Environmental Impact
Assessment Report

NISA
North Irish Sea Array

Volume 9: Appendices (Offshore)

Appendix 15.6
Offshore and Intertidal Ornithology Population Viability Analysis

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Offshore Ornithology Population Viability Analysis

North Irish Sea Array Offshore Wind Farm

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Acronyms

Term	Definition
CGR	Counterfactual of Population Growth Rate
CPS	Counterfactual of Population Size
ECC	Export Cable Corridor
OWF	Offshore Wind Farm
PVA	Population Viability Analysis
SD	Standard Deviation

1 Introduction

1.1 Project Background

1.1.1 This document has been prepared by Arup and GoBe Consultants Limited (GoBe) on behalf of North Irish Sea Array Limited (NISA Ltd), (hereafter 'the Developer').

1.1.2 The Northern Irish Sea Array (hereafter the 'proposed development') Offshore Wind Farm (OWF) is proposed for construction 11.3 km off the east coast of Ireland (at their nearest points to the mainland). The project will consist of offshore wind turbines, an offshore converter station, inter-array cables, interconnector cables and on- and offshore cables taking power to an onshore converter station. The area considered in the context of offshore ornithological receptors includes the entire proposed development array area, covering 89 km^2, an asymmetric 4 km buffer surrounding the array area, and the offshore Export Cable Corridor (ECC) covering a further 67.8 km^2.

1.1.3 During the breeding season, the Irish Sea region provides foraging, loafing and preening habitat for a range of seabirds, including (but not limited to) northern gannet, *Morus bassanus*, various gull species, and several species of auks and terns. An overview of key species that are present within and in close proximity to NISA, including data collection methods is presented in Volume 9, Appendix 15.1: Offshore Ornithology Baseline Characterisation (hereafter referred to as the 'Technical Baseline').

1.2 Population Viability Analysis (PVA)

1.2.1 For species that have a high number of predicted mortalities due to displacement or collision, it is important to assess the implications of these moralities on the regional populations. To estimate the effect that a development, alone or cumulatively, may have on a designated feature, Population Viability Analysis (PVA) can be used. Further analysis in the form of PVA was triggered if the impacts from the project alone or cumulatively with other projects were predicted to increase baseline mortality of a population by more than 1%.

1.2.2 PVA models use demographic parameters to forecast future populations levels under different scenarios over a set period, comparing 'baseline' conditions and 'impact' scenarios by alteration of demographic parameters (survival and productivity). The baseline conditions consider there to be no development and therefore the population will follow unaltered growth rates. Whereas the impact scenarios consider the development over a defined period with estimated impacts on the population level.

1.2.3 This report provides the modelling methodology and results using regional populations (as presented in the technical baseline) and wider biogeographic population scales (Furness, 2015). PVA was carried out for the following species, for which predicted impacts exceeded a 1% increase in baseline mortality for at least one assessment scenario (see Table 1.1):

- Common gull (*Larus canus*);
- Great black-backed gull (*Larus marinus*);
- Herring gull (*Laurs argentatus*);

- Lesser black-backed gull (*Larus fuscus*); and
- Common guillemot (*Uria aalge*).

Table 1.1: Initial regional and biogeographic population sizes

Species	Initial regional population size (Individuals)	Initial population size - Biogeographic Population (Individuals) (Furness, 2015)
Common gull	67,500	525,000
Great black-backed gull	53,406	235,000
Herring gull	187,094	1,098,000
Lesser black-backed gull	171,500	864,000
Guillemot	1,332,623	4,125,000

1.2.4 PVA was undertaken using the Seabird PVA Tool developed by Natural England (Searle *et al.,* 2019). The Seabird PVA Tool was accessed via the 'Shiny App' interface, which is a user-friendly graphical user interface accessible via a standard web-browser that uses the nepva R package to perform the modelling and analysis. The advantages of using an online platform for modelling and analysis purposes are that users are not required to use any R code, users are not required to install or maintain R, and updates to the model are made directly to the server. The tool can assess any type of impact in terms of change to demographic parameters, or as a cull or harvest of a fixed size per year (Searle *et al.,* 2019).

2 Methodology

2.1 Guidance and Models

2.1.1 The user guide for the Seabird PVA Tool provided by Natural England (Searle *et al.,* 2019) has been followed for modelling and assessment of potential impacts. The demographic parameters used for the PVA are presented in Section 2.2.

2.2 PVA Modelling Approach and Demographic Parameters

Modelling Approach

Simulation Type

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

2.2.2 The Seabird PVA Tool 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, density dependence, density independence or whether they want the model to run an entirely deterministic model.

2.2.3 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.

2.2.4 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 can have on a population and is modelled by the incorporation of randomly generated values for the probability of survival from one-time step to the next. Demographic stochasticity refers to the effect of random variation in population structure on demographic rates and is modelled by 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).

2.2.5 All PVA modelling in this report was undertaken with environmental and deterministic stochasticity. To ensure robust results, all simulations were set to run 5,000 times. All models were run for a 35-year time span, representing the likely lifespan of NISA. 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, Townsend & Harper 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.

2.2.6 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. If density dependence is mis-specified in an assessment, the modelled predictions may be unreliable. Therefore, it is more typical to use density independent models for seabird assessments, despite the lack of biologically necessary density dependence. As such, density independent models lack any means by which a population can recover once it has been reduced beyond a certain point, they are therefore appropriate for impact assessment purposes on the grounds of precaution (i.e. another source of precaution in the assessment process) (Ridge *et al.,* 2019).

2.2.7 Two main metrics are used to report the results of PVA models, the counterfactual of population size (CPS) and the counterfactual of population growth rate (CGR). They present the relative difference in population size or growth rate of a population between two or more scenarios, including a baseline scenario (unimpacted) and an impacted scenario.

2.2.8 Although both the CPS and CPR are presented within this report, it is generally considered that CGR only should be used for interpreting the predicted impacts. This is because the CGR can be compared against known population trends for a feature / receptor and is relatively insensitive to the baseline rate of growth and direction (positive or negative). Whereas the CPS will predict very large differences in comparison to the baseline population size, especially when density dependent factors allowing for population recovery or preventing exponential growth are not considered within the PVA, as is the case with these assessments.

Demographic Parameters

2.2.9 The input parameters were primarily taken from Horswill and Robinson (2015), with some parameters provided within the tool. Where the parameters differ from this it has been highlighted (Table 2.1).

Table 2.1: Summary of demographic rates for PVA species. Source: Horswill and Robinson (2015) unless otherwise specified.

Demographic Parameter	Great black-backed gull	Herring gull	Lesser black-backed gull	Common gull	Guillemot
Adult survival	0.83 (0.08)	0.83 (0.08)	0.89 (0.06)	0.83 (0.05)	0.94 (0.03)

Productivity (SD) (per pair)	1.14 (0.61)	0.92 (0.68)	0.53 (0.25)	0.54 (0.39)	0.67 (0.12)
Age of recruitment	5	5	5	3	6
Brood size (per pair)	3	3	3	1	1
Survival 0-1	0.79 (0.08)	0.79 (0.08)	0.82 (0.06)	0.41 (0.05)	0.56 (0.06)
Survival 1-2	0.83 (0.08)	0.83 (0.08)	0.89 (0.06)	0.71 (0.05)	0.79 (0.15)
Survival 2-3	0.83 (0.08)	0.83 (0.08)	0.89 (0.06)	0.83 (0.05)	0.92 (0.10)
Survival 3-4	0.83 (0.08)	0.83 (0.08)	0.89 (0.06)	-	0.94 (0.12)
Survival 4-5	0.83 (0.08)	0.83 (0.08)	0.89 (0.06)	-	0.94 (0.03)
Survival 5-6	-	-	-	-	0.94 (0.03)

PVA Species-Specific Outputs

2.2.10 The outputs from the PVA tool are the CGR and CPS (Searle *et al.,* 2019). These are the ratio of impacted to unimpacted scenarios and allows for interpretation of the predicted impact upon the population (Cook and Robinson, 2016). CPS is the median of the ratio of end-point size of the impacted to un-impacted (baseline) population. CGR is the median of the ratio of the annual growth rate of the impacted to un-impacted population. Both are expressed as a proportion.

3 Impacts Assessed

3.1 Magnitude of Impact

3.1.1 Each impact scenario has an additional population-level mortality due to the presence of turbines, and therefore imposed risk of collision and of displacement effects. This additional mortality impacts the survival rate and therefore predicts the magnitude of impact on the population for different scenarios. The model used relative harvest which was calculated using the predicted mortalities apportioned to the site and the initial regional population size see (Table 1.1). These scenarios are presented in Table 3.1 to Table 3.5 but additional decimal places were entered into the model to retain accuracy in the outputs.

Table 3.1: Common gull collision risk magnitude of impact.

Scenario	Mortalities	Impact on adult survival rate
Proposed development alone	5.4	0.000
Cumulative	168.5	0.002

Table 3.2: Greater black-backed gull collision risk magnitude of impact.

Scenario	Mortalities	Impact on adult survival rate
Proposed development alone	26.3	0.000
Cumulative	154.9	0.003

Table 3.3: Herring gull collision magnitude of impact.

Scenario	Mortalities	Impact on adult survival rate
Proposed development alone	57.2	0.000
Cumulative	328.9	0.002

Table 3.4: Lesser black-backed gull collision risk magnitude of impact.

Scenario	Mortalities	Impact on adult survival rate
Proposed development alone	1.8	0.000
Cumulative	232.6	0.001

Table 3.5: Guillemot displacement magnitude of impact.

Scenario	Mortalities	Impact on adult survival rate
Proposed development alone (Project bio-season approach) 30, 1	130.4	0.000
Proposed development alone (Project bio-season approach) 50, 1	217.3	0.000
Proposed development alone (Project bio-season approach) 70, 5	1521.4	0.001
Proposed development alone (Furness bio-season approach) 30, 1	94.7	0.000
Proposed development alone (Furness bio-season approach) 50, 1	157.9	0.000
Proposed development alone (Furness bio-season approach) 70, 5	1105.2	0.001

Cumulative (Project bio-season approach) 30, 1	505.0	0.000
Cumulative (Project bio-season approach) 50, 1	841.6	0.001
Cumulative (Project bio-season approach) 70, 5	5,891.4	0.004
Cumulative (Furness bio-season approach) 30, 1	540.7	0.000
Cumulative (Furness bio-season approach) 50, 1	901.1	0.001
Cumulative (Furness bio-season approach) 70, 5	6307.6	0.005

4 PVA Results

4.1 Introduction

4.1.1 The outputs of the Seabird PVA Tool are set out in Table 4.1 to Table 4.5 below for all five species. The metrics used to summarise the PVA results are based on the CGR calculated as the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a percentage decrease.

4.2 Common gull

Table 4.1: Metrics and counterfactuals for 5000 simulations over 35 years of the common gull PVA.

Scenario/Approach	Median CGR	Median CPS	Difference in GR (%)	Difference in PS (%)
Proposed development alone	1.000	0.999	0.008	0.148
Cumulative	0.997	0.902	0.333	9.836

4.3 Great black-backed gull

Table 4.2: Metrics and counterfactuals for 5000 simulations over 35 years of the great black-backed gull PVA.

Scenario/Approach	Median CGR	Median CPS	Difference in GR (%)	Difference in PS (%)
Proposed development alone	0.999	0.982	0.060	1.822
Cumulative	0.996	0.896	0.351	10.359

4.4 Herring gull

Table 4.3: Metrics and counterfactuals for 5000 simulations over 35 years of the herring gull PVA.

Scenario/Approach	Median CGR	Median CPS	Difference in GR (%)	Difference in PS (%)
Proposed development alone	1.000	0.988	0.039	1.182
Cumulative	0.998	0.936	0.213	6.409

4.5 Lesser black-backed gull

Table 4.4: Metrics and counterfactuals for 5000 simulations over 35 years of the lesser black-backed gull PVA.

Scenario/Approach	Median CGR	Median CPS	Difference in GR (%)	Difference in PS (%)
Proposed development alone	1.000	1.000	0.001	0.046
Cumulative	0.998	0.953	0.155	4.678

4.6 Guillemot

Table 4.5: Metrics and counterfactuals for 5000 simulations over 35 years of the guillemot PVA.

Scenario/Approach	Median CGR	Median CPS	Difference in GR (%)	Difference in PS (%)
Proposed development alone (Project bio-season approach) 30, 1	1.000	0.997	0.011	0.332
Proposed development alone (Project bio-season approach) 50, 1	1.000	0.994	0.018	0.556
Proposed development alone (Project bio-season approach) 70, 5	0.999	0.961	0.128	3.899
Proposed development alone (Furness bio-season approach) 30, 1	1.000	0.998	0.008	0.248
Proposed development alone (Furness bio-season approach) 50, 1	1.000	0.996	0.013	0.414
Proposed development alone (Furness bio-season approach) 70, 5	0.999	0.972	0.093	2.847
Cumulative (Project bio-season approach) 30, 1	1.000	0.987	0.043	1.316
Cumulative (Project bio-season approach) 50, 1	0.999	0.978	0.071	2.178
Cumulative (Project bio-season approach) 70, 5	0.995	0.857	0.497	14.312
Cumulative (Furness bio-season approach) 30, 1	1.000	0.986	0.046	1.405
Cumulative (Furness bio-season approach) 50, 1	0.999	0.977	0.076	2.337
Cumulative (Furness bio-season approach) 70, 5	0.995	0.847	0.532	15.250

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