Written Representation

for the

Royal Society for the Protection of Birds

Deadline 7

Offshore Ornithology

Comments on selected Deadline 6 submissions

Submitted for Deadline 7

10 August 2022

Planning Act 2008 (as amended)

In the matter of:

Application by Hornsea Project Four Limited for an Order

Granting Development Consent for the Hornsea Project Four Offshore Wind Farm

Planning Inspectorate Ref: EN010098

RSPB Registration Identification Ref: 20029909

Contents

1. Introduction

Scope of submission

1.1. Below, the RSPB sets out its comments on the following documents submitted by the Applicant and Natural England at Deadline 6:

- REP6-027: G4.7 Ornithological Assessment Sensitivity Report (Tracked) - Revision: 03
- REP6-029: G5.25 Ornithology Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) Annex (Tracked) - Revision 03

2. Update on RSPB position

2.1. The RSPB has reviewed the Applicant's clarifications on the inconsistencies reported on the Revised Ornithology baseline (REP5a-010) and the data used for collision risk modelling (REP5a-012). We are now content with the baseline and subsequent predictions of collision and displacement mortalities presented in the revised Ornithology EIA and HRA Annex (REP6-029: G5.25 Ornithology Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) Annex (Tracked) - Revision 03) and are able to come to conclusions with regard to the adverse effects on the integrity of the Flamborough and Filey Coast (FFC) SPA populations of gannet and kittiwake. Our conclusions with regard to the guillemot and razorbill populations of the SPA remain unchanged and are as follows.

2.2. For **guillemot**, the displacement assessment shows that the FFC SPA population is likely to be **13.9 -20.6% lower** after the lifetime of Hornsea Project Four wind farm than it would be without the development, and **24.0-41.7% lower** in-combination with other developments. As such, it is impossible to rule out an Adverse Effect on the Integrity of the FFC SPA guillemot population for the project alone and in-combination.

2.3. For **razorbill**, the displacement assessment shows that the FFC SPA population is likely to be **11.1-21.9% lower** after the lifetime of Hornsea Project Four wind farm, in combination with other developments, than it would be without the developments. As such, it is impossible to rule out an Adverse Effect on the Integrity of the FFC SPA razorbill population for the project in-combination.

2.4. Based on the additional information and clarifications received at Deadline 6, we have come to the following conclusions with regard to the gannet and kittiwake populations of the FFC SPA.

2.5. For **gannet**, the combined displacement and collision assessment shows that the FFC SPA population is likely to be **5.2-7.2% lower** after the lifetime of Hornsea Project Four wind farm than it would be without the development, and **62.0-69.6% lower** in-combination with other developments. While the SPA population may previously have been sufficiently robust to be maintained, even with the additional mortality associated with the project alone, in the context of the current outbreak of Highly Pathogenic Avian Influenza there is considerable uncertainty as to the continued viability of this population. As such, it is not possible to rule out an Adverse Effect on the Integrity of the FFC SPA gannet population both for the project alone and in-combination.

2.6. For **kittiwake**, the displacement assessment shows that the FFC SPA population is likely to be **3.0% lower** after the lifetime of Hornsea Project Four wind farm than it would be without the development, and **16.4% lower** in-combination with other developments. Given the FFC SPA restore objective for this species' population and the vulnerability of the population, both locally and in the wider biogeographic region, it is not possible to rule out an Adverse Effect on the Integrity of the FFC SPA kittiwake population for the project alone and that an Adverse Effect on Integrity exists in-combination.

2.7. Below we have set out the RSPB's updated position with respect to adverse effects on the integrity of the FFC SPA from the project alone and in-combination with other projects. This replaces our position set out at Deadline 6 (in REP6-067 and REP6-068).

Project alone – RSPB AEOI conclusions

2.8. For the species where it has been possible to reach a conclusion on adverse effect on the integrity of the FFC SPA from the project alone, the RSPB's conclusions are:

- **Gannet:** cannot rule out adverse effect on site integrity due to the impact of combined displacement and collision mortality.
- **Kittiwake:** cannot rule out adverse effect on site integrity due to the impact of collision mortality.
- **Guillemot:** cannot rule out adverse effect on site integrity due to the impact of displacement mortality.
- **Seabird assemblage:** cannot rule out adverse effect on site integrity due to the impact of combined collision and displacement mortality on the seabird assemblage.

Project in combination with other plans and projects – RSPB AEOI conclusions

2.9. The RSPB's conclusions for each feature of the FFC SPA from Hornsea Four in-combination with other projects are:

- **Kittiwake:** adverse effect on site integrity exists due to the impact of collision mortality on the kittiwake population;
- **Gannet:** adverse effect on site integrity exists due to the impact of combined collision and displacement mortality on the gannet population;
- **Guillemot:** adverse effect on site integrity exists due to the impact of displacement mortality on the guillemot population;
- **Razorbill:** cannot rule out adverse effect on site integrity due to the impact of displacement mortality on the razorbill population;
- **Seabird assemblage:** adverse effect on site integrity exists due to the impact of combined collision and displacement mortality on the seabird assemblage.

3. A note on Precaution

3.1. The Applicant has argued in its Ornithological Assessment Sensitivity Report (REP6-027: G4.7 Ornithological Assessment Sensitivity Report (Tracked) - Revision: 03) that they consider that the recommended approach to the assessment of offshore wind farm developments is overly precautionary. In contrast, the RSPB considers its approach, and that of Natural England, is a measured and reasonable response to the considerable uncertainty inherent in the assessment procedure; and is entirely in line with the precautionary principle.

3.2. In our Deadline 6 submission, REP6-068, we outlined that precaution in assessment is a necessary consequence of the degree of uncertainty in that assessment; and that uncertainty is directly proportional to the extent of scientific uncertainty inherent in that assessment. We also outlined how the approach taken by the Applicant often increased the amount of uncertainty. In the context of the aspects of the assessment we are now considering, the potential impact on gannet and kittiwake, only having reliable collision risk estimates presented toward the end of inquiry, can be seen as increasing uncertainty.

3.3. While the Applicant argues that they have always taken the most precautionary approach there are instances where they have not. For example, there is no consideration of the potential consequences of displacement and barrier effects on kittiwake. While the RSPB acknowledge that consideration of these impacts is not included in statutory guidance in England, it is recommended to be included in Scotland, and we mention them to highlight that their omission from the assessment guidance means the guidance cannot be considered overly precautionary.

3.4. Similarly, the Applicant prefers a truncated breeding season for gannet of April to August, despite adult gannets with juveniles being present at the colony from March to October[1]. For example, the photograph taken by Dr. Lane (see Appendix 1) was taken at Bass Rock on 20 September 2019, and Lane *et al*., (2021)[2] describes juveniles being caught at the colony in October. In support of the truncated breeding season the Applicant cites Langston *et al*., 2013[3] and Cleasby *et al.,* 2018[4]. Both papers report on tracking studies, (paragraph 2.3.1.2 in REP6-029: G5.25 Ornithology Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) Annex (Tracked) - Revision 03) although Cleasby *et al* does not include any tracking of gannet. Furthermore, it is entirely unclear how any information from Langston *et al* could be used to determine phenology. The Applicant's use of citations, that do not contain evidence to support the arguments being made, acts to increase uncertainty and thereby the consequent need for precaution.

[1] Nelson, B.(1978). *The Gannet*. T.A.&D. Poyser, Hertfordshire

[2] Lane, J. V., Pollock, C. J., Jeavons, R., Sheddan, M., Furness, R. W., & Hamer, K. C. (2021). Post-fledging movements, mortality and migration of juvenile northern gannets. *Marine Ecology Progress Series*, *671*, 207-218.

[3] Langston, R.H.W., Teuten, E. & Butler, A. (2013). Foraging ranges of northern gannets Morus bassanus in relation to proposed offshore wind farms in the North Sea: 2010-2012. RSPB Report to DECC. RSPB, Sandy.

[4] Cleasby IR, Owen E, Wilson LJ, Bolton M (2018) Combining habitat modelling and hotspot analysis to reveal the location of high density seabird areas across the UK: Technical Report. RSPB Research Report no. 63. RSPB Centre for Conservation Science, RSPB, The Lodge, Sandy, Bedfordshire, SG19 2DL.

3.5. Despite advice from both Natural England and the RSPB, the Applicant has only presented a single output metric of Population Viability Analysis (PVA), the Counterfactual of Population Growth Rate (CPGR), and omitted the Counterfactual of Population Size (CPS). As described below and in our Written Representation (REP2-089), a key utility of the Counterfactual of Population Size is its ease of comprehension. The British Trust for Ornithology, in their review of PVA metrics[5], alongside the specific recommendation to include both in offshore wind farm assessment, included recommendations on how to use each metric most effectively. They highlight that the CPS should be used, to provide "an easily understandable context". This is of relevance to the inherent uncertainty in the assessment, as providing understandable context is key to reducing linguistic and decision-making uncertainty (Masden et al., 2015[6], Searle et al., 2021[7]). As such, in omitting the Counterfactual of Population Size, the Applicant is actually increasing uncertainty and the consequent need for precaution.

[5] Cook, A.S.C.P. & Robinson, R.A. (2016) Testing sensitivity of metrics of seabird population response to offshore wind farm effects, JNCC Report No. 553, JNCC, Peterborough, ISSN 0963-8091.

[6] Masden, E. A., McCluskie, A., Owen, E., & Langston, R. H. (2015). Renewable energy developments in an uncertain world: the case of offshore wind and birds in the UK. Marine Policy, 51, 169-172.

[7] Searle, K.R., Jones, E.L., Trinder, M., McGregor, R., Donovan, C., Cook, A., Daunt, F., Humphries, L., Masden, E., McCluskie, A. & Butler, A. 2021. JNCC Report on the Correct treatment of uncertainty in ornithological assessments. JNCC Report No. 677, JNCC, Peterborough, ISSN 0963-8091

4. Highly Pathogenic Avian Influenza (HPAI)

4.1. In paragraphs 4.2-4.3 below we have provided an updated version of our Deadline 6 submission on HPAI.

4.2. A new virulent form of bird flu, Highly Pathogenic Avian Influenza (HPAI), that originated in poultry in east Asia has now killed tens of thousands of wild birds in the UK and around the world. First confirmed in Britain during winter 2021/22, it has had major impacts on populations of seabirds across Scotland, and there have been an increasing number of confirmed cases appearing across England, including east coast seabird colonies. At the Farne Islands in Northumberland, thousands of seabirds have died. The disease is now strongly suspected to be the cause of death of seabirds at the Flamborough and Filey Coast SPA, awaiting post-mortem confirmation from DEFRA. Current ongoing monitoring is recording dead and symptomatic birds and includes affected gannet, kittiwake, guillemot and razorbill. Since our Deadline 6 submission, RSPB monitoring staff at FFC have recorded that the spread of the disease amongst gannets and kittiwakes is escalating, and is likely to continue to do so.

4.3. It is currently unclear what the population scale impacts of the outbreak will be, but it is likely that they will be severe. This year's outbreak at the Bass Rock gannetry has coincided with, and is the likely cause of, an estimated 95% nest failure. This scale of impact means that seabird populations will be considerably less robust to any additional mortality arising from offshore wind farm developments. It also means that there will need to be a reassessment of whether the relevant FFC seabird SPA populations remain in Favourable Conservation Status. With such uncertainty as to the future of these populations, there is the need for an extremely high level of precaution to be included in examination of impacts arising from the proposed development of Hornsea Project Four.

5. Counterfactual metrics

5.1. Paragraphs 4.2-4.4 below repeat the RSPB's submission on counterfactual metrics from REP6-068.

5.2. The RSPB has argued in its main Written Representation (REP2-089) why it is wrong for the Applicant to only have presented a single output metric of Population Viability Analysis (PVA), the Counterfactual of Population Growth Rate (CPGR), and omitted the Counterfactual of Population Size (CPS). This is contrary to a specific recommendation of a review of output metrics, following work by the RSPB[8], commissioned by the Joint Nature Conservation Committee (JNCC) and carried out by the British Trust for Ornithology (BTO)[9]. That review recommended the ratio of growth rates are presented to quantify the consequence of impacts at a population level and the ratio of population sizes to present these impacts in an easily understandable context. A further review was commissioned by Marine Scotland Science and carried out by the Centre for Ecology and Hydrology[10], and the conclusions as to utility of output metrics was similar.

5.3. As we argued previously, the ease of understanding of the CPS is crucial to its utility; the numbers given by the CPGR are less understandable outwith a population modelling context. To use the theoretical example quoted by the BTO, a CPS of 0.515 means the population size of a breeding colony is expected to be 51.5% (i.e. half) of what it would have been in the absence of the development after 25 years, which is easy to understand. Whereas the corresponding CPGR, 0.973, means that the annual population growth rate at the breeding colony declines from 0.994 to 0.967. The actual scale of the consequence of this is hard for a non-specialist to comprehend, that of the CPS is not. This issue of comprehension is crucial in reducing uncertainty, as lack of clarity in presenting results acts to increase uncertainty, and the consequent need for precaution (Masden *et al*., 2015[11], Seale *et al*., 2021[12]).

5.4. The Applicant is incorrect in disassociating the two metrics, arguing that this is necessary because of the use of density independent formulations. However, the two metrics are very similar, the only key difference is that CPGR does not include the length of time that the wind farm will be operational. They are both outputs of the same modelling process and will therefore both be equally affected if density dependence is included or not in the formulation. The only difference is that because CPGR is a smaller number, the relative change between density independent and density dependent formulations will appear to be

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[8] Green, R. E., Langston, R.H. W., McCluskie, A., Sutherland, R., & Wilson, J. D. (2016). Lack of sound science in assessing wind farm impacts on seabirds. Journal of Applied Ecology, 53(6), 1635-1641

[9] Cook, A.S.C.P. & Robinson, R.A. (2016) Testing sensitivity of metrics of seabird population response to offshore wind farm effects, JNCC Report No. 553, JNCC, Peterborough, ISSN 0963-8091

[10] Jitlal, M., Burthe, S., Freeman S. and Daunt, F. (2017) Testing and Validating Metrics of Change Produced by Population Viability Analysis (PVA). Scottish Marine and Freshwater Science Vol 8 No 23, 210pp. DOI: 10.7489/2018-1

[11] Masden, E. A., McCluskie, A., Owen, E., & Langston, R. H. (2015). Renewable energy developments in an uncertain world: the case of offshore wind and birds in the UK. Marine Policy, 51, 169-172

[12] Searle, K.R., Jones, E.L., Trinder, M., McGregor, R., Donovan, C., Cook, A., Daunt, F., Humphries, L., Masden, E., McCluskie, A. & Butler, A. 2021. JNCC Report on the Correct treatment of uncertainty in ornithological assessments. JNCC Report No. 677, JNCC, Peterborough, ISSN 0963-8091

small. The consequent change to the impacted population will be identical with both metrics.

6. Collision Risk Modelling

6.1. In order to assess the mortality that could arise from avian collision with turbine blades, the Applicant has used the stochastic version of the Band Collision Risk Model (sCRM)[13,14]. This approach is welcomed by the RSPB. This method combines a series of parameters describing the turbine design and operation with estimates of a bird's size and behaviour to generate a predicted number of birds that would collide with a turbine over a given time period. The stochastic formulation was initially developed by Masden (2015)[15] and then produced in an easier to use interface by McGregor *et al,* (2018)[14]. The stochastic version allows for some account of uncertainty and variability in parameters to be made.

6.2. The input parameters related to bird size and behaviour include a parameter known as "Avoidance Rate". This is defined by Band (2012)[13] as the inverse of the ratio of the number of actual collisions to number of predicted collisions. As such "Avoidance Rate" is a misnomer; it is a catch all term for the inconsistency between predicted and actual mortalities, an inconsistency that can be derived from a variety of sources, including avoidance behaviour *per se*, survey error and model misparameterisation.

6.3. The Applicant has used Avoidance Rates (see above) in the sCRM, as recommended by the Statutory Nature Conservation Bodies (SNCBs 2014[16]) including Natural England. Whilst the RSPB agree with the majority of the advised rates including the use of a 98.9% avoidance rate for non-breeding gannets, in our opinion, a 98% avoidance rate is more appropriate for breeding gannets. This is because the figures used for the calculation of avoidance rates advocated by the SNCBs are largely derived from the non-breeding season for gannet[17,18]. During the breeding season, gannets are constrained to act as central placed foragers meaning they return to the colony after feeding in order to maintain territories, incubate eggs and provide for chicks. Once chicks have fledged adult gannets remain at sea and no longer visit the colony. Differences in behaviour between the breeding and non-breeding season are likely to result in changes in avoidance behaviour.

6.4. There is evidence that the foraging movements and behaviour of gannets will vary in relation to stage of the breeding season in response to changes in the distribution and abundance of prey and changing constraints as they progress from pre-laying to chick-rearing[19]. GPS tracking of gannets breeding on the Bass Rock between 2010 and 2021 has

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[13] Band, B. 2012. Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Wind Farms. Report by British Trust for Ornithology (BTO). Report for The Crown Estate.

[14] McGregor, R.M., King, S., Donovan, C.R., Caneco, B. and Webb, A. (2018) A Stochastic Collision Risk Model for Seabirds in Flight. Report to Marine Scotland Science

[15] Masden, E. (2015). Scottish Marine and Freshwater Science Vol 6 No 14: Developing an avian collision risk model to incorporate variability and uncertainty. Published by Marine Scotland Science. DOI: 10.7489/1659-1. http://www.scotland.gov.uk/Resource/0048/00486433.pdf

[16] SNCBs. 2014. Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review [redacted]

[17] Cook, A S C P, Humphreys, E. M., Masden, E. A., & Burton, N. H. K. 2014. The Avoidance Rates of Collision Between Birds and Offshore Turbines. Edinburgh.

[18] Cook, A.S.C.P., Humphreys, E.M., Bennet, F., Masden, E.A., Burton, N.H.K. 2018 Quantifying avian avoidance of offshore wind turbines: Current evidence and key knowledge gaps. Marine Environmental Research, 140, 278-288

[19] Lane, J.V., Jeavons, R., Deakin, Z., Sherley, R.B., Pollock, C.J., Wanless, R.J., Hamer, K. C., 2020. Vulnerability of northern gannets to offshore wind farms; seasonal and sex specific collision risk and demographic consequences. Marine Environmental Research. 162.

shown variation in the two-dimensional foraging behaviour of birds across the breeding season (prior to chick-rearing and during chick-rearing), between sexes, and between years[20,21,22]. Three-dimensional tracking of gannets during chick-rearing has also revealed that flight height and flight speed both vary according to behaviour, sex and wind conditions[23,24,25] and similar patterns have been recorded in other seabirds[26] Because any error in the use of flight height and flight speed as input parameters in the sCRM should be corrected for in the use of the Avoidance Rate, any seasonal variation in these parameters should also be reflected in variation in the Avoidance Rate, in the absence of any actual evidence from the breeding season.

6.5. Further to advice from Natural England, the Applicant has applied a reduction of 60-80% to the baseline densities inputted into the gannet collision risk modelling in order to account for macro-avoidance. This approach follows suggestions in Cook (2021[27]), the recommendations from which have not yet been formally adopted by the SNCBs. Cook (2021) is currently being reviewed and revised by two projects, one funded by JNCC and one by Natural England. Until these projects have reported, the RSPB do not accept this approach.

6.6. The current evidence of a strong macro avoidance of wind farms by gannets, established from observed behaviour, is almost entirely derived from non-breeding birds[28]. The evidence for macro avoidance during the breeding season is limited with the exception of a study of gannets breeding on Helgoland[29] in the German North Sea. However, it is unclear from this study what the breeding status of the tracked birds was, or how their behaviour differed from what would have been expected pre-construction as two of the three wind farms were already operational during the first year of tracking. What the study does clearly show is that breeding gannets do fly through offshore wind farms, often showing no avoidance behaviour at all. Below we reproduce Figure 2 from this paper showing tracked gannets' movements in

[2020] Cleasby, I.R., Wakefield, E.D., Bodey, T.W., Davies, R.D., Patrick, S.C., Newton, J., Votier, S.C., Bearhop, S., Hamer, K.C. 2015a. Sexual segregation in a wide-ranging marine predator is a consequence of habitat selection. Marine Ecology Progress Series, 518, 1-12.

[21] Lane, J.V., Jeavons, R., Deakin, Z., Sherley, R.B., Pollock, C.J., Wanless, R.J., Hamer, K. C., 2020. Vulnerability of northern gannets to offshore wind farms; seasonal and sex specific collision risk and demographic consequences. Marine Environmental Research. 162.

[22] Lane, J.V. and Hamer, K.C. 2021. Annual adult survival and foraging of gannets at Bass Rock, Scotland: Report to the Ornithology subgroup of the Forth and Tay Regional Advisory Group (FTRAG-O) – October 2021

[23] Cleasby, I.R., Wakefield, E.D., Bearhop, S., Bodey, T.W., Votier, S.C., Hamer, K.C., 2015b. Three-dimensional tracking of a wide-ranging marine predator: flight heights and vulnerability to offshore wind farms. Journal of Applied Ecology, 52, 1474–1482

[24] Lane, J.V., Spracklen, D.V., Hamer, K.C., 2019. Effects of windscape on three-dimensional foraging behaviour in a wide-ranging marine predator, the northern gannet. Marine Ecology Progress Series, 628, 183–193.

[25] Lane, J.V., Jeavons, R., Deakin, Z., Sherley, R.B., Pollock, C.J., Wanless, R.J., Hamer, K. C., 2020. Vulnerability of northern gannets to offshore wind farms; seasonal and sex specific collision risk and demographic consequences. Marine Environmental Research. 162.

[26] Masden, E.A., Cook, A.S.C.P., McCluskie, A., Bouten, W., Burton, N.H.K, Thaxter, C. 2021. When speed matters: the importance of flight speed in an avian collision risk model. Environmental Impact Assessment Review, 90

[27] Cook A.S.C.P. (2021) Additional analysis to inform SNCB recommendations regarding collision risk modelling. BTO research report 739

[28] Dierschke, V., Furness, R. W., Garthe, S. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation, 202, 59–68.

[29] Peschko, V., Mendel, B., Merker, M., Dierschke, J., Garthe, S. 2021. Northern gannets (Morus bassanus) are strongly affected by operating offshore wind farms during the breeding season. Journal of Environmental Management. 279.

respect to wind farms. While some show clear avoidance others do not and may even be attracted to the wind farm.

6.7. In the Cook (2021) report that suggests the application of macro avoidance to baseline densities, the suggestion is based on reviews that do not include this German tracking study, although it does acknowledge that it shows clear differences between individuals in relation to their response to wind farms. The previous gannet recommended avoidance rate was based on 'all gulls' data because no gannet data were available. The evidence of macro avoidance of gulls in response to wind farms is equivocal, so this rate was only calculated from 'within wind farm' avoidance. As gannets can show macro avoidance it therefore was suggested that this was applied to the baseline densities, and then collision risk modelling was carried out using the 'all gull' avoidance rate, so effectively applying avoidance twice. In response to this suggestion Natural England commissioned a further review of gannet avoidance rates, including whether macro avoidance should be incorporated in this way but this has not yet been reported. In the absence of having this report, the recommendations from it should not be acted upon, and the suggestions in Cook (2021) should not be taken up without the context of this review.

6.8. Notwithstanding the above, the RSPB does not agree with the approach for two reasons. Firstly, it does not take into account the likely seasonal variation in macro avoidance as described above, and as acknowledged by the Applicant (REP2-045: G2.9 Gannet Displacement and Mortality Evidence Review). Secondly, by basing the 'within wind farm' avoidance rate on the 'all gull' rate, it assumes that gannets will have the same 'within wind farm' reactive flight response as gulls. This assumption is very unlikely to be met, as gannets have much lower flight maneuverability than gulls[30].This will result in a lesser ability to make rapid reactions and consequently have a greater risk of collision. This should be reflected in the 'within wind farm' avoidance rate if any further changes are to be made.

6.9. Any evidence of macro avoidance should also be seen in the context of recent work in Belgian offshore windfarms that has shown potential habituation to the presence of turbines. This effectively results in lower macro avoidance[31]and so an elevated risk of collision. It is also important to acknowledge that corpses of Northern Gannets with injuries consistent with collisions with offshore wind farms have been recovered (Rothery et al., 2009[32]), and the imperfect detection of these corpses indicate that there may be many more.

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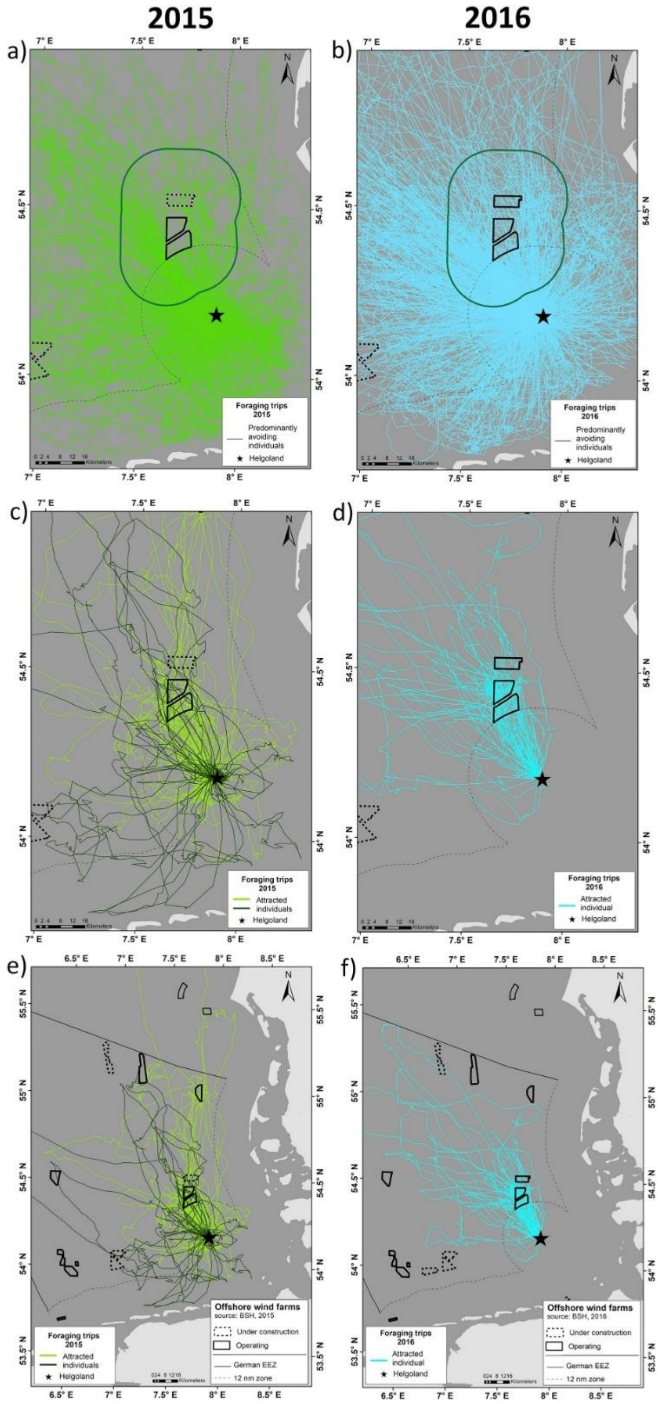
[30] Furness, R. W., Wade, H. M., & Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of environmental management*, *119*, 56-66.

[31] Vanermen, N.; Courtens, W.;.; Van de walle, M.; Verstraete, H.; Stienen, E. 2021. Macro-avoidance of GPS-tagged lesser black-backed gulls and potential habituation of auks and gannets. In Degraer, Brabant, Rumes & Vigin (eds) 2021. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea, avoidance and habitat use at various spatial scales.* Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management

[32] Rothery, P., Newton, I., & Little, B. (2009). Observations of seabirds at offshore wind turbines near Blyth in northeast England. *Bird Study*, *56*(1), 1-14.

“Figure 2”: from Peschko et al 2021[33] showing flight of tagged birds from Heligoland (indicated by a star) in the vicinity of wind farms (outlined in black). Original figure legend is: ”*Flight behaviours of gannets tagged in 2015 (n = 10) (a) and 2016 (n = 15) (b) that ‘predominantly avoided’ the OWFs (all individuals shown in the same colour). Gannets tagged in 2015 (n = 2) (c) and 2016 (n = 1) (d) that were classified as ‘attracted individuals’ (individuals shown in different colours). (e) & (f) Large-scale movements of individuals shown in (c) and (d). OWFs: dashed black = under construction, solid black = operating, dark green line = 15 km buffer applied for PPM analysis.”*



[33] Peschko, V., Mendel, B., Merker, M., Dierschke, J., Garthe, S. 2021. Northern gannets (Morus bassanus) are strongly affected by operating offshore wind farms during the breeding season. Journal of Environmental Management. 279

7. Impact predictions

7.1. To aid the examination, the RSPB presents here the mortalities and consequent Counterfactual of Population Size apportioned to the gannet and kittiwake populations of the Flamborough and Filey Coast SPA. For gannet these are mortalities from displacement and collision impacts combined and for kittiwake from collision alone. These have been calculated from the values presented by the Applicant in the tables in sections 5 and 6 of REP6-029: G5.25 Ornithology Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) Annex (Tracked) - Revision 03.

7.2. For gannet, we present them as derived from three sets of displacement and consequent mortality rates, combined with mortality arising from collision:

- **For displacement**, we have used:
  - the minimum and maximum of the two ranges favoured by the Applicant (60-80% all year, and breeding 40-60%, non-breeding 60-75%);
  - a *plausible* range of 60-80% advocated by Natural England; and what can be considered
  - a *probable* value of 70%, as reflected in advice to offshore wind farm developments in Scottish waters.
- **For mortality**, we have used:
  - the 1% rate favoured by the Applicant;
  - a *plausible* range of 1-10% as advocated by Natural England; and what can be considered
  - a *probable* range of 1-3% as reflected in advice to offshore wind farm developments in Scottish waters.

7.3. The collision mortalities are derived from the Applicant's preferred approach to apportionment, the NE and RSPB preferred approach to apportioning, and the preferred avoidance rates, which for RSPB includes a 98% breeding season Avoidance Rate. For gannet we also present the Applicant and NE's range with additional macro avoidance.

7.4. As kittiwake is only assessed for collision impacts, we have not presented a range of mortalities. This is for clarity and to aid the examination. However, we stress the importance of also looking at the potential range of values using upper and lower confidence intervals.

7.5. The Counterfactuals of Population Size, that is the percentage decrease in impacted population size relative to unimpacted population size, have been taken from Population Viability Analysis run using the Natural England PVA tool, mirroring the original model logs used by the Applicant.

7.6. The predicted annual mortalities and CPS values arising from displacement and collision of gannet and collision of kittiwake apportioned to the Flamborough and Filey Coast SPA are presented below, both in tabular and in graphic form. The source tables in REP6-029 that the figures were derived from are listed in the table legend.

Gannet

Table 1. The predicted annual mortality of gannet apportioned to the Flamborough and Filey Coast SPA arising from Hornsea Project Four alone and in-combination and the consequent percentage decrease in impacted population size relative to unimpacted population size (CPS) presented as ranges using the Applicant's approach, the plausible range and the probable range of displacement and mortality rates, combined with predicted collision estimates. Derived from tables 68, 70, 72, 75, 77, 79, 81, 84, 111, 112, and 115) of REP6-029 (Ornithology EIA and HRA Annex).

	Project alone						In combination					
	Applicant		Plausible/NE		Probable		Applicant		Plausible/NE		Probable	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Displacement	2.8	5.3	5.7	75.7	6.6	19.9	41	76.1	58.8	783.6	68.6	205.7
Collision	7.1	7.1	14.6	14.6	26.4	26.4	330.6	330.6	338.1	338.1	458.9	458.9
Collision + MA	1.4	2.8	2.9	5.8	n/a	n/a						
Total	9.9	12.4	20.3	90.3	33.0	46.3	371.6	406.7	396.9	1121.7	527.5	664.6
CPS (%)	1.6	1.9	3.2	13.4	**5.2**	**7.2**	44.9	47.9	47.1	83.9	**62.0**	**69.6**
Total + MA	4.2	8.1	8.6	81.5	n/a	n/a						
CPS (%)	0.7	1.2	1.4	12.2								

Figure 1. The predicted annual mortality of gannet apportioned to the Flamborough and Filey Coast SPA arising from Hornsea Project Four alone and in-combination presented as ranges using the Applicant's approach, the plausible range and the probable range of displacement and mortality rates combined with collision mortalities.

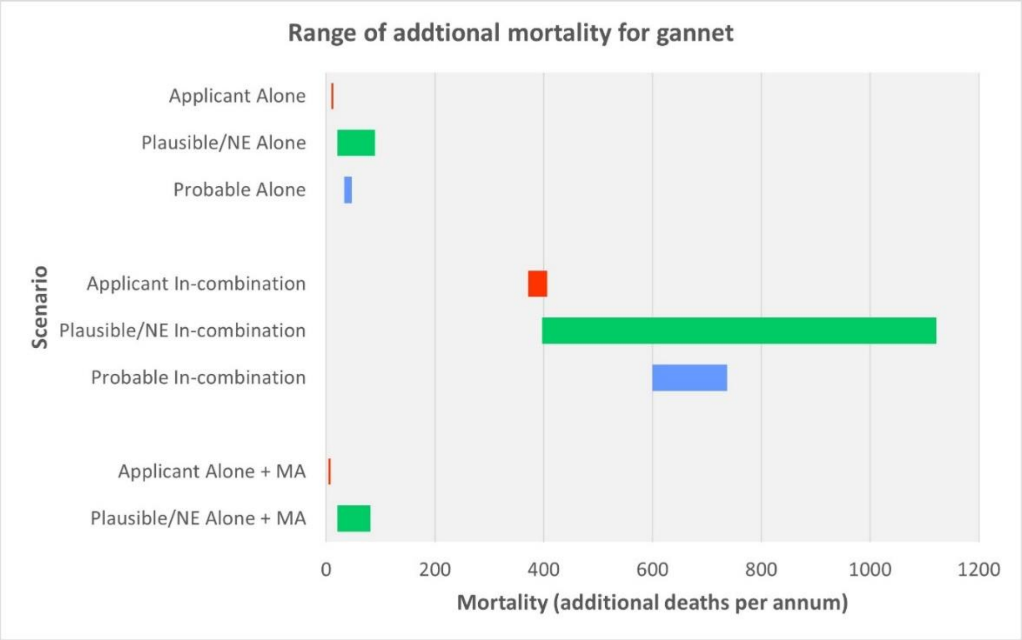
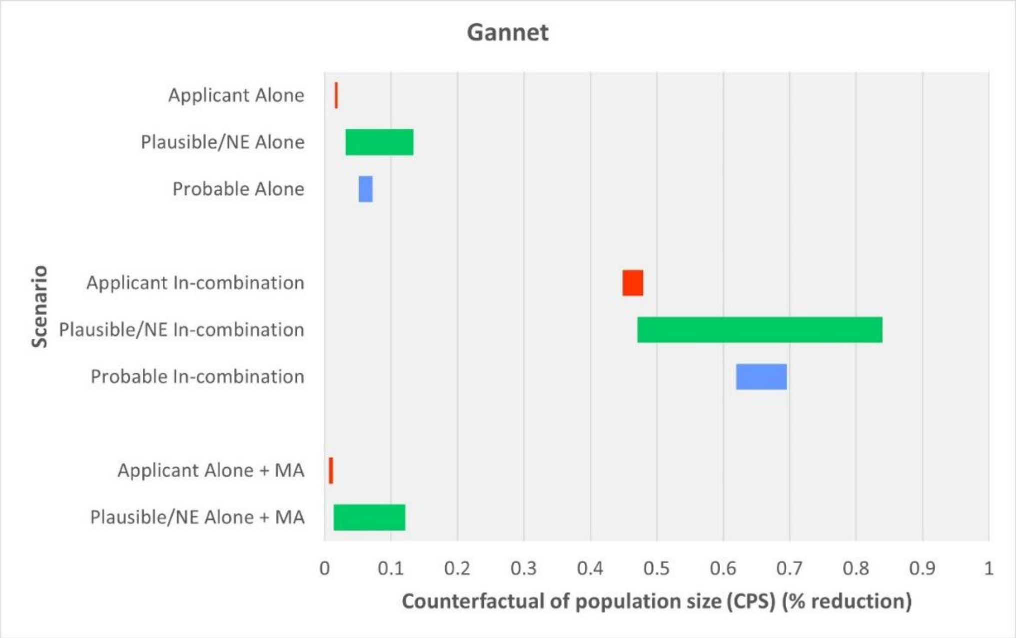


Figure 2. The predicted percentage reduction in impacted population size relative to unimpacted population size (CPS) of gannet apportioned to the Flamborough and Filey Coast SPA arising from Hornsea Project Four alone and in-combination, over the lifetime of the development, presented as ranges using the Applicant's approach, the plausible range and the probable range of displacement and mortality rates combined with collision mortalities.



Kittiwake

Table 2. The predicted annual collision mortality of kittiwake apportioned to the Flamborough and Filey Coast SPA arising from Hornsea Project Four alone and in-combination and the consequent percentage decrease in impacted population size relative to unimpacted population size (CPS) Derived from tables 85, 86 and 118 of REP6-029 Ornithology EIA and HRA Annex.

	Project alone			In combination		
	Applicant	NE	RSPB	Applicant	NE	RSPB
Mortality	23.3	71.4	71.4	364.3	412.4	412.4
CPS (%)	1.0	**3.0**	3.0	14.6	**16.4**	16.4

7.7. These figures show, that for **gannet**, the additional mortality predicted to arise through displacement and collision combined will result in the Flamborough and Filey Coast SPA population being a probable **5.2-7.2%** lower after the lifetime of Hornsea Project Four wind farm than it would be without the development, and **62.0-69.6%** lower in-combination with other developments, although plausibly it could be as much as 13.4% lower through the project alone, and 83.9% in combination.

7.8. For **kittiwake**, the additional mortality predicted to arise through collision will result in the Flamborough and Filey Coast SPA population being a probable **3.0%** lower after the lifetime of Hornsea Project Four wind farm than it would be without the development, and **16.4%** lower in-combination with other developments.

7.9. The magnitude of these figures, in comparison to those suggested by the Applicant, has implications for any resulting compensation requirements, and whether the currently proposed measures are capable of meeting this scale of impact (see section 3 of RSPB REP6-069 for further discussion on this matter).

Appendix 1: Gannets present at colony in September

Photograph of Northern Gannets (adults and juveniles) present at colony on Bass Rock on 20 September 2019