

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 (tracked
changes)

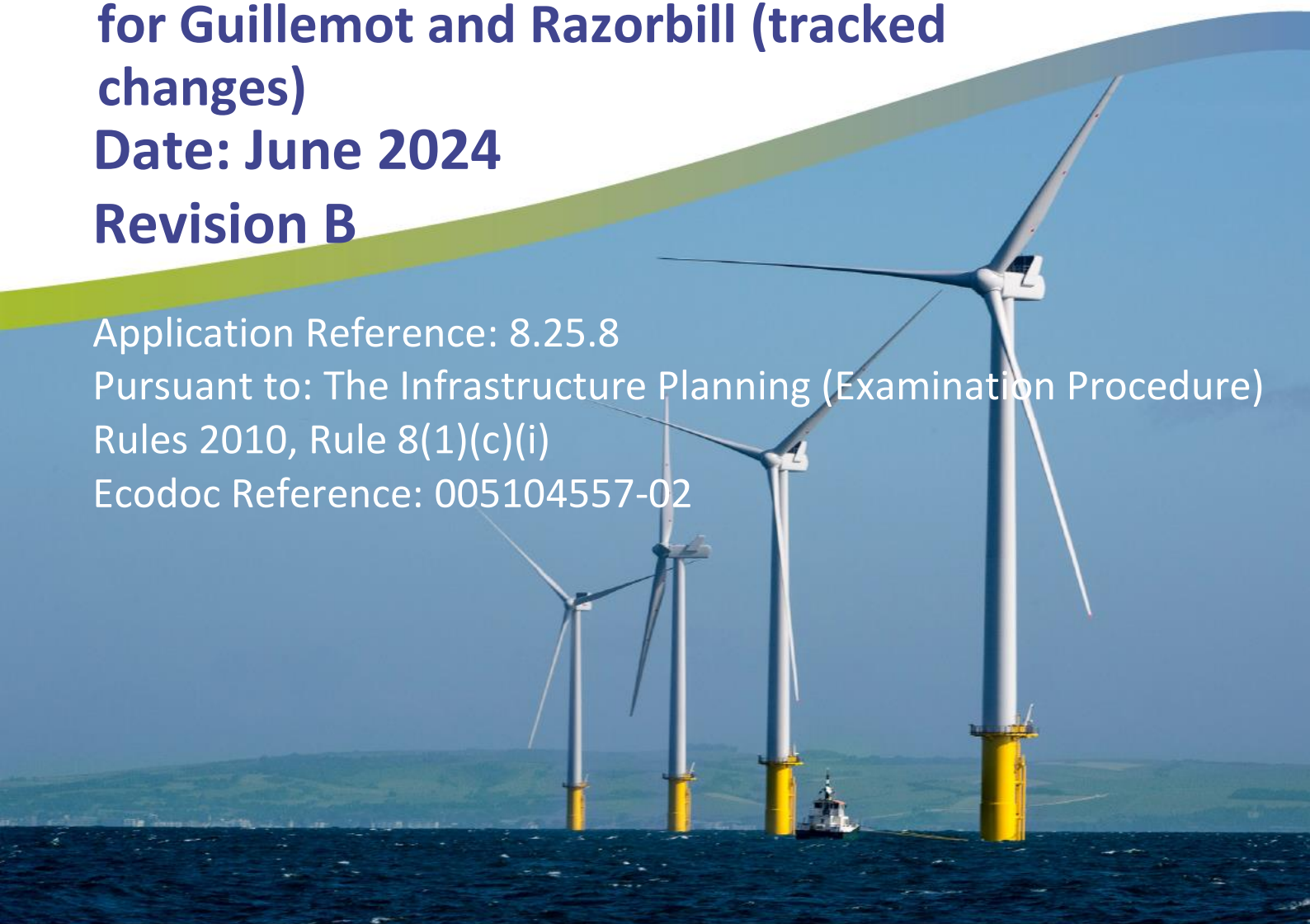
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1. Introduction

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 160km². 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 advise 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 3a | Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted |
| Tier 3 | 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 RIAs 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 of 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 4,910 | 1a |
| Hornsea Project Two | 3,581 | 579 | 4,160 579 | 1a |
| Moray East | 0 | 24 | 24 | 1b |
| Triton Knoll | 425 | 33 | 458 | 1b |
| Kincardine | 0 | 0 | 0 | 1b |
| Dogger Bank A | 1,893 | 270 | 2,163 70 | 1c |
| Dogger Bank B | 3,318 | 467 | 3,785 467 | 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) | <u>1,138</u><u>23,866</u> | <u>8,474</u><u>31,447</u> | <u>9,612</u><u>55,313</u> | |
| 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 |
| 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) | | |
| Bio-season | Rampion 2 and Sheringham Shoal and Dudgeon Extension Projects plus all consented projects (excluding Hornsea Four) | 8,520 | 141,815 | 8,651 | 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 | | | 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) | | |
| | 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|--|--|--|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| | All projects | 35,637 | 141,815 | 8,651 | 178.2 | 3.51% |
| | All projects (excluding Hornsea Four) | 12,710 | | | 63.6 | 1.25% |
| | Rampion 2 plus all consented projects only | 30,745 | | | 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|------------|--|--|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| | 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% |
| | 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% |

| 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 | 141,815 | 8,651 | 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 | | | 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% |
| | 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% |

| 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 | 141,815 | 8,651 | 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 | | | 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) | | |
| 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|------------------|--|--|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| | 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 | 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|------------------|--|---|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| 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 | 59,055 | 6,201 | 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 | | | 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 | 59,055 | 6,201 | 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 | | | 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 | | | 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|--------------|--|---|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| 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) 50% Disp 1% Mort | Increase in baseline mortality (%) 50% Disp 1% Mort |
|------------|--|---|--|--|---|--|
| | | | Population (breeding adults) | Baseline mortality (breeding adults per annum) | | |
| | 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 | | | | | | | |
| | | Latest count | 141,814 | 0.715 ± 0.075 | | | | | | |
| | 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 | | | | | | | |
| | | Latest count | 59,055 | 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) |

- 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 |

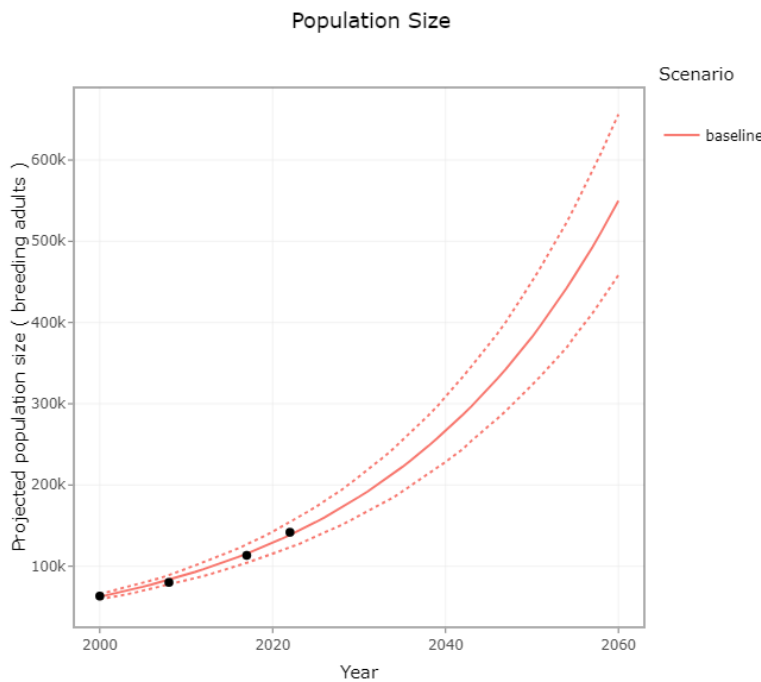
Table 4.3 Farne Islands SPA historic colony counts for guillemot and razorbill

| 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.

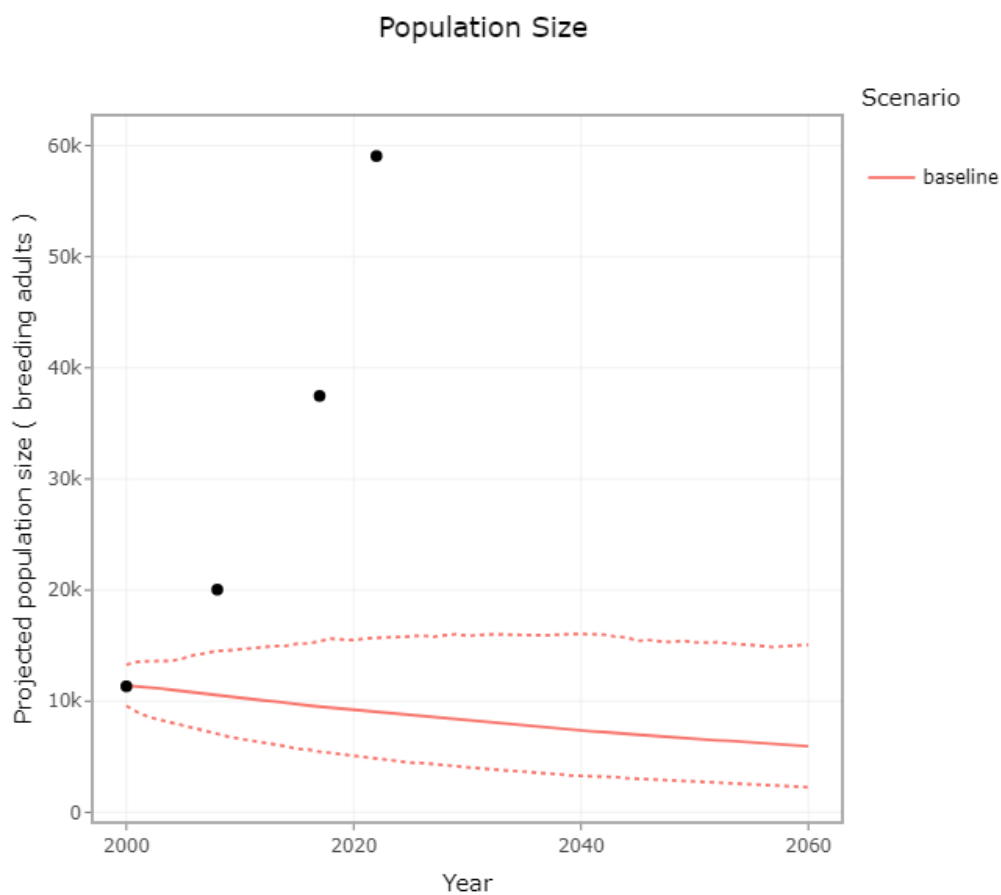
Figure 4.1 FFC SPA guillemot baseline PVA model validation



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

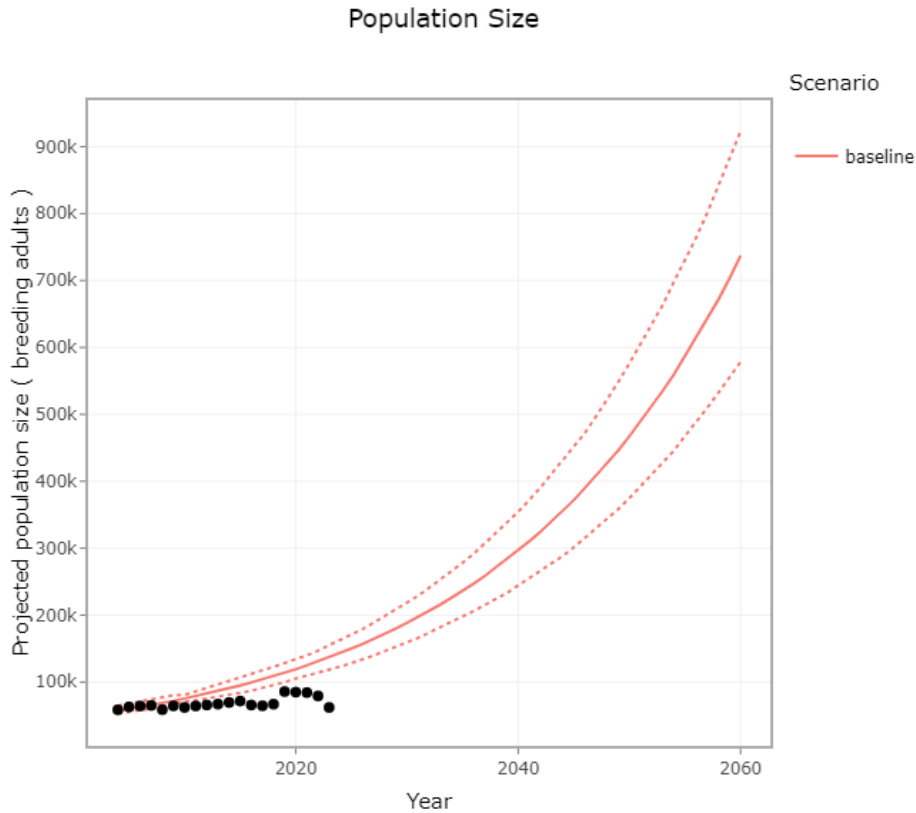


Guillemot Validation for Farne Islands SPA

- 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) | | |
| | Secretary of State | All projects (excluding Hornsea Four) | 197 | 0.998 (<0.001) | 0.953 (0.004) | 0.2% | 4.7% |
| | | 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 AEol 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% |
| | | Rampion 2 plus all consented projects only | 291 | 0.994 (<0.001) | 0.836 (0.011) | 0.6% | 16.4% |
| | Natural England | 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 AEol 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.

5. References

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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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|---------------------|------------------------------------|-----|-----|-------|-------|------------------------------------|-------|-------|--------|--------|---------------------------------------|--------|--------|--------|
| | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|------------------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|---------------------------------------|-------|-------|-------|-------|
| | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|------------------------------------|-------|-------|-------|-------|------------------------------------|--------|--------|--------|--------|---------------------------------------|--------|--------|--------|--------|
| | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|------------------------------------|-----|-------|-------|-------|------------------------------------|-------|--------|--------|--------|---------------------------------------|--------|--------|--------|--------|
| | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|---------------------|------------------------------------|-----|-----|-------|-------|------------------------------------|-------|-------|--------|--------|---------------------------------------|--------|--------|--------|
| | 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)

| 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 | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|------------------------------------|-------|-------|-------|-------|------------------------------------|--------|--------|--------|--------|---------------------------------------|--------|--------|--------|--------|
| | 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 |
| | <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 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 | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | | |
|------------------|---------------------|------------------------------------|-------|-------|-------|-------|------------------------------------|--------|--------|--------|--------|---------------------------------------|--------|--------|--------|--|
| | 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)

| Displacement (%) | Mortality rates (%) | | | | | | | | | | | | | | |
|------------------|---------------------|------------------------------------|-----|-------|-------|-------|------------------------------------|-------|--------|--------|--------|---------------------------------------|--------|--------|--------|
| | 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

