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Subject: Hornsea Project Three (UK) Ltd response to Deadline 4 (Part 11)
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[D4_HOW03_Appendix 38_Regeneris Report 2014.pdf](#)
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[D4_HOW03_Appendix 41_Regeneris Report 2015.pdf](#)
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[D4_HOW03_Appendix 45_O2.2.65.pdf](#)
[D4_HOW03_Appendix 46_Site Integrity Plan V2.0.pdf](#)
[D4_HOW03_Appendix 47_In Principle Monitoring Plan V3.0.pdf](#)
[D4_HOW03_Appendix 48_O2.9.3.pdf](#)

Dear Kay, K-J

Please find attached the 11th instalment of documents.

Best regards,
Dr Dominika Chalder PIEMA
Environment and Consent Manager



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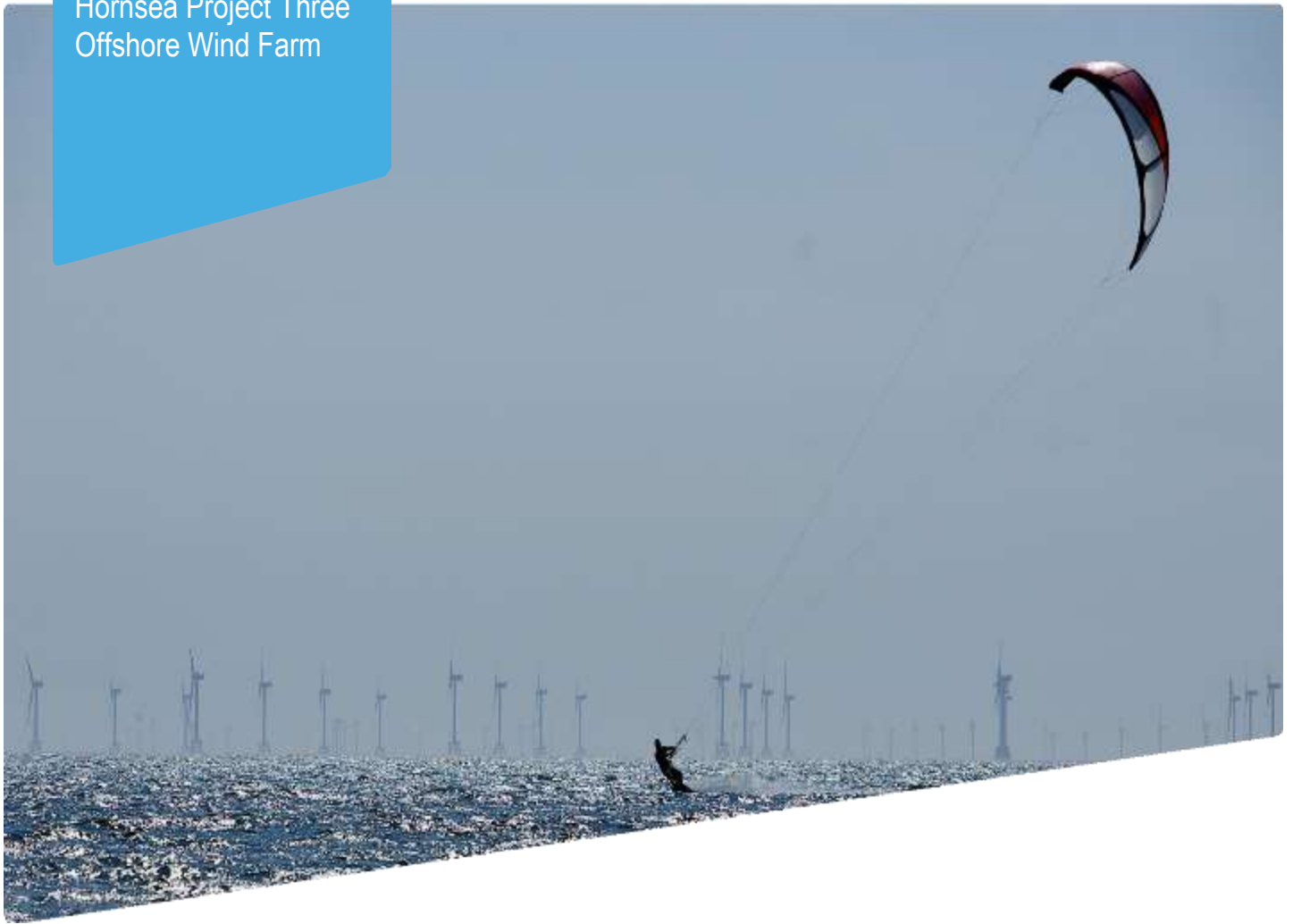
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Hornsea Project Three Offshore Wind Farm

**Appendix 45 to Deadline 4 submission – Detailed response to
the ExA Q2.2.65**

Date: 15th January 2019

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Front cover picture: Kite surfer near a UK offshore wind farm © Ørsted Hornsea Project Three (UK) Ltd., 2019.

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1. Detailed response to ExA Q2.2.65

Introduction

- 1.1 This Appendix provides a brief description of the results of a comparison of the prediction of the consequences of offshore wind farm construction on the North Sea harbour porpoise population between the older iPCoD model detailed in Booth et al (2017) (version 3.0) (as used to inform the Hornsea Project Three ES) and the recently updated version (version 5.1) referred to in the Ex.A Question 2.2.65 to The Wildlife Trusts:
- 1.2 “You stated in [REP1-023] that it was not appropriate to use the Booth et al (2017) paper as the basis for determining the significance of cumulative underwater noise impacts on harbour porpoise because the model heavily relies upon expert opinion rather than empirical data. The Applicant has since run an updated version of the iPCoD model, incorporating all available empirical information on harbour porpoise energetics, diet and responses to piling noise. The Applicant has stated in [REP2-004] that this has a similar or lower magnitude of effect for an equivalent scenario. Consequently, the appellant maintains that the ES outcomes that were based upon Booth et al (2017) remain valid and no long-term population level impact is expected. What are your views on this additional analysis and how does it affect your stated position?”
- 1.3 The interim Population Consequences of Disturbance framework (iPCoD) is an approach for assessing and quantifying the potential consequences for marine mammal populations of any disturbance and/or injury that may result from offshore energy developments. iPCoD uses a stage structured model of population dynamics and, in the absence of empirical data on the extent to which disturbance and/or injury impacts affects individual survival and fecundity, the iPCoD framework uses the results of an expert elicitation process to predict the effects of disturbance and a permanent threshold shift in hearing threshold (PTS) on individual survival and reproductive rates. The process generates a set of statistical distributions for these effects and then simulations for the impacted population are conducted using values randomly selected from these distributions that represent the opinions of a “virtual” expert. This process is repeated 1,000 times to capture the uncertainty among experts. Within the 1,000 simulations run for the iPCoD code, each simulation contains a matched pair of populations (an un-impacted population (baseline) and an impacted population) and within 1 matched pair, the only difference is that impacts are allocated to the impacted population. Version 1.0 of the iPCoD code was released in 2013 alongside a report detailing how the interim approach is implemented based on the expert elicitation process (Harwood et al., 2013). Subsequently the code underwent several updates which resulted in the publicly available code version 3.0 which was used in Booth et al. (2017). Since then, the code has been updated further to version 5.1 in 2018 with the results of a new expert elicitation.

- 1.4 The primary difference between the two versions of the iPCoD model are the transfer functions which link the amount of disturbance estimated to be received by the population to the resulting changes in vital rates (the probability of survival and reproduction). The transfer functions in version 5.1 were updated as a result of an international symposium (INPAS - <http://www.inpas.nl/>) and an associated expert elicitation workshop held in Amsterdam in June 2018. This expert elicitation was based on a body of empirical data that had become available since the original expert elicitation. This included studies on porpoise responses to impulsive noise and studies of porpoise energetics and life history. The workshop was also carried out using an improved methodology for formal expert elicitation processes. A full report on the workshop and the updated model is currently under review by BEIS and will be submitted to the Examination as soon as possible (Booth et al. 2018).
- 1.5 In order to compare the predicted impacts using iPCoD version 5.1 with those obtained using version 3.0 (as used in Booth et al. 2017), one of the scenarios presented in Booth et al. (2017) was re-run in version 5.1 to allow a direct comparison of the resulting predicted population level impacts. The selected scenario included the piling of 16 offshore wind farms over a 12-year period, indicative of the predicted levels of cumulative disturbance resulting from the construction of offshore wind farms in the North Sea. The scenario was developed originally in collaboration with a number of offshore wind farm developers and representatives from JNCC and Natural England. The input parameters used in both versions of iPCoD (version 3.0 and version 5.1) were identical.

2. Results

- 2.1 The results from the two iPCoD code versions are presented in Figure 1 and Table 1. The mean predicted impacted population size expressed as a percentage of the mean un-impacted population size at the end of the model simulation was higher using iPCoD version 5.1: the predicted impacted population size was 98.7% of the predicted un-impacted population size compared to a counterfactual of 97.1% when using version 3.0. Therefore, there was less of a predicted population level impact using the updated model under the same development scenario. Therefore, the ES conclusions that were based upon Booth et al (2017) remain valid and no long-term population level impact is expected.

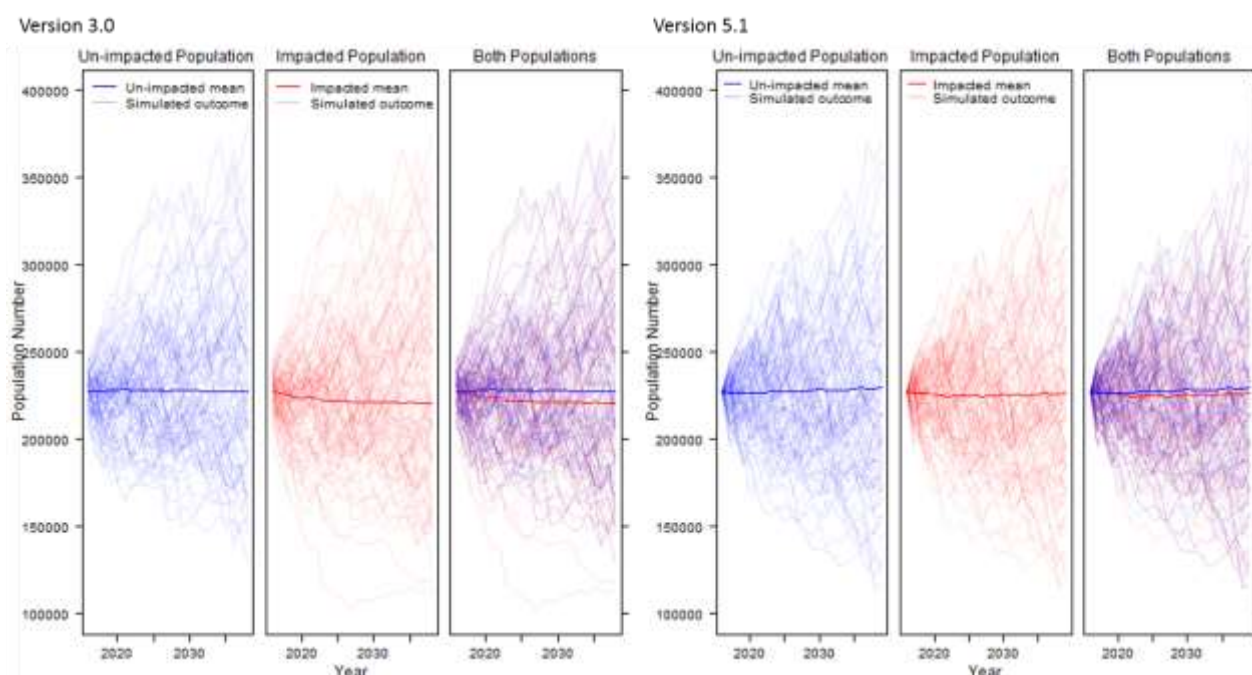


Figure 1. Predicted population trajectories for the same CEA scenario using both iPCoD version 3.0 (left) and 5.1 (right) during the 24 years of simulation. Each line is an individual population simulation and the bold line on each graph is the mean calculated across 1000 replicates incorporating environmental stochasticity.

Table 1. Summary statistics of the population simulations of the same CEA scenario using both iPCoD version 3.0 and 5.1 after 24 years of simulation.

PCoD version	3.0	5.1
Mean un-impacted population size	227,680	229,748
Mean impacted population size	221,107	226,772
Difference between mean un-impacted and impacted population sizes after 24 years	6,573	2,976
Mean impacted population size as a percentage of the un-impacted population size after 24 years	97.1%	98.7%

3. References

Booth, C.G., Harwood, J., Plunkett, R., Mendes, S., & Walker, R. 2017. Using the Interim PCoD framework to assess the potential impacts of offshore wind developments in Eastern English Waters on harbour porpoises in the North Sea. Natural England Joint Report, Number 024 York.

<http://publications.naturalengland.org.uk/publication/4813967957950464>

Booth, C.G, Heinis, F& Harwood J. Updating the Interim PCoD Model: Workshop Report -New transfer functions for the effects of disturbance on vital rates in marine mammal species. 2018. Report Code

SMRUC-BEI-2018-011, submitted to the Department for Business, Energy and Industrial Strategy (BEIS), October 2018 (unpublished).

Harwood, J., King, S., Schick, R., Donovan, C. & Booth, C. (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). <https://www2.gov.scot/Resource/0044/00443360.pdf>