	18	36	54	72	90	179	358	537	716	896	1,075	1,254	1,433	1,612	1,791
25	22	45	67	90	112	224	448	672	896	1,119	1,343	1,567	1,791	2,015	2,239
30	27	54	81	107	134	269	537	806	1,075	1,343	1,612	1,881	2,149	2,418	2,687
35	31	63	94	125	157	313	627	940	1,254	1,567	1,881	2,194	2,508	2,821	3,134
40	36	72	107	143	179	358	716	1,075	1,433	1,791	2,149	2,508	2,866	3,224	3,582
50	54	107	161	215	269	537	1,075	1,612	2,149	2,687	3,224	3,761	4,299	4,836	5,373
60	54	107	161	215	269	537	1,075	1,612	2,149	2,687	3,224	3,761	4,299	4,836	5,373
70	63	125	188	251	313	627	1,254	1,881	2,508	3,134	3,761	4,388	5,015	5,642	6,269
80	72	143	215	287	358	716	1,433	2,149	2,866	3,582	4,299	5,015	5,732	6,448	7,164
90	81	161	242	322	403	806	1,612	2,418	3,224	4,030	4,836	5,642	6,448	7,254	8,060
100	90	179	269	358	448	896	1,791	2,687	3,582	4,478	5,373	6,269	7,164	8,060	8,956
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects (using 153.7km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	6	11	17	22	28	55	111	166	221	277	332	387	443	498	553
10	55	111	166	221	277	553	1,106	1,659	2,213	2,766	3,319	3,872	4,425	4,978	5,531
15	83	166	249	332	415	830	1,659	2,489	3,319	4,148	4,978	5,808	6,638	7,467	8,297
20	111	221	332	443	553	1,106	2,213	3,319	4,425	5,531	6,638	7,744	8,850	9,956	11,063
25	138	277	415	553	691	1,383	2,766	4,148	5,531	6,914	8,297	9,680	11,063	12,445	13,828
30	166	332	498	664	830	1,659	3,319	4,978	6,638	8,297	9,956	11,616	13,275	14,935	16,594
35	194	387	581	774	968	1,936	3,872	5,808	7,744	9,680	11,616	13,552	15,488	17,424	19,360
40	221	443	664	885	1,106	2,213	4,425	6,638	8,850	11,063	13,275	15,488	17,700	19,913	22,125
50	277	553	830	1,106	1,383	2,766	5,531	8,297	11,063	13,828	16,594	19,360	22,125	24,891	27,657
60	332	664	996	1,328	1,659	3,319	6,638	9,956	13,275	16,594	19,913	23,232	26,550	29,869	33,188
70	387	774	1,162	1,549	1,936	3,872	7,744	11,616	15,488	19,360	23,232	27,103	30,975	34,847	38,719
80	443	885	1,328	1,770	2,213	4,425	8,850	13,275	17,700	22,125	26,550	30,975	35,400	39,826	44,251
90	498	996	1,493	1,991	2,489	4,978	9,956	14,935	19,913	24,891	29,869	34,847	39,826	44,804	49,782
100	553	1,106	1,659	2,213	2,766	5,531	11,063	16,594	22,125	27,657	33,188	38,719	44,251	49,782	55,313

<1% increase in baseline mortality | >1% increase in baseline mortality | >1% threshold for citation population

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects (using 95.2km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	4	8	13	17	21	42	84	126	168	210	252	294	336	378	420
10	42	84	126	168	210	420	839	1,259	1,679	2,098	2,518	2,938	3,357	3,777	4,197
15	63	126	189	252	315	630	1,259	1,889	2,518	3,148	3,777	4,407	5,036	5,666	6,295
20	84	168	252	336	420	839	1,679	2,518	3,357	4,197	5,036	5,875	6,715	7,554	8,393
25	105	210	315	420	525	1,049	2,098	3,148	4,197	5,246	6,295	7,344	8,393	9,443	10,492
30	126	252	378	504	630	1,259	2,518	3,777	5,036	6,295	7,554	8,813	10,072	11,331	12,590
35	147	294	441	588	734	1,469	2,938	4,407	5,875	7,344	8,813	10,282	11,751	13,220	14,689
40	168	336	504	671	839	1,679	3,357	5,036	6,715	8,393	10,072	11,751	13,430	15,108	16,787
50	210	420	630	839	1,049	2,098	4,197	6,295	8,393	10,492	12,590	14,689	16,787	18,885	20,984
60	252	504	755	1,007	1,259	2,518	5,036	7,554	10,072	12,590	15,108	17,626	20,144	22,662	25,180
70	294	588	881	1,175	1,469	2,938	5,875	8,813	11,751	14,689	17,626	20,564	23,502	26,439	29,377
80	336	671	1,007	1,343	1,679	3,357	6,715	10,072	13,430	16,787	20,144	23,502	26,859	30,216	33,574
90	378	755	1,133	1,511	1,889	3,777	7,554	11,331	15,108	18,885	22,662	26,439	30,216	33,993	37,770
100	420	839	1,259	1,679	2,098	4,197	8,393	12,590	16,787	20,984	25,180	29,377	33,574	37,770	41,967
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects excluding Hornsea Four (using 153.7km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	2	5	7	9	12	23	46	69	92	115	138	161	184	207	230
10	23	46	69	92	115	230	460	690	920	1,150	1,380	1,610	1,840	2,070	2,300
15	35	69	104	138	173	345	690	1,035	1,380	1,725	2,070	2,415	2,761	3,106	3,451
20	46	92	138	184	230	460	920	1,380	1,840	2,300	2,761	3,221	3,681	4,141	4,601
25	58	115	173	230	288	575	1,150	1,725	2,300	2,876	3,451	4,026	4,601	5,176	5,751
30	69	138	207	276	345	690	1,380	2,070	2,761	3,451	4,141	4,831	5,521	6,211	6,901
35	81	161	242	322	403	805	1,610	2,415	3,221	4,026	4,831	5,636	6,441	7,246	8,051
40	92	184	276	368	460	920	1,840	2,761	3,681	4,601	5,521	6,441	7,361	8,282	9,202
50	115	230	345	460	575	1,150	2,300	3,451	4,601	5,751	6,901	8,051	9,202	10,352	11,502
60	138	276	414	552	690	1,380	2,761	4,141	5,521	6,901	8,282	9,662	11,042	12,422	13,803
70	161	322	483	644	805	1,610	3,221	4,831	6,441	8,051	9,662	11,272	12,882	14,493	16,103
80	184	368	552	736	920	1,840	3,681	5,521	7,361	9,202	11,042	12,882	14,723	16,563	18,403
90	207	414	621	828	1,035	2,070	4,141	6,211	8,282	10,352	12,422	14,493	16,563	18,633	20,704
100	230	460	690	920	1,150	2,300	4,601	6,901	9,202	11,502	13,803	16,103	18,403	20,704	23,004
		<1% increase in baseline mortality				>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects excluding Hornsea Four (using 95.2km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	10	19	29	39	48	58	68	77	87	97
10	10	19	29	39	48	97	193	290	386	483	579	676	773	869	966
15	14	29	43	58	72	145	290	435	579	724	869	1,014	1,159	1,304	1,449
20	19	39	58	77	97	193	386	579	773	966	1,159	1,352	1,545	1,738	1,932
25	24	48	72	97	121	241	483	724	966	1,207	1,449	1,690	1,932	2,173	2,415
30	29	58	87	116	145	290	579	869	1,159	1,449	1,738	2,028	2,318	2,608	2,897
35	34	68	101	135	169	338	676	1,014	1,352	1,690	2,028	2,366	2,704	3,042	3,380
40	39	77	116	155	193	386	773	1,159	1,545	1,932	2,318	2,704	3,091	3,477	3,863
50	48	97	145	193	241	483	966	1,449	1,932	2,415	2,897	3,380	3,863	4,346	4,829
60	58	116	174	232	290	579	1,159	1,738	2,318	2,897	3,477	4,056	4,636	5,215	5,795
70	68	135	203	270	338	676	1,352	2,028	2,704	3,380	4,056	4,733	5,409	6,085	6,761
80	77	155	232	309	386	773	1,545	2,318	3,091	3,863	4,636	5,409	6,181	6,954	7,727
90	87	174	261	348	435	869	1,738	2,608	3,477	4,346	5,215	6,085	6,954	7,823	8,692
100	97	193	290	386	483	966	1,932	2,897	3,863	4,829	5,795	6,761	7,727	8,692	9,658
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for all projects (using 153.7km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	7	14	22	29	36	72	144	215	287	359	431	503	574	646	718
10	72	144	215	287	359	718	1,436	2,154	2,871	3,589	4,307	5,025	5,743	6,461	7,179
15	108	215	323	431	538	1,077	2,154	3,230	4,307	5,384	6,461	7,538	8,614	9,691	10,768
20	144	287	431	574	718	1,436	2,871	4,307	5,743	7,179	8,614	10,050	11,486	12,922	14,357
25	179	359	538	718	897	1,795	3,589	5,384	7,179	8,973	10,768	12,563	14,357	16,152	17,947
30	215	431	646	861	1,077	2,154	4,307	6,461	8,614	10,768	12,922	15,075	17,229	19,382	21,536
35	251	503	754	1,005	1,256	2,513	5,025	7,538	10,050	12,563	15,075	17,588	20,100	22,613	25,125
40	287	574	861	1,149	1,436	2,871	5,743	8,614	11,486	14,357	17,229	20,100	22,972	25,843	28,715
50	359	718	1,077	1,436	1,795	3,589	7,179	10,768	14,357	17,947	21,536	25,125	28,715	32,304	35,893
60	431	861	1,292	1,723	2,154	4,307	8,614	12,922	17,229	21,536	25,843	30,150	34,458	38,765	43,072
70	503	1,005	1,508	2,010	2,513	5,025	10,050	15,075	20,100	25,125	30,150	35,175	40,200	45,226	50,251
80	574	1,149	1,723	2,297	2,871	5,743	11,486	17,229	22,972	28,715	34,458	40,200	45,943	51,686	57,429
90	646	1,292	1,938	2,584	3,230	6,461	12,922	19,382	25,843	32,304	38,765	45,226	51,686	58,147	64,608
100	718	1,436	2,154	2,871	3,589	7,179	14,357	21,536	28,715	35,893	43,072	50,251	57,429	64,608	71,787

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for all projects (using 95.2km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	6	12	18	23	29	58	117	175	234	292	351	409	468	526	584
10	58	117	175	234	292	584	1,169	1,753	2,338	2,922	3,506	4,091	4,675	5,260	5,844
15	88	175	263	351	438	877	1,753	2,630	3,506	4,383	5,260	6,136	7,013	7,889	8,766
20	117	234	351	468	584	1,169	2,338	3,506	4,675	5,844	7,013	8,182	9,350	10,519	11,688
25	146	292	438	584	731	1,461	2,922	4,383	5,844	7,305	8,766	10,227	11,688	13,149	14,610
30	175	351	526	701	877	1,753	3,506	5,260	7,013	8,766	10,519	12,273	14,026	15,779	17,532
35	205	409	614	818	1,023	2,045	4,091	6,136	8,182	10,227	12,273	14,318	16,363	18,409	20,454
40	234	468	701	935	1,169	2,338	4,675	7,013	9,350	11,688	14,026	16,363	18,701	21,039	23,376
50	292	584	877	1,169	1,461	2,922	5,844	8,766	11,688	14,610	17,532	20,454	23,376	26,298	29,220
60	351	701	1,052	1,403	1,753	3,506	7,013	10,519	14,026	17,532	21,039	24,545	28,051	31,558	35,064
70	409	818	1,227	1,636	2,045	4,091	8,182	12,273	16,363	20,454	24,545	28,636	32,727	36,818	40,908
80	468	935	1,403	1,870	2,338	4,675	9,350	14,026	18,701	23,376	28,051	32,727	37,402	42,077	46,752
90	526	1,052	1,578	2,104	2,630	5,260	10,519	15,779	21,039	26,298	31,558	36,818	42,077	47,337	52,597
100	584	1,169	1,753	2,338	2,922	5,844	11,688	17,532	23,376	29,220	35,064	40,908	46,752	52,597	58,441
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for all projects excluding Hornsea Four (using 153.7km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	4	8	12	16	20	39	79	118	158	197	237	276	316	355	395
10	39	79	118	158	197	395	790	1,184	1,579	1,974	2,369	2,763	3,158	3,553	3,948
15	59	118	178	237	296	592	1,184	1,776	2,369	2,961	3,553	4,145	4,737	5,329	5,922
20	79	158	237	316	395	790	1,579	2,369	3,158	3,948	4,737	5,527	6,316	7,106	7,896
25	99	197	296	395	493	987	1,974	2,961	3,948	4,935	5,922	6,909	7,896	8,882	9,869
30	118	237	355	474	592	1,184	2,369	3,553	4,737	5,922	7,106	8,290	9,475	10,659	11,843
35	138	276	415	553	691	1,382	2,763	4,145	5,527	6,909	8,290	9,672	11,054	12,435	13,817
40	158	316	474	632	790	1,579	3,158	4,737	6,316	7,896	9,475	11,054	12,633	14,212	15,791
50	197	395	592	790	987	1,974	3,948	5,922	7,896	9,869	11,843	13,817	15,791	17,765	19,739
60	237	474	711	947	1,184	2,369	4,737	7,106	9,475	11,843	14,212	16,581	18,949	21,318	23,687
70	276	553	829	1,105	1,382	2,763	5,527	8,290	11,054	13,817	16,581	19,344	22,107	24,871	27,634
80	316	632	947	1,263	1,579	3,158	6,316	9,475	12,633	15,791	18,949	22,107	25,266	28,424	31,582
90	355	711	1,066	1,421	1,776	3,553	7,106	10,659	14,212	17,765	21,318	24,871	28,424	31,977	35,530
100	395	790	1,184	1,579	1,974	3,948	7,896	11,843	15,791	19,739	23,687	27,634	31,582	35,530	39,478
		<1% increase in baseline mortality					>1% increase in baseline mortality				>1% threshold for citation population				

FFC SPA guillemot in-combination operation and maintenance phase annual displacement matrix for all projects excluding Hornsea Four(using 95.2km foraging range)

	Mortality rates (%)														
Displacement (%)	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	3	5	8	10	13	26	52	78	105	131	157	183	209	235	261
10	26	52	78	105	131	261	523	784	1,045	1,307	1,568	1,829	2,091	2,352	2,613
15	39	78	118	157	196	392	784	1,176	1,568	1,960	2,352	2,744	3,136	3,528	3,920
20	52	105	157	209	261	523	1,045	1,568	2,091	2,613	3,136	3,658	4,181	4,704	5,226
25	65	131	196	261	327	653	1,307	1,960	2,613	3,266	3,920	4,573	5,226	5,880	6,533
30	78	157	235	314	392	784	1,568	2,352	3,136	3,920	4,704	5,488	6,272	7,056	7,839
35	91	183	274	366	457	915	1,829	2,744	3,658	4,573	5,488	6,402	7,317	8,231	9,146
40	105	209	314	418	523	1,045	2,091	3,136	4,181	5,226	6,272	7,317	8,362	9,407	10,453
50	131	261	392	523	653	1,307	2,613	3,920	5,226	6,533	7,839	9,146	10,453	11,759	13,066
60	157	314	470	627	784	1,568	3,136	4,704	6,272	7,839	9,407	10,975	12,543	14,111	15,679
70	183	366	549	732	915	1,829	3,658	5,488	7,317	9,146	10,975	12,804	14,634	16,463	18,292
80	209	418	627	836	1,045	2,091	4,181	6,272	8,362	10,453	12,543	14,634	16,724	18,815	20,905
90	235	470	706	941	1,176	2,352	4,704	7,056	9,407	11,759	14,111	16,463	18,815	21,167	23,518
100	261	523	784	1,045	1,307	2,613	5,226	7,839	10,453	13,066	15,679	18,292	20,905	23,518	26,132
		<1% increase in baseline mortality				>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects (Using 164.6km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	10	19	29	39	49	58	68	78	88	97
10	10	19	29	39	49	97	195	292	389	487	584	681	779	876	973
15	15	29	44	58	73	146	292	438	584	730	876	1,022	1,168	1,314	1,460
20	19	39	58	78	97	195	389	584	779	973	1,168	1,363	1,558	1,752	1,947
25	24	49	73	97	122	243	487	730	973	1,217	1,460	1,704	1,947	2,190	2,434
30	29	58	88	117	146	292	584	876	1,168	1,460	1,752	2,044	2,336	2,628	2,920
35	34	68	102	136	170	341	681	1,022	1,363	1,704	2,044	2,385	2,726	3,066	3,407
40	39	78	117	156	195	389	779	1,168	1,558	1,947	2,336	2,726	3,115	3,504	3,894
50	49	97	146	195	243	487	973	1,460	1,947	2,434	2,920	3,407	3,894	4,381	4,867
60	58	117	175	234	292	584	1,168	1,752	2,336	2,920	3,504	4,089	4,673	5,257	5,841
70	68	136	204	273	341	681	1,363	2,044	2,726	3,407	4,089	4,770	5,451	6,133	6,814
80	78	156	234	312	389	779	1,558	2,336	3,115	3,894	4,673	5,451	6,230	7,009	7,788
90	88	175	263	350	438	876	1,752	2,628	3,504	4,381	5,257	6,133	7,009	7,885	8,761
100	97	195	292	389	487	973	1,947	2,920	3,894	4,867	5,841	6,814	7,788	8,761	9,735
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects (Using 122.2km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	2	3	4	8	17	25	33	42	50	58	66	75	83
10	8	17	25	33	42	83	166	249	332	415	498	581	664	747	830
15	12	25	37	50	62	125	249	374	498	623	747	872	996	1,121	1,245
20	17	33	50	66	83	166	332	498	664	830	996	1,162	1,328	1,494	1,661
25	21	42	62	83	104	208	415	623	830	1,038	1,245	1,453	1,661	1,868	2,076
30	25	50	75	100	125	249	498	747	996	1,245	1,494	1,744	1,993	2,242	2,491
35	29	58	87	116	145	291	581	872	1,162	1,453	1,744	2,034	2,325	2,615	2,906
40	33	66	100	133	166	332	664	996	1,328	1,661	1,993	2,325	2,657	2,989	3,321
50	42	83	125	166	208	415	830	1,245	1,661	2,076	2,491	2,906	3,321	3,736	4,151
60	50	100	149	199	249	498	996	1,494	1,993	2,491	2,989	3,487	3,985	4,483	4,982
70	58	116	174	232	291	581	1,162	1,744	2,325	2,906	3,487	4,068	4,650	5,231	5,812
80	66	133	199	266	332	664	1,328	1,993	2,657	3,321	3,985	4,650	5,314	5,978	6,642
90	75	149	224	299	374	747	1,494	2,242	2,989	3,736	4,483	5,231	5,978	6,725	7,472
100	83	166	249	332	415	830	1,661	2,491	3,321	4,151	4,982	5,812	6,642	7,472	8,303
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects (using 164.6km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	4	5	10	20	30	39	49	59	69	79	89	98
10	10	20	30	39	49	98	197	295	393	492	590	688	787	885	983
15	15	30	44	59	74	148	295	443	590	738	885	1,033	1,180	1,328	1,475
20	20	39	59	79	98	197	393	590	787	983	1,180	1,377	1,574	1,770	1,967
25	25	49	74	98	123	246	492	738	983	1,229	1,475	1,721	1,967	2,213	2,459
30	30	59	89	118	148	295	590	885	1,180	1,475	1,770	2,065	2,360	2,655	2,950
35	34	69	103	138	172	344	688	1,033	1,377	1,721	2,065	2,409	2,754	3,098	3,442
40	39	79	118	157	197	393	787	1,180	1,574	1,967	2,360	2,754	3,147	3,540	3,934
50	49	98	148	197	246	492	983	1,475	1,967	2,459	2,950	3,442	3,934	4,426	4,917
60	59	118	177	236	295	590	1,180	1,770	2,360	2,950	3,540	4,130	4,721	5,311	5,901
70	69	138	207	275	344	688	1,377	2,065	2,754	3,442	4,130	4,819	5,507	6,196	6,884
80	79	157	236	315	393	787	1,574	2,360	3,147	3,934	4,721	5,507	6,294	7,081	7,868
90	89	177	266	354	443	885	1,770	2,655	3,540	4,426	5,311	6,196	7,081	7,966	8,851
100	98	197	295	393	492	983	1,967	2,950	3,934	4,917	5,901	6,884	7,868	8,851	9,835
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects (using 122.2km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	3	4	8	17	25	34	42	50	59	67	76	84
10	8	17	25	34	42	84	168	252	336	420	504	588	672	756	840
15	13	25	38	50	63	126	252	378	504	630	756	882	1,008	1,134	1,260
20	17	34	50	67	84	168	336	504	672	840	1,008	1,176	1,344	1,512	1,681
25	21	42	63	84	105	210	420	630	840	1,050	1,260	1,470	1,681	1,891	2,101
30	25	50	76	101	126	252	504	756	1,008	1,260	1,512	1,765	2,017	2,269	2,521
35	29	59	88	118	147	294	588	882	1,176	1,470	1,765	2,059	2,353	2,647	2,941
40	34	67	101	134	168	336	672	1,008	1,344	1,681	2,017	2,353	2,689	3,025	3,361
50	42	84	126	168	210	420	840	1,260	1,681	2,101	2,521	2,941	3,361	3,781	4,201
60	50	101	151	202	252	504	1,008	1,512	2,017	2,521	3,025	3,529	4,033	4,537	5,042
70	59	118	176	235	294	588	1,176	1,765	2,353	2,941	3,529	4,117	4,705	5,294	5,882
80	67	134	202	269	336	672	1,344	2,017	2,689	3,361	4,033	4,705	5,378	6,050	6,722
90	76	151	227	302	378	756	1,512	2,269	3,025	3,781	4,537	5,294	6,050	6,806	7,562
100	84	168	252	336	420	840	1,681	2,521	3,361	4,201	5,042	5,882	6,722	7,562	8,403
	<1% increase in baseline mortality					>1% increase in baseline mortality					>1% threshold for citation population				

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for all projects (using 164.6km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	2	3	5	6	8	16	31	47	62	78	93	109	124	140	155
10	16	31	47	62	78	155	311	466	621	777	932	1,088	1,243	1,398	1,554
15	23	47	70	93	117	233	466	699	932	1,165	1,398	1,631	1,864	2,097	2,331
20	31	62	93	124	155	311	621	932	1,243	1,554	1,864	2,175	2,486	2,797	3,107
25	39	78	117	155	194	388	777	1,165	1,554	1,942	2,331	2,719	3,107	3,496	3,884
30	47	93	140	186	233	466	932	1,398	1,864	2,331	2,797	3,263	3,729	4,195	4,661
35	54	109	163	218	272	544	1,088	1,631	2,175	2,719	3,263	3,806	4,350	4,894	5,438
40	62	124	186	249	311	621	1,243	1,864	2,486	3,107	3,729	4,350	4,972	5,593	6,215
50	78	155	233	311	388	777	1,554	2,331	3,107	3,884	4,661	5,438	6,215	6,992	7,768
60	93	186	280	373	466	932	1,864	2,797	3,729	4,661	5,593	6,525	7,458	8,390	9,322
70	109	218	326	435	544	1,088	2,175	3,263	4,350	5,438	6,525	7,613	8,701	9,788	10,876
80	124	249	373	497	621	1,243	2,486	3,729	4,972	6,215	7,458	8,701	9,943	11,186	12,429
90	140	280	419	559	699	1,398	2,797	4,195	5,593	6,992	8,390	9,788	11,186	12,585	13,983
100	155	311	466	621	777	1,554	3,107	4,661	6,215	7,768	9,322	10,876	12,429	13,983	15,537
	<1% increase in baseline mortality					>1% increase in baseline mortality						>1% threshold for citation population			

FFC SPA razorbill in-combination operation and maintenance phase annual displacement matrix for all projects (using 122.2km foraging range)

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	3	4	6	7	14	28	42	56	71	85	99	113	127	141
10	14	28	42	56	71	141	282	423	564	705	846	987	1,128	1,269	1,410
15	21	42	63	85	106	212	423	635	846	1,058	1,269	1,481	1,693	1,904	2,116
20	28	56	85	113	141	282	564	846	1,128	1,410	1,693	1,975	2,257	2,539	2,821
25	35	71	106	141	176	353	705	1,058	1,410	1,763	2,116	2,468	2,821	3,174	3,526
30	42	85	127	169	212	423	846	1,269	1,693	2,116	2,539	2,962	3,385	3,808	4,231
35	49	99	148	197	247	494	987	1,481	1,975	2,468	2,962	3,456	3,949	4,443	4,937
40	56	113	169	226	282	564	1,128	1,693	2,257	2,821	3,385	3,949	4,514	5,078	5,642
50	71	141	212	282	353	705	1,410	2,116	2,821	3,526	4,231	4,937	5,642	6,347	7,052
60	85	169	254	339	423	846	1,693	2,539	3,385	4,231	5,078	5,924	6,770	7,617	8,463
70	99	197	296	395	494	987	1,975	2,962	3,949	4,937	5,924	6,911	7,899	8,886	9,873
80	113	226	339	451	564	1,128	2,257	3,385	4,514	5,642	6,770	7,899	9,027	10,155	11,284
90	127	254	381	508	635	1,269	2,539	3,808	5,078	6,347	7,617	8,886	10,155	11,425	12,694
100	141	282	423	564	705	1,410	2,821	4,231	5,642	7,052	8,463	9,873	11,284	12,694	14,105
	<1% increase in baseline mortality					>1% increase in baseline mortality				>1% threshold for citation population					

Farne Islands SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2 plus all consented projects

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	2	3	4	8	16	24	32	40	48	56	64	72	80
10	8	16	24	32	40	80	160	240	320	400	480	560	640	720	801
15	12	24	36	48	60	120	240	360	480	600	720	841	961	1,081	1,201
20	16	32	48	64	80	160	320	480	640	801	961	1,121	1,281	1,441	1,601
25	20	40	60	80	100	200	400	600	801	1,001	1,201	1,401	1,601	1,801	2,001
30	24	48	72	96	120	240	480	720	961	1,201	1,441	1,681	1,921	2,161	2,402
35	28	56	84	112	140	280	560	841	1,121	1,401	1,681	1,961	2,241	2,522	2,802
40	32	64	96	128	160	320	640	961	1,281	1,601	1,921	2,241	2,562	2,882	3,202
50	40	80	120	160	200	400	801	1,201	1,601	2,001	2,402	2,802	3,202	3,602	4,003
60	48	96	144	192	240	480	961	1,441	1,921	2,402	2,882	3,362	3,842	4,323	4,803
70	56	112	168	224	280	560	1,121	1,681	2,241	2,802	3,362	3,923	4,483	5,043	5,604
80	64	128	192	256	320	640	1,281	1,921	2,562	3,202	3,842	4,483	5,123	5,764	6,404
90	72	144	216	288	360	720	1,441	2,161	2,882	3,602	4,323	5,043	5,764	6,484	7,205
100	80	160	240	320	400	801	1,601	2,402	3,202	4,003	4,803	5,604	6,404	7,205	8,005

<1% increase in baseline mortality | >1% increase in baseline mortality | >1% threshold for citation population

Farne Islands SPA guillemot in-combination operation and maintenance phase annual displacement matrix for Rampion 2, Dudgeon and Sheringham Shoal Extension Projects plus all consented projects

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	1	2	3	3	4	9	17	26	34	43	52	60	69	77	86
10	9	17	26	34	43	86	172	258	344	430	516	602	688	774	860
15	13	26	39	52	65	129	258	387	516	645	774	903	1,032	1,161	1,290
20	17	34	52	69	86	172	344	516	688	860	1,032	1,204	1,376	1,548	1,720
25	22	43	65	86	108	215	430	645	860	1,075	1,290	1,505	1,720	1,935	2,150
30	26	52	77	103	129	258	516	774	1,032	1,290	1,548	1,806	2,064	2,322	2,580
35	30	60	90	120	151	301	602	903	1,204	1,505	1,806	2,107	2,408	2,709	3,010
40	34	69	103	138	172	344	688	1,032	1,376	1,720	2,064	2,408	2,752	3,096	3,441
50	43	86	129	172	215	430	860	1,290	1,720	2,150	2,580	3,010	3,441	3,871	4,301
60	52	103	155	206	258	516	1,032	1,548	2,064	2,580	3,096	3,613	4,129	4,645	5,161
70	60	120	181	241	301	602	1,204	1,806	2,408	3,010	3,613	4,215	4,817	5,419	6,021
80	69	138	206	275	344	688	1,376	2,064	2,752	3,441	4,129	4,817	5,505	6,193	6,881
90	77	155	232	310	387	774	1,548	2,322	3,096	3,871	4,645	5,419	6,193	6,967	7,741
100	86	172	258	344	430	860	1,720	2,580	3,441	4,301	5,161	6,021	6,881	7,741	8,601

<1% increase in baseline mortality

>1% increase in baseline mortality

>1% threshold for citation population

Farne Islands SPA guillemot in-combination operation and maintenance phase annual displacement matrix for all projects

Displacement (%)	Mortality rates (%)														
	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
1	2	3	5	6	8	15	30	45	60	75	91	106	121	136	151
10	15	30	45	60	75	151	302	453	604	755	906	1,057	1,208	1,358	1,509
15	23	45	68	91	113	226	453	679	906	1,132	1,358	1,585	1,811	2,038	2,264
20	30	60	91	121	151	302	604	906	1,208	1,509	1,811	2,113	2,415	2,717	3,019
25	38	75	113	151	189	377	755	1,132	1,509	1,887	2,264	2,641	3,019	3,396	3,773
30	45	91	136	181	226	453	906	1,358	1,811	2,264	2,717	3,170	3,623	4,075	4,528
35	53	106	158	211	264	528	1,057	1,585	2,113	2,641	3,170	3,698	4,226	4,755	5,283
40	60	121	181	242	302	604	1,208	1,811	2,415	3,019	3,623	4,226	4,830	5,434	6,038
50	75	151	226	302	377	755	1,509	2,264	3,019	3,773	4,528	5,283	6,038	6,792	7,547
60	91	181	272	362	453	906	1,811	2,717	3,623	4,528	5,434	6,339	7,245	8,151	9,056
70	106	211	317	423	528	1,057	2,113	3,170	4,226	5,283	6,339	7,396	8,453	9,509	10,566
80	121	242	362	483	604	1,208	2,415	3,623	4,830	6,038	7,245	8,453	9,660	10,868	12,075
90	136	272	408	543	679	1,358	2,717	4,075	5,434	6,792	8,151	9,509	10,868	12,226	13,585
100	151	302	453	604	755	1,509	3,019	4,528	6,038	7,547	9,056	10,566	12,075	13,585	15,094
		<1% increase in baseline mortality				>1% increase in baseline mortality					>1% threshold for citation population				

Appendix B
PVA validation logs

Population Viability Analysis Parameter log – Guillemot FFC SPA

Set up

The log file was created on: 2024-02-16 12:12:15 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"

Basic information

This run had reference name “GU_FFC”.

PVA model run type: validation.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 63268 in 2000

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 0.

Output:

First year to include in outputs: NA

Final year to include in outputs: 2060

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

Validation data

63268 in 2000

80154 in 2008

113427 in 2017

141814 in 2022

Population Viability Analysis Parameter log – Razorbill FFC SPA

Set up

The log file was created on: 2024-02-20 12:12:34 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"

Basic information

This run had reference name “FFC SPA_razorbill”.

PVA model run type: validation.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 11340 in 2000

Productivity rate per pair: mean: 0.653 , sd: 0.0995

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.209 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.209 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 0.

Output:

First year to include in outputs: NA

Final year to include in outputs: 2060

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

Validation data

11340 in 2000

20041 in 2008

37473 in 2017

59055 in 2022

Population Viability Analysis Parameter log – Guillemot Farne Islands SPA

Set up

The log file was created on: 2024-02-16 11:50:45 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"

Basic information

This run had reference name “GU_Farne Islands”.

PVA model run type: validation.

Model to use for environmental stochasticity: betagamma.

Model for density dependence: nodd.

Include demographic stochasticity in model?: Yes.

Number of simulations: 5000.

Random seed: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 58550 in 2004

Productivity rate per pair: mean: 0.823 , sd: 0.164

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 0.

Output:

First year to include in outputs: NA

Final year to include in outputs: 2060

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

Validation data

58550 in 2004

62866 in 2005

64234 in 2006

65191 in 2007

58779 in 2008

64489 in 2009

62116 in 2010

64289 in 2011

65761 in 2012

67064 in 2013

69523 in 2014

71638 in 2015

65709 in 2016

64634 in 2017

66963 in 2018

85816 in 2019

84973 in 2020

84334 in 2021

79285 in 2022

62085 in 2023

Appendix C
PVA run logs

Population Viability Analysis Parameter log – Guillemot at FFC SPA (153.7km foraging range) using 50% displacement and 1% mortality rates

Set up

The log file was created on: 2024-02-21 08:41:26 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"

Basic information

This run had reference name “RG1_GU_FFC SPA_153.7 foraging range”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0019 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0025 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-04 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-04 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0014 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for Guillemot at FFC SPA (153.7km foraging range) using 70% displacement and 2% mortality rates

Set up

The log file was created on: 2024-02-21 10:31:21 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"

Basic information

This run had reference name “GU_FFC SPA_153.7 foraging range-70 disp and 2 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0054 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0055 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0071 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0022 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0023 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0039 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for Guillemot at FFC SPA (153.7km foraging range) using 70% displacement and 5% mortality rates

Set up

The log file was created on: 2024-02-21 09:05:55 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"

Basic information

This run had reference name “GU_FFC SPA_153.7 foraging range-70 disp and 5 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0135 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0137 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0177 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0055 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0057 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0097 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for Guillemot at FFC SPA (95.2km foraging range) using 50% displacement and 1% mortality rates

Set up

The log file was created on: 2024-02-21 10:20:04 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"

Basic information

This run had reference name “GU_FFC SPA_95.2 foraging range-50 disp and 1 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0015 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0015 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0021 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 3e-04 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 3e-04 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 9e-04 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for Guillemot at FFC SPA (95.2km foraging range) using 70% displacement and 2% mortality rates

Set up

The log file was created on: 2024-02-21 10:52:32 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"

Basic information

This run had reference name “GU_FFC SPA_95.2 foraging range-70 disp and 2 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0041 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0041 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0058 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 9e-04 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0026 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for Guillemot at FFC SPA (95.2km foraging range) using 70% displacement and 5% mortality rates

Set up

The log file was created on: 2024-02-21 11:04:13 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"

Basic information

This run had reference name “GU_FFC SPA_95.2 foraging range-70 disp and 5 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 141815 in 2022

Productivity rate per pair: mean: 0.715 , sd: 0.075

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 6.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0102 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0104 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0144 , se: NA

Scenario D - Name: Consented plus R2 (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0022 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP(without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0024 , se: NA

Scenario F - Name: All projects (without H4)

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0064 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for razorbill at FFC SPA (using 164.6km foraging range) for all scenarios of displacement and mortality rates

Set up

The log file was created on: 2024-02-21 12:29:39 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"

Basic information

This run had reference name “RA_FFC SPA_ 164.6 foraging”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 59055 in 2022

Productivity rate per pair: mean: 0.653 , sd: 0.0995

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.209 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.209 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 9.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2 - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-04 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 8e-04 , se: NA

Scenario C - Name: All projects - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0013 , se: NA

Scenario D - Name: Consented plus R2 - 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0023 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP- 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0023 , se: NA

Scenario F - Name: All projects- 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0037 , se: NA

Scenario G - Name: Consented plus R2 - 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0058 , se: NA

Scenario H - Name: Consented plus R2 and DEP and SEP- 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0058 , se: NA

Scenario I - Name: All projects- 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0092 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for razorbill at FFC SPA (using 122.2km foraging range) for all scenarios of displacement and mortality rates

Set up

The log file was created on: 2024-02-21 13:58:01 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"

Basic information

This run had reference name “RA_FFC SPA_122.2 foraging range”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Razorbill.

Region type to use for breeding success data: Global.

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

Age at first breeding: 5.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 59055 in 2022

Productivity rate per pair: mean: 0.653 , sd: 0.0995

Adult survival rate: mean: 0.895 , sd: 0.067

Immatures survival rates:

Age class 0 to 1 - mean: 0.63 , sd: 0.209 , DD: NA

Age class 1 to 2 - mean: 0.63 , sd: 0.209 , DD: NA

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

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

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

Impacts

Number of impact scenarios: 9.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: consented and R2 - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-04 , se: NA

Scenario B - Name: Consented plus R2 and DEP and SEP - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-04 , se: NA

Scenario C - Name: all projects - 50 and 1

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0012 , se: NA

Scenario D - Name: consented and R2 - 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002 , se: NA

Scenario E - Name: Consented plus R2 and DEP and SEP - 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.002 , se: NA

Scenario F - Name: all projects - 70 and 2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0033 , se: NA

Scenario G - Name: consented and R2 - 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0049 , se: NA

Scenario H - Name: Consented plus R2 and DEP and SEP - 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.005 , se: NA

Scenario I - Name: all projects - 70 and 5

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0084 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for guillemot at Farne Islands SPA for 50% displacement and 1% mortality rate

Set up

The log file was created on: 2024-02-21 11:21:33 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"

Basic information

This run had reference name “GU_Farne Island SPA_ 50 disp and 1 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 62085 in 2023

Productivity rate per pair: mean: 0.823 , sd: 0.164

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 6e-04 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 7e-04 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0012 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for guillemot at Farne Islands SPA for 70% displacement and 2% mortality rate

Set up

The log file was created on: 2024-02-21 11:33:24 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"

Basic information

This run had reference name “GU_Farne Island SPA_ 70 disp and 2 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 62085 in 2023

Productivity rate per pair: mean: 0.823 , sd: 0.164

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0018 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0019 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0034 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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

Population Viability Analysis Parameter log for guillemot at Farne Islands SPA for 70% displacement and 5% mortality rate

Set up

The log file was created on: 2024-02-21 12:02:19 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"

Basic information

This run had reference name “GU_Farne Island SPA_ 70 disp and 5 mort”.

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: 1234.

Years for burn-in: 10.

Case study selected: None.

Baseline demographic rates

Species chosen to set initial values: Common Guillemot.

Region type to use for breeding success data: Global.

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

Age at first breeding: 6.

Is there an upper constraint on productivity in the model?: Yes, constrained to 1 per pair.

Number of subpopulations: 1.

Are demographic rates applied separately to each subpopulation?: No.

Units for initial population size: breeding.adults

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

Population 1

Initial population values: Initial population 62085 in 2023

Productivity rate per pair: mean: 0.823 , sd: 0.164

Adult survival rate: mean: 0.939 , sd: 0.015

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.001 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.001 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 3 to 4 - mean: 0.917 , sd: 0.001 , DD: NA

Age class 4 to 5 - mean: 0.939 , sd: 0.015 , DD: NA

Age class 5 to 6 - mean: 0.939 , sd: 0.015 , DD: NA

Impacts

Number of impact scenarios: 3.

Are impacts applied separately to each subpopulation?: No

Are impacts of scenarios specified separately for immatures?: No

Are standard errors of impacts available?: No

Should random seeds be matched for impact scenarios?: No

Are impacts specified as a relative value or absolute harvest?: relative

Years in which impacts are assumed to begin and end: 2030 to 2060

Impact on Demographic Rates

Scenario A - Name: Consented plus R2

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0045 , se: NA

Scenario B - Name: Consented plus R2 & DEP and SEP

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0048 , se: NA

Scenario C - Name: All projects

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.0085 , se: NA

Output:

First year to include in outputs: 2030

Final year to include in outputs: 2060

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