Buchan Offshore Wind

Offshore Ornithology Compensation Evidence Plan

QMS Review

Name	Company	Date	Reviewed	Approved
RMR	Natural Power	13/03/2025	LJN	SMM
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CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1. Two documents are provided to assess the potential for compensation measures to be effective and secured should the Appropriate Assessment of the Proposed Offshore Development conclude that no adverse effect on site integrity for any SPA cannot be concluded. The first report reviews and assesses the available ecological evidence that there are measures that could benefit seabirds, if implemented (the **Offshore Ornithology Compensation Evidence Plan**, i.e. this document). The second report assesses how measures could be implemented, monitored and secured, should they be required (see the **Outline Offshore Ornithology Compensation Implementation & Monitoring Plan**).

2. This structure is designed to separate the evidence that a measure is ecologically possible and the evidence that it can be effective if implemented using a particular approach.

3. This document provides the compensation evidence plan for predicted impacts on Special Protection Area (SPA) seabird features and will inform the Without-Prejudice Habitats Regulations Appraisal (HRA) derogation case. This report forms part of the evidence that compensation measures can be sufficient to overcome predicted impacts to SPAs where it was not possible for the competent authority to conclude no adverse effect on site integrity, but where it is concluded there are no alternative solutions to the Proposed Offshore Development and that there are imperative reason of overriding public interest (IROPI) for the consenting of the Proposed Offshore Development. The purpose of the Compensation Plan for the Proposed Offshore Development (comprising of this Offshore Ornithology Compensation and Evidence Plan and the Outline Offshore Ornithology Implementation and Monitoring Plan) is to demonstrate that appropriate compensation measures at project level have been identified and that these are sufficient to secure the overall coherence of the UK SPA site network. Along with this report an **Outline Offshore Ornithology Compensation Implementation and Monitoring Plan** is provided. It should be noted, although not the focus of these documents, the project is willing to engage with regional and strategic compensation schemes where timely and proportional.

4. This Offshore Ornithology Compensation Evidence Plan outlines the process undertaken for identifying suitable compensation measures for the SPA qualifying features where there may be an Adverse Effect of Site Integrity, and demonstrating that these are sufficient to maintain the overall coherence of the SPA network.

5. Following this Evidence Plan, the **Offshore Ornithology Compensation Implementation and Monitoring Plan** outlines how the short-listed measures will be implemented. An indicative monitoring programme for each measure is also presented. Part of the implementation plan includes adaptive management approaches. It is important to note that adaptive management plans are iterative and respond to results from monitoring. The adaptive management process is in place to ensure that the overall coherence of the network is secured notwithstanding circumstances where the predicted benefit from the initial proposed compensation measures are not met and thus further measures (or changes to existing measures) need to be implemented. Where novel measures are applied an element of adaptive management necessarily includes responding to unexpected outcomes. Timescales for the securing and applying of compensation

measures are provided in the **Outline Offshore Ornithology Compensation Implementation and Monitoring Plan.**

6. This report provides evidence of project-specific compensation measures and does not include potential regional scale compensation that may be progressed by a group of developers, such as the North East and East Ornithology Group (NEEOG). It also does not include any plan level compensation measures that are likely to be progressed.

2 CONTEXT FOR THE POTENTIAL REQUIREMENT FOR COMPENSATION

7. Analyses of project alone impacts, when apportioned to SPAs, is shown in **Table 2-1**. NatureScot consultation responses indicate that where total project-alone impact mortalities apportioned to SPA features do not exceed 0.2 breeding adults per annum (one breeding adult per five-year period), the contribution of such additional mortality to in-combination impact totals are non-tangible and therefore such impacts are not likely to result in an adverse effect on site integrity. Non-tangible impacts are those determined by NatureScot to be so small that there is no likelihood of an adverse effect from the project alone on the relevant SPA qualifying feature. These non-tangible impacts are also shown in **Table 2-1**.

Table 2-1 Predicted impacts from the project alone on SPA qualifying features and which features may require compensation. SPAs and features requiring compensation cannot be confirmed until the Appropriate Assessment has been completed. Values shown in bold are greater than 0.2 breeding birds/annum and strikethrough values are less than 0.2.

SPA	Predicted total mortality (breeding adults per annum)				
	Guillemot	**Razorbill**	**Puffin**	**Kittiwake**	**Gannet**
Troup, Pennan and Lion's Heads	**70.461**	**0.710**		**1.007**	
Copinsay	**13.285**			~~0.024~~	
Buchan Ness to Collieston Coast	**47.668**			**0.859**	
North Caithness Cliffs		**0.661**	**0.452**	**0.341**	
East Caithness Cliffs		**2.449**		**1.372**	
Fair Isle	**16.498**	~~0.094~~	**1.054**	~~0.022~~	**0.450**
Calf of Eday	**4.498**			~~0.012~~	
Hoy	**8.565**		~~0.059~~	~~0.013~~	
Rousay	**4.357**			~~0.029~~	
West Westray	**16.568**	~~0.056~~		~~0.167~~	
Sumburgh Head	**1.514**			~~0.009~~	
Marwick Head	**5.574**			~~0.035~~	
Fowlsheugh				**0.549**	
Noss			~~0.076~~	~~0.006~~	**0.550**
Foula			**0.262**	~~0.009~~	
Sule Skerry and Sule Stack			**3.463**		**0.306**
Cape Wrath			~~0.143~~	~~0.046~~	
Forth Islands SPA			**2.634**	~~0.109~~	**2.250**
Handa				~~0.043~~	
Hermaness, Saxa Vord and Valla Field				~~0.005~~	**0.563**
St Abb's Head to Fast Castle				~~0.089~~	
North Rona and Sula Sgeir				~~0.005~~	~~0.153~~

SPA	Predicted total mortality (breeding adults per annum)				
	Guillemot	**Razorbill**	**Puffin**	**Kittiwake**	**Gannet**
Farne Islands				~~0.071~~	
St Kilda					**0.463**
Flamborough and Filey Coast					**0.235**
TOTAL (requiring compensation)	188.988	3.82	7.865	2.928	4.817

3 LONG LIST OF POTENTIAL MEASURES

8. Multiple potential compensation measures have been identified for the species shown in **Table 2-1** (RHDHV 2024, Furness 2021, Furness et al. 2013). These sources of information were used to create a long list of potential measures that could be applied to compensate for the predicted project alone impacts on the UK SPA network (**Table 3-1**). These sources provided an assessment on the strength of the evidence that each species may benefit from the implementation of that. However, it is important to note that these sources assessed the evidence relative to larger scale compensation being required. At an individual project level various key characteristics (such as relative and absolute impacts) could differ sufficiently that a different conclusion of strength of evidence being sufficient to provide compensation to the UK SPA network can be made.

Table 3-1 Long list of potential compensation measures for the SPA qualifying features that may require compensation.

Measure	Kittiwake	Guillemot	Razorbill	Puffin	Gannet
Sandeel fishery closure	YES	YES	YES	YES	YES
Other fisheries – closures / no-take zones / sustainable management	YES	YES	YES	YES	YES
Mammalian predator control / management	YES	YES	YES	YES	YES
Avian predator control / management (e.g. diversionary feeding, deterrents)	YES	YES	YES	YES	YES
Establish new colonies at suitable natural sites	NO	YES	YES	YES	YES
Provision of artificial nest sites	YES	YES	YES	YES	YES
Reduce anthropogenic disturbance at colonies	YES	YES	YES	YES	YES
Reduce anthropogenic disturbance at sea	YES	YES	YES	YES	YES
Bycatch mitigation	YES	YES	YES	NO	YES
Reduction / cessation of illegal harvesting of birds	NO	NO	NO	NO	YES
Reduction / cessation of legal harvesting of eggs, chicks and / or adult birds	NO	NO	NO	YES	YES
Supplementary feeding / 'headstarting' chicks	YES	NO	NO	YES	NO
Management of supporting habitats at colony	NO	NO	NO	YES	NO
Seagrass restoration and recovery	YES	YES	YES	YES	YES
Oyster restoration	YES	YES	YES	YES	YES
Seaweed farming in the proximity of gannet colonies	YES	YES	YES	YES	YES
Extend protection of kelp beds beyond 17 MPAs where currently protected in Scottish waters	YES	YES	YES	YES	YES
Reduce anthropogenic pollution from agricultural runoff or discharge from waste treatment facilities	YES	YES	YES	YES	YES
Marine (plastic) litter removal	YES	YES	YES	YES	YES
Biosecurity (prevention of threats via incursion response)	YES	YES	YES	YES	YES

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4 SHORT LIST OF POTENTIAL MEASURES

9. This offshore ornithology compensation evidence plan outlines a proposed package of compensation mechanisms identified by the project to be sufficient to compensate the predicted impacts from the Proposed Offshore Development as outlined in **Table 2-1**where there is potential AEoSI, as identified in the Report to Inform Appropriate Assessment (RIAA) for the Proposed Offshore Development (Part 3 – Assessment on Special Protection Areas and Ramsar Sites) submitted alongside the Environmental Impact Assessment Report (EIAR).

10. Five mechanisms are proposed which are described below, with further detail provided in their relevant sections::

- **Section** Error! Reference source not found.**:** Measure 1 – Management of marine litter. Management of marine litter would encompass a suite of measures to remove litter from the marine environment within areas with connectivity to the UK SPA network.
- **Section 4.2:** Measure 2 – Artificial nesting structures for kittiwake. Providing additional offshore nesting structures for kittiwake would provide additional recruits into the UK SPA network;
- **Section 4.3:** Measure 3 – Additional management measures at protected sites. Additional management measures would be carried out to achieve demographic benefits to the relevant populations in the SPA. This proposed compensation mechanism is an umbrella term, which includes a suite of site-specific management measures, which would include:
    - reduction of anthropogenic disturbance at colonies;
    - management of supporting habitats at colony;
    - mammalian predator control / management; and
    - measures to reduce Highly Pathogenic Avian Influenza impacts.

11. **Section 4.3.5:** Measure 4 – Prey species habitat creation. Prey species habitat creation is the alteration or introduction of structures within marine habitats in such a way that the abundance of prey species of SPA features needing compensation become more abundant within or surrounding those areas. Within the long list of measures (Table 3-1), these include Seagrass restoration and recovery and Oyster restoration, and a measure not captured in the reviews summarised in Table 3-1; Nature Inclusive Design.

12. Methods to achieve prey species habitat creation include the alteration of marine habitats so that they become more suitable for prey species, or by the provision of additional or better habitat in which prey species can breed. By increasing the availability of prey species within areas available to features requiring compensation, the intention of this measure would be to increase prey availability for those features, with demographic benefits to productivity and / or survival.

- **Section 4.5:** Measure 5 – Strategic and/or regional compensation measures. Various measures are being progressed at the time of writing to provide compensation at more regional or strategic level. In particular, the Scottish Marine Recovery Fund (MRF) will be "used to receive and make payments to secure compensation to address the adverse impacts of offshore wind activities on protected sites.[1]". Offshore wind farm developers would be able to discharge their environmental compensation conditions, wholly or in part, through making agreed payments to the MRF. The MRF would then deliver the agreed compensation measures.

13. The measures listed here are not in any order of preference or benefit to SPA populations. However, it is noted that Measure 5 (MRF) would be preferred if it is operational within a suitable period for this Proposed Offshore Development.

4.1 MEASURE 1 – MANAGEMENT OF MARINE LITTER

14. Removal of marine litter is predicted to be beneficial to the marine environment and to seabirds in particular.

15. Two approaches to reduce marine litter would be applied:

- reduction of litter at sea; and
- reduction of litter on the coast.

16. This measure would comprise implementing steps to alleviate pressures from marine litter, through funding the expansion of existing schemes and developing new methods of managing marine litter.

17. Marine litter, including plastics and fishing gear, can have impacts affecting the ecology and physiology of multiple seabird species including the features requiring compensation (Ryan, 2018). Removal of debris would reduce mortality rates whilst also benefitting wider marine ecosystems and biological receptors. Focusing management strategies along the east coast of Scotland and waters around the key impacted SPAs would provide a focused potential benefit and scope of impact of the measure, as initiatives could likely benefit areas used by features for foraging and breeding. Removal of marine litter in areas of high ecological importance to these species would likely reduce the impacts from; ingestion and associated mortality, entanglement, and reduction in the use of plastic in nesting structures – often associated with increased mortality rates in chicks. Specific examples of these impacts and how they are adversely affecting these features of SPAs are:

18. The ingestion of plastic marine litter is particularly harmful to seabirds with serious physiological and reproductive consequences, often leading to mortality. Data on the ingestion of plastics by seabirds in the Bay of Biscay revealed guillemot and puffin were the best candidate species to act as monitors of the impacts of plastic debris as plastics were found in 60% of individuals sampled (Franco *et al*., 2019). High plastic load in the stomach of seabirds can lead to gut blockages (Ryan, 1987), potentially inducing starvation and eventually mortality. Pursuit divers in southern Norway had a high frequency of plastic in their stomachs (Benjaminsen *et al*., 2024), with emaciated puffin carcasses exhibiting the highest stomach plastic content (58%), followed by guillemot, likely caused by gut blockages causing starvation. Regurgitation of plastic by some seabirds into 'pellets'

[1] Marine+Recovery+Fund+operational+planning+and+delivery+-+interim+guidance+4+July+2025.pdf

allows for analysis of their stomach contents, as shown in cormorants in Ireland: plastic was found in 3.2% of pellets analysed (Acampora, 2017). Plastic ingestion was investigated in an internationally-important breeding population of Manx shearwaters on Skomer Island, Wales in 2018–19 by Alley *et al*., (2022): plastic was found in 71% of stomach contents (68% of adults, 75% of fledglings). Fackelmann et al. (2023) found that ingested plastic negatively impacted the gut microbiome of fulmar and Cory's shearwater and were associated with decreases in commensal microbiota and increases in (zoonotic) pathogens and antibiotic-resistant and plastic-degrading microbes. Rivers-Auty et al. (2023) found that flesh-footed Shearwaters (*Ardenna carneipes*) had embedded microplastic particles in all the internal organs examined (kidney, spleen, proventriculus) and this was correlated with microplastic exposure. Considerable tissue damage was recorded. De Jersey et al. (2025) found neurodegeneration in flesh-footed shearwater chicks with high levels of ingested plastic.

19. The use of plastic debris as nesting material has been observed in gannets. 58% of nesting material collected comprised of marine litter, with the majority being boat rope (Massetti *et al.*, 2021). Another study revealed that threadlike plastics, such as hoses from fishing gear, were present in 45% of gannet nests, and was more common in colonies closer to intensive fishing activity (O'Hanlon *et al*., 2019). It was concluded that gannets were useful indicator species for monitoring fishery related debris. The majority of artificial nesting material used by gannets is synthetic rope, which appears to be used preferentially, leading to entanglement of nestlings, which make up 75% of recorded entanglements (Votier *et al*., 2011). Entanglement also poses a serious threat to seabirds outside of use in nesting material, with 36% of species recorded to have been entangled in plastic marine litter, with fishing gear playing a major factor (Ryan, 2018).

20. Marine litter is indiscriminate and will continue to impact all seabirds. Efforts to reduce the impact of marine litter on seabirds would likely have positive effects on many species, reducing multiple possible risks to health, and therefore productivity and/or survival, that plastic and fishing pollution provides

21. As there are no SPA management measures presently in place to reduce levels of marine litter, the proposed measures would be additional to the normal practices undertaken to protect SPAs and would thereby provide additional benefit to SPAs. This additionality constitutes a key principle necessary in the development of compensatory measures (DEFRA, 2021).

22. As part of NEEOG , which the Proposed Offshore Development is a partner in, the viability of marine litter removal as a measure for delivering compensation at a strategic / regional scale has been assessed. While the Proposed Offshore Development remains part of the regional compensation measures being developed with other NEEOG developers, the evidence for this measure as a project alone approach is considered here. Should this measure be progressed as a regional measure with other northeast and east developers then the measure suggested here could be replaced with the regional measure. At the time of writing there was uncertainty on whether this measure could be secured at a regional scale, due to current legislation and guidance, so a project alone measure has been progressed at time of application. Should regional compensation through Marine Litter removal become available within suitable timescales, the Proposed Development is likely to implement this measure through joining a regional scale project subject to proportional and timely delivery.

23. This includes the initial stages of the development of a quantitative framework to relate litter removal effort with compensated seabird mortality for the following species: kittiwake, gannet, guillemot, razorbill, puffin and fulmar (a benefit to a species not requiring compensation from the Proposed Development).

24. Despite the development of this approach with the intention of informing compensation requirements at a regional scale, marine litter removal initiatives (with this approach to estimate their potential efficacy) could be scaled to a smaller level suitable for an individual project.

25. The NEEOG regional compensation project (Pizzolla *et al.*, 2024) has highlighted two key pathways by which physical impairment effects from plastic pollution may affect seabirds: entanglement (resulting in mortality through injury or drowning) or ingestion (resulting in mortality through impairment of the digestive system) (Wang *et al.*, 2021). The relative risk presented by each of these pathways for each species, as estimated with consideration of a review of available literature by Pizzolla et al. (2024), is summarised in **Table 4-1** Estimated relative risk of physical impairment effects from marine litter to seabird species.

Table 4-1 Estimated relative risk of physical impairment effects from marine litter to seabird species.Species	**Descriptor on score scale (low, medium, high)**	
	Ingestion	**Entanglement**
Kittiwake	Medium	Medium
Gannet	Low	High
Guillemot	Low	Medium High*
Razorbill	Low	Medium High*
Puffin	Low	Medium High*

**Pizzola et al., 2024 note a paucity of information on the risk presented to these species and base the scoring of 'Medium High' on the dive depths and foraging behaviours of these species.*

26. The regional compensation project references a recent study estimating that 582 tonnes per year of plastic waste are introduced into the marine environment along the Scottish east coast (Liao and Kaiser, 2025).

27. The regional compensation project estimated the present annual mortality to Scottish east and north coast seabird populations which may be attributable to physical impairment effects resulting from marine plastic. This was calculated by summing the east and north coast breeding seabird colony sizes (as shown in **Table 4-2**) and, from this total regional population, estimating a baseline number of individuals of each species which die each year using published survival rates and proportions of that baseline mortality which may be attributable to ingestion or entanglement effects (**Table 4-3**).

28. The regional compensation project stressed that figures relating to regional ingestion and entanglement mortalities are based upon several uncertain assumptions and are therefore to be treated as indicative.

29. To incorporate consideration of this uncertainty within assessment of litter removal measures, conservatism is applied when considering the scale at which measures to reduce seabird exposure to macroplastic would be implemented.

30. This compensation measure would be implemented at a scale whereby moderate efficacy scenario estimates of mortality reductions (see **Table 4-4**, below) are expected to exceed estimates of total compensation requirements for each species (see **Table 2-1,** above); while low efficacy scenario estimates of mortality reductions (**Table 4-4**) are expected to equate to approximately half of the total compensation requirements for guillemot and to exceed estimates of total compensation requirements for other relevant species.

Table 4-2 Regional population of breeding seabirds (individuals) in north and east Scotland

Species	Adults			Immature	Total regional population
	Counted	Sabbatical	Total		
Kittiwake	255249	1277	268012	158254	426566
Gannet	128197	12820	141017	103840	244856
Guillemot	600084	42006	642090	444062	1086152
Puffin	124298	8701	132999	129270	262269
Razorbill	98814	6917	105731	74111	179842

Table 4-3 : Regional baseline mortality and estimated ingestion and entanglement mortality figures derived as proportions of baseline mortality.

Species	All annual mortalities		All litter ingestion deaths including indeterminate deaths (7.67%)	All known litter ingestion deaths (1.27%)	Plastic only known ingestion deaths (0.81%)	Entanglement deaths (high rate)	Entanglement deaths (low rate)
	Number of deaths	% of regional population					
Kittiwake	39173	17.44	3005	498	317	2938	521
Gannet	36370	14.85	2790	462	295	2728	484
Guillemot	147371	13.57	11303	1872	1194	11053	1960
Puffin	43785	16.69	3358	556	355	3284	582
Razorbill	38523	21.42	2955	489	312	2889	512

31. The NEEOG regional compensation project (Pizzolla,*et al*. 2024) presents information relating to the present scale of funding to the Fishing for Litter initiative and an estimate of how much litter is retrieved from the marine environment as a result of that funding. On this basis it was estimated that the removal of approximately 1 tonne of litter from the marine environment costs approximately £1,000. It was highlighted that litter removed by the Fishing for Litter initiative would be targeted towards large macroplastic items which are likely to present an entanglement risk to seabirds than smaller microplastic items associated with potential ingestion effects. However, a proportion of microplastics are derived from the breakdown of macroplastics. Therefore, the removal of macroplastics would be expected to result in some reduction of microplastics that may be ingested by seabirds.

32. On the basis of the above costs of litter removal and the estimated 582 tonnes per annum of plastic waste introduced into the marine environment along the Scottish east coast (Liao and Kaiser, 2025), it was estimated that the removal of 1% of litter introduced each year within that region would require £5,820 of funding to be provided to the Fishing for Litter initiative. On this basis, annual funding of £58,200 may be estimated to result in an approximate net 10% reduction in the amount of plastic litter being introduced to the marine environment each year.

33. If it is assumed that:

a. the rate at which marine litter is being introduced to the Scottish east coast marine region is not increasing (Defra Outcome Indicator Framework monitoring measures C1a [beach litter items] and C1b [plastic levels in the stomachs of fulmars] support this assumption (DEFRA, 2025)),

b. and that entanglement risk to seabirds disproportionately relates to litter which has been recently introduced into the marine environment (on the basis that such litter would be expected to be, on average, more accessible to seabirds prior to settlement on the seabed)

Then: reductions in marine litter input rates (particularly focussed at the removal of high entanglement risk macroplastic items), would be expected to result in an overall reduction to seabird exposure to marine litter which may cause entanglement.

34. Potential reductions in entanglement risk exposure associated with a 10% reduction in annual regional plastic marine litter inputs are considered in **Table 4-4** in relation to 3 scenarios: Low (1% reduction in exposure), Moderate (5% reduction in exposure) and High (10% reduction in exposure). For each scenario a minimum and maximum estimated reduction in entanglement mortality is provided in accordance with regional entanglement baseline estimates presented in **Table 4-3**. An additional estimated figure, accounting for the relative sensitivity of the species to entanglement risk, is also provided. This estimate ('Est' in **Table 4-4**) equates to the mid-value between minimum and maximum estimates where relative sensitivity is considered to be moderate; the 75th percentile value between minimum and maximum estimates where relative sensitivity is considered to be moderate/high; and the maximum value where relative sensitivity is considered to be high.

Table 4-4 Estimations of potential entanglement mortality reductions associated with exposure risk from a 10% estimated annual reduction in marine litter input.

Species	Estimated baseline entanglement mortality		Relative sensitivity to entanglement risk	Reduction to exposure to entanglement risk macro plastics associate with a 10% reduction in net input rate (reduction in mortality per annum)								
				Low scenario 1%			Moderate scenario 5%			High scenario 10%		
	Min	Max		Min	Max	Est	Min	Max	Est	Min	Max	Est
Kittiwake	521	2938	Moderate	5	29	17	26	147	86	52	294	173
Gannet	484	2728	High	5	27	27	24	136	136	48	273	273
Guillemot	1960	11053	Moderate/High	20	111	88	98	553	439	196	1105	878
Razorbill	582	3284	Moderate/High	6	33	26	29	164	130	58	328	261
Puffin	512	2889	Moderate/High	5	29	23	26	144	115	51	289	229

4.1.1 Conclusions

35. There is a logical argument that if marine litter removal is a known pressure on seabird populations (including those requiring compensation) then removal of marine litter is reducing that pressure. While there is evidence that marine litter removal has the potential to be a useful compensation measure, it is clear from the precautionary assessment here there is a high likelihood that this would provide sufficient benefit for the small predicted impacts requiring compensation from the Proposed Offshore Development. The uncertainty around the predictions of benefit would be subject to monitoring and adaptive management as part of the overall package of measures described here.

36. Implementation and monitoring of this measure is described in Section 3 of the **Outline Offshore Ornithology Compensation Implementation & Monitoring Plan.**

4.2 MEASURE 2 – ARTIFICIAL NESTING STRUCTURE FOR KITTIWAKE

37. A potential measure for providing compensation for predicted impacts to breeding kittiwakes in the UK SPA network is the provision of artificial nesting structures (Furness *et al*. 2013). This approach has been applied multiple times to compensate for predicted impacts on breeding kittiwakes from other offshore wind farm projects in the English North Sea (Section 4.2.2 & 4.2.3). Rather than undertake another review to repeat the same information, a shorter summary has been provided here, with reference made to the previous reviews.

4.2.1 Evidence that kittiwakes use artificial structures

38. Coulson (2011) noted that kittiwakes do not seem to exhibit a preference for natural nesting location over artificial structures. The use of artificial structures can be divided into two types:

- existing structures used opportunistically; and
- designed structures provided as an artificial nesting structure.

4.2.2 Existing structures used opportunistically

39. The review by Hornsea 3 (2020) includes a comprehensive list of existing structures used by kittiwakes. These included 15 locations across five countries. Most of these structures (11) were onshore while four were offshore. The majority of onshore structures were on buildings (such as the Tyneside colony) and most of the offshore structures were on oil and gas infrastructure. The offshore structures were in both the Irish Sea and North Sea.

40. Christensen-Dalsgaard *et al*. (2019) studied the productivity of four offshore oil rigs in Norwegian waters with a total of 1,164 nesting pairs recorded.

41. Hornsea 4 (2021) surveyed sixteen offshore platforms in the southern North Sea and found “good numbers” (i.e. >100 pairs) on eight of these, totalling 1,350 pairs.

42. Van Bemmelen *et al*. (2025) tracked kittiwakes nesting on an offshore platform in the Dutch sector of the North Sea. The authors noted that there are no kittiwakes breeding on onshore locations, either natural or anthropogenic structures, but breeding on offshore structures was first noted in 2000 by Camphuysen & De Vreeze (2005). Nesting has since been found on three further structures, but there has not been a structured and comprehensive count of seabirds nesting on the available structures in the Dutch North Sea.

4.2.3 Designed structures for kittiwakes

43. The Hornsea 3 (2020) review identified five structures that had been built for kittiwakes and had been occupied, which excluded structures built as compensation. All of these structures were onshore. These were across four countries and varied from adapted structures (e.g. Middleton tower, Alaska) to purpose-built structures (e.g. Gateshead kittiwake tower).

44. In addition, four structures were identified that had been built for kittiwake nests but had not been successfully occupied at the time of writing the Hornsea 3 report (2020). However, it appears that all four structures have since been occupied.To date, two artificial nesting projects, comprising three structures, have been constructed in the UK as part of a derogation compensation measure for kittiwakes. Two offshore structures were installed in 2023 as compensation for predicted impacts from the Hornsea 3 project (Figure 1). Both were approximately 1 km from shore. One was east of Lowestoft, Norfolk, and the other was east of Minsmere, Suffolk. One pair of kittiwakes successfully fledged one chick from the Lowestoft structure in 2024.

Figure 1: Offshore kittiwake nesting structure constructed for Hornsea 3 compensation (Orsted, 2023)[2]

45. The onshore structure was constructed as compensation from the predicted impacts for the East Anglia and Norfolk projects (**Figure 2**). It is located on the harbour wall at the Port of Lowestoft in Norfolk. It was constructed in 2023 and has not been occupied at the time of writing.

[2] Available at: https://orsted.co.uk/media/newsroom/news/2023/07/how03-nesting-structures [Accessed 24/07/2025]

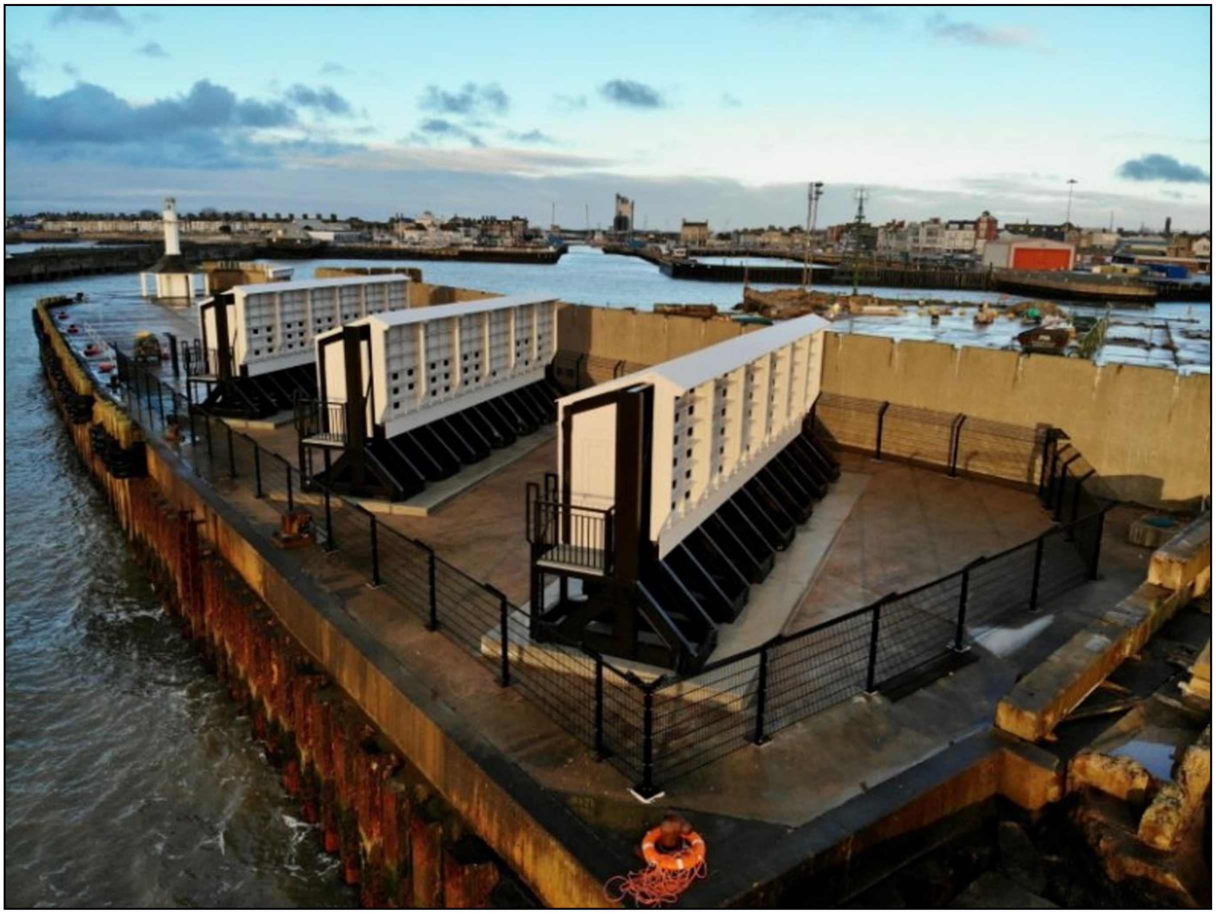

Figure 2: Onshore kittiwake nesting structure constructed for the East Anglia and Norfolk compensation (Vattenfall, 2023)[3]

46. Furness (2022) stated that “It has been suggested that creation of artificial colonies for kittiwakes would only represent suitable compensation when carried out in regions where there is no available unoccupied natural habitat (as is the case along the east coast of England from Lincolnshire to Kent).”. This has been used to suggest that this is not a suitable measure in Scotland, as there is no substantial part of the coastline without some apparently suitable cliff nesting habitat being available. However, Furness (2022) also noted that this was “over-simplifying the situation”, as there was evidence for strong competition for nest sites (Coulson 2011), evidence of density dependence at large kittiwake colonies (Acker *et al*. 2017) and evidence of density-dependent competition for prey around large colonies (Wakefield *et al*. 2017). Thus, there may be suitable locations between large colonies in Scotland, where artificial nesting

[3] Available at: https://group.vattenfall.com/uk/newsroom/pressreleases/2023/kittiwake-hotel-in-lowestoft [Accessed 24/07/2025]

colonies would provide kittiwakes with nesting opportunities with lower competition and therefore higher breeding success.

47. Kittiwakes have also been recorded nesting on artificial structures at sea. It has been shown that nesting offshore results in higher productivity of breeding birds (Christensen-Dalsgaard *et al*. 2019), due to the closeness of suitable foraging habitat and lower predator abundance (e.g. large gulls). To be effective, artificial colonies need to have a productivity of 0.8 or greater. Coulson (2017) noted that kittiwake colonies with a long-term average productivity below 0.8 were declining and those with a productivity value of above 0.8 were increasing. Christensen-Dalsgaard *et al*. (2019) found the productivity of kittiwakes on offshore platforms in Norway were four times higher than natural, coastal, nesting colonies in the same region of Norway.

48. On the north-east coast of Scotland available information on productivity of kittiwakes (Horswill & Robinson 2015) suggests that productivity is below the 0.8 chicks per pair that Coulson (2017) observed as a threshold between increasing and decreasing colonies. The mean of the available data from natural sites was 0.59 chicks per pair, suggesting that productivity in the region where compensation is proposed was relatively small and below the threshold of 0.8 chicks per pair where colony growth is observed. An artificial nesting platform off the northeast coast of Scotland would likely exceed the threshold value of 0.8 chicks per pair, if a similar pattern occurred in Scotland that was observed in Norway (Christensen-Dalsgaard *et al*. 2019). As a result, as the population on the artificial nesting structure reached capacity, there would be a new export of chicks from the colony to the general population of kittiwakes in the region, including those in the UK SPA network.

49. It would be expected that an export of chicks from an offshore artificial colony would begin before the colony became saturated, as not all fledged kittiwakes return to their natal colony (Coulson & Nève de Mévergnies, 1992).

4.2.4 Size of the colony needed to compensate

50. The method used by the Hornsea 3 project was applied to estimate the number of pairs of kittiwakes nesting on an artificial nesting structures needed to compensate for the predicted number of kittiwakes per annum that would be impacted by the Proposed Offshore Development. The key population demographic information used to make this estimate were:

- productivity (chicks per pair);
- age at first breeding;
- age specific survival rate; and
- dispersal of birds from breeding colonies.

51. The productivity value used was based on Horswill & Robinson (2015), as recommended in NatureScot Guidance Note 114 for undertaking a PVA. While this value of 0.819 chicks per pair is an overall average productivity value across age classes and colonies, the Hornsea 3 method also makes use of the difference in productivity across age classes, with a lower value used for birds during their first breeding attempt (0.561 chicks per pair) than in subsequent breeding attempts (0.863 chicks per pair).

52. While most kittiwakes start to breed between the ages of three and five years old, there is variation in the proportion of new recruits to the breeding population across the age at first breeding between two and ten years old. The Hornsea 3 approach used the available data (**Table 4-5**) from the breeding colony at North Sheilds (Coulson 2011).

Table 4-5 Percentage of kittiwakes from different ages that recruit into the population (from Coulson 2011).

Age at first breeding	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Percentage of recruits	0.7	26.5	35.2	22.7	10.5	2.5	0.9	0.9	0.4

53. Age-specific survival was also drawn from the recommended source for PVA (Horswill and Robinson 2015). This only used two age classes:

- juvenile (year 0 to 1) = 0.790
- adult (year 2 or greater) = 0.854

54. Most kittiwake chicks do not recruit back to their natal colony, with a dispersal rate of 0.89 (i.e. 89% of fledged kittiwakes recruit to another colony) (Horswill & Robinson, 2015). The Hornsea 3 method also made use of a lower natal dispersal value of 0.77 (Coulson, 2011), to provide a "worst case" alternative.

55. Adult kittiwakes are very site faithful once they are established as breeding birds, with only a very small proportion of adults dispersing from a breeding colony (0.012 – Horswill & Robinson, 2015).

56. Using these demographic parameters, the Hornsea 3 method was used (See Appendix A) to predict the number of breeding pairs of kittiwakes on an artificial nesting structure that would be needed to compensate for the predicted impact from the Proposed Offshore Development alone on the UK SPA network of 15 birds per annum. This calculation is summarised in **Table 4-6.**

[4] Guidance Note 11: Guidance to support Offshore Wind Applications: Marine Ornithology - Recommendations for Seabird Population Viability Analysis (PVA) | NatureScot

Table 4-6 Demographic input parameters and predicted number of additional pairs of kittiwakes needed for compensation.

Productivity		Age at first breeding	Survival rate		Breeding dispersal		Additional pair required on ANS
First breeding	Adult		Juvenile	Adult	Natal	Adult	
0.562	0.863	2 – 10	0.790	0.854	0.770	0.012	166
					0.890		144

57. Using the Hornsea 3 method, used in the consent of that project, and the input parameters described above, between 144 and 166 additional kittiwake pairs would be needed in total on an artificial nesting structure to create sufficient recruits to compensate for a predicted mortality of 26 adults per annum from the UK SPA.

4.2.5 Evidence of higher productivity at offshore locations

58. On average productivity of kittiwakes on the east coast of Scotland are c. 0.819 chicks per pair, however there is large level of interannual variability around this value (SD = 0.332; Horswill & Robinson 2015). Thus, based on these data, in almost half of years productivity would be predicted to be below 0.8 chicks per pair. This is below the observed productivity among colonies that are increasing (Coulson 2017). It is also notable that Frederiksen et al. (2004) found that productivity on the Isle of May needed to be above 1.17 chicks per pair to maintain population stability during a period when adult survival was reduced due to pressures on the sandeel fisheries. Thus, the population of kittiwakes on the east coast of Scotland (which are mostly in SPAs) are vulnerable to demographic pressures.

59. The predicted number of additional kittiwakes nests is based on an assumption that the productivity of birds would be no higher than natural colonies on the east coast of the UK. However, the evidence from Norway (Christensen-Dalsgaard *et al*. 2019) shows that it is likely that the productivity of birds would be higher for an offshore artificial nesting structure likely due to less exposure to predators and closer proximity to foraging areas than onshore structures. Based on the assumption of a lower natal dispersal value of 0.77, the predicted number of additional pairs needed for higher plausible levels of adult productivity (see Coulson 2017) are shown in **Table 4-7**. As the productivity increases, fewer additional nests would be required to compensate for the predicted impact on the UK SPA network.

Table 4-7 Number of additional pairs needed to compensate for a predicted impact of 15 kittiwakes per annum across a range of higher productivity values.

Productivity	Additional pairs needed
0.9	84
1	72
1.1	63
1.2	56

4.2.6 Growth rate of newly established colonies

60. Coulson (2011) described the colonisation and growth of new kittiwake colonies. It appears that colonisation and growth of artificial structures is no different to new natural colonies. New colonies are formed by a small number of pairs (3 to 20 pairs) followed by a rapid initial growth rate with numbers doubling every two to four years. Growth is then slowed, but at an annual increase of 10 - 20%.

61. While it appears to be unknown when colonisation occurred, there were approximately 155 pairs of kittiwakes nesting on a substation at the Walney 2 offshore wind farm in the Irish Sea in 2023. The wind farm was commissioned in 2012, with construction of the platform sometime during 2011 or 2012. This would be an average of 14 pairs per year across this period, though it is likely that the pattern followed the same initial rapid colonisation followed by slower growth.

4.2.7 Conclusions

62. It is apparent that kittiwakes readily nest on artificial structures, both onshore and offshore. While it is unlikely that there is a shortage of natural nesting sites on the coast of Scotland, there may be opportunities to add structures if suitable locations can be identified. However, the higher productivity of kittiwakes breeding on offshore structures means that these are more likely to be suitable in Scotland than coastal artificial nesting structures. It is apparent that kittiwakes readily nest on suitable structures on the underside of offshore structures and that colonies are likely to grow quickly once established. A suitable offshore structure in Scottish waters could compensate for the predicted impact of 15 birds per annum through the addition of between 56 and 96 pairs, depending on the productivity of the colony. Such a colony would likely produce sufficient recruits to maintain the coherence of the UK SPA network for breeding kittiwakes.

63. NatureScot advised that, "Availability of suitable nesting habitat is not generally considered to be a limiting factor for kittiwake in Scotland currently" (correspondence by email on 4 July 2025). However, it is important to note that the primary aim of this measure is not to create a new colony in Scotland, but to create recruits to colonies nesting on natural sites, most of which are SPAs, thus increasing the number of breeding birds within the UK SPA site network. The evidence above shows that it is very likely that an offshore ANS would have higher productivity and lower predation risk than colonies nesting on natural sites on the coast in Scotland it would be a source population adding to the UK SPA network for breeding kittiwakes.

64. It is also highly unlikely that the presence of an offshore ANS for kittiwakes in Scotland would result in a reduction of breeding adult birds already breeding within the UK SPA network. NatureScot expressed concern that an offshore ANS for kittiwakes would result in "recruiting breeding birds to the ANS and away from existing colonies". As discussed above, breeding adult kittiwakes are very site faithful and the presence of nest sites away from their established breeding locations does not result in emigration from the colonies they are established within. As described above, recruitment to the offshore ANS would be expected from the pool of immature birds within the wider population that would include birds dispersing from natal colonies within the UK SPA network. Growth of the colony would also not be expected to be intrinsic (i.e. from immature birds from the offshore ANS), but through recruitment from the pool of immature birds, as they reach breeding age. As such, recruitment from the offshore ANS colony into the coastal

breeding colonies (including those in the UK SPA network) would occur from the initial successful breeding on the offshore ANS. Once the offshore ANS reached capacity, the number of recruits from the pool of immature birds would be expected to decline, and therefore the net benefit to the UK SPA network would reach a stable level. Most recruitment to the offshore ANS colony would then only be expected to occur as adult breeding birds from the colony die, and nest sites become available for new recruits.

65. Since an offshore ANS is expected to begin and grow from recruitment into the colony from the pool of immature birds in the wider population, and not through intrinsic growth, there is not expected to be a lag in the growth of the colony due to the age at first breeding of birds reaching maturity. NatureScot expressed concern that there would be a lagged response due to age at first breeding and that this could affect any future management of an offshore ANS. However, since the colony on an offshore ANS would not require intrinsic population growth, this concern can be resolved.

66. Implementation and monitoring of this measure is described in Section 4 of the **Outline Offshore Ornithology Compensation Implementation & Monitoring Plan.**

67.

4.3 MEASURE 3 –ADDITIONAL MANAGEMENT MEASURES AT PROTECTED SITES

68. Four primary additional management measures would be undertaken at a suitable SPA with at least some of the relevant species requiring compensation:

- reduction of disturbance from anthropogenic sources;
- management of breeding habitat;
- suppression of terrestrial mammal predators; and
- management of Highly Pathogenic Avian Influenza (HPAI) outbreaks.

69. Additionally regular whole SPA colony counts, and annual productivity plots would be completed by the Proposed Offshore Development on the SPA where additional management measures would be applied.

4.3.1 Reduction of disturbance from anthropogenic sources

70. Anthropogenic disturbance at seabird breeding colonies has been shown to negatively affect breeding success. For example, disturbances to cliff nesting auks during the breeding season can lead to a range of escalated behavioural responses, including flushing, increased energy expenditure and exposure of eggs and chicks to predators. All of these effects have the potential to reduce reproductive success (Carney and Sydeman, 1999). Guillemot and razorbill breeding within heavily disturbed areas have been demonstrated to show lower hatching rates than individuals in less disturbed areas (Cairns, 1980). In a study for SNH (NatureScot), Harris & Wanless (1995) found a significant difference in breeding success at location on the Isle of May subjected to visitor disturbance for guillemots, but not for razorbill, puffin and kittiwake.

71. Beale and Monaghan (2005) showed that increases in visitor numbers at St Abb's Head National Nature Reserve (NNR) resulted in reduced nesting success of both kittiwakes and guillemots (Figure 3).

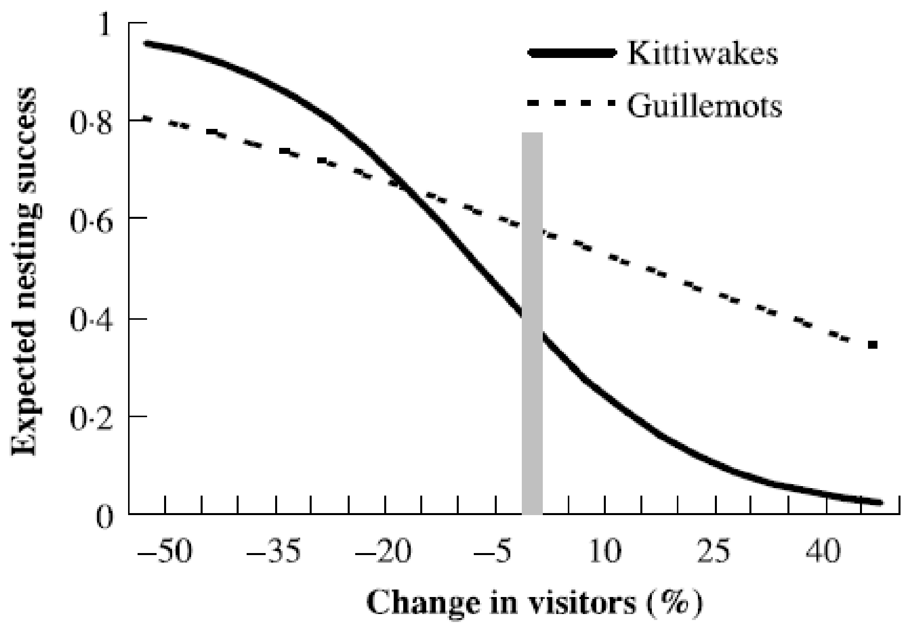

Figure 3: Relationship between human disturbance and nesting success of kittiwakes and guillemots at St Abb's Head NNR. The shaded vertical bar shows the visitor number in 2003 (Beale and Monaghan, 2005).

72. Beale and Monaghan (2005) noted that "fixed set-back distances and buffer zones are likely to be inappropriate conservation measures in situations where the numbers of visitors to wildlife areas fluctuates spatially and temporally". This suggests that careful management is needed to balance access for visitors, researchers, etc. and breeding success of seabirds in protected sites. The authors noted that larger parties of visitors should be kept further back than smaller parties, or that set back distances should be set based on the size of larger parties known to visit the site.

73. Additional analyses of the data from St Abb's Head NNR from Beale and Monaghan (2005), combined with further data on both kittiwake and guillemot from two sites in Orkney (Mull Head and Marwick Head), showed a sigmoid dose-response curve for guillemots (Figure 4). Beale (2007) therefore recommended that management should be to keep disturbance during the breeding season below 0.6 people minutes (cumulative minutes of exposure multiplied by the number of people) per hour per month and that spreading visitors spatially and temporally would be a suitable approach. Due to the sigmoid nature of the dose-response curve applicable to guillemot, it is likely that this species would be sensitive to both increases (negative effects) and decreases (positive effects) of disturbance.

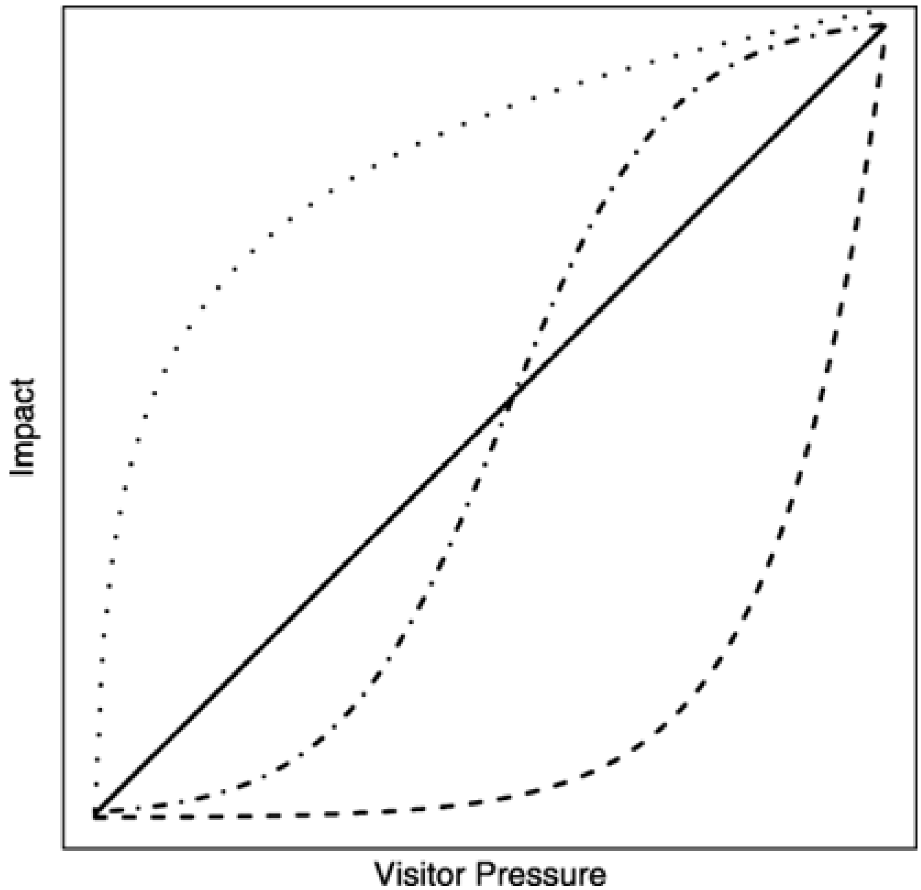

Figure 4: Types of dose–response curves described in Beale (2007). Solid line, linear; dotted line, logarithmic; dashed line, exponential; dashed and dotted line, sigmoidal.

74. However, for kittiwake the response to visitors at St Abb's (Beale and Monaghan, 2005) was not able to predict nesting success for the colonies in Orkney. As such, a general management guideline for kittiwakes may not be suitable. A more precautionary management approach may therefore be more appropriate for kittiwake.

75. It is apparent from this research that suitable management can be applied through the interaction of numbers of visitors and the amount to time spent at the colony. A combination of set back distances depending on group size and variation in the time spent at the colony could be applied to reduce disturbance.

76. Human disturbance can also occur when boats approach nesting seabird colonies. There has been little published research on the effects of disturbance from boats on demographic parameters, including on the species requiring compensation here. However, Rojek *et al*. (2007) found that nesting guillemots in California were disturbed when recreational boats approached within 50 m of active nest and remained within the area for extended periods. Hearne (1999) described negative behavioural response of guillemot, razorbill and puffin to tourist boat traffic, though this study did not relate these effects to demographic responses. Natural England (2015) have noted

the potential for disturbance of nesting seabirds from jet skis at the Flamborough and Filey Coast SPA.

77. Management measures to reduce anthropogenic disturbance to breeding seabird colonies within SPAs are likely to align with the conservation objectives of those SPAs and, as such, no significant legal constraints are considered likely.

4.3.2 Management of breeding habitat

78. Three compensation measures are proposed to manage breeding habitat of the relevant species within a suitable SPA (or SPAs):

- management of vegetation on existing sea cliffs;
- removal of illegally dumped materials (i.e. fly tipping); and
- alteration of watercourse(s) draining on to sea cliffs.

79. Some invasive non-native species are known to occur on coastal cliff habitats in the UK which have the potential to cause negative effects on suitable nesting habitat for seabirds. While these effects are likely to be limited in scale, since it has not been identified in the available literature as an important pressure on seabirds at a wider scale, the small level of compensation required for the Proposed Offshore Development may result from these measures, as part of a suite of measures, being a useful further management action.

80. Alteration of watercourses draining onto sea cliffs may provide addition nesting habitat where cliff faces which appear otherwise suitable for occupation by nesting seabirds, but are presently unsuitable due to wetting from above, may dry and become available. For example, compensation measures proposed in the derogation case for Greenvolt OWF include plans to manage drainage above a guillemot colony within East Caithness Cliffs SPA with a view that additional cliff areas surrounding the existing colony become dry during the breeding period and thereby facilitate the growth of the colony (Greenvolt, 2024).

81. Fly tipping has the potential to negatively affect suitable nesting habitat within SPAs for the species requiring compensation. For example, the Site Improvement Plan for the Flamborough and Filey Coast SPA and SAC (Natural England 2015) specifies that illegal dumping of garden waste is resulting in colonisation of sea cliffs by invasive non-native species (e.g. *Montbretia*). The Bullers of Buchan Coast SSSI site management plan statement notes that supporting appropriate public access to the site could help prevent fly tipping, and this has been noted as occurring in the Longhaven Nature Reserve by the Scottish Wildlife Trust. While current management action includes restricting access (e.g. through adding gates across access tracks) or provision of interpretation or educational materials it appears that removing debris fly tipped on to suitable nesting habitat is not part of these management plans. Thus, providing specialist removal of fly-tipped debris on seabird nesting habitat would be additional to existing management practices. However, this measure would need to be reactive and impacts cannot be meaningfully estimated and so neither can potential benefits be estimated. However, as part of any adaptive management plan, removal of fly tipped debris is included as an option.

4.3.3 Suppression of mammalian predators from nesting areas

82. Reviews by Furness (2021) and Furness *et al*. (2013) both found that there was evidence to support predator eradication as a suitable measure to compensate for impact on razorbill and puffin. However, the evidence for guillemot was weak. This was due to the difference in response of guillemots from Lundy Island, where the population increased after rat eradication, and Canna, where the population continued to decline after rat eradication. However, on Canna guillemots were in poor condition in the period following rat eradication (Bob Swann pers. comm.). Where food supply isn't driving bird condition and population change to a significant amount, rat presence on an island is clearly able to suppress population growth.

83. Predators at seabird colonies may adversely affect the productivity of those colonies, may reduce breeding adult survival rates and may result in predator accessible nesting sites being unused. In relation to mammalian predators, invasive species such as American mink have impacted seabird populations with documentation of species in the west of Scotland experiencing breeding failures due to island invasions (Craik, 1997). Mink have also had impacts on the kittiwake colony at St Abb's head (see Furness 2021). While foxes can also pose a risk to seabirds, this has generally been limited to shag, tern and gull species, so are not likely to be relevant here.

84. Unlike predator eradication from offshore islands, coastal SPAs on the UK mainland cannot have predators completely eradicated without building anti-predator enclosures around each colony.. Predators are unlikely to impact core colonies, which are likely to only occur on areas of cliff that are inaccessible to terrestrial predators. However, suppression of terrestrial predators within an SPA is likely to create small benefits to those seabirds nesting on the periphery of colonies that are accessible to predators.

4.3.4 Management of Highly Pathogenic Avian Influenza outbreaks

85. Highly Pathogenic Avian Influenza (HPAI) outbreaks pose a threat to UK seabird populations, demonstrated through mass mortalities in the 2022 and 2023 breeding seasons (Falchieri *et al*., 2022; EFSA *et al*., 2023). HPAI was detected in 15 seabird species in the 2022 outbreak, with more than 22,500 mortalities documented by September that year. Gannet and guillemot were identified as experiencing high levels of mortality; kittiwake as experiencing moderate levels of mortality, and puffin and razorbill identified as experiencing low levels of mortality (Tremlett *et al.*, 2024). HPAI is primarily spread through direct contact between infected birds, but anthropogenic activities, such as contaminated footwear or equipment, can also facilitate its transmission.

86. Compensation measures targeted at HPAI impact minimisation would focus on reducing viral transmission through implementing response strategies and protocols in the event of an outbreak to reduce the risk of mortality in the colonies.

87. Measures would focus upon the removal of carcasses of birds infected with HPAI from shorelines nearby to breeding colonies within SPAs. Carcass removal would be limited to birds on the periphery of colonies (e.g. at the base of cliffs, where accessible). Removing carcasses from cliffs would likely be very disturbing to the nesting birds and/or chicks in the colony and could be more

damaging than the transmission from dead birds to other seabirds (e.g. large gulls). So, the removal of birds from cliffs would not be included in this measure.

88. The Scottish Government noted that, “At present, there is no scientific evidence that the removal of carcasses significantly reduces the risk of onward spread of the current strain of HPAI H5N1 amongst wild birds in high bird density areas (e.g., seabird nesting sites)” (Scottish Government 2023). However, there would appear to be a risk of HPAI transmission to scavengers and coastal mammal predators. Carcass removal was associated in decreased mortality of seabirds within effected colonies by up to 15% (Knief *et al*., 2024). The current experience from Sandwich terns suggests that removing carcasses at an early stage of an outbreak can reduce the mortality of both adults and chicks (Bregneballe *et al*., 2023). However, better resource management and planning are needed, and that mechanisms of carcass removal need to be researched and implemented before the next serious outbreak (Roberts, 2023). It is recommended to remove carcasses as soon as possible after death, which would require planning and resource management ahead of the next outbreak effecting UK seabirds.

4.3.5 Conclusions

89. Management of pressures within an existing SPA, where such measures are either not subject to existing management or are unlikely to have these management measures applied due to logistic constraints, are logically likely to provide benefits to breeding seabirds. It is clear that there are numerous pressures on breeding seabirds in SPAs that are not already subject to management. Reducing, or eliminating, these pressures would therefore logically result in demographic benefits to breeding seabirds. There is strong evidence that pressure from human disturbance is likely to have negative effects on at least some species of breeding seabirds. Identifying a suitable SPA where these pressures are likely to occur, and then managing these pressures down would likely increase productivity in that SPA colony for a variety of species. Where there is apparently suitable, but unoccupied, nesting habitat, within an SPA it is likely there are opportunities to improve habitats. While there is strong evidence of the benefits of eradicating terrestrial predators from offshore islands, there is only limited evidence of impacts from terrestrial predators negatively affecting breeding seabirds on mainland colonies. This is likely due to these colonies being limited to cliff nesting sites and sea stacks that are inaccessible to terrestrial predators, rather than due to an absence of these predators. Suppression of predators at mainland colonies would therefore likely provide benefits to those birds nesting on the periphery of inaccessible cliffs. The benefits from HPAI management cannot be quantified, but preventing the spread of the virus would be likely to reduce the negative pressures on seabirds. Removing dead birds and implementing biosecurity measures within an SPA would be likely to reduce spread of the virus. All of these management measures would be integrated into a single improved management application approach.

90. Implementation and monitoring of this measure is described in Section 5 of the **Outline Offshore Ornithology Compensation Implementation & Monitoring Plan.**

4.4 MEASURE 4 – PREY SPECIES HABITAT CREATION

91. Reductions in the availability of small fish prey species is widely considered as the primary driver of regional declines in seabird breeding abundances and reduced breeding productivity (Cefas, 2018). Key small fish prey species vary between species and areas but typically include sandeels, sprat, herring, cod, whiting and capelin. Sandeel spawning grounds overlap with the proposed project and within foraging range of breeding seabird SPA features. Targeting an increase in availability of sandeel is unlikely to be achieved through the introduction of artificial habitat, as sandeel primary habitat is offshore sandbanks. The closure of sandeel fisheries could improve sandeel provision without any further input from the project. However, sandeel fisheries in the UK were recently closed. Therefore, promotion of the abundance of demersal spawning fish prey species is the primary focus of this measure, as the provision of reef habitat could provide shelter for these species during early life stages, leading to higher concentrations of prey availability for seabirds.

92. Boosting the abundances of demersal fish seabird prey species, whose spawning grounds overlap with the project area (information from the Fish & Shellfish Chapter of the Buchan Offshore Wind EIA), could be used as a targeted approach to compensation. For example, herring and cod as demersal spawners (ICES, n.d.) (Jose *et al*., 2016) would likely benefit from the introduction of scour protection and anchors from the project construction, which would act as additional habitat. However, it should be considered that this reef-effect will have non-species-specific implications, and that seabird prey species will unlikely be the sole beneficiary of this measure. Monitoring of a demonstration turbine in the northern Bay of Biscay showed a broad range of ecosystem responses to the presence of a single floating wind turbine (Reynaud *et al*. 2021). Despite this, the presence of the installed infrastructure increasing local prey biomass will give general positive ecosystem benefits which should in turn improve food availability for seabirds.

93. Across the North Sea, there is evidence that offshore artificial structures, including wind farms and their associated infrastructure, act as artificial reefs and fish aggregation devices (FADs). Additionally, floating turbines could attract a variety of species and alter biodiversity in midwater and surface ecological communities (Farr *et al*., 2021), thus increasing feeding opportunities for foraging seabirds. Boosting abundances of demersal fish seabird prey species (such as herring and cod) within their spawning grounds that overlap the Proposed Development area could be suitable as a compensation measure. Increasing biomass and fish abundance would likely happen naturally in the years following the Proposed Offshore Development construction, as a result of structures such as anchors, scour protection, Intermediate Reactive Compensation (IRC) platform and Offshore Substation Platforms (OSPs) (Danovaro *et al*., 2024). A study in the Belgian North Sea illustrated improved species fitness in cod and pouting populations that were feeding at wind turbine sites (Reubens *et al*., 2013). It has been evidenced from studies on other offshore wind projects that their associated infrastructure carries a significant reef effect, with increased recordings of biofouling epifauna, crustaceans and fish recorded near structures other than the turbines themselves. This evidence shows that reef effects occur at offshore wind farm sites readily without providing additional structures, suggesting that additional structures are likely to result in increases in biofouling and the abundance of fauna which benefit from this effect, including the species requiring compensation.

4.4.1 Nature Inclusive Design as compensation

94. The infrastructure associated with the Proposed Offshore Development is likely to provide reef benefits to the area, causing an overall gain in fish species that has the potential to improve provision of prey species available to seabirds. In their response to HRA Screening, (MD-LOT, 2024) RSPB Scotland commented that consideration of wider ecosystem impacts would be welcomed, including impacts to seabird prey species affecting food availability to seabirds within the vicinity of the Proposed Offshore Development. Therefore, it is proposed that adding habitat to infrastructure or modifying existing designs to provide improved habitat to the infrastructure, could be considered as compensation – these suggestions are outlined below.

95. The reported increase in gadoid species abundance around structures acting as artificial reefs is well documented, but the biological mechanisms behind such findings are not well understood (Fujii *et al*. 2011). This highlights the need for better research into these reef effects and how they can be improved; possibly using Nature Inclusive Design (NID) to develop structures to be better suited to objectives of increasing biomass. This could be achieved through increasing the complexity of submerged structures to increase the variety of species they attract, including cable protection. Cable protection would likely need to occur at various points along each cable, particularly closer to shore, where benefits would be greater to breeding seabirds. Hunter & Sayer (2009) evidenced that fish and invertebrate species abundance was two to three times higher on complex artificial reefs than their smooth counterparts in northern temperate waters. This has been evidenced in demersal fish (Sargent, 2024) in the US, with the explanation that habitat complexity is a key factor in supporting healthy fish populations, which is crucial for seabird ecology.

96. The creation of prey habitat as a compensation measure must consider how best to target prey species for seabirds within foraging range. Increasing sandeel provision may be unlikely, as their habitat would not benefit from these measures, however increasing numbers of cod and herring could be achieved through improving their habitat, which would secondarily increase feeding opportunities for seabirds. Novel 3D-printed reef technology incorporates topographically complex surfaces to attract varying species of marine organisms (Wang *et al*., 2022). These are emerging technologies that could be incorporated into scour protection, turbine anchors and foundations of OSPs to improve their fish abundance-boosting abilities through provision of shelter and refuge from predators. The below suggestions of how NID could be included into project infrastructure have been lifted from the Crown Estate Report on Nature Inclusive Design: Challenges and Opportunities for UK Offshore Wind Farms (Baxter *et al*., 2021), which highlighted possible biodiversity enhancement options for export cable scour protection.

97. Alternatives to traditional rock dumping, which typically neglects positive impacts on marine life due to smooth surfaces, could provide additional habitat for seabird prey species. 'ExoReefs' which provide scour protection with Nature-Inclusive Designs, seeks to achieve biodiversity gain by incorporating complex features and unique microhabitats (Figure 5a). A "reef effect" can be created which can support a range of native species, more so than traditional non-NID options (Exo Engineering, 2024).

98. Figure 6b shows the design of the Marine Matt® - a matrix of concrete units linked together to create a flexible structure that lies on the seabed over cables. This includes holes and nooks aimed at providing shelter for Atlantic cod, Edible crab and European lobster (ARC Marine, 2024).

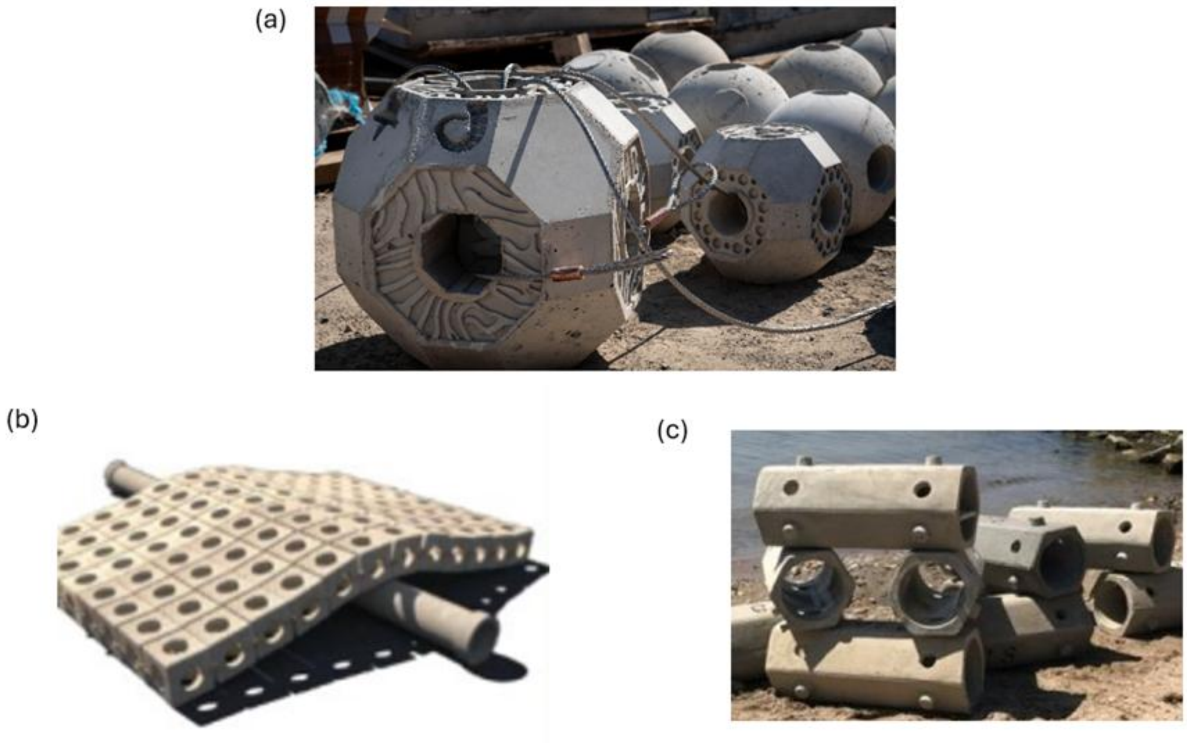

Figure 5: Possible NID that could be included as a compensation measure: (a): ExoReefs (Exo Engineering), (b): Marine Matt® (ARC Marine), (c): fish hotels (WUR).

99. Provision of additional habitat either on the scour protection or on other offshore infrastructure could include the introduction of 'fish hotels' (Figure 5c). These structures are hollow tubes with multiple holes along their length., with the ability to be stacked on top of each other and interlocking to create a complex and stable structure (WUR, 2024). The fish hotels were designed as a habitat for juvenile cod however, they also provide shelter for crab and lobster (Hermans et al., 2020).

100. There is some published research and data to support the concept of the additional provision of habitat through modifying project infrastructure Modifying hard structures installed within marine environments using Nature Inclusive Design (NID) to increase a population's carrying capacity is an active area of research (Linley et al., 2007). It should be noted that increased prey availability surrounding floating turbines, if attracting foraging birds to the immediate vicinity of operational WTGs, may result in the potential for increases to collision mortality due to increased flight activity within these areas. However, these measures could be applied to the cable route and around the IRC, and so away from the wind turbine generators, negating the potential to increase collisions to the relevant species..

101. It would be difficult to quantify the success of this measure, particularly as there would be many uncertainties in the degree to which prey species abundance has improved, and whether this has had a measurable impact on reducing the pressures faced by seabirds via reduction in food availability. If improving prey habitat provision does increase food uptake by seabirds, it would be challenging to assess whether this has had a positive impact on population levels and breeding success in these SPA features, particularly given the very small levels of predicted impact that will need to be compensated for.

102. It is important to note that this measure, while highly likely to benefit seabirds in both the breeding season and non-breeding seasons, the benefit is indirect and cannot be quantified. However, this measure would be additional to the measures provided above and so would create greater confidence that the whole package of proposed measures would provide more than sufficient benefits to compensate for the predicted impacts. Adding NID, that provide improved habitats for multiple benthic and fish species, including seabird prey species, compliments the provision of offshore artificial nesting structures for kittiwake and improved nesting habitat within onshore locations in a breeding seabird SPA. Thus, the proposed package of measures provides both increased nesting habitats and increased foraging opportunities for the birds benefiting from improved nesting opportunities.

4.4.2 Restoration of seagrass beds

103. Among the available options for marine habitat creation and restoration, seagrass beds are one of the more established methods. Seagrass beds provide nursery habitat for a range of fish species, including those that are prey species for seabirds (Franco *et al*., 2022). Seagrass beds can increase primary marine productivity, which has been associated with supporting bird populations (Unsworth and Butterworth, 2021).

104. This method was being progressed as a compensatory measure due to impacts on seabirds from the Hornsea 4 project (Hornsea 4, 2021). The species predicted to benefit from this measure were kittiwake, guillemot, razorbill and gannet. Due to the indirect nature of the benefits to seabirds it is not possible to meaningfully predict a number of seabirds in the UK SPA network that would result from a particular area of seagrass bed being created or restored. However, it is apparent that this measure would improve the health of the marine ecosystem and that it would benefit seabirds through an improved population of prey species.

4.4.3 Restoration of oyster beds

105. Native European oysters (*Ostrea edulis*) act as an ecosystem engineer, building biogenic reefs and provide many essential ecosystem services (Pogoda *et al*., 2019). Like seagrass beds, biogenic reefs built though oyster restoration, improves productivity of key fish species (Hancock & zu Ermgassen, 2018) and also improve water quality (zu Ermgassen *et al*., 2016). These ecosystem improvements will indirectly benefit seabirds through increased ecosystem productivity resulting in great resilience to seabird populations. However, these benefits cannot be quantified and should be considered as a qualitative benefit to the UK SPA network for breeding seabirds.

4.4.4 Conclusions

106. Seabird populations may be limited by prey availability and therefore measures to improve prey populations are likely to benefit breeding seabirds, including those species requiring compensation. Three measures are proposed that are likely to benefit prey populations, albeit with very limited quantitative evidence that a certain level of compensation would result in a measurable response from seabird populations. However, the combination of all three proposed measures would be highly likely to benefit prey species, and this would likely benefit seabird populations. Since this measure cannot be quantified it is important that it is considered along with the other proposed measures and its inclusion add to the reduction in uncertainty that the whole package of measures would be sufficient to compensate for the predicted impacts.

4.5 MEASURE 5 – STRATEGIC/REGIONAL COMPENSATION MEASURES

107. Various measures are being progressed at the time of writing to provide compensation at more regional or strategic level. These will be preferred if available in suitable time scales.

108. The Scottish MRF published interim guidance in July 2025[5]. The MRF will be "used to receive and make payments to secure compensation to address the adverse impacts of offshore wind activities on protected sites.". Offshore wind farm developers would be able to discharge their environmental compensation conditions, wholly or in part, through making agreed payments to the MRF. The MRF would then deliver the agreed compensation measures.

109. While the interim guidance for the MRF states that "developers will be expected to identify other appropriate measures to deliver the necessary compensation for their projects" prior to the MRF becoming operational, it is included here as it is expected to become available during the consenting process for the Proposed Offshore Development.

110. Should the MRF become operational in a suitable timescale for this Proposed Offshore Development, this will be the preferred option and other measures considered here will only be applied as needed to address any residual impacts requiring compensation.

111. Implementation and monitoring of this measure is described in Section 7 of the **Outline Offshore Ornithology Compensation Implementation & Monitoring Plan.**

4.6 CONCLUSIONS

112. While there may be limited empirical evidence that some of the measures proposed will result in a particular increase in seabird numbers, their combined effect on marine ecosystem health is apparent and it is logical that seabird populations would benefit from these ecosystem improvements. This is in part due to the indirect benefits to seabirds achieved through improving their marine environment. It is therefore considered that, by providing a package of measures that both increase nesting opportunities and improving feeding opportunities the confidence in the package of measures is greater than sum of the individual components. The Proposed Offshore Development is confident that the overall package of measures provided will be more

[5] Supporting documents - Scottish Marine Recovery Fund: interim guidance - gov.scot

than sufficient to compensate for the very small predicted impacts from the Proposed Offshore Development alone.

113. The proposed measures and their predicted benefit to each species are summarised in **Table 4-8**. This shows that Measure one (marine litter) is predicted to benefit all species and is expected to provide similar levels of benefit as the predicted impacts. Measure two benefits one species, kittiwake, but will likely be sufficient on its own to provide sufficient compensation for the predicted impacts to all SPAs that may be impacted. Measure three would likely benefit three species, kittiwake, guillemot and razorbill. Measure four is predicted to benefit all five species.

Table 4-8 Summary of proposed measures, which species are predicted to benefit, the number of birds predicted benefit (where calculation is possible) and the predicted impact requiring compensation.

Measure		Kittiwake	Guillemot	Razorbill	Puffin	Gannet
1	Marine litter	5 - 29	20 - 111	5 - 29	6 - 33	5 - 27
2	Kittiwake ANS	26	N	N	N	N
3	SPA management	Y	Y	Y	N	N
4	Prey habitat	Y	Y	Y	Y	Y
5	Marine Recovery Fund	Y	Y	Y	Y	Y
Compensation requirement		23 - 26	0 - 94	10 - 15	3 - 10	0 - 8

114. Finally, should the Scottish MRF become operational within a suitable time scale for this Proposed Offshore Development this will be the preferred approach to discharging all or most of the required compensation. Any residual compensation would be undertaken through one or more appropriate measures described here.

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Appendix A – Calculation of additional pairs on ANS to compensate for predicted impacts

115. The calculation of the number of additional pairs of kittiwakes needed to compensate for the predicted impacts from the Proposed Offshore Development followed the approach taken for the consented Hornsea 3 project (Hornsea 3 2020). The details of the calculations are provided below:

116. Inputs are provided in **Table 4-9**. Demographic parameters are from Horswill & Robinson (2015).

Table 4-9 Kittiwake ANS calculation input parameters

Parameter	Value
Annual mortality (individuals)	26
Productivity rate	0.819
Natal Dispersal rate	0.89
Adult survival rate	0.854
1st year survival rate	0.79
Adult dispersal rate	0.012

117. To compensate for the Proposed Offshore Development 26 adult birds per annum will need to disperse into the SPA population from the ANS colony. In addition to these birds an additional 23% of philopatric birds would need to be taken into account. Thus, a total of 29.2 birds per annum would need to be compensated for if using an ANS approach (i.e. 26/0.77 = 29.2).

118. The proportion from each age class that reaches breeding age as a recruit to the ANS is based on the information from Coulson (2011), thus the contribution needed to compensate the predicted impact of 26 adult birds per annum (and the additional philopatric birds = 29.2) from each age class can be calculated (**Table 4-10**Table 4-10).

Table 4-10 Proportion of recruits from each age class of breeding birds and the estimated number from each age class needed to compensate for the predicted impacts.

Year class	Recruits (proportions: Coulson 2011)	Contribution from year group to 26	Contribution from year group to 29.2
0	0	0	0
1	0	0	0
2	0.0065	0.169	0.190
3	0.2645	6.877	7.727
4	0.352	9.152	10.283
5	0.2265	5.889	6.617
6	0.1045	2.717	3.053
7	0.0245	0.637	0.716
8	0.009	0.234	0.263
9	0.009	0.234	0.263
10	0.0035	0.091	0.102

119. From the calculated proportion of recruits from each age group as first time breeders, the number of fledged chicks needed to provide the 29.2 first time breeders across the different contribution year groups can be calculated, without taking into account annual adult mortality (**Table 4-11**Table 4-11). This calculation estimates that 78.0 breeding pairs will be needed to compensate for the predicted impacts.

Table 4-11 The number of fledged chicks required to provide the 29.2 first time breeders need taking into account the different contributing year groups (Cell shaded amber).

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year class	TOTAL
											78.019
0	0.281	13.411	20.899	15.747	8.507	2.335	1.005	1.176	0.536	0	63.898
	0.222	10.595	16.510	12.440	6.721	1.845	0.794	0.929	0.423	1	50.479
		9.048	14.100	10.624	5.739	1.576	0.678	0.794	0.361	2	42.919
			12.041	9.073	4.901	1.346	0.579	0.678	0.309	3	28.926
				7.748	4.186	1.149	0.494	0.579	0.264	4	14.420
					3.575	0.981	0.422	0.494	0.225	5	5.698
						0.838	0.361	0.422	0.192	6	1.813
							0.308	0.361	0.164	7	0.833
								0.308	0.140	8	0.448
									0.120	9	0.120
										10	

120. It is necessary to account for annual adult mortality from the ANS colony. The estimated 78.0 pairs are 156.0 individuals. With an annual adult survival rate of 0.854 (Horswill & Robinson 2015) the estimated annual background mortality is 22.8 individuals (i.e. 156.0 * (1-0.854)). There would also be an estimate annual adult emigration from the ANS colony of 1.8 birds (156 * 0.012). Thus, to compensate using an ANS the number breeding adults needed is 53.9 (i.e. 29.2 + 22.8 + 1.9). When this number of birds is applied to the same calculation as Table 4-11 the result is 144 birds will be needed on the ANS to compensate for a predicted impact of 26 kittiwakes (**Table 4-12**Table 4-12).

Table 4-12 The number of breeding pairs required to provide the 53.9 first time breeders need taking into account the different contributing year groups (Cell shaded amber).

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year class	TOTAL
											143.862
0	0.519	24.729	38.536	29.036	15.687	4.306	1.852	2.169	0.988	0	117.823

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year class	TOTAL
	0.410	19.536	30.444	22.938	12.392	3.402	1.463	1.714	0.780	1	93.080
		16.684	25.999	19.589	10.583	2.905	1.250	1.463	0.666	2	79.140
			22.203	16.729	9.038	2.481	1.067	1.250	0.569	3	53.338
				14.287	7.718	2.119	0.911	1.067	0.486	4	26.589
					6.592	1.810	0.778	0.911	0.415	5	10.506
						1.545	0.665	0.778	0.354	6	3.343
							0.568	0.665	0.303	7	1.535
								0.568	0.259	8	0.826
									0.221	9	0.221
										10	