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Morlais Project

Marine Ornithology Collision Risk Modelling Note

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1 Introduction

The scale of the first deployment phase for the proposed Morlais project will be selected primarily to reduce potential impacts on bottlenose dolphin through underwater collision risk. The maximum deployment resulting in no more than 0.7 bottlenose dolphin collisions per year ("the 0.7 bottlenose dolphin scenario") has been calculated for each of eight different devices during consultation on marine mammal impacts.

The purpose of this document is to present revised collision estimates under the 0.7 bottlenose dolphin scenario for marine ornithology receptors. This approach was initially agreed during a marine ornithology project meeting (at which both NRW and RSPB were represented) on 29/11/2019. This note supersedes the one previously published on 31/03/2020.

For each bird species reviewed, the worst-case device scenario modelled has been selected for assessment. The working supporting this is not shown here, but is based on calculating a "collisions per MW" value for each technology under consideration and multiplying this by the maximum number of MW deployable under the 0.7 bottlenose dolphin scenario. The technology under consideration and its input parameters for the modelling have not changed, and it is only the scale of the initial deployment which has been changed compared to the original modelling presented in the Environmental Statement (ES) Chapter 11, Marine Ornithology, Technical Appendix 11.3. Therefore, the device parameters are constant and there is a linear relationship between the number of MW deployed and the number of collisions predicted for each species. This is as discussed and agreed with RSPB during the meeting on 04/08/2020. This means that this approach produces valid theoretical collision estimates for the 0.7 bottlenose dolphin scenario for seabird species.

In addition, Population Viability Analysis (PVA) has been undertaken for three species; guillemot, razorbill and Manx shearwater (as agreed in the meeting of 29/11/2019) to provide further detail on potential population level effects.

Finally, the model outputs are used to assess the magnitude of impact and impact significance for the worst-case deployment scenario for each of these three species.

This document should be read in conjunction with the following ES documents:

- Chapter 5, EIA Methodology;
- Chapter 11, Marine Ornithology; and
- Chapter 11, Marine Ornithology, Technical Appendix 11.3.

2 Methodology and Scenarios Assessed

2.1 Estimating Collision Risk

The naming conventions for the devices included in the modelling are the same as in ES Chapter 11, Marine Ornithology. Whilst the same devices were modelled by the marine mammal assessment, the naming convention is different. The information in Table 2.1 indicates which device name in the ornithology assessments relates to which in the marine mammal assessment.

Table 2.1. Differences in the naming conventions of devices between the ornithology and marine mammal assessments.

Ornithology Assessment	Marine Mammal Assessment
1F	1
2F	3
3F	2a
4F	4
5S	5a
6S	5b
7S	6a
8S	6b
9F	7a

The methodology for Encounter Rate Modelling (ERM) and Collision Risk Modelling (CRM) remains the same as that presented in ES Chapter 11, Marine Ornithology and Technical Appendix 11.3, as do the biological season definitions. The outputs presented are a mean of ERM and CRM. The level of deployment of each device resulting in no more than 0.7 bottlenose dolphin collisions annually is presented in

Table 2.2, along with an indication of which scenario results in the greatest number of predicted collisions by species.

Table 2.2. Deployment scenarios for first phase of proposed Morlais project, based on restricting bottlenose dolphin collisions to an annual maximum of 0.7, along with identification of worst case deployment for each seabird species under consideration. The device scenarios across the top of this table correspond to those originally presented in ES Chapter 11, Marine Ornithology.

Device	1F	3F	4F	5S	6S	7S	8S
MW	11.24	6.57	6.4	10.90	8.84	6.56	7.66
Guillemot					X		
Razorbill		X					
Puffin		X					
Red-throated Diver		X					
Manx shearwater	X						
Gannet	X						
Shag					X		

2.2 PVA

The PVA for guillemot and razorbill retains the same methodology, assumptions and inputs as the models previously presented in ES Chapter 11, Marine Ornithology and Technical Appendix 11.3. In addition to presenting the results of the modelling over a 25-year period, results over a five-year period are also presented, as this may be closer to the timeframe within which a second phase of deployment may be considered by the proposed project. It should be noted that the starting populations used in the PVA presented in ES Chapter 11, Marine Ornithology and Technical Appendix 11.3 have been retained, but the latest available population estimates for the South Stack and Penlas colonies are much larger; by approximately 100% for guillemot, and 25% for razorbill. It should therefore be recognised when interpreting these PVA outputs (along with the outputs of the PVAs presented in the original assessment) that these models are based upon underestimated population sizes, which is likely to indicate higher levels of impact than if PVAs were run using the updated population estimates.

Manx shearwater PVA was carried out using a recently published online tool (Searle et al., 2019). The model selected was a deterministic model without density dependence. Manx shearwater demographic parameters were obtained from a recent review of seabird demographic rates (Horswill and Robinson, 2015). There are no published parameters for immature and juvenile survival rates in this species, and its unique ecological traits mean that the identification of an ecologically justifiable surrogate is challenging. On the basis of its similar age of first breeding and adult survival rate, according to Horswill and Robinson (2015), gannet was selected as a surrogate to obtain these parameters. The input parameters for Manx shearwater, along with the information sources from which these inputs were taken, are presented in Table 2.3.

Table 2.3. PVA input parameters for Manx shearwater.

Parameter	Value	Source
Starting population size (in terms of no. of breeding adults)	41,350 (Bardsey Island; 2016)	JNCC (2020)
Age of first breeding	5	Horswill and Robinson (2015)
Annual survival rate of breeding adults	0.870	Horswill and Robinson (2015)
Juvenile annual survival rate	0.424 (gannet surrogate)	Horswill and Robinson (2015)
Immature (1-2) annual survival rate	0.829 (gannet surrogate)	Horswill and Robinson (2015)
Immature (2-4) annual survival rate	As adult survival rate	Horswill and Robinson (2015)
Annual breeding success per active site	0.62 (Skomer Island average 2012 to 2016)	Stubbings (2017)

The annual harvest levels (i.e. predicted annual collision mortality) for the Manx shearwater PVA were taken from ES Chapter 11, Marine Ornithology and Technical Appendix 11.3, and are the worst-case deployment at 40MW, and an indicative 240MW array. These were the two scenarios originally considered by the ES. It should be noted that the 0.7 bottlenose dolphin scenarios presented in Table 2.2 represent approximately 17% to 31% of the generating capacity of the 40MW scenario originally presented in the ES. As the indicative 240MW array comprised a mix of devices, it cannot be directly compared with single device scenarios, but for context, the overall MW of the 0.7 bottlenose dolphin scenarios represent approximately 3% to 5% of the generating capacity of a 240MW indicative array. The annual harvest levels for the 40MW worst case and indicative 240MW array for Manx shearwater are presented in Table 2.4.

It should be noted that PVA has been run for the population of Bardsey Island only, and not the Skomer population. The SNH apportioning tool (SNH, 2018) indicated that approximately 42% of birds at the Morlais Development Zone (MDZ) would originate from this colony, and 56% from Skomer. The PVA has assumed that 100% of the birds at the MDZ are from Bardsey Island, meaning that the model is precautionary in this respect. As the Skomer population of Manx shearwater is much larger than the Bardsey Island population (632,140 breeding adults versus 41,350), it is expected that population level effects at the Skomer colony will be reduced relative to the Bardsey population. Therefore, if very minor population level effects are predicted for the Bardsey Island population, the same can be assumed for the Skomer population.

Table 2.4. Annual harvest values for Manx shearwater.

Avoidance Rate	40MW Worst Case Scenario	240MW Indicative Array
0.000	31	173
0.500	16	86
0.900	3	17
0.950	2	9
0.980	1	3
0.990	0	2

Avoidance Rate	40MW Worst Case Scenario	240MW Indicative Array
0.995	0	1
0.999	0	0

2.3 Impact Assessment

The impact assessment presented uses the same approach and definitions provided in ES Chapter 5, EIA Methodology and Chapter 11, Marine Ornithology.

3 Model Results

3.1 Revised Collision Estimates

For each of the worst case scenarios presented in

Table 2.2, the predicted number of annual collisions for each species by avoidance rate is presented in Table 3.1.

Table 3.1. Predicted number of annual collisions (mean of ERM and CRM) for the worst-case scenario for each relevant species for breeding (B), non-breeding (NB) and annual (ALL) periods at a range of avoidance rates[1].

Avoidance Rate	Guillemot (B)	Guillemot (NB)	Razorbill (B)	Razorbill (NB)	Puffin (B)	Red-throated diver (All)	Manx shearwater (B)	Gannet (B)	Shag (B)
0.000	1269	272	249	249	4	25	7	1	1
0.500	635	136	125	124	2	12	4	<1	<1
0.900	127	27	25	25	<1	2	1	<1	<1
0.950	63	14	12	12	<1	1	<1	<1	<1
0.980	25	5	5	5	<1	<1	<1	<1	<1
0.990	13	3	2	2	<1	<1	<1	<1	<1
0.995	6	1	1	1	<1	<1	<1	<1	<1
0.999	1	<1	<1	<1	<1	<1	<1	<1	<1

1. The device and capacity of the worst-case scenario for each species is as defined in Table 2.2.

3.2 Revised PVA Outputs

3.2.1 Guillemot

Table 3.2. PVA outputs for guillemot based on the levels of additional mortality presented in Table 3.1 after a 5-year period of operation.

Avoidance Rate	Growth Rate	Population After 5 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 5 Year Population	5 Year Population Relative to Current Population
Baseline	1.037	8,932	1	1	1.198
0.950	1.032	8,675	0.996	0.971	1.163
0.980	1.034	8,804	0.998	0.986	1.181
0.990	1.035	8,856	0.999	0.992	1.188
0.995	1.036	8,870	0.999	0.993	1.189
0.999	1.036	8,890	0.999	0.995	1.192

Table 3.3. PVA outputs for guillemot based on the levels of additional mortality presented in Table 3.1 after a 25-year period of operation.

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.037	18,353	1	1	2.461
0.950	1.032	16,408	0.996	0.894	2.200
0.980	1.034	17,370	0.998	0.946	2.329
0.990	1.035	17,772	0.999	0.968	2.383
0.995	1.036	17,875	0.999	0.974	2.397
0.999	1.036	18,027	0.999	0.982	2.417

3.2.2 Razorbill

Table 3.4. PVA outputs for razorbill based on the levels of additional mortality presented in Table 3.1 after a 5-year period of operation.

Avoidance Rate	Growth Rate	Population After 5 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 5 Year Population	5 Year Population Relative to Current Population
Baseline	1.035	1,737	1	1	1.185
0.950	1.030	1,688	0.996	0.971	1.151
0.980	1.033	1,716	0.998	0.988	1.170
0.990	1.034	1,729	0.999	0.995	1.179
0.995	1.034	1,733	1.000	0.998	1.181
0.999	1.034	1,733	1.000	0.998	1.181

Table 3.5. PVA outputs for razorbill based on the levels of additional mortality presented in Table 3.1 after a 25-year period of operation.

Avoidance Rate	Growth Rate	Population After 25 Years (total individual breeding adults)	Counterfactual of Growth Rate	Counterfactual of 25 Year Population	25 Year Population Relative to Current Population
Baseline	1.035	3,430	1	1	2.338
0.950	1.030	3,065	0.9962	0.893	2.089
0.980	1.033	3,275	0.998	0.955	2.232
0.990	1.034	3,369	0.999	0.982	2.296
0.995	1.034	3,398	1.000	0.991	2.316
0.999	1.034	3,398	1.000	0.991	2.316

3.2.3 Manx Shearwater

Table 3.6. PVA outputs for Manx shearwater based on the 40MW worst case deployment presented in Chapter 11, Marine Ornithology, after a 25-year period of operation.

Avoidance Rate	Annual Harvest	Counterfactual of Growth Rate	Counterfactual of 25 Year Population
0.950	2	1.000	0.998
0.980	1	1.000	0.999

Avoidance Rate	Annual Harvest	Counterfactual of Growth Rate	Counterfactual of 25 Year Population
0.990	0	1.000	1.000
0.995	0	1.000	1.000
0.999	0	1.000	1.000

Table 3.7. PVA outputs for Manx shearwater based on the 240MW indicative deployment presented in Chapter 11, Marine Ornithology, after a 25-year period of operation.

Avoidance Rate	Annual Harvest	Counterfactual of Growth Rate	Counterfactual of 25 Year Population
0.950	9	1.000	0.993
0.980	4	1.000	0.997
0.990	2	1.000	0.998
0.995	1	1.000	0.999
0.999	0	1.000	1.000

4 Impact Assessment

4.1 Guillemot

ES Chapter 11, Marine Ornithology, assessed the sensitivity for guillemot as "High". The magnitudes of impact and resulting impact significance for the different scenarios assessed in ES Chapter 11, Marine Ornithology are presented in Table 4.1, along with the impact assessment for the new scenarios. These outputs demonstrate that a minor adverse impact on the breeding guillemot population of the South Stack and Penlas subcolonies is predicted for the initial phase of the deployment, when assessed over both a five year and 25-year operational period.

Table 4.1. Impact assessment for guillemot under different deployment scenarios over a 25-year deployment. The 240MW indicative array and 40MW worst case scenarios were presented in ES Chapter 11, Marine Ornithology.

Scenario	Avoidance Rate	Magnitude of Impact	Impact Significance
240MW indicative array	0.950	Very high	Major adverse
	0.990	Medium	Not assessed
40MW worst case	0.950	Medium	Moderate adverse
	0.990	Low	Not assessed
0.7 bottlenose dolphin, worst case	0.950	Low	Minor adverse
	0.990	Low	Minor adverse

4.2 Razorbill

ES Chapter 11, Marine Ornithology, assessed the sensitivity for razorbill as "High". The magnitudes of impact and resulting impact significance for the different scenarios assessed in ES Chapter 11, Marine Ornithology are presented in Table 4.2, along with the impact assessment for the new scenarios. These outputs demonstrate that a minor adverse impact on the breeding razorbill population of the South Stack and Penlas subcolonies is predicted for the initial phase of the deployment, when assessed over both a five year and 25-year operational period.

Table 4.2. Impact assessment for razorbill under different deployment scenarios over a 25-year deployment. The 240MW indicative array and 40MW worst case scenarios were presented in ES Chapter 11, Marine Ornithology.

Scenario	Avoidance Rate	Magnitude of Impact	Impact Significance
240MW indicative array	0.950	Very high	Major adverse
	0.990	High	Not assessed
40MW worst case	0.950	High	Moderate adverse
	0.990	Low	Not assessed
0.7 bottlenose dolphin, worst case	0.950	Low	Minor adverse
	0.990	Low	Minor adverse

4.3 Manx Shearwater

ES Chapter 11, Marine Ornithology, assessed the sensitivity for Manx shearwater as "High", and the magnitude of impact "Negligible" at both 40MW worst case and 240MW indicative array deployment levels, using avoidance rates of 0.950 and 0.990. This resulted in a "Minor adverse" impact significance.

This conclusion remains unchanged when the assessment includes consideration of the PVA outputs.

5 References

Horswill, C., Robinson, R.A., 2015. Review of seabird demographic rates and density dependence (JNCC Report No. 552). JNCC, Peterborough.

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SNH, 2018. Interim Guidance on Apportioning Impacts from Marine Renewable Developments to Breeding Seabird Populations in Special Protection Areas (Guidance note). Scottish Natural Heritage.

Stubbings, E., Büche, B., Riordan, J., Moss, J., Wood, M., 2017. Seabird monitoring on Skomer Island in 2017 (JNCC Report).