Spiorad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Appendix 13.4: Marine Mammal Population Modelling, Volume 2c

Document Reference No.: SNM-SNM-PAC-APP-1134

Date: February 2026

Quality Control Page

Document details	
Document title	Offshore Project Environmental Impact Assessment Report
Document subtitle	Appendix 13.4: Marine Mammal Population Modelling
Document Reference No.	SNM-SNM-PAC-APP-1134
Date	February 2026
Version	1.0
Author	WSP
Client Name	Spiorad na Mara Ltd

Document history

Version	Revision	Issued	Checked	Approved	Date	Comments
1.0	A	WSP	WSP	WSP	February 2026	Final for submission

Contents

List of Tables

List of Plates

1 INTRODUCTION

1.1 OVERVIEW

1.1.1.1 This appendix of the Environmental Impact Assessment Report (EIAR) presents the interim Population Consequences of Disturbance (iPCoD) modelling of the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as 'the Offshore Project'). This appendix accompanies **Chapter 13: Marine Mammals**, **Volume 2a**.

1.1.1.2 This appendix should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a**.

1.1.2 PROJECT BACKGROUND

1.1.2.1 Spiorad na Mara Limited (hereafter referred to as 'the Applicant') is proposing to develop the Project. The Project is an offshore wind farm (OWF) that will consist of up to 60 fixed-bottom wind turbine generators (WTGs).

1.1.2.2 The Project will include both offshore and onshore infrastructure. This Offshore EIAR supports the application for the offshore components of the Project as outlined in **Chapter 1: Introduction, Volume 1a**. The offshore components of the Project (the Offshore Project) includes all infrastructure and activities located seaward of Mean High Water Springs (MHWS) within the Array Area and Offshore Cable Area of Search (OCAS) (**Figure 1.2: Project Layout, Volume 1c**). Further detailed information is provided in **Chapter 3, Volume 1a**.

1.1.2.3 The Offshore Project is situated off the northwest coast of Isle of Lewis/*Eilean Leòdhais* and the Array Area is located approximately 5-13 km offshore and is approximately 161 km^2 in size. It will comprise WTGs, foundations, Offshore Cables, Offshore Substation Platform (OSP) (if required), and Landfall. The Array Area combined with the OCAS is defined as the Offshore Project Boundary. The water depths across the Turbine Area range from 37 m-67 m with the southwest corner of the Array Area reaching 72 m. The proposed WTGs and fixed foundations will be located within a Turbine Area of approximately 140 km^2, within the Array Area.

1.2 PURPOSE OF THIS APPENDIX

1.2.1.1 NatureScot have requested that the Offshore Project undertakes iPCoD modelling as part of the quantitative impact assessment to assess the long-term impact (over 25 years) of the predicted disturbance of percussive piling.

1.2.1.2 WSP have contracted SMRU Consulting to conduct iPCoD modelling to assess the impact of the construction of both the Project alone construction and in-combination with the construction of

other nearby OWF projects. The modelling was conducted for the following marine mammal populations identified in **Chapter 13**, **Volume 2a** as having the potential to be present in the Project area. These species are listed alongside their management unit which has been identified as overlapping with the Offshore Project location. Note that iPCoD can only be run on the 5 species listed below and, therefore, other marine mammal species presented in **Chapter 13**, **Volume 2a** are not discussed in this report.

- **Harbour porpoise** (*Phocoena phocoena*) in the UK portion of the West Scotland (WS) Management Unit (MU);
- **Bottlenose dolphins** (*Tursiops truncatus*) in the Coastal West Scotland and Hebrides (CWSH) MU and the UK portion of the Oceanic Waters (OW) MU;
- **Minke whales** (*Balaenoptera acutorostrata*) in the UK portion of the Celtic and Greater North Seas (CGNS) MU;
- **Harbour seals** (*Phoca vitulina*) in the Western Isles (WI) Seal Monitoring Unit (SMU);
- **Grey seals** (*Halichoerus grypus*) in the WI SMU.

1.2.1.3 This appendix presents an overview of the iPCoD model, and the methodology and results for the Project alone and cumulative iPCoD simulations.

2 POPULATION MODEL BACKGROUND

2.1 IPCOD MODEL OVERVIEW

2.1.1.1 The iPCoD framework (Harwood *et al.*, 2014, King *et al.*, 2015) (version 5.2) was used to predict the potential population consequences of the predicted amount of permanent threshold shift (PTS) and disturbance resulting from the piling.

2.1.1.2 The iPCoD uses a stage structured model of population dynamics for each marine mammal species modelled with 9 age classes and 1 stage class (adults 10 years and older). The model is used to run a number of simulations of future population trajectory with and without the predicted level of impact from the activity causing disturbance, in this case percussive piling, to allow an understanding of the potential future population level consequences of predicted behavioural responses. Each iPCoD model simulation is run with matched pairs of populations: 1 un-impacted population and impacted population (1,000 simulations are recommended for each scenario of interest). These matched-pairs experience exactly the same environmental and demographic stochasticity within 1 simulation of the model. The only variable element between the matched pair is that 1 marine mammal population is subjected to a stressor (impulsive noise such as percussive piling) and, therefore, demonstrates the potential effect of disturbance (this is considered to be the impacted population in the pair). The other population in the pair receives no exposure to a stressor and is considered the un-impacted population.

2.1.1.3 In iPCoD, all individuals within the impacted population (within a pair) are assumed to be equally likely to be disturbed by a particular piling operation[1]. On each day of piling, iPCoD performs a binomial trial for each simulated individual using the probability of being disturbed[2] divided by the size of the total population (pmean) to determine whether or not that individual will be disturbed. This results in a calendar record of the days during the simulated year on which each individual is disturbed. The probability of each animal being disturbed on a given day is independent from the probability of this individual being disturbed previously.

2.1.1.4 The potential for a change in an individual's vital rates (survival and fertility) is determined by the number of repeated piling days that an individual experiences. The probability distributions that form the transfer functions in iPCoD provide the number of days of repeated disturbance an animal is expected to experience before the disturbance can have any effect on its vital rates (and

[1] There were no vulnerable sub-populations present in the MUs identified to use for iPCoD modelling for the Offshore Project, so assumption made that all individuals are equally likely to be disturbed by particular piling operation.

[2] Calculated as the total number of animals predicted to be disturbed by a particular piling operation (numDT), as specified by the user.

many individuals need to have their vital rates markedly impacted before any change in the population is observed).

2.1.1.5 The effects of disturbance on vital rates (survival and reproduction) are currently unknown. Therefore, expert elicitation was used to construct a probability distribution to represent the knowledge and beliefs of a group of experts regarding a specific Quantity of Interest. In this case, the quantity of interest is the effect of disturbance on the probability of survival and fertility in harbour porpoise, harbour seal and grey seals (Booth *et al.*, 2019). The elicitation assumed that the behaviour of the disturbed harbour porpoise would be altered for 6 hours on the day of disturbance, and that no feeding (or nursing) would occur during the 6 hours of disturbance. For harbour and grey seals, the experts assumed that on average, the behaviour of the disturbed seals would be impacted for much less than 24 hours but did not define an exact duration.

2.2 IPCOD MODEL LIMITATIONS

2.2.1 OVERVIEW

2.2.1.1 There is a lack of empirical data on the way in which changes in behaviour and hearing sensitivity may affect the ability of individual marine mammals to survive and reproduce. Therefore, due to this limitation, the iPCoD framework uses the results of an expert elicitation process conducted according to the protocol described in Donovan *et al.* (2016) to predict the effects of disturbance and PTS on survival and reproductive rate (based on assumed behavioural responses and for specific levels of threshold shift). The process generates a set of statistical distributions for these effects and then simulations are conducted using values randomly selected from these distributions that represent the opinions of a "virtual" expert. This process is repeated many 100s of times to capture the uncertainty among experts.

2.2.1.2 There are several precautions built into the iPCoD model and this specific scenario that mean that the results are considered to be highly precautionary and likely over-estimate the true population level effects. These precautions (detailed further throughout this Section) include:

- The fact that the model assumes a minke whale will not forage for 24 hours after being disturbed;
- The lack of density dependence in the model (meaning the population will not respond to any reduction in population size);
- The level of environmental and demographic stochasticity in the model;
- The estimates of the number of animals disturbed come from noise impact assessments with many levels of precaution in the way these numbers are calculated (e.g. underwater noise model parameters, impact thresholds, worst-case scenario location, density estimate).

2.2.2 DURATION OF DISTURBANCE: MINKE WHALES AND BOTTLENOSE DOLPHINS

2.2.2.1 The iPCoD model for minke whale and bottlenose dolphin disturbance was last updated following the expert elicitation in 2013 (Harwood *et al.*, 2014). When this expert elicitation was conducted, the experts provided responses on the assumption that a disturbed individual would not forage for 24 hours. However, the most recent expert elicitation in 2018 highlighted that this was an unrealistic assumption for harbour porpoises (generally considered to be more responsive than minke whales and bottlenose dolphins), and the 2018 elicitation was amended to assume that disturbance resulted in 6 hours of non-foraging time (Booth *et al.*, 2019). Unfortunately, neither minke whale nor bottlenose dolphins were included in the updated expert elicitation for disturbance, and thus the iPCoD model still assumes 24 hours of non-foraging time for both minke whales and bottlenose dolphins. This is unrealistic considering what we now know about marine mammal behavioural responses to pile driving. A recent study of a number of marine mammal species (including harbour porpoise and minke whales) estimated energetic costs associated with disturbance from sonar, where it was assumed that 1 hour of feeding cessation was classified as a mild response, 2 hours of feeding cessation was classified as a strong response and 8 hours of feeding cessation was classified as an extreme response (Czapanskiy *et al.*, 2021). Assuming 24 hours of feeding cessation for both minke whales and bottlenose dolphins in the iPCoD model is significantly beyond that which is considered to be an extreme response and is, therefore, considered to be overly precautionary and will over-estimate the true disturbance levels expected from the Offshore Project. In the absence of better data for these species, this precautionary approach considered to be the current best approach to determining population level effects of disturbance.

2.2.3 LACK OF DENSITY DEPENDENCE

2.2.3.1 Density dependence is described as "*the process whereby demographic rates change in response to changes in population density, resulting in an increase in the population growth rate when density decreases and a decrease in that growth rate when density increases*" (Harwood et al., 2014). The iPCoD models run for this assessment assume no density dependence for any of the species available in the model, since there is insufficient data to parameterise this relationship. Essentially, this means that there is no ability for the modelled, impacted population to increase in size and return to carrying capacity (the maximum number of individuals the environment can sustainably support) following disturbance. It is possible that populations with a positive growth rate (i.e. an increasing population) will continue to increase in the absence of disturbance.

2.2.3.2 At a recent expert elicitation, conducted for the purpose of modelling population impacts of the Deepwater Horizon oil spill (Schwacke et al., 2021), experts agreed that there would likely be a concave density dependence on fertility. That means, for a population which is assumed to be stable (i.e., neither increasing or decreasing), it would be expected that if the impacted population declines, it would later recover to carrying capacity, rather than continuing at a stable trajectory

that is smaller than that of the un-impacted population. Note that in the iPCoD model, for stable populations, carrying capacity is assumed to be equal to the size of un-impacted population – i.e., it is assumed the un-impacted population is at carrying capacity.

2.2.4 ENVIRONMENTAL AND DEMOGRAPHIC STOCHASTICITY

2.2.4.1 The iPCoD model attempts to model some of the sources of uncertainty inherent in the calculation of the potential effects of disturbance on marine mammal populations. This includes environmental variation and demographic stochasticity. Environmental variation is defined as "*the variation in demographic rates among years as a result of changes in environmental conditions*" (Harwood *et al.*, 2014). Demographic stochasticity is defined as "*variation among individuals in their realised vital rates as a result of random processes*" (Harwood *et al.*, 2014).

2.2.4.2 The iPCoD protocol describes this in further detail:

2.2.4.3 *"Demographic stochasticity is caused by the fact that, even if survival and fertility rates are constant, the number of animals in a population that die and give birth will vary from year to year because of chance events. Demographic stochasticity has its greatest effect on the dynamics of relatively small populations, and we have incorporated it in models for all situations where the estimated population within an MU is less than 3000 individuals. One consequence of demographic stochasticity is that two otherwise identical populations that experience exactly the same sequence of environmental conditions will follow slightly different trajectories over time. As a result, it is possible for a "lucky" population that experiences disturbance effects to increase, whereas an identical undisturbed but "unlucky" population may decrease"* (Harwood *et al.*, 2014).

2.2.4.4 This is clearly evidenced in the outputs of iPCoD where the un-impacted (baseline) population size varies greatly between iterations, not as a result of disturbance but simply as a result of environmental and demographic stochasticity. In the example provided in **Plate 2-1**, after 25 years of simulation, the un-impacted population size varies between 6,692 (lower 2.5%) and 16,516 (upper 97.5%). Thus, the change in population size resulting from the impact of disturbance is significantly smaller than that driven by the environmental and demographic stochasticity in the model.

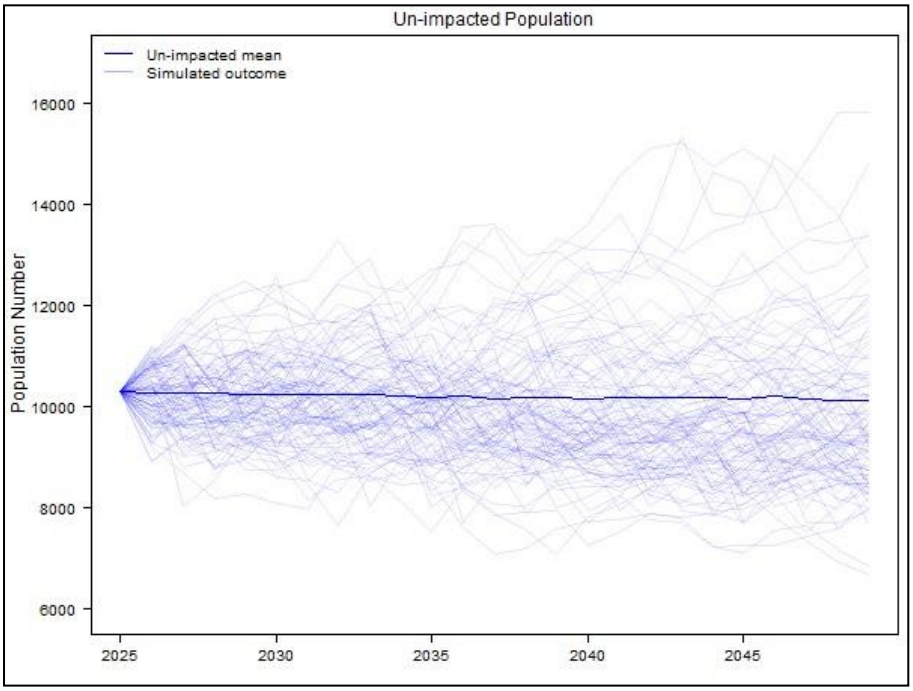

Plate 2-1 Simulated un-impacted (baseline) population size over the 25 years modelled.

2.2.5 SUMMARY

2.2.5.1 All of these precautions built into the iPCoD model mean that the results are considered to be highly conservative and provide a worst case scenario of the effects of disturbance on a population level. Despite these limitations and uncertainties, this assessment has been carried out according to current best practice and using the best available scientific information at this time. The information provided is, therefore, considered to be sufficient to carry out an adequate assessment, though a level of precaution around the results should be taken into account when drawing conclusions.

3 OFFSHORE PROJECT MODEL INPUTS

3.1 OFFSHORE PROJECT PILING PARAMETERS

3.1.1.1 The Offshore Project construction is proposed to be undertaken in 2030 and 2031 between April and October (inclusive) each year. Construction activities are aligned with favourable weather conditions with the aim of minimising disruptions to the local marine environment. Therefore, more piling days are expected to occur between May and August (**Plate 3-1**).

3.1.1.2 It is anticipated that the Offshore Project will be constructed using a combination of percussive piling (of pin piles and/or casings) and drilling and grouting. iPCoD is based on a set of transfer functions which specifically parameterise how piling affects vital rates (survival and fecundity) of the modelled species and, therefore, only the activities involving percussive piling have been assessed in the modelling.

3.1.1.3 Of the 60 jacket WTGs, 35 are proposed to be installed using percussive piling (with each jacket requiring 4 pin piles). The OSP, comprising 16 pin piles (8 legs with 2 pin piles per leg), will also be installed using percussive piling. This results in a total of 156 pin piles which will be installed using percussive piling. Only 1 pin pile will be installed per day, resulting in a total of 156 percussive piling days over the 2 years of piling (78 days in each year).

3.1.1.4 The indicative piling schedule provided to SMRU Consulting for use in the iPCoD modelling is based on the parameters presented above and in **Chapter 3, Volume 1a.** There is no concurrent percussive piling expected during construction and, therefore, only 1 piling scenario has been modelled.

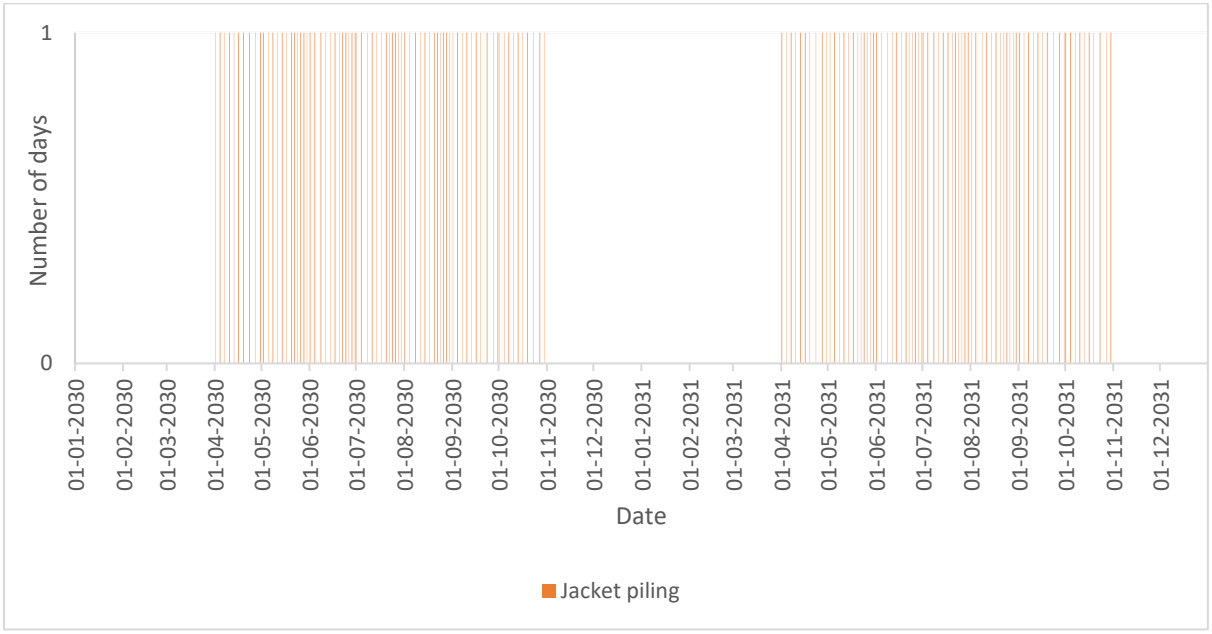

Plate 3-1 Indicative piling schedule for the Offshore Project.

3.2 MARINE MAMMAL DEMOGRAPHIC PARAMETERS

3.2.1.1 **Table 3-1** and **Plate 3-2** present the MUs included in this assessment and their respective population sizes which reflects those presented in **Chapter 13**, **Volume 2a**.

3.2.1.2 Demographic parameters for these MUs were obtained primarily from Sinclair *et al.* (2020). The exception was for the calf/pup survival rate for bottlenose dolphins which was obtained from Harwood and King (2017) to reflect the stable status of the CWSH and OW MUs (**Table 3-1**).

3.2.1.3 There are no recommended demographic parameters for harbour porpoise in the West Scotland MU. Therefore, the demographic parameters recommended for the North Sea MU (Sinclair *et al.*, 2020) were used in this assessment, under the assumption that the West Scotland MU also has a stable population trajectory (**Table 3-1**).

Table 3-1 Demographic parameters used in iPCoD modelling.

Parameters	**Harbour porpoise**	**Bottlenose dolphin**		**Minke whale**	**Harbour seal**	**Grey seal**
MU	WS	CWSH	OW	CGNS	WI	WI
Population size	24,305	45	1,299	10,288	4,905	31,000
Trajectory	Stable	Stable	Stable	Stable	Stable	Stable
Calf/pup survival	0.8455	0.86	0.86	0.7	0.4	0.222
Juvenile survival	0.85	0.94	0.94	0.77	0.78	0.94
Adult survival	0.925	0.94	0.94	0.96	0.92	0.94
Fertility	0.34	0.25	0.25	0.91	0.85	0.84
Age at independence	1	2	2	1	1	1
Age at first birth	5	9	9	9	4	6

3.3 MARINE MAMMAL DISTURBANCE NUMBERS

3.3.1.1 The number of animals predicted to be disturbed per piling day (**Table 3-2**) and the methodology used to calculate them are presented in **Chapter 13, Volume 2a**.

Table 3-2 Disturbance values used in iPCoD modelling

Parameters	**Harbour porpoise**	**Bottlenose dolphin**		**Minke whale**	**Harbour seal**	**Grey seal**
MU	WS	CWSH	OW	CGNS	WI	WI
Number of animals disturbed per piling day	1,040	12	21	65	11	83
MU disturbed per piling day (%)	4.28%	27.70%	1.63%	0.63%	0.22%	0.27%

3.4 CUMULATIVE EFFECTS ASSESSMENT

3.4.1.1 Cumulative iPCoD modelling was conducted for the same species as modelled for the Offshore Project alone assessment (see **Table 3-1** for species and demographic parameters). An initial shortlist of offshore wind farm (OWF) developments within Scottish waters was identified for each of the MUs and provided for the cumulative effects assessment. Further information on the cumulative assessment methodology and the initial shortlist can be found in **Chapter 13, Volume 2a** (**Appendix 5.4: Cumulative Development List, Volume 1d** provides the longlist of developments that the shortlist for the cumulative assessment was drawn from). Additional screening criteria were then applied based on the following criteria, which are elaborated on below:

- Status of OWF development;
- OWF development construction period.

3.4.1.2 OWF developments included in the final cumulative short list are presented in **Table 3-3**, alongside the parameters used for each development, with the timelines presented in **Table 3-4**.

3.4.1.3 The status of the OWF development was considered in the screening process. Developments in the pre-planning phase without submission documents (Scoping or EIAR) available in the public domain did not have sufficient information available to be included in the model (e.g. construction years, number and type of structures), and so were screened out of the cumulative iPCoD model.

3.4.1.4 Other OWF developments with a construction period which overlaps temporally with the Offshore Project may result in cumulative disturbance to marine mammals. NatureScot advised that the time period considered for screening OWFs into the cumulative iPCoD modelling should be the Offshore Project construction period (2030 -2031) ± 1 year. Therefore, only OWF developments scheduled to be under construction between 2029 and 2032 inclusive were screened into the cumulative iPCoD modelling. The modelling included all piling years for each of the OWF developments screened into the assessment (not just piling in 2029-2032) to take account of the potential cumulative impact across the length of each wind farm's construction period.

3.4.1.5 For each marine mammal species, only the OWF developments located within their respective MUs were screened into the cumulative iPCoD assessment (**Plate 3-2**).

3.4.1.6 For developments where an EIAR was available at the time of the assessment, piling parameters were obtained from the project-specific EIARs (where available). If multiple piling parameters were presented in an EIAR, those resulting in the greatest number of piling days were selected.

3.4.1.7 For developments where only a scoping report was available at the time of the assessment, fewer details regarding piling parameters were available. In these instances, the number of piling days were assumed, given the following:

- 1 day per monopile;

- 2 days per jacket structure;
- 3 days per floating structure.

3.4.1.8 For developments without an EIAR available, the number of animals potentially disturbed had to be estimated based on a set of assumptions. The area of impact was determined using an effective deterrence range (EDR). For developments with fixed monopile foundations, a 26 km EDR (impact area of 2,124 km^2) was used, and for fixed jacket and floating foundations, a 15 km EDR (impact area of 707 km^2) was used based on the guidance provided by JNCC (2020). For all species, except bottlenose dolphin, the relevant SCANS IV species-specific densities (Gilles *et al.*, 2023) were then multiplied by the EDR impact area to calculate the number of animals disturbed by the development.

3.4.1.9 For bottlenose dolphins, some of the EDRs for the relevant OWF developments intersected both the CWSH and OW MUs. Therefore, the area of impact was calculated using the area of the EDR within each MU boundary, and a uniform density (assuming the same density per km^2 across the whole MU) was calculated by dividing each MU population size by the total area of that MU. The number of animals disturbed was then calculated by multiplying the calculated uniform density by the area of the EDR within each MU, allowing a different disturbance value to be used for the CWSH and OW MU.

3.4.1.10 For each species, the cumulative iPCoD modelling commenced at the start of the first year of construction of any OWF development included in the species assessment and ran for 25 years. For all cetacean species this was from the start of 2026 until the end of 2051, and for both seal species this was from the start of 2029 until the end of 2053.

Table 3-3 OWF-specific information input into the cumulative iPCoD model. WTG = Wind Turbine Generator, OSP = Offshore Substation Platform

OWF	Source	Pile type	Number of foundations	Piling days
Spiorad na Mara	EIAR	Fixed – jacket	35 WTGs (4 piles/WTG) 1 OSP (8 legs x 4 piles)	156
Arven OSP (including Arven and Arven South array areas)	Scoping	Fixed – jacket	10 OSPs (16 piles/OSP)	20
Arven WTG (including Arven and Arven South array areas)	Scoping	Floating	161 WTGS (9 piles/WTG)	483
Aspen WTG	EIAR	Floating	72 WTGs (2 piles/WTG)	162
Aspen OSP	EIAR	Fixed – jacket	3 OSPs (8 piles/OSP)	12
Ayre OSP	Scoping	Fixed – jacket	3 OSPs (4 piles/OSP)	6
Ayre WTG	Scoping	Floating	67 WTGs (9 piles/ WTG)	201
Bellrock	Scoping	Floating	80 WTGs	240
Berwick Bank WTG	EIAR	Fixed – jacket	179 WTGs (8 piles/WTG)	287

OWF	Source	Pile type	Number of foundations	Piling days
Berwick Bank OSP	EIAR	Fixed – jacket	10 OSPs (8 x 6-leg foundations with 24 piles/leg, 2 x 8-leg foundations with 32 piles/leg)	85
Bowdun	Scoping	Fixed - jacket	67 WTGs (4 piles/WTG)	134
Broadshore	Scoping	Floating	60 WTGs (12 piles/WTG)	180
Buchan WTG	EIAR	Floating	70 WTGs (9 piles/WTG)	630
Buchan OSP	EIAR	Fixed - jacket	3 OSPs (4 piles/OSP)	3
Buchan Intermediate Reactive Compensation (IRC) platform	EIAR	Fixed - jacket	1 ICR platforms (4 piles/ICR platform)	1
Caledonia fixed WTG	EIAR	Fixed – jacket	105 WTGs (4 piles/WTG)	105
Caledonia floating WTG	EIAR	Floating	39 WTGs (6 piles/ WTG)	410
CampionWind	Scoping	Floating	210 WTGs	630
Cenos WTG	EIAR	Floating	95 WTGs (9 piles/WTG)	285
Cenos OSP	EIAR	Fixed – jacket	2 OSPs (12 piles/OSP)	8
Havbredey OSP/Reactive Compensation Station (RCS)	Scoping	Fixed – jacket	3 OSPs 3 RCSs	12
Havbredey WTG	Scoping	Floating	110 WTGs	330
Machair Wind	Scoping	Fixed – jacket	147 WTGs (4 piles/WTG)	294
MarramWind OSP/RCS	Scoping	Fixed – jacket	4 OSPs 2 RCPs	12
MarramWind WTG	Scoping	Floating	225 WTGs	675
Morven OSP	Scoping	Fixed – jacket	11 OSPs	22
Morven WTG	Scoping	Floating	191 WTGs	382
Muir Mhòr WTG	EIAR	Floating	67 WTGs (9 piles/WTG)	151
Muir Mhòr OSP	EIAR	Fixed – jacket	2 OSPs (12 piles/OSP)	24
Ossian WTG	EIAR	Floating	265 WTG (6 piles/WTG)	530
Ossian OSP	EIAR	Fixed – jacket	15 OSPs (12 or 6 piles/OSP)	72
Scaraben	Scoping	Floating	6 WTGs (12 piles/WTG)	18
Seagreen 1A	Piling Strategy	Fixed – jacket	36 WTGs (4 piles/WTG)	72
Sinclair	Scoping	Floating	6 WTGs (12 piles/WTG)	18
Stromar WTG	Scoping	Floating	71 WTGs	213
Stromar OSP	Scoping	Fixed – jacket	3 OSPs (4 piles/OSP)	6
Talisk OSP	Scoping	Fixed – jacket	1 OSP (16 piles/OSP)	2
Talisk WTG	Scoping	Floating	33 WTGs (9 piles/WTG)	99
West of Orkney	EIAR	Fixed – jacket	130 WTGs (4-16 piles/WTG)	290

Table 3-4 Construction periods for OWFs screened into the cumulative effects assessment. Green cells = OWF development is piling, red cells = OWF development is not piling.

OWF	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Spiorad na Mara															
Arven															
Aspen															
Ayre															
Bellrock															
Berwick Bank															
Bowdun															
Broadshore															
Buchan															
Caledonia															
CampionWind															
Cenos															
Havbredey															
Machair Wind															
MarramWind															
Morven															
Muir Mhòr															
Ossian															
Scaraben															
Seagreen 1A															
Sinclair															
Stromar															
Talisk															
West of Orkney															

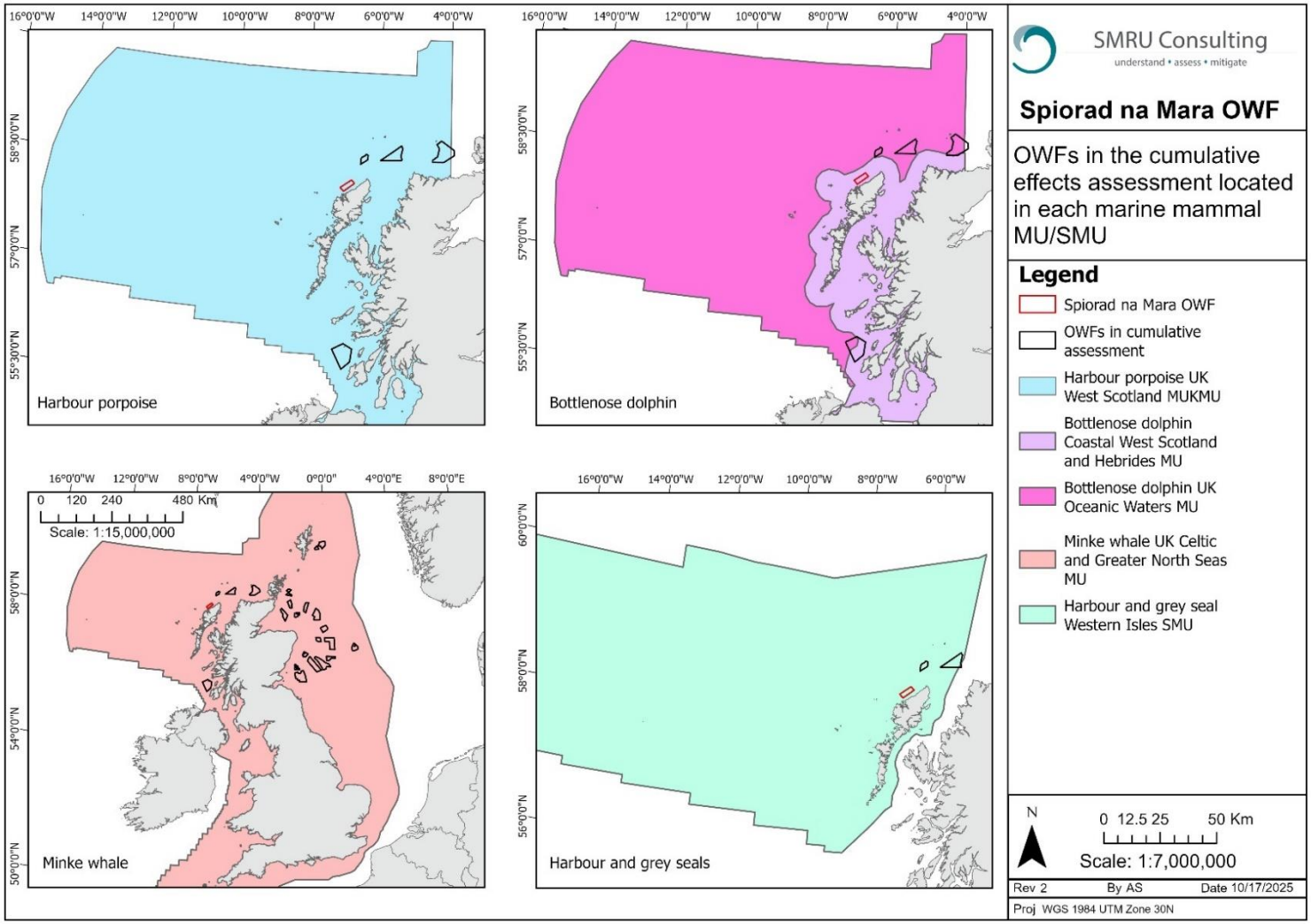

Plate 3-2 OWFs screened into the cumulative effects assessment located in each marine mammal MU/SMU. .

4 PROJECT ALONE IPCOD MODEL RESULTS

4.1.1.1 The iPCoD results present the predicted population size for both the modelled un-impacted and the impacted populations. The difference between the two is the result of the modelled disturbance. For example: at timepoint X, if the mean un-impacted population size is 100 animals and the mean impacted population size is 90 animals, then the mean impacted population is 90% of the size of the mean un-impacted population (i.e. disturbance has resulted in a 10% change in mean population size).

4.1.1.2 The line plots show the mean value for the 1,000 simulated populations (mean denoted by the thick line), and the predicted population size for a random 100 of the 1,000 simulated populations. This is presented separately for the un-impacted population (baseline, left plot), the impacted population (middle plot) and both overlain for direct comparison (right plot). There is large variation in the predicted population size across the random 100 simulated populations due to environmental and demographic stochasticity. The environmental and demographic stochasticity is exactly the same between the un-impacted and the impacted populations. Thus, any difference in the predicted population size between the two is due to the effect of disturbance.

4.2 HARBOUR PORPOISE UK WEST SCOTLAND MANAGEMENT UNIT

4.2.1.1 The iPCoD modelling shows that the mean impacted population size of harbour porpoise in the UK WS MU remains at 99.97 - 99.76% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 4-1** and **Table 4-1**).

Plate 4-1 Predicted population trajectories for the un-impacted (baseline) and impacted harbour porpoise iPCoD simulations for the UK WS MU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-1 Mean un-impacted and impacted population sizes for the UK West Scotland Management Unit for harbour porpoise.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	24,304	24,304	100.00%
End 2030 (end piling year 1)	24,291	24,284	99.97%
End 2031 (end piling year 2)	24,263	24,222	99.83%
End 2032 (1 year after piling ends)	24,289	24,231	99.76%
End 2037 (6 years after piling ends)	24,150	24,109	99.83%
End 2043 (12 years after piling ends)	24,222	24,181	99.83%
End 2049 (18 years after piling ends)	24,196	24,155	99.83%

4.3 BOTTLENOSE DOLPHIN COASTAL WEST SCOTLAND AND HEBRIDES MANAGEMENT UNIT

4.3.1.1 The iPCoD modelling shows that the mean impacted population size of bottlenose dolphins in the CWSH MU remains at 100 - 95.45% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 4-2** and **Table 4-2**).

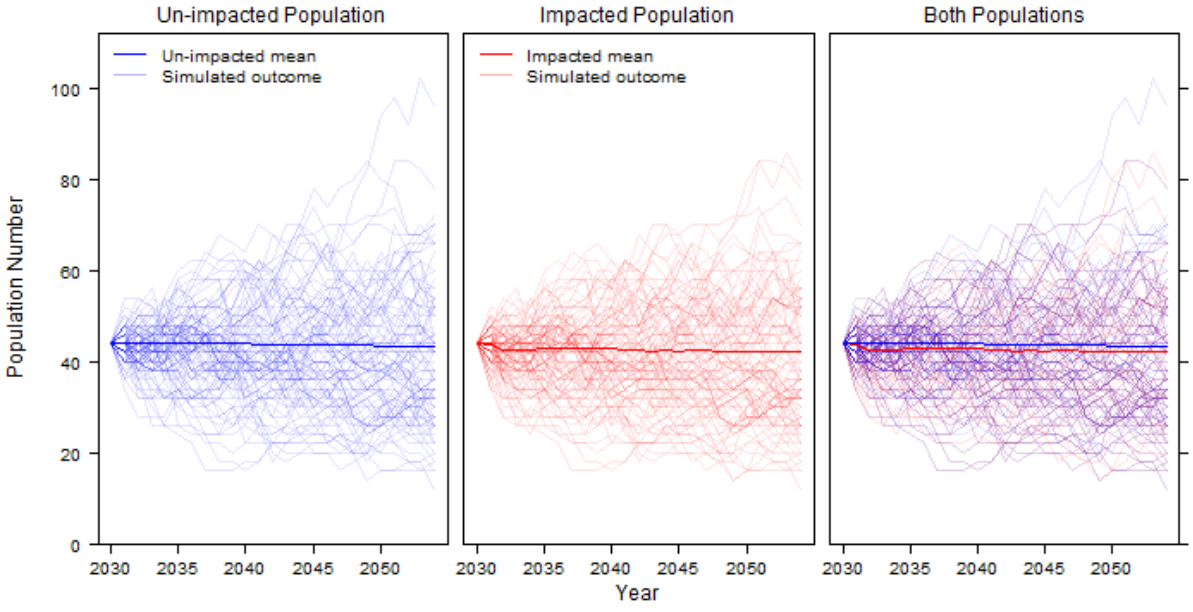

Plate 4-2 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin iPCoD simulations for the CWSH MU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-2 Mean un-impacted and impacted population sizes for the CWSH MU for bottlenose dolphins.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	44	44	100%
End 2030 (end piling year 1)	44	44	100%
End 2031 (end piling year 2)	44	43	97.73%
End 2032 (1 year after piling ends)	44	42	95.45%
End 2037 (6 years after piling ends)	44	43	97.73%
End 2043 (12 years after piling ends)	44	42	95.45%
End 2049 (18 years after piling ends)	43	42	97.67%

4.4 BOTTLENOSE DOLPHIN UK OCEANIC WATERS MANAGEMENT UNITS

4.4.1.1 The iPCoD modelling shows that the mean impacted population size of bottlenose dolphins in the UK OW MU remains at 100 - 99.92% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 4-3** and **Table 4-3**).

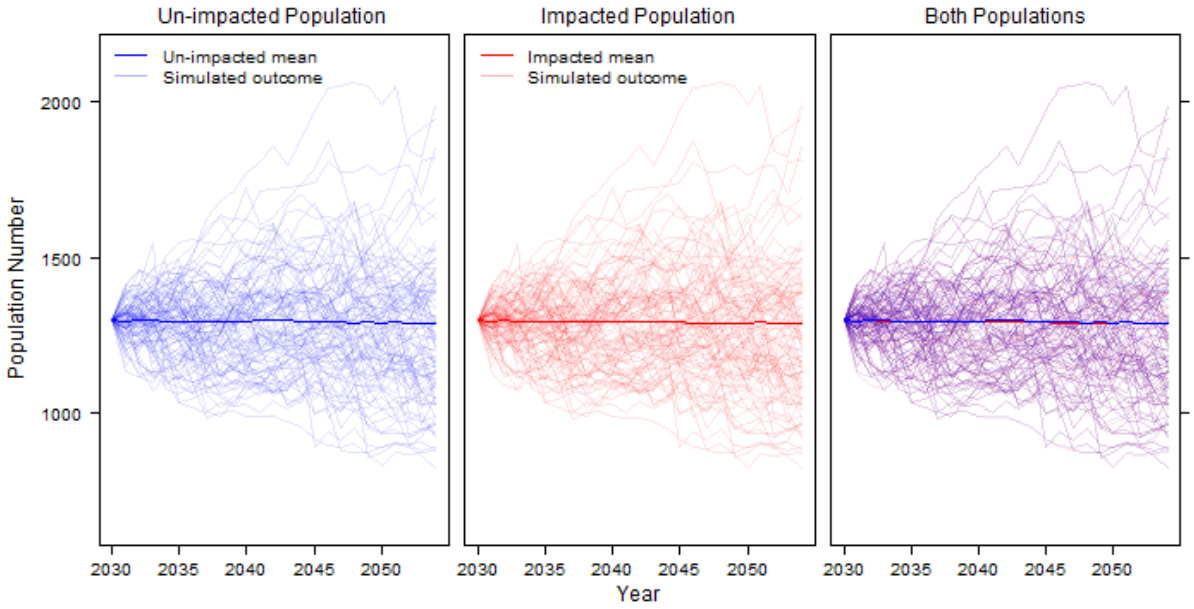

Plate 4-3 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin iPCoD simulations for the UK OW MU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-3 Mean un-impacted and impacted population sizes for the UK OW MU for bottlenose dolphins.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	1,298	1,298	100%
End 2030 (end piling year 1)	1,297	1,297	100%
End 2031 (end piling year 2)	1,299	1,298	99.92%
End 2032 (1 year after piling ends)	1,297	1,296	99.92%
End 2037 (6 years after piling ends)	1,293	1,292	99.92%
End 2043 (12 years after piling ends)	1,296	1,295	99.92%
End 2049 (18 years after piling ends)	1,289	1,288	99.92%

4.5 MINKE WHALE UK CELTIC AND GREATER NORTH SEAS MANAGEMENT UNIT

4.5.1.1 The iPCoD modelling shows that the mean impacted population size of minke whales in the UK CGNS MU remains at exactly 100% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 4-4** and **Table 4-4**).

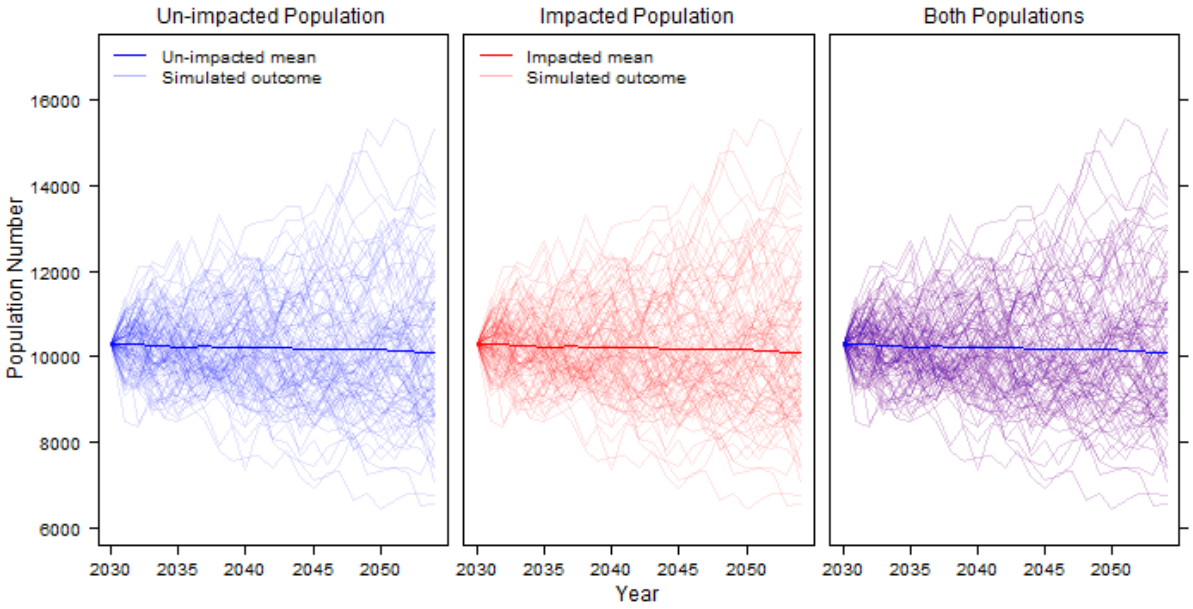

Plate 4-4 Predicted population trajectories for the un-impacted (baseline) and impacted minke whale iPCoD simulations for the UK CGNS MU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-4 Mean un-impacted and impacted population sizes for the UK CGNS MU for minke whales.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	10,288	10,288	100%
End 2030 (end piling year 1)	10,289	10,289	100%
End 2031 (end piling year 2)	10,282	10,282	100%
End 2032 (1 year after piling ends)	10,259	10,259	100%
End 2037 (6 years after piling ends)	10,215	10,215	100%
End 2043 (12 years after piling ends)	10,175	10,175	100%
End 2049 (18 years after piling ends)	10,186	10,186	100%

4.6 HARBOUR SEAL WESTERN ISLES SEAL MONITORING UNIT

4.6.1.1 The iPCoD modelling shows that the mean impacted population size of harbour seals in the WI SMU remains at exactly 100% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 4-5** and **Table 4-5**).

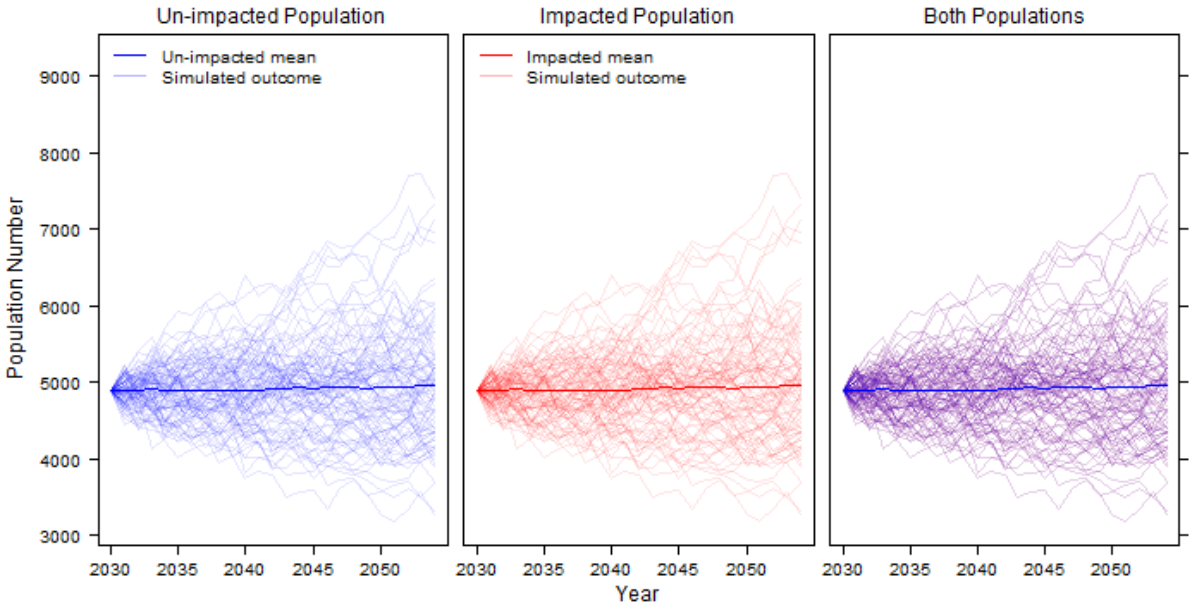

Plate 4-5 Predicted population trajectories for the un-impacted (baseline) and impacted harbour seal iPCoD simulations for the WI SMU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-5 Mean un-impacted and impacted population sizes for the WI SMU for harbour seals.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	4,902	4,902	100%
End 2030 (end piling year 1)	4,903	4,903	100%
End 2031 (end piling year 2)	4,902	4,902	100%
End 2032 (1 year after piling ends)	4,906	4,906	100%
End 2037 (6 years after piling ends)	4,892	4,892	100%
End 2043 (12 years after piling ends)	4,927	4,927	100%
End 2049 (18 years after piling ends)	4,939	4,939	100%

4.7 GREY SEAL WESTERN ISLES SEAL MONITORING UNIT

4.7.1.1 The iPCoD modelling shows that the mean impacted population size of grey seals in the WI SMU remains at exactly 100% of the size of the un-impacted population mean and is predicted to continue on an increasing trajectory, the same as the un-impacted population (**Plate 4-6** and **Table 4-6**).

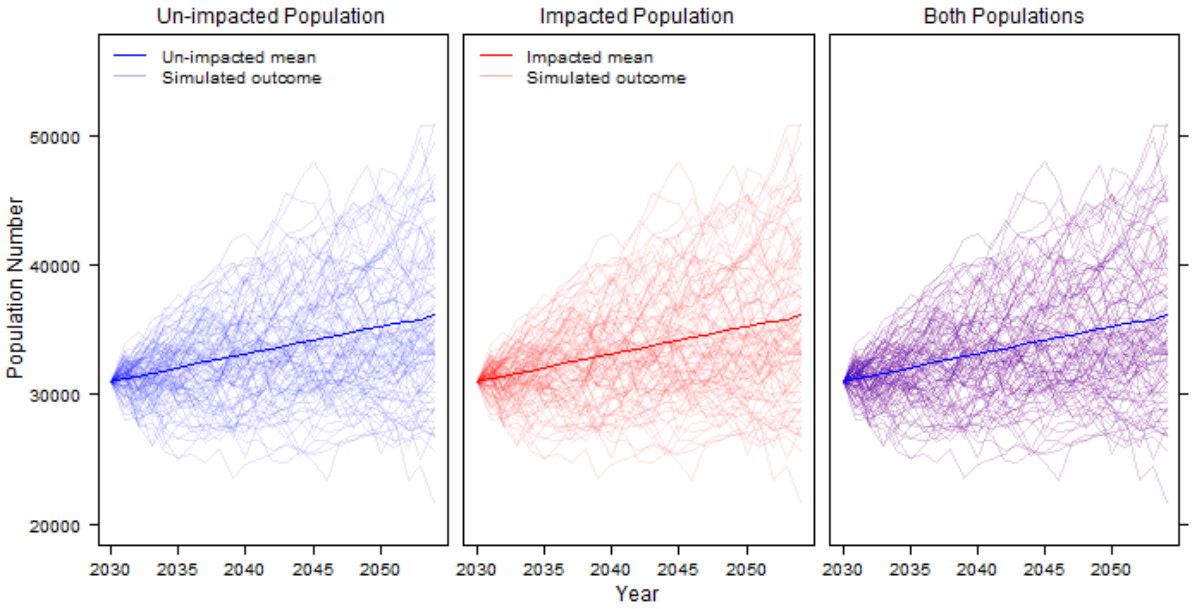

Plate 4-6 Predicted population trajectories for the un-impacted (baseline) and impacted grey seal iPCoD simulations for the WI SMU. Piling is occurring between 2030 - 2031 inclusive.

Table 4-6 Mean un-impacted and impacted population sizes for the WI SMU for grey seals.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2030 (pre-piling)	30,998	30,998	100%
End 2030 (end piling year 1)	31,259	31,259	100%
End 2031 (end piling year 2)	31,386	31,386	100%
End 2032 (1 year after piling ends)	31,618	31,618	100%
End 2037 (6 years after piling ends)	32,740	32,740	100%
End 2043 (12 years after piling ends)	34,029	34,029	100%
End 2049 (18 years after piling ends)	35,202	35,202	100%

5 CUMULATIVE IPCOD MODEL RESULTS

5.1 HARBOUR PORPOISE UK WEST SCOTLAND MANAGEMENT UNIT

5.1.1.1 For the cumulative scenario for harbour porpoise in the UK WS MU, there were 4 OWF developments that met the screening criteria that were modelled alongside the Offshore Project. The disturbance numbers for harbour porpoise used in the modelling are presented in **Table 5-1**.

Table 5-1 Number of harbour porpoise in the UK WS MU disturbed per piling day per OWF development in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	2030 - 2031	1,040
Havbredey	2030 - 2035	70 (OSP/RCS), 70 (WTG)
Machair Wind	2026 - 2030	142
Talisk	2029 - 2030	70 (OSP), 70 (WTG)
West of Orkney	2028 - 2030	1,149

5.1.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of harbour porpoise in the UK WS MU remains at 99.81 - 99.47% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 5-1** and **Table 5-2**).

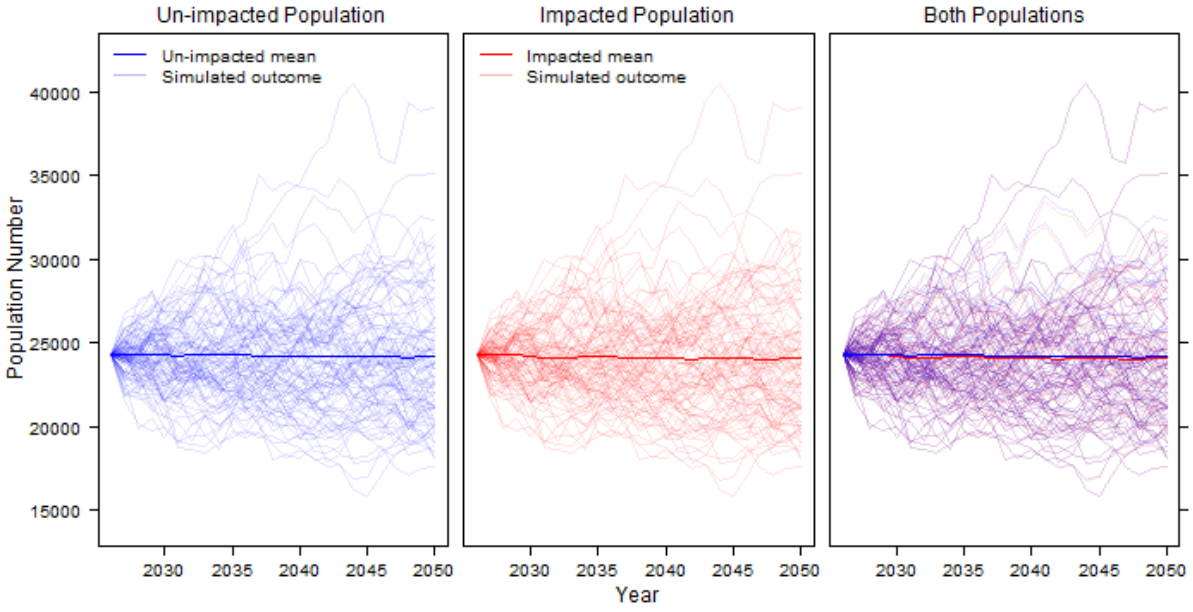

Plate 5-1 Predicted population trajectories for the un-impacted (baseline) and impacted harbour porpoise cumulative iPCoD simulations for the UK WS MU. Piling is occurring between 2026 - 2035 inclusive.

Table 5-2 Mean un-impacted and impacted population sizes for the UK WS MU for harbour porpoise in the cumulative iPCoD simulations.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2026 (pre piling)	24,304	24,304	100.00%
End 2029 (after 4 years cumulative piling)	24,271	24,226	99.81%
End 2030 (end Offshore Project piling year 1)	24,222	24,135	99.64%
End 2031 (end Offshore Project piling year 2)	24,251	24,122	99.47%
End 2035 (end of cumulative piling)	24,286	24,163	99.49%
End 2036 (1 year after cumulative piling ends)	24,246	24,120	99.48%
End 2041 (6 years after cumulative piling ends)	24,167	24,042	99.48%
End 2047 (12 years after cumulative piling ends)	24,123	23,999	99.49%

5.2 BOTTLENOSE DOLPHIN COASTAL WEST SCOTLAND AND HEBRIDES MANAGEMENT UNIT

5.2.1.1 For the cumulative scenario for bottlenose dolphins in the CWSH MU, there were 2 OWF developments that met the screening criteria that were modelled alongside the Offshore Project. The disturbance numbers for bottlenose dolphin used in the modelling are presented in **Table 5-3**.

Table 5-3 Number of bottlenose dolphins in the CWSH MU disturbed per piling day per OWF development in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	2030 - 2031	12
Machair Wind	2026 - 2030	1
West of Orkney	2028 - 2030	0

5.2.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of bottlenose dolphins in the CWSH MU remains at 100 - 95.45% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 5-2** and **Table 5-4**).

Plate 5-2 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin cumulative iPCoD simulations for the CWSH MU. Piling is occurring between 2026 - 2031 inclusive.

Table 5-4 Mean un-impacted and impacted population sizes for the CWSH MU for bottlenose dolphins in the cumulative iPCoD simulation.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2026 (pre piling)	44	44	100.00%
End 2029 (after 4 years cumulative piling)	44	44	100.00%
End 2030 (end Offshore Project piling year 1)	44	43	97.73%
End 2031 (end Offshore Project piling year 2 & end of cumulative piling)	44	42	95.45%
End 2032 (1 year after cumulative piling ends)	44	42	95.45%
End 2037 (6 years after cumulative piling ends)	43	42	97.67%
End 2043 (12 years after cumulative piling ends)	43	42	97.67%
End 2049 (18 years after cumulative piling ends)	43	42	97.67%

5.3 BOTTLENOSE DOLPHIN UK OCEANIC WATERS MANAGEMENT UNITS

5.3.1.1 For the cumulative scenario for bottlenose dolphins in the UK OW MU, there were 4 OWF developments that met the screening criteria that were modelled alongside the Offshore Project. The disturbance numbers for bottlenose dolphin used in the modelling are presented in **Table 5-5**.

Table 5-5 Number of bottlenose dolphins in the UK OW MU disturbed per piling day per project in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	**2030 - 2031**	**21**
Havbredey	2030 - 2035	5 (OSP/RCS), 5 (WTG)
Machair Wind	2026 - 2030	2
Talisk	2029 - 2030	4 (OSP), 4 (WTG)
West of Orkney	2028 - 2030	0

5.3.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of bottlenose dolphins in the UK OW MU remains at 100 - 99.77% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 5-3** and **Table 5-6**).

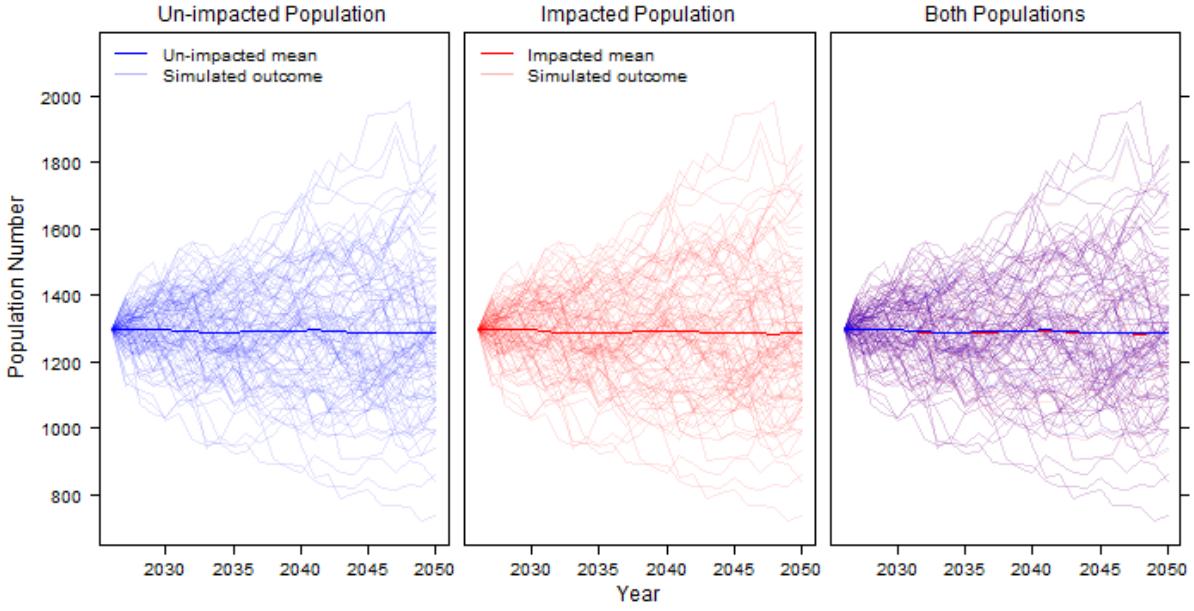

Plate 5-3 Predicted population trajectories for the un-impacted (baseline) and impacted bottlenose dolphin cumulative iPCoD simulations for the UK OW MU. Piling is occurring between 2026 - 2035 inclusive.

Table 5-6 Mean un-impacted and impacted population sizes for the UK OW MU for bottlenose dolphins in the cumulative iPCoD simulation.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2026 (pre piling)	1,298	1,298	100.00%
End 2029 (after 4 years cumulative piling)	1,295	1,295	100.00%
End 2030 (end Offshore Project piling year 1)	1,293	1,293	100.00%
End 2031 (end Offshore Project piling year 2)	1,290	1,288	99.84%
End 2035 (end of cumulative piling)	1,291	1,288	99.77%
End 2036 (1 year after cumulative piling ends)	1,292	1,289	99.77%
End 2041 (6 years after cumulative piling ends)	1,294	1,292	99.85%
End 2047 (12 years after cumulative piling ends)	1,286	1,284	99.84%

5.4 MINKE WHALE UK CELTIC AND GREATER NORTH SEAS MANAGEMENT UNIT

5.4.1.1 For the cumulative scenario for minke whales in the UK CGNS MU, there were 23 OWF developments that met the screening criteria that were modelled alongside the Offshore Project. The disturbance numbers for minke whales used in the modelling are presented in **Table 5-7**.

Table 5-7 Number of minke whales in the UK CGNS MU disturbed per piling day per OWF development in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	2030 - 2031	65
Arven	2030 - 2033	9 (OSP), 9 (WTG)
Aspen	2028 - 2030	1,368 (WTG), 1,321 (OSP)
Ayre	2029 - 2033	8 (OSP), 8 (WTG)
Bellrock	2028 - 2030	30
Berwick Bank	2026 - 2031	82 (OSP), 82 (WTG)
Bowdun	2029 - 2032	30
Broadshore	2028 - 2031	9
Buchan	2028 - 2030	378 (WTG), 418 (OSP), 443 (ICR)
Caledonia	2028 - 2032	502 (fixed WTG), 415 (floating WTG)
CampionWind	2030 - 2040	30
Cenos	2029 - 2033	357 (WTG), 384 (OSP)
Havbredey	2030 - 2035	16 (OSP/RCS), 16 (WTG)
Machair Wind	2026 - 2030	10
MarramWind	2028 - 2036	9 (OSP/RCS), 9 (WTG)
Morven	2026 - 2032	30 (WTG), 30 (OSP)
Muir Mhòr	2029 - 2031	777 (OSP), 735 (WTG)
Ossian	2031 - 2038	318 (OSP), 168 (WTG)
Scaraben	2029 - 2031	9
Seagreen 1A	2029 - 2032	30
Sinclair	2029 - 2031	9
Stromar	2028 - 2031	8 (WTG), 8 (OSP)
Talisk	2029 - 2030	16 (OSP), 16 (WTG)
West of Orkney	2028 - 2030	77

5.4.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of minke whales in the UK CGNS MU remains at 99.94 – 99.36% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 5-4** and **Table 5-8**).

Plate 5-4 Predicted population trajectories for the un-impacted (baseline) and impacted minke whale cumulative iPCoD simulations for the UK CGNS MU. Piling is occurring between 2030 - 2040 inclusive.

Table 5-8 Mean un-impacted and impacted population sizes for the UK CGNS MU for minke whales in the cumulative iPCoD simulation.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2026 (pre piling)	10,288	10,288	100.00%
End 2029 (after 4 years cumulative piling)	10,301	10,295	99.94%
End 2030 (end Offshore Project piling year 1)	10,295	10,274	99.80%
End 2031 (end Offshore Project piling year 2)	10,321	10,265	99.46%
End 2032 (1 year after Project piling ends)	10,309	10,243	99.36%
End 2040 (end cumulative piling)	10,275	10,261	99.86%
End 2041 (1 year after cumulative piling ends)	10,288	10,272	99.84%
End 2046 (6 years after cumulative piling ends)	10,319	10,299	99.81%

5.5 HARBOUR SEAL WESTERN ISLES SEAL MONITORING UNIT

5.5.1.1 For the cumulative scenario for harbour seals in the WI SMU, there were 2 OWF developments that met the screening criteria that was modelled alongside the Offshore Project. The disturbance numbers for harbour seals used in the modelling are presented in **Table 5-9**.

Table 5-9 Number of harbour seals in the WI SMU disturbed per piling day per OWF development in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	2030 - 2031	11
Havbredey	2030 - 2035	1 (OSP/RCS), 1 (WTG)
Talisk	2029 - 2030	1 (OSP), 1 (WTG)

5.5.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of harbour seals in the WI SMU remains at exactly 100% of the size of the un-impacted population mean and is predicted to continue on a stable trajectory, the same as the un-impacted population (**Plate 5-5** and **Table 5-10**).

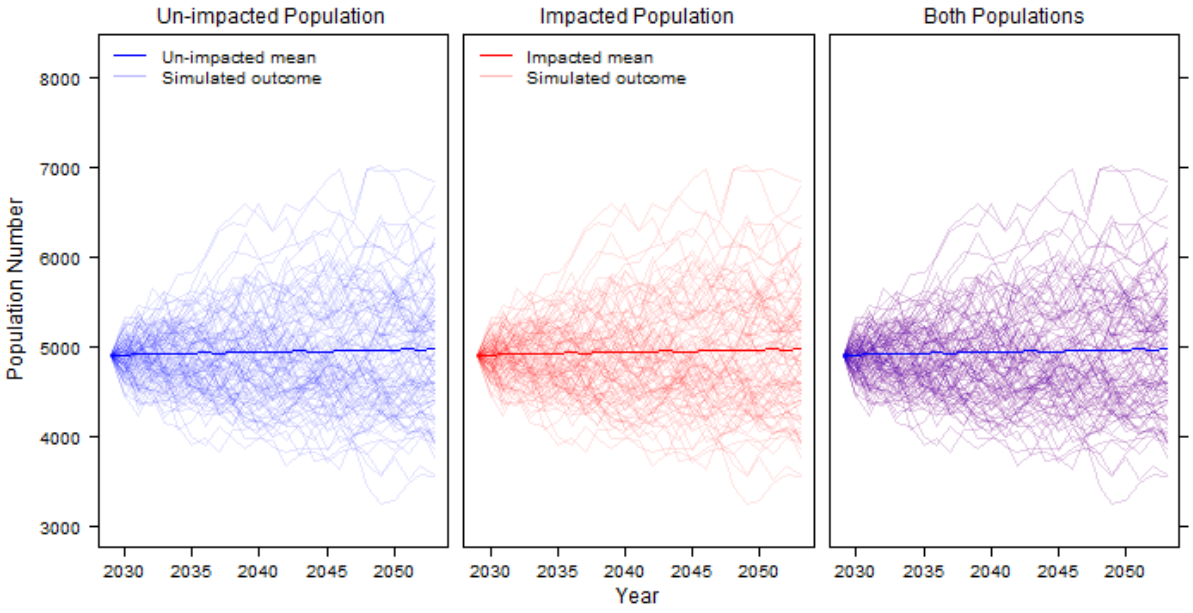

Plate 5-5 Predicted population trajectories for the un-impacted (baseline) and impacted harbour seal cumulative iPCoD simulations for the WI SMU. Piling is occurring between 2029 - 2035 inclusive.

Table 5-10 Mean un-impacted and impacted population sizes for the WI SMU for harbour seals in the cumulative iPCoD simulation.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2029 (pre piling)	4,902	4,902	100%
End 2029 (after 1 year cumulative piling)	4,906	4,906	100%
End 2030 (end Offshore Project piling year 1)	4,918	4,918	100%
End 2031 (end Offshore Project piling year 2)	4,926	4,926	100%
End 2035 (end cumulative piling)	4,936	4,936	100%
End 2036 (1 year after cumulative piling ends)	4,931	4,931	100%
End 2041 (6 years after cumulative piling ends)	4,945	4,945	100%
End 2047 (12 years after cumulative piling ends)	4,960	4,960	100%
End 2053 (18 years after cumulative piling ends)	4,967	4,967	100%

5.6 GREY SEAL WESTERN ISLES SEAL MONITORING UNIT

5.6.1.1 For the cumulative scenario for grey seals in the WI SMU, there were 2 OWF developments that met the screening criteria that was modelled alongside the Offshore Project. The disturbance numbers for grey seals used in the modelling are presented in **Table 5-11**.

Table 5-11 Number of grey seals in the WI SMU disturbed per piling day per OWF development in the cumulative iPCoD simulation.

OWF development	Piling years	Number of animals disturbed per day
Spiorad na Mara	2030 - 2031	83
Havbredey	2030 - 2035	35 (OSP/RCS), 35 (WTG)
Talisk	2029 - 2030	18 (OSP), 18 (WTG)

5.6.1.2 The cumulative iPCoD modelling shows that the mean impacted population size of grey seals in the WI SMU remains at exactly 100% of the size of the un-impacted population mean and is predicted to continue on an increasing trajectory, the same as the un-impacted population (**Plate 5-6** and **Table 5-12**).

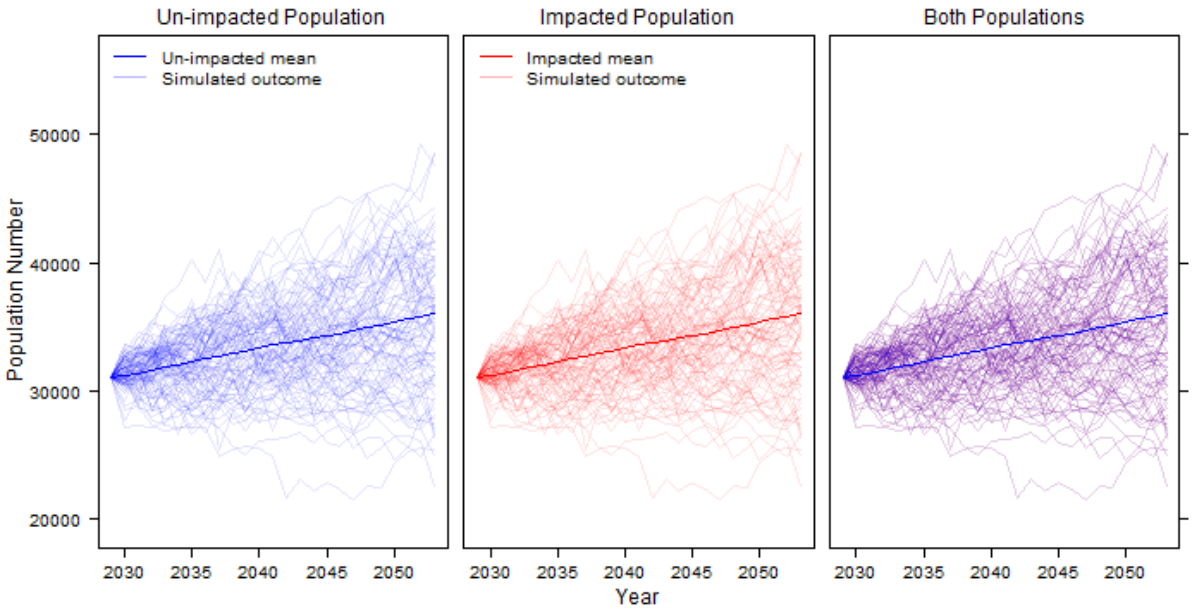

Plate 5-6 Predicted population trajectories for the un-impacted (baseline) and impacted grey seal iPCoD simulations for the WI SMU. Piling is occurring between 2030 - 2035 inclusive.

Table 5-12 Mean un-impacted and impacted population sizes for the WI SMU for grey seals.

Year	Mean un-impacted population size	Mean impacted population size	Mean impacted population size as a proportion of the mean un-impacted population size
Start 2029 (pre piling)	30,998	30,998	100%
Start 2030 (after 1 year cumulative piling)	31,166	31,166	100%
End 2030 (end Offshore Project piling year 1)	31,358	31,358	100%
End 2031 (end Offshore Project piling year 2)	31,585	31,585	100%
End 2035 (end cumulative piling)	32,454	32,454	100%
End 2036 (1 year after cumulative piling ends)	32,659	32,659	100%
End 2041 (6 years after cumulative piling ends)	33,679	33,679	100%
End 2047 (12 years after cumulative piling ends)	34,918	34,918	100%
End 2053 (18 years after cumulative piling ends)	36,184	36,184	100%

6 CONCLUSION

6.1.1.1 This appendix provides the methods and the results of the iPCoD modelling. In summary, the Project alone and cumulative iPCoD model results show that the mean impacted population size for harbour porpoise, bottlenose dolphins, minke whales and harbour seals is predicted to continue on a stable trajectory, the same as the un-impacted populations. For grey seals, the mean impacted population size is predicted to continue on an increasing trajectory, the same as the un-impacted population. Full interpretation of these results in terms of the magnitude of impact and resulting impact significance of effect is presented in **Chapter 13**, **Volume 2a**.

7 GLOSSARY OF TERMS AND ABBREVIATIONS

7.1.1.1 A list of key terms and acronyms used in this Appendix are provided in **Table 7-1** and **Table 7-2**.

Table 7-1 Acronyms and abbreviations

Term	Definition
CGNS	Celtic and Greater North Seas
CWSH	Coastal West Scotland and Hebrides
EIAR	Environmental Impact Assessment Report
EDR	Effective Deterrence Range
ICR	Intermediate Reactive Compensation
iPCoD	interim Population Consequences of Disturbance
MU	Management Unit
OP	Offshore Platform
OSP	Offshore Substation Platform
OW	Oceanic Waters
OWF	Offshore Wind Farm
pmean	size of the total population
PTS	Permanent Threshold Shift
RCS	Reactive Compensation Station
SMU	Seal Monitoring Unit
WI	Western Isles
WS	West Scotland
WTG	Wind Turbine Generator

Table 7-2 Glossary

Term	Meaning
Environmental Impact Assessment Report (EIAR)	The Environmental Impact Assessment Report (EIAR) is the written output of the EIA prepared to present the assessment of the likely significant effects of the Project on the environment.
Offshore Substation Platform (OSP)	An offshore substation platform housing the electrical components needed to transform power supplied by the wind turbine generators. An export cable connects the offshore substation and the transition joint bay at landfall.
Offshore Windfarm (OWF)	A group of wind turbine generators (WTGs) located offshore.
Western Isles (WI)	Also known as the Outer Hebrides, they are the islands situated to the North West of Scotland.
Wind Turbine Generator (WTG)	The components of a wind turbine, including the tower, nacelle and rotor.

8 REFERENCES

Booth, C. G., F. Heinis, and H. J. (2019). Updating the Interim PCoD Model: Workshop Report - New transfer functions for the effects of disturbance on vital rates in marine mammal species. Report Code SMRUC-BEI-2018-011, submitted to the Department for Business, Energy and Industrial Strategy (BEIS), February 2019 (unpublished).

Czapanskiy, M. F., M. S. Savoca, W. T. Gough, P. S. Segre, D. M. Wisniewska, D. E. Cade, and J. A. Goldbogen. (2021). Modelling short-term energetic costs of sonar disturbance to cetaceans using high-resolution foraging data. Journal of Applied Ecology **58**:1643-1657.

Donovan, C., J. Harwood, S. King, C. Booth, B. Caneco, and C. Walker. (2016). Expert elicitation methods in quantifying the consequences of acoustic disturbance from offshore renewable energy developments. Advances in Experimental Medicine and Biology.

Gilles, A., M. Authier, N. Ramirez-Martinez, H. Araújo, A. Blanchard, J. Carlström, C. Eira, G. Dorémus, C. Fernández-Maldonado, S. Geelhoed, L. Kyhn, S. Laran, D. Nachtsheim, S. Panigada, R. Pigeault, M. Sequeira, S. Sveegaard, N. Taylor, K. Owen, C. Saavedra, J. Vázquez-Bonales, B. Unger, and P. Hammond. (2023). Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys. Final report published 29 September 2023.

Harwood, J., and S. King. (2017). The Sensitivity of UK Marine Mammal Populations to Marine Renewables Developments. Report number. SMRUC-MSS-2017-005.

Harwood, J., S. King, R. Schick, C. Donovan, and C. Booth. (2014). A protocol for Implementing the Interim Population Consequences of Disturbance (PCoD) approach: Quantifying and assessing the effects of UK offshore renewable energy developments on marine mammal populations. Report Number SMRUL-TCE-2013-014. Scottish Marine And Freshwater Science, 5(2).

JNCC. (2020). Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). Report No. 654, JNCC, Peterborough.

King, S. L., R. S. Schick, C. Donovan, C. G. Booth, M. Burgman, L. Thomas, and J. Harwood. (2015). An interim framework for assessing the population consequences of disturbance. Methods in Ecology and Evolution **6**:1150-1158.

Schwacke, L. H., T. A. Marques, L. Thomas, C. Booth, B. C. Balmer, A. Barratclough, K. Colegrove, S. De Guise, L. P. Garrison, and F. M. Gomez. (2021). Modeling population impacts of the Deepwater Horizon oil spill on a long-lived species with implications and recommendations for future environmental disasters. Conservation Biology.

Sinclair, R., J. Harwood, and C. Sparling. (2020). Review of demographic parameters and sensitivity analysis to inform inputs and outputs of population consequences of disturbance assessments for marine mammals. Scottish Marine and Freshwater Science **11**:74.