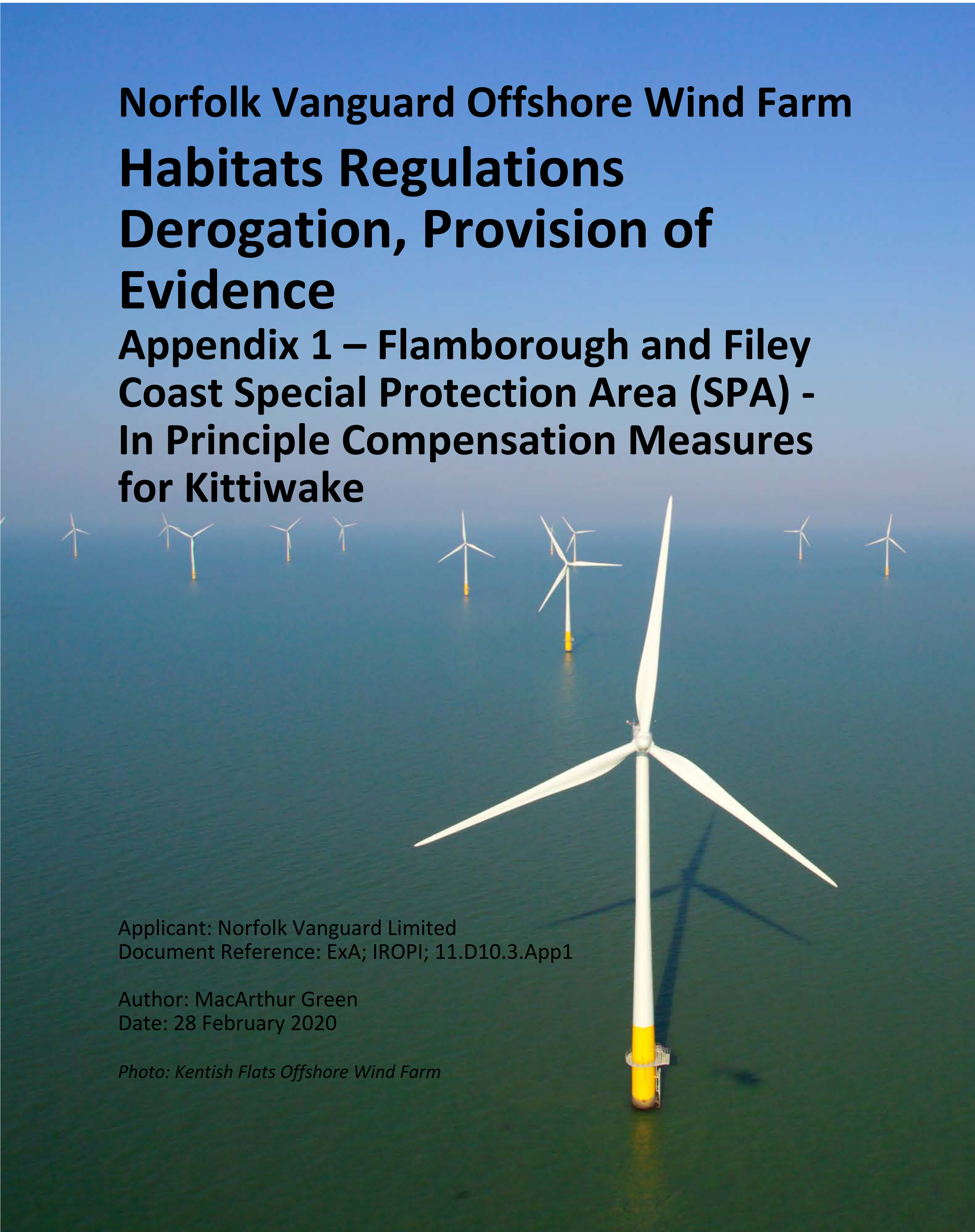
Norfolk Vanguard Offshore Wind Farm

Habitats Regulations Derogation, Provision of Evidence

Appendix 1 – Flamborough and Filey Coast Special Protection Area (SPA) - In Principle Compensation Measures for Kittiwake



Applicant: Norfolk Vanguard Limited
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Photo: Kentish Flats Offshore Wind Farm

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1 INTRODUCTION

1.1 Background

1. In response to a letter from the Department for Business, Energy and Industrial Strategy (BEIS) (dated 6 December 2019), Norfolk Vanguard Limited ('the Applicant') is proposing to implement further mitigation measures from those set out during the Examination in order to *"lessen or avoid"* any adverse effects of Norfolk Vanguard Offshore Wind Farm ('the Project') on kittiwake at Flamborough and Filey Coast (FFC) Special Protection Area (SPA).

2. This mitigation is detailed in full in the Additional Mitigation document (document reference ExA; Mit; 11.D10.2, submitted 28 February 2020) and updated collision risk modelling based on these commitments is provided in Appendix 1 of the Additional Mitigation (document reference ExA; Mit; 11.D10.2.App1).

3. This additional mitigation results in the collision risk for kittiwake being reduced by up to 50% compared with those figures presented for the final wind farm design submitted during the Project Examination (AS-049) and up to 85% compared with the original DCO application.

4. As stated during the Development Consent Order (DCO) Examination, and in light of this additional mitigation, the Applicant firmly maintains that there is no Adverse Effect on Integrity (AEoI) for this site as a result of the Project alone and in-combination however, it is noted that the BEIS letter also makes reference to a potential derogation case, albeit "*In addition, or alternatively,...*" to any mitigation. The letter states:

   "In addition, or alternatively, the Applicant, in consultation with Natural England as necessary, is invited to provide evidence as to:

   - *whether there are any feasible alternative solutions to the Norfolk Vanguard project which could avoid or lessen any adverse effects on the integrity of these sites;*
   - *any imperative reasons of overriding public interest for the Norfolk Vanguard project to proceed; and*
   - *any in-principle compensatory measures proposed to ensure that the overall coherence of the network of Natura 2000 sites is protected."*

5. This document therefore outlines in-principle compensatory measures that could be developed should the Secretary of State (SoS) conclude AEoI on the qualifying kittiwake feature of the FFC SPA.

6. Following the considerable reductions in the predicted impacts from the Project as a result of additional mitigation, the Applicant firmly maintains the position presented during the Examination, and updated in this document, that in respect of the FFC SPA, an AEoI as a result of the Project alone and in-combination can be ruled out beyond reasonable scientific doubt.

1.2 Purpose of this Document

1.2.1 Context

7. The Applicant notes that the letter from BEIS requests "*in-principle*" compensatory measures. This document therefore provides a review of a range of potential measures that could be adopted to compensate for the potential effects on collision risk for kittiwake at the FFC SPA. This range of compensation measures has been discussed with Natural England (NE) and the Marine Management Organisation (MMO) (as detailed in Section 1.2.2 below) and their feedback incorporated where appropriate.

8. However, it should be noted that the Applicant does not believe that any compensatory measures will need to be progressed due to the delivery of specific mitigation measures committed to by the Applicant which provide certainty that AEoI on the FFC SPA can be avoided. Therefore, the provision of evidence regarding in principle compensation measures is entirely without prejudice to the Applicant's position that there will be no AEoI on the FFC SPA.

9. In addition, the advantages and inherent compensation which renewable energy provides for the features of the Natura 2000 network should not be forgotten; with climate change representing the key pressure for a wide range of features. The RSPB identifies climate warming as a major threat to kittiwakes. They state "*higher kittiwake breeding success was associated with lower sea surface temperatures during the breeding season*"… "*climate change therefore poses a longer-term threat to kittiwakes*" and "*if they are to have any hope, it's critically important that we act on climate change*".[1] The recent EU funded SEANSE project has assessed the impact of climate change on key bird species (Rijkswaterstaat Zee & Delta, 2020) and concluded that changes in prey availability due to climate change is the current pressure which appears to have the largest impact on kittiwake at the wider North Sea level. This is likely to be responsible for a substantially greater effect than impacts resulting from any other activity (including collision risk). Hence, the benefits

[1] https://www.rspb.org.uk/our-work/conservation/projects/impacts-of-climate-and-oceanographic-change-on-seabirds/; https://www.rspb.org.uk/about-the-rspb/about-us/media-centre/press-releases/kittiwake-joins-the-red-list-of-birds-facing-risk-of-global-extinction/

of the Project would clearly outweigh the harm, although it is recognised that these are extremely challenging to quantify and, therefore, these benefits are the focus of the Imperative Reasons of Overriding Public Interest (IROPI) case (discussed in Habitats Regulations Derogation Provision of Evidence, document reference ExA; IROPI; 11.D10.3).

1.2.2 Consultation

10. The Applicant has undertaken extensive consultation with NE and the MMO in response to the BEIS letter, as outlined in the Consultation Overview (document reference ExA; Consult; 11.D10.3).

11. In relation to compensatory measures, draft in principle compensatory measures were provided to NE and the MMO on 17 January 2020 in order to seek guidance on the effectiveness of the potential compensatory measures identified by the Applicant; in particular whether they would be sufficient to ensure that the overall coherence of the Natura 2000 network is protected.

12. A workshop was held between the Applicant, NE and the MMO on 23 January, which included discussion regarding compensatory measures, in particular:

- Whether an AEoI would in fact arise in practice due to the Project.
- How to compensate for a conclusion of AEoI based on uncertainty and a highly precautionary assessment.
- Proportionality: the extent to which any compensatory measures are necessary for NV alone; and
- Proposals and timescales for the implementation and establishment of any potential compensation.

13. Written feedback was received from NE on 4 February and this has been taken into account in this document.

1.2.3 This document

14. Following this introduction, Section 2 of this document provides a description of the FFC SPA.

15. Section 3 quantifies the predicted effect of the Project on the FFC SPA.

16. Section 4 considers the guidance on compensation and sets out in principle compensation measures for Norfolk Vanguard and the FFC SPA, including how these measures may be secured.

2 FFC SPA

2.1 Overview

17. Flamborough and Filey Coast SPA covers an area of 7,858ha and is located on the Yorkshire coast between Bridlington and Scarborough. The SPA is in two sections: the southern section extends north from South Landing around Flamborough Head to Speeton; the northern section covers the peninsula of Filey Brigg before extending north west to Cunstone Nab. The seaward boundary extends 2km throughout the two sections of the site into the marine environment, running parallel to the landward boundaries to include the adjacent coastal waters. The SPA includes the RSPB reserve at Bempton Cliffs, the Yorkshire Wildlife Trust Flamborough Cliffs Nature Reserve and the East Riding of Yorkshire Council Flamborough Head Local Nature Reserve.

18. The site description indicates that the Flamborough and Filey Coast SPA qualifies under Article 4.2 of the Birds Directive (2009/147/EC) by supporting over 1% of the biogeographical populations of four regularly occurring migratory species and a breeding seabird assemblage of European importance: kittiwake 44,520 pairs (89,040 breeding adults, 4 year average 2008-2011); gannet 8,469 pairs (16,938 breeding adults, 2008-2012); guillemot 41,607 pairs (83,214 breeding adults, 2008-2011) and razorbill 10,570 pairs (21,140 breeding adults, 2008-2011). In addition, the SPA supports a breeding seabird assemblage of 216,730 individuals (average 2008-2012).

19. The Flamborough and Filey Coast SPA replaced the Flamborough Head and Bempton Cliffs SPA. The trend in the kittiwake population for this site has been subject to discussion and disagreement between seabird experts (e.g. John Coulson) and the Statutory Nature Conservation Bodies (SNCBs). At the time of citation, the Flamborough Head and Bempton Cliffs SPA was thought to support 83,370 breeding pairs of kittiwakes (2.6% of the breeding Eastern Atlantic population) (count as of 1987). However, there were 37,617 kittiwake pairs or 75,234 breeding adults recorded in 2008 (JNCC Seabird Colony Register). The citation (JNCC 2011b) notes that the SPA designations were reviewed in 2000, at which point kittiwakes were the only notified feature of the site. There is some uncertainty as to whether there were ever as many as 83,370 pairs of kittiwakes at this site; this number has been challenged repeatedly by the world's leading expert on kittiwake biology (Coulson, 2011), most recently by noting that this colony should have been increasing in numbers based on monitoring data on its productivity. The apparent decline from 83,370 pairs in 1987 to 37,617 pairs in 2008 does not correspond with population trajectories elsewhere based on the influence of productivity on population change (Coulson 2017). Recent counts by RSPB indeed show a small increase in kittiwake

breeding numbers in the years since 2008 (RSPB data), as predicted by Coulson (2017).

20. This site does not support any priority habitats or species.

2.2 Conservation Objectives

21. The Conservation Objectives for the site are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- the extent and distribution of the habitats of the qualifying features;
- the structure and function of the habitats of the qualifying features;
- the supporting processes on which the habitats of the qualifying features rely;
- the populations of each of the qualifying features; and
- the distribution of the qualifying features within the site.

22. Natural England has stated the target is to restore the size of the breeding population at a level which is above 83,700 breeding pairs, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

3 QUANTIFICATION OF EFFECT ON THE FFC SPA

3.1 Summary of Revised Collision Risk Modelling

3.1.1 Norfolk Vanguard alone

23. At the close of the project examination the wind farm design comprised 180 x 10MW turbines with a minimum draught height (the gap between the lower rotor tip and the sea level at Mean High Water Springs, MHWS[2]) of 27m, which was a refinement from the DCO submission which was based on 200 x 9MW turbines with a draught height of 22m (from MHWS).

24. Following the close of examination, Norfolk Vanguard has undertaken further investigations into the design envelope and has now committed to additional design restrictions in order to further reduce the predicted collision risks. Additional mitigation proposed by the Applicant is detailed in full in the Applicant's Additional Mitigation report (ExA; Mit; 11.D10.2).

25. In summary, this includes the following measures:

- Reduced maximum number of turbines from 180 to 158 by increasing the minimum turbine size from 10MW to 11.55MW; and
- Increased draught height:
  - Minimum draught height increased from 27m to 35m (above MHWS) for turbine models of up to and including 14.6MW capacity; and
  - Minimum draught height increased from 27m to 30m (above MHWS) for turbine models of 14.7MW and above.

26. The worst case turbine option (with respect to collision risk) is the 14.7MW turbine and the following summary of collision risks is for this turbine.

27. Using Natural England's preferred CRM parameters, the annual kittiwake mortality apportioned to the Flamborough and Filey Coast SPA has reduced from 44 individuals to 21 (this update has been agreed by Natural England), while using the Applicant's preferred parameters the reduction is from 9.6 to 4.6 individuals (the

[2] It should be noted that in documents reporting on collision risk modelling submitted for Norfolk Vanguard prior to Deadline 8 (AS-049) rotor draught heights were given in relation to Highest Astronomical Tide (HAT) while subsequent ones were given in relation to Mean High Water Springs (MHWS). As was noted in AS-049, this was an error in labelling only, with HAT mistakenly used in place of MHWS. The tidal offset used in the collision risk modelling to adjust to Mean Sea Level (MSL) was the same throughout and should have been stated as relating to MHWS from the outset. It is important to state that the draught heights presented for the project through the course of the application, examination and in the current submission (i.e. 22m, 27m, 30m and 35m) have at all times been in relation to MHWS.

Applicant has derived these parameters from a robust analysis of available evidence).

28. Thus, the worst case scenario of a 14.7MW turbine at 30m has predicted collision risks which are over 50% lower for kittiwake compared with the estimate submitted at the close of the project examination for the 10MW turbine at a draught height of 27m (REP7-062) and up to 85% compared with the original DCO application.

29. Natural England has agreed with the Applicant that impacts for the Project alone do not cause any adverse effects on integrity (AEoI) on any SPA population, and therefore the request for compensation is not with respect to Norfolk Vanguard alone.

3.1.2 In combination

30. The in-combination total kittiwake collisions assigned to the Flamborough and Filey Coast SPA from all wind farms predicted to have connectivity are provided in ExA; Mit; 11.D10.2.App1.

31. Using the Applicant's estimate for Norfolk Vanguard of 4.6, the total in-combination kittiwake collision risk for the Flamborough and Filey Coast SPA population is estimated to be between 684 (including the estimate for Hornsea Project Three which Natural England have advised the Applicant to use and the Preliminary Environmental Impact Report estimate for Hornsea Project Four) and 346 when the two Hornsea projects are omitted (which Natural England advised the Applicant to present). If the Natural England estimate of 21 is used, these figures are 701 and 362 respectively.

32. Therefore, Norfolk Vanguard's contribution to the total using Natural England's figures is between 5.8% (=21/362) and 2.9% (=21/693) and using the Applicant's figures is between 1.3% (=4.6/346) and 0.6% (=4.6/684).

33. The Applicant has presented further analysis of the potential impact of the in-combination mortality which clearly concludes there will be no adverse effect on the integrity of the FFC SPA due to in-combination kittiwake mortality (ExA; Mit; 11.D10.2.App1).

34. The Project impacts are now reduced to very small levels and the contributions of the Project to in-combination impacts are also very small. Indeed, as presented in the Ornithology Position Statement (ExA; Pos; 11.D10.2), Norfolk Vanguard's predicted mortality of kittiwake from Flamborough and Filey Coast SPA (using Natural England's precautionary figure of 21) is lower than those for several

consented offshore wind farms including Hornsea Project One, Dogger Bank Creyke Beck A and B, Dogger Bank Teesside A and B and Triton Knoll.

35. Furthermore, the impacts from the Project are more than offset by the reductions in in-combination totals currently locked up in the available headroom, created by the difference between assessed, consented and as built schemes.

36. On this basis, the Applicant firmly maintains the position presented during the Examination, as supplemented in this submission, that in respect of these designated sites, an in-combination AEoI can be ruled out beyond reasonable scientific doubt for all relevant designated sites.

37. The contribution to the in-combination total from Norfolk Vanguard must also be taken into consideration with respect to the scale and timescale for delivery of compensation measures.

4 COMPENSATION

4.1 Guidance

38. Following a conclusion by the Competent Authority that, following Appropriate Assessment, an AEoI on a Natura 2000 site(s) cannot be ruled out, that there are no alternative solutions and that there are IROPI, Article 6(4) of the Habitats and Wild Birds Directives "*requires that all necessary compensatory measures are taken to ensure the overall coherence of the network of European sites as a whole is protected.*"

39. DEFRA (2012) and EC (2012 and 2018) explain that for SPAs, the overall coherence of the Natura 2000 Network can be maintained by:

- compensation that fulfils the same purposes that motivated the site's designation;
- compensation that fulfils the same function along the same migration path; and,
- the compensation site(s) are accessible with certainty by the birds usually occurring on the site affected by the project.

40. The guidance provides an element of flexibility, recognising that compensation of a 'like for like' habitat and/or in the same designated site may not be practicable.

41. Compensation should not be used to address issues that are causing designated habitats or species to be in an unfavourable condition. This is the responsibility of the UK Government.

42. Ideally, compensation should be functioning before the effect takes place, although it is recognised that this may not always be possible, as stated in the EC (2012) guidance: "*in principle, the result of implementing compensation has normally to be operational at the time when the damage is effective on the site concerned. Under certain circumstances where this cannot be fully fulfilled, overcompensation would be required for the interim losses*."

43. In line with the guidance, indicative compensation options for collision risk to kittiwake at the FFC SPA are summarised in Table 4.1 and could include:

- Prey enhancement;
- Predator control / mortality reduction; and
- Productivity improvement.

4.2 Review of Potential Compensation Measures – Measures suggested in the DEFRA report

44. In a report to Defra, Furness et al. (2013) suggested possible measures that could improve the conservation status of UK seabird populations. These are summarised for kittiwake in Table 4.1.

Table 4.1 Measures listed in the Defra report (Furness et al. 2013) to improve conservation status of kittiwake at colonies throughout the UK

Type of measure	Suggested method plus in parentheses comments on suitability in relation to the key SPA population
Prey enhancement	Closure of sandeel and sprat fisheries close to SPA colonies; (sandeels are the key breeding season prey of kittiwakes at FFC, but sprats do not occur in diet of North Sea kittiwakes (but are taken by kittiwakes breeding in the Irish Sea)
	Purchase of sandeel fishery quota (as above sandeels are the key breeding season prey of kittiwakes at FFC)
Predator control / mortality reduction	Eradicate American mink (not a pressure at FFC)
	Eradicate feral cats (not a pressure at FFC)
	Eradicate rats (not a pressure at FFC)
	Exclusion of foxes from colonies (not a pressure at FFC)
	Exclusion of great skuas from around colonies (not a pressure at FFC)
Productivity improvement	Artificial structures to support colonies (not appropriate at FFC but could be effective at sites in southern North Sea close to sandeel feeding grounds and distant from FFC)

45. Only some of the measures presented in Table 4.1 would be appropriate for the focal SPA populations of Flamborough and Filey Coast SPA for reasons summarised in Table 4.1 and detailed further in the following sections. In addition, knowledge of seabird ecology has advanced in the six years since publication of the Defra report so the suitability of these measures requires further consideration in relation to new evidence.

4.3 Prey enhancement

46. Two mechanisms seem suitable to achieve this long-term, strategic compensation, as described below; closure of a defined area for sandeel fishing and purchase of sandeel fishery quota.

4.3.1 Closure of sandeel fishing to benefit kittiwakes at Flamborough and Filey Coast SPA

4.3.1.1 Overview

47. In particular, since 2013, understanding of the impact of sandeel fishing on the stock of sandeels most relevant to the kittiwakes at Flamborough and Filey Coast SPA has improved considerably. There is now a clearer understanding of the impact of fishing

effort on sandeel stock size and on the impact of sandeel stock size on breeding success of kittiwakes at FFC SPA. That has identified that changes in fishery management to reduce fishing mortality imposed on the stock would permit this stock to recover from heavy exploitation. This would increase breeding success of kittiwakes at FFC SPA.

48. During the breeding season, kittiwakes breeding at colonies around the North Sea feed mainly on sandeels (Furness and Tasker 2000, Coulson 2011). Sandeel abundance strongly influences breeding success of kittiwakes, and breeding success strongly influences whether kittiwake colonies increase or decrease in breeding numbers (Coulson 2011, 2017). In Shetland, kittiwake breeding success, and breeding numbers, crashed after the collapse of the Shetland sandeel stock (Furness and Tasker 2000). Kittiwake breeding success has also been affected at the Isle of May, off east Scotland, when the sandeel stock in that area (which is distinct from the sandeel stocks at Shetland or in the southern North Sea; Frederiksen et al. 2005; ICES 2019) was heavily fished (Frederiksen et al. 2004). Sandeels (specifically Ammodytes marinus) are the target of what has been the largest single-species fishery in the North Sea over recent decades. Kittiwakes at Flamborough and Filey Coast SPA forage over a large area from that colony, and their foraging area includes some of the most important sand banks supporting high densities of sandeels and the sandeel fishery (Carroll et al. 2017). There is strong evidence, summarised below, that the sandeel fishery has caused depletion of sandeel biomass in this region (Lindegren et al. 2018), and that reduced abundance of sandeels as a result of the high fishing effort on sandeels has led to reduced breeding success of kittiwakes at Flamborough and Filey Coast SPA (Carroll et al. 2017). Reducing the level of fishing effort on sandeels, or closing the fishery in waters close to the colony, would, therefore, represent mechanisms to improve breeding success of kittiwakes at that colony by making it possible for the biomass of the sandeel stock to recover from the high fishing mortality that has been imposed in recent decades. Such reduction would be anticipated to lead to rapid recovery of sandeel abundance. Sandeel is a short-lived fish which starts to breed when only 1 or 2 years old, with high reproductive potential, and since kittiwakes will feed on all age classes of sandeels but especially on 1 and 2 year old sandeels, the increase in sandeel abundance would be likely to influence kittiwake breeding success with a time lag of only 1 or 2 years.

49. There is very clear evidence that reduction in the abundance of sandeels can cause a reduction in breeding success of kittiwakes, and that large reductions in sandeel abundance result in breeding failure of kittiwakes and population decline (Furness and Tasker 2000, Oro and Furness 2002, Frederiksen et al. 2004, Furness 2007, Carroll et al. 2017). It is however more difficult to demonstrate the benefits of

closing a fishery on sandeel abundance because closure of a fishery is usually accompanied by ending of the monitoring of sandeel abundance. At Shetland, the local sandeel fishery closed in 1990, and immediately after the fishery was closed, sandeel recruitment was particularly high in 1991, but it is not clear that this was a consequence of the closure of the fishery. Subsequently, sandeel abundance at Shetland has not been monitored in any detail, but there has been little evidence of any further recovery of sandeel abundance at Shetland, possibly due to increases in abundance of adult herring which feed on the scarce larval sandeels (Frederiksen et al. 2007), and climate change reducing the productivity of the small numbers of sandeels remaining in the area (Wright et al. 2018).

50. Frederiksen et al. (2004) showed that breeding success of kittiwakes at the Isle of May (part of Forth Islands SPA) was on average 0.5 chicks per pair lower during years when sandeel fishing occurred in the area than it was in years with no sandeel fishing. A decision was taken to close an area to sandeel fishing (the ‘sandeel box’ off the east of Scotland) because of persistent low breeding success of kittiwakes indicative of the poor condition of the sandeel stock in the area. The consequence of that closure was monitored. Closure of the fishery resulted in an increase in sandeel stock biomass (Greenstreet et al. 2006) and an increase in kittiwake breeding success at colonies within the closed area compared to those outside (Daunt et al. 2008, Frederiksen et al. 2008), providing experimental evidence for the mitigation of fishery impact by closing the fishery. Recovery of sandeel abundance in the closed area has led to the sandeel fishing industry seeking the opportunity to resume fishing within the closed area, but until now the regulator has retained this closed box, although fishing for sandeels has occurred right up to the offshore (eastern) edge of the closed box.

51. Closure of the sandeel fishery off east Scotland also altered the age structure of the sandeel population. When the stock was heavily fished, very few sandeels lived beyond two years old, resulting in high variability on stock abundance from year to year depending on the highly variable level of production of young fish. When the fishery was closed, sandeels tended to live longer, with large cohorts remaining in the stock for up to six years (Peter Wright, pers. comm.). The longer life expectancy of sandeels when not subject to fishing not only increases mean biomass of the stock, but also reduces variability in abundance driven by variable recruitment. This in turn will also be beneficial to kittiwake breeding success, by ensuring that even if recruitment is poor, the biomass of the stock is buffered by presence of older age classes of fish.

52. Breeding success of the Flamborough and Filey Coast SPA kittiwake population was 1.2 chicks/pair in 1986-1990, but fell to about 1 chick/pair in 1990-2010 and to 0.8

chicks/pair in 2010-2014, with that reduction largely being attributable to high fishing mortality of sandeels especially at Dogger Bank but also generally in the southern North Sea, resulting in a reduction in sandeel abundance (Carroll et al. 2017). The productivity of kittiwakes at Flamborough and Filey Coast SPA is significantly correlated with sandeel stock biomass. The relationship found by Carroll et al. (2017) for kittiwakes at Flamborough and Filey Coast SPA in relation to sandeel stock in ICES (International Council for the Exploration of the Sea) North Sea sandeel management Area 1 ('Dogger Bank' and neighbouring areas) is similar to that previously identified elsewhere: kittiwake breeding success and adult survival at Shetland was closely related to changes in sandeel stock biomass in that area (Furness and Tasker 2000, Oro and Furness 2002, Furness 2007), and kittiwake breeding success at the Isle of May was strongly influenced by effects of sea surface temperature and sandeel fishing on the sandeel stock off the Firth of Forth, east Scotland (Frederiksen et al. 2004).

53. Lindegren et al. (2018) carried out a hindcast analysis of the Dogger Bank sandeel stock to assess the consequence of the high fishing mortality. They estimated that sandeel spawning stock biomass would have been about twice as large now as it is, if the fishery had maintained fishing mortality (F) at F=0.4 rather than at the levels of F=0.8 to 1.2 as seen during 1999-2009 in the history of this fishery. Indeed, the stock would be even larger now if there had been no fishery harvesting sandeels, although Lindegren et al. (2018) did not report on that scenario. However, their results further support the conclusion that the high fishing mortality imposed on the sandeel stock has been a major influence on the abundance of the sandeel, and hence on the breeding success of kittiwakes. Lindegren et al. (2018) also identified influences of sea temperature and copepod abundance on the abundance of sandeels, and suggested that long term trends in those drivers may inhibit recovery of sandeels if fishing pressure was reduced.

54. At present, the sandeel stock remains considerably below its long term average abundance, and is subject to a fishing mortality around F=0.6 (ICES 2018), a figure above the level tested in the scenario of Lindegren et al. (2018), and a figure which their scenario modelling clearly demonstrates has a negative impact on sandeel abundance. Indeed, at present the spawning stock biomass in this area is at an unusually low level of 97,636 tonnes in 2019, which is less than 10% of its highest historical level and is slightly below the limiting spawning stock biomass at which ICES should recommend closure of the fishery (Blim of 110,000 tonnes SSB) because there is an increased risk of recruitment failure in this stock (ICES 2019).

55. Cury et al. (2011) used empirical evidence from several seabird-fishery interactions around the world to suggest that management should aim to keep food fish stocks

such as sandeels above a threshold of one-third of their historical maximum biomass in order to achieve good productivity among dependent seabird populations. The southern North Sea sandeel stock has fallen far below that rule of thumb management objective. This suggests that the continuation of sandeel fishery is likely to continue to cause mortality of many thousands of kittiwake chicks per year compared to a scenario with no fishing of the sandeel stock. It also identifies that the single most effective practical management action to assist the kittiwake population would be closure of the sandeel fishery (Carroll et al. 2017, Lindegren et al. 2018, Wright et al. 2018).

56. Mortality of chicks has less impact on the kittiwake population than the same mortality of adults. On the basis of the demographic parameters of kittiwakes in the North Sea (adult survival 0.854, juvenile survival 0.79, age of first breeding 4 years; Horswill and Robinson 2015), 4,000 fledglings would be expected to give rise to about 2,000 adults per year surviving to recruit into colonies at 4 years of age. If sandeel fishing reduced productivity by 20,000 chicks per year which appears to be approximately the scale of the impact indicated by the data for this region, that would be equivalent to nearly 10,000 adults per year surviving to recruit into colonies at 4 years of age.

4.3.1.2 Delivery Mechanism

57. Closure of a defined area for sandeel fishing was achieved off the east coast of Scotland, and has been successful in recovering sandeel abundance and kittiwake breeding success (although these have also been affected over the years by climate change). This is an example of where the EU Common Fisheries Policy (as discussed further below) has previously been used as a management measure; ICES advised closure of the area off east Scotland and the EU took that advice. Rather than complete closure of the fishery, it is also possible to promote a closed box under the Common Fisheries Policy.

58. ICES promotes ‘ecosystem-based management’ of fish stocks. However, their management of the sandeel stock has recently been criticised as not being ‘ecosystem-based’ because it sets a quota only on the basis of sustaining the sandeel stock and not on the basis of the needs of higher trophic level predators (such as kittiwakes) (Hill et al. 2019). ICES should be highly receptive to the need to better manage that sandeel stock to avoid adverse impacts on kittiwakes and other top predators.

59. The Common Fisheries Policy recognises that conservation measures which affect fishing interests may need to be adopted to comply with obligations in relation to

environmental legislation[3]. Member States are allowed to adopt measures which do not affect other Member States under their own legislation, e.g. through bylaws under Section 129 (promoted by the MMO) and Section 155 (promoted by Inshore Fisheries Conservation Authorities) of the MCAA 2009. However where conservation objectives would affect other Member States which have a direct management interest in the fishery, a joint recommendation must be made to the European Commission (EC) to adopt those measures. In summary, the process for a joint recommendation is as follows:

1. Informal consultation between Member States;
2. Initiating Member State to provide information to other Member States;
3. Member States to then submit a joint recommendation to the EC;
4. EC to check the recommendation is in line with existing legislation, undertake an assessment of the proposal, and adopt any necessary measures;
5. Period for objections; and
6. Publication of the joint recommendation in the EU official journal.

60. The UK Government is therefore required to promote the Joint Recommendation as the initiating Member State. The purpose of the joint recommendation process is to meet the obligations under Article 6 of the Habitats Directive. Article 6 requires the establishment of necessary conservation measures (including through management plans) and avoidance of the deterioration of natural habitats. However, EC Guidance[4] states that compensatory measures should be additional to the actions that are considered normal practice under the Habitats and Birds Directives or obligations laid down in EU law, including the standard measures required for designation, protection and management of Natura 2000 sites.

61. Whilst this compensatory measure would be analogous to the examples above, and could even be achieved simply by extending the existing closed area box southward to beyond FFC SPA, at present, no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK

[3] Articles 11 and 18 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy
[4] Managing Natura 2000 sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC – C(2018) 7621

Government in allocating appropriate powers to a relevant management body and, potentially, through the delivery of legislation to secure the necessary powers.

4.3.1.3 Spatial Scale

62. To compensate for a worst case of 21 kittiwakes from FFC SPA estimated to be killed by collisions each year at Norfolk Vanguard (applying Natural England's preferred methods which the Applicant considers include a very large degree of precaution), it would be necessary to increase fledgling production at FFC SPA by at least 42 fledglings per year (as about half of those will survive to reach breeding age). Since there are over 40,000 pairs of kittiwakes at FFC SPA, that compensation can be achieved by increasing breeding success by 0.00105 chicks per nest on average. The change in breeding success at this very large colony required in order to compensate for loss of a maximum of 21 birds per year is extremely small. The analysis by Carroll et al. (2017) suggests that if fishing mortality on the southern North Sea sandeel stock was reduced by 50%, kittiwake productivity would increase by at least 0.2 chicks per nest on average. That would be 190 times the compensation level required to offset any potential impact of Norfolk Vanguard.

63. It can therefore be concluded that reducing fishing mortality on sandeels may be an effective long-term, strategic compensation, but it would be very difficult to precisely achieve the small amount of proportionate compensation for Norfolk Vanguard and it would also be very difficult to measure the effect of the very small change required to compensate for loss of 21 birds.

64. In view of the large numbers of kittiwake chicks dying at Flamborough and Filey Coast SPA as a consequence of reduced abundance of sandeels due to fishing impacts, there is evidently scope for compensation through either reducing fishing effort directed at sandeels, or through closing areas within the main foraging range of this kittiwake population to sandeel fishing.

4.3.1.4 Timescale

65. There is some evidence to suggest that recovery of sandeel stocks may be slow, or incomplete, as a consequence of other ecological factors (for example the effects of climate change on zooplankton on which sandeels feed, such as large copepods, and the recovery to high abundance of predatory fish such as cod, hake, haddock and whiting that eat sandeels) and impacts of climate change (Lindegren et al. 2018). Therefore, any compensation (in terms of improved stock biomass) on these grounds should aim to exceed the minimum suggested by the statistical relationship between sandeel total stock biomass and kittiwake productivity.

66. This therefore represents a long-term, strategic opportunity for compensation for all relevant offshore wind farms with a cumulative/in-combination impact on North Sea

kittiwake populations, as an increase in breeding success equivalent to the loss of 10,000 adult kittiwakes per year could be achieved by closing areas of sandeel fishery in UK waters, and this is considerably greater than the worst case cumulative impact estimated for all UK offshore wind developments on kittiwake in the North Sea.

4.3.1.5 Monitoring

67. The breeding success of kittiwakes at FFC SPA is already monitored, so the consequence of adjusting sandeel fishing effort would be visible from the long-term data on kittiwake breeding success. Breeding success is also already monitored at other colonies that are distant from the southern North Sea sandeel stock and the productivity of those colonies would provide some baseline data against which to compare FFC SPA productivity. However, there would be no ideal ‘control’ for this manipulation. Similarly, sandeel stock biomass is assessed annually by ICES. There is no ‘control’ site in that case either, but population modelling (Lindegren et al. 2018) provides strong evidence of the changes resulting from adjustment of fishing effort. By such mechanisms it would therefore be possible to monitor the effectiveness of this compensation.

4.3.1.6 Feasibility

68. As noted above, at present no authority has the jurisdiction to deliver fisheries management areas as compensation. An extension to a proposed fisheries management area or a new proposal would need to be facilitated by the UK Government in allocating appropriate rights to a relevant management body and, potentially, through the delivery of legislation to secure the necessary rights. The feasibility of this measure is, therefore, currently uncertain and so the Applicant would not propose to progress this option.

4.3.2 Prey enhancement -Purchase of sandeel fishery quota

4.3.2.1 Overview

69. A second, long-term strategic option would be for developers to purchase quota for sandeel, in order to reduce the catch taken by the fishery.

4.3.2.2 Delivery mechanism

70. The fishery quota is held entirely by Danish fisheries interests, so purchase of quota may or may not be possible. However, the ability of the Applicant to purchase fishing quotas would be dependent on fishermen with appropriate quotas being willing to sell.

4.3.2.3 Spatial scale

71. The extent to which fishing effort needs to be reduced to compensate for loss of 21 kittiwakes is very small. Coulson (2011) reported that prior to fledging, chicks were fed around 3kg of fish. The North Sea sandeel fishery total annual landings is currently around 500,000 tonnes. Therefore, allowing for the fact that approximately half of fledged chicks reach adult recruitment age, the amount of sandeel prey required to raise 42 chicks to fledging is approximately 126kg, which is an extremely small proportion of the total take (c. 0.00002%).

4.3.2.4 Timescale

72. The timescale would be dependent on the agreement reached with a seller if one could be found, but potentially this could be achieved prior to operation of the wind farm and would then be maintained for the duration of the wind farm’s operational life.

4.3.2.5 Feasibility

73. Due to the uncertainty associated with the acceptability and deliverability of this compensatory measure, the Applicant would not propose to progress this option.

4.4 Predator control / mortality reduction

4.4.1 Overview

74. Kittiwakes normally nest on narrow ledges of steep cliffs. Their nest sites are usually on the lower part of the cliff, often overhanging the sea. Coulson (2011) states ‘predation by mammals on kittiwakes is extremely rare’. Furness et al. (2013) reviewed JNCC Annual Reports of Seabird numbers and breeding success in Britain and Ireland (1986-2006) to extract information on causes of reduced breeding success at kittiwake colonies. Factors identified by JNCC were food shortage (43 cases), great skua predation (6 cases), extreme weather events (5 cases), gull predation (3 cases), mink predation (2 cases), peregrine predation (1 case), feral cat predation (1 case), fox predation (1 case), rat predation (1 case). The cases of predation by great skuas and gulls were mostly in Orkney and Shetland, where breeding success was low due to food shortage so adults left nests unattended. The few cases of predation by mammals were at St Abb’s Head (mink in 1999 and 2001), at an artificial colony on Lowestoft pier (fox in 2006), and at the Isles of Scilly (feral cat in 1998, rat in 1994).

75. Brown rats were eradicated from St Agnes and Gugh islands in the Isles of Scilly in 2013-14 (Heaney 2018). There were immediate signs of recovery and recolonization by seabirds that had been affected by rats. However, kittiwake breeding numbers on St Agnes have decreased since the eradication of rats; none bred there in 2017 or

2018. Kittiwake breeding numbers on Gugh fell to zero before the eradication of rats; 30 pairs bred there in 2017 and 35 pairs in 2018, but they fledged only 9 chicks in 2017 and none in 2018. Overall across the Isles of Scilly, kittiwake breeding numbers fell from around 70 pairs in 2010-2015 to only 30 and 35 pairs in 2017 and 2018. It was suggested that rats had an adverse effect on kittiwake breeding success in the Isles of Scilly in 1994 (Walsh et al. 1995). However, changes in kittiwake numbers and breeding success since eradication of rats from St Agnes and Gugh were not considered to be related in any way to absence of rats, but rather to be a response to a shortage of food for kittiwakes in the waters around the Isles of Scilly (Heaney 2018). Isles of Scilly are in the south-west of England, in a different marine ecosystem from the southern North Sea, and therefore the shortage of food inferred by Heaney (2018) in the area off Isles of Scilly does not indicate anything about food availability for kittiwakes in the southern North Sea.

4.4.2 Feasibility

76. Mammal predators were not recorded by JNCC at Flamborough & Filey kittiwake colonies in any year. Based on the national picture described above, and on the apparent absence of mammal predator impacts on kittiwakes at Flamborough & Filey it is unlikely that predator control would significantly increase breeding success of kittiwakes at Flamborough and Filey Coast SPA, because this colony is on large cliffs that give birds good protection from mammalian predators and disturbance.

77. Due to the highly doubtful benefit associated with this compensatory measure, the Applicant would not propose to progress this option.

4.5 Productivity Improvement - Construction of artificial nest sites

4.5.1 Overview

78. Provision of artificial nest sites for kittiwakes is one potential short term compensation mechanism. There is strong evidence that kittiwakes in the southern North Sea are limited by nesting habitat (Coulson 2011). The natural habitat for kittiwakes to nest is sea cliffs with narrow ledges, where the birds can place their nests on the cliff in a way that prevents other seabird species from taking over the nest sites (because other species require broader ledges than kittiwakes), and which makes their nest site relatively safe from predators. There is a lack of suitable cliffs (cliffs of solid rock with narrow ledges) for kittiwakes along much of the south-eastern coast of England. Seabird 2000 (Mitchell et al. 2004) found no kittiwakes breeding in Norfolk or Essex, and only 369 pairs in Suffolk (those birds all nesting on man-made artificial structures, and not in natural habitat). In contrast, the cliffs of Flamborough and Filey Coast in Humberside hold over 40,000 pairs of kittiwakes, the

largest colony of the species in the UK (Mitchell et al. 2004). Exceptionally large colonies occur only where there is little or no suitable nesting habitat elsewhere within the foraging range of seabirds from that colony (Furness and Birkhead 1984). This implies that provision of artificial nest sites in south-east England would be likely to attract kittiwakes to nest at sites where competition for resources would be less than at the exceptionally large colony of Flamborough and Filey Coast SPA.

79. Where a kittiwake colony is large there is strong evidence of density-dependent competition; for example, breeding adults have to travel further from the colony to seek food for their chicks (Wakefield et al. 2017). Breeding success, and possibly adult survival, may decrease as a result of density-dependent competition. Creating small new colonies in locations away from high levels of intra-specific competition (i.e. not at Flamborough and Filey Coast SPA, but at sites well away from that large colony) would be likely to increase breeding success of birds in new artificial colonies relative to that achieved in larger colonies, and providing breeding success averaged more than 0.8 chicks per nest these new colonies in artificial nest habitat would contribute to supporting the kittiwake regional population (Coulson 2017). This could boost productivity of the regional population.

80. Artificial nest sites used by kittiwakes exist in many places where there is a shortage of natural nesting habitat. In southeast England, kittiwakes have nested on the pavilion on the pier at Lowestoft (Brown and Grice 2005). When that pavilion was demolished in 1998-99, the kittiwakes subsequently took to nesting on a specially provided concrete wall, with numbers on the wall increasing to 259 pairs in 1995, more than double the number that had previously nested on the pavilion (Brown and Grice 2005). Kittiwakes have used the outfall structures of Sizewell nuclear power station as another nesting site in Suffolk where there are no natural cliff sites available. Kittiwakes nested in large numbers on several buildings beside the River Tyne over many decades, where they were the subject of detailed research (Coulson 2011). When individual buildings on which these birds nested were demolished, birds moved to use other buildings. There is a long-established kittiwake colony on the walls of the castle overhanging Dunbar harbour, where kittiwakes nest within a few metres of a busy fishing harbour. Kittiwakes have attempted to nest on a number of operational North Sea oil and gas platforms in UK waters, but have generally been discouraged from doing so on operational platforms for human health and safety reasons. Nevertheless, two pairs bred successfully on a gas platform off the Lancashire coast in 1998 and 1999 (Brown and Grice 2005), and kittiwakes have nested on several platforms in the Norwegian Sea and in the Barents Sea, where they have been tolerated by the oil company and workers. Indeed, at an oil production platform in north Norway where about 200 pairs of kittiwakes are now nesting on the platform, a new research study has just been started by

Norwegian ornithologists, equipping breeding kittiwakes with GPS tags to track their foraging trips from this platform in order to compare their breeding success and time budgets at this artificial colony with the performance of kittiwakes at coastal natural colonies; initial results suggest that the breeding success is higher on this platform because there is no predation or disturbance and the birds are close to preferred foraging grounds (Signe Dalsgaard, pers. comm.). Kittiwakes also nest on many coastal artificial structures such as wooden buildings or sheds at harbours in Norway and elsewhere across their range. For example, kittiwakes have nested for many decades on the wooden window ledges of warehouses on the rather flat island of Utsira, which lacks natural cliff habitat (Tveit et al. 2004). In Norway, breeding success of kittiwakes is higher at these 'urban' sites than at natural colonies because those birds are less at risk of predation and disturbance by natural avian predators such as ravens and white-tailed eagles (Signe Dalsgaard, pers. comm.).

81. Breeding success of kittiwakes on artificial structures can be just as high as at more natural sites in the UK too. Research on the kittiwakes nesting on buildings on the River Tyne showed that survival rates of adults and breeding success were higher than for some natural colonies because nest sites on the building were less vulnerable to predation or to disturbance by other species (Coulson 2011).

4.5.2 Delivery mechanism

82. The absence of suitable natural sites for kittiwakes to breed in the southern North Sea clearly limits their breeding numbers in that area. Despite the lack of nesting habitat, there are potentially good food supplies for kittiwakes in the southern North Sea (depending on how the sandeel stock is managed). Dogger Bank has the potential to hold a very large stock of sandeels, the main food of kittiwakes during the breeding season. Provision of artificial nesting structures for kittiwakes in the southern North Sea could allow kittiwakes to breed in places close to this high quality food resource, that is not possible at present because there are few suitable structures in areas away from human disturbance and mammal predators. Provision of suitable artificial nest sites in this region would not only be highly likely to attract kittiwakes, it would also be highly likely to support higher than normal breeding success where kittiwakes could nest, undisturbed and safe from predators and close to their preferred food supply.

83. The proposed approach would increase production of kittiwake chicks by providing novel nesting opportunities in the southern North Sea. Some of the extra chicks arising from such nest sites may not survive to replace breeding adults that may be lost from the population through collisions with offshore wind turbines, so the increase in numbers of chicks produced would need to take account of the demography of the species, and therefore the chances of surviving through to

adulthood. The survival rate of kittiwakes through their first year of life averages 79% while survival in subsequent years averages 85.4% (Horswill and Robinson 2015). Kittiwakes reach breeding age on average at four years of age (Horswill and Robinson 2015). This means that each kittiwake chick fledged has about a 50% chance of reaching the age of recruitment into the breeding population. Collision mortality is likely to affect all age classes of kittiwakes, and not just adults. However, it would be appropriate to aim for compensation that exceeded likely losses due to collision mortality. To achieve that, numbers of kittiwake chicks fledging from new artificial nest sites should be at least double the numbers thought likely to be killed by collisions.

84. A simple wall adjacent to the sea may be adequate, as shown at Lowestoft, in Dunbar and on the River Tyne, so constructing a suitable wall at the coast may be sufficient. There is, for example, a colony of about 700 pairs of kittiwakes on an artificial cliff constructed onshore adjacent to a road accessing the fish processing factory beside the harbour at Vanse in Norway. However, a greater benefit to kittiwakes may be possible if an artificial site could be provided at sea, close to their preferred foraging area. One option might be to use existing gas platforms that are due to be decommissioned, or offshore electrical platforms, as it is likely that kittiwakes would take to nesting on these structures if allowed to do so. There may be options to enhance the structure for kittiwakes, for example by providing narrow horizontal ledges, since kittiwakes would not normally choose to nest on large horizontal platforms where large gulls could land and walk up to a kittiwake nest. Large surfaces on platforms are likely to attract roosting herring gulls, lesser black-backed gulls and great black-backed gulls, all of which are predators on kittiwake eggs and chicks, so structures on a gas platform may require extensive modifications to make them suitable for kittiwakes and unsuitable for large gulls.

85. Compensation in the form of creating new nesting sites for kittiwakes would not be carried out at FFC SPA, as any effort to increase breeding numbers there would increase competition for food around that exceptionally large colony. However, creating new nesting sites (colonies) elsewhere in the southeast of England would benefit the regional population (the vast majority of which breeds at FFC SPA).

86. The Applicant would engage with Natural England and other relevant stakeholders in the process of site selection and it is expected this would take into account factors including current understanding on prey distributions, kittiwake foraging activity and the location of existing kittiwake colonies.

4.5.3 Spatial Scale

87. To compensate for the annual loss of the worst case predicted mortality of about 21 kittiwakes from FFC SPA due to collisions with turbines at Norfolk Vanguard, it would be desirable to achieve a colony of at least 200 pairs of kittiwakes breeding on novel structures and achieving a breeding success of around 1 chick per pair per year. That would produce 200 fledglings per year, of which the demographic data suggest about 100 would survive to become breeding adults. Part of that production would be required to support any potential additional losses from the population of 200 breeding pairs, but part would provide compensation for the 21 lost per year from collisions which are considered to be part of the SPA population. It is known that kittiwakes that fledge from one colony will often recruit to breed at another colony in the region, so birds from the new site will take up vacant nest sites elsewhere, including at the FFC SPA.

88. A colony of 200 pairs of kittiwakes would easily fit onto a structure such as a wall of 30 m length and 8 m height, or onto a steel lattice structure at sea that could be much smaller in length (e.g. all sides totalling 30m in length, because kittiwakes could nest on all four sides of such a structure), but would probably need to be considerably taller to ensure that kittiwakes could nest high enough above the sea surface to avoid waves during storms. On natural sites, kittiwakes prefer to nest on the lower parts of cliffs, relatively close to the water, rather than high up. However, they avoid areas where waves or sea spray may hit their nests.

89. Depending on the location of the artificial site and its proximity to wind turbines, there may be a risk that birds in the new colony are at risk of collisions themselves, thereby reducing the degree of compensation for the FFC SPA. As noted above, a colony of 200 pairs would be expected to produce an average of 100 adult recruits per year, which is five times the predicted Norfolk Vanguard mortality of FFC SPA birds. This ratio ought to be more than sufficient to allow for additional losses. However, if this was considered insufficient to guarantee the necessary level of compensation then the artificial site could readily be made 50% larger (e.g. 30m long and 12m high), allowing space for up to 300 pairs, which would produce 150 adult recruits, 7.5 times the FFC SPA losses and thereby ensuring an even bigger margin. It is proposed that the size of artificial structure be agreed once suitable structures have been identified and expert judgement used to determine the appropriate dimensions, calculated using the above considerations.

90. In order to maximise benefit to breeding kittiwakes, an artificial colony close to the key feeding areas on Dogger Bank and presenting narrow ledges on a steel structure which would not be suitable for large gulls to rest on (so avoids having any large horizontal open surfaces) would be the optimal solution. This could be a purpose-built structure, or might be adapted from an existing met mast or sub-station

platform or other platform (and indeed this could be informed by the research currently being carried out in north Norway which is studying the performance of kittiwakes that have been allowed to colonise an oil platform there). Alternatively, construction of a wall at a coastal site, preferably created so that its base is within the water at all stages of tide, with narrow ledges on the seaward side would also create an artificial structure for kittiwakes to nest on.

4.5.4 Timescale

91. Kittiwakes have been quick to use artificial structures when made available (for example in the Tyne they were encouraged to move from a building where they nested that was to be demolished and were given a new structure to move to), but if a site is created in an area away from existing colonies, the colonisation of the structure could be facilitated by placing some model kittiwakes on model nests and using playback of the sounds from an established kittiwake colony to attract potential recruits to the new site. Speed of colonisation of new sites may vary according to the status of the kittiwake population; novel sites are adopted faster where a population is growing rather than declining. However, experience from previous projects establishing artificial nest sites for kittiwakes has been that these have generally been occupied within the first three or four years after being made available. For example, a new oil platform recently set up in north Norway was colonised within four years by breeding kittiwakes, despite the fact that numbers breeding in natural sites in that region were declining (Signe Dalsgaard, pers. comm.).

4.5.5 Monitoring

92. The success of such a scheme would be monitored through observation of numbers and breeding success, the ease of which would depend on the location and accessibility of the structure (i.e. simple for an onshore location, but potentially requiring monitoring visits if offshore).

93. Monitoring effectiveness of artificial structures for kittiwakes would be straightforward; kittiwake nests are easy to count, and it is easy to see large chicks in nests during the latter part of the breeding season. The standard method of monitoring productivity of kittiwakes is to count numbers of large chicks in the nests once during mid-July, before chicks start to fly but when chicks are nearly ready to fly so can be expected to survive to fledging. This monitoring approach would be equally applicable to artificial colonies, although a colony on a gas platform might require the use of a drone to obtain views into nests, depending on how those were situated on the structure. Success would be easy to assess; productivity in excess of 0.8 chicks per nest on the artificial site would represent a net benefit to the regional

kittiwake population. Since kittiwakes in good breeding conditions can fledge an average of 1.5 chicks per nest (Coulson 2017), there is considerable scope for success to be achieved by provision of artificial nest sites. How many pairs of kittiwakes would colonise an artificial structure would be uncertain until tested, but evidence suggests that hundreds of pairs could do so, as seen on the walls in the River Tyne, Dunbar harbour, and Lowestoft.

94. Monitoring at Flamborough and Filey Coast SPA, similar to that already performed by the RSPB, would also be undertaken by the Applicant in order to consider if the new site had caused a redistribution of the population rather than an expansion. However, it should be noted that given the size of the SPA colony (c. 50,000 pairs), it is unlikely that variations at the scale of 200 pairs (the proposed size of the new colony) would be detectable.

95. It is also worth reiterating that it is anticipated that colonisation of additional nesting sites would occur within a few years (e.g. less than 5) and that this would be confirmed through regular monitoring. If the monitoring indicates that the measure is not providing the necessary degree of compensation then the longer term strategic option of making efforts to improve the availability of prey stocks (as discussed in section 4.3) could be taken forward.

4.5.6 Feasibility

96. The Applicant considers that provision of artificial nest sites to enhance kittiwake productivity is a feasible measure and further details are provided in Section 4.6. The cost of this measure would be met entirely by the Applicant.

4.6 Proposed Approach to Delivery of Compensation (if required)

97. If compensation is deemed to be required following the Appropriate Assessment, the Applicant proposes that provision of artificial nest sites would be the most appropriate measure to deliver compensation prior to the construction of Norfolk Vanguard.

98. The measures which would be undertaken by the Applicant to secure artificial nest sites are as follows:

1. Following consultation with Natural England, it is proposed to secure the construction of offshore artificial nest sites, so that they are constructed and available for use prior to first operation of any wind turbine generator forming part of the authorised development.
2. The nest sites would be located on a structure similar in size and form to a meteorological mast. This structure would be consented outside of the DCO

application for the Project, by way of a separate Marine Licence. A degree of flexibility may need to be retained in the details submitted to ensure the artificial nest sites approved aligned with the structure subsequently approved under the Marine Licence application. Alternatively, it may be possible to progress these applications in parallel. In any event, flexibility is also included in the condition to enable subsequent changes (from those approved) to be approved by the Secretary of State should this be necessary.

3. The artificial nest sites are likely to be constructed within the existing offshore Order limits for the Project. For example, the division of turbines between the east and west sites offers potential to locate the artificial nest sites away from turbines whilst within the Order limits, but this can only be considered once final layouts for the turbines have been progressed. Therefore flexibility would be retained to enable the precise location of the nest sites to be subject to approval by the Secretary of State (in consultation with the MMO and Natural England).

4. The exact number of nest sites to be provided would also be subject to approval by the Secretary of State. This is because it would be dependent on the final location chosen for the nest sites, with a higher number of nest sites required if the nest sites are located in closer proximity to the turbines. However, given the comparatively small number of nest sites envisaged (to support 200-300 pairs of kittiwakes), it is anticipated that these can be accommodated on a single steel lattice structure with all sides totalling approximately 30m in length. The new colony would be managed by the Applicant for benefit of the birds and would be subject to the same protections as those afforded a natural site within the UK.

5. The success of the compensation measures would be monitored through observation of numbers and breeding success.

4.6.1.1 DCO Condition

99. Schedule 17 of the draft DCO submitted on 28 February 2018 includes the following proposed condition to secure artificial nest sites as a compensatory measure if the Secretary of State is minded to conclude an AEoI on the FFC SPA.

98 (1) No later than 12 months prior to the commencement of any offshore works, details of the design, location, and number of artificial kittiwake nest sites to be provided, an implementation timetable including timescales for delivery of the artificial kittiwake nest sites, and proposals for monitoring and reporting on their *effectiveness, must be submitted to the Secretary of State for written approval, in consultation with the MMO and the relevant statutory nature conservation body.*

(2) The artificial kittiwake nest sites must be implemented as approved and suitable for use prior to first operation of any wind turbine generator comprised in Work No. 1, unless otherwise approved in writing by the Secretary of State.

(3) Results from the monitoring scheme required under sub-paragraph (1) including any proposals to address the effectiveness of the artificial kittiwake nest sites must be submitted to the Secretary of State, the MMO and the relevant statutory nature conservation body, and any proposals to address effectiveness must thereafter be implemented by the undertaker as approved in writing by the Secretary of State.

(4) The approved artificial kittiwake nest sites must be retained during the operation of the offshore generating station, unless otherwise approved in writing by the Secretary of State.

Summary

100. Table 4.2 provides a summary of the compensatory measures that have been reviewed by the Applicant in consultation with NE and the MMO.

101. While there is a range of potential measures to compensate collision risk to kittiwake at the FFC SPA, the Applicant considers that construction of artificial nest sites is the most deliverable within the timescales required for Norfolk Vanguard.

102. It is noted that compensation would only be required should the Secretary of State conclude that an AEoI on the kittiwake at the FFC SPA cannot be ruled out and support the Assessment of Alternative Solutions and IROPI case presented in the Applicant's Habitats Regulations Derogation Provision of Evidence (document reference ExA; IROPI; 11.D10.3).

Table 4.2 Summary of In Principle Compensation Measures

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
Prey enhancement	Partial or complete closure of sandeel fishery in the North Sea would improve fish stocks and evidence strongly indicates this would have a very large beneficial effect on FFC SPA kittiwake productivity (and also for other species which feed on sandeel).	✓ Define a closed area	✓ For practical reasons this would need to be an area much in excess of that required to compensate for the loss of 21 kittiwakes attributed to Norfolk Vanguard. For example, reducing fishery mortality by 50% (approximately equivalent to closing half the current area) has been estimated to provide 190 times as much improvement in productivity as required to compensate for Norfolk Vanguard. On this basis the Applicant considers this option is more suitable as a long term strategic measure covering the potential impacts for multiple wind farms.	✓ Long-term, likely requiring >5 years for effects to become apparent at the colony.	? Currently no authority has the jurisdiction to deliver fisheries management areas for the purposes of compensation. The feasibility of this measure therefore requires government intervention	x Due to the uncertainty in deliverability of this compensatory measure in the timescales required for the Project, the Applicant would not propose to progress this option
		✓ Purchase part of the existing fishery quota.	✓ Small scale required to compensate for loss of 21 kittiwakes due to Norfolk Vanguard (it is estimated that to increase the number of fledged chicks to compensate this level of mortality the amount of additional sandeel prey required is equivalent to 0.00002% of the current fishery landings).	✓ Potentially could be put in place prior to wind farm operation. Increased prey stock would potentially be available within 2-3 years.	? This is only feasible if a current owner of part of the sandeel quota was willing to sell. This is highly uncertain	x Due to the uncertainty in deliverability and acceptability of this compensatory measure the Applicant would not propose to progress this option.
Predator control	Kittiwakes are not generally considered to be subject to high levels of mammalian predation so benefits of	x Not considered feasible or beneficial	x Not considered feasible or beneficial	x Not considered feasible or beneficial	x Not considered feasible or beneficial	x Due to the highly doubtful benefit associated with this

Indicative Measure	Benefits	Delivery mechanism	Spatial scale	Timescale	Potential feasibility	Measure taken forward as compensation for Norfolk Vanguard
	mammal predator control are likely to be negligible. While a small amount of predation by large gulls and skuas is known to occur, these species are also protected so control would not be appropriate.					compensatory measure, the Applicant would not propose to progress this option.
Productivity Improvement - Construction of artificial nest sites	Kittiwakes readily make use of artificial breeding sites. A small area of wall, measuring 30m by 8m could accommodate 200 pairs. A colony of this size could produce around 5 times as many adult recruits as the 21 mortalities to be lost at Norfolk Vanguard.	✓ A wall attached to an offshore structure would be closer to foraging grounds than onshore locations and therefore potentially of greater benefit (studies have found colonies on offshore platforms have higher productivity than ones at coastal locations).	✓ The structure would need to be no more than 30m long and 8-12m high. Thus four lengths of 7.5m attached to the sides of an offshore structure would be sufficient. This would support a population of 200-300 pairs which would produce the same number of fledglings (at c. 1/pair) 50% of which would be predicted to reach adult recruitment age. This would be >5 times the loss of 21 predicted at Norfolk Vanguard. Siting the structure in the wind farm Order limits would enhance feasibility.	✓ Colonisation would be expected to occur naturally within 3-4 years but could be enhanced using playback of kittiwake colony sounds and model kittiwakes.	✓ Construction of artificial nest sites could be achieved prior to wind farm operation and therefore is deliverable within the timescales required for Norfolk Vanguard .	✓

5 REFERENCES

Brown, A. and Grice, P. 2005. Birds in England. T & AD Poyser, London.

Carroll, M.J., Bolton, M., Owen, E., Anderson, G.Q.A., Mackley, E.K., Dunn, E.K. and Furness, R.W. 2017. Kittiwake breeding success in the southern North Sea correlates with prior sandeel fishing mortality. Aquatic Conservation: Marine and Freshwater Ecosystems 27: 1164-1175.

Coulson, J.C. 2011. The Kittiwake. T & AD Poyser, London.

Coulson, J.C. 2017. Productivity of the black-legged kittiwake Rissa tridactyla required to maintain numbers. Bird Study 64: 84-89.

Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J-P., Shannon, L. and Sydeman, W.J. 2011. Global seabird response to forage fish depletion – one-third for the birds. Science 334: 1703-1706.

Daunt, F., Wanless, S., Greenstreet, S.P.R., Jensen, H., Hamer, K.C. and Harris, M.P. 2008. The impact of the sandeel fishery closure on seabird food consumption, distribution, and productivity in the northwestern North Sea. Canadian Journal of Fisheries and Aquatic Sciences 65: 362-381.

DEFRA (2012): Habitats and Wild Birds Directives: guidance on the application of article 6(4) Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69622/pb13840-habitats-iropi-guide-20121211.pdf.

EC (2012) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC Clarification of the Concepts of: Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence, Opinion of the Commission. https://ec.europa.eu/environment/nature/natura2000/management/docs/art6/new_guidance_art6_4_en.pdf

EC (2018). Managing Natura 2000 sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Brussels, 21.11.2018 C(2018) 7621 final.

Frederiksen, M., Wanless, S., Harris, M.P., Rothery, P. and Wilson, L.J. 2004. The role of industrial fisheries and oceanographic change in the decline of North Sea black-legged kittiwakes. Journal of Applied Ecology 41: 1129-1139.

Frederiksen, M., Wright, P.J., Harris, M.P., Mavor, R.A., Heubeck, M. & Wanless, S. 2005. Regional patterns of kittiwake Rissa tridactyla breeding success are related to variability in sandeel recruitment. Marine Ecology Progress Series 300: 201-211.

Frederiksen, M., Furness, R.W. and Wanless, S. 2007. Regional variation in the role of bottom-up and top-down processes in controlling sandeel abundance in the North Sea. Marine Ecology Progress Series 337: 279-286.

Frederiksen, M., Jensen, H., Daunt, F., Mavor, R.A. and Wanless, S. 2008. Differential effects of a local industrial sand lance fishery on seabird breeding performance. Ecological Applications 18: 701-710.

Furness, R.W. 2007. Responses of seabirds to depletion of food fish stocks. Journal of Ornithology 148: S247-252.

Furness, R.W. and Birkhead, T.R. 1984. Seabird colony distributions suggest competition for food supplies during the breeding season. Nature 311: 655-656.

Furness, R.W. and Tasker, M.L. 2000. Seabird-fishery interactions: Quantifying the sensitivity of seabirds to reductions in sandeel abundance, and identification of key areas for sensitive seabirds in the North Sea. Marine Ecology Progress Series 202: 253-264.

Furness, R.W., MacArthur, D., Trinder, M. and MacArthur, K. 2013. Evidence review to support the identification of potential conservation measures for selected species of seabirds. Report to Defra.

Greenstreet, S.P.R., Armstrong, E., Mosegaard, H., Jensen, H., Gibb, I.M., Fraser, H.M., Scott, B.E., Holland, G.J. and Sharples, J. 2006. Variation in the abundance of sandeels Ammodytes marinus off southeast Scotland: an evaluation of area-closure fisheries management and stock abundance assessment methods. ICES Journal of Marine Science 63: 1530-1550.

Heaney, V. 2018. Seabird Monitoring and Research Project Isles of Scilly 2018. Downloaded from https://www.ios-wildlifetrust.org.uk/

Hill, S.L., Hinke, J., Bertrand, S., Fritz, L., Furness, R.W., Ianelli, J.N., Murphy, M., Oliveros-Ramos, R., Pichegru, L., Sharp, R., Stillman, R.A., Wright, P.J. and Ratcliffe, N. 2019. Reference points for predators will progress ecosystem-based management of fisheries. Fish and Fisheries doi: 10.1111/faf.12434

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

ICES 2017. Report of the Benchmark on Sandeel (WKSand 2016), 31 October – 4 November 2016, Bergen, Norway. ICES CM 2016/ACOM:33. 301pp.

ICES 2018. ICES advice on fishing opportunities, catch and effort, Sandeel (Ammodytes spp.) in divisions 4.b-c, Sandeel Area 1r (central and southern North Sea, Dogger Bank). ICES, Copenhagen.

ICES 2019. Herring assessment working group for the area south of 62oN (HAWG). Volume 1 Issue 2. ICES Scientific Reports. ICES, Copenhagen.

Lindegren, M., van Deurs, M., MacKenzie, B.R., Clausen, L.W., Christensen, A. and Rindorf, A. 2018. Productivity and recovery of forage fish under climate change and fishing: North Sea sandeel as a case study. Fisheries Oceanography 27: 212-221.

Mavor, R.A., Pickerell, G., Heubeck, M. and Thompson, K.R. 2001. Seabird numbers and breeding success in Britain and Ireland, 2000. JNCC. Peterborough. (UK Nature Conservation, No. 25).

Mavor, R.A., Pickerell, G., Heubeck, M. and Mitchell, P.I. 2002. Seabird numbers and breeding success in Britain and Ireland, 2001. JNCC. Peterborough. (UK Nature Conservation, No. 26).

Mavor, R.A., Parsons, M., Heubeck, M., Pickerell, G. and Schmitt, S. 2003. Seabird numbers and breeding success in Britain and Ireland, 2002. JNCC. Peterborough. (UK Nature Conservation, No. 27).

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. 2004. Seabird Populations of Britain and Ireland. Results of the Seabird 2000 Census (1998-2002). T & AD Poyser, London.

Oro, D. and Furness, R.W. 2002. Influences of food availability and predation on survival of kittiwakes. Ecology 83: 2516-2528.

Rijkswaterstaat Zee & Delta 2020. Assessment of relative impact of anthropogenic pressures on marine species in relation to Offshore Wind. SEANSE.

Sherley, R.B., Ladd-Jones, H., Garthe, S., Stevenson, O. and Votier, S.C. 2020. Scavenger communities and fisheries waste: North Sea discards support 3 million seabirds, 2 million fewer than in 1990. Fish and Fisheries 21: 132-145.

Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clemet, P., Lewis, P., McLean, I., Baker, H. and Whitehead, S. (2001) The UK SPA network: its scope and contents. Peterborough: Joint Nature Conservation Committee.

Tveit, B.O., Mobakken, G. and Bryne, O. 2004. Fugler og fuglafolk på Utsira. Utsira Fuglestasjon, Utsira.

Wakefield, E.D., Owen, E., Baer, J. et al. 2017. Breeding density, fine-scale tracking, and large-scale modeling reveal the regional distribution of four seabird species. Ecological Applications 27: 2074-2091.

Walsh, P.M., Brindley, E. and Heubeck, M. 1995. Seabird numbers and breeding success in Britain and Ireland, 1994. UK Nature Conservation No. 18. JNCC, Peterborough.

Wright, P., Regnier, T., Eerkes-Medrano, D. and Gibb, F. 2018. Climate change and marine conservation: Sandeels and their availability as seabird prey. MCCIP, Lowestoft.