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MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Population Viability Analysis for the Regional Population of Guillemot

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Image of an offshore wind farm

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Prepared by:

NIRAS

Prepared for:

Morgan Offshore Wind Limited.

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Glossary

Term	Meaning
Applicant	Morgan Offshore Wind Limited.
Morgan Offshore Wind Project: Generation Assets	This is the name given to the Morgan Generation Assets project as a whole (includes all infrastructure and activities associated with the project construction, operations and maintenance, and decommissioning).
Parameter	Parameters are the input elements of a model that together affect the output of a model. In collision risk models, examples of parameters are the number of wind turbines and the length of the bird.

Acronyms

Acronym	Description
CGR	Counterfactual of Growth Rate
CPS	Counterfactual of Population Size
EIA	Environmental Impact Assessment
HRA	Habitats Regulations Assessment
PVA	Population Viability Analysis
SNCB	Statutory Nature Conservation Body

Units

Unit	Description
%	Percentage

1 POPULATION VIABILITY ANALYSIS FOR THE REGIONAL POPULATION OF GUILLEMOT

1.1 Introduction

1.1.1.1 As part of their response at Deadline 5 (REP5-079), Natural England requested that the Applicant undertake Population Viability Analysis (PVA) to explore the potential cumulative impact on guillemot *Uria aalge* quantified in the Applicant's submission at Deadline 5 (REP5-032, REP5-033 and REP5-034).

1.1.1.2 This note therefore presents PVA modelling for the cumulative impact on guillemot to support the assessments required as part of the Environmental Impact Assessment (EIA).

1.2 Methodology

1.2.1.1 Following the approach applied in Annex 16.1 to Ornithological assessment clarification data English sites (REP5-032), this note provides the following information for the predicted cumulative impact on guillemot:

- Calculation of cumulative totals for the following scenarios:

– Using the Applicant's parameter assumptions

1. The cumulative impact for guillemot incorporating all projects when applying a 50% displacement rate and a 1% mortality rate
2. The cumulative impact for guillemot when applying a 50% displacement rate and a 1% mortality rate excluding the Morgan Generation Assets.

– Using Natural England's parameter assumptions

3. The cumulative impact for guillemot incorporating all projects when applying a 70% displacement rate and a 10% mortality rate
4. The cumulative impact for guillemot when applying a 70% displacement rate and a 10% mortality rate excluding the Morgan Generation Assets
5. The cumulative impact for guillemot incorporating all projects when applying a 30% displacement rate and a 1% mortality rate
6. The cumulative impact for guillemot when applying a 30% displacement rate and a 1% mortality rate excluding the Morgan Generation Assets.

– Using rates applied by the Secretary of State:

7. The cumulative impact for guillemot incorporating all projects when applying a 70% displacement rate and a 2% mortality rate
8. The cumulative impact for guillemot when applying a 70% displacement rate and a 2% mortality rate excluding the Morgan Generation Assets.

1.2.1.2 The calculation of these scenarios incorporates population estimates for all projects, incorporating those for which impacts are available from project-specific information and those for which impacts were calculated as part of Annex 4.5 to Response to Hearing Action Point 15: Offshore Ornithology CEA and In-combination Gap-filling of

Historical Projects Note (REP1-010) and Explanatory note to support SNCB and Applicant workbooks(S_D6_37.1).

1.2.1.3 Scenarios 1 and 2 provide impacts calculated applying the Applicant's parameter assumptions. Displacement mortality is calculated using a 50% displacement rate and a 1% mortality rate. Scenarios 3 to 6 provide impacts calculated applying the Statutory Nature Conservation Bodies (SNCBs) parameter assumptions. Displacement mortality is calculated using a 30-70% displacement rate range and a 1-10% mortality rate range. Scenarios 7 and 8 provide impacts calculated utilising those rates incorporated into the Secretary of State's Habitats Regulations Assessment (HRA) as part of the Sheringham Shoal Extension and Dudgeon Extension offshore wind farms and Hornsea Four offshore wind farm decisions for guillemot, razorbill and gannet, using a 70% displacement rate and a 2% mortality rate.

1.3 Cumulative totals

1.3.1.1 At Deadline 5, the Applicant submitted Annex 16.1 to Ornithological assessment clarification data English sites (REP5-032) which quantified the predicted cumulative impact on guillemot. This impact was estimated applying Natural England's preferred parameters. **Error! Reference source not found.** provides the population estimates for all projects included in the cumulative assessment.

Table 1.1: Guillemot cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase (all values represent no. of birds) (yellow highlighting identifies those projects for which gap-filling has been undertaken).

Project	Breeding season cumulative abundance	Non-breeding season cumulative abundance
Awel y Môr Offshore Wind Farm	1,569	2,919
Barrow Offshore Wind Farm	43	62
Burbo Bank Offshore Wind Farm	41	42
Burbo Bank Extension Offshore Wind Farm	1,000	1,561
Erebus Floating Wind Demo	7,001	28,338
Gwynt y Môr Offshore Wind Farm	149	146
Llŷr 1 Offshore Wind Farm	2,026	13,009
Mona Offshore Wind Farm	4,220	3,756
Morecambe Offshore Wind Farm: Generation Assets	6,374	8,315
Morgan Offshore Wind Farm: Generation Assets	4,010	3,824
North Hoyle Offshore Wind Farm	44	63
Ormonde Wind Farm	912	43
Rhyl Flats Offshore Wind Farm	49	66
Robin Rigg Offshore Wind Farm	138	73
TwinHub (Wave Hub Floating Wind Farm)	39	217

Project	Breeding season cumulative abundance	Non-breeding season cumulative abundance
Walney 1 & 2 Offshore Wind Farm	161	173
Walney (3 & 4) Extension Offshore Wind Farm	4,169	1,927
West of Duddon Sands Offshore Wind Farm	1,321	126
West of Orkney Windfarm	7,973	4,393
White Cross Offshore Windfarm	3,304	1,059
Scenario Totals		
Scenario 3: Morgan Offshore Wind Farm: Generation Assets, Transmission Assets, Tier 1, Tier 2, and Tier 3 projects		**114,849**

1.4 Assessment

1.4.1.1 The total cumulative abundance of guillemot is 114,849 birds. A displacement matrix incorporating this population is provided in Table 1.2. A displacement matrix discounting the Morgan Generation Assets from the cumulative total is provided in Table 1.3.

Table 1.2: Cumulative guillemot mortality following displacement from offshore wind farms.

Guillemot		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	115	230	574	1,148	2,297	3,445	4,594	5,742	6,891	8,039	9,188	10,336	11,485
	15	172	345	861	1,723	3,445	5,168	6,891	8,614	10,336	12,059	13,782	15,505	17,227
	20	230	459	1,148	2,297	4,594	6,891	9,188	11,485	13,782	16,079	18,376	20,673	22,970
	30	345	689	1,723	3,445	6,891	10,336	13,782	17,227	20,673	24,118	27,564	31,009	34,455
	35	402	804	2,010	4,020	8,039	12,059	16,079	20,099	24,118	28,138	32,158	36,177	40,197
	40	459	919	2,297	4,594	9,188	13,782	18,376	22,970	27,564	32,158	36,752	41,346	45,940
	50	574	1,148	2,871	5,742	11,485	17,227	22,970	28,712	34,455	40,197	45,940	51,682	57,424
	60	689	1,378	3,445	6,891	13,782	20,673	27,564	34,455	41,346	48,237	55,128	62,018	68,909
	70	804	1,608	4,020	8,039	16,079	24,118	32,158	40,197	48,237	56,276	64,315	72,355	80,394
	80	919	1,838	4,594	9,188	18,376	27,564	36,752	45,940	55,128	64,315	73,503	82,691	91,879
	90	1,034	2,067	5,168	10,336	20,673	31,009	41,346	51,682	62,018	72,355	82,691	93,028	103,364
	100	1,148	2,297	5,742	11,485	22,970	34,455	45,940	57,424	68,909	80,394	91,879	103,364	114,849

Table 1.3: Cumulative guillemot mortality following displacement from offshore wind farms discounting the Morgan Generation Assets.

Guillemot		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	107	214	535	1,070	2,140	3,210	4,281	5,351	6,421	7,491	8,561	9,631	10,702
	15	161	321	803	1,605	3,210	4,816	6,421	8,026	9,631	11,237	12,842	14,447	16,052
	20	214	428	1,070	2,140	4,281	6,421	8,561	10,702	12,842	14,982	17,122	19,263	21,403
	30	321	642	1,605	3,210	6,421	9,631	12,842	16,052	19,263	22,473	25,684	28,894	32,105
	35	375	749	1,873	3,746	7,491	11,237	14,982	18,728	22,473	26,219	29,964	33,710	37,455
	40	428	856	2,140	4,281	8,561	12,842	17,122	21,403	25,684	29,964	34,245	38,526	42,806
	50	535	1,070	2,675	5,351	10,702	16,052	21,403	26,754	32,105	37,455	42,806	48,157	53,508
	60	642	1,284	3,210	6,421	12,842	19,263	25,684	32,105	38,526	44,946	51,367	57,788	64,209
	70	749	1,498	3,746	7,491	14,982	22,473	29,964	37,455	44,946	52,438	59,929	67,420	74,911
	80	856	1,712	4,281	8,561	17,122	25,684	34,245	42,806	51,367	59,929	68,490	77,051	85,612
	90	963	1,926	4,816	9,631	19,263	28,894	38,526	48,157	57,788	67,420	77,051	86,682	96,314
	100	1,070	2,140	5,351	10,702	21,403	32,105	42,806	53,508	64,209	74,911	85,612	96,314	107,015

1.4.1.2 The increase in baseline mortality as a result of cumulative displacement impacts on the regional population of guillemot is presented for each scenario in Table 1.4. The cumulative displacement impact on guillemot surpasses the 1% threshold for further assessment when considering scenarios 3, 4 and 7 only. For scenarios 1, 2, 5, 6 and 8 the 1% threshold was not breached.

Table 1.4: Increase in baseline mortality as a result of cumulative displacement impacts on the regional population of guillemot.

Scenario	Parameter assumptions	Impact (no. of birds)	Increase in baseline mortality (%)
1	Displacement rate = 50% Mortality rate = 1%	574	0.38
2		535	0.35
3	Displacement rate = 70% Mortality rate = 10%	8,039	5.32
4		7,491	4.95
5	Displacement rate = 30% Mortality rate = 1%	345	0.23
6		321	0.21
7	Displacement rate = 70% Mortality rate = 2%	1,608	1.06
8		1,498	0.99

1.4.1.3 PVA modelling has therefore been conducted for scenarios 3, 4 and 7 incorporating the largest regional population (1,145,528 individuals) as defined by the SNCBs and derived from Furness (2015). The predicted impacts for these scenarios are presented in Table 1.5. Scenario 8 has also been included to enable with and without Morgan

Generation Assets comparisons with scenario 7. The PVA input parameters are presented in Appendix A:.

Table 1.5: PVA input values for scenarios for which an increase in baseline mortality of greater than 1% has been calculated plus scenario 8 for comparison.

Scenario	Decrease in survival rate
3	0.0070180990
4	0.0065394069
7	0.0014036198
8	0.0013078814

1.4.1.4 The results of the PVA for the cumulative impacts associated with scenarios 3, 4, 7 and 8 are presented in Table 1.6. The baseline 'unimpacted' scenario (i.e. assuming no additional mortality other than baseline mortality exists) is also shown for comparison purposes.

Table 1.6: PVA outputs for the regional population of guillemot (Scenarios 3, 4, 7 and 8).

Notes:

CGR = Counterfactual of Growth Rate

CPS = Counterfactual of Population Size

Year	Impact scenario	Simulated population size	Median population change (%)	Median growth rate	Lower confidence limit of simulated growth rate	Upper confidence limit of simulated growth rate	Median CGR	Median CPS
2030	Baseline (unimpacted)	1,686,613	2.7	1.027	0.954	1.094	-	-
2030	Scenario 3	1,673,045	1.9	1.019	0.946	1.085	0.992	0.992
2030	Scenario 4	1,674,630	2.0	1.020	0.946	1.086	0.993	0.993
2030	Scenario 7	1,684,408	2.6	1.026	0.952	1.092	0.998	0.998
2030	Scenario 8	1,684,300	2.6	1.026	0.953	1.092	0.999	0.998
2065	Baseline (unimpacted)	4,140,140	151.7	1.026	1.017	1.034	-	-
2065	Scenario 3	3,115,383	89.5	1.018	1.009	1.026	0.992	0.753
2065	Scenario 4	3,178,542	93.2	1.018	1.010	1.027	0.993	0.767
2065	Scenario 7	3,915,708	138.1	1.024	1.016	1.033	0.998	0.945
2065	Scenario 8	3,929,484	138.9	1.024	1.016	1.033	0.999	0.949

1.4.1.5 The Counterfactual of Growth Rate (CGR) is a more realistic metric than population size to review the impact when undertaking density independent PVAs. When considering all four impact scenarios, there is a marginal change in the CGR (0.992 to 1.000) compared to the baseline (unimpacted) scenario. Even when considering the larger impact (70% displacement and 10% mortality plus the collision impact from tidal projects), the predicted median growth rate of the common guillemot population is >1. Therefore, the modelled population is predicted to grow under all impact scenarios. Similarly, the upper and lower confidence intervals indicate that after 35 years and under all impact scenarios the population is predicted to increase in size (>1 median growth rate).

1.4.1.6 When considering outputs associated with scenario 7 which incorporates an impact calculated using a 70% displacement rate and 2% mortality rate, the magnitude of changes to key output metrics from the PVA are reduced when compared to those predicted for scenario 3. For example, the CGR for scenario 7 is 0.998 compared to 0.992 for scenario 3.

1.4.1.7 When the impact of the Morgan Generation Assets is removed from the cumulative impact there is little change in the key PVA output metrics, suggesting that the inclusion of the Morgan Generation Assets in the cumulative impact will make little difference to the potential impact on the regional population of guillemot.

1.4.1.8 The Applicant considers that the assumptions associated with scenario 1 (50% displacement and 1% mortality) provide the best reflection of the potential cumulative impact on the regional population of guillemot (see paragraphs 5.9.1.10 to 5.9.1.28 and Table 5.27 in APP-023). Applying the assumptions associated with scenario 1 leads to an impact that represents less than a 1% increase in the baseline mortality of the largest regional population of guillemot.

1.4.1.9 As stated within Volume 2, Chapter 5: Offshore ornithology (APP-023), the cumulative effect is predicted to be of local spatial extent, medium term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. As the predicted impact results in the population continuing to increase under all scenarios and only reduces the growth rate by 0.8% under the worst-case scenario of 70% displacement and 10% mortality, the magnitude is considered to be negligible.

1.4.1.10 Guillemot are deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.

1.4.1.11 As set out in Table 5.24 of Volume 2, Chapter 5: Offshore ornithology (APP-023), a negligible magnitude impact on a species of medium sensitivity results in a negligible impact, which is not significant in EIA terms.

1.4.1.12 The conclusions reached in this note are therefore identical to those reached in Volume 2, Chapter 5: Offshore ornithology (APP-023). This is despite the use of higher displacement and mortality rates that are considered to provide impacts that are considerably over-estimated. When considering displacement and mortality rates that are evidence-based, the cumulative impact does not surpass the 1% threshold for further consideration.

1.5 References

Furness, R.W. (2015) Non-breeding season populations of seabirds in UK waters. [Online]. Available at: [redacted] (Accessed May 2015).

Appendix A: PVA input log

A.1 Set up

The log file was created on: 2025-02-04 12:08:15 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"
```

A.2 Basic information

This run had reference name “Guillemot_Regional”.
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: 15.
Years for burn-in: 5.
Case study selected: None.

A.3 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: all.individuals
Are baseline demographic rates specified separately for immatures?: Yes.

A.3.1 Population 1

Initial population values: Initial population 1145528 in 2015

Productivity rate per pair: mean: 0.58321 , sd: 0.07931989

Adult survival rate: mean: 0.94 , sd: 0.025

Immatures survival rates:

Age class 0 to 1 - mean: 0.56 , sd: 0.058 , DD: NA

Age class 1 to 2 - mean: 0.792 , sd: 0.152 , DD: NA

Age class 2 to 3 - mean: 0.917 , sd: 0.098 , DD: NA

Age class 3 to 4 - mean: 0.938 , sd: 0.107 , DD: NA

Age class 4 to 5 - mean: 0.94 , sd: 0.025 , DD: NA

Age class 5 to 6 - mean: 0.94 , sd: 0.025 , DD: NA

A.4 Impacts

Number of impact scenarios: 4.

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 2065

A.4.1 Impact on Demographic Rates

A.4.1.1 Scenario A - Name: GU_Reg_Scenario3

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.007018099 , se: NA

A.4.1.2 Scenario B - Name: GU_Reg_Scenario4

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.006539407 , se: NA

A.4.1.3 Scenario C - Name: GU_Reg_Scenario7

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.00140362 , se: NA

A.4.1.4 Scenario D - Name: GU_Reg_Scenario8

All subpopulations

Impact on productivity rate mean: 0 , se: NA

Impact on adult survival rate mean: 0.001307881 , se: NA

A.5 Output:

First year to include in outputs: 2030
Final year to include in outputs: 2065
How should outputs be produced, in terms of ages?: whole.population
Target population size to use in calculating impact metrics: NA
Quasi-extinction threshold to use in calculating impact metrics: NA