APPENDIX 11-6

PVA TECHNICAL REPORT

SCEIRDE ROCKS OFFSHORE WIND FARM: POPULATION MODELLING REPORT

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CONTENTS

LIST OF FIGURES

SUMMARY

This report presents the results of population modelling for the proposed Sceirde Rocks Offshore Wind Farm. The purpose of the modelling was to evaluate the potential effects of the predicted collision risks from the wind farm project on important seabird populations.

Population modelling was carried out for the Great Black-backed Gull regional breeding population. This was the only regional population where the predicted collision risk would result in an increase of more than 1% in the baseline mortality. The modelling was carried out using the Natural England PVA tool.

The modelling indicated that the additional mortality from the predicted collision risk would not stop the growth of the population. The population viability analyses produced counterfactual ratios of the final population size after 50 years of 0.95 for the mean collision risk and 0.89 for the 97.5 percentile collision risk. The counterfactual ratios of the annual growth rates were 0.999 and 0.998, respectively.

1. INTRODUCTION

1.1. SCOPE

This report presents the results of population modelling for the proposed Sceirde Rocks Offshore Wind Farm. The purpose of the modelling was to evaluate the potential effects of the predicted collision risks from the wind farm project on important seabird populations.

Population modelling was carried out for regional populations where the predicted collision risk would result in an increase of more than 1% in the baseline mortality.

The analyses in this report are based on population data from the Offshore Ornithology Apportioning Report (Technical Appendix 11-5) and predicted collision risks from the Collision Risk Modelling Report (Technical Appendix 11-3 The modelling was carried out using the Natural England PVA tool.

1.2. STATEMENT OF COMPETENCE

Tom Gittings is an ecologist with 28 years' experience in professional consultancy work and research. Tom specialises in ecological surveying, monitoring and evaluation, ecological impact assessment, habitat management, and avian, invertebrate, wetland and woodland ecology. He is currently working as an independent ecological consultant. His previous experience includes working for the RPS Group (a multi-disciplinary environmental consultancy) and carrying out research into forest and wetland biodiversity in the Department of Zoology, Ecology and Plant Science at University College Cork. He has a BSc (Hons) and a PhD in Ecology and is a member of the Chartered Institute of Ecology and Environmental Management and has extensive professional experience in project management and ecological assessment. His recent consultancy work includes assessments for planning applications (including Appropriate Assessments, Environmental Impact Statements, and expert witness work at oral hearings), large-scale habitat surveys, preparation of management plans, contributions to multi-disciplinary conservation plans, and specialist ecological survey and research.

2. METHODS

2.1. GENERAL

I based the approach to the population viability analyses on the NatureScot population viability analysis guidance (NatureScot, 2023). I used the online Natural England PVA tool[1] to implement the population viability analyses following the guidance in Mobbs *et al.* (2020).

Adult seabirds may not breed every year, so the number of breeding adults at a colony may not reflect the total size of the population. The NatureScot guidance recommends that incidences of missed breeding (sabbatical rates of adult birds) should be included in the population viability analysis, but the Natural England PVA tool does not provide an option to directly include this parameter. Incidences of missed breeding could be included in the modelling by increasing the population size to include the missing adults and reducing the productivity rate to reflect the zero productivity from the missing adults. However, these two adjustments should largely balance out.

I used the predicted collision risks from the Option 2 stochastic model (see Collision Risk Modelling Report; Technical Appendix 11-3). I modelled separate impact scenarios using the mean and 97.5 percentile collision risks.

I followed the NatureScot guidance and modelled impacts over periods of 25 years, 50 years, and the lease period (38 years) for this project.

As recommended by Mobbs *et al.* (2020), I modelled the impacts using a relative reduction in survival rate, rather than absolute numbers of collision mortalities. This reflects the fact that as the population size changes, the numbers of birds visiting the wind farm area are likely to change, so the absolute value of the collision risk is likely to change.

The relative reduction in survival rate is given by the additional mortality (in this case the predicted collision risk) divided by the baseline population size.

2.2. REGIONAL POPULATIONS

Population viability analyses were required for regional populations where the predicted collision risk would result in an increase of more than 1% in the baseline mortality. From the analyses in the Environmental Impact Assessment Report Ornithology chapter, the only such populations were the Great Black-backed Gull and Common Tern regional breeding populations. In the latter case, the mortality increase refers to the collision risk in the migration-free breeding season (see Chapter 11 - Marine Ornithology chapter,).

Basic information about the population viability analyses of these populations is shown in

Table 2.1.

The baseline demographic rates included in the population viability analyses are shown in

Table 2.2 and Table 2.3.

For Common Tern, I first tried running the model using the global value for productivity rate from the Natural England PVA tool. However, this resulted in rapid extinction of the population, even with the baseline scenario[2]. There was an increase of 176% in the Common Tern breeding population in County Galway between the Seabird 2000 census (1998-2002) and the Seabirds Count census (2015-2021) (Burnell et al., 2023). Therefore, productivity rates that result in declines in the population are unlikely to be appropriate. The productivity rate for Rockabill from Horswill and Robinson (2015) generated a modest increasing trend, so I used this productivity rate in the model.

[1] Tool v 2 (Code: v 4.18 Interface: v 1.7); http://ec2-34-243-66-127.eu-west-1.compute.amazonaws.com/shiny/seabirds/PVATool_Nov2022/R/

[2] The decrease was so rapid that the population became extinct within the burn-in period.

Horswill and Robinson (2015) do not provide data on incidence of missed breeding for Great Black-backed Gull, while they describe the incidence of missed breeding for Common Tern as "low". Therefore, I did not include any adjustments to reflect this parameter in the models (see also above).

The impact scenarios included in the population viability analyses are shown in

Table 2.4.

For Great Black-backed Gull, the impact scenarios included the collision risk from both the breeding and non-breeding seasons. I applied all of the breeding season collision risk to adult birds as all the aged Great Black-backed Gulls recorded during the breeding season surveys were adults (Offshore Ornithology Baseline Report; Technical Appendix 11-1). I adjusted the non-breeding season collision risk by the totals of the weightings in Table 38 of the Offshore Ornithology Apportioning Report (Technical Appendix 11-5). I then split the adjusted non-breeding season collision risk between adults and immatures using the ratios of the totals of adults and immatures in that table.

For Common Tern, the impact scenarios were restricted to the migration-free breeding season collision risk (see Chapter 11 – Marine Ornithology chapter). I applied all of the collision risk to adult birds as the incidence of offshore juvenile and immature Common Tern flight activity during the migration-free breeding season is likely to be low.

Table 2.1. Basic information about the population viability analyses of the Great Black-backed Gull and Common Tern regional breeding populations.

Attribute	Details
PVA run type	Simulation
Model to use for environmental stochasticity	Beta/Gamma
Model for density dependence	No density dependence
Include demographic stochasticity in model?	Yes
Number of simulations	1000
Random seed	1149
Years for burn-in	5

Table 2.2. Baseline demographic rates used for the population viability analysis of the Great Black-backed Gull regional breeding population.

Attribute	Value / mean	Standard deviation
Age at first breeding (years)	5	-
Maximum brood size per pair (chicks)	3	-
Initial population size (adults)	1410	-
Productivity rate per pair	0.971	0.435
Survival rate (adult)	0.93	0.05
Survival rate (age class 0-1)	0.93	0.05
Survival rate (age class 1-2)	0.93	0.05
Survival rate (age class 2-3)	0.93	0.05
Survival rate (age class 3-4)	0.93	0.05
Survival rate (age class 4-5)	0.93	0.05

Sources for age at first breeding and maximum brood sizes: default values from the Natural England PVA tool. Source for initial population size: Offshore Ornithology Apportioning Report (Technical Appendix 11-5). Source for productivity rate: global value from the Natural England PVA tool. Source for mean survival rates: national values from the Natural England PVA tool. Source for standard deviations of survival rates: nominal values (see text).

Table 2.3. Baseline demographic rates used for the population viability analysis of the Common Tern regional breeding population.

Attribute	Value / mean	Standard deviation
Age at first breeding (years)	3	-
Maximum brood size per pair (chicks)	4	-
Initial population size (adults)	256	-
Productivity rate per pair	1.59	0.465
Survival rate (adult)	0.883	0.014
Survival rate (age class 0-1)	0.441	0.006
Survival rate (age class 1-2)	0.441	0.006
Survival rate (age class 2-3)	0.85	0.014

Sources for age at first breeding and maximum brood sizes: default values from the Natural England PVA tool. Source for initial population size: Offshore Ornithology Apportioning Report (Technical Appendix 11-5). Source for productivity rate: Rockabill value from Horswill and Robinson (2015); see text. Source for survival rates: Horswill and Robinson (2015); the rate for immatures (3-4 years) was used for age class 2-3.

Table 2.4. Impact scenarios used for the population viability analysis of the Great Black-backed Gull regional breeding population.

Attribute	Details
Are impacts specified separately for immatures?	Yes
Are standard errors of impacts available?	No
Should random seeds be matched for impact scenarios?	Yes
Impacts are specified as	Relative
Years in which impacts are assumed to begin and end	2031 – 2067
Impact on adult survival rate (mean collision risk)	0.00182
Impact on adult survival rate (97.5% collision risk)	0.00570
Impact on immature survival rate (mean collision risk)	0.00009
Impact on immature survival rate (97.5% collision risk)	0.00025

Impacts were the reduction in survival rates due to the predicted collision risks (see text).

Table 2.5. Impact scenarios used for the population viability analysis of the Common Tern regional breeding population.

Attribute	Details
Are impacts specified separately for immatures?	Yes
Are standard errors of impacts available?	No
Should random seeds be matched for impact scenarios?	Yes
Impacts are specified as	Relative
Years in which impacts are assumed to begin and end	2031 – 2067
Impact on adult survival rate (mean collision risk)	0.00129
Impact on adult survival rate (97.5% collision risk)	0.00489
Impact on immature survival rate (mean collision risk)	0.00000
Impact on immature survival rate (97.5% collision risk)	0.00000

Impacts were the reduction in survival rates due to the predicted collision risks (see text).

3. RESULTS

3.1. REGIONAL POPULATIONS

3.1.1. General

The two ratio metrics recommended by NatureScot (2023) to compare impacted and un-impacted populations are the counterfactual ratio of the final population sizes, and the counterfactual ratio of the population growth rates.

NatureScot (2023) state that a counterfactual population size ratio of 0.95, or a counterfactual population growth rate ratio of 0.90, “might be considered to be a small enough effect that the development would not lead to an adverse effect on site integrity”. However, they caution that “there is no standard threshold with respect to what might be considered an “acceptable” level of impact”.

3.1.2. Great Black-backed Gull

The population viability analysis for the Great Black-backed Gull regional breeding population produced exponential growth under all the scenarios (Figure 3.1) reflecting the absence of density-dependence in the model. These results are not likely to represent realistic trajectories of the future variation in this population, as density-dependent factors are likely to be important in situations where exponential increases occur.

The population growth rates were reduced by around 0.1% under the mean collision risk scenario, and by around 0.2-0.3% under the 97.5 percentile collision risk scenario (Table 3.1). The counterfactual ratio was slightly higher after 50 years, compared to after 25 and 38 years, reflecting the end of the collision risk impacts after 38 years.

The reduction in final population size increased with the duration of the simulation, which is an inevitable mathematical consequence of applying a reduced growth rate for longer periods of time. After 50 years, the final population size was around 5% lower under the mean collision risk scenario, and around 11% lower under the 97.5 percentile collision risk scenario (Table 3.1).

3.1.3. Common Tern

The population viability analysis for the Common Tern regional breeding population produced modest growth in the median population size over 50 years under all the scenarios (Figure 3.2), although the lower limits of the confidence interval for the 97.5 percentile collision risk scenario showed a slight decrease.

The population growth rates were reduced by around 0.1-0.2% under the mean collision risk scenario, and by around 0.4-0.5% under the 97.5 percentile collision risk scenario (
Table 3.2). The counterfactual ratio was slightly higher after 50 years, compared to after 25 and 38 years, reflecting the end of the collision risk impacts after 38 years.

The reduction in final population size increased with the duration of the simulation, which is an inevitable mathematical consequence of applying a reduced growth rate for longer periods of time. After 50 years, the final population size was around 6% lower under the mean collision risk scenario, and around 20% lower under the 97.5 percentile collision risk scenario (
Table 3.2).

Table 3.1. Effects of the predicted mean and 97.5 percentile predicted collision risks, compared to the baseline scenario, on the simulated final population sizes and annual growth rates of the Great Black-backed Gull regional breeding population.

Year	Scenario	Annual growth rate		Final population size	
		Median (95% CI)	Counterfactual ratio	Median (95% CI)	Counterfactual ratio
25	Baseline	1.133 (1.104-1.162)	-	30422 (17483-51555)	-
	Mean CR	1.132 (1.103-1.161)	0.999	29732 (17228-50371)	0.98
	97.5 percentile CR	1.130 (1.101-1.159)	0.997	28156 (16533-47667)	0.93
38	Baseline	1.133 (1.111-1.156)	-	154826 (81258-286184)	-
	Mean CR	1.132 (1.11-1.156)	0.999	149095 (77955-274151)	0.96
	97.5 percentile CR	1.13 (1.108-1.153)	0.997	137638 (71218-254252)	0.89
50	Baseline	1.134 (1.115-1.151)	-	710192 (319438-1416582)	-
	Mean CR	1.133 (1.114-1.15)	0.999	676678 (317237-1383431)	0.95
	97.5 percentile CR	1.132 (1.112-1.148)	0.998	630302 (294811-1264453)	0.89

Table 3.2. Effects of the predicted mean and 97.5 percentile predicted migration-free breeding season collision risks, compared to the baseline scenario, on the simulated final population sizes and annual growth rates of the Common Tern regional breeding population.

Year	Scenario	Annual growth rate		Final population size	
		Median (95% CI)	Counterfactual ratio	Median (95% CI)	Counterfactual ratio
25	Baseline	1.011 (0.995-1.027)	-	342 (116-246)	-
	Mean CR	1.009 (0.993-1.025)	0.998	324 (112-236)	0.95
	97.5 percentile CR	1.005 (0.988-1.022)	0.993	288 (96-207)	0.84
38	Baseline	1.011 (0.998-1.024)	1	778 (476-1208)	1
	Mean CR	1.009 (0.996-1.021)	0.998	727 (446-1134)	0.93
	97.5 percentile CR	1.004 (0.99-1.016)	0.993	606 (354-940)	0.78
50	Baseline	1.011 (1.000-1.021)	-	442 (126-365)	-
	Mean CR	1.010 (0.998-1.02)	0.999	417 (116-345)	0.94
	97.5 percentile CR	1.006 (0.995-1.016)	0.995	351 (99-281)	0.80

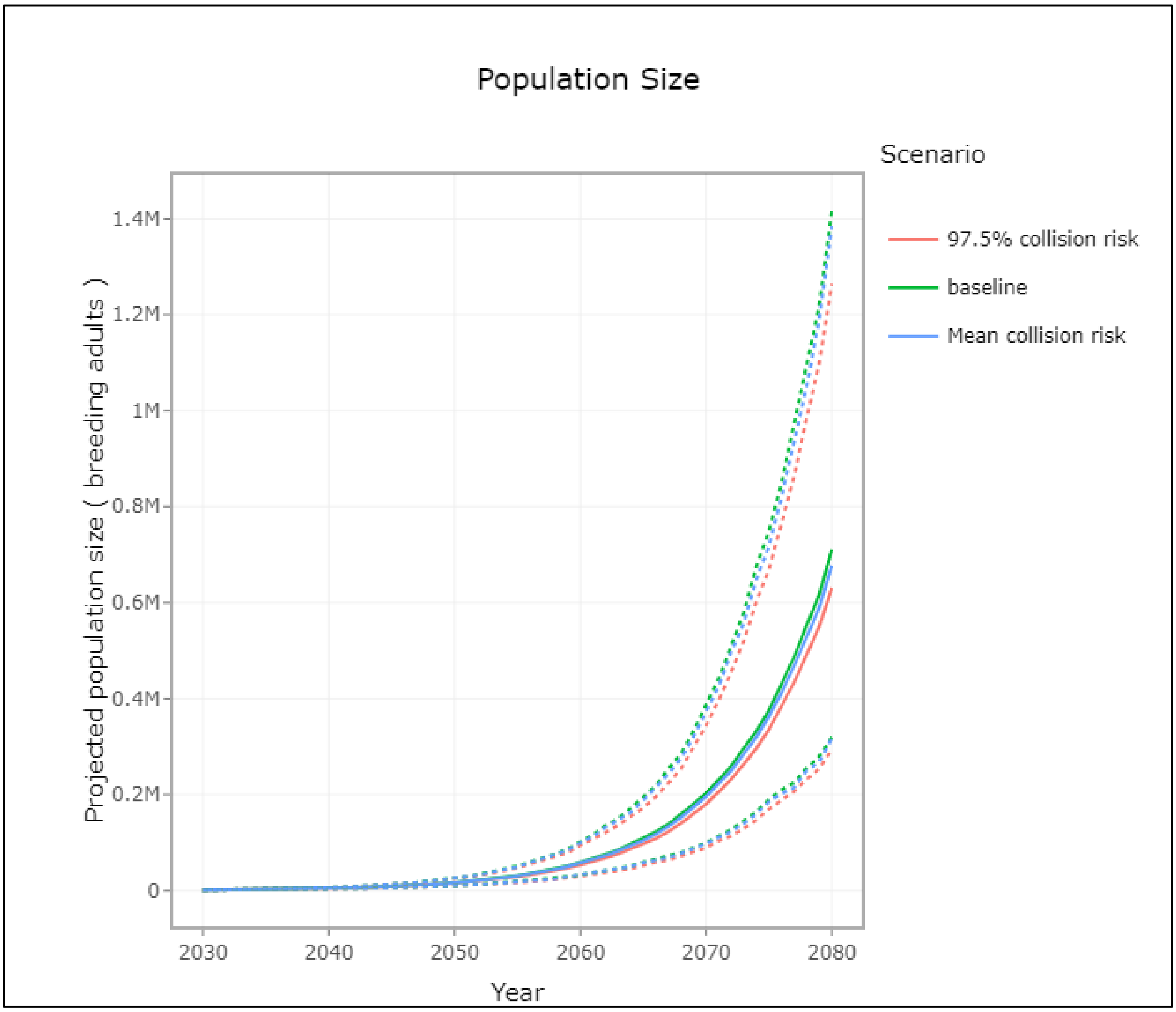

Figure 3.1. Effects of the predicted mean and 97.5 percentile predicted collision risks, compared to the baseline scenario, on the simulated population growth of the Great Black-backed Gull regional breeding population.

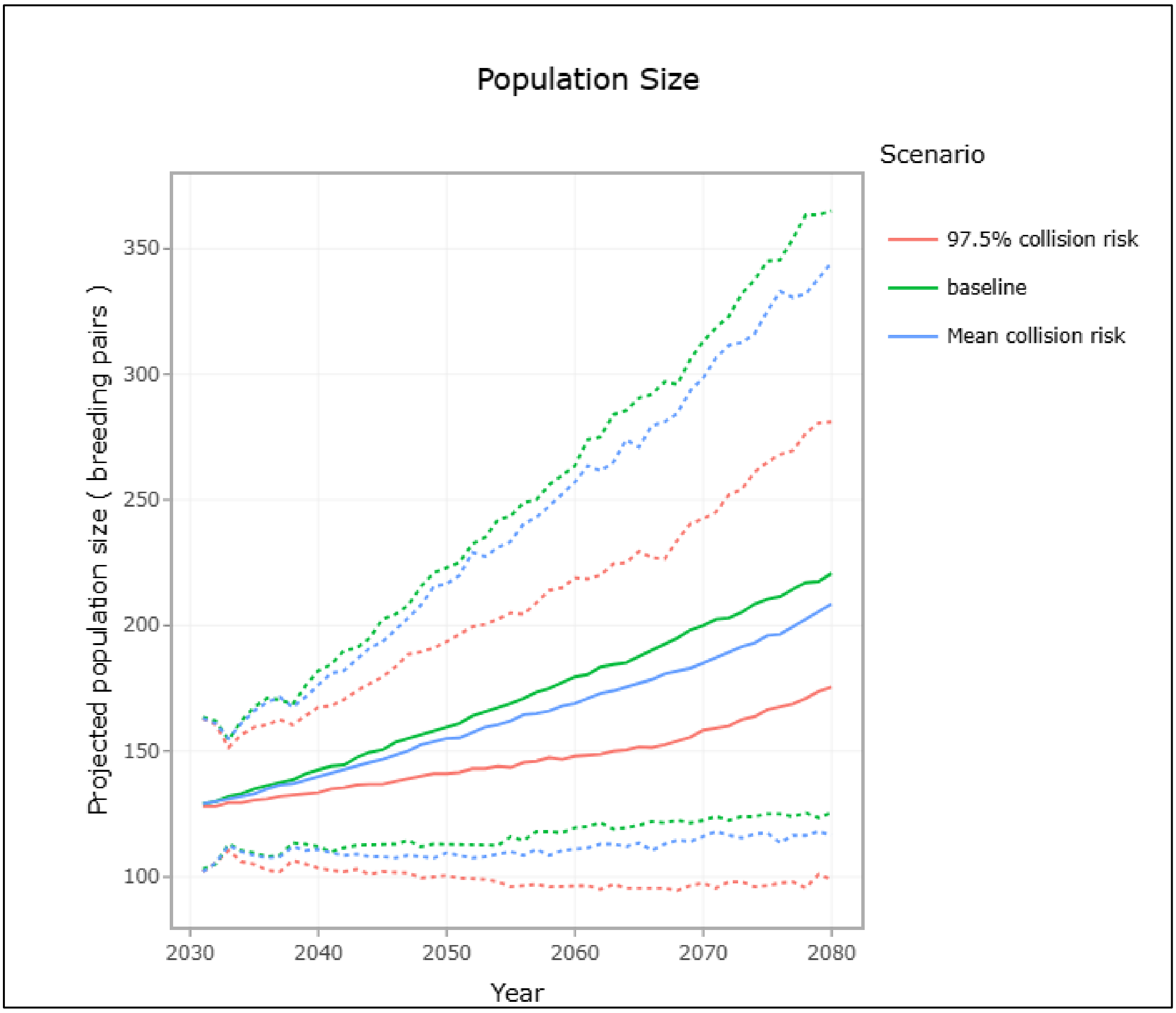

Figure 3.2. Effects of the predicted mean and 97.5 percentile predicted migration-free breeding season collision risks, compared to the baseline scenario, on the simulated population growth of the Common Tern regional breeding population.

4. CONCLUSIONS

Population viability analyses of the effects of the predicted collision risk on the Great Black-backed Gull and Common Tern regional breeding populations indicated that the additional mortality would not stop the growth of the populations.

For Great Black-backed Gull, the population viability analyses produced counterfactual ratios of the final population size after 50 years of 0.95 for the mean collision risk and 0.89 for the 97.5 percentile collision risk. The counterfactual ratios of the annual growth rates were 0.999 and 0.998, respectively.

For Common Tern, the population viability analyses produced counterfactual ratios of the final population size after 50 years of 0.94 for the mean collision risk and 0.80 for the 97.5 percentile collision risk. The counterfactual ratios of the annual growth rates were 0.999 and 0.995, respectively.

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