From:	Taylor, Jessica (NE)
To:	Norfolk Vanguard
Subject:	RE: EN010079 Norfolk Vanguard Natural England Written Representation (Ref: 264171) E-mail 1
Date:	16 January 2019 18:19:44
Attachments:	EN010079_264171 Annex A Norfolk Vanguard NE Response to ExA Written Questions_Final.pdf EN010079_264171 Annex B Norfolk Vanguard NE detailed comments on Offshore Ornithology_Final.pdf EN010079_264171 Annex C Norfolk Vanguard Benthic Ecology and HRA_Final.pdf EN010079_264171 Annex D Copies of Natural England DAS response letters_Final.pdf EN010079_264171 Annex E Norfolk Vanguard Summary of NE Relevant Representation_Final.pdf EN010079_264171 Annex F Norfolk Vanguard Natural England Comments on Other Parties Relevant Representations.pdf EN010079_264171 Annex G Norfolk Vanguard Natural England summary of written representation_Final.pdf EN010079_264171 Natural England Norfolk Vanguard Written Representations 160119_Final.pdf

Dear Sirs,

Please find attached Natural England's Written Representation in relation to the Norfolk Vanguard Offshore windfarm Application, including referenced documents not in the public domain, summary of our Relevant Representations, summary of our Written Representations, response to other interested parties Relevant Representations (where appropriate), our response to the first set of Examiners questions and detailed supporting annexes on offshore ornithology, benthic ecology and Natural England Discretionary Advice Service letters provided to the Applicant.

Due to the MB size of these documents we will need to send you a subsequent series of emails (1 – 3).

Please also accept this email as notification that we do not wish to make oral representations at the up and coming Issue Specific Hearings (only) on 5-7th February. However, we reserve the right to change this position for future Issue Specific Hearings.

Natural England does not wish to attend an Accompanied Site Inspection (ASI).

We are also content to receive further communications electronically.

Best wishes,
Jessica Taylor

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www.gov.uk/natural-england

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In an effort to reduce Natural England's carbon footprint, I will, wherever possible, avoid travelling to meetings and attend via audio, video or web conferencing.

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THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex A: Schedule of Natural England's responses to Examining Authority's first round of written questions.

16 January 2019

The table below presents Natural England's responses to the first round of the Examining Authority's Written Questions. We have omitted the questions that were not directed at Natural England from this document.

		Question:	NE Comments
1.	**General**		
1.2	Breckland Council, Broadland District Council, Norfolk County Council, North Norfolk District Council, Natural England (NE), Marine Management Organisation (MMO), Environment Agency, Historic England (HistE), Highways England (HE)	Please provide comments on any relevant information contained in the Change Report [AS-009] and Errata document [AS-010], and whether you agree with the conclusions reached by the Applicant. In the event that the amendments are accepted please indicate any consequential amendments which you require to the dDCO.	Natural England is supportive of the general approach set out in the change report, and broadly agrees with the conclusions presented. However, we have the following additional comments: a) In-combination – The change report does not fully detail how these changes may impact any in-combination assessment. Whilst it is the view of Natural England that this increase is unlikely to alter the conclusions laid out in the original application you should undertake this assessment and present the results; b) Temporal WCS - The Applicant states in paragraph 36 of the change report 'In addition to the spatial extent of underwater noise impacts, consideration was also given to the temporal worst case scenario (wcs). The Environmental Statement (ES) assessed a total duration of 1,260 hours of piling activity (equivalent of 52.5 days), for all project infrastructure which could be piled over a 4 year construction duration.' However, table 2.8 details a WCS of 59 days. This discrepancy should be clarified; and c) There are no units against 'average piling time per foundation' in table 2.2. Whilst it has been assumed that this is in hours this should be confirmed. A full copy of our response to the Applicant in this regard can be found in Annex D. With reference to document AS-010 - Both the availability of the documents and significance of them has been missed by Natural England until review of the ExA questions that refer to Section 51 Advice document amendments. Unfortunately as they are rather large documents Natural England has not had the chance to review and consider potential implications for advice in time for deadline one especially as one of them is 342 pages long. Therefore, Natural England will review these documents and provide Written

		Question:	NE Comments
			Representation at Deadline 2.
3.	**Ecology offshore - ornithology**		
3.1	NE and RSPB	Can you confirm that you are content that the baseline environment for ornithology along the offshore cable corridor has been sufficiently well informed and has been characterised correctly?	Natural England assumes that the data utilised by the Applicant for the offshore cable corridor assessments are that presented in the Greater Wash Special Protection Area (SPA) Department Brief (i.e. Natural England & JNCC 2016) and that the Applicant has not requested the raw data from JNCC. Although, we have not received anything from the Applicant to clarify our assumption. As noted in our RRs, the Applicant has not presented any evidence to back up its statements that the offshore cable corridor does not overlap spatially with the distributions of common scoter and tern features of the Greater Wash SPA. With regard to the red-throated diver (RTD) density data utilised by the Applicant, we assume that the Applicant has used Figure 2 of the mean density surface maps for RTD presented in the Greater Wash Departmental Brief to obtain the figure of 1.36–3.38 birds/km2 for the peak density of birds in the SPA crossed by the cable route. These values are presented in both the ES and the Report to Inform the HRA. Use of the upper figure of 3.38 birds/km2 is unlikely to be precautionary, bearing in mind recent surveys of Outer Thames Estuary SPA have identified higher RTD densities when digital aerial surveys have been undertaken compared with earlier visual aerial surveys, data from the latter having been used for the classification of the Greater Wash SPA. However, a more robust approach would be for the underlying density estimate data for all 1x1km squares that cover the offshore export cable route and buffer from the individual surveys are utilised to calculate a mean peak density for the cable route for use in the assessments. Nevertheless, for the area covered by the Vanguard offshore export cable, in the absence of site-specific surveys of the cable corridor area (which is typical for offshore wind farm assessments), we would consider the data utilised in the Greater Wash SPA Departmental Brief (i.e. Natural England & JNCC 2016 and that in Lawson et al. 2016) to be the best available evidence currently

		Question:	NE Comments
			available to characterise that section of the cable route through this area of the Greater Wash SPA. Provided that the upper density figure of 3.38 birds/km2 is used for the assessments we feel the best available evidence has been utilised.
3.2	NE	Based on the 'Rochdale envelope' parameters for the project that the Applicant has stated, can you confirm whether in your view the methodology used in the modelling assesses the worst case collision risk?	The Applicant's worst case scenario for the Collision Risk Modelling (CRM) assessment is based on 200 x 9MW turbines, which is the smallest turbine option, but represents the largest number of turbines. Notwithstanding our concerns regarding the approach the Applicant has taken to the broader methodological issues of CRM, based on the information provided by the Applicant in the CRM annexes of the offshore ornithology technical appendix (annexes 3, 4 and 5 of Appendix 13.1), this option produced the highest collision predictions (higher than the 90 x 20MW turbine option). The assessments are then based on whichever of the build out options of either all the turbines in Vanguard East or all of the turbines in Vanguard West is the highest CRM prediction for the 200 x9MW turbine option, as this is considered the worst case. We would agree that this approach is the worst case option, as from our calculations any split in the turbines across Vanguard East and West does not result in a higher collision prediction than the highest prediction from either all turbines in West or East.
3.3	Applicant, NE and RSPB	Can an update be provided on the progress that has been made since NE's RR [RR-106] and RSPB's RR [RR-197] in resolving the outstanding areas of disagreement regarding the following offshore ornithology matters for Norfolk Vanguard alone and in-combination, and in particular in regard to the following matters:	Natural England has not received any further discussions/clarifications from the Applicant regarding resolving any of the outstanding areas of disagreement regarding offshore ornithology matters. However, we have been able to utilise information provided by the Applicant in their original submission documents, and can provide more detail and some updates on the following issues raised by the ExA: a) Our position regarding the use of Potential Biological Removal (PBR) vs Population Viability Analysis (PVA) remains the same as highlighted in our Relevant Representations (RRs) – NE does not advocate the use of PBR modelling when PVA modelling is available. Therefore our consideration will focus only on the PVA outputs. Although NE has previously considered PBR outputs for assessing population impacts in cases where up to date PVA models have not been available at an appropriate population scale. However, the use

		Question:	NE Comments
		(a) The use of potential biological removal (PBR) versus population viability analysis (PVA) modelling; (b) The mean peak seasonal abundances for red-throated diver that have been used in the operational displacement assessments and matrices in Tables 13.27 to 13.29 of ES Chapter 13 [APP-337]; (c) The displacement and mortality rate levels that have been used for red- throated diver; (d) The use of the Applicant's own stochastic collision modelling (CRM) rather than that advocated by the RSPB and NE (ie the Marine Scotland Science Model, MacGregor *et al* 2018);	of PBR on its own, as the means of assessing population impacts on seabird populations presents a number of issues. Therefore, NE advises that wherever possible the population level impacts of predicted mortality from developments should be assessed using PVA models as these allow the effects of factors such as density dependence, population trends and varying demographic parameters to be explicitly investigated in terms of their effect on the population trajectory. PVA models also allow relative comparisons of population level effects with and without the additional mortality to be considered in a way that is not possible with PBR. b) No further clarification/information has been received from the Applicant regarding the mean peak seasonal abundances for RTD used in the operation displacement matrices for Vanguard West (Tables 13.27-13.29 of the ES). Therefore, our position remains that we do not agree with the figures used in the assessment, as these appear to be based on data for just birds on the water and hence the figures used are too low. This approach is not consistent with the advice in the joint Statutory Nature Conservation Body (SNCB) interim displacement advice note (MIG-Birds, 2017), which advises that displacement assessments should use bird data for birds sitting on the water and birds in flight. This is also inconsistent with the approach the Applicant has taken for the assessments of operation displacement for Vanguard East for RTD and also for all of the auk and gannet assessments, as these have used the recommended approach of using abundances of birds on the water plus birds in flight. We therefore recommend that the Applicant revisits its operational displacement assessment for RTD at Vanguard West, and hence also the assessment of the operational displacement for RTD from Vanguard East and West combined. c) No further clarification/information has been received from the Applicant regarding the displacement rate of 80% and mortality rate of 5% used in their assessments of RTD displacement (at Environmental

		Question:	NE Comments
		(e) As requested by NE, please can the Applicant please provide the CRM input data that it has used in its own stochastic CRM, including the R code; (f) The use of median bird densities within the CRM, and the overall derivation of bird densities used in the CRM; (g) The Nocturnal Activity Factor that has been used in the CRM; (h) Can the Applicant explain its reasoning for using displacement assessments for Norfolk Vanguard East using birds in flight and birds on the water, but only birds on the water for Norfolk Vanguard West, and clarify whether any corrections if made would be likely to alter the conclusions reached; (i) The differences between	Impact Assessment (EIA)) for operational displacement and for construction/cable laying of the offshore export cable for both EIA and HRA for the Greater Wash SPA). Our position remains that we do not consider the 80% displacement and 5% mortality rate used by the Applicant to be appropriate for assessing disturbance and displacement impacts to RTD from offshore wind farms and that this does not follow SNCB guidance (MIG-Birds, 2017). As highlighted in our RRs, based on the available evidence, we consider that there is no clear justification to change our current advice of a 4km buffer and 100% displacement across this (as advised in the joint SNCB displacement interim advice note, MIG-Birds, 2017) at this stage for the purpose of impact assessment. It would seem that while 4km may be an underestimate of the true extent of the displacement, assuming a magnitude of 100% out to 4km is likely to be an over-estimate. Therefore, the use of the two components of our current advice (a conservative estimate of extent and a precautionary estimate of magnitude within that extent) in combination, is likely to result in an appropriate estimate, based on our current understanding of the evidence base. Indeed the recent evidence (described in our RRs) suggests that this approach (100%, 4km) might be closer to the truth, and hence less precautionary than has been previously suggested. As a result we continue to advise that assessments of operational disturbance and displacement for RTD for offshore wind farm assessments are based on a constant displacement rate across the offshore wind farm site and a 4km buffer and suggest that a range of displacement rates up to 100% and a mortality rate of up to 10% are considered. As the full EIA operational displacement matrices of up to 100% displacement and 100% mortality have been presented by the Applicant in their original submission document, NE has been able to calculate the figures we believe are the appropriate impact predictions based on our preferred worst case scenario of 100% displacement and 10% mortality rates for Vanguard East: • Autumn migration period: if 100% of the turbines are constructed in

		Question:	NE Comments
		the deterministic model and the Applicant's model in terms of collision mortality; (j) The apportioning of mortality to SPAs; (k) Having regard to the evidence from Cleasby *et al* (2015) that the RSPB has cited, the appropriateness of the gannet avoidance rate in regard to the breeding season; (l) The kittiwake tracking data, including the availability of the RSPB data; (m) The effectiveness of predator management at the Alde-Ore Estuary SPA as a mitigation measure in regard to lesser black-backed gull.	Vanguard East, a maximum of 5 RTDs are predicted to die, which equates to 0.17% of baseline mortality for the spring Biologically Defined Minimum Population Scales (BDMPS) population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. • Winter period: if 100% of the turbines are constructed in Vanguard East, a maximum of 3 RTDs are predicted to die, which equates to 0.13% of baseline mortality for the winter BDMPS population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. • Spring migration period: if 100% of the turbines are constructed in Vanguard East, a maximum of 12 RTDs are predicted to die, which equates to 0.40% of baseline mortality for the spring BDMPS population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. • Annual impact: if 100% of the turbines are constructed in Vanguard East, the summed annual mortality for EIA operational displacement equals a maximum of 20 RTDs (5+3+12) predicted to die (range from CLs of abundance data: 0-57 birds), which when assessed against the largest BDMPS population (from Furness 2015) equates to 0.66% of baseline mortality (range from CLs: 0.00-1.88%), or when assessed against the biogeographic population (from Furness 2015) equates to 0.32% of baseline mortality (range from CLs: 0.00-0.93%). Using the mean peak abundance data, the predicted level of impact would not the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. However, using the upper CLs of the abundance data, the predicted levels of impact are not insignificant and require further consideration by the Applicant. It has not been possible for us to complete such an assessment for

		Question:	NE Comments
			Vanguard West (or for Vanguard East and West combined) due to the errors identified in the seasonal abundance estimates used in the displacement matrices for this site. d) The Applicant has not provided any further information on their stochastic CRM model. Our position remains that as we are uncertain of the R code the Applicant has used in their stochastic CRM model, we do not know whether this is the same as the MSS model (McGregor et al. 2018) and this means that potentially we would not end up with the same set of results from Vanguard as with the MSS work. The MSS stochastic CRM (McGregor et al. 2018) is now available and the general view of NE is that the stochastic CRM can be used for assessments, but that assessments should also provide the outputs from the standard Band model spreadsheets as well. We recommend the Applicant gives consideration to this. e) Question for Applicant. f) No further information has been provided regarding the issues raised in NE's RRs regarding the use of median densities of birds in flight rather than mean densities. Therefore, our concerns regarding this raised in our RRs remain, namely: • We are uncertain as to why in the stochastic CRMs the Applicant has not used the monthly density estimate +/- 95% confidence limits to give a range of predicted collisions. • We consider the use of a bootstrapped median to estimate density in the non-stochastic CRM to be questionable, when a mean density already exists. We note that the point of bootstrapping is to estimate variance – the Applicant claim's that it has to be this way to enable comparison with stochastic CRM outputs, but we aren't looking to compare the two. Additionally, Appendix 13.1 (Offshore Ornithology Technical Appendix) defends this approach by saying that *"all collision predictions accurately reflected the observed densities"*, but we are not certain that this is true. The observed densities are those derived from the images (average of birds per image), whilst the bootstrapped data is a theoretical distribution of

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			densities, from which the median gives an estimate of central tendency – therefore not a probability of being the 'true' density. We note that using the mean densities rather than the median densities, will result in increased CRM predictions. g) With regard to nocturnal activity factors for gannet, we are aware that the paper reviewing gannet nocturnal activity has been accepted and published in the Journal of Applied Ecology (Furness et al. 2018). Furness et al. (2018) has calculated average activity rates for gannet from several studies and recommended use of a "precautionary" nocturnal activity of 8% of daytime activity in the breeding season and 3% in the non-breeding season applied to the period sunset to sunrise. However, in the Norfolk Vanguard submission documents, the Applicant refers to a gannet review paper by Furness et al. (in subm.), which recommends use of 4.3% nocturnal activity in the breeding season and 2.3% in the non-breeding season for gannet, and these are the figures the Applicant has used in their stochastic CRM for assessment of impacts from Vanguard alone both for EIA and HRA. There is clearly a difference between the published figures in Furness et al. (2018) and the figures used by the Applicant in its submission assessment. Additionally, the analyses by Furness et al. (2018) and also used in the Applicant's submission documents are both different from those recommended in the first review undertaken as part of the East Anglia 3 assessment, which recommended use of 0% nocturnal activity during the breeding season and 2% nocturnal activity for gannet in the non-breeding season (see MacArthur Green 2015). Likewise, for kittiwake, the review undertaken as part of the East Anglia 3 assessment recommended use of 0% nocturnal activity during the breeding season and 12% nocturnal activity for kittiwake in the non-breeding season (see MacArthur Green 2015).The Norfolk Vanguard Applicant has used evidence reported in Furness et al. (in prep.) to suggest use of a nocturnal activity rate of 20% of daytime activity in the breeding season and 17% in the non-breeding season, with variability around these mean levels for kittiwake. Apparently, the

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			emerging evidence on nocturnal activity levels from analysis of tagging work has itself generated conflicting recommendations. The activity levels of birds in the Norfolk Vanguard areas are defined as the percentage of birds in flight from the site-specific digital aerial surveys, which are effectively 'snapshot' surveys of the birds and their activities present at the site at the time of the survey. These surveys take place more in core daylight hours, i.e. well away from sunrise and sunset. However, the nocturnal activity factors/rates that are calculated from the reviews of the tagging studies (e.g. MacArthur Green 2015; Furness et al. 2018) calculate nocturnal:diurnal ratios over all hours of the day. Therefore, the daytime flight activity recorded in the Norfolk Vanguard digital aerial surveys may not match the levels of daytime flight activity that are the basis of the calculations in the empirical tagging studies. Thus, is not clear whether it is appropriate to apply the nocturnal activity factors/rates derived from tracking data to the site-specific survey data. h) For Applicant to answer. i) Given our outstanding concerns regarding the CRM methods, NE is not in a position to comment without further clarification being provided by the Applicant. **j) Non-breeding season apportionment** As noted in our RRs, we recommend that for the apportionment of impacts of species to relevant SPA colonies during the non-breeding seasons, the data presented in the tables in Appendix A of Furness (2015) for the relevant species Biologically Defined Minimum Population Scales (BDMPSs) for each season (e.g. migration, winter etc.) are used. Whether the colony figure in the BDMPS tables used is the adult figure or that for all ages depends on any Population Viability Analysis (PVA) model and outputs to be used. <u>Lesser black-backed gull (LBBG), Alde-Ore Estuary SPA</u>: The approach taken by the Applicant for apportioning impacts in the non-breeding season for LBBG for the Alde-Ore Estuary SPA colony departs from the standard practice set out above. However, in this

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			instance the Applicant's approach does not appear to make a significant difference to the apportionment figures in the non-breeding season that result from taking the NE recommended approach (for more detail see comment to question 23.34 below). Gannet, FFC SPA: As noted in our RRs, for gannets from the Flamborough and Filey Coast (FFC) SPA in the non-breeding season it is unclear from the Vanguard assessment documents what BDMPS figure has been used in the apportionment. In addition, further information was required as to the FFC SPA colony population used in these calculations, and confirmation was required that the BDMPS population estimates used are those presented in Furness (2015) for the North Sea and Channel BDMPSs. No further information has been received from the Applicant on this issue. Kittiwake, FFC SPA: We note that the approach taken by the Applicant for apportioning impacts for kittiwake from the FFC SPA in the non-breeding season is consistent with our standard advice outlined above. We advise that the same approach is taken for gannet for FFC SPA. **Breeding season apportionment** LBBG, Alde-Ore Estuary SPA: No further information has been received from the Applicant regarding the concerns we raised in our RRs regarding the apportioning of LBBGs to the Alde-Ore Estuary SPA in the breeding season. Therefore, we again recommend that the Applicant considers these concerns and revisits its apportioning for the site and species in the breeding season in light of this. Further information on this issue can be found in the comments to question 23.34 below. Gannet, FFC SPA: As noted in our RRs, we agree with the approach used to apportion 100% of predicted impacts in the breeding season to birds from the FFC SPA. Kittiwake, FFC SPA: No further information has been received from the Applicant regarding our recommendation to consider the more recent tracking data for kittiwakes from the FFC SPA in its apportionment calculations for this species from this site in the

		Question:	NE Comments
			breeding season. Therefore, we again recommend that the Applicant requests this data from RSPB and then revisits the kittiwake breeding season apportioning following consideration of this data. k) NE's position remains that the most appropriate avoidance rates to use in CRM for gannet are those recommended in the joint SNCB response to the MSS avoidance rate review (JNCC et al, 2014). In the case of gannet for the 'basic' Band model (i.e. options 1 or 2), this is 98.9% ±2SD, which is the rate and ranges used by the Applicant in their assessment. l) As noted in our response to point j above, we continue to recommend that the Applicant requests the more recent (2017) kittiwake tracking data from the FFC SPA from RSPB and then revisits the kittiwake breeding season apportioning following consideration of this data. m) Predation levels at the Alde-Ore Estuary SPA LBBG colony form part of the environmental baseline (and associated condition status) and therefore the Appropriate Assessment will need to consider the impacts of Norfolk Vanguard as potentially exerting a potential additional pressure on a struggling colony, rather than comparing the relative importance of different negative impacts. We are aware that during the examination of Galloper Offshore Windfarm (OWF) this potential mitigation measure was brought forward and funds put aside. However to date predator control has not been possible at the SPA due to a wide range of reasons. The fact that these funds have not been used to date indicates that predator control may not be a practicable mitigation measure at the SPA.
3.13	NE	In reference to the errors that you have noted in your RR [RR-106] in regard to Tables 13.69 and 13.71 of the ES [APP-337], please confirm that	With reference to document AS-010 - Both the availability of the documents and significance of them has been missed by NE until review of the ExA questions that refer to Section 51 Advice document amendments. Unfortunately as they are rather large documents Natural England has not had the chance to review and consider the implications for our advice in time

		Question:	NE Comments
		these have now been corrected in the revised assessment that has been submitted by the Applicant.	for deadline one especially as one of them is 342 pages long. Therefore, Natural England will review these documents and provide Written Representation at Deadline 2.
3.16	NE and Applicant	Can you confirm for which species of non-seabird migrants you consider cumulative CRM is required?	As advised in our RRs, we recommend that for the Norfolk Vanguard project alone, CRM is conducted using the Vanguard turbine specifications and site locational information for the non-seabird migrant modelled at East Anglia Three – namely dark bellied-brent goose, wigeon, gadwall, teal, pintail, shoveler, pochard, tufted duck, common scoter, golden eye, marsh harrier, oystercatcher, ringed plover, golden plover, grey plover, lapwing, knot, sanderling, dunlin, bar-tailed godwit, curlew, redshank and turnstone. In addition to this, we would also recommend that migration modelling and CRM is undertaken for the following additional species: Bewick's swan and avocet. Until the outputs of these assessments are available it is not clear whether the impacts of Norfolk Vanguard would be of sufficient significance to occasion a cumulative CRM.
3.18	Applicant or RSPB or NE	Please provide the following papers that have been referred to in either the ES, NE's RR [RR-106] or RSPB's RR [RR-197]: Cleasby *et al* (2015), Furness (2015), Furness *et al* (2013), Furness *et al* (2018), Garthe *et al* (2004), Green *et al* (2016), MacGregor *et al* (2018), O'Brien *et al* (2017), Wade et al (2016).	The following requested references are referred to in the NE RR: Furness (2015). This can be downloaded from: http://publications.naturalengland.org.uk/publication/6427568802627584. This document has also been provided at Deadline 1.
5.	**Ecology offshore – other**		
5.6	Applicant and NE	Chapter 10 of the ES [APP-334] states that cable would be micro-sited through areas	Natural England supports the mitigation measure to avoid impacts to *Sabellaria spinulosa* reef through micro siting/routing cables. However, our concern relates to the phrase 'where possible'. Natural England is aware of a

		Question:	NE Comments
		of *Sabellaria spinulosa* reef, where possible. Please comment on the effectiveness of this micro-siting technique as a mitigation measure.	large area of Annex I reef straddling the export cable corridor. Therefore the 'wiggle' room available to avoid reef within the Development Consent Order (DCO) boundary of the cable is limited. NE welcomes the reduced number of export cables from 12 to 4 with the High Voltage Direct Current (HVDC) electrical system proposed for Norfolk Vanguard and Boreas which helps to free up more space within the cable corridor. However, we continue to advise that all reef is avoided within Haisborough Hammond and Winterton (HHW) Special Area of Conservation (SAC). That recoverability of reef is not guaranteed as evidence is presented for individual *Sabellaria* tubes and not reef or recovery from unrelated activities to that of cable installation. It should also be noted that Natural England is currently advising Eastern Inshore Fisheries Conservation Agency on a fisheries byelaw closure area to protect the area of *Sabellaria* reef within the Vanguard cable corridor from repeated damage from fishing gear. It is anticipated that the closure will not only maintain the areas of known reef, but in the absence of fishing pressures restore *Sabellaria spinulosa* reef across any closure area. Therefore it is highly likely that the presence of Annex I *Sabellaria spinulosa* reef will have significantly changed prior to any OWF construction activities. Therefore, whilst we continue to advocate that the standard mitigation measure/marine licence conditioned to avoid reef features is included in the Projects DML it may not be feasible to do so. To address this the Applicant has included the caveat 'where possible', but Natural England have concerns about the increased level of risk to the integrity of the site such a caveat would endorse as there are no parameters to assess and agree what is "possible".
6.	**Construction - offshore**		
6.12	MMO and NE	Do you agree with the contingency estimate of 10% of the total cabling for unburied cables that the Applicant has applied?	Based on evidence presented for Hornsea Project 3 examination (REP-138) in relation to the amount of rock armouring used by Orsted on their installed cables around the UK, Natural England agrees that 10% is conservative, however that doesn't make it acceptable in terms of impact to nature conservation and Marine Protected Areas MPAs). Natural England notes that the 10% presented for Norfolk Vanguard is as a contingency, but currently there is no certainty that the sandwave levelling

		Question:	NE Comments
			and other installation techniques will be successful such that cable protection will not still be required as well.
20.	**Content of the draft DCO (dDCO)**		
20.4	Natural England	Unexploded Ordnance (UXO) detonation is detailed within the ES (cf Appendix 5.2 - Norfolk Vanguard Detonation Effects of UXO and Appendix 5.4 - Underwater noise from UXO) but not referenced in the dDCO/DMLs. Explain in detail why you consider that a separate Marine Licence will need to be sought prior to construction, and why it is likely that a European Protected Species (EPS) licence will need to be applied for prior to any UXO detonation works.	A separate licence is required for removal of unexploded ordnance as it is considered a separate activity to the construction of the windfarm and involves the removal of items from the seabed. An European Protected Species (EPS) licence is required for any activity that is likely to disturb protected species. Although a MMMP should form part of the application for an EPS licence, this only provides mitigation for injury effects, not disturbance, so a licence is still required.
20.75	Natural England	Please comment on the suggestion that you be included in the notification referred to in the preceding question.	Natural England would welcome inclusion in this notification as the decision on how to build out the projects will inform our advice more widely on marine sustainable development projects within the southern north sea.
20.87	Natural England	Explain, in your relevant representations [RR-106] "*also allow amendments to the plan to be reviewed in context with the existing volumes and the success to the cable protection and scour protection deployed*" and clarify whether the dDCO	The phrase '*also allow amendments to the plan to be reviewed in context with the existing volumes and the success to the cable protection and scour protection deployed*' refers to a need to allow flexibility in the cable installation plans as the knowledge develops on the success of cable protection and scour protection deployed to date. The plans should also be flexible to be reviewed as knowledge of volume of sandwaves to be levelled and therefore subsequent volume of disposal material is known. The dDCO should be amended to reflect the need for this flexibility.

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		needs to be amended in this regard and if so how.	
20.88	Natural England	Justify the proposed amendment to Condition 14 (e) (scour protection and cable protection plan) to require an as-built report to be submitted after completion of cable installation works, to confirm the locations and volumes deployed and thus confirm adherence to the approved plan.	To date developers have never had to confirm to the MMO or NE as standard what they have actually installed on the ground and the location in relation to the parameters of their 'Rochdale envelope'. This is something that we are wanting to address across the industry as knowledge of this should benefit the developer by informing amendments to post construction monitoring proposals. For Natural England this amendment enables us to better advise on wider management of designated sites in relation to conservation objectives and potentially enable wider sustainable development within the marine environment.
20.117	NE and RSPB	In the relevant DML Conditions in Schedules 10 and 11of the made DCO for East Anglia THREE and Requirement 2(2), there was a specified minimum draught height of 22m above MHWS, but there was also the stipulation of a maximum number of wind turbine generators (WTGs) with a draught height of less than 24m from MHWS. Are you satisfied that this has not been included in the dDCO for Norfolk Vanguard?	Natural England accepts the principle that raising the draft height will result in a reduction in collision risk. We have previously advised the Applicant (in our Section 42 response) to give consideration to proposals of best practice mitigations that seeks to reduce the cumulative/in-combination collision totals, for example by raising the height of the lower rotor tip of the turbines. We advise that the Applicant gives consideration to mitigation measures which seek to reduce the cumulative/in-combination total impacts. Therefore, we would welcome discussions with the Applicant regarding this issue.
23.	**Habitats Regulation Assessment**		
23.3	NE	Please comment on whether the corrections made to the Greater Wash SPA citation would have any bearing on the Applicant's assessment.	The corrections made to the Greater Wash SPA citation have resulted in a reconfiguration of the site boundary (exclusion of an area around the outer perimeters of Lincs, Lynn and Inner Dowsing and LID6 offshore wind farms) and changes to the site area and changes to the estimated sizes of the populations of three of the qualifying features (common scoter, red-throated diver and little gull) from the Applicant's assessment. The aspects of the development relevant to these features are the

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			construction of the offshore export cable for common scoter and RTD and collision risk from the operating wind farm to little gull. The Norfolk Vanguard offshore cable route does not pass through the footprints of the three offshore wind farms in the area that is now excluded from the SPA boundary, so these changes would not affect the Applicant's assessment for these species. Common scoter: We understand that the Vanguard cable route does not pass through the areas of the SPA used by common scoter and if this can be backed up by the Applicant (e.g. though the provision of figures), then the changes to the common scoter population will also not affect the Applicant's assessment for the feature. Red-throated diver: The RTD density data for the Greater Wash SPA has not been altered by the corrections, meaning that the density figures for the offshore cable corridor used by the Applicant of 1.36-3.38 birds/km2 has not altered and hence the numbers of birds at risk of 100% displacement around a 2km buffer from two cable laying vessels remains at between 34 and 85 RTDs. The Applicant has used a 5% mortality rate in their assessment, which has calculated that the numbers of birds at risk of dying is between 2 and 4. The corrected RTD estimated population size for the SPA is 1,407 (rather than 1,511 as used by the Applicant), which means that the natural mortality of the SPA population (based on the 0.228 average mortality rate across all ages used by the Applicant) would be 281 rather than the approx. 300 used by the Applicant, which would result in a slight increase to proportion of baseline mortality figures that the predictions equate to from those calculated in the Applicant's assessment for Vanguard alone. However, it should be noted that NE does not agree with the Applicant's use of a 5% mortality rate, and advises a worst case scenario of 10% mortality. Using the corrected SPA RTD population size of 1,407 and the corrected natural mortality of the SPA population figure of 281 (rather than the approx. 300), the addition of between 3 and 8.5 birds equates to 0.94-2.65% of baseline mortality (our previous calculation based on the original RTD population of 1,511 was 0.87-2.46% of baseline mortality). These new % figures are therefore slightly increased in comparison to those based on the original higher SPA population. However, the change has not materially altered the conclusion that we reached before i.e. that these levels of

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			predicted additional mortality for Vanguard alone when expressed as a % of the baseline mortality level are not insignificant and require further consideration by the Applicant. As noted in our RRs, the in-combination assessment for RTD at the Greater Wash SPA should also consider the potential for displacement from cable laying for Hornsea 3 OWF and that consideration should also be given to the in-combination disturbance/displacement effect on RTD of cable laying with the currently constructed or consented wind farms within the Greater Wash SPA, not just those consented after Triton Knoll OWF. No further information has been received from the Applicant on this aspect, so this issue still remains and therefore we cannot reach a conclusion regarding the level of impact from in-combination displacement at this stage. Little gull: The corrected little gull estimated population size for the SPA is 1,255 individuals (rather than 1,303 as used by the Applicant). This change would not significantly alter the Applicant's apportionment percentages calculated for apportioning impacts of CRM of little gull to the Greater Wash SPA. However, we note that the issues regarding the CRM remain and therefore we cannot reach a conclusion regarding the level of impact from Vanguard alone at this stage. Therefore, we also recommend that the in-combination collision risk to little gulls from the Greater Wash SPA is revisited once these issues/uncertainties are resolved. No changes have been made to the tern qualifying features, as these were based on colony counts rather than at sea counts.
23.7	NE	Please set out the CRM methodology and data that you consider the Applicant should provide and use in order for you to be able to fully determine whether or not there would be no AEOI for the Greater Wash SPA.	For determining whether or not there would be no Adverse Effect On Integrity (AEOI) for collision risk from Vanguard alone for the little gull qualifying feature of the Greater Wash SPA, we require the deterministic CRM/Band model to be undertaken using the mean densities of birds in flight rather than the median densities as currently used by the Applicant, together with use of an avoidance rate of 99.2%, the maximum likelihood flight height data from Johnston et al. (2014), a nocturnal activity factor of 2 (Garthe & Hüppop 2004). If the Applicant is to use its R coding for the deterministic model rather than the Band (2012) spreadsheet, then it should provide the full input data required to run the Band model and also the R code that has been used.

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			The uncertainty/variability in the densities of birds in flight, avoidance rates, flight heights and nocturnal activity should also be considered. This should be done either by presenting multiple deterministic/Band model outputs for the different ranges of input parameters, or by using the MSS stochastic CRM (rather than the Applicant's version of a stochastic CRM) and also presenting the deterministic/Band model outputs for using the mean bird density, the maximum likelihood flight height data, a nocturnal activity factor of 2 and an avoidance rate of 99.2%, to see whether the stochastic model predictions are similar to these for the central values.
23.10	NE	In your RR [RR-106] you have advised that you cannot complete any in-combination assessment relating to marine mammal disturbance until the Review of Consents is completed. The Examining Authority (ExA) understands that the Department for Business, Energy and Industrial Strategy has published a draft HRA for consultation. Taking this into account, are you now able to provide further comment on potential impacts to marine mammals of the Southern North Sea cSAC?	The Department for Business, Energy and Industrial Strategy (BEIS) published a draft Habitats Regulations Assessment (HRA) of their review of consents (RoC) in autumn 2018 and Natural England submitted a response to this on 13 December. In our response we advised that the draft assessment had not covered sufficient scenarios so we are of the view that the in combination assessment is not yet sufficiently comprehensive. However, despite this, some of the in combination scenarios presented indicate that seasonal noise thresholds for the Site of Community Importance (SCI) as advised by the Statutory Nature Conservation Bodies (SNCBs) could be exceeded by windfarm projects constructing at the same time (and also in conjunction with other noisy activities from other marine sectors). The RoC refers to Vanguard as a Tier 4 project in the in combination assessment, which means there is a low level of confidence in the final design envelope and construction schedule. Despite this, it does show (Fig 52 of the draft HRA) that possible construction of the Vanguard project in 2024-26 overlaps with a number of other offshore wind projects which could also be in construction. This therefore confirms that developers including for the Vanguard project (as well as other industries with noisy activities) may need to include mitigation to reduce the spatio-temporal disturbance footprint (e.g. through the use of noise mitigation systems or alternative foundations, by ensuring the location of simultaneous piling reduces the spatial extent within the SCI, or by looking at concurrent piling in close proximity so the deterrence footprints overlap).

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			In our response to the consultation on the RoC draft HRA we expressed our concern that there remains a lack of clarity on how SIP conditions will ensure that mitigation will be put in place to prevent exceedance of the SNCB thresholds for disturbance. A mechanism will need to be developed by the regulators to ensure continuing adherence to the SNCB thresholds as multiple Site Integrity Plans (SIPs) are developed over time, especially when piling can take place over several years, and new projects can come online during this time. Should potential exceedance of the thresholds occur, a process for dealing with this issue needs to be in place – the affected developers / industries will need to work together with the regulator and SNCBs to prevent adverse effect on the SCI. We advise that this mechanism/regulatory responsibility to control noisy subsea activities is identified and committed to now to ensure that in-combination there will be AEoI, otherwise there is a risk projects proceeding and the likelihood of significant delays. See response to 23.22
23.13	NE	Can you confirm whether or not you agree with the European sites and features screened in by the Applicant, i.e. for which a LSE has been identified.	Natural England generally agrees with the European sites and features screened in by the Applicant, i.e. for which a Likely Significant Effect (LSE) has been identified. However, we disagree with the exclusion of Outer Thames Estuary SPA as it is the view of Natural England that until the operations and maintenance port has been confirmed this site must be screened in.
23.14	NE	Can you provide further details of your concerns with regard to the identification of a LSE for red-throated divers of the Outer Thames Estuary SPA, and please detail how you consider your concerns could be resolved by the Applicant.	The concerns relating to LSE for RTD at the Outer Thames Estuary SPA relate to the possibility of disturbance/displacement of RTDs due to movements of operations and maintenance vessels through the SPA, depending on the operations and maintenance (O&M) port, for which the location is still to be agreed. In the instance that the O&M port location once decided means that vessels will pass through the Outer Thames Estuary SPA, if mitigation measures regarding RTD displacement such as that agreed at East Anglia Three can be agreed with the Vanguard Applicant, then this will remove the likelihood of AEOI for this feature of the SPA.
23.15	Applicant and NE	Please provide comment on whether you consider that	Natural England can confirm that we would consider these activities as mitigation.

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		trenchless crossing (Appendix 5.2, paragraph 86) [APP-047], limited construction hours (Information for the HRA report, paragraph 102) [APP-045], mitigation for noise effects from piling and UXO clearance (Table 8.4) [APP-045] and micrositing to avoid permanent habitat loss (Information for the HRA report, paragraph 67) [APP- 045] should be considered mitigation in light of the judgement in the People over Wind, Peter Sweetman v Coillte Teoranta case C-323/17.	
23.22	NE, MMO, TWT and WDC	The Applicant has proposed a number of mitigation measures within the draft Marine Mammal Mitigation Protocol [APP-037], and the Draft SNS cSAC Site Integrity Plan [APP-041], and it has also proposed that a Marine Pollution Contingency Plan be produced post-consent. The successful delivery of these plans is relied upon for concluding no AEOI, and yet there remains some doubt about the nature and efficacy of some of the proposed measures. Therefore can you please confirm to what extent you are satisfied that the measures referred to in these plans are sufficiently well-defined and	The proposed measures set out within the draft SIP include alternate foundation methodologies, noise mitigation systems, scheduling of pile driving and other relevant technologies or methodologies that may emerge in the future. These are all the sorts of measures that we refer to in our advice above (23.10) in relation to ensuring in combination adverse effects are avoided to the SCI. Therefore we are content that the scope of the measures in the draft SIP is appropriate. There has not yet been a need to adopt these measures in windfarm construction to date therefore they have not been proven to be deliverable. The Applicant will need a clear requirement to agree and secure the necessary measures in the period between consent and the commencement of piling, following an updated assessment of the potential impacts from pile driving and an assessment of their efficacy. Potential strategic management measures such as scheduling of pile driving (section 6.1.3) would need to be carefully managed by the Regulators to achieve a coordinated approach with other developers.

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		deliverable?	
23.24	NE, MMO and WDC	In regard to the Applicant's proposed MMMP for UXO clearance, please indicate the degree of confidence you have in the efficacy of mitigation measures that are yet to be defined.	There is currently little empirical evidence on the range of noise generated by Unexploded Ordnance (UXO) clearance and therefore the potential significance of effect on marine mammals. There is similarly little or no information available to date on the efficacy of mitigation measures, such as use of bubble curtains. Given the potential significance of the impacts, there is a need to gather more evidence and Natural England, the Crown Estate, BEIS and windfarm developers recognise this and are in discussion over ways to do this. If successful, some information should be available before the construction of the Vanguard project and would be included in any updated assessment of the potential effects of UXO clearance and mitigation considered necessary.
23.25	NE	Do you agree that an AEOI can be ruled out for any of the features of any of the European sites for which a LSE has been identified?	No, based on current evidence proposed it is the view of Natural England that adverse effect on integrity cannot be ruled out for any of the features of any of the European sites for which a LSE has been identified.
23.27	NE	Can you set out the extent to which you consider it necessary for your advocated PVA approach to be implemented by the Applicant, and also provide your views on how the approach you advocate may affect the Applicant's findings of no AEOI for the species and sites concerned.	In order for the risk of in-combination/cumulative CRM to be quantified it is key for the PVAs to be undertaken following the approach we have outlined in our RRs. In our RRs we noted a number of issues with the PVA models used by the Applicant, namely: • Models had not been run as 'matched runs/pairs'. Where stochastic PVA models are used, it is important to use a 'matched-runs' approach where a metric is derived for each matched pair of baseline and impacted simulations. Stochasticity is included in the population models, but the survival and productivity rates used for a 'pair' of impacted and un-impacted populations at each time step are matched. This means that the effect that is measured with the metric can be more clearly attributed to the impact, than to model uncertainties such as the variability in the demographic parameters that have been sampled or to observation errors. Cook & Robinson (2017) tested the effect of using unmatched compared to matched runs in PVA models and demonstrated that the median values of the evaluation metrics

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			(counterfactuals of population size and growth rate) predicted greater impacts when a matched runs approach was used compared to when the simulations were unmatched and the uncertainty around the metrics was much greater in the unmatched scenario. Models were run with 1,000 iterations. It may be the case that the median values of the matched versus unmatched runs approach will converge if a larger number of simulations (e.g. 5,000) are used, however the confidence limits are still expected to vary between the two approaches. NE therefore advises that one amendment required to the existing PVA models used by the Applicant is to run the simulations using matched-pairs. • Use of NE recommended metrics - the counterfactual of population growth rate and the counterfactual of population size to quantify the relative changes in a population in response to anthropogenic impacts. NE considers that assessments should focus on the counterfactual of growth rate and the counterfactual of final population size, as these are the two metrics that are, in NE's opinion, least sensitive to mis-specification of the population trend and demographic rates used in the PVA model. These metrics should be calculated at the end of the impact period. Whilst the EIA models for kittiwake and great black-backed gull (GBBG) present the counterfactual of population size they do not present the output for counterfactual of growth rate. The other models utilised do not present outputs for the required metrics. • The existing PVA models used by the Applicant were only run over 25 years and it appears from the submission documents (Chapter 5 of the ES) that the Vanguard project has an indicative project design life of a maximum of 30 years. The Applicant's approach whereby PVA models are run over 25 rather than 30 years would lead to an underestimate of impact, given that if the windfarm has an operational period of 30 years, then potential impacts occurring in the last five years of operation are not being accounted for in the models. • A further issue with deriving the metrics from the existing PVAs is that Applicant has had to select impact levels from those published for Hornsea 2, Galloper etc., which means that the Applicant can only derive metric values from a pre-populated set of impact levels and cannot calculate a metric that

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			is specific to the impact level that they have calculated for Vanguard. The solution to this would be for the Applicant to present models and outputs that have been run/structured in the way recommended and that are run over 30 years and are therefore applicable to Norfolk Vanguard. NE recommends interpreting the metrics from population modelling against a framework of considerations including the Conservation Objectives for that site/population, focal and wider population status, threats and pressures acting on the population and policies which may change the wider population status. Until the modelling is undertaken in the way recommended, we are unable to provide a view on how the advocated approach may affect the Applicant's findings of no AEOI for the species and sites concerned.
23.29	NE	As your RR [RR-106] did not make any mention of the Humber Estuary SAC, The Wash and North Norfolk Coast SAC or Winterton-Horsey Dunes SAC, please can you confirm whether or not you concur with the Applicant's assessment of no AEOI for these sites. If you do not agree, then please set out your specific areas of disagreement.	Natural England can confirm that we support the Applicants conclusions for these sites in relation to the proposals submitted for Norfolk Vanguard
23.30	NE	Do you have any comments to make on the Applicant's screening and integrity matrices submitted in the Applicant's Response to Section 51 Advice from the Planning Inspectorate [AS-006].	Both the availability of the documents and significance of them has been missed by NE until review of the ExA questions that refer to Section 51 Advice document amendments. Unfortunately as they are rather large documents Natural England have not had the chance to review and consider any implications in relation to our advice in time for deadline one especially as one of them is 342 pages long. Therefore, Natural England will review these documents and provide Written Representation at Deadline 2.

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23.34	NE and RSPB	In terms of the seasonal apportioning of impacts for the Alde-Ore Estuary SPA and Ramsar site, what figure do you consider should be applied to lesser black-backed gulls?	**Non-breeding season apportioning** As noted in point 36 of our table of additional detailed comments in Appendix 1 of our Relevant Representations, we agree with the Applicant's use of the figure of 2,000 pairs of LBBG for the Alde-Ore Estuary SPA colony and our preferred approach to the apportionment would be to use the colony figure of 2,000 pairs (or 4,000 adults) and the use of 0.58 (the proportion adults comprise of the population in Furness (2015), i.e. approx. 58%) as used by the Applicant to get the all age colony figure, which we calculate to equal 6,897 – so if 4,000 of these are adults then the remaining 2,897 are immatures. Then using this figure and the information in the relevant tables of Appendix A of Furness (2015), our preferred apportionment calculations are: • Autumn migration: number of Alde-Ore SPA adult LBBG in North Sea and Channel BDMPS = 100% = 4,000 and the total number of birds of all ages in the BDMPS = 209,007. So the proportion of Alde-Ore SPA adult birds = (4,000/209,007) x 100 = 1.9%. The number of Alde-Ore SPA LBBG of all ages in the North Sea and Channel BDMPS = 100% of adults and 70% of immatures = 4,000 + 2,028 = 6,028. So the proportion of Alde-Ore SPA birds of all ages = (6,028/209,007) x 100 = 2.9%. Both of the figures above are lower than the 3.3% apportionment figure for the autumn used by the Applicant in their report of Information for the Habitats Regulation Assessment and the Applicant's approach can be considered precautionary. • Winter: number of Alde-Ore SPA adult LBBG in North Sea and Channel BDMPS = 50% = 2,000 and the total number of birds of all ages in the BDMPS = 39,314. So the proportion of Alde-Ore SPA adult birds = (2,000/39,314) x 100 = 5.1%. The number of Alde-Ore SPA LBBG of all ages in the North Sea and Channel BDMPS = 50% of adults and 5% of immatures = 2,000 + 145 = 2,145. So the proportion of Alde-Ore SPA birds of all ages = (2,145/39,314) x 100 = 5.5%. Both of the of the figures above are close to the 5% apportionment figure for

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			the winter season used by the Applicant in their report of Information for the Habitats Regulation Assessment and the Applicant's approach can be considered reasonable. • Spring migration: number of Alde-Ore SPA adult LBBG in North Sea and Channel BDMPS = 100% = 4,000 and the total number of birds of all ages in the BDMPS = 197,483. So the proportion of Alde-Ore SPA adult birds = (4,000/197,483) x 100 = 2.0%. The number of Alde-Ore SPA LBBG of all ages in the North Sea and Channel BDMPS = 100% of adults and 70% of immatures = 4,000 + 2,028 = 6,028. So the proportion of Alde-Ore SPA birds of all ages = (6,028/197,483) x 100 = 3.1%. Both of the figures above are lower than the 3.3% apportionment figure for the spring used by the Applicant in their report of Information for the Habitats Regulation Assessment and the Applicant's approach can be considered precautionary. **Breeding season apportioning** In our Relevant Representations we raised a number of concerns regarding the Applicant's approach to the derivation of the 25% apportionment figure used to account for the contribution of the Alde-Ore Estuary SPA colony of LBBGs to the numbers of birds seen at Norfolk Vanguard during the breeding season: • The figure of 25% used by the Applicant for the breeding season is based on simply summing the totals of counts from LBBG colonies within foraging range of Vanguard (141km mean-maximum range in Thaxter et al. 2012) and that this approach does not take account of the distance each colony is from Vanguard or segregation, which apportioning approaches should do. • There may have been some LBBG colonies within foraging range that have not been included in the Applicant's summed figure, which should be considered. • Given the potential for roof nesting urban colonies to be controlled, we

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			were uncertain about the Applicant's approach to doubling the summed urban colonies figure based on the age of data, and the Applicant's assertion that these colonies would have significantly increased in the interim. NE has not received any further discussions/clarifications from the Applicant regarding resolving our concerns on these issues. As highlighted in Section 3 of the offshore ornithology annex of our Written Representations, we recommend that the Applicant considers our concerns raised in our RR and revisits its approach to apportioning of LBBG to the Alde-Ore Estuary SPA during the breeding season, including reviewing the merits of previous approaches undertaken for apportionment to account for the contribution of SPA colonies to the numbers of birds seen at marine renewable development sites during the breeding season, including the approach outlined in the SNH interim guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs, updated November 2018 (SNH 2018) and that undertaken by Natural England during the Galloper offshore wind farm examination (Natural England 2012) We also advise that the Applicant give consideration to the degree to which LBBG distributions are influenced by at-sea foraging area segregation (Bolton et al. 2018). There is the possibility that the Vanguard development areas may in fact be used predominantly or nearly exclusively by birds originating from the nearest relatively large colony due to segregation of resources amongst colonies (Bolton et al 2018), although this would need to be considered in the context of the RSPB's representations regarding the potential for urban gull colonies to show different foraging habits to more traditional, coastal colonies
23.40	NE	Can you please provide reasons in support of your statement that you cannot rule out an AEOI on auks at Flamborough and Filey Coast SPA, and confirm which impacts this would be in relation to.	The Applicant has considered in their Report to Inform Appropriate Assessment that because no significant cumulative displacement impacts were identified for auks at EIA in the ES, the same conclusion about the risk of displacement effects applies to the FFC SPA auk populations. The Applicant has therefore concluded that the potential for an LSE on the SPA populations of these species due to in-combination displacement is negligible and no further assessment is required. As noted in NE's RRs, the Applicant has considered that a value of 1% mortality when combined with the 70% displacement rate is considered

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			appropriate for assessment of cumulative displacement for auks in the ES. As definitive mortality rates associated with displacement for seabirds, including auks are not known, therefore we advise consideration of a range of mortality rates are used in assessments. Whilst we agree that the mortality for auks is likely to be at the low end of the range, we do not agree that using 1% mortality for the cumulative (and hence in-combination) assessment (with 70% displacement) can be considered the worst case scenario. Therefore, our recommendation is a range of mortality rates of 1-10% and displacement rates of 30-70%, with 70% displacement and 10% mortality as the worst case. We noted in our RRs that within the Natural England assessment scenario of 30% displacement and 1% mortality to 70% displacement and 10% mortality, a number of the annual predicted cumulative additional auk mortalities equate to greater than 1% of baseline mortality of both the largest BDMPS and the biogeographic populations. This is not insignificant and we again advise further consideration be given to this once the figures are agreed. In turn, this undermines the logic regarding auk displacement in the Report to Inform HRA, which is essentially that because there is no significant cumulative displacement impact at EIA, there is no possibility of a LSE at the site level. Therefore, we advise that once the figures are agreed and the summed figures accurately presented that the assessment and conclusion of the LSE screening for auk in-combination displacement from FFC SPA is reviewed by the Applicant.
23.41	NE	Can you explain why you do not agree with the Applicant's approach in the Information for the HRA report [APP-045] in which a LSE for common scoter is screened out for the Greater Wash SPA.	As noted in our the ornithology Appendix of our RRs, we welcome that the Applicant has given consideration in its Information for the HRA report to the distribution of common scoter (and foraging terns) and how these distributions may overlap with the offshore cable corridor. We would suggest that the Applicant provides a figure(s) to back up these statements. However, we consider that the LSE screening should be a coarse filter and as the offshore cable route passes through the Greater Wash SPA, this would indicate a potential impact pathway for species sensitive to disturbance/displacement from the presence of vessels and hence an LSE concluded for the common scoter, RTD and tern qualifying features. The analysis of whether the cable corridor overlaps spatially with the distributions of these species should then be considered within the Appropriate Assessment.

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23.43	NE	In relation to red-throated diver for the Outer Thames Estuary SPA, please clarify whether all of the concerns noted in section 4.2.6 of your RR [RR-106] apply or just the concern with regard to vessel movements.	To clarify just the concern with regard to vessel movements from the operational phase and how these may be mitigated apply for red-throated diver for the Outer Thames Estuary.
23.47	MMO, NE, WDC, TWT	In light of the information contained in the Change Report [AS-009], and in particular the amended proposal for up to 36 piles in total for the two offshore electrical platforms and an increase in the diameter of the pin piles from 3m to 5m, please confirm whether you concur with the findings contained in the ES and the Change Report.	Natural England is supportive of the general approach set out in the change report, and broadly agrees with the conclusions presented. However, we have the following additional comments: a) In-combination – The change report does not fully detail how these changes may impact any in-combination assessment. Whilst it is the view of Natural England that this increase is unlikely to alter the conclusions laid out in the original application you should undertake this assessment and present the results. b) Temporal WCS - The Applicant states in paragraph 36 of the change report 'In addition to the spatial extent of underwater noise impacts, consideration was also given to the temporal worst case scenario (wcs). The ES assessed a total duration of 1,260 hours of piling activity (equivalent of 52.5 days), for all project infrastructure which could be piled over a 4 year construction duration.' However, table 2.8 details a WCS of 59 days. Therefore the Applicant should clarify this discrepancy. c) There are no units against 'average piling time per foundation' in table 2.2. Whilst it has been assumed that this is in hours this should be confirmed by the applicant. A full copy of our response to the Applicant in this regard can be found in Annex D.
23.48	Applicant Natural England	Confirm the extent to which you consider the HRA report is legally compliant in light of the judgment in People over Wind,	It is the opinion of Natural England that for the most part the HRA is legally compliant in light of Sweetman ruling as long as all documents and mitigation requirements are secured in DCO/DML. The Applicant should ensure this happens based on final discussions.

		Question:	NE Comments
		Peter Sweetman v Coillte Teoranta Case C-323/17.	However, the current mechanism in place for in-combination impacts on Southern North Sea SCI / cSAC is currently not compliant. This can only be secured through outcome of Review of Consents and a mechanism to ensure that management thresholds for the SAC are not exceeded. Natural England are unable to comment further on this until the RoC has been undertaken.
23.49	Applicant Natural England	Appendix 5.2 of the HRA Report screened out likely significant effects at Broadland SPA and Ramsar site on the basis of low numbers of wintering birds but, NE (Appendix 4 #12) [RR-106] suggests that the low numbers were due to the cropping regime at the time of the survey. (i) Please comment on the feasibility of conducting further surveys to optimise the accuracy of numbers of wintering birds by the time the examination closes. (ii) What would 'suitable mitigation measures' comprise and how would they be secured? (iii) If no additional measures were to be implemented, can NE confirm whether it agrees with the Applicant's conclusion of no LSE at Broadland SPA and Ramsar site? If the answer to (iii) is no, the	(i) Unless the Applicant commenced these surveys in Sept 2018 and these surveys are ongoing until Spring this year there isn't sufficient time within examination process to conduct further surveys to optimise the accuracy of numbers of wintering birds. (ii) NE would defer to the Applicant to identify mitigation measures and would suggest the ExA direct this question to Local Planning Authority (LPA) to determine how to secure them. (iii) Natural England considers that further work on non-seabird migration modelling and hence CRM needs to be undertaken, particularly regarding Broadland and Breydon SPAs. We would also again suggest the CRM is undertaken again using the Vanguard turbine specifications and site locational information. There may also be a need to consider cumulative CRM impacts on non-seabird migrants as Vanguard East is located immediately north of East Anglia 3 and so birds migrating north and south may encounter both sites. Also if Vanguard is built across both Vanguard East and Vanguard West then birds migrating east-west as could encounter both sites. Therefore, we advise that once the figures are agreed and the summed figures accurately presented that the assessment and conclusion of the LSE screening is reviewed by the Applicant. (iv) Natural England requires further information from the

		Question:	NE Comments
		ExA is mindful of the need to consider the Sweetman judgement which stipulates that mitigation should not be taken into account at the screening stage. As such, does NE suggest that there would be a LSE on the Broadland SPA and Ramsar site? If this is the case, for which features and which potential impacts? Is NE content that there would be no adverse effect on integrity?	Applicant in order to determine LSE or AEOI, including further work on non-seabird migration modelling and CRM.
23.50	Natural England	Do you consider there are potential likely significant effects for non-seabird migrants of Broadland and Breydon SPA and North Norfolk Coast SPA? If so, for which qualifying features and which potential impacts?	Natural England considers that further work on non-seabird migration modelling and hence CRM needs to be undertaken, particularly regarding Broadland and Breydon SPAs. We would also again suggest the CRM is undertaken again using the Vanguard turbine specifications and site locational information. There may also be a need to consider cumulative CRM impacts on non-seabird migrants as Vanguard East is located immediately north of East Anglia 3 and so birds migrating north and south may encounter both sites. Also if Vanguard is built across both Vanguard East and Vanguard West then birds migrating east-west as could encounter both sites. Therefore, we advise that once the figures are agreed and the summed figures accurately presented that the assessment and conclusion of the LSE screening is reviewed by the Applicant.
23.53	Natural England	Please clarify whether Likely Significant Effects (LSE) should be identified for Wash and North Norfolk Coast SAC, Winterton-Hersey Dunes SAC and Humber Estuary SAC and if so why? Confirm otherwise whether you agree with the onshore European	We do not have any outstanding concerns regarding Wash and North Norfolk Coast SAC, Winterton-Horsey Dunes SAC and Humber Estuary SAC. We agree that the following onshore European sites as identified by the Applicant should be screened in: • River Wensum SAC; • Paston Great Barn SAC;

		Question:	NE Comments
		sites and features screened in by the Applicant for which a LSE has been identified?	• Norfolk Valley Fens SAC, and; • The Broads SAC. In our Relevant Representations submitted on 31 August 2018, Para 2.2 we outlined the features for which outstanding concerns remain. We also advise that Natural England does not consider it appropriate that no further work on non-seabird migration modelling and hence CRM has been undertaken since East Anglia 3. Whilst the sites may be of a similar area to the East Anglia 3 site, there are coastal SPAs with wintering waterbirds that are qualifying species that are in the shadow of the Vanguard sites – particularly •Broadland SPA •Breydon Water SPA, •and potentially also the North Norfolk Coast SPA. These sites should therefore also be screened in.
23.56	Natural England	Please provide further clarification in relation to your RR (para 4.5.12) [RR-106]. In particular why, in relation to Norfolk Valley Fens SAC, should horizontal directional drilling be required for the watercourses which feed into Blackwater Drain, given that [RR-106] Appendix 4 para 90 states the qualifying features of the SAC at Booton Common are water sensitive habitats reliant on the groundwater supply and not surface water from the Blackwater Drain?	4.5.12 'There appears to be 2 Horizontal Directional Drilling (HDD) sites very close to Blackwater Drain tributary crossings (Norfolk Vanguard Information to Support HRA Figure 9.6), and we are unsure as to why HDD cannot be undertaken for the watercourses which feed into Blackwater Drain rather than the trenched crossings which are proposed'. Appendix 4 Para 90 states 'The qualifying features of the Norfolk Valley Fens SAC present at Booton Common are water-sensitive habitats reliant on the groundwater supply and not surface water from the Blackwater Drain to maintain their structure and function as stated. Measures to safeguard water quality should be employed at watercourse crossings As the crossing sites are upstream of the Booton Common SSSI, and the Wensum SSSI, the use of HDD may reduce the potential for any pollution and water quality issues on the designated sites. However, the final project design should be informed by potential impacts on water dependant designated sites. Natural England provided comment on Appendix 2 Clarification Note: Norfolk Vanguard Water Dependent Designated Sites to the Applicant on 08 January 2018. The information

		Question:	NE Comments
			provided within Appendix 2 does not currently contain sufficient information or detail to ascertain potential effects on water dependant designated sites, and does not reference WETMECS as identified by the EA. If the installation of the cable route may affect the water supply to these sites, then a detailed assessment should be undertaken and mitigation measures implemented to minimise any identified effects.
23.58	Natural England	Clarify what further detail in the outline Code of Construction Practice [APP-025] you consider necessary in relation to sediment control and reinstatement of work areas to safeguard designated sites, specifying the measures for each site where further detail is considered to be required,	Our Relevant Representation 4.5.3. states that 'There is insufficient detail in the Code of Construction Practice (CoCP) for measures to safeguard the designated site in relation to sediment control and reinstatement of all work areas. In addition, detailed management and monitoring procedures should be provided in the CoCP in case of 'breakout' (where the drilling fluid leaves the bore and escapes into the surrounding substrate). Paragraph 1166 within the Information for the Habitats Regulations Assessment sets out a number of mitigation measures that will be put in place to minimise the risk of sediment or pollutant release into the watercourses which are functionally connected to the River Wensum. However, as raised in our Relevant Representations No 67., none of the points regarding sediment management and decommissioning of sediment traps post construction highlighted in Para 1166 are detailed in the current CoCP. Details of actual methods employed are needed in relation to sediment control, and reinstatement of all work areas. Interceptor drains are an important part of sediment control and therefore need to be combined with sediment management measures in 11.1.1. In relation to onshore ecology 22.7.6.6.2, Para 371 and Para 372, waiting for natural regeneration to occur leaves areas at risk of erosion and/or colonisation by invasive or injurious weeds. More proactive reinstatement will be needed, appropriate to the existing and adjacent vegetation, e.g. replacing turfs or reseeding with appropriate species mix. Effective development and delivery of these plans will be crucial to achieve

		Question:	NE Comments
			the required mitigation. Plans will need to be site specific, not just generic across the whole work area. Further detail is required for: • River Wensum SAC • Norfolk Valley Fens SAC • The Broads SAC • SSSIs downstream including, Dillington Carr, Gressenhall SSSI and River Wensum SSSI
23.61	Natural England	In [RR-106] you state that you do not agree that adverse effects on integrity (AEOI) can be excluded for any of the sites assessed by the applicant. Do you agree that an AEOI can be ruled out for any of the features of any of the onshore European sites for which a LSE has been identified?	Our Relevant Representations (Paragraph 3.1.2) states that' On the basis of information submitted, Natural England is not satisfied that it can be concluded beyond all reasonable scientific doubt that the project would not have an adverse effect on the integrity of' a number of terrestrial sites namely: • River Wensum SAC; • Paston Great Barn SAC; • Norfolk Valley Fens SAC, and; • The Broads SAC. Features for which concerns remain are: **River Wensum SAC** Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Desmoulin`s whorl snail *Vertigo moulinsiana*; **Paston Great Barn SAC** Barbastelle *Barbastella barbastellus* **Norfolk Valley Fens SAC** Alkaline fens; Northern Atlantic wet heaths with *Erica tetralix*

		Question:	NE Comments
			European dry heaths Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*) Narrow-mouthed whorl snail *Vertigo angustior* Desmoulin`s whorl snail *Vertigo moulinsiana* **The Broads SAC** Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation Transition mires and quaking bogs Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* Alkaline fens Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) Desmoulin`s whorl snail *Vertigo moulinsiana* Fen orchid *Liparis loeselii* Ramshorn snail *Anisus vorticulus* From the information provided, we are satisfied that there is unlikely to be a significant effect on Annex II species Otter *Lutra lutra* associated with The

		Question:	NE Comments
			Broads SAC.
23.62	Natural England	Confirm whether your concerns relating to Norfolk Valley Fens SAC and the Broads SAC and Ramsar apply to all features?	Features for which outstanding concerns remain are listed below and outlined in our Relevant Representations (2.2.2). **Norfolk Valley Fens SAC**: Alkaline fens; Northern Atlantic wet heaths with *Erica tetralix* European dry heaths Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) Narrow-mouthed whorl snail *Vertigo angustior* Desmoulin`s whorl snail *Vertigo moulinsiana* **The Broads SAC and Ramsar:** Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation Transition mires and quaking bogs Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* Alkaline fens Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae)* *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)

		Question:	NE Comments
			Desmoulin`s whorl snail *Vertigo moulinsiana* Fen orchid *Liparis loeselii* Ramshorn snail *Anisus vorticulus* Not Annex II species Otter *Lutra lutra*
24.	**Onshore Ecology**		
24.3	Natural England	Significant limitations to the onshore ecological surveys are identified in Paragraphs 82-83 of Chapter 22 ES – APP-347] due to landowner access not being possible for the entire onshore project area. A precautionary approach is said to be adopted where survey data is not available. Please confirm that, notwithstanding your comments on the River Wensum, Norfolk Valley Fens and The Broads SACs, you are satisfied that the Applicant's ecological assessment has been undertaken in a sufficiently precautionary manner and that appropriate mitigation has been developed and secured.	Chapter 22 states that access for field surveys was only gained for 50% of the onshore project area and was conducted outside the optimal survey period. We are satisfied that the great crested newt (GCN) plans reflect our advice given earlier in the year. The report identifies where licenses may be required for bats and water voles. We advise that the procedure outlined for badger main setts within the project area which require to be closed and destroyed (para 408) should include other types of setts which may be found within (previously un-surveyed) areas of the project area. Nesting and ground nesting birds should be included with OLEMS measures to safeguard protected species if they are unexpectedly found, i.e. work to cease immediately. We therefore do not agree that appropriate mitigation has been developed or secured in the CoCP or Outline Landscape and Environmental Management Strategy (OLEMS) as yet. We advise that any future ecological assessments undertaken cover a greater area and are conducted within the optimum survey window. This requirement should be included within any DCO and the Applicant should refer to Natural England's EPS standing advice for further details.
24.9	Natural England	Confirm, in light of your comments at Appendix 4, point	Natural England's Relevant Representation point 14 states that 'We agree that there will be a temporary, long term loss of habitats along the cable route

		Question:	NE Comments
		14 of your RR [RR-106] whether you agree with the Applicant's assessment of residual significance in the onshore ornithology chapter and, if not, why not?	which support wintering and breeding birds. Whilst arable land can be re-instated fairly quickly, hedgerow habitat will take up to 7 years to re-establish. In addition to direct habitat loss, there is the potential to disturb birds during construction from noise and human presence. Again, no detailed noise assessment appears to have been carried out. The residual impact in the ornithology chapter has been assessed based on embedded mitigation and project commitments made during the design process. In light of the Sweetman ruling mitigation measures should not be considered as part of the project, and the screening stage of HRA should not take account of them. Natural England do not currently agree with the residual impact for birds • Impacts to wintering / on passage bird species • Impacts to breeding bird species • Bird species during operational lighting and noise as identified in Chapter 23 Table 23.32. The Applicant has not conducted a noise survey and mitigation outlined as part of the design has not been successfully incorporated or detailed in the CoCP or OLEMS. Further measures should be included in OLEMS to deal with the risk of damaging or destroying ground nesting birds (i.e. skylarks) during construction.
24.15	Natural England	Comment on the Applicant's approach to the assessment in light of the gaps to surveys identified.	Further Assessments should be undertaken during the optimum survey window and provide a good coverage of the rochdale envelope.

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THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex B: Natural England detailed advice on offshore ornithology

16 January 2019

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1. Introduction

1.1. In this appendix Natural England has set out what we consider to be the main issues in relation to the assessment of ornithology associated with the offshore elements of Norfolk Vanguard Offshore Wind Farm application, drawing upon information contained in the original application documents.

1.2. Natural England has identified a number of areas of uncertainty within the original offshore ornithological information provided by the Applicant. In our Relevant Representations, Natural England set out the main issues in relation to offshore ornithology in detail. This Written Representation is intended to provide more detail on certain issues raised in our Relevant Representations and any updates on those issues. Where relevant this Written Representation will refer to the specific sections of the Relevant Representation.

1.3. It is our understanding that a draft SoCG for Offshore Ornithology between Natural England and the Applicant will be submitted at Deadline 1. As noted in the main body of our Written Representations, Natural England has not reviewed any new submissions from the Applicant. The SoCG therefore highlights those matters that are still outstanding between the two parties.

1.4. Following a review of the environmental material submitted by the Applicant, in our Relevant Representations Natural England identified the key issues as:

a. Seasonal definitions for lesser black-backed gull (LBBG) and gannet;
b. Seasonal apportionment of impacts for HRA in non-breeding seasons to the relevant SPA colonies and in the breeding season for LBBG at the Alde-Ore Estuary SPA and kittiwake at the Flamborough and Filey Coast (FFC) SPA;
c. Assessment of displacement impacts regarding consideration of uncertainty and variability and red-throated diver assessments;
d. Collision risk modelling (CRM);
e. Cumulative and in-combination assessments (displacement and CRM); and
f. Population modelling approaches (Environmental Impact Assessment, EIA and Habitats Regulations Assessment, HRA).

1.5. As per Natural England's Relevant Representation the colour coding of specific points indicates the significance of the advice (red – major concerns; amber – moderate concerns; green – minor comments).

2. Seasonal Definitions for Lesser Black-backed Gull (LBBG) and Gannet

2.1. In our Relevant Representations, Natural England raised some issues/queries regarding the seasonal definitions used by the Applicant for LBBG and gannet, namely:

a. That the most appropriate breeding season definitions to use for these two species was the full breeding season defined in Furness (2015) rather than the migration free breeding season.

b. In such instances, where the full breeding season is used to define the breeding season, there will then be overlap of months considered in both the full breeding season and the non-breeding seasons (e.g. with autumn and spring migration seasons). In cases where this occurs we advise that the non-breeding periods are adjusted accordingly to exclude these months.

c. It was unclear whether the Applicant had applied this approach for the seasonal LBBG collision impact figures they had presented and only the migration free breeding season had been used for gannet assessments.

2.2. No further information has been received from the Applicant regarding these aspects. Therefore, our queries remain. Please refer to paragraphs 4.2-4.2.1 of our Relevant Representations and to points 1.1 for LBBG and 1.2 for gannet of our table of key concerns in Appendix 1 of our Relevant Representations for further information on these issues.

3. Seasonal apportionment of impacts for HRA

Apportioning of impacts in the non-breeding seasons to relevant SPA colonies

3.1. No further information has been received from the Applicant regarding the issues/queries raised regarding this issue. However, as noted in our Relevant Representations (paragraph 4.2.2 of our Relevant Representations and point 2.1 of our table of key concerns in Appendix 1 of our Relevant Representations), we advised that for the apportionment of impacts of species to relevant SPA colonies during the non-breeding seasons, the data presented in the tables in Appendix A of Furness (2015) for the relevant species Biologically Defined Minimum Population Scales (BDMPSs) for each season (e.g. migration, winter etc.) are used. Whether the colony figure in the BDMPS tables used is the adult figure or that for all ages depends on any Population Viability Analysis (PVA) model and outputs to be used.

3.2. **LBBG at Alde-Ore Estuary SPA**

Our standard advice regarding apportionment of impacts in the non-breeding seasons to relevant colonies is set out in point 3.1 above. The approach taken by the Applicant for apportioning impacts in the non-breeding season for LBBG for the Alde-Ore Estuary SPA colony departs from this standard practice. However, in this instance the Applicant's approach does not appear to make a significant difference to the apportionment figures in the non-breeding season that result from taking the Natural England advised approach.

3.3. **Gannet at Flamborough and Filey Coast (FFC) SPA**

Our standard advice regarding apportionment of impacts in the non-breeding seasons to relevant colonies is set out in point 3.1 above. However, as noted in our Relevant Representations (paragraph 4.2.2 of our Relevant Representations and point 2.1 of our table of key concerns, and point 42 of our table of additional detailed comments in Appendix 1 of our Relevant Representations), it is unclear from the Vanguard assessment documents what BDMPS figure has been used in the non-breeding season apportionment of gannets to the FFC SPA. In addition, further information was required as to the FFC SPA colony population used in these calculations, and confirmation was required that the BDMPS population estimates used are those presented in Furness (2015) for the North Sea and Channel BDMPSs. No further information has been received from the Applicant on this issue.

3.4. **Kittiwake at Flamborough and Filey Coast (FFC) SPA**

We note that the approach taken by the Applicant is consistent with our standard advice outlined in point 3.1 above. We advise that the same approach is taken for gannet for FFC SPA.

Apportioning of impacts in the breeding season for LBBG at the Alde-Ore Estuary SPA

3.5. Since the submission of our Relevant Representations, no further information has been provided by the Applicant in response to the concerns that we raised regarding their approach to the derivation of the 25% apportionment figure used to account for the contribution of the Alde-Ore Estuary SPA colony of lesser black-backed gulls (LBBGs) to the numbers of birds seen at Norfolk Vanguard during the breeding season. Therefore, our concerns remain.

3.6. As presented in Natural England's Relevant Representation (see paragraph 4.2.3 and point 2.2 of our Table of key concerns, and point 32 of our Table of additional detailed comments in Appendix 1), our concerns were that:

- The figure of 25% used by the Applicant for the breeding season is based on simply summing the totals of counts from LBBG colonies within foraging range of Vanguard (141km mean-maximum range in Thaxter et al. 2012) and that this approach does not take account of the distance each colony is from Vanguard or segregation, which apportioning approaches should do.
- There may have been some LBBG colonies within foraging range that have not been included in the Applicant's summed figure, which should be considered.
- Given the potential for roof nesting urban colonies to be controlled, we were uncertain about the Applicant's approach to doubling the summed urban colonies figure based on the age of data, and the Applicant's assertion that these colonies would have significantly increased in the interim.

3.7. We note various approaches have been previously undertaken for apportionment to account for the contribution of SPA colonies to the numbers of birds seen at marine renewable development sites during the breeding season, including:

a. That undertaken by Natural England during the Galloper offshore wind farm examination (Natural England 2012); and

b. SNH interim guidance on apportioning impacts from marine renewable developments to breeding seabird populations in SPAs, updated November 2018, available from: https://www.nature.scot/sites/default/files/2018-11/Guidance%20-%20Apportioning%20impacts%20from%20marine%20renewable%20developments%20to%20breeding%20seabird%20populations%20in%20SPAs_0.pdf.

3.8. We therefore advise that the Applicant considers our concerns and revisits its approach to apportioning of LBBG to the Alde-Ore Estuary SPA during the breeding season, including reviewing the merits of the approaches highlighted in 3.7 above. The Applicant should also give consideration to the degree to which LBBG distributions are influenced by at-sea foraging area segregation (Bolton et al. 2018). There is the possibility that the Vanguard development areas may in fact be used predominantly or nearly exclusively by birds originating from the nearest relatively large colony due to segregation of resources amongst colonies (Bolton et al 2018), although this would need to be considered in the context of the RSPB's representations regarding the potential for urban gull colonies to show different foraging habits to more traditional, coastal colonies.

Apportioning of impacts in the breeding season for kittiwake at the FFC SPA

3.9. In our Relevant Representations, we raised some concerns regarding the 16.8% apportionment figure used by the Applicant to account for the contribution of the FFC SPA colony of kittiwakes to the numbers of birds seen at Norfolk Vanguard during the breeding season. We advised that the Applicant considers the further tagging of kittiwakes from the FFC SPA colony that was undertaken in 2017 and

then revisits the kittiwake breeding season apportioning following consideration of this data. For further details on this, please refer to:

- Paragraph 4.2.4 of our main Relevant Representations;
- Point 2.3 of our table of key concerns in Appendix 1 of our Relevant Representations; and,
- Point 53 of our table of additional detailed comments in Appendix 1 of our Relevant Representations.

3.10. No further information has been received from the Applicant regarding the issues raised around this issue and therefore our advice remains the same as that presented in our Relevant Representation.

4. Assessment of Displacement Impacts

Lack of consideration of confidence intervals in bird abundance data for displacement assessments

4.1. As detailed in our Relevant Representation (see paragraph 4.2.5), the Applicant has not considered the variability (uncertainty) in the underlying population estimates (i.e. through consideration of appropriately calculated upper and lower confidence intervals) in the displacement assessments for construction or operation.

4.2. However, as noted in point 3.1 of our table of key concerns in Appendix 1 of our Relevant Representations (Offshore Ornithology Appendix), as the confidence limits are presented in the tables in Annex 1 of Appendix 13.01 of the Applicant's submission documents, Natural England has considered these figures as well.

4.3. For EIA construction displacement, the range of predicted impacts if the confidence limits are considered does not alter the conclusions made by the Applicant for any species for displacement due to construction. See point 3.1 of our table of key concerns in Appendix 1 of our Relevant Representations.

4.4. The same is true for EIA assessments of operational displacement for all species (gannet and auks), with the exception of red-throated diver, which is for a variety of reasons detailed below. Again, see point 3.1 of our table of key concerns in Appendix 1 of our Relevant Representations.

4.5. Therefore, no further work is required by the Applicant to address this issue regarding all species for EIA construction displacement or gannet and auks (guillemot, razorbill and puffin) for EIA operational displacement assessments.

Red-throated diver (RTD) displacement assessments

4.6. In our Relevant Representations we noted errors in the data presented in the operational displacement matrices for the Vanguard West site for RTD, as the figures presented in the submission documents appeared to be only for birds on the water and did not include birds in flight. See part a) of paragraph 4.2.6 of our Relevant Representations and point 3.2 of our table of additional detailed comments in Appendix 1 of our Relevant Representations.

4.7. No further clarification has been provided by the Applicant on this issue, and therefore our advice remains the same as that presented in our Relevant Representation.

4.8. We also noted in our Relevant Representation that we did not agree with the 80% displacement and 5% mortality rates used by the Applicant in the assessments of operational displacement for RTD for EIA. See part b of paragraph 4.2.6 of our Relevant Representations and point 3.3 of our table of additional detailed comments in Appendix 1 of our Relevant Representations. However as the full EIA operational displacement matrices of up to 100% displacement and 100% mortality have been presented by the Applicant in their original submission document, Natural England has been able to calculate the figures we believe are the appropriate impact predictions based on our preferred worst case scenario of 100% displacement and 10% mortality rates for

Vanguard East (this has not been possible for Vanguard West due to the errors identified in the seasonal abundance estimates used in the displacement matrices for this site):

a. In the autumn migration period if 100% of the turbines are constructed in Vanguard East, a maximum of 5 birds are predicted to die (rather than 2 as estimated by the Applicant for 80% displacement and 5% mortality), which equates to 0.17% of baseline mortality for the spring BDMPS population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter.

b. In the winter period if 100% of the turbines are constructed in Vanguard East, a maximum of 3 birds are predicted to die (rather than 1 as estimated by the Applicant for 80% displacement and 5% mortality), which equates to 0.13% of baseline mortality for the winter BDMPS population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter.

c. In the spring migration period if 100% of the turbines are constructed in Vanguard East, a maximum of 12 birds are predicted to die (rather than 5 as estimated by the Applicant for 80% displacement and 5% mortality), which equates to 0.40% of baseline mortality for the spring BDMPS population (from Furness 2015), which would not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter.

d. If 100% of the turbines are constructed in Vanguard East and using the Natural England preferred worst case scenario of 100% displacement and 10% mortality, the summed annual mortality for EIA operational displacement equals a maximum of 20 birds (5+3+12) predicted to die, which when assessed against the largest BDMPS population (from Furness 2015) equates to 0.66% of baseline mortality, or when assessed against the biogeographic population (from Furness 2015) equates to 0.32% of baseline mortality. This level of impact would not change the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. However, using the upper and lower confidence limits of the population estimates means that for Vanguard East using the Natural England preferred worst case scenario of 100% displacement and 10% mortality an annual prediction of an additional 20 individuals (range from CLs: 0-57 birds) equates to 0.66% (range from CLs: 0.00-1.88%) of baseline mortality for the largest BDMPS and to 0.32% (range from CLs: 0.00-0.93%) of baseline mortality for the biogeographic population. The figures using the upper CLs are not insignificant and require further consideration by the Applicant.

4.9. In the absence of any further clarification/discussion from the Applicant regarding the errors identified with the Vanguard West RTD operational displacement matrices, it has not been possible for us to calculate the overall EIA operational displacement impact of Vanguard East + Vanguard West combined using the Natural England preferred 100% displacement and 10% mortality scenario. We note however that red-throated diver densities are

generally higher in Vanguard West, and therefore displacement impacts are likely to be greater for Vanguard West compared to Vanguard East

4.10. We also advise that the Natural England preferred worst case scenario of 100% displacement and 10% mortality is used for assessing displacement effects of cable laying activities on RTD (both for EIA and HRA) (see part b of paragraph 4.2.6 of our Relevant Representations). Again, no further information has been received from the Applicant regarding this issue. However, based on the information provided by the Applicant in their submitted ES Offshore Ornithology Chapter, for the EIA displacement assessment of construction of the export cable for a worst case scenario of 100% displacement and 10% mortality, a maximum of between 3 and 8.5 RTDs would be expected to die (rather than between 2 and 4 birds as calculated by the Applicant for an 80% displacement and 5% mortality scenario). As noted in point 3.3 of our table of key concerns in Appendix 1 of our Relevant Representations, this does not alter the conclusion of a minor adverse impact made by the Applicant in their submitted ES Offshore Ornithology Chapter. Therefore, no further work is required by the Applicant to address this issue regarding EIA RTD displacement during construction of the offshore export cable.

4.11. As noted in point 64 of our table of additional detailed comments in Appendix 1 of our Relevant Representations, using the Natural England worst case scenario of 100% displacement and 10% mortality for assessment of offshore cable laying disturbance/displacement for Vanguard alone on RTD within the Greater Wash SPA predicts between 3 and 8.5 birds will die, which equates to 0.87-2.46% of baseline mortality, which is not insignificant and may not result in no adverse effect on site integrity and requires further consideration by the Applicant. However, at this stage, no further information has been received from the Applicant regarding this issue.

4.12. In our Relevant Representations, we also noted that impacts from the operational phase of the development through vessel movements etc., and how these impacts might be mitigated have not been given sufficient consideration with regard to the Greater Wash SPA and potentially also the Outer Thames Estuary SPA RTD population (see part c of paragraph 4.2.6 of our Relevant Representations). No further information has been provided by the Applicant at this stage regarding this issue.

5. Collision Risk Modelling

5.1. Based on the information reviewed by Natural England to date the issues/queries raised in our Relevant Representations remain, namely:

a. Requirement for provision of the full set of input parameters and R code used for the deterministic model in order to allow full appraisal by Natural England of the CRM (for full details see paragraph 4.2.7 of our Relevant Representations);

b. Use of the Applicant's version of a stochastic CRM and approach to accounting for uncertainty and variability in input parameters (for full details see point 4.1.1 of our table of key concerns in Appendix 1 of our Relevant Representations);

c. Concerns regarding the use of median rather than mean densities of birds in flight (for full details see paragraph 4.2.8 of our Relevant Representations; point 4.1.2 of our table of key concerns in Appendix 1 of our Relevant Representations);

d. Nocturnal activity factors used, particularly regarding empirical rates for gannet and kittiwake (for full details see paragraphs 4.2.9-4.2.10 of our Relevant Representations; point 4.1.3 of our table of key concerns in Appendix 1 of our Relevant Representations);

e. Lack of full assessment for herring gull CRM for impacts from Vanguard alone for EIA (for full details see paragraph 4.2.11 of our Relevant Representations; point 4.1.4 of our table of key concerns in Appendix 1 of our Relevant Representations); and,

f. Lack of any Vanguard specific CRM assessments for non-seabird migrants both for Vanguard alone and cumulatively and the need for inclusion of Bewick's swan and avocet (for full details see paragraphs 4.2.12-4.2.13 of our Relevant Representations; point 4.3 of our table of key concerns in Appendix 1 of our Relevant Representations).

5.2. With regard to nocturnal activity factors for gannet (point d above), Natural England is aware that the paper reviewing gannet nocturnal activity has been accepted and published in the Journal of Applied Ecology (Furness et al. 2018). We note that Furness et al. (2018) has calculated average activity rates for gannet from several studies and recommended use of a "precautionary" nocturnal activity of 8% of daytime activity in the breeding season and 3% in the non-breeding season applied to the period sunset to sunrise. In the Norfolk Vanguard submission documents, the Applicant refers to a gannet review paper by Furness et al. (in subm.), which recommends use of 4.3% nocturnal activity in the breeding season and 2.3% in the non-breeding season for gannet, and these are the figures the Applicant has used in their stochastic CRM for assessment of impacts from Vanguard alone both for EIA and HRA. These analyses differ in terms of suggested levels of nocturnal activity and are also different from those recommended in the first review undertaken as part of the East Anglia 3 assessment, which recommended use of 0% nocturnal activity during the breeding season and 2% nocturnal activity for gannet in the non-breeding season (see MacArthur Green 2015).

5.3. Likewise, for kittiwake, the review undertaken as part of the East Anglia 3 assessment recommended use of 0% nocturnal activity during the breeding

season and 12% nocturnal activity for kittiwake in the non-breeding season (see MacArthur Green 2015).The Norfolk Vanguard Applicant has used evidence reported in Furness et al. (in prep.) to suggest use of a nocturnal activity rate of 20% of daytime activity in the breeding season and 17% in the non-breeding season, with variability around these mean levels for kittiwake. Clearly, the emerging evidence on nocturnal activity levels from analysis of tagging work has itself generated conflicting recommendations.

5.4. The activity levels of birds in the Norfolk Vanguard areas are defined as the percentage of birds in flight from the site-specific digital aerial surveys, which are effectively 'snapshot' surveys of the birds and their activities present at the site at the time of the survey. These surveys take place more in core daylight hours, i.e. well away from sunrise and sunset. However, the nocturnal activity factors/rates that are calculated from the reviews of the tagging studies (e.g. MacArthur Green 2015; Furness et al. 2018) calculate nocturnal:diurnal ratios over all hours of the day. Therefore, the daytime flight activity recorded in the Norfolk Vanguard digital aerial surveys may not match the levels of daytime flight activity that are the basis of the calculations in the empirical tagging studies. Thus, is not clear whether it is appropriate to apply the nocturnal activity factors/rates derived from tracking data to the site-specific survey data.

5.5. As noted in our Written Representations for Hornsea 3 (Natural England 2018), we recognise that from recent evidence presented e.g. by MacArthur Green (2015) and Furness et al. (2018), nocturnal activity levels relative to daytime levels for some species may be lower than the levels that equate to the nocturnal activity factors currently used in CRM. However we also note that there is uncertainty about the empirical activity levels derived from tracking studies and how these levels may vary, uncertainty around the models that are used to derive daylight hours and how day-length is defined (Forsythe et al. 1995), and uncertainty about how these might translate into nocturnal factors applicable to the Band model. For example, there will be variability in nocturnal activity levels with time of year, location, levels of ambient lighting e.g. from offshore structures etc.

5.6. Therefore, given the uncertainty as well as variability in the data on activity levels (both during the daytime and during night), Natural England continues to advise (as per our Relevant Representations) that collision risk outputs covering a range of nocturnal activity factors are considered to account for the uncertainty/variability (in the same way as has been recommended for bird densities, avoidance rates and flight heights). The suggested range of nocturnal flight activities to be considered within the Band model CRM are:

a. Gannet: 1-2 (equating to 0-25% nocturnal activity)
b. Kittiwake: 2-3 (equating to 25-50% nocturnal activity)
c. Large gulls: 2-3 (equating to 25-50% nocturnal activity)

6. Cumulative and In-combination Assessments

6.1. In our Relevant Representations we highlighted that due to issues with the Vanguard alone figures (particularly for CRM) along with issues/uncertainties with the Hornsea 3 and Thanet Extension figures that we could not reach any conclusions at present regarding the scale of any cumulative and in-combination displacement and CRM impacts (see paragraph 4.2.14 of our Relevant Representations; point 5.1 of our table of key concerns in Appendix 1 of our Relevant Representations for further information). Discussions are ongoing regarding the issues around both Hornsea 3 and Thanet Extensions as part of their Examination Process and we hope to hold further discussions with the Vanguard Applicant regarding issues with the Vanguard alone figures. We advise that the associated values presented by the Vanguard Applicant for Hornsea 3 and Thanet Extension in the cumulative and in-combination assessments are unlikely to reflect the impacts of these developments should they be consented.

6.2. In Natural England's Relevant Representations we other issues regarding the cumulative and in-combination assessments, namely:

6.3. RTD cumulative and in-combination displacement assessments (see paragraphs 4.2.15-4.2.16 of our Relevant Representation; point 5.2 of our table of key concerns in Appendix 1 of our Relevant Representations for further information):

a. Mortality and displacement rates used in the assessment for cumulative and in-combination displacement assessment for RTD – we continue to advise that a worst case scenario of 100% displacement and 10% mortality are used.

b. Consideration that wind farms where turbines were installed before or during 2012 form part of the Norfolk Vanguard baseline in the cumulative assessment for RTD – we continue to advise that these wind farms should not be considered part of the baseline and should be considered in the cumulative displacement assessment for RTD.

c. We continue to advise that all OWFs within the south-west North Sea BDMPS are included in the cumulative displacement assessment for RTD.

d. We continue to advise that a similar approach to that undertaken for the auk cumulative displacement assessments is undertaken for the RTD cumulative displacement assessment.

6.4. Gannet cumulative and in-combination displacement assessments:

a. We continue to suggest that a similar approach to that undertaken for the auk cumulative displacement assessments is undertaken for gannet for cumulative displacement for EIA and also for the assessment of LSE for in-combination assessment of gannet displacement from the FFC SPA (see paragraph 4.2.17 of our Relevant Representations; point 5.3 of our table of key concerns in Appendix 1 of our Relevant Representations for further information).

b. As noted in point 30 of our table of additional detailed comments in Appendix 1 of our Relevant Representations, displacement predictions for gannet at FFC SPA should be added to collision predictions for gannet at

FFC SPA, and the combined impacts considered for Vanguard alone and in-combination with other relevant offshore wind farms.

6.5. Auk cumulative and in-combination displacement assessments (see paragraphs 4.2.18-4.2.19 of our Relevant Representations; point 5.4 of our table of key concerns in Appendix 1 of our Relevant Representations for further information):

a. We continue to advise that a range of mortality rates of 1-10% and displacement rates of 30-70%, with 70% displacement and 10% mortality as the worst case are considered for auk cumulative displacement assessments.

b. We again note that within the Natural England assessment scenario of 30% displacement and 1% mortality to 70% displacement and 10% mortality, a number of the annual predicted addition auk mortalities equates to greater than 1% of baseline mortality of both the largest BDMPS and the biogeographic populations, which is not insignificant and hence we advise further consideration be given to this once the cumulative total displacement figures are agreed. This also applies to the assessment of LSE for in-combination assessment of auk displacement from the FFC SPA.

6.6. In addition to the offshore wind farms noted in our Relevant Representations that should be included in the cumulative and in-combination assessments for displacement and collision risk, namely:

a. Those noted above for RTD assessments (i.e. all OWFs located within the south-west North Sea RTD BDMPS) and those that where turbines were installed from 2012 onwards;

b. The Scottish wind farms Kincardine and Hywind (as noted in point 13 of our table of additional detailed comments in Appendix 1 of our Relevant Representations) and also Moray West as discussed with the Applicant as part of SoCG; and,

c. The non-breeding auk figures for the Seagreen projects (as noted in point 5.4 of our table of key concerns in Appendix 1 of our Relevant Representations).

6.7. We also advise that figures are included for the Moray West OWF in the cumulative and in-combination assessments.

7. Population Modelling Approaches (EIA and HRA)

7.1. In Natural England's Relevant Representations we raised issues regarding the population modelling approaches used by the Applicant in both the Vanguard EIA and HRA assessments. These issues were regarding:

a. Use of Potential Biological Removal (PBR) outputs in assessments – Natural England continues to advise that wherever possible the population level impacts of predicted mortality from developments should be assessed using Population Viability Analysis (PVA) models rather than PBR (see paragraph 4.2.20 of our of Relevant Representations and point 6.1 of our table of key concerns in Appendix 1 of our Relevant Representations for further information).

b. Issues regarding the suitability of the existing PVA models used by the Applicant for gannet and kittiwake at FFC SPA; LBBG at Alde-Ore Estuary SPA; and gannet, kittiwake and great black-backed gull (GBBG) for EIA:

c. use of matched pairs;

d. outputs of Natural England recommended counterfactuals (population growth rate and population size);

e. 25 year projection of models rather than the indicative Vanguard project design life of a maximum of 30 years;

f. ability to use these models to calculate a metric that is specific to the impact level calculated for Vanguard (see paragraph 4.2.21 of our Relevant Representations and point 6.2 of our table of key concerns in Appendix 1 of our Relevant Representations for further information).

7.2. Whilst no further discussions have occurred with the Vanguard Applicant regarding these issues, we are aware that further PVA models have been run for gannet, kittiwake and guillemot at the FFC SPA as part of the Hornsea 3 Examination (see: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001142-DI_HOW03_Appendix%209.pdf).

7.3. These models have attempted to address the concerns raised by Natural England regarding the previous FFC SPA PVA models used by both the Hornsea 3 and Norfolk Vanguard Applicants, as they have been run using a matched pairs approach, have been run over 35 years and present outputs for the Natural England recommended counterfactuals of population growth rate and population size. However, Natural England has outstanding concerns and clarification requests related to these updated PVAs and their outputs that have been raised during the Hornsea 3 Examination process in our Written Submission for Deadline 3 and in Appendix 2 of this document, available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001357-Natural%20England%20-%20Post%20hearing%20submissions%20including%20written%20submissions%20of%20oral%20cases%20-%20ISH%202%20PART%201%20-%20Ornithology.pdf

7.4. It should also be noted that the updated models submitted by Hornsea 3 do not include models for LBBG for the Alde-Ore Estuary SPA, or gannet, kittiwake or

GBBG for EIA. Therefore, the issues raised in our Relevant Representations (summarised in 7.1 above) still stand for these species, sites and populations.

8. Implications for EIA and HRA Assessments

8.1. As highlighted in our Relevant Representations (see paragraph 4.2.22 of our Relevant Representations). Until the issues raised above/in our Relevant Representations have been addressed, Natural England is not in a position to provide formal advice on the accuracy of the predicted impacts at either the biogeographic/BDMPS or SPA scale.

9. References

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Natural England (2018) Hornsea Project Three Offshore Wind Farm, Annex C: Natural England detailed advice on ornithology. Planning Inspectorate Reference: EN10080. Available from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001237-EN10080%20261379%20Annex%20C%20Hornsea%20Three%20-%20NE%20Detailed%20ornithology%20comments.pdf

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THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex D: Copies of Natural England's Discretionary Advice Service (DAS) response letters to the Applicant on various additional documents.

16 January 2019

Date: 08 January 2019
Our ref: 268017 10430
Your ref: Pre-ExA; Change Report; 9.3

Royal Haskoning DHV

BY EMAIL ONLY

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Dear Gemma,

Consultation: Norfolk Vanguard Offshore Windfarm Change Report
Location: Norfolk

Thank you for your recent consultation regarding the above, which was received on 21 November 2018. This advice is being provided as part of Natural England's Discretionary Advice Service.

The advice contained in this letter is based upon the following documents:

- Norfolk Vanguard Offshore Wind Farm Change Report. Document Reference: Pre-ExA; Change Report; 9.3.

This document builds upon information submitted as part of the Development Consent Order (DCO) application to the planning inspectorate.

1. Overview

Natural England notes that Norfolk Vanguard Limited (NVG Ltd) is seeking a DCO for Norfolk Vanguard, an offshore wind farm located approximately 47 km at its closest point from the Norfolk coast. The DCO application was submitted by NVG Ltd. on 26 June 2018, however following this submission, ongoing liaison with potential contactors has identified two changes needed to the offshore electrical platforms:

1. An increase in the number of piles per platform (from 6 to 18), resulting in an increase in the total number of piles from 834 to 858; and
2. An increase in the diameter of the piles from 3 m to 5 m.

The change report document details these changes and where appropriate updates the Environmental Statement (ES).

2. Specific Comments

Natural England is supportive of the general approach set out in the change report, and broadly agrees with the conclusions presented. However, we have the following additional comments:

a) **In-combination –** The change report does not fully detail how these changes may impact any in-combination assessment. Whilst it is the view of Natural England that this increase is unlikely to alter the conclusions laid out in the original application you should undertake this assessment and present the results.
b) **Temporal WCS -** The applicant states in paragraph 36 of the change report '*In addition to the spatial extent of underwater noise impacts, consideration was also given to the temporal worst case scenario (wcs). The ES assessed a total duration of 1,260 hours of piling activity (equivalent of 52.5 days), for all project infrastructure which could be piled over a 4 year construction duration*.' However, table 2.8 details a WCS of 59 days. Could this discrepancy please be clarified?
c) There are no units against 'average piling time per foundation' in table 2.2. Whilst it has been assumed that this is in hours could this please be confirmed?

For clarification on any points in this letter, please contact Jessica Taylor on the details provided below.

☒ The advice provided in this letter has been through Natural England's Quality Assurance process.

The advice provided within the Discretionary Advice Service is the professional advice of the Natural England adviser named below. It is the best advice that can be given based on the information provided so far. Its quality and detail is dependent upon the quality and depth of the information which has been provided. It does not constitute a statutory response or decision, which will be made by Natural England acting corporately in its role as statutory consultee to the competent authority after an application has been submitted. The advice given is therefore not binding in any way and is provided without prejudice to the consideration of any statutory consultation response or decision which may be made by Natural England in due course. The final judgement on any proposals by Natural England is reserved until an application is made and will be made on the information then available, including any modifications to the proposal made after receipt of discretionary advice. All pre-application advice is subject to review and revision in the light of changes in relevant considerations, including changes in relation to the facts, scientific knowledge/evidence, policy, guidance or law. Natural England will not accept any liability for the accuracy, adequacy or completeness of, nor will any express or implied warranty be given for, the advice. This exclusion does not extend to any fraudulent misrepresentation made by or on behalf of Natural England.

Yours sincerely,

Jessica Taylor
Marine Lead Adviser
E-mail: Jessica.Taylor@naturalengland.org.uk
Telephone: 0208 225 8234

Date: 08 January 2019
Our ref: 268019 Case 10430
Your ref: Appendix 1 & 2

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Dear Gemma,

Planning consultation: Norfolk Vanguard Offshore Windfarm Appendix 1 Clarification Note – Coastal Erosion and Appendix 2 Clarification Note - Water Dependant Designated Sites
Location: Norfolk

Thank you for your consultation on the above dated 29 November 2018 which was received by Natural England on 03 December 2018. The following advice is provided under Natural England Discretionary Advice Service (DAS).

Appendix 1 Clarification Note – Coastal Erosion

Concerns withdrawn

Following receipt of further information on 29/11/2018 Natural England is satisfied that the specific issues we have raised in previous correspondence relating to the assessment of coastal erosion at Happisburgh have been resolved.

Within the Relevant Representations of Natural England dated 31 August 2018 we advised that we did not feel that the unpredictable nature of cliff recession had been fully captured at Happisburgh landfall site. At the sites cited in the application the future coastal management and management techniques are also uncertain, particularly regarding up-drift management and sediment input. Cliff recession itself is also often episodic, going long periods of observable stability before large and significant events of retreat/erosion. Compounding the uncertainty around cliff recession is the variability of beach levels, particularly at this location, which are forced both through seasonal variability as well as storm conditions.

Whilst the Norfolk Vanguard Environmental Statement (ES) chapter and appendix take cliff recession into detailed consideration, it was suggested that a more precautionary approach should be developed at Happisburgh, due to the historically rapid erosion and future unpredictability of cliff recession. Two methods were suggested for this:

- Lower bound estimate; this has involved simply extrapolating the assumed baseline rate over 50-years: 50-Year Distance = Baseline Rate x 50;
- Upper bound estimate; this is based on the use of the “historical projection” method, and involves multiplying the baseline rate by an adjustment factor calculated from the

ratio of the historical and future rates of relative sea-level rise (RSLR11): 50-Year Distance = Baseline Rate x 50 x (Future RSLR/Historical RSLR).

Whilst neither of these methods have been undertaken by Vattenfall and your consultants, Natural England is satisfied with the information provided within Appendix 1 – Coastal Erosion Clarification Note and agrees that it contains sufficient information to detail how cliff recession prediction has been undertaken. Therefore we agree with the Applicant's conclusions.

Appendix 2 Clarification Note - Water Dependant Designated Sites

Insufficient information provided

There remains insufficient information to enable Natural England to provide a substantive response to this consultation as required under the Town and Country Planning (Development Management Procedure) (England) Order 2015. Please provide the information listed below and re-consult Natural England.

Within the Relevant Representations of Natural England dated 31 August 2018 we advised that *'further information is obtained from Environment Agency and used in a detailed appraisal of groundwater effects, e.g. WETMEC data showing the water supply mechanism for all the component sites and/or EA's groundwater modelling. If the installation of the cable route would affect the groundwater supply to these sites, then a detailed assessment should be undertaken and mitigation measures implemented to minimise any identified effects*.'

The information provided within Appendix 2 does not contain sufficient information or detail to ascertain potential effects on water dependant designated sites, and does not reference WETMECS as identified by the EA.

European/International Sites
No WETMEC data for the sites Norfolk Valley Fens or Broads Special Area of Conservation have been provided. There is, therefore, currently insufficient information for you to undertake a Habitats Regulation Assessment of the proposed development. We advise Vattenfall to obtain the following information:

- *WETMEC data showing the water supply mechanism for all the component sites and/or Environment Agency groundwater modelling.*
- *If the installation of the cable route would affect groundwater supply to these sites then a detailed assessment should be undertaken and mitigation measures implemented.*

Sites of Special Scientific Interest (SSSI)
No WETMEC data for the sites have been presented and therefore no assessment has been provided of the potential impacts the proposal may have on the following SSSIs:

- Booton Common;
- Broad Fen, Dilham;
- Dereham Rush Meadow;
- Holly Farm Meadow, Wendling; and
- Whitwell Common.

We advise Vattenfall to obtain the following information in order to assess potential impacts of the proposal on these designated sites:

- *WETMEC data showing the water supply mechanism for all the component sites and/or Environment Agency groundwater modelling.*
- *If the installation of the cable route would affect groundwater supply to these sites then*

a detailed assessment should be undertaken and mitigation measures implemented.

For any queries relating to the content of this letter please contact me using the details provided below.

☒ The advice provided in this letter has been through Natural England's Quality Assurance process.

The advice provided within the Discretionary Advice Service is the professional advice of the Natural England adviser named below. It is the best advice that can be given based on the information provided so far. Its quality and detail is dependent upon the quality and depth of the information which has been provided. It does not constitute a statutory response or decision, which will be made by Natural England acting corporately in its role as statutory consultee to the competent authority after an application has been submitted. The advice given is therefore not binding in any way and is provided without prejudice to the consideration of any statutory consultation response or decision which may be made by Natural England in due course. The final judgement on any proposals by Natural England is reserved until an application is made and will be made on the information then available, including any modifications to the proposal made after receipt of discretionary advice. All pre-application advice is subject to review and revision in the light of changes in relevant considerations, including changes in relation to the facts, scientific knowledge/evidence, policy, guidance or law. Natural England will not accept any liability for the accuracy, adequacy or completeness of, nor will any express or implied warranty be given for, the advice. This exclusion does not extend to any fraudulent misrepresentation made by or on behalf of Natural England.

Yours sincerely,

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THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex C: Natural England detailed comments on Benthic Ecology and Habitats Regulation Assessment for Haisborough Hammond and Winterton SAC

16 January 2019

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1. Introduction

1.1. In this appendix Natural England sets out what we consider to be the main issues in relation to the Habitats Regulation Assessment (HRA) for Haisborough Hammond and Winterton SAC, drawing upon information contained in the original application documents.

1.2. Natural England identified a number of areas of uncertainty within the original information provided by the Applicant. These were set out in our Relevant Representations, submitted to PINS on 31 August 2018.

1.3. Within our Relevant Representation Natural England was unable to advise beyond all scientific doubt that the project both alone and in-combination would not have an adverse effect on the integrity of the Haisborough Hammond and Winterton SAC Annex I sandbanks and reef features due to several reasons.

1.4. These main outstanding concerns relate to

a. the ability to effectively implement some of the proposed mitigation measures, for example micro-siting around *Sabellaria spinulosa* reef;
b. the evidence presented to support the successful avoidance of reef and the ability of reef to recover if impacted through cable installation, particularly the mapping of extent of *Sabellaria spinulosa* reef and the analyses applied to the data;
c. the ability to use 'sensitive' cable protection, i.e. that which has the least environmental impact at each particular location;
d. the ability to remove cable protection at the time of decommissioning and therefore consideration as to whether this should be considered temporary or permanent habitat loss;
e. the lack of empirical data that relate to interventions of similar spatial and temporal scale to the proposals and for this particular sandbank system to support the modelling for sandwave levelling;
f. the lack of evidence that sandwave levelling ensures cables remain buried and therefore the assessment which indicates that there will be no future need for reburial or cable protection;
g. the assessment that there will be a low impact magnitude in terms of Haisborough Hammond and Winterton SAC when Boreas is considered in-combination as the export cable footprint will be 11% of the cable corridor running through the SAC and doesn't take into account the interest features impacted; and
h. the lack of detail as to how single build vs. phased build both alone and / or in-combination with Norfolk Boreas has been assessed against the conservation objectives for the site.

1.5. This Written Representation is intended to provide more detail on certain issues raised in our Relevant Representations and any updates on those issues. Where relevant this Written Representation will refer to the specific sections of the Relevant Representation.

1.6. A draft SoCG for benthic ecology between Natural England and the Applicant will be submitted by the Applicant at Deadline 1.

2. Annex I Sandbanks

2.1. Adverse effect on sandbanks feature

2.1.1. Based on our current understanding, Natural England does not consider it likely that human activities taking place within the site have the potential to permanently impact on the large-scale topography of the Haisborough Hammond and Winterton SAC Annex I sandbanks. However, they could, have an impact on the other variables that help define the extent and distribution of a sandbank, namely sediment composition and presence and distribution of biological communities. Of note for the activities taking place and proposed within the site are operations associated with the deposition of material (e.g. rock and concrete mattress placement/armouring), or other alteration of surface sediment (e.g. cabling operations), that are likely to lead to a persistent change to substrate which is not suitable habitat for sandbank communities.

2.1.2. As such, some of the sandbank's extent and distribution is likely to be lost, in that there are areas present within the site that no longer represent sandbank feature, as defined by sediment composition and/or biological communities, because the substrate has been changed. We believe that there has been physical change in sediment composition as a result of pipelines and their protection material in the HHW SAC, but it is unclear what impact this may have on overall sediment composition and distribution. Furthermore, due to lack of evidence about deposits within the site, partially due to lack of historical data, it is currently not possible to quantify the loss of extent.

2.1.3. Natural England has recently produced revised conservation advice for Annex I Sandbanks feature of Haisborough Hammond and Winterton SAC which sets a restore objective for:

a. the presence and spatial distribution of subtidal sandbank communities.
b. the total extent and spatial distribution of subtidal sandbanks to ensure no loss of integrity, while allowing for natural change and succession; and
c. the species composition of component communities.

2.1.4. This revised conservation advice can be found by following this link (available online only): https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030369&SiteName=haisborough&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

2.1.5. Natural England has recently undertaken a condition assessment of the features within Haisborough Hammond and Winterton SAC (unpublished) and our latest view on condition is that the sandbank feature is in unfavourable condition and needs to be restored to favourable condition. Restoration of the feature requires an overall reduction, or removal, of pressures associated with human activities that cause impacts to the sandbanks' extent and distribution, delineated by both substratum and biological communities. As such, any human activities which can cause pressures resulting in changes to substratum or biological communities to the sandbank feature may present a risk to the site's restoration.

2.1.6. We note that there is no expectation that The Applicant should demonstrate recovery of the site. Recovery is an objective for all sectors placing pressure on the site, including oil and gas, renewables, aggregates and fisheries. We do, however, expect The Applicant to demonstrate the risk levels that they believe their proposed operations will present to the restoration of the extent and distribution of the sandbank feature. As a minimum, this would be to demonstrate that proposed

activities will be mitigated to not impede restoration, i.e. that activities will not increase the site's exposure to damaging pressures, particularly in regard to changes in extent and distribution of substratum and biological communities. We note that The Applicant may find our discussion of mitigation below helpful in this.

2.1.7. We note the Applicant's conclusion of "high confidence that the seabed will recover to a new natural equilibrium state within a timescale of months to years." We would suggest that approaching a new equilibrium may not be in accord with restoration of the site, if that new equilibrium is without the sediment composition or biological communities expected from the designated feature.

2.1.8. Conservation objectives must be considered against the total impact, rather than individual impacts split by different sections of the project lifecycle, as is currently the case in the application. We currently cannot provide advice on the total impact including all remedial work during O&M with the information provided, which is highlighted in our response to the first set of examiners written questions.

2.2. Mitigation of adverse effect on sandbanks

2.2.1. Natural England suggests that there are a number of ways that The Applicant could discuss how the proposed operations could aid in restoration of the sandbank feature and the site as well as deliver net gain. Ongoing and new activities must look to minimise, as far as is technically practicable, changes in substratum and the biological communities within the site to minimise further impact on feature extent and distribution, demonstrating the risk levels that proposed operations will present to the restoration of the extent and distribution of the sandbank feature.

2.2.2. Understanding the mitigation put in place by The Applicant that decreases seabed impact from a worst case scenario could potentially aid in demonstrating that the proposed operations could be considered as reducing impedance of recovery. While Natural England would not expect The Applicant to include a large amount of comparative assessment within their application, it may prove helpful to provide a tabular summary of major mitigation actions that ameliorate impact on seabed. Examples of mitigation measures undertaken by other activities in SACs designated for similar features include reduction of footprint associated with vessel stabilisation through use of alternative work vessels, provision of evidence to quantify footprint of rock armouring potentially needed for works and reuse of existing stabilisation material footprints.

2.2.3. We also suggest that any operations or evidence The Applicant can undertake or provide that reduces uncertainty around impact to feature and site could support provision of a more robust assessment that better reflects the nature of any impacts associated with planned activities.

2.2.4. Natural England welcome the commitment by the Applicant to ensure that the dredged material from sandwave clearance operations will be deposited within Haisborough Hammond and Winterton SAC (HHW) such that the sediment will remain within the sandbank system. It is acknowledged that there will need to be further agreement on the disposal location/s post-consent based on the pre-construction surveys, as we would wish areas of Annex I *Sabellaria spinulosa* reef to be avoided when depositing the sediment, but we believe that this is achievable. **This should be secured in the DML.**

2.3. Sandwave Levelling

2.3.1. The main factors that are considered to influence the recovery potential (i.e. the mechanism and speed of recovery) of the levelled sandwaves are:

- The dimensions of the dredged area, particularly the width and depth of the dredged channel relative to the overall sandwave height, and the alignment of the dredged channel relative to the crest axis; and

- The degree of sediment mobility at the dredge location, which is in turn controlled by the environmental forcing conditions and water depth.

2.3.2. Natural England is aware that Hornsea Project Three OWF (also in the planning system) proposes sandwave levelling within an Offshore SAC namely North Norfolk Sandbanks. Therefore we thought it appropriate to undertake a review to compare the evidence presented to support this application with that for HOW03 and North Norfolk Sandbanks. In summary both HOW03 and Norfolk Vanguard come to the same conclusions – i.e. no significant impacts from sandwave clearance on relevant MPAs, with the evidence in the Norfolk Vanguard's assessment providing more confidence in the conclusions. Therefore, we are more confident in the conclusions, but there still remains some uncertainty around site specific impacts from the actual cable installation that are set out in the detailed comments below.

2.3.3. There is no discussion in the application about the fact that even with sandwave levelling cables may be sub optimally buried and require protection or become exposed over the life time of the protect resulting in further impacts to the site.

2.3.4. Natural England advises that a pre-construction sandwave levelling report and assessment is required to ensure that the results of any further monitoring and specific site characteristics are taken into consideration and the impacts remain within the parameters assessed especially in relation to orientation of levelling to wave and interaction with troughs. **This should be secured as part of the DML**

2.3.5. The assumption to date was that the levelling within HHW SAC would be over discrete waves / banks, not levelling across a larger number of smaller features. This situation may impact differently on the conservation objectives for the site and a more detailed HRA assessment is required before we can agree with the conclusions of the HRA that there is no adverse effect on Integrity from sandwave levelling.

2.4. Cable Protection

2.4.1. Currently 10% cable protection is proposed as a contingency should cables be sub optimally buried within the SAC which if permitted as set out would result in persistent habitat loss of Annex I sandbank feature. Habitat change is a pressure different to habitat loss, but it is still a change to the feature that the site was designated for. Sandbanks features have high sensitivity to both habitat loss and habitat change.

2.5. Cable Installation

2.5.1. As with the other documents provided, Natural England is of the view that the reasoning is not unsound, but it could have be evidenced further to support and give us the necessary confidence. Overall we believe that it is likely that the sediments will recover from cable installation, assuming that the sediments are what is stated here and if no protection/ sand wave clearance occurs. Although it should be recognised that in coarser sediment areas scarring will remain. But if the benthos recovers, which is likely if the sediment composition remains unchanged we believe that it is unlikely to impact the conservation objective for the site.

2.5.2. More information on cable burial operations is needed for us to reconsider our current position that adverse effect on integrity of the site cannot be ruled out. We acknowledge that much of the technical detail will only be available post-consent, and as such, we strongly recommend that The Applicant's assessment must be considered with sufficient precaution added to allow for significant, post-consent

increases in worst case scenarios, especially when operations occur within Marine Protected Areas.

2.5.3. Based on lessons learnt our standard advice is for the early provision of a pre consent Cable Burial Risk Assessment for activities within Marine protected areas which pose a significant risk to interest features and there is limited confidence in the proposed installation activities. Ideally, the cable burial risk assessment should be based on the data from a recent comprehensive geotechnical and geophysical survey campaign. But consideration of the likely success of the installation techniques in particular sandwave levelling and alternative options to that of cable burial in relation to contingency measures should the cable be sub optimally buried. Natural England would welcome further discussions with the applicant on this.

3. Reefs

3.1. Adverse effect on reef features

3.1.1. Based on the information presented and flawed methods used for assessment, Natural England cannot currently provide an evidence-based opinion on the actual scale of the potential impacts to the Annex I *Sabellaria spinulosa* reef feature of the HHW SAC.

3.1.2. Based on our current understanding, Natural England considers it likely that operations and activities already taking place within the site have the potential to impact on variables that are used to delineate the extent and distribution of area to be managed as *Sabellaria* reef (sediment composition and biological assemblages), structure and function (physical structure and biological structure), and supporting processes (supporting habitats). Of note for the activities taking place and proposed within the site are operations associated with the deposition of material (e.g. rock and concrete mattress placement/armouring), or other alteration of surface sediment (e.g. cabling operations), that are likely to lead to a persistent change to substrate which is not suitable habitat for mixed sediment Annex I reef communities.

3.1.3. Fishing byelaw:

a. Defra's revised approach to fisheries requires that fishing activity in European Marine Sites are managed in line with the requirements of Article 6 of the Habitats Directive. Towed demersal gear is considered a red risk interaction with *Sabellaria* spp. reef, meaning the use of towed demersal gear over *Sabellaria* spp. reef is not considered compatible with achieving the conservation objectives for the feature.

b. *Sabellaria* spp. reef is sensitive to the following pressures exerted by towed demersal gear:

   i. Abrasion/disturbance of the substrate on the surface of the seabed;

   ii. Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion;

   iii. Removal of non-target species; and

   iv. Physical change (to another sediment type).

c. Reef in Haisborough Hammond and Winterton SAC is currently considered to be in unfavourable condition, in part due to insufficient fisheries management. Natural England has advised that all areas of *S. spinulosa* reef within Haisborough Hammond and Winterton SAC are closed to towed demersal gears in order to remove these pressures and so enable the reefs to recover and the site to achieve its conservation objectives. Natural England have advised that fisheries closures protect areas which are suitable for reef formation, as described in the Conservation Advice package, rather than solely where reef is present at any given time, due to *S. spinulosa* reef extent being variable in space and time and reliant on the physical and biological processes that allow reefs to form.

d. Eastern Inshore Fisheries and Conservation Authority are currently developing fisheries closures for within 6nm. Closures for beyond 6nm are being progressed through the Joint Recommendation process under the

Common Fisheries Policy and one such area coincides with the Applicant's cable corridor.

3.2. Favourable condition status of the reef features

3.2.1. Some extent and distribution of area to be managed as reef could have been lost, in that there are areas present within the site that no longer represent reef feature either due to changes in substrate or movement of the reef feature. However, due to lack of evidence about deposits present within the site, partially due to lack of historical data, it is currently not possible to quantify the loss of extent. NB: We recognise that in the cable protection clarification note provided by Hornsea Project Three (REF1 – 183 and REF1-138) the Applicant has referenced some Dutch studies that provide some confidence that *Sabellaria spinulosa* will colonise artificial structures with similar biological communities to those of natural rocky reef, but until these papers are reviewed in detail by the SNCB's our advice remains unchanged in relation to requirement to protect the existing habitat and features which support the Annex I reef

3.2.2. Natural England has recently produced revised conservation advice for Annex I Reefs feature of Haisborough Hammond and Winterton SAC which sets a restore objective for:

a. the presence and spatial distribution of reef communities;
b. the total extent and spatial distribution and types of reef (and each of its subfeatures); and
c. the species composition of component communities.

3.2.3. In addition Annex I reef extent attribute states: *When Sabellaria reef develops within the site, its extent and persistence should not be compromised by human activities, accepting that, due to the naturally dynamic nature of the feature, its extent will fluctuate over time.*

3.2.4. This revised conservation advice can be found by following this link (available online only): https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030369&SiteName=haisborough&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea=

3.2.5. Natural England have recently undertaken a condition assessment of the features within Haisborough Hammond and Winterton SAC (unpublished) and our latest view on condition is that the reef feature is in unfavourable condition and needs to be restored to favourable condition. Installation of infrastructure may have a continuing effect on extent and distribution of the reef within the site. Restoration of the feature requires an overall reduction, or removal, of pressures associated with human activities that cause impacts to the reefs' extent and distribution, delineated by both substratum and biological communities. As such, any human activities which can cause pressures resulting in changes to substratum or biological communities to the reef feature may present a risk to the site's restoration. Activities must look to minimise, as far as is practicable, damaging the established, i.e. high confidence, reef within the site.

3.2.6. We note that there is no expectation that The Applicant should demonstrate recovery of the site. Recovery is an objective for all sectors placing pressure on the site, including oil and gas, renewables, aggregates and fisheries. We do, however, expect The Applicant to demonstrate the risk levels that they believe their proposed operations will present to the restoration of the extent and distribution of the reef feature. We note that The Applicant may find our discussion of mitigation below

helpful in this. As a minimum, this would be to demonstrate that proposed activities will be mitigated to not impede restoration, i.e. that activities will not increase the site's exposure to damaging pressures, particularly in regard to changes in extent and distribution of substratum and biological communities.

3.3. Micro-routing as mitigation

3.3.1. We believe that with the current cable corridor routing, primary mitigation (i.e. avoiding Annex I reefs within SACs and/or biogenic or geogenic reefs outside SACs within the Norfolk Vanguard offshore cable corridor) will not always be possible. We do not consider the Applicant's consideration of routing through 'lower quality' reef to be acceptable in terms of restoration of conservation objectives as the 'lower quality' reef mentioned by the Applicant is still contained within area to be managed as reef, with the protection provided by Annex I status.

3.3.2. We welcome the Applicant's desire to avoid areas of higher quality reef and/or restrict cable installation to the periphery of reef features, and we consider that both of these mitigations may decrease impact on individual reefs. However, we do not consider that they will lower the risk related to leaving the overall reef feature in unfavourable condition.

3.3.3. We acknowledge that the Applicant considers that *Sabellaria* biotopes have a wide distribution throughout the southern North Sea benthic ecology study area. Natural England agrees with this statement, however, this does not preclude mitigation measures being sought to avoid areas of Annex I reef.

3.3.4. The primary mitigation for impact to *Sabellaria spinulosa* reef in the application is "where possible" avoidance of reef area. We note that if the suggested mitigation is successful in its entirety (i.e. all reef feature is avoided) we would agree with the assessment of magnitude. However, we advise that it is necessary to look at this primary mitigation with a degree of precaution, and question whether there are any studies from HHW or IDNRRB that could inform likelihood of success.

3.4. Core reef

3.4.1. The Applicant provided an assessment of likelihood of reef being present in the area of SAC intersected by the cable corridor prior to construction. This uses Natural England's concept of core reef and the reef index (Roberts et al, 2016). A core reef approach requires a historical evidence dataset of suitable confidence, which limits its application not least in offshore sites due to the resources required to develop a sufficient evidence base. It has been the SNCB's consistent opinion on offshore casework that a core reef approach is unlikely to be applicable to the assessment of *Sabellaria spinulosa reef* in MPAs because results of the reef index are highly dependent on the number of surveys undertaken in the area of interest.

3.4.2. It should be noted that a trial is being agreed of use of the core reef approach at Thanet Extension OWF on the basis that this is outside a designated site. This may change opinion on use of core reef approach in the future, but this data will not be in time for this application. Alternative reef indices are being agreed to account for the lower availability of survey data.

3.5. Cable Protection

3.5.1. Contrary to point 66 and 349 of Vanguard Information to support HRA (APP – 045), Natural England didn't agree in the January 2018 evidence plan working group meeting that cable protection was a temporary impact for *Sabellaria spinulosa* reef. Please see further points below in relation to why this is the case. Therefore Natural England doesn't agree with Table 7.4 and other locations within the Vanguard Information to support the HRA that there will be no habitat loss.

3.5.2. Natural England advises against the use of cable protection within designated sites as the addition of hard substrata is often incompatible with the conservation objectives for Annex I sandbanks and reef features.

3.5.3. Natural England agrees that 10% is conservative, but equally that doesn't make it acceptable in terms of impact to nature conservation and MPAs. In order for it to be considered as part of the application we provide advice on the worst case scenario being applied for, i.e. 10% in this case. However, we would welcome further discussion with the Applicant to see if some agreement can be found between us in relation to the contingency measure.

3.5.4. Overall, it is the view of Natural England that cable protection should not be used within MPAs as it has the potential to cause long-term impacts. Theoretically impacts may not be permanent if a condition is put in place to remove cable protection at decommissioning stage, however, at present there is uncertainty both around the ability to remove cable protection and around what the impacts of removal would be on the designated features of the site.

3.5.5. Natural England note that Coolen (2017) and similar studies discuss the positive effects of rock protection in terms of wider North Sea biodiversity. They do not consider it in terms of MPAs and their conservation objectives. We advise that considering rock protection installation as a positive effect is not in line with the Habitat Regulations which are protecting the features the site is designated for.

3.5.6. **Sensitive cable protection measures** – In our opinion this is unlikely to be possible in mobile sediment environments as it requires mimicking the natural sediment size and composition with the cable protection.

3.5.7. Natural England questions whether sensitive cable protection measures can be undertaken due to engineering requirements. The evidence presented for Race Bank OWF marine licence variation and marine licence re the type of protection that can be technically used, such as similar grain size has been discounted because it could be moved during a storm and doesn't provide sufficient protection again anchors and fisheries (Ref. WSP Remedial Burial Assessment – SJ20180628115546973)

3.5.8. There is also the added concern that any protection of this nature will be displaced over time and there will need to be operation and maintenance work over the life time of the project to recharge any cable protection; thus ultimately requiring the use of rock protection anyway and subsequently increasing the amount of rock in the marine environment. And as noted for Hornsea Project 3 there would be no ability to review/control this going forwards as often the O&M assessment simply says 'where rock has been previously placed' with no information on amount and locations.

3.5.9. Between the SNCB's there is ongoing discussions in relation to the Annex I status of any *Sabellaria spinulosa* reef growing over artificial substrate such as cable protection.

3.5.10. Natural England agrees that in some locations and in a wider seas context that cable protection may become infilled or even buried, but currently this is not a valid argument for lack of longer term impact within an MPA. Habitat change is a pressure different to habitat loss, but it is still a change to the feature that the site was designated for, although Natural England recognise that *Sabellaria spinulosa* has medium sensitivity to habitat change.

3.5.11. Therefore, Natural England advises the Applicant seeks to find alternatives to rock armouring for cable protection. If the Applicant determines that there is no alternative to rock armouring then details should be provided as to how this will be removed at decommissioning stage and this should be secured as part of DCO.

3.6. Survey evidence

3.6.1. Natural England has concerns about the analysis and interpretation of benthic survey results. We had the opportunity through the Benthic EWG to provide initial comments to The Applicant on the quality of their benthic analysis. Where The Applicant provided comment, we remain uncertain that the analyses have been undertaken to the standards that we would expect in a development of this nature.

3.7. Colonisation of foundations / cable protection / scour protection may affect benthic ecology and biodiversity

3.7.1. Whilst it is true that hard substrate used to be naturally more prevalent in the North Sea this is not the recent and current situation and is not a justification that anthropogenic introduction of hard substrate, and any associated changes to the fauna are acceptable. Additionally as noted here, these earlier natural hard substrates were oyster reefs, gravel field and peat deposits, not terrestrial-sourced granite from Norwegian quarries.

3.7.2. We agree that potential beneficial effects may occur from introduction of hard substrate into a soft substrate system. However, within MPAs, this must be considered secondary to the requirement to recover or maintain the features for which the site is designated. As such, any potential benefits from hard substrate in HHW SAC are contradicted by the impact that the hard substrate will have on the features of the site and the achievement of recovery.

3.7.3. **A change of habitat is just as significant as loss of habitat, when that habitat is the designated feature.**

3.8. Invasive Non-Native Species

3.8.1. We suggest that The Applicant continues to consider potential interaction with *Didemnum vexillum* before construction, given that it has been found subtidally in the North Sea, and that it is known to be both invasive and can invade sediment seabeds.

4. Specific Comments regarding Habitats Regulation Assessment

4.1. Avoidance of Annex I *Sabellaria spinulosa* Reef

4.1.1. The primary mitigation for impact to *Sabellaria spinulosa* reef in the application is "where possible" avoidance of reef area. We note that if the suggested mitigation is successful in its entirety (i.e. all reef feature is avoided) we would agree with the assessment of magnitude. However, we advise that it is necessary to look at this primary mitigation with a degree of precaution, and question whether there are any studies from HHW or Inner Dowsing North Ridge and Race Bank SAC that could inform likelihood of success.

4.1.2. In addition Natural England has concerns with the caveat 'where possible', due to the increased level of risk to the integrity of the site such a caveat would endorse as there are no parameters to assess and agree what is "possible".

4.1.3. Using the Applicant's survey data and the recent site survey data it is highly probable that the area to be managed as a fisheries byelaw area for the recovery of reef could straddle the cable route. We therefore advise that this leaves insufficient space in the proposed cable corridor to micro-route around the byelaw area and any additional reef feature. Whilst we continue to advocate that the standard mitigation measure/marine licence conditioned to avoid reef features should be included in the Projects DML, it may not be feasible to do so.

4.1.4. We do not consider the Applicant's consideration of routing through 'lower quality' reef to be acceptable in terms of restoration of conservation objectives as the 'lower quality' reef mentioned by the Applicant is still contained within area to be managed as reef, with the protection provided by Annex I status. As part of the SOCG between NE and the Applicant it has now been agreed that all quality of Annex I reef will be avoided

4.1.5. In addition the evidence presented in the HRA to support conclusions on recoverability predominantly relates to individuals/abundance, and doesn't take into account repeated O&M impacts or cable protection. Therefore we have limited confidence in the ability of reef to recover from cable installation and ongoing maintenance activities. Therefore, we further advocate that the standard mitigation measure of avoidance is adhered to.

4.1.6. Furthermore whether reef is avoided or not during installation there does remain a risk during O&M cable remediation activities that reef could establish across the cable corridor or nearby areas where remediation activities needed to occur. Accordingly, every effort should be made, with input from the MMO and NE, to minimise the impacts at the time of undertaking the works.

4.2. Long term loss of sea bed habitat including from cable protection.

4.2.1. Without removal at decommissioning the impacts are likely to persist and depending on the location may hinder the conservation objectives of the designated sites. Currently there is no guarantee of removal. The documents provided for the current Race Bank marine licence application includes two options for rock armouring removal that involve dredging up the material. The document provided was purely a method statement and didn't take into consideration the feasibility and confidence in being able to decommission in similar environments; including the associated impacts. For example the two options presented involve dredging to no lower than 30cm below seabed, and in undertaking this activity there would almost certainly be disturbance to, or removal of, the interest features of the site.

4.2.2. We suggest that there needs to be some evidence presented where rock armouring has been decommissioned, in similar sediment types, and monitoring provided of the

associated impacts. To date all the evidence presented to NE from OWF developers is that rock armouring cannot currently be feasibly removed. A good example of this issue is within Thanet OWF, where a section of cable under rock armouring needed to be replaced. It was determined that removing that hard substrate to access the cable wasn't feasible, so a new cable section was spliced in around the existing cable leaving the original section with protection in situ. See Natural England's recent cable's paper (Natural England, 2018).

4.2.3. Whilst the information presented provides a robust argument for WCS presented as being 10% of cable to be rock armoured within a designated site, it doesn't take into account the impacts from any secondary scouring that may happen**.**

4.2.4. Overall, it is the view of Natural England that cable protection should not be used within MPAs as it has the potential to cause long-term impacts. Theoretically impacts may not be permanent if a condition is put in place to remove cable protection at decommissioning stage. However, at present there is uncertainty both around the ability to remove cable protection and around what the impacts of removal would be on the designated features of the site

5. References

Coolen, J. W. P (2017) North Sea Reefs. Benthic biodiversity of artificial and rocky reefs in the southern North Sea. PhD thesis, Wageningen University and Research, Wageningen, NL (2017).

Natural England (2018) Natural England Offshore wind cabling: ten years experience and recommendations. This document has been provided at Deadline 1.

Roberts, G., Edwards, N., Neachtain, A., Richardson, H. & Watt, C. 2016. Core reef approach to *Sabellaria spinulosa* reef management in The Wash and North Norfolk Coast SAC and The Wash approaches. *Natural England Research Reports, Number 065.* This document has been provided at Deadline 1.

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Annex E: Summary of Natural England Relevant Representations

16 January 2019

1. Introduction

1.1. Natural England ("NE") submitted Relevant Representations on 31 August 2018. This document is a summary of those representations.

1.2. The Relevant Representations focused primarily on the potential nature conservation issues, but also on the quality of the data and approach that had been used to determine many of the conclusions presented within the Development Consent Order ("DCO") application.

1.3. Section 2 of the Relevant Representations provides an overview of the protected sites and associated designated features in respect of which NE has outstanding concerns. In total, NE highlighted 26 sites: 4 Special Protection Areas ("SPAs"), 5 Special Areas of Conservation ("SACs"), 1 candidate SAC, 2 Ramsar sites, and 14 Sites of Special Scientific Interest (SSSIs). The various features of these sites in relation to which NE has outstanding concerns are also listed.

1.4. Section 3 sets out NE's overall position, which states that we generally consider the documents presented to the Planning Inspectorate in support of the DCO application for Norfolk Vanguard to be of reasonable quality and in general present an acceptable overview of the impacts on nature conservation issues in line with the relevant legislation. However, NE has concerns regarding the detailed assessment of impacts on the designated sites identified. As a consequence, in our Relevant Representations we sought to provide high-level comments, covering our fundamental issues and main concerns, with further detail to be provided upon the Examining Authorities request and within our Written Representations.

1.5. Section 4 contains Natural England's fundamental overarching concerns and issues in relation to the application, which need to be addressed for a robust assessment to be undertaken. If these concerns are not addressed we will be unable to advise beyond all reasonable scientific doubt that there will be no adverse effect on integrity for the relevant SACs and SPAs.

1.6. Section 5 highlights issues that require further consideration and provides detailed comments on individual chapters within the DCO application.

2. Overarching Concerns – Section 4 within the Relevant Representations

2.1. Evidence

2.1.1. Natural England (NE) has some concerns with the standard of evidence provided in support of the application, primarily in relation to birds and Annex I Sandbanks and/or Reef features. Consequently Natural England is unable to reach conclusions beyond reasonable scientific doubt in a number of areas.

2.2. Cumulative / in-combination assessment

2.2.1. Currently it is not feasible to reach a conclusion on the significance of effects of the project alone and in-combination as a result of the uncertainties arising from the lack of site specific data.

2.3. Habitats Regulation Assessment/ Report to Inform Appropriate Assessment

2.3.1. NE is unable to agree with the conclusions set out in the HRA/RIAA due to the reasons set out within the written representations.

2.4. Offshore Ornithology

2.4.1. Natural England raised a number of concerns that had not been addressed sufficiently and need addressing in the assessment on offshore ornithology receptors. These can be summarised as:

- Seasonal definitions, specifically for lesser black-backed gull (LBBG) and gannet;
- Seasonal apportioning of impacts for Habitats Regulations Assessments (HRA) in non-breeding seasons to the relevant SPA colonies and in the breeding season for LBBG at the Alde-Ore Estuary SPA and kittiwake at the Flamborough and Filey Coast (FFC) SPA;
- Assessment of displacement impacts (EIA and HRA) for red-throated divers;
- Collision risk modelling (CRM) (EIA and HRA);
- Cumulative and in-combination assessments (displacement and CRM);
- Population modelling approaches (EIA and HRA).

2.4.2. NE cannot currently conclude beyond reasonable scientific doubt the absence of an adverse effect on the integrity on the SPAs and pSPAs assessed by the Applicant.

2.5. Haisborough Hammond and Winterton SAC

2.5.1. Both the Applicant and Natural England have identified several impact pathways that could impact on the Annex I Sandbank and/or Reef features, when considered alone and cumulatively. However, Natural England has concerns in relation to the Applicant's use of data sets, the over-reliance on the evidence presented, and assessment of the impacts against the conservation objectives for the designated site, which has resulted in a disagreement between the Applicant and Natural England on the significance of these impacts.

2.5.2. Therefore Natural England is unable to agree with the conclusions within the Habitats Regulation Assessment that there will be no adverse effect on the integrity Haisborough Hammond and Winterton SAC Annex I sandbanks and reef features both alone and in-combination.

2.5.3. Natural England have specific concerns regarding:

- **Consideration of alternative cable routes**, in particular the ability to effectively implement some of the proposed mitigation measures i.e. micro siting / routing around *Sabellaria spinulosa* reef;
- **Sandwave levelling**, specifically due to the lack of empirical data that relate to interventions of similar spatial and temporal scale to this project and for this particular sandbank system to support the modelling and uncertainty in cumulative / in-combination assessment with Norfolk Boreas;
- **Cable installation**, specifically NE has significant doubt regarding the evidence presented to i) support the successful avoidance of reef and ii) the ability of reef to recover if impacted through cable installation; and
- **Cable protection**. NE advises against the use of cable protection within designated sites as the addition of hard substrata is often incompatible with the conservation objectives for Annex I sandbanks and reef features. In addition, NE have significant doubt regarding the evidence presented to i) support the successful avoidance of reef and ii) the ability of reef to recover if impacted through cable installation.

2.6. Marine Mammals

2.6.1. **The management of cumulative noise impacts on the Southern North Sea cSAC from both piling and Unexploded Ordnance (UXO) activities** - As a result of the in-combination effect of underwater noise during the construction period of the project (from piling and UXO clearance), the Information to Support the HRA indicates that there is potential for Likely Significant Effect (LSE). Natural England advises that without the Site Integrity Plan and a mechanism to control subsea noise from multiple sources, there could be the potential for an adverse effect on the integrity of the Southern North Sea cSAC because of potential impacts on harbour porpoise. This is not an issue unique to the project and work will need to be undertaken to reduce the noise levels of multiple wind farms potentially constructing at the same time. This has been reflected in the Environmental Statement.

2.6.2. **Southern North Sea cSAC HRA assessment in-combination with other plans or projects –** NE currently does not agree with the conclusion in HRA.

2.6.3. **Effectiveness of UXO mitigation; particularly in relation to the largest UXOs** - NE is concerned about the reliance placed on mitigation to minimise the risk of injury to marine mammals from UXO clearance as it is currently possible to mitigate against the effects of the largest UXOs.

2.7. Onshore Ecology

2.7.1. NE requires further information on the potential impacts to the following designated sites:

- River Wensum SAC – there is insufficient information to enable NE to conclude that the designated site will be safeguarded during construction and subsequent restoration;
- Norfolk Valley Fens SAC and flow to component SSSIs – there is insufficient evidence to assess any impacts which may arise from changes in groundwater in groundwater flow;
- The Broads SAC – there is insufficient information on the water supply mechanism and how this may be affected by the installation of the cable route; and

- Paston Great Barn SAC – there is insufficient information to assess the significance of the impact on the SAC due to loss and severance of foraging and commuting habitat for Barbastelle bats.

2.7.2. There is insufficient information in the Code of Construction Practice (CoCP) for measures to safeguard the designated site in relation to sediment control and reinstatement of work all work areas for River Wensum SAC, Norfolk Valley Fens SAC and The Broads SAC as well as component SSSIs and SSSIs located downstream from the SACs.

2.7.3. Detailed management and monitoring procedures should be provided in the CoCP in case of 'breakout River Wensum SAC, Norfolk Valley Fens SAC and The Broads SAC as well as component SSSIs and SSSIs located downstream from the SACs.

2.8. Coastal Processes

2.8.1. Natural England suggests that a more precautionary approach should be developed at Happisburgh landfall site, due to the historically rapid erosion and future unpredictability of cliff recession.

2.9. Fish and Shellfish Ecology

2.9.1. Natural England is concerned that no further monitoring or independent surveys are proposed regarding fish and shellfish ecology within the In Principle Monitoring Plan.

2.9.2. These concerns primarily relate to fish assemblages which form a functional role in the food web for harbour porpoise within Southern North Sea cSAC.

2.10. Landscape and Visual Assessment

2.10.1. Natural England is satisfied that there will be no adverse effect from the project on the purposes of designation of protected landscapes, including North Norfolk Coast AONB and The Broads National Park.

2.10.2. Natural England still requires confirmation from the Applicant that there will be no temporary closures of England Coast Path during construction, operation or decommissioning or that these issues have been adequately addressed and agreed. Natural England is happy to provide further advice in this regard.

2.11. Land Use

2.11.1. Natural England is pleased to see that a Soils Management Plan, including method statements for soil handling, will be produced and agreed in advance and this should be legally binding on contractors. Please note that Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites has been withdrawn; our current advice is that you should continue to refer to the Construction Code as the best good practice guidance until further notice.

2.11.2. We are also pleased to see that the project will take account of any agri-environment schemes and their land management objectives by negotiation with individual agreement holders.

2.11.3. It should be noted that Grade 3 ALC soils need to be split into Grade 3a and Grade 3b, so that the assessment of loss of best and most versatile land (BMV) can be properly made (Table 21.10). The amount of BMV land that would be permanently lost to the development, i.e. by buildings etc., and the time it would take for the recovery of soils that are disturbed by the construction should be quantified in the ES.

2.12. DCO and DML

2.12.1. Natural England has fundamental concerns with several areas of the Development Consent Order (DCO) requirements and the Deemed Marine Licence (DML) licences, and require further suggested conditions based on the conditions set out in the Environmental Statement and the Habitats Regulations Assessment. These include, but are not limited to:

- **Arbitration Provision** – NE does not agree the provisions made for arbitration within this DCO are appropriate. Furthermore, on the subject of arbitration costs, we consider it inappropriate for a statutory body to be subject to additional costs while performing its statutory function;
- **Confidentiality clause** – NE cannot guarantee confidentiality or agree to be bound by such a requirement as we are subject to the requirements of the Freedom of Information Act 2000 and the Environmental Information Regulations 2004; and
- **The volumes and figures presented in the Development Consent Order (DCO) are not always represented within the Environmental Statement (ES) project description**. The project description should contain clear tables highlighting all the worst case scenarios and the figures there should be reflected in the licence. On many occasions this does not seem to have been the case, including (but not limited to) disposal, scour protection, maximum hub height and number of cable crossings;

2.13. Outline Operations and Maintenance Plan

2.13.1. **J-Tube and Ladder cleaning** - The ES project description does not detail the number of occasions this would occur or the volumes of material being deposited in the marine environment.

2.13.2. **Cable repair** – details are provided of a maximum of 5 cable failures per year, 2 for array cables, 1 for interconnector and 2 for export cables. The ES project description para 253 page 70 details 1 export cable failure, 2 array cable failures and 1 interconnector failure per year. The project ES does not fully detail the length of cable repair for all cables, just array cables which are detailed at 6km (para 257 page 71) which is significantly larger than the 600m implied by the outline O&M plan.

THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex F: Natural England's Response to Relevant Representations submitted by other parties

16 January 2019

Norfolk Vanguard Offshore Wind Farm – Response to Relevant Representations

Following submission of Natural England's and other consultees Relevant Representations regarding the construction and operation of Norfolk Vanguard Offshore Wind Farm, Natural England has reviewed other consultees Relevant Representations, including statutory and non-statutory consultees, and commented on the major issues within the remit of Natural England. Relevant comments from other consultees are summarised in Table 1, together with Natural England's position on the comments. These comments are colour coded as:

Green Comments- comments support/agree with NE position or does not impact on NE concerns

Amber Comments- NE comments may be in contradiction further advice needed, or potential new issue not included in NE comments

Red Comments- Comments in direct contradiction/argument with NE position or represents a significant issue not mentioned in NE relevant reps

Grey Comments – Comments that are not relevant to NE

Table 1: Summary of main comments from other consultees and Natural England's position.

Comment Number/ Page	Summary of Major Comments	Do they contradict or support NE comments, or is this a new issue NE needs to consider
Marine Management Organisation (22 page response)		
1.1	Since the submission of the Preliminary Environmental Information Report (PEIR), Vanguard has made the following decisions: • to use High Voltage Direct Current (HVDC) • the long option for horizontal direction drilling (HDD) works; • the construction window has reduced from 7 years to 4 years and the maximum number of turbines set at 200. The MMO welcomes these clarifications, however still feels there is considerable uncertainty regarding the impacts of construction, especially with regard to phased construction and areas of construction with regard to designated areas.	Matches NE position
1.2	Concerns that no worst case summary for the whole project has been provided. Similarly, the total amount of cable protection has been included for key areas but it is unclear what the worst case scenario quantities for the project is as a whole.	Similar to NE position
1.3	Suggest a summary table of O&M impacts would be useful to assist with assessing longer term impacts	NE supports this

1.4	Concerns that ES does not detail the number of occasions J-tube and ladder cleaning may occur, nor the volumes of material that would be deposited	NE supports this
1.5	Highlights discrepancies between the number of instance of cable repair detailed in the O&M Maintenance Plan and ES	NE supports this
1.6	Requests that reference is made to previous engagements and agreements with MMO	Not relevant to NE
1.7	Requests greater detail as to how the project complies with the overarching objectives of the Marine Policy Statement and the East Inshore and East Offshore marine plans	No NE position, however we would support this inclusion
1.8	Notes that UXO detonation is not included within the DCO/DMLS and therefore states that a separate marine licence would need to be obtained	Matches NE position
1.9	Recommends the indicative construction programme should include pre-construction activities such as UXO, sea bed preparation and scour protection to fully understand the timescales involved.	No NE position, however we would support this inclusion
1.10	The maximum hammer energy of 5,000kJ as assessed in the ES should be detailed within the design parameters on the DCO and all DMLs.	Matches NE position
1.11	Notes that the disposal volumes given in the ES chapters assessing impacts match the site characterisation report however they do not match reduced values in the DCO/DML.	Matches NE position
1.12	Concerns that there are a number of outstanding actions regarding mitigation	Similar to NE position
1.13	Significant concerns around underwater noise, particularly with regard to in-combination effects can be nagged and mitigated effectively.	Similar to NE position
2.1-2.7	Detailed comments regarding Schedule 14 Arbitration of DCO. In particular the request by applicant to use Article 38.	Similar to NE position
2.9	Concerns that DMLs opens the possibility of a transfer of benefit but that it is unclear what mechanisms would be in place to ensure two different windfarm developers working in the same area work in cooperation.	Not a comment we have raised but one we would support
2.10	Comments that all pre-construction monitoring reports must be submitted six months before commencement as applicant still has timescales of 4 months in several places	Not a comment we have raised but one we would support
2.11	Queries hub height	Matches NE position
2.12	Highlights that for both cable protection and scour protection the area of impact should be stated in DCO/DML not just volume	Matches NE position
2.13	Recommends ES and DCO/DML is aligned with regards to scour protection	Matches NE position
2.14	Cable crossings should be defined in the DCO/DML and limited to the number assessed in the ES.	Matches NE position
2.15	Queries disposal volumes The total maximum array cables, cable protection or cable crossings should be defined in the condition as described in the ES.	Matches NE position

2.16	Recommends a condition is included to restrict maximum hammer energy to 5000kJ	Matches NE position
2.17	Comments regarding inclusion of notification of all stages of works into Kingfisher bulletins	Not relevant to NE
2.18	Recommends wording of condition to ensure no man-made material is deposited at sea	Not a comment we have raised but one we would support.
2.19	Amendment to wording of disposal return condition	Not a comment we have raised but one we would support
2.20+2.25+2.27	Suggestion to extend survey outside order limits where the cable route crossed HH&W SAC. Concerns that the information in the IPMP does not align with these conditions	Not a comment we have raised but one we would support
2.21+2.24+2.27	Suggests post construction surveys should also be conducted for a period of 3 years (non-consecutive e.g. 1, 3, 6 or 1, 5, 10) to determine any long term effects within the SAC due to dredging and placement of the export cables and associated cable protection. Concerns that the information in the IPMP does not align with these conditions.	Not a comment we have raised. Support principle, but needs to be agreed for each activity independently as statement in current form is too generic, i.e. probably more appropriate for cable protection than dredging.
2.22	Recommended amendment to condition regarding noise monitoring	Matches NE position
2.23	Suggested amendment to condition regarding soft start procedures.	Matches NE position
2.28	Suggest monitoring should not be restricted to Annex 1 habitats	Similar to NE position;
2.29	Request that for fisheries appropriate mitigation measures, once agreed, are included as conditions on the licence	Not a comment we have raised, but one we would support.
2.30	Request further engagement with applicant with regards to O&M plan	Not a comment we have raised but one we would support
3.1.1 – 3..1.4	General comments on Coastal Processes section of ES	
3.1.5	Query regarding reliability of modelling data. The applicant is using data from East Anglia One OWF as they state that normal processes acting at this largely dynamic site will be unaffected and will prevent any significant long-term effects. MMO highlight that this is a reasonable expectation but since the applicant has carried out no new modelling for any aspect of this specific new development there is room for doubt or error and, importantly, no strong evidence to counter any opposing expert opinion.	Not a comment we have raised but one we would support
3.1.6	Comments regarding sandwave levelling. MMO is not fully in agreement with the statement that the HH&W SAC will ‘remain undisturbed’.	Matches NE position
3.1.7 + 3.3.5	Queries regarding quoted volume of SSC as there are discrepancies throughout the report. MMO state the values and ranges presented could be better explained and made consistent, possibly with reference to distribution through the water column (as absolute values may	Not a comment we have raised but one we would support

	disguise a change in the distribution, with potential consequences for light transmission over wide areas).	
3.1.8	Query cumulative impact assessments as the applicant states that additive impacts from multiple OWFs on waves and tidal currents are expected, but then that sediment transport, which they drive, will not be affected.	Not a comment we have raised but one we would support
3.1.9	Comments regarding excluding East Anglia One from cumulative assessment on the basis of the assessment for East Anglia Three. MMO flag that cumulative assessments for other OWF have included all OWFs in the East Anglia region and suggest Vanguard should acknowledge this modelling in assessments	Not a comment we have raised but one we would support
3.2.1	Other OWF DCO conditions and ES have considered operation and maintenance activities such as bird waste removal, paint and repair, J-tube and ladder cleaning. If these activities are likely to be undertaken for Vanguard then the likely effects to the benthos need to be assessed within the relevant chapter.	Similar to NE position
3.2.2	The application specifically states that some enabling works for the Norfolk Boreas project will be included within the DCO application, however this project (with respect to the shared export cable corridor) has only been considered within the in-combination effects chapters. It is not clear what 'enabling works' will be included in the DCO and whether they should be assessed within the main impact assessment sections i.e. if both projects (cable works) are being considered within this DCO then the installation of both need to be considered within the EIA.	Similar to NE position
3.2.3	Requests revision to sentence which states that 'Regardless of the phasing scenario selected, the two trenches (associated with Vanguard) would be installed sequentially and on new ground (with 120m between each trench); therefore, no direct recurring disturbance impact to Sabellaria is anticipated.' As it is likely that there will be further disturbance with the Norfolk Boreas trenches.	Matches NE position
3.2.4	Comments regarding colonisation of turbines with respect to decommissioning with regards to whether a survey is needed.	No comment raised due to location of the works outside of MPAs
3.2.5	Query related to colonisation of Sabellaria requesting that the applicant provide further information on whether these references actually relate to introduced substrate or whether they relate to the areas in general.	Not a comment we have raised but one we would support
3.2.6	Queries discrepancies in stated distance of sediment disposal from Sabellaria: (100m (advice from Natural England) vs. 50m)	We have stated that it should be at least 50m from Sabellaria based on recent aggregates advice.
3.2.7	Queries discrepancies in maximum number of boulders that may need to be cleared within HH&W SAC (allowance for clearing 22 boulders (up to 5m in diameter) vs. up to 100 boulders of 5m diameter within the SAC. This should be revised accordingly.	Not a comment we have raised but one we would support

3.2.9	Clarification of what type of artificial substrate was used at Hornsea ONE OWF and if it is directly comparable with what is proposed for Vanguard.	Not a comment we have raised but one we would support
3.2.10	Comments regarding the use of polypropylene fronds as scour protection. The MMO is engaging in further strategic investigations regarding this topic and invites Vanguard to participate with a view to reaching a more robust and confident conclusion.	Not relevant to NE
3.3.1 – 3.3.4	General comments on data used in fish chapter of ES, inc assessment of underwater noise impacts	Not relevant to NE.
3.3.6 + 4.4.2	The MMO notes that the updated assessment of underwater noise (Appendix 5.1) states that piles more than 7.0 m in diameter, the largest where measured data is available, have been used for the monopile modelling and piles of approximately 4.0 m in diameter (mid-way between the 3 m and 5 m pin pile options currently under consideration) have been used for pin pile modelling. A maximum 5,000 kJ hammer energy for monopiles has been modelled and used as the worst-case scenario for assessment. The applicant has indicated any sized monopiles between 9 and 20 MW could be installed at Vanguard and therefore potentially the worst-case for the larger monopiles ≥9 and ≤ 20 MW has not been fully considered in the assessment, though we acknowledge the modelling has been based on available data for 7 MW turbines and has and assumed that the trends would continue to the larger piles of up to 15 m diameter under consideration for the monopiles. We have potential concern that the modelled/assumed TTS impact ranges for the larger proposed turbines may under estimate/represent potential overlap with known spawning grounds/or areas of high herring larval density. The MMO are aware that the IPMP proposes to compare the measured data, from the first four piles of each type (e.g. monopile or pin-pile), with predictions for received levels and source levels that were made in the ES. In the event that any monitored noise levels exceed the predicted levels or impact ranges assessed in the ES, the impact ranges would need to reconsidered and assessed for fish receptors, especially those that are more acoustically or ecologically sensitive such as herring and cod. Potentially noise reduction and/or species protective mitigation would also need to be considered as well.	Not a comment we have raised but one we would support
3.3.7	Comments stating the limitations of the International Bottom Trawl Survey (IBTS) data have not been fully considered within the ES, however highlighting that the IBTS data provides indicative information for captured species and the omission of the limitations of the IBTS sampling does not affect overall confidence in the conclusions and information presented in relation to this data.	Not relevant to NE
3.3.9 - 3.3.11	Comments regarding mitigation measures for fish, highlighting that there is no species-specific mitigation currently but that this may need to be considered in the future if noise monitoring shows that piling noise levels and impact ranges exceed those predicted in the ES.	Not a comment we have raised but one we would support in relation to

		prey for harbour porpoise and Annex I birds
3.4.1 + 4.5.1	Comments regarding shellfish identified as being present in the area and highlighting problems with use of certain gear types to assess shellfish abundances	Not relevant to NE
3.4.2	Queries regarding assessment of displacement issues for <15m fishing fleet. Acknowledging that consultations to inform the ES have been carried out, but stating that unable to find reference to displacement issues.	Not relevant to NE
3.4.3	Request to see a description of the possible procedures, including those used previously, in the EIA to be put in place for the relocation of static gear which should be sufficient to reduce the impact to minor adverse significance.	Not relevant to NE
3.5.1	Comments regarding using source mitigation (e.g. bubble curtains) as the primary means of reducing the potential acoustic impact of pile driving (and UXO) operations	Not a comment we have raised but one we would support
3.5.2 – 3.5.12	General comments regarding underwater noise impacts including marine mammals and fish	Not relevant to NE
3.5.9	The MMO recommends that the underwater noise assessment should also provide a plot showing the predicted received sound levels with range, for the single strike sound exposure level (SEL). This will facilitate and streamline the process of comparing predictions with any future construction noise monitoring data collected for compliance purposes.	Not a comment we have raised but one we would support
3.6.1 – 3.6.4	General comments regarding dredge and disposal. Including confirmation that analysis method for sediment samples meets MMO criteria and that mitigation measures are appropriate.	Not relevant to NE
4.1.1	State that although Vanguard commit to strategic monitoring of marine mammals through the DEPONS project and of ornithological impacts via the European Offshore Wind Deployment Centre Research. it is important to meet the monitoring requirements for Vanguard by applying the results specifically to the individual project and analysed against assumptions made in the environmental statement.	Not a comment we have raised but one we would support
4.2.1	Comments that due to limited specific modelling and the reliance instead on expert interpretation for impact assessment, and the likely future pressure this will generate to rely on such methods in future development cases, monitoring should be specified to validate the spatial and temporal scale of impacts and to verify the anticipated recovery of (particularly) the designated features of the HH&W) SAC (particularly as the plan is presently for no benthic monitoring).	Not a comment we have raised but one we would support
4.2.2 – 4.2.3	Comments regarding IPMP stating that monitoring should, as a minimum, verify the expert assessments, necessary, as the ES assessments are based on expert assessment only and when designing possible future interventions (e.g. responses to cable exposures or repairs),	Not a comment we have raised but one we would support

	particularly within the SAC, it would be valuable to understand more accurately how the seabed actually responds.	
4.2.4 – 4.2.5	Concerns that the application refers to the models being calibrated but this phrasing obscures the more important point that the 'post-construction' impacts predicted by the models have not been validated by observations (i.e. through monitoring). Important as although the development passes through a protected area, directly affects the designated sedimentary system the impact of doing so has been assessed as (effectively) unimportant on the basis of no case-specific evidence.	Not a comment we have raised but one we would support
4.2.6 – 4.2.8	Further comments regarding IPMP regarding offshore monitoring and concerns that the applicant justifies their proposed offshore monitoring largely by engineering concerns; however, the driver quoted implies that the sandwaves in the HH&W SAC are a valid target for monitoring; specifically, whether the expected recovery is being observed following levelling. It is possible that the proposed 500m buffer area will be sufficient to capture this, depending on the local wavelength of the bedforms, but it may be that a wider area of disturbance is identified and that a programme of repeated monitoring is required. The MMO conclude that it is therefore important that the applicant has allowed (in the IPMP) that the final monitoring schedule remains to be agreed with the MMO.	Not a comment we have raised but one we would support
4.4.1	Comments regarding fish monitoring. Highlighting that no fish ecology or fisheries monitoring has been included in IPMP	Not relevant to NE
4.6.2	Comments that that underwater data should be recorded that allows a comparison with the EIA underwater noise modelling with analysis using un-weighted metrics, such as peak sound pressure level, sound exposure level and peak to peak pressure level. Also see comment 3.5.9.	Not a comment we have raised but one we would support
4.7.1	Confirm it is acceptable that no monitoring has been suggested in relation to dredge and disposal activities due to the low contamination levels of sediment	We would defer to MMO and CEFAS on this
4.8.1 – 4.8.2	Concerns that the lack of consideration of potential in-combination effects with other projects undertaking noise generating activities in the same temporal and spatial area is a major weakness in SIP. The MMO continue to have concerns regarding this uncertainty. Especially since current projects have extended their piling and UXO schedules by considerable amounts and one recent assessment brought the daily noise thresholds in the Sothern North Seas (SNS) pSAC at 16% which is perilously close to the limit of 20%.	Matches NE position
4.8.3	MMO request to see SIP six months before commencement not 4 months as stated.	Matches NE position
4.8.4	Highlights discrepancies - *the point of the site integrity plan is to deal with the fact that without a comprehensive plan, there is a risk to the conservation objectives for harbour porpoise from*	Not a comment we have raised but one we would support

	the potential in-combination effects during the construction period at Vanguard vs. *not enough information is available at this present time to assess effects and plan mitigation.*	
4.8.5	Point 68 – page 21 states "Potential strategic management measures such as scheduling of pile driving (section 6.1.3) would need to be carefully managed by the Regulators to achieve a coordinated approach with other developers." The MMO has informed Vanguard when an early draft of the Site Integrity Plan was shared (date) that no processes nor agreements are in place for the MMO to manage concurrent piling. No further engagement has been undertaken on this topic since then.	Not relevant to NE but reflects our advice
4.8.6 – 4.8.7	Following on from points 4.8.4 and 4.8.5 MMO acknowledges that Vanguard is waiting for new conservation objectives and guidelines to be circulated as detailed in the report however the MMO feels strongly that this issue cannot be relegated to post-consent plans but that a strategic approach to look forward to anticipate considerable problems is undertaken and resolved. Concluding that the ongoing uncertainties regarding the points raised above and the difficulties experienced by current wind farms means that this issue needs to be considered at both a strategic and project level and more certainty and confidence in solutions developed at this stage in the process. If progress is not made at submission stage, then the applicant and the MMO will have difficulties meeting the requirements to allow construction to be undertaken without unacceptable risk to protected marine mammals.	Similar to NE position
The Crown Estate		
	No significant comments raised, just confirmation that they were the landowner of the seabed and that the applicant has an agreement for lease.	Not relevant to NE
Anglian Water Services Ltd.		
	Highlights that there are both existing water and water recycling infrastructure in Anglian Water's ownership within the onshore cable route.	Not relevant to NE
	Groundwater sources: We have been in dialogue with the applicant regarding the proposed crossings of groundwater Source Protection Zones which include public water suppliers in Anglian Water's ownership within the onshore cable route.	Not relevant to NE
	Acknowledged that specific protective provisions have been included in the current version of the DCO and are therefore supportive of the wording of the Draft DCO	Not relevant to NE
	Comments they are not aware of any water supply or wastewater requirements made upon them for the above project and detail application process if a service is required.	Not relevant to NE
National Grid Electricity Transmission plc		
	National Grid want protective provisions to be included in the DCO to ensure that its interests are adequately protected and to ensure compliance with relevant safety standards. Inc:	Not relevant to NE

	• 400kV overhead transmission line and a 400kV substation within the onshore scoping area. • 3 high pressure gas transmission pipelines, above ground installations (AGI's) and a gas terminal located within or in close proximity to the onshore scoping area.	
	National Grid's primary concern is to meet its statutory obligations and ensure that any development does not impact in any adverse way upon those statutory obligations.	Not relevant to NE
Trinity house		
	No significant comments raised, just note that they wish to be registered as an interested party due to the impact the development will have on navigation within their area of jurisdiction.	Not relevant to NE
Orsted Wind Power A/S		
	No significant comments raised. Highlight that there are possible in combination impacts between Vanguard and Hornsea 3 and that Orsted and in regular contact with Vattenfall to liaise on environmental matters.	Not relevant to NE
Network Rail Infrastructure ltd.		
	Objects to the inclusion of a plot of land (plot 10/04), which is currently acquired by Network Rail, and to which the applicant is seeking compulsory acquisition powers. Network Rail requests the information below in order for them to be in a position to withdraw this objection: (a) agreements with the Applicant that regulate: - the manner in which rights over Plot 10/04 and any other railway property are carried out including terms which protect Network Rail's statutory undertaking and agreement that compulsory acquisition powers will not be exercised in relation to such land; and - the carrying out of works in the vicinity of the operational railway network to safeguard Network Rail's statutory undertaking. (b) the inclusion of protective provisions in the DCO for its benefit. Network Rail notes and welcomes the fact that there are protective provisions for its benefit in the Order and, if necessary, will provide detailed comments on, and amendments to, the protective provisions when it submits its detailed Written Representation.	Of interest although not directly relevant to NE
Environment Agency (Summary letter + 7 page response)		
Section 2.0 - CoCP	General comments regarding Code of Construction Practice. Including key points:	
2.3	The Outline CoCP does not appear to contain an assessment of risk nor	Not a comment we have raised but one we would support

	monitoring process for the release of bentonite or other drilling fluids at trenchlesscrossings; this should have been included.	
2.9	Request that Requirement 20 in the Draft Development Consent Order includes a requirement that for each phase a code of construction practice and associated pollution control plans are submitted to and approved by the Environment Agency prior to works on that phase.	Not a comment we have raised but one we would support
2.10	Section 3.2 Construction Site Layout and Housekeeping paragraph 45 sets out measures for working in Flood Zones 2 or 3. This includes a proposal to leave gaps in stored spoil. This measure is not acceptable. Spoil should not be stored in the functional floodplain of a watercourse. Any spoil stored in a functional floodplain will take away the flood storage capacity for that area and so increase flood risk elsewhere. In addition, storage of spoil in the functional floodplain would increase the risk of sediment mobilisation and drainage to watercourses in a flood event.	Not a comment we have raised but one we would support
Section 3.0 - Ground Conditions and Contamination	General Comments regarding ground conditions and contaminations, concluding that EA generally concur with the proposed approach and protocol to address unexpected contamination and waste soils but further consideration should be given to the following:	Not a comment we have raised but one we would support
3.2	the impacts of mobilising existing contamination on excavation	Not a comment we have raised but one we would support
3.3 – 3.4	the sensitivity applied to unlicensed household water supplies	Not a comment we have raised but one we would support
3.5 – 3.6	more detailed assessment of potentially contaminated sites at Happisburgh, near North Walsham and Necton.	Not a comment we have raised but one we would support
3.9 – 3.10	the impacts on shallow wells in close proximity excavations	Not a comment we have raised but one we would support
4.1 – 4.2- Water Resources and Flood Risk	Comments on Whitewater River, associated flood risk and the need to apply for appropriate permits.	Not a comment we have raised but one we would support
4.3 - Water Resources and Flood Risk	Comments that excavated materials must not be stored in the floodplain	Not a comment we have raised but one we would support
4.5 - Water Resources and Flood Risk	We concur that the worst case shallow depth of the cable corridor (1.5m) and jointing bays (2 m) and small volume of the installations should mean that any change in shallow aquifer groundwater flow should be localised and insignificant.	Not a comment we have raised but one we would support

4.6 - Water Resources and Flood Risk	Please that there will be a consultation on private water supplies	Not relevant to NE
4.7 - Water Resources and Flood Risk	Monitoring schemes for pollution remediation and crossing schemes are to be put in place and EA request engagement.	Not a comment we have raised but one we would support
4.8 – 4.13 - Water Resources and Flood Risk	Details of errors/omissions in various maps: Bedrock and superficial aquifers, Bedrock geology maps and WFD Compliance Assessment table 20.2	Not a comment we have raised but one we would support
5.1 – Onshore Ecology	Further information is required to inform mitigation during construction for the active Sand Martin colony at Happisburgh	NE concerns are similar
5.2 – Onshore Ecology	Raise concerns that document states that all non-statutory designated sites are considered of medium importance, however, there are local wildlife and County wildlife sites that have qualifying features of similar quality and importance to SSSI's suggesting Norfolk Wildlife Trust should advise which have features similar to a SSSI.	Not a comment we have raised but one we would support
5.3 – Onshore Ecology	Advice regarding fish passage at open cut trenched sites - Recommend pumps are avoided, or if necessary appropriate screening is used to prevent uptake of fish into pump mechanism.	Not relevant to NE
6.1 – 6.5 Consents and Licences required under other legislation	General advice regarding environmental permits or disapplication required; including the need to apply for a flood risk activity permit	Not relevant to NE
7.1 – Protective Provisions	The Applicant seeks to disapply various pieces of legislation (Article 43, Schedule 16, Part 7 of the draft Development Consent Order submitted with the application). EA are currently considering their position in relation to the legislation which is relevant to the Environment Agency and the suggested draft protective provisions included in the draft DCO which accompanies the application. They will be responding to the Applicant on these issues in due course and will provide the Examining Authority with an update	Not relevant to NE
Historic England		
	Acknowledge decisions are still to be made about offshore installation of infrastructure, such as the wind turbine generator foundation options and the seabed preparation that may be required and highlight that all such matters therefore regarding different design options need to consider the impact that they may have on the historic environment in line with National Policy Statement: Renewable Energy Infrastructure (EN-3).	Not relevant to NE

	Identify heritage assets of international significance in the vicinity of the proposed electricity export cable landfall location (near Happisburgh, Norfolk), stating that all mitigation measures, as included in the outline archaeological Written Schemes of Investigations (WSIs), must be secured through the draft Development Consent Order (DCO) to inform delivery of this project, should consent be obtained.	Not relevant to NE
	Likewise for the on-shore cable route from the landfall to the substation we note the outline WSI (onshore) and we wish to ensure that all necessary mitigation measures, are secured through the draft DCO and are agreed with the relevant local authority archaeological advisors to ensure delivery of this project, should consent be obtained.	Not relevant to NE
	Specific provisions within the draft deemed Marine Licence of the draft Development Consent Order must allow effective delivery of agreed archaeological mitigation programmes in line with published professional guidance for the archaeological sector.	Not relevant to NE
	The assessment of cumulative impact to both potential heritage assets and to the setting of heritage assets and historic seascape character identifies a number of relevant matters. A key factor is how the accumulation of information derived from development-led archaeological assessments might increase knowledge and understanding. It is therefore a relevant matter that a core component of a viable mitigation strategy is the satisfactory completion of analysis programmes, within defined time periods, to accepted professional standards with publication and access through public archives.	Not relevant to NE
	Previously raised concerns in relation to the impact of the substation on the significance of a number of designated heritage assets through development within their setting and acknowledge that a specific historic environment visualisations chapter has been produced, but will explore this issue further in the written representation.	Not relevant to NE
Maritime and Coastguard Agency.		
	MCA is satisfied with how the applicant has assessed the risk. However, they have a few outstanding concerns these include: • Layout design – MCA will seek to ensure structures are aligned in straight rows and columns. In particular the scale of development in combination with other windfarms in SNS • Hydrographic surveys – Data yet to be submitted and therefore MCA highlight that failure to report the survey or conduct it to Order 1a might invalidate the NRA if it was deemed not fit for purpose • Cable routes – MCA highlight that export cable routes, cable burial protection index and cable protection are issues that are yet to be fully developed and confirm they	Not relevant to NE.

	would accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum.	
	SoCG to be sought.	Not relevant to NE.
Public Health England		
	No comments to make. They have chosen NOT to register an interest	Not relevant to NE.
National Trust (below refers to separate representation, however National Trust and also represented by Savills UK Ltd as part of NFU representation)		
	The National Trust ("the Trust") owns the freehold of 2000 ha of land to the west of Aylsham, Norfolk, which Vattenfall is proposing to acquire new permanent and temporary rights over land within the Estate, including a 100m wide easement through 4.5km of the Estate. This land in "inalienable" and therefore although it appears that none of the Trust's interests are susceptible to compulsory acquisition under the DCO, the Estate is intended to be used for the purposes of the DCO should the Trust grant the necessary rights. Concluding that whilst Vattenfall have said that the Trust's interests are excluded from compulsory acquisition under the draft DCO, the documentation does not make that clear. The book of reference should be amended or an appropriate undertaking given.	Not relevant to NE
	The National Trust have two key outstanding concerns, and therefore objects to the proposed DCO: 1) the impact of the proposals on the little understood archaeology of the Estate. 2) the impact of disturbance to the highways network and the consequent effect on our visitor based business.	Not relevant to NE
Scottish Power Renewables		
	No significant comments raised, just note that they wish to be registered as an interested party in order to make representations in relation to cumulative and in combination issues. This may include seeking protective provisions within the Norfolk Vanguard DCO.	Not relevant to NE concerns
Whale and Dolphin Conservation		
	Particularly concerned that the construction of Norfolk Vanguard offshore wind farm has the potential to negatively impact cetaceans, in particular harbour porpoises and the integrity of the Southern North Sea SCI, for which harbour porpoise (Phocoena phocoena) are the qualifying feature.	Matches NE Comments
	As Norfolk Vanguard offshore windfarm lies directly within the SCI, in both summer and winter habitat for harbour porpoises, our concern is that the windfarm construction will impact the SCI both alone and in-combination.	Matches NE Comments
	WDC have concerns regarding the effectiveness of some noise mitigation methods and the SNCB guidance on noise management within mobile species marine protected areas (MPAs).	Matches NE Comments
	Key Recommendations:	In line with NE comments

	• That pile driving is not used at all during construction; • That strict limits be placed on noise levels during construction, including cumulative noise; • That proven mitigation methods are in place around the source to mitigate the impacts of radiated noise levels; • That a robust impact monitoring strategy (Marine Mammal Monitoring Plan (MMMP)) is developed for the range of species that can reasonably be expected to be impacted; • That WDC is included as a consultee of the MMMP and that we are included in the discussions for the design of the MMMP as we have concerns regarding effectiveness of some mitigation methods; • A robust MMMP should include: shut-down when marine mammals approach within a specified distance of operations (mitigation zone); • That the monitoring strategy is appropriate to consider cumulative impacts of all developments in the region; • Ground-truthing of modelled noise assessment data should be undertaken; • Should any incident that results in mortality occur during construction, activities should be halted immediately until an investigation can be completed; • An assessment report is publicly available within a reasonable timeframe of construction completion	
Royal Yachting Association		
	The RYA's main concern relates to the cable landfall where the cable comes within the 10m contour and any resulting reduction in water depth. There could be issues where the cables cross other wind farm export cables and other inland waterways on route to the onshore Grid connection and the RYA should be consulted with respect to this. RYA maintains its position with respect to not seeing the need for operational safety zones for floating offshore winds turbines. The RYA respects the need for safety zones during construction, major maintenance and decommissioning as well as for manned structures during operation.	Not relevant to NE
CPRE Norfolk		
	CPRE Norfolk will be covering the following points in its written representation: - preference for an HVDC system as submitted for approval, rather than an HVAC system. - environmental/ecological concerns, in particular with reference to river valleys. - issues with connection to the National Grid. - impacts on the countryside	General comments in line with NE comments
East of England Energy Group (EEEGR		

	Full support for this application from Vattenfall for the Norfolk Vanguard project.	Not relevant to NE
Norfolk Wildlife Trust		
	The principal issue is mitigation of impacts on Local Wildlife Sites, which may occur through cabling or associated location of haul roads.	Not NE remit
	With regard to mitigation of impacts on great-crested newt, we wish to see consideration made to the potential for using the new Natural England licencing procedure to enable restoration of great-crested newt habitat, in order to mitigate for impacts of cabling.	NE position is that GCN mitigation will be included in SOCG. In SOCG Vattenfall state mitigation is appropriate and proportionate as outlined in the draft great crested newt mitigation licence, circulated and discussed at April 2018 meeting. This includes the potential to use district wide licensing which may be in place by 2020.
	With regard to offshore impacts, we support The Wildlife Trust's submission regarding impacts of noise on marine mammal and inclusion of fishing in cumulative/in-combination assessment.	This is ongoing discussion for Hornsea Project 3.
The Wildlife Trusts		
	TWT has concerns regarding the impact of underwater noise from construction on marine mammals. In particular, we are concerned about cumulative underwater noise disturbance impacts on the harbour porpoise North Sea Management Unit and in-combination disturbance within the Southern North Sea (SNS) SCI. We are pleased that the applicant has committed to the production of a Site Integrity Plan (SIP). However, in its current form the SIP lacks detail and therefore TWT does not consider it adequate to ensure no adverse effect on the SNS SCI beyond reasonable scientific doubt.	NE argued without SIP **and** a mechanism to control subsea noise from multiple sources, there could be the potential for an adverse effect on the integrity of the Southern North Sea cSAC because of potential impacts on harbour porpoise
	To achieve this, more detail should be provided on the effectiveness of the proposed mitigation as outlined in the SIP. This should include referenced examples of how the implementation of mitigation will reduce underwater noise disturbance impacts within the SNS SCI. Noise modelling should also be undertaken to demonstrate the degree of noise reduction which could be achieved through mitigation.	In line with NE comments
	Finally, TWT recommends that all offshore wind farm developments should be conditioned as part of their Development Consent Order to pay into an underwater noise levy which would fund and deliver strategic mitigation and monitoring and establish an implementation group. Based on the scale and ambition of the offshore wind industry, there is potential for tens of thousands of harbour porpoise to be impacted by underwater noise disturbance (up to 75,789	In line with NE comments 4.47

	porpoise indicated in appendix 12.6). Therefore, a mechanism to deliver strategic monitoring and mitigation to understand and manage in-combination underwater disturbance impacts is urgently required. TWT has produced a paper on the underwater noise levy which we are happy to share with the Planning Inspectorate.	
	fishing has not been included in any cumulative/in-combination assessments for Norfolk Vanguard. TWT does not consider fishing to be part of the baseline. Following the commencement of judicial review proceedings by TWT against Dogger Bank Wind farms, we were given assurances that fishing would be included in future offshore wind farm assessments. We make this case for all SACs assessed in the application.	This is ongoing discussion for Hornsea Project 3.
Eastern Inshore Fisheries and Conservation Authority		
	Eastern IFCA would like to take this opportunity to note our appreciation for the change in the route to avoid the MCZ.	Matches NE comments
	Haisborough, Hammond and Winterton SCI: We appreciate that Vattenfall have stated its commitment to minimising cable protection where possible within the Environmental Statement, on the back of comments about Policy CAB1 of the East Marine Plan (HM Government, 2014). The worst-case scenario examined still states that up to 4 km of cable protection could be required in the SCI per cable pair if hard substrate is encountered (total of 8 km in the SCI). Cable protection would result in direct habitat loss where protection is placed. We would like to re-emphasize that cable protection works in Haisborough, Hammond and Winterton SCI are extremely undesirable, and are not in keeping with the East Marine Plans. Every effort should be made to maximise the length of cables that are buried and maintain burial over time. Using cable armouring instead of cable burial increases the likelihood of adverse environmental and fishery impacts. For more details on this matter please review the Eastern IFCA response to the Preliminary Environmental Information Report (PEIR) for this development (Section 3.3, Policy CAB1).	In line with NE comments
	Haisborough, Hammond and Winterton SCI: We defer to Natural England for formal conservation advice on the impacts of the offshore cable corridor on both sandbanks and Sabellaria spinulosa reefs and measures that could be put in place to mitigate these impacts.	Defer to NE advice
	Eastern IFCA are seeking fishing closures (via a byelaw) to protect sensitive features within the inshore section (within six nautical miles of the shore) of the SCI. These closures are yet to be finalised, but any works in this area will need to proactively take into consideration up-to-date closures and the latest available information on the location of sensitive species and habitats.	In line with NE advice. NE advise cable activities are avoided in these areas
	Eastern IFCA is keen to encourage parity by encouraging regulators of non-fishing activities that could damage or disturb sensitive features (e.g. cable laying, remedial works and cable	In line with NE

	protection) to prevent or at least minimise such activities in areas closed to fishing for the protection of these features.	
	Southern North Sea Harbour Porpoise candidate SAC: Within Eastern IFCA's response to the PEIR we requested that the impact of the project on sandeels, which are among the most important prey species for harbour porpoise and which inhabit and spawn in the project area, was further assessed in combination with other plans and projects in the Southern North Sea. We acknowledge that the Environmental Statement concluded that the potential for the project to significantly contribute to the cumulative impact on sandeel populations (because "the project overlaps with low intensity spawning grounds for this species with high intensity spawning areas located to the north of the project area"). This conclusion was drawn despite medium behavioural sensitivity of sandeels to underwater noise from piling and medium sensitivity of sandeels to permanent loss of seabed habitat during operation. We defer to Natural England for formal conservation advice on this matter, however we would like to once again highlight Eastern IFCA's concern about the scale of both licensed and planned offshore activities (particularly aggregate extraction and offshore wind farm construction) in the Southern North Sea, because of cumulative effects these could have on seabed habitats. Sandeels depend on the presence of adequate sandy substratum in which they burrow and are demersal spawners that lay eggs on the seabed. Whilst we appreciate the difficulty in studying potential wide-scale impacts of all offshore activity, this is an important issue worth considering.	In line with NE comments. NE recommend Sandeel and herring
	Cromer Shoal Chalk Beds MCZ : Eastern IFCA agree with the conclusion that the cable corridor, which is located approximately 60 m from the edge of the MCZ, will have an impact of negligible significance on the MCZ, as the MCZ is deemed to be of low sensitivity and the magnitude of impact is negligible. We do however defer to Natural England for formal conservation advice on Cromer Shoal Chalk Beds MCZ.	NE agrees with the Applicant's assessment
	2.2 Policies EC3 and ECO1 In response to the PEIR, Eastern IFCA stated that we "would encourage further assessment on an ongoing basis of the cumulative impacts of all Southern North Sea wind farm activity, as well as other activities including aggregate extraction activities. The impacts of these projects on the marine environment and fisheries should be assessed in-combination, highlighting any potential cumulative effects associated with the licence application." While we understand the response from Vatenfall that this is "not within the remit of a single project and would need to be undertaken at a strategic level and under the guidance of Regulators", we still believe that it is the collective responsibility of all projects to comprehensively assess the cumulative	In line with NE comments

	impacts, under the guidance of the Regulators.	
	Eastern IFCA have already stated that we do not agree that already installed infrastructure and practiced licenced activities should not be included in the cumulative impact assessment. All possible cumulative impacts need to be assessed, regardless of whether an activity is already licenced, installed or otherwise. This should include, but not necessarily be limited to, planned and licensed wind farm and aggregate dredging activity in the Southern North Sea.	NE 4.2.16 The Applicant has considered that all wind farms at which turbines were installed before or during 2012 form part of the Norfolk Vanguard baseline. Natural England does not agree that these wind farms should be considered part of the baseline. This is because, although some of the wind farms included in the Applicant's list have been operational for over 10 years, there are on-going impacts on the RTD population and the data used in Furness (2015) pre-date the installations.
	2.4 Policy FISH2 2.4.1 Electromagnetic fields Overall impacts of electromagnetic fields (EMF) are assessed as an issue of minor adverse significance to elasmobranch species within the Environmental Statement. In the context of the assessments of EMFs, Vattenfall have stated that "it is important to note that from the results of other post-consent monitoring conducted to date, there is no evidence to suggest that EMFs pose a significant threat to elasmobranchs at the site or population level". However, we highlight that there are appreciable gaps in the scientific literature as to the potential effects of EMF emissions from subsea cables on marine fauna, and therefore there remain uncertainties in the ability of Vattenfall to determine that there will be no adverse effects on fish and shellfish ecology. Eastern IFCA is particularly concerned about the proliferation of marine electricity cables off the East Anglian coast and the potential – but very poorly understood – impacts on marine life. Outside of the assessment of EMF impacts on elasmobranchs, Eastern IFCA would like to refer you to the recently published Marine Pollution Bulletin paper by Scott et al. (2018) on the	Not a comment we have raised, but one we would support

	effects of EMF on edible crab, *Cancer pagarus*. The impact of EMF on crustaceans is another issue worth considering due to the commercial and ecological importance of the edible crab and European lobster, *Homarus gammarus*, and the recent advance in scientific research on this subject.	
National Farmers Union (represented collectively by Savills UK Ltd.)		
	details on timings of construction to be able to understand the impact on the cropping rotation of the farm or the commercial shoot over the winter months. Therefore it has not been possible to discuss all aspects of the scheme in detail.	Not relevant to NE
	2.3 Further specific detail has been requested from Vattenfall on soil management during construction, access routes shown on the plans submitted with the heads of terms, and in particular on how the location for the substation was chosen.	Soil management discussed by NE 5.6.1 to 5.6.3
	3.3 The NFU and the land agents LIG believe that no meaningful negotiations have taken place in regard to the site for the converter substation and the access routes. Therefore a compelling case as yet cannot be made.	Not relevant to NE
	4.3. At the present time the plans are showing for the new converter substation to be located at the top of a hill on a very prominent site near to Necton Wood. Further to a site visit on 10th September 2018 to look at the proposed elevated site, information has been requested on why such a prominent site position has been chosen as it will be visible particularly from the south and west.	Not NE's remit. NE consider Landscape Visual Impact Assessment in designated sites.
	4.4 Questions have been raised as to why the substation is not being sited nearer to the National Grid substation on land lying to the north of the existing substation. This land lies lower down and is not as visible as the proposed location.	Not relevant to NE
	5.1 Landowners from the start were notified by Vattenfall that they would be looking to carry out the project as two schemes Vanguard and Boreas. Vanguard is to be constructed first, with underground cables being laid in ducts. At the same time ducts will be laid to take underground cables for the Boreas scheme. Vattenfall has stated that they will need at least 2 years to lay the ducts and cables for Vanguard. There then may be a gap of a year before the start of the Boreas scheme. Further clarification is needed from Vattenfall on timings of construction and how construction will take place for the Boreas scheme. For example will working areas just be needed for jointing bays on the Boreas scheme? Landowners do not yet understand what the interference will be from constructing Boreas following Vanguard	Not relevant to NE
	6.1 Confirmation is sort from Vattenfall on whether a Cumulative Affect Assessment has been addressed of both of their schemes Vanguard and Boreas along with the Orsted Scheme Hornsea 3 which are programmed to be constructed at approximately the same time. Hornsea 3 is running north to south and Vanguard and Boreas running east to west. This greatly	Not relevant to NE

	impacts the number of landowners affected and as this takes more land out of agricultural production.	
	7.2 It is understood that some link boxes will be needed with the cables being HVDC cables and further clarification is sort on how many there are likely to be and the location of the link boxes. Link boxes do stand proud above ground level and so greatly interfere with agricultural operations and are a hazard to farm machinery. It is extremely important to have further design information on link boxes and the siting of them. The preference is that all link boxes are located within field boundaries.	Potential for link boxes within field boundaries to effect hedgerows, habitat connectivity, flight and feeding lines.
	9. Soils 9.1 As above the treatment and reinstatement of soil during and after construction is one of the main issues of concern. Limited detail has been provided to landowners and occupiers. Again LIG does not know how soil reinstatement and aftercare will be dealt with in the Option or Deed. Further no information has been provided as to how soil will be reinstated or the measures that will be put in place to bring the soil back to its condition and quality before the works took place. An after care plan should be included in a code of construction or soil management plan.	In line with NE comments on requirement for soil handling plan.
	10.Flood Issues 10.1 No details have been provided to landowners and occupiers on how any increase in surface run off of water from the haul road or the construction compounds will be dealt with during construction. Therefore there is concern that retained land may flood during the construction works.	Not relevant to NE
	12.Access routes to the Order Limits 12.1 At the present time Vattenfall has provided details of access routes it would like to use to gain access to the working strip. Issues have been raised by some of the agents that some of the access routes are not actually physically possible on the ground due to differing ground levels. Further a lot of access routes have been highlighted and agents are not actually sure that all of these access routes are needed. In some instances there are better access routes available to reach the working strip but Vattenfall as yet has not engaged in agreeing viable access routes.	Not relevant to NE
Royal Society for the Protection of Birds (RSPB)		
	the RSPB remains concerned that some methodological procedures used in the assessment are inadequate to ensure a robust assessment and therefore a proper understanding of the likely impacts of the scheme.	In line with NE comments

	2. Offshore ornithology impacts We have significant concerns regarding the findings of some of the impact assessments. As a result of the methodological concerns (set out below) and our own recalculation of collision risk using the Marine Scotland stochastic model, the RSPB considers that the impacts have not been adequately assessed and, as such consider that an adverse effect on the integrity (AEOI) of the following SPAs/pSPAs and their species cannot be ruled out for the following ornithological interests: • The impact of collision mortality on the kittiwake population of the Flamborough Head and Bempton Cliffs SPA and the Flamborough and Filey Coast pSPA (FHBC SPA/FFC pSPA) alone and in-combination with other plans and projects; • The impact of collision mortality on the gannet population of the FHBC SPA/FFC pSPA alone and in-combination with other plans and projects; and • The impact of collision mortality on the lesser black-backed gull population of the Alde-Ore Estuary SPA alone and in-combination with other projects.	In line with NE comments on stochastic and non stochastic modelling.
	We also consider that potential for likely significant effects on the following site exists, and that this site cannot be screened out from further assessment at this stage: • Bruine Bank pSPA (Netherlands) – displacement of razorbills and guillemots, particularly during migratory periods.	Not within NE remit
	we consider that insufficient evidence has been provided to rule out potential significant impacts on the following North Sea populations: • Cumulative collision mortality to North Sea populations of kittiwake and great black-backed gull; and • Cumulative operational displacement to North Sea populations of auks (guillemot, razorbill and puffin) and red-throated diver.	In line with NE comments
	(a) Potential Biological Removal Potential Biological Removal (PBR) is used in justification of conclusions of no AEOI for both gannet and kittiwake. The RSPB disagree with the use of PBR in this context following the publication of the review by O'Brien et al. (2017) and the RSPB Practitioner's Perspective (Green et al., 2016), and therefore support NE's position that PBR does not provide an appropriate threshold for this purpose (as outlined in the Secretary of State's HRA for the Hornsea Project 2 offshore windfarm). PBR was designed to manage whaling quotas by detecting unsustainable mortality in a population leading to risk of its extinction, whereas SPAs are set up to maintain or restore a population of conservation importance. Levels of acceptable mortality derived from PBR are therefore likely to be higher than those acceptable for a population to continue to meet the conservation objectives of a SPA. Where population	In line with NE comments, advise PVA.

	modelling is required to inform an assessment, this should be based on Population Viability Analysis (PVA). PVA enables comparison of the change in population size with and without the project after several years, thereby presenting an indication of the magnitude of change attributable to the proposal and is therefore more suitable for assessing the effects of a project on a SPA.	
	(b) Stochastic Collision Risk Model (CRM) In order to predict the collision risk mortality of an offshore wind farm in the UK, the Band (2012) model has previously been used in assessment. This model uses a number of input parameters, such as bird size, flight speed and turbine blade dimensions, to calculate the probability of a bird that passes through the swept area of a turbine blade colliding with that blade. For this deterministic model the input parameters were defined as single values with no indication of variability around them. In reality, most of the parameters will exhibit a considerable degree of variability and stochastic collision risk modelling has been developed to allow this to be incorporated into the model and thus generate a potential range of output predicted collision mortalities. MacGregor et al., (2018), under commission of Marine Scotland Science and overseen by an expert steering panel, produced a revised and fully tested stochastic model to widespread stakeholder acceptance. By contrast, the Applicant has presented an entirely untested new version that does not follow a recognised methodology, with insufficient detail provided as to how it incorporates variability or how it overcomes the statistical difficulties of non-independence (the degree of interrelation) of some of the variables. The RSPB therefore does not agree that the model presented by the Applicant is fit for purpose and recommend that the Marine Scotland (MacGregor et al., 2018) model version is used in preference.	In line with NE comments. NE advised used Band 2012 model.
	(c) Use of median bird densities within the CRM The Applicant has presented deterministic and stochastic versions of the CRM (see above). For the deterministic version (Band 2012) of the CRM the correct value to use for bird density is the mean monthly value. As detailed in Environmental Statement Appendix 13.1 Ornithology Technical Appendix Annex 3 [APP-217], the values used by the applicant appear to be median values, which will result in the model predicting considerably lower collision mortalities.	In line with NE comments, also question the use of median
	(d) Nocturnal Activity Factor We do not agree with the changes in Nocturnal Activity Factor (a parameter used in collision risk modelling) proposed. The value presented for kittiwake is based on unpublished evidence which does not appear to form part of the examination documentation and therefore we are unable to assess the robustness of the study. The current factor is derived from the expert	In line with NE comments 4.1.3 Twilight

	opinion collected by Garthe and Huppop (2004) and this use is endorsed by Band (2012). A review of seabird vulnerability to offshore wind farms (Furness et al., 2013) recommended that no changes be made to the nocturnal activity scores for these species, and an update, including the same authors (Wade et al., 2016) maintained this recommendation. It is also not clear how these revised rates account for the distinction between the definition of daylight as used in the Band model and with the official concept of 'twilight' and 'night'. This is an issue as the Band (2012) model considers the nocturnal period as between sunset to sunrise and so treats flight activity that occurs at twilight as being within the nocturnal flight period. Evidence from tagging shows that an important number of seabirds actively forage at twilight.	
	While we welcome the latest published evidence review for gannet (Furness et al., 2018), we are concerned that the mortalities predicted using revised nocturnal activity rates for gannet (and this is also applicable to kittiwake) are potentially underestimated because they do not account for the potential interaction between survey timing and diurnal behavioural patterns. Peaks in foraging activity at first and last light (see for example Fig. 3 in Furness et al. 2018) will not be accounted for in the assessment if these did not coincide with surveys (the timings of which are currently unknown, but likely to be midday if aerial), and the survey may have been carried out at a time of much lower activity. Thereby the application of the revised nocturnal activity factor recommended by Furness et al., (2018) could result in inaccurate underestimates of collision risk.	Not a comment we have raised but one we would support
	The Nocturnal Activity Score presented for gannet in the application documents is also not in accordance with this latest review (Furness et al., 2018) which recommends 8% in the breeding season and 3% in the non-breeding season. The values used in the assessment, 4.3% and 2.3% respectively, will result in a prediction of fewer collisions.	NE raise nocturnal activity in our Rel. Rep. 4.1.3, for Gannet suggest 0-25%
	(e) Underestimation of collision mortality Based on a comparison with our own calculations using the MacGregor et al., (2018) model version with a range of nocturnal activity rates, the Applicant's model underestimates collision mortality for key species, and it produces significantly reduced predictions compared to the deterministic model, particularly when the deterministic model is also re-run using mean (rather than median) monthly bird densities.	In line with NE comments
	(f) Breeding season definitions We have concerns about the manner in which biological seasons for gannet and kittiwake have been defined by Vattenfall's consultants. The use of the 'migration-free breeding season' means that months where breeding and migration can overlap are excluded from the analysis of breeding season impacts, artificially reducing the duration of the breeding season and	In line with NE comments 4.2

	hence risks underestimating collision mortality of breeding birds. The definition of 'breeding season' as presented in Furness (2015), should therefore be used, except where colony specific evidence clearly suggests otherwise.	
	(g) Apportioning of mortality to SPAs We have concerns about some of the figures used for apportioning of collision mortality to SPAs and the evidence used to support this. The estimated proportion of kittiwake from FHBC SPA/FFC pSPA used in the HRA is 16.5% and is based on no site-specific historical estimates. Notwithstanding the applicants unfounded criticisms of the FAME and STAR tracking of kittiwakes, which is dealt with below, the assessment does not take into account more recent tracking of kittiwakes from FHBC SPA/FFC pSPA carried out in 2017, using lighter tags (<3% bodyweight) and following the birds for a longer period due to a novel attachment method, that showed a high degree of overlap of colony breeding birds with the development site. We therefore do not agree with the value used for apportioning kittiwake collision mortalities to the FHBC SPA/FFC pSPA as it will considerably underestimate the actual impact.	NE also question mortality and displacement figures at SPA and biogeographic level
	We are concerned that the methods used for apportioning collision mortality of lesser black-backed gulls to the Alde-Ore Estuary SPA are inadequately explained, with insufficient reference to current knowledge and with a cavalier attitude toward precaution. Such calculation is difficult because of two competing factors. Throughout the UK, the urban population of lesser black-backed gulls is increasing, while those in "natural" colonies is decreasing (JNCC, 2018). In simplistic terms this could be argued as reducing the impact apportioned to the SPA. In the Applicant's calculations of the number breeding birds within foraging range of the developments a number of inland, urban colonies are included, such as Ipswich and Norwich as likely sources of birds foraging in the development areas. While we acknowledge that there is a need for more research on the foraging behaviour of urban gulls, it is unlikely that such gulls, especially those from non-coastal urban colonies will forage in the offshore marine environment to the same extent as those breeding at coastal "natural" colonies, such as the Alde-Ore Estuary SPA. The inclusion of birds from such sites dilutes the potential significance of impact on the Alde-Ore Estuary SPA. Furthermore in calculating the number of non-SPA birds the Applicant gives a rounded up figure of 5400 birds, then simply doubles it (and rounds up further) to 11000, with scant justification other than saying 5400 was a likely underestimate, but presenting no supporting	In line with NE comments 6.3.1.1

	evidence. By overstating the non-SPA population in this way, the potential impact on the Alde-Ore Estuary SPA is again significantly understated. We therefore do not agree that these calculations provide confidence to support a conclusion of no adverse effects on integrity of the population of lesser black-backed gull from the Alde-Ore Estuary SPA and consider that a full assessment, including PVA should be carried out.	
	(h) Gannet avoidance rate Whilst the RSPB accepts the SNCB's recommended amendment to the gannet avoidance rate (AR) from 98% to 98.9% for non-breeding birds, we do not agree that this figure should be applied to the breeding season due to the lack of available evidence relating to breeding birds. In light of evidence from Cleasby et al., (2015), which demonstrated that foraging birds flew higher, and were therefore at greater risk of collision, than commuting birds, and given that the BTO avoidance rate review was heavily biased to non-breeding gannets, we prefer a more precautionary AR of 98% for the breeding season.	NE advises 98.9% and welcome future monitoring, don't differentiate between breeding and non breeding.
	i) Criticisms of kittiwake tracking data The Applicant raises a number of issues with regard to the suitability of tracking data obtained as part of the FAME and STAR projects for use in the assessment. However the Applicant's report contains a number of misinterpretations and erroneous assertions. In particular: • It is claimed that the longest foraging trips from FAME/STAR kittiwake data were largely from colonies where the breeding success was zero or close to zero. This is incorrect. The longest trips were recorded from Flamborough and Filey, where breeding success was comparatively high over the time of tracking • The claim that tagged birds were more likely to have failed is also incorrect. For the FAME and STAR data, where remote download tags were used, birds had to be re-caught when on the nest so were required to be successful, at least up until the point of recapture, in order to obtain the data. • Tagging conducted in 2017 used tags that were less than 2.5 % of the birds' body weight and observed longer foraging ranges with multiple actively breeding birds visiting the Norfolk Vanguard site. • The applicant repeatedly asserts that the RSPB data are not available. This is simply not true, they are available upon formal request, and the consultants who authored this section have had data made available to them under such a request.	In line with NE comments, recommend using 2017 RSPB data.
	(j) Potential for mitigation of impacts on the Alde-Ore Estuary SPA The RSPB are concerned at the Applicant's interest in mitigating impacts on lesser black-backed gull through predator management at the Alde-Ore Estuary SPA. Mitigation measures	Predator management not mentioned in NE comments

	need to counter or at least lessen effects arising from the development proposals and must be over and above required management measures for the SPA. Due to the uncertainty around the relative importance of the various factors affecting this population, and therefore the likely effectiveness of the proposed management measures on productivity as well as no evidence that they will be over and above required management for the site, we do not agree that measures of this sort should be considered as mitigation for SPA impacts.	
	(k) Screening out of Bruine Bank pSPA The Bruine Bank pSPA in Dutch waters is approximately 20km from Norfolk Vanguard at the closest point and is of importance for wintering razorbill and guillemot. Although the site was screened, we do not consider that sufficient evidence has been provided to screen this pSPA out from further assessment, particularly in relation to displacement of birds during the migration period.	Not NE remit
Little Dunham Parish Council		
	This development represents an over expansion of the existing site. Whilst landscaping will ameliorate the impact of the low lying structures proposed on the 120 acre site , the large converter buildings will only be partially disguised and this is conceded by the applicants in their submission. This could be avoided by the applicants making the AC choice. The existing site uses AC transmission. If the application is allowed to proceed on the DC basis then this will represent an over-development of this agricultural area bearing in mind also the number of wind turbines that are in the locality.	Not within AONB so not within NE remit
Witton and Ridlington Parish Council		
	We are gravely concerned about disruption, noise, disturbance to wildlife and general access throughout the process	General comments
East Ruston Parish Council		
	East Ruston Parish Council, as one of the parishes directly affected by the proposed pipeline, intend to make submissions regarding road closures, traffic management and arable land disturbances. We are pleased that there will no longer be any relay stations in our parish but none the less there will still be a considerable upheaval which we intend to monitor and report on	General comments
Holme Hale Parish Council		
	The choice of site is inappropriate, and other more appropriate sites have not been given due consideration.	General comments

	The size of the structures involved in this application are disproportionate to the rural setting/location, and it is unlikely that screening efforts will mitigate the impact on surrounding villages. Light pollution and noise pollution will have a severe detrimental effect on the rural landscape and nearby residents. Construction traffic will increase the hazards on the A47. The high number of accidents along this highway make it unsuitable for further extensive HGV usage. The sheer scale of the infrastructure, and the extensive industrialisation to be carried out, is totally out of keeping with the area. Immense environmental damage will result from this process, and this will be ongoing for many years.	
Cawston Parish Council		
	We have concerns regarding the traffic impact through Cawston. This relates to the fact that the proposed mitigation, given the increase in HGV traffic, does not appear to be adequate. We also have concerns with regards properties adjacent to the B1145 and request further consideration is made of these.	Not NE remit
Necton Parish Council		
	The Parish Councillors of Necton unanimously believe that given the constraints listed, the small rural parish of Necton is not a suitable location for this massive industrial development, which when completed will be the biggest of its kind in the world, and when viable alternatives exist. • Flawed public consultation: • Insufficient information on the National Grid extensions • Inaccurate inflation of distance to nearest property • Incorrectly stating no other suitable connection sites. • Allowing comments on 4 footprint options to just an invited audience. 2) Radiation Risk: Vattenfall claim ignorance of the 1996 Danish air force F16 crash site which lies central to their 400kV cabling, and the associated radiation substance risk warning (given to MAFF in 1996, NGR TF 894100). NCC informed Vattenfall of crash and radiation risk on 5 June 2018. Insufficient space exists for this development between protected archaeology and radioactive risk. 3) Flood Risk: Proposed site capped by thick layer of impervious clay. Run-off taken by a small tributary (Wissey) that historically and regularly floods the road and nearby properties and blocks the 4” culvert. Inadequately addressed. (NB Dudgeon already made this worse). 4) Breckland Noise Limit: We doubt the noise constraints required by statute can be met when the three sub-stations: Dudgeon, Vanguard & Boreas are working at full capacity. The	Not within NE remit

	elevation of the chosen site means noise mitigation measures will be difficult and expensive and suspect they will be ignored. Vattenfall refuse to build an earth bank. 5) Breckland and NP Restrictions: Vattenfall state the development is too massive to be screened from view, and does not fit into the rural landscape. (PEIR ref: Chapter 29 - Table 29.18) Vattenfall admit it will not comply with the Breckland Local Plan which states: "Development…should be of a scale and design that respects the character and rural setting of the settlement." And "All design proposals must conserve or enhance the existing character of an area."	
	It lies on Grade 3 agricultural land so doesn't comply with the NP Planning Framework 2012, which requires the loss of more than 20 hectares (approx. 50 acres) of BMV to be avoided if possible. 140 acres plus of BMV will be lost from arable use when all infrastructure and landscaping is complete (includes Dudgeon) Vanguard and Boreas alone mean 100 acres lost.	NE advises 3a should be added to BMV
	1) Four of the five holiday let/camping sites nearby ignored. 2) Two species of rare bats ignored. 3) Fire Risk: Inadequate measures against field fire risk to substations. eg firebreaks and fences. Adequate protection would increase the amount of land required. Approx. 200 field fires in Norfolk in 2018. 4) Terrorism Threat: This major project (the biggest of its kind in the world + Dudgeon) is an attractive target for terrorists; the nearby woodland makes this site difficult to defend. In consideration of these points, the Parish Councillors of Necton would like you to insist that Vattenfall and The National Grid choose an alternative site	Bats will be considered under NE species licence
Happisburgh Parish Council		
	Happisburgh Parish Council is concerned about the following: - The impact of the work on beach and cliffs. - The timing of the work in the village, mainly its disruption to tourism within the village - Road closures and temporary traffic lights. - Work going on at night - The onward cable channels towards Necton - The possible impact on houses close to the cables (loss of value etc) - Road disruption including heavy works traffic (which should not be allowed through the village)	Happisburgh Cliffs SSSI, otherwise not within NE remit. Outside dark skies designation.

	- Excessive lighting (which should not be permitted) - Ensuring that the village receives some form of compensation	
Oulton Parish Council		
	Oulton Parish Council welcomes the use of HVDC and the installation of ducting for Norfolk Vanguard and Boreas if both projects progress; this will reduce the construction time for the projects and the impact on residents. However there are still issues of major concern: 1. Cumulative Impact OPC are still unaware of how Norfolk Vanguard's cable route/mobilisation zone/cable logistic area and Orsted Hornsea Three Main Construction Compound at Oulton will interact with each other, given that they will be using the same access route B1149/The Street. The cumulative impact from traffic created by the two projects and its interaction with existing agricultural traffic, local businesses, tourists going to Blickling Hall and local residents has not been assessed. The rural road network in Oulton is already stretched almost to breaking point with the very large scale (both in vehicle size and volume) of existing agricultural traffic. Vattenfall has used Orsted Hornsea Three PEIR documents to assess cumulative impacts, but Oulton's Main Compound did not appear in those PEIR documents. (Orsted have still not fully assessed this area nor put together a CTMP.) There is also a lack of information on the cumulative impact of Norfolk Vanguard and Orsted Hornsea Three projects on residents of Oulton regarding noise, traffic, air quality etc. Vattenfall PIC (Personal Injury Collison) data did not include B1149. Orsted Hornsea Three used PIA (Personal Injury Accident) data, which included sections of B1149, indicating that accidents were 25% higher than the national average. It would appear that the two projects, although accessing the same road routes, are neither assessing the same data, nor in the same way. NCC/BDC may not have been fully aware of all data relating to Oulton at time of consultations due to late addition of Vattenfall's Cable Logistics Area and lack of traffic details relating to cumulative impact of Norfolk Vanguard & Orsted Hornsea Three on Oulton.	General comments not within NE remit

	There are concerns over the B1149 where the cable route crosses the road. Vattenfall have said they will not be using trenchless crossing (horizontal directional drilling) but will dig up the road to install their cabling. Orsted Hornsea Three will be using B1149 at potentially the same time. How will a CTMP work around this? One residential property in particular will be impacted directly by both projects, being next to the entrance to Saltcarr Farm and directly alongside the proposed shared access route for both projects - the southern end of Oulton Street. This impact has not been assessed. This property was highlighted in a planning appeal, alongside the unsuitability of 'The Street' to cope with large volumes of HGVs….. Appeal Ref: APP/K2610/A/14/2212257 . In summary, there is no specific traffic data in the DCO documents that looks at the cumulative impact at Oulton, from either project. 2. Cable Logistic Area The Cable Logistic Area is only mentioned on maps, no data in any documents specifically describing its location, function or reason for selection. This area was a late addition and only appeared on final maps. Link 68 only seems to refer to traffic to Mobilisation Area and cable route - traffic to and from Cable Logistic Area is not mentioned in DCO documents. 3. Other Issues Some areas of cable route seem to have been omitted in the ES, specifically Oulton area (Map 4). Blickling Conservation Area is missing from map 'Policies and designations (map 4)' Confusion in some documents where Breckland appears twice in tables and Broadland District Council is omitted.	
Norfolk County Council		
	(a) Supports the principle of this offshore renewable energy proposal, which is consistent with national renewable energy targets and objectives, subject to: 1. The holding highway objection set out in the report being satisfactorily resolved;	General comments

	2. The implementation of appropriate highway; historic environment; and surface water conditions / requirements being resolved through the DCO; and 3. The detailed comments set out in this report and in the Appendix (below) being addressed through the DCO process. (b) Supports the use of HVDC technology which removes the need for an additional HVAC Booster / Cable Relay Station near Happisburgh.	
	Grid Connection Issues 1.2. Comment - the County Council welcomes the decision by Vattenfall to pursue a HVDC solution which removes the need for additional onshore infrastructure (cable relay station) in North Norfolk and reduces the potential environmental impact associated with the cable route by narrowing the cable corridor from 100m to 45 m.	Not relevant to NE
	Electricity Supply Issues 1.3. It is felt that Vattenfall should work with National Grid and UK Power Networks to consider options regarding the potential to feed electricity into the local transmission networks. In addition the County Council will continue to work with the Local Enterprise Partnership (LEP) through the TRI - Local Energy Strategy (endorsed by this Committee in July 2018), in order to lobby central government to make legislative changes to overcome the obstacles to secondary inter-connection raised above.	Not relevant to NE
	Socio-Economic Issues 1.4. The County Council should continue to work pro-actively with Vattenfall to demonstrate the economic benefits of using the Port facilities at Great Yarmouth for: • Construction; assembly and manufacture of windfarm components; and • Operations and maintenance. The County Council should also continue to work with the applicant to develop the creation of apprenticeships; work experience; and internships.	Not relevant to NE
	Wider Community Issues and Impact on Business 1.5. The County Council welcomes the commitment towards establishing some form of community benefit and would ask Vattenfall to ensure all stakeholders/communities are made aware of such funds and have the opportunity to make appropriate bids. 1.6. The reduction in the potential impacts and disruption to business as a consequence of using HVDC technology is welcomed, however, it is felt that Vattenfall should commit to providing appropriate compensation for businesses and communities adversely affected by the construction works	Not relevant to NE
	Commercial Fishing	Not relevant to NE

	1.7. The County welcomes the revised/amended design of the above proposal and mitigation measures set out in the applicant's ES. However, where there is likely to be a demonstrable impact (i.e. during: construction; operation and/or decommissioning) on commercial fishing affecting communities in Norfolk, it is considered that Vattenfall should provide appropriate compensation (i.e. disturbance payments) to those fishing businesses affected. It is understood that Vattenfall are prepared to provide compensation in appropriate circumstances.	
	Local Highway - key Issues 1.8. It is felt that the applicant needs to find a different site for their main compound. However, if they wish to pursue their chosen site then they will need to: (i) provide a scheme of permanent off-site highway improvement works comprising carriageway widening along the entire route from the compound to the main road; and (ii) demonstrate that such a scheme is capable of overcoming the issues previously identified by PINS. In the meantime it is felt that a holding objection on highway safety grounds should be raised to the inclusion of this site. 1.9. At the time of writing this report the County Council's highway officers are still carefully assessing the supporting documentation in respect of the above matters and will make appropriate comments under delegated officer powers and feed these back to the Planning Inspectorate within the prescribed consultation period. This may include, where appropriate: (a) Raising any necessary holding highway objection in the event that highway safety is deemed to be compromised; and/or (b) Seeking Planning Conditions (Requirements) to be attached to the DCO in order to overcome any highway issue.	Not relevant to NE
	Wider Strategic Highway Issues 1.10. (a) Vattenfall need to satisfy Highways England with regard to the safety of their proposed access at Necton onto the A47(T). Impact upon driver delay along the trunk road network will also be assessed by Highways England. (b) Vattenfall should work closely with Highways England and Norfolk County Council (Highway Authority) to ensure the proposed cable route does not fetter any future plans for the dualling of the A47(T);	Not relevant to NE

	(c) Vattenfall are asked to ensure that their underground Cable Route does not fetter any future highway improvement schemes in Norfolk and that where any reinforcement or diversion is needed to the cable route as a result of such highway works, that Vattenfall will be responsible for any upgrades or diversion of the cables and will fully meet the costs of these works.	
	Minerals and Waste 1.11. Norfolk County Council in its capacity as the Minerals and Waste Planning Authority does not object to the Proposed Vanguard Wind Power Project provided that the applicant continues to work with Norfolk County Council regarding the mitigation of impacts on the Mineral Safeguarding Areas.	Not relevant to NE
	Flood and Drainage Issues and Comments 1.12. The LLFA welcomes that sustainable drainage systems (SuDS) have been proposed for the project where permanent above ground infrastructure is proposed to mitigate against additional impermeable surfaces creating an additional risk of flooding. The LLFA have considered the submitted documents and are pleased to see that strategies have been supplied for the sub-station and the National Grid sub-station extension study areas. The cable corridor has not been considered in the post construction drainage strategy due to the fact that the cable would be below ground and reinstatement to pre development state would mitigate the potential for increased runoff. 1.13. It is noted that Greenfield run-off rates and volumes have as yet to be agreed with the LLFA. This will need to be considered during detailed design stage. 1.14. It should be noted that where ordinary watercourses are to be crossed by open cut, or any other temporary works are proposed as part of this project are likely to affect flows in an ordinary watercourse, then the applicant would need the approval of Norfolk County Council. The County Council would appreciate early consultation on the number of such crossings of Ordinary Watercourses and the required timeframes for approval. This will enable the team to have adequate staffing resources in place to ensure approvals are not unduly delayed and for and issues to be identified. It should also be noted that other ordinary watercourse crossings would need consent approval from the relevant Internal Drainage Board (IDB). In line with good practice, Norfolk County Council seeks to avoid culverting, and its consent for such works will not normally be granted except as a means of access. Such approvals are separate from planning and temporary mitigation methods may be required while cable laying is undertaken.	NE comment on drainage water needs to be maintained, and not drainage plan

	1.15. Norfolk County Council appreciates that these are initial drainage proposals, however, ideally these matters above (covering infiltration testing and drainage design) should be clarified prior to determination, to ensure that the site has a deliverable surface water drainage strategy. In particular there is no maintenance or management strategy supplied with the application and the LLFA have had to assume that the applicant will take responsibility for maintaining the drainage for the lifetime of development. The LLFA recognise this is a strategic application and is being determined by the Secretary of State as the Planning Authority and to ensure the best possible drainage strategy is developed Norfolk County Council would ask that the attached condition / requirement (see Appendix 1) is integrated into any final DCO consent. Additional technical LLFA will be sent under delegated officer powers to the Planning Inspectorate along with the above comments.	
	Landscape 1.16. It should be noted that landscape issues are ultimately a matter for Breckland District Council to comment on as the Local Planning Authority with their own adopted Local Plan policies covering landscape and other environmental matters. 1.17. While it is accepted that the onshore elements of Norfolk Vanguard have the potential to impact the landscape and visual amenity, measures have been "designed-in" to minimise these impacts. It is also noted that the location chosen has been selected to minimise visual impact, particularly in relation to the Substation and the National Grid Substation Extension, where existing vegetation and landform have been used to intercept views. 1.18. The decision by Vattenfall to pursue a HVDC option in terms of its cable route has, as indicated above, taken away the need for a cable relay station / booster station close to the Norfolk Coast (near Happisburgh). This option is welcomed in terms of minimising the impacts of this development on the landscape in North Norfolk.	NE is satisfied there will be no adverse effect on AONB
	Public Health 1.19. The County Council would expect detailed matters relating to, for example construction noise; local environmental health; and any other potential contamination issue, to be addressed by the relevant District Councils and/or other statutory body such the Environment Agency. Providing the District Councils are satisfied with the proposal in relation to the above matters, the County Council would not wish to raise any public health concerns at this time	Not relevant to NE

	Public Rights of Way 1.20. It is noted that the onshore cable route intersects with Public Rights of Way (PRoW), including National and County Trails, at 45 locations. Mitigation for impacts on users of the PRoW network is in the form of embedded ('designed-in') mitigation and method statements. Comment 1.21. Norfolk County Council welcomes the use of HDD underneath some of the particularly heavily-used recreational routes (long-distance trails), particularly at landfall where the cables will intersect with the England Coast Path. HDD is also proposed for cable-laying across two further Trails managed by Norfolk Trails, namely Marriott's Way (twice) and Paston Way (both these sites are also designated County Wildlife Sites at the crossing points). This approach should result in negligible disruption to users of these Trails. It is noted that HDD is not proposed at the crossings of two further Norfolk Trails, the Wensum Way and Weaver's Way, nor the majority of the crossing points of the general PRoW network. 1.22. Mitigation for impacts on the majority of the PRoW and Trails network will be addressed by two documents: A Public Right of Way Strategy, and a Code of Construction Practice (CoCP), draft versions of which have been submitted with the DCO application. The Council believes these documents should result in appropriate measures to manage impacts in relation to cable-laying. In relation to the discharge of the DCO requirement for the CoCP, the documents refer to liaison with the "relevant local planning authority" (e.g. CoCP, section 4; paragraph 71; p 16). However, when it comes to matters relating to PRoW and Trails, it is felt that the County Council as the Highways Authority should be the relevant local authority to agree the management of PRoW. 1.23. The County Council welcomes the intention of the applicant to liaise with the PRoW Officers and Trail Officers over short-term temporary diversions of PRoW or other potential impacts. This will be important in reducing the burden on NCC in managing matters relating to the PRoW network with regards to the cable-laying works. The County Council also welcomes the approach for providing advanced warning of works that would affect PRoW. Where Norfolk Trails would be affected, it would additionally be helpful if information could be provided for inclusion on the Norfolk Trails website.	NE note HDD under ECP, seek confirmation there will be no temporary closures of ECP
	Ecology 1.24. The involvement of the County Council with regards to ecology has been with onshore works only. Representatives from the Natural Environment Team have been involved in the onshore Ecology Expert Topic Group (ETG).	NE advise the OLEMS is amended to include further survey data and provide suitable mitigation regarding Broadland SPA/Ramsar

	1.25. The Ecology Chapter of the ES (Chapter 22) and the onshore Ornithology Chapter (Chapter 23) describe the ecological baseline and assess the impacts resulting from the onshore infrastructure requirements. The design of the scheme contains “embedded mitigation” for ecology. Where “additional mitigation” is required, potential impacts on terrestrial ecology will be delivered as described in the Outline Code of Construction Practice (OCoCP) and the Outline Landscape Ecological Management Strategy (OLEMS). The final detail of the mitigation and enhancement measures will be provided through one or more Ecological Management Plans (EMP) which will act as a single document for all ecological mitigation considerations on site. Comments 1.26. The County Council welcome the above approach and agree the content of the outline CoCP and the OLEMS. In the second document, it is stated that “Norfolk Vanguard Limited will work with the relevant local authorities to ensure appropriate resourcing is in place to monitor compliance with the provisions of the OLEMS, and the plans and schemes of which it forms the basis”. The Natural Environment Team of the County Council would wish to be involved in this process. 1.27. The County Council welcomes the use of HDD where cable routes intersect with County Wildlife Sites. It is noted that a running track will still be necessary at the Wendling Carr CWS, but the need for this was discussed at the ETG meeting and is further described in the ES. The County accept that this approach is needed and believe the proposed mitigation is appropriate. 1.28. The County Council has previously raised concerns about the following matters, which have now been addressed: • The constraints on access for ecological surveys: The OLEMS states that due to access constraints only 50% of the onshore project area was subject to ecological field surveys, and only 40% of the ponds. It is noted that the use of the Norfolk Living Map to ‘fill-in’ data gaps at this stage, but recognise field surveys of the currently un-surveyed locations will be necessary post-consent, and these surveys may lead to further mitigation at specific locations. • Insufficient survey effort of CWS: At an early stage of the scoping process, the County Council advised that surveying of CWS close to the cable corridor was necessary (ETG meeting Jan 2107). This was accepted by Vattenfall and the surveys were completed. The results of those surveys are included in the ES.	

	• The suitability of the bat surveys to enable delivery of appropriate assessments of impacts and therefore appropriate mitigation (ETG Meeting July 2017): Vanguard came back to the County Council on this matter with revised reports, and the County Council is now satisfied that the assessments are broadly valid and the proposed mitigation for is appropriate. It is noted that some surveys will still need to be made post-consent at locations where access constraints resulted in no or incomplete surveys (OLEMS, paragraph 68). It is also noted that during the design process, landfall has moved away from the key area of concerns for barbastelle bats at the Paston Great Barn SAC colony.	
	Historic Environment Onshore Comments 1.29. Subject to the submission and approval of a revised version of Document 8.5 Outline Written Scheme of Investigation: Archaeology and Cultural Heritage (Onshore) to state that work will be carried out in accordance with the Norfolk County Council Standards for Development-led Archaeological Projects in Norfolk (2018), the County Council is happy to recommend that the following requirements are placed on the consent if granted; 1.30. A) No development shall take place other than in accordance with the submitted and approved Outline Written Scheme of Investigation: Archaeology and Cultural Heritage (Onshore). And, separately, B) The development shall not be operated until the site investigation and post investigation assessment has been completed in accordance with the programme set out in the archaeological written scheme of investigation approved under (A) and the provision to be made for analysis, publication and dissemination of results and archive deposition has been secured.	Not relevant to NE
	Offshore Comments 1.31. The Offshore Historic Environment implications of the proposed development are considered in Chapter 17 of the ES (Offshore Archaeology and Cultural Heritage). The offshore historic environment below the low-water mark is not specifically within the remit of the County Council. 1.32. A decision has been made by Vattenfall to use a long HDD technique at the landfall of the cable route. As a result of this there will be no construction work, or resulting historic	General comments on historical coast at Happisburgh

	environment impact, within the inter-tidal zone on Happisburgh beach (where internationally significant archaeological remains of Palaeolithic date are known to exist). As such the County Council does not have any specific comments or recommendations to make on the offshore archaeology and cultural heritage of the proposed development. However, Vattenfall and their heritage consultants should continue to liaise with Historic England and other key stakeholders (e.g. Ancient Human Occupation of Britain) regarding any post-consent works.	
	Lead Local Flood Authority (LLFA) Comments 1.33. The ES states that the crossing of ordinary watercourses would be by Horizontal Directional Drilling (trenchless) or open cut. Referring to Appendix 20.4 Detailed Watercourse Crossing Schedule Table 20.1 it is noted that it appears that the majority all Norfolk County Council ordinary watercourses are proposed to be crossed by open cut rather than Horizontal Directional Drilling for permanent works. If this is the case, or any other temporary works proposed as part of this project are likely to affect flows in an ordinary watercourse, then the applicant would need the approval of Norfolk County Council. The County Council would appreciate early consultation on the number of such crossings of Ordinary Watercourses and the required timeframes for approval. This will enable the team to have adequate staffing resources in place to ensure approvals are not unduly delayed and for and issues to be identified. It is also noted that other ordinary watercourse crossings would need consent approval from the relevant Internal Drainage Board (IDB). In line with good practice, Norfolk County Council seeks to avoid culverting, and its consent for such works will not normally be granted except as a means of access. It should be noted that this approval is separate from planning and temporary mitigation methods may be required while cable laying is undertaken. Proposed Condition/Requirement - 1.34. Prior to commencement of development, in accordance with the submitted Environmental Statement for Application for Development Consent - The proposed Norfolk Vanguard Offshore Wind Farm, detailed designs of a surface water drainage scheme incorporating the following measures shall be submitted to and agreed with the Secretary of State or his delegated approving body. The approved scheme will be implemented prior to the first use of the development. The scheme shall address the following matters: I. Detailed infiltration testing to be undertaken in accordance with BRE Digest 365 within the study areas for the sub-station and the National Grid sub-station extension for the design of SuDs features.	

	II. If infiltration is not possible surface water runoff rates will be attenuated to the pre development 1 in 1 year rate (or 2 l/s/ha). Where applicable confirmation should be sought from the Internal Drainage Board that the proposed rates and volumes of surface water runoff from the development are acceptable. III. Provision of surface water infiltration / attenuation storage should be sized and designed to accommodate the volume of water generated in all rainfall events up to and including the critical storm duration for the 1 in 100 year return period, including allowances for climate change, flood event. IV. Detailed designs, modelling calculations and plans of the of the drainage conveyance network in the: • 1 in 30 year critical rainfall event to show no above ground flooding on any part of the site. • 1 in 100 year critical rainfall plus 40% climate change event to show, if any, the depth, volume and storage location of any above ground flooding from the drainage network ensuring that flooding does not occur in any part of a building or any utility plant susceptible to water (e.g. electricity equipment required at the converter / booster station and substation) within the development. V. The design of any drainage structures will include appropriate freeboard allowances. Plans to be submitted showing the routes for the management of exceedance surface water flow routes that minimise the risk to people and property during rainfall events in excess of 1 in 100 year return period VI. Details of how temporary works or temporary storage areas that will generate surface water runoff will be controlled to prevent a temporary increased risk of flooding. These details will also include what strategy/ plans will be provided to reinstate land to the pre-development state. VII. Finished ground floor levels of the converter / booster station and substation should have a freeboard such that all infrastructure is above expected flood levels from all sources of flooding, including fluvial flooding associated with the ordinary watercourse, tidal flooding and any above ground storage or flooding from the proposed drainage scheme. VIII. Details of how all surface water management features are to be designed in accordance with The SuDS Manual (CIRIA C697, 2007), or the updated The SuDS Manual (CIRIA C753, 2015), including appropriate treatment stages for water quality prior to discharge. IX. A maintenance and management plan detailing the activities required and details of who will adopt and maintain the all the surface water drainage features for the lifetime of the development. This will also include the ordinary watercourse and any structures such as culverts within the development boundary.	

	Reason: To prevent flooding in accordance with National Planning Policy Framework paragraph 103 and 109 by ensuring the satisfactory management of local sources of flooding surface water flow paths, storage and disposal of surface water from the site in a range of rainfall events and ensuring the surface water drainage system operates as designed for the lifetime of the development. 1.35. NB Further detailed technical comments will be sent to both the applicant and the Planning Inspectorate.	
	Additional LLFA Comments Summary of Local Flood risks in the vicinity of the site • The project has been split into study areas, Landfall – Onshore cable route including access routes and mobilisation areas, Onshore project substation and National Grid substation extension and overhead line. • There are areas at risk of surface water flooding within the study area boundary 1 in 1000 (0.1% annual probability) flood event as shown in the Environment Agency's Risk of Flooding from Surface Water (RoFSW) maps. • The onshore project landfall, substation and National Grid substation extension are located in Flood Zone 1 of the Environmental Agency Flood Zone Risk Maps, which is classified as land with a low risk of flooding (less than 0.1% chance of flooding in any year). The majority of the onshore cable route is located within Flood Zone 1, however there are a number of locations at which the onshore cable route intersects areas of Flood Zone 2 and 3. • The British Geological Survey (BGS) maps identify the bedrock underlying the onshore project area as Chalk to the west and Neogene and Quaternary Rocks to the east, overlain by superficial deposits of till (Diamicton), glacial sand and gravel, clay, silt and sand alluvium, and Crag Group (sand and gravel). • A number of Source Protection Zones (SPZs) are identified within the onshore project area, with both inner and outer zones of the SPZ areas extending across the eastern section of the onshore cable route. • No infiltration testing has been carried out at this stage. Geotechnical investigation should be undertaken to determine whether material on this site has infiltration potential in line with the SuDS hierarchy. This information should be representative of on-site conditions. If material is	

	found to have infiltration potential, detailed infiltration testing should be undertaken in line with BRE 365 : • The flood risk study areas include a number of catchments associated with EA designated main rivers and IDB/local authority ordinary watercourses including the River Bure catchment, the River Wensum catchment, and the River Wissey catchment. Mitigation measures have been identified including a commitment to trenchless crossing techniques for a number of sensitive watercourses, sediment management, construction drainage, and implementation of best practice measures. • The flood risk study area crosses a number of existing field drains, ditches and irrigation channels which may require consents for works to ensure that any flood risk is not adversely affected. • The site passes through the several IDB areas for the regulation of ordinary watercourses where consents may be required. • There are no LLFA records of incidents of internal or external flooding on or adjacent to the study areas. However it should be noted that our records only cover the period of 2011 to the present day. Summary of assessment of Flood Risk and submitted drainage proposals The Flood Risk Assessment / Drainage submitted with the Environmental Statement, has been assessed against the National Planning Policy Framework (NPPF), Planning Practice Guidance, the SuDS Non-Statutory Technical Standards (NSTS) (March, 2015) and the policies of the adopted Norfolk Local Flood Risk Management Strategy as follows: • The Environmental Statement has made an assessment of local flood risk issues and identifies all sources of risk for the main catchment areas and study areas, both during construction and the operation/maintenance of the scheme. It has also considered the cumulative effect of other proposed schemes. • The Environmental Statement drainage strategy states that the SuDS discharge location hierarchy will be followed (soakaway testing will be carried out to determine the feasibility of infiltration or evidence for not discharging via infiltration).(Volume 2 Appendix 20.01 20.10.1 (194)). This should be demonstrated at detailed design. • Greenfield run-off rates have as yet not been agreed with the LLFA. This will be required at detailed design.	

	• Post construction the controlled runoff rate will be equivalent to the greenfield runoff rate. The resultant storage / attenuation volume provided will be sufficient to ensure that during the 1 in 100 year event plus an allowance for climate change there will be no increase in runoff from the site. • Description of SuDS component elements: It is stated that a pre-construction Surface Water and Drainage Plan will be developed, agreed with regulators and implemented to minimise water within the working areas, to ensure ongoing drainage of surrounding land and that there is no increase in surface water flood risk. This will assess the current and proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the site. However no detail is currently provided in the ES. During construction, the cable route will be bounded by drainage channels (one on each side) to intercept drainage from within the working corridor. Additional drainage channels will be installed to intercept water from the cable trench. Where water enters the trenches during installation, this would be pumped via settling tanks or ponds to remove sediment, before being discharged at a controlled rate into local ditches or drains via temporary interceptor drains. Depending upon the precise location, water from the channels will be infiltrated or discharged into the drainage network. Some form on contingency plan will be required to be considered for any significant rainfall event. Post construction the surface water drainage requirements for the National Grid substation extension and onshore project substation will be dictated by the final Surface Water Drainage Strategy. Changes in surface water runoff as a result of the increase in impermeable area from the onshore project substation and National Grid substation extension will be attenuated and discharged at a controlled rate equivalent to the greenfield runoff rate. The resultant storage / attenuation volume provided will be sufficient to ensure that during the 1 in 100 year event plus an allowance for climate change there will be no increase in runoff from the site. An attenuation pond with a volume of 4,050m3 (approximate dimensions of 58m x 58m x 1.2m) has been allowed for at the onshore project substation to provide sufficient attenuation to greenfield runoff rates into the closest watercourse or sewer connection. The full specification for the attenuation pond should be addressed as part of the detailed design. • Trenchless crossings are to be used at key watercourse crossing locations. At other crossing locations it is proposed that open cut techniques are utilised to cross the watercourse. • The applicant has not identified exceedance routes for flows in excess of a 1 in 100 year rainfall event. This will be expected at detailed design stage. Consideration should be given to the expected depth/velocity of flood water to quantify any potential risks to people and property in the event of exceedance of the drainage inlets. This should be provided at detailed design.	

	• A maintenance plan has not been submitted as part of the DCO at this stage. Consideration needs to be given to the ongoing management and maintenance of all drainage features over the lifetime of the development. A maintenance plan identifying the required actions and responsible owners should be submitted to ensure that all parties understand their responsibilities. This includes all drainage infrastructure, such as pipes and tanks, permeable paving within the curtilage of the station sites, as well as the ordinary watercourse and any structures such as culverts within the development boundary. We recommend that further information is requested. Summary of alignment to relevant Non-statutory technical standards for sustainable drainage systems S2 . The FRA states that the post development 1:1 year run off rates will be equal to the calculated greenfield rates for the sub-station sites. This should be determined during detailed design. S4/S6 – The information provided indicates that runoff volumes will not increase post-development by limiting to 2l/s/ha or QBAR whichever is the greatest. This should be maintained during detailed design. S7 – The FRA does not include calculations to show that there will be no flooding on site from the proposed drainage scheme for the 1:30 plus climate change rainfall event. S8 – At this stage the FRA does not state what protection will be provided to prevent flooding of any utility plant (e.g. sub station electrical infrastructure) during the 1 in 100 year rainfall event. Essential equipment throughout the sites is recommended to be set above the anticipated flood levels to ensure that the substation operates during a significant rainfall event. S9 – At this stage the FRAs have not identified exceedance routes for flows in excess of a 1 in 100 year rainfall event. Consideration should be given to the expected depth/velocity of flood water to quantify any potential risks to people and property in the event of exceedance of the drainage inlets. This will be expected at detailed design stage.	
	Additional Comments agreed at Norfolk County Council's Environment, Development and Transport Committee on 7/9/18: (a) Hedgerow	In line with NE comments

	Comment - The County Council would ask that maximum possible replanting / mitigation of hedgerows is undertaken after works are carried out in respect of the cable route and any other onshore development resulting in the potential removal of hedgerow. (b) Coastal Erosion Comment – The County Council would ask that sufficient safeguards and mitigation measures are put in place where the offshore cable route makes landfall to the south of Happisburgh (as a planning requirement), in order to ensure the onshore infrastructure does not exacerbate existing coastal erosion in the area. (c) Highway Access The County Council will address all local highway issues arising from construction by seeking suitable planning requirements (conditions), in particular with regard to updating the outline Construction Traffic Management Plans. In addition the County Council will expect the developer to: (A) enter into a legal agreement with the Highway Authority to ensure any damage is rectified; (B) set up local stakeholder involvement group/s to enable any traffic issues arising during the construction phase to be discussed and resolved.	
Breckland Council		
	Breckland Council intends to submit a Local Impact Report in terms of the planning issues for the District.	Not relevant to NE
Broadland District Council		
	A separate cable corridor and associated development within the District is proposed as part of the Hornsea Three off-shore windfarm. The cumulative impacts of the two proposals need to be considered. In this respect it is noted that Hornsea Three are proposing their main construction compound on part of the former airfield to the east of Oulton, in addition to the two construction compounds that Vattenfall are proposing in Oulton using the same access road as the Hornsea Three proposals. There are concerns about whether the construction programmes will overlap and therefore cause significant disruption in the village and the surrounding area. In addition the two cable corridors cross at a point north of Reepham and this has the potential to increase the visual and environmental impacts of the proposal in the locality of this intersection.	NE request an in combination assessment with Hornsea 3

	The installation of the cable route will also require the removal of sections of hedgerow; these will have to be assessed using the criteria set out in the Hedgerow Regulations 1997 to establish if they would be considered as important due to the flora, fauna or historical significance associated with them. If sections are removed and cannot be replaced following installation of the cables this will have greater long term significance to the landscape of the locations and some form of mitigation would be appropriate which could include replacement planting on adjacent land.	NE request further info on each hedgerow and timescale of recovery, and request a mitigation plan.
	The District Council would like to reiterate that the Norfolk authorities have signed up to County position statement in respect of offshore wind energy proposals that was sent to the Rt. Hon Dr Greg Clark MP on 26 February 2018 which requests that the offshore energy companies undertake to: a) Secure improvements to the local electricity distribution networks in the County; and b) Ensure real economic benefits in respect of the (i) provision of high quality jobs; (ii) creation of training/skills initiatives in the energy sector and (iii) the provision of wider community benefits.	Not relevant to NE
National Federation of Fisherman's Organisations (NFFO)		
	Intend to pursue a SoCG with applicant.	General comments
Better Broadband for East Ruston (BB4ER)		
	Proposing that fibre optic cables be installed within the trench to allow the community access to better broadband.	Not relevant to NE
Cadent Gas Limited		
	Cadent has identified that it will require adequate protective provisions to be included within the DCO to ensure that its apparatus and land interests are adequately protected and to include compliance with relevant safety standards. Cadent has low or medium, intermediate and high pressure (major accident hazard) gas pipelines and associated below or above ground apparatus located within the order limits which are affected by works proposed.	Not relevant to NE
No to relay Stations		
	Support proposal for HVDC transmission system.	Not relevant to NE
	Concerns over rapid erosion at Happisburgh and therefore its proposal as landfall site with suggestion Bacton may be more appropriate.	Matches NE position
Norfolk Coast Partnership		
	Largely positive acknowledging that the proposed landfall is outside AONB and selection of HVDC technology.	Not relevant to NE
Health and Safety Executive		

	Identifies 8 potential major hazard sites and pipelines which may be affected by the onshore elements of the Norfolk Vanguard offshore wind farm. The actual sites and pipelines will depend on the final route of the export cables. There are other, non-Major Hazard pipelines in the area (possibly operated by BPA and GPSS) that may also be affected by the proposed NSIP.	Not relevant to NE
	Highlights that Hazardous Substances Consent would be required if the site is intending to store or use any of the Named Hazardous Substances or Categories of Substances and Preparations at or above the controlled quantities set out in schedule 1 of these Regulations.	Not relevant to NE
	Indicates that there are no licensed explosive sites in the vicinity. However, there is a fixed rule licence for Maritime and Coastguard Agency North, Norfolk, Sector Base, Pollard Street, Bacton, Norfolk NR12 0LB and they are unable to make a decision until it is known where the construction traffic will go and where the control station for the windfarm will be and if it will be manned.	Not relevant to NE
Members of the Public (Summary of key points from 234 responses)		
	Most feedback from MOP object to development largely due to the position of the substation at Necton, the presence of contaminated land from a prior military air crash, the potential increase risk of flooding, the presence of 2 species of protected bats and the erosion problems at the landfall site.	Not relevant to NE
	There is also some support for the development although these responses are far less numerous.	Not relevant to NE

THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

NORFOLK VANGUARD OFFSHORE WIND FARM

Planning Inspectorate Reference: EN010079

Annex G: Summary of NE Written Representations

16 January 2019

1. Summary

1.1. Natural England's (NE) Written Representations provide our statutory advice in respect of the potential impacts of the proposed development on the natural environment and landscape. Natural England's Written Representations expand upon the issues outlined in our Relevant Representations submitted to PINs on 31st August 2018, and reflect discussions that have taken place with the Applicant to date and the information that has been submitted by the Applicant to address certain issues. Agreed issues are also captured in our Statement of Common Ground (SOCG) with the Applicant

1.2. In its letter of 19 December 2018 the Examining Authority asked the parties, including NE, a number of written questions. The answers to those questions are contained within a separate document submitted alongside our Written Representations.

2. Overview of the sections of Natural England's Written Representations

2.1. Section one sets out the introduction and background sections of the Written Representations.

2.2. Section 2 sets out the status and functions of NE.

2.3. Section 3 provides information on the legislative framework which applies in this case, with reference to the relevant pieces of environmental law and policy.

2.4. Section 4 provides an account of the policy framework that can provide assistance to competent authorities when considering the legal steps is set out in section 3 in respect of European sites and SSSIs. Please note that currently Defra hasn't issued any formal guidance on the undertaking of MCZ assessments. The consideration of MCZs is also novel to Offshore Windfarm NSIPs. Therefore have suggested to all examining panels that the MMO guidance is used to ensure consistency with post-consent marine licence condition discharge process.

2.5. Section 5 introduces the statutory nature conservation designations and interests in the area of the proposed development. It provides links to designation citations and boundary maps. The relevant protected sites potentially affected by the proposed development are as follows:

- Alde-Ore Estuary Special Protection Area (SPA);
- Flamborough and Filey Coast SPA;
- Greater Wash SPA;
- Outer Thames Estuary SPA;
- Haisborough Hammond and Winterton Special Area of Conservation (SAC);
- Southern North Sea candidate SAC (cSAC) / Site of Community Importance (SCI);
- River Wensum SAC;
- Paston Great Barn SAC;
- Norfolk Valley Fens SAC;
- The Broads SAC;
- Alde-Ore Estuary Ramsar site;
- Broadland Ramsar site;

- Alde-Ore Estuary Site of Special Scientific Interest (SSSI);
- Flamborough Head (SSSI);
- River Wensum SSSI;
- Dereham Rush Meadow SSSI;
- Holly Farm Meadow, Wendling SSSI;
- Whitwell Common SSSI;
- Booton Common SSSI;
- Dillington Carr, Gressenhall SSSI;
- Felbrigg Wood SSSI;
- Buxton Heath SSSI;
- Badley Moor SSSI;
- Southrepps Common SSSI;
- Potter and Scarning Fens, East Dereham SSSI;
- Paston Great Barn SSSI; and
- North Norfolk Coast Area of Outstanding Natural Beauty (AONB)

2.6. Section 5 also introduces the relevant European Protected Species :

- Bats
- Great Crested Newt
- Harbour Porpoise.

2.7. Finally, section 5 introduces the relevant Nationally Protected Species:

- Badgers

2.8. Section 6 contains the statutory advice of NE with regard to the issues of concern arising as a result of the proposed development. In its Relevant Representations, NE identified the main principle issues of concern which are dealt with in the Written Representation. Detailed comments on some principle issues are supplied in supporting annexes.

3. Principal Issues

3.1. **Evidence**

Natural England has some concerns with the standard of evidence provided in support of the application, primarily in relation to birds and Annex I Sandbank and/or Reef features. Consequently Natural England is unable to reach conclusions beyond reasonable scientific doubt in a number of areas.

3.2. **Cumulative / in-combination assessment**

Currently it is not feasible to advise beyond all reasonable scientific doubt that the project both alone and in-combination would not have an adverse effect on site integrity for the relevant SPAs.

3.3. **Habitats Regulation Assessment/ Report to Inform Appropriate Assessment**

NE is unable to agree with the conclusions set out in the HRA/RIAA due to the reasons set out within the Written Representations.

3.4. **Progress since the Relevant Representations**

Since the submission of our Relevant Representations NE has engaged with the Applicant. This has included through teleconferences and work on a joint Statement of Common Ground (SoCG), which will be submitted by the Applicant at Deadline 1. This section outlines those meetings and notes that the Applicant has provided updated information and documents, some of which NE has not had sufficient time to review to provide comment within the Written Representation and will therefore provide a response later.

3.5. **DCO and DML**

As stated in our Relevant Representation Natural England has fundamental concerns with several areas of the Development Consent Order (DCO) requirements and the Deemed Marine Licence (DML) licences, and require further suggested conditions based on the conditions set out in the Environmental Statement and the Habitats Regulations Assessment. These concerns were set out in detail in Appendix 5 of the Relevant Representation

There has been no further engagement with the Applicant in relation to DCO or DML and therefore our concerns remain the same as presented in our Relevant Representation.

3.6. **Offshore Ornithology**

Natural England was unable to advise beyond all reasonable scientific doubt that the project both alone and in-combination would not have an adverse effect on site integrity for the relevant SPAs.

Natural England was unable to advise with certainty that the project will not have a significant impact on a number of seabird species in an EIA context, namely red-throated diver, gannet, kittiwake, guillemot, razorbill, puffin, herring gull, lesser black-backed gull, and greater black-backed gull.

Natural England identified a number of methodological issues in relation to the offshore ornithological assessment, particularly the type of modelling used in displacement estimates.

The key issues are:

a. Seasonal definitions for lesser black-backed gull (LBBG) and gannet;

b. Seasonal apportionment of impacts for HRA in non-breeding seasons to the relevant SPA colonies and in the breeding season for LBBG at the Alde-Ore Estuary SPA and kittiwake at the Flamborough and Filey Coast (FFC) SPA;

c. Assessment of displacement impacts regarding consideration of uncertainty and variability and red-throated diver assessments;

d. Collision risk modelling (CRM);

e. Cumulative and in-combination assessments (displacement and CRM); and

f. Population modelling approaches (Environmental Impact Assessment, EIA and Habitats Regulations Assessment, HRA).

3.7. **Benthic ecology and protected sites**

Natural England is unable to agree with the conclusions within the Habitats Regulation Assessment that there will be no adverse effect on the integrity of Haisborough Hammond and Winterton SAC Annex I sandbanks and reef features both alone and in-combination.

These concerns primarily relate to:

- Impacts from sandwave levelling;
- Scour prevention and cable protection;
- Impacts on *Sabellaria spinulosa* reef; and
- Boulder clearance

3.8. **Coastal processes**

At the Relevant Representation stage Natural England raised concerns regarding erosion rates at Happisburgh landfall site (paragraph 5.4.1 – 5.4.6). The Applicant provided a clarification note on 30 November 2018 (Appendix 1 – Coastal erosion Clarification).

Natural England has reviewed this document as part of our submission in this Written Representation and is satisfied that the specific issues we have raised in previous correspondence relating to the assessment of coastal Erosion at Happisburgh have been resolved.

3.9. **Marine mammals**

At the Relevant Representations stage Natural England raised a number of issues regarding potential impacts to marine mammals. We have since had discussions with the Applicant regarding some of those points. Areas of agreement between Natural England and the Applicant are included in the draft SoCG provided by the Applicant.

For any points not agreed in the SoCG, the submissions made in the Relevant Representations are still valid and should be considered as outstanding points of concern. These relate to:

- The management of cumulative noise impacts on the Southern North Sea SCI from both piling and UXO activities;
- Southern North Sea SCI HRA assessment in- combination with other plans or projects;
- Effectiveness of UXO mitigation; particularly in relation to the largest UXOs.

3.10. **Onshore ecology**

Within our Relevant Representations NE raised a number of issues related to onshore ecology. Some progress has been made with the Applicant and some issues resolved. Those resolved issues are outlined in the agreed SoCG with the Applicant.

Main outstanding points of concern are;

- Lack of in-combination assessment for Norfolk Valley Fens SAC
- NE is not able to agree with the conclusion that there is no adverse effect adverse effect on the integrity of the River Wensum SAC, Paston Great Barn SAC and Norfolk Valley Fens SAC in relation to the conservation objectives for the site due to insufficient evidence.

- There is insufficient detail in the CoCP measures to safeguard River Wensum SAC, Norfolk Valley Fens SAC and The Broads SAC and SSSI in relation to sediment control and reinstatement of all work areas
- Lack of detailed noise assessment for disturbance to birds during onshore construction.
- NE notes that there is no information provided on the water supply mechanism for The Broads and Norfolk Valley Fens SACs and how this may be affected by the installation of the cable route
- Natural England considers that there is likely to be an impact on the Paston Great Barn SAC due to loss and severance of foraging and commuting habitat over at least 7 years.

3.11. **Landscape and visual impact assessment**

As identified in our Relevant Representations Natural England is satisfied that there will be no adverse effect from the project on the purposes of designation of protected landscaped, including North Norfolk Coast AONB and The Broads National Park.

3.12. **Fish and Shellfish Ecology**

Natural England noted concerns in its Relevant Representation (paragraph 5.3.1) that no further monitoring or independent surveys are proposed regarding fish and shellfish ecology within the In Principle Monitoring Plan

These concerns primarily relate to fish assemblages which form a functional role in the food web for harbour porpoise within Southern North Sea SCI.

Natural England's position remains the same as that presented in our Relevant Representation. However, we acknowledge that the Applicant will seek to address these concerns post consent.

3.13. **Decommissioning**

NE acknowledges that a decommissioning programme will be required post consent and that this will be agreed at the relevant time under the provisions of the Energy Act 2004. The decommissioning plan should include an assessment on whether in-combination decommissioning impacts have been assessed fully and, if not, request additional information on the impact assessment. NE would welcome a discussion with the Applicant on the potential for in-combination impacts at that time.

Furthermore, Natural England recommends that removal of scour protection and cables (where scour is severe) is essential within designated sites in order for the seabed to return to its natural state as required under OSPAR. These matters should be subject to consideration during the examination process as part of the Habitats Regulations Assessment

3.14. **Contract for Difference (CfD)**

In relation to discussions In relation to discussions about Contract for Difference (CfD) potentially influencing how much of the consented project is built out and therefore influencing the electrical system used for the whole project or as two separate phases; Natural England requests that there is a requirement for all Applicants to formally and legally notify the regulators, and the SNCB, that all construction works have completed and no further phases of construction will commence. This is to ensure that monitoring plans and ongoing requirements for the development take proper account of future works and to ensure clarity on when operations and maintenance phase has begun to allow related conditions to be enforced. However, this will also have an additional

benefit to the wider industry in that it will release any remaining Mega Watt capacity in order for the Habitats Regulations Assessments to be revised/use best available information allowing possible further headroom for other projects.

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

FOR OFFICE USE ONLY.

DD MM YY

Designation date | Site Reference Number

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
Cambridgeshire PE1 1JY
UK
Telephone/Fax: +44 (0)1733 – 562 626 / +44 (0)1733 – 555 948
Email: RIS@JNCC.gov.uk

2. Date this sheet was completed/updated:

Designated: 04 October 1996

3. Country:

UK (England)

4. Name of the Ramsar site:

Alde–Ore Estuary

5. Designation of new Ramsar site or update of existing site:

This RIS is for: Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area:

** Important note: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site included:

Refer to Annex III of the *Explanatory Notes and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

i) **hard copy** (required for inclusion of site in the Ramsar List): *yes* ✓ -or- *no* □;
ii**) an electronic format** (e.g. a JPEG or ArcView image) Yes
iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** *yes* ✓ -or- *no* □;

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site boundary is the same as, or falls within, an existing protected area.

For precise boundary details, please refer to paper map provided at designation

8. Geographical coordinates (latitude/longitude):

52 04 58 N 01 33 03 E

9. General location:

Include in which part of the country and which large administrative region(s), and the location of the nearest large town.

Nearest town/city: Woodbridge

Alde-Ore Estuary is located on the east coast of Suffolk, east of Woodbridge, stretching between Aldeburgh to the north and Bawdsey to the south.

Administrative region: Suffolk

10. Elevation (average and/or max. & min.) (metres): 11. Area (hectares): 2546.99

Min. -1
Max. 5
Mean 1

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

The site comprises the estuary complex of the rivers Alde, Butley and Ore, including Havergate Island and Orfordness. There are a variety of habitats including, intertidal mudflats, saltmarsh, vegetated shingle (including the second-largest and best-preserved area in Britain at Orfordness), saline lagoons and grazing marsh. The Orfordness/Shingle Street landform is unique within Britain in combining a shingle spit with a cuspate foreland. The site supports nationally-scarce plants, British Red Data Book invertebrates, and notable assemblages of breeding and wintering wetland birds.

13. Ramsar Criteria:

Circle or underline each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11).

2, 3, 6

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Ramsar criterion 2

The site supports a number of nationally-scarce plant species and British Red Data Book invertebrates.

Ramsar criterion 3

The site supports a notable assemblage of breeding and wintering wetland birds.

Ramsar criterion 6 – species/populations occurring at levels of international importance.

Qualifying Species/populations (as identified at designation):

Species regularly supported during the breeding season:

Lesser black-backed gull , *Larus fuscus graellsii*, W Europe/Mediterranean/W Africa	5790 apparently occupied nests, representing an average of 3.9% of the breeding population (Seabird 2000 Census)

Species with peak counts in winter:

Pied avocet , *Recurvirostra avosetta*, Europe/Northwest Africa	1187 individuals, representing an average of 1.6% of the population (5 year peak mean 1998/9-2002/3)
Common redshank , *Tringa totanus totanus*,	2368 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9-2002/3)

Contemporary data and information on waterbird trends at this site and their regional (sub-national) and national contexts can be found in the Wetland Bird Survey report, which is updated annually. See www.bto.org/survey/webs/webs-alerts-index.htm.

See Sections 21/22 for details of noteworthy species

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15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation)**:**

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Atlantic

b) biogeographic regionalisation scheme (include reference citation):

Council Directive 92/43/EEC

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16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Soil & geology	shingle, mud, nutrient-rich, sedimentary
Geomorphology and landscape	lowland, coastal, shingle bar, intertidal sediments (including sandflat/mudflat), estuary, lagoon
Nutrient status	mesotrophic
pH	no information
Salinity	saline / euhaline
Soil	mainly mineral
Water permanence	usually permanent

Summary of main climatic features	Annual averages (Lowestoft, 1971–2000) (www.metoffice.com/climate/uk/averages/19712000/sites/lowestoft.html) Max. daily temperature: 13.0° C Min. daily temperature: 7.0° C Days of air frost: 27.8 Rainfall: 576.3 mm Hrs. of sunshine: 1535.5

General description of the Physical Features:

This estuary is the only bar-built estuary in the UK with a shingle bar. This bar has been extending rapidly along the coast since 1530, pushing the mouth of the estuary progressively south-westwards. The eastwards-running Alde River originally entered the sea at Aldeburgh, but now turns south along the inner side of the Orfordness shingle spit. It is relatively wide and shallow, with extensive intertidal mudflats on both sides of the channel in its upper reaches and saltmarsh accreting along its fringes. The Alde subsequently becomes the south-west flowing River Ore, which is narrower and deeper with stronger currents. The smaller Butley River, which has extensive areas of saltmarsh and a reedbed community bordering intertidal mudflats, flows into the Ore shortly after the latter divides around Havergate Island. The mouth of the River Ore is still moving south as the Orfordness shingle spit continues to grow through longshore drift from the north.

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, general land use, and climate (including climate type).

The Alde-Ore Estuary comprises the estuarine complex of the rivers Alde, Butley and Ore, including Havergate Island and Orfordness.

This estuary is the only bar-built estuary in the UK with a shingle bar. This bar has been extending rapidly along the coast since 1530, pushing the mouth of the estuary progressively south-westwards. The eastwards-running Alde River originally entered the sea at Aldeburgh, but now turns south along the inner side of the Orfordness shingle spit. It is relatively wide and shallow, with extensive intertidal mudflats on both sides of the channel in its upper reaches and saltmarsh accreting along its fringes. The Alde subsequently becomes the south-west flowing River Ore, which is narrower and deeper with stronger currents. The smaller Butley River, which has extensive areas of saltmarsh and a reedbed community bordering intertidal mudflats, flows into the Ore shortly after the latter divides around Havergate Island. The mouth of the River Ore is still moving south as the Orfordness shingle spit continues to grow through longshore drift from the north.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Shoreline stabilisation and dissipation of erosive forces

19. Wetland types:

Inland wetland, Marine/coastal wetland

Code	Name	% Area
E	Sand / shingle shores (including dune systems)	33.3
H	Salt marshes	23.6
G	Tidal flats	17.7
M	Rivers / streams / creeks: permanent	9.8
Sp	Saline / brackish marshes: permanent	5.9

Tp	Freshwater marshes / pools: permanent	3.9
U	Peatlands (including peat bogs swamps, fens)	3.8
J	Coastal brackish / saline lagoons	2

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The main habitat types of the Alde-Ore Estuary are: intertidal mudflats, saltmarsh, reedswamp, coastal freshwater, brackish lagoons, semi-improved grazing marsh, brackish ditches and vegetated shingle, the second-largest and best-preserved example in Britain.

A unique feature for East Anglian beaches is the abundance on the ground of normally epiphytic lichens.

There is a zonation of shingle vegetation from shifting to more stable areas of grassland and lichen communities.

Areas of saltmarsh succeed to higher saltmarsh and neutral grassland with ditches.

There is a series of brackish lagoons and ditches; and borrow pits.

Ecosystem services

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Nationally important species occurring on the site.

Higher Plants.

A range of nationally scarce plant species characteristic of freshwater, estuarine, and shingle habitats, and their transitions are present. These include: *Althaea officinalis, Frankenia laevis, Lathyrus japonicus, Lepidium latifolium, Medicago minima, Parapholis incurva, Puccinellia fasciculata, Ruppia cirrhosa, Sarcocornia perennis, Sonchus palustris, Trifolium suffocatum, Vicia lutea* and *Zostera angustifolia*.

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Birds

Species currently occurring at levels of national importance:

Species regularly supported during the breeding season:

Eurasian marsh harrier , *Circus aeruginosus*, Europe	3 pairs, representing an average of 1.9% of the GB population (5 year mean 1993-1997)
Mediterranean gull , *Larus melanocephalus*, Europe	6 apparently occupied nests, representing an average of 5.5% of the GB population (Seabird 2000 Census)
Sandwich tern , *Sterna (Thalasseus) sandvicensis sandvicensis*, W Europe	169 pairs, representing an average of 1.6% of the GB population (5 year mean 1991-1995)

Little tern , *Sterna albifrons albifrons*, W Europe	88 apparently occupied nests, representing an average of 4.5% of the GB population (Seabird 2000 Census)
Species with peak counts in spring/autumn:	
Black-tailed godwit , *Limosa limosa islandica*, Iceland/W Europe	283 individuals, representing an average of 1.8% of the GB population (5 year peak mean 1998/9-2002/3)
Spotted redshank , *Tringa erythropus*, Europe/W Africa	44 individuals, representing an average of 32.3% of the GB population (5 year peak mean 1998/9-2002/3)
Common greenshank , *Tringa nebularia*, Europe/W Africa	29 individuals, representing an average of 4.8% of the GB population (5 year peak mean 1998/9-2002/3)
Species with peak counts in winter:	
Greater white-fronted goose , *Anser albifrons albifrons*, NW Europe	186 individuals, representing an average of 3.2% of the GB population (5 year peak mean for 1996/7-2000/01)
Common shelduck , *Tadorna tadorna*, NW Europe	1398 individuals, representing an average of 1.7% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian wigeon , *Anas penelope*, NW Europe	6851 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian teal , *Anas crecca*, NW Europe	2447 individuals, representing an average of 1.2% of the GB population (5 year peak mean 1998/9-2002/3)
Northern pintail , *Anas acuta*, NW Europe	556 individuals, representing an average of 1.9% of the GB population (5 year peak mean 1998/9-2002/3)
Northern shoveler , *Anas clypeata*, NW & C Europe	224 individuals, representing an average of 1.5% of the GB population (5 year peak mean 1998/9-2002/3)

Species Information

Nationally important species occurring on the site.

Invertebrates.

The highly specialised invertebrate fauna of the saline lagoons includes *Nematostella vectensis*, and *Gammarus insensibilis*, both species protected under Schedules 5 and 8 of the Wildlife and Countryside Act 1981 (as amended).

Other notable invertebrates on the site include: *Malacosoma castrensis, Campsicnemus magius, Cheilosia velutina, Empis prodomus, Dixella attica, Hylaeus euryscapus, Pseudamnicola confusa, Euophrys browningi, Baryphyma duffeyi, Haplodrassus minor, Trichoncus affinis*.

23. Social and cultural values:

Describe if the site has any general social and/or cultural values e.g. fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values.

Aesthetic
Aquatic vegetation (e.g. reeds, willows, seaweed)
Archaeological/historical site
Environmental education/ interpretation
Fisheries production
Livestock grazing
Non-consumptive recreation

Scientific research
Sport fishing
Sport hunting
Tourism
Transportation/navigation

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? No

If Yes, describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

Ownership category	On-site	Off-site
Non-governmental organisation (NGO)	+	+
National/Crown Estate	+	
Private	+	+
Public/communal	+	

25. Current land (including water) use:

Activity	On-site	Off-site
Nature conservation	+	+
Tourism	+	+
Recreation	+	+
Current scientific research	+	
Collection of non-timber natural products: commercial	+	
Fishing: recreational/sport	+	
Marine/saltwater aquaculture	+	
Gathering of shellfish	+	
Permanent arable agriculture		+
Grazing (unspecified)	+	+
Hunting: recreational/sport	+	
Harbour/port		+
Flood control		+
Irrigation (incl. agricultural water supply)		+
Non-urbanised settlements		+

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

Explanation of reporting category:

1. *Those factors that are still operating, but it is unclear if they are under control, as there is a lag in showing the management or regulatory regime to be successful.*
2. *Those factors that are not currently being managed, or where the regulatory regime appears to have been ineffective so far.*

NA = Not Applicable because no factors have been reported.

Adverse Factor Category	Reporting Category	Description of the problem (Newly reported Factors only)	On-Site	Off-Site	Major Impact?
Erosion	2		+		+

For category 2 factors only.
What measures have been taken / are planned / regulatory processes invoked, to mitigate the effect of these factors?
Erosion - English Nature provides advice to the Environment Agency and coastal local authorities in relation to flood and coastal protection management. This will inform the development of the Suffolk Estuaries strategies and the second generation shoreline management plan.
A Management Scheme is required, taking into account the effects of erosion. A Coastal Habitat Management Plan will be produced for this site.

Is the site subject to adverse ecological change? YES

27. Conservation measures taken:

List national category and legal status of protected areas, including boundary relationships with the Ramsar site; management practices; whether an officially approved management plan exists and whether it is being implemented.

Conservation measure	On-site	Off-site
Site/ Area of Special Scientific Interest (SSSI/ASSI)	+	
National Nature Reserve (NNR)	+	
Special Protection Area (SPA)	+	
Land owned by a non-governmental organisation for nature conservation	+	+
Site management statement/plan implemented	+	
Other	+	
Area of Outstanding National Beauty (AONB)	+	
Environmentally Sensitive Area (ESA)	+	
Special Area of Conservation (SAC)	+	
Management plan in preparation	+	

b) Describe any other current management practices:
The management of Ramsar sites in the UK is determined by either a formal management plan or through other management planning processes, and is overseen by the relevant statutory conservation agency. Details of the precise management practises are given in these documents.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

No information available

29. Current scientific research and facilities:

e.g. details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Fauna.
Numbers of migratory and wintering wildfowl and waders are monitored annually as part of the national Wetland Birds Survey (WeBS) organised by the British Trust for Ornithology, Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee.

Environment.
Monitoring estuarine processes.
Saline lagoon survey.
Study on the effects of guanofication on shingle flora.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitor centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

None reported

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Activities.
The site is used informally for walking, boating and angling.

Facilities provided.

River moorings.

Seasonality.

Walking and boating activities are predominantly in spring and summer. Seasonal (winter) wildfowling occurs on the estuary.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept. of Agriculture/Dept. of Environment, etc.

Head, Natura 2000 and Ramsar Team, Department for Environment, Food and Rural Affairs, European Wildlife Division, Zone 1/07, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6EB

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Site Designations Manager, English Nature, Sites and Surveillance Team, Northminster House, Northminster Road, Peterborough, PE1 1UA, UK

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see **15** above), list full reference citation for the scheme.

Site-relevant references

Anon. (1995) *Biodiversity: The UK Steering Group Report. Volume 2: Action plans*. HMSO, London

Anon. (2002) *Suffolk Coast and Estuaries Coastal Habitat Management Plan: Executive summary*. English Nature, Peterborough (Living with the Sea LIFE Project) www.english-nature.org.uk/livingwiththesea/project_details/good_practice_guide/HabitatCRR/ENRestore/CHaMPs/SuffolkCoast/SuffolkCHaMP.pdf

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Downie, AJ & Barnes, RSK (1996) Survey of the brackish pools on the King's Marshes, Orfordness, Suffolk, 1994. *English Nature Research Reports*, No. **209**

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Morris, RKA & Parsons, MA (1992) A survey of invertebrate communities on the shingle of Dungeness, Rye Harbour and Orford Ness *JNCC Report*, No. **77**

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Please return to: **Ramsar Secretariat, Rue Mauverney 28, CH-1196 Gland, Switzerland**
Telephone**: +41 22 999 0170** • Fax: **+41 22 999 0169** • email: **ramsar@ramsar.org**

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

FOR OFFICE USE ONLY.

DD MM YY

Designation date | Site Reference Number

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
Cambridgeshire PE1 1JY
UK
Telephone/Fax: +44 (0)1733 – 562 626 / +44 (0)1733 – 555 948
Email: RIS@JNCC.gov.uk

2. Date this sheet was completed/updated:

Designated: 21 September 1994

3. Country:

UK (England)

4. Name of the Ramsar site:

Broadland

5. Designation of new Ramsar site or update of existing site:

This RIS is for: Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area:

** Important note: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site included:

Refer to Annex III of the *Explanatory Notes and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

i) **hard copy** (required for inclusion of site in the Ramsar List): *yes* ✓ -or- *no* □;
ii**) an electronic format** (e.g. a JPEG or ArcView image) Yes
iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** *yes* ✓ -or- *no* □;

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site boundary is the same as, or falls within, an existing protected area.

For precise boundary details, please refer to paper map provided at designation

8. Geographical coordinates (latitude/longitude):

52 43 56 N 01 36 00 E

9. General location:

Include in which part of the country and which large administrative region(s), and the location of the nearest large town.

Nearest town/city: Great Yarmouth

Located in eastern Norfolk, part of East Anglia.

Administrative region: Norfolk; Suffolk

10. Elevation (average and/or max. & min.) (metres): 11. Area (hectares): 5488.61

Min. -2
Max. 4
Mean 1

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

Broadland is a low-lying wetland complex straddling the boundaries between east Norfolk and northern Suffolk. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The open distinctive landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow. The region is important for recreation, tourism, agriculture and wildlife.

13. Ramsar Criteria:

Circle or underline each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11).

2, 6

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Ramsar criterion 2

The site supports a number of rare species and habitats within the biogeographical zone context, including the following Habitats Directive Annex I features:

H7210	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	Calcium-rich fen dominated by great fen sedge (saw sedge).
H7230	Alkaline fens	Calcium-rich springwater-fed fens.
H91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	Alder woodland on floodplains,
and the Annex II species		
S1016	*Vertigo moulinsiana*	Desmoulin`s whorl snail
S1355	*Lutra lutra*	Otter
S1903	*Liparis loeselii*	Fen orchid.

The site supports outstanding assemblages of rare plants and invertebrates including nine British Red Data Book plants and 136 British Red Data Book invertebrates.

Ramsar criterion 6 – species/populations occurring at levels of international importance.

Qualifying Species/populations (as identified at designation):

Species with peak counts in winter:

Tundra swan , *Cygnus columbianus bewickii*, NW Europe	196 individuals, representing an average of 2.4% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian wigeon , *Anas penelope*, NW Europe	6769 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)
Gadwall , *Anas strepera strepera*, NW Europe	545 individuals, representing an average of 3.1% of the GB population (5 year peak mean 1998/9-2002/3)
Northern shoveler , *Anas clypeata*, NW & C Europe	247 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)

Species/populations identified subsequent to designation for possible future consideration under criterion 6.

Species with peak counts in winter:

Pink-footed goose , *Anser brachyrhynchus*, Greenland, Iceland/UK	4263 individuals, representing an average of 1.7% of the population (5 year peak mean 1998/9-2002/3)
Greylag goose , *Anser anser anser*, Iceland/UK, Ireland	1007 individuals, representing an average of 1.1% of the population (Source period not collated)

Contemporary data and information on waterbird trends at this site and their regional (sub-national) and national contexts can be found in the Wetland Bird Survey report, which is updated annually. See www.bto.org/survey/webs/webs-alerts-index.htm.

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Atlantic

b) biogeographic regionalisation scheme (include reference citation):

Council Directive 92/43/EEC

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Soil & geology	acidic, basic, neutral, clay, alluvium, peat, nutrient-rich, sedimentary
Geomorphology and landscape	lowland, valley, floodplain
Nutrient status	eutrophic, highly eutrophic, mesotrophic, oligotrophic
pH	acidic, alkaline, circumneutral
Salinity	brackish / mixosaline, fresh
Soil	mainly mineral, mainly organic
Water permanence	usually permanent, usually seasonal / intermittent
Summary of main climatic features	Annual averages (Lowestoft, 1971–2000) (www.metoffice.com/climate/uk/averages/19712000/sites/lowestoft.html) Max. daily temperature: 13.0° C Min. daily temperature: 7.0° C Days of air frost: 27.8 Rainfall: 576.3 mm Hrs. of sunshine: 1535.5

General description of the Physical Features:

Broadland is a low-lying wetland complex in eastern England. The Broads are a series of flooded medieval peat cuttings within the floodplains of five principal river systems. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The distinctive open landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow, forming one of the finest marshland complexes in the UK. The differing types of management of the vegetation for reed, sedge and marsh hay, coupled with variations in hydrology and substrate, support an extremely diverse range of plant communities.

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, general land use, and climate (including climate type).

Broadland is a low-lying wetland complex in eastern England. The Broads are a series of flooded medieval peat cuttings within the floodplains of five principal river systems. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The distinctive open landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow, forming one of the finest marshland complexes in the UK.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Recharge and discharge of groundwater, Flood water storage / desynchronisation of flood peaks, Maintenance of water quality (removal of nutrients)

19. Wetland types:

Inland wetland

Code	Name	% Area
U	Peatlands (including peat bogs swamps, fens)	30
Tp	Freshwater marshes / pools: permanent	30
W	Shrub-dominated wetlands	15
Xf	Freshwater, tree-dominated wetlands	10
O	Freshwater lakes: permanent	10
Q	Saline / brackish lakes: permanent	3
M	Rivers / streams / creeks: permanent	2

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The peatland areas of this site support: alder woodland on the floodplain dominated by *Alnus glutinosa* and the *Betula-Dryopteris cristata* community; mixed tall-herb fen typical of calcareous conditions are dominated by *Phragmites australis* and *Cladium mariscus*. The very wet mires are dominated by *Carex* spp. and *Juncus* spp., and spring-fed fens with *Schoenus nigricans*, *Carex dioica* and *Pinguicula nigricans*. Open waters are mostly highly eutrophic; however, some plant-rich mesotrophic and eutrophic examples remain, dominated by *Chara* sp., *Najas marina* and *Ceratophyllum demersum*. The ditch systems within the drained grasslands support Magnopotamion and Hydrocharition vegetation, often with *Stratiotes aloides*.

Ecosystem services

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Nationally important species occurring on the site.

Higher Plants.

Nationally Rare:

S1903 *Liparis loeselii* Fen orchid.

S1831 *Luronium natans* Floating water-plantain.

Najas marina, *Potamogeton acutifolius*, *Dryopteris cristata*

Nationally Scarce: *Althaea officinalis, Dactylorhiza traunsteineri, Potamogeton compressus, Potamogeton trichoides, Pyrola rotundifolia, Sonchus palustris, Cicuta virosa, Carex appropinquata, Thelypteris palustris, Lathyrus palustris, Potamogeton coloratus, Sium latifolium, Stratiotes aloides, Myriophyllum verticillatum.*

Lower Plants.

Nationally Rare: *Chara intermedia, Nitellopsis obtusa*, *Chara connivens, Chara intermedia* and *Cinclodium stygium*

Nationally scarce: *Chara curta, Drepanocladus vernicosus, Chara pendunculata, Campylium elodes, Chara aspera, Ricciocarpus natans, Tolypella glomerata*.

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Birds

Species currently occurring at levels of national importance:

Species regularly supported during the breeding season:

Eurasian marsh harrier , *Circus aeruginosus*, Europe	16 pairs, representing an average of 10.5% of the GB population (5 year mean 1987/8-1991/2)

Species with peak counts in spring/autumn:

Common coot , *Fulica atra atra*, NW Europe	3112 individuals, representing an average of 1.7% of the GB population (5 year peak mean 1998/9-2002/3)

Species with peak counts in winter:

Great cormorant , *Phalacrocorax carbo carbo*, NW Europe	273 individuals, representing an average of 1.1% of the GB population (5 year peak mean 1998/9-2002/3)
Great bittern , *Botaurus stellaris stellaris*, W Europe, NW Africa	2 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9-2002/3)
Bean goose , *Anser fabalis fabalis*, NW Europe - wintering	238 individuals, representing an average of 59.5% of the GB population (5 year peak mean for 1996/7-2000/01)
Greater white-fronted goose , *Anser albifrons albifrons*, NW Europe	351 individuals, representing an average of 6% of the GB population (Source period not collated)
Eurasian teal , *Anas crecca*, NW Europe	2934 individuals, representing an average of 1.5% of the GB population (5 year peak mean 1998/9-2002/3)
Common pochard , *Aythya ferina*, NE & NW Europe	800 individuals, representing an average of 1.3% of the GB population (5 year peak mean 1998/9-2002/3)
Smew , *Mergellus albellus*, NW & C Europe	10 individuals, representing an average of 2.7% of the GB population (5 year peak mean 1998/9-2002/3)
Hen harrier, *Circus cyaneus*, Europe	22 individuals, representing an average of 2.9% of the GB population (5 year peak mean 1987/8-1991/2)
Water rail , *Rallus aquaticus*, Europe	23 individuals, representing an average of 5.1% of the GB population (5 year peak mean 1998/9-2002/3)
Ruff , *Philomachus pugnax*, Europe/W Africa	82 individuals, representing an average of 11.7% of the GB population (5 year peak mean 1998/9-2002/3)

Species Information

Species occurring at levels of international importance.

Invertebrates.

S1016 *Vertigo moulinsiana* Desmoulin`s whorl snail

Assemblage.

This site supports a diverse assemblage of invertebrates including:
Aeshna isosceles, Papilio machaon britannicus.
136 British Red Data Book invertebrate species have been recorded on the site.

Nationally important species occurring on the site.

Mammals.

S1355 *Lutra lutra* Otter

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23. Social and cultural values:

Describe if the site has any general social and/or cultural values e.g. fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values.

Aesthetic
Aquatic vegetation (e.g. reeds, willows, seaweed)
Archaeological/historical site
Environmental education/ interpretation
Fisheries production
Forestry production
Livestock grazing
Non-consumptive recreation
Scientific research
Sport fishing
Sport hunting
Tourism
Transportation/navigation

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? No

If Yes, describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

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24. Land tenure/ownership:

Ownership category	On-site	Off-site
Non-governmental organisation (NGO)	+	
Local authority, municipality etc.	+	
National/Crown Estate	+	

Private	+	+

25. Current land (including water) use:

Activity	On-site	Off-site
Nature conservation	+	+
Tourism	+	+
Recreation	+	+
Current scientific research	+	+
Collection of non-timber natural products: commercial	+	
Commercial forestry	+	+
Cutting/coppicing for firewood/fuel	+	+
Cutting of vegetation (small-scale/subsistence)	+	+
Fishing: commercial	+	+
Fishing: recreational/sport	+	+
Permanent arable agriculture		+
Rough or shifting grazing	+	+
Permanent pastoral agriculture	+	+
Hay meadows	+	+
Hunting: recreational/sport	+	+
Sewage treatment/disposal		+
Flood control	+	+
Irrigation (incl. agricultural water supply)		+
Mineral exploration (excl. hydrocarbons)		+
Transport route		+
Domestic water supply		+
Urban development		+
Non-urbanised settlements		+

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

Explanation of reporting category:

1. *Those factors that are still operating, but it is unclear if they are under control, as there is a lag in showing the management or regulatory regime to be successful.*
2. *Those factors that are not currently being managed, or where the regulatory regime appears to have been ineffective so far.*

NA = Not Applicable because no factors have been reported.

Adverse Factor Category	Reporting Category	Description of the problem (Newly reported Factors only)	On-Site	Off-Site	Major Impact?
No factors reported	NA				

For category 2 factors only. What measures have been taken / are planned / regulatory processes invoked, to mitigate the effect of these factors?
Is the site subject to adverse ecological change? NO

27. Conservation measures taken:

List national category and legal status of protected areas, including boundary relationships with the Ramsar site; management practices; whether an officially approved management plan exists and whether it is being implemented.

Conservation measure	On-site	Off-site
Site/ Area of Special Scientific Interest (SSSI/ASSI)	+	
National Nature Reserve (NNR)	+	
Special Protection Area (SPA)	+	
Land owned by a non-governmental organisation for nature conservation	+	+
Management agreement	+	+
Site management statement/plan implemented	+	
Other	+	+
Environmentally Sensitive Area (ESA)	+	+
Special Area of Conservation (SAC)	+	

b) Describe any other current management practices:
The management of Ramsar sites in the UK is determined by either a formal management plan or through other management planning processes, and is overseen by the relevant statutory conservation agency. Details of the precise management practises are given in these documents.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

No information available

29. Current scientific research and facilities:

e.g. details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Contemporary.

Flora.
The entire site has had a vegetation survey, primarily fen, wet woodland and open water areas, lakes plus ditch systems, and this is now on GIS.
Monitoring is undertaken on the site, particularly freshwater and fen habitats.

Completed.

Fauna.
Wintering and breeding bird survey of all drained marshland area completed, results on a GIS.
Some species survey and monitoring, e.g. *Liparis loeselii*, *Luronium natans* and a number of molluscs.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitor centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

Many nature trails and footpaths with information boards and leaflets plus five visitor centres at Ranworth, Hickling, Strumpshaw, How Hill and Carlton Colville.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Activities.

The area attracts large numbers of tourists predominantly during the summer, many of which are water-borne. The river and broads (lakes) both within and adjacent to the site carry large numbers of power and sail craft which results in large-scale erosion and loss of fringing reedswamp. Speed limits have been imposed, however boat numbers remains too high.

Facilities provided.

Land-based recreation within the site is well managed, directing people to facilities where boardwalks are provided.

Seasonality.

All year.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept. of Agriculture/Dept. of Environment, etc.

Head, Natura 2000 and Ramsar Team, Department for Environment, Food and Rural Affairs, European Wildlife Division, Zone 1/07, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6EB

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Site Designations Manager, English Nature, Sites and Surveillance Team, Northminster House, Northminster Road, Peterborough, PE1 1UA, UK

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see **15** above), list full reference citation for the scheme.

Site-relevant references

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Natural England Commissioned Report NECR164

Non-breeding season populations of seabirds in UK waters

Population sizes for Biologically Defined Minimum Population Scales (BDMPS)

First published 22 January 2015

www.gov.uk/natural-england

NATURAL ENGLAND

Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

The current, unprecedented amount of marine renewables development proposed in UK waters have the potential to impact on seabird populations.

Impact assessments for marine renewables have tended to focus on potential impacts to seabirds during the breeding season when breeding birds are closely associated with their colonies, and where impacts can more easily be attributed to breeding populations, for example, based on foraging ranges. However, impacts to seabirds may also occur outside the breeding season, and to address the impacts of marine renewables across each species' full annual cycle, we need to determine a method for assessing seabird impacts during the non-breeding season. At the moment this is limited as we do not have agreed population scales or population estimates relevant to the non-breeding season to consider in assessments, and against which to apportion any non-breeding season impacts to populations or sites.

The aim of this project was to address this limitation by reviewing and defining species-specific non-breeding season seabird populations at biologically defined minimum population scales (BDMPS) to enable the apportioning of potential impacts of marine renewable developments during the non-breeding season.

The findings will be used by those engaged in marine spatial planning and impact assessments, in particular the Statutory Nature Conservation Bodies (SNCBs), regulators and developers in the offshore sector who need to assess the potential impact of offshore development proposals on seabird populations and protected sites for seabirds across their annual cycle.

The results will be used by the SNCBs to develop agreed methodologies on how to use the outputs of the work in the context of our advice to developers on assessing impacts to seabird populations from offshore developments.

This report should be cited as:

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MacArthur Green Ltd

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Keywords - environmental impact assessments (eia), habitats regulations assessment (hra), marine, non-breeding, offshore renewables, ornithology, populations, seabirds, special protection areas (spa)

Further information
This report can be downloaded from the Natural England website: **www.gov.uk/natural-england**. For information on Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**.

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SUMMARY

This report reviews evidence concerning the populations of seabirds that are present in UK waters during the non-breeding period. It uses the literature to assess the sizes of seabird populations with the aim to use the most up to date available data (usually expressed in terms of numbers of breeding pairs in each country). It uses data on the demography of seabirds (survival rates, age of first breeding, productivity) to model population age structure in order to assess the numbers of immature birds that are associated with breeding populations, since it is not normally possible to census immature components of seabird populations. Data on the timing of breeding and of migration are used to assess the appropriate seasonal definitions to use in this project; this assessment was based on literature and on appropriate data compliations such as annual bird reports, and online databases presenting seabird migration statistics. For each key species, migratory movements are reviewed based on literature and web pages reporting ring recovery data, geolocator tracking (for the few species for which tracking data are available), seawatching, at-sea survey data, biometrics and other markers of origins of birds. Numbers thought to be present in UK waters were also reviewed from these sources. Data on numbers of breeding pairs in UK Special Protection Area (SPA) breeding populations were tabulated for each species. Data were used to present hierarchical scales that can be of use in assessment of impacts on populations; firstly the biogeographic population with connectivity to UK waters (defining which populations visit UK waters and the estimated total numbers of birds (adults and immatures) in that combined population); secondly the total number of birds present in all UK territorial waters during the defined season; thirdly the total number of birds in each spatially distinct biologically defined minimum population scales (BDMPS) population during that defined season. BDMPS population sizes were estimated from the information reviewed on migrations of each population, and the most up to date data were used in an apportioning of birds from each population into each BDMPS. Confidence in the assessments of BDMPS population sizes was expressed using a traffic light coding where green represents numbers thought likely to be accurate to no more than 30% less or 50% more than the estimated number, amber represents numbers thought likely to be accurate to no more than 50% less or 80% more than the estimated number, and red represents numbers where the true value may lie more than 50% below, or 80% above, the estimate presented. It is intended that the apportioning tables (69 tables presented as Appendix A) can be updated as new census data become available, and as new data on migrations and winter distribution are gathered that allow more precise and accurate quantifications of proportions of populations present within defined spatial areas. A summary of the BDMPS populations is given in the following table. For details of defined spatial areas named in Table 0.1 see maps in each individual species' account.

Table 0.1. Summary of the estimated numbers of birds (adults plus immatures) in each BDMPS spatial and seasonal population for each seabird species considered in this report. BDMPS are colour coded to indicate level of uncertainty about numbers (green low, amber moderate, red high). See species accounts for details of uncertainty, including issues about numbers of BDMPS to be defined which are in addition to uncertainty about numbers.

Red-throated diver						
	Winter (December-January)		**Migration seasons (Sept-Nov and Feb-April)**			
	NW North Sea	1,523	UK North Sea	13,277		
	West of Scotland	861	UK western waters & Channel	4,373		
	SW North Sea	10,177				
	NW England & Wales	1,657				
	SW England & Channel	1,153				
Great northern diver						
	Non-breeding season (Sept-May)					
	West of Scotland	2,000				
	NW North Sea	1,000				
	SW North Sea & Channel	200				
	NW England & Wales	300				
	SW England	500				
Northern fulmar						
	Winter (November)		**Migration seasons (Sept-Oct and Dec-Mar)**			
	UK North Sea	568,736	UK North Sea	957,502		
	Western waters & Channel	556,367	Western waters & Channel	828,194		
Manx shearwater						
	Migration seasons (Aug-early Oct and late Mar-May)					
	UK North Sea	8,507				
	Western waters & Channel	1,580,895				
Northern gannet						
	Autumn (Sept-Nov)		**Spring (Dec-Mar)**			
	UK North Sea & Channel	456,298	UK North Sea & Channel	248,385		
	Western waters	545,954	Western waters	661,888		
Great cormorant						
	Non-breeding season (Sept-Mar)					
	NW North Sea	6,012				
	SW North Sea & Channel	10,460				
	West of Scotland	7,049				
	SW England & Wales	9,602				
European shag						
	Non-breeding season (Sept-Jan)					
	NW North Sea	45,503				
	SW North Sea & Channel	4,346				
	West of Scotland	37,363				
	SW England & Wales	13,075				
Arctic skua						
	Autumn (Aug-Oct)		**Spring (Apr-May)**			
	North Sea & Channel	6,427	North Sea & Channel	1,227		
	Western waters	5,287	Western waters	5,111		
Great skua						
	Autumn (Aug-Oct)		**Winter (Nov-Feb)**		**Spring (Mar-Apr)**	
	North Sea & Channel	19,556	North Sea & Channel	143	North Sea & Channel	8,485
	Western waters	16,336	Western waters	1,398	Western waters	25,090

Lesser black-backed gull						
	Autumn (Aug-Oct)		**Winter (Nov-Feb)**		**Spring (Mar-Apr)**	
	North Sea & Channel	209,007	North Sea & Channel	39,314	North Sea & Channel	197,483
	Western waters	163,304	Western waters	41,159	Western waters	163,304
Herring gull						
	Non-breeding season (Sept-Feb)					
	North Sea & Channel	466,511				
	Western waters	173,299				
Great black-backed gull						
	Non-breeding season (Sept-Mar)					
	UK North Sea	91,399				
	West of Scotland	34,380				
	SW and Channel	17,742				
Black-legged kittiwake						
	Autumn (Aug-Dec)		**Spring (Jan-Apr)**			
	UK North Sea	829,937	UK North Sea	627,816		
	Western waters & Channel	911,586	Western waters & Channel	691,526		
Sandwich tern						
	Migration seasons (July-Sept & Mar-May)					
	North Sea & Channel	38,051				
	Western waters	10,761				
Roseate tern						
	Migration seasons (Aug-Sept & late Apr-May)					
	East coast & Channel	251				
	N & W Scotland	4				
	W England & Wales	2,100				
Common tern						
	Migration seasons (late July-early Sept & Apr-May)					
	North Sea & Channel	144,911				
	Western waters	64,659				
Arctic tern						
	Migration seasons (July-early Sept & late Apr-May)					
	North Sea & Channel	163,930				
	Western waters	71,398				
Little tern						
	Migration seasons (late July-early Sept & mid-Apr-May)					
	North Sea & Channel	3,524				
	Western waters	1,602				
Common guillemot						
	Non-breeding season (Aug-Feb)					
	North Sea & Channel	1,617,306				
	Western waters	1,139,220				
Razorbill						
	Migration seasons (Aug-Oct & Jan-Mar)		**Winter (Nov-Dec)**			
	North Sea & Channel	591,874	North Sea & Channel	218,622		
	Western waters	606,914	Western waters	341,422		
Black guillemot						
	Non-breeding season (September-March)					
	N within 20 km					
Atlantic puffin						
	Non-breeding season (mid-August-March)					
	North Sea & Channel	231,957				
	Western waters	304,557				

1. INTRODUCTION

1.1 Background to this project

The UK Statutory Nature Conservation Bodies (SNCBs) – the Joint Nature Conservation Committee (JNCC), Natural England (NE), Natural Resources Wales (NRW), Scottish Natural Heritage (SNH), the Department of the Environment, Northern Ireland (DOENI) and Marine Scotland (MS) – require agreed population estimates for seabird populations in the non-breeding season. With recent Crown Estate leasing rounds, there is now an unprecedented amount of marine renewables development proposed in UK waters, all of which has the potential to impact on seabird populations, to a greater or lesser degree.

Current impact assessments for marine renewables focus on potential impacts to seabirds during the breeding season when breeding birds are closely associated with their colonies, and where impacts can more easily be attributed to breeding populations (e.g. based on foraging ranges). However, there is a need to consider potential impacts to seabirds outwith the breeding season, for which there is current lack of agreement on population scale and non-breeding season population estimates. These are required in order that non-breeding season impacts can be assessed, against appropriate populations.

To address the impacts of marine renewables across each species' full annual cycle, we need to determine the origins and sizes of seabird populations during the non-breeding season, and agree how to combine assessment of non-breeding season impacts with breeding season ones. As a first step, we require population estimates, at an agreed scale, for key seabird species (those most likely to be affected by development) occurring in UK waters in the non-breeding season. These then need to be adjusted to take account of immature birds present since those can form a high proportion of the population in species with deferred maturity. These regionally defined populations are the appropriate ones to consider for Environmental Impact Assessment (EIA). For Habitats Regulation Assessment (HRA), it is then necessary to consider which Special Protection Areas (SPAs) contribute to each regionally defined population.

1.2 Overall Aim

The overall aim of the project is to review and define species-specific non-breeding season seabird populations at biologically defined minimum population scales (BDMPS) to enable the apportioning of potential impacts of marine renewable developments during the non-breeding season. Species included in this review are: red-throated diver, great northern diver, northern fulmar, Manx shearwater, northern gannet, great cormorant, European shag, Arctic skua, great skua, lesser black-backed gull, herring gull, great black-backed gull, black-legged kittiwake, Sandwich tern, roseate tern, common tern, Arctic tern, little tern, common guillemot, razorbill, black guillemot, and Atlantic puffin.

1.3 EIA and HRA non-breeding season assessments; project requirements

For EIA purposes, impacts need to be assessed against relevant regional populations, including not only birds from the UK but also birds from overseas populations that pass through UK waters on migration or winter in UK waters. This assessment can be at a range of spatial scales, from the biogeographic population downwards (biogeographic population scales have been well defined by JNCC and others – see for example Stroud et al. 2001; Kober et al. 2010, 2012; JNCC 2014). The largest spatial scale (the biogeographic population) is most easily defined in terms of seabird numbers and distribution, but would require cumulative assessment of all projects within the entire biogeographic population range which may be impractical. This report presents a smaller scale which is the

biogeographic population with connectivity to UK waters. That population is the sum of numbers in the UK population plus each overseas population known to visit UK waters either to winter or during migration to winter quarters elsewhere. That population is therefore in most cases smaller than the biogeographic population since the latter may include populations of the species that do not ever visit UK waters so are not at risk from development within UK waters. However, in many cases, overseas populations are large yet only a very small fraction of the population visits UK waters. So assessing impacts against the biogeographic population with connectivity to UK waters might assess the impact against much larger numbers than are ever present in UK waters. So the next step may be to consider assessment against the total number of individuals of the species that are present in UK waters at a particular season (non-breeding season, autumn migration, winter etc). For each species this total number, and the contribution of birds from UK and from overseas, is presented as a reference value. However, for Habitats Regulations Assessment (HRA) and to make EIA more practical, it may be more appropriate to consider smaller spatial scales, hence the derivation of the BDMPS. In general, for many species there are two clear BDMPS in UK waters, one in the UK North Sea and one in UK western waters. The UK land mass separates these areas and does present a significant barrier to movement of seabirds so that for most species the birds in the North Sea mix very little with birds in UK western waters and vice versa. For some species there are also clear separations between populations in northern and southern parts of UK waters. For a few species, while the two BDMPS seem appropriate, there is limited movement of birds from specific colonies within a BDMPS, so that a smaller spatial scale than the BDMPS would be appropriate for assessment. In such cases a more appropriate Reference Area needs to be defined in relation to a proposed development, taking account of the limited mobility of birds from focal colonies within the BDMPS.

The smallest spatial scale makes identifying all relevant projects much simpler, but comes at a cost of less clearly defined seabird populations as the exact movements in time and space of each age class of each population are not well known for any seabird species. For EIA, it is therefore likely that the optimal compromise is to define regional populations at an intermediate spatial scale between biogeographic and local. HRA requires that impacts to the proportion of the population that are qualifying features at SPAs are considered. This includes assessing the potential impact of offshore projects on SPA population features throughout the whole year. Where evidence allows, impacts to non-breeding season populations should be linked to specific breeding colonies. Where this is not possible, potential impacts might need to be assessed against the overall UK SPA network population of the respective species.

This requires the definition of the wintering area of UK breeding populations and an understanding of the influx of birds breeding abroad but mixing with UK SPA breeding birds within UK waters during the non-breeding season. As our understanding of biogeographic populations is relatively advanced, and breeding and non-breeding range for those biogeographic population units are more or less defined, the biogeographic population, which includes UK breeding birds, might represent the largest reference unit to start with in the absence of more specific knowledge.

Based on population estimates of the overall biogeographic population (e.g. AEWA (2012)) and the UK population of a specific species within the SPA suite, the proportional contribution of the UK SPA birds to a biogeographic population can be derived. Assuming an equal mixing of birds from across the biogeographic breeding range during the non-breeding season, this allows apportioning of potential impacts on the overall UK SPA network, or even to individual SPAs.

Nonetheless, whenever evidence allows, the aim should be to define non-breeding season biologically relevant population scales (BDMPS) which are smaller than the biogeographic

region. There could be a need to define different BDMPSs for different seasons. BDMPS may be appropriate for the entire non-breeding period for some species, or may need to be split into separate BDMPS for migration periods and for that part of winter when no migration occurs. The driver for all this is to generate a useful scale that allows us to determine what the impacts of an offshore project are on seabird populations and SPA populations. For this we need to be able to a) assign the birds that are predicted to be impacted by a project to a particular population and SPA; b) to calculate what proportion of the population and SPA population that number of birds represents.

With very few exceptions (such as penguins) seabird population sizes have never been counted. This is because, unlike penguins which moult communally with all age classes represented, most seabird species are never all in one place together. Data on seabird 'population' sizes are mainly presented in terms of numbers of breeding pairs, or in similar units (such as Apparently Occupied Territories) based on census work at colonies. However, these counts monitor only one part of the whole population (breeding adults). Seabird populations include not only these breeding pairs but also large numbers of sexually immature birds (because seabirds exhibit deferred maturity so immature birds can represent similar numbers to the breeding component), and in some cases some sexually mature non-breeding adults. Once the non-breeding season BDMPS is defined and the wintering population quantified, it is necessary to estimate the proportion of the population which do not contribute to the number of breeding pairs estimated at relevant breeding colonies. This will consist of large numbers of sexually immature sub-adults, and might in some cases also include sexually mature but non-breeding adults.

For the breeding season, the BDMPS is defined as the breeding population within foraging range from the project, plus non-breeders and immatures, which are likely to originate from a much wider range of colonies and may include young immature birds spending the summer in their wintering area as well as immatures loosely associated with local colonies. For the non-breeding season, the steps are as outlined above except for apportioning any impacts back to the SPA; separate BDMPS may need to be defined for the migration seasons as well as for the 'winter' period between migration seasons.

A literature review has been conducted to establish whether such proportions have been estimated for any of the priority species, and whether proportional estimates are appropriate to the BDMPS. Secondly, where such estimates have not been made, a review of demographic parameters has been undertaken to establish the most appropriate values to use for the BDMPS and indicate where data gaps exist, focussing on age at first breeding, productivity, and age/life stage-specific survival rates at suitable population scales. Thirdly, demographic parameters have been used to inform age-structured population models (e.g. Leslie matrices), to estimate a stable age distribution from which the proportion of breeding adults and of immature birds within the BDMPS can be estimated.

This report will soon become out of date. It will be necessary to update seabird population estimates and seabird movement patterns, to take account of new data and to take account of changes that are occurring as a consequence, for example, of changes in environmental conditions (such as distributions of fish stocks and fisheries management practices such as discarding). Furthermore, we will soon see new designations of Special Protection Areas for non-breeding seabirds. These new SPA designations are anticipated first to include inshore areas for non-breeding aggregations of divers, grebes and seaducks, and subsequently also marine areas for non-breeding offshore seabirds. Those designations have not been included in this report as the exact areas and species to be included remain uncertain at the present time.

2. METHODS

2.1 Breeding range and taxa

Information on the breeding range of the species, the number of sub-species that are recognised, and the breeding ranges of individual sub-species, was summarised from Forrester et al. (2007) and Brown and Grice (2005), with reference where necessary to Handbook of the Birds of the World (Hoyo et al. 1992-2011) and Birds of the Western Palearctic (Cramp et al. 1977-1994). Where sub-species are recognised, there is clearly scope to reduce the biogeographic population being considered to the relevant sub-species, and differences in the biometrics of different sub-species or populations within sub-species can also be informative about the origins of birds if their measurements can be obtained.

2.2 Non-breeding component of the population

Seabirds are generally long-lived animals which show deferred maturity. The species that are the focus of this project start to breed when, on average 2 (roseate tern) to 9 years old (northern fulmar). Therefore, a major part of the population will comprise immature birds. Seabirds are almost always censused in units of breeding pairs, so the population size based on breeding pairs provides only a partial census of the entire population. In this report the numbers of immature birds associated with breeding populations have been estimated by applying the simplest of Leslie matrix models to estimate the numbers of birds in each age class in a stable (equilibrium) model population (stable age distribution and immature survival rates adjusted to give a zero net rate of population change) with defined demographic parameters. Consistent as well as appropriate selection of demographic parameters is important. Therefore, for each species the age at first breeding and adult survival rate data presented by BTO Birdfacts (http://www.bto.org/about-birds/birdfacts accessed 11 March 2014) which presents the values considered to be most up to date and most appropriate for UK seabird populations were taken as the basis for modelling populations. This was done for consistency of approach and convenience, but with the caveat that BTO Birdfacts might not be the most appropriate source for all species and is only updated periodically. However, assessing all demographic data for all species would in itself represent a major project and was agreed to be outwith the scope of this project. Generally, most seabirds have been studied in enough detail to provide moderately precise measures of adult survival rate, although this can vary with colony size, food abundance and climate (Sandvik et al. 2012). Data on productivity (breeding success as chicks fledged per pair) were extracted as annual measures from each individual monitored colony from the JNCC seabird productivity monitoring database (http://jncc.defra.gov.uk/page-1550 accessed 11 March 2014) for the years 1986 to 2006 (the years for which data are presented in tables in annual reports). For the population model, data on age at first breeding, adult survival and mean productivity were used at face value. Data on juvenile or immature survival are not available for many seabird species, and those data reported in literature tend to be highly uncertain with very large confidence intervals and possible biases. So data on immature survival were used as a guide in constructing models, but survival rates input into the model were iteratively adjusted until the model produced approximate stability (a zero rate of population growth). This approach was considered to be precautionary in that an increasing population will tend to have a higher ratio of immatures to breeding adults than will be present in a stable population, whereas a declining population may or may not differ in ratio of immatures to adults depending on which age classes are exposed to elevated mortality rates that are causing the population decline. Adjustments of immature survival rates were made so that survival rates always increased with age up to the adult survival rate. Numbers in each age class were then used to estimate the ratio of immatures to breeding adults, making the (precautionary) assumption that no birds of breeding age took sabbatical years off breeding. In practice, it is known that in some seabird populations subject to extreme environmental stresses, some breeders will take sabbatical years, although for most species when conditions are normal or good, virtually all birds of

breeding age do breed (Harris and Wanless 1995). The age composition of populations is, of course, strongly affected by the mean age at first breeding. The BTO Birdfacts web site does not indicate the published sources from which they obtained data on mean age of first breeding for each species. However, their presented values appear to match with the literature, except in the case of Atlantic puffin. For puffins, Harris and Wanless (2011) indicate a mean age of first breeding of 7 years old, whereas BTO Birdfacts cites a mean age of first breeding at 5 years old. Modelling the population using an age of first breeding of 5 years generates an estimated 0.82 immatures per breeding adult whereas for an age of first breeding of 7 years generates an estimated 1.08 immatures per breeding adult (making no changes to the productivity and adult survival rates used in the model). This is likely to be the largest uncertainty in the estimated ratio of immatures to adults, as the age of first breeding seems to be better known for most other seabirds.

Implications of altering adult survival rate for the ratio of immatures per adult are generally moderate (Figure 2.1), as are implications of altering age at first breeding (Figure 2.2) or productivity (Figure 2.3). The proportion of immatures tends to decrease with increasing adult survival rate, but tends to increase where age at first breeding increases, and tends to increase with productivity of the population.

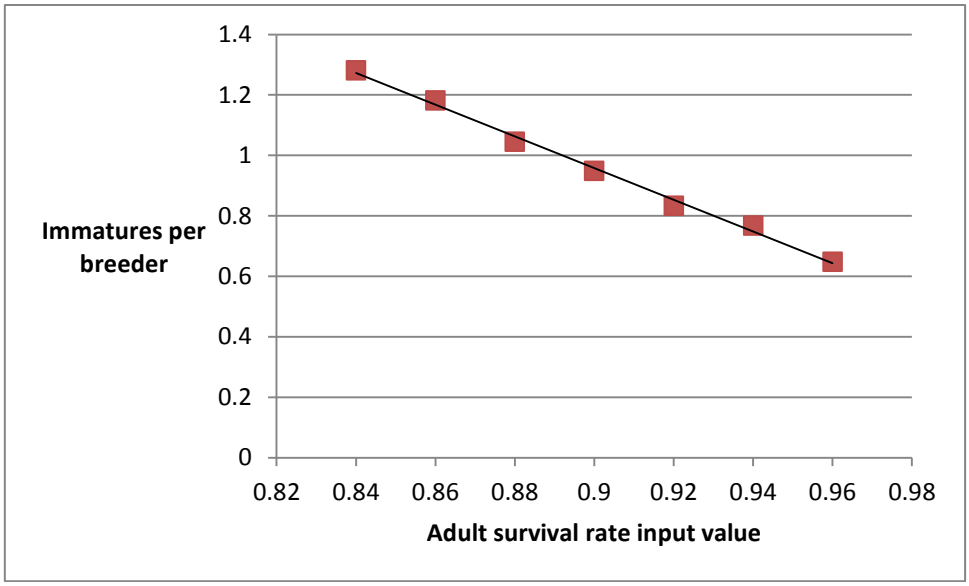


Figure 2.1. Model estimates of the numbers of immatures per breeder (ranging from 0.65 to 1.28) for a range of values of adult survival rate (from 0.84 to 0.96), values of productivity and age of first breeding being held constant at mean values.

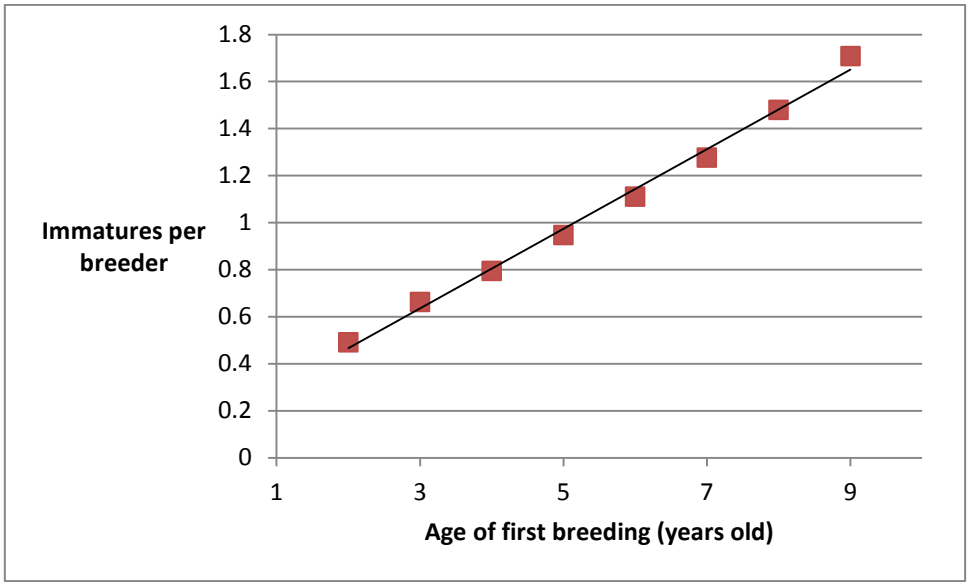


Figure 2.2. Model estimates of the numbers of immatures per breeder (ranging from 0.49 to 1.71) for a range of values of age of first breeding (from 2 to 9 years old), values of productivity and adult survival being held constant at mean values.

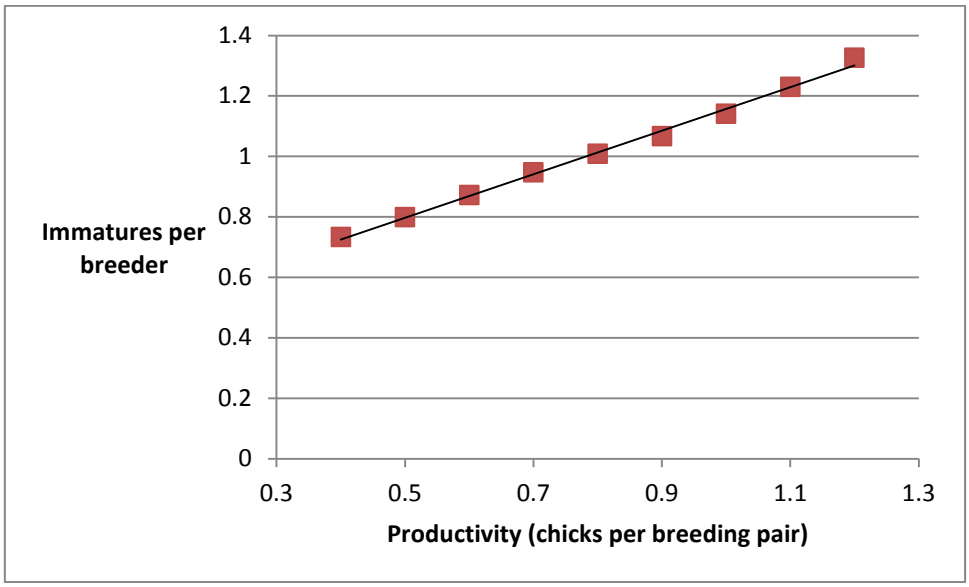


Figure 2.3. Model estimates of the numbers of immatures per breeder (ranging from 0.73 to 1.32) for a range of values of productivity (from 0.4 to 1.2 chicks per pair), values of age of first breeding and adult survival being held constant at mean values. Note that in all of these analyses, the ratio of immatures to breeders is close to 1, meaning that under a range of plausible demographic values seabird populations contain a similar total number of immature birds to the total number of breeding adults.

Age of first breeding, adult survival rate and productivity data input into the Leslie Matrix model are summarised below, together with the derived estimate of the number of immatures per breeding adult in a typical population of each species.

Species	**Age of first breeding (years)**	**Adult survival rate**	**Mean productivity**	**Estimated immatures per breeding adult in population**
Red-throated diver	3	0.84	0.635	0.74
Great northern diver	6	0.9	0.635	1.1
Northern fulmar	9	0.972	0.424	0.62
Manx shearwater	5	0.905	0.591	0.84
Northern gannet	5	0.92	0.684	0.81
Great cormorant	3	0.88	1.913	1.17
European shag	4	0.878	1.289	1.31
Arctic skua	4	0.886	0.522	0.71
Great skua	7	0.888	0.664	1.42
Lesser black-backed gull	4	0.913	0.517	0.68
Herring gull	4	0.88	0.936	1.09
Great black-backed gull	4	0.88	1.139	1.26
Black-legged kittiwake	4	0.882	0.672	0.88
Sandwich tern	3	0.898	0.656	0.63
Roseate tern	2	0.855	1.293	0.75
Common tern	3	0.9	0.721	0.67
Arctic tern	4	0.9	0.402	0.58
Little tern	3	0.899	0.521	0.56
Common guillemot	5	0.946	0.678	0.74
Razorbill	4	0.9	0.633	0.75
Black guillemot	4	0.87	1.295	1.32
Atlantic puffin	7	0.93	0.67	1.04

Although modelling shows that the ratio of immatures per adult is relatively robust to errors in demographic parameter estimates, it would be useful to be able to validate these ratios. Data on the proportions of different age classes of seabirds at sea might seem to be one way to try to do this. However, very few seabird species can be identified to age classes with confidence. For example, ageing of auks at sea is almost impossible. Kittiwakes can be identified as juvenile/first year or 'adult' based on plumage, but the 'adult' category will include many immatures as well as birds of breeding age. Large gulls can be more securely aged based on plumage, but there is considerable overlap in plumages between age classes and older immatures are not easy to separate from adults in the field so that survey fieldwork that is not specifically aimed at determining numbers of each age class is likely to mis-classify many individuals. Gannets have a sequence of plumages that allow fairly detailed classification of birds into ages, but again the older immatures can be mistaken for adults if not examined in detail. Moreover, the at sea distribution of seabirds differs between age classes, with youngest birds tending to spend their time in the winter quarters even during summer, breeding adults tending to stay closest to their breeding area, and immature birds probably at sea in areas that have good food supplies but are away from large colonies. So it is not clear that any at sea data on proportions of different age classes would provide a secure test of the estimated proportions based on demographic data.

2.3 Phenology

Information on the timing of seabird breeding seasons (initial arrival back at the colony in spring, modal return to colony in spring, modal departure from colony at the end of the breeding season, and final departure from the colony) was extracted from Forrester et al. (2007) and Pennington et al. (2004). In addition, data on modal arrival at colonies in spring, and modal departure from colonies in autumn were extracted from Orkney Bird Reports for 2008, 2009, 2011 and 2012, Shetland Bird Reports for 2008 to 2012, and Fair Isle Bird Observatory Reports for 2007 to 2012. These data were collated in an Excel spreadsheet and then used to describe the timing of seabird breeding seasons. Data on timing of seabird migrations were obtained from several sources. Timings for autumn and spring migrations (beginning/peak/end), were extracted from Cramp et al. (1977-1994), Wernham et al. (2002), Pennington et al. (2004), Brown and Grice (2005), Forrester et al. (2007) and Vanermen et al. (2013). The earliest spring sighting of the species, peak of spring migration, peak of autumn migration, and the last reported sighting of the autumn were extracted from Orkney Bird Reports for 2008, 2009, 2011 and 2012, Shetland Bird Reports for 2008 to 2012, Fair Isle Bird Observatory Reports for 2007 to 2012, Argyll Bird Reports for 2008 to 2012, and the Gibraltar migration watch website www.gonhs.org. In addition, data for each seabird species on the mean numbers per hour observed at UK migration sites for each week of the year (averaged over all years for which data were collected) were extracted from the Trektellen migration web site www.trektellen.nl. The Trektellen data were used to plot histograms describing the seasonality of observations at migration sites (most of which are located in E or SE England), to infer the timings of spring and autumn migrations. As with timing of breeding, extracted data on timing of migrations were entered into an Excel spreadsheet and these data were then used to describe phenology in individual species accounts. The timing of breeding seasons defined within this report is evidence-based from the literature, but does not replace SNCB guidance documents on seabird breeding seasons. Where SNCB guidance differs from the seasons presented in this report, the definitions of seabird breeding and non-breeding periods in assessments needs to be agreed with SNCBs in advance of assessments being made.

Accounts of phenology in Cramp et al. (1977-1994) differ somewhat from those in Wernham et al. (2002), Pennington et al. (2004), and Forrester et al. (2007), in that Cramp et al. consider the timings of migrations throughout the species' range and not specifically in UK waters. For that reason, less attention was given to details in Cramp et al. (1977-1994) except where this either did, or did not, match up with data in the other sources. Data on

phenology in Wernham et al. (2002) were sometimes equivocal, as it was not always evident whether text was describing seabird phenology or the phenology of ring recoveries from seabirds; phenology indicated by the timing of ring recoveries is likely to be biased by the fact that recoveries may occur some days, or even weeks, after the death of the bird rather than at the exact time of death. For this reason, more weight was given to the phenology data in Pennington et al. (2004), Brown and Grice (2005), and Forrester et al. (2007). Data in Bird Reports provide accurate and detailed information on the first arrival dates of spring migrants, and fairly detailed and accurate data on the last sightings of the year of departing autumn migrants, but provide less information on modal migration dates. Data from Pennington et al. (2004) were compared with data from Forrester et al. (2007) and Brown and Grice (2005) to see whether there was a detectable progressive difference in timing between the north and south of the UK. Data from Gibraltar and Belgian migration studies reported in www.gonhs.org and Vanermen et al. (2013) were used as context, specifically to test whether there were clear differences in phenology between the UK, and regions south of the UK. For almost all species, differences in timing between years (Frederiksen et al. 2004, 2013), and differences reported by different authorities were as great as, or greater than, any slight differences in timing between latitudes within the UK, so to avoid excessive complexity, summaries of phenology were derived for all UK waters rather than for separate regions.

2.4 Defined seasons

Seasons were defined for each species as 'breeding season' and 'non-breeding season' in the context of UK breeding. Breeding season was defined as the period from modal return to the colony through to modal departure from the colony at the end of breeding, for birds at UK colonies. Breeding season was defined as the period between modal return of breeding adults to colonies in 'spring' to modal departure from colonies at the end of the breeding season. Modal date is roughly equivalent to mean or median date, but is used here for pragmatic reasons – mean or median dates are difficult to measure and are rarely reported in the literature, whereas modal date is frequently reported. Use of first or last dates was avoided since extreme cases can be very misleading and atypical, and tend to vary with sample size. Non-breeding season was defined as the remaining part of the year.

Post-breeding (autumn) dispersal/migration, and pre-breeding (spring) migration periods were also defined, based on the periods during which substantial migration of the species occurs through UK waters. Therefore, the migration periods may overlap with the UK breeding season and with the non-breeding season, since timing of migrations of birds from high latitude regions can differ from that of UK birds. Wherever possible, seasons were defined as a set of months rather than in any more precise terms. This reflects the fact that for many seabird species phenology can vary by several weeks from year to year, so that greater precision is inappropriate. It also acknowledges the fact that survey work is normally carried out by calendar month, so that splitting survey data by periods shorter than one month can be inconvenient and technically difficult. However, for some species, especially long distance migrants such as terns, phenology is highly predictable and occurs within a narrow window. In such cases subdivision into fractions of months is appropriate, and has been done where necessary.

Spring migration for each species was defined as the months during which migratory movements of the species through UK waters towards breeding colonies (whether UK colonies or colonies of overseas populations) was clearly evident. Thus, spring migration may overlap with either or both of the non-breeding season and breeding season. Autumn dispersal/migration for each species was defined as the months during which migratory movements of the species through UK waters away from breeding colonies (whether UK colonies or colonies of overseas populations) was clearly evident. Thus, autumn dispersal/migration may overlap with either or both of the non-breeding season and breeding

season. Rationale for choice of months to define in each season is presented in the text for each individual species account, and each species' account is based on the extracted bird report phenology data tabulated in Excel, in addition to the broad literature review.

2.5 Movements of birds from the UK population through UK waters and from overseas populations into or through UK waters

A number of approaches can provide data on seabird migrations, including seawatching from coastal sites, recoveries of ringed birds, deployment of geolocators or other tracking devices, interpretation of biometrics, genetics, stable isotopes and other markers. The utility of these methods is outlined below.

2.5.1 Seawatching

Data from seawatching sites provides information on phenology of movements, but relatively little information on where birds come from or are going to. However, combined with other methods, seawatching data can provide supporting evidence of the seasonal movements of seabirds. The Trektellen web site www.trektellen.nl provides data on rates of movement of seabirds past UK (and other European) migration sites. Seawatching data are also used by Forrester et al. (2007) to assess numbers of seabirds migrating through Scottish waters. Seawatching data do not necessarily provide a good measure of numbers of birds as the counts one day may, or may not, involve the same individuals seen on a previous day. This can give a misleading impression. In general, numbers recorded on spring migration tend to be smaller than on autumn migration. While there will be smaller numbers migrating through UK waters in spring (in part because there will be many juveniles in the autumn passage but few in the spring return passage because most remain in winter quarters for their first summer and some do not survive the winter), another likely explanation of this is that migration in autumn can be a slow process with birds stopping off to feed at suitable sites on their way through UK waters, whereas in spring the adults migrate rapidly back to their breeding site because there is potentially competition for nest sites and a bird arriving back late may miss out. As a result, counts in autumn on any one day may be larger than in spring because birds remain on autumn passage for days or weeks, compared to the rapid flight through in spring. Tracking studies provide some support for this impression of more leisurely migration progress in autumn than in spring, but do not yet provide an accurate quantification of this difference.

2.5.2 Ringing data

Much of our understanding of seabird migrations is based on recoveries of ringed (and in some cases colour marked) seabirds. Ring recovery data were summarised for each bird species occurring in the UK by Wernham et al. (2002). A migration atlas has also been published for the Faroes (Hammer et al. 2013). Numerous papers have been published describing details of the seasonal movements of particular species of seabirds. Ring recovery data have many potential biases. Ringed birds are very unlikely to be recovered in the open ocean. Dead seabirds can be carried large distances by currents and can be deposited onto beaches far from where they died. Reporting probability can be high in countries (such as Greenland) where many seabirds are hunted for food. Recoveries of seabirds may be associated with fisheries bycatch or oil pollution incidents. Large numbers of seabirds may be ringed at a few colonies but none at other colonies (for example, most gannet ringing has been done on the Bass Rock, and for obvious reasons none or very few have been ringed at most of the gannet colonies where safe access to nests is impractical). Large numbers may be ringed in some countries but not in others. Interpretation of the migration routes and wintering areas of seabirds has to be done with great caution, trying to take account of these potential biases in data. Fortunately, these biases are well recognised and can mostly be taken into account, although the magnitude of the bias may not be easy to assess in some cases, especially in relation to the more pelagic seabird species. Ring

recovery data have been used as key information in this project to assess movement patterns of UK seabirds and to assess origins of seabirds that winter in, or migrate through UK waters. The Migration Atlas (Wernham et al. 2002) has been used as the most important source of information on this topic for most species of seabird, supplemented by more recent publications on seabird migration (which are predominantly single-species studies). Other especially useful accounts providing coverage of most species of seabirds include the Faroese Migration Atlas (Hammer et al. 2013), and species accounts in the book on seabirds in the Barents Sea (Anker-Nilssen et al. 2000).

2.5.3 Geolocation data loggers and other tracking devices

In recent years, new technologies have become available that can be used to study seabird migrations and wintering areas. In particular, several studies have deployed geolocation data loggers on breeding seabirds at various colonies. Geolocation data loggers are very small devices that can be attached to a leg ring on a breeding seabird of moderate size. About a year later, if the bird can be recaptured, the logger can be removed and data downloaded for analysis. These loggers record light intensity, and usually also temperature, on a time base. In principle, analysis of location from these data is simple. In the northern hemisphere, daylength is longer further north in summer, shorter further north in winter. At any given latitude, sunrise occurs earlier further east. Using light intensity data recorded in the logger, the location of a bird can be estimated twice each day from the light data (Phillips et al. 2004). In some situations, temperature data can help with estimating location (Teo et al. 2004) since the temperature recorded will be sea surface temperature when the bird is sitting on the water (which many seabirds always do at night when away from the colony). Location estimates are imprecise. The average error is around 180 km (Phillips et al. 2004, Teo et al. 2004). But this is adequate to establish the general area in which the bird is present. Geolocation does not work at the equinoxes, but this results in the loss of only a few weeks of data at those times of year (although those periods may well be during active migration by many species). Logger data can also be used to infer behaviour of birds, especially amounts of time spent flying, and spent sitting on the water (Mackley et al. 2010).

2.5.4 Biometrics

Many seabirds show variation in biometrics between populations. In many cases birds breeding further north tend to be larger in size. Biometrics can be used to infer origins of those seabirds that show clear and known variation in measurements between populations. This has been used very successfully for great northern divers, and to some extent for auks. There are probably several species of seabird where biometrics could be informative but there has not yet been an assessment of the use of this approach. There are, however, some seabirds where biometric variation between populations appears to be too small to be useful. There are also difficulties created by post-mortem shrinkage (e.g. Harris 1980), and variability in measurements recorded by different researchers, some, but not all, of which are due to differences in measurement technique (Barrett et al. 1989).

2.5.5 Genetics

There are a few phenotypic features of seabirds that show clinal variation with latitude, and so have potential to provide information on the breeding season origins of birds sampled in winter. While most Arctic skuas at lowest latitude breeding areas are dark phase birds, the proportion of light phase increases northwards and reaches 100% on Arctic tundra. The proportion of dark phase fulmars increases with latitude in the North Atlantic. The proportion of ‘bridled’ common guillemots increases with latitude. Herring gulls from high latitude colonies tend to have more white on the tips of the outer primaries than seen on birds from low latitude colonies, and also have darker grey mantle plumage. A number of studies have investigated whether molecular genetic markers, such as mtDNA, can be used to identify breeding colony or regional origins of seabirds sampled outside the breeding season, but these studies have not generally been very successful in identifying specific genetic markers

that can be used in this way. However, it seems likely that some suitable genetic markers might be identified in future.

2.5.6 Stable isotopes and other natural markers and pollutant markers

Stable isotopes of carbon and nitrogen can be measured in feather samples. These ratios tend to reflect diet at the time of feather growth, which for juvenile seabirds is at the breeding site, whereas for most species of seabirds the moult of adults occurs in the wintering area, though there are certain exceptions (Cherel et al. 2006). Leat et al. (2013) recently showed that the carbon isotope ratio in feathers of great skuas sampled at breeding colonies is indicative of whether individual breeding adults overwintered off west Africa, or off southern Europe, or off North America. That study also identified characteristic differences in the proportions of different persistent organic pollutants in birds, reflecting which of these three regions the individual used as its wintering area. Similar differences have been seen in feathers of gannets and lesser black-backed gulls that could be used to identify which individual birds had spent the winter off west Africa and which had wintered in European waters (the difference in carbon isotope being determined by the upwelling oceanography off west Africa which creates a distinct carbon isotopic signature in the food web that is clearly different from that found in European shelf seas). The use of isotopes, pollutants and other markers (such as heavy metals in feathers) as tracers of the origins of individual seabirds almost certainly has the potential to be developed in future, but has not yet been investigated in enough detail to be used to assess existing data except in a very few cases.

2.6 Numbers in UK waters

At sea surveys include the European Seabirds at Sea (ESAS) database which holds information on numbers of seabirds at sea counted using standardized methodology (Tasker et al. 1987). These data can be used to estimate seabird densities at sea in different months and locations and hence can provide evidence of seasonal changes in distribution (Tasker et al. 1985). ESAS data primarily relate to the North Sea and data are predominantly from the 1980s with fewer surveys in recent years, but ESAS methods have also been used in marine areas west and south of the UK and to some extent in years from the 1990s to the present. The ESAS data have been used to identify areas that may qualify as Special Protection Areas for seabirds on the basis of high densities of key species at particular times of year (Kober et al. 2010, 2012). However, Kober et al. (2010) were cautious about interpreting the absolute magnitude of density estimates from the ESAS data and chose to make corrections to absolute numbers of some species in order to make them match to ICES published data on numbers of seabirds in European waters. Some of the 'rescaling' factors quoted by Kober et al. (2010) were large. The accuracy of these 'rescaling' factors is rather uncertain, but suggests that the ESAS data provide only indications of relative abundance in different areas rather than meaningful measures of absolute abundance of seabirds at sea. WWT Consulting (2013) combined the ESAS data together with WWT aerial survey data to describe seabird distributions within English territorial waters. That exercise makes use of more recent survey data and allows aerial survey data to be included as well as boat-based survey data. That work also indicated significant discrepancies between data sets from aerial and from boat-based surveys (WWT Consulting 2013). However, the data were adequate to map seabird relative density across large areas of UK waters, and the methodology has recently been presented in Bradbury et al. (2014), and this represents the best available dataset for assessment of seabird distribution and relative abundance in UK waters during the non-breeding season. However, recognising the uncertainty about absolute numbers estimated from ESAS data and the somewhat out of date nature of that database, in this report, estimates of seabird density and distribution from ESAS and publications based on that database have been used primarily to provide a sense check on numbers considered to be in UK waters based on knowledge of population sizes and migration behaviour, rather than as a tool to define BDMPS totals.

2.7 Biogeographic populations

Starting from the Biogeographic population defined by Stroud et al. (2001) each species specific appropriate Biogeographic population was refined by considering only those populations with connectivity to UK waters at some time of year based on ringing and tracking data and the most recently available data on population sizes in the relevant countries (the latter primarily from Mitchell et al. 2004 but taking account of more recent publications where available – see individual species accounts for details). Estimates of breeding numbers in the UK were taken from Mitchell et al. (2004) as the most recent comprehensive surveys of most species, updated if possible by more recent survey data (such as national gannet surveys, skua surveys in Orkney), and data presented by SNH (Foster and Marrs 2012) or JNCC online seabird database. Amongst other sources, numbers were taken from the review by Lewis et al. (2012) but these data need to be treated with caution as SNH have found that numbers in that report are sometimes based on incorrect boundaries and population estimates. Numbers can be expressed in terms of the normal census unit (breeding pairs or equivalent such as (Apparently Occupied Territories (AOTs) or Apparently Occupied Nests (AONs)), or as the total population including numbers of immatures associated with a breeding population of the estimated size (based on the ratio of immatures to breeding adults estimated from the simple population model).

For those species where possible, data from the JNCC seabird population monitoring database were used to graph the breeding population trend from 1986 to 2012 in monitored UK colonies. As default, a linear trend line was fitted to these data, but where a non-linear trend provided a significantly better fit to the empirical data, a non-linear trend is presented, with the equation of the trend line and the amount of variance explained by the trend also presented on the graph. These trend lines have not been used to adjust count data for individual populations to bring it up to date, although such extrapolations would be possible if felt desirable in specific cases. The objective of presenting trends (which are shown for regions of the UK when the data allow and trends show different patterns in different regions) is to provide context that may be useful in the interpretation of BDMPS data and the understanding of how UK seabird populations may be changing in breeding numbers.

2.8 Proportion of UK population from UK breeding SPAs

The proportion of the UK population of each species that represents birds from UK SPAs with that species as a feature (including all those listed in JNCC 2014) was estimated by reviewing literature to obtain the most up to date available count of breeding numbers of each species at each SPA. JNCC (2014) provides an estimate of the proportion of the breeding population that is in SPA breeding sites, focused on the time period around 2000-2005 (since many colonies, especially non-SPA colonies, have not been counted since Seabird2000). However, for many SPAs, data are available for years since 2005. In many cases, the most up to date data were found on the JNCC Seabird Colony Monitoring web site database http://jncc.defra.gov.uk/smp/. Where there was evidently more recent data available for a site but those data were not entered into the SCM database, requests were made to access those data. For example, red-throated diver breeding numbers are not included in the SCM database but the SNH Sitelink web page indicated that Site Condition Monitoring data existed for some sites that were not available in published literature, and these were obtained from SNH staff. David Stroud at JNCC kindly provided access to the forthcoming JNCC SPA 2014 review to check that most recent survey data presented in this report match those used in the JNCC SPA 2014 review (JNCC 2014). That review also provides an estimate of the proportion of birds breeding in UK SPAs during the period around 2005. Where there have been no recent surveys of seabird numbers at particular SPAs, national, or where available regional, breeding population trends were obtained from the JNCC Seabird Numbers and Productivity database http://jncc.defra.gov.uk/page-1550. These trend data could be used to extrapolate numbers from the historical data to the present based on the estimated population trend at regularly monitored colonies; this

approach could be used for individual SPA sites where recent count data are not available, and could be used for national/regional numbers. There are potential difficulties using data from a subset of sites to extrapolate either for individual SPA sites or regional population size, since the set of monitored sites may not be representative of an individual site or of the entire population. This approach may only be required for a small number of cases, as many populations have been surveyed regularly so up to date data are available. For example, almost all tern colonies are monitored annually. In a very few cases (for example for great skua), trend data were not available from the JNCC monitoring programme. In such cases a trend could be estimated from available data from other SPA populations of that species. Where relevant, such issues are detailed in individual species accounts. However, to provide transparency in this report, the most recent counts are used for each population (and are listed in detail) so that subsequent work could make use of these counts (updating them or applying trend data to refine estimates as felt appropriate). However, in this report the use of trend data to correct population estimates has generally been avoided because it is often uncertain which trend would be appropriate to use, and there is evidence that trends at individual colonies often do not follow national or regional trends. So applying corrections to update old survey data is tempting, but the temptation has been resisted in order to present best available data rather than adjusted data.

Therefore, numbers presented in Appendix A Tables 1 to 69 are the most recent available counts for each colony or national population. The key exception to this rule is the estimate of numbers of pairs at non-SPA colonies in the UK where census data are generally not available since Seabird2000. In that case, for a few species where large changes in numbers are known to have occurred, the total in non-SPA colonies has been estimated to a value that approximately retains the proportion breeding in SPA populations at the value defined by the JNCC 2014 SPA review (JNCC 2014), and is consistent with the national or regional trend in breeding numbers reported by Foster and Marrs (2012) and the JNCC Seabird Monitoring Programme. Where this correction has been applied it is clearly indicated as a footnote to the tables in Appendix A.

Adjustment of old SPA count data allowing for trends would alter the estimated BDMPS slightly, but in practice there are few seabird SPA populations in the UK that have not been counted since Seabird2000, and trend adjustment would make only rather small differences to BDMPS totals relative to the influence of other factors such as estimation of the proportions of overseas populations entering UK waters or the sizes of overseas populations. There may be a case for employing trend adjustments of old count data where HRA is assessing impacts on specific SPA populations where data are old, but for EIA and for HRA where the colony is not the focal colony in an assessment, correction of old data is probably undesirable in most cases.

2.9 Appropriate BDMPS populations

Where the proportion of each population that occurs in UK waters is known, the Biogeographic population estimate can be narrowed to the numbers occurring within defined UK waters, creating Biologically Defined Minimum Population Sizes (BDMPS). The BDMPS spatial area is from the UK coast to the edge of UK territorial waters, bounded by defined lines running from selected points on the coast to the UK waters limit. The justification for having more than one BDMPS in UK waters is that there may be good evidence that the overall number of birds or the population origins of a particular species differ between areas. In that case estimating the impact that might be attributed to a particular SPA population whose birds occur within a development area depends upon identifying and using in apportionment the estimate of the appropriate number of birds which may be represented at a particular time of year in that sea area. Using different figures in different parts of UK waters is justified only if the overall suite of birds passing through the area is known to be different to that in another area. Thus, for example, red-throated divers in the southwestern

North Sea originate predominantly from continental European populations with only a small minority of birds from UK populations, whereas red-throated divers in the northwestern North Sea originate predominantly from UK populations, with only a minority of birds coming from overseas populations. These areas are therefore more appropriately considered as separate BDMPS.

Where the BDMPS is over an inconveniently large area, and especially where it is known that birds from specific colonies tend to remain within only a part of the BDMPS, it may be possible to define geographical reference regions that are convenient but not necessarily distinct in terms of the biogeographic populations present. That approach may be necessary for a few species, where populations are not very mobile but are distributed in overlapping areas across a much larger spatial scale. An example of this is common guillemot, where there are numerous SPA populations distributed from northern Shetland to the southern North Sea in a continuum, yet birds from particular SPA colonies are not distributed over the whole region but tend to remain nearer to their colony. It is therefore difficult to establish BDMPS boundaries within the whole region, but an assessment of impact needs to consider the localised movements of birds from particular colonies. In these cases, it may be necessary for HRA assessment to consider only the part of the BDMPS which would have connectivity with any particular development site rather than the entire BDMPS (so defining a specific 'reference region' that would be project-specific). The proportions of birds of a particular species present in each BDMPS or reference region can be estimated from information in the literature on seabird numbers and distribution, and from the evidence on the migrations of birds from defined populations. The allocation of numbers of seabirds from overseas populations migrating through, or wintering in different regions is rather uncertain for most seabird species, and in almost all species is much less well known than for UK populations. In a few cases, there are clear distribution patterns and well defined numbers of birds, but in most cases the numbers in different regions are not well defined, and movement patterns of immature birds are not known except in a very general way. This represents a major constraint on assessing the proportions of birds in UK waters from different overseas populations. Although numbers are often uncertain, calculations need to be made using best available data and explicit assumptions. Therefore the computations involved in establishing BDMPS totals are presented in Appendix A Tables 1 to 69. It is assumed that these working tables can be updated as new information becomes available to make estimates of BDMPS and the contributions of individual SPA populations to these BDMPS more up to date and more accurate. It has to be recognised however, that while numbers can be added together to achieve a total for the BDMPS, there is much uncertainty about the values being summed, and that the resulting BDMPS has a large, but also uncertain, confidence interval. For this reason, BDMPS estimates in the report are colour coded green, amber or red, according to the uncertainty, with a narrative explanation of the colour coding given below the summary table at the start of each species account. For estimates that are coded green, the numbers are likely to be no more than 30% less or 50% more than the estimate presented. For estimates that are coded amber the numbers are likely to be no more than 50% less or 80% more than the estimate presented. For estimates coded red the numbers might be more than 50% less or 80% more than the estimate presented. While these ranges are expert judgement based on the literature reviewed in this project, it is impossible to measure the uncertainty and so no confidence limits can be quantified. Therefore, the colour coding itself can only be considered indicative based on available knowledge, and should not be used to estimate confidence limits for BDMPS population estimates.

For some seabirds, such as Arctic skuas, terns and Manx shearwaters, there is no need to derive winter BDMPS on the grounds that to all intents and purposes these species are absent from UK waters at that time of year.

2.10 Proportions of birds from UK SPA populations in each BDMPS

Using the best available data of numbers of birds in UK SPA populations and taking account of associated numbers of immature birds, numbers in non-SPA colonies and numbers from overseas populations, once the size of a BDMPS population has been estimated, it is possible to estimate the proportion of those birds in the BDMPS originating from each individual UK SPA population, as required for HRA. This estimate will be very imprecise where details of population sizes or migratory movements are not well known, which unfortunately is the case for many seabird species.

2.11 Spatial distribution of UK breeding SPA birds across the BDMPS

For most seabirds, SPAs have been selected to give a good geographical representation of the species' protected breeding sites within the UK, so that the distribution of SPAs reflects the distribution of the population as a whole. This is particularly the case where the SPA populations sum to a high proportion of the total population. For relatively few seabird species, the distribution of SPA populations may not closely reflect the overall distribution pattern. Where this might be the case the distribution of SPA populations is assessed in relation to the overall distribution of the breeding population.

2.12 Presentation of BDMPS data in this report

Each of the species accounts that follows in this report starts with presentation of summary data outlining:

a) The biogeographic population with connectivity to UK waters (total number of birds including adults and immatures) and the contribution from UK and from overseas populations;
b) The number of birds (adults and immatures) in the whole of UK territorial waters within each distinct seasonal period relevant for that species and the contribution from UK and from overseas populations;
c) The number of birds (adults and immatures) in each separate BDMPS defined for that species in each distinct seasonal period relevant for that species and the contribution from UK and from overseas populations.

This hierarchical approach provides the opportunity to consider the relevant population scale for EIA, from biogeographic to BDMPS. It seems likely that the BDMPS population would be the most appropriate scale for use in EIA assessment in most cases, though the greater confidence in numbers at higher levels in the hierarchy could provide grounds for considering use of a higher level population scale in some cases.

Each of these totals is colour coded using the traffic light system, with reasons for the colour coding outlined in text below the summary table. For estimates that are coded green, the numbers are likely to be no more than 30% less or 50% more than the estimate presented. For estimates that are coded amber the numbers are likely to be no more than 50% less or 80% more than the estimate presented. For estimates coded red the numbers might be more than 50% less or 80% more than the estimate presented. The data on which these totals are based is presented in detailed tables (Appendix A Tables 1 to 69) which give the most recent count of each SPA population size, non-SPA population or overseas population (breeding pairs) on which the BDMPS numbers are based, the computed total number of adults, the corresponding total number of immatures, and the proportion of each population estimated to be present in each BDMPS and the resulting total number of individuals (adults, immatures and all ages). These data tables are likely to be used in assessments apportioning impacts of developments on particular populations for EIA and especially for HRA assessments. The data could be updated in each table as new data become available, and updates could include not only updating of population counts but also updating of proportions present in the BDMPS as new information on migrations becomes available.

Numbers in the BDMPS population estimate are given to the nearest individual bird because those totals are the sum of calculations presented in Appendix A Tables 1 to 69. However, the presentation of those totals to the nearest bird does not indicate high accuracy and comments on uncertainty in the BDMPS estimates should be considered with care.

3. RED-THROATED DIVER *Gavia stellata*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in winter (December-January) (adults and immatures)	Numbers in UK waters in migration seasons (September-November and February-April) (adults and immatures)
Overseas	**22,600**	**12,079**	**13,375**
UK	**4,400**	**3,292**	**4,275**
Total	**27,000**	**15,371**	**17,650**

Winter BDMPS (December-January)	**Total number of birds in BDMPS (adults plus immatures)**	**Number from overseas populations (adults plus immatures)**	**Number from UK population (adults plus immatures)**
NW North Sea	1,523	365	1,158
West of Scotland	861	195	666
SW North Sea	10,177	9,398	779
NW England & Wales	1,657	1,271	386
SW England & Channel	1,153	850	303
Migration BDMPS (September-November and February-April)			
UK North Sea	13,277	10,623	2,654
UK Western waters plus Channel	4,373	2,752	1,621

Colour coding is green for UK numbers and totals because UK breeding numbers have been counted several times in recent decades and are considered to be well known and moderately stable, while wintering numbers off UK coasts have also been surveyed and because red-throated divers tend to occur relatively close to shore their numbers are easier to survey at sea than for species dispersed over larger areas. Numbers from overseas populations are less certain (classified amber except for SW North Sea) but since totals at sea are moderately well known and breeding numbers are well known, numbers from overseas can be assessed against those numbers. Numbers from overseas in the SW North

Sea are thought to be rather well known based on surveys of coastal waters in the southern North Sea which indicate large totals in a region where relatively few UK adults overwinter, and so it can be inferred (supported by ring recovery data) that those birds are predominantly from the Fennoscandian population.

Colour coding is amber for migration numbers, as the numbers and distribution during migration are less well known than for mid-winter, and the migration routes used are only broadly known from the relatively limited ring recovery data for this species. However, colour coding is amber rather than red because population sizes and breeding distributions are well known and largely stable, and the available evidence indicates consistent numbers and migrations from year to year with evidence for birds consistently returning to the same sites by the same routes in successive years, but for immature birds to migrate further south than adults.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 1 to 7.

3.1 Breeding range and taxa

This circumpolar species is monotypic, with Scotland at the southern edge of its breeding range. There appears to be little information about use of biometrics to identify origins of individuals.

3.2 Non-breeding component of the population

Red-throated divers start to breed when 3 years old (BTO Birdfacts). Adult survival rate is 0.84 (BTO Birdfacts), juvenile survival estimated at 0.61 (BTO Birdfacts) and mean productivity is 0.635 chicks per pair (JNCC database, n=136 measurements). To obtain a stable population, survival of immatures was adjusted to 0.72 for juveniles, 0.84 for older age classes. The model population comprised 60% adults, 19% juveniles, 11% 1-year olds, and 10% 2-year olds. There are 0.74 immatures per adult.

3.3 Phenology

Red-throated diver breeding season ends by September-October (Forrester et al. 2007), or the end of September (Pennington et al. 2004), but most birds have left their breeding sites by August-September (Forrester et al. 2007) or mid-August (Pennington et al. 2004). Autumn migration starts in August (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007) or mid-August (Cramp et al. 1977-94). Peak autumn migration occurs in September in Shetland (Pennington et al. 2004), September-October in the UK (Wernham et al. 2002; Forrester et al. 2007), September-November in English waters (Brown and Grice 2005), or October-November in Belgium (Vanermen et al. 2013) or throughout Europe (Cramp et al. 1977-94). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in September-December (Figure 3.1). Autumn migration is completed by November (Pennington et al. 2004; Forrester et al. 2007) or mid-December (Cramp et al. 1977-94). Spring migration starts in February (Pennington et al. 2004; Forrester et al. 2007) or early March (Cramp et al. 1977-94) or March (Wernham et al. 2002). Peak spring migration occurs in February-April in Belgium (Vanermen et al. 2013), in late February and early March in English waters (Brown and Grice 2005), in April (Cramp et al. 1977-94), or in April-May (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak rate of change in numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in February-March (Figure 3.1). Spring migration is completed by June (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007) or mid-June (Cramp et al. 1977-94). The first spring records of red-throated diver in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from 1 January and the last records were predominantly at 31 December, as large numbers of red-throated divers overwinter, while

peak autumn migration was reported in September or October in most years, and peak spring migration was reported in March, April or May in most years. Birds reoccupy nest sites from as early as February, but most return to breeding sites in the UK in mid-March (Pennington et al. 2004; Forrester et al. 2007). Orkney and Shetland Bird Reports indicate modal return to nest sites in February (4 cases), and March (5 cases).

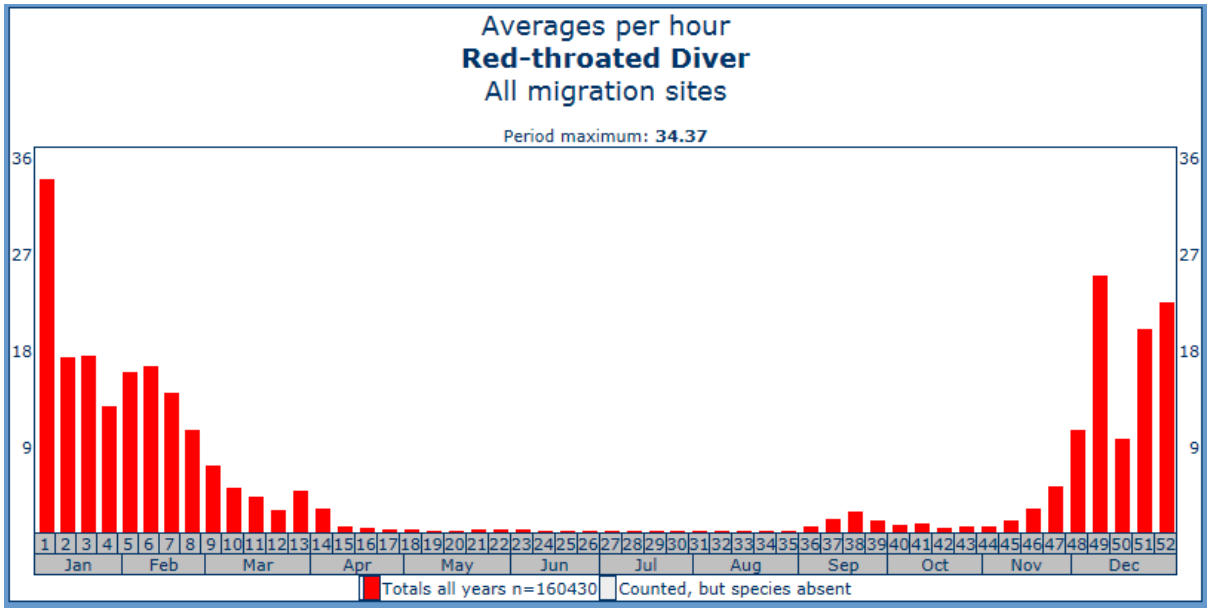


Figure 3.1. Average numbers of red-throated divers counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

3.4 Defined seasons

- UK Breeding season — March-August
  - Migration-free breeding season — May-August
- Non-breeding season
  - **Post-breeding migration in UK waters (migration BDMPS**[1]**)** — **September-November**
  - **Migration-free winter season BDMPS)** — **December-January (winter**
  - **Return migration through UK waters BDMPS**) — **February-April (migration**

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for red-throated diver:

Migration seasons BDMPS (September-November and February-April); and

Winter BDMPS (December-January).

3.5 Movements of birds from the UK population

Red-throated divers breed at freshwater pools close to the coast, but feed in the sea on small fish, and winter inshore on sheltered coasts. The young make their first flight to the sea attended by their parents and then move away from the breeding areas within a few days (Wernham et al. 2002). Scandinavian birds winter in the southern North Sea and southwards

[1] Seasons for which BDMPS have been generated are annotated (BDMPS).

to central France (Eriksson 2000). The Scottish population (of about 1,255 pairs; Gibbons et al. 1997; Dillon et al. 2009) travels shorter distances to winter than more northerly birds (Wernham et al. 2002). Recoveries of birds ringed in Orkney and Shetland show a southerly movement in autumn. Juveniles move furthest, reaching as far south as northwest France (Okill 1994). Adults from Shetland mostly overwinter along Scottish coasts, with some remaining in Shetland (Okill 1994; Wernham et al. 2002). One quarter of one-year olds return to natal areas in their first summer while three quarters remain in wintering areas (Okill 1994). Among two year olds, two-thirds return to natal areas in summer but about one-third remain along northern Scottish coasts, whereas by their third summer all birds return in summer to their breeding area (Wernham et al. 2002).

3.6 Movements of birds from overseas into UK waters

Foreign-ringed birds found in Britain in winter originated from Greenland (3), Finland (4), and Sweden (3) (Wernham et al. 2002). Most were recovered in south-east England (in contrast to most Scottish birds being recovered on Scottish or Irish coasts) (compare Figures 4 and 5 in the chapter on red-throated diver in Wernham et al. 2002). There is no evidence to suggest that red-throated divers from the Russian population (which winters in the Baltic Sea) ever reach the UK (Wernham et al. 2002). No red-throated divers ringed in Iceland (where there are about 1,500 breeding pairs; Hagemeijer and Blair 1997) have been recovered in Britain or Ireland (Wernham et al. 2002), but one Icelandic bird was recovered in the Faroes in its first winter (Hammer et al. 2013). This suggests that Icelandic red-throated divers probably mostly remain in Icelandic waters throughout the year, a suggestion supported by recent geolocator deployments on red-throated divers breeding in Iceland (Ib Krag Petersen pers. comm.). That would make red-throated diver an example of 'leap-frog migration' with birds from the Greenland population migrating past the relatively sedentary populations of Iceland, Faroes and Scotland. Winter populations in Scottish waters seem most likely to be predominantly birds from the Scottish population (and especially adults from that population), with a minority coming from Greenland (where there are about 1,000 pairs; Wetlands International 2006) and Fennoscandia (where there are about 5,500 pairs; Hagemeijer and Blair 1997), and possibly a few from Iceland. Birds wintering in English waters apparently include birds from Scotland (with a high proportion of those being juveniles and immatures rather than adults), Greenland, and Fennoscandia, possibly including small numbers from Iceland. There are only 25 pairs breeding in the Faroes (Hammer et al. 2013) so that population is very small and may well remain in Faroese waters or migrate to Scottish waters, but no birds have been ringed there.

3.7 Numbers in UK waters

O'Brien et al. (2008) estimated that 17,000 red-throated divers overwinter in Great Britain, updating previous estimates from Lack (1986) and Batten et al. (1990) that were underestimates due to lack of knowledge of numbers in the Outer Thames in particular. Of these, just over 10,000 winter between Flamborough Head and Dungeness. In Scottish territorial waters, there were 2,270 in winter, mostly inshore and with larger numbers on the east coast than on the west coast. The UK summer population is estimated to total 4,146 birds (Dillon et al. 2009), and most of these overwinter in British waters (Okill 1994), with adults predominantly in Scottish waters and immatures often further south. This suggests that most of the red-throated divers wintering in Scottish waters are likely to be from the UK population if the estimated numbers present in winter are moderately accurate. In contrast, the much larger numbers overwintering off south-east England could only be explained by presence of large numbers from overseas populations. Given evidence from ring recoveries, these appear to be predominantly birds from Fennoscandia, plus substantial numbers from Greenland. Based on population size it seems likely that no more than about 2,000 of these birds in English waters originate from Scottish breeding areas, whereas about 12,000 are probably from Fennoscandia and Greenland. About 48,000 red-throated divers winter in the area from the Kattegat to the River Elbe, about 43,000 in the Baltic Sea (Danielsen et al.

1993; Brown and Grice 2005). In English waters, wintering red-throated divers are scarce off SW England, uncommon off the south coast, present in large numbers off NW England, but in highest numbers off E England (Brown and Grice 2005).

3.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of Europe, comprising 7,158 pairs, and the biogeographic winter population of Europe as 75,000 individuals (based on data in Rose and Scott 1997), but updated to an estimate of 100,000 to 1,000,000 by Delaney and Scott 2002 (see also Musgrove et al. 2011). Red-throated divers in UK waters originate almost entirely from UK, Fennoscandia or Greenland, so populations outside those areas can be discounted as not occurring in UK waters (e.g. Iceland, Russia), or too small to be relevant (e.g. Faroe), or both. Thus a limited biogeographic population could be defined as birds from UK (1,255 pairs), Greenland (1,000 pairs), and Fennoscandia (5,500 pairs), a total of 7,755 pairs. This is equivalent to a total of 15,500 breeding adults and an associated 11,500 immatures, so a total of 27,000 birds. BirdLife International (2004) suggests a population of 5,000 to 30,000 pairs in Greenland, but this number, which is not supported by any original reference, seems highly unlikely given that previous estimates for Greenland were all around 1,000 pairs.

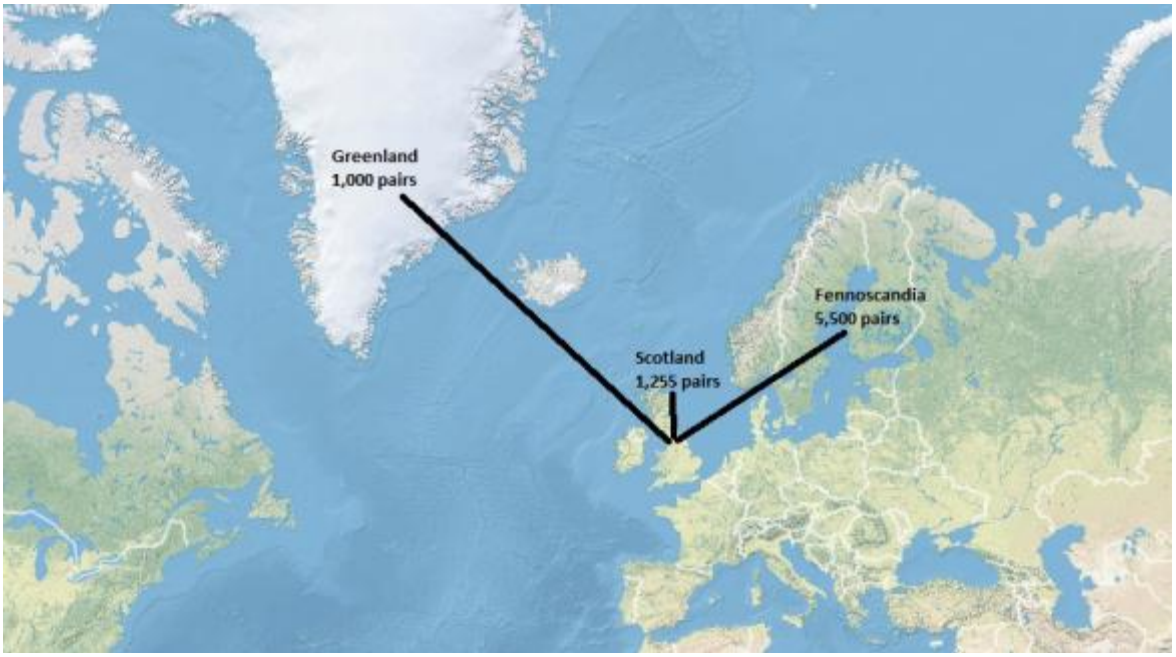


Figure 3.2. Breeding population origins of red-throated divers in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap ©OpenStreetMap contributors.

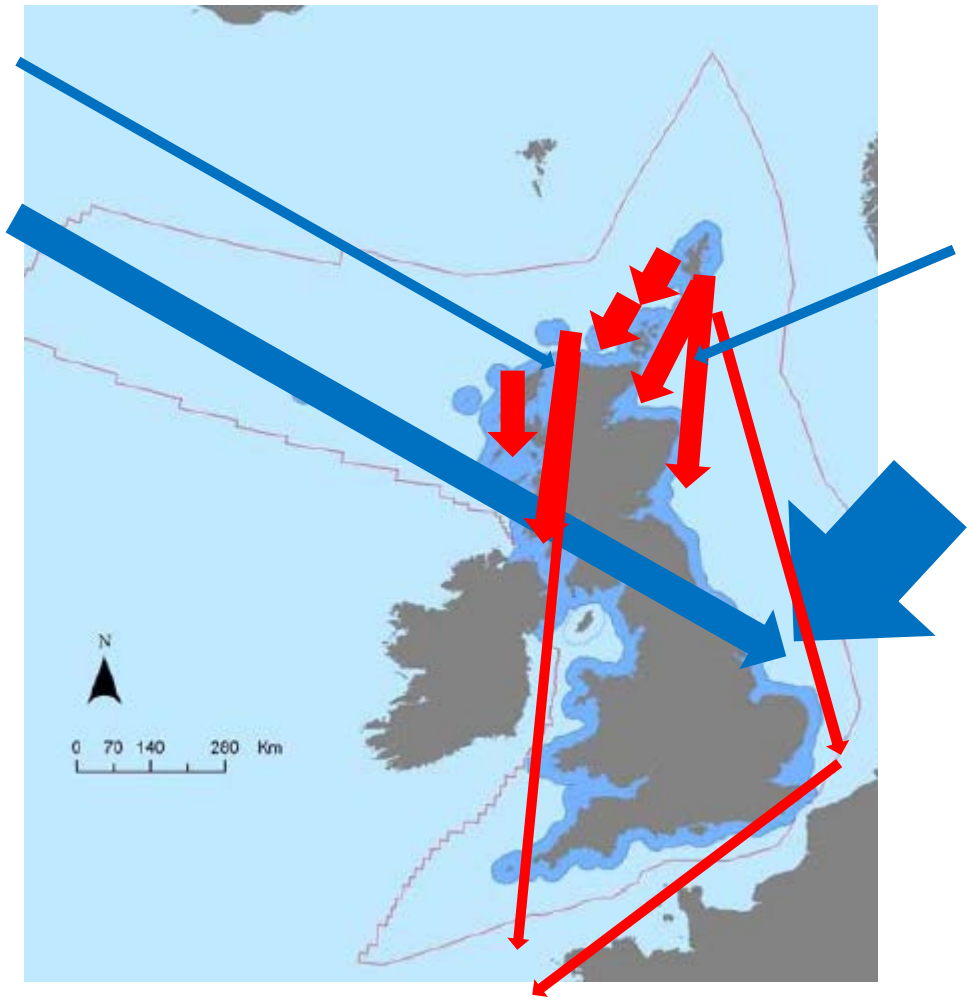


Figure 3.3. Main movements of red-throated divers from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure. Counts of numbers of red-throated divers in winter in different areas around the UK are thought to be moderately accurate (although this represents a change from the past as large numbers have been 'discovered' in recent years in some areas). Those counts, combined with knowledge of movements from ringing studies, give moderate confidence in the fact that relatively few birds from overseas winter in Scottish waters, and that most birds wintering in English waters of the southern North Sea originate from Fennoscandia.

3.9 Proportion of UK population from UK breeding SPAs

The 10 SPAs with breeding red-throated divers as a feature together held 395 pairs at designation, estimated to represent 31% of the UK breeding population of 1,255 pairs (Stroud et al. 2001). Breeding numbers at UK SPAs appear to have generally remained stable (Table 3.1). Breeding numbers in the UK in total also appear to have remained approximately stable over recent decades or increased slightly (Gibbons et al. 1997; Stone et al. 1997; BirdLife International 2004; Baker et al. 2006; Forrester et al. 2007; O'Brien et al. 2008; Musgrove et al. 2013). UK SPAs with red-throated diver as a breeding feature are distributed predominantly in Shetland, Orkney, Caithness, and the western islands of

Scotland (Western Isles and Inner Hebrides) (Figure 3.4). Seven of the SPA populations lie within the NW North Sea region, and three lie in the West of Scotland region (Table 3.1). The SPA populations in the NW North Sea region held a total of 237 pairs in the most recent census at each SPA (Table 3.1). The SPA populations in the West of Scotland region held a total of 108 pairs in the most recent census at each SPA (Table 3.1). It is therefore likely that SPA populations now represent about 27% of the UK Breeding population based on these data. Stroud et al. (2014) estimated that SPA populations represented 30.5% of the GB population in 2006.

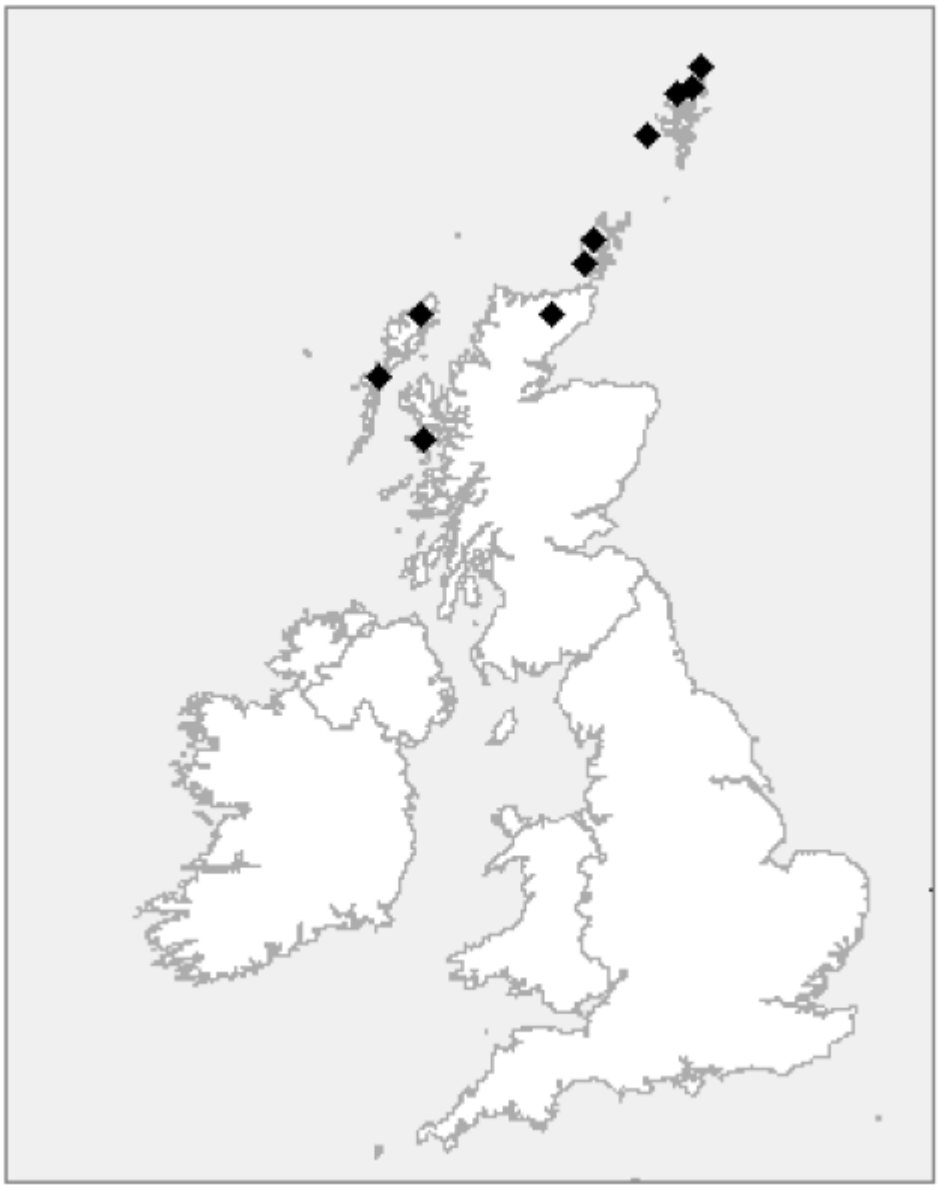


Figure 3.4. Locations of the 10 UK SPAs with red-throated diver as a breeding feature. These SPA populations are listed in Table 3.1. From Stroud et al. 1990.

Table 3.1. The UK SPA suite for breeding red-throated diver.

SPA	Location	Pairs	Year desig-nated	Site condition monitoring*	Latest counts (pairs)	Year	Reference
NW North Sea							
Hermaness, Saxavord & Valla	Shetland NE	28 (1994-1996)	1994	Declined 2013	16	2013	SNH (Bob Bryson in litt.)
Otterswick and Graveland	Shetland NE	27 (1992-1996)	2001	Maintained 2006	>25	2006	SNH (Bob Bryson in litt.)
Ronas Hill North Roe Tingon	Shetland NE	50 (1994)	1997	Maintained 2006	50	2006	SNH (Bob Bryson in litt.)
Foula	Shetland NE	11 (1994)	1995	Maintained 2013	10 12	2012 2013	Gear 2012 Gear 2013
Orkney Mainland Moors	Orkney NE	15 (1994-1996)	2000	Maintained 2007	>28	2007	SNH (Bob Bryson in litt.)
Hoy	Orkney NE	56 (1994)	2000	Maintained 2007	60	2007	SNH (Bob Bryson in litt.)
Caithness & Sutherland Peatlands	N Scotland NE	89 (1993-1994)	1999	Maintained 2006	46	2006	Stroud et al. 2014
West of Scotland							
Lewis Peatlands	Western Isles NW	60 (mid-1990s)	2000	Declined 2004	80	2006	Stroud et al. 2014
Mointeach Scadabhaigh	Western Isles NW	48 (1994)	1999	Maintained 2004	33-35 17	2004 2006	SNH (Bob Bryson in litt.) Stroud et al. 2014
Rum	Inner Hebrides NW	11 (1992-1996)	1982	Maintained 2007	11	2013	SNH (Bob Bryson in litt.)

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

3.10 BDMPS

There are thought to be about 15,300 birds in UK waters in winter, with most birds from the UK population included (about 3,300 birds, allowing for small numbers of immatures wintering further south), and about 12,000 birds from the overseas populations. During migration, there will be marginally larger numbers passing through UK waters as some birds winter further south in Europe; during migration around 17,300 birds, about 4,300 from the UK and about 13,000 from overseas populations.

It makes biological sense to consider Scottish North Sea waters separately from English North Sea waters, since it seems that most birds wintering in Scottish North Sea waters are from the UK population, whereas most birds wintering in English North Sea waters are from Fennoscandia. It also makes sense to separate the populations to the west and east of mainland UK. Most red-throated divers from SPA populations in the Western Isles and Inner Hebrides winter to the west of the UK mainland, whereas probably most of those from SPA populations in the NW North Sea winter in the North Sea. Red-throated divers wintering off NW England may be a mixture of birds from UK populations and from Greenland. Only small numbers winter in the English Channel and SW England, but probably include a mixture of

mainly immatures from the UK population and birds from Greenland and Fennoscandia. Therefore, proposed BDMPS regions are as shown in Figure 3.5.

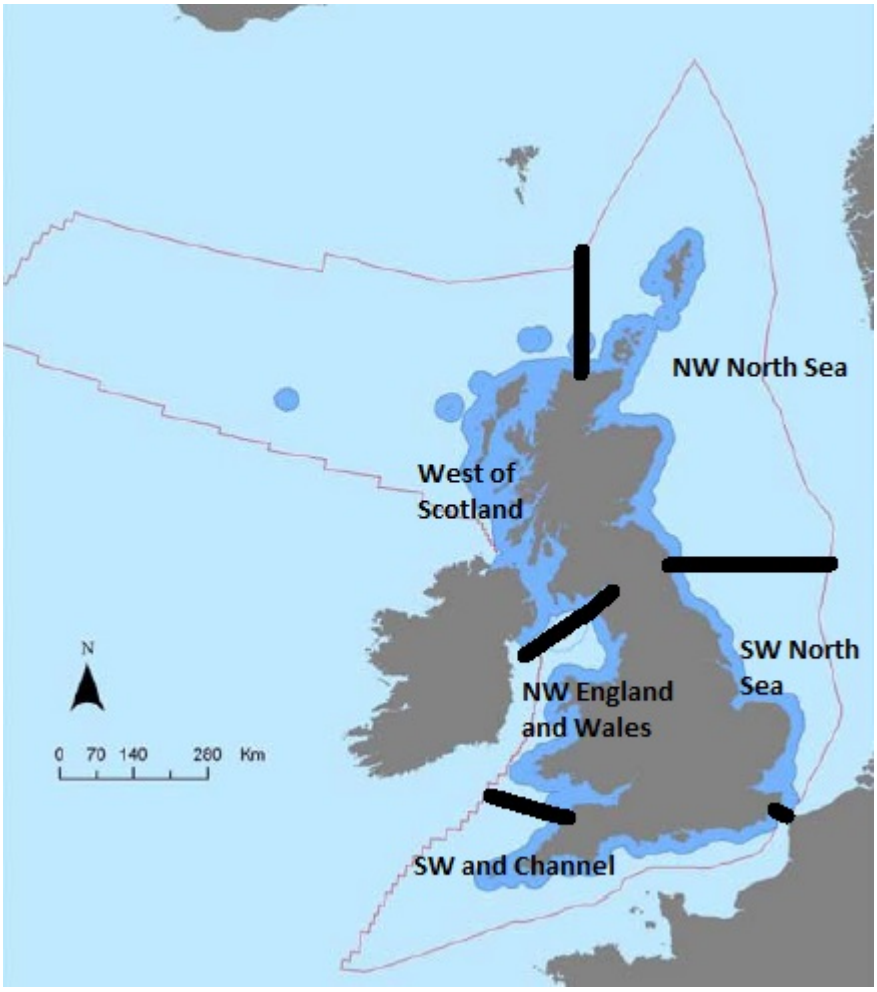


Figure 3.5. Five defined BDMPS spatial areas for red-throated divers in UK waters in winter. Limits of UK waters are shown by red line. BDMPS spatial areas extend from the UK coast to the red limit, bounded by the thick black lines marking the sides of each BDMPS area. The five BDMPS are 'NW North Sea', 'SW North Sea', West of Scotland', NW England & Wales' and 'SW and Channel'. For migration seasons there are two BDMPS, 'North Sea' (NW and SW North Sea combined) and 'Western waters plus Channel' (West of Scotland, NW England & Wales, and SW & Channel areas combined).

It is estimated that about 50% of adults from breeding areas in the northern isles and North Sea coast of Scotland winter in the NW North Sea whereas only a very few (perhaps 5%) of those from western UK breeding areas winter in the NW North Sea (based on literature reviewed in section 3.5). Very few birds from Greenland or Fennoscandia have been recovered in the NW North Sea (section 3.6) but it seems likely that some birds from Greenland will stop in the NW North Sea rather than continuing to the SW North Sea so the proportions wintering in this area are estimated at 5% and 1% respectively. There is apparently very little movement of adults from western breeding areas to winter in the NW North Sea (section 3.5), so this proportion is estimated at 5%. The same percentages are applied for immature birds from western UK, Greenland and Fennoscandia as for adults. There is evidence for birds from the northern isles that many immatures winter further south so the proportion of those in the NW North Sea in winter is estimated at 20% with most moving further south. These combinations of proportions result in an estimated winter BDMPS in NW North Sea of 1,523 birds, a number that is consistent with the counts of red-

throated divers wintering in NW North Sea (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Table 1.

It is estimated that about 20% of adults from breeding areas in the northern isles and North Sea coast of Scotland winter in the SW North Sea whereas only a very few (perhaps 5%) of those from western UK breeding areas winter in the SW North Sea (based on literature reviewed in section 3.5). Ringed birds from Greenland and Fennoscandia have been recovered in the SW North Sea (section 3.6) and the numbers in that area in winter require a substantial movement of birds from those populations to winter there. Based on the observation that divers are likely to avoid migrating overland, it seems likely that birds from Greenland make up a higher proportion of the overseas birds wintering in UK western waters and that most overseas birds in North Sea waters originate from Fennoscandia rather than Greenland, so the proportions wintering in this area are estimated at 2% and 40% respectively. Similarly, there is apparently very little movement of adults from western breeding areas to winter in the SW North Sea (section 3.5), so this proportion is estimated at 5%. The same percentages are applied for immature birds from western UK. For Fennoscandia it is estimated that 60% of immatures winter in the SW North Sea because it is generally the case that immature red-throated divers winter further south than adults. For Greenland it is estimated that 5% of immatures winter in the SW North Sea because it is generally the case that immature red-throated divers winter further south than adults. There is evidence for birds from the northern isles that many immatures w*i*nter further south so the proportion of those in the SW North Sea in winter is estimated at 30% for immatures compared to 20% for adults. These combinations of proportions result in an estimated winter BDMPS in SW North Sea of 10,177 birds, a number that is consistent with the counts of red-throated divers wintering in SW North Sea (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Table 2.

It is estimated that about 5% of adults from breeding areas in the northern isles and North Sea coast of Scotland winter in West of Scotland waters whereas 40% of adults from western UK breeding areas winter in West of Scotland waters (based on literature reviewed in section 3.5). There is evidence for birds from the northern isles that many immatures w*i*nter further from the breeding area so the proportion of those in West of Scotland waters in winter is estimated at 20% for immatures compared to 40% for adults for birds from western populations. Immatures from North Sea UK populations are likely to be more represented in west of Scotland waters than adults, so the proportion is estimated at 10% for immatures compared to 5% for adults. Based on the observation that divers are likely to avoid migrating overland, it seems likely that birds from Greenland make up a small proportion of the overseas birds wintering in UK western waters, so the proportions wintering in this area are estimated at 2% and 5% respectively for adults and immatures. There is no evidence from ringing that birds from Fennoscandia winter west of Scotland, so proportions from that population are set at zero for adults but 1% for immatures. That is also consistent with total numbers wintering west of Scotland being relatively small, and can be accounted for by the proportions estimated above. These combinations of proportions result in an estimated winter BDMPS for the West of Scotland area of 861 birds, a number that is consistent with the counts of red-throated divers wintering in the West of Scotland area (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Table 3.

It is estimated that about 2% of adults from breeding areas in the northern isles and North Sea coast of Scotland winter in NW England and Wales waters whereas 20% of adults and immatures from western UK breeding areas winter in NW England and Wales waters (based on literature reviewed in section 3.5). Immatures from North Sea UK populations are likely to be more represented in NW England and Wales waters than adults, so the proportion is estimated at 5% for immatures compared to 2% for adults. Based on the observation that divers are likely to avoid migrating overland, it seems likely that birds from Greenland make up a small proportion of the overseas birds wintering in NW England and Wales waters, so

the proportions wintering in this area are estimated at 10% and 30% respectively for adults and immatures. Probably few birds from Fennoscandia winter in NW England and Wales (but there is one ring recovery), so proportions from that population are set at 2% for adults but 5% for immatures. These combinations of proportions result in an estimated winter BDMPS for the NW England and Wales area of 1,657 birds, a number that is consistent with the counts of red-throated divers wintering in the NW England and Wales area (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Table 4.

It is estimated that about 2% of adults and 5% of immatures from breeding areas in the northern isles and North Sea coast of Scotland winter in SW England and Channel waters whereas 10% of adults and 20% of immatures from western UK breeding areas winter in SW England and Channel waters (based on literature reviewed in section 3.5). Immatures from North Sea UK populations are likely to be more represented in SW England and Channel waters than adults, so the proportion is estimated at 5% for immatures compared to 2% for adults. Based on the observation that divers are likely to avoid migrating overland, it seems likely that birds from Greenland make up a proportion of the overseas birds wintering in SW England and Channel waters, so the proportions wintering in this area are estimated at 10% and 20% respectively for adults and immatures. Probably few birds from Fennoscandia winter in SW England and Channel waters (but there is one ring recovery in the area), so proportions from that population are set at 1% for adults but 3% for immatures. These combinations of proportions result in an estimated winter BDMPS for the SW England and Channel waters of 1,153 birds, a number that is consistent with the counts of red-throated divers wintering in SW England and Channel waters (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Table 5.

Ringing data indicate that most red-throated divers from the northern isles move southwards in autumn through the North Sea and that birds from western UK populations mostly move south through western waters (Section 3.5) but there is some evidence from ringing of small numbers moving between western waters and North Sea and vice versa. In computing BDMPS for these two areas for the migration seasons it is therefore estimated that 95% of adults and 80% of immatures from UK North Sea populations are in UK North Sea waters (NW plus SW North Sea areas) during migration seasons (September-November and February-April), while possibly 5% of western UK red-throated divers (adults and immatures) also pass through North Sea waters on migration. Similarly it is estimated that 95% of adults and 80% of immatures from western populations migrate through western waters (West of Scotland to Channel) while 5% of North Sea adults and 20% of North Sea immatures (birds from the northern isles) migrate through western waters. Large numbers from Fennoscandia migrate through the North Sea but ring recoveries indicate that few reach western waters, so proportions estimated for this population are 45% of adults and 65% of immatures migrating through UK North Sea waters, with 5% and 10% respectively in western waters. Conversely it seems likely that birds from Greenland migrate more through western waters than through the North Sea, so proportions were estimated at 8% of adults and 15% of immatures migrating through UK North Sea waters and 25% of adults and 60% of immatures through western waters. These percentages result in estimated numbers in the migration season BDMPS that are consistent with diver count data and estimates in the literature (Section 3.7). Details of apportioning and estimated numbers are in Appendix A Tables 6 and 7.

3.11 Proportion of UK SPA birds in each BDMPS

Proportions of each BDMPS that are adults from UK SPA breeding populations can be calculated directly from Appendix A Tables 1 to 7. For example, in the UK NW North Sea area in winter (Appendix A Table 1) there are 248 adults from SPA populations in the winter BDMPS of 1,523 birds, so approximately 16% of birds in that BDMPS are adults from SPA populations. In contrast, for the UK SW North Sea area in winter (Appendix A Table 2) there are 105.6 adults from SPA populations in the winter BDMPS of 10,177 birds, so

approximately 1% of birds in that BDMPS are adults from SPA breeding populations (SPA populations for wintering birds are not considered in this calculation).

3.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Red-throated divers migrate primarily through coastal waters, and winter in shallow coastal waters. Their distribution across the regions will therefore be far from uniform, with almost all birds close to the coast and predominantly in more sheltered areas. Birds from SPA populations may tend to winter relatively close to their SPA breeding sites, but this is uncertain. Given that the spatial distribution of SPAs is similar to the spatial distribution of the broader breeding population of the species in Scotland, it is likely that the proportion of birds from SPAs will be fairly consistent throughout Scottish waters. In England, it is likely that a high proportion of the birds from Scottish SPAs will be immatures rather than breeding adults, since the immatures winter further south than adults. However, most birds in southern North Sea waters are likely to be from Fennoscandia rather than the UK population, and birds from UK SPA populations are likely to be fairly randomly distributed amongst these.

4. GREAT NORTHERN DIVER *Gavia immer*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (September to May) (adults and immatures)
Overseas	430,000	4,000
UK	0	0
Total	430,000	4,000

Non-breeding season BDMPS (September to May)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK breeding population (adults plus immatures)
West of Scotland	2,000	2,000	0
NW North Sea	1,000	1,000	0
SW North Sea & Channel	200	200	0
NW England & Wales	300	300	0
SW England	500	500	0

Breeding numbers in overseas populations are not well known so are coded red. Colour coding is green for numbers from UK breeding population because great northern divers do not normally breed in Britain. Colour coding is amber for numbers of birds from overseas and in total because the species is not easy to count at sea, but there have been dedicated surveys of wintering divers in UK waters that appear to provide moderately accurate numbers in each region. Great northern divers are apparently highly faithful to the same wintering site in successive years and numbers appear to be fairly stable across years. There is, however, a possibility that wintering numbers are higher than counts indicate (for example numbers oiled in Shetland in one oil spill exceeded the numbers thought at the time to be present). There is also some uncertainty about numbers migrating through UK waters, although those numbers are likely to be similar to the wintering numbers as relatively few great northern divers winter further south in Europe than UK waters. Migration routes are also uncertain, but it seems likely that birds arrive directly at, and depart directly from, winter areas rather than necessarily moving northwards through UK waters, since their breeding sites lie far to the west or north-west and migrations must involve long trans-Atlantic flights. Origins of birds from overseas in UK waters have been quite well established from biometric analysis. Because there is no clear evidence for numbers migrating through UK waters being significantly different from numbers wintering in UK waters, a single BDMPS has been defined for the non-breeding period (September to May). If knowledge of migrating numbers improves in future there might be merit in separating this into seasonal BDMPS for migration seasons and for winter.

4.1 Breeding range and taxa

Great northern diver is a monotypic species with a predominantly Nearctic breeding range, from Alaska to Greenland and Iceland, where it nests at large freshwater lakes. Although monotypic, there is variation among populations in biometrics which can be used to identify origins of individuals (Weir et al. 1996).

4.2 Non-breeding component of the population

Great northern divers start to breed when 6 years old (BTO Birdfacts). Adult survival rate is unknown (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is unknown. Assuming an adult survival rate of 0.9 (typical of birds recruiting when 6 years old) and productivity of 0.635 chicks per pair (as in red-throated diver), to obtain a stable population, survival of immatures was adjusted to 0.7 for juveniles, 0.8 for 1 and 2 year olds, 0.88 for 3 year olds and 0.9 for older age classes. The model population comprised 48% adults, 15% juveniles and 37% older immatures. There are 1.1 immatures per adult.

4.3 Phenology

Autumn migration starts in August (Wernham et al. 2002), late-August (Cramp et al. 1977-94), September (Forrester et al. 2007) or late September (Pennington et al. 2004). Peak autumn migration occurs in late October in Shetland (Pennington et al. 2004) and in English waters (Brown and Grice 2005), October-November in the UK (Wernham et al. 2002; Forrester et al. 2007), or throughout Europe (Cramp et al. 1977-94). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in September-November (Figure 4.1). Autumn migration is completed by December (Pennington et al. 2004; Forrester et al. 2007) or late December (Cramp et al. 1977-94).

Spring migration starts in early March (Cramp et al. 1977-94), March (Pennington et al. 2004; Forrester et al. 2007) or late April (Wernham et al. 2002). Peak spring migration occurs in early April from English waters (Brown and Grice 2005), in April (Cramp et al. 1977-94), in April-May (Forrester et al. 2007), or May (Wernham et al. 2002; Pennington et al. 2007). Peak rate of change in numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in February-March but with a smaller but distinct peak in May (Figure 4.1). Spring migration is completed by early June (Cramp et al. 1977-94), or June (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007).

The first spring records of red-throated diver in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from 1 January and the last records were predominantly at 31 December, as large numbers of great northern divers overwinter, while peak autumn migration was reported in October in most years, and peak spring migration was reported in April-May or May in most years.

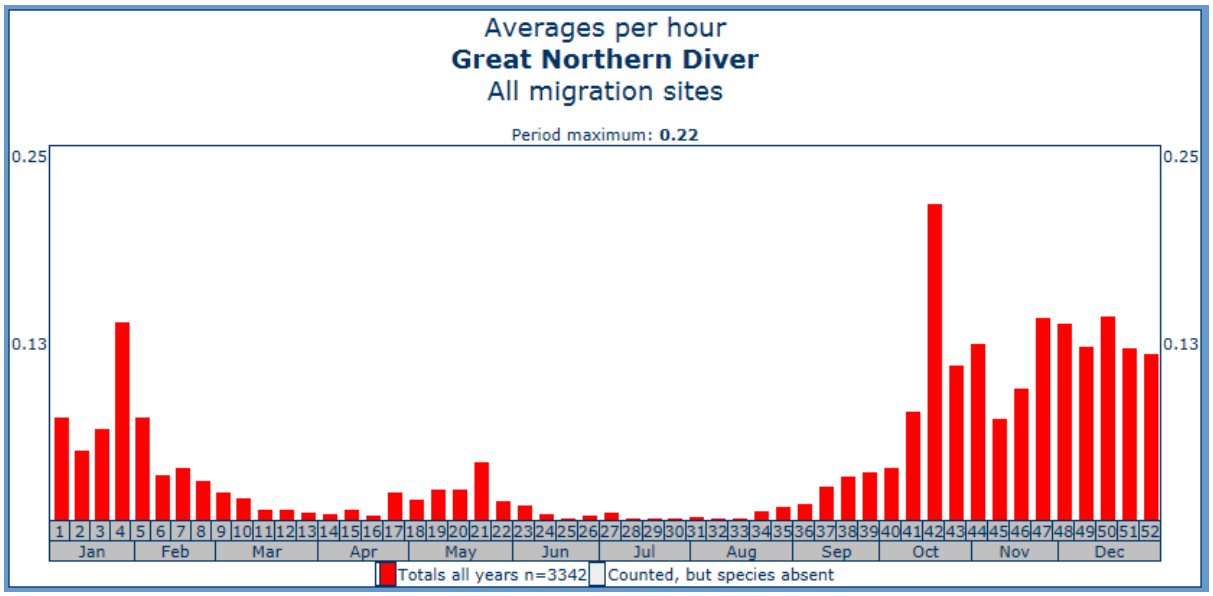


Figure 4.1. Average numbers of great northern divers counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

4.4 Defined seasons:

- UK Breeding season — not applicable
- Post-breeding migration in UK waters — September-November
- **non-breeding season** — **September-May** (**BDMPS**)
- Return migration through UK waters — March-May
- Migration-free breeding season — not applicable
- Migration-free winter season — December-February

Apart from the breeding season, one seasonal BDMPS period was considered to be appropriate for great northern diver:

Non-breeding season (September-May).

4.5 Movements of birds from the UK population

With the very rare exception of the odd pair, or individual, in occasional years, the species does not breed in the UK.

4.6 Movements of birds from overseas into UK waters

Relevant breeding populations are 300-500 pairs in Iceland, 400-1,800 pairs in Greenland, and around 100,000 pairs in Canada (Wernham et al. 2002; Wetlands International 2006). Birds mostly leave breeding areas in September-October, but some arrive in NW Scotland in August. Spring migration occurs in April-May, but substantial numbers of immature birds remain in British waters through the summer. Measurement of great northern diver study skins in the National Museums of Scotland suggested, on the basis of biometric differences between populations, that 45% of those wintering in Scotland were from the Icelandic population, 45% from Greenland and Baffin Island, and only 10% from mainland Canada (Weir et al. 1996). Camphuysen et al. (2010) looked at a sample killed by the Prestige oil spill in Galicia, and concluded that most birds wintering off Spain appear to be juveniles, but that biometrics suggest those birds also come from Iceland and Greenland rather than mainland Canada. Most Canadian birds therefore appear to overwinter in North America rather than migrating to Europe.

4.7 Numbers in UK waters

While many great northern divers winter inshore off coasts of North America, about 6,000 winter inshore from northern Norway to northern Spain (Pennington et al. 2004), of which about 3,500-4,500 individuals winter off Britain and Ireland (Wernham et al. 2002). Wintering birds in British waters are mostly found in shallow sea off the west and north coasts of Scotland and adults seem to predominate in those areas (Weir et al. 1996). Numbers wintering in English waters are unlikely to exceed 1,000 birds, most of which winter off SW England (Brown and Grice 2005). Given the predominance of adults in Scottish waters it is likely that most birds wintering in English waters are immatures (since numbers of immatures are similar to numbers of adults, and in almost all seabirds the immatures winter further from the source population than do the adults).

4.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of Iceland and Greenland, comprising 700-2,300 pairs (BirdLife International 2004 suggests 500 to 2,000 pairs in Greenland but provides no reference to support this), and the biogeographic winter population of Europe as 5,000 individuals (based on data in Rose and Scott 1997). A population of 700-2,300 pairs will have an associated component of immature birds numbering about 1,400 to 4,600 individuals. So the total population size can be estimated at 1,400 to 4,600 birds (Iceland plus Greenland). Since the UK also receives birds from eastern Canada that overwinter in UK waters, it could be appropriate to include that population in the biogeographic population with connectivity to UK waters (and that has been done in this report). However, the Canadian population is very large (perhaps 100,000 pairs) and only a very small proportion of birds wintering in the UK originate from that population (about 10% of birds wintering in UK waters), so it may be appropriate (and precautionary) to omit that population from consideration. The numbers wintering in UK waters (about 3,500 to 4,500 birds) appear to represent the vast majority of the populations from Iceland and Greenland, based on this comparison of breeding numbers, population demography, and wintering numbers.

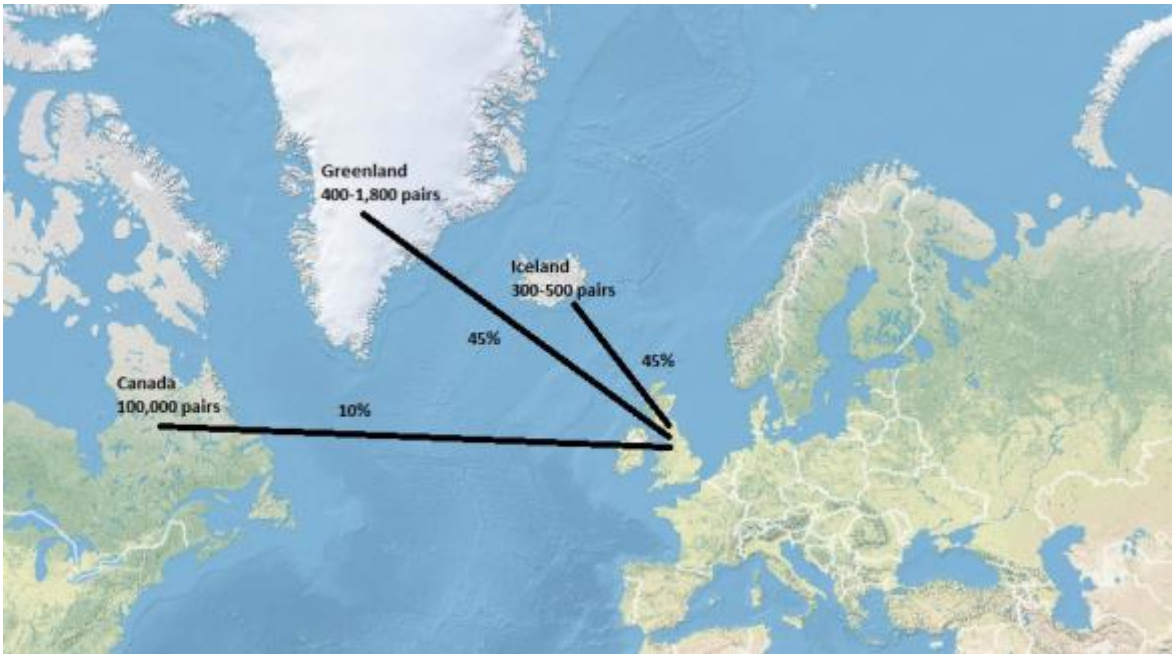


Figure 4.2. Breeding population origins of great northern divers in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given, as are the proportions from each source population represented in non-breeding populations in UK waters. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors

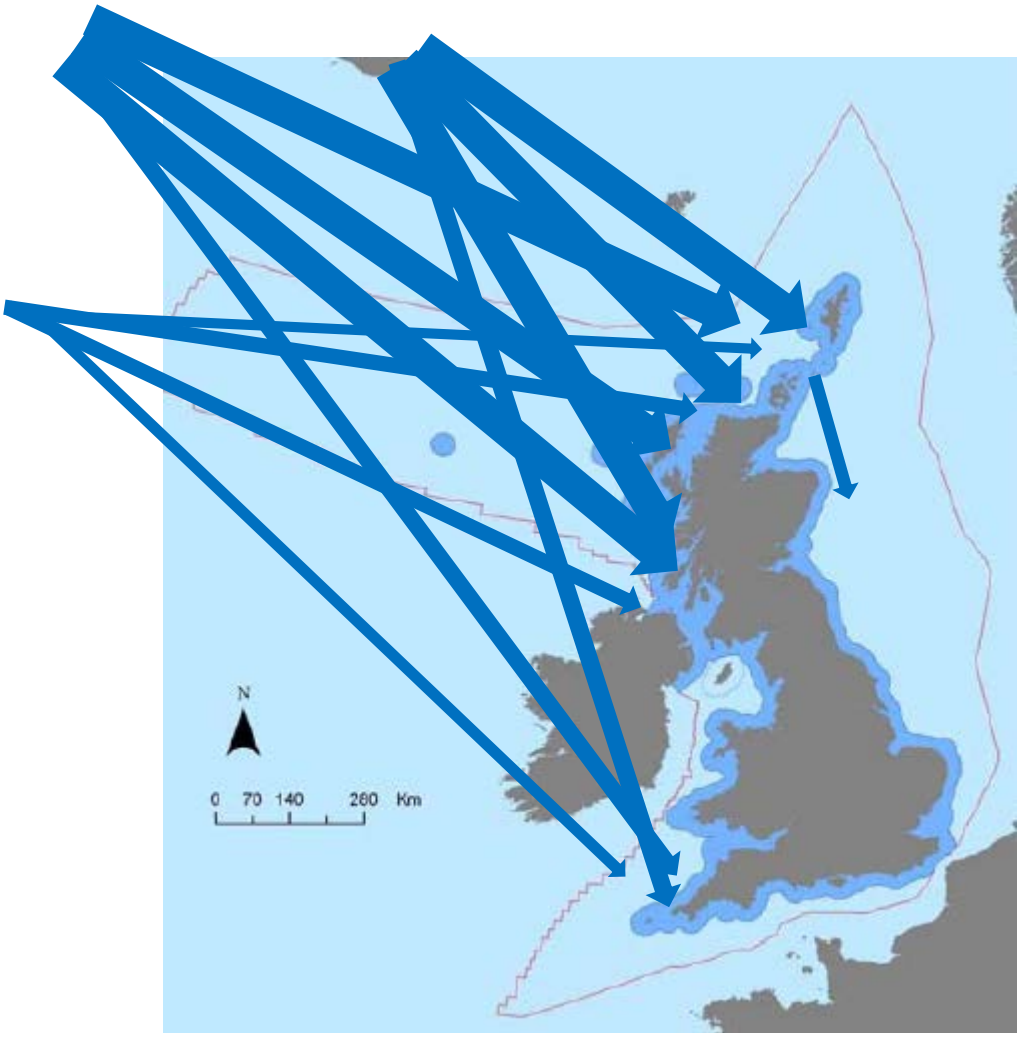


Figure 4.3. Main movements of great northern divers from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure. Museum based studies of biometrics of great northern divers collected from sites in UK waters suggest that the proportions of birds from Iceland (45%), Greenland (45%) and eastern Canada (10%) are consistent across regions, and therefore that there is little or no difference in the use of UK regions between these source populations. The proportions of the source populations wintering in UK waters probably do vary considerably, since the Canadian population is much the largest but represents only 10% of birds wintering in the UK. Wintering numbers are highest in the north and west of the UK.

4.9 Proportion of UK population from UK breeding SPAs

There are no breeding great northern divers in the UK in most years, and no SPAs in the UK include breeding great northern diver as a feature.

4.10 BDMPS

Since great northern divers from all three source populations appear to be similarly represented in different regions, the entire UK waters could be treated as a single BDMPS for this species. However, numbers wintering in different regions are moderately well known,

and are much higher in West of Scotland than elsewhere. Numbers are higher in the NW North Sea than in English waters, where the main concentration of the species is found in SW England. Division into the 5 regions shown in Figure 4.4 may therefore be useful.

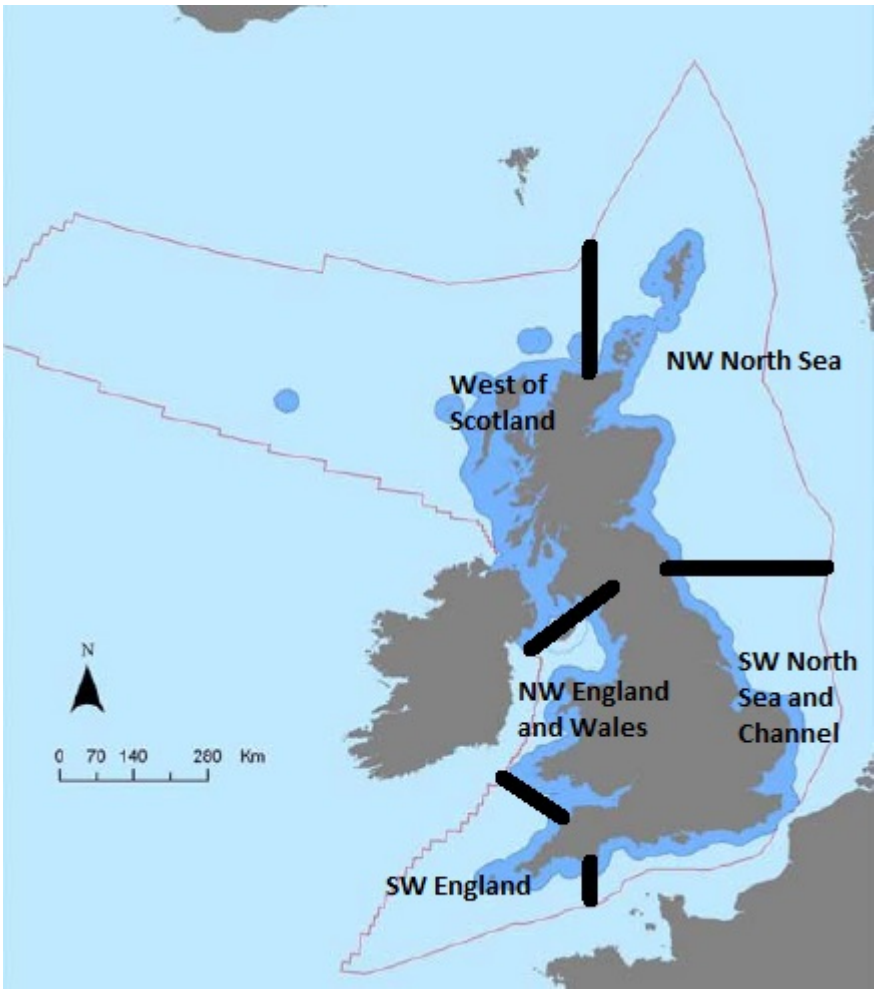


Figure 4.4. Five defined BDMPS spatial areas for great northern divers in UK waters; 'NW North Sea', SW North Sea & Channel', West of Scotland', NW England & Wales', and 'SW England'.

It appears that the proportions from each source population are similar in all the defined regions: 45% from Iceland, 45% from Greenland, and 10% from eastern Canada. About 3,000 of these birds winter in Scottish and Northern Irish waters, with perhaps 2,000 in the West of Scotland region and 1,000 in the NW North Sea region. About 1,000 birds winter in English and Welsh waters, with perhaps 500 of those in the SW England region, 300 in NW England and Wales and 200 in SW North Sea and Channel. Confidence in these numbers is moderate. None of these birds originate from UK breeding SPA populations.

5. NORTHERN FULMAR *Fulmarus glacialis*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in winter (November) (adults and immatures)	Numbers in UK waters in migration seasons (September-October and December-March) (adults and immatures)
Overseas	6,435,000	192,826	385,652
UK	1,620,000	932,277	1,400,044
Total	8,055,000	1,125,103	1,785,696

	Total number of birds in BDMPS (adults and immatures)	Number from overseas populations (adults and immatures)	Number from UK population (adults and immatures)
'Winter' BDMPS (November)			
UK North Sea waters	568,736	96,413	472,323
UK Western waters plus Channel	556,367	96,413	459,954
'Migration seasons' BDMPS (September & October, December to March)			
UK North Sea waters	957,502	192,826	764,676
UK Western waters plus Channel	828,194	192,826	635,368

Colour coding for numbers from overseas populations is red since these overseas populations are very large and while only a very small proportion of those birds pass through or winter in UK waters, this makes estimating numbers very difficult. Although there are ring recovery data, fulmar recoveries provide only a very weak picture of migrations and winter distribution (as with other highly pelagic species), and there are very few tracking studies of this species up until now. Colour coding for UK numbers is amber as these are moderately well documented from breeding colony surveys, but some counts are relatively old (from 1999-2002) and there is evidence for declines in numbers at some colonies though this appears patchy and may partly reflect changes in breeding effort rather than population size.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 8 to 11.

5.1 Breeding range and taxa

The fulmar has a circumpolar breeding range, with two subspecies; *rodgersii* which is found in the northern North Pacific, and nominate *glacialis* which is found in the northern North Atlantic. In the North Atlantic, there are two colour phases of plumage. Birds at colonies at low latitude are all pale phase birds, whereas in the high Arctic most birds are dark phase 'blue' fulmars. Biometrics do not seem to be useful in identifying origins of individuals.

5.2 Non-breeding component of the population

Fulmars start to breed when 9 years old (BTO Birdfacts). Adult survival rate is 0.972 (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is 0.424 chicks per pair (JNCC database, n=455 measurements). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.6 for 1-year olds, 0.8 for 2-year olds, 0.9 for 3-6 year olds, 0.92 for 7-year olds and 0.95 for 8-year olds. The model population comprised 62% adults, 13% juveniles and 25% older immatures. There are 0.62 immatures per adult.

5.3 Phenology

The end of the breeding season is described as late August (Forrester et al. 2007) or early September (Pennington et al. 2004). Modal departure from colonies is in August (Pennington et al. 2004; Forrester et al. 2007). However, autumn migration starts in July (Cramp et al. 1977-94), August (Wernham et al. 2002; Forrester et al. 2007) or early September (Pennington et al. 2004). Peak autumn migration occurs in September-October (Cramp et al. 1977-94; Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in September-October but was not clearly pronounced (Figure 5.1). Autumn migration is completed by November (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007) or November-December (Cramp et al. 1977-94).

Spring migration starts in November (Forrester et al. 2007), January (Cramp et al. 1977-94; Pennington et al. 2004) or February (Wernham et al. 2002). Peak spring migration occurs in January-March (Forrester et al. 2007), January-April (Pennington et al. 2004), February-March (Cramp et al. 1977-94), or in March-April (Wernham et al. 2002). Peak rate of change in numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late January-March (Figure 5.1). Spring migration is completed by April (Cramp et al. 1977-94; Forrester et al. 2007) or May (Wernham et al. 2002; Pennington et al. 2004).

Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 reported fulmars present from 1 January to 31 December, but peak autumn migration was reported in September in most years, and peak spring migration was reported in January in most years. The breeding season (birds returning to nest sites) starts from October, but modal return is in November-January (Pennington et al. 2004; Forrester et al. 2007).

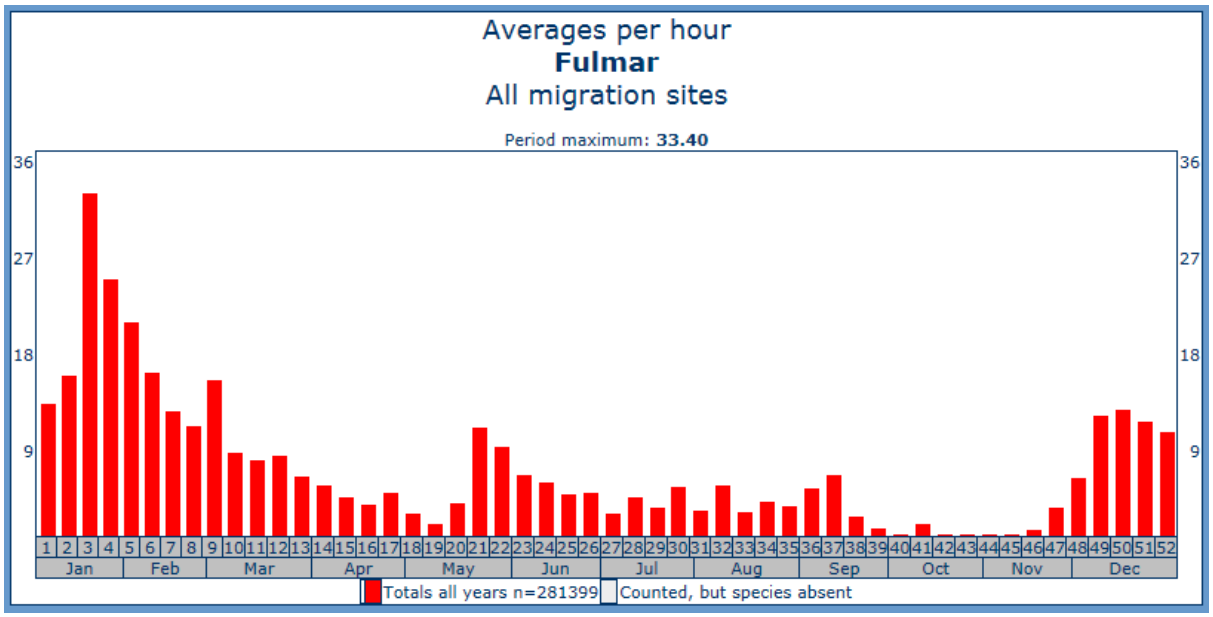


Figure 5.1. Average numbers of fulmars counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as March-July, non-breeding season August-February. However, from the data reviewed above, a more appropriate definition would be breeding season January-August, non-breeding season September-December.

5.4 Defined seasons:

- UK Breeding season — January-August
- Post-breeding migration in UK waters — September-October (**migration BDMPS**)
- non-breeding season — September-December
- Return migration through UK waters — December-March (**migration BDMPS**)
- Migration-free breeding season — April-August
- Migration-free winter season — November (**winter BDMPS**)

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for northern fulmar:

Migration seasons BDMPS (September-October and December-March); and

Winter BDMPS (November).

5.5 Movements of birds from the UK population

After fledging, young fulmars from colonies in the British Isles spend about four years at sea, during which time they disperse widely over the eastern and western North Atlantic, Norwegian and Barents Seas and the Arctic (Macdonald 1977; Wernham et al. 2002). As older immatures, they tend to return to their natal area in summer but for shorter periods than the breeding birds (Forrester et al. 2007). When chicks fledge in August-September, breeders disperse away from the colony and complete moult at sea before returning to re-occupy nest sites only about two to six months later. Breeders attend nest sites from early winter through to chick fledging in August-September. However, fulmars can travel hundreds of kilometres during foraging trips while breeding, and nest site attendance in winter is sporadic so even longer trips may occur at that time of year. Nest attendance in winter

seems to be mainly by males (Wernham et al. 2002) and so females may range over larger areas in winter than males. 'Spring' (i.e. pre-breeding) migration back to colonies must occur in October-February. Many (apparently between 100 and 200) fulmars ringed as chicks at colonies in Britain have been recovered in the Faroes (Hammer et al. 2013). Most (over 80%) of those were deliberately harvested for food, and predominantly caught as immatures. However, recoveries of fulmars ringed at British colonies provides a very incomplete picture of migrations and wintering areas as the chances of ringed birds being recovered are extremely low in many areas such as the mid-Atlantic or high Arctic.

5.6 Movements of birds from overseas into UK waters

Up to publication of the Migration Atlas, 22 foreign-ringed fulmars had been recovered in the British Isles. Seven of these had been ringed at sea so were of uncertain population of origin. The others came from the Faroes, Iceland, Denmark, and Norway (Wernham et al., 2002). Given the very uneven distribution of ringing effort among fulmar populations, these data provide only a very crude indication of the origins of fulmars that are present in British waters (Wernham et al. 2002), but suggest that most may come from Faroes, Iceland, and Norway. Fulmars from high Arctic populations are predominantly of the dark colour morph 'blue fulmars'. These birds are occasionally seen in British waters, especially in winter, but represent a very small proportion of the fulmars present, suggesting that numbers of fulmars from high Arctic populations reaching British waters are negligible and that the vast majority of birds seen in British waters are either from British colonies, or from populations in Faroe, Iceland or Norway. There are around 500,000 pairs in the UK, 600,000 in Faroe, 1.5 million pairs in Iceland (though numbers breeding there declined by 30% from 1983-86 to 2005-08; Gardarsson 2006, Gardarsson et al. 2011), and 386,000 pairs in Norway. All of these populations will have large numbers of immature birds associated with them. The tendency for breeding age birds to attend colonies from October-November through to August-September suggests that most fulmars in British waters are likely to be from UK colonies, but the high numbers in populations in Faroe, Iceland and Norway, together with the relatively mobile nature of immature fulmars, suggests that an unknown but potentially moderately high proportion of birds in British waters could originate from those populations, especially in early winter.

5.7 Numbers in UK waters

ESAS data suggest that there are about 2 to 50 birds per km^2 in Scottish territorial waters in winter (Forrester et al. 2007). From surveys in 2007 and 2008, Fauchald and Tveraa (2009) reported mean densities at sea of 80-400 birds per km^2 in the Norwegian Sea in spring/summer, and 25-300 birds per km^2 in the Barents Sea in autumn, suggesting much higher densities than found around the UK. Only low densities occur in English waters (Stone et al. 1995; Brown and Grice 2005). However, Forrester et al. (2007) suggest that about 1,000,000 fulmars are in Scottish waters during winter (defined in that work as December-February so note that much of that period would involve breeding birds already being back at nest sites). During migration periods, densities of fulmars are higher than in winter, and suggest that closer to 2,000,000 birds are present at sea in UK waters during peak migration seasons, a number that is still only slightly greater than the total population of the UK (including immatures) so does not indicate that there are necessarily large numbers of birds from overseas populations passing through UK waters even during the migration period.

5.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *glacialis* which breeds around the North Atlantic, comprising 7,540,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 2,700,000-4,000,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 10,000,000 individuals. Based on ringing data, it appears that some birds from Iceland, Faroe and

Norway visit UK waters. Therefore, a biogeographic population with connectivity to UK waters is the sum of numbers in UK, Iceland, Faroe and Norway (2,486,000 pairs). When accounting for immature birds, this represents a total of almost 5,000,000 adults and about 3,000,000 immatures; i.e. a total of about 8,000,000 birds.



Figure 5.2. Breeding population origins of fulmars in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

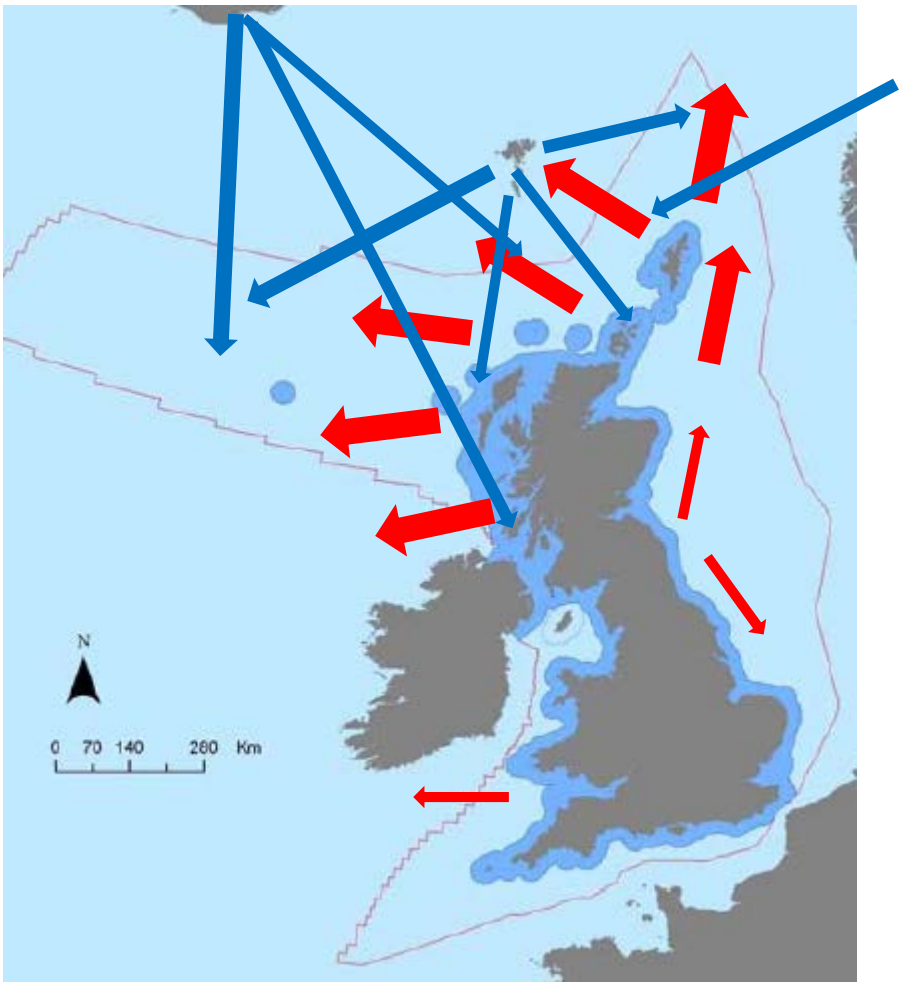


Figure 5.3. Main movements of fulmars from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure. There is only low to moderate confidence in these data, since none of these populations have been studied by tracking (apart from a very small number of birds in Orkney for which no data are yet in the public domain), and fulmar movements are not easy to determine because the species is so widely distributed and predominantly pelagic.

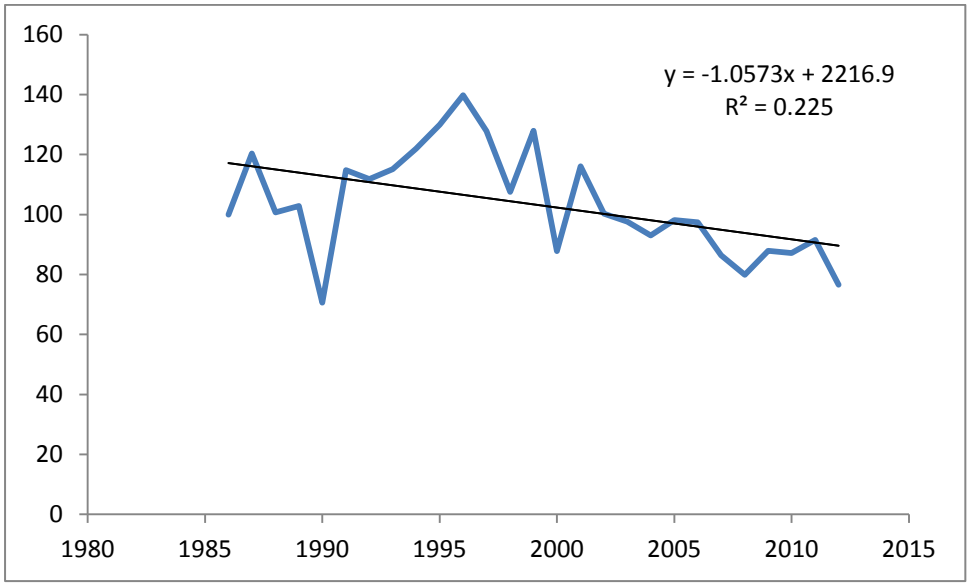


Figure 5.4. Trend in the fulmar breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

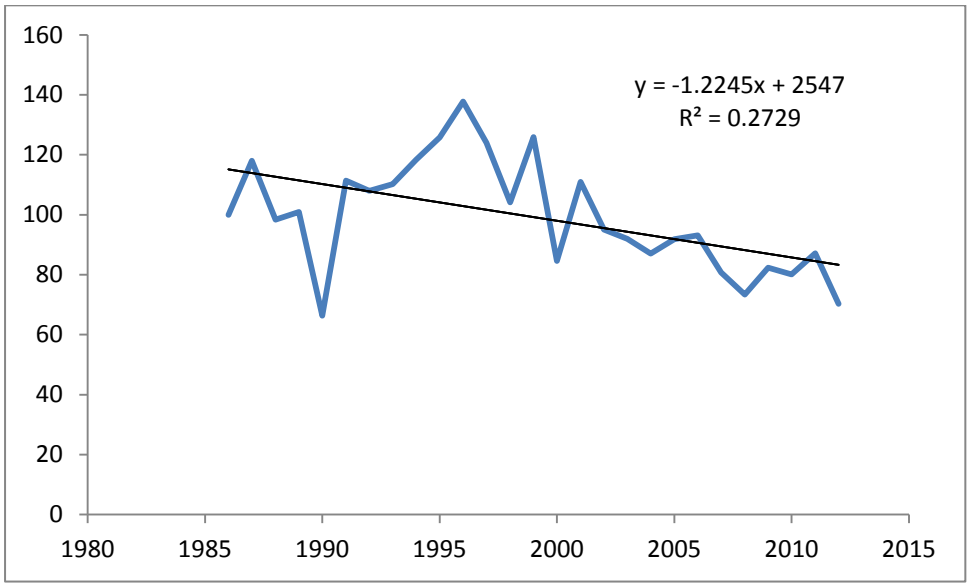


Figure 5.5. Trend in the fulmar breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

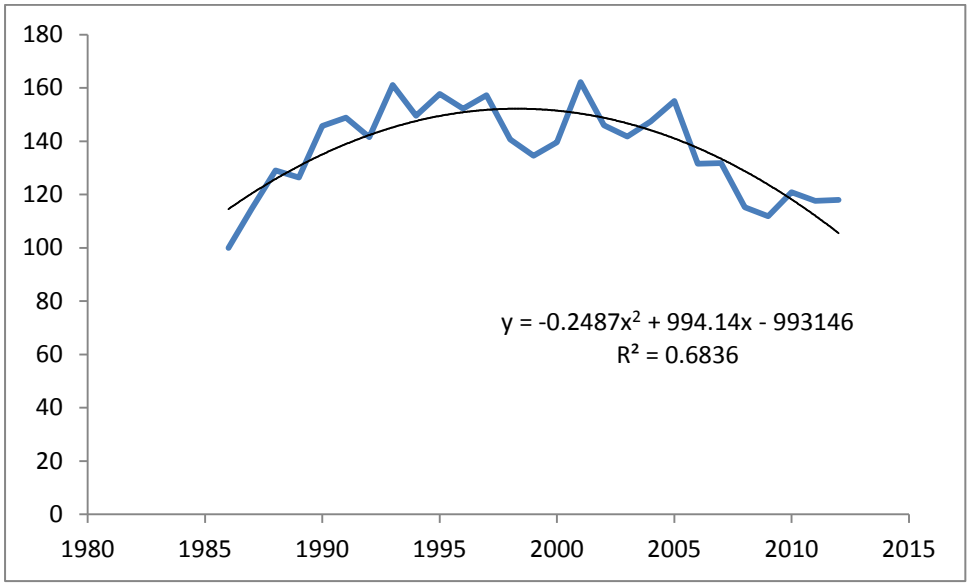


Figure 5.6. Trend in the fulmar breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

5.9 Proportion of UK population from UK breeding SPAs

The 25 SPAs with breeding fulmars as a feature together held 310,279 pairs at designation, estimated to represent ca. 57% of the British breeding population (Stroud et al. 2001). Given that the geographical distribution of SPAs (Figure 5.7) reflects the geographical distribution of the population as a whole, it is likely that this percentage remains a valid estimate for the current population. Breeding numbers have declined since 2000 (by about 10% between 2000 and 2012) in the UK, Scotland and Wales (Figures 5.4 to 5.6). However, that decline is likely to have affected SPA and non-SPA populations, so should not greatly alter the proportion within SPAs. It is likely that larger populations (which are predominantly the SPA populations) may have declined more, which would reduce the proportion within the SPA suite. Stroud et al. (2014) estimated that the SPA suite held about 49.7% of the GB population in the early 2000s.

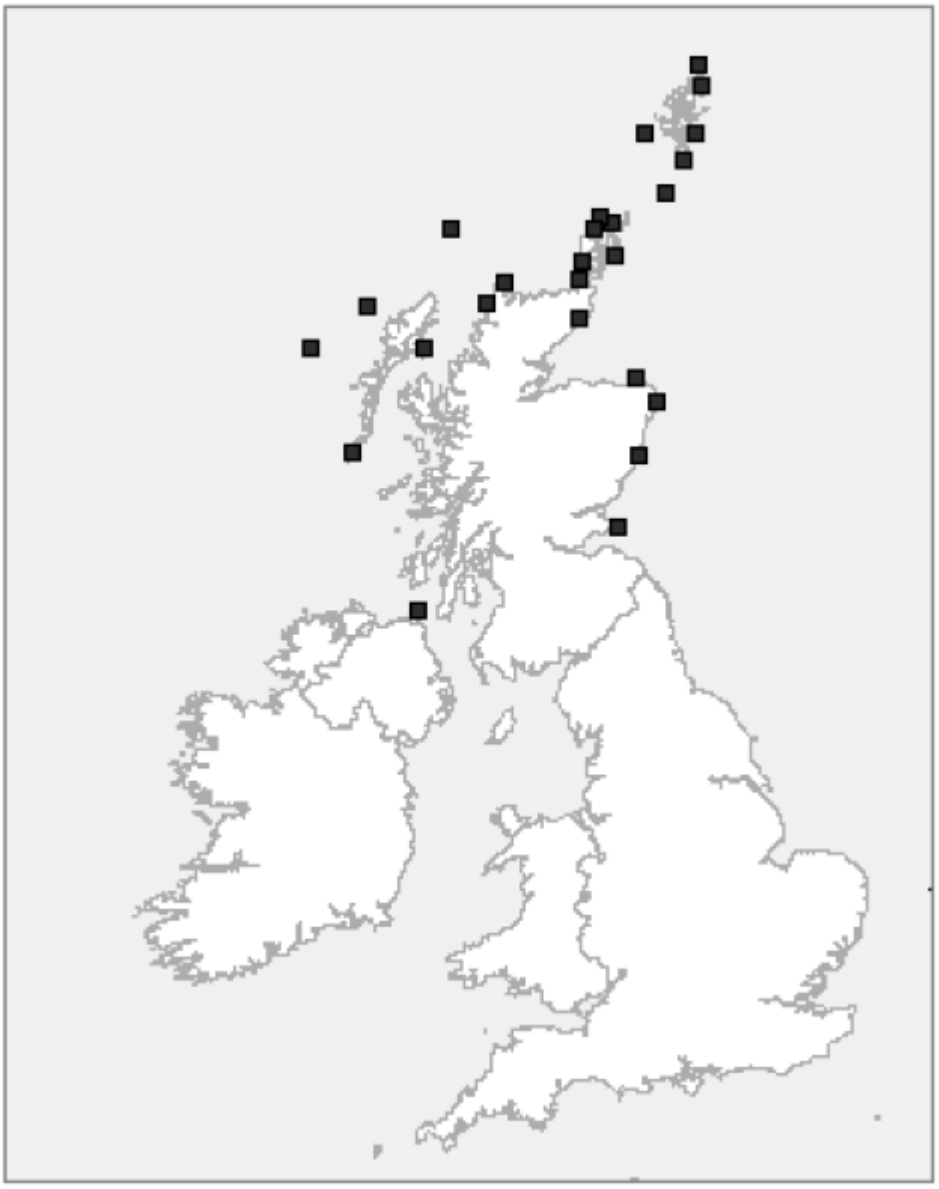


Figure 5.7. Locations of the 25 UK SPAs with fulmar as a breeding feature. These SPA populations are listed in Table 5.1. From Stroud et al. 1990.

Table 5.1. The UK SPA suite for breeding fulmars.

SPA	Location	Pairs	Year desig-nated	Site condition monitoring*	Recent counts (pairs)	Year	Reference
UK North Sea							
Hermaness, Saxavord & Valla F	Shetland	14,890	1994	Declined 2007	13,958 >6,723	1999 2011	SMP database SMP database
Fetlar	Shetland	9,800	1994	Maintained 2002	8,912	1999-2002	Stroud et al. 2014
Foula	Shetland	46,800	1995	Declined 2007	21,106 19,758	2000 2007	Seabird2000 SMP database
Noss	Shetland	5,870 (1993)	1996	Maintained 1998	4,999 5,169 6,144 5,248	1998 2002 2006 2011	Seabird2000 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012

Sumburgh Head	Shetland	2,542	1996	Maintained 2001	1,487 230 233	2001 2007 2009	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
Fair Isle	Shetland	43,320	1994	Maintained 2000	29,649	2011	Lewis et al. 2012
West Westray	Orkney	1,400	1996	Declined 2007	4,270 677	2000 2007	Seabird2000 Lewis et al. 2012
Calf of Eday	Orkney	1,955	1998	Maintained 2002	1,842	2002	Lewis et al. 2012
Rousay	Orkney	1,240	2000	Recovering 2009	712 1,030	2000 2009	Seabird2000 Lewis et al. 2012
Hoy	Orkney	35,000	2000	Declined 2007	19,586	2007	Lewis et al. 2012
Copinsay	Orkney	1,615	1994	Recovering 2008	1,630	2008	Lewis et al. 2012
North Caithness Cliffs	N Scotland	14,700 Or 16,310 (Stroud et al. 2001)	1996	Maintained 2000	14,250	2000	Seabird2000
East Caithness Cliffs	N Scotland	15,000	1996	Maintained 1999	14,202	1999	Seabird2000
Buchan Ness to Collieston Coast	NE Scotland	1,765 (1986)	1998	Declined 2007	1,389 1,367	2007 2007	Lewis et al. 2012 Stroud et al. 2014
Troup, Pennan and Lion's Heads	NE Scotland	4,400 (1995)	1997	Declined 2007	2,900 1,795	2001 2007	Lewis et al. 2012 Lewis et al. 2012
Fowlsheugh	NE Scotland	1,170	1992	Maintained 1999	246 193	2006 2009	Lewis et al. 2012 Lewis et al. 2012
Forth Islands	E Scotland	798 (1985) or 1,600 (Stroud et al. 2001)	1990	Maintained 2004	1,364 676 832	2004 2005-2009 2010	Lewis et al. 2012 Stroud et al. 2014 Lewis et al. 2012
Flamborough and Filey Coast pSPA	E England	Not stated	Not yet		1,355 878	2000 2008	SCM database SCM database
Western waters & Channel							
Cape Wrath	NW Scotland	2,300	1996	Maintained 2000	2,115	2000	Seabird2000
Handa	NW Scotland	3,500 (1986)	1990	Declined 2008	4,323 3,550 2,119 1,915 1,870	1996 2000 2004 2008 2012	SMP database Seabird2000 Lewis et al. 2012 Lewis et al. 2012 SMP database
Flannan Isles	Western Isles	4,700 (1988)	1992	Recovering 2013	7,328	1998	Seabird2000
North Rona and Sula Sgeir	N Scotland	11,500	1985-1986	Declined 2012	North Rona only: 3,738 3,520 2,616 1,438	 1986 1998 2005 2012	 SMP database SMP database SMP database SMP database

Shiant Isles	Western Isles	6,820	1992	Maintained 1999	4,387	1999	Seabird2000
St Kilda	Western Isles	62,800	1992	Maintained 2000	66,055	1999	Seabird2000
Mingulay and Berneray	Western Isles	12,500 (1994)	1994	Maintained 1998	15,023 9,046	2003 2009	Lewis et al. 2012 Lewis et al. 2012
Rathlin Island	N Ireland	1,482 (1985)	1999		2,032 1,072 1,518	1999 2007 2011	SCM database SCM database SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

5.10 BDMPS

Given that breeding fulmars from Scotland may make foraging trips while breeding to as far as the mid-Atlantic ridge, and non-breeding birds may disperse over thousands of kilometres, this pelagic species cannot readily be subdivided into local regional populations. It seems more appropriate to consider all UK waters as a single BDMPS for this species. However, if it is convenient to work on a smaller spatial scale, division into UK North Sea waters and UK Western waters plus Channel would be practical, based on the fact that there appears to be relatively low movement of birds between UK North Sea and UK western waters (Figure 5.8). The following interpretation is based on the review of literature presented in Sections 5.5, 5.6 and 5.7. In UK waters there are about 1,000,000 fulmars at sea on average during the winter. The vast majority of these occur in Scottish waters rather than further south. Approximately half of these occur in the BDMPS 'UK North Sea waters' and approximately half in 'UK Western waters plus Channel'. However, the contributions of SPA breeding populations differ strongly between these two BDMPS, with most birds from North Sea SPA populations in North Sea waters and most birds from western SPA populations in western waters. Details of apportioning used in computing these BDMPS are given in Appendix A Tables 8 and 9 for winter BDMPS, and Appendix A Tables 10 and 11 for migration season BDMPS. The numbers of birds from overseas populations contributing to these BDMPS is particularly uncertain. It is clearly a very low proportion as estimates of the numbers of fulmarsv at sea in UK waters would not allow for large numbers from overseas in addition to the better known numbers from UK populations. In the BDMPS calculations the proportion coming from Iceland, Norway and Faroe has been estimated at 1% of the adult population and 2% of the immature population (3% for Faroe) in winter in the UK North Sea and in UK western waters, and at twice these values for the migration seasons.

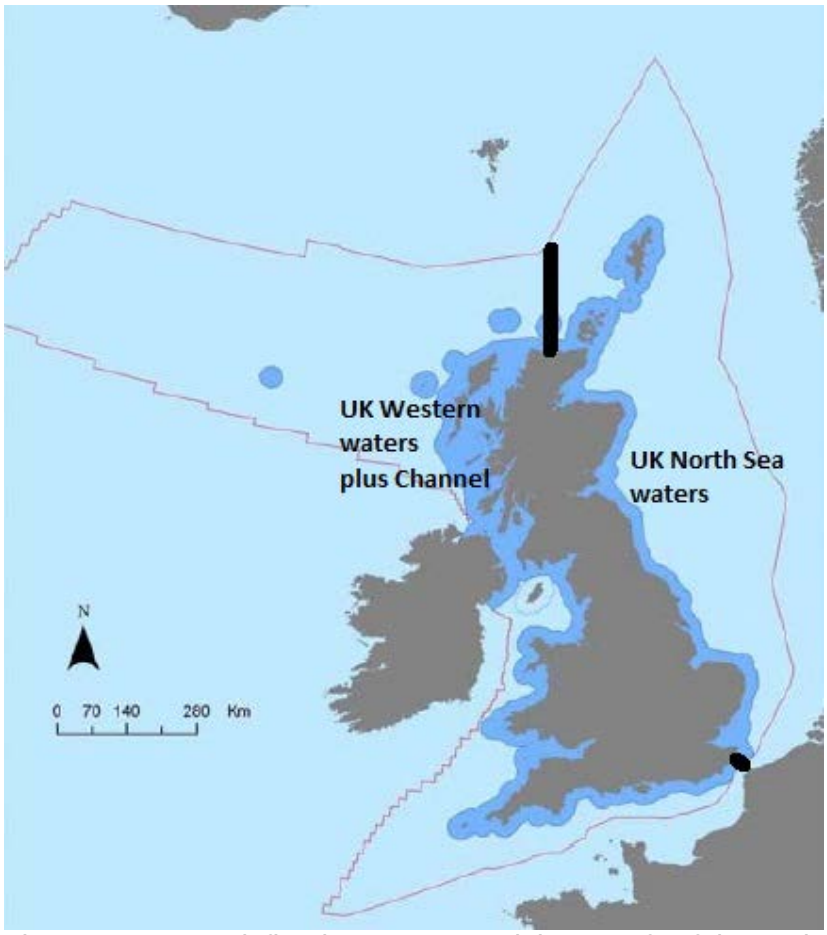


Figure 5.8. Two defined BDMPS spatial areas for fulmar; the two defined areas are 'UK North Sea' and 'UK Western waters plus Channel'.

5.11 Proportions of UK SPA birds in each BDMPS

Proportions of each BDMPS represented by adults from UK breeding SPA populations can be computed from the data in Appendix A Tables 8 to 11. For example, the UK North Sea winter BDMPS holds an estimated 96,413 birds from overseas populations and 472,323 birds from UK populations, a total of 568,736 birds. Of these, 184,608 are adults from SPA breeding populations, so these represent 32.5% of the UK North Sea winter BDMPS total. In UK western waters the winter BDMPS holds an estimated 96,413 birds from overseas populations and 459,954 birds from UK populations, a total of 556,367 birds. Of these, 162,063 are adults from SPA breeding populations, so these represent 29.1% of the UK western waters plus Channel winter BDMPS total.

5.12 Spatial distribution of UK breeding SPA birds across the BDMPS

The 25 UK SPAs with fulmar as a feature are almost all in Scotland (Figure 5.7), but this also reflects the broader breeding distribution of the species in the UK: Seabird 2000 (Mitchell et al. 2004) reported 485,852 pairs in Scotland, 9,755 in England, 3,474 in Wales and nearly 6,000 in Northern Ireland, so the Scottish population represents over 96% of the UK total. Within Scottish waters, the spread of fulmar SPAs is also distributed much as the overall breeding population, so that the at sea distribution of birds from SPA populations is likely to be very similar to that of birds from colonies that are not SPAs. Furthermore, about 50% of the fulmar population breeds on SPAs with fulmar as a designated feature, so the high proportion of the population in designated sites also makes it likely that the geographic spread of birds from SPAs matches closely that of the general population. The high mobility of this pelagic species also means that birds are likely to be well mixed at sea during migration seasons and in winter.

6. MANX SHEARWATER *Puffinus puffinus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (August to early October and late March to May)
Overseas	242,000	11,206
UK	1,700,000	1,578,196
Total	2,000,000	1,589,402

Migration season BDMPS (August to early October, late March to May)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
UK North Sea waters	8,507	111	8,396
UK Western waters plus Channel	1,580,895	11,095	1,569,800

Colour coding is amber for western waters as numbers in colonies in the UK and overseas are moderately well known and have in most cases not been censused since Seabird 2000 (and there are some issues with estimated numbers at Skomer where recent census suggests surprisingly large increase in numbers), most birds in UK waters originate from UK colonies so the influence of uncertain numbers coming from overseas is relatively small, and movement patterns of this species appear to be consistent from year to year. Colour coding for the North Sea migrating BDMPS is red because numbers entering the North Sea are low, are not well documented, and seem to vary somewhat from year to year, possibly in response to variable weather conditions.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 12 and 13.

6.1 Breeding range and taxa

Manx shearwaters are monotypic, with a core breeding range in the British Isles, smaller populations in Faroe and Iceland, and very small colonies in eastern Canada, France, Azores, Madeira and Canaries. Biometric variation appears to be of no value in assessing origins of individuals. Manx shearwaters are trans-equatorial migrants, wintering off the coast of Brazil (Brooke 1990).

6.2 Non-breeding component of the population

Manx shearwaters start to breed when 5 years old (BTO Birdfacts). Adult survival rate is 0.905 (BTO Birdfacts), juvenile survival 0.25 up to 5 years old (BTO Birdfacts) and mean productivity is 0.591 chicks per pair (JNCC database, n=56 measurements). To obtain a stable population, survival of immatures was adjusted to 0.6 for juveniles, 0.8 for 1-year olds,

0.85 for 2-year olds, 0.88 for 3-year olds, and 0.9 for 4-year olds. The model population comprised 54% adults, 16% juveniles and 30% older immatures. There are 0.84 immatures per adult.

6.3 Phenology

Some chicks may still be emerging and fledging from burrows on Rum in mid-October after adults have departed. However, most adults leave the breeding colonies by late September or early October (Pennington et al. 2004; Forrester et al. 2007). The literature indicates that autumn migration starts in July (Cramp et al. 1977-94; Pennington et al. 2004), August (Forrester et al. 2007), or mid-August (Wernham et al. 2002). Peak autumn migration occurs in August in Shetland (Pennington et al. 2004), August-October throughout the range from Europe to South America (Cramp et al. 1977-94) or in September in the UK (Wernham et al. 2002; Forrester et al. 2007). Argyll Bird Reports indicate very large movements of Manx shearwaters through Argyll waters in August each year (flocks of tens of thousands of birds) but only small numbers in September and very few in October. It is unclear whether this means that migration mainly occurs in August (whenm chicks are still in burrows) or whether these very large movements are foraging by breeding adults rather than migration movements. If the latter, this would imply that migration occurs rather directly into the Atlantic so is not evident from coastal Argyll for example. Numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) suggest that autumn migration occurred mainly in September with a little in early October (Figure 6.1). Autumn migration is completed by late September (Pennington et al. 2004; Forrester et al. 2007) or early October (Cramp et al. 1977-94; Wernham et al. 2002; Brown and Grice 2005).

Spring migration starts from South America in mid-January (Cramp et al. 1977-94), and in UK waters in February-March (Wernham et al. 2002) or early March (Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in February-March through in the entire range of the species (Cramp et al. 1977-94), but in mid-March in English waters (Brown and Grice 2005), in late March according to Forrester et al. (2007), April according to Wernham et al. (2002), or May in Shetland (Pennington et al. 2004). Numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) suggest that spring migration occurred in April-May (Figure 6.1). Spring migration is completed by April (Cramp et al. 1977-94), late April (Wernham et al. 2002), May (Forrester et al. 2007) or as late as June in Shetland (Pennington et al. 2004).

The first spring records of Manx shearwater in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from late March to late April, and the last records were predominantly in late September or October, while peak autumn migration was reported in July, August or September in most years, and peak spring migration was reported in May in most years. Breeding colonies are first re-occupied in March or April, with modal arrival at colonies in late March or April (Pennington et al. 2004; Forrester et al. 2007).

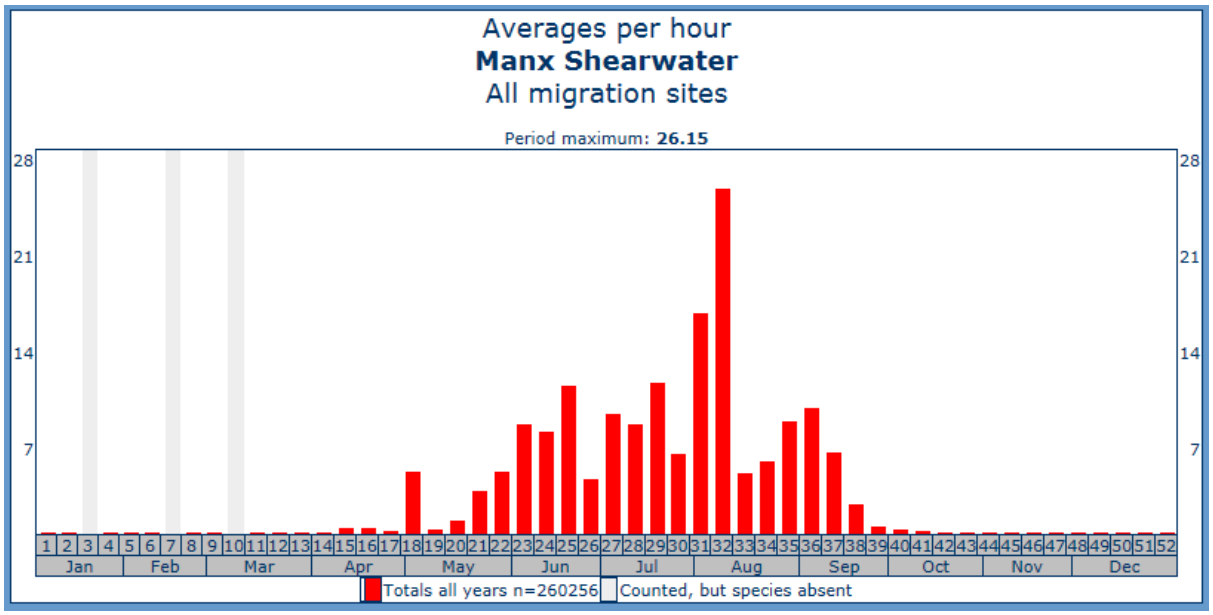


Figure 6.1. Average numbers of Manx shearwaters counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-September, non-breeding season birds absent from UK waters. However, from the data reviewed above, a more appropriate definition would be breeding season April-August, non-breeding season September-March.

6.4 Defined seasons:

- UK Breeding season — April-August
- Post-breeding migration in UK waters — August-early October (**migration BDMPS**)
- non-breeding season — September-March
- Return migration through UK waters — late March-May (**migration BDMPS**)
- Migration-free breeding season — June-July
- Migration-free winter season — November-February

Apart from the breeding season, one seasonal BDMPS periods is considered to be appropriate for Manx shearwater:

Migration seasons BDMPS (August-early October and late March-May).

6.5 Movements of birds from the UK population

Birds from UK colonies depart in August to October, apparently predominantly in September, and most reach South America by October (Brooke 1990; Wernham et al. 2002). Indeed, there are recoveries of chicks that have reached South America within two to three weeks of the date of ringing at the nest (Brooke 1990). Birds from Rum are thought to migrate predominantly past the west of Ireland rather than through the Irish Sea (supported by the records of Argyll Bird Club that very large numbers of Manx shearwaters feed in Argyll waters in August but rather few tende to be seen in Argyll waters in September and hardly any in October), and then past France and Spain and probably past west Africa before crossing to South America (Wernham et al. 2002). Spring migration appears to follow a more westerly route (Brooke 1990). Large numbers are seen off North Carolina in February-March (Wernham et al. 2002). There is some evidence to suggest that the use of waters off the United States is a feature that has developed since the 1950s, as the species was largely

unknown there in earlier decades (Brooke 1990), suggesting some flexibility in migration route, perhaps in response to changing environmental conditions. Some immature birds, predominantly birds that are only one year old, remain in wintering areas or off the southeastern United States rather than returning to British waters (Wernham et al. 2002). Movements of adults through the South and North Atlantic have been tracked by geolocator deployment, but although these provide clear evidence of the large scale pattern they give only very little indication of directions of migration movements through UK waters (Guilford et al. 2009).

6.6 Movements of birds from overseas into UK waters

Of the 1,036 birds ringed in the Faroes (357 as chicks) none have been recovered in Britain (Hammer et al. 2013). According to Wernham et al. (2002), there is no evidence from ringing, or from any other sources, to suggest that birds from colonies in other countries apart from Ireland pass through British waters during migration, although a small number of birds reared in French colonies have recruited into colonies in the UK. However, it seems highly likely that most birds from the Faroes pass through the NW area of UK territorial waters on migration, and some from Iceland may do so. Most birds from Irish colonies probably migrate directly between the open Atlantic Ocean and Irish waters rather than moving through UK waters. There are probably about 400,000 pairs in UK colonies (numbers being somewhat uncertain due to variations in recent counts at the largest colonies), 32,600 pairs in Ireland, 25,000 pairs in Faroes, and 8,500 pairs in Iceland (Mitchell et al. 2004). These data would suggest that all, or almost all, of the Manx shearwaters occurring in British waters during migration are from British colonies. Although there are occasional records of Manx shearwaters in British waters as late as November or December, these are highly unusual, and no birds are thought to overwinter successfully in British waters.

6.7 Numbers in UK waters

Very high densities occur in summer (May-August) in Irish and Celtic Sea, whereas the species is scarce in the Channel and in the North Sea (Brown and Grice 2005). Forrester et al. (2007) suggest that passage of Manx shearwaters through Scottish waters is ‘minimal’ apart from the arrival and departure of birds to and from the large colonies on Rum and St Kilda. This is supported by the very small numbers of migrant Manx shearwaters seen at Shetland or Orkney or along the east coast of the Scottish mainland, where the species has no significant breeding colonies (Annual Bird Reports and Pennington et al. 2004).

6.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the entire species’ population, comprising 265,100 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 340,000-410,000 pairs. Since then, the estimated large increase in numbers at Skomer suggests that a more appropriate total may be at least 400,000 pairs for the UK, possibly slightly more. Kober et al. (2010) presented an estimated biogeographic population of 1,130,000 individuals. Since populations in the UK, Iceland, Faroe and Ireland have possible connectivity with UK waters, the appropriate biogeographic breeding population with connectivity is a total population of ca. 2,000,000 birds. However, given that there is no evidence that Manx shearwaters from Ireland, Iceland and Faroe pass though UK coastal waters, and these birds are considerably outnumbered by the UK population, it would be a reasonable first approximation to consider all Manx shearwaters occurring in UK waters to be birds from the UK population, comprising ca. 400,000 pairs (800,000 adults) and an associated 672,000 immatures. Some of the younger immatures spend the entire year in the wintering area (off South America) so that perhaps 1,580,000 birds from UK colonies plus about 11,200 from overseas colonies may be in UK waters during the migration periods. Numbers breeding at Rum are not known with confidence as that (very large) colony is very difficult to census, and trends in breeding numbers are

unclear for Rum, and for other major colonies (Table 6.1). Numbers at Skomer are also somewhat uncertain due to the estimated large increase in numbers there when a new census methodology was adopted (Perrins et al. 2012).



Figure 6.2. Breeding population origins of Manx shearwaters in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

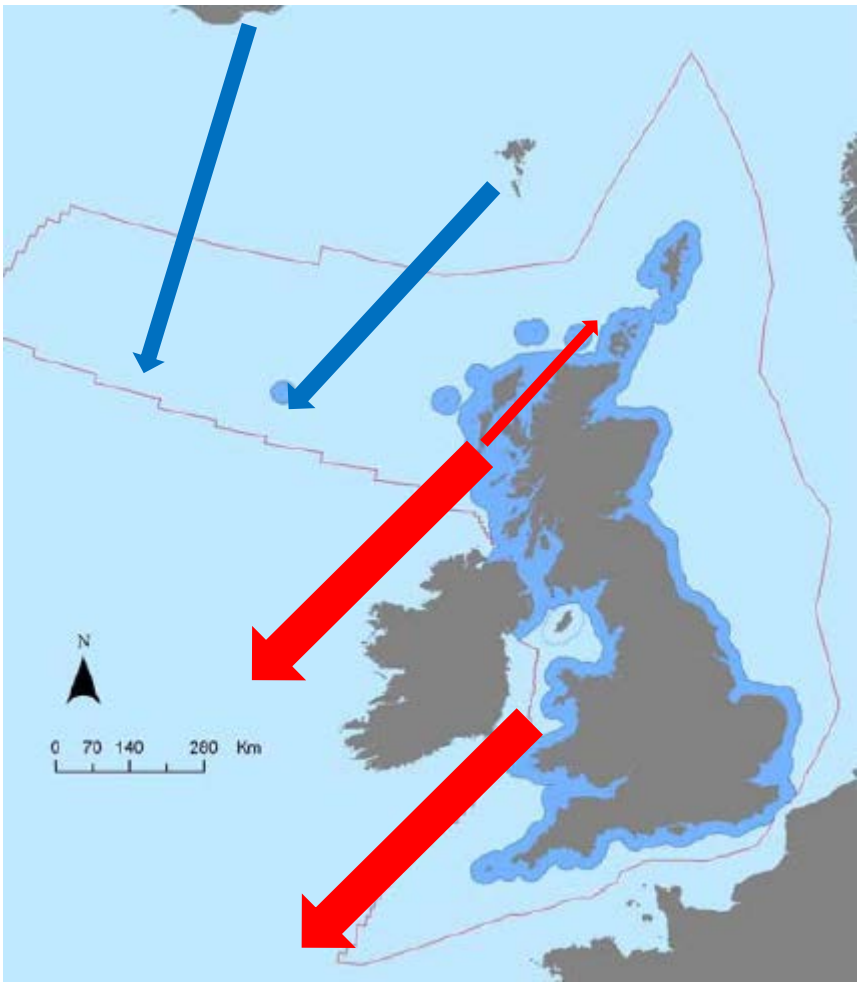


Figure 6.3. Main movements of Manx shearwaters from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure, except that in spring it is thought that birds tend to arrive from further west, crossing the North Atlantic from the Grand Banks area.

6.9 Proportion of UK population from UK breeding SPAs

The 4 SPAs with breeding Manx shearwaters as a feature together held 219,898 pairs at designation, estimated to represent ca. 100% of the British breeding population (Stroud et al. 2001). These SPA populations continue to represent almost the entire UK population. Stroud et al. (2014) estimated that GB SPAs held 96.2% of the GB population in the early 2000s. However, a recent census of Skomer found an estimated 316,070 breeding pairs on that island, more than twice the expected number (Perrins et al. 2012), suggesting that the total for the Skokholm, Skomer and Middleholm SPA is likely to have reached about 350,000 pairs, considerably increasing the total estimated UK (and world) population size. If this recent census is confirmed to be accurate (it used a new census method but is thought by Perrins et al. 2012 to be appropriate) this implies that the UK population of Manx shearwaters is at least 400,000 pairs, and possibly higher. The UK SPA suite for breeding Manx shearwaters still certainly holds very near to 100% of the UK breeding population.

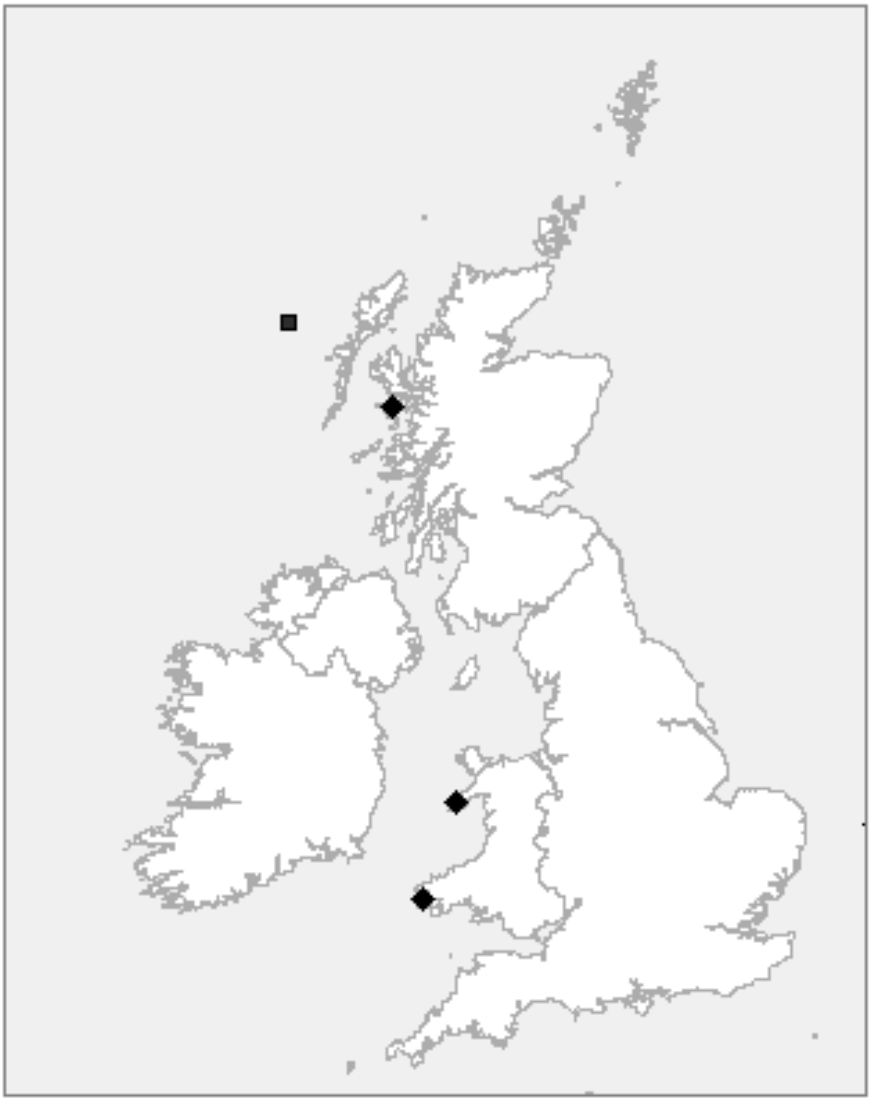


Figure 6.4. Locations of the 4 UK SPAs with Manx shearwater as a breeding feature. These SPA populations are listed in Table 6.1. From Stroud et al. 1990.

Table 6.1. The UK SPA suite for breeding Manx shearwaters.

SPA	Location	Pairs	Year desig-nated	Site condition monitoring*	Recent counts (pairs)	Year	Reference
Western waters & Channel							
St Kilda	Western Isles NW	<5,000 or 1,000 (Stroud et al. 2001)	1992	Maintained 2000	4,802	1999	Seabird2000
Rum	Inner Hebrides NW	61,000 (1995)	1982	Maintained 2003	120,000	2001	Seabird2000
Aberdaron Coast & Bardsey Island	Wales SW	6,930 (1996)	1992		16,183	2001	SCM database
Skomer, Skokholm & Middleholm	Wales SW	150,968 (1998)	1982		350,000	2011	Perrins et al. 2012 and in litt.

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

6.10 BDMPS

The following interpretation is based on the review of literature summarised in sections 6.5, 6.6 and 6.7. Although Manx shearwater is a highly pelagic species, the migration of this species out of, and back into UK waters appears to take place fairly quickly and directly. The BDMPS 'UK Western waters plus Channel' holds the large colonies in Wales, on Rum and St Kilda and a few small colonies. The BDMPS 'UK North Sea waters' holds no large colonies and no SPA breeding populations of the species and has very few migrant Manx shearwaters passing through. All these areas hold no birds in winter, so the BDMPS of concern is that for migration seasons. During migration, there will be about 1.6 million passing through the 'UK Western waters plus Channel' area. Numbers passing through the 'UK North Sea waters' are low, possibly around 8,000-9,000 birds but varying from year to year and often much less than this. Details of apportioning are given in Appendix A Tables 12 and 13. It is estimated that only about 1% of immatures and no adults from UK SPA colonies, 1% of adults and immatures from UK non-SPA colonies, and 0.1% of immatures and no adults from Iceland, Faroe and Ireland migrate through UK North Sea waters, while 100% of adults and 70% of immatures from UK SPA colonies migrate through UK western waters, together with 80% of adults and 60% of immatures from UK non-SPA colonies (numbers in these colonies being trivial by comparison to numbers in SPA colonies), and 1% of adults and 3% of immatures from Iceland and Faroe, 5% of adults and 10% of immatures from Ireland. Numbers of immatures in UK waters (and so components of these two BDMPS) do not sum to 100% because many of the youngest immatures remain in South American waters until at least their second year.

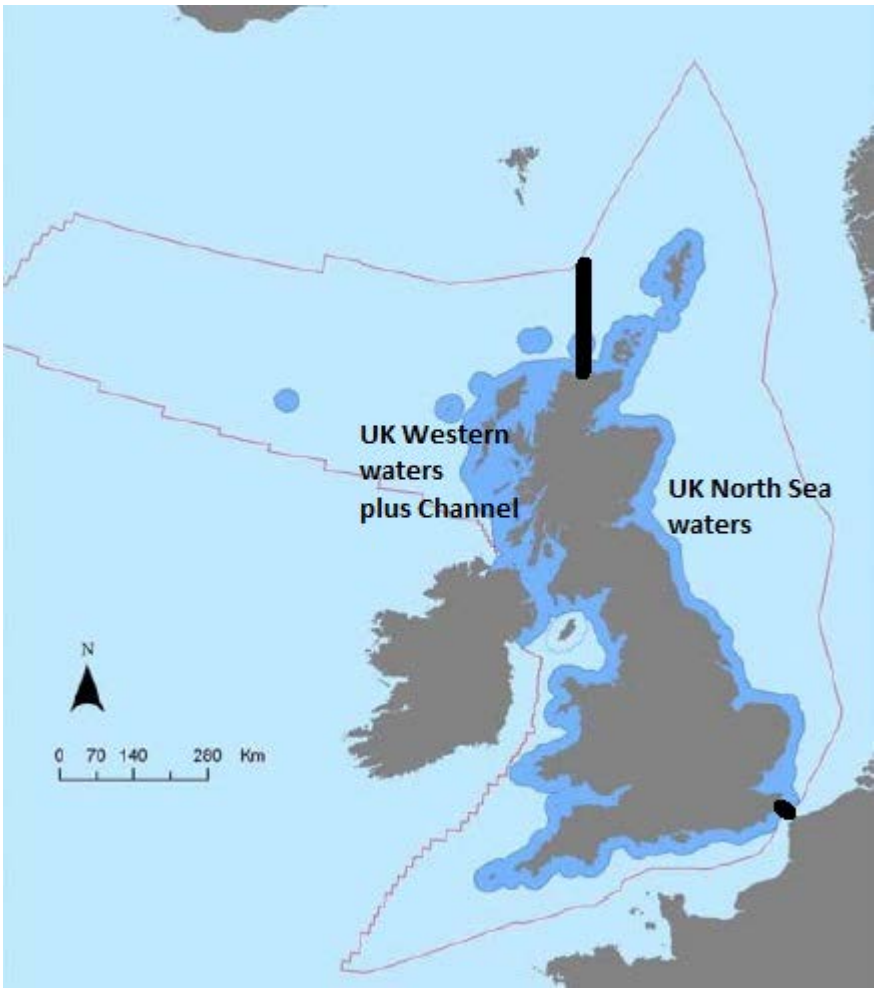


Figure 6.5. Two defined BDMPS spatial areas for Manx shearwater. The two areas are: 'UK North Sea waters' and 'UK Western waters plus Channel'.

6.11 Proportions of birds from BDMPS in reference regions

The vast majority of all birds found in these two BDMPS are associated with UK colonies. A very small number of birds migrate through from or towards colonies in Ireland, Iceland or Faroe, but those numbers are trivial based on the limited evidence. Almost all of the birds are from UK colonies and almost all birds in UK colonies are in SPA populations. The proportion of the BDMPS that comprises adults from SPA populations can be computed from Appendix A Tables 12 and 13. In the UK North Sea BDMPS of 8,507 birds, none are thought to be adults from SPA populations since the small numbers passing through the North Sea are most likely to be immatures rather than breeders, or birds from Faroe and Iceland. In the UK Western Waters plus Channel BDMPS of 1,580,895 birds, 981,970 are estimated to be adults from SPA breeding populations, or 62% of the total (most of the rest being immatures that originated from these SPA colonies).

6.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Since virtually 100% of Manx shearwaters in UK colonies are in SPAs with Manx shearwater as a feature, the spatial distribution of SPA birds is virtually identical to that of the population as a whole.

7. NORTHERN GANNET *Morus bassanus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in autumn (September-November) (adults and immatures)	Numbers in UK waters in spring (December-March) (adults and immatures)
Overseas	260,000	108,522	87,606
UK	923,000	893,730	822,667
Total	1,180,000	1,002,252	910,273

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK breeding population (adults plus immatures)
'Autumn migration' BDMPS (September to November)			
UK North Sea and Channel	456,298	45,173	411,125
UK Western waters	545,954	63,349	482,605
'Spring migration' BDMPS (December to March)			
UK North Sea and Channel	248,385	21,903	226,482
UK Western waters	661,888	65,703	596,185

Colour coding is green for numbers of birds in UK waters since the numbers are based on rather accurately known breeding numbers in UK colonies, and match quite well with estimates of numbers at sea from ESAS and general literature (such as Forrester et al. 2007). Movements of UK gannets are well known from ringing and are less subject to recovery bias than for more pelagic seabird species. Numbers visiting UK waters from overseas populations are certainly much smaller than numbers from UK colonies, but are less certain. There have been studies tracking migrating gannets (deploying geolocators) from colonies in Norway and Iceland which indicate movement of adults from those populations into and through UK waters, and ringing data also show connectivity, but the proportion of birds from those populations visiting UK waters is rather uncertain. However, given that numbers from overseas populations coming into UK waters are undoubtedly small relative to numbers from UK colonies, overall total numbers are coded green because those are mainly determined by numbers from UK colonies. Due to extensive tracking studies of breeding adults from many different colonies in different countries, confidence in the

movement patterns of gannets is high. However, details of the movements of immature birds are less well known, although the general pattern appears to be similar to that of adults but with immatures moving further south on average, and migrating later in spring, with youngest immatures remaining in wintering areas. There is some uncertainty about numbers at sea because much survey work that was boat-based involved data that appear to be biased by the stong attraction of gannets towards boats.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 14 to 17.

7.1 Breeding range and taxa

Gannet is a monotypic species with core breeding range within the British Isles, but colonies also in Norway, Russia, Faroe, Iceland, eastern Canada, Germany and France. Biometrics do not seem to vary significantly among populations.

7.2 Non-breeding component of the population

Gannets start to breed when 5 years old (BTO Birdfacts; WWT 2012). Adult survival rate is 0.92 (BTO Birdfacts; WWT 2012), juvenile survival 0.42 (BTO Birdfacts) and mean productivity is 0.684 chicks per pair (JNCC database, n=97 measurements). Survival of immatures was retained at 0.42 for juveniles, 0.83 for 1-year olds, 0.89 for 2-year olds, and 0.92 for older age classes. The model population comprised 55% adults, 19% juveniles and 26% older immatures. There are 0.81 immatures per adult.

7.3 Phenology

Breeding colonies are not completely deserted until mid-November, but modal departure occurs in late September (Pennington et al. 2004; Forrester et al. 2007). However, autumn dispersal/migration starts in August (Cramp et al. 1977-94; Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak autumn migration occurs in September in Shetland (Pennington et al. 2004) and in English waters (Brown and Grice 2005), late September in Scotland (Forrester et al. 2007), September-October in the UK (Wernham et al. 2002), September-November throughout Europe (Cramp et al. 1977-94), and October in Belgium (Vanermen et al. 2013). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in mid-September although seasonal pattern was not very pronounced in that data set (Figure 7.1). Autumn migration is completed by November (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007) or December if considering southern areas of Europe as well (Cramp et al. 1977-94).

Spring migration starts in December- January (Wernham et al. 2002; Pennington et al. 2004) early January (Forrester et al. 2007) or January (Cramp et al. 1977-94). Peak spring migration occurs in February-March (Pennington et al. 2004), February-April in Belgium (Vanermen et al. 2013), early March (Forrester et al. 2007), March (Wernham et al. 2002) or March-April (Cramp et al. 1977-94). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late-January and February (Figure 7.1). Spring migration is completed by late March (Pennington et al. 2004; Forrester et al. 2007) or early May (Wernham et al. 2002) or May (Cramp et al. 1977-94).

The first spring records of gannet in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly in early January and the last records were predominantly in late December, as some gannets overwinter, while peak autumn migration was reported in August to October in most years, and peak spring migration was reported in March or March-April in most years, but sometimes in January or February. Breeding sites are re-

occupied from early January, with modal re-occupation in mid-February to mid-March (Pennington et al. 2004; Forrester et al. 2007).

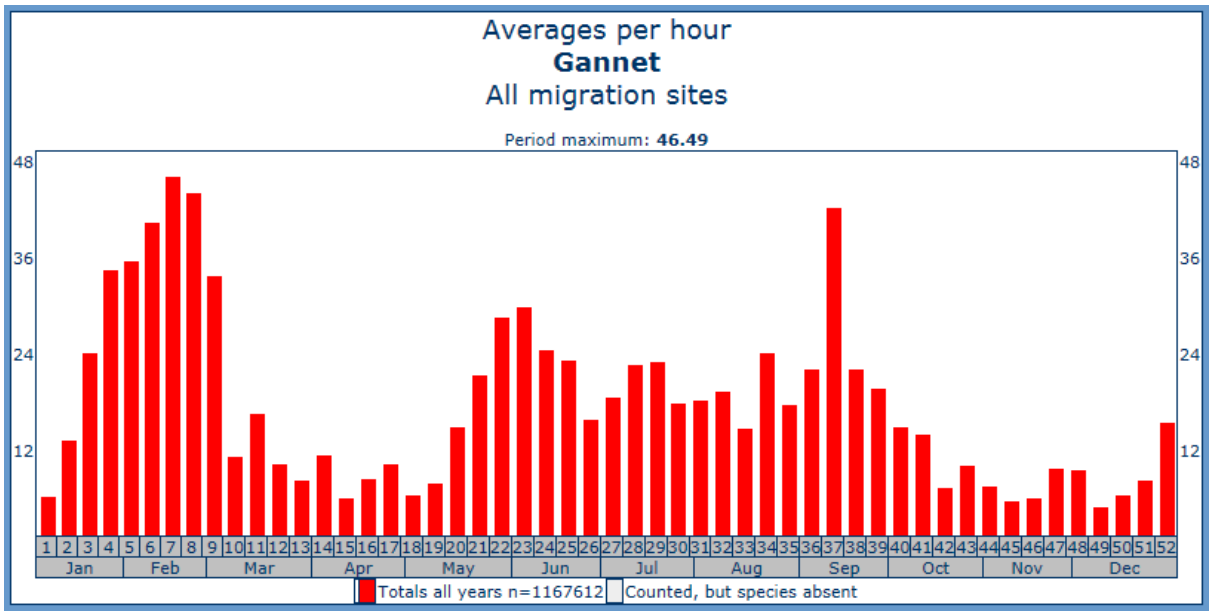


Figure 7.1. Average numbers of gannets counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-September, non-breeding season October-April. However, from the data reviewed above, a more appropriate definition would be breeding season March-September, non-breeding season October-February.

7.4 Defined seasons:

- UK Breeding season — March-September
  - Migration-free breeding season — April-August
- Non-breeding season — October-February
  - Post-breeding migration in UK waters — September-November (**autumn BDMPS**[2])
  - Migration-free winter season — None
  - Return migration through UK waters — December-March (**spring BDMPS**)

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for northern gannet:

'Autumn' (post-breeding) migration season BDMPS (September-November); and

'Spring' (pre-breeding) migration season BDMPS (December-March).

7.5 Movements of birds from the UK population

Gannets leave colonies mainly in August-October. Chicks fledge with large fat stores and begin migration by swimming, independent from their parents (Wernham et al. 2002) until their fat load is reduced. Fledglings generally move south quite rapidly; for example, birds ringed on the sea below the colony on Noss moved an average of 60 km per day during their

[2] Seasons for which BDMPS have been generated are annotated (BDMPS).

first 10-16 days (Wanless and Okill 1994) so clearly do not remain flightless for long. Adults from colonies in the UK do not necessarily move directly southwards in autumn, but may move to areas with abundant food for some time in late summer before heading towards their wintering area. On the basis of ring recovery data and observations of gannets on migration and in winter, Nelson (1978, 2002) suggested that most gannets breeding at the Bass Rock probably spend the winter in the North Sea or no further south than the Channel. Geolocators were fitted to experienced breeding gannets on the Bass Rock in 2002 and 2003 (Kubetzki et al. 2009). Birds attended the colony until between 24 September and 16 October (median 5 October). Although gannets fly at an average speed of about 58 km per hour (Garthe et al. 2007), migration took up to four weeks to complete, as birds spent considerable amounts of time sitting on the water or foraging locally rather than travelling consistently towards their goal, so net movement was often only 200 to 400 km per day. Of the 22 birds tracked until at least December, 18% wintered in the North Sea and the English Channel, 27% in the Bay of Biscay and the Celtic Sea, 9% in the Mediterranean Sea and 45% off West Africa. Birds wintering off West Africa migrated to their wintering areas mostly within 3 to 5 weeks, usually starting between early and late October. Most of these birds stayed off West Africa for a period of about 3 months, where they remained in a relatively restricted area. Individual winter home ranges as measured by the 75% kernel density contours varied between 8100 and 308 500 km^2 (mean = 134 000 km^2). Return migration was initiated between the end of January and mid-February, and took about as long as autumn migration. Kubetzki et al. (2009) inferred that the migration habits of gannets may be changing in response to human impacts on marine ecosystems, as the proportion of Bass Rock breeding adults that wintered within the North Sea was much smaller than appears to have been the case in earlier decades, whereas increased proportions were wintering off west Africa, where adult plumaged gannets had previously been relatively scarce. This trend was even more evident when loggers were deployed on Bass Rock gannets in 2008; none of the birds overwintered as far north as the North Sea that year (Garthe et al. 2012). These results are in strong contrast to the previously established view that adult gannets from the Bass Rock predominantly winter in the North Sea and only extremely exceptionally travel as far as Africa. Kubetzki et al. (2009) suggest that gannet migration behaviour may have changed in recent years, in response to changes in fish stocks and fisheries. In particular, amounts of fish discarded in the North Sea have been drastically reduced in recent years, whereas large fisheries have developed on the west African continental shelf and large quantities of discards are generated in that region (Meraz Hernando 2011). Almost all gannets (over 88%) seen on the west African shelf occur behind fishing vessels (Camphuysen and van der Meer 2005). In support of this suggested change in gannet winter distribution, Garthe (unpublished) analysed the ESAS database and found that the numbers of adult-plumaged gannets present in the North Sea in winter have declined since the 1980s despite very large increases in the gannet population. None of the birds carrying loggers wintered over deep water; all were on the continental shelf sea, wintering in areas where there are large fisheries as well as large stocks of pelagic fish (Meraz Hernando 2011). For birds where the logger data indicated migration routes used by breeding adults from the Bass Rock, twelve individuals migrated southwards through the English Channel, and eight left the North Sea around the north coast of Scotland and flew southwards west of the British Isles. On spring northward migration, only three birds moved back into the North Sea through the English Channel, while six moved into the North Sea around the north of Scotland (some loggers failed to record spring migration route because battery power was depleted). Birds that left in autumn through the Channel did not consistently return by the same route but in several cases moved north by a westerly route. A further deployment of loggers on Bass breeding adults in summer 2008 showed similar results (Garthe et al. 2010). On southward migration, 14 left the North Sea through the English Channel, and seven around the north of Scotland (apparently none of these birds flew overland from the North Sea to the Irish Sea or Atlantic). On northward migration in early spring, five entered the North Sea through the English Channel, and 16 flew up the west coast of Ireland and into the North Sea around the north of Scotland. Wernham et al. (2002) concluded that

distributions of gannet ring recoveries from different areas of Britain and Ireland, and recoveries from other European countries, show that gannets from all east Atlantic colonies intermingle in winter, distributed over a large area from the North Sea to west Africa. There is no clear evidence from ringing data that gannets from colonies in Britain and Ireland show differences among colonies in their wintering areas (Thomson 1974; Veron 1988; Wernham et al. 2002; Veron and Lawlor 2009). However, ringing effort has been high at the Bass Rock, moderate at Ailsa Craig, Hermaness, Grassholm and Great Saltee, and low or non-existent at other colonies. In particular, very little gannet ringing has been done at St Kilda, Sule Stack or Sula Sgeir, long-established and large colonies that represent a high proportion of the population and that are all located in the NW of the British Isles.

7.6 Movements of birds from overseas into UK waters

Ring recoveries from Faroese gannets suggest that those birds also share much the same winter distribution, but half of those birds were recovered as juveniles and wintering areas of adults were thought to be further north than most of these recoveries (Hammer et al. 2013). Deployment of geolocation loggers on breeding adult gannets from a variety of colonies showed evidence of different wintering areas used by birds from particular populations (Fort et al. 2012), although birds from all studied colonies were in UK waters in October. Their analysis showed that maximum distance between the colony and wintering area was similar across colonies despite their wide latitudinal range, strongly suggesting oriented chain migration (a pattern in which populations move uniformly southward). About 50% of the winter position fixes of birds from two Norwegian colonies were in UK waters (in the North Sea, west of Scotland, Channel, and Celtic Sea; see also Pettex et al. 2010). About 15% of the winter position fixes of birds from the Bass Rock were in UK waters (in the southern North Sea, Channel, and Celtic Sea). About 15% of the winter position fixes of birds from Rouzic (France) were in UK waters (almost all in the Celtic Sea). Less than 5% of the winter position fixes of birds from Grassholm were in UK waters. More recently, 12 loggers deployed on gannets at a colony in Iceland in summer 2010 were recovered in summer 2011 and preliminary analysis of these loggers indicates that the Icelandic gannets wintered from west Africa to west of Scotland (Garthe, Furness, Montevecchi and Halgrimsson unpublished data). During autumn migration, some of these birds passed through the North Sea and English Channel (5 out of 12) whereas in spring all returned northwards past the west of Ireland. Ringing studies indicate that immature gannets tend to winter further south than adults from the same population (Wernham et al. 2002). Wintering areas used by gannets breeding at colonies in Shetland and off NW Scotland have not been determined; no birds from those colonies have been equipped with geolocators and very few have been ringed. However, it seems likely that they will show patterns intermediate between colonies to the north (Norway and Iceland) and colonies to the south (Bass Rock, Grassholm, Rouzic). These data would suggest that a relatively small proportion of adult gannets from UK colonies overwinter in UK waters (and an even smaller proportion of immatures), whereas a relatively high proportion of adult gannets (but small proportion of immatures) from Norwegian and Icelandic colonies overwinter in UK waters. There are around 220,000 pairs in UK colonies, 36,000 pairs in Ireland, 5,950 pairs in the Channel Islands, 17,000 pairs in France, 28,500 pairs in Iceland, and 4,500 pairs in Norway (Wanless et al. 2005), 2,500 pairs in the Faroes (Hammer et al. 2013), about 632 pairs in Germany (Helgoland) (J. Dierschke in litt to JNCC July 2013) and a handful of pairs in Russia (Wanless et al. 2005). The fact that the UK population is by far the largest of these suggests that most gannets overwintering in southern UK waters are probably from UK colonies, whereas in the North Sea and off west Scotland, there may be a fairly high proportion of birds from Norwegian and Icelandic colonies. However, more data on movements of birds from those colonies would be needed to quantify these proportions accurately.

In the North Sea, gannets in summer show distributions that relate to the locations of breeding colonies (Langston et al. 2013), with birds travelling out from the colony to forage

up to 540 km (and into Norwegian waters) from the colony in the case of the largest colonies such as the Bass Rock (Hamer et al. 2001), predominantly on pelagic fish such as sandeels, herring and mackerel. Foraging ranges from smaller colonies are much shorter. Foraging ranges of gannets breeding in Norwegian colonies are small, which relates at least in part to the small size of those colonies so less competition among foraging adults. Birds equipped with GPS trackers at two Norwegian colonies while breeding fed no more than 22 km from their colony in 2007, no more than 56 km in 2008 and no more than 49 km in 2009 (Pettex et al. 2010) so would not have entered UK waters during their breeding foraging trips. A similar situation probably applies for Faroese and Icelandic breeding gannets. Birds breeding at Irish colonies apparently avoid foraging during the breeding season close to areas used by gannets breeding in UK colonies, so that few gannets in UK waters in summer are likely to be from Irish colonies (Wakefield et al. 2013). However, gannets from the colonies in the Channel Islands apparently forage in UK waters of the western English Channel while breeding (Wakefield et al. 2013).

Many immature gannets, particularly of the 3 and 4 year old cohorts, attend colonies during the summer (mostly from May to August so for a shorter period than breeding adults are present), and those birds tend also to show 'Central Place foraging' with their feeding flights radiating out from the colony, but over larger areas of sea than used by breeding adults (Votier et al. 2011).

7.7 Numbers in UK waters

Tasker et al. (1985) found that about 60% of gannets in the southern North Sea in summer were immatures, whereas in the northern North Sea this was only 20%. In winter, there are few immature gannets in the North Sea (fewer than 7% of all records), and densities of adults are lower than in summer (Tasker et al. 1985). Tasker et al. (1985) reported an average across the North Sea of 0.4 gannets per km^2 in October but only 0.04 per km^2 in December to February. Gannet distribution in the North Sea show a stronger correlation in winter with the distribution of fishing vessels, as they scavenge extensively on trawl fishery discards in winter when pelagic fish are less available (Garthe et al. 1996). Off the west of Britain, gannets were found to be present in relatively much lower numbers in winter than in summer, with gannets in winter mostly associated with fishing vessels (Webb et al. 1990). Surprisingly few occurred within the Irish Sea at any time of year with peak abundance there (in September) still below 0.5 birds per km^2 (Webb et al. 1990). However, large numbers of adults and immatures feed at the shelf-edge in the SW Approaches, in the western English Channel and Celtic Sea in November to February (Stone et al. 1995; White and Reid 1998; Brown and Grice 2005). Forrester et al. (2007) consider that 'a few thousand' may be in Scottish waters during winter, but they define winter as December to February, while also noting that gannets may be back on nest sites from the start of January, whereas lowest numbers at sea in Scottish waters may occur in late November or early December.

7.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the entire species' population, comprising 263,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 390,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 1,160,000 individuals. Birds in UK waters may originate from colonies in UK (255,500 pairs), Ireland (36,000 pairs), Iceland (28,500 pairs), Faroe (2,500 pairs), Norway (4,500 pairs) or Germany (632 pairs) (Mitchell et al. 2004, updated by Wanless et al. 2004, and Dierschke in litt). This gives a biogeographic population with connectivity to UK waters of 327,600 pairs, or 655,000 adults. Associated with this will be about 530,000 immatures, giving a total of around 1,180,000 individuals.



Figure 7.2. Breeding population origins of gannets in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

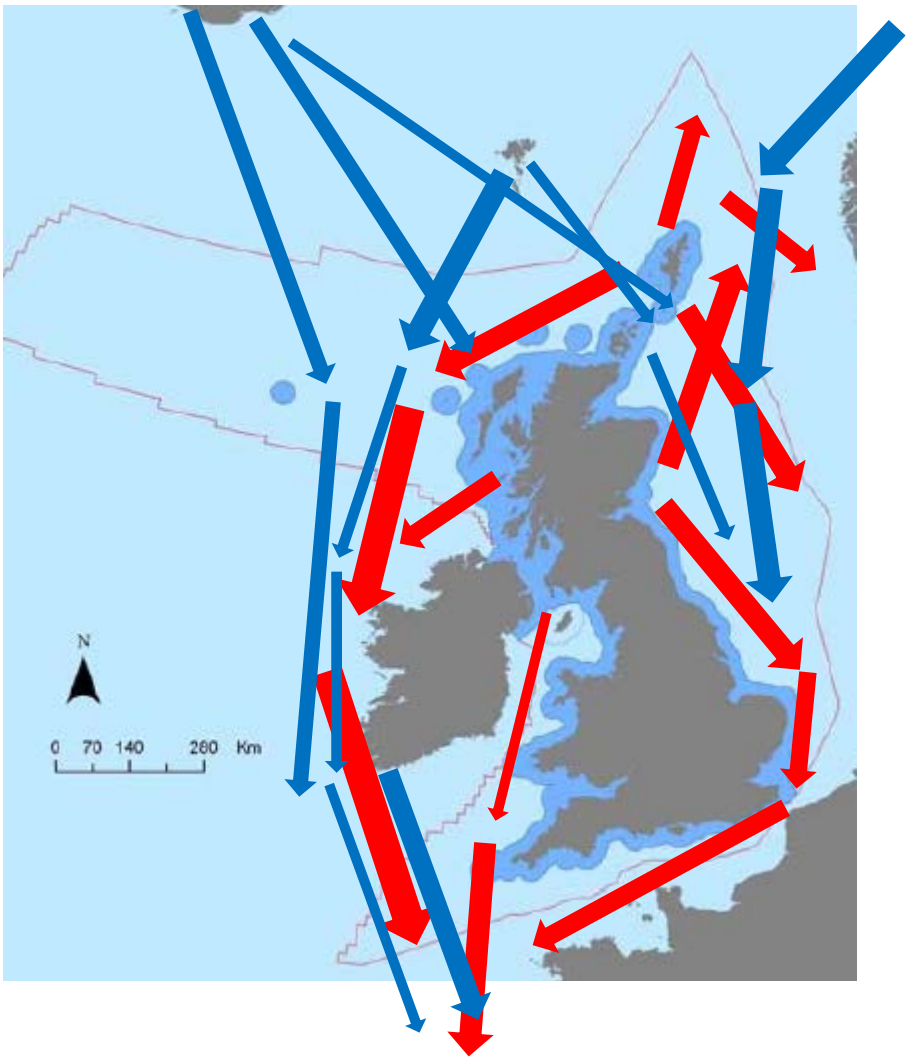


Figure 7.3. Main movements of gannets from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes.

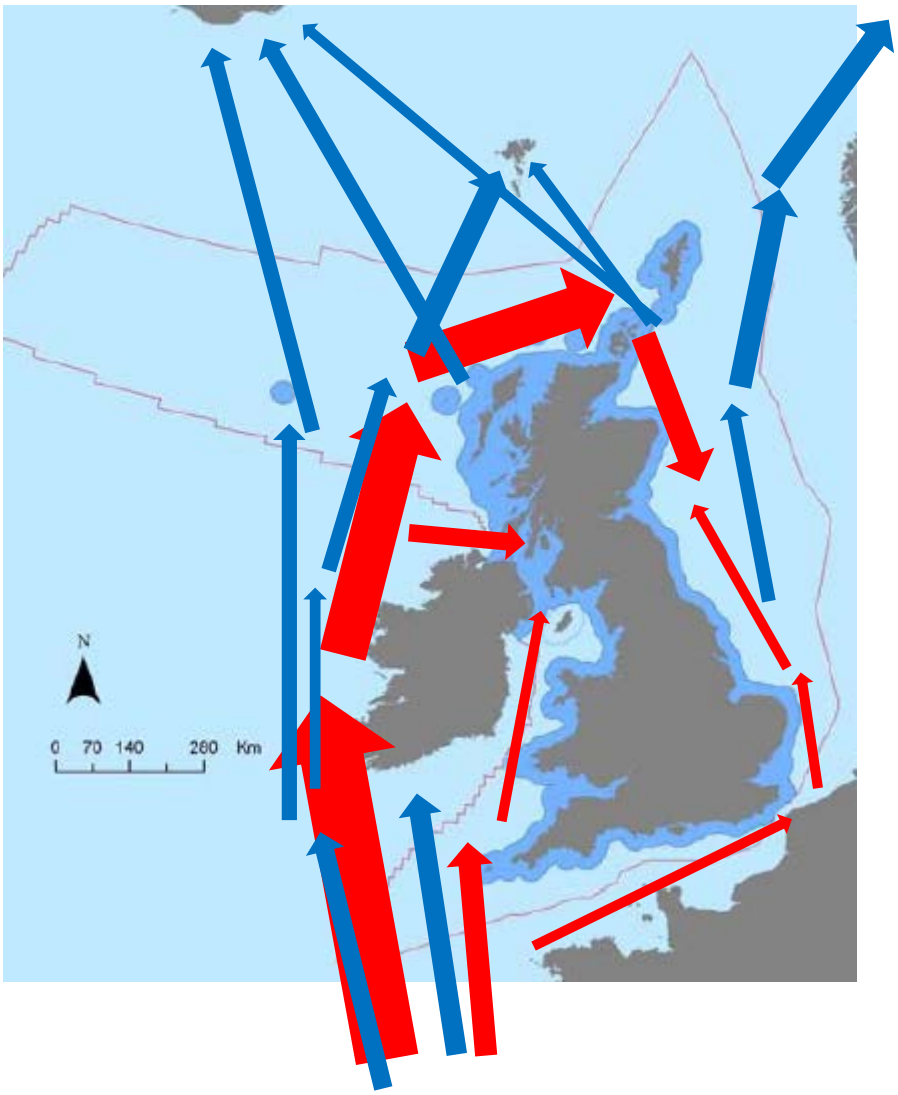


Figure 7.4. Main movements of gannets to UK breeding areas (red arrows) and by overseas populations (blue arrows) through UK waters during 'spring' migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. Note that spring migration routes differ from those in autumn as very few birds migrate through the southern North Sea in spring; most birds returning to colonies in the North Sea do so past the west of Scotland.

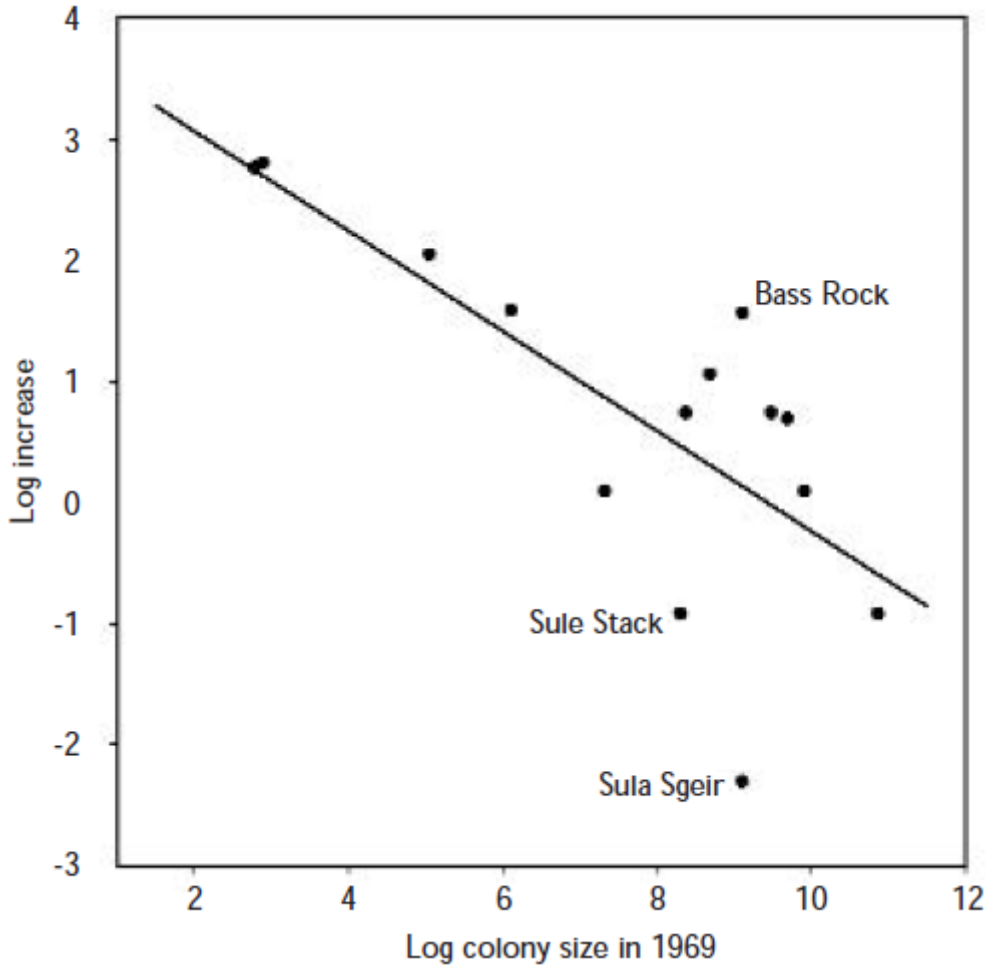


Figure 7.5. Rate of increase in breeding numbers of gannets at each colony in relation to original size of the colony in 1969. Larger colonies grow more slowly. From Wanless et al. (2004). The data are historical but are presented as an example of a pattern that appears to be typical; smaller colonies tend to grow faster than larger colonies, implying density-dependence, probably of recruitment as there is no evidence of reduced productivity in large colonies, and no evidence (though based on very limited data) of differences in adult survival rates between large and small colonies.

7.9 Proportion of UK population from UK breeding SPAs

The 10 SPAs with breeding gannets as a feature designated before 2000 together held 197,127 pairs at designation, estimated to represent ca. 98% of the British breeding population (Stroud et al. 2001). Almost all of these populations have increased in numbers since designation, and smaller colonies have tended to increase more rapidly than the largest colonies (Figure 7.5). Therefore, the proportion of the population in colonies that are not SPAs with gannet as a feature will have increased slightly since designation was completed. Several colonies that are SPAs for seabirds but held too few gannets for that species to qualify as a feature now hold large enough numbers to qualify (Table 7.1). For example, there were 2,787 pairs at Troup, Pennan and Lion's Heads SPA in 2010, 2,760 pairs on the Flannans SPA in 2004, both of which exceed the 1% of UK population threshold numbers based on the current population estimate of 220,000 pairs. However, even with the smaller colonies growing faster than SPA populations, the SPA suite still held 95.9% of the GB population around 2004 (Stroud et al. 2014), and this percentage is likely to remain around 95% in the near future.

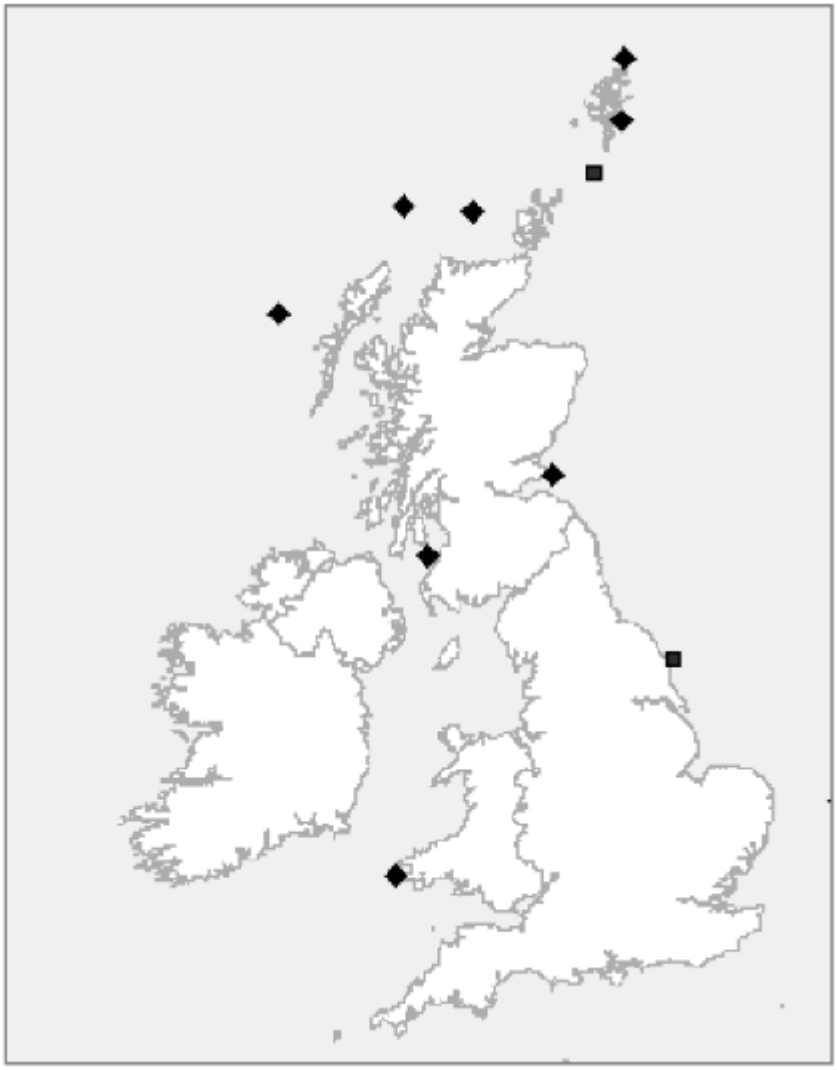


Figure 7.6. The UK SPA suite for gannet. These SPA populations are listed in Table 7.1.

Table 7.1. The UK SPA suite for breeding gannets and data for other major colonies.

SPA	**Location**	**Pairs**	**Year desig-nated**	**Site Condition Monitoring***	**Recent count**	**Year**	**Reference**
UK North Sea & Channel							
Hermaness, Saxavord & Valla	Shetland	12,000 (1994)	1994	Maintained 2008	15,633 24,353	2003 2008	Wanless et al. 2005 Lewis et al. 2012
Noss	Shetland	7,310 (1994)	1996	Maintained 2008	8,652 9,767	2003 2008	Wanless et al. 2005 Lewis et al. 2012
Foula	Shetland	Not yet listed as a qualifying feature			220 280 600 723 919 1,370	1990 1991 1994 2000 2004 2007	SCM database SCM database SCM database SCM database SCM database SCM database

Fair Isle	Shetland	1,166	1994	Maintained 2001	3,968 4,085 3,862 3,924	2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 SCM database SCM database
West Westray	Orkney	Not yet listed as a qualifying feature	1996		167 345 499 583 600 623	2007 2008 2009 2010 2011 2012	SCM database SCM database SCM database SCM database SCM database SCM database
Troup, Pennan and Lion's Heads	NE Scotland	Not yet listed as a qualifying feature	1997		545 1,085 1,228 1,547 1,810 2,787	1995 1998 2001 2004 2007 2010	SCM database SCM database SCM database SCM database SCM database SCM database
Forth Islands	E Scotland	21,600 (1985) Or 34,400 (Stroud et al. 2001)	1990	Maintained 2004	34,397 48,065 55,482	1995 2004 2009	Mitchell et al. 2004 Lewis et al. 2012 Lewis et al. 2012
Flamborough Head & Bempton (to be subsumed into Flamborough and Filey Coast SPA subject to consultation)	E England	2,501 (Stroud et al. 2001)	1993		3,940 3,480 6,487 7,859 11,061	2004 2005 2008 2009 2012	Wanless et al. 2005 SCM database SCM database SCM database SCM database
Flamborough and Filey Coast pSPA	E England	8,469 (2008-2012)	Not yet		As above		As above
UK Western waters							
Sule Skerry and Sule Stack	N Scotland	4,890 (1994)	1994	Maintained 2004	4,675	2004	Wanless et al. 2005
North Rona and Sula Sgeir	N Scotland	10,400 (1994) Or 9,000 (Stroud et al. 2001)	2001	Not reported	10,703 9,225	1999 2004	Lewis et al. 2012 Wanless et al. 2005
St Kilda	Western Isles	50,050 (1985) Or 60,400 (Stroud et al. 2001)	1992	Maintained 2000	60,428 59,622	1995 2004	Mitchell et al. 2004 Wanless et al. 2005
Flannan Isles	Western Isles	Not yet listed as a qualifying feature	1992		414 679 1,438 1,244 2,760	1988 1992 1994 1998 2004	SCM database SCM database SCM database SCM database SCM database

Ailsa Craig	W Scotland	23,000 (1987) or 32,460 (Stroud et al. 2001)	1990	Maintained 2004	32,456 27,130	1995 2004	Mitchell et al. 2004 Wanless et al. 2005
Grassholm	Wales	33,000 (1994)	1986		32,094 39,292	2004 2009	Wanless et al. 2005 SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

7.10 BDMPS

UK gannet numbers are much larger than numbers in Iceland, Norway, Faroe, so that UK birds, almost all of which are from SPA populations, generally predominate throughout UK waters. Gannets migrate southwards after initial autumn dispersal which can be northwards or southwards but birds tend to remain on or at the edge of the continental shelf rather than going into deep oceanic waters. Northern parts of UK waters see a large reduction in gannet numbers from 'autumn' (September-October) into 'winter' (November) and then increasing numbers with return migration in December to March. This could suggest three seasonal divisions: autumn, winter, and spring. However, in southern UK waters there seems to be little evidence of a distinct 'winter' period with low numbers and no migration activity, and numbers recorded monthly at offshore wind farm development sites show little or no winter minumim of numbers, and so it may be more appropriate to define two seasonal periods; 'autumn' (September-November) and 'spring' (December-March). These two migration seasons cannot be aggregated into a single non-breeding period because the migration routes used by gannets are distinctly different in autumn and spring; many birds migrate southwards through UK North Sea waters in autumn, but most migrate northwards in UK western waters in spring, even if returning towards UK North Sea breeding colonies. It makes sense to separate UK North Sea waters from UK western waters as separate BDMPS because the contributions of birds from particular SPA populations differ considerably between these two areas as a result of gannets rarely migrating overland.

The contributions of individual UK SPA populations, UK non-SPA populations, and overseas populations in the four BDMPS (UK North Sea and Channel autumn, UK North Sea and Channel spring, UK western waters autumn, UK western waters spring) are presented in detail in Appendix A Tables 14 to 17.

Based on evidence reviewed in sections 7.5, 7.6 and 7.7, it is estimated that 80% of adults and 80% of immatures from Shetland colonies are in the UK North Sea and Channel autumn BDMPS, as are 100% of adults and 90% of immatures from colonies in eastern Scotland and England, 10% of adults and 20% of immatures from colonies in the northern part of UK western waters (from north Scotland to St Kilda), 0% of adults and 10% of immatures from the southern part of UK western waters (from Ailsa Craig to Wales), 30% of adults and immatures from Iceland, Norway, Faroe, 0% of adults and 10% of immatures from Ireland, and 30% of adults and 40% of immatures from Germany. These sum to a total of 45,174 birds from overseas and 411,125 birds from UK populations, a total of 456,298 overall (Appendix A Table 14).

Based on evidence reviewed in sections 7.5, 7.6 and 7.7, it is estimated that 20% of adults and 10% of immatures from Shetland colonies are in the UK western waters autumn BDMPS, as are 0% of adults and 10% of immatures from colonies in eastern Scotland and England, 90% of adults and 70% of immatures from colonies in the northern part of UK western waters (from north Scotland to St Kilda), 100% of adults and 80% of immatures from

the southern part of UK western waters (from Ailsa Craig to Wales), 20% of adults and 30% of immatures from Iceland, Norway, Faroe, and Ireland, and 0% of adults and 0% of immatures from Germany. These sum to a total of 63,359 birds from overseas and 482,605 birds from UK populations, a total of 545,954 overall (Appendix A Table 15).

Based on evidence reviewed in sections 7.5, 7.6 and 7.7, it is estimated that 70% of adults and 40% of immatures from Shetland colonies are in the UK North Sea and Channel spring BDMPS, as are 70% of adults and 40% of immatures from colonies in eastern Scotland and England, 0% of adults and 0% of immatures from colonies in UK western waters (from north Scotland to Wales), 10% of adults and immatures from Iceland, 20% of adults and immatures from Norway and Faroe, 0% of adults and 10% of immatures from Ireland, and 30% of adults and 30% of immatures from Germany. These sum to a total of 21,903 birds from overseas and 226,482 birds from UK populations, a total of 248,385 overall (Appendix A Table 16). This lower number in the UK North Sea and Channel BDMPS in spring than in autumn reflects the observation that many gannets migrating back towards colonies in the North Sea do so up the west coast of Scotland rather than through the North Sea, so are present in western waters during most of spring migration.

Based on evidence reviewed in sections 7.5, 7.6 and 7.7, it is estimated that 30% of adults and 30% of immatures from North Sea colonies are in the UK western waters spring BDMPS, as are 100% of adults and 80% of immatures from colonies in UK western waters (from north Scotland to Wales), 20% of adults and 20% of immatures from Iceland and Norway, 30% of adults and immatures from Faroe and Ireland, and 0% of adults and 0% of immatures from Germany. These sum to a total of 65,703 birds from overseas and 596,185 birds from UK populations, a total of 661,888 overall (Appendix A Table 17). The higher number in the UK western waters BDMPS in spring than in autumn reflects the observation that many gannets migrating back towards colonies in the North Sea do so up the west coast of Scotland rather than through the North Sea, so are present in western waters during most of spring migration.

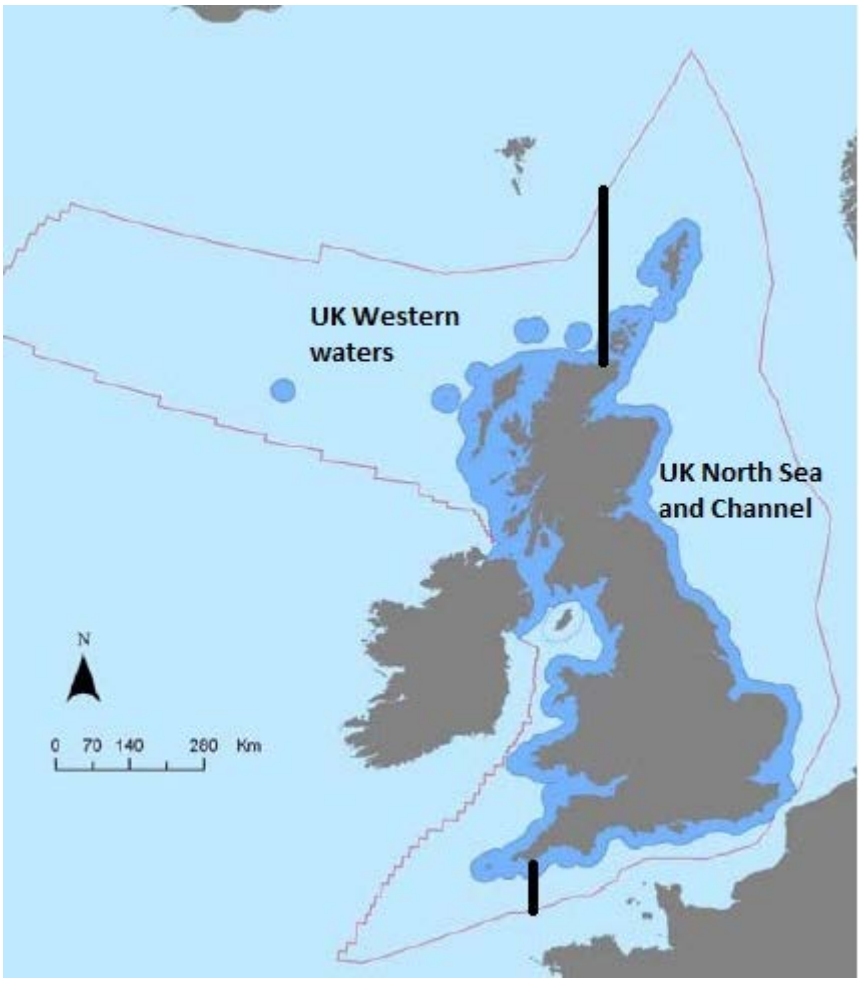


Figure 7.7. Two defined BDMPS spatial areas for gannet; 'UK North Sea and Channel' and 'UK Western waters'.

7.11 Proportions of UK SPA birds in each BDMPS

Since over 95% of UK gannets are in SPA populations, the proportion of UK SPA birds in each BDMPS is virtually the same as the proportion that is from UK colonies. The proportions that are adult SPA birds in each BDMPS total can be computed from data in Appendix A Tables 14-17. For example, in the UK North Sea BDMPS in autumn, there are 208,661 adults from UK breeding gannet SPA populations out of a total of 456,298 birds, giving a proportion of 46% being adults from UK SPA populations.

7.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Since over 95% of UK gannets are in SPA populations, the geographical distribution of UK SPA birds is virtually identical to that of the UK population as a whole. During migrations gannets range widely, and are likely to be thoroughly mixed with birds from other populations across each BDMPS range.

8. GREAT CORMORANT *Phalacrocorax carbo*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (September to March) (adults and immatures)
Overseas	285,000	1,470
UK	39,000	31,653
Total	324,000	33,123

'Non-breeding season' BDMPS (September to March)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
NW North Sea	6,012	98	5,914
SW North Sea & Channel	10,460	1,107	9,353
West of Scotland	7,049	56	6,993
SW England & Wales	9,602	209	9,393

Colour coding is green for numbers from UK colonies in each BDMPS since the locations and sizes of cormorant colonies are well known from survey data and breeding numbers have shown only small changes in total numbers in the UK over recent years, apparently peaking around 2000 and declining slightly since then back to totals similar to those present in the mid-1980s. Colour coding for numbers of cormorants arriving into UK waters from overseas is red in recognition of the fact that the proportions of overseas populations visiting UK are not well known, although numbers of cormorants present in winter have been estimated and indicate that very few overseas birds are present in most of the UK apart from the southern North Sea. Even in the southern North Sea, continental cormorants represent only a small proportion of the total present, considerably outnumbered by UK birds, so that total numbers are mainly determined by the UK numbers, and so are coded green.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 18 to 21.

8.1 Breeding range and taxa

There are six subspecies of great cormorant which is a widely distributed species around the world. However, only two of these subspecies occur in the British Isles; nominate *carbo* breeds in Britain but also the Atlantic coast of Fennoscandia, Iceland and Greenland and breeds mainly at coastal colonies, and *sinensis* breeds mainly at freshwater colonies from northern France to the Baltic Sea and eastwards into China. Although most British and Irish cormorants are of the nominate race *carbo*, some cormorants breeding in Britain and Ireland at freshwater sites are of the continental race *sinensis* (Sellers et al. 1997). There might be potential to identify origins of individual cormorants from biometrics, but this does not seem to have been investigated. Although most cormorants found in UK waters are from the *carbo*

subspecies, substantial numbers of birds of the *sinensis* subspecies visit UK waters on migration and overwinter, these *sinensis* birds being found predominantly in UK southern North Sea waters and being scarce in other parts of the UK marine area.

8.2 Non-breeding component of the population

Great cormorants start to breed when 3 years old (BTO Birdfacts). Adult survival rate is 0.88 (BTO Birdfacts), juvenile survival 0.58 (BTO Birdfacts) and mean productivity is 1.913 chicks per pair (JNCC database, n=62 measurements). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.6 for 1-year olds and 0.7 for 2-year olds. The model population comprised 46% adults, 30% juveniles and 24% older immatures. There are 1.17 immatures per adult.

8.3 Phenology

Breeding colonies are not completely deserted until September (Brown and Grice 2005), but modal departure occurs in late June and July (Pennington et al. 2004; Forrester et al. 2007). However, autumn migration starts in mid-June (Cramp et al. 1977-94), July/August (Wernham et al. 2002; Forrester et al. 2007), or mid-August (Pennington et al. 2004). Peak autumn migration occurs in August-October (Cramp et al. 1977-94), September (Forrester et al. 2007), mid-September (Pennington et al. 2004), September-November (Wernham et al. 2002). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late July and August (Figure 8.1). Autumn migration is completed by early November (Forrester et al. 2007), mid-November (Pennington et al. 2004) or November (Cramp et al. 1977-94; Wernham et al. 2002), excluding a few stragglers still moving in mid-late November.

Spring migration starts in January (Wernham et al. 2002), mid-January (Cramp et al. 1977-94), early March (Pennington et al. 2004) or March (Forrester et al. 2007). Peak spring migration occurs in February-March (Cramp et al. 1977-94; Wernham et al. 2002) or April (Pennington et al. 2004) or April-May (Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late January to late-March (Figure 8.1). Spring migration is completed by early April (Cramp et al. 1977-94), May (Wernham et al. 2002) or late May (Pennington et al. 2004; Forrester et al. 2007).

The first spring records of cormorant in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from 1 January and the last records were predominantly at 31 December, as cormorants overwinter, while peak autumn migration was reported in August to October in most years, and peak spring migration was reported in March to May in most years. Birds re-occupy breeding sites from February or March, but modal re-occupation occurs in March (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007).

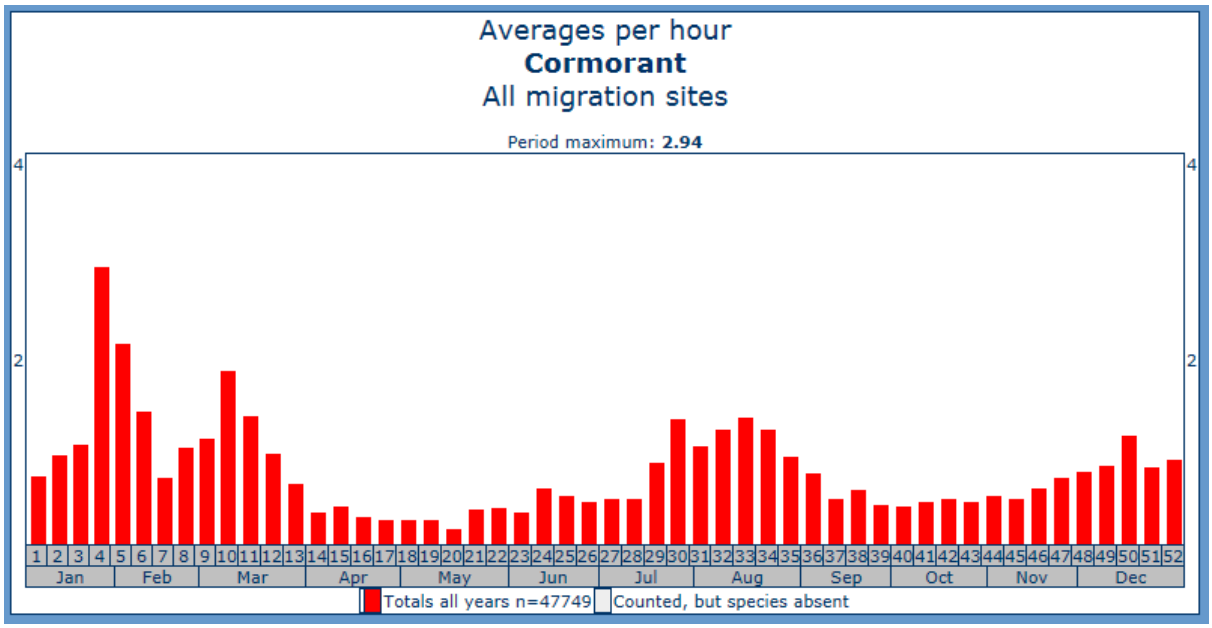


Figure 8.1. Average numbers of great cormorants counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as April-August, non-breeding season September-March.

8.4 Defined seasons:

- UK Breeding season — April-August
- Post-breeding migration in UK waters — August-October (with a few in July and November)
- non-breeding season — September-March (**non-breeding BDMPS**)
- Return migration through UK waters — February-April
- Migration-free breeding season — May-July
- Migration-free winter season — November-January

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for great cormorant:

Non-breeding season BDMPS (September-March).

8.5 Movements of birds from the UK population

Birds from British and Irish coastal colonies mostly overwinter near to their breeding site in coastal habitat (Wernham et al. 2002), but some move onto freshwater habitat in winter (Bearhop et al. 1999). In England, birds show a progressive movement from coastal areas to freshwater sites from September to December (Brown and Grice 2005). The proportion using freshwater habitat in winter has increased (Rehfisch et al. 1999), but is likely to vary according to winter weather, with birds moving back to marine habitats if freshwater sites freeze over. A small proportion of breeders move longer distances south to winter in France or northern Iberia. Long distance movements are more frequent among immatures, especially juveniles (Wernham et al. 2002). Ringing data suggest that birds hardly move south from breeding areas until October, and reach maximum distance south in November, slowly moving northwards from December to May (Wernham et al. 2002). However, it is

evident from observation that birds depart from breeding colonies from July onwards (Wernham et al. 2002) so presumably initial dispersal is of a very limited scale. Almost all adult recoveries are in the breeding area from March onwards, while northward movements of immatures in spring occur later than those of adults (Wernham et al. 2002). There are regional differences around the British Isles in distances and directions moved by cormorants in autumn/winter (Coulson and Brazendale 1968; Wernham et al. 2002). Cormorants from Shetland and Orkney rarely move further south than southern Scotland or northern England. Cormorants from west England may cross the Irish Sea into Ireland, but the predominant direction of movement of those birds is southeastwards into SE England. Cormorants from Wales are the ones most likely to winter inland, predominantly moving to freshwater sites in England. Cormorants from SW England are the ones most likely to winter in Iberia or France. Cormorants tend to be faithful to their particular wintering site; colour ringed birds tend to be observed at their preferred wintering site both within and between winters (Wernham et al. 2002). Most immature cormorants tend to spend the summer close to colonies, although a few may summer in wintering areas.

8.6 Movements of birds from overseas into UK waters

Apart from Irish cormorants moving in small numbers into English freshwater habitat, most foreign-ringed cormorants recovered in the British Isles have been juvenile or immature birds recovered in SE England (where there used to be few breeding colonies). Most recoveries have been in winter, indicating some movement of immatures from continental populations of *sinensis*. These birds, predominantly from the Netherlands, Denmark, or France (Wernham et al. 2002) represent about 2.5% of the British wintering population of cormorants (but 20% of those wintering in freshwater habitat in England), but almost entirely located in SE England. A few of these birds have recruited to breed in SE England. Cormorants ringed as chicks at inland colonies show movement patterns different from UK *carbo* birds and more like those of continental *sinensis* birds (Wernham et al. 2002). Typically, *sinensis* birds migrate further southwards in winter. Many inland reared birds move south into France rather than overwintering in the UK, especially when young. Seabird 2000 reported 8,884 pairs in UK (but numbers have since declined slightly), 4,100 pairs in Ireland, 40,126 pairs in Denmark, 25,150 pairs in Norway, 19,205 pairs in the Netherlands, and 1,500 pairs in France (Mitchell et al. 2004), so populations in Norway, Denmark and the Netherlands are considerably larger than the population in the UK, but only a very small proportion of the birds from those continental populations visit the UK.

8.7 Numbers in UK waters

Highest numbers wintering in marine habitat in English waters occur in coastal areas in NW England (Brown and Grice 2005). However, ESAS data are not informative about cormorant numbers at sea because their distribution tends to be very coastal, in a band that is generally not covered by boat surveys at sea. Forrester et al. (2007) suggested that about 9,000-11,500 cormorants are in Scotland and Scottish waters in winter, and that numbers are not greatly higher during the migration periods. Musgrove et al. (2013) reported that there are 25,000 in Britain in winter, and 41,000 in the UK in winter.

8.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *carbo* population, comprising 41,200 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 52,500 pairs. Kober et al. (2010) presented an estimated biogeographic population of 117,900 individuals. In addition, the population of the subspecies *sinensis*, which occurs in small numbers in the UK, is some 300,000 to 330,000 pairs (Brown and Grice 2005). However, numbers of cormorants reaching UK waters from overseas are very small in relation to the large size of the European populations from which they are derived, and represent no more than about 2.5% of the British winter population of cormorants. Almost all of these continental birds occur in SE England, and mostly inland on

freshwater habitat. The biogeographic population with connectivity to UK waters can therefore be defined as the populations of UK (now probably about 8800 pairs so a total of about 39,000 birds including adults and immatures) plus the populations of Denmark, Netherlands, Ireland and France. Those overseas populations sum to 285,000 birds including both adults and immatures. However, it may be more appropriate to consider the total numbers in UK waters in the non-breeding season since very few of those continental birds visit the UK. The total in UK waters in the non-breeding season sums to about 33,500 birds, of which 32,000 originate from UK colonies.



Figure 8.2. Breeding population origins of great cormorants in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

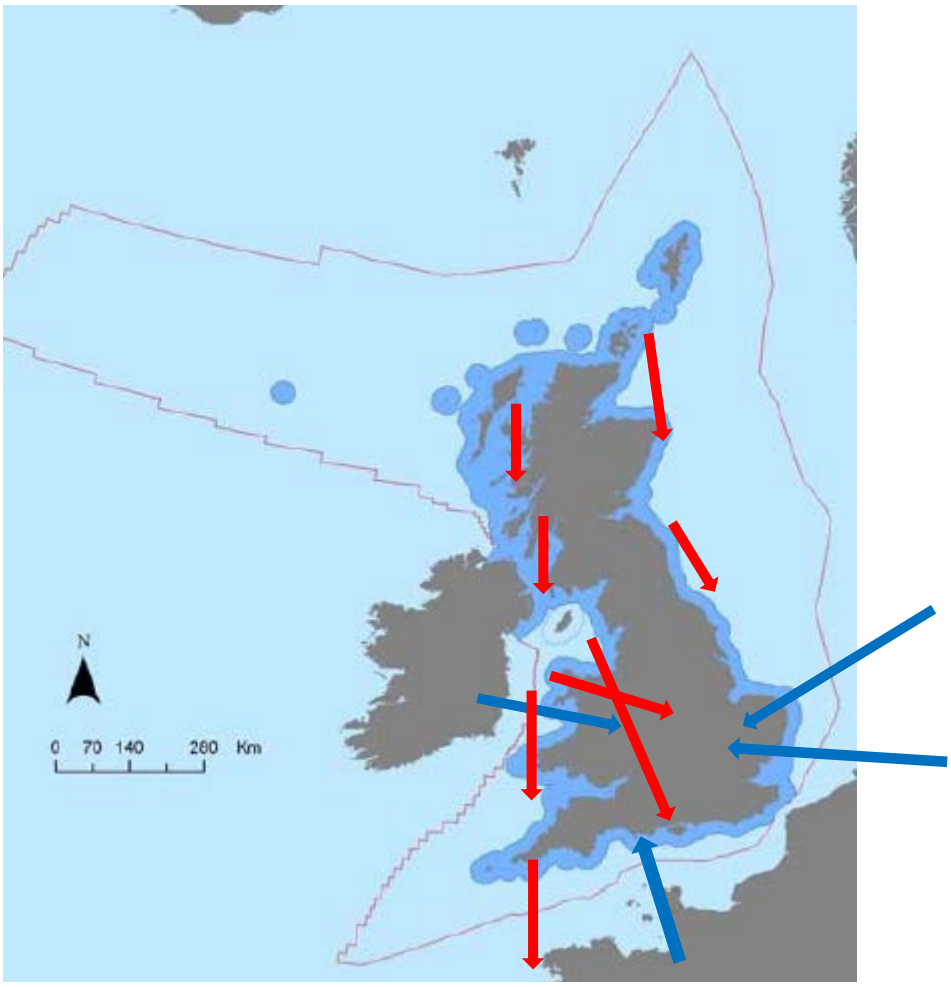


Figure 8.3. Main movements of great cormorants from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

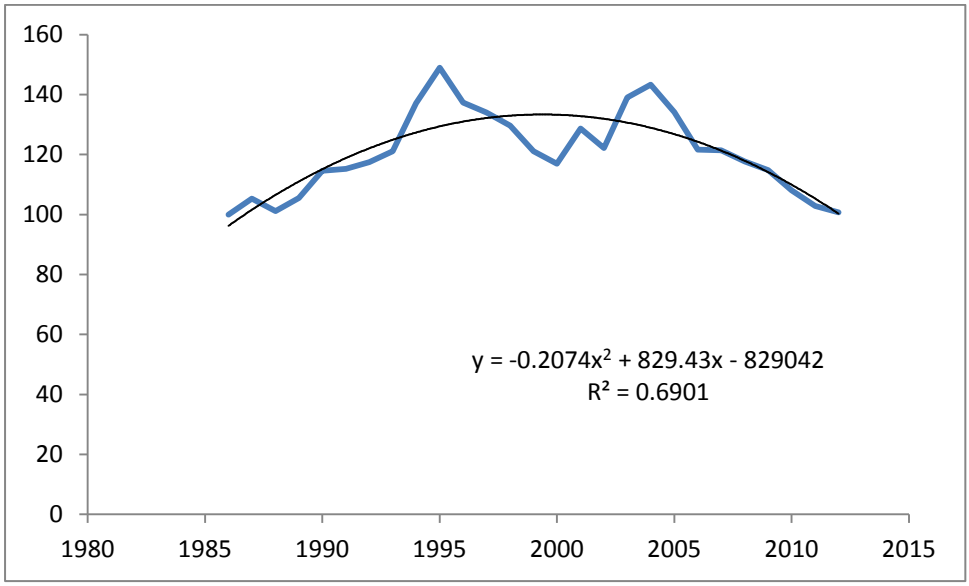


Figure 8.4. Trend in the great cormorant breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

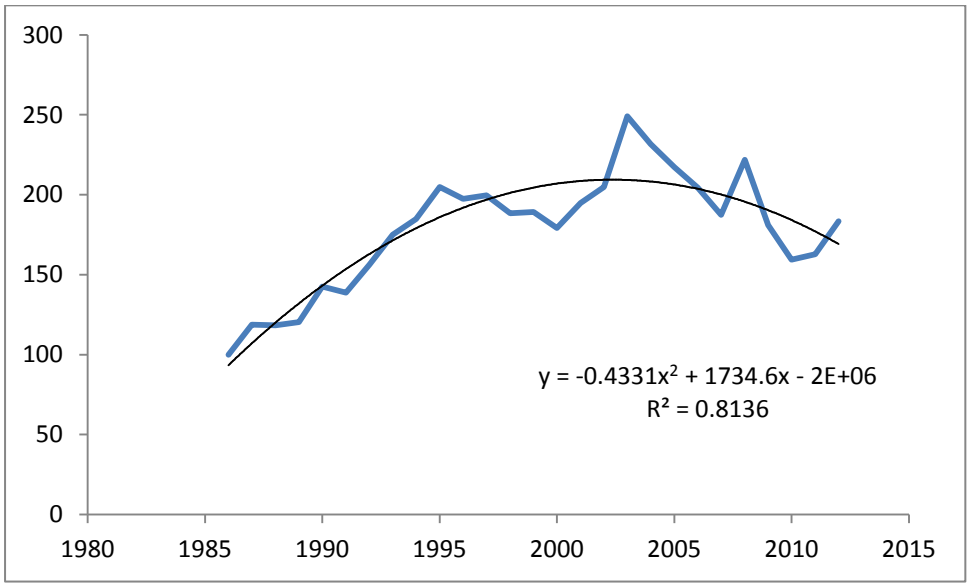


Figure 8.5. Trend in the great cormorant breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

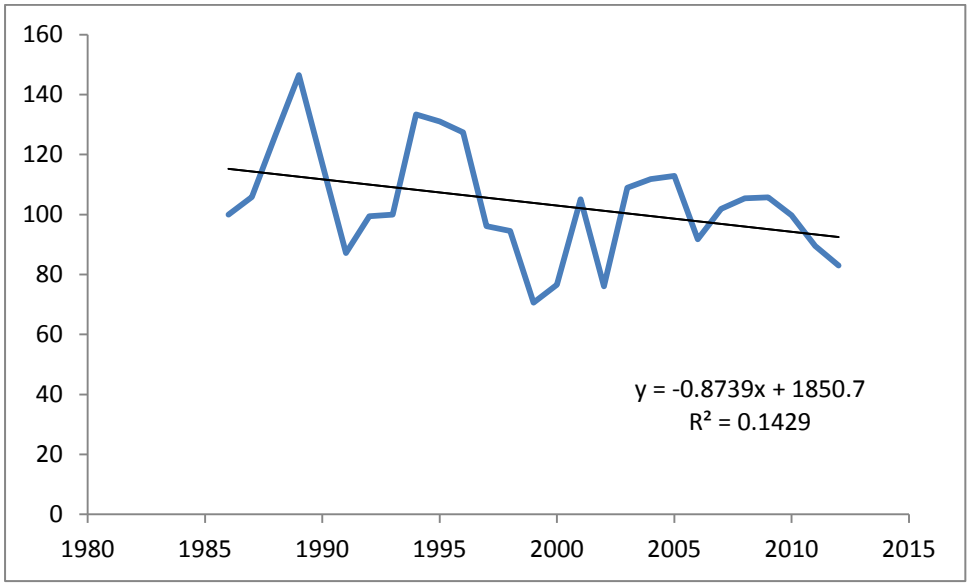


Figure 8.6. Trend in the great cormorant breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

8.9 Proportion of UK population from UK breeding SPAs

The 7 SPAs with breeding great cormorants as a feature together held 2,316 pairs at designation, estimated to represent ca. 30% of the British breeding population (Stroud et al. 2001). Numbers at several of these SPAs have decreased considerably since designation, while the overall population has declined only very slightly relative to numbers around the period of SPA designations. As a consequence the proportion of the GB population breeding within the SPA suite has fallen to an estimated 14.8% in the early 2000s (Stroud et al. 2014). There are also SPAs designated for non-breeding cormorants (Stroud et al. 2001), but those are not relevant in the context of establishing BDMPS.



Figure 8.7. The UK SPA suite for great cormorant. These SPA populations are listed in Table 8.1.

Table 8.1. The UK SPA suite for breeding great cormorants.

SPA	**Location**	**Pairs**	**Year desig-nated**	**Site Condition Monitoring***	**Recent counts**	**Year**	**Reference**
NW North Sea							
Calf of Eday	Orkney	223 (1995)	1998	Maintained 2006	195 204 181	2003 2006 2012	SCM database Lewis et al. 2012 SCM database
East Caithness Cliffs	N Scotland	230 Or 144 (Stroud et al. 2001)	1996	Declined 1999	53 81 67 85 52	2009 2010 2011 2012 2013	SCM database Lewis et al. 2012 SCM database SCM database SCM database
Forth Islands	E Scotland	200 (1985) Or 240 (Stroud et al. 2001)	1990	Declining 2010	102 91 132 57 80	2009 2010 2011 2012 2013	SCM database SCM database Lewis et al. 2012 SCM database SCM database

SW North Sea & Channel							
Farne Islands	NE England	194 (Stroud et al. 2001)	1985		158 145 141 139 121 135 87	2007 2008 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database SCM database
Abberton Reservoir	SE England	490 (1993-1997)	1999		370 352 332 322 216	2000 2001 2002 2004 2005	SCM database SCM database SCM database SCM database SCM database
West of Scotland							
Sheep Island	N Ireland	249 (1992-1996)	1992		182 141 100 117 112	2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database
SW England & Wales							
Puffin Island	Wales	556 (1996-2000) Or 776 (Stroud et al. 2001)	2002		383 730 491 606 760 464 484 410 448	2002 2005 2006 2007 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database SCM database SCM database SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

8.10 BDMPS

It seems appropriate to define four BDMPS for regions of UK waters (Figure 8.8) based on biological populations present. The 'NW North Sea' region holds about 6,000 cormorants in winter, almost exclusively birds from UK colonies within the NW North Sea region, making the composition of this BDMPS highly distinctive in having predominantly birds from NW North Sea colonies. The 'West of Scotland' region holds about 7,000 cormorants in winter, almost exclusively birds from UK colonies within the West of Scotland region, so again highly distinctive and separate from the other BDMPS populations. The 'SW England and Wales' region holds about 9,600 cormorants in winter, almost exclusively birds from UK colonies, but also including some immature birds from colonies in NW Scotland. The 'SW North Sea and Channel' region holds about 10,500 cormorants in winter, including large numbers of immature birds from colonies in Scotland and small numbers of continental birds. In the SW North Sea and Channel region, many birds move onto freshwater sites during winter, if weather permits. A few thousand birds from the UK population, mostly immatures, winter in France rather than in the UK. Migration of those birds to/from the Continent (mostly northern France) will marginally increase the BDMPS in southern Britain in the migration seasons compared to winter, but this difference is thought to be small enough that the BDMPS can be used for the entire non-breeding period.

Detailed composition of each of these four BDMPS populations is presented in Appendix A Tables 18 to 21.

Based on evidence reviewed in sections 8.5, 8.6 and 8.7, in the UK NW North Sea BDMPS numbers from UK breeding colonies are large enough to provide virtually all of the numbers of cormorants thought to be found in this area in the non-breeding season, so the proportions of overseas populations visiting this area appear to be extremely small. It is estimated that the percentages derived from overseas populations are 0% of birds from Ireland and France, 0.1% of immatures from Denmark, and 0.01% of immatures from The Netherlands, giving an estimate of only 98 birds from overseas populations in this BDMPS (Appendix A Table 18). It is estimated that 100% of adults and immatures from colonies in Orkney and Caithness remain in this BDMPS in the non-breeding season, together with 60% of adults and 50% of immatures from the Forth Islands and 80% of adults and immatures from UK NW North Sea non-SPA colonies, 10% of adults and 20% of immatures from the Farne Islands, 5% of adults and immatures from UK SW North Sea non-SPA colonies, but 0% of birds from Abberton Reservoir. In addition, ringing suggests that small numbers from western waters colonies move into the NW North Sea during the non-breeding season (Wernham et al. 2002) so the proportions are estimated at 0% of adults and 0.1% of immatures from western colonies (Appendix A Table 18). This gives an estimated total of 5,914 birds from UK populations in this BDMPS.

Based on evidence reviewed in sections 8.5, 8.6 and 8.7, in the UK SW North Sea and Channel BDMPS proportions of overseas populations visiting this area appear to be small, but much larger than in the other BDMPS populations. It is estimated that the percentages derived from overseas populations are 0.5% of immatures from Denmark, and 0.1% of adults and 0.1% of immatures from The Netherlands, giving an estimate of 1,107 birds from overseas populations in this BDMPS (Appendix A Table 19). It is estimated that negligible numbers (rounded to 0%) of adults and immatures from colonies in Orkney and Caithness join this BDMPS in the non-breeding season, but that there are 40% of the adults and 50% of immatures from the Forth Islands, and 20% of adults and immatures from UK NW North Sea non-SPA colonies, 90% of adults and 80% of immatures from the Farne Islands, 80% of adults and 70% of immatures from UK SW North Sea non-SPA colonies and from Abberton Reservoir. In addition, ringing suggests that small numbers from western waters colonies move into the SW North Sea during the non-breeding season (Wernham et al. 2002) so the proportions are estimated at 0% of adults and 0.1% of immatures from western colonies (Appendix A Table 19). This gives an estimated total of 9,353 birds from UK populations in this BDMPS.

Based on evidence reviewed in sections 8.5, 8.6 and 8.7, in the UK West of Scotland BDMPS proportions of overseas populations visiting this area appear to be extremely small. It is estimated that the percentages derived from overseas populations are 0.1% of immatures from Ireland and 0.05% of immatures from Denmark, giving an estimate of 56 birds from overseas populations in this BDMPS (Appendix A Table 20). Ring recovery data suggest that 0% of adults and immatures from colonies in the North Sea join this BDMPS in the non-breeding season. Ringing suggests that most birds from colonies in the West of Scotland area remain there during the non-breeding season (Wernham et al. 2002) so the proportions are estimated at 80% of adults and 60% of immatures from Sheep Island, 70% of adults and 50% of immatures from non-SPA colonies (which tend to be further south than Sheep Island so have higher connectivity with the BDMPS to the south of this. Probably a very small proportion of immatures from Welsh colonies may disperse northwards into this BDMPS (Wernham et al. 2002), so this proportion is estimated at 1% (Appendix A Table 20). This gives an estimated total of 6,993 birds from UK populations in this BDMPS.

Based on evidence reviewed in sections 8.5, 8.6 and 8.7, in the UK SW England and Wales BDMPS proportions of overseas populations visiting this area appear to be very small. It is estimated that the percentages derived from overseas populations are 2% of immatures from Ireland, 0.1% of immatures from France, and 0.01% of immatures from Denmark and The Netherlands, giving an estimate of 209 birds from overseas populations in this BDMPS

(Appendix A Table 21). Ring recovery data suggest that 0% of adults and immatures from colonies in the North Sea join this BDMPS in the non-breeding season. Ringing suggests that most birds from colonies in the West of Scotland area remain there during the non-breeding season (Wernham et al. 2002) but that some move south into the UK SW England and Wales BDMPS; the proportions are estimated at 20% of adults and 40% of immatures from Sheep Island, 30% of adults and 50% of immatures from non-SPA colonies (Appendix A Table 21). Although some move south into French waters, many birds from Puffin Island (Wales) and from non-SPA colonies in SW England and Wales remain within this area during the non-breeding season; the proportions are estimated at 60% of adults and 40% of immatures. This gives an estimated total of 9,393 birds from UK populations in this BDMPS.

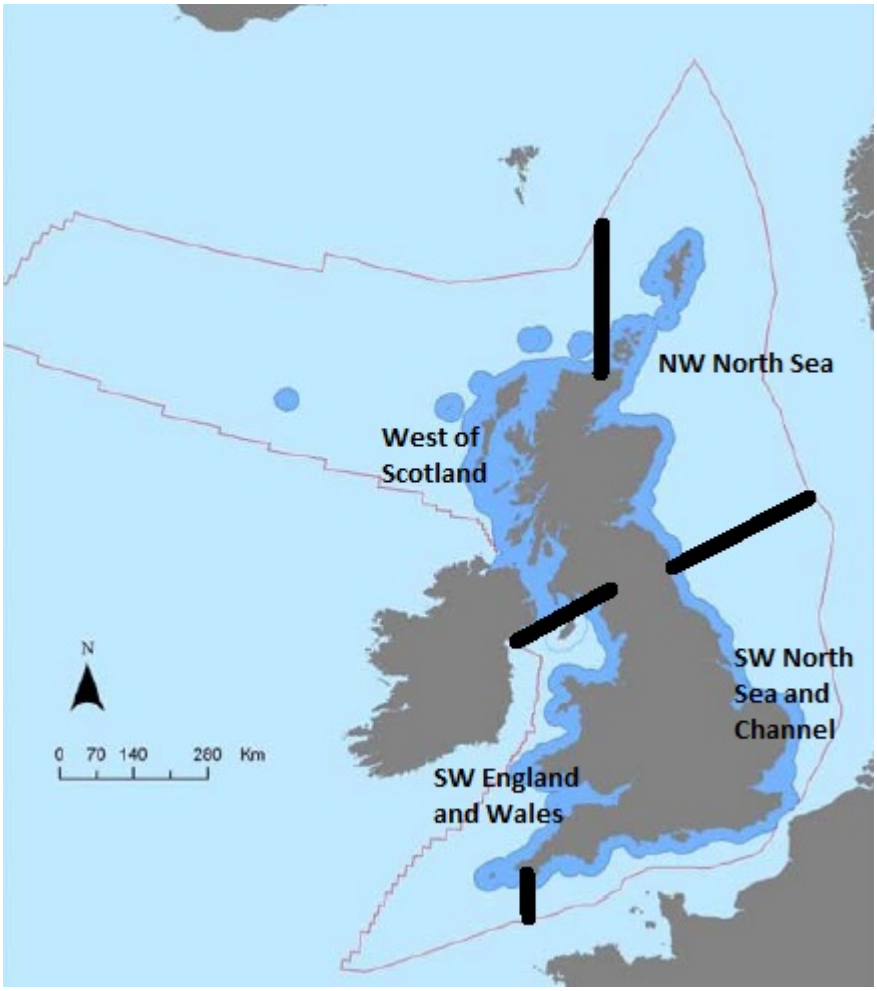


Figure 8.8. Four defined BDMPS spatial areas for great cormorant; NW North Sea, SW North Sea and Channel, West of Scotland, and SW England & Wales.

8.11 Proportions of birds from BDMPS in reference regions

Since almost all cormorants wintering in UK waters are from the UK population and only the SW North Sea and Channel BDMPS receives more than trivial numbers of continental birds, the proportion of birds in each BDMPS that originate from UK SPA breeding populations will be close to the UK average representation of 15%. The NW North Sea region holds the largest number of breeding cormorant SPAs (Table 8.1) but the largest SPA colonies are in the SW England and Wales area and SW North Sea and Channel area. The general population of cormorants breeding in the UK is widely spread across all of these regions, so the proportions of each BDMPS that are birds from UK breeding SPAs will be similar in the four areas. Proportions can be estimated directly from data in Appendix A Tables 18 to 21. For example, for the UK NW North Sea area (Appendix A Table 18), there are estimated to

be 579 adults from UK SPA populations out of a total of 6,012 birds in the non-breeding season BDMPS, giving an estimate of 9.6% of this BDMPS population being adults from UK SPA populations.

8.12 Spatial distribution of UK breeding SPA birds across the BDMPS

The UK breeding cormorant SPA suite is widely distributed across the breeding range of the species in the UK. However, the suite holds only about 15% of the population. Given that many breeding adult cormorants may normally overwinter very close to their breeding site (Wernham et al. 2002 report a median distance between breeding site and wintering site based on ring recovery data of 179 km), it is likely that SPA birds tend to be aggregated in areas close to the seven SPAs, and relatively scarce in areas furthest from the SPAs. However, immature birds are likely to be more widely dispersed than the breeding adults.

9. EUROPEAN SHAG *Phalacrocorax aristotelis*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (September to January) (adults and immatures)
Overseas	9,000	209
UK	97,000	96,078
Total	106,000	96,287

'Non-breeding season' BDMPS (September to January)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
NW North Sea	41,503	0	41,503
SW North Sea & Channel	4,346	0	4,346
West of Scotland	37,363	52	37,311
SW England & Wales	13,075	157	12,918

Colour coding is green for overseas numbers since it is well established from ringing that extremely few shags from overseas populations have ever reached UK waters. Since locations of shag colonies are well known, and shags are known to remain mostly close to their breeding sites throughout the year, colour coding for numbers from UK and total numbers would be green apart from the fact that there is strong evidence for substantial recent declines in numbers at some, but not all, shag colonies. Because some other colonies have not been censused since 1999-2000, there is some uncertainty as to the sizes of those populations (as is evident from Table 9.1 which shows a 90% decline in breeding numbers at Foula SPA in 2000-2013, but much smaller declines at some other sites). This uncertainty seems not enough to code the data red since many of the SPA populations have been counted several times since 2000, and it is likely that declines at non-SPA colonies will be less pronounced since smaller colonies are likely to be less severely affected by density-dependent processes such as competition which is likely to be the cause of declines in numbers.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 22 to 25.

9.1 Breeding range and taxa

The European shag has three subspecies. Nominate *aristotelis* breed from Iceland and northern Scandinavia along the European coast to the Iberian peninsula. *P. a. desmarestii* breeds in the Mediterranean and Black Sea. *P. a. riggenbachi* breeds on the Atlantic coast of

Morocco. Neither of the latter two subspecies has been recorded in UK waters. Biometrics of nominate *aristotelis* do not seem to be useful to identify origins of individual birds.

9.2 Non-breeding component of the population

European shags start to breed when an average of 4 years old (BTO Birdfacts), though Daunt et al. (2003) point out that age of first breeding can vary from 3 to 17 years old in males and 3 to 15 years old in females, while Aebischer et al. (1986) report age of first breeding as 2 for males and 3 for females. Adult survival rate is 0.878 (BTO Birdfacts), juvenile survival 0.38 up to 2 years of age (BTO Birdfacts) and mean productivity is 1.289 chicks per pair (JNCC database, n=237 measurements) (but these can all be greatly affected by weather conditions, especially at exposed colonies on the east coast of Scotland, Frederiksen et al. 2008). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.62 for 1-year olds, 0.72 for 2-year olds, 0.85 for 3-year olds. The model population comprised 43% adults, 28% juveniles and 29% older immatures. There are 1.31 immatures per adult.

9.3 Phenology

Although breeding colonies are not completely deserted until October or November, modal departure occurs in August to October (Pennington et al. 2004; Forrester et al. 2007) and extremely few birds remain at colonies after September. In extreme cases, shags can sometimes still be breeding into October, and the last chicks may not fledge until after October in some years and colonies. However, autumn post-breeding dispersal/migration starts in July (Cramp et al. 1977-94), August (Wernham et al. 2002; Forrester et al. 2007), or mid-August (Pennington et al. 2004). Peak autumn migration occurs in August-October (Cramp et al. 1977-94), September (Pennington et al. 2004), or September-October (Wernham et al. 2002; Forrester et al. 2007). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late August and early September, but autumn passage was not pronounced (Figure 9.1). Autumn migration is completed by late October (Pennington et al. 2004), early November (Forrester et al. 2007) or November (Cramp et al. 1977-94; Wernham et al. 2002).

Spring migration starts in November (Pennington et al. 2004), late November (Forrester et al. 2007), December (Wernham et al. 2002) or mid-January (Cramp et al. 1977-94). Peak spring migration occurs in December (Pennington et al. 2004; Forrester et al. 2007), January (Wernham et al. 2002) or February (Cramp et al. 1977-94). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late November to February, with the most rapid decline in numbers (which may indicate birds returning to breeding areas) in January-March (Figure 9.1). Spring migration is completed by January (Pennington et al. 2004; Forrester et al. 2007), mid-March (Wernham et al. 2002) or mid-April (Cramp et al. 1977-94).

The first spring records of shag in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 1 January and the last records were at 31 December, as large numbers of shags overwinter, while peak autumn migration was reported in August to October in most years, and peak spring migration was not evident in most years. Birds start to re-occupy colonies from the start of January, but modal re-occupation occurs in February (Pennington et al. 2004; Forrester et al. 2007).

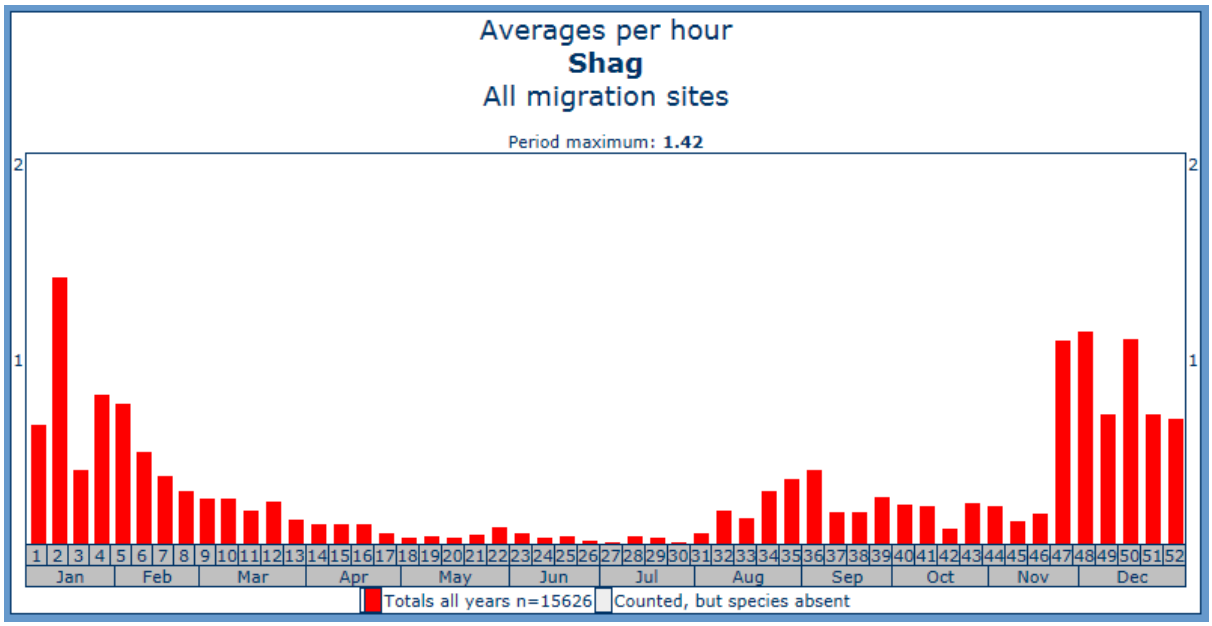


Figure 9.1. Average numbers of shags counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as March-September, non-breeding season October-February. However, from the data reviewed above, a more appropriate definition would be breeding season February-August, non-breeding season September-January.

9.4 Defined seasons:

- UK Breeding season — February-August (sometimes into October)
- Post-breeding migration in UK waters — August-October
- non-breeding season — September-January (**non-breeding BDMPS**)
- Return migration through UK waters — December-February
- Migration-free breeding season — March-July
- Migration-free winter season — November

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for European shag:

Non-breeding season BDMPS (September-January).

9.5 Movements of birds from the UK population

Shags at colonies in the British Isles are considered to disperse and not migrate, and relatively few birds move from their natal colony to breed at another colony (Barlow et al. 2013). However, the extent of dispersal varies between regions (Galbraith et al. 1986), probably to a large extent in response to the ease with which birds can find sheltered areas in the non-breeding season to avoid storms (Harris and Swann in Wernham et al. 2002). Thus birds from colonies in NE England and SE Scotland move the furthest, along a coastline where there is little protection from easterly storms. Indeed, 'wrecks' of shags from colonies in East Britain occur associated with easterly storms (Aebischer 1995), whereas wrecks are very unusual elsewhere in the UK (Frederiksen et al. 2008, Wernham et al. 2002). Birds at colonies in west Britain move very little. Many adults remain within 50 km of

their breeding site throughout the year, even at northernmost colonies (Harris and Swann in Wernham et al. 2002). Immature birds disperse further, on average, than adults (Harris and Swann in Wernham et al. 2002). Very few shags from UK colonies have been recovered outside the UK; a few birds from the northern isles have been recovered in Norway, Denmark and as far as the southern North Sea, and a few from colonies in SW Britain and southern Ireland have been recovered in France (Wernham et al. 2002). Fledglings are fed by parents for some weeks after fledging, and after that period post-fledging dispersal occurs away from colonies. The timing of this dispersal varies greatly as timing of breeding in shags is much earlier in SW Britain than in NE Britain, and the breeding season is very protracted everywhere. So chicks may fledge from April to August.

9.6 Movements of birds from overseas into UK waters

No shags from Norway, Iceland or Faroe have been recovered in the UK (Wernham et al. 2002; Hammer et al. 2013). The only 'foreign-ringed' shags recovered in the British Isles originated from France and the Channel Islands, involving small numbers of birds crossing the English Channel (Wernham et al. 2002). However, some Irish-ringed birds have been recovered in SW England (Brown and Grice 2005) but these are not classified as 'foreign' because Ireland uses the same ringing scheme as the UK. Deployment of geolocators on breeding adult shags at colonies in UK (Isle of May), Iceland (Flatey), and north Norway (Røst and Hornøya) showed that birds from the UK and Icelandic colonies remained close to their colony through the winter. Some birds from Hornøya remained in the Barents Sea near to their colony through winter, but some moved south into the Norwegian Sea (Daunt et al. 2010). However, none of the Norwegian birds moved anywhere near to UK waters. Seabird 2000 reported 26,565 pairs in UK, so even if small numbers of shags from overseas populations occasionally visit UK waters, they are unlikely to represent more than a negligible fraction of the numbers in the UK during migration periods or winter.

9.7 Numbers in UK waters

Shags are not efficiently surveyed by ESAS surveys because they are extremely coastal, and often stand on the shore when not foraging. However, numbers in UK waters will be almost identical to the UK shag population size, since hardly any birds from overseas move into UK waters, and hardly any UK shags move out of UK waters. Numbers of shags in UK colonies have declined considerably since the Seabird 2000 survey, by about 20% from 2000 to 2012 (Figure 9.4), although there are divergent regional patterns with larger decreases in Scotland than in England, and an increase in Wales (Figures 9.5 to 9.7). There are relatively few in Wales though, so the increase there is far smaller than the decrease in Scotland. Overall, the UK breeding population is likely to be about 20,000 to 21,000 pairs now, or up to 42,000 adults. There will be about 55,000 immatures associated with these breeding numbers, so the total population is around 97,000 individuals.

9.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *aristotelis* population, comprising 125,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 66,000-73,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 201,800 individuals. Given that movement of birds into and out of UK waters is negligible except with regard to birds from Ireland, an appropriate biogeographic population with connectivity to UK waters would be the UK population of 20,000 to 21,000 pairs, or 97,000 birds including the immatures, plus the population in Ireland of around 2,000 pairs (equivalent to about 9,000 birds including immatures), so a grand total of 106,000 birds. From this population, numbers in the non-breeding season in all UK waters are estimated at 200 birds from overseas, plus 96,000 from UK colonies, giving a grand total in UK waters of 96,200 birds in the non-breeding season.



Figure 9.2. Breeding population origins of shags in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

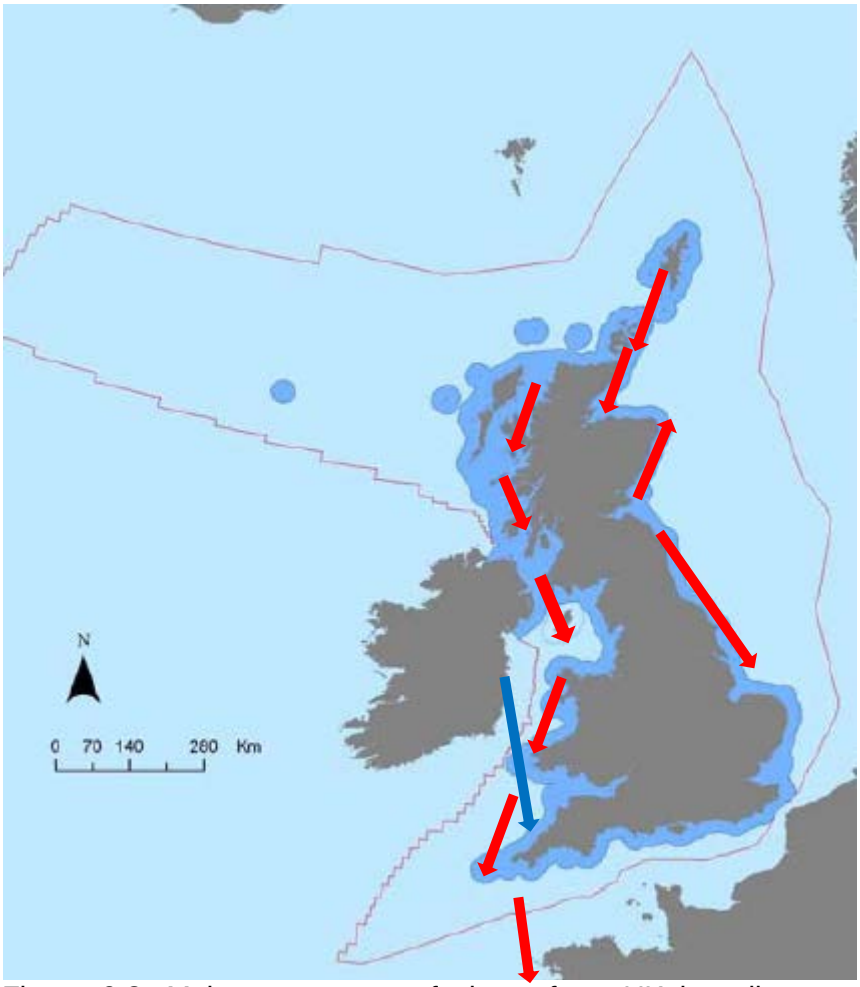


Figure 9.3. Main movements of shags from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration.

Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

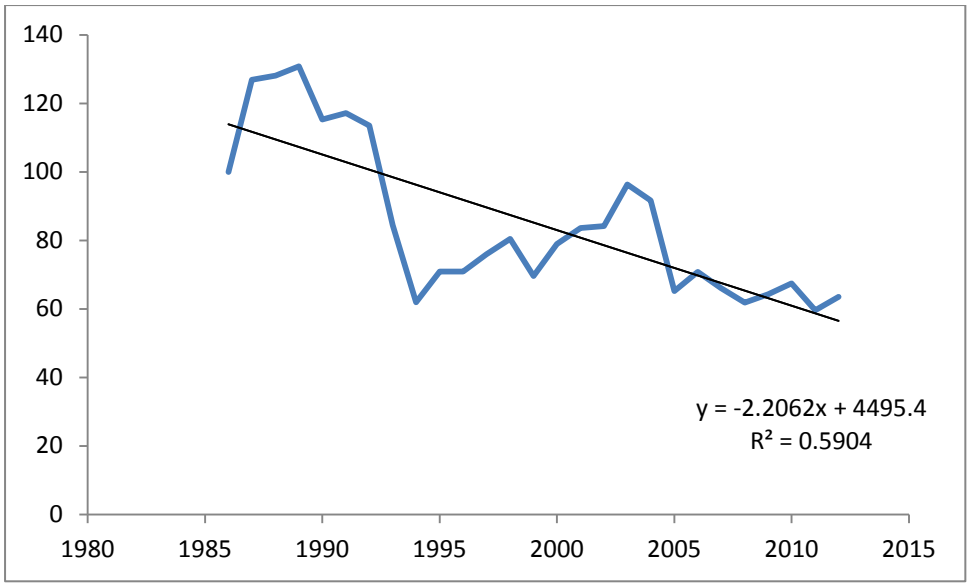


Figure 9.4. Trend in the shag breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

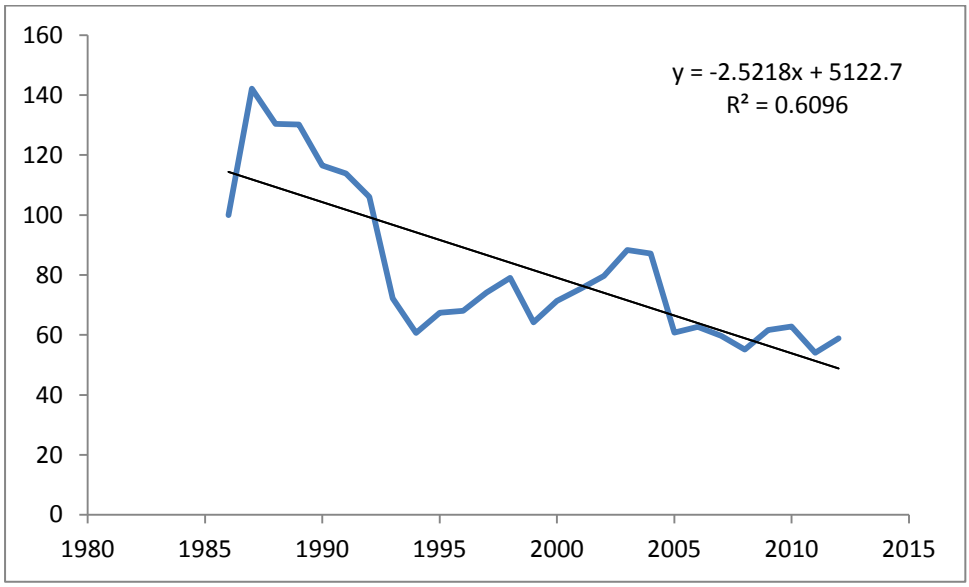


Figure 9.5. Trend in the shag breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

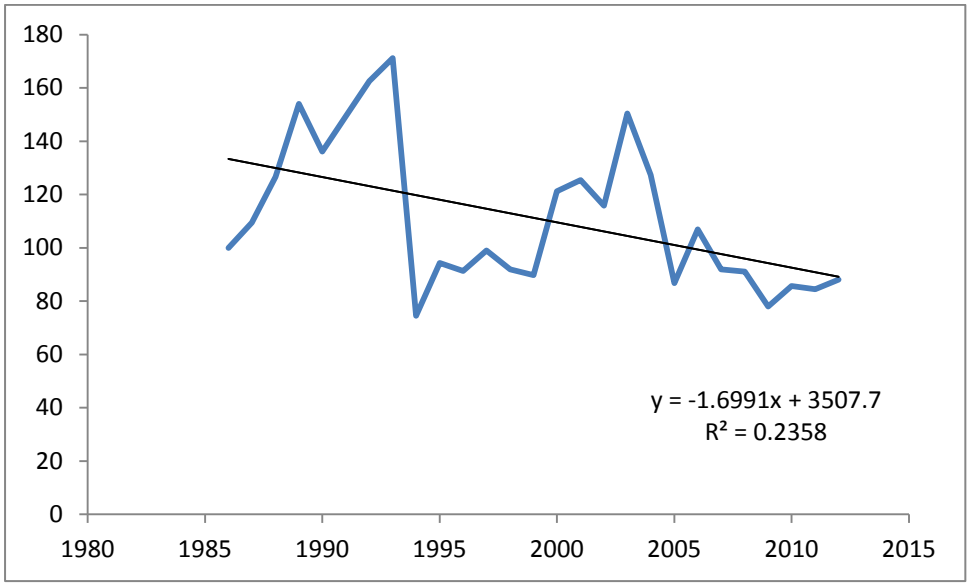


Figure 9.6. Trend in the shag breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

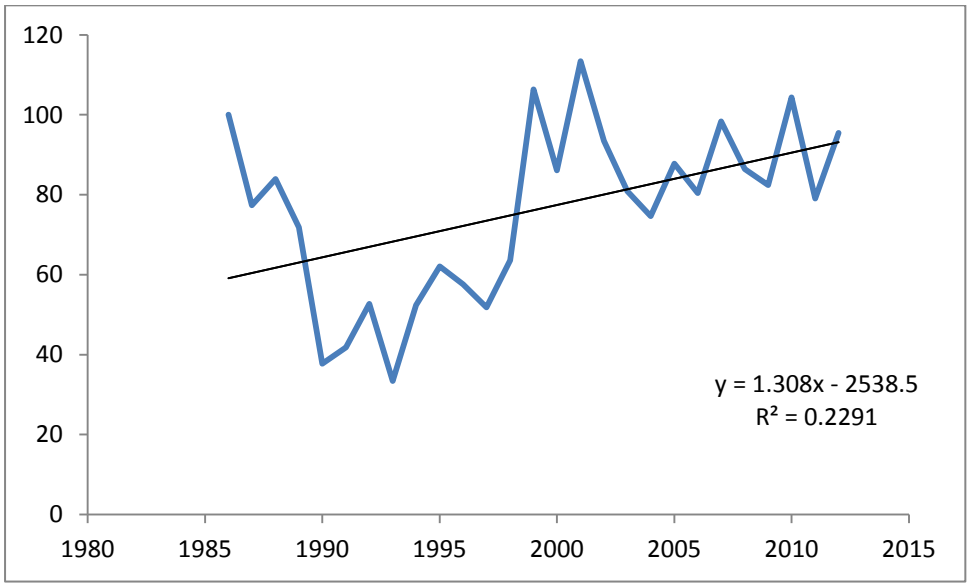


Figure 9.7. Trend in the shag breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

9.9 Proportion of UK population from UK breeding SPAs

The 13 SPAs with breeding shags as a feature together held 17,584 pairs at designation, estimated to represent ca. 47% of the British breeding population (Stroud et al. 2001). Numbers of shags have declined considerably in Scotland, but have declined only slightly in England and have increased slightly in Wales (but because most shags in the UK breed in Scotland, the better performance further south does not compensate for declines in Scottish colonies). Some colonies have declined very dramatically (for example the largest colony in Europe was at Foula, Shetland, and that fell from around 3,000 pairs in the 1970s to 2,277 pairs in 2000, and fewer than 200 pairs in 2013. Many of the largest declines appear to have occurred at the largest colonies, consistent with a density-dependent impact of reduced food supply. As a consequence, the proportion of the population within the SPA suite for shags fell to about 34% of the GB population in the 2000s (Stroud et al. 2014). The proportion within the SPA suite has almost certainly fallen further still since then (for example Stroud et

al. 2014 used the 2000 estimate of 2,300 pairs for Foula whereas now that number is down to <200). The suite probably now holds around 25-30% of the UK shag population.

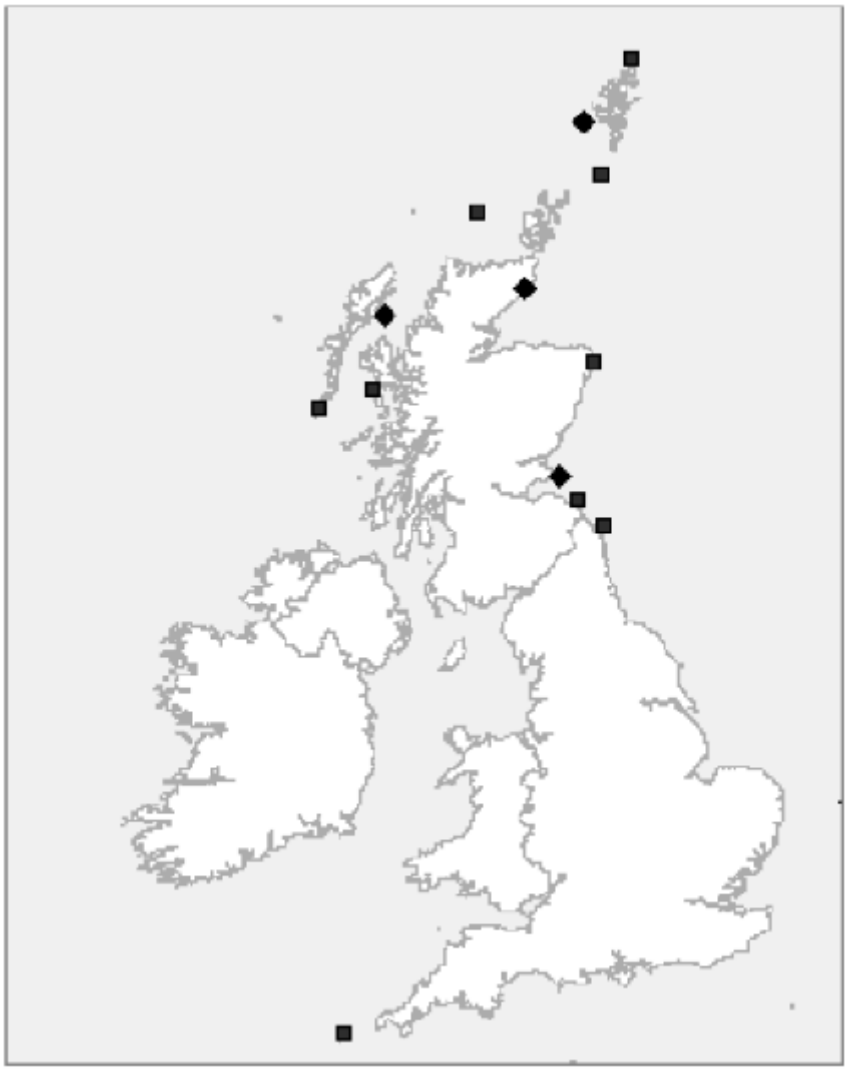


Figure 9.8. The SPA suite for shag. These SPA populations are listed in Table 9.1.

Table 9.1. The UK SPA suite for breeding shags.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent counts	Year	Reference
NW North Sea							
Hermaness, Saxavord & Valla Field	Shetland	540	1994	Declined 2002	82 H'ness only: 94 33 41	1999 1994 1999 2002	Stroud et al. 2014 SMP database SMP database SMP database
Foula	Shetland	2,400 (1997)	1995	Declined 2007	2,300 258 <200	2000 2007 2013	Seabird2000 SMP database Gear 2013
Fair Isle	Shetland	1,099	1994	Declined 2008	567 663 732 235 204	1998 2001 2003 2008 2013	SMP database SMP database SMP database Lewis et al. 2012 SMP database

East Caithness Cliffs	N Scotland	2,345 (1986)	1996	Declined 1999	1,056	1999	Seabird2000
Buchan Ness to Collieston Coast	NE Scotland	1,045	1998	No change 2007	344 331	2007 2007	Lewis et al. 2012 Stroud et al. 2014
Forth Islands	E Scotland	2,400 (1985) Or 2,887 (Stroud et al. 2001)	1990	Recovering 2001	1,088 1,050 1,060 850	2010 2011 2012 2013	Lewis et al. 2012 SMP database SMP database SMP database
SW North Sea & Channel							
St Abb's Head to Fast Castle	E Scotland	651	1997	Declined 2008	329 269 160	2000 2000 2011	Stroud et al. 2014 Seabird2000 Lewis et al. 2012
Farne Islands	NE England	994 (Stroud et al. 2001)	1985		1,059 1,015 838 925 926 965 582	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
West of Scotland							
Sule Skerry and Sule Stack	N Scotland	874 (1986)	1994	Maintained 1998	701 724 15 200	1993 1998 2007 2011	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
Shiant Isles	Western Isles	1,780 (1986)	1992	Maintained 1999	506	1999	Seabird2000
Canna and Sanday	Inner Hebrides	1,140	1998	No change 2006	305 226 270 255	2010 2011 2012 2013	SMP database SMP database SMP database SMP database
Mingulay and Berneray	Western Isles	721 (1985)	1994	Declined 2009	281 330 115	1998 2003 2009	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
SW England & Wales							
Isles of Scilly	SW England	1,108	2001		1,296	2006	SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

9.10 BDMPS

Since adult shags show only very limited migration (most adults recovered in the non-breeding season being within 50 km of their breeding site; Wernham et al. 2002), UK waters can be split into several distinct non-breeding season BDMPS for shags. Birds from North Sea colonies tend to be more mobile than birds from western waters colonies, probably due to the greater exposure of east coast waters compared to relatively sheltered conditions in much of the west coast coastline. Based on evidence reviewed in sections 9.5, 9.6 and 9.7, the UK NW North Sea region holds about 41,500 birds in winter, with some birds, especially immatures, moving up or down much of the coastline. The West of Scotland region holds about 37,000 birds in winter, almost all derived from local colonies in that area. The SW England and Wales region holds about 13,000 birds in winter, many of which are immature birds from breeding sites further north, as breeding numbers in that region are relatively

small but immatures from colonies further north move southwards into the area with relatively few locally breeding birds. The SW North Sea and Channel holds about 4,000 birds in winter, most of which are immature birds from breeding sites further north. Numbers during migration periods are essentially the same as these wintering numbers, so the BDMPS are appropriate for migration periods as well as wintering period.

The UK NW North Sea BDMPS has no birds from overseas populations. All adults from colonies in Shetland to Berwickshire are likely to remain within this BDMPS in the non-breeding season. All immatures from Shetland to Aberdeenshire are also likely to remain in the area, while it is estimated that 90% from Forth Islands and 80% of immatures from St Abbs Head area do so. It is estimated that 30% of adults and 40% of immatures from the Farne Islands spend the non-breeding period in the UK NW North Sea BDMPS. No birds from western colonies are thought to move into the area during the non-breeding season so that connectivity with populations to the west of the UK is negligible or zero. These figures result in an estimated BDMPS population of 41,503 birds in the UK NW North Sea BDMPS (Appendix A Table 22).

There have been a few recoveries of ringed shags from NW France in SE England (Wernham et al. 2002), but these appear to be negligible numbers from a small population in which many birds have been ringed, so connectivity between the French breeding population and UK waters is considered to be negligible. On this basis, the UK SW North Sea and Channel BDMPS has no significant numbers of birds from overseas populations. Although no birds from colonies in Shetland to Aberdeenshire are likely to move into the UK SW North Sea and Channel BDMPS, it is estimated that 10% of immatures from Forth Islands and 20% of immatures from St Abbs Head area do so. It is estimated that 70% of adults and 60% of immatures from the Farne Islands, and all birds from the non-SPA colonies in UK SW North Sea and Channel spend the non-breeding period in the UK SW North Sea and Channel BDMPS. No birds from western colonies are thought to move into the area during the non-breeding season so that connectivity with populations to the west of the UK is negligible or zero. These figures result in an estimated BDMPS population of 4,346 birds in the UK SW North Sea and Channel BDMPS (Appendix A Table 23).

Based on evidence reviewed in sections 9.5, 9.6 and 9.7, the UK West of Scotland waters BDMPS has small numbers of birds from Irish populations; it is estimated that perhaps 1% of immatures from Ireland spend the non-breeding season in this BDMPS (an estimated 52 birds). No birds from North Sea colonies are likely to be in this BDMPS in the non-breeding season. All birds from colonies in west Scotland are thought to remain within the area during the non-breeding season, but no birds from Wales and SW England are thought to move into the area. These figures result in an estimated BDMPS population of 37,311 birds in West of Scotland waters BDMPS (Appendix A Table 24).

Based on evidence reviewed in sections 9.5, 9.6 and 9.7, the UK Wales and SW England waters BDMPS has small numbers of birds from Irish populations; it is estimated that 3% of immatures from Ireland (157 birds) are in the BDMPS in the non-breeding season. No birds from North Sea or West of Scotland colonies are thought to move into the area during the non-breeding season. All birds from the Isles of Scilly and from non-SPA colonies in SW England and Wales are thought to remain within this BDMPS in the non-breeding season. These figures result in an estimated BDMPS population of 13,075 birds in the UK Wales and SW England waters BDMPS, with 12,918 coming from UK colonies (Appendix A Table 25).

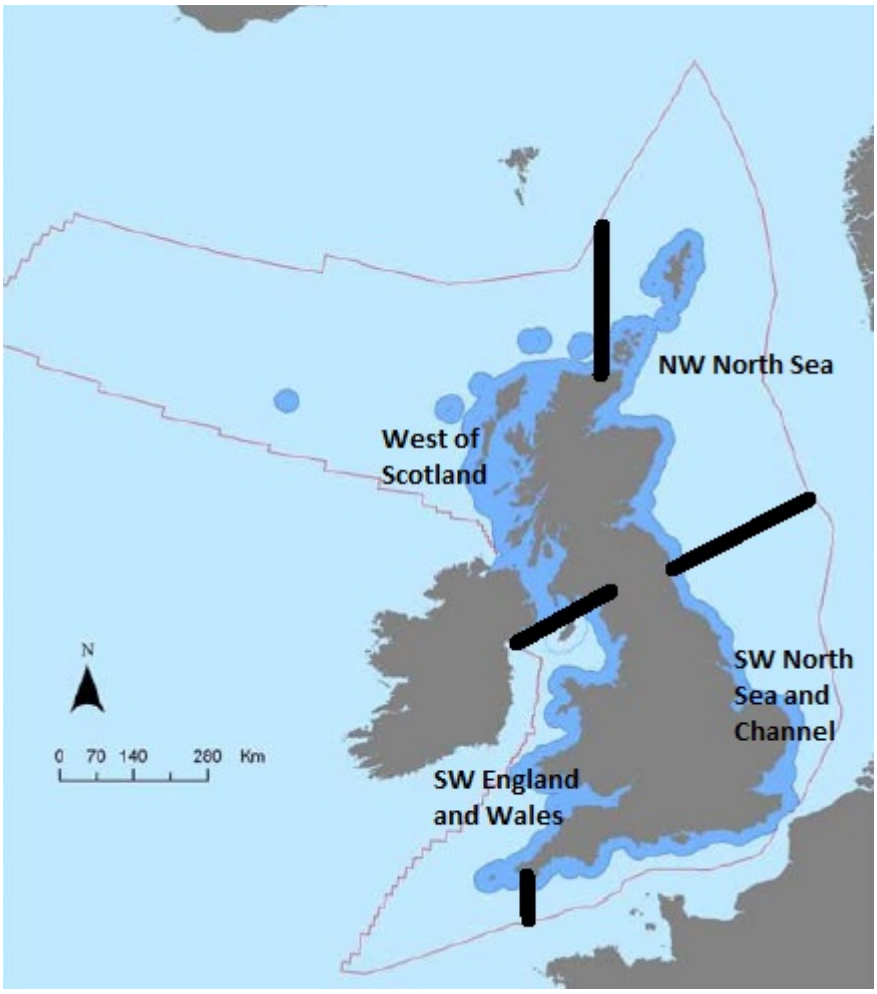


Figure 9.9. Four defined BDMPS spatial areas for shag; NW North Sea, SW North Sea and Channel, West of Scotland, and SW England & Wales.

9.11 Proportions of UK breeding SPA birds in each BDMPS

The distribution of breeding shag SPA populations is closely similar to the overall distribution of breeding shags in the UK. While almost all of the SPA sites are in the northern BDMPS (with the sole exception of the Isles of Scilly), most shags occurring in winter in the SW North Sea and Channel are immature birds dispersed from sites in the NW North Sea, so include immatures from SPAs. However, there are no breeding shag SPA populations in Wales or SW Scotland where there are breeding colonies, so the proportion of SPA birds in the SW England and Wales BDMPS will be lower than in the others. Proportions of adults from SPA colonies in each BDMPS can be computed from data in Appendix A Tables 22 to 25. For example, in the UK NW North Sea non-breeding season BDMPS, there are estimated to be 41,503 birds, of which 6,033 are adults from SPA populations, so those birds represent 14.5% of the total present in that BDMPS.

9.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Although only about 25-30% of shags in UK waters are from SPA populations, the 13 SPAs with breeding shags as a feature are well distributed across the breeding range of this species in the UK. Because adult shags may remain at colony sites through the winter, there is likely to be a tendency for SPA birds to be aggregated close to SPAs at all times of year (ring recoveries suggest that most adults remain within 50 km of their breeding area during the non-breeding season; Harris and Swann in Wernham et al. 2002). This aggregation may be most evident in the West of Scotland and SW England and Wales regions, where shags are most sedentary (Harris and Swann in Wernham et al. 2002). Birds from SPAs in the NW

North Sea region tend to disperse further. However, to counteract that effect, there are relatively more small non-SPA colonies of shags in the West of Scotland region between the SPA sites. Clearly if most adults move only a few tens of kilometres between breeding sites and wintering sites, the shags from colonies in on part of a BDMPS will not mix extensively with shags from areas on the other end of the BDMPS area. It might therefore be appropriate in assessments of impacts to define a reference area smaller than an entire BDMPS centered around a development site, and focus on the populations within that defined reference area. An appropriate reference area might be smaller in UK western waters than in the North Sea since shags are less mobine in western waters than in North Sea waters. Which populations should be included can be assessed from data presented in Tables 22 to 25. It would probably be appropriate to consider birds from all colonies within a radius of 300 km from a development site, but exclude consideration of birds from colonies at greater distances (since ring recoveries even of immature birds are predominantly from within 100 km of the location where the bird was originally ringed).

10. ARCTIC SKUA *Stercorarius parasiticus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in autumn (August to October) (adults and immatures)	Numbers in UK waters in spring (April-May) (adults and immatures)
Overseas	226,000	9,064	3,786
UK	3,000	2,650	2,552
Total	229,000	11,714	6,338

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Autumn migration BDMPS (August to October)			
UK North Sea and Channel	6,427	5,216	1,211
UK Western waters	5,287	3,848	1,439
Spring migration BDMPS (April-May)			
UK North Sea and Channel	1,227	582	645
UK Western waters	5,111	3,204	1,907

Although there are relatively few colonies of Arctic skuas in the UK, and the species is relatively easy to census, the numbers breeding in UK colonies have declined dramatically in recent years, with this species moving directly from being Green-listed to Red-listed as a consequence of the large decrease in breeding numbers. In addition, several colonies have not been censused since Seabird2000, so that current numbers are uncertain, especially in areas where the species is widely scattered at low density – areas where population trends may differ from those at large colonies with high nesting density. However, most SPA populations have been counted several times since 2000, and a complete survey was carried out in Orkney in 2010. So estimated numbers of UK birds migrating through UK waters are coded amber. Numbers of Arctic skuas that pass through UK waters have been estimated from sources such as seawatching data and ESAS data and reported in several publications (e.g. Forrester et al. 2007), but these numbers are relatively uncertain, and seem to vary from year to year, especially during spring migration when passage is predominantly west of the UK and may be more evident in years when weather conditions

bring birds closer to land. Therefore, total numbers in BDMPS are coded red. Many of the birds passing through UK waters are from overseas populations rather than UK populations and although colour phase data can provide some indication of the origins of Arctic skuas, numbers that originate from overseas populations are rather uncertain, so are also coded red.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 26 to 29.

10.1 Breeding range and taxa

The monotypic Arctic skua is a trans-equatorial migrant and the UK is at the extreme southern limit of its breeding range which is circumpolar and largely Arctic (Furness 2010). Although there is no evidence that biometrics can be used to identify origins of individuals, Arctic skuas have two colour phases, with clinal variation in the proportions. Dark birds predominate at colonies at the southern edge of the range whereas all birds at high Arctic breeding sites are pale phase birds.

10.2 Non-breeding component of the population

Arctic skuas start to breed when 4 years old (BTO Birdfacts). Adult survival rate is 0.886 (BTO Birdfacts), juvenile survival 0.68 (BTO Birdfacts) and mean productivity is 0.522 chicks per pair (JNCC database, n=82 measurements). This estimate of productivity is low, but is certainly representative of breeding performance in the UK in recent decades. Productivity may be higher than this in regions where populations are performing better. However, for the population model, using a low value of productivity tends to be compensated for by increased estimates of juvenile and immature survival in order to achieve a stable population, so the exact value used in the model does not greatly alter the estimated proportion of immatures per adult. To obtain a stable population, survival of immatures was adjusted to 0.69 for juveniles, 0.8 for 1-year olds, and 0.886 for older age classes. The model population comprised 58% adults, 15% juveniles and 27% older immatures. There are 0.71 immatures per adult.

10.3 Phenology

Breeding colonies in the UK are deserted in August, with modal departure in early August (Pennington et al. 2004; Forrester et al. 2007). Autumn migration starts in early August (Wernham et al. 2002; Pennington et al. 2004) or August (Cramp et al. 1977-94; Forrester et al. 2007). Peak autumn migration occurs in August-September (Wernham et al. 2002; Pennington et al. 2004), early September (Forrester et al. 2007), September in English waters (Brown and Grice 2005), or September-October (Cramp et al. 1977-94) (but this last includes migration through southern hemisphere waters). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred very distinctly in late-August and early-September (Figure 10.1). Autumn migration is completed by late October (Pennington et al. 2004; Forrester et al. 2007) or late-November when also considering continued migration through southern hemisphere waters (Cramp et al. 1977-94).

Spring migration starts in late-March from southern hemisphere wintering areas (Cramp et al. 1977-94) but birds start to reach UK waters in early April (Wernham et al. 2002) or April (Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in April-May (Cramp et al. 1977-94; Wernham et al. 2002), early May (Pennington et al. 2004) or May (Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late April and early May (Figure 10.1). Spring migration is completed by late May (Cramp et al. 1977-94; Pennington et al. 2004), early June (Wernham et al. 2002) or June (Forrester et al. 2007).

The first spring records of Arctic skua in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were between 10 April and 7 May, but mostly in mid-April. The last records in autumn fell between 3 September and 8 November but mostly in October. Peak autumn migration was reported in July-September in most years, and peak spring migration was reported in May in most years. Birds re-occupy colonies from early April, with modal return in late April (Pennington et al. 2004; Forrester et al. 2007).

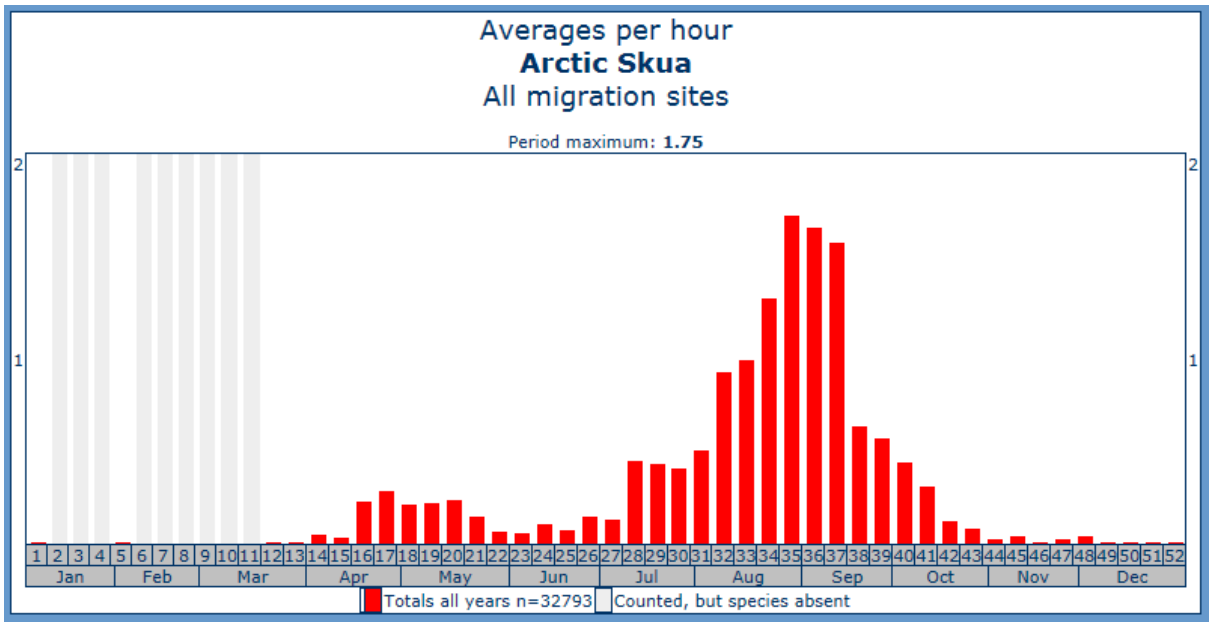


Figure 10.1. Average numbers of Arctic skuas counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season September-April. However, from the data reviewed above, a more appropriate definition would be breeding season May-July, non-breeding season August-April.

10.4 Defined seasons:

- UK Breeding season — May-July
- Post-breeding migration in UK waters — August-October (**autumn BDMPS**)
- non-breeding season — August-April
- Return migration through UK waters — April-May (**spring BDMPS**)
- Migration-free breeding season — June-July
- Migration-free winter season — November-March

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for Arctic skua:

'Autumn' (post-breeding) migration BDMPS (August-October); and

'Spring' (pre-breeding) migration BDMPS (April-May).

10.5 Movements of birds from the UK population

Some failed breeders and some immatures attending UK colonies as pre-breeders may set off on autumn migration as early as July, but most fledglings and adults at UK colonies

depart in early August (Furness 2010; Wernham et al. 2002). Birds from North Sea colonies (Orkney and Shetland) disperse in autumn either through the North Sea or through western waters. Birds from colonies in western waters probably disperse through western waters mainly southwards or southwestwards rather than moving into the North Sea. However, spring migration seems to be more often through western waters, even for adults returning to colonies within the North Sea (Orkney, Shetland and Caithness).

10.6 Movements of birds from overseas into UK waters

Migrants from populations further north pass through British waters mainly in August-September. Autumn migration tends to occur close to the coast. At this time, individuals may hang around areas where there are flocks of terns. A few stragglers may still be present in October, but records from November are extremely scarce (and may involve identification errors as pomarine skuas may occasionally still be seen in November). No Arctic skuas overwinter in British waters. Return migration in spring tends to be more rapid, and with a high proportion of birds passing up the west side of Scotland rather than through the North Sea (Forrester et al. 2007). The proportion of light phase birds tends to increase through spring, as birds that breed at more southerly colonies (where dark phase birds predominate) tend to arrive first, with birds travelling on to the Arctic (where virtually all birds are pale phase) migrating later (Newnham 1984). Scottish adult Arctic skuas return to colonies in late April and May, but Arctic-breeding individuals may not occupy breeding grounds until June (Wernham et al. 2002). It is during May that the proportion of dark phase Arctic skuas is lowest in UK waters, consistent with these birds being predominantly from northern populations (Tasker et al. 1987). There are around 8,000 pairs in Fennoscandia, 7,500 pairs in Iceland, 750 pairs in the Faroes, and tens to hundreds of thousands of pairs on the Arctic tundra bordering the North Atlantic (Mitchell et al. 2004); figure of 50,000 pairs has been used in this report but that estimate is fairly uncertain. Small proportions of each of those populations are thought to migrate through UK waters, but there is very little evidence to indicate which of those populations predominate in the migration season.

10.7 Numbers in UK waters

Autumn migration of Arctic skuas in English waters is seen especially off the coast of E England, whereas spring migration is mainly seen off the S coast and rather few pass along the coast of E England (Brown and Grice 2005). In spring, numbers moving north along the east coast of Scotland tend to be small, but there can be large numbers off the west of Scotland, although these may often pass too far from the coast to be seen from land. As a result, numbers migrating through UK waters are not well defined, but Forrester et al. (2007) suggest that spring migration involves around 1,000 to 5,000 birds in Scottish waters, predominantly to the west of Scotland, while autumn migration involves 1,000 to 10,000 birds, with possibly slightly more than half of these off the west coast, but much better data on numbers available from observations at the east coast. These numbers are likely to be underestimates of the strength of migration of this species, particularly because the species is easily overlooked during boat-based surveys, and because migration can occur in pulses of birds passing beyond sight from shore-based observation points unless driven inshore by weather.

10.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the NE Atlantic population, comprising 30,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 15,000-35,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 75,000 individuals. It is likely that most of this widely distributed biogeographic population has connectivity with UK waters, but that the proportion of the population passing through UK waters is rather small. The UK population of Arctic skuas is small. Seabird 2000 recorded 2,136 AOTs (approximately equivalent to pairs) and numbers have declined considerably since 2000; data presented by Foster and Marrs (2012)

suggest a 57% decline in numbers of AOTs at monitored colonies between 2000 and 2011, so the current UK population may be around 1,000 AOTs. However, the decline in numbers of AOTs does not necessarily mean a proportionate decline in population size, since adults from many of the abandoned AOTs may simply be non-breeding during times of low food supply, and might reoccupy AOTs if conditions were to improve. The biogeographic population with connectivity to UK waters is therefore estimated at 3,000 birds from the UK population and 226,000 birds from overseas populations, giving a total of 229,000 but with a very high uncertainty associated with this estimate. Total numbers in UK waters during autumn migration are estimated at 9,000 birds from overseas and 2,600 from UK populations, so about 12,000 birds overall. Total numbers in UK waters during spring migration are estimated at 4,000 birds from overseas and 2,500 from UK populations, so about 6,500 birds overall. These estimates also have a high uncertainty, especially regarding numbers from overseas populations which represent a major part of the totals.

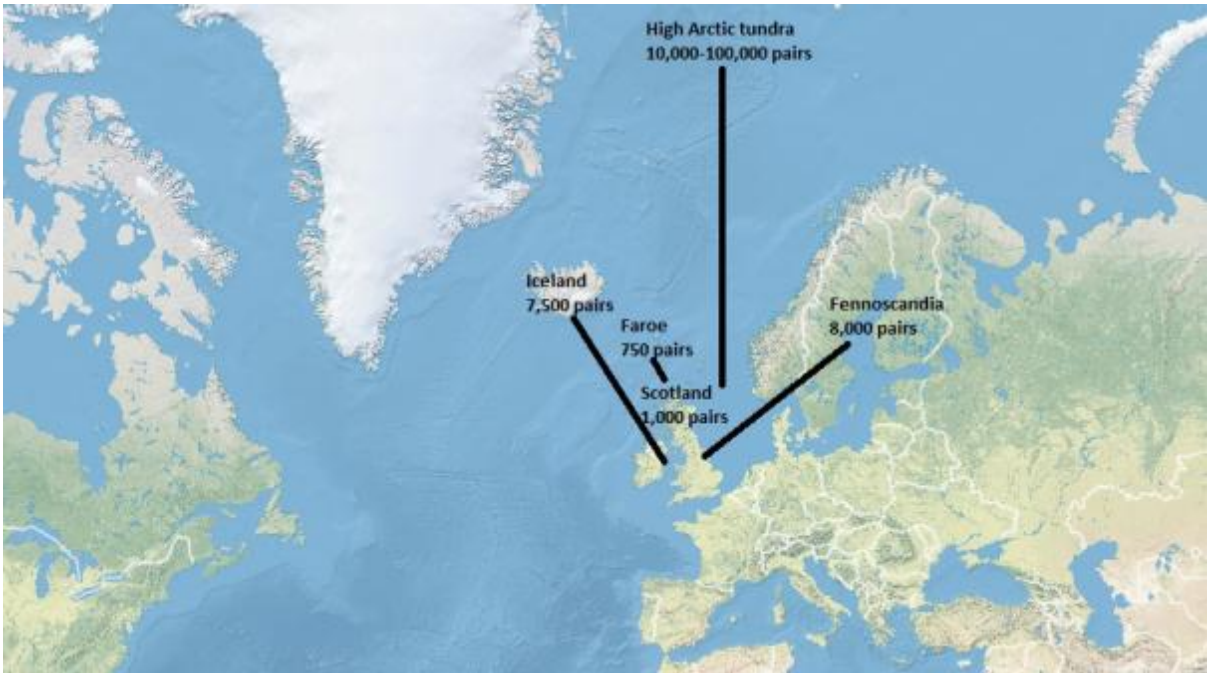


Figure 10.2. Breeding population origins of Arctic skuas in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

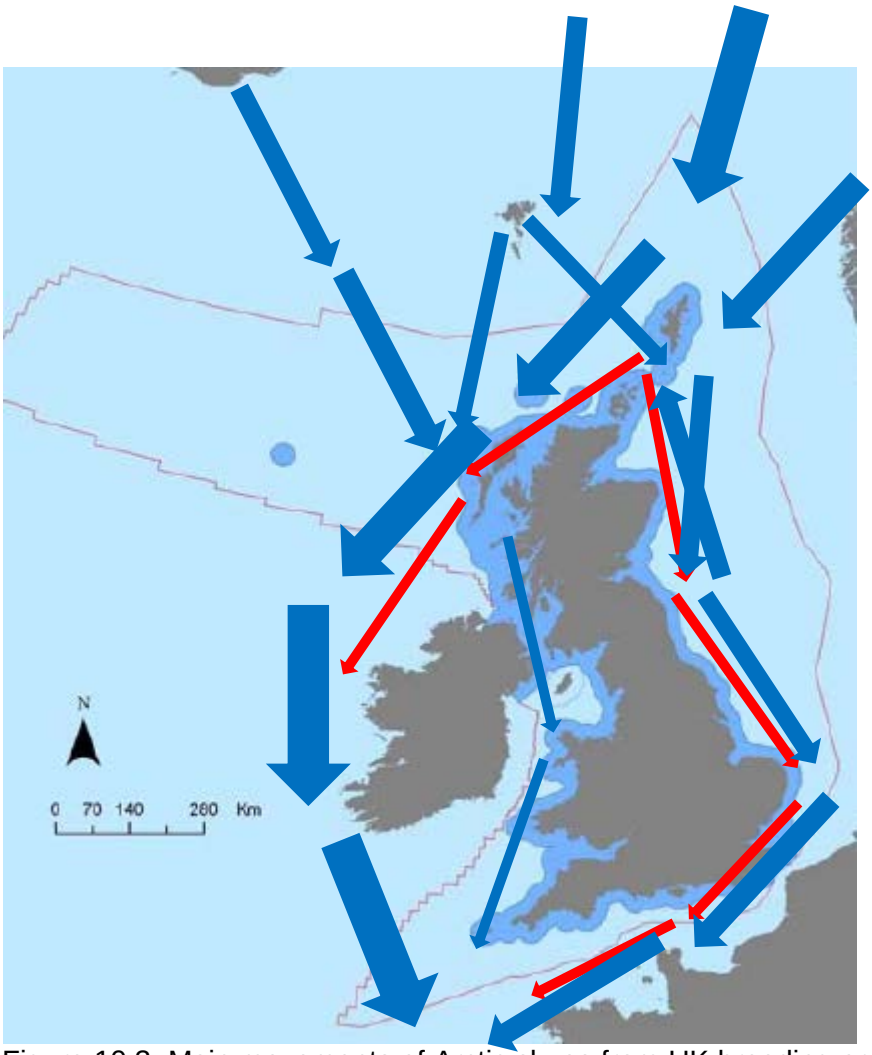


Figure 10.3. Main movements of Arctic skuas from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. See also Forrester et al. (2007) page 728.

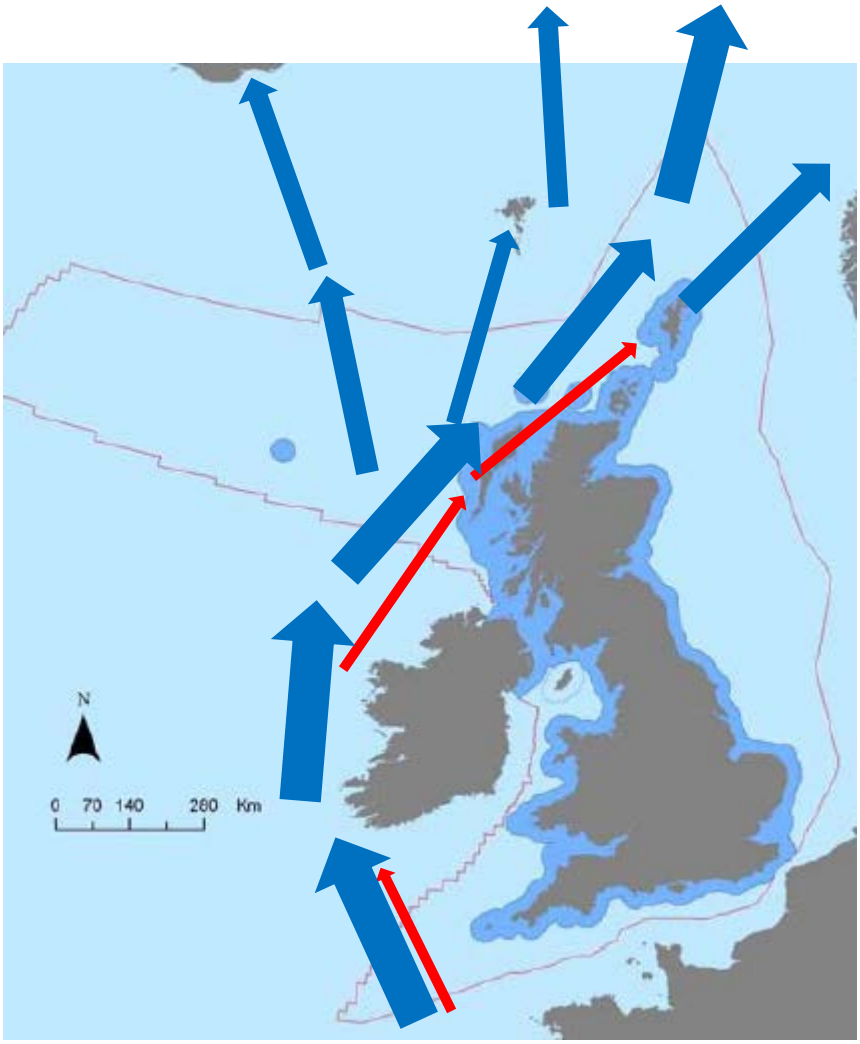


Figure 10.4. Main spring movements of Arctic skuas to UK breeding areas (red arrows) and towards overseas populations (blue arrows) through UK waters. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. See also Forrester et al. (2007) page 728.

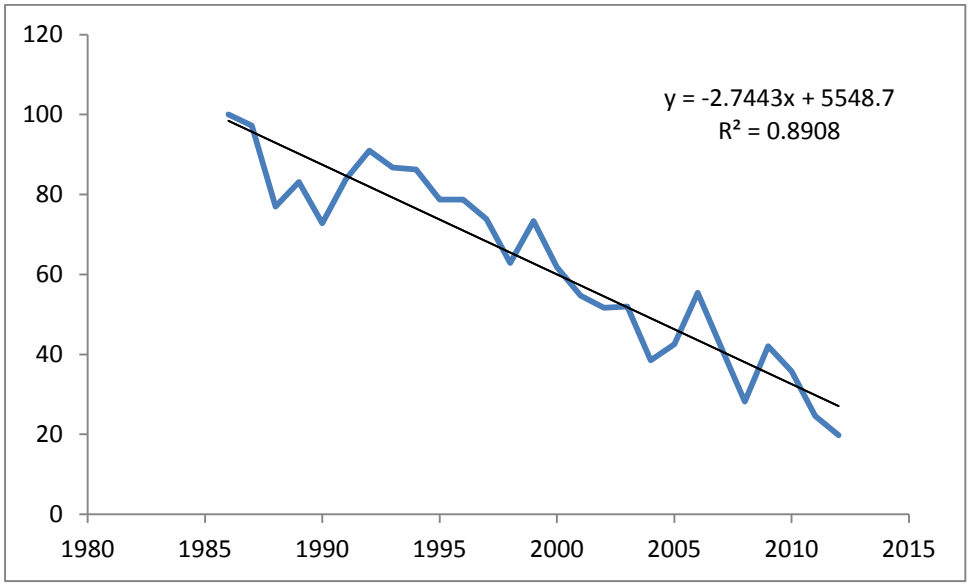


Figure 10.5. Trend in the Arctic skua breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

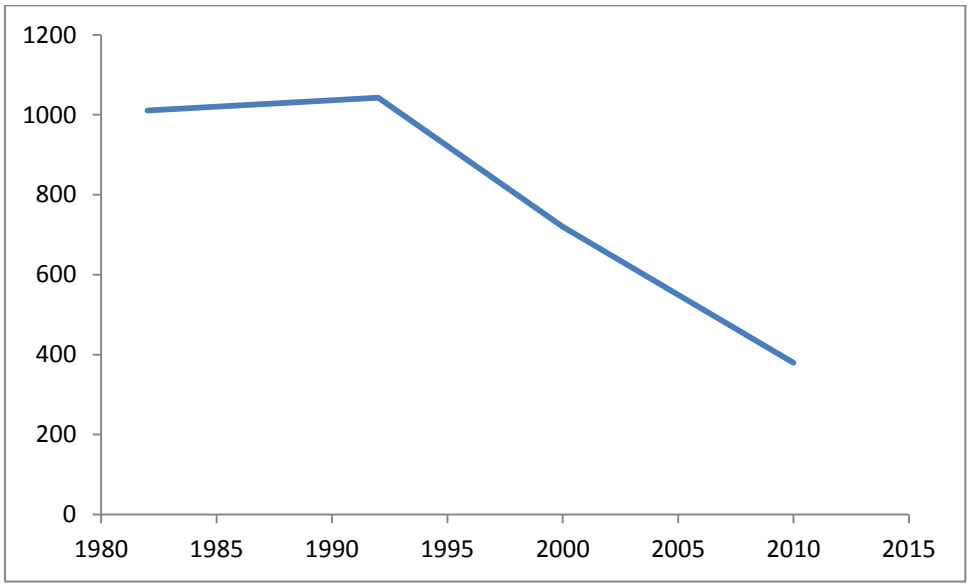


Figure 10.6. Trend in the Arctic skua breeding numbers in Orkney from 1982-2010. Data from Meek et al. (2011).

Data show a 31% decline in 8 years from 1992 to 2000, and a 47% decline in 10 years from 2000 to 2010 (Meek et al. 2011). Meek et al. (2011) concluded that declines in Arctic skua colonies in Orkney were related to colony size (a density-dependent relationship with larger colonies declining more than smaller ones) and to the numbers of great skuas in the area (an impact of predation, of mortality caused by fighting over territory ownership, and loss of nesting habitat to the larger species; see also Phillips et al. 1998).

10.9 Proportion of UK population from UK breeding SPAs

The 7 SPAs with breeding Arctic skuas as a feature together held 780 pairs at designation, estimated to represent ca. 24% of the British breeding population at that time (Stroud et al. 2001). Breeding numbers of Arctic skuas have declined very considerably since 2000 (Figures 10.5 and 10.6), with the decline being especially large at some of the largest colonies (which are the SPA populations). Therefore, the percent of the population breeding within the SPA suite for the species has decreased. Based on census data mostly from

around 2010, Stroud et al. (2014) estimated that the breeding Arctic skua SPA suite held 16.3% of the GB (=UK) population at that time. The sum of the most recent counts at each SPA is only 235 pairs (Table 10.1) whereas Stroud et al. (2014) summed counts dated mostly around 2010 to 343 pairs. So it is clear that the decline in the numbers at SPAs has continued, and so the percent of the UK population in the SPA suite for breeding Arctic skuas is likely to be less than the 16.3% estimated by Stroud et al. (2014). The exact percentage is difficult to assess because the total breeding population in the UK has not been surveyed recently, and numbers in areas where the species breeds at low density outwith SPAs may possibly not have declined as much. The percent in the SPA suite is therefore likely to now be around 15%, but might possibly be even lower than that as the large colony on Fetlar SPA has not been counted since 2002 when there were still 83 pairs there, and it is highly likely that numbers there are now much lower than that, given that other SPA populations in Shetland that were previously similar in numbers to Fetlar have fallen to only 30 or 40 pairs (Table 10.1).



Figure 10.7. The SPA suite for Arctic skua. These SPA populations are listed in Table 10.1.

Table 10.1. The UK SPA suite for breeding Arctic skuas.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Fetlar	Shetland	130	1994	Recovering 2006	96 83	2001 2002	SMP database Stroud et al. 2014
Foula	Shetland	125	1995	Declined 2007	71 41 63 50 41 37 35	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database Lewis et al. 2012 SMP database Gear 2012 Gear 2013
Fair Isle	Shetland	74	1994	Maintained 2009	37 65 70 29 20 19	2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database FIBO Report SMP database
West Westray	Orkney	77	1996	Declined 2007	55 38 <27	2000 2007 2010	Stroud et al. 2014 Lewis et al. 2012 Meek et al. 2011
Papa Westray	Orkney	135	1996	Declined 2000	25 22	2011 2012	Lewis et al. 2012 Orkney Bird Report
Hoy	Orkney	59	2000	Maintained 2000	16 12	2010 2010	Meek et al. 2011 SCR database
Rousay	Orkney	180	2000	Declined 2007	114 46 37	2000 2007 2010	Lewis et al. 2012 Lewis et al. 2012 Meek et al. 2011

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

10.10 BDMPS

UK waters can be split into two BDMPS for Arctic skuas during migration seasons. The UK North Sea and Channel region holds about 6,000 birds in autumn and 1,000 in spring. The UK Western waters region holds about 5,000 birds in autumn and 5,000 in spring. These two areas should be treated as spatially separate BDMPS because although all breeding Arctic skua SPAs are in the UK North Sea and Channel area, much of the migration of this species passes through UK western waters. Therefore UK SPA birds are strongly represented in one BDMPS but not in the other. Details of apportioning of birds from different populations are given in Appendix A Tables 26 to 29. Since individual birds cannot be members of more than one spatially defined BDMPS, a minority of birds from colonies in the North Sea are (perhaps counter-intuitively) allocated to the UK western waters BDMPS rather than to the UK North Sea and Channel BDMPS. These are birds, predominantly from colonies in Shetland and Orkney, which migrate quickly out of, or into, the North Sea, but linger in UK western waters for some prolonged period during migration. These birds are therefore allocated to the BDMPS spatial area in which they spend more time, rather than necessarily being allocated into the BDMPS spatial area within which their breeding site happens to be located.

Based on evidence reviewed in sections 10.5, 10.6 and 10.7, it is estimated that in autumn 60% of adults and 40% of immatures from breeding Arctic skua UK SPA populations migrate through the UK North Sea and Channel waters, whereas 40% of adults and 30% of immatures migrate through UK western waters, whereas 100% of adults and 70% of

immatures from UK non-SPA western waters migrate through UK western waters. It is estimated that in autumn, 1% of adults and immatures from high Arctic populations migrate through UK North Sea and Channel waters and the same percentage through UK western waters, 2% of adults and immatures from Iceland migrate through UK North Sea and Channel waters and the same percentage through UK western waters, 10% of adults and immatures from Fennoscandia and Faroe migrate through UK North Sea and Channel waters, 5% of birds from Fennoscandia and 10% of birds from Faroe migrate through UK western waters (Appendix A Tables 26 and 27). This results in an estimate of 1,211 birds from UK and 5,216 from overseas in the autumn migration UK North Sea and Channel waters BDMPS and 1,439 birds from UK and 3,848 from overseas in the autumn migration UK western waters BDMPS.

Based on evidence reviewed in sections 10.5, 10.6 and 10.7, it is estimated that in spring, 40% of adults and 10% of immatures from breeding Arctic skua UK SPA populations migrate through the UK North Sea and Channel waters, whereas 60% of adults and 50% of immatures migrate through UK western waters, whereas 100% of adults and 70% of immatures from UK non-SPA western waters migrate through UK western waters. It is estimated that in spring, 0.2% of adults and 0.1% of immatures from high Arctic populations migrate through UK North Sea and Channel waters whereas 1% of birds from high Arctic populations migrate through UK western waters, 0.5% of adults and 0.1% of immatures from Iceland migrate through UK North Sea and Channel waters and 1% of Icelandic birds through UK western waters, 1% of adults and 0.5% of immatures from Fennoscandia migrate through UK North Sea and Channel waters, 5% of adults and 3% of immatures from Fennoscandia migrate through UK western waters, 0.5% of adults and 0.1% of immatures from Faroe migrate through UK North Sea and Channel waters and 5% of adults and 2% of immatures migrate through UK western waters (Appendix A Tables 28 and 29). This results in an estimate of 645 birds from UK and 582 from overseas in the spring migration UK North Sea and Channel waters BDMPS and 1,907 birds from UK and 3,204 from overseas in the spring migration UK western waters BDMPS.

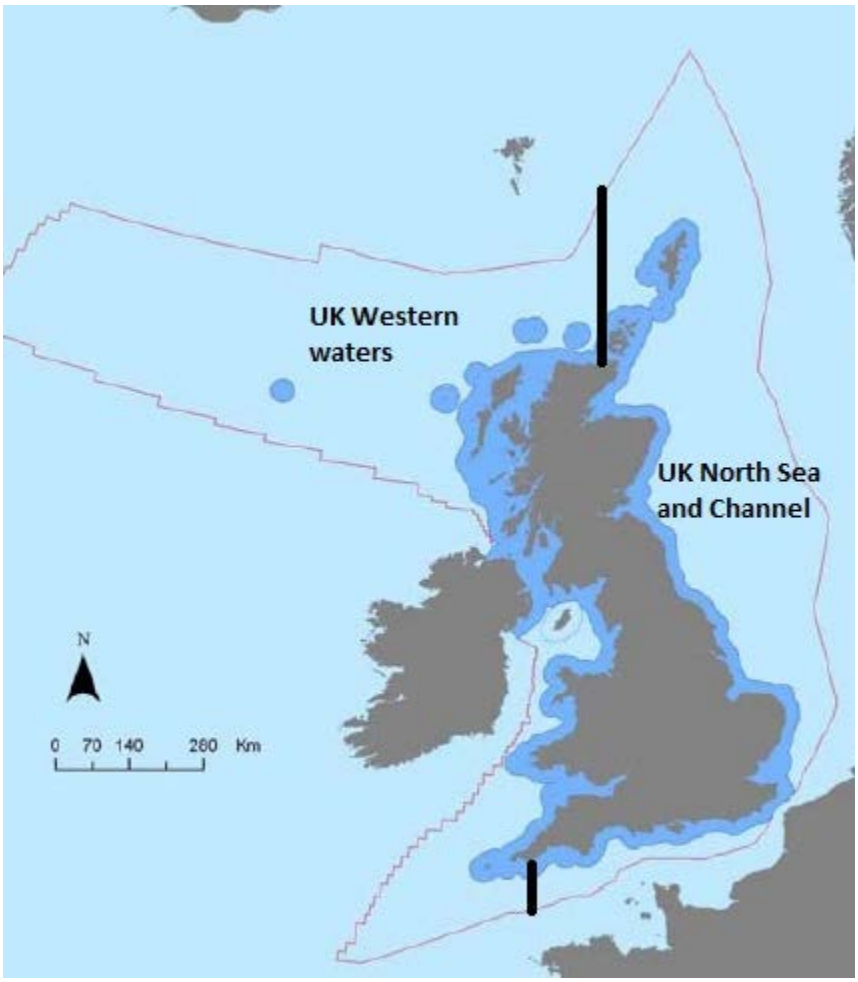


Figure 10.8. Two defined BDMPS spatial areas for Arctic skua: 'UK North Sea and Channel' and 'UK Western waters'.

10.11 Proportion of UK breeding SPA birds in BDMPS

During migration, the relatively small UK population (about 1,000 pairs, so 2,000 adults giving a total of about 3,000 birds of which many young immatures do not return from wintering areas to UK waters so a total of about 2,600 birds in UK waters) represents a minority of the birds present in UK waters. Probably UK birds represent about 20% of the birds present in UK waters on average during the migration months, but this percentage is very uncertain. The percentage is unlikely to be much higher than this, however, since most UK birds are dark phase, and the proportion of dark phase birds observed during migration watches at UK sites is generally small, indicating that a large majority of the birds originate from breeding areas further north where dark phase birds are at a frequency close to zero. Probably only about 15% of Arctic skuas from the UK colonies are from within the breeding Arctic skua SPA suite. However, since all the SPA populations and most of the species' breeding population in the UK, are in the NW North Sea area, and rather few Arctic skuas migrate northwards through that area, the proportion of SPA birds in that area in spring will be higher than in other BDMPSs. The proportion of the BDMPS represented by adults from UK SPA populations can be computed from data in Appendix A Tables 26 to 29. For example, in the UK North Sea and Channel BDMPS in autumn migration season there are 6,427 birds of which 281 are adults from UK SPA populations, so those represent 4.4% of the total present.

10.12 Spatial distribution of UK breeding SPA birds across the BDMPS

During autumn migration, birds dispersing from UK SPAs will all be in the North Sea and Channel BDMPS initially. However, these birds will move through this and some through the UK western waters BDMPS and often stop for some days in locations where there are opportunities to steal food from terns, so the distribution of SPA birds will quickly become fairly random across the BDMPSs. In spring, this process is likely to act in reverse, but with spring migration generally being somewhat faster and more direct towards colonies than in autumn.

11. GREAT SKUA *Stercorarius skua*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in autumn (August to October) (adults and immatures)	Numbers in UK waters in winter (November to February) (adults and immatures)	Numbers in UK waters in spring (March-April) (adults and immatures)
Overseas	30,000	5,562	1,363	5,655
UK	43,000	30,330	178	27,920
Total	73,000	35,892	1,541	33,575

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Autumn migration BDMPS (August to October)			
UK North Sea and Channel	19,556	2,141	17,415
UK Western waters	16,336	3,421	12,915
Winter BDMPS (November-February)			
UK North Sea and Channel	143	143	0
UK Western waters	1,398	1,220	178
Spring migration BDMPS (March-April)			
UK North Sea and Channel	8,485	982	7,503
UK Western waters	25,090	4,673	20,417

Colour coding for numbers of UK birds in the autumn migration BDMPS is amber. This reflects uncertainty about changes in breeding numbers at some UK colonies that have not been censused since Seabird2000. Breeding numbers have declined recently at some of the larger colonies but appear to still be increasing at some small colonies, and it is the latter that tend to lack recent census data. Colour coding for numbers of birds from overseas populations passing through UK waters in autumn is coded red because information on migrations of great skuas from Iceland, Faroe and Norway is based only on ring recovery data. Recoveries of pelagic or offshore seabirds tend to be highly biased because only a very small proportion of ringed birds are recovered, and many recoveries are associated with mortality related to human activities (such as fishery bycatch or birds being shot). There is only limited data from tracking birds equipped with geolocators (small numbers of breeding adults having been tracked from Iceland and Norway in only a single year). For these reasons, numbers in the winter BDMPS are coded red as are numbers in the spring migration BDMPS. The spring data are considered less reliable than the autumn data because spring passage results in very few ring recoveries, tends to occur over a shorter time period, and tends to occur in western waters which have lower survey coverage in the ESAS database than for North Sea waters and also have fewer and less consistently watched migration sites.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 30 to 35.

11.1 Breeding range and taxa

The species is monotypic (unless southern hemisphere taxa which do not visit European waters are included as conspecific which seems to be contrary to genetic evidence) and biometrics do not appear to help to identify origins of individuals. Great skuas breed in Scotland (9,634 pairs; Mitchell et al. 2004, but now decreased to probably about 8,900 pairs or less based on known declines at UK SPA colonies and assuming similar declines at other colonies), Faroe (500 pairs; Hammer et al. 2013), Iceland (5,400 pairs; Mitchell et al. 2004), Norway (360 pairs including Bear Island, Svalbard and Jan Mayen; Mitchell et al. 2004), and Russia (at least 10 pairs; Anker-Nilssen et al. 2000).

11.2 Non-breeding component of the population

Great skuas start to breed when 7 years old (BTO Birdfacts). Adult survival rate is 0.888 (BTO Birdfacts), juvenile survival 0.8 (BTO Birdfacts) and mean productivity is 0.664 chicks per pair (JNCC database, n=138 measurements). To obtain a stable population, survival of immatures was retained at 0.8 for juveniles, set at 0.82 for 1-year olds, 0.84 for 2-year olds, 0.86 for 3-year olds and 0.888 for older age classes. The model population comprised 41% adults, 14% juveniles and 45% older immatures. There are 1.42 immatures per adult.

11.3 Phenology

Breeding colonies in the UK are largely deserted by October, with modal departure in August (Pennington et al. 2004; Forrester et al. 2007). Autumn migration starts in August (Cramp et al. 1977-94; Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak autumn migration occurs in August-October in English waters (Brown and Grice 2005), early September (Pennington et al. 2004), September (Forrester et al. 2007), September-October (Cramp et al. 1977-94; Wernham et al. 2002), and July-October in Belgium (Vanermen et al. 2013). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in September and early October (Figure 11.1). Autumn migration is completed by late October (Forrester et al. 2007), early November (Pennington et al. 2004), November (Wernham et al. 2002) or early December (Cramp et al. 1977-94).

Spring migration starts in early March (Cramp et al. 1977-94; Pennington et al. 2004) or March (Wernham et al. 2002; Forrester et al. 2007). Peak spring migration occurs in January-April in Belgium (Vanermen et al. 2013) but the inclusion of January probably represents movement of very small numbers of birds, in March-April (Cramp et al. 1977-94), or in April in the UK (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late April (Figure 11.1). Spring migration is completed by May (Wernham et al. 2002), late May (Cramp et al. 1977-94; Pennington et al. 2004) or June (Forrester et al. 2007).

The first spring records of great skua in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were between 13 February and 24 April but mostly in late March, and the last records ranged from 11 October to 15 December but were predominantly in mid-November. Peak autumn migration was reported in August-September in most years, and peak spring migration was reported in April in most years. Birds re-occupy colonies from late March, with modal return in April (Pennington et al. 2004; Forrester et al. 2007).

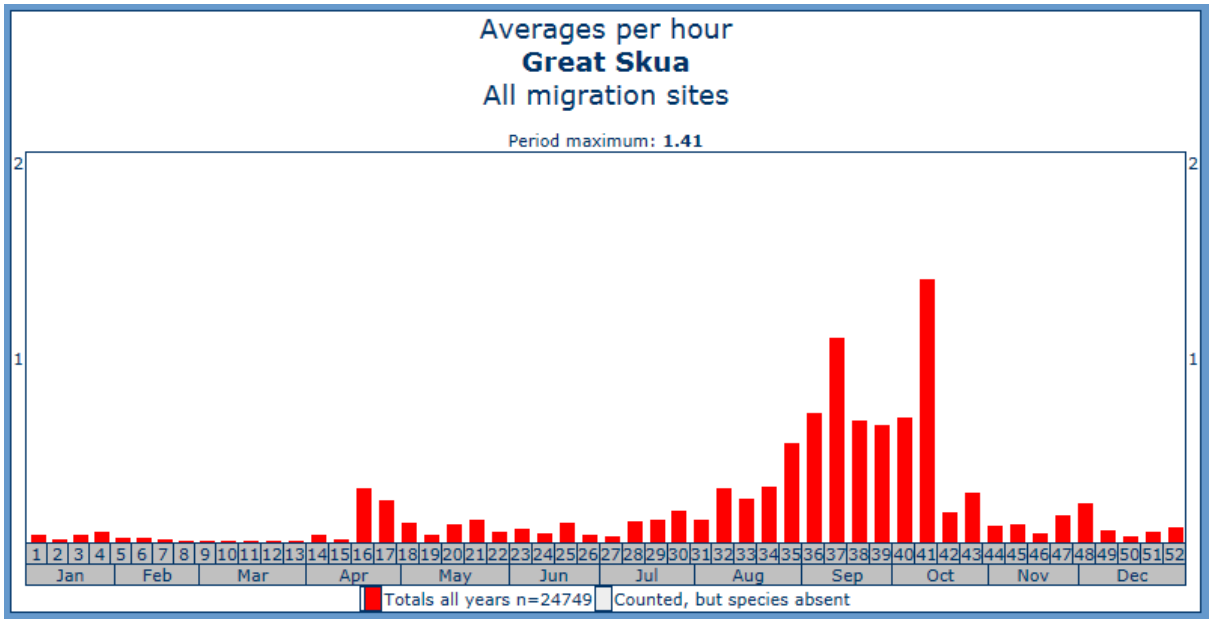


Figure 11.1. Average numbers of great skuas counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season September-April. From the data reviewed above, this would appear to be an appropriate definition.

11.4 Defined seasons:

- UK Breeding season — May-August
- Post-breeding migration in UK waters — August-October (**autumn BDMPS**)
- non-breeding season — September-April
- Return migration through UK waters — March-April (**spring BDMPS**)
- Migration-free breeding season — May-July
- Migration-free winter season — November-February (**winter BDMPS**)

Apart from the breeding season, three seasonal BDMPS periods are considered to be appropriate for great skua:

'Autumn' (post-breeding) migration BDMPS (August-October);

'Winter' BDMPS (November-February); and

'Spring' (pre-breeding) migration BDMPS (March-April).

11.5 Movements of birds from the UK population

Immatures (Klomp and Furness 1990) and failed breeders may leave colonies in July, followed in August-September by fledglings and successful breeders (Wernham et al. 2002; Furness 2010). Late breeders and young may not depart until October, and very small numbers remain in UK waters through to the end of the year and occasionally overwinter (Trektellen web site). Birds from UK colonies migrate over the Continental Shelf to the Bay of Biscay, Iberia or NW Africa. No adults from UK populations have been identified as wintering in North America. Only one or two ringed immatures from UK populations have been recovered on the coast of North America (Klomp and Furness 1992), so that region appears not to be visited by UK adults and not by significant numbers of UK immatures. Stable isotopes in feathers grown in the wintering area show location-specific signatures allowing individuals to be classified by major wintering areas: West Africa, southern Europe, or North America (Leat et al. 2013). Satellite tracking and deployment of geolocators on breeding great skuas suggests that numbers of adults wintering off west Africa may have increased, as numbers of ring recoveries from adult aged birds there were very small (Furness et al. 2006; Magnusdottir et al. 2012). Spring migration occurs in March-May, with rather rapid northwards movement mostly in April (Wernham et al. 2002; Trektellen web site). The high speed of spring migration may partly explain why there are far fewer ring recoveries in spring than in autumn (Wernham et al. 2002), but it also seems that most birds migrate northwards to the west of the British Isles with very few passing through the North Sea in spring, whereas during autumn migration much larger numbers are seen in the North Sea (Tasker et al. 1987; Forrester et al. 2007; Trektellen web site). As with most migrant seabirds, juveniles tend to winter further south, on average, than immatures which in turn tend to winter further south than breeding adults (Klomp and Furness 1992).

11.6 Movements of birds from overseas into UK waters

Migrants from all other breeding areas may pass through UK waters in autumn, at about the same time as UK birds are moving from colonies; there are autumn ring recoveries from birds ringed in Faroe and Iceland (Wernham et al. 2002). During autumn, peak numbers in the North Sea are seen in September (Tasker et al. 1987) and this pattern is also evident from seawatching data (Trektellen web site). While all breeders from UK colonies are thought to migrate through Europe to winter in southern Europe and off West Africa, about half of the breeders at colonies in Iceland and Bear Island migrate to winter off North America (Magnusdottir et al. 2012). A few of the birds wintering off North America also visit European waters during the same winter (Magnusdottir et al. 2012). Stable isotopes in feathers grown in the wintering area show location-specific signatures allowing individuals to be classified by major wintering areas: West Africa, southern Europe, or North America (Leat et al. 2013). Within the east Atlantic wintering range of the species, birds from Norway and Iceland tended to winter further north than those from UK (Magnusdottir et al. 2012). Great skuas from Faroe appear to show much the same migration and winter distribution as birds from UK colonies (Hammer et al. 2013). Thus, the very small numbers of great skuas present in UK waters in winter are more likely to be adults from Norway or Iceland than they are to be from UK colonies. Since the UK breeding numbers are twice those in Iceland, and numbers in Norway, Faroe and Russia are relatively small, birds from UK colonies predominate in the total population. In UK waters during migration, probably at least 80% of

birds are from UK colonies, since half of the birds from Iceland and Norway apparently travel to North America directly and do not pass through UK waters. In winter, however, the very small numbers of great skuas in UK waters may be predominantly adults from Iceland and Norway because those birds winter further north than birds from the UK.

11.7 Numbers in UK waters

Very few great skuas are present in English waters in winter, but small numbers are in the SW Approaches from November to March (Brown and Grice 2005). Very few (Forrester et al. 2007 estimate fewer than ten birds) are present in Scottish waters in winter. However, large numbers (relative to population size) migrate south through UK waters, especially through the North Sea, in autumn, and similar numbers migrate north through UK waters in spring, but predominantly to the west of the British Isles. Forrester et al. (2007) suggest that there are about 2,000 to 10,000 birds in Scottish waters in autumn, and about 1,000 to 6,000 in spring. These birds passing south inevitably also pass through English waters, as they winter off southern Europe or west Africa. It is reasonable to assume that almost the entire UK great skua population passes south through UK waters in autumn and all but the youngest age classes pass north through UK waters in spring (the youngest birds may remain in wintering areas all year, while middle ages of immature birds may migrate to Greenland and Norway in summer rather than stopping at UK breeding areas). The UK population is probably about 9,000 pairs at present, so 18,000 adults. Associated with this population are about 25,600 immatures, of which perhaps half will return to UK waters in summer and half be either in the wintering area or visit high latitudes rather than the UK in summer. So about 30,300 birds from the UK population are estimated to pass through UK waters on autumn migration. In addition, a few thousand birds from colonies in Norway, Russia, Faroe and Iceland pass through UK waters in autumn and spring. The exact number is not known, but the total is likely to be around 4,000 to 6,000 birds, as a large part of the Norwegian and Icelandic populations migrate west across the North Atlantic to Canadian waters, and some appear to migrate south from Iceland over the mid-Atlantic rather than via UK waters. These numbers are rather larger than the numbers suggested by Forrester et al. (2007) which presumably at least in part reflects the turnover that occurs with birds migrating through over a period of time, so that total numbers involved are larger than the ‘snapshot’ estimates provided by survey data.

11.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the species’ population, comprising 13,600 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 16,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 40,800 individuals. The biogeographic population with connectivity to UK waters is probably much the same as the total biogeographic population – so is estimated at 73,000 birds, 43,000 from the UK and 30,000 from overseas. This includes large numbers of immatures that do not necessarily return to UK waters but may range over areas from northern South America and west Africa to Greenland and the Barents Sea. Numbers in UK waters are estimated at 36,000 birds in autumn (August to October), 1,600 birds in winter (November to February), and 34,000 birds in spring (March and April).



Figure 11.2. Breeding population origins of great skuas in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

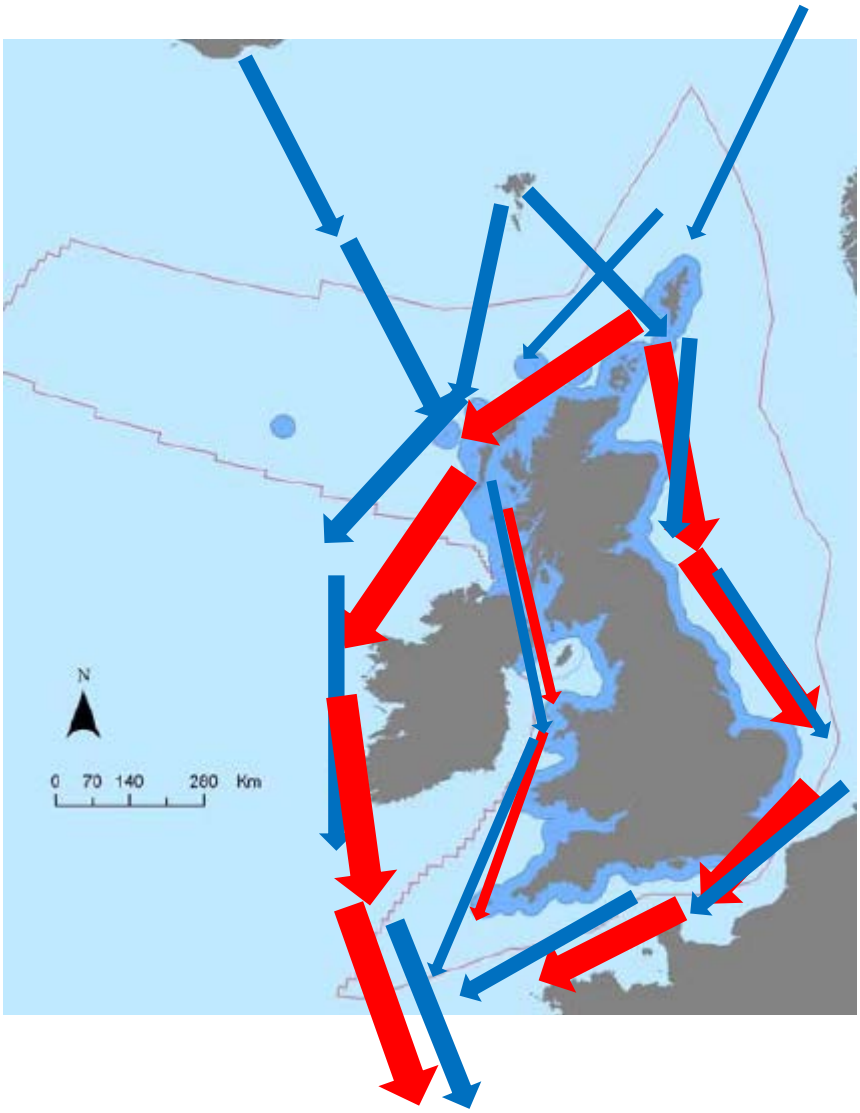


Figure 11.3. Main movements of great skuas from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes.

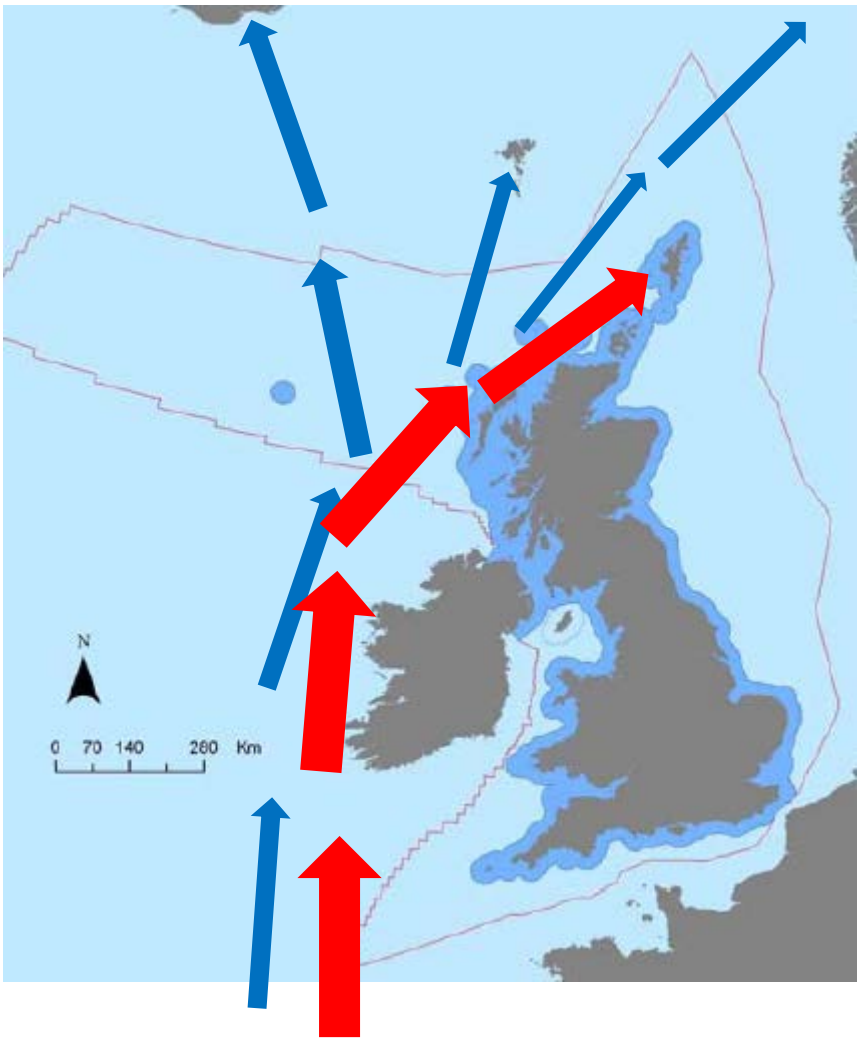


Figure 11.4. Main return movements of great skuas in spring to UK breeding areas (red arrows) and towards overseas populations (blue arrows) through UK waters. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes.

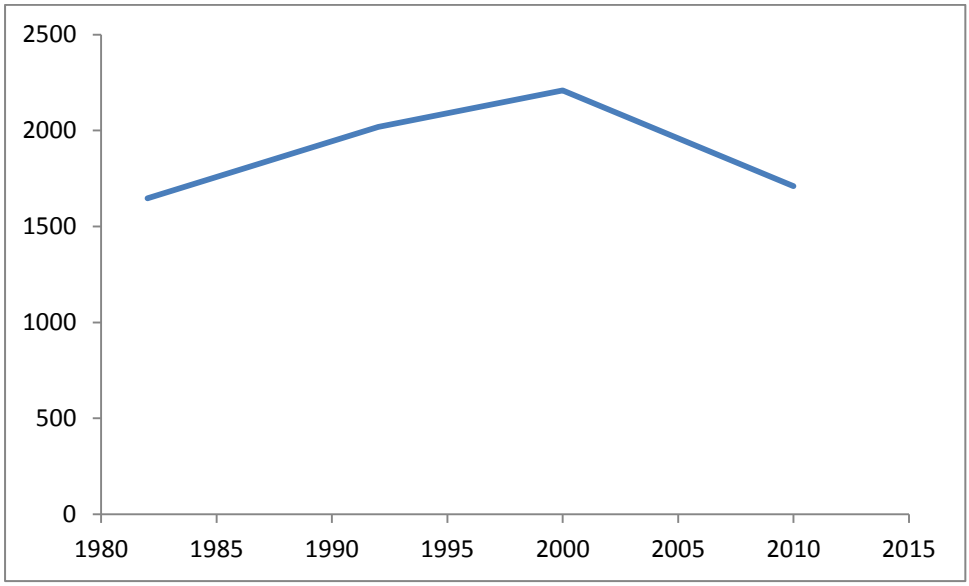


Figure 11.5. Trend in the great skua breeding numbers in Orkney from 1982-2010. Data from Meek et al. (2011).

Data show a 22.6% decline over the 10-year period between 2000 and 2010.

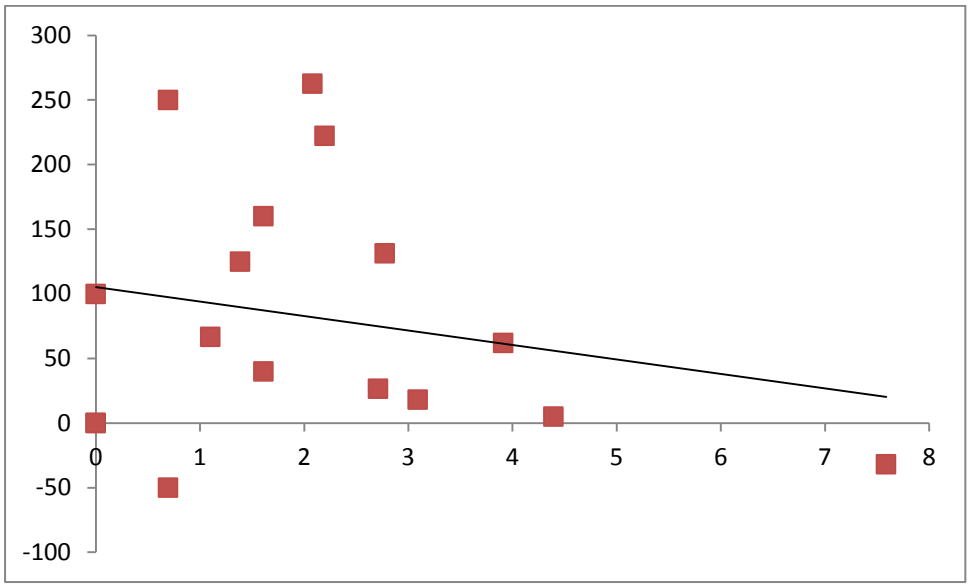


Figure 11.6. Rate of growth (% change in numbers) of breeding numbers of great skuas at colonies in Orkney between 2000 and 2010 in relation to size of the colony in 2000 (Natural Log). While the largest colony (Hoy) decreased considerably in numbers, many of the small colonies grew. Data from Meek et al. (2011).

11.9 Proportion of UK population from UK breeding SPAs

The 9 SPAs with breeding great skuas as a feature together held 6,262 pairs at designation, estimated to represent ca. 74% of the British breeding population (Stroud et al. 2001). Numbers have decreased since 2000 in Orkney, and at large SPA colonies in Shetland such as Foula, but have continued to increase at some smaller colonies. So the exact population size now is uncertain but is likely to be around 9,000 pairs. Because several of the largest colonies have decreased particularly markedly in size, and those are all SPA populations, the proportion of the UK population in the SPA suite for breeding great skuas will probably be less than it was previously. Based on data from years between 2000 and 2011, Stroud et al. (2014) estimated that 73.6% of the population was on SPAs. However, the figure may

now be closer to 70% due to continued large declines at Foula and Hoy in particular (the two largest colonies) and possibly some increases in areas that are not SPA populations where small numbers breed although those increases are very unlikely to be large enough to have much effect in reducing the overall decline in total breeding numbers that seems to be occurring (see Figure 11.8).

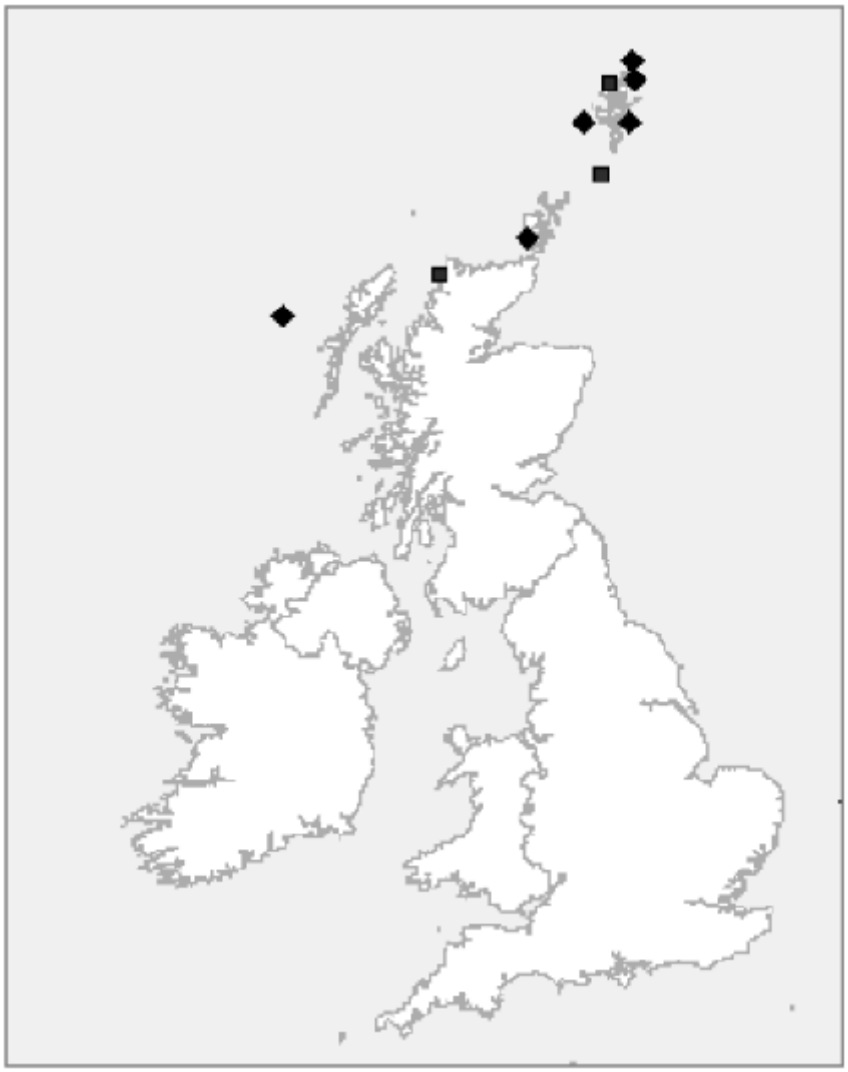


Figure 11.7. The SPA suite for great skua. These SPA populations are listed in Table 11.1.

Table 11.1. The UK SPA suite for breeding great skuas.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Hermaness, Saxavord & Valla	Shetland	630	1994	Maintained 2013	726 751 979	2001 2007 2013	SMP database SMP database SMP database
Ronas Hill – North Roe & Tingon	Shetland	130	1997	Maintained 2002	189	2002	Stroud et al. 2014
Fetlar	Shetland	512	1994	Maintained 2006	593 585	2001 2002	SMP database Stroud et al. 2014
Foula	Shetland	2,170 (1992)	1995	Declined 2007	2,293 1,657	2000 2007	Seabird2000 SMP database

Noss	Shetland	410	1996	Maintained 2007	432 365 465	2001 2007 2013	Lewis et al. 2012 Lewis et al. 2012 SMP database
Fair Isle	Shetland	130	1994	Maintained 2009	280 227 300 266	2010 2011 2012 2013	SMP database SMP database FIBO Report SMP database
Hoy	Orkney	1,900 (1992)	2000	Maintained 2000	1,973 1,346	2000 2010	Seabird2000 Meek et al. 2011
UK Western waters							
Handa	NW Scotland	110	1990	Maintained 2000	212 202 190 272 266 241 135	2005 2006 2007 2008 2009 2010 2013	SMP database SMP database SMP database Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database
St Kilda	Western Isles	270 (1997)	1992	Maintained 2000	240 Hirta only: 210 189 139 174 151	2000 2000 2007 2008 2009 2012	Seabird2000 SMP database SMP database SMP database SMP database SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

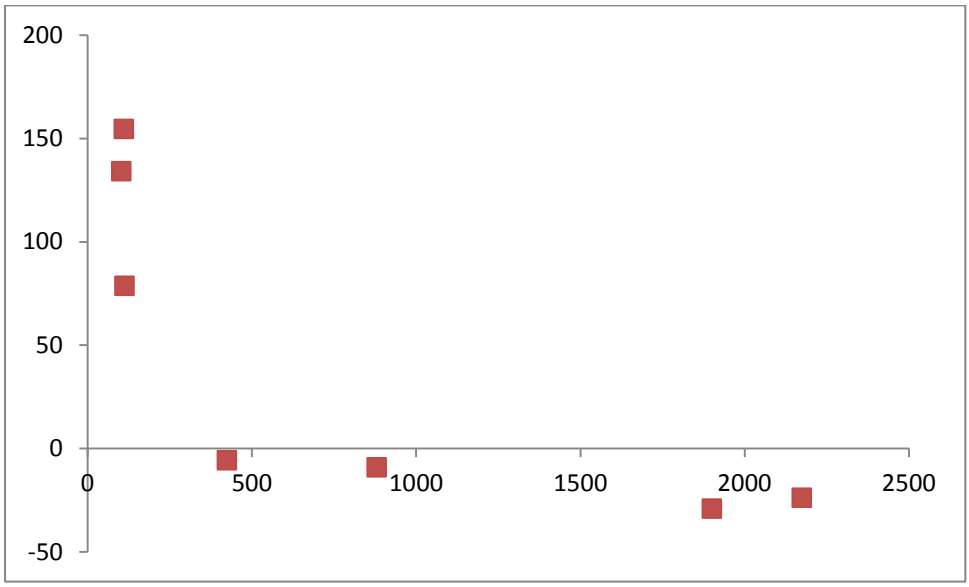


Figure 11.8. Percent change in numbers of pairs of great skuas from 1992 to 2010 at the largest colonies where count data are available (Foula, Hoy, Hermaness, Noss, St Kilda, Fair Isle, Handa). The data indicate that colonies of more than 400 pairs would decline in size while those with considerably fewer than 400 would grow. Data from Seabird Monitoring Programme database.

11.10 BDMPs

We need to consider three separate seasonal BDMPSs as the numbers in UK waters in winter are very much smaller than in autumn or spring, while in spring the migration route most used by great skuas is different from that used in autumn. We need to consider two spatial units for BDMPS; UK North Sea and Channel waters, and UK western waters. Most great skua colonies are in UK North Sea and Channel waters, but large numbers of migrants pass through UK western waters, especially in spring. Details of apportioning of birds into BDMPS are presented in Appendix A Tables 30 to 35.

Based on evidence reviewed in sections 11.5, 11.6 and 11.7, in autumn in the UK North Sea and Channel BDMPS, it is estimated that 60% of adults and 30% of immatures from colonies in the Northern Isles and Caithness will be members of the UK North Sea and Channel BDMPS, while 40% of adults and 20% of immatures will be members of the UK western waters BDMPS. This recognises that fact that a substantial number of birds from colonies in the northern isles move quickly during autumn migration into UK western waters but then spend some time there before moving further south to wintering areas, so those birds are allocated pro rata to the UK western waters BDMPS rather than to the UK North Sea and Channel BDMPS from which they departed from their breeding colonies at the end of the breeding season. No birds from colonies in the west of Scotland will be in the North Sea and Channel BDMPS whereas 100% of adults and 40% of immatures will be in the UK western waters BDMPS (Appendix A Tables 30 and 31). In addition, during autumn migration it is estimated that 10% of adults and 5% of immatures from Iceland, Norway and Faroe will be in the UK North Sea and Channel BDMPS, and 20% of adults and 5% of immatures from Iceland, 10% of adults and 5% of immatures from Norway, and 30% of adults and 5% of immatures from Faroe will be in the UK western waters BDMPS. These values result in an estimated BDMPS of 19,556 birds in the UK North Sea and Channel in autumn (17,415 originating from the UK), and 16,336 birds in the UK western waters BDMPS (12,915 originating from the UK).

Geolocator data loggers, satellite tracking data, and stable isotope analysis indicate that virtually all great skuas from the UK winter further south than UK waters with only a few adults wintering in the UK SW Approaches, whereas tracking data from adults nesting in Iceland and Norway show that birds from those populations tend to winter further north than birds from the UK. This implies that most, and apparently almost all, great skuas wintering in UK waters are birds from overseas populations. In the winter UK North Sea and Channel BDMPS there are thought to be no birds from UK colonies, and only very small numbers from overseas. Based on evidence reviewed in sections 11.5, 11.6 and 11.7, it is estimated that 1% of adults and 0.1% of immatures from Iceland, Norway and Faroe winter in UK North Sea and Channel waters (a total of 143 birds; Appendix A Table 32), while it is estimated that 1% of adults from UK colonies, 5% of adults and 0.1% of immatures from Faroe, 10% of adults and 0.1% of immatures from Iceland and Norway winter in UK western waters. This results in a BDMPS for UK western waters in winter of 1,398 birds. These totals appear to be reasonably consistent with evidence from the ESAS database and other at sea survey data which suggest a small winter hotspot for great skuas in the far SW of UK waters (Kober et al. 2010).

Based on evidence reviewed in sections 11.5, 11.6 and 11.7, spring migration of great skuas sees rather few birds moving north through the southern North Sea, but more pronounced migration through UK western waters, with many adults returning to colonies in the northern isles by way of western waters rather than through the North Sea. It is estimated that 30% of adults and 10% of immatures from UK North Sea colonies are in the UK North Sea and Channel spring BDMPS, whereas 70% of adults and 30% of immatures are in the UK western waters spring BDMPS (Appendix A Tables 34 and 35). 100% of adults and 40% of immatures from western colonies are in the UK western waters spring BDMPS. For birds

from overseas populations in spring, 5% of adults and 2% of immatures from Iceland, Norway and Faroe are estimated to be in the UK North Sea and Channel spring BDMPS, whereas 30% of adults and 5% of immatures from Iceland, 20% of adults and 5% of immatures from Norway, and 40% of adults and 5% of immatures from Faroe are in the UK western waters spring BDMPS (Appendix A Tables 34 and 35). This gives estimated BDMPSs for spring of 8,485 birds in the UK North Sea and Channel, and 25,090 birds in the UK western waters.

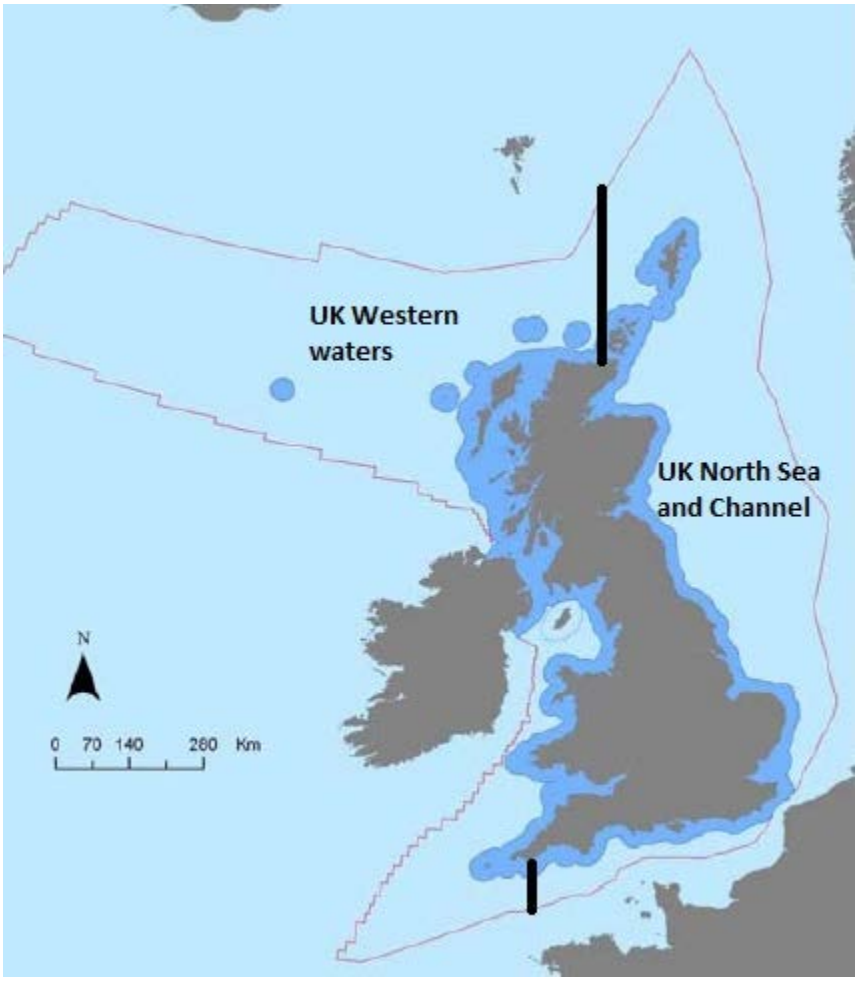


Figure 11.9. Two defined BDMPS spatial areas for great skua: 'UK North Sea and Channel' and 'UK Western waters'.

11.11 Proportions of UK SPA birds in each BDMPS

The UK suite for breeding great skuas is very strongly concentrated in the NW North Sea, with only small numbers in the West of Scotland region (Handa 135 pairs, St Kilda 151 pairs). The birds from SPA populations in the NW North Sea do not all migrate south through the North Sea; a proportion migrate southwards via the west of the British Isles. So the proportions of UK SPA birds in the different BDMPS in autumn and spring are not dramatically different despite the concentration of SPA birds being in Orkney and Shetland. Proportions can be computed from data in Appendix A Tables 30, 31, 34 and 35. For example, 6,584 adults from great skua breeding UK SPAs are in the UK North Sea and Channel autumn BDMPS which totals 19,556 birds, so adults from SPA colonies represent 34% of the total present. In UK western waters in autumn, adults from SPA colonies total 5,022 birds out of a population of 16,336, or 31%. Wintering birds in each BDMPS are likely to be predominantly from colonies in Norway and possibly Iceland, as those birds winter further north, on average, than birds from the UK. Data in Appendix A Tables 32 and 33 can

be used to estimate the proportion of each winter BDMPS comprising adults from breeding great skua UK SPAs. In the winter UK North Sea and Channel BDMPS this proportion is 0% adults from UK SPA colonies. In the winter UK western waters BDMPS there are estimated to be 116 adults from breeding great skua UK SPAs, from a BDMPS of 1,398 birds, so about 8% are adults from UK SPAs.

11.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Great skuas disperse from colonies in all directions at the end of the breeding season, and so the SPA birds will be mixed with non-SPA birds across the BDMPS. Aggregations of SPA birds are unlikely except to the extent that in Shetland some adults may attend colonies late into autumn, so there is likely to be some tendency for proportions of SPA birds to be locally higher close to the main SPA sites into the autumn, and birds returning early in spring may similarly aggregate in waters close to colonies before returning to their breeding territories onshore. However, aggregations are not likely to be pronounced, and there will be considerable mixing of birds from different populations.

12. LESSER BLACK-BACKED GULL *Larus fuscus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in autumn (August to October) (adults and immatures)	Numbers in UK waters in winter (November to February) (adults and immatures)	Numbers in UK waters in spring (March-April) (adults and immatures)
Overseas	572,000	105,969	15,350	94,445
UK	292,000	266,342	65,123	266,342
Total	864,000	372,311	80,473	360,787

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Autumn migration BDMPS (August-October)			
UK North Sea and Channel	209,007	62,870	146,137
UK Western waters	163,304	43,099	120,205
Winter BDMPS (November-February)			
UK North Sea and Channel	39,314	7,724	31,590
UK Western waters	41,159	7,626	33,533
Spring migration BDMPS (March-April)			
UK North Sea and Channel	197,483	51,346	146,137
UK Western waters	163,304	43,099	120,205

Numbers of lesser black-backed gulls in colonies in the UK are moderately well documented, with most SPA populations counted in at least one year since completion of Seabird2000. Moderate but fairly consistent declines in breeding numbers since 2000 are indicated both

by the JNCC seabird monitoring data and by examination of SPA colony counts. Thus data on numbers of UK lesser black-backed gulls migrasting through UK waters are coded amber. However, numbers of overseas lesser black-backed gulls passing through UK waters on migration are less well known. Information is mainly from ring recovery data (but including very extensive and detailed colour ringing studies from the Netherlands). Populations of lesser black-backed gulls overseas are large, and although only small or very small proportions of these birds migrate through UK waters, this increases the uncertainty about numbers passing through UK waters so estimated numbers of overseas birds are coded red. Numbers of lesser black-backed gulls wintering in UK waters seem to vary from year to year, presumably in relation to weather or food abundance. These numbers have increased over recent decades, but there is further uncertainty regarding the extent to which these birds spend time at sea or in terrestrial habitats. Wintering numbers in BDMPS are coded red both for numbers from overseas and from UK.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 36 to 41.

12.1 Breeding range and taxa

Three subspecies of lesser black-backed gull breed in Europe, but biometrics of individuals do not seem to have been used to identify origins of individuals. The subspecies *fuscus* breeds in Finland, northern Norway and northern and eastern Sweden, and has a distinct migration pattern, moving to winter in east Africa (Bustnes et al. 2013). Birds from that subspecies (which are relatively easy to identify in the field from plumage features) only occur in UK waters as vagrants. The subspecies *graellsii* breeds in Iceland, Faroe, the British Isles, and western Europe south to Portugal, and winters predominantly in Iberia or on the coast of northwest Africa. The subspecies *intermedius* breeds in Denmark, southern Norway and southern Sweden while populations somewhat intermediate between *intermedius* and *graellsii* breed in Germany and the Netherlands (Wernham et al. 2002). Birds from populations of *intermedius* show much the same migration patterns as birds from *graellsii* (Wernham et al. 2002).

12.2 Non-breeding component of the population

Lesser black-backed gulls start to breed when 4 years old (BTO Birdfacts). Adult survival rate is given as 0.913 in BTO Birdfacts (but more recent work on this species indicates a decline in survival with time for the population at Skomer http://jncc.defra.gov.uk/page-2886 so a lower value could be used but would have only a small influence on the ratio estimate because of corresponding adjustment of immature survival rates in the opposite direction to achieve a stable population trend), juvenile survival unknown (BTO Birdfacts) and mean productivity is 0.517 chicks per pair (JNCC database, n=66 measurements). To obtain a stable population, survival of immatures was adjusted to 0.7 for juveniles, 0.74 for 1-year olds, 0.79 for 2-year olds, 0.84 for 3-year olds. The model population comprised 60% adults, 15% juveniles and 25% older immatures. There are 0.68 immatures per adult.

12.3 Phenology

Breeding colonies in the UK are deserted by September, with modal departure in late July or early August (Pennington et al. 2004; Forrester et al. 2007). Autumn migration starts in late June (Pennington et al. 2004), July (Cramp et al. 1977-94; Forrester et al. 2007) or mid-July (Wernham et al. 2002). Peak autumn migration occurs in August (Pennington et al. 2004), August-September (Wernham et al. 2002), September (Forrester et al. 2007), and June-October in Belgium (Vanermen et al. 2013) and August-November throughout Europe and North Africa (Cramp et al. 1977-94). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred rather consistently through August-November (Figure 12.1) suggesting a very protracted autumn

migration through UK waters. Autumn migration is completed by early October in Shetland (Pennington et al. 2004) but not until October-November (Wernham et al. 2002) or November (Forrester et al. 2007) or early December (Cramp et al. 1977-94) in the UK as a whole.

Spring migration starts in February in the winter quarters (Cramp et al. 1977-94), mid-February (Wernham et al. 2002) or late February (Forrester et al. 2007) in the UK as a whole, or early March (Pennington et al. 2004) in Shetland. Peak spring migration occurs in February-April in Belgium (Vanermen et al. 2013), in March (Wernham et al. 2002; Forrester et al. 2007), March-April (Cramp et al. 1977-94), or in April in Shetland (Pennington et al. 2004). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in early March, although there were suggestions of a further peak in mid-April (Figure 12.1). Spring migration is completed by April (Wernham et al. 2002) or May (Cramp et al. 1977-94; Forrester et al. 2007) or early June in Shetland (Pennington et al. 2004).

The first spring records of lesser black-backed gull in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 2 January to 1 April, but mostly in February, and the last records were from 25 August to 29 December, but mostly in late October. Peak autumn dispersal/migration was reported in July-August in most years, and peak spring migration was reported in March in most years. Birds re-occupy colonies from late February or early March with modal return in late March (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007).

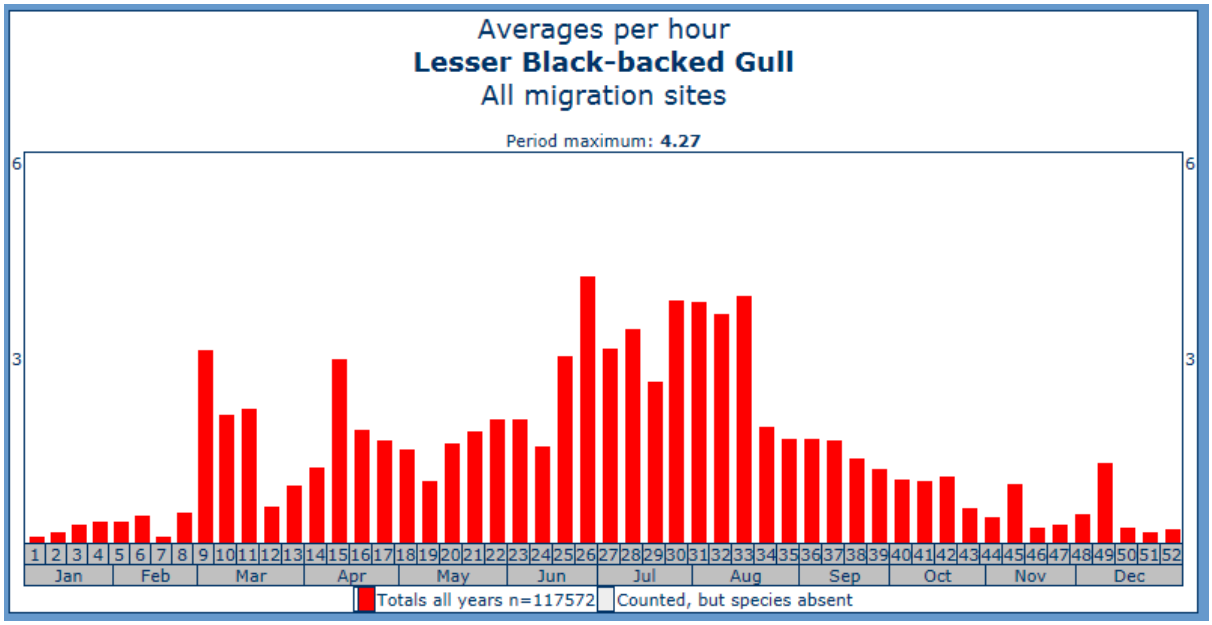


Figure 12.1. Average numbers of lesser black-backed gulls counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season September-April. However, from the data reviewed above, a more appropriate definition would be breeding season April-August, non-breeding season September-March.

12.4 Defined seasons:

- UK Breeding season — April-August
- Post-breeding migration in UK waters — August-October (**autumn BDMPS**)
- non-breeding season — September-March
- Return migration through UK waters — March-April (**spring BDMPS**)
- Migration-free breeding season — May-July
- Migration-free winter season — November-February (**winter BDMPS**)

Apart from the breeding season, three seasonal BDMPS periods are considered to be appropriate for lesser black-backed gull:

'Autumn' (post-breeding) migration BDMPS (August-October);

'Winter' BDMPS (November-February); and

'Spring' (pre-breeding) migration BDMPS (March-April).

12.5 Movements of birds from the UK population

In the UK, autumn movements start in the second half of July. Migration southwards is fairly rapid from northern colonies, with most birds away by August (Orkney Bird Reports; Shetland Bird Reports), but is protracted in southern Britain where some birds remain near colonies until early October (Wernham et al. 2002). Timing of dispersal from colonies is the same in The Netherlands; occurring in July-August (Camphuysen 2013). Many fledglings are accompanied by their parents during initial autumn dispersal, but it is unclear if families remain together during autumn migration. Camphuysen (2013) found that successful breeders abandoned the colony when their young were about 50 days old, and that southward autumn movement started first in immatures, then in adults, and last in juveniles, suggesting that post-fledging care of juveniles was mostly minimal. Camphuysen (2013) reported that movement away from colonies in The Netherlands occurred earlier in autumn in years since 2000 than it had previously, suggesting deteriorating conditions in the breeding areas. Young birds tend to move further south than adults (Wernham et al. 2002). Some adults apparently tend to return each year to the same wintering site, although some may change wintering areas between years. Adults return to colonies in the UK in February to April (Wernham et al. 2002), with some evidence for birds that winter furthest north arriving back at colonies first. Until the 1950s the lesser black-backed gull in the UK was considered to be a migrant, with all birds wintering in southern Europe or north Africa. However, in the 1960s and 1970s increasing numbers, mostly of adults, remained in the UK overwinter (Wernham et al. 2002). This change may relate as much to availability of land-fill feeding sites as to warming of the climate (Banks et al. 2007). There were estimated to be about 70,000 lesser black-backed gulls wintering in Britain and Ireland in censuses held in 1985 and 1993 (Wernham et al. 2002), and 125,113 in 2003-06 (Burton et al. 2013) suggesting that numbers have continued to increase. Not only did winter distribution change, but migration routes also changed, with increasing numbers migrating overland. Recent tracking studies by the British Trust for Ornithology of breeding adults from a colony in East Anglia found that although autumn migration was predominantly coastal, the more rapid spring migration from north Africa to England occurred overland through central France.

12.6 Movements of birds from overseas into UK waters

Foreign-ringed lesser black-backed gulls recovered in Britain and Ireland have come from Iceland, Faroe, Norway, Sweden, Finland, Denmark, the Netherlands, Belgium, the Channel Islands and Spain; almost 60% of these are likely to be from the subspecies *intermedius* mostly from breeding sites in Norway, Sweden and Denmark, while the remaining 40% are

predominantly *graellsii* from Iceland and Faroe (Wernham et al. 2002). The single recovery of a bird of the subspecies *fuscus* from Finland can be discounted as exceptional, as that subspecies can be identified in the field from plumage features, and is only very rarely seen in the UK (Wernham et al. 2002). Most foreign-ringed lesser black-backed gulls from Norway, Sweden, Denmark, the Netherlands and Belgium have been found in SE England (Wernham et al. 2002), suggesting that these continental birds cross the southern North Sea. Birds from Iceland and Faroe have been more broadly distributed through the British Isles. However, lesser black-backed gulls from colonies in The Netherlands mostly winter in France, Portugal and Spain, and relatively few birds marked in The Netherlands have been seen in the UK (Camphuysen 2013), although there are a few records. Seabird 2000 reported 87,413 pairs in UK, 3,800 pairs in Ireland, 25,000 pairs in Iceland, 9,000 pairs in Faroe, 25,000-36,000 pairs in Norway, 15,000-20,000 pairs in Sweden (however BirdLife International (2004) cite 2000-5000 pairs in Sweden but without listing the data source), 4,400 pairs in Denmark, 32,000-57,000 pairs in the Netherlands. In the Netherlands, breeding numbers peaked around 2005 (Camphuysen 2013) at around 90,000 pairs and are probably now around 80,000 pairs (Camphuysen 2013).

12.7 Numbers in UK waters

Musgrove et al. (2013) report that there are 120,000 in Britain in winter, 130,000 in UK in winter, but it is unclear if these include birds at sea as well as onshore and at coastal roosts. From surveys in 2007 and 2008, Fauchald and Tveraa (2009) reported mean densities at sea of 0.7-10 birds per km^2 in the Norwegian Sea in spring/summer, and 0 birds per km^2 in the Barents Sea in autumn. Lesser black-backed gulls are distributed throughout the North Sea in summer but with much higher densities in the southeastern North Sea and low densities in the northwestern North Sea (Skov et al. 1995; Camphuysen 2013). About 130,000 birds were estimated to be in the North Sea in March-August (Skov et al. 1995) (although this estimate was based on data that are now rather out of date), with about 95% of these in the eastern half of the North Sea (Camphuysen 2013). Areas of greatest importance for this species in the North Sea are between Vlieland and Ijmuiden (off Texel) from May to October, in the Skagerrak in March-April and Helgoland Bight in May-June (Camphuysen 2013). Lesser black-backed gulls show a strong association with the distribution of fishing vessels in the southern North Sea in summer, congregating in areas where fisheries discards are available (Camphuysen et al. 1995), so their distribution reflects the locations of large colonies and also the behaviour of fisheries in the area. In winter, the North Sea is largely abandoned, but about 15,000 birds spend the winter in the English Channel (Camphuysen 2013). According to Brown and Grice (2005) highest numbers in English waters in winter are found in the Celtic and Irish Seas and SW Approaches. Wintering numbers inland in England have increased from 165 in 1953 to 6,960 in 1963, 15,823 in 1973, 36,154 in 1983, and 27,230 in 1993 (Brown and Grice 2005). It is estimated that there were 70,000 lesser black-backed gulls wintering in England (inland plus English waters) in the 1980s, and that numbers have increased since then (Brown and Grice 2005). Forrester et al. (2007) suggest that only about 200-600 birds winter in Scotland but that there are 30,000-50,000 in spring passage and 50,000-80,000 in autumn passage. Bradbury et al. (in press) used ESAS and offshore wind farm survey data to compare the relative importance of different marine areas at different times of year.

12.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *graellsii* population, comprising 124,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 179,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 550,000 individuals. The biogeographic population with connectivity to UK waters totals about 292,000 birds (adults plus immatures) from the UK plus 572,000 birds (adults plus immatures) from overseas populations (Iceland, Norway, Sweden, Denmark, Faroe, Ireland, and The Netherlands). However, only small proportions

of the birds from overseas populations visit UK waters, so the estimated total numbers in UK waters are much smaller than this total. In autumn (August to October) there are estimated to be 372,000 birds in UK waters, 266,000 from UK and 106,000 from overseas. In winter (November to February) there are estimated to be 80,000 birds in UK waters, 65,000 from the UK and 15,000 from overseas. In spring (March and April) there are estimated to be 360,000 birds in UK waters, 266,000 from UK and 94,000 from overseas.

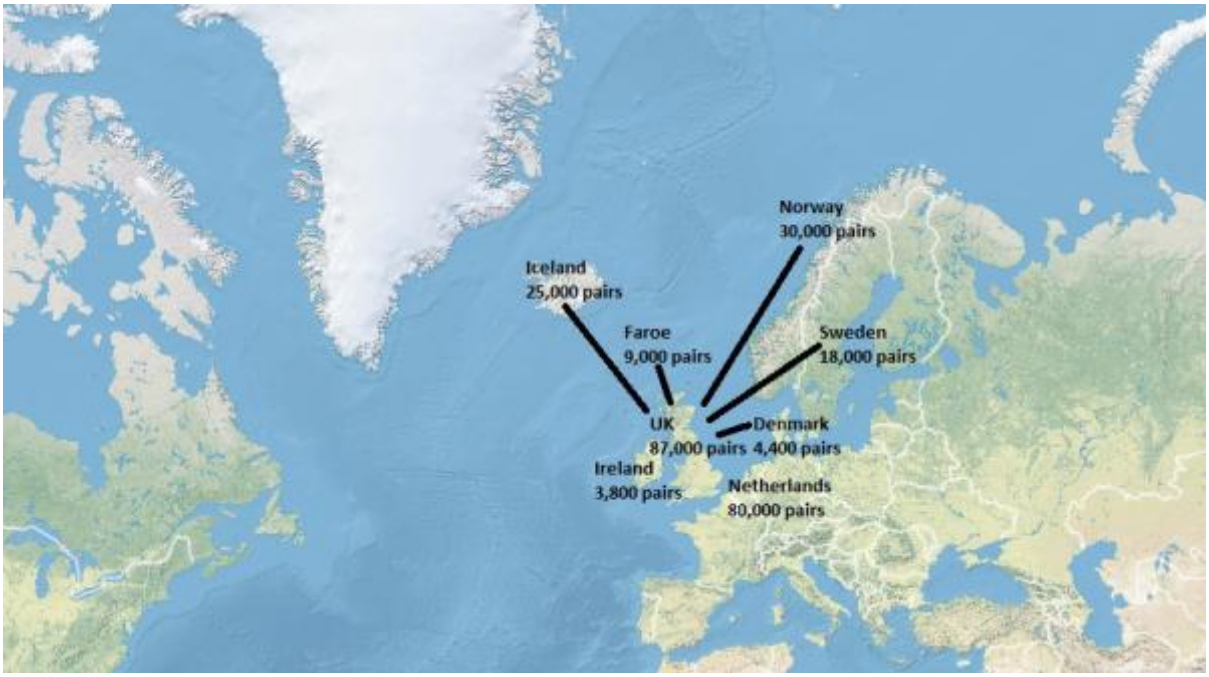


Figure 12.2. Breeding population origins of lesser black-backed gulls in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

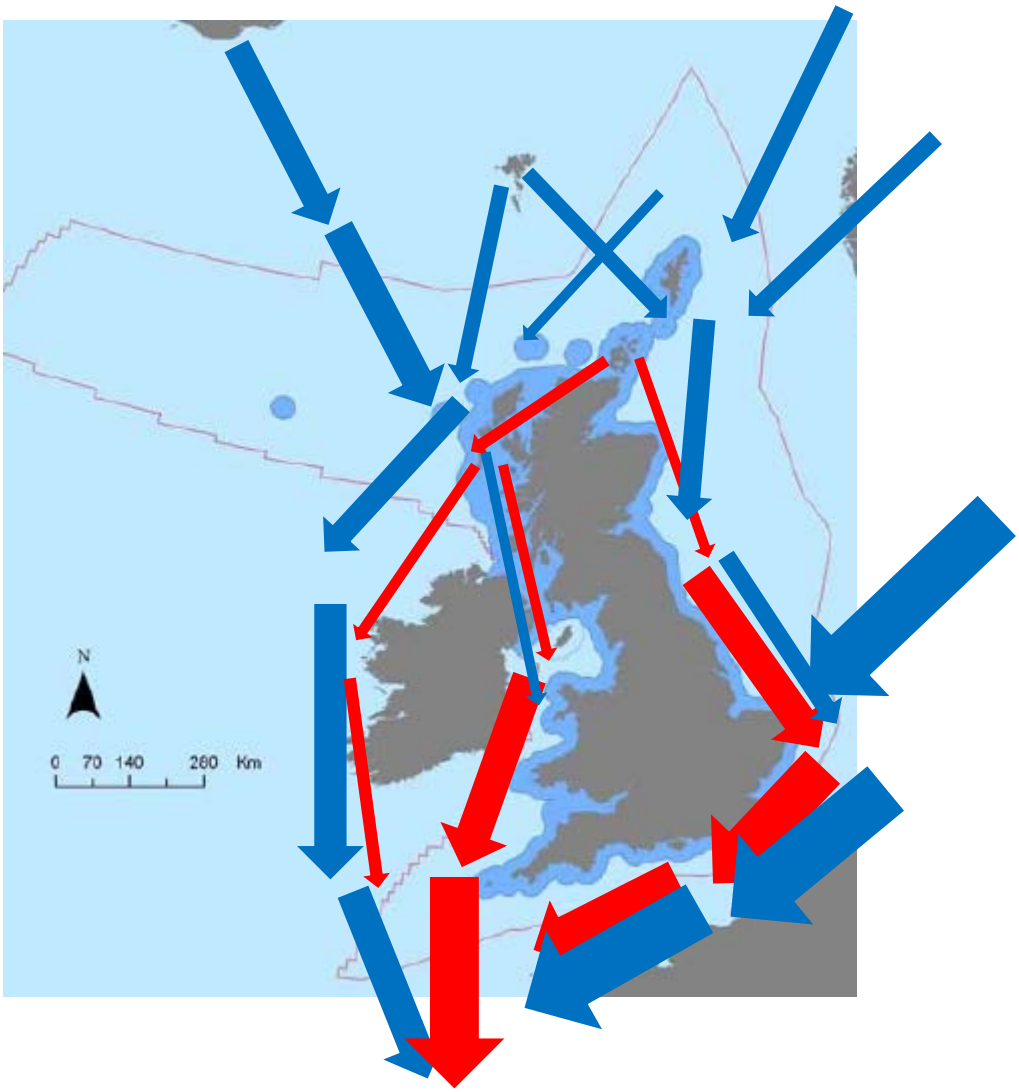


Figure 12.3. Main movements of lesser black-backed gulls from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes.

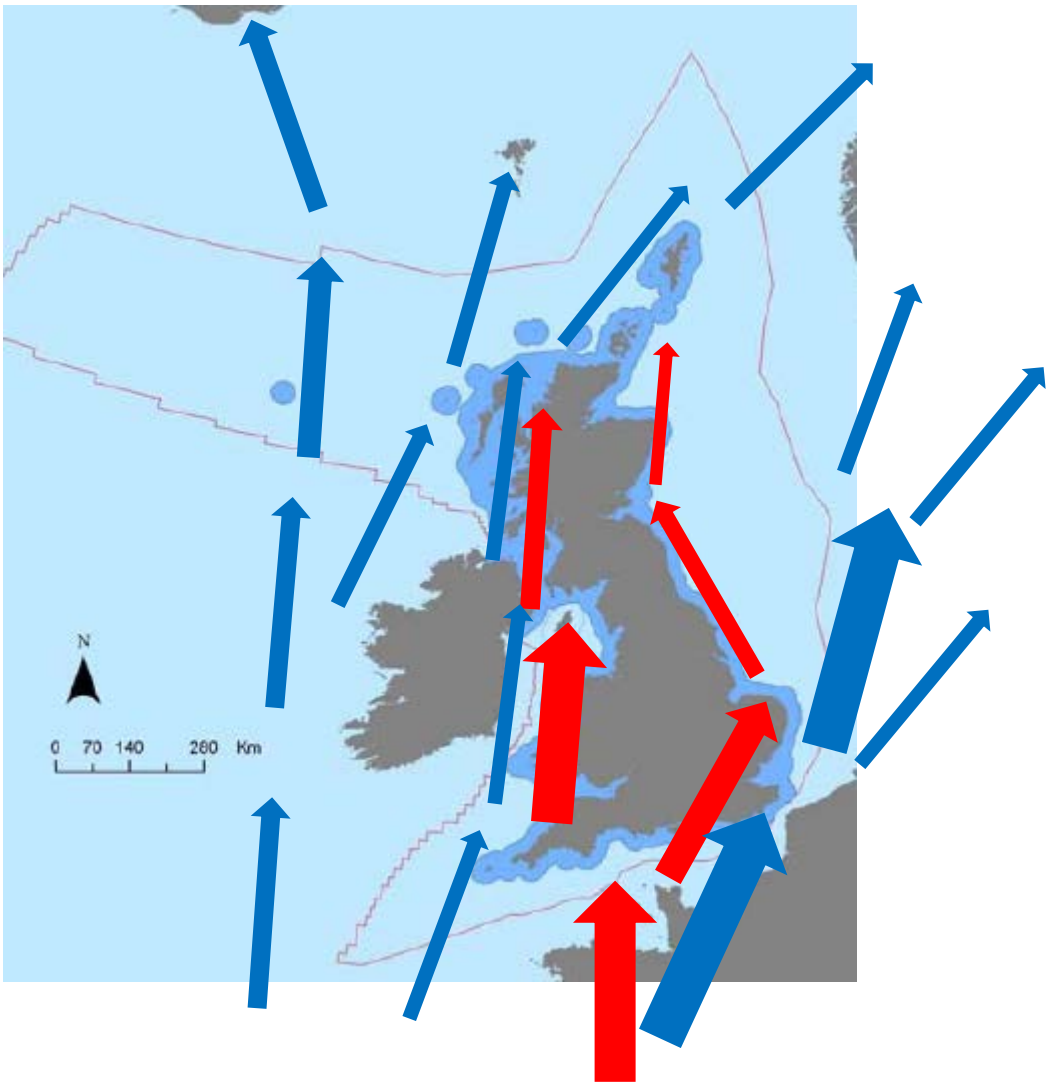


Figure 12.4. Main return movements of lesser black-backed gulls in spring to UK breeding areas (red arrows) and towards overseas populations (blue arrows) through UK waters. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes.

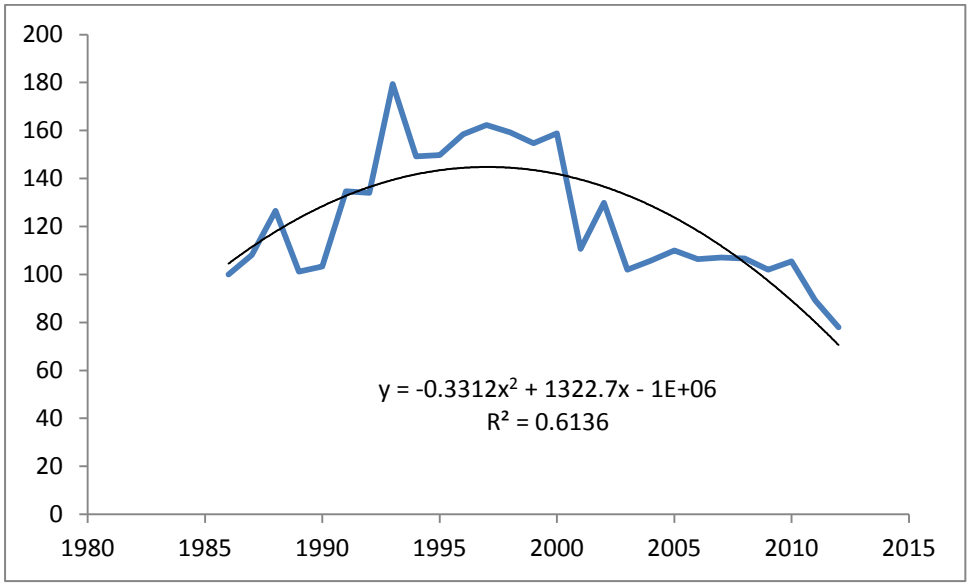


Figure 12.5. Trend in the lesser black-backed gull breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

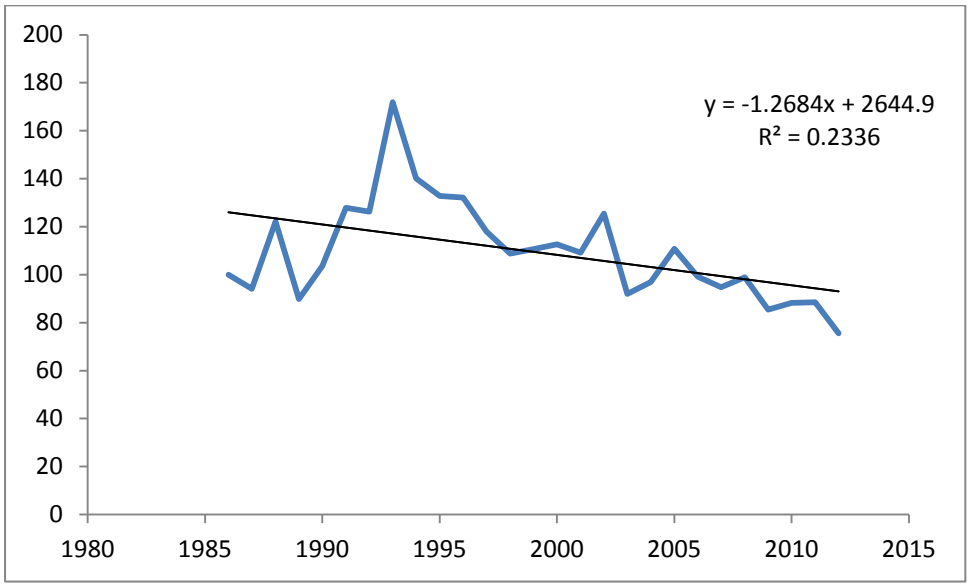


Figure 12.6. Trend in the lesser black-backed gull breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

12.9 Proportion of UK population from UK breeding SPAs

The 10 SPAs with breeding lesser black-backed gulls as a feature together held 88,633 pairs at designation, estimated to represent ca. 100% of the British breeding population (Stroud et al. 2001). However, this clearly overestimates the proportion on SPAs as there have been non-SPA colonies with substantial numbers for many decades. The 2014 UK SPA review (Stroud et al. 2014) reported that the UK breeding SPA populations represented 38.5% of the GB population in 2003-11, this large decrease being due to very large declines in breeding numbers at some of the largest colonies (all of which are SPAs).



Figure 12.7. The SPA suite for lesser black-backed gull. These SPA populations are listed in Table 12.1.

Table 12.1. The UK SPA suite for breeding lesser black-backed gulls.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Forth Islands	E Scotland	1,500 (1985) Or 2,920 (Stroud et al. 2001)	1990	Maintained 2008	2,013 >2,100 1,608	2002 2008 2005-2009	Lewis et al. 2012 Lewis et al. 2012 Stroud et al. 2014
Alde-Ore Estuary	SE England	14,070 (1994-1998) Or 21,700 (Stroud et al. 2001)	1996	Counts may relate to just Orfordness and may exclude Havergate Marshes; there were 1747 AON there in 2013	6,000 5,000 1,678 1,584 900 550 550 640	2003 2006 2007 2008 2009 2010 2011 2012	Stroud et al. 2014 SMP database SMP database SMP database SMP database SMP database SMP database SMP database

UK Western waters							
Ailsa Craig	W Scotland	1,800 (1987)	1990	Declined 2010	183	2010	Lewis et al. 2012
Rathlin Island	N Ireland	155 (1985)	1999		127 36 107	1999 2007 2011	SMP database SMP database Stroud et al. 2014
Lough Neagh & Lough Beg	N Ireland	450 (Stroud et al. 2001)	1996		385 493	2000 2000	SMP database Stroud et al. 2014
Bowland Fells	NW England	11,470 Or 13,900 (1998) (Stroud et al. 2001)	1993		18,518 4,575	2001 2008-2012	SMP database Stroud et al. 2014
Morecambe Bay	NW England	22,000 (Stroud et al. 2001)	1996		12,100 11,988 10,354 10,670 9,829 8,130 4,987	2006 2007 2008 2009 2010 2011 2012	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Ribble and Alt Estuaries		1,800 (1993)	1995	The 2012 count used a new method and may not be a real increase from 2008	4,150 3,348 4,117 8,267	1998 2003 2008 2012	SMP database SMP database SMP database SMP database
Skomer and Skokholm	Wales	20,300 (1993-1997)	1982		12,660 12,780 12,690 10,890 9,640	2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database
Isles of Scilly	SW England	3,608 (1999)	2001		3,400 3,333	2006 2006	SMP database Stroud et al. 2014

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

12.10 BDMPS

UK waters can be split into two spatial BDMPS for lesser black-backed gulls, the UK North Sea and Channel, and the UK western waters (Figure 12.8). This split is based on the fact that while some lesser black-backed gulls from colonies in western Britain move into the North Sea during autumn migration, many tend to move southwards in autumn through UK western waters whereas birds from North Sea colonies tend primarily to move southwards through the North Sea. In addition, birds from overseas are likely to show a tendency to occur more in one side of the UK than the other, with birds from continental Europe more frequent in the North Sea than in western waters. There is a need to define three distinct seasonal BDMPS in each of these spatial units – autumn migration (August to October), winter (November to February), and spring migration (March and April). Numbers are much smaller in winter than during the migration periods.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 36 to 41.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in autumn in the UK North Sea and Channel, the BDMPS is estimated to include 100% of adults and 70% of immatures from colonies on the UK North Sea coast, 50% of adults and 40% of immatures from UK colonies in western Scotland, Northern Ireland and NW England, 30% of birds from colonies in Wales and 10% of adults and 5% of immatures from the Isles of Scilly (Appendix A Table 36). The BDMPS is also estimated to include birds from several overseas populations; 20% of adults and 10% of immatures from Iceland, 30% of adults and 10% of immatures from Norway, 40% of adults and 20% of immatures from Faroe, 10% of adults and 5% of immatures from Sweden, Denmark and Ireland, 5% of adults and 2.5% of immatures from The Netherlands. These proportions result in an estimated BDMPS of 209,007 birds in the UK North Sea and Channel in autumn, 146,137 from the UK and 62,870 from overseas.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in autumn in UK western waters, the BDMPS is estimated to include no adults from UK North Sea colonies but 10% of immatures from those sites, 50% of adults and 40% of immatures from colonies from west Scotland, Northern Ireland and NW England, 70% of adults and 40% of immatures from colonies in Wales, 90% of adults and 60% of immatures from colonies in SW England (Appendix A Table 37). The BDMPS is also estimated to include birds from several overseas populations; 20% of adults and 10% of immatures from Iceland, 10% of adults and 5% of immatures from Norway, 40% of adults and 20% of immatures from Faroe, 5% of adults and 2% of immatures from Sweden and Denmark, 40% of adults and 20% of immatures from Ireland, 2.5% of adults and 1% of immatures from The Netherlands. These proportions result in an estimated BDMPS of 163,304 birds in the UK North Sea in autumn, 120,205 from the UK and 43,099 from overseas.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in winter in the UK North Sea and Channel, the BDMPS is estimated to include 50% of adults and 5% of immatures from colonies on the UK North Sea coast, 10% of adults and 1% of immatures from UK colonies in western Scotland, Northern Ireland, Wales and W England (Appendix A Table 38). The BDMPS is also estimated to include birds from several overseas populations; 5% of adults but no immatures from Iceland, Norway, and Faroe, 1% of adults but no immatures from Sweden, Denmark and Ireland, 0.5% of adults but no immatures from The Netherlands. These proportions result in an estimated BDMPS of 39,314 birds in the UK North Sea and Channel in winter, 31,590 from the UK and 7,724 from overseas.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in winter in UK western waters, the BDMPS is estimated to include no birds from UK North Sea colonies, 20% of adults and 5% of immatures from colonies from west Scotland, Northern Ireland, Wales and W England (Appendix A Table 39). The BDMPS is also estimated to include birds from several overseas populations; 5% of adults but no immatures from Iceland, 2% of adults but no immatures from Norway, 5% of adults but no immatures from Faroe, 1% of adults but no immatures from Sweden and Denmark, 20% of adults and 5% of immatures from Ireland, 0.5% of adults but no immatures from The Netherlands. These proportions result in an estimated BDMPS of 41,159 birds in the UK North Sea in winter, 33,533 from the UK and 7,626 from overseas.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in spring in the UK North Sea and Channel, the BDMPS is estimated to include 100% of adults and 70% of immatures from colonies on the UK North Sea coast, 50% of adults and 40% of immatures from UK colonies in western Scotland, Northern Ireland and NW England, 30% of birds from colonies in Wales and 10% of adults and 5% of immatures from the Isles of Scilly (Appendix A Table 40). The BDMPS is also estimated to include birds from several overseas populations; 10% of adults and 5% of immatures from Iceland, 30% of adults and 10% of immatures from

Norway, 20% of adults and 10% of immatures from Faroe, 10% of adults and 5% of immatures from Sweden, Denmark and Ireland, 5% of adults and 2.5% of immatures from The Netherlands. These proportions result in an estimated BDMPS of 197,483 birds in the UK North Sea and Channel in spring, 146,137 from the UK and 51,346 from overseas.

Based on evidence reviewed in sections 12.5, 12.6 and 12.7, in spring in UK western waters, the BDMPS is estimated to include no adults from UK North Sea colonies but 10% of immatures from those sites, 50% of adults and 40% of immatures from colonies from west Scotland, Northern Ireland and NW England, 70% of adults and 40% of immatures from colonies in Wales, 90% of adults and 60% of immatures from colonies in SW England (Appendix A Table 41). The BDMPS is also estimated to include birds from several overseas populations; 20% of adults and 10% of immatures from Iceland, 10% of adults and 5% of immatures from Norway, 40% of adults and 20% of immatures from Faroe, 5% of adults and 2% of immatures from Sweden and Denmark, 40% of adults and 20% of immatures from Ireland, 2.5% of adults and 1% of immatures from The Netherlands. These proportions result in an estimated BDMPS of 163,304 birds in the UK North Sea in spring, 120,205 from the UK and 43,099 from overseas.

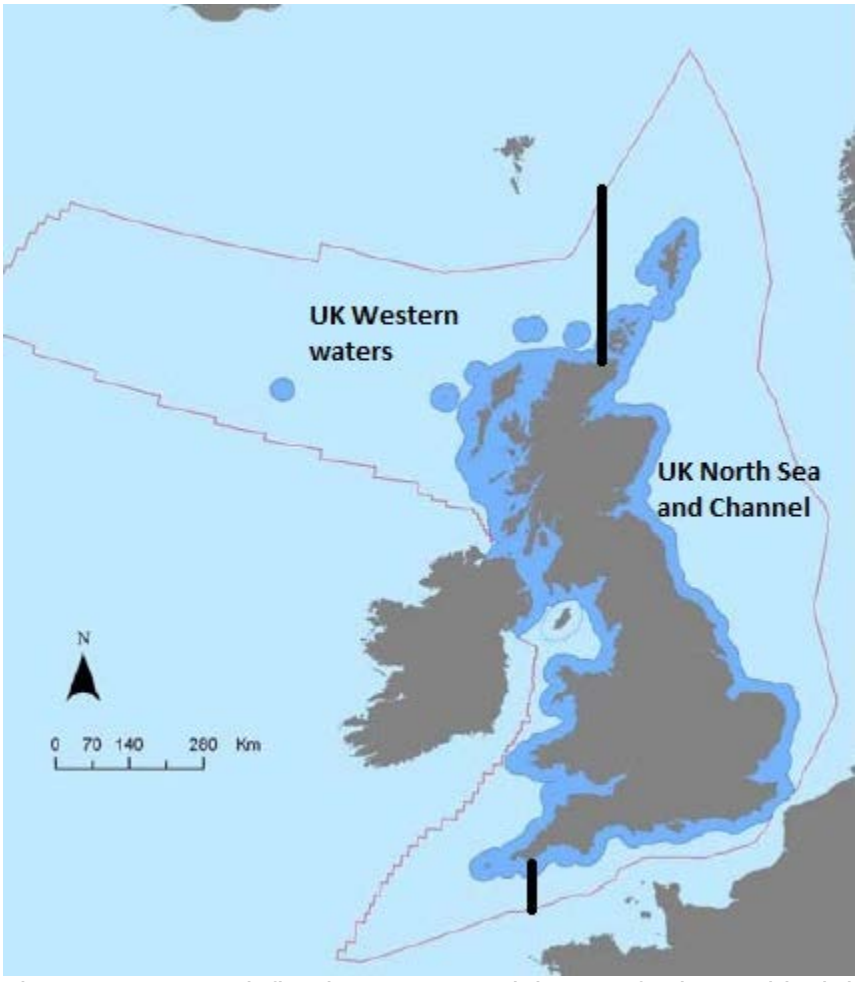


Figure 12.8. Two defined BDMPS spatial areas for lesser black-backed gull: 'UK North Sea and Channel' and 'UK Western waters'.

12.11 Proportions of UK SPA birds in each BDMPS

These proportions can be estimated directly from data in Appendix A Tables 36 to 41. For example, in the UK North Sea and Channel autumn migration BDMPS (Appendix A Table 36), there are 209,007 birds in the BDMPS, of which 29,572 are adults from UK SPA

populations, giving a percent of 14%. In contrast, in the UK western waters autumn migration BDMPS (Appendix A Table 37), there are 163,304 birds in the BDMPS, of which 38,228 are from UK SPA populations, giving a percent of 23%.

12.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Most SPA populations of lesser black-backed gulls are in southern Britain, and the northernmost SPA populations (Forth Islands in the east, Ailsa Craig and Rathlin Island in the west) hold only 1,608 pairs, 183 pairs and 107 pairs respectively (Table 12.1), so the proportions of UK SPA birds in the northern parts of the North Sea and the West of Scotland will be lower than in the southern parts. During the migration seasons and during winter, birds are likely to be well mixed with a large number of UK SPA, UK non-SPA, and overseas populations represented. As a result, proportions of birds within each BDMPS that are adults from UK SPA populations will be likely to be fairly consistent across much of each BDMPS spatial area, apart from a likely tendency for the proportion of UK SPA birds to be lower in the northern parts of each BDMPS range.

13. HERRING GULL *Larus argentatus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (September to February)
Overseas	555,000	145,696
UK	543,000	494,114
Total	1,098,000	639,810

Non-breeding season BDMPS (September to February)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
UK North Sea and Channel	466,511	135,130	331,381
UK Western waters	173,299	10,566	162,733

Most UK herring gull SPA populations have been censused since Seabird2000. The JNCC seabird monitoring programme indicates a decline in breeding numbers since 2000, as do counts from several SPA colonies. Because a high proportion of breeding herring gulls in the UK are not in SPA colonies, up to date breeding numbers away from major SPA populations are less well known. Movements of breeding adults and of immatures in the UK have been studied in detail by individual colour ringing of birds in wintering areas and on migration, and have provided a fairly comprehensive picture of local movement patterns as well as connectivity with overseas populations. The key overseas population in the Barents Sea is thought to be approximately stable in numbers. Ringing studies abroad have also shown migrations of herring gulls from Faroe and Norway. Thus although there have not been geolocator tracking studies of herring gulls, the colour ringing work in the late 20th century does provide a good understanding of herring gull movements. BDMPS contributions from UK and overseas populations are coded amber.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 42 and 43.

13.1 Breeding range and taxa

The herring gull breeds across the Western Palearctic, with two subspecies. Birds breeding in Britain and Ireland are the endemic subspecies *argenteus*. Seabird 2000 reported 132,000 pairs in the UK and 5,500 pairs in Ireland (Mitchell et al. 2004). Elsewhere in northern Europe, birds are of the nominate subspecies *argentatus*. Herring gulls show clinal variation in size, with birds from northern Europe noticeably larger than those from the British Isles. They also show variation in the grey shade of the mantle and upperwing, and variation in wing tip pattern. These variations can be used to infer origins of individual birds at least in terms of broad geographical regions; in particular, adult birds from northern colonies can be

identified in the field when alongside British herring gulls, from differences in size and colour, though differences are not quite so obvious in juveniles and immatures.

13.2 Non-breeding component of the population

Herring gulls start to breed when 4 years old (BTO Birdfacts). Adult survival rate is 0.88 (BTO Birdfacts; Pons and Migot 1995), juvenile survival 0.63 up to age 4 years (BTO Birdfacts) and mean productivity is 0.936 chicks per pair (JNCC database, n=136 measurements). To obtain a stable population, survival of immatures was adjusted to 0.6 for juveniles, 0.7 for 1-year olds, 0.75 for 2-year olds, 0.83 for 3-year olds. The model population comprised 48% adults, 22% juveniles and 30% older immatures. There are 1.09 immatures per adult. The use of an alternative adult survival rate (for example derived from studies at Skomer http://jncc.defra.gov.uk/page-2886) would only alter this ratio very slightly.

13.3 Phenology

Although most adults remain close to their breeding sites throughout the year, few adults remain at colonies after August, with modal departure in August (Pennington et al. 2004; Forrester et al. 2007). However, as a partial migrant species in the UK, some adults remain close to their colony throughout the year. Autumn dispersal/migration starts in August (Wernham et al. 2002; Forrester et al. 2007) or mid-August (Cramp et al. 1977-94). Peak autumn migration occurs in July-December (Brown and Grice 2005), September-October (Forrester et al. 2007; Pennington et al. 2004), or October (Cramp et al. 1977-94; Wernham et al. 2002). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late October to late December (Figure 13.1). Trektellen sites (predominantly in east and south-east England) may observe mostly herring gulls arriving from north Norway rather than dispersing birds from UK colonies, but timing of autumn movements appears not to differ much between UK and north Norwegian populations (Stanley et al. 1981; Horton et al. 1983; Brown and Grice 2005). Autumn migration is completed by November (Forrester et al. 2007), early December (Cramp et al. 1977-94), or December (Wernham et al. 2002).

Spring migration starts in January (Wernham et al. 2002; Forrester et al. 2007) or mid-February (Cramp et al. 1977-94). Peak spring migration occurs in January (Pennington et al. 2004), January-April (Forrester et al. 2007), or March-April (Cramp et al. 1977-94; Wernham et al. 2002; Brown and Grice 2005). Peak rate of change in numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in February-April (Figure 13.1). Spring migration is completed by early May (Cramp et al. 1977-94) or May (Wernham et al. 2002; Forrester et al. 2007).

The first spring records of herring gull in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 1 January and the last records were predominantly at 31 December, as large numbers of herring gulls overwinter, but peak autumn migration was reported in October in most years, and peak spring migration was reported in January-March if detected at all which it was not in most years. Birds re-occupy colonies from early January, with modal return in early March (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007).

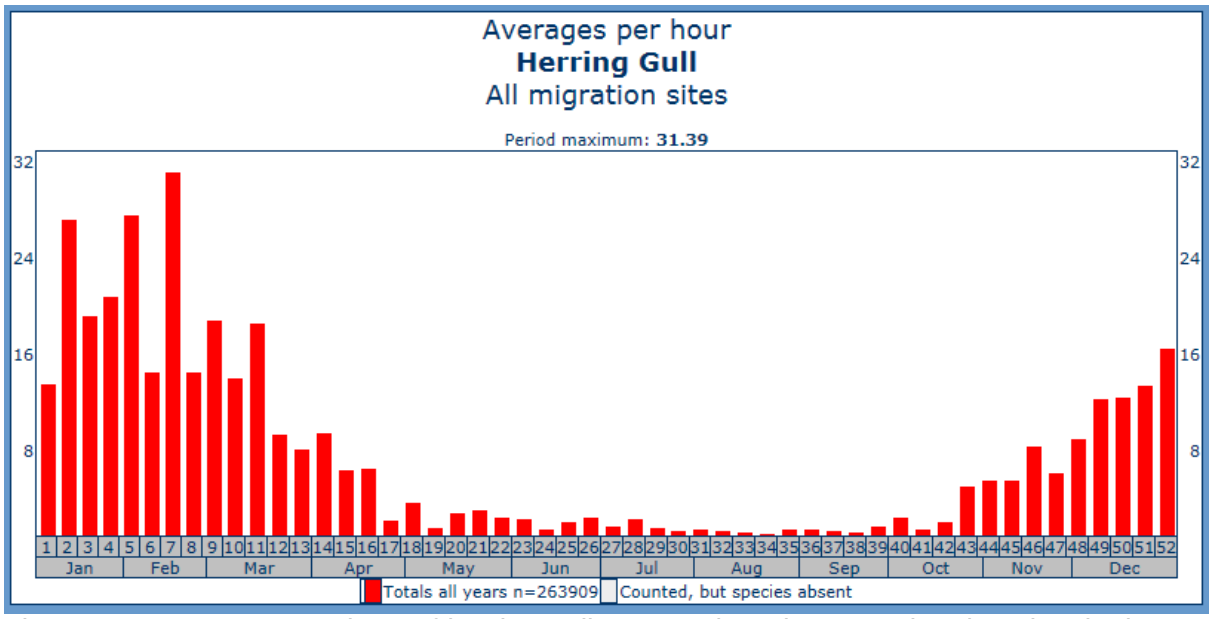


Figure 13.1. Average numbers of herring gulls counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as April-August, non-breeding season September-March. However, from the data reviewed above, a more appropriate definition would be breeding season March-August, non-breeding season September-February.

13.4 Defined seasons:

- UK Breeding season — March-August
- Post-breeding migration in UK waters — August-November
- non-breeding season — September-February (**non-breeding BDMPS**)
- Return migration through UK waters — January-April
- Migration-free breeding season — May-July
- Migration-free winter season — December

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for herring gull:

Non-breeding season BDMPS (September-February).

13.5 Movements of birds from the UK population

Herring gulls in Britain and Ireland do not migrate, and show only limited dispersal. Most adults remain close to their breeding sites throughout the year. Young birds move further than adults, but the median distance between ringing site and recovery site for all UK ringed herring gulls (so predominantly ringed as chicks in colonies) was only around 15 km (Wernham et al. 2002). Camphuysen (2013) found that successful breeders abandoned the colonies in The Netherlands in July-August, when their young were about 50 days old, and that southward autumn movement started first in immatures, then in adults, and last in juveniles, suggesting that post-fledging care of juveniles was mostly minimal. At UK colonies, dispersal after breeding can be evident from August onwards and while birds can move in all directions the autumn movements tend to be predominantly southwards, but lead to little increase in distance between ringing and recovery site until October. A measureable

but small average distance is evident in ring recoveries until March, but by April virtually all recoveries of adults are at or very close to the colony, although immature birds may be somewhat more widely distributed (Wernham et al. 2002). Studies on refuse tips in north-east England found that colour ringed herring gulls originated from the whole east coast of Scotland as well as local birds from NE England. Adults started to arrive from late July (presumably these were failed breeders) with peak passage in September-October and some individuals not arriving until December, with a tendency for individuals to show the same seasonal pattern in successive years (Wernham et al. 2002). Herring gulls generally tend to remain close to coasts, occurring at rather low density in pelagic waters. Although herring gulls may move along coasts or sometimes across water, movements between east and west coasts of the UK are surprisingly limited (Wernham et al. 2002). Populations to the west of the UK are therefore unlikely to mix much with populations to the east of the UK.

13.6 Movements of birds from overseas into UK waters

Many nominate *argentatus* birds, especially those from furthest north, can be identified in the field from their considerably larger body size and plumage features (darker mantle, white tip to outermost primary). In winter, those birds tend to be seen in largest numbers in eastern Britain (Coulson et al. 1984). Birds from the nominate subspecies mostly occur in the UK from September to February (Wernham et al. 2002). Ringing suggests that very few of those birds come from Iceland (Wernham et al. 2002). Ringing in Faroe has resulted in two recoveries of birds ringed as chicks and subsequently recovered in their first winter in the UK (Hammer et al. 2013), indicating that at least some young birds from Faroe winter in the UK. However, these come from a relatively small population (1,500 pairs; Hammer et al. 2013). Much larger numbers arrive from the Barents Sea coast of north Norway and north Russia (Wernham et al. 2002), where there are around 126,000 pairs (Anker-Nilssen et al. 2000). Those birds obviously carry out a long-distance migration with extensive travel across the sea from Norway to Scotland, but perhaps surprisingly they very rarely occur in west Britain, tending to remain on the east coast of the UK from Shetland to SE England (Wernham et al. 2002). The Barents Sea population of herring gulls is considered to be partially migratory, with some adults remaining in the Barents Sea throughout the year, but some adults and a higher proportion of immatures migrate during October to winter in the North Sea. Birds from northern Norway winter further south than birds from southern Norway (Haftorn 1971), so Norwegian birds in UK waters are almost all of northern Norwegian origin. Large numbers of herring gulls (many thousands) overwinter along the coast of southern Norway (Petersen et al. 2011), but those birds are probably mostly local breeders that remain in the same area throughout the year, possibly with some birds from north Norway too. While birds from the Norwegian sector of the Barents Sea predominantly migrate along the Norwegian coast, birds from the Russian sector of the Barents Sea (including the White Sea) mostly migrate through the Baltic Sea. Some of these reach the North Sea, while others winter further east (Anker-Nilssen et al. 2000). Herring gulls breeding in The Netherlands are largely sedentary, with many adults remaining within a few km of their colony through winter (Camphuysen 2013). The limited dispersal of herring gulls from colonies in The Netherlands apparently does not normally involve movements to the UK since only 3 sightings out of over 86,000 movements of colour ringed herring gulls from colonies in The Netherlands were made in the UK (Camphuysen et al. 2011).

13.7 Numbers in UK waters

Musgrove et al. (2013) report that there are 730,000 in Britain in winter, 740,000 in UK in winter, but it appears that these totals do not include birds at sea except where they were visible from land. From surveys in 2007 and 2008, Fauchald and Tveraa (2009) reported mean densities at sea of 9.7 to 13.6 birds per km^2 in the Norwegian Sea in spring/summer, and 1.8 to 6.4 birds per km^2 in the Barents Sea in autumn. Nearly 1,000,000 herring gulls are in the entire North Sea in winter (November to February) dispersed throughout the North Sea but many of these birds are not in UK waters (Skov et al. 1995) (although these data are

now rather out of date). About 175,000 more winter in the Wadden Sea (Camphuysen 2013). Lack (1986) estimated that about 500,000 herring gulls winter inland or on coasts in Britain and Ireland, with about 122,000 of these in England (Brown and Grice 2005). There were estimated to be 63,780 birds at inland roosts in England in January 1993 and 192,846 at coastal roosts (Burton et al. 2003; Brown and Grice 2005; Burton et al. 2013). Forrester et al. (2007) suggest that there are well over 91,000 herring gulls from the UK population in Scotland, in mid-winter, in terrestrial habitats, but numbers that may be at sea at that time in addition to this total were not estimated, and that count did not include herring gulls in Shetland, Orkney, Western Isles or several parts of northern Scotland, so this number is clearly a large underestimate. In addition, Forrester et al. (2007) estimated that between 5,000 and 20,000 Scandinavian herring gulls are in Scotland in winter, but again this estimate seems to be based mainly on data from terrestrial sites rather than from marine habitats, and is likely to be an underestimate of the total.

In March-April most central areas of the North Sea are vacated by herring gulls, with concentrations found in the Southern Bight and German Bight, the Skagerrak/Kattegat, and in Shetland to NE Scotland (Camphuysen 2013). In summer and early autumn, herring gull numbers in the North Sea are low, showing a coastal distribution related to breeding colony locations (Camphuysen 2013). In winter, herring gulls show a strong association with the distribution of fishing vessels, congregating in areas where fisheries discards are available (Camphuysen et al. 1995). Thus the numbers and distribution of herring gulls in UK waters in winter are likely to vary in response to changes in fisheries activity.

13.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the NW Europe population, comprising 940,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 705,000-799,000 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. Populations with connectivity to UK waters sum to 262,500 pairs, with the UK population almost exactly half of this. Thus the biogeographic population including immatures as well as adults may number about 1,098,000 birds, with 543,000 from UK and 555,000 from overseas. However, only part of the large Barents Sea population comes into UK waters in winter, so UK birds will tend to outnumber birds from overseas populations during migration periods and midwinter. The total numbers in UK waters in the non-breeding season (September to February) sum to a total of about 640,000 birds, 494,000 from UK and 146,000 from overseas.



Figure 13.2. Breeding population origins of herring gulls in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

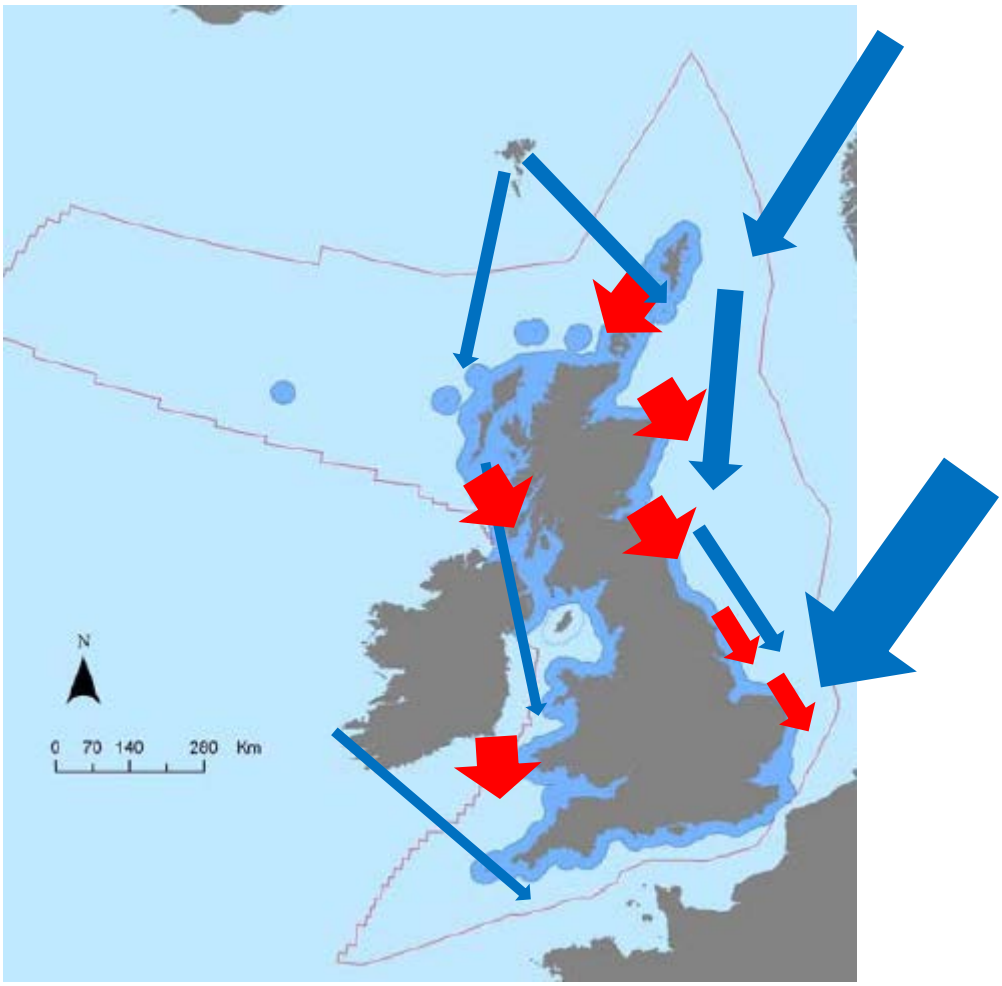


Figure 13.3. Main movements of herring gulls from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

13.9 Proportion of BDMPS from UK breeding SPAs

The 12 SPAs with breeding herring gulls as a feature together held 54,650 pairs at designation, estimated to represent ca. 32% of the British breeding population (Stroud et al. 2001) (although this misses some of the inland breeding colonies so probably rather overestimates the proportion breeding on SPAs; G Mudge in litt.). Herring gull numbers have declined considerably since these SPAs were designated, and as with other declining seabird populations, the decreases have been especially large in the largest populations, which are the SPAs. Stroud et al. (2014) estimated that the UK SPA suite for breeding herring gulls held 12.5% of the GB population in 1999-2011, and since numbers have declined further at some of the SPAs where they used data from 1999-2003, this percentage has almost certainly decreased further and may now be around 11% based on more up to date data in Table 13.1.



Figure 13.4. The SPA suite for herring gull. These SPA populations are listed in Table 13.1.

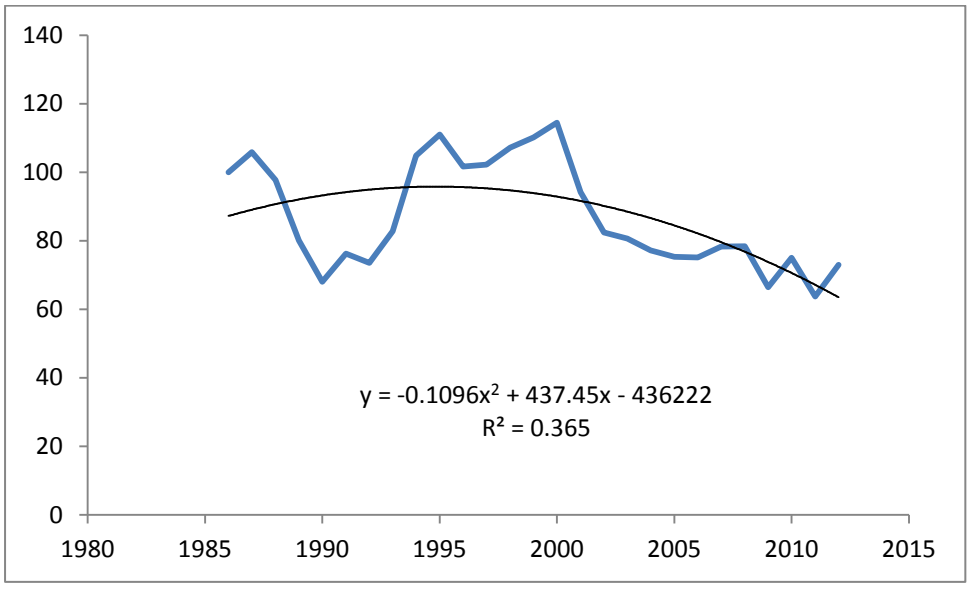


Figure 13.5. Trend in the herring gull breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

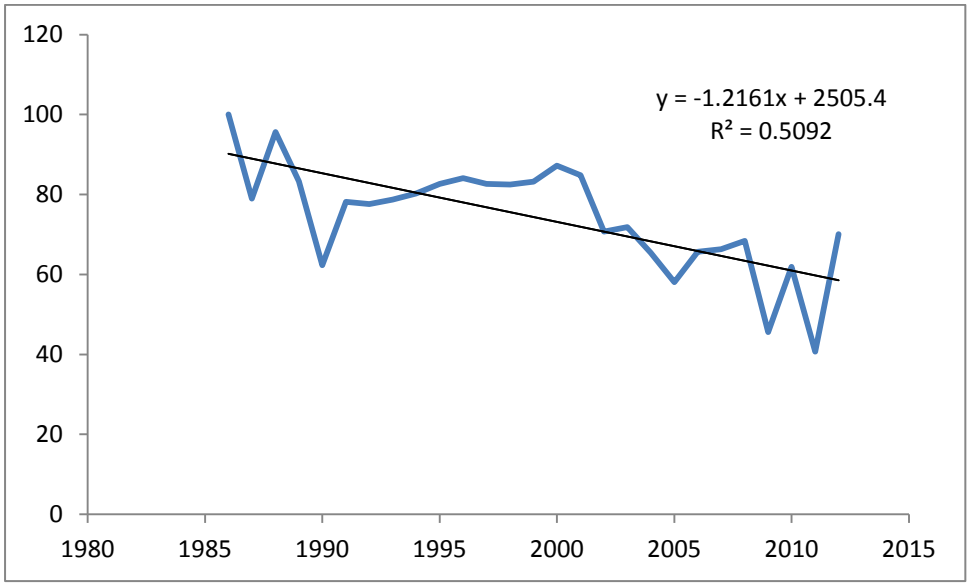


Figure 13.6. Trend in the herring gull breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

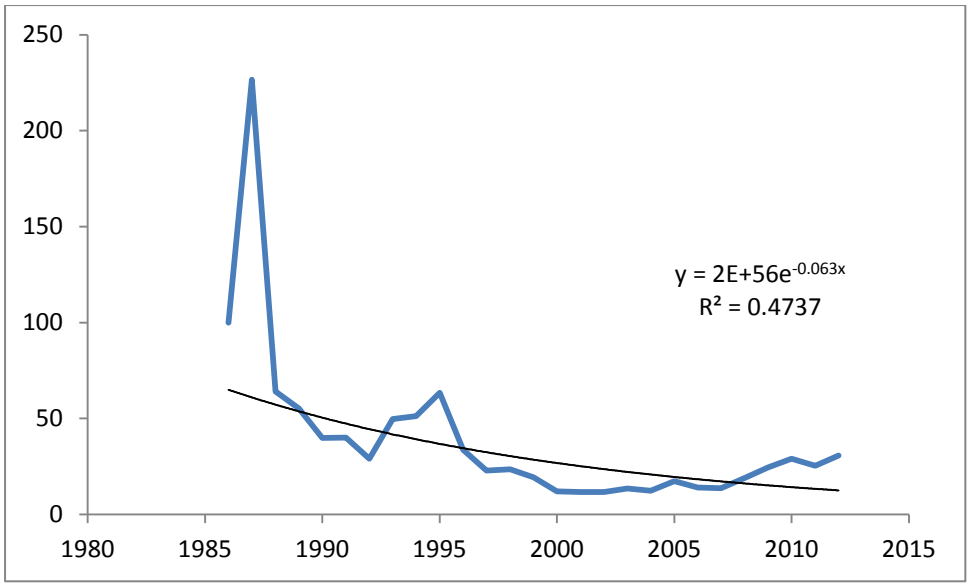


Figure 13.7. Trend in the herring gull breeding population index in Northern Ireland from 1986-2012. Data from JNCC seabird population monitoring database.

Table 13.1. The UK SPA suite for breeding herring gulls.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
East Caithness Cliffs	N Scotland	9,370 (1986)	1996	Declined 1999	3,393	1999	Seabird2000
Troup, Pennan and Lion's Heads	NE Scotland	4,200 (1995)	1997	No change 2007	1,951 1,687 1,597	2001 2007 2007	Lewis et al. 2012 Lewis et al. 2012 SCM database
Buchan Ness to Collieston Coast	NE Scotland	4,292	1998	No change 2007	3,079 3,114	2007 2010	SCM database Lewis et al. 2012

Fowlsheugh	NE Scotland	3,190	1992	Declined 1999	122 214 259	2008 2009 2012	Lewis et al. 2012 Lewis et al. 2012 SCM database
Forth Islands	E Scotland	6,600 (1985)	1990	Maintained 2001	5,026 5,100 2,827	2002 2004 -12 2005 -09	Lewis et al. 2012 SCM database Stroud et al. 2014
St Abb's Head to Fast Castle	SE Scotland	1,160	1997	Declined 2002	541 647 220 266 239	2000 2000 2011 2012 2013	Seabird2000 Stroud et al. 2014 SCM database SCM database SCM database
Flamborough Head & Bempton Cliffs	E England	1,110 (1987)	1993		721 533 495	2000 2008 2010	SCM database SCM database SCM database
Alde-Ore Estuary	SE England	6,050 (Stroud et al. 2001)	1996	These counts are for Orfordness only and exclude Havergate	6,750 2,575 2,000 1,000 1,000 800	2000 2002 2003 2004 2005 2006	SCM database SCM database SCM database SCM database SCM database SCM database
UK Western waters							
Canna and Sanday	Inner Hebrides	1,391	1998	Declined 2001	70 63	2010 2011	Lewis et al. 2012 Lewis et al. 2012
Ailsa Craig	W Scotland	2,250 (1987)	1990	Declined 2010	131 82 129	2010 2012 2013	Lewis et al. 2012 SCM database SCM database
Rathlin Island	N Ireland	4,037	1999		14 5 28 23	1999 2007 2011 2011	SCM database SCM database SCM database Stroud et al. 2014
Morecambe Bay	NW England	11,000	1996		3,225 3,040 2,246 2,094 1,734	2008 2009 2010 2011 2012	SCM database SCM database SCM database SCM database SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

13.10 BDMPS

UK waters can be split into two spatial BDMPS for herring gulls; UK North Sea and Channel waters, and UK western waters. Although some birds move between these two areas, there is a distinct tendency for birds to remain in one or other of these two areas with little interchange. Also, birds from the Barents Sea tend to migrate into the North Sea in large numbers, but very few of those birds enter UK western waters. Population sizes in these two spatial BDMPS are essentially the same for the migration periods (once birds from overseas have reached UK waters and until they depart in spring) and winter, so there is no requirement to split these into separate temporal units.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 42 and 43.

Based on evidence reviewed in sections 13.5, 13.6 and 13.7, in the non-breeding season (September to February) in the UK North Sea and Channel, the BDMPS is estimated to include 99% of adults and 95% of immatures from colonies on the UK North Sea coast, 5% of adults and 10% of immatures from UK colonies in western Scotland, Northern Ireland, Wales and W England (Appendix A Table 42). The BDMPS is also estimated to include birds from three overseas populations; 20% of adults and 30% of immatures from the Barents Sea, 20% of adults and 30% of immatures from Faroe, 2% of adults and 5% of immatures from Ireland. These proportions result in an estimated BDMPS of 466,511 birds in the UK North Sea and Channel in the non-breeding season, 331,381 from the UK and 135,130 from overseas.

Based on evidence reviewed in sections 13.5, 13.6 and 13.7, in the non-breeding season (September to February) in the UK western waters, the BDMPS is estimated to include 0.1% of adults and 0.1% of immatures from colonies on the UK North Sea coast, 80% of adults and 70% of immatures from UK colonies in western Scotland, Northern Ireland, Wales and W England (Appendix A Table 43). The BDMPS is also estimated to include birds from three overseas populations; 0.1% of adults and 0.5% of immatures from the Barents Sea, 20% of adults and 30% of immatures from Faroe, 30% of adults and 40% of immatures from Ireland. These proportions result in an estimated BDMPS of 173,299 birds in UK western waters in the non-breeding season, 162,733 from the UK and 10,566 from overseas.

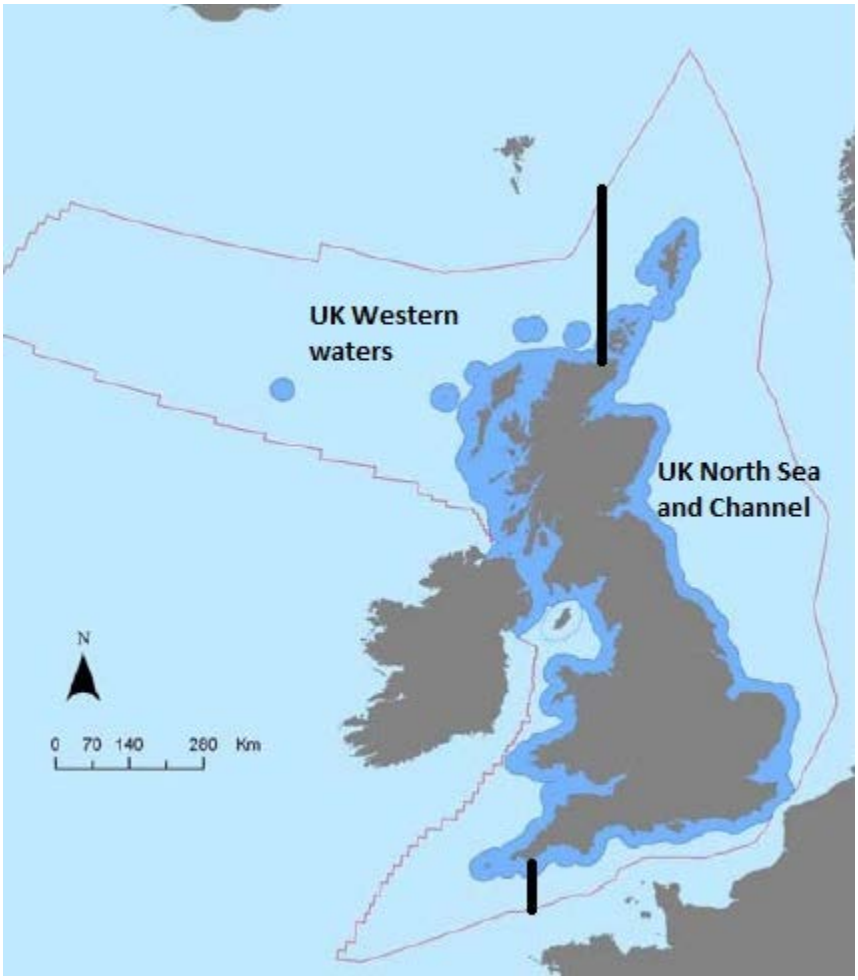


Figure 13.8. Two defined BDMPS spatial areas for herring gull: 'UK North Sea and Channel' and 'UK Western waters'.

13.11 Proportions of UK SPA birds in each BDMPS

About 11% of the UK adult herring gull population breeds in the UK SPA suite for breeding herring gull. Given that the SPAs for herring gull are distributed in a way that reflects fairly closely the breeding distribution of the species in the UK (Figure 13.4), this will probably apply in all areas. However the proportion will be diluted by the presence of immature birds and by the presence of birds from overseas populations. The proportion of birds in each BDMPS that are adults from UK SPA populations can be estimated directly from Appendix A Tables 42 and 43. For example, the UK North Sea and Channel non-breeding season BDMPS comprises 466,511 birds in total, of which 25,389 are adults from UK SPA populations, giving an estimate of 5.4% being adults from UK SPAs.

13.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Because adult herring gulls from UK colonies tend to remain close to their colony throughout the year, there is likely to be a tendency for SPA birds to be aggregated near the SPA sites, although immature birds will disperse more widely and be more mixed. There is some evidence to suggest that herring gulls from the Barents Sea population tend to be more marine than UK herring gulls during migration periods and winter, so that birds at sea may include a higher proportion of 'foreign' herring gulls while birds in terrestrial sites may include a higher proportion of UK herring gulls, and so also a higher proportion of birds from UK SPA populations than found at sea. However, this difference in local distribution of birds has not been quantified so cannot be assessed in any detail.

14. GREAT BLACK-BACKED GULL *Larus marinus*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (September to March)
Overseas	163,000	76,492
UK	72,000	67,029
Total	235,000	143,521

Non-breeding season BDMPS (September to March)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
UK North Sea	91,399	62,736	28,663
UK West of Scotland	34,380	9,677	24,703
UK South-west & Channel	17,742	4,079	13,663

Slightly more than half of the UK great black-backed gull SPA populations have been censused since Seabird2000, so breeding numbers in these large colonies are known in some cases but rather uncertain in others. The JNCC seabird monitoring programme indicates a decline in breeding numbers since 2000, as do counts from several SPA colonies. Because a high proportion of breeding great black-backed gulls in the UK are not in SPA colonies, up to date breeding numbers away from major SPA populations are less well known. Movements of breeding adults and of immatures in the UK have been studied in detail by individual colour ringing of birds in wintering areas and on migration, and have provided a fairly comprehensive picture of local movement patterns as well as connectivity with overseas populations. The key overseas population in the Barents Sea is thought to be approximately stable in numbers. Ringing studies abroad have also shown migrations of great black-backed gulls from Faroe and Norway. Although there have not been geolocator tracking studies of great black-backed gulls, the colour ringing work in the late 20th century does provide a good understanding of great black-backed gull movements, and these appear to be consistent from year to year. BDMPS contributions from UK and overseas populations are therefore coded amber overall.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 44 to 46.

14.1 Breeding range and taxa

This Holarctic breeding species is monotypic, and there is no evidence to suggest that biometrics are useful in assessing origins of individuals.

14.2 Non-breeding component of the population

Great black-backed gulls start to breed when 4 years old (BTO Birdfacts). Adult survival rate is unknown (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is 1.139 chicks per pair (JNCC database, n=132 measurements). To obtain a stable population, adult survival was set at 0.88 (the same as herring gull), survival of immatures was adjusted to 0.56 for juveniles, 0.67 for 1-year olds, 0.74 for 2-year olds, and 0.78 for 3-year olds. The model population comprised 44% adults, 25% juveniles and 31% older immatures. There are 1.26 immatures per adult.

14.3 Phenology

Breeding colonies in the UK are deserted by early September, with modal departure in late July or early August (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in July (Wernham et al. 2002), August (Forrester et al. 2007) or mid-August (Cramp et al. 1977-94). Peak autumn migration occurs in July-October (Brown and Grice 2005), September (Wernham et al. 2002), October (Pennington et al. 2004), September-October (Forrester et al. 2007), or September-November in Belgium (Vanermen et al. 2013) or throughout Europe (Cramp et al. 1977-94). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in November-December (Figure 14.1), suggesting that those sites recorded later arriving birds from north Norway rather than birds dispersing from UK colonies. Autumn migration is completed by November (Forrester et al. 2007), early December (Cramp et al. 1977-94) or December (Wernham et al. 2002).

Spring migration starts in January (Forrester et al. 2007), February (Wernham et al. 2002) or mid-February (Cramp et al. 1977-94). Peak spring migration occurs in January-February in Belgium (Vanermen et al. 2013), January in Shetland (Pennington et al. 2004) January-April (Forrester et al. 2007), late February in England (Brown and Grice 2005), February-March (Wernham et al. 2002), or March (Cramp et al. 1977-94). Peak rate of change in numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in January-March (Figure 14.1). Spring migration is completed by April (Wernham et al. 2002) early May (Cramp et al. 1977-94), or May (Forrester et al. 2007).

The first spring records of great black-backed gull in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 1 January and the last records were at 31 December, as large numbers of great black-backed gulls overwinter, while peak autumn migration was reported in October or November in most years, and peak spring migration was reported as not evident in most years. Birds re-occupy colonies from early February, with modal return in March (Forrester et al. 2007).

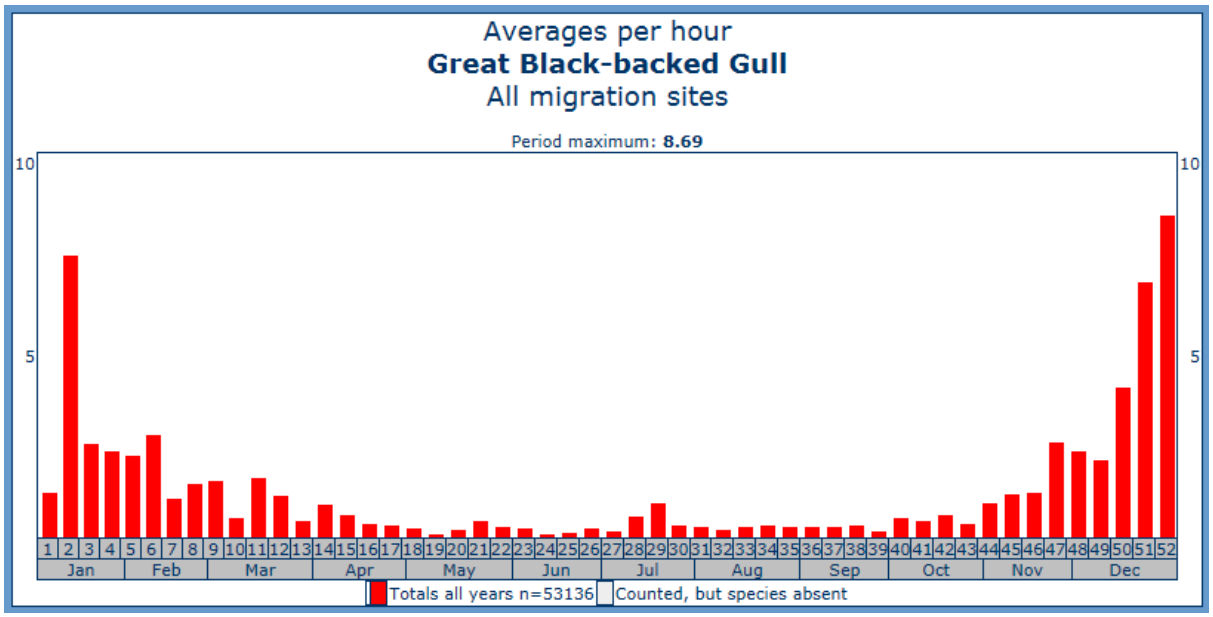


Figure 14.1. Average numbers of great black-backed gulls counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as April-August, non-breeding season September-March. From the data reviewed above, this appears to be an appropriate definition.

14.4 Defined seasons:

- UK Breeding season — late March-August
- Post-breeding migration in UK waters — August-November
- non-breeding season — September-March (**non-breeding BDMPS**)
- Return migration through UK waters — January-April
- Migration-free breeding season — May-July
- Migration-free winter season — December

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for great black-backed gull:

Non-breeding season BDMPS (September-March).

14.5 Movements of birds from the UK population

Adult great black-backed gulls in the UK are partial migrants, with adults being mainly sedentary or travelling only short distances from their breeding area. Some adults disperse short distances from colonies to winter mainly south or east of their colony, tending to return to the same wintering site each year (Coulson et al. 1984). Juveniles and older immatures disperse slightly further than adults; the median distance between colony and wintering area was 54 km for adults but 115 km for immatures ringed in Britain and Ireland (Wernham et al. 2002). Adults return to breeding areas in late winter. Birds ringed at colonies in the northern isles and north Scotland were mainly recovered close to the breeding areas where they were ringed, or down the east coast, a very few birds reaching the south coast of England or coast of the Netherlands or Belgium (Wernham et al. 2002). Very few of these birds crossed to the West coast of Britain or to Ireland. Birds ringed at colonies in the west of Scotland, northwest

of England or northern half of Ireland were mainly recovered close to the breeding areas where they were ringed, with a very few reaching the south coast of Ireland, Wales and SW of England. Extremely few birds from the west coast crossed Britain to reach the North Sea. Birds ringed at colonies in SW England, Wales, and the southern part of Ireland were mainly recovered close to the breeding areas where they were ringed, with a very few reaching France.

14.6 Movements of birds from overseas into UK waters

In contrast to the mainly sedentary nature of adult great black-backed gulls in Britain and Ireland, some birds from northern populations migrate long distances, especially to overwinter in the North Sea. Although large numbers breed in Iceland (15,000 to 20,000 pairs; Mitchell et al. 2004), and moderate numbers in Faroe (1,200 pairs; Hammer et al. 2013), these birds are predominantly sedentary (Wernham et al. 2002). Hammer et al. (2013) reported one recovery in the UK and three in Ireland of great black-backed gulls ringed in Faroe, all of which were recovered when less than a year old. Similarly, great black-backed gulls in southern Norway are considered to be mainly sedentary, most remaining in Norwegian waters throughout the year (Anker-Nilssen et al. 2000; Wernham et al. 2002). Foreign-ringed great black-backed gulls recovered in Britain and Ireland mainly originate from the north coasts of Norway and Russia. These birds begin arriving in July, mainly on the east coast of England (Wernham et al. 2002). Numbers peak in September (Wernham et al. 2002), then remain high through early winter until the return migration in February (Wernham et al. 2002). The Barents Sea population of great black-backed gulls, most of which breed along the north coast of Norway, is estimated at around 33,000 pairs (Anker-Nilssen et al. 2000). The Barents Sea great black-backed gull is a partial migrant. Some birds remain close to colonies all year round, while others migrate to winter in the North Sea. It is not clear what proportion of this population winters in the North Sea rather than in the Barents Sea or Norwegian Sea, or in the Caspian or Black Sea, but it is thought that the North Sea is their main wintering area (Anker-Nilssen et al. 2000). Most migrate along the Norwegian coast. Some migrate through the White Sea then along rivers to the Volga delta to winter in the Caspian or Black Sea. Some migrate overland between the White and Baltic Seas, then may continue to the North Sea (Anker-Nilssen et al. 2000). Southward movement is more extensive among immatures than among adults. Birds leave the breeding colonies in north Norway in August, but migration south mainly occurs in September-October (Anker-Nilssen et al. 2000). Adults arrive back at colonies in the Barents Sea in March-April (Anker-Nilssen et al. 2000). With a population in the UK of around 16,800 pairs, with many of these in colonies on the west of the British Isles rather than in the North Sea, the resident great black-backed gulls in the North Sea are likely to be outnumbered in winter by great black-backed gulls from northern Norway. There may be very small numbers of great black-backed gulls from southern Norway, Denmark, SW Sweden and France that visit UK waters, but these numbers appear to be so small relative to the large numbers from the Barents Sea and from the UK that they can be ignored as trivial.

14.7 Numbers in UK waters

Musgrove et al. (2013) report that there are 76,000 in Britain in winter, 77,000 in UK in winter, but these estimates only include birds at sea that could be counted from land, as well as birds onshore and at coastal roosts. From surveys in 2007 and 2008, Fauchald and Tveraa (2009) reported mean densities at sea of 4.8-11.3 birds per km^2 in the Norwegian Sea in spring/summer, and 0.5-1.4 birds per km^2 in the Barents Sea in autumn. Most migrants in English waters occur off east England, whereas most breeders in England are in Cornwall and the Scillies (Brown and Grice 2005). Some northern immatures remain in the southern North Sea all year round (Brown and Grice 2005). There were estimated to be 21,077 birds at inland roosts in England in January 1993 and 17,838 at coastal roosts (Burton et al. 2003; Brown and Grice 2005). Forrester et al. (2007) suggest that there are around 2,000 to 10,000 birds in Scotland during the migration seasons, and 7,500 to 10,000

in winter. However, these estimates appear to be based on counts of birds onshore rather than at sea. Skov et al. (1995) estimated that there are around 300,000 great black-backed gulls in the North Sea in winter (although these data are now rather out of date), with peak numbers in November to February (Stone et al. 1995). However, this number may be an overestimate because great black-backed gulls are attracted to boats (Kober et al. 2010). Since almost all UK great black-backed gulls winter in UK waters, there will be the 16,000 pairs from UK colonies (32,000 adults) plus associated immatures (about 40,000 of those) so about 72,000 birds. However, it is likely that about half of these are in waters west of the UK and half in the North Sea, as very few great black-backed gulls breed along the east coasts of England and Scotland except in the far north (Shetland, Orkney and Caithness). In contrast, the species breeds along most of the west coast of Scotland and in smaller numbers in Wales and west England. However, most of the SPA populations (the largest colonies) are in Orkney and north Scotland. In addition to birds from the UK, birds from Barents Sea colonies arrive in autumn, especially into the North Sea. It is uncertain how many of these winter in UK waters as some may winter in the Norwegian Sea (Anker-Nilssen et al. 2000), but there is evidence from colour ringing studies that relatively few from the Barents Sea winter in the west of Scotland. Count data suggest that the majority of birds in the North Sea in winter are likely to be from the Barents Sea. The Barents Sea population is 33,000 pairs and is apparently approximately stable (Anker-Nilssen et al. 2000, R.T. Barrett pers. comm.), so 66,000 adults plus about 83,000 immatures, so 149,000 birds. Given the estimate that up to 300,000 birds winter in the North Sea, it would seem likely that most birds from the Barents Sea population are in the North Sea in winter, as it would otherwise be impossible to reach such a large total.

14.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the European population, comprising 95,546 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 100,000-110,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 440,000 individuals. The biogeographic population with connectivity to UK waters comprises birds from the UK, Ireland, Faroe and Barents Sea (Figure 14.2). This sums to 235,000 birds (adults plus immatures), of which 72,000 are from UK and 163,000 from overseas populations. Substantial proportions of these populations occur in UK waters in the non-breeding period (September to March); the totals for UK waters are estimated at 143,000 birds, with 67,000 frrom UK and 76,000 from overseas populations.



Figure 14.2. Breeding population origins of great black-backed gulls in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

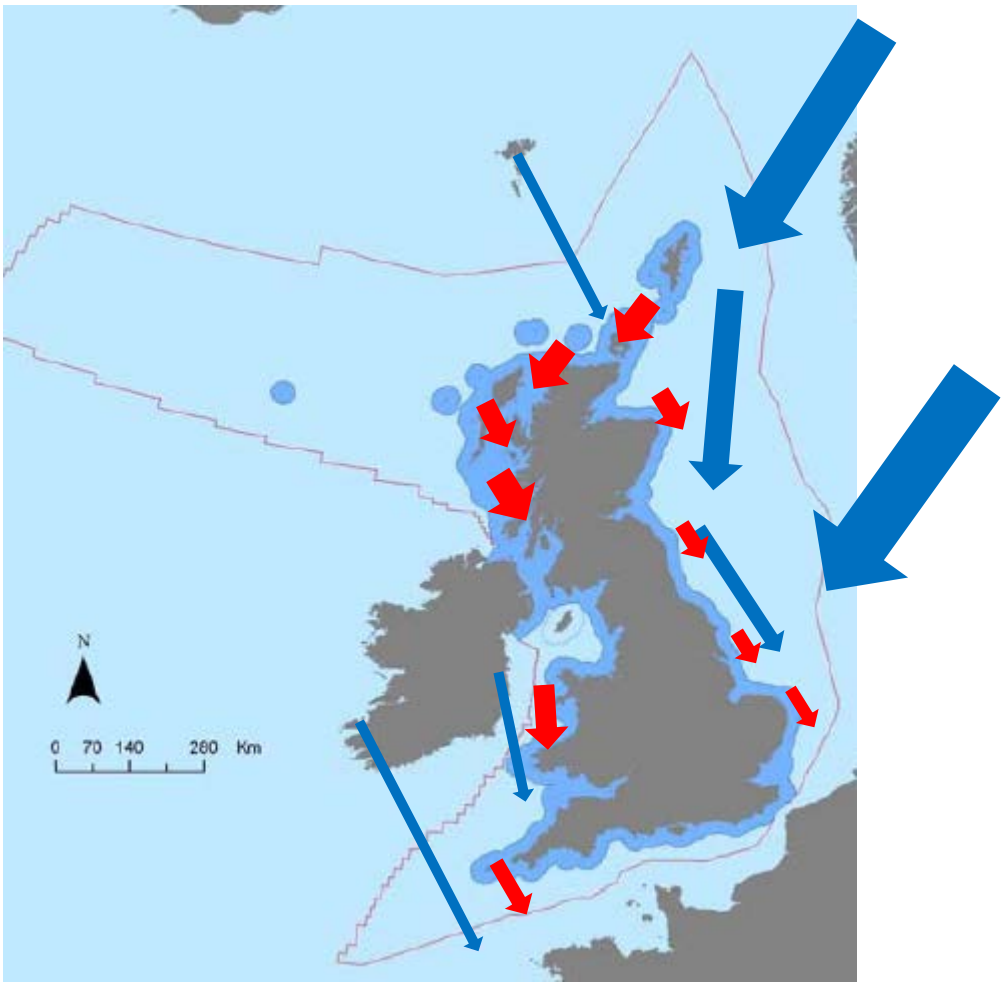


Figure 14.3. Main movements of great black-backed gulls from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

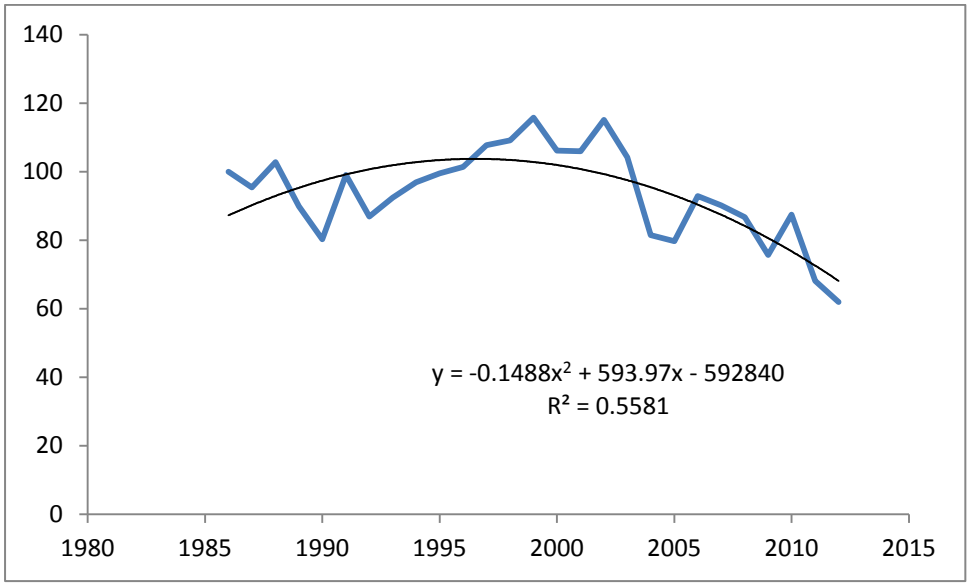


Figure 14.4. Trend in the great black-backed gull breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

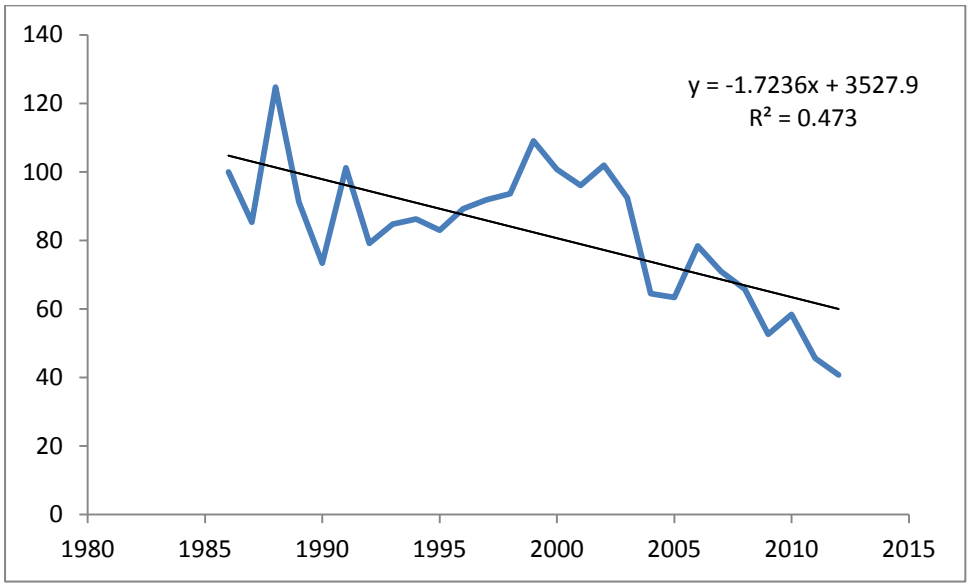


Figure 14.5. Trend in the great black-backed gull breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

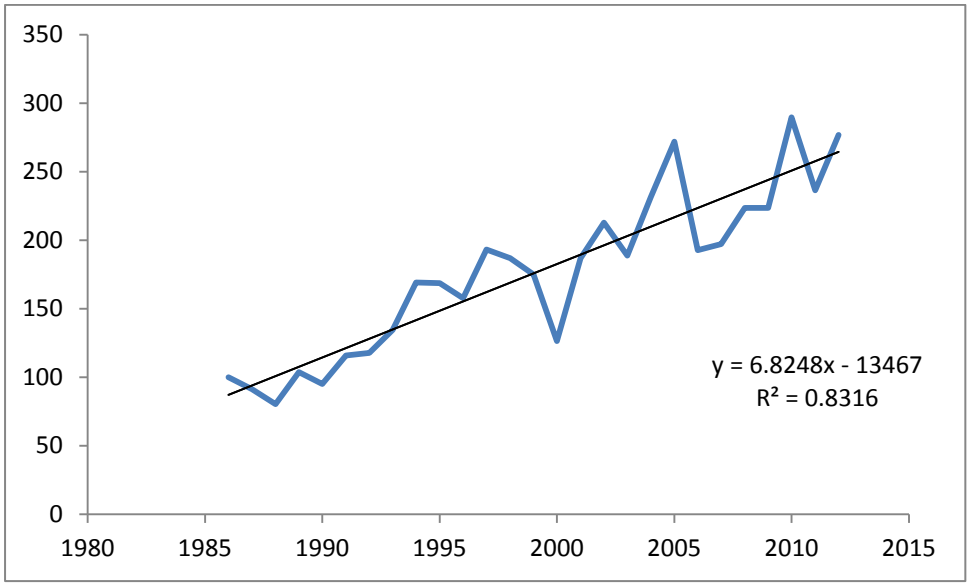


Figure 14.6. Trend in the great black-backed gull breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

14.9 Proportion of UK population from UK breeding SPAs

The six SPAs with breeding great black-backed gulls as a feature together held 4,457 pairs at designation, estimated to represent ca. 23.5% of the British breeding population (Stroud et al. 2001). Stroud et al. (2014) estimated that the six SPAs held about 2,863 pairs in counts made around 1999-2009, but data used for several of these colonies came from 1999-2000 so are rather out of date. Their estimate was that the SPA suite then held about 16.8% of the GB population. However, the most recent counts for these sites (Table 14.1) sum to only 1,826 pairs, with half of these being at Isles of Scilly SPA, so if the UK population is around 16,800 pairs the data suggest that the SPA suite now holds close to 11% of the population, with the single SPA in SW England being by far the largest contribution, due to very large declines in the colonies in north Scotland.



Figure 14.7. The SPA suite for breeding great black-backed gulls. These SPA populations are listed in Table 14.1.

Table 14.1. The UK SPA suite for breeding great black-backed gulls.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea							
Calf of Eday	Orkney	938 (1996)	1998	Declined 2006	675 100 281	2000 2004 2006	Stroud et al. 2014 Lewis et al. 2012 Lewis et al. 2012
Copinsay	Orkney	600	1994	Declined 2008	324 218	2008 2010	Lewis et al. 2012 SCM database
East Caithness Cliffs	N Scotland	850	1996	Declined 1999	175	1999	Seabird2000
Hoy	Orkney	570	2000	Maintained 2000	438 ca.60	2000 2011	Stroud et al. 2014 SMP database
West of Scotland							
North Rona & Sula Sgeir	N Scotland	733 (1986)	2001	Declined 2012	350 191	2009 2012	SMP database SMP database
SW and Channel							
Isles of Scilly	SW England	766	2001		901	2006	SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

14.10 BDMPS

UK waters can be divided into three BDMPS for great black-backed gull. It would be difficult to divide the North Sea region into separate northern and southern BDMPS populations because great black-backed gulls in the North Sea appear to be fairly mobile in the non-breeding period, changing distribution with movement of trawl fishery fishing effort, and because there have been no studies of great black-backed gulls using tracking methods, the details of movements of birds from particular sites are not known. In the UK North Sea BDMPS the population appears to be dominated by birds arriving from Barents Sea colonies in late summer and remaining until spring. There are probably about 910,000 birds in the area in the non-breeding season, with about 29,000 coming from the UK population and 63,000 from the Barents Sea. The area west of Scotland is quite distinct from the North Sea BDMPS because very few birds from the Barents Sea population enter the west of Scotland area, and few birds from North Sea colonies cross into west of Scotland. Similarly, few birds from west of Scotland colonies cross to the North Sea. In the West of Scotland BDMPS there are probably about 34,000 birds in the area in the non-breeding season, with about 25,000 from the UK population and 10,000 from the Barents Sea, Irish and Faroe populations. The southwest of Britain and Channel represents another distinct BDMPS for this species because birds in that area originate from local colonies in that area, together with rather small numbers of immatures from colonies further north in west of Scotland area, and very small numbers of birds from overseas (mostly Ireland). In the South-west and Channel BDMPS there are probably about 18,000 birds in the non-breeding season, with about 14,000 from the UK population and 4,000 from the Barents Sea, Irish and Faroe Populations (most of those coming from Irish colonies).

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 44 to 46.

Based on evidence reviewed in sections 14.5, 14.6 and 14.7, in the non-breeding season (September to March) in the UK North Sea, the BDMPS is estimated to include 100% of adults and 100% of immatures from colonies on the UK North Sea coast, 1% of adults and 10% of immatures from UK colonies in western Scotland, Northern Ireland, Wales and W England (Appendix A Table 44). The BDMPS is also estimated to include birds from two overseas populations; 30% of adults and 50% of immatures from the Barents Sea, 30% of adults and 30% of immatures from Faroe, but no birds from Ireland. These proportions result in an estimated BDMPS of 91,399 birds in the UK North Sea in the non-breeding season, 28,663 from the UK and 62,736 from overseas.

Based on evidence reviewed in sections 14.5, 14.6 and 14.7, in the non-breeding season (September to March) in the UK West of Scotland, the BDMPS is estimated to include no adults or immatures from colonies on the UK North Sea coast, 99% of adults and 80% of immatures from UK colonies in western Scotland, but none from Northern Ireland, Wales and W England (Appendix A Table 45). The BDMPS is also estimated to include birds from three overseas populations; 1% of adults and 8% of immatures from the Barents Sea, 10% of adults and 30% of immatures from Faroe, and 10% of adults and 20% of immatures from Ireland. These proportions result in an estimated BDMPS of 34,380 birds in UK West of Scotland in the non-breeding season, 24,703 from the UK and 9,677 from overseas.

Based on evidence reviewed in sections 14.5, 14.6 and 14.7, in the non-breeding season (September to March) in the UK South-west waters and Channel, the BDMPS is estimated to include no adults or immatures from colonies on the UK North Sea coast, no adults but 10% of immatures from UK colonies in western Scotland and Northern Ireland, 90% of adults and 70% of immatures from colonies in SW England (Appendix A Table 46). The BDMPS is also estimated to include birds from three overseas populations; no adults but 2% of immatures from the Barents Sea, no adults but 20% of immatures from Faroe, 10% of adults

and 30% of immature from Ireland. These proportions result in an estimated BDMPS of 17,742 birds in the UK SW waters and Channel in the non-breeding season, 13,663 from the UK and 4,079 from overseas.

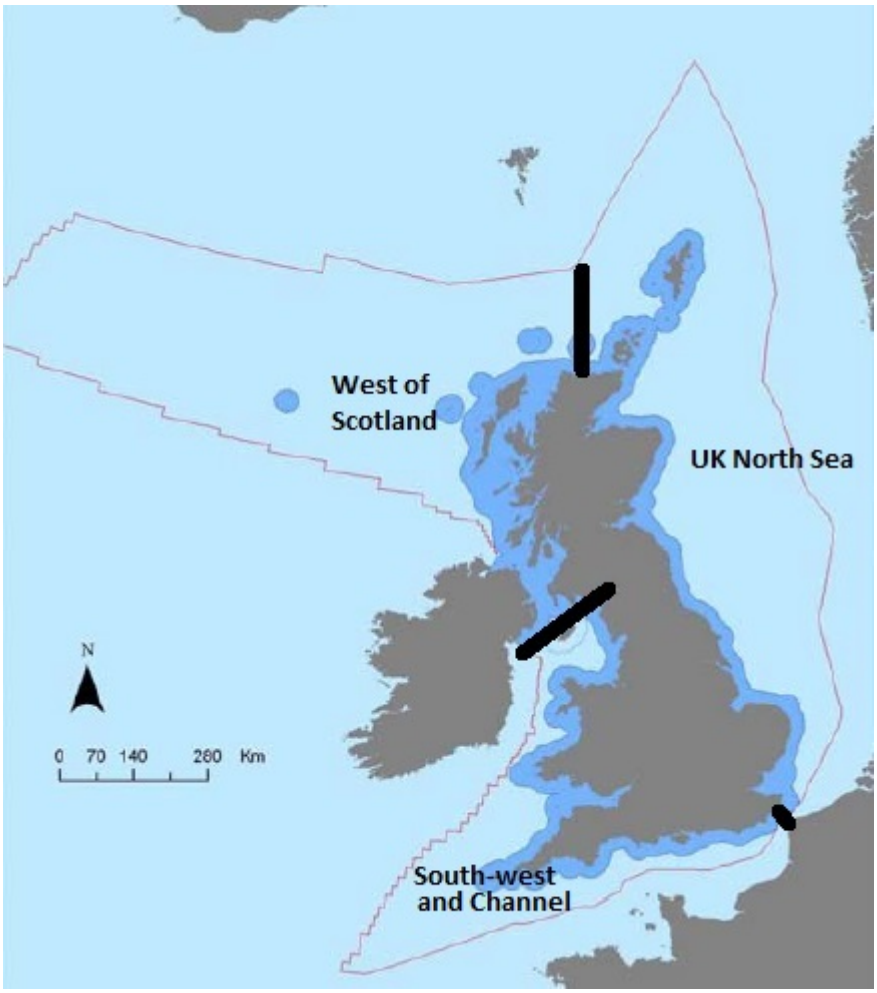


Figure 14.8. Three defined BDMPS spatial areas for great black-backed gull: 'UK North Sea', 'West of Scotland' and 'South-west and Channel'.

14.11 Proportions of UK SPA birds in each BDMPS

The UK North Sea BDMPS holds four of the six UK SPAs for breeding great black-backed gulls, but breeding numbers in these colonies have decreased dramatically. There are now probably no more than 700 pairs in total at these four sites combined, and possibly fewer than 600 given that no count data are available since 1999 for East Caithness Cliffs SPA or since 2006 for Calf of Eday SPA. The BDMPS of 91,399 birds in the UK North Sea is likely to contain only about 1,490 adults from UK SPA populations (Appendix A Table 44). So UK SPA breeding adults represent only about 2% of the BDMPS population in that area. The West of Scotland BDMPS holds only one SPA population, on North Rona and Sula Sgeir SPA. This contributes 378 adults to the non-breeding BDMPS, represent about 1% of the BDMPS total of birds (Appendix A Table 45). Ringing data suggest that very few birds from North Sea colonies (including Orkney and Shetland) move out of the North Sea into the West of Scotland region, so these populations appear to be fairly discrete, though it is less certain that birds from North Rona remain entirely in the West of Scotland rather than moving into the North Sea, as few birds have been ringed at North Rona. The UK South-west waters and Channel BDMPS contains one SPA population, Isles of Scilly SPA. There were 901 pairs there in 2006 and that population, in contrast to those in Scotland, appears to be increasing or at least stable (Table 14.1). The UK SPA breeding adults contributing to

that non-breeding season BDMPS (1,622 adults) represent about 9% of the BDMPS in UK South-west waters and Channel (Appendix A Table 46).

14.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Adult great black-backed gulls from UK colonies may remain very close to the colony throughout the year, while immatures tend to move south but not over very large distances. So the distribution of UK SPA birds within the BDMPS is likely to be aggregated in waters close to SPA colony sites. This may be especially the case in the West of Scotland BDMPS, with adult birds from North Rona mainly being close to North Rona, and in UK South-west waters and Channel with adult birds being around the Scillies all through the year. However, no detailed tracking studies have been carried out with great black-backed gulls, so the interpretation is based on ring recovery data and it would be useful to support that with work deploying geolocators on this species at major SPA colonies.

15. BLACK-LEGGED KITTIWAKE *Rissa tridactyla*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in autumn (August to December) (adults and immatures)	Numbers in UK waters in spring (January to April) (adults and immatures)
Overseas	4,020,000	1,017,320	567,136
UK	1,080,000	724,203	752,206
Total	5,100,000	1,741,523	1,319,342

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Autumn migration BDMPS (August to December)			
UK North Sea	829,937	397,808	432,129
UK Western waters plus Channel	911,586	619,512	292,074
Spring migration BDMPS (January to April)			
UK North Sea	627,816	238,424	389,392
UK Western waters plus Channel	691,526	328,712	362,814

Breeding adult kittiwakes have been equipped with geolocators in many different countries to investigate migrations and wintering areas, and that work has been summarised in a detailed paper by Frederiksen et al. (2012). However, it must be recognised that the geolocator study provides data for only a single winter, so that annual variation is not assessed, and provides data only for breeding adults, so that comparison with movements of immature birds cannot be made. There is other evidence indicating that individual breeding kittiwakes may differ in their migration behaviour from year to year depending on their breeding success, and that numbers of kittiwakes passing through UK waters vary strongly from year to year apparently in relation to weather conditions. Ring recovery data for kittiwakes are quite limited, and with a pelagic seabird tend to provide a biased indication of distribution. Geolocator data show rather different pattern from ring recovery data. In addition to this uncertainty about movement patterns, and evidence that these show high variability, there is also considerable uncertainty about very recent changes in kittiwake population sizes; several populations

appear to be in decline, but the extent and scale of decline are uncertain for most overseas populations. While breeding numbers at some UK SPA colonies have been counted since Seabird2000, some particularly large populations have not been counted since 2000 (e.g. East Caithness Cliffs where over 40,000 pairs nested in 1999). Many non-SPA colonies in the UK have not been counted recently. Changes in breeding numbers differ between Shetland (extreme decline), Orkney (decline in some colonies but perhaps not in others), southern Scotland (more stable numbers), and Wales (increases in some colonies but declines in others). Therefore, overall, numbers from UK in BDMPS are coded amber, and numbers from overseas are coded red, as are total numbers in BDMPS.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 47 to 50.

15.1 Breeding range and taxa

This Holarctic breeding species is usually split into two subspecies; *R. t. pollicaris* breeds in the North Pacific and does not normally reach the Atlantic. *R. t. tridactyla* breeds in the North Atlantic from Spain to the Arctic Ocean. Because *R. t. pollicaris* does not normally reach the Atlantic Ocean, this report focuses only on the nominate subspecies *R. t. tridactyla.* There is clinal variation in size, with birds from further north being larger (Barrett et al. 1985), but there does not seem to be much use of this variation to assess origins of individual birds.

15.2 Non-breeding component of the population

Kittiwakes start to breed when 4 years old (BTO Birdfacts). Coulson (2011) gives mean ages at first breeding of 3.97 years for males and 4.7 years for females at North Shields. Adult survival rate is 0.882 (BTO Birdfacts), juvenile survival 0.79 (BTO Birdfacts) and mean productivity is 0.672 chicks per pair (JNCC database, n=189 measurements), though this is strongly influenced by sandeel abundance near to the colony (Frederiksen et al. 2005). Coulson (2011) presents a table listing estimated adult survival rates for studies of kittiwakes breeding at North Shields, Marsden, Skomer, Brittany, Foula, Isle of May, Fair Isle, and colonies in north Norway and Alaska. Adult survival rate varied with period and colony, ranging from 0.8 to 0.93, indicating that this parameter is certainly not a constant for the species. To obtain a stable population, survival of immatures was adjusted to 0.68 for juveniles, and set at 0.76 for 1-year olds, 0.8 for 2-year olds, and 0.86 for 3-year olds. The model population comprised 53% adults, 18% juveniles and 29% older immatures. There are 0.88 immatures per adult.

15.3 Phenology

Breeding colonies in the UK are deserted in August, with modal departure in early August (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in July (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007) or August (Cramp et al. 1977-94). Peak autumn migration occurs in August-September in Shetland (Pennington et al. 2004), August-November in Scottish waters (Forrester et al. 2007), September-November throughout Europe (Cramp et al. 1977-94), but as late as October-November in Belgium (Vanermen et al. 2013). Variation in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) was erratic and not clearly indicative of autumn migration (Figure 15.1). Autumn migration is completed by December (Cramp et al. 1977-94; Pennington et al. 2004; Forrester et al. 2007).

Spring migration starts in January (Pennington et al. 2004) or January-February (Cramp et al. 1977-94; Forrester et al. 2007). Peak spring migration occurs in January-April in Belgium (Vanermen et al. 2013), in March-April generally in Europe (Cramp et al. 1977-94; Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites

(predominantly in south and east England) occurred in March (Figure 15.1). Spring migration is completed by May (Cramp et al. 1977-94; Forrester et al. 2007).

The first spring records of kittiwake in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from January and the last records were predominantly in December. Peak autumn migration was reported in August-October in most years, and peak spring migration was reported in April in most years. Birds re-occupy colonies from February, with modal return in March (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007). Recent studies of kittiwakes have shown that corticosterone levels influence migratory and breeding behaviour. Experimentally increased levels of corticosterone caused female kittiwakes to migrate away from the breeding colony earlier and to spend longer on the wintering grounds (Schultner et al. 2014), while in years with poor food availability, corticosterone levels increased in kittiwakes, birds bred later and made longer foraging trips travelling further from the colony in the pre-breeding period (Goutte et al. 2014). Although demonstrated in kittiwakes, these patterns seem likely to apply in all seabirds.

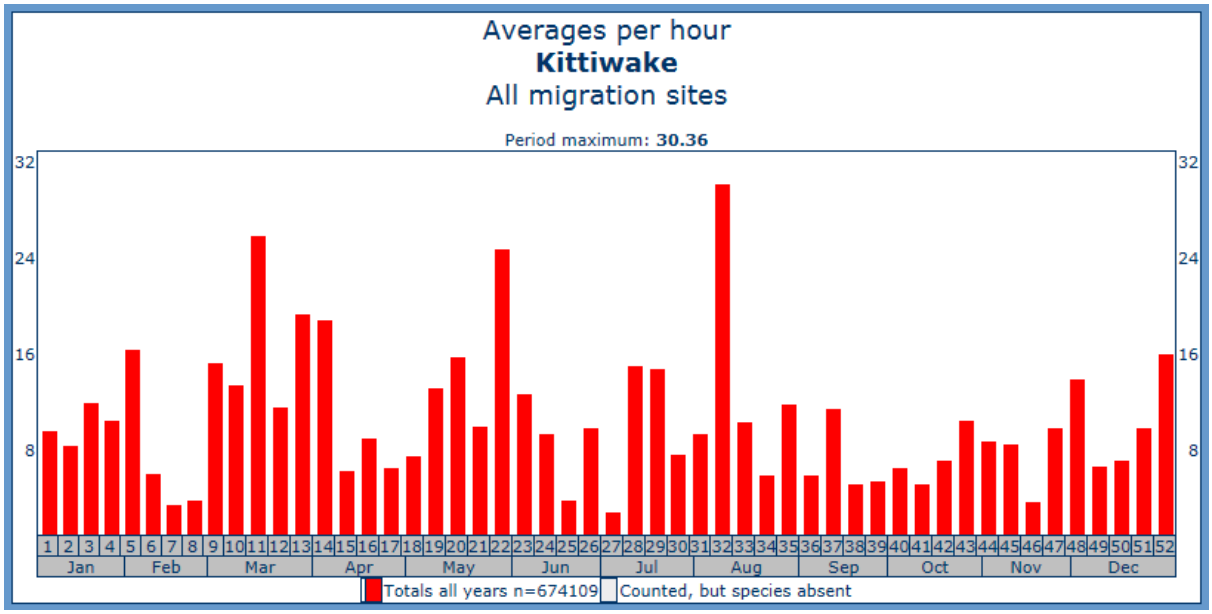


Figure 15.1. Average numbers of kittiwakes counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-September, non-breeding season October-April. However, from the data reviewed above, a more appropriate definition would be breeding season March-August, non-breeding season September-February.

15.4 Defined seasons:

- UK Breeding season — March-August
  - Migration-free breeding season — May-July
- Non-breeding season — September-February
  - Post-breeding migration in UK waters — August-December (**autumn BDMPS**)
  - Return migration through UK waters — January-April (**spring BDMPS**)

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for black-legged kittiwake:

'Autumn' (post-breeding) migration BDMPS (August-December); and

'Spring' (pre-breeding) migration BDMPS (January-April).

15.5 Movements of birds from the UK population

In the UK, kittiwake chicks disperse rapidly from colonies, leaving the area about 10 days on average after their first flight (Coulson 2011). Rapid dispersal is consistent with the fact that chicks are not fed by their parents after departing, so can depart without constraint (Coulson 2011). After initial dispersal which can be in any direction with birds congregating where food is available, subsequent autumn migration takes some young birds west across the Atlantic and others south towards Iberia (Wernham et al. 2002). Kittiwakes in winter may be distributed all across the North Atlantic and North Sea, regularly as far south as about 40^{o}N, but with a few birds even crossing into the southern hemisphere (Coulson 2011). The main spread southwards occurs in early October, birds reaching their southernmost distribution in December-January (Coulson 2011). Ring recovery data show that in spring, young birds may move north, with birds on the west side of the Atlantic visiting seas around Greenland, and birds on the east side possibly moving north but not as far as their breeding colony (Coulson 2011). However, in their first summer and in subsequent summers, kittiwakes vacate the open ocean areas they occupy in winter, and move into shallow continental shelf waters, and may rest on shores though generally away from colonies (Coulson 2011). Immature birds follow a similar pattern to juveniles (although a few two year olds do return to the colony in summer if only briefly), and then tend to return towards breeding colonies in their third summer, though even at that age some may remain in the west Atlantic (Wernham et al. 2002; Coulson 2011). Adults depart from colonies in the northern part of the UK rather rapidly in late July or early August, apparently at least in part in response to sandeels becoming unavailable towards the end of the summer. Further south, adults may linger near colonies for longer. Some adults cross the Atlantic to winter off Newfoundland, but there are far more recoveries of adult kittiwakes in the east Atlantic (Wernham et al. 2002). Ring recoveries indicate that British kittiwakes tend to winter further south than those from colonies in the far north of Europe, so populations only show partial overlap outside of the breeding season (Wernham et al. 2002; Coulson 2011).

15.6 Movements of birds from overseas into UK waters

Over 100 foreign-ringed kittiwakes have been recovered in the British Isles, mostly in autumn and winter. Those birds originated mainly from Norway, Russia, France, and the Channel Islands. Only small numbers of recoveries originated from Iceland, Faroe, Denmark, Sweden, Germany and Greenland. Deployment of geolocators on breeding kittiwakes at many colonies in Svalbard, Barents Sea, Norwegian Sea, North Sea, Celtic-Biscay Shelf, Faroe, Iceland, Greenland and Canada (Frederiksen et al. 2012) has provided more detailed information on the migrations and wintering areas of 236 adult breeding status kittiwakes from different North Atlantic populations. Those data are largely consistent with the ring recovery data, but tend to more strongly emphasise the tendency for birds to cross to the west side of the Atlantic, strongly suggesting that ring recovery data under-represent trans-Atlantic movements. Geolocation data must be considered with some caution, as they are not available from all kittiwake populations in the North Atlantic, they represent only birds of breeding adult status, and data were collected in only two years (2008-09 and 2009-10), so may not be typical of kittiwake migration behaviour in other years. Nevertheless, the geolocation data provide detailed information on the movements of a large sample of birds from many different regions and colonies. Details of this study can be accessed at http://www.hav.fo/PDF/Ritgerdir/2011/Kittiwake_paper_Bergur.pdf. Most tracked birds moved to the west Atlantic to winter between Newfoundland and the mid-Atlantic ridge.

Some wintered in the North Sea and west of the British Isles, and those birds mostly came from colonies in the British Isles or from colonies in the Barents Sea. No birds from colonies in west Atlantic wintered in Europe. There was considerable overlap in winter distributions of birds from different colonies, although colonies closer together showed greatest overlap in distribution, so there was some spatial structuring. Overall, about 80% of the 4.5 million breeding adult kittiwakes in the Atlantic were estimated to winter west of the mid-Atlantic ridge, with only birds from British Isles and France remaining predominantly on the European side. Many equipped birds remained near to their breeding site throughout August, but some moved to post-breeding aggregations in the Barents Sea, the Denmark Strait, and the Labrador Sea. In November most birds had reached wintering areas mostly south of 62^{o}N, but some birds remained in the Norwegian Sea. In December, most birds were in the west Atlantic, but with substantial numbers in the North Sea and west of the British Isles. By January, some birds were returning towards breeding sites. Most birds were back at breeding sites by April, but some high-Arctic breeders remained offshore in the Barents Sea or Davis Strait or off Newfoundland. Frederiksen et al. (2012) present electronic supplementary material to their paper indicating estimates that 255,261 adult kittiwakes were present in the entire North Sea (not just the UK portion) in December 2009, with 102,671 of these from Barents Sea colonies, 114,195 from North Sea colonies, 24,071 from Norwegian Sea colonies, and 14,324 from Celtic Shelf colonies. In the Celtic-Biscay Shelf area they estimate that there were 345,288 adult kittiwakes in December 2009, with 189,934 from Celtic-Biscay shelf colonies, 116,027 from Barents Sea colonies, 39,180 from North Sea colonies, and 147 from Norwegian Sea colonies. While these detailed data are extremely valuable, it must be remembered that these only apply to adult kittiwakes and not immatures, and only apply to a single winter, so it is uncertain whether these are typical or not. Kittiwakes may return to breeding colonies from mid-February in the UK, though not until April in the Arctic (Coulson 2011). To complicate this picture further, Bogdanova et al. (2011) found that unsuccessful breeding kittiwakes from the Isle of May colony were more likely than successful breeders to migrate to the west Atlantic area. Males and females may also differ in migratory behaviour although this is less certain (Bogdanova et al. 2011). The difference in migration behaviour of successful and failed breeders could indicate a time constraint to the migration to the west Atlantic, as birds that fail in their breeding attempt tend to leave the colony earlier in the summer than successful breeders. Since breeding success was very poor at many kittiwake colonies in the eastern Atlantic in the two years when geolocators were deployed, it is possible that the proportion of adults migrating to the west Atlantic was higher than in other years.

15.7 Numbers in UK waters

Although clearly an abundant seabird, kittiwake numbers in UK waters during migration and winter are not well known, and apparently vary considerably, perhaps in relation to food supply and weather conditions. ESAS data suggest a total of around 1,500,000 birds in the North Sea in autumn migration period, with the majority of these birds in the NW North Sea (up to 700,000 birds) and off the English north-east coast (up to 200,000 birds) (Camphuysen et al. 1995), with at sea densities of around 4 birds per km^2. From surveys in 2007 and 2008, Fauchald and Tveraa (2009) reported mean densities at sea of 24-60 birds per km^2 in the Norwegian Sea in spring/summer, and 15-54 birds per km^2 in the Barents Sea in autumn, so densities in the North Sea are not high when compared with some other regions. Breeding numbers in Iceland declined by 17% from 630,000 pairs in 1983-86 to 523,000 pairs in 2005-08 (Gardarsson 2006), but apparently Icelandic kittiwakes do not visit UK waters. However, breeding numbers of kittiwakes have apparently been declining throughout most of the North Atlantic over recent years, so numbers are almost certainly lower in most countries than they were in the period that informed total population estimates in Stroud et al. (2001) and Mitchell et al. (2004). Forrester et al. (2007) suggest that there may be about 10,000 birds in Scottish inshore waters in winter, but give no estimate for numbers in offshore waters. Frederiksen et al. (2012) present electronic supplementary

material to their paper estimating that 255,261 adult kittiwakes were present in the entire North Sea (not just the UK portion) in December 2009. This would suggest that taking immatures into account (and the fact that a higher proportion of immatures move across to the west Atlantic) there would probably be about 200,000 kittiwakes in UK North Sea waters in winter. Camphuysen et al. (1995) estimated that there were about 300,000 to 1,100,000 kittiwakes in the (entire) North Sea in February based on surveys in 1993 and 1994 and ESAS data, with the largest proportion of these in UK sectors of the North Sea. Densities of kittiwakes in inshore waters west of the UK in winter are very low indeed; close to zero. Offshore, densities in winter are low, but highly variable as occasional large numbers pass through UK waters in winter, apparently in response to weather more than to food. During autumn, large numbers disperse from UK colonies out of UK waters, returning in spring. Birds from populations further north pass through western UK waters in autumn, and to a lesser extent in spring, but the absolute numbers involved are very uncertain, despite the detailed tracking reported by Frederiksen et al. (2012).

15.8 Biogeographic population and relevant smaller units (BDMPS)

Stroud et al. (2001) defined the biogeographic breeding population as that of the North Atlantic population, comprising 3,170,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 2,500,000-3,000,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 8,400,000 individuals. Counts in the UK suggest a breeding population of around 288,500 pairs (Appendix Table 47). Summing populations with connectivity to UK waters gives an estimated total of about 1,270,000 pairs (Figure 15.2); the huge size of populations in the Barents Sea is a major part of this total. Numbers in the Barents Sea have apparently not declined as much as numbers in the UK and probably in Faroe, but there is low confidence in the exact numbers at Barents Sea colonies and how much these have changed (Frederiksen 2010, Frederiksen et al. 2012). Numbers in Norway have declined too, but there is some uncertainty about how much and how this pattern varies regionally (Barrett et al. 2006). The biogeographic population with connectivity to UK waters is therefore a total of about 5.1 million birds, 1.08 million from UK and 4.02 million from overseas. However, only very small proportions of these overseas populations are found in UK waters during migration seasons (autumn; August to December, and spring; January to April). The estimated total numbers in UK waters in autumn are 1,740,000 birds (720,000 from UK, 1,020,000 from overseas) and 1,320,000 birds in spring (750,000 from UK, 570,000 from overseas).

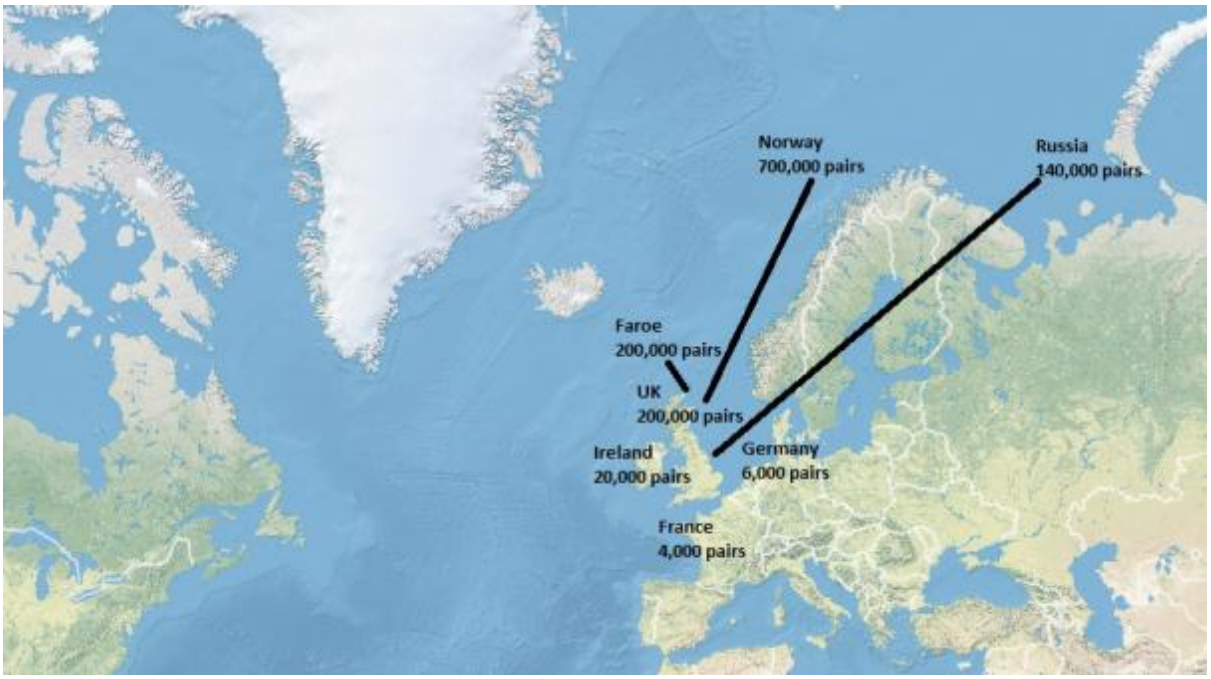


Figure 15.2. Breeding population origins of kittiwakes in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

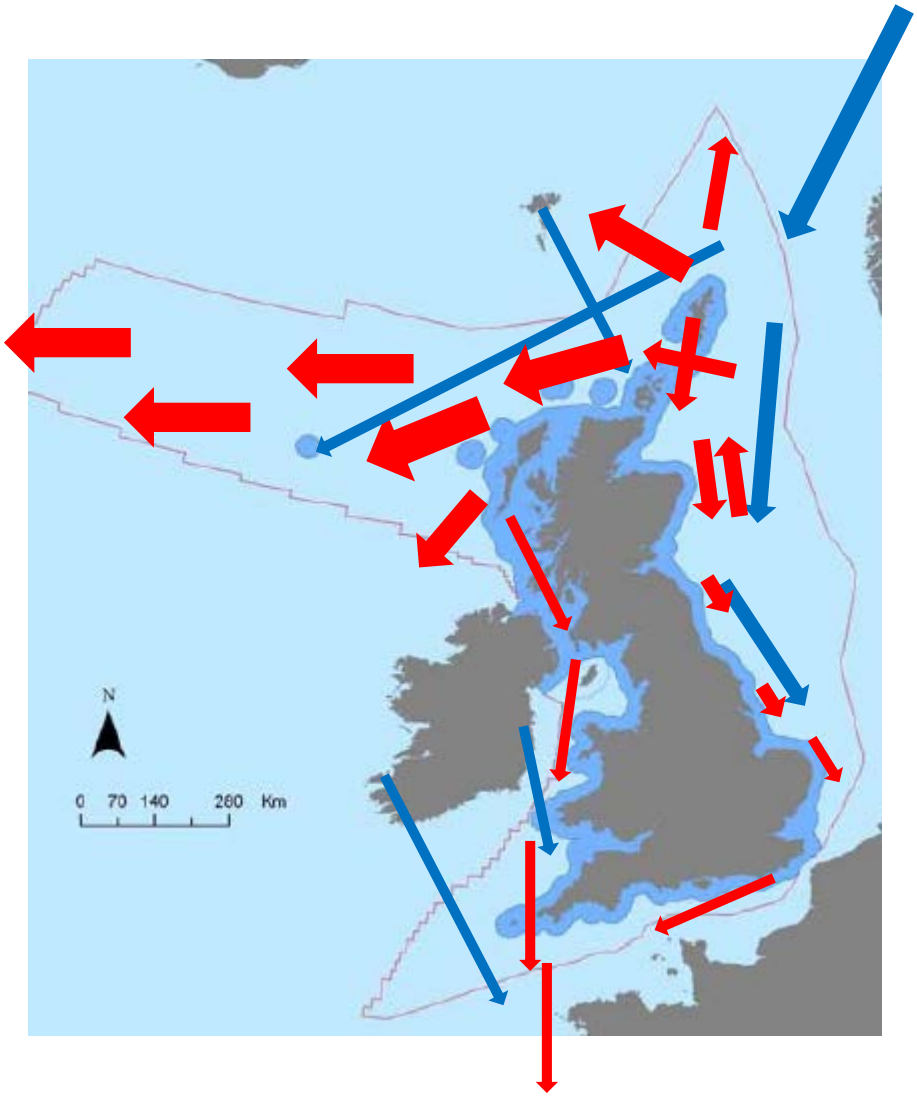


Figure 15.3. Main movements of kittiwakes from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

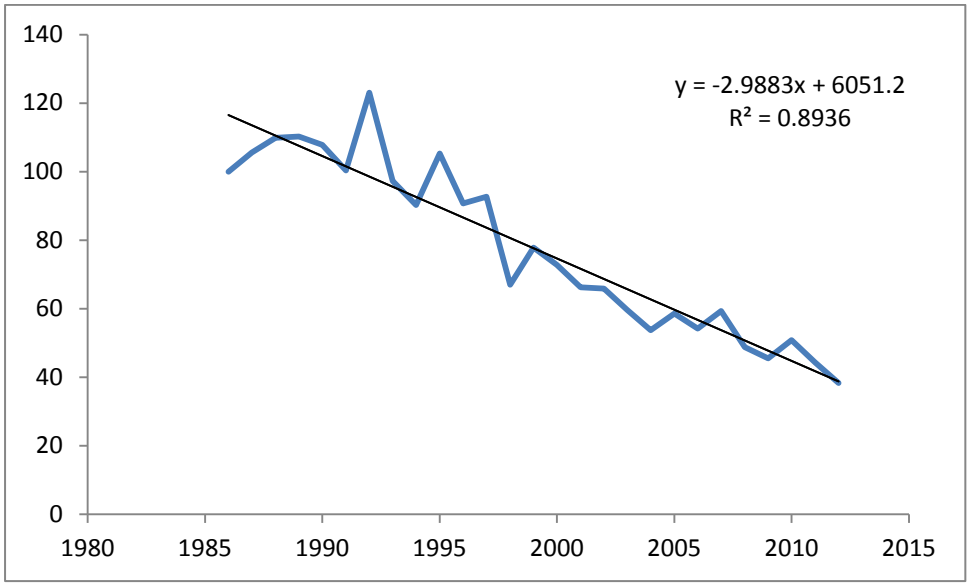


Figure 15.4. Trend in the kittiwake breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

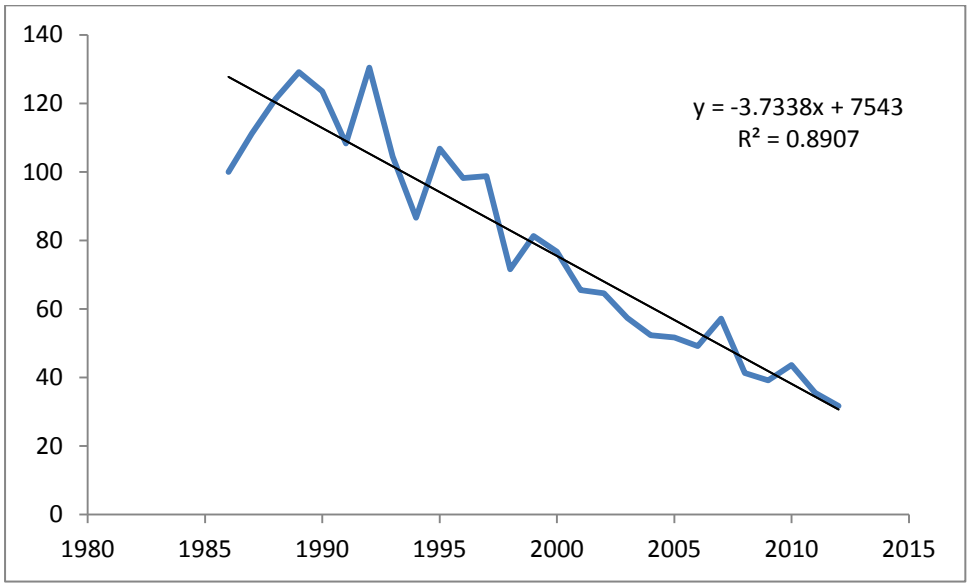


Figure 15.5. Trend in the kittiwake breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

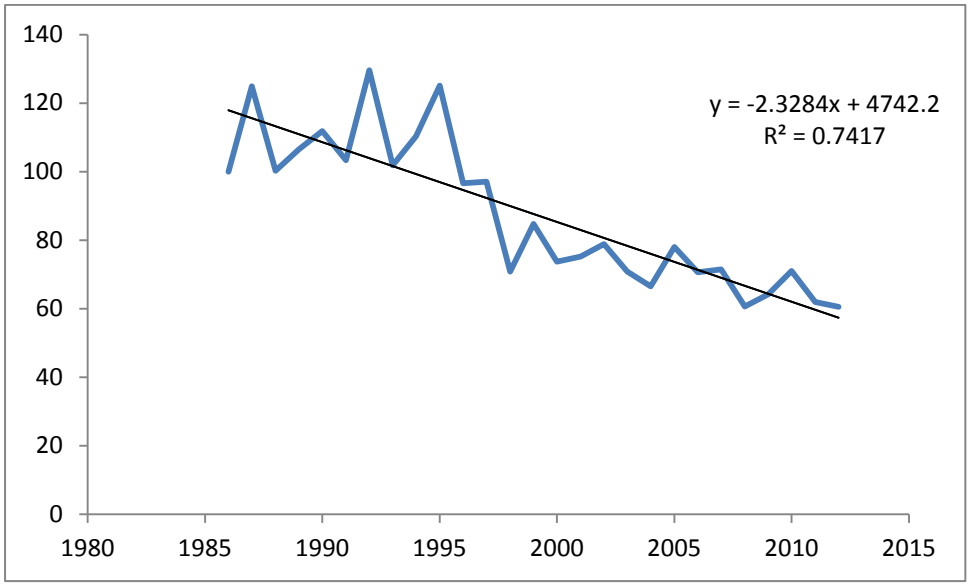


Figure 15.6. Trend in the kittiwake breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

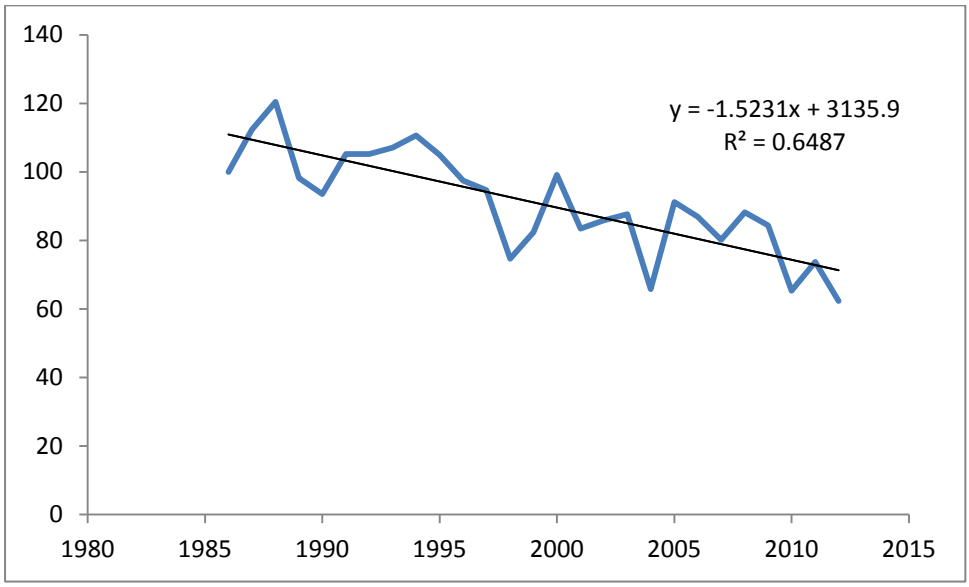


Figure 15.7. Trend in the kittiwake breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

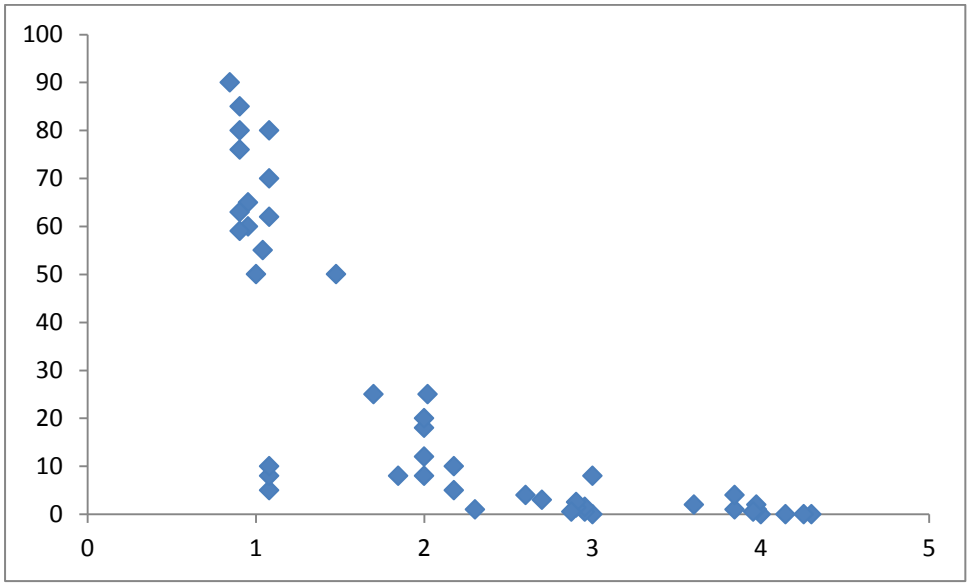


Figure 15.8. Percentage increase in kittiwake colony size (number of nests) at 46 colonies in the UK between surveys in 1959 and 1969 (from Coulson 2011), showing the density-dependent relationship between colony size and growth rate during this period of rapid population growth. Colony size is on a log scale. The same sort of density-dependent relationship between growth rate and colony size has been shown for other time periods so this graph is simply one example of this general phenomenon.

15.9 Proportion of UK population in UK breeding SPAs

The 33 SPAs with breeding kittiwakes as a feature together held 390,597 pairs at designation, estimated to represent ca. 78% of the British breeding population (Stroud et al. 2001). However, based on census data for 1999-2011, Stroud et al. (2014) estimated that this suite held 56.5% of the GB population, as many of the largest colonies have declined even more than the population as a whole. Since a number of the colony size estimates used by Stroud et al. (2014) were from 1999 or 2000, so are very likely to be considerable overestimates of numbers in those colonies now, the true percentage of the population in the SPA suite for breeding kittiwakes is likely to be slightly lower than the estimate in Stroud et al. (2014), perhaps around 55% now.

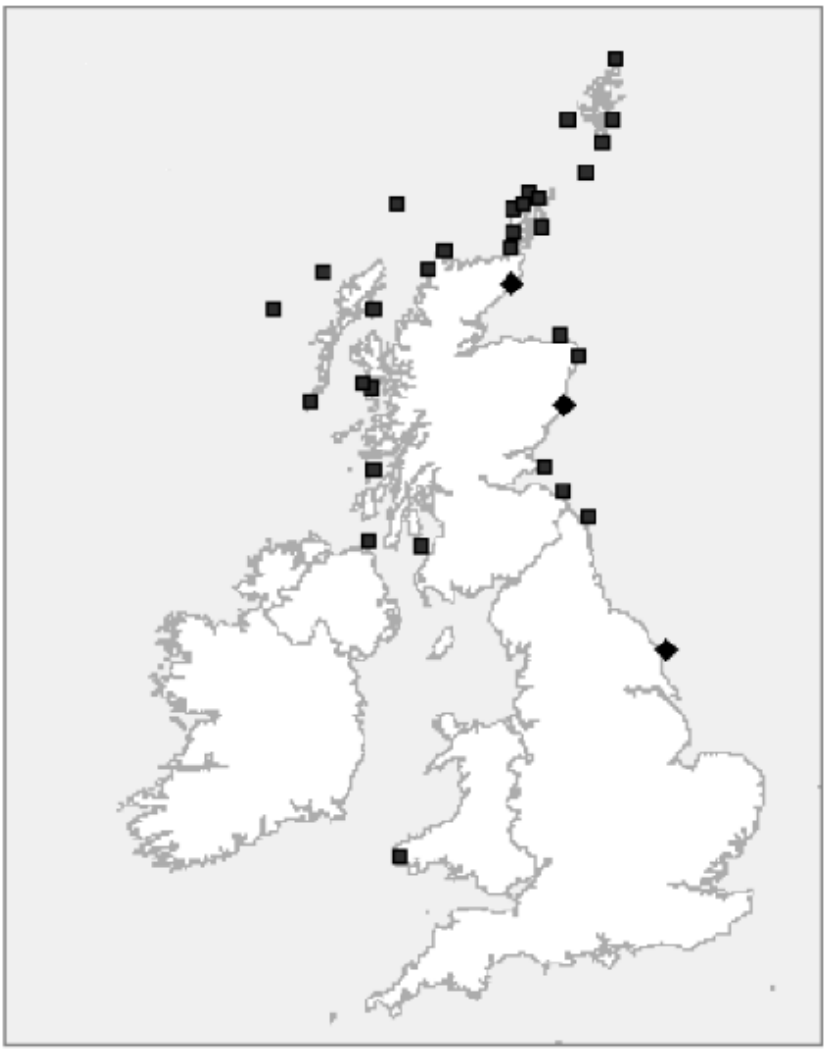


Figure 15.9. UK SPA suite for breeding kittiwakes. These SPA populations are listed in Table 15.1.

Table 15.1. The UK SPA suite for breeding kittiwakes.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent counts	Year	Reference
UK North Sea							
Hermaness, Saxavord & Valla	Shetland	1,710	1994	Declined 2009	710 624 490 391	1999 2002 2005 2009	SCM database SCM database SCM database SCM database
Foula	Shetland	3,840	1995	Declined 2007	997 509 582 480 378 327	2007 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SCM database Gear 2012 Gear 2013
Noss	Shetland	4,270	1996	Declined 2005	2,395 1,427 507	2000 2005 2010	Seabird2000 Lewis et al. 2012 Lewis et al. 2012
Sumburgh Head	Shetland	1,366 (1994)	1996	Declined 2007	506 500 549 210	2007 2009 2010 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SCM database

Fair Isle	Shetland	9,660	1994	Declined 2008	2,688 1,438 1,225 771	2008 2011 2012 2013	SCM database SCM database FIBO Report SCM database
West Westray	Orkney	24,000	1996	Declined 2007	33,281 12,055	1999 2007	Seabird2000 Lewis et al. 2012
Calf of Eday	Orkney	1,717	1998	No change 2006	765 747	2002 2006	Lewis et al. 2012 Lewis et al. 2012
Marwick Head	Orkney	7,110	1994	Declined 2006	3,860 2,185 2,018 1,134 526	2003 2006 2009 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SCM database SCM database
Rousay	Orkney	4,900	2000	Declined 2009	2,713 1,764	1999 2009	Seabird2000 Lewis et al. 2012
Copinsay	Orkney	3,610	1994	Declined 2008	3,552 666	2008 2012	Lewis et al. 2012 SCM database
Hoy	Orkney	3,000	2000	Declined 2007	781 397	1999 2007	Seabird2000 Lewis et al 2012
North Caithness Cliffs	N Scotland	15,650	1996	Declined 2000	10,150	2000	Seabird2000
East Caithness Cliffs	N Scotland	31,930 (1986)	1996	Maintained 1999	40,410	1999	Seabird2000
Troup, Pennan and Lion's Heads	NE Scotland	31,660 (1995)	1997	No change 2007	18,482 15,570 17,171 14,896	2001 2004 2007 2007	Seabird2000 Lewis et al. 2012 Lewis et al. 2012 SCM database
Buchan Ness to Collieston Coast	NE Scotland	30,452	1998	No change 2007	13,330 14,133 12,542	2004 2007 2007	SCM database Lewis et al. 2012 SCM database
Fowlsheugh	NE Scotland	34,870	1992	Maintained 1999	11,140 9,454 9,337	2006 2009 2012	Lewis et al. 2012 Lewis et al. 2012 SCM database
Forth Islands	E Scotland	8,400 (1985) Or 9,380 (Stroud et al. 2001)	1990	Declined 2007	5,164 3,884 3,766 3,100	2007 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 SCM database SCM database
St Abb's Head to Fast Castle	E Scotland	19,600	1997	Declined 2008	15,430 c.5,000 4,314 3,403	2000 2011 2012 2013	Seabird2000 Lewis et al. 2012 SCM database SCM database
Farne Islands	NE England	6,236	1985		4,275 3,699 4,768 3,976 4,241 3,443	2008 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database
Flamborough Head & Bempton (to be subsumed into Flamborough and Filey Coast SPA)	E England	83,370 (1987)	1993		42,692 37,617	2000 2008	SCM database SCM database

Flamborough and Filey Coast	E England	44,520 (2008-2011)	Not yet		42,692 37,617	2000 2008	SCM database SCM database
UK Western waters & Channel							
Cape Wrath	NW Scotland	9,660	1996	Maintained 2000	10,344	2000	Seabird2000
North Rona and Sula Sgeir	N Scotland	5,040 (1986)	2001	Declined 2012	4,119 1,253	1998 2012	Lewis et al. 2012 SCM database
Handa	NW Scotland	7,420	1990	Declined 1999	7,013 5,985 4,466 1,872	1999 2005 2009 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SCM database
St Kilda	Western Isles	7,800 (1987)	1992	Maintained 2000	4,268 1,516 957	1999 2006 2008	Seabird2000 Lewis et al. 2012 Lewis et al. 2012
Flannan Isles	Western Isles	2,800 (1988)	1992	Declined 2013	1,392	1998	Seabird2000
Shiant Isles	Western Isles	1,850	1992	Maintained 1999	2,006 549	1999 2008	Seabird2000 Lewis et al. 2012
Canna and Sanday	Inner Hebs	1,193	1998	Maintained 2001	960 1,002 1,083 820	2010 2011 2012 2013	SCM database SCM database SCM database SCM database
Rum	Inner Hebs	1,500	1982	No change 2006	788	2000	Seabird2000
Mingulay and Berneray	Western Isles	8,610 (1985)	1994	Declined 2009	5,511 4,974 2,228	1998 2003 2009	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
North Colonsay & Western Cliffs	W Scotland	4,512	1997	Maintained 2008	5,563	2000	Seabird2000
Ailsa Craig	W Scotland	3,100 (1987)	1990	Declined 2003	1,675 200 428 489	2001 2008 2009 2013	SCM database SCM database Lewis et al. 2012 SCM database
Rathlin Island	N Ireland	6,822 (1985)	1999		9,917 9,896 7,922	1999 2007 2011	SCM database SCM database SCM database
Skomer and Skokholm	Wales	1,959 Stroud et al. 2001)	1982		2,282 2,046 1,922 1,837 1,594 1,045	2008 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

15.10 BDMPS

The UK waters can be divided into two spatially distinct BDMPS. Most birds from UK North Sea colonies are members of the UK North Sea BDMPS, whereas few birds from western colonies enter the North Sea. Conversely, although some birds from UK North Sea colonies enter UK western waters plus Channel, these are a minority from those populations whereas most birds from colonies in western waters contribute to the UK western waters plus Channel BDMPS. UK North Sea holds about 830,000 birds during autumn migration (August to December), and 630,000 in spring migration (January to April). It seems that slightly more than half of these birds are from the UK population. UK western waters plus Channel BDMPS holds about 910,000 birds during autumn migration, and 690,000 in spring

migration. It should be recognised, however, that although kittiwake numbers are undoubtedly large in both these populations, numbers are not known with confidence, and appear to be highly variable depending on weather patterns, and possibly also on food supply.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 47 to 50.

Based on evidence reviewed in sections 15.5, 15.6 and 15.7, the UK North Sea autumn migration BDMPS is estimated to contain 60% of adults and 40% of immatures from colonies in the UK North Sea, 1% of adults and 5% of immatures from colonies in UK western waters, 10% of adults and immatures from Russia, Norway, Faroe and Germany, 5% of adults and immatures from France and Ireland. This results in an estimated BDMPS population of 829,937 birds in autumn, 432,129 from UK and 397,808 from overseas (Appendix A Table 47).

Based on evidence reviewed in sections 15.5, 15.6 and 15.7, the UK western waters plus Channel autumn migration BDMPS is estimated to contain 20% of adults and 20% of immatures from colonies in the UK North Sea, 60% of adults and 40% of immatures from colonies in UK western waters, 10% of adults and immatures from Russia, 15% of adults and immatures from Norway, 20% of adults and immatures from Faroe and 5% of adults and immatures from Germany, 10% of adults and immatures from France, and 30% of adults and 20% of immatures from Ireland. This results in an estimated BDMPS population of 911,586 birds in autumn, 292,074 from UK and 619,512 from overseas (Appendix A Table 48).

Based on evidence reviewed in sections 15.5, 15.6 and 15.7, the UK North Sea spring migration BDMPS is estimated to contain 60% of adults and 30% of immatures from colonies in the UK North Sea, 1% of adults and 2% of immatures from colonies in UK western waters, 5% of adults and 7% of immatures from Russia, Norway, and Faroe, 15% of adults and 25% of immatures from Germany, 5% of adults and 10% of immatures from France, and 1% of adults and immatures from Ireland. This results in an estimated BDMPS population of 627,816 birds in spring, 389,392 from UK and 238,424 from overseas (Appendix A Table 49).

Based on evidence reviewed in sections 15.5, 15.6 and 15.7, the UK western waters plus Channel spring migration BDMPS is estimated to contain 30% of adults and 20% of immatures from colonies in the UK North Sea, 80% of adults and 40% of immatures from colonies in UK western waters, 5% of adults and 10% of immatures from Russia and Norway, 10% of adults and immatures from Faroe, 5% of adults and immatures from Germany, 10% of adults and immatures from France, 30% of adults and 20% of immatures from Ireland. This results in an estimated BDMPS population of 691,526 birds in spring, 362,814 from UK and 328,712 from overseas (Appendix A Table 50).

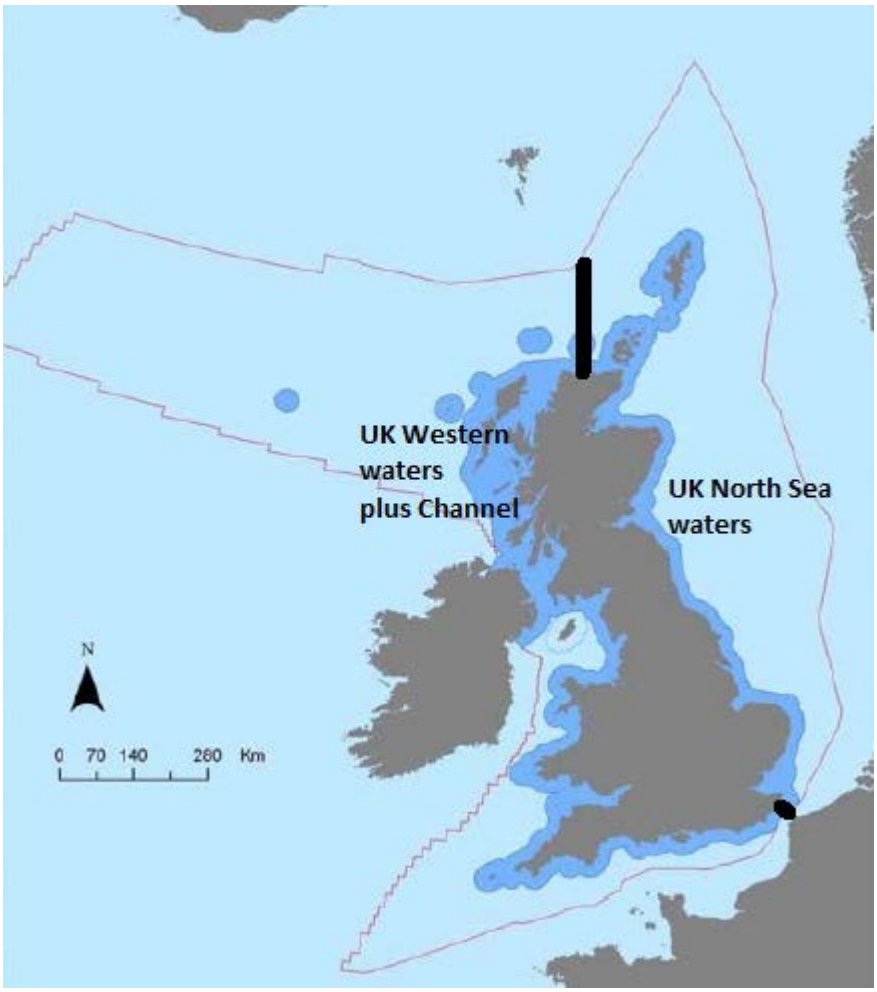


Figure 15.10. Two defined BDMPS spatial areas for kittiwake: 'UK North Sea waters' and 'UK Western waters plus Channel'.

15.11 Proportions of UK breeding SPA birds in BDMPS

The proportion of birds in each BDMPS that are adults from UK SPA populations can be estimated directly from Appendix A Tables 47 to 50. For example, the UK North Sea autumn migration season BDMPS comprises 829,937 birds in total, of which 184,615 are adults from UK SPA populations, giving an estimate of 22% being adults from UK SPAs.

15.12 Spatial distribution of UK breeding SPA birds across the BDMPS

The SPAs for breeding kittiwakes in UK North Sea BDMPS and UK Western waters plus Channel BDMPS are well distributed through the broad breeding range of the species in those areas. In the South-west and Channel area there is only one SPA population, in south Wales, so the distribution of SPA birds could be patchy, but since kittiwakes disperse very widely it is likely that in all areas they are very thoroughly mixed through the broader UK population and with birds from overseas.

16. SANDWICH TERN *Thalasseus sandvicensis*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (July-September and March-May)
Overseas	107,000	13,560
UK	41,000	35,252
Total	148,000	48,812

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (July-September and March-May)			
UK North Sea and Channel	38,051	10,090	27,961
UK Western waters	10,761	3,470	7,291

Sandwich tern numbers in UK SPA colonies are almost all monitored frequently. However, numbers in UK colonies that are not SPA populations are less well monitored, and do represent a substantial proportion of the UK total. Sandwich tern migrations have not been studied by geolocator deployment, and ringing recoveries from the migration period in UK waters are very limited. So understanding of details of Sandwich tern movements are relatively poor, especially to the extent that birds from overseas populations are concerned. While ring recoveries show that some birds from overseas pass through UK waters, the proportions of those populations doing so are very uncertain since ring recovery data are subject to considerable potential bias. Therefore, numbers of overseas birds and total numbers in the BDMPS are classed as red, whereas numbers from the UK population are classed amber.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 51 and 52.

16.1 Breeding range and taxa

Sandwich tern has a Holarctic breeding distribution in warm temperate latitudes. There are three subspecies, but only nominate *T. s. sandvicensis* occurs within British waters. There is no evidence that biometrics would allow origins of individuals to be identified. Most populations breed south of the UK. There are moderate numbers in Denmark and Germany, but few in Norway or Sweden.

16.2 Non-breeding component of the population

Sandwich terns start to breed when 3 years old (BTO Birdfacts). Adult survival rate is 0.898 (BTO Birdfacts), juvenile survival 0.358 (BTO Birdfacts) and mean productivity is 0.656 chicks per pair (JNCC database, n=174 measurements). To obtain a stable population, survival of immatures was adjusted to 0.55 for juveniles, 0.7 for 1-year olds, and 0.8 for 2-year olds. The model population comprised 61% adults, 20% juveniles and 19% older immatures. There are 0.63 immatures per adult.

16.3 Phenology

Breeding colonies in the UK are deserted by late September (Brown and Grice 2005), with modal departure in August (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in July (Cramp et al. 1977-94; Pennington et al. 2004; Forrester et al. 2007) or August (Wernham et al. 2002). Peak autumn migration occurs in August in Shetland (Pennington et al. 2004), and Scotland (Forrester et al. 2007), July-September in Belgium (Vanermen et al. 2013) or September throughout Europe (Cramp et al. 1977-94; Wernham et al. 2002). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred from July to September (Figure 16.1). Autumn migration is completed in UK waters by October (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007) or early November throughout the geographical range (Cramp et al. 1977-94).

Spring migration starts in late February in the winter quarters (Cramp et al. 1977-94) and in March in UK waters (Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in March-April in Belgium (Vanermen et al. 2013) and in English waters (Brown and Grice 2005), in April (Cramp et al. 1977-94; Wernham et al. 2002) in April-May in Scottish waters (Forrester et al. 2007) and in June in Shetland (Pennington et al. 2004). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in April (Figure 16.1). Spring migration is completed in May (Cramp et al. 1977-94; Wernham et al. 2002), June (Forrester et al. 2007) or July in Shetland (Pennington et al. 2004).

The first spring records of Sandwich tern in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 2 March to 26 April but predominantly in late March, and the last records were from 28 June to 31 December but mostly in October. Peak autumn migration was reported in August-September in most years, and peak spring migration was reported in April or May in most years. Birds re-occupy colonies from March, with modal return in April (Pennington et al. 2004; Forrester et al. 2007).

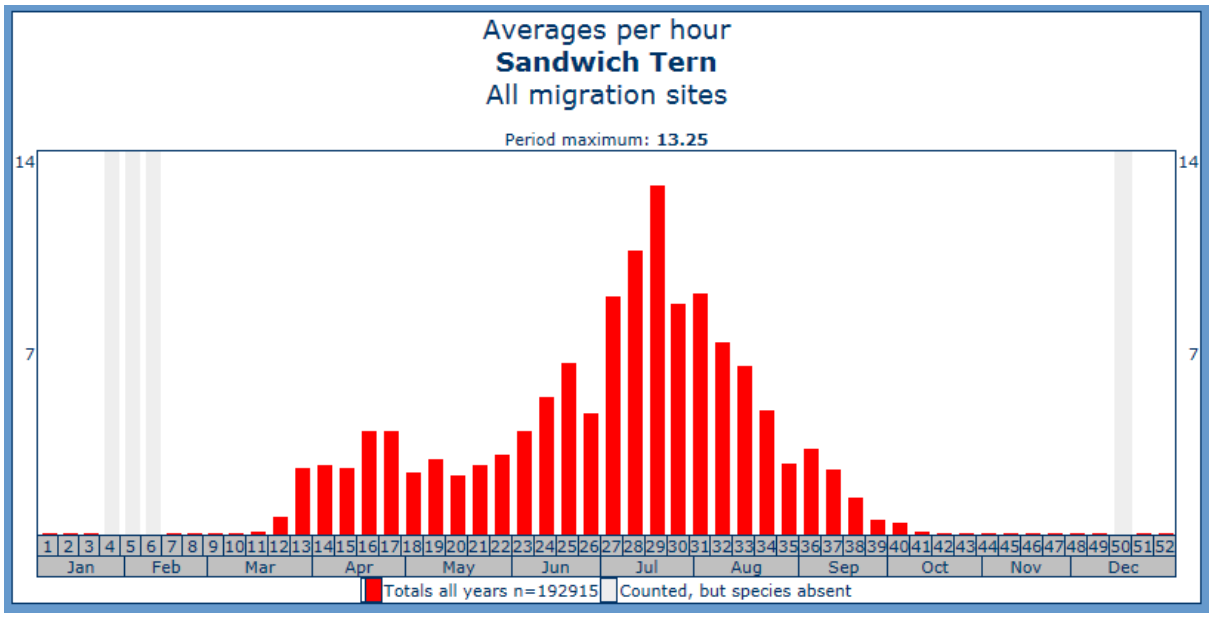


Figure 16.1. Average numbers of Sandwich terns counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season birds predominantly absent from UK waters. However, from the data reviewed above, a more appropriate definition would be breeding season April-August, non-breeding season September-March.

16.4 Defined seasons:

- UK Breeding season — April-August
- Post-breeding migration in UK waters — July-September (**migration BDMPS**)
- non-breeding season — September-March
- Return migration through UK waters — March-May (**migration BDMPS**)
- Migration-free breeding season — June
- Migration-free winter season — October-February

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for Sandwich tern:

Migration periods BDMPS (July-September, and March-May).

16.5 Movements of birds from the UK population

Sandwich terns breeding in the UK are mainly concentrated in a small number of colonies, with high concentrations in Norfolk, and Northumberland. Breeding adults may abandon colonies where habitat change, predation or flooding impact on productivity, and may move considerable distances to recruit into another colony, so European populations represent a large meta-population (Møller 1981). Birds begin to disperse from colonies in late June and many fledglings may cross the North Sea between continental and UK colonies in July-August (Wernham et al. 2002). Sandwich tern fledglings remain dependent on their parents for food for some weeks after fledging, so move as family parties rather than as independent individuals (Meissner and Krupa 2007). Birds move quite rapidly southwards to wintering areas from west Africa to southern Africa, so that very few remain in UK waters after September (Wernham et al. 2002), although there are small numbers seen as late as November on English coasts (Balmer et al. 2013).

16.6 Movements of birds from overseas into UK waters

Ring recoveries show movements of Sandwich terns from populations in Ireland, Denmark, Germany, The Netherlands and Belgium moving through UK waters. For example, birds caught at Teesmouth in late summer included individuals ringed in Belgium (2), Netherlands, Denmark (2) and Northern Ireland (3) as well as 75 ringed in the UK (Ward 2000). All but one of these ringed birds from the continent were juveniles, suggesting that young birds are most likely to cross the North Sea during autumn dispersal. There is also one recovery of a juvenile reared at a colony in North America (so of a different subspecies from the birds in Europe) recovered dead in SW England in November (Wernham et al. 2002). The North American subspecies normally winters in South America, so this ring recovery is highly atypical. Many juveniles remain dependent on their parents for some of their food during migration and during winter (Fernandez-Cordeiro and Costas 1991; Wernham et al. 2002). Most first year birds remain in the winter quarters through their first summer and second years mainly move only part way towards their natal area, summering off west Africa or southern Europe. Most three year olds and older birds migrate rapidly back to their breeding area in March-April, but some three year olds, and some older birds spend the summer in west Africa or southern Europe rather than breeding (Wernham et al. 2002). Birds may recruit into colonies hundreds of kilometres from where they were reared, so there is considerable interchange between colonies in UK, Ireland and countries on the east side of the North Sea (Wernham et al. 2002). Seabird 2000 estimated that about 12,490 pairs bred in the UK, 1,800 pairs in Ireland, 4,500 in Denmark, 9,700 in Germany, 14,500 in The Netherlands, and 1,550 in Belgium (Mitchell et al. 2004). With extensive dispersal between these populations and the large numbers on each side of the North Sea, it is likely that many of the Sandwich terns in UK waters in July-October originate from mainland European colonies (and some also from Ireland though numbers there are relatively small). Few breed in Norway or Sweden (in total about 300 to 400 pairs) and there are none in Faroe or Iceland, so numbers migrating through UK waters from further north will be very small. Meissner and Krupa (2007) reported that Sandwich terns caught in the southern Baltic during migration had longer wing lengths than birds caught in NE England on migration, indicating that different populations were involved in these two regions. It is likely that the numbers of birds crossing the North Sea during post-breeding dispersal will vary considerably from year to year, as terns will congregate, post-breeding, in areas where there are aggregations of prey fish; small pelagic fish such as sandeels, sprats and young herring (Stienen and Brenninkmeijer 1998, 2002). Productivity of these short-lived fish varies considerably from year to year, and so there may be some years when many UK birds move to Danish waters to feed on sprats, some years when many Dutch birds move to UK waters to feed on sandeels, and so on. As a result, the proportions of birds from different countries and the absolute numbers of birds in UK waters post-breeding and during migration may vary considerably from year to year. Although large numbers of Sandwich terns breed in France (about 7,000 pairs) and many birds are ringed in those colonies, they are not recovered in the UK and so appear not to pass through UK waters. The distribution of Sandwich tern colonies in France is predominantly in the Bay of Biscay, with few nesting in northern France (Hagemeijer and Blair 1997), so the lack of connectivity with the UK is understandable.

16.7 Numbers in UK waters

Forrester et al. (2007) suggest that about 500 to 1,500 birds are in Scottish waters during autumn migration, and about 100 to 1,000 birds during spring migration, and that there may be up to 5 birds in Scottish waters in winter. Numbers in English waters are uncertain, but likely involve all of the UK population (of about 12,500 pairs so 25,000 adults). Associated with that UK adult population will be about 15,700 immatures, but the youngest age class will predominantly remain in the winter quarters rather than return to UK waters, so perhaps about 8,000 to 9,000 of the immatures are likely to be in UK waters during the migration periods. In addition, even more uncertain numbers from overseas populations pass through

UK waters on passage. These are likely to include about 1,000 to 4,000 birds from Ireland passing mainly through SW English waters, and perhaps 1,000 to 20,000 birds from Norway to Belgium passing mainly through southern North Sea UK waters (as many of those birds will pass through southern North Sea continental rather than UK waters). Summing these suggests that about 44,000 birds may pass through UK waters during autumn migration, and perhaps similar or slightly smaller numbers in spring.

16.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the European population, comprising 132,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 69,000-79,000 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. The biogeographic population with connectivity to UK waters would be the sum of the populations listed in Figure 16.2, or a total of about 45,000 pairs. Populations in France (which are predominantly in the Bay of Biscay and western Mediterranean; Hagemeijer and Blair 1997) and Spain appear to have no connectivity with UK waters. The biogeographic population with connectivity to UK waters comprises 148,000 birds (adults and immatures) with 41,000 from UK and 107,000 from overseas. However, only a small proportion of the birds from the connected overseas populations occur within UK waters, so that the estimated total number of birds in UK waters during migration is 49,000 birds, with 35,300 from UK and 13,600 from overseas.



Figure 16.2. Breeding population origins of Sandwich terns in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

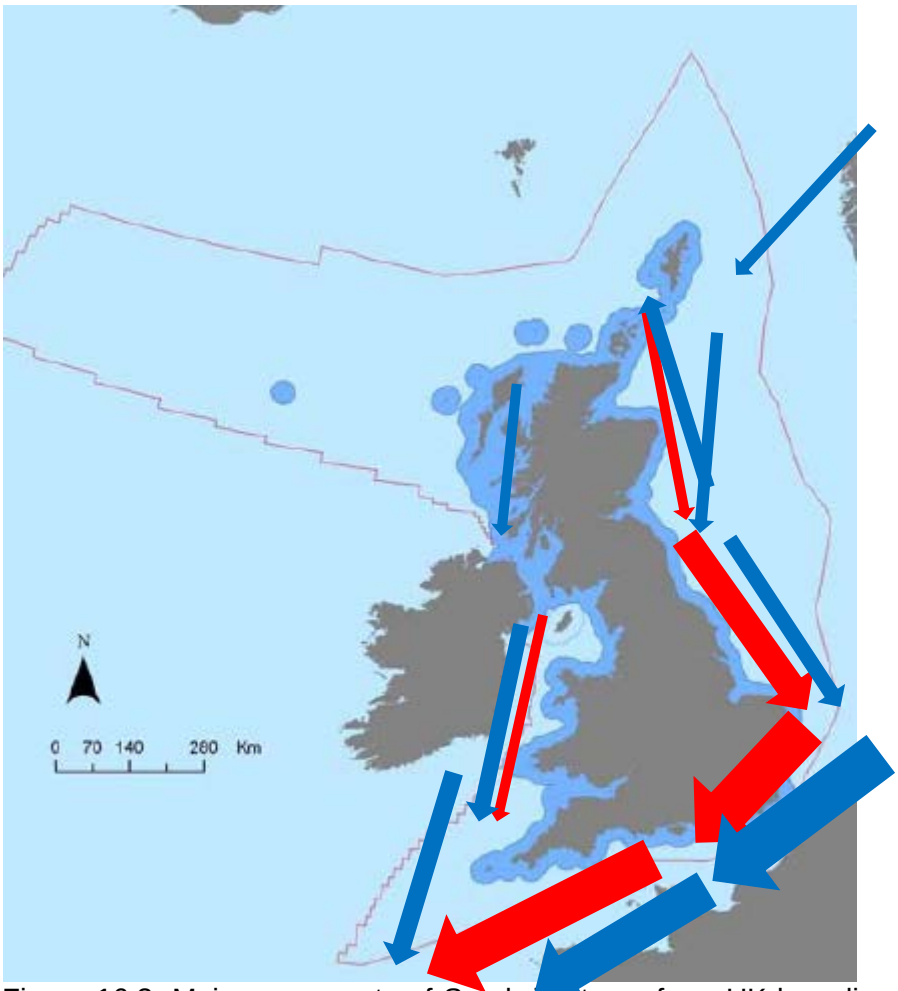


Figure 16.3. Main movements of Sandwich terns from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

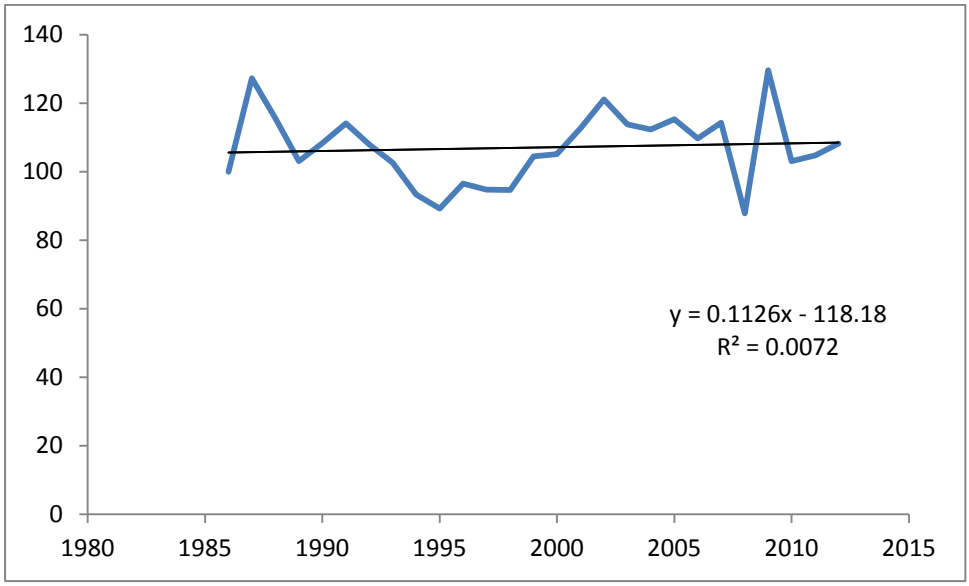


Figure 16.4. Trend in the Sandwich tern breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

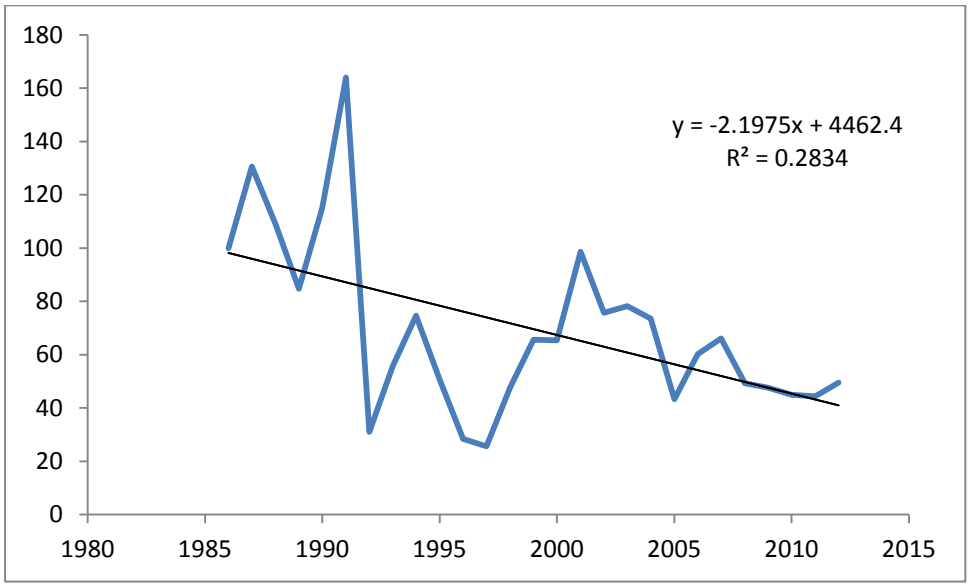


Figure 16.5. Trend in the Sandwich tern breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

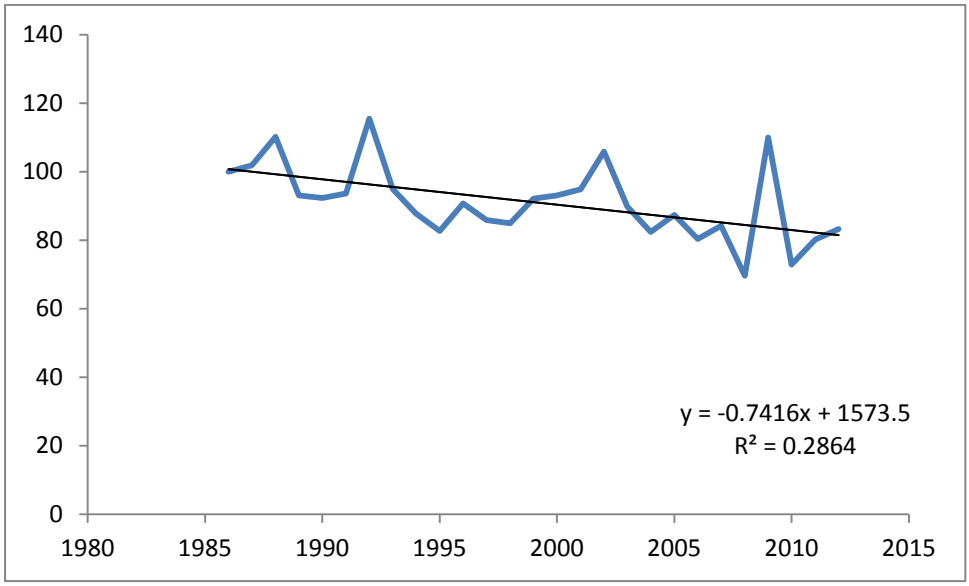


Figure 16.6. Trend in the Sandwich tern breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

16.9 Proportion of BDMPS from UK breeding SPAs

The 16 SPAs with breeding Sandwich terns as a feature together held 11,440 pairs at designation, estimated to represent ca. 72% of the British breeding population (Stroud et al. 2001). Based on census data from 2006-2011, Stroud et al. (2014) estimated that the population on GB SPAs for breeding Sandwich terns comprised 72%, suggesting no change overall in this statistic since SPA designations. This is despite the fact that several SPA populations have declined to zero (Table 16.1).

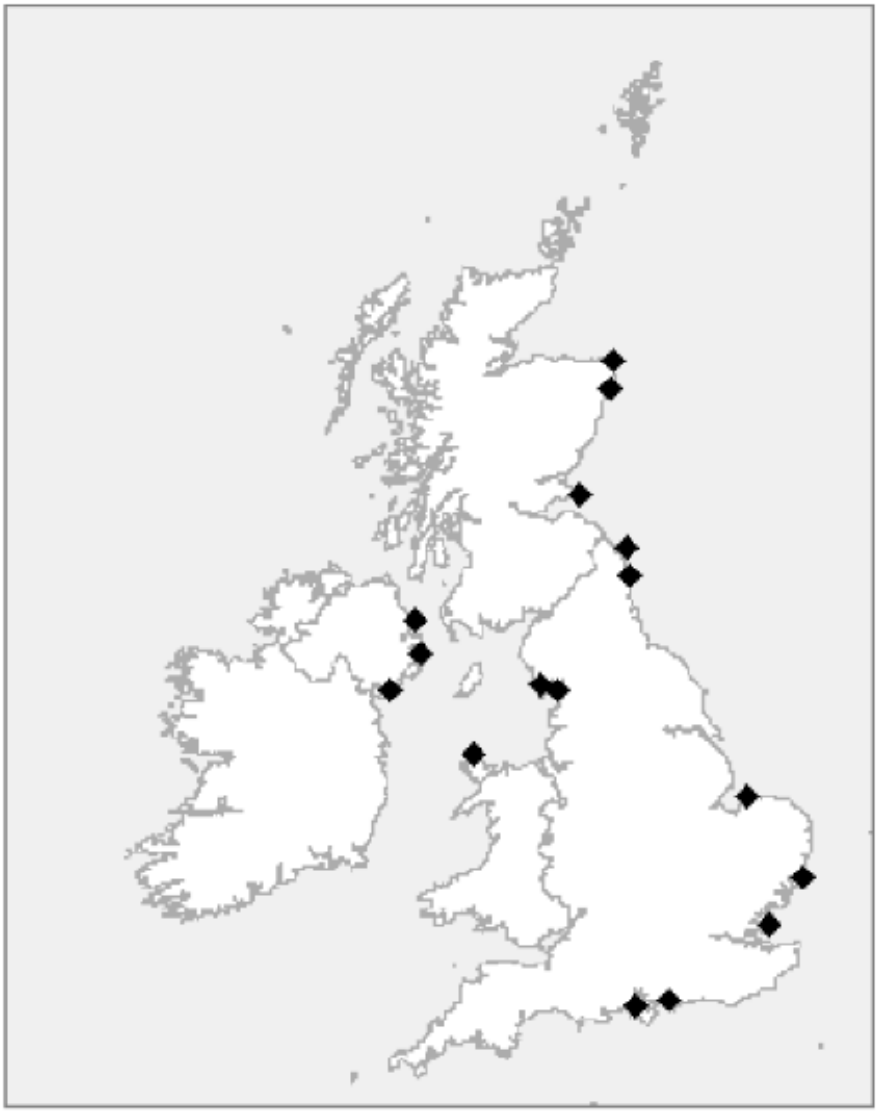


Figure 16.7. The UK SPA suite for breeding Sandwich terns. These SPA populations are listed in Table 16.1.

Table 16.1. The UK SPA suite for breeding Sandwich terns.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Loch of Strathbeg	NE Scotland	530	1995	Declined 2004	0 0 0 0 0 0 0	2007 2008 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database SMP database SMP database
Ythan Estuary, Sands of Forvie	NE Scotland	600 (early 1990s)	1998	Maintained 2012	900 670 645 674 590 657 565	2007 2008 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database SMP database

Forth Islands	E Scotland	440 (1985) Or 22 (Stroud et al. 2001)	1990	Declined 2003	0 1 0 0 0 0	2007 2008 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database SMP database
Farne Islands	NE England	2,070 (1993-1997)	1985		1,413 1,358 1,415 1,019 544 966 824	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Coquet Island	NE England	1,590 (1993-1997)	1985		759 1,223 804 873 1,069 1,717 1,289 670	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
North Norfolk Coast	E England	3,700 (1992-1996) Or 3,457 (Stroud et al. 2001)	1989		3,550 3,450 3,600 2,680 3,100 2,980 3,562 4,135	2005 2006 2007 2008 2009 2010 2011 2012	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Alde-Ore Estuary	E England	170 (1992-1996) Or 169 (Stroud et al. 2001)	1996		2 3 0 0 0 2	2004 2005 2006 2007 2008 2009	SMP database SMP database SMP database SMP database SMP database SMP database
Foulness		320 (1992-1996)	1996		0 0 0 0	2003 2004 2005 2006	SMP database SMP database SMP database SMP database
Chichester & Langstone Harb	S England	31 (1993-1997) Or 158 (Stroud et al. 2001)	1987		271 204 78 130 183 205 175 46 6	2005 2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Solent & Southampton Water	S England	231 (1993-1997)	1998		275 268 210 226 0 140 0 0 0 215 0	1999 2000 2001 2002 2003 2004 2005 2006 2007 2007 2008	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database Stroud et al. 2014 SMP database

UK Western waters							
Carlingford Lough	N Ireland	575 (1993-1997)	1998		1,125 826 363 170 0 78 0	2005 2006 2007 2008 2009 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Larne Lough	N Ireland	165 Stroud et al. 2001)	1997		788 465 695 545 373 449 324 433 257	2005 2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Strangford Lough	N Ireland	593 (1993-1997)	1998		1,092 1,385 1,594 1,398 1,994 1,203 978 771	2005 2006 2007 2008 2009 2010 2011 2012	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Morecambe Bay	NW England	422 (1992-1996) Or 290 (Stroud et al. 2001)	1996		0 0 0 0 0 1	2002 2003 2004 2005 2006 2011	SMP database SMP database SMP database SMP database SMP database SMP database
Duddon Estuary	Cumbria	210 (1988-1992)	1998		300 300 280 400 400 10 0 1	2005 2006 2007 2008 2009 2010 2011 2012	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Ynys Feurig, Cemlyn Bay	Wales	460 (1993-1997)	1992		0 0 1 0 0 0	2004 2005 2006 2007 2008 2009	SMP database SMP database SMP database SMP database SMP database SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

16.10 BDMPS

The UK waters can be divided into two distinct spatial BDMPS for Sandwich tern, the UK North Sea and Channel, and the UK western waters. These areas are appropriate for passage periods, including both autumn and spring. The UK North Sea and Channel BDMPS holds the bulk of the overseas migrants passing through UK waters and the bulk of the UK breeding population. About 38,000 birds may occur in this BDMPS in autumn and spring, with about 28,000 of those being from the UK population. The UK western waters

BDMPS holds smaller numbers of birds, with about 11,000 in total and 7,300 of these from the UK and 3,500 from overseas.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 51 and 52.

Based on evidence reviewed in sections 16.5, 16.6 and 16.7, the UK North Sea and Channel migration seasons BDMPS holds 100% of adults and 70% of immatures from UK North Sea colonies, none from UK western waters colonies, and 10% of adults and immatures from Norway, Sweden, Denmark, Germany, The Netherlands, and Belgium, but none from Ireland. This gives a BDMPS total of 38,051 birds, 27,961 from UK and 10,090 from overseas.

Based on evidence reviewed in sections 16.5, 16.6 and 16.7, the UK western waters migration seasons BDMPS holds 0% of adults and immatures from UK North Sea colonies, 100% of adults and 70% of immatures from UK western waters colonies, 5% of adults and immatures from Norway and Sweden, 3% of adults and immatures from Denmark, 2% of adults and immatures from Germany, 1% of adults and immatures from The Netherlands and Belgium, 30% of adults and immatures from Ireland. This gives a BDMPS total of 10,761 birds, 7,291 from UK and 3,470 from overseas.

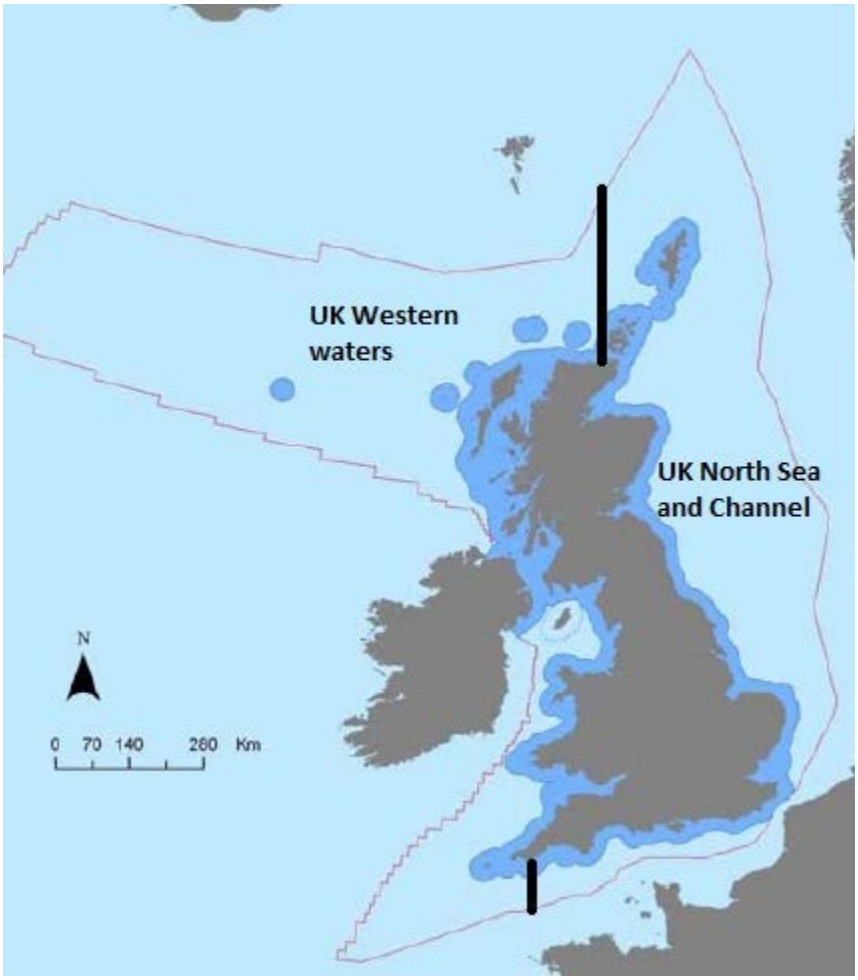


Figure 16.8. Two defined BDMPS spatial areas for Sandwich tern: 'UK North Sea waters and Channel' and 'UK Western waters'.

16.11 Proportions of UK SPA birds in BDMPS

The proportion of birds in each BDMPS that are adults from UK SPA populations can be estimated directly from Appendix A Tables 51 and 52. For example, the UK North Sea and Channel migration season BDMPS comprises 38,051 birds in total, of which 12,404 are adults from UK SPA populations, giving an estimate of 33% being adults from UK SPAs.

16.12 Spatial distribution of UK breeding SPA birds across the BDMPS

During migration periods, UK SPA birds will be fairly well mixed throughout the BDMPS area. In UK western waters the very high concentration of most SPA birds in a single SPA may result in some local aggregation of SPA birds around North Wales. However, dispersal of birds in autumn can be quite rapid so that aggregations of UK SPA birds are likely to disappear as migration proceeds.

17. ROSEATE TERN *Sterna dougallii*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (August-September and late April-May) (adults and immatures)
Overseas	2,600	2,111
UK	300	244
Total	2,900	2,355

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (August-September and late April-May)			
East coast and Channel	251	7	244
North and west Scotland	4	4	0
West England & Wales	2,100	2,100	0

Although scarce, roseate tern is intensively monitored in the UK and Ireland. Colony locations are regularly checked, and breeding numbers are counted annually at most colonies. Migrations of roseate terns through UK waters have not been studied in detail, but it is certain that birds from UK colonies pass through UK waters on migration (apart from very young immatures that remain in the winter quarters throughout their first summer). It is almost certain that Irish roseate terns migrate through western UK waters, since they would have difficulty getting from Ireland to west Africa without passing through the SW Approaches. There is unlikely to be significant interchange between birds from western waters and the North Sea, as roseate terns are not seen migrating overland in the way that common terns often do. The main uncertainty is what proportion of immature roseate terns from the Irish population migrate through UK waters, and for that reason the numbers of overseas roseate terns in the West England & Wales BDMPS are coded amber, while other component numbers are coded green.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 53 to 55.

17.1 Breeding range and taxa

Roseate tern is a cosmopolitan species, breeding in tropical, sub-tropical and temperate regions around the world. There are five subspecies, but only nominate *dougallii* occurs in

British waters. The species is so scarce in the UK that useful biometrics are unlikely to be available.

17.2 Non-breeding component of the population

Roseate terns start to breed when 2 years old (BTO Birdfacts). Adult survival rate is 0.855 (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is 1.293 chicks per pair (JNCC database, n=88 measurements). To obtain a stable population, productivity was adjusted to 1 chick per pair as the reported productivity seems out of line with other data on productivity of terms and may be biased by coming predominantly from highly protected colonies, survival of immatures was adjusted to 0.5 for juveniles, and 0.6 for 1-year olds. The model population comprised 57% adults, 29% juveniles and 14% older immatures. There are 0.75 immatures per adult.

17.3 Phenology

Breeding colonies in the UK are deserted by late August, with modal departure in August (Pennington et al. 2004; Forrester et al. 2007). Autumn migration starts in July (Wernham et al. 2002; Forrester et al. 2007) or late-August (Cramp et al. 1977-94). Peak autumn migration occurs in August (Forrester et al. 2007), August-September (Wernham et al. 2002), or September (Cramp et al. 1977-94). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in August, with very few after early September (Figure 17.1). Autumn migration is completed by early October (Forrester et al. 2007) mid-October (Cramp et al. 1977-94) or October (Wernham et al. 2002).

Spring migration starts in late March from southern hemisphere wintering areas (Cramp et al. 1977-94), late April (Forrester et al. 2007) or early May (Wernham et al. 2002) in UK waters. Peak spring migration occurs in May (Cramp et al. 1977-94; Wernham et al. 2002; Brown and Grice 2005; Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in mid- to late-May (Figure 17.1). Spring migration is completed by early June (Cramp et al. 1977-94; Wernham et al. 2002) or June (Forrester et al. 2007). Birds re-occupy colonies from early May, with modal return in mid- to late-May (Forrester et al. 2007). It is interesting to note that numbers seen on spring migration are very much smaller than numbers seen on autumn migration (Figure 17.1). This pattern is typical of most seabird species but is very pronounced for roseate tern. The reasons for this are not understood. The fact that spring migration occurs more rapidly than autumn migration may be a major factor. Possibly the fact that autumn migration includes juvenile birds may also be a factor (since the inexperienced juveniles may be particularly evident passing coastal migration watch points in autumn as they might perhaps migrate closer to shore than most adults do).

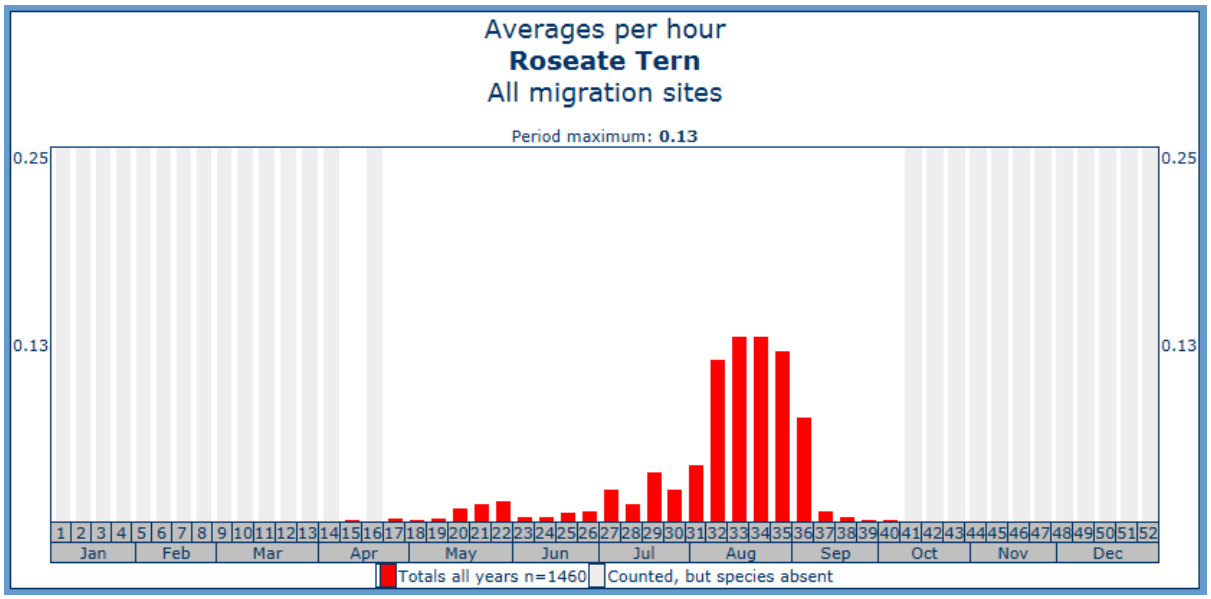


Figure 17.1. Average numbers of roseate terns counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season birds predominantly absent from UK waters. From the data reviewed above, an appropriate definition would be breeding season May-August, non-breeding season September-April.

17.4 Defined seasons:

- UK Breeding season — May-August
- Post-breeding migration in UK waters — August-September (**migration BDMPS**)
- non-breeding season — September-April
- Return migration through UK waters late — April-May (**migration BDMPS**)
- Migration-free breeding season — June-July
- Migration-free winter season — October-March

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for roseate tern:

Migration periods BDMPS (August-September, and late April-May).

17.5 Movements of birds from the UK population

Roseate terns at UK colonies fledge chicks in July, and pre-migratory dispersal occurs in August (Wernham et al. 2002). At this time, birds tend to congregate where there is suitable food, and chicks remain dependent on their parents for feeding (Wernham et al. 2002). Autumn migration to wintering areas off west Africa occurs mainly during August-October, although some birds (presumably failed breeders or nonbreeders) arrive on the wintering grounds by July (Wernham et al. 2002). Almost all juveniles remain on the wintering grounds through their first summer, although very small numbers return to visit breeding colonies briefly in July. Many, but not all, 2nd year birds return to breeding areas in late June and July to prospect for nest sites. Older birds leave west Africa in March-April and return to colonies in May (Wernham et al. 2002).

17.6 Movements of birds from overseas into UK waters

No roseate terns ringed at colonies outside the British Isles have been recovered within UK waters (Wernham et al. 2002). However, although there is a preference for returning to the natal colony, chicks are likely to recruit into any colony in NW Europe, so this population clearly represents a meta-population with extensive gene flow. In contrast, chicks from NW Europe have hardly ever been seen in colonies in the Azores (where there are between 1,000 and 1,500 pairs) or North America (where there are around 4,000 pairs), suggesting that those populations are somewhat distinct. Seabird 2000 recorded about 56 pairs breeding in the UK, 734 in Ireland, 80 in France, and 1-3 pairs in Germany, Netherlands and Belgium (Mitchell et al. 2004). Based on the much larger numbers breeding in Ireland than in the UK, it seems likely that a very high proportion of the roseate terns seen in UK waters to the west of the UK in spring or autumn will be Irish birds (Brown and Grice 2005). Most UK roseate terns breed on the coast of Northumberland (colonies in the Firth of Forth which used to be a stronghold have declined to just one or two pairs since 2000). A high proportion of roseate terns in North Sea UK waters are likely to be from UK colonies as there is no evidence to suggest that Irish (or French) roseate terns pass through the North Sea.

17.7 Numbers in UK waters

Numbers in UK waters are very low, and so are very difficult to assess with any confidence. Forrester et al. (2007) suggest that between 5 and 20 birds migrate through Scottish waters. The relatively large population breeding in Ireland (750 pairs plus some of the associated immatures) almost certainly passes though SW English waters during autumn and spring migrations.

17.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the European population, comprising 1,770 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 1,900-2,400 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. The biogeographic population with possible connectivity to UK waters comprises 84 pairs in the UK, 750 pairs in Ireland, and 3 pairs in Germany to Belgium (Figure 17.2). This equates to 2,900 birds in total, with 300 from UK and 2,600 from overseas. A high proportion of this biogeographic population with connectivity does pass through UK waters on migration. Estimated numbers in UK waters during migration are 2,340 birds in total, with 240 from UK and 2,100 from overseas (the total from UK in UK waters is less than the biogeographic total in the UK population because some first year birds remain in winter quarters so do not enter UK waters at that stage of their life).



Figure 17.2. Breeding population origins of roseate terns in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

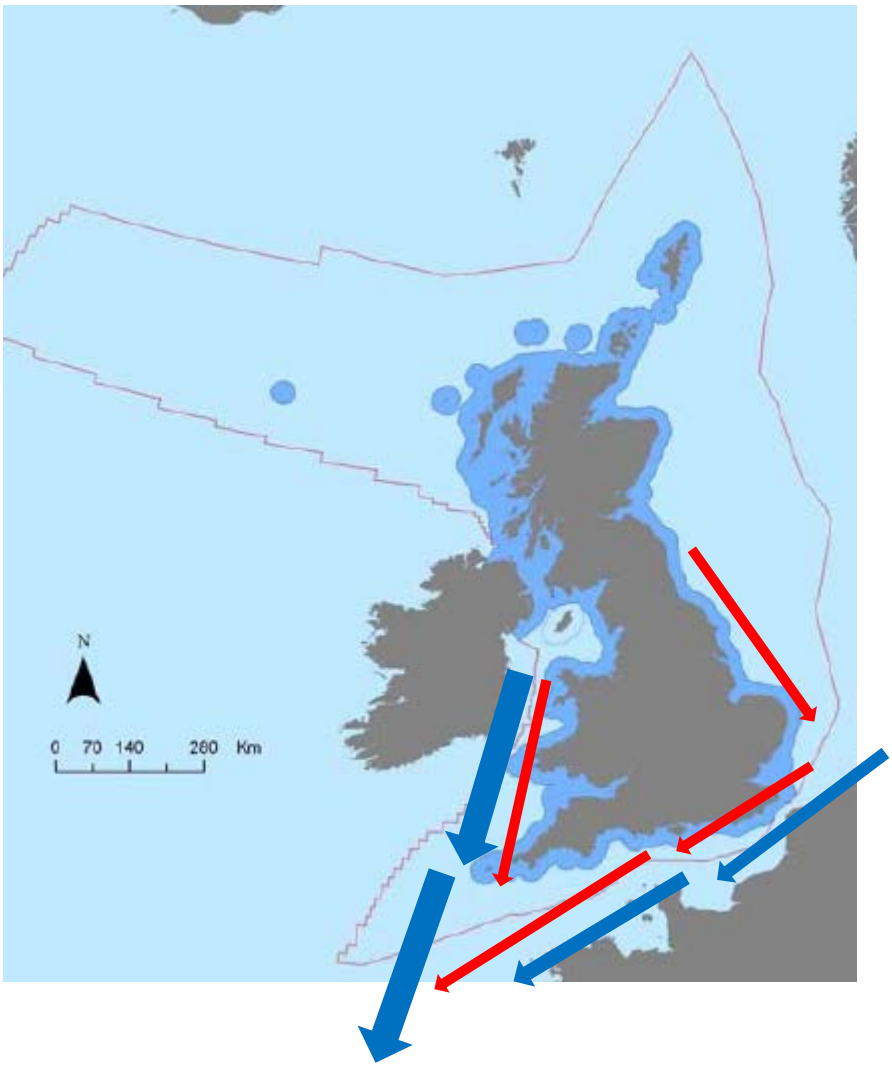


Figure 17.3. Main movements of roseate terns from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

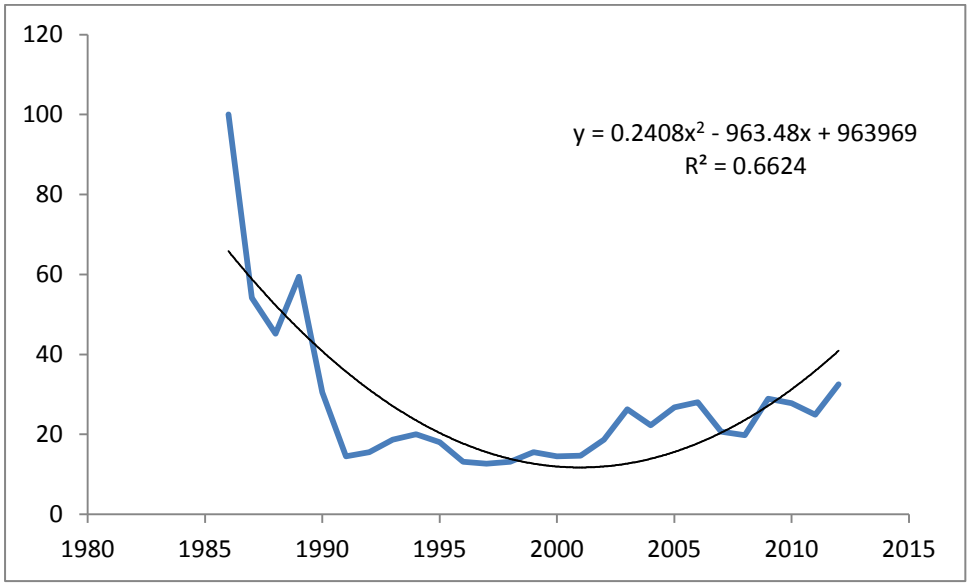


Figure 17.4. Trend in the roseate tern breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

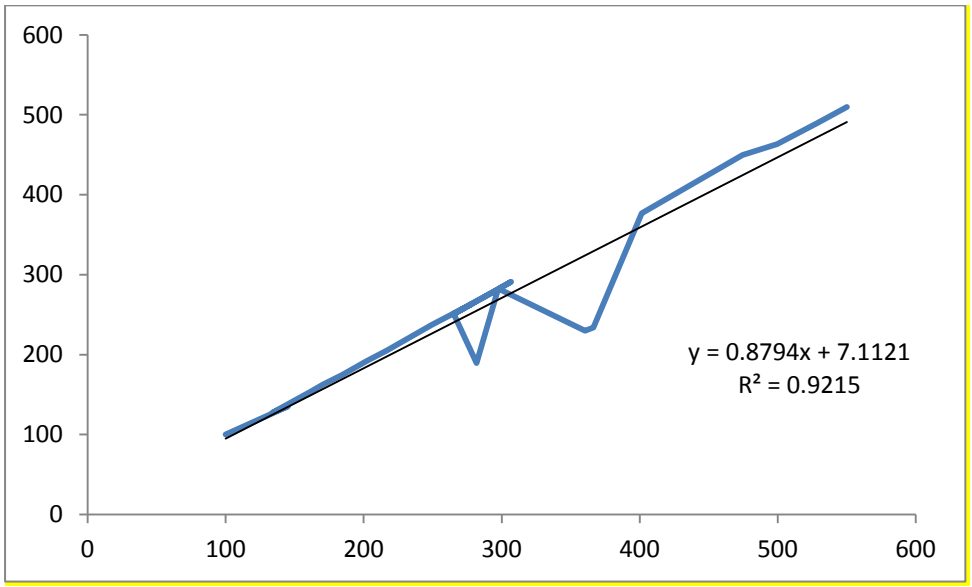


Figure 17.5. Trend in the roseate tern breeding population index in all-Ireland from 1986-2012. Data from JNCC seabird population monitoring database.

17.9 Proportion of UK population from UK breeding SPAs

The 7 SPAs with breeding roseate terns as a feature together held 56 pairs at designation, estimated to represent ca. 88% of the British breeding population and 1.4% of the all-Ireland breeding population (Stroud et al. 2001). Stroud et al. (2014) estimate that the UK SPA populations counted in 2005-2011 represented 94% of the GB population.



Figure 17.6. SPA suite for roseate tern. These SPA populations are listed in Table 17.1.

Table 17.1. The UK SPA suite for breeding roseate terns.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
East coast and Channel							
Forth Islands	E Scotland	8 (1997-2001) Or 9 (Stroud et al. 2001)	1990 (and 2004)	Declined 2009	3	2005-2009	Stroud et al. 2014
Farne Islands	NE England	3 (Stroud et al. 2001)	1985		0	2011	Stroud et al. 2014
Coquet Island	NE England	31 (1993-1997)	1985		78	2011	Stroud et al. 2014
North Norfolk Coast	E England	2 (Stroud et al. 2001)	1989		0	2010	Stroud et al. 2014

Solent & Southampton Water	S England	2 (1993-1997)	1998		0	2009	Stroud et al. 2014
West England & Wales							
Larne Lough	N Ireland	6 (1993-1997)	1997		0	2011	Stroud et al. 2014
Ynys Feurig, Cemlyn Bay	Wales	3 (1992-1996)	1992		0	2011	SCM database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

17.10 BDMPS

UK waters can be divided into three BDMPS based on strong differences in origins and numbers of birds present in the three areas during migration seasons. 'North and West Scotland' holds no breeding birds and has a BDMPS of about 4 birds, which are most likely to be immatures from the Irish population. 'East Coast and Channel' holds a breeding population of about 82-84 pairs, of which 81 are in SPAs. The BDMPS comprises these 82-84 pairs plus associated immatures, plus about 7 birds from the population in Germany to Belgium that may pass through UK waters. In total this BDMPS probably includes 251 birds. The 'West England and Wales' BDMPS holds no UK breeding birds, but will see migration of many birds from the population in Ireland. Possibly some 2,100 roseate terns migrate to and from the east coast of Ireland through the West of England and Wales marine area. So the BDMPS for this area is 2,100 birds, all from outwith the UK population.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 53 to 55.

Based on evidence reviewed in sections 17.5, 17.6 and 17.7, the East coast and Channel migration seasons BDMPS holds 100% of adults and 60% of immatures from UK North Sea colonies but no birds from other parts of the UK, 5% of adults and 10% of immatures from Germany, The Netherlands and Belgium, and 0.2% of adults and 0.3% of immatures from Ireland (Appendix A Table 53). These proportions result in a BDMPS population total of 251 birds, 244 from UK and 7 from overseas.

Based on evidence reviewed in sections 17.5, 17.6 and 17.7, the North and West Scottish waters migration seasons BDMPS holds no birds from UK colonies, but 0.1% of immatures from Germany, The Netherlands and Belgium, and 0.05% of adults and 0.3% of immatures from Ireland (Appendix A Table 54). This gives an estimated BDMPS of 4 birds, all from overseas populations.

Based on evidence reviewed in sections 17.5, 17.6 and 17.7, the West England and Wales migration seasons BDMPS holds no birds from UK North Sea colonies, 100% of adults and 60% of immatures from UK west coast colonies, 0.01% of immatures from Germany, The Netherlands and Belgium, 95% of adults and 60% of immatures from Ireland (Appendix A Table 55). This gives an estimated BDMPS of 2,100 birds, none from UK colonies but 2,100 from overseas colonies.

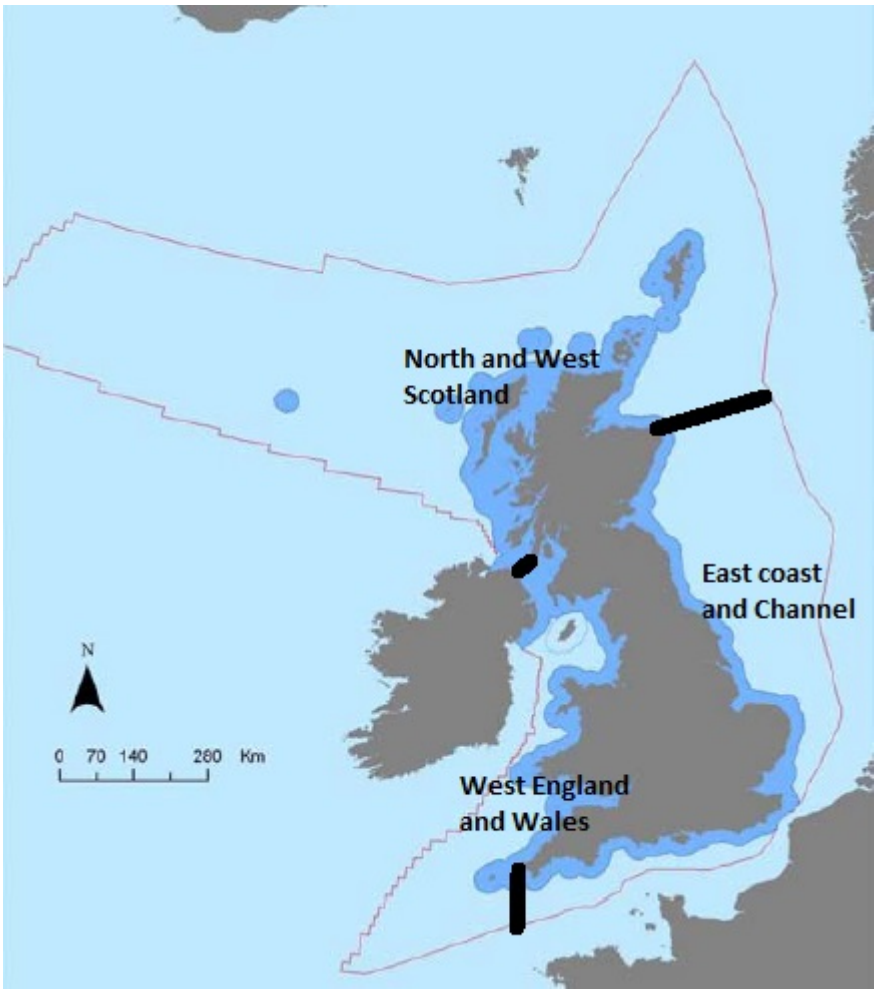


Figure 17.7. Three defined BDMPS spatial areas for roseate tern: ‘East coast and Channel’, ‘North and West Scotland’ and ‘West England and Wales’.

17.11 Proportions of UK SPA birds in BDMPS

In North and West Scotland BDMPS there are probably no UK SPA birds. In East Coast and Channel BDMPS UK birds are likely to form 97% of the population, with 94% of those 97% being UK SPA birds, so that UK SPA birds represent 91% of the population. In West England and Wales BDMPS UK birds are likely to form 0% of the population. The proportion of birds in each BDMPS that are adults from UK SPA populations can be estimated directly from Appendix A Tables 53 to 55. For example, the East coast and Channel migration season BDMPS comprises 251 birds in total, of which 168 are adults from UK SPA populations, giving an estimate of 67% being adults from UK SPAs.

17.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Since the UK SPA birds either form 0% or a high percentage of the BDMPS, the spatial distribution within regions is likely to be consistent; high in East coast and Channel BDMPS and zero in North and West Scotland BDMPS and in West England and Wales BDMPS.

18. COMMON TERN *Sterna hirundo*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (late July to early September, and April-May) (adults and immatures)
Overseas	440,000	174,416
UK	40,000	35,154
Total	480,000	209,570

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (late July to early September and April-May)			
UK North Sea and Channel	144,911	125,969	18,942
UK Western waters	64,659	48,447	16,212

Common tern numbers in most UK SPA colonies are monitored frequently. However, numbers in UK colonies that are not SPA populations are less well monitored, and do represent a substantial proportion of the UK total. Common tern migrations have not been studied by geolocator deployment, and ringing recoveries from the migration period in UK waters are very limited. So understanding of details of common tern movements is relatively poor, especially to the extent that birds from overseas populations are concerned. While ring recoveries show that many birds from overseas pass through UK waters, the proportions of those populations doing so are very uncertain since ring recovery data are subject to considerable potential bias. Furthermore, these overseas populations are large, and certainly represent a high proportion of the total of common terns in UK waters during the migration season. There is yet another complication, which is that common terns rather frequently will migrate overland, and there is known to be considerable movement from North Sea estuaries over to western waters in autumn, and overland from southern England in spring. Therefore, estimated numbers of birds in the BDMPS are classed as red for the total population and numbers from overseas, whereas numbers from the UK population are classed amber.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 56 and 57.

18.1 Breeding range and taxa

Common tern has a Holarctic breeding range, predominantly in temperate latitudes. There are four subspecies, but only nominate *hirundo* occurs in British waters. Subspecies *hirundo*

breeds in North America, northern South America, the Atlantic Islands, most of Europe, north and west Africa, and through the Middle East to central Russia. Despite this large range, there appears to have been no assessment of whether biometrics would allow origins of individuals to be identified (Ward 2000). However, timing of primary moult varies between populations and can help to infer origins of birds caught on autumn migration (Ward 2000).

18.2 Non-breeding component of the population

Common terns start to breed when 3 years old (BTO Birdfacts). Adult survival rate is 0.9 (BTO Birdfacts), juvenile survival 0.47 up to 2 years old (BTO Birdfacts) and mean productivity is 0.721 chicks per pair (JNCC database, n=246 measurements). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.7 for 1-year olds, and 0.8 for 2-year olds. The model population comprised 60% adults, 22% juveniles and 18% older immatures. There are 0.67 immatures per adult.

18.3 Phenology

Breeding colonies in the UK are deserted by late August, with modal departure in early August (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in early July (Pennington et al. 2004), mid-July (Cramp et al. 1977-94) or July (Wernham et al. 2002; Forrester et al. 2007). Peak autumn migration occurs in early August in Shetland (Pennington et al. 2004), in August (Forrester et al. 2007), August-September in UK waters in general (Wernham et al. 2002) and in Belgium (Vanermen et al. 2013). Peak migration through southern Europe and past west Africa continues through October (Cramp et al. 1977-94). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in August, with numbers declining rapidly in early September (Figure 18.1). Autumn migration is completed in Shetland by early September (Pennington et al. 2004), in UK waters by early October (Brown and Grice 2005; Forrester et al. 2007) or October (Wernham et al. 2002).

Spring migration starts in mid-March in the wintering areas of the southern hemisphere (Cramp et al. 1977-94), but starts in UK waters in early April (Wernham et al. 2002) or mid- to late-April in Shetland and Scotland (Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in early to mid-April in English waters (Brown and Grice 2005), April (Cramp et al. 1977-94), in April-May in Belgium (Vanermen et al. 2013), in April-May in UK waters (Wernham et al. 2002) and in early May in Shetland (Pennington et al. 2004). Forrester et al. (2007) suggests peak spring migration occurs in June, which seems rather late. Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late April and early May (Figure 18.1). Spring migration is completed by late May (Pennington et al. 2004), early June (Cramp et al. 1977-94), June (Wernham et al. 2002) or late June (Forrester et al. 2007). It is interesting to note that numbers seen on spring migration are very much smaller than numbers seen on autumn migration (Figure 18.1). This pattern is typical of most seabird species but is very pronounced for common tern. The reasons for this are not understood but seem to be due to behaviour of birds rather than to differences in numbers present. The fact that spring migration occurs more rapidly than autumn migration may be a major factor; if birds spend ten times longer on autumn migration through UK waters than on spring migration through UK waters it would be reasonable to expect counts at Trektellen sites to be ten times higher in autumn than in spring even if numbers of birds involved were the same. Possibly the fact that autumn migration includes juvenile birds may also be a factor (since the inexperienced juveniles may be particularly evident passing coastal migration watch points in autumn as they might perhaps migrate closer to shore than most adults do).

The first spring records of common tern in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 10 April to 20 May, but mostly in late April, and the last records were from 24 August to 30 October, but mostly in late September. Peak autumn

migration was reported in July-August in most years, and peak spring migration was reported in May (and usually in early May) in most years. Birds re-occupy colonies from late April, with modal return in mid- to late-May (Pennington et al. 2004; Forrester et al. 2007).

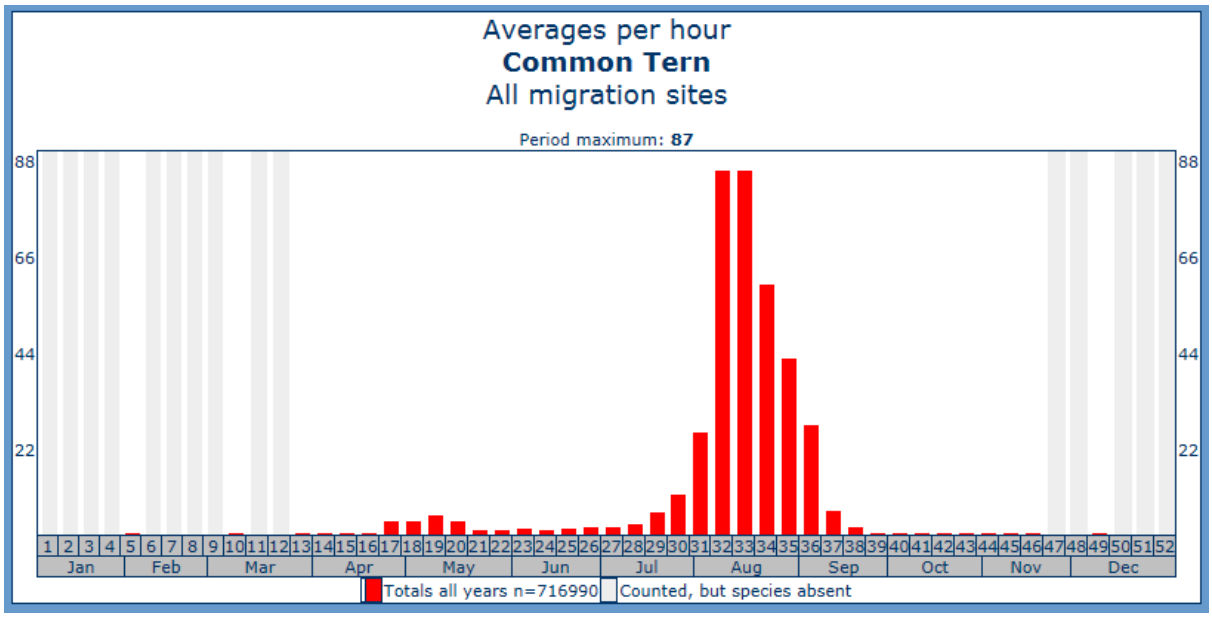


Figure 18.1. Average numbers of common terns counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-September, non-breeding season birds predominantly absent from UK waters. However, from the data reviewed above, a more appropriate definition would be breeding season May-August, non-breeding season September-April.

18.4 Defined seasons:

- UK Breeding season — May-August
- Post-breeding migration in UK waters — late July-early September (**migration BDMPS**)
- non-breeding season — September-April
- Return migration through UK waters — April-May (**migration BDMPS**)
- Migration-free breeding season — June-mid-July
- Migration-free winter season — October-March

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for common tern:

Migration periods BDMPS (late July-early September, and April-May).

18.5 Movements of birds from the UK population

Post-fledging dispersal from UK (and continental) colonies begins in July, but continues as late as October (Wernham et al. 2002). Post-fledging dispersal may be northwards rather than southwards, and may involve birds crossing the North Sea. For example, a fledgling ringed in Belgium was recovered in Durham together with fledglings from colonies in Norfolk in late August/early September (Wernham et al. 2002). As with many other tern species, fledglings tend to congregate in areas where feeding is easy (especially in estuaries and

large bays where there are presumably aggregations of sprats or sandeels), and may remain dependent on their parents for food for some time after fledging (Johnasson and Jakobsson 1997; Newton 2010), although they become independent of parents more quickly than Sandwich tern fledglings (Meissner and Krupa 2007). Some birds travel quickly to Africa, arriving in west Africa by August, while others remain in UK waters into September. During September and October, a strong southward migration occurs out of UK waters and along the coast of SW Europe to west Africa, with juveniles often still being fed by their parents. Migration follows the coastline (Wernham 2002). British birds appear to move south somewhat earlier than those from Norway, with those from Baltic colonies later still (Ward 2000).

18.6 Movements of birds from overseas into UK waters

Birds from many northern European countries pass through UK waters during post-fledging dispersal and autumn migration. Some birds move overland rather than following coasts, recognised routes being between the Firth of Forth and Clyde (Forrester et al. 2007) and between Teesmouth and Merseyside (Ward 2000). Ward (2000) reported peak numbers of common terns at Teesmouth in mid-August, with ringed fledglings from Lithuania (2), Finland (6), Sweden (2), Norway (9), and Netherlands (2) as well as 32 ringed as chicks at UK colonies. Based on moult scores, Ward (2000) inferred that a substantial minority of the adult common terns at Teesmouth in August were from the Baltic population, but the analysis was unable to estimate an accurate proportion because differences in timing of moult of UK and Baltic breeders are not well enough known. Wernham et al. (2002) report 101 ring recoveries to or from countries to the north and east, with 23 involving Belgium and the Netherlands, 14 involving Germany, Poland and the Baltic States, and 64 involving Fennoscandia. In contrast, there is no evidence from ringing of any movement of common terns from southern or eastern populations through UK waters. Common terns from North America are extremely rare visitors to Europe, and there are no records of American common terns reaching UK (Wernham et al. 2002).

Many adults return to breeding areas in the UK by April, and it is thought that spring migration is rapid and often occurs overland rather than tracking coasts (Wernham et al. 2002) At Dungeness and Portland Bill, spring passage of common terns peaks in late April and early May, and since movement is primarily eastwards at those sites and occurs at a time when many UK birds are already back at their colonies, probably involves birds returning to colonies in Fennoscandia or the Baltic States rather than to UK colonies (Wernham et al. 2002). However, migration timing may alter with climate change and oceanographic system oscillations (Favero et al. 2006). Although most first year birds remain in the wintering areas during the summer, most two year olds return to colonies, though they arrive from late May to late June. Three year olds often recruit into their natal colony, but substantial numbers may recruit elsewhere, with occasional movements to colonies in another country. In contrast, breeding adults are highly philopatric, usually returning to the same nest site in successive years, although there are a few cases of breeding dispersal to colonies across the North Sea (Wernham et al. 2002).

Based on data for Seabird 2000 (Mitchell et al. 2004), the UK breeding population (11,838 pairs) is small compared to some of the populations that may at least in part migrate through UK waters which total about 140,000 pairs (Finland 50,000, Sweden 22,000, Netherlands 19,000, Norway 15,000, Baltic States 12,750, Germany 9,000, Poland 6,000, Ireland 2,700, Belgium 2,250, Denmark 1,000). So it is likely that in August-October and in April-May, a substantial proportion of common terns in UK waters originate from these foreign populations. Meissner and Krupa (2007) reported that common terns caught in the southern Baltic during migration had longer wing lengths than birds from British breeding sites or birds caught in NE England on migration, indicating that different populations were involved in these two regions.

18.7 Numbers in UK waters

Numbers of migrating terns are difficult to assess. Forrester et al. (2007) suggest that between 2,000 and 20,000 are in Scottish waters during migration periods. However, migration through English waters will almost certainly include all of the UK breeding population (24,000 adults) plus some of the associated immatures (perhaps 8,000). It is also certain that large numbers of birds from continental Europe pass through UK waters, involving many tens of thousands of birds.

18.8 Biogeographic population and relevant smaller units (BDMPS)

Stroud et al. (2001) defined the biogeographic breeding population as that of the European population, comprising 195,105 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 220,000-340,000 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. The biogeographic population with possible connectivity to UK waters (Figure 18) includes the 12,000 breeding pairs in the UK plus associated immatures (of the immature population of about 16,000 birds about half are likely to remain in the wintering area so will not pass through UK waters during migration periods). However, overseas populations with possible connectivity to UK waters sum to over 130,000 pairs plus associated immatures. This gives an estimated biogeographic population with connectivity to UK waters of 480,000 birds (adults and immatures), of which 40,000 are from the UK and 440,000 from overseas populations. So birds in UK waters during migration may include very large numbers from overseas. Unfortunately it is very uncertain how many of those overseas birds move through UK waters. The best available data suggest that there bare about 209,000 common terns (adults and immatures) in UK waters during migration, with 35,000 of these being from the UK population and 174,000 from overseas populations. Not all birds from the UK population are in UK waters during migration because many young immature birds remain in the winter quarters through their first summer.



Figure 18.2. Breeding population origins of common terns in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

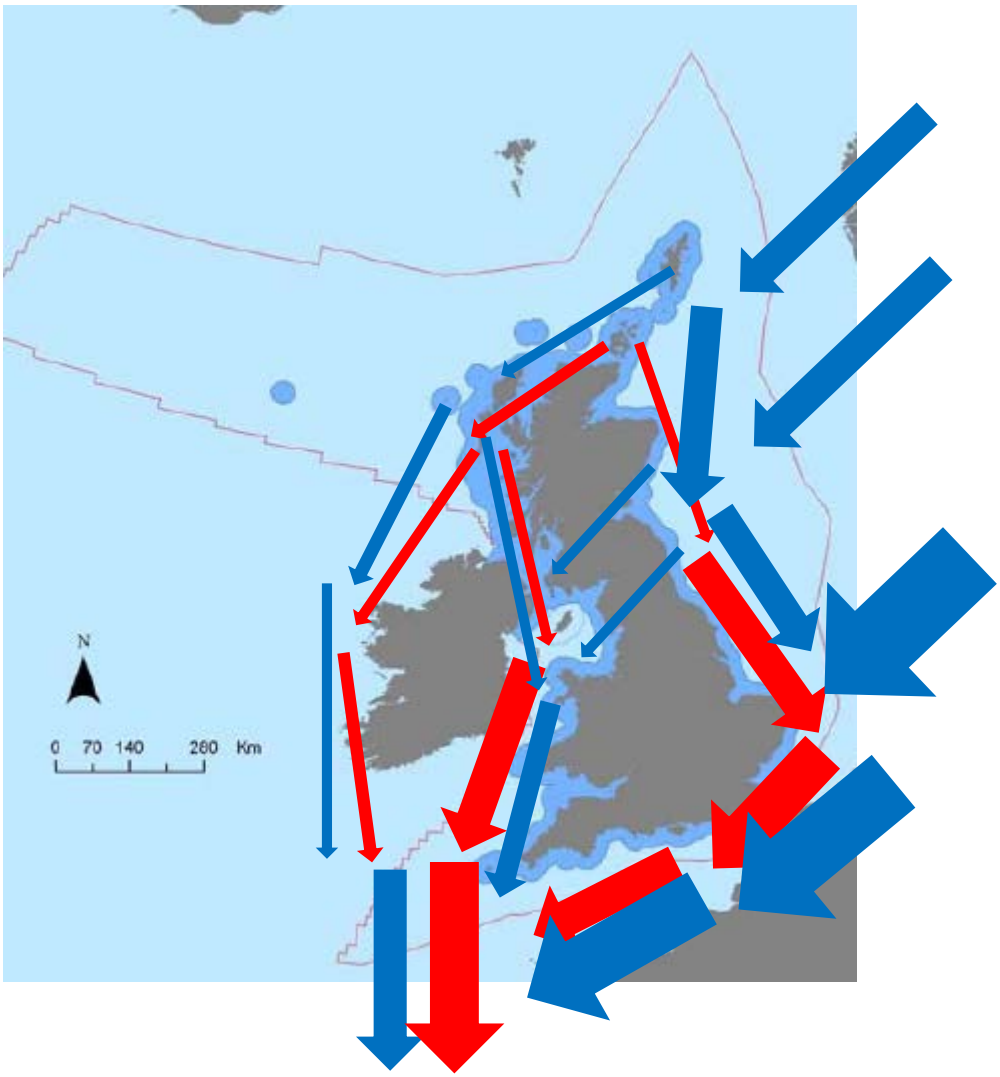


Figure 18.3. Main movements of common terns from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines, but for this species arrows that cross land do imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

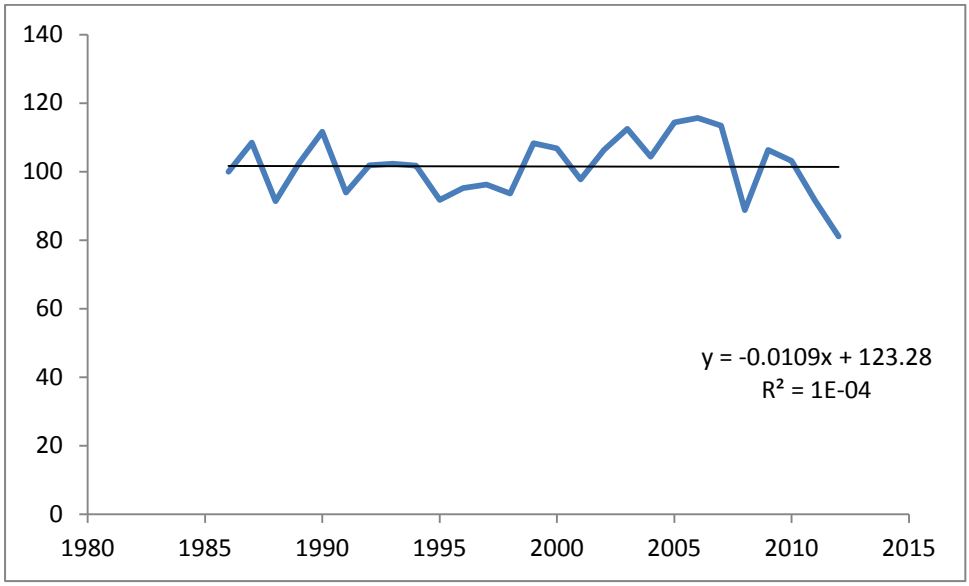


Figure 18.4. Trend in the common tern breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

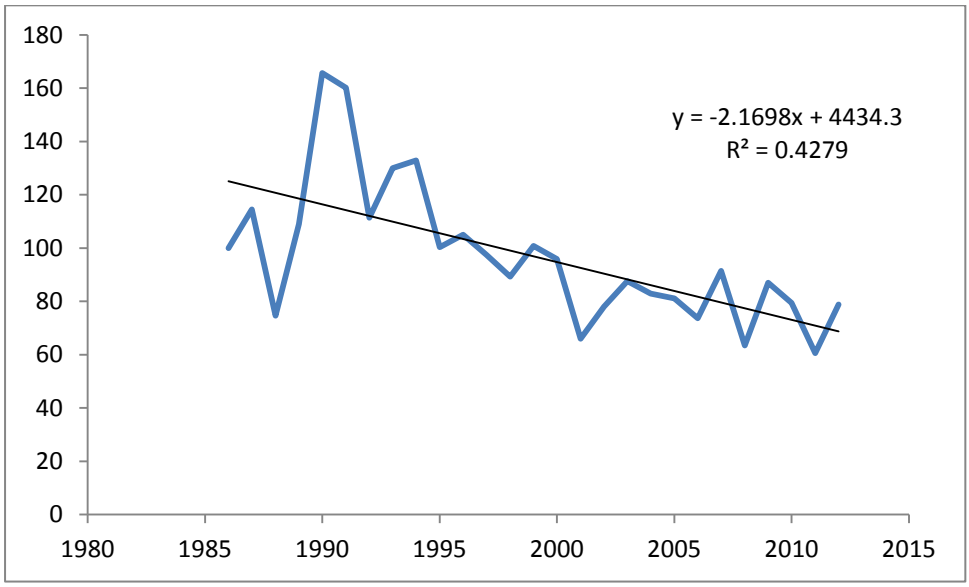


Figure 18.5. Trend in the common tern breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

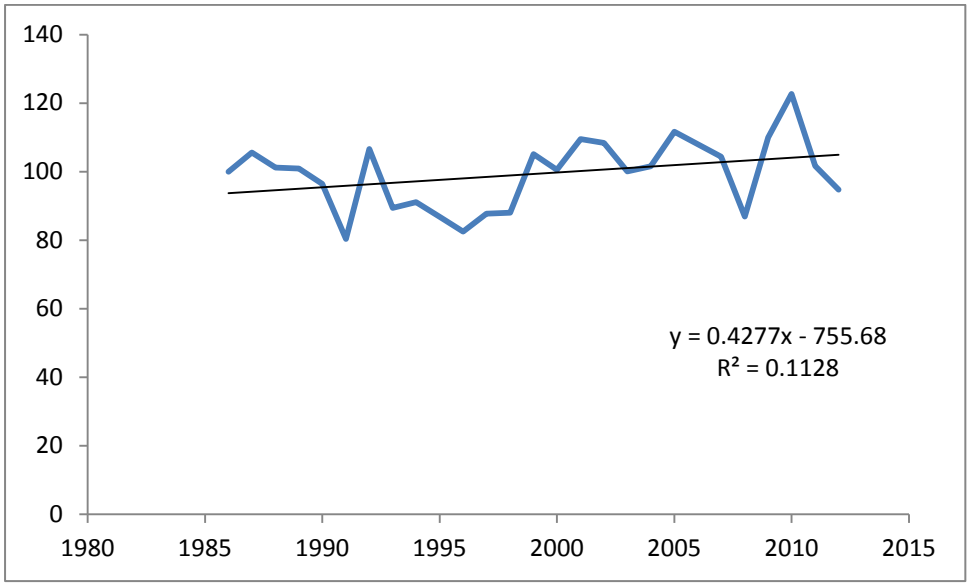


Figure 18.6. Trend in the common tern breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

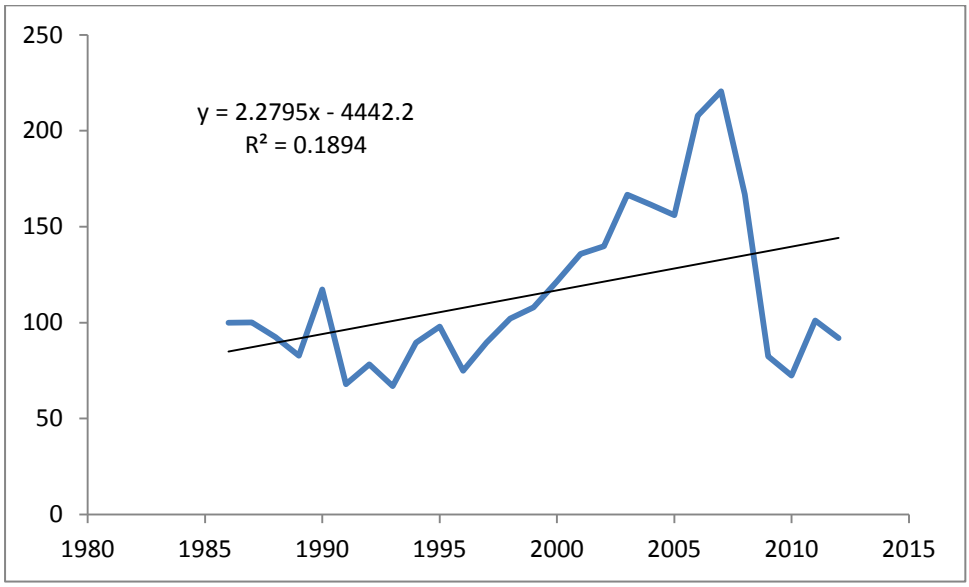


Figure 18.7. Trend in the common tern breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

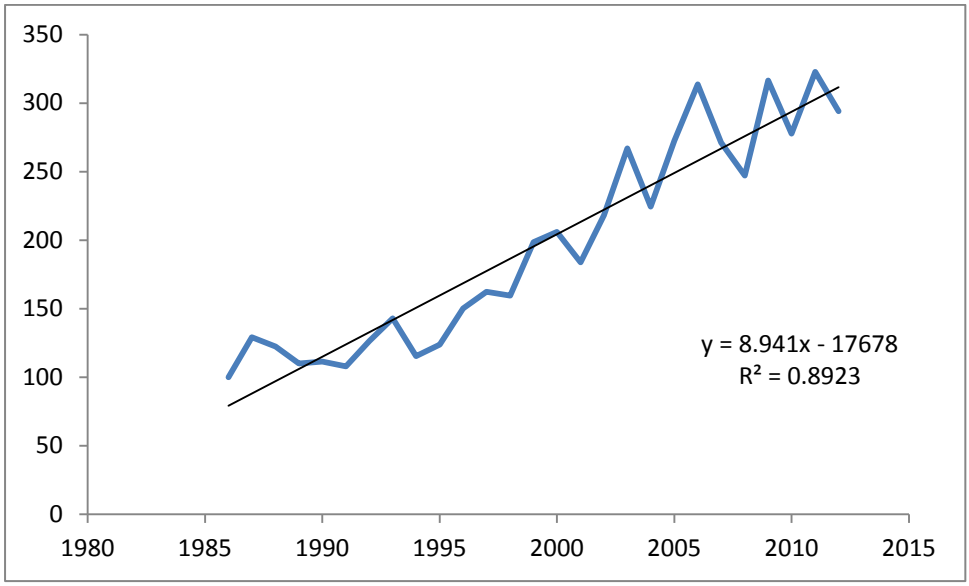


Figure 18.8. Trend in the common tern breeding population index in all-Ireland from 1986-2012. Data from JNCC seabird population monitoring database.

18.9 Proportion of UK population in UK breeding SPAs

The 23 SPAs with breeding common terns as a feature together held 7,551 pairs at designation, estimated to represent ca. 48% of the British breeding population and 42% of the all-Ireland breeding population (Stroud et al. 2001, updated to add Imperial Dock Lock SPA). Stroud et al. (2014) estimated that the GB SPA suite for breeding common terns held 43.8% of the GB population based on counts in 2007-2011.

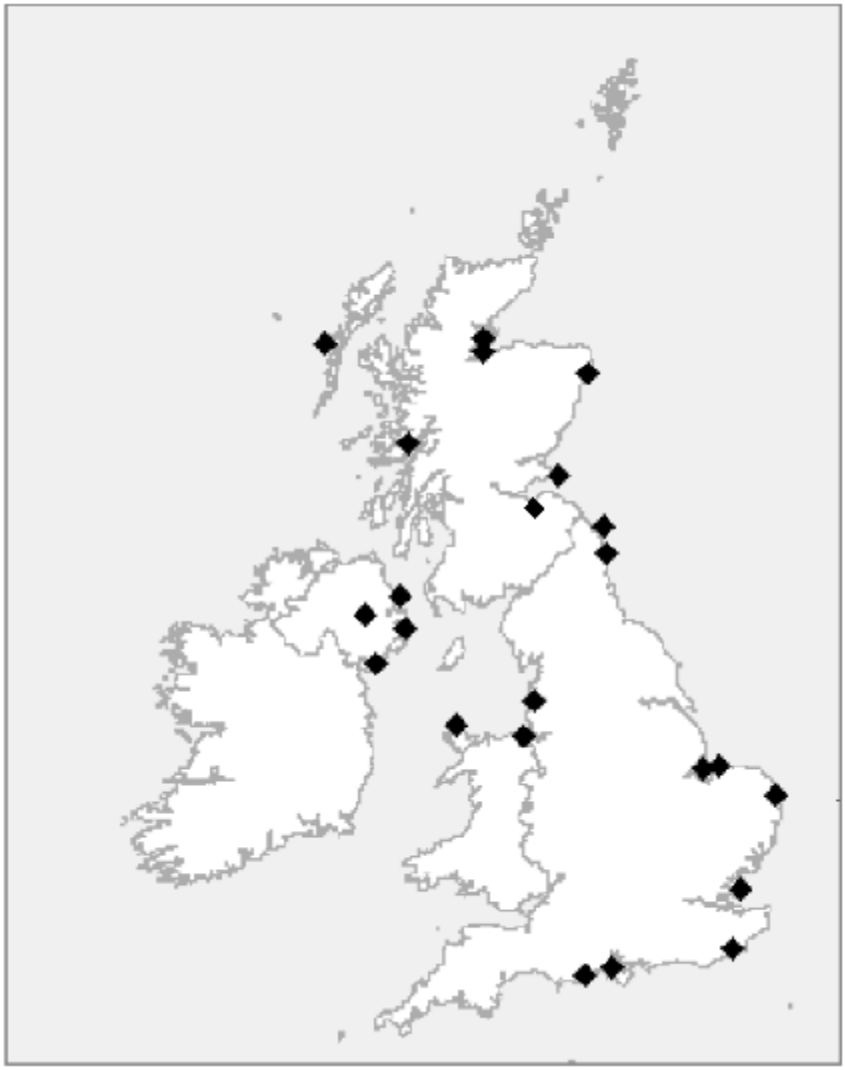


Figure 18.9. UK SPA suite for breeding common terns. These SPA populations are listed in Table 18.1.

Table 18.1. The UK SPA suite for breeding common terns.

SPA	Location	Pairs	Year designated	Site Condition Monitoring*	Recent counts	Year	Reference
UK North Sea & Channel							
Cromarty Firth	N Scotland	294 (1989-1993)	1999	Declined 2000	16 82 68	2008 2009 2010	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
Inner Moray Firth	N Scotland	310	1999	No change 2000	0 0 0 0 0 0	2008 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database SMP database

Ythan Estuary, Sands of Forvie	NE Scotland	265	1998	No change 2012	19 0 6 4	2004 2005 2006 2010	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012
Forth Islands	E Scotland	334 (1997-2001) Or 800 (Stroud et al. 2001)	1990 (and 2004)	Maintained 2003	191 155 197 17 26	2006 2007 2008 2010 2011	SMP database SMP database Lewis et al. 2012 Lewis et al. 2012 Stroud et al. 2014
Imperial Dock Lock	E Scotland	558	2004	Maintained 2009	989 789 732 818	2007 2008 2009 2010	SMP database Jennings 2012 Jennings 2012 Jennings 2012
Farne Islands	NE England	230 (1993-1997)	1985		118 117 104 98 112 101 88 94	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Coquet Island	NE England	740 (1993-1997)	1985		1,226 1,228 1,022 1,228 1,358 1,193 1,158 1,041	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
The Wash	E England	152 (1993)	1988		115 169 208 221	2010 2011 2012 2013	SMP database SMP database SMP database SMP database
North Norfolk Coast	E England	>460 (1996)	1989		434 437 347 270 198	2007 2008 2010 2011 2012	SMP database SMP database SMP database SMP database SMP database
Breydon Water		155 (1992-1996)	1996		197 181 170 173 158 93 92	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Foulness	S England	220 (1996)	1996		121 130 72 82 25	1998 2000 2002 2004 2008	SMP database SMP database SMP database SMP database SMP database

Dungeness to Pett Level	S England	266 (1993-1997)	1999		170 177 149 236 343 235 149 79	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Poole Harbour (Brownsea Island)	S England	155 (1993-1997)	1999		248 157 180 185 191 222 171 163	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Solent & Southampton Water	S England	267 (1993-1997)	1998		375 200 285 256 371 266 280	2002 2003 2004 2005 2006 2007 2007	SMP database SMP database SMP database SMP database SMP database SMP database Stroud et al. 2014
UK Western waters							
Glas Eileanan	W Scotland	530	1998	Maintained 2005	0 515 0 303 97 22	2006 2007 2008 2009 2011 2012	SMP database SMP database SMP database SMP database Lewis et al. 2012 SMP database
Carlingford Lough	N Ireland	339 (1993-1997)	1998		282 200 11 108 69 130 119	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Larne Lough	N Ireland	199 (1993-1997) Or 180 (Stroud et al. 2001)	1997		530 314 387 380 317 319 231	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Lough Neagh and Lough Beg	N Ireland	185 (1995)	1996		>54 >62 >73 >78	2010 2011 2012 2013	SMP database SMP database SMP database SMP database
Strangford Lough	N Ireland	603 (1993-1997)	1998		762 650 1,174 578 726 84 352	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database

The Dee Estuary	Engl-Wales	392 (1995-1999) Or 277 (Stroud et al. 2001)	1985		136 221 196 202 200 165	2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database
Ribble and Alt Estuaries		182 (1996)	1995		100 137 106 98 111 111	1997 1998 1999 2000 2003 2008	SMP database SMP database SMP database SMP database SMP database SMP database
Ynys Feurig, Cemlyn Bay	Wales	>189 (1992-1996)	1992		180 180 167 170 196 178 592	2005 2006 2007 2008 2009 2011 2011	SMP database SMP database SMP database SMP database SMP database SMP database Stroud et al. 2014

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

18.10 BDMPS

UK waters can be divided into two spatial BDMPS (UK North Sea and Channel, and UK western waters) which are appropriate for the migration seasons of this species (late July to early September, and April-May). This division into two BDMPS is based on the tendency for birds from UK colonies to migrate south after breeding and north back to their colony predominantly through the North Sea if birds breed at colonies in UK North Sea waters, or through UK western waters if birds breed at colonies in UK western waters, and for birds from European continental countries to migrate predominantly through UK North Sea waters rather than UK western waters. However, the common tern shows a greater tendency to migrate overland than seen in most other seabird species, so that use of a single BDMPS for all UK waters would also be a reasonable approach for this species.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 56 and 57.

Based on evidence reviewed in sections 18.5, 18.6 and 18.7, the UK North Sea and Channel migration seasons BDMPS is estimated to hold 70% of adults and 50% of immatures from UK North Sea colonies, 10% of adults and immatures from UK western waters colonies, 30% of birds from Norway, Finland, Sweden, Baltic States, 25% of birds from Germany and The Netherlands, 20% of birds from Ireland (Appendix A Table 56). These proportions give an estimated BDMPS of 144,911 birds, 18,942 from UK and 125,969 from overseas.

Based on evidence reviewed in sections 18.5, 18.6 and 18.7, the UK western waters migration seasons BDMPS is estimated to hold 30% of adults and 20% of immatures from UK North Sea colonies, 90% of adults and 60% of immatures from UK western waters colonies, 20% of birds from Norway, 10% of birds from Finland, Sweden, Baltic States and Germany, 5% of birds from The Netherlands, and 40% of birds from Ireland (Appendix A Table 57). These proportions give an estimated BDMPS of 64,659 birds, 16,212 from UK and 48,447 from overseas.

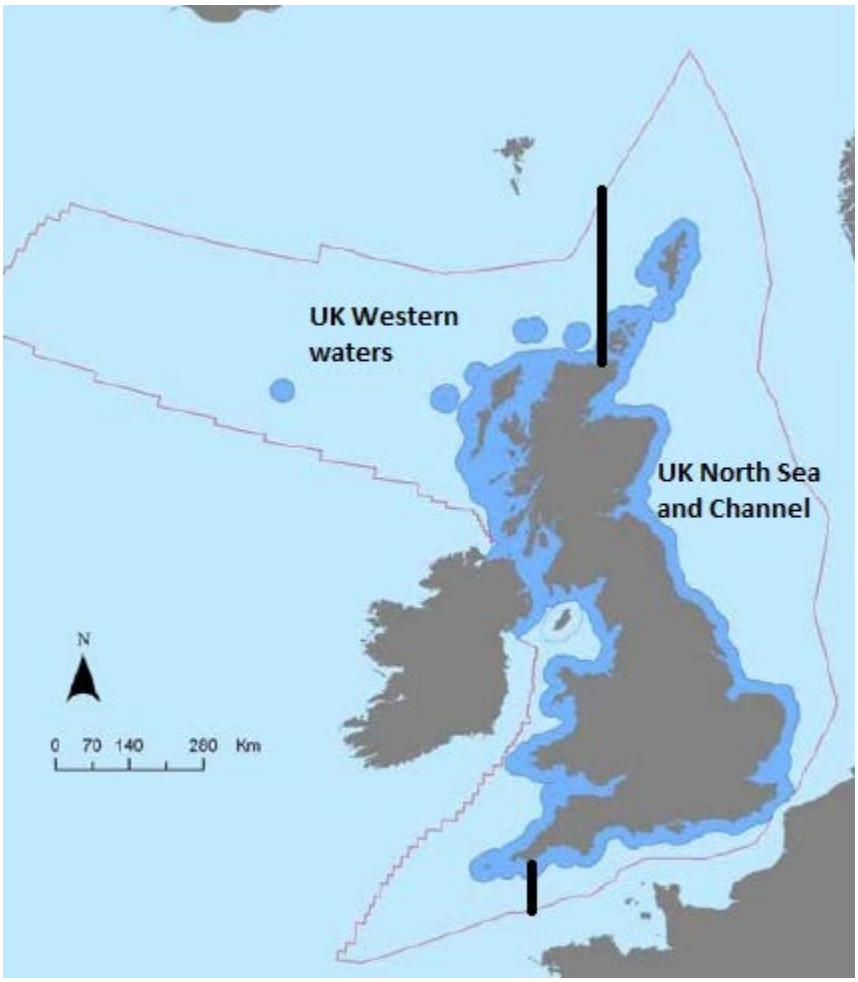


Figure 18.10. Two defined BDMPS spatial areas for common tern: 'UK North sea waters and Channel' and 'UK Western waters'.

18.11 Proportions of UK SPA birds in BDMPS

UK SPAs for common tern are widely distributed across the breeding range of the species in the UK. SPA birds represent about 44% of the UK population, so the main factor determining the proportion of each BDMPS derived from UK SPAs will be the ratio of overseas to UK birds in each BDMPS during the migration season. These percentages depend very much on the estimate of proportions of overseas populations migrating through UK waters so are very tentative estimates, as numbers of birds from overseas populations migrating through UK waters are very uncertain, although clearly are large. Proportions of birds that are adults from UK SPA colonies can be estimated directly from the data in Appendix A Tables 56 and 57. For example, in the UK western waters BDMPS (64,659 birds) there are estimated to be 4,126 adults from SPA colonies, so these represent 6% of the total birds present.

18.12 Spatial distribution of UK breeding SPA birds across the BDMPS

With large numbers of birds migrating through UK waters, and apparently many more overseas birds than UK birds in these migrations, the SPA birds are likely to be well mixed across each of the BDMPS areas.

19. ARCTIC TERN *Sterna paradisaea*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (July to early September, and late April to May) (adults and immatures)
Overseas	470,000	99,780
UK	158,000	135,548
Total	628,000	235,328

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (July to early September, and late April to May)			
UK North Sea and Channel	163,930	82,084	81,846
UK Western waters	71,398	17,696	53,702

Arctic tern numbers in most UK SPA colonies are monitored frequently. However, numbers in UK colonies that are not SPA populations are less well monitored, and do represent a substantial proportion of the UK total. Arctic tern breeding numbers in SPA populations in the UK have declined very considerably, especially in Shetland and most of Orkney. How much numbers in UK non-SPA colonies have declined is far less clear, but numbers may be smaller than in the summary table above if non-SPA colonies have also declined as much as SPA colonies. Arctic tern migrations have not been studied by geolocator deployment except in Iceland (a population that does not pass through UK waters), and ringing recoveries from the migration period in UK waters are very limited. So understanding of details of Arctic tern movements is relatively poor, especially to the extent that birds from overseas populations are concerned. While ring recoveries show that many birds from overseas pass through UK waters, the proportions of those populations doing so are very uncertain since ring recovery data are subject to considerable potential bias. Furthermore, these overseas populations are large, and probably represent a moderate to high proportion of the total of Arctic terns in UK waters during the migration season. Therefore, estimated numbers of birds in the BDMPS are classed as red for the total population and numbers from overseas, and for numbers from the UK population given the uncertainty about breeding numbers in non-SPA colonies at present.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 58 and 59.

19.1 Breeding range and taxa

Arctic tern is monotypic, with a Holarctic breeding distribution, predominantly in Arctic and sub-Arctic regions. There appears to have been no assessment of whether biometrics would allow origins of individuals to be identified, but this seems unlikely as there seems to be no evidence of clinal variation, and birds are known to sometimes recruit to breed in locations far from their natal area.

19.2 Non-breeding component of the population

Arctic terns start to breed when 4 years old (BTO Birdfacts). Adult survival rate is 0.9 (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is 0.402 chicks per pair (JNCC database, n=227 measurements). To obtain a stable population, survival of immatures was adjusted to 0.72 for juveniles, 0.85 for 1-year olds, and 0.9 for 2-year olds and 3-year olds. The model population comprised 63% adults, 13% juveniles and 24% older immatures. There are 0.58 immatures per adult.

19.3 Phenology

Breeding colonies in the UK are deserted by mid-August, with modal departure in late July or early August (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in early July (Pennington et al. 2004; Forrester et al. 2007) or late July (Cramp et al. 1977-94). Peak autumn migration occurs in late July in Shetland (Pennington et al. 2004) and Scotland (Forrester et al. 2007), but continues from August to October when considering the entire migration to Antarctic waters (Cramp et al. 1977-94). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late July and early August (Figure 19.1). Autumn migration is completed in Shetland by late August (Pennington et al. 2004) and in Scotland and England by September (Brown and Grice 2005; Forrester et al. 2007), but in the southern hemisphere may continue until mid-November (Cramp et al. 1977-94).

Spring migration starts in the southern hemisphere in early March (Cramp et al. 1977-94), and the first migrants appear in UK waters in March (Wernham et al. 2002), but in Scottish waters and Shetland not until late April (Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in mid-May in UK waters (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in early May (Figure 19.1). Spring migration is completed by late May (Pennington et al. 2004), early June (Cramp et al. 1977-94), or June (Forrester et al. 2007).

The first spring records of Arctic tern in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 6 April to 9 May but mostly in late April, and the last records were from 9 September to 21 November, but mostly in late October. Peak autumn migration was reported in July or July-August in most years, and peak spring migration was reported in May in almost all years. Birds re-occupy colonies from late April, with modal return in mid-May (Pennington et al. 2004; Forrester et al. 2007).

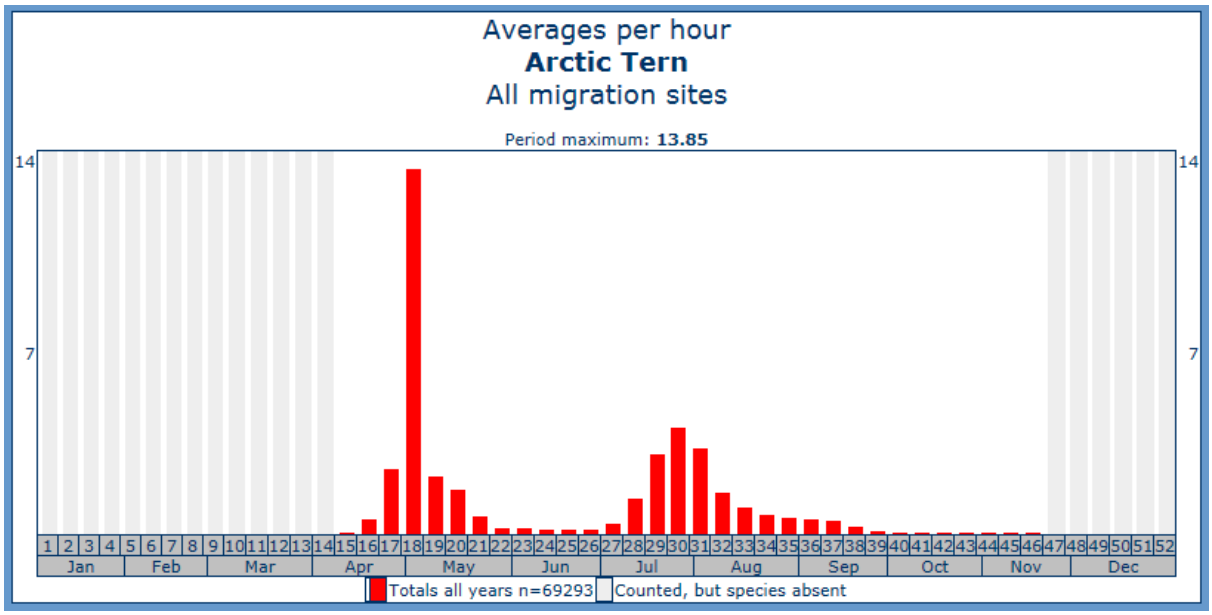


Figure 19.1. Average numbers of Arctic terns counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season birds predominantly absent from UK waters. However, from the data reviewed above, this may be refined to breeding season May-early August, non-breeding season mid-August-April.

19.4 Defined seasons:

- UK Breeding season — May-early August
- Post-breeding migration in UK waters — July-early September (**migration BDMPS**)
- non-breeding season — mid August-April
- Return migration through UK waters late — April-May (**migration BDMPS**)
- Migration-free breeding season — June
- Migration-free winter season — October-March

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for Arctic tern:

Migration periods BDMPS (July-early September, and late April-May).

19.5 Movements of birds from the UK population

Although Post-breeding dispersal occurs from colonies in July (with some UK fledglings moving as far as the Baltic Sea), followed by southwards migration in August-September Wernham et al. 2002; Pennington et al. 2004; Forrester et al. 2007). Several Scandinavian and Baltic fledglings have also been recovered in the UK as early as August, indicating rapid dispersal of some young birds into UK waters. As with other terns, post-fledging dispersal takes birds to areas with high density of prey fish where juveniles have a good chance of learning fishing skills, surviving and putting on weight before the southwards migration. In contrast to many other terns, Arctic terns seem less likely to remain in family groups and chicks seem to become independent rather quickly. Arctic terns are thought to migrate somewhat further offshore than other British tern species, past west Africa to southern Africa then onwards to the edge of Antarctic pack ice (Wernham et al. 2002). Movements of first summer and second summer birds are not well documented, but it appears that most first

and second summer birds remain in the southern hemisphere all year, with very few of these birds in immature plumage returning to UK waters in summer (Wernham et al. 2002). Some three year olds breed, while others visit breeding areas to loaf at 'club' sites on the periphery of the colony. Most four year olds breed, but it is likely that many recruit into colonies away from where they were reared, while there is also some evidence for adults moving colony between years (Wernham et al. 2002).

19.6 Movements of birds from overseas into UK waters

Foreign-ringed birds recovered in UK waters, or on shore, mainly originate from Scandinavia and the Baltic (Wernham et al. 2002). Post-breeding dispersal/migration can be very rapid and can bring birds from overseas populations into close contact with local breeding populations in late summer. For example, a bird ringed as a chick in the Baltic States in early July was killed by a great skua hunting for terns roosting adjacent to the Arctic tern colony at Foula in mid-July, just a few days after it had fledged; without the ring this bird would have been assumed to be a local fledgling from the Foula colony. Although there is one recovery in the UK of a chick ringed in Greenland, no birds ringed in Iceland have been found in the UK according to Wernham et al. (2002). However, three out of over 12,000 ringed in Faroe (88% as chicks) were recovered during autumn migration in the British Isles (Hammer et al. 2013). Seabird 2000 reported 53,380 pairs in UK, 2,730 in Ireland, 131,000 pairs in Fennoscandia, 8,000 pairs in the Baltic States, 375,000 pairs in Iceland (Mitchell et al. 2004), and Hammer et al. (2013) report 7,600 pairs in Faroe. Given the evidence for extensive post-breeding dispersal of birds from Fennoscandia and the Baltic into UK waters, and the large populations in those areas, it seems likely that a substantial proportion of Arctic terns in UK waters in August-September will be from those regions. Recent breeding failures of Arctic terns in Iceland, and circumstantial observational evidence at colonies, suggest that numbers there may well have declined considerably (Vigfusdottir et al. 2013). Given the very large size of the Icelandic population, those birds might be expected to form a substantial part of the total in UK waters in August-September. However, deployment of geolocators on ten Arctic terns in Greenland and one in Iceland showed that all eleven birds moved directly south from Iceland to the Newfoundland Basin, where they spent some time before migrating to the South Atlantic (Egevang et al. 2010). All birds showed essentially the same route, with none coming near to UK waters. Return migration in spring was even further to the west, passing close to Newfoundland before completing the journey to Iceland and Greenland. This study suggests that very few Arctic terns from Iceland and Greenland ever visit UK waters, consistent with the lack of recoveries of Arctic terns ringing in Iceland in the British Isles. Spring migration through UK waters (some of which can occur overland; Wernham et al. 2002) may also involve large numbers from colonies in Fennoscandia and the Baltic, but the spring migration produces few ring recoveries so this is uncertain.

19.7 Numbers in UK waters

Terns are very difficult to census during migrations. However, Forrester et al. (2007) suggest that there are 10,000 to 200,000 on passage through Scottish waters in autumn and spring. No equivalent estimates for other parts of UK waters appear to be published. Clearly all UK breeders, and probably about half of the immatures associated with these pass through UK waters during the migration seasons, but so do large numbers of birds from overseas. Numbers from those populations passing through are very uncertain.

19.8 Biogeographic population and relevant smaller units (BDMPS)

Stroud et al. (2001) defined the biogeographic breeding population as that of the European and North Atlantic population, comprising 900,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 493,000-1,800,000 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. Populations with possible connectivity to UK waters are the UK population (50,000 pairs), and the populations of Fennoscandia (131,000 pairs), Faroe (7,600 pairs), Baltic states (8,000 pairs)

and Ireland (2,500 pairs) (Figure 19.2). So overseas populations are large relative to the UK population, but the proportion of these overseas birds that pass through UK waters is very uncertain. The biogeographic population with connectivity to UK waters is estimated at 628,000 birds (adults and immatures) with 158,000 from UK and 470,000 from overseas populations. Allowing for the likely proportions of each population that pass through UK waters on migration, the total numbers in UK waters during the migration seasons is estimated at 236,000 birds (adults and immatures) with 136,000 of these from the UK population and 100,000 from overseas.

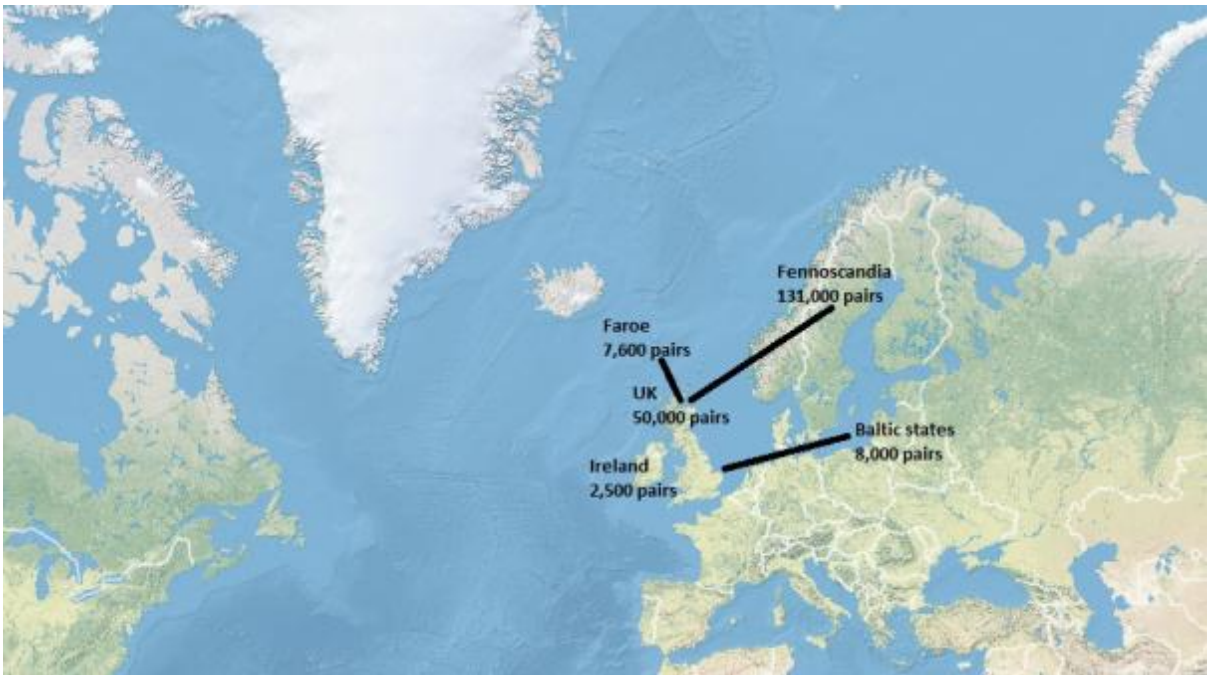


Figure 19.2. Breeding population origins of Arctic terns in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

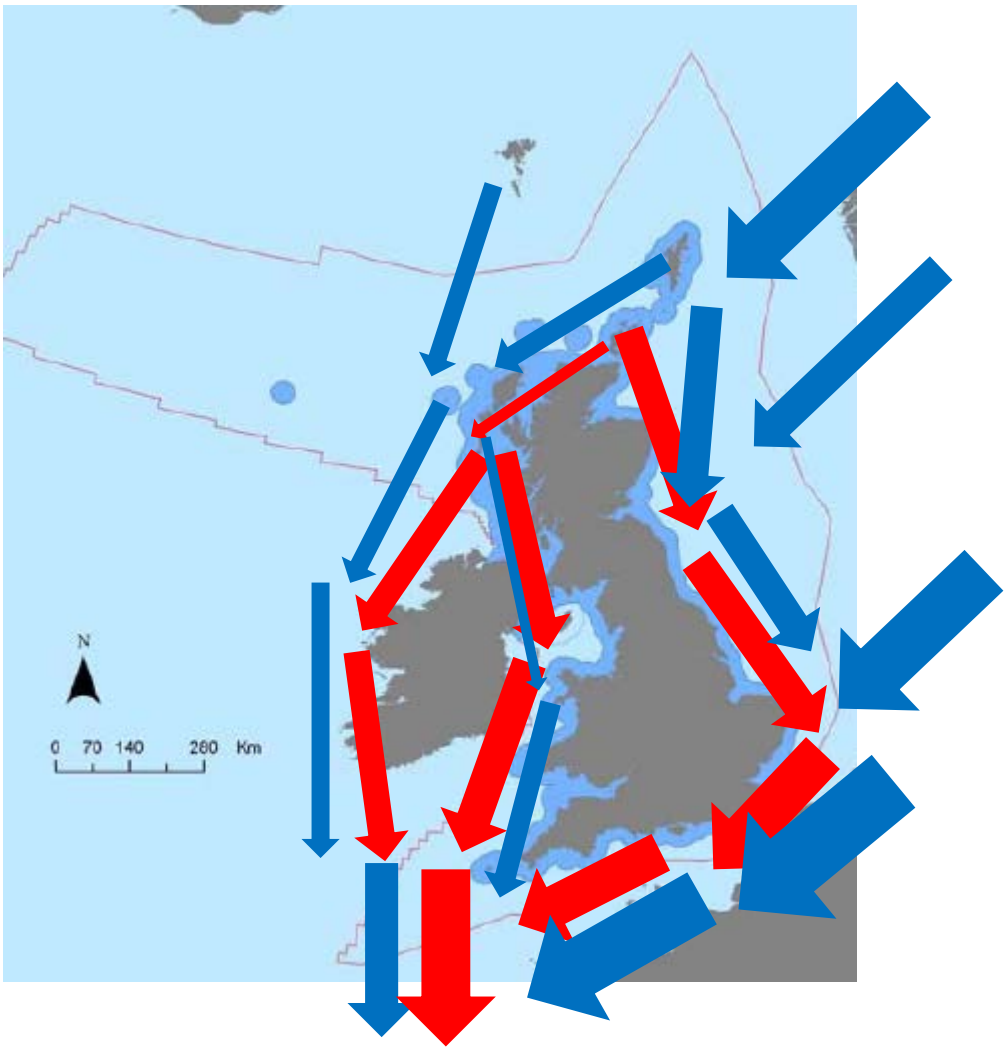


Figure 19.3. Main movements of Arctic terns from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply specific overland migration routes, although this species may sometimes migrate over land. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

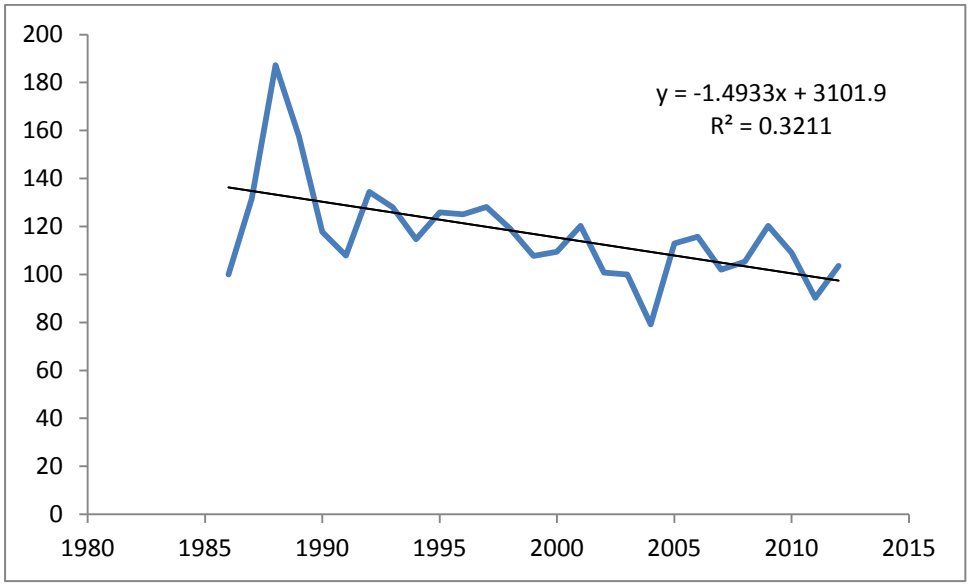


Figure 19.4. Trend in the Arctic tern breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

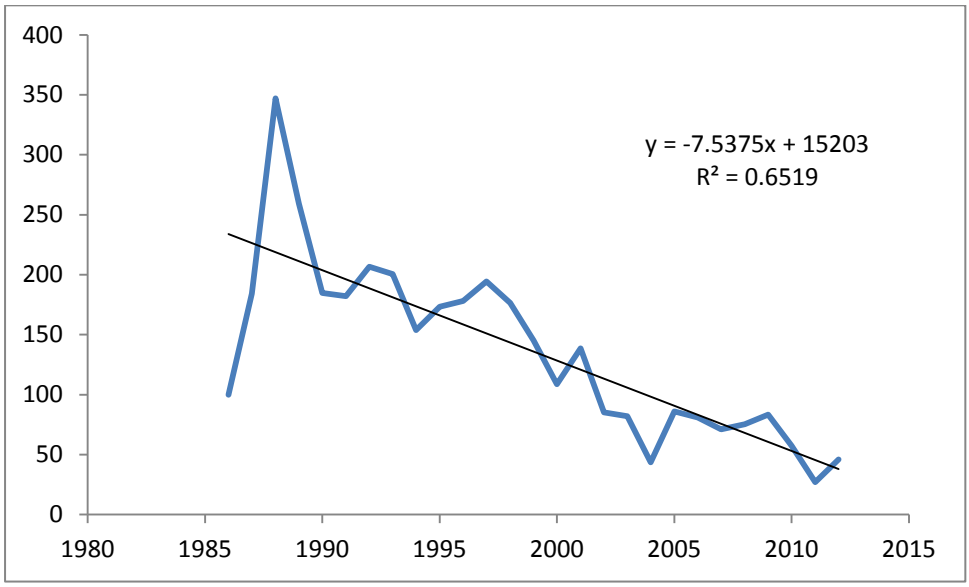


Figure 19.5. Trend in the Arctic tern breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

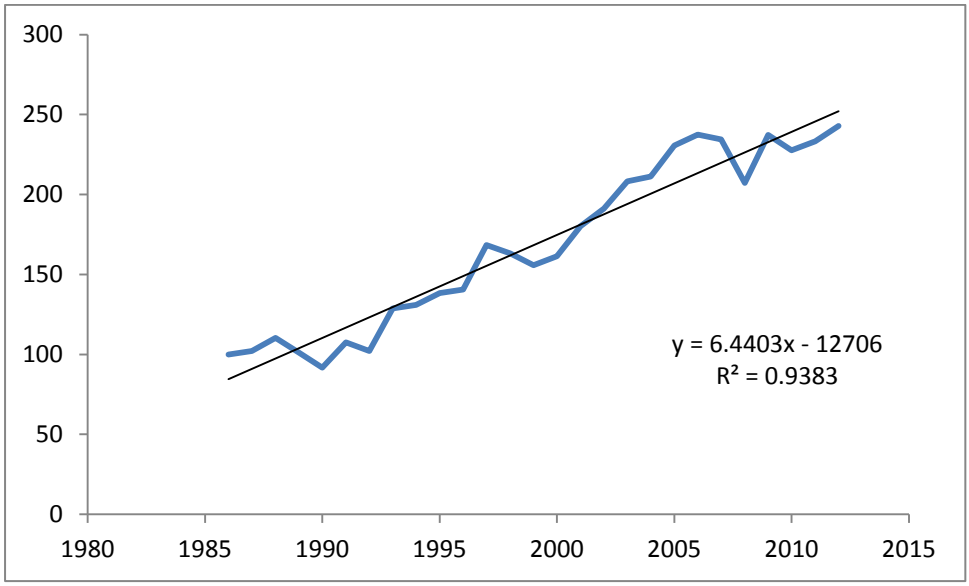


Figure 19.6. Trend in the Arctic tern breeding population index in England from 1986-2012. Data from JNCC seabird population monitoring database.

19.9 Proportion of UK population from UK breeding SPAs

The 17 SPAs with breeding Arctic terns as a feature together held 17,124 pairs at designation, estimated to represent ca. 38% of the British breeding population and 17% of the all-Ireland breeding population (Stroud et al. 2001). Stroud et al. (2014) suggest on the basis of census data at these sites in 2000-2011 that 20.6% of the GB breeding population is on UK SPAs for breeding Arctic terns. This decrease is consistent with a density-dependent effect of food shortage, reducing breeding numbers proportionately more at larger colonies, which is very likely to occur and has been shown in several other seabird species although not specifically for Arctic tern.



Figure 19.7. The UK SPA suite for breeding Arctic terns. These SPA populations are listed in Table 19.1.

Table 19.1. The UK SPA suite for breeding Arctic terns.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Fetlar	Shetland	520 (1994-1997)	1994	Recovering 2002	486 213 16 14 2 0 21	2006 2007 2008 2009 2010 2011 2012	SMP database SMP database Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database
Foula	Shetland	1,100 (1992-1997)	1995	Maintained 2000	0 70 35 100 20	2006 2007 2011 2012 2013	Lewis et al. 2012 SMP database SMP database Gear 2012 Gear 2013
Papa Stour	Shetland	1,000	2000	Declined 2008	1,172	2000	Stroud et al. 2014

Mousa	Shetland	767 (1994)	1995	No change 2000	143 751 400 925 42 0 41 18	2001-06 2007 2008 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database SMP database SMP database
Sumburgh Head	Shetland	700 (1994)	1996	Declined 2001	ca40 ca150 203	1999 2000 2000	SCM database SCM database Stroud et al. 2014
Fair Isle	Shetland	1,120 (1993-1997)	1994	Declined 2009	818 208 0 283 400 9 227 29	2006 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database FIBO Report SMP database
West Westray	Orkney	1,200	1996	Declined 2007	1,067 ca500	2000 2009	Stroud et al. 2014 SCM database
Papa Westray	Orkney	1,950	1996	Declined 2006	813 556 393 176	2005 2006 2010 2011	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Stroud et al. 2014
Rousay	Orkney	1,000	2000	Declined 2007	707 ca60	2000 2006	Stroud et al. 2014 SCM database
Auskerry	Orkney	780 (1995)	1998	Maintained 2007	0 550 667 0 750	2005 2006 2007 2011 2013	SMP database SMP database SMP database Lewis et al. 2012 SMP database
Pentland Firth Islands	N Scotland	1,200 (1992-1995)	1997	Declined 2007	327 1,400 0 669	2004 2005 2007 2009	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Stroud et al. 2014
Forth Islands	E Scotland	540 (1992-1996)	1990	Declined 2009	515 525 511 316 34 250 265	2006 2007 2008 2009 2010 2011 2012	SMP database SMP database SMP database Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SMP database
Farne Islands	NE England	2,840 (1993-1997)	1985		2,256 2,239 2,198 2,199 1,830 1,866 1,921	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database

Coquet Island	NE England	700 (1993-1997)	1985		1,247 983 1,259 1,046 1,140 1,275 1,224	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database
UK Western waters							
Outer Ards	N Ireland	207 (not stated)	2002		182 215 191 174 108 60	2008 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database
Strangford Lough	N Ireland	210 (1993-1997)	1998		891 559 316 645 373 229 55 164	2006 2007 2008 2009 2010 2011 2012 2013	SCM database SCM database SCM database SCM database SCM database SCM database SCM database SCM database
Ynys Feurig, Cemlyn Bay	Wales	1,290 (1992-1996)	1992		540 493 416 531 550 3,620	2006 2007 2008 2009 2011 2011	SMP database SMP database SMP database SMP database SMP database Stroud et al. 2014

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

19.10 BDMPS

The UK waters can be divided into two spatial BDMPS; UK North Sea and Channel waters, and UK western waters (Figure 19.8), which are appropriate for the migration seasons of this species (July to early September, and late-April to May). This division into two BDMPS is based on the tendency for birds from UK colonies to migrate south after breeding and north back to their colony predominantly through the North Sea if birds breed at colonies in UK North Sea waters, or through UK western waters if birds breed at colonies in UK western waters, and for birds from European continental countries to migrate predominantly through UK North Sea waters rather than UK western waters.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 58 and 59.

Based on evidence reviewed in sections 19.5, 19.6 and 19.7, the UK North Sea and Channel migration seasons BDMPS is estimated to hold 90% of adult and 60% of immature Arctic terns from Orkney and Shetland colonies, 100% of adults and 70% of immatures from colonies along the mainland east coast of Scotland and England, none from colonies in UK western waters, 20% of adults and 15% of immatures from Fennoscandia and Faroe, 10% of birds from the Baltic States, but none from Ireland (Appendix A Table 58). These proportions lead to an estimated BDMPS of 163,930 birds, 81,846 from the UK and 82,084 from overseas populations.

Based on evidence reviewed in sections 19.5, 19.6 and 19.7, the UK western waters migration seasons BDMPS is estimated to hold 10% of adult and 10% of immature Arctic terns from Orkney and Shetland colonies, no adults but 10% of immatures from colonies along the mainland east coast of Scotland and England, 100% of adults and 70% of immatures from colonies in UK western waters, 3% of adults and immatures from Fennoscandia, 10% of adults and immatures from Faroe, 2% of birds from the Baltic States, and 30% of birds from Ireland (Appendix A Table 59). These proportions lead to an estimated BDMPS of 71,398 birds, 53,702 from the UK and 17,696 from overseas populations.

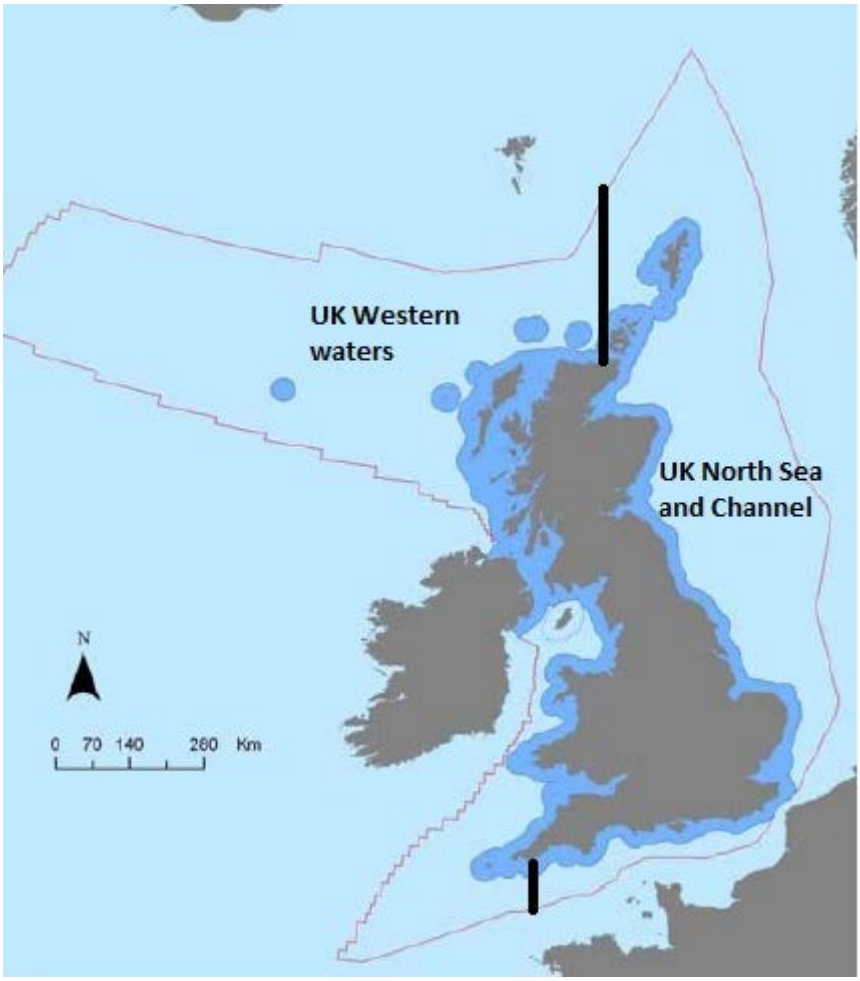


Figure 19.8. Two defined BDMPS spatial areas for Arctic tern: 'UK North Sea waters and Channel'and 'UK Western waters'.

19.11 Proportions of UK SPA birds in BDMPS

UK SPAs for Arctic tern are strongly concentrated in Shetland and Orkney, but with little representation in the west of Scotland. Numbers breeding in Shetland and Orkney have declined very considerably since the 1980s, at least in part as a result of declines in sandeels in the NW North Sea. SPA birds probably represent about 20% of the UK population now (section 19.9), so the main factor determining the proportion of each BDMPS derived from UK SPAs will be the ratio of overseas to UK birds in each of the two BDMPS during the migration season. These percentages depend very much on the estimate of proportions of overseas populations migrating through UK waters so are very tentative estimates, as numbers of birds from overseas populations migrating through UK waters are very uncertain. Proportions of birds that are adults from UK SPA colonies can be estimated directly from the data in Appendix A Tables 58 and 59. For example, in the UK western

waters BDMPS (71,398 birds) there are estimated to be 2,138 adults from SPA colonies, so these represent 3% of the total birds present.

19.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Since birds can disperse quickly from colonies, but may stop to feed at locations where there are suitable food stocks, UK SPA birds are likely to be well mixed among non-SPA populations and overseas populations also passing through and responding to the same opportunities.

20. LITTLE TERN *Sternula albifrons*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (late July to early September, and mid-April to May) (adults and immatures)
Overseas	620	514
UK	5,620	4,612
Total	6,240	5,126

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (late July to early September, and mid-April to May)			
UK North Sea and Channel	3,524	0	3,524
UK Western waters	1,602	514	1,088

Little tern breeding numbers are well monitored at most SPA colonies, and the SPA colonies hold a fairly high proportion of the total UK population of this species. The only overseas population of little terns to migrate through UK waters is the Irish population, and it seems almost certain that almost all adult little terns from the well-studied population in Ireland pass through UK waters in SW Approaches during migration. Therefore, all categories are coded green.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 60 and 61.

20.1 Breeding range and taxa

Little tern has a wide breeding range that includes the Palearctic, Afrotropic and Australasian regions. There are six subspecies, but only the nominate *S. a. albifrons* occurs in British waters. That subspecies breeds across most of Europe (but not in northern areas and with largest numbers mainly in southern countries) to central Asia and northern India, and in North Africa. There appears to have been no assessment of whether biometrics would allow origins of individuals to be identified.

20.2 Non-breeding component of the population

Little terns start to breed when 3 years old (BTO Birdfacts). Adult survival rate is 0.899 (BTO Birdfacts), juvenile survival 0.578 (BTO Birdfacts) and mean productivity is 0.521 chicks per pair (JNCC database, n=362 measurements). To obtain a stable population, survival of immatures was adjusted to 0.65 for juveniles, 0.75 for 1-year olds, and 0.8 for 2-year olds. The model population comprised 64% adults, 17% juveniles and 19% older immatures. There are 0.56 immatures per adult.

20.3 Phenology

Breeding colonies in the UK are deserted by August, with modal departure in late July (Forrester et al. 2007). Autumn migration starts in mid-July (Cramp et al. 1977-94) or late July (Forrester et al. 2007). Peak autumn migration occurs in August (Wernham et al. 2002), August-September (Forrester et al. 2007), or August-October considering the entire range in Europe (Cramp et al. 1977-94). Peak numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late July with quite rapid decrease in numbers through August (Figure 20.1). Autumn migration is completed by September (Wernham et al. 2002), early October in Scotland (Forrester et al. 2007), mid-October in England (Brown and Grice 2005).

Spring migration starts in March in southern Europe (Cramp et al. 1977-94), but first migrants arrive in UK waters in April (Wernham et al. 2002) and in mid-April in Scottish waters (Forrester et al. 2007). Peak spring migration occurs in mid-April to mid-May in English waters (Brown and Grice 2005), late April in Scotland (Forrester et al. 2007) or April-May (Cramp et al. 1977-94; Wernham et al. 2002). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in very late April and early May (Figure 20.1). Spring migration is completed by May (Forrester et al. 2007) or late May (Cramp et al. 1977-94).

The first spring records of little tern in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from 9 April to 12 May, but mostly in mid- to late-April, and the last records were from 21 July to 29 September, but mostly in early August. Peak autumn migration was reported in July in most years, and peak spring migration was reported in late April or in May in most years. Birds re-occupy colonies from mid-April, with modal return in late April (Forrester et al. 2007).

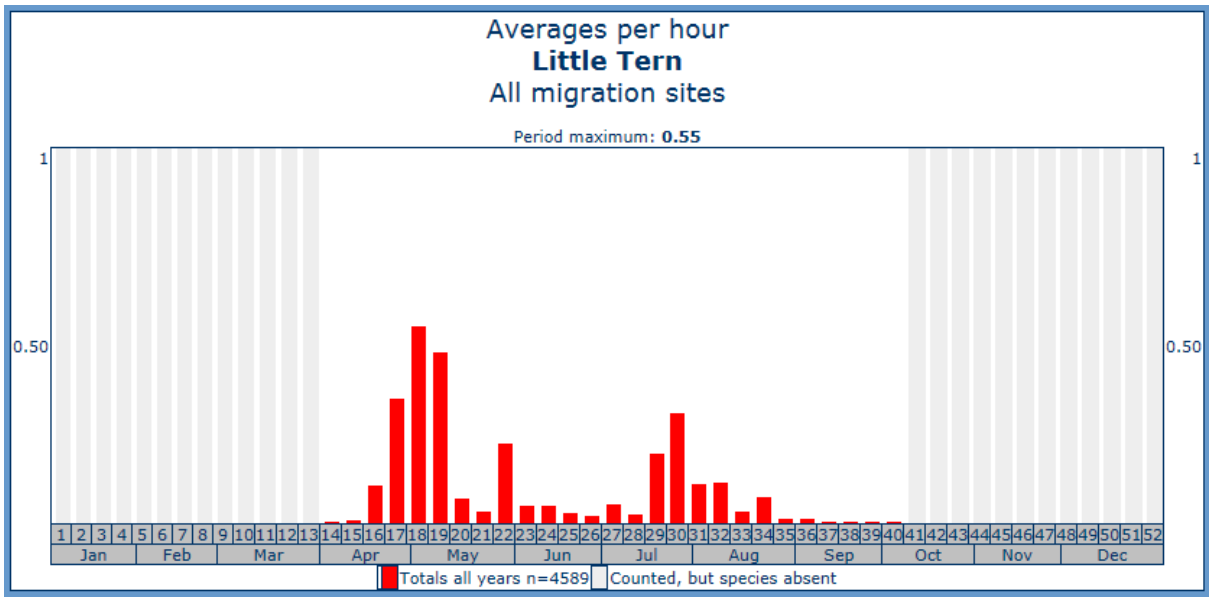


Figure 20.1. Average numbers of little terns counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-August, non-breeding season birds predominantly absent from UK waters. However, from the data reviewed above, this may be refined to breeding season May-early August, non-breeding season mid August-April.

20.4 Defined seasons:

- UK Breeding season — May-early August
- Post-breeding migration in UK waters — late July-early September (**migration BDMPS**)
- non-breeding season — mid August-April
- Return migration through UK waters — mid April-May (**migration BDMPS**)
- Migration-free breeding season — June
- Migration-free winter season — October-March

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for little tern:

Migration periods BDMPS (late July-early September, and mid April-May).

20.5 Movements of birds from the UK population

Birds depart rather rapidly after the breeding season, with ring recoveries from southern Europe as early as August, one within 6 days of ringing at a colony in England (Wernham et al. 2002). Large flocks of little terns in The Netherlands in August suggest that is a staging area used by birds from a wide geographical area during autumn migration (Wernham et al. 2002). Several ring recoveries of birds from Scottish colonies have been in Denmark, whereas most English birds have been recovered in The Netherlands, suggesting that Scottish birds cross the North Sea eastwards from Scotland rather than flying southwards (Wernham et al. 2002). Little terns do not breed until they are at least two years old, and it has been assumed that they spend their first year in African winter quarters, but there is no ringing evidence to support this (Wernham et al. 2002).

20.6 Movements of birds from overseas into UK waters

Wernham et al. (2002) point out that we know little about whether there is passage through UK waters of birds breeding elsewhere. Presumably at least the Irish population (210 pairs in Seabird 2000; Mitchell et al. 2004) must pass through UK waters on migration between Ireland and Africa, but while there are quite large numbers in Fennoscandia (1,019 pairs), the Baltic States (550 pairs), Germany (870 pairs), The Netherlands (500 pairs) and Belgium (224 pairs) (Mitchell et al. 2004) there is no evidence that any of these birds cross the North Sea into UK waters, while ring recovery data suggest that they do not, but that tose populations migrate through continental Europe.

20.7 Numbers in UK waters

Direct observation gives no indication of numbers passing through UK waters, as little terns seem rarely to be observed except in the immediate vicinity of colonies (see for example how few are recorded in the Trektellen data set for UK waters, Figure 20.1). Forrester et al. (2007) refrain from suggesting how many pass through Scottish waters, but comment 'little tern is rare outside its breeding range'. Nevertheless, it is clear that UK and Irish little terns must migrate through UK waters, while it seems that no birds from other populations do so. Therefore, numbers can be estimated from population sizes, which are fairly accurately known.

20.8 Biogeographic population and relevant smaller units (BDMPS)

Stroud et al. (2001) defined the biogeographic breeding population as that of the European population, comprising 20,643 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 17,000-22,000 pairs. Kober et al. (2010) did not present an estimated biogeographic population for this species. In terms of populations with connectivity to UK waters it would appear that only the UK population (1,800 pairs) and Irish population (200 pairs) are likely to migrate through UK waters (Figure 20.2). These 3,600 UK adults will have an associated 2,000 or so immatures, but perhaps half of these may not migrate into UK waters as young immatures, so the UK population in UK waters during the migration seasons may be around 4,600 birds (slightly more in autumn and fewer in spring). The 200 pairs from Ireland will similarly have associated immatures, giving a total population that may migrate through UK waters of about 500 birds. Thus the biogeographic population with connectivity to UK waters is estimated at 6,240 birds (adults and immatures), with 5,620 from UK and 620 from overseas. Of these, it is estimated that 5,120 birds migrate through UK waters, with 4,610 being from the UK population and 510 from overseas. The number from the UK population migrating through UK waters is less than the number contributing to the biogeographic population because it is believed that many first summer birds remain in their winter area rather than returning to the UK.



Figure 20.2. Breeding population origins of little terns in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

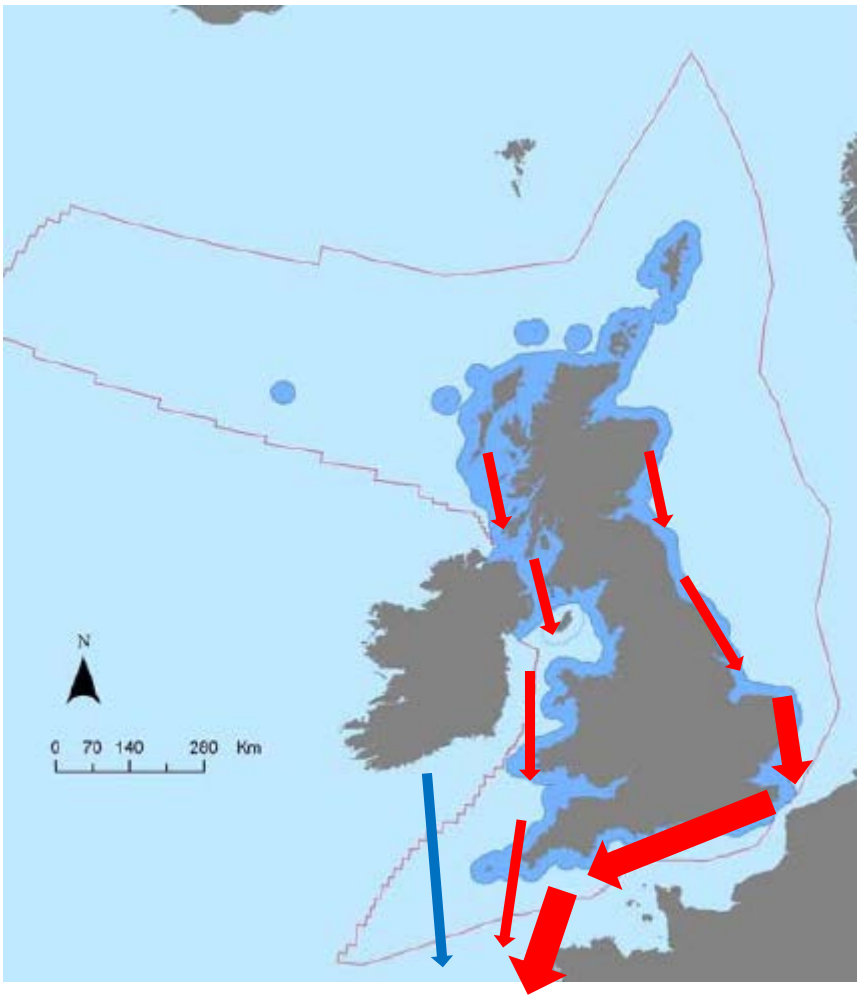


Figure 20.3. Main movements of little terns from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

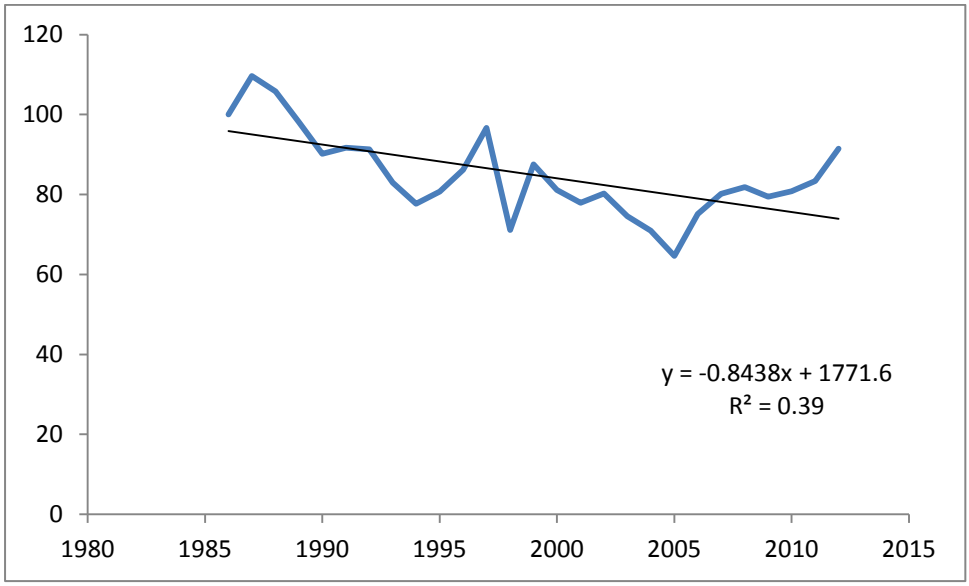


Figure 20.4. Trend in the little tern breeding population index in UK (which come almost entirely from colonies in England) from 1986-2012. Data from JNCC seabird population monitoring database.

20.9 Proportion of UK population in UK breeding SPAs

The 27 SPAs with breeding little terns as a feature together held 1,616 pairs at designation, estimated to represent ca. 67% of the British breeding population (Stroud et al. 2001). Stroud et al. (2014) suggest on the basis of census data for these populations from 2000-2011 (but mostly from 2011) that the GB SPA suite for breeding little terns held 61% of the GB population in that period. Numbers of little terns in the UK appear to have declined only slightly in recent years (Figure 20.4), but the decrease in proportion on SPAs suggests losses from some SPA populations have been greater than in the overall population.

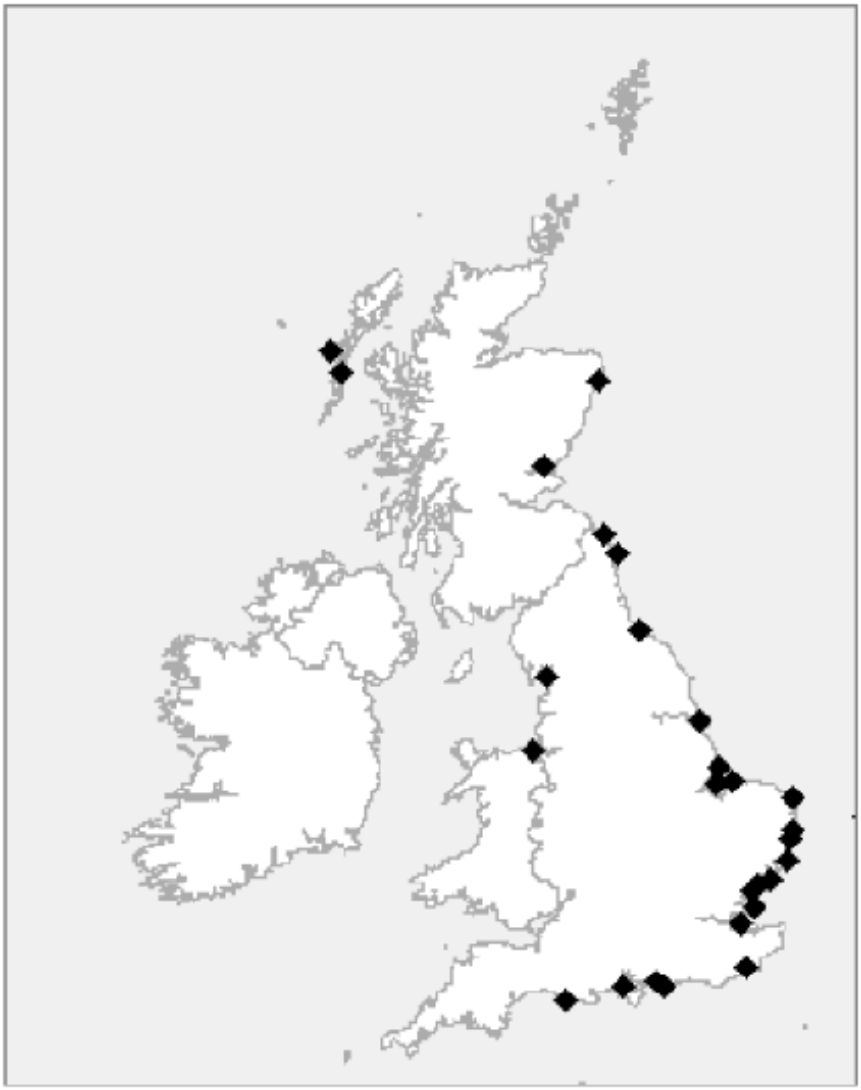


Figure 20.5. UK SPA suite for breeding little terns. These SPA populations are listed in Table 20.1.

Table 20.1. The UK SPA suite for breeding little terns.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count	Year	Reference
UK North Sea & Channel							
Ythan Estuary, Sands of Forvie	NE Scotland	41	1998	Maintained 2012	21 36 37 31 27 40	2008 2009 2010 2011 2012 2013	Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 Lewis et al. 2012 SCM database SCM database
Firth of Tay and Eden Estuary	E Scotland	44	2000	No change 2001	1 1	2005 2007	Lewis et al. 2012 Lewis et al. 2012

Lindisfarne	NE England	15 (1992-1996) Or 38 (Stroud et al. 2001)	1992		8	2011	Stroud et al. 2014
Northumbria Coast	NE England	40 (1992-1996)	2000		38	2011	Stroud et al. 2014
Teesmouth & Cleveland Estuary	NE England	40 (1995-1998) Or 37 (Stroud et al. 2001)	1995		84	2011	Stroud et al. 2014
Gibraltar point	Lincs	23 (1992-1996)	1993		12	2011	Stroud et al. 2014
Humber Flats, Marshes & Coast	E England	51 (1998-2002) Or 63 (Stroud et al. 2001)	2007		29	2011	Stroud et al. 2014
The Wash	E England	>33 (1992-1996)	1988		0	2009 - 2010	Stroud et al. 2014
North Norfolk Coast	E England	>330 (1992-1996) Or 377 (Stroud et al. 2001)	1989		409	2011	Stroud et al. 2014
Alde-Ore Estuary	E England	48 (1993-1997)	1996		0	2009	Stroud et al. 2014
Minsmere-Walberswick	E England	28 (1992-1996)	1992		30	2010	Stroud et al. 2014
Great Yarmouth North Denes	E England	220 (1992-1996)	1993		5	2011	Stroud et al. 2014
Foulness	Essex	>24 (1992-1996)	1996		0	2005	Stroud et al. 2014
Dungeness to Pett Level	SE England	35 (1993-1997)	1999		10 14 11	2011 2012 2013	SMP database SMP database SMP database
Medway Estuary and Marshes	Kent	28	1995		18	2009	Stroud et al. 2014
Benacre to Easton Bavents	E England	21 (1992-1996) Or 53 (Stroud et al. 2001)	1996		45	2011	Stroud et al. 2014

Blackwater Estuary	Essex	>21 (1992-1996) Or 36 (Stroud et al. 2001)	1995		99	2000	Stroud et al. 2014
Colne Estuary	Essex	>38 (1992-1996)	1994		0	2011	Stroud et al. 2014
Hamford Water	Essex	55 (1992-1995)	1993		45	2011	Stroud et al. 2014
Chesil Beach and The Fleet	S England	55	1985		19	2011	Stroud et al. 2014
Chichester & Langstone Harb	S England	100 (1992-1996)	1987		60	2011	Stroud et al. 2014
Pagham Harbour	Sussex	7 (1992-1996) Or 12 (Stroud et al. 2001)	1988		6	2011	Stroud et al. 2014
Solent & Southampton Water	S England	49 (1993-1997)	1998		0	2007	Stroud et al. 2014
UK Western waters							
Monach Isles	Western Isles	26 (1992)	1994	Declined 2001	2	2001	Seabird2000
South Uist Machair & Lochs	Western Isles	31 (1986-1990)	1997	Declined 2009	7 17	1999 2002	Seabird2000 Stroud et al. 2014
The Dee Estuary	Cheshire & Flintshire	69 (1995-1999) Or 56 (Stroud et al. 2001)	1985		126	2011	Stroud et al. 2014
Morecambe Bay	NW England	26	1996		62	2011	Stroud et al. 2014

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

20.10 BDMPS

UK waters can be split into two distinct spatial BDMPS which are appropriate for the migration periods (late July to early September, and mid-April to May): UK North Sea and Channel waters, and UK western waters. These are distinct for little tern because the evidence suggests that birds from colonies in the North Sea and Channel rarely migrate into UK western waters and vice versa. In addition, although birds from Ireland migrate through UK western waters so contribute to that BDMPS, no significant numbers of little terns from overseas populations are thought to migrate through UK North Sea waters. Numbers of this species predominantly occur in the southern parts of each of these BDMPS areas. Numbers in the NW part of the North Sea BDMPS are very small. About 100 pairs breed in this area, with 41 pairs on SPAs (Ythan Estuary, Firth of Tay). Numbers in the West of Scotland part of

the UK western waters BDMPS are also small. About 220 pairs breed in this area, with about 19 pairs on SPAs (Monach Isles, S Uist Machair).

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 60 and 61.

Based on evidence reviewed in sections 20.5, 20.6 and 20.7, the UK North Sea and Channel migration seasons BDMPS is estimated to hold 100% of adults and 60% of immatures from colonies in the UK North Sea and Channel, but no birds from colonies in the UK western waters area or from Ireland (Appendix A Table 60). These proportions give an estimated BDMPS of 3,524 birds (adults and immatures) with 3,524 of these from the UK population and none from overseas.

Based on evidence reviewed in sections 20.5, 20.6 and 20.7, the UK western waters migration seasons BDMPS is estimated to no birds from colonies in the UK North Sea and Channel, but 100% of adults and 60% of immatures from colonies in the UK western waters area, and 95% of adults and 60% of immatures from Ireland (Appendix A Table 61). These proportions give an estimated BDMPS of 1,602 birds (adults and immatures) with 1,088 of these from the UK population and 514 from overseas.

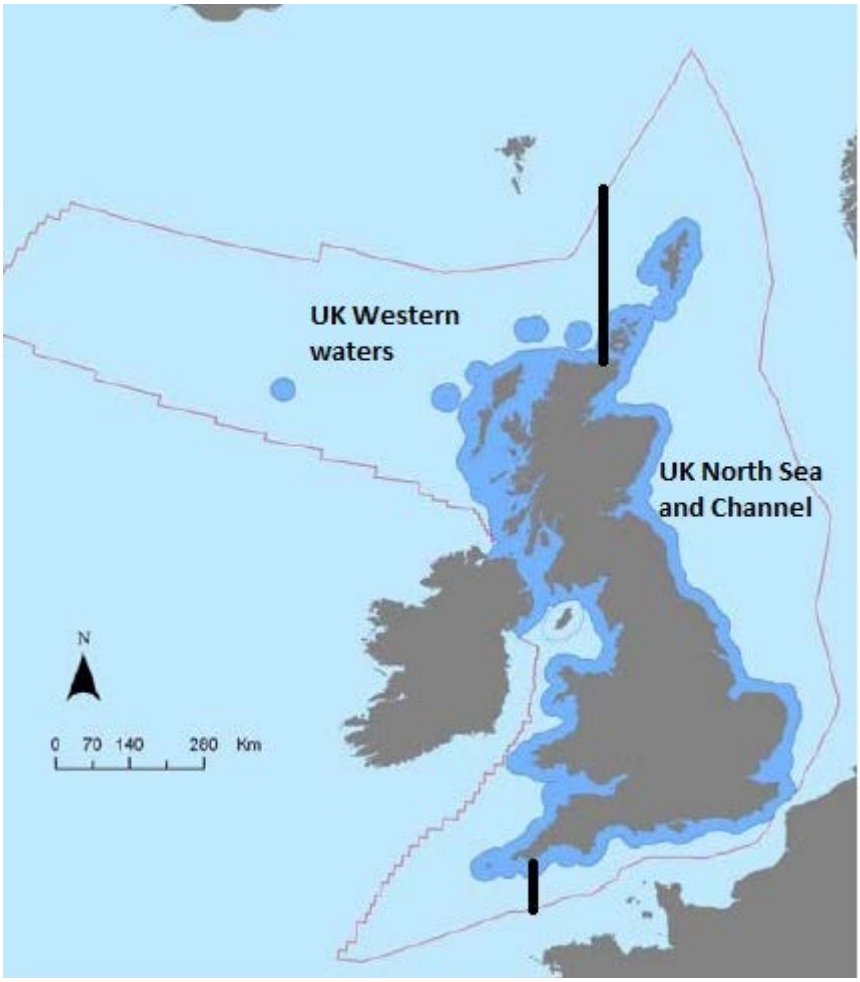


Figure 20.6. Two defined BDMPS spatial areas for little tern: ‘UK North Sea waters and Channel’ and ‘UK Western waters’.

20.11 Proportions of UK SPA birds in BDMPS

SPA birds represent about 40% of the UK population. Proportions of birds that are adults from UK SPA colonies in each BDMPS can be estimated directly from the data in Appendix A Tables 60 and 61. For example, in the UK North Sea and Channel BDMPS (3,524 birds) there are estimated to be 1,918 adults from SPA colonies, so these represent 54% of the total birds present.

20.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Although the general migration pattern of little terns is understood and colony sizes are rather well documented, almost nothing is known about the details of local (colony-specific) patterns of dispersal and migration behaviour of little terns through UK waters. However, it seems likely that birds will mix across the BDMPS when away from colonies, particularly because there are numerous but mostly fairly small colonies in each of the two BDMPS areas.

21. COMMON GUILLEMOT *Uria aalge*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (August to February) (adults and immatures)
Overseas	993,000	128,360
UK	3,132,000	2,628,166
Total	4,125,000	2,756,526

Non-breeding season BDMPS (August to February)	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
UK North Sea and Channel	1,617,306	94,160	1,523,146
UK Western waters	1,139,220	34,200	1,105,020

Colour coding is amber for numbers of birds in the UK population in the biogeographic total and in UK waters and each BDMPS since the locations and sizes of colonies in the UK are well known. Only a few colonies have not been censused since Seabird 2000, and population monitoring by JNCC has a strong focus on common guillemot so national and regional trends in numbers are well monitored. Dispersal and migratory movements of common guillemots from UK colonies are broadly well known based on ring recovery data, seawatching and at sea observations, although there is evidence for long term changes in migration patterns that relate to changes in availability of small pelagic fish (e.g. Heubeck et al. 1991), and the details of post-breeding dispersal of males with chicks are not well understood at a local level where interactions with renewables might be an issue as birds disperse rapidly from breeding areas. Numbers of birds from overseas populations that visit UK waters are much less well known, and there is much more uncertainty about population sizes in many overseas populations and whether those numbers are changing. Therefore the data for overseas contributions to the biogeographic population and BDMPS are coded red. However, because total numbers in the BDMPS are mainly determined by numbers in the UK component of the BDMPS, the totals are coded amber rather than red, as the influence of uncertainty in numbers from overseas on the total numbers present seems to be relatively small.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 62 and 63.

21.1 Breeding range and taxa

Common guillemot has a Holarctic breeding distribution. There are five subspecies, three of which occur in UK waters. *U. a. hyperborea* breeds in Svalbard and northern Norway, east to Novaya Zemlya in northern Russia, and has been recorded in very small numbers in the UK in winter. *U. a. albionis* breeds in Ireland, Britain south of 55° 38'N, at Helgoland (Germany) and from Brittany to northern Portugal. Nominate *U. a. aalge* breeds in Britain north of 55° 38'N, in southern Norway and the Baltic Sea (Peterz and Blomqvist 2010), Faroe, Iceland, Greenland and the northern Atlantic coast of North America. However, these subspecies may really represent clinal variation in size and plumage rather than discrete types, as colonies close to 55° 38'N may contain a mixture of birds that could be assigned to either *albionis* or *aalge*, and several chicks ringed in one subspecies have subsequently recruited into a colony of a different subspecies (for example *aalge* from Shetland found breeding in Arctic Norway where the subspecies is *hyperborea*). However, birds can generally be identified to subspecies from plumage and biometrics, and there is clinal variation in size (Hope Jones 1988, 1995) with larger birds further north, and in the presence of 'bridled' plumage with a higher frequency further north (Birkhead 1984; Reiertsen et al. 2012). As a result, there is scope to assess origins of birds sampled in winter (most frequently from beached birds associated with oil spills or winter wrecks or as a result of chronic winter mortality), although Barrett et al. (2008) concluded that biometrics only allow the most likely sea area of origin to be estimated rather than the specific colony. Attempts have also been made to use DNA markers to identify origins of common guillemots, but there is little variation in common guillemot DNA between populations (Moum et al. 1991; Moum and Arnason 2001; Cadiou et al. 2004; Riffaut et al. 2005).

21.2 Non-breeding component of the population

Common guillemots start to breed when 5 years old (BTO Birdfacts). Adult survival rate is 0.946 (BTO Birdfacts; Harris et al. 2000), juvenile survival 0.56 (BTO Birdfacts; Harris et al. 2007) and mean productivity is 0.678 chicks per pair (JNCC database, n=191 measurements). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.6 for 1-year olds, 0.7 for 2-year olds, 0.85 for 3-year olds and 0.9 for 4-year olds. The model population comprised 57% adults, 19% juveniles and 24% older immatures. There are 0.74 immatures per adult.

21.3 Phenology

Breeding colonies in the UK are deserted in August, with modal departure in July (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007). Autumn dispersal/migration starts in mid-July (Cramp et al. 1977-94), July (Pennington et al. 2004), late July (Forrester et al. 2007) or August (Wernham et al. 2002). The late start date noted by Wernham et al. (2002) may be because that analysis is based primarily on ring recoveries, and there may be a lag before recoveries are found. Peak autumn migration occurs in August according to Pennington et al. (2004) and Forrester et al. (2007), in August-October (Cramp et al. 1977-94), in September-October (Wernham et al. 2002), or October-December in Belgium (Vanermen et al. 2013). Numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) are remarkably small, and do not indicate timing of autumn migration, presumably because birds from breeding sites move eastwards across the North Sea rather than southwards along the coast past most of these seawatching sites (Figure 21.1). Autumn migration is completed by September (Pennington et al. 2004; Forrester et al. 2007) or October (Cramp et al. 1977-94) or November (Wernham et al. 2002). Again the estimate from ring recovery data may be a little late by comparison with estimates based on direct observations.

Spring migration starts in October-November (Cramp et al. 1977-94; Pennington et al. 2004), October-February (Forrester et al. 2007) or December (Wernham et al. 2002). Peak spring migration occurs in December-February (Cramp et al. 1977-94; Forrester et al. 2007),

January-February (Pennington et al. 2004), January-March (Wernham et al. 2002) and January-March in Belgium (Vanermen et al. 2013). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in early February (Figure 21.1). Spring migration is completed by March (Pennington et al. 2004; Forrester et al. 2007), mid-April (Cramp et al. 1977-94), or April-May (Wernham et al. 2002).

The first spring records of common guillemot in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were predominantly from 1 January and the last records were predominantly at 31 December, as large numbers of common guillemots overwinter, while peak autumn migration was reported in July in most years, and peak spring migration was reported in January-March in most years. Birds re-occupy colonies from November, with modal return in January (Mudge et al. 1987; Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007).

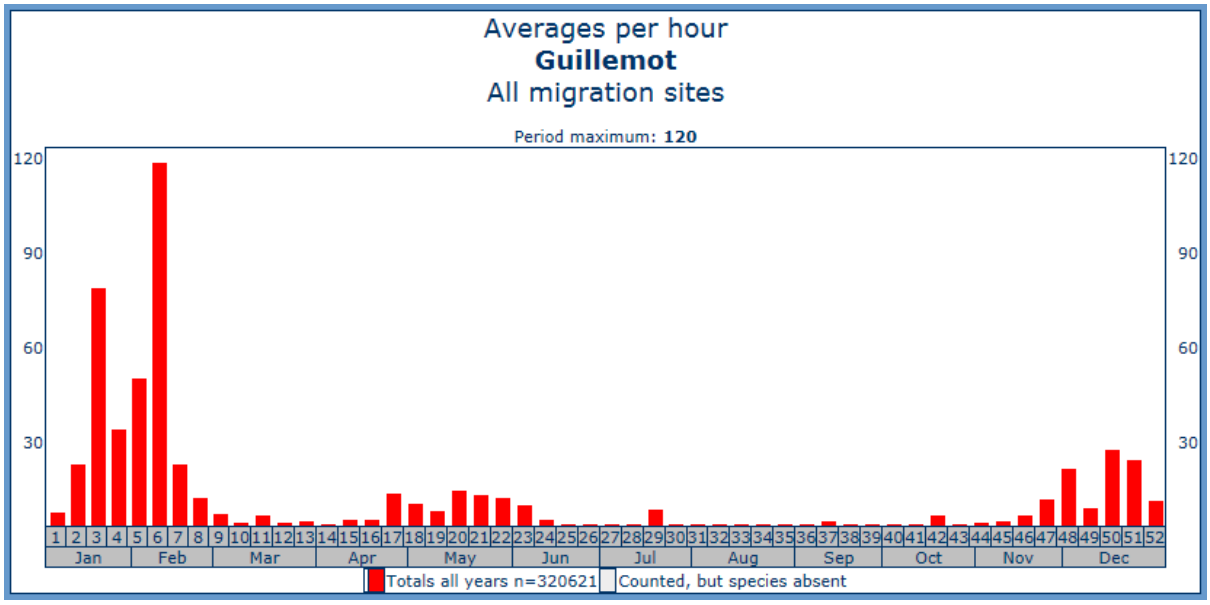


Figure 21.1. Average numbers of common guillemots counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-June, non-breeding season October-April. However, from the data reviewed above, this could be refined to breeding season March-July, non-breeding season August-February.

21.4 Defined seasons:

- UK Breeding season — March-July
- Post-breeding migration in UK waters — July-October
- non-breeding season — August-February (**non-breeding BDMPS**)
- Return migration through UK waters — December-February
- Migration-free breeding season — March-June
- Migration-free winter season — November

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for common guillemot:

Non-breeding season BDMPS (August-February).

21.5 Movements of birds from the UK population

Common guillemots in Britain and Ireland are considered to be dispersive rather than migratory (Wernham et al. 2002). Many adults remain close to their colony throughout the year (Brown and Grice 2005). With the exception of August-September, when adults moult and are flightless for about six to seven weeks (Brown and Grice 2005), adults can be seen at breeding sites occupying ledges, though sporadically through winter. Young birds disperse further than adults, and juveniles from UK colonies have been recovered in October onwards from north Norway to Portugal, whereas few adults move beyond UK waters (Wernham et al. 2002). There is a slight indication for birds from different parts of the UK wintering in different areas, as suggested by Mead (1974). Birds from northern Britain move furthest (and include most of the recoveries in north Norway) (Wernham et al. 2002; see also Heubeck et al. 1991). Those from colonies in SW England mostly move southwards into the Bay of Biscay and travel least (Wernham et al. 2002). Common guillemots from colonies in the east coasts of England and Scotland mostly remain in the North Sea in winter (Wernham et al. 2002). Although typical patterns of distribution and seasonal movements are described above, there is very strong evidence indicating that common guillemot seasonal movements, distribution patterns and overwinter survival are strongly affected by the distribution and abundance of prey fish stocks, and especially the distribution and abundance of sprats. Since sprat stock biomass can vary considerably from year to year, common guillemot seasonal movements can vary according to the availability of their winter prey. Blake (1984) suggested that guillemot survival in winter was influenced by abundance of small prey fish stocks within local areas. Mass mortality of guillemots in 1983 correlated with apparent low abundance of sprat, one of their main winter foods in areas of the North Sea (Underwood and Stowe 1984). Blake et al. (1984) suggested that guillemot distribution across the North Sea related to presence of sprat stocks, while Peterz and Olden (1987) found that increased numbers of common guillemots wintering off the west coast of Sweden related to high abundance of young herring in that area at the time. Skov et al. (2000) also found that the distribution of common guillemots in winter in the Skagerrak and Kattegat correlated with the distribution of young herring. Harris and Bailey (1992) showed that first year common guillemot survival rates in the North Sea were best explained by sprat stock biomass. Although Pennington et al. (2004) stated that the breeding numbers and breeding success of common guillemots in Shetland was primarily determined by the biomass of the Shetland sandeel stock, sandeels remain buried in the sea bed during autumn and winter so are not readily available at that time of year (although common guillemots have been recorded to dig sandeels out of the sand in winter). Their winter prey is predominantly sprats and young herring (Blake 1984).

When common guillemot chicks fledge from Shetland colonies in July, in most years the chicks swim eastwards accompanied by the male parent, arriving off the coast of Norway within a few weeks (Pennington 2004). During 1982-84, many thousands remained in inshore waters around Shetland instead of travelling to Norway. This altered behaviour coincided with a high abundance of sandeels at Shetland and low sprat biomass in the North Sea. No such large numbers were encountered there post-fledging during the late 1980s or 1990s when sandeel stocks had declined to very low abundance at Shetland. These observations suggest that the movements and resulting winter distribution of common guillemots, perhaps especially first year birds, are highly flexible, with birds aggregating in areas where there are high concentrations of food fish. In English waters, post-breeding aggregations are particularly found in August over Dogger Bank, off East England northwards of Flamborough, and in the Irish Sea (Brown and Grice 2005); these birds become more widely dispersed from October to February. There is concern that common guillemots dispersing from breeding areas may possibly aggregate in, or pass through, sites being considered for marine renewables development during their dispersal phase. Since that can be very rapid, lasting just two or three weeks in July, such aggregations could easily be overlooked by a survey protocol of monthly counts at a proposed development site, while

such aggregations may not necessarily occur in the same place in successive years, depending on fish stocks. There is, therefore, much uncertainty about local aggregations post-breeding, and where these might be located. More work is required to map dispersal by males and chicks before it is possible to define a BDMPS or set of BDMPSs for the dispersal phase. Therefore in this report the dispersal phase is not treated separately, but is subsumed into the defined breeding season (March to July) or non-breeding season (August to February).

21.6 Movements of birds from overseas into UK waters

Wernham et al. (2002) report 69 foreign ringed common guillemots recovered in the British Isles (i.e. not including birds ringed in Ireland as foreign). These included 8 ringed in Netherlands, 29 in Germany, 23 in Faroes, 5 in Norway, 3 in France, and 1 in Russia. Some of these were ringed as rehabilitated birds (e.g. those from Netherlands, and probably those from France and some from Germany). From this they concluded that small numbers of common guillemots from Scandinavian and Faroese colonies reach northern Britain in autumn and winter and some enter the North Sea (Wernham et al. 2002). Deployment of geolocators on breeding common guillemots at colonies in Central Norway found that all moved northwards up the Norwegian Sea after the breeding season (Lorentsen and May 2012). 80% of these then moved into the Barents Sea, while 20% remained in the north Norwegian Sea. After moult, some moved back into the north Norwegian Sea so that 50% overwintered in the Barents Sea and 50% in the north Norwegian Sea. Lorentsen and May (2012) point out that there are ring recoveries of common guillemots from Central Norway in southern Norway as well as to the north, and caution that their geolocator results may represent only the year of deployment (2009-10) and that patterns may differ in other years, but they suggest that the Barents Sea may represent the main moulting area and a major wintering area for common guillemots from colonies in Central Norway (see also Steen et al. 2013). Most of the recoveries abroad of common guillemots ringed in the Faroes that were recovered in September to November were from the coast of Norway, with only two from UK coasts (Hammer et al. 2013). Later in the winter, in December to February, 7 were recovered on UK North Sea coasts (including Shetland), 18 on the Norwegian coast, 1 in Denmark and 1 in Iceland (Hammer et al. 2013). Birds from Germany (Helgoland) winter in the North Sea and some may enter UK waters (Wernham et al. 2002). The Baltic population apparently remains within the Baltic Sea (Wernham et al. 2002). Wernham et al. (2002) did not report any common guillemots from Iceland recovered in UK waters. Pennington et al. (2004) reported that the only foreign-ringed common guillemots recovered in Shetland were three birds ringed in Faroe. A very few birds found in Shetland in winter appear from measurements to be from the subspecies *hyperborea* which breeds in Arctic Norway, Bear Island, Svalbard and northern Russia (Pennington et al. 2004) but these have only been found on a very few occasions so numbers coming from far northern populations appear to be negligible. Fort et al. (2013) report on deployment of geolocators on common guillemots breeding at a northern Barents Sea colony. Those birds remained within the Barents Sea, White Sea or north Norwegian Sea throughout the winter, so geolocator data suggest that high latitude common guillemots are unlikely to reach UK waters except as vagrants. This supports conclusions based on ringing, which also indicated that common guillemots from colonies in the southern Barents Sea (north Norwegian coast) spend the winter either in the Barents Sea, or in the north Norwegian Sea (Nikolaeva et al. 1996). A small number of birds ringed as chicks have been recovered at breeding colonies far from their natal origins; two chicks from UK colonies were recovered at a colony in north Norway, two from UK colonies were recovered at colonies in the Baltic, and one from the Baltic bred at Skomer in the Irish Sea (Wernham et al. 2002). However, these long-distance natal dispersals are very exceptional. Anker-Nilssen et al. (1988) used biometrics of 826 common guillemots (18% of which were adults) killed by oil in the Skagerrak in January 1981 to infer that most were probably from Scottish or south Norwegian colonies. Cadiou et al. (2004) used ring recoveries and biometrics of 1,851 common guillemots killed in the 'Erika' oil spill in the Bay

of Biscay to infer that birds originated from a large area that included colonies from across the British Isles, along with some from more northerly colonies, but with most birds coming from colonies between west Scotland and the Celtic Sea. Grantham (2004) identified differences in wintering areas used by birds from different colonies as recovered in major oil spills; birds wintering in the southwestern approaches to the English Channel and in the Bay of Biscay tended to be immature birds from colonies in west Britain and Ireland, whereas birds wintering in the English Channel and southern North Sea tended to be adults from colonies in eastern Britain. Seabird 2000 reported 965,000 pairs in UK, 80,000 pairs in Ireland, 101,000 pairs in Norway, 175,000 pairs in Faroe, 990,000 pairs in Iceland, 2,500 pairs in Germany, 2,500 pairs in Denmark, and 250 pairs in France (Mitchell et al. 2004). More recently, Hammer et al. (2013) estimated that there are about 100,000 pairs in Faroe, while Gardarsson (2006) suggested that breeding numbers in Iceland had declined by 30% between 1983-86 and 2005-08, with 693,000 pairs in 2005-08. In the UK, changes in numbers are uncertain as no complete survey has been carried out since 2000, but JNCC monitoring data from a selection of colonies suggest a decrease in breeding numbers of about 40% in Scotland between 2000 and 2011 with the decrease most evident in Shetland (Foster and Marrs 2012) whereas numbers breeding in Wales have increased by a similar percentage (JNCC database).

21.7 Numbers in UK waters

Forrester et al. (2007) suggest that in winter there are around 750,000 individuals of *Uria aalge aalge* in Scottish waters. Numbers of *Uria aalge albionis* in Scottish waters in winter are uncertain, but there may be around 20,000, with most of those birds (which breed mostly on Ailsa Craig and Sanda) being in SW Scotland in winter. A small proportion of those birds may originate from colonies in England, Wales and Ireland, as some of those birds may disperse northwards in autumn (Forrester et al. 2007). Blake et al. (1984) estimated from ESAS data that common guillemots moved rapidly out of waters adjacent to breeding colonies in July, with perhaps 1,500,000 birds in North Sea waters in autumn and winter. Numbers in waters to the west of the UK appear to be similar in total to numbers in UK North Sea waters, so perhaps about 1,500,000 birds are in waters west of the UK in autumn and winter. Those totals would suggest that most of the UK population (900,000 pairs so 1,800,000 adults which would probably have an associated 1,300,000 immature birds) are in UK waters in autumn and winter, or that the birds from the UK population that move into overseas waters are similar in number to the totals that enter UK waters from overseas. This total would suggest that the estimate presented by Forrester et al. (2007) is most likely an underestimate of numbers in Scottish waters. For this reason, estimated numbers in the BDMPS have been set between the (lower) numbers thought to be at sea based on ESAS survey data and (higher) numbers thought to be present based on known population size and movement patterns.

21.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the North Atlantic population, comprising 2,250,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 2,800,000-2,900,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 8,500,000 individuals. Populations with connectivity to UK waters include UK (900,000 pairs), Ireland (80,000 pairs), Faroe (100,000 pairs), Norway (100,000 pairs), Germany and Denmark (5,000 pairs) and France (250 pairs). Therefore the biogeographic population with connectivity to UK waters sums to 4,125,000 birds (including adults and immatures), with 3,132,000 in UK, and 993,000 in overseas, populations. The UK population represents a high proportion of this total, and many of the birds from these overseas populations do not visit UK waters, so the birds in UK waters are, at all times of year, predominantly birds from UK colonies. The estimated total numbers in UK waters in the non-breeding season (August to February) are 2,708,000 birds, with 2,580,000 of these from the UK. The slightly smaller number of UK birds in UK waters than

in the biogeographic population recognises that some younger immature birds from the UK will be in overseas waters.



Figure 21.2. Breeding population origins of common guillemots in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

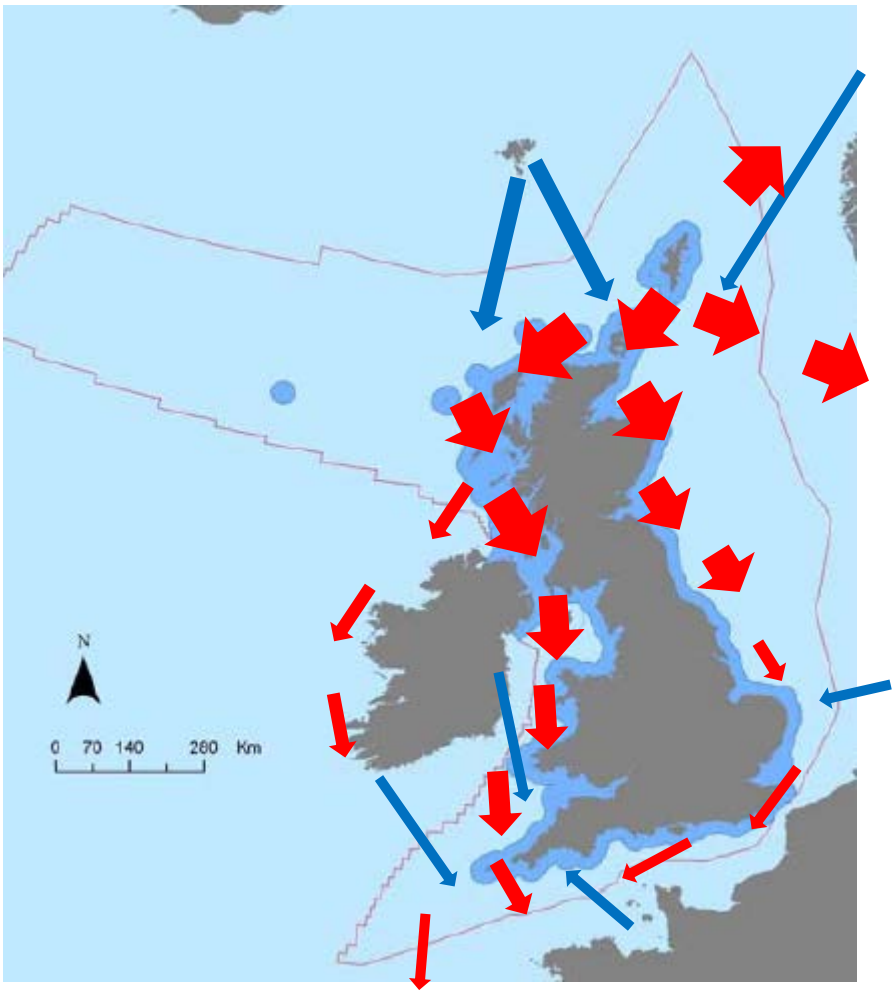


Figure 21.3. Main movements of common guillemots from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

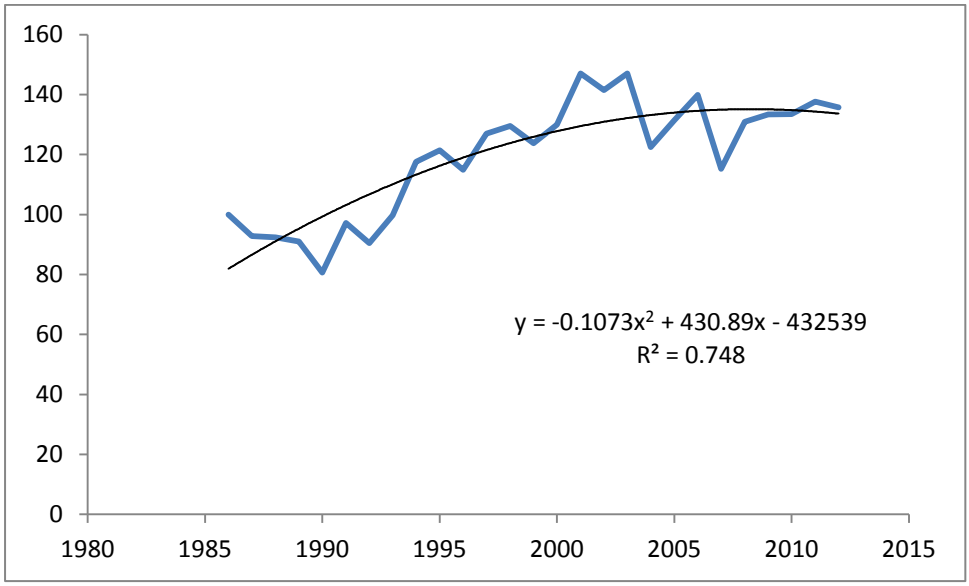


Figure 21.4. Trend in the common guillemot breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

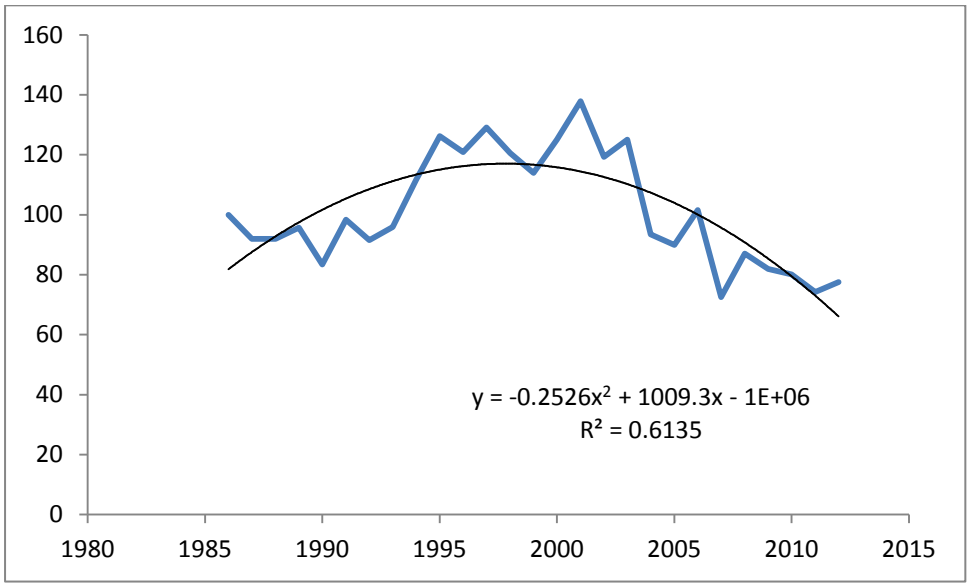


Figure 21.5. Trend in the common guillemot breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

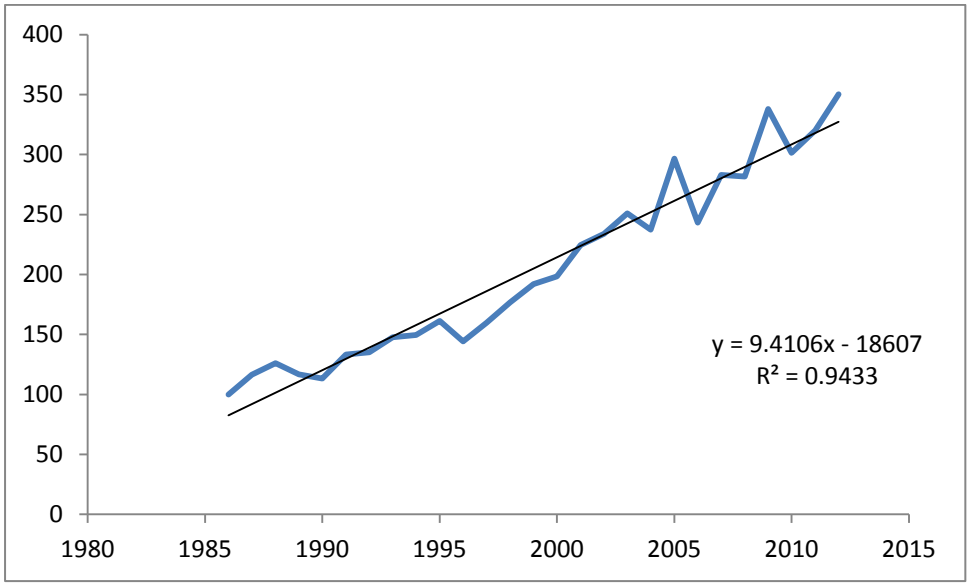


Figure 21.6. Trend in the common guillemot breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

21.9 Proportion of BDMPS from UK breeding SPAs

The 34 SPAs with breeding common guillemots as a feature together held 693,120 pairs at designation, estimated to represent ca. 95% of the British breeding population and ca. 27% of the all-Ireland breeding population (Stroud et al. 2001). Stroud et al. (2014) considered the two subspecies that occur in the UK separately. The subspecies *Uria aalge aalge* breeding populations are features in 30 GB SPAs, and survey data from 1999-2011 showed that those then held an estimated 75% of the GB population of that subspecies. The subspecies *Uria aalge albionis* breeding populations are features in 3 GB SPAs, and survey data from 2009-2011 showed that those then held an estimated 68% of the GB population of that subspecies. The single SPA for *Uria aalge albionis* in Northern Ireland then held an estimated 55% of the all-Ireland population of that subspecies. Since the surveys reported in Stroud et al. (2014) numbers have declined further in northern Scotland but increased in England and Wales; the proportion in the SPA suite may have further reduced slightly, but probably very little overall.

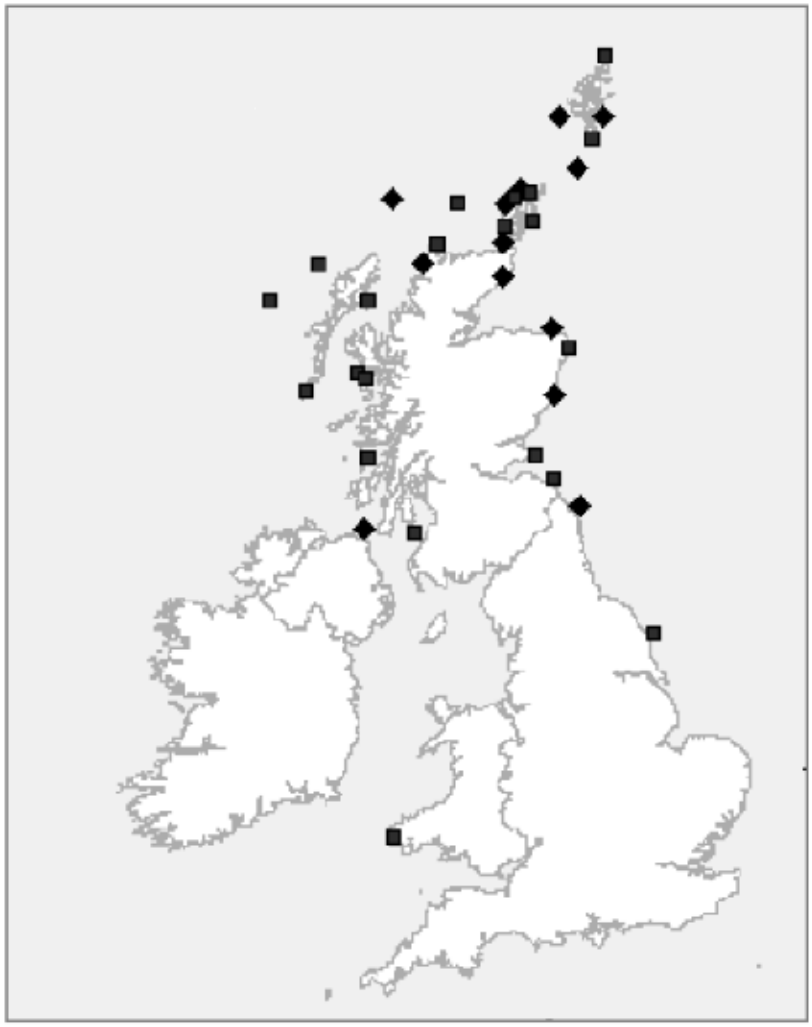


Figure 21.7. The UK SPA suite for breeding common guillemots. These SPA populations are listed in Table 21.1.

Table 21.1. The UK SPA suite for breeding common guillemots (counts expressed as individual birds are converted to pairs by multiplying by 0.67).

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count (pairs)	Year	Reference
UK North Sea & Channel							
Hermaness, Saxavord & Valla	Shetland	11,363	1994	Maintained 2000	6,994 4,020 4,620	2000 2004 2009	SMP database SMP database SMP database
Foula	Shetland	25,125 (1987)	1995	Declined 2007	27,805 16,615	2000 2007	SMP database SMP database
Noss	Shetland	30,619	1996	Declined 2005	30,671 14,908 16,172 14,783	2001 2004 2005 2009	SMP database SMP database SMP database SMP database
Sumburgh Head	Shetland	10,752	1996	Declined 2007	10,269 5,109 4,908 5,314 4,762 3,323 4,896 4,207	2001 2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database

Fair Isle	Shetland	25,165 (1994)	1994	Maintained 1999	26,302 18,304 13,066	1999 2005 2010	SMP database SMP database SMP database
West Westray	Orkney	28,274	1996	Maintained 2007	36,700 33,900	1999 2007	Seabird2000 Lewis et al. 2012
Calf of Eday	Orkney	8,241	1998	No change 2006	1,715 6,300	2002 2006	SMP database Lewis et al. 2012
Rousay	Orkney	7,102	2000	Recovered 2009	4,300 6,200	1999 2009	Seabird2000 Lewis et al. 2012
Marwick Head	Orkney	24,388	1994	Maintained 1999	23,235 7,019 11,267 11,097	1999 2004 2006 2012	SMP database SMP database SMP database SMP database
Hoy	Orkney	13,400	2000	Declined 2007	6,300	2007	Lewis et al. 2012
Copinsay	Orkney	13,333	1994	Declined 2008	9,166 5,607	2008 2012	SMP database SMP database
North Caithness Cliffs	N Scotland	26,994	1996	Maintained 2000	47,000	2000	Lewis et al. 2012
East Caithness Cliffs	N Scotland	71,509 (1986)	1996	Maintained 1999	120,789 or 158,895 individuals	1999	Lewis et al. 2012
Troup, Pennan & Lion's Heads	NE Scotland	29,902 (1995)	1997	Declined 2007	30,300 10,938	2001 2007	Seabird2000 SMP database
Buchan Ness - Collieston Coast	NE Scotland	8,640	1998	Declining 2007	19,691 12,928	2001 2007	SMP database SMP database
Fowlsheugh	NE Scotland	40,140	1992	Maintained 1999	41,800 36,300 33,900 30,100	1999 2006 2009 2012	SMP database SMP database SMP database SMP database
Forth Islands	E Scotland	16,000 (1985) Or 22,452 (Stroud et al. 2001)	1990	Maintained 2007	14,096 15,829 16,091 15,779 14,674	2007 2008 2009 2010 2011	SMP database SMP database SMP database SMP database SMP database
St Abb's Head to Fast Castle	E Scotland	20,971	1997	Maintained 1998	27,282 27,061 22,231 22,103	1998 2003 2008 2013	SMP database SMP database SMP database SMP database
Farne Islands	NE England	23,499	1985		32,596 29,390 32,244 31,058 32,145 32,881 33,532	2007 2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database

Flamborough Head & Bempton (to be subsumed into Flamborough and Filey Coast SPA)	E England	16,150	1993		31,279 39,641	2000 2008	SMP database SMP database
Flamborough and Filey Coast	E England	41,607 (2008-2011)	Not yet				See row above
UK Western waters							
Sule Skerry and Sule Stack	N Scotland	6,298 (1986)	1994	Maintained 1998	7,633	1998	SMP database
North Rona and Sula Sgeir	N Scotland	28,944 (1986)	2001	Declined 2012	21,021 North Rona only: 7,033 4,096 3,324	1998 1998 2005 2012	SMP database SMP database SMP database SMP database
Cape Wrath	NW Scotland	9,159	1996	Maintained 2000	27,359	2000	SMP database
Handa	NW Scotland	76,105 (1994)	1990	Declined 2007	75,493 60,370 30,550 37,993	1998 2003 2007 2011	SMP database SMP database SMP database SMP database
Shiant Isles	Western Isles	12,315	1992	Declined 2008	11,026 5,148	1999 2008	SMP database SMP database
Flannan Isles	Western Isles	14,693	1992	Declined 2013	9,807	1998	Mitchell et al. 2004
St Kilda	Western Isles	15,209	1992	Maintained 2000	15,700	1999	Seabird2000
Canna and Sanday	W Scotland	3,858	1998	Maintained 2001	3,913	1999	SMP database
Rum	W Scotland	2,680	1982	No change 2000	1,644	2000	SMP database
Mingulay and Berneray	Western Isles	20,703	1994	Declined 2009	21,835 29,725 13,527	1998 2003 2009	SMP database SMP database SMP database
North Colonsay & West Cliffs	W Scotland	6,656	1997	Maintained 2008	13,500	2000	Seabird2000
Ailsa Craig	W Scotland	3,350 (1987)	1990	Maintained 2003	7,818 5,247	2009 2013	SMP database SMP database
Rathlin Island	N Ireland	28,064 (1985)	1999		54,473 87,398	2007 2011	SMP database SMP database
Skomer and Skokholm	Wales	7,067	1982		12,479 14,210 14,577 16,375 16,641 16,300	2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

21.10 BDMPS

UK waters can be split into two spatial BDMPS for common guillemots, the UK North Sea and Channel, and the UK western waters (Figure 21.8). This split is based on the fact that very few common guillemots from colonies in western Britain move into the North Sea during autumn migration or vice versa. In addition, birds from overseas are likely to show a tendency to occur more in one side of the UK than the other, with birds from continental Europe more frequent in the North Sea than in western waters. While there is a possibility that spatial distribution patterns may differ in the immediate post-breeding dispersal period in July-August, the details of distribution and movements at that time are not well known except broadly. There have not yet been any tracking studies of males with dependent chicks as they disperse, so details of colony-specific patterns of dispersal and how much these vary from year to year are uncertain. Until such data are available it seems best to define just two seasonal periods; breeding season (March to July) and non-breeding season (August to February).

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 62 and 63.

Based on evidence reviewed in sections 21.5, 21.6 and 21.7, the UK North Sea and Channel non-breeding season BDMPS is estimated to hold 70% of adults and 60% of immatures from North Sea colonies in Shetland to Aberdeenshire, 80% of adults and 70% of immatures from Aberdeenshire to Fife, 90% of adults and 80% of immatures from Fife to Humberside, 5% of adults and 10% of immatures from colonies from NW Scotland to Argyll, 0% of adults and 5% of immatures from Argyll to Northern Ireland, 5% of adults and 10% of immatures from Wales, 10% of adults and 20% of immatures from Faroes, 5% of adults and 20% of immatures from Norway, 20% of adults and 40% of immatures from Germany and Denmark (Appendix A Table 62). These proportions result in an estimated BDMPS of 1,617,306 birds (adults and immatures) with 1,523,146 of these from UK and 94,160 from overseas populations.

Based on evidence reviewed in sections 21.5, 21.6 and 21.7, the UK western waters non-breeding season BDMPS is estimated to hold 2% of adults and 5% of immatures from North Sea colonies in Shetland, Orkney and north Caithness, no birds from colonies between East Caithness and East Anglia, 95% of adults and 90% of immatures from colonies from NW Scotland to Argyll, 100% of adults and 95% of immatures from Argyll to Northern Ireland, 90% of adults and 80% of immatures from Wales, 5% of adults and 10% of immatures from Faroes, 1% of adults and 5% of immatures from Norway (Appendix A Table 63). These proportions result in an estimated BDMPS of 1,139,220 birds (adults and immatures) with 1,105,020 of these from UK and 34,200 from overseas populations.

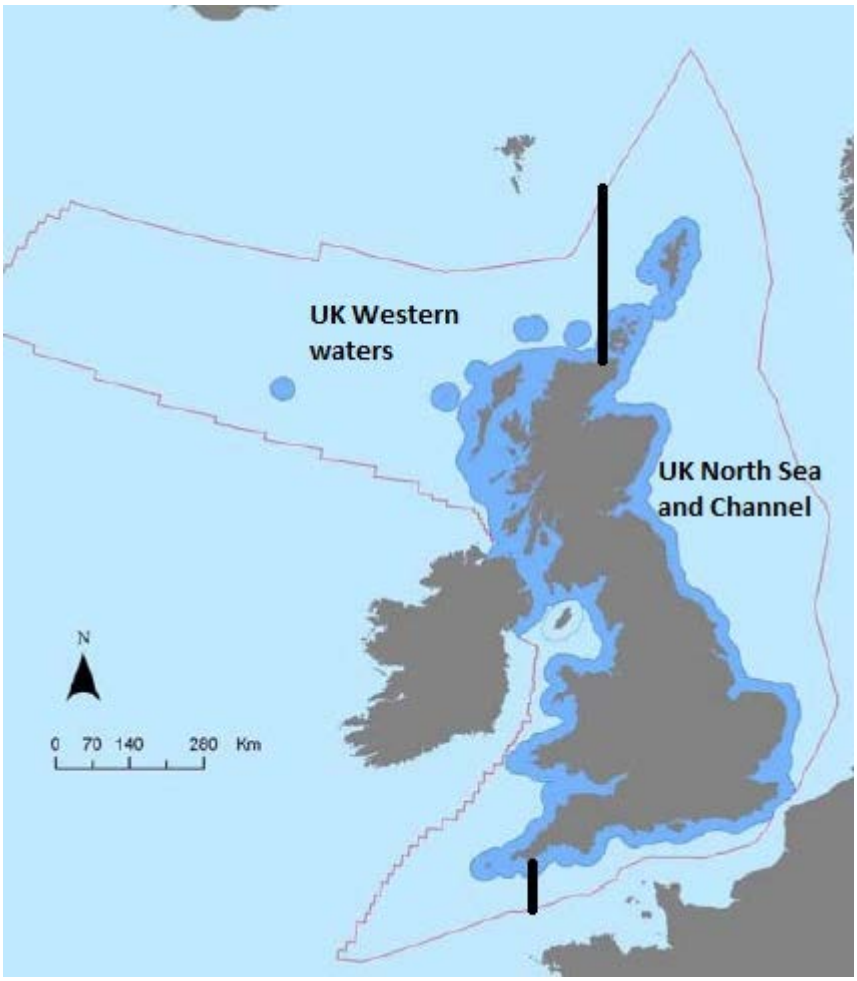


Figure 21.8. Two defined BDMPS spatial areas for common guillemot: 'UK North Sea waters and Channel' and 'UK Western waters'.

21.11 Proportions of UK SPA birds in BDMPS

SPA birds represent about 70-75% of the UK population. Proportions of birds that are adults from UK SPA colonies in each BDMPS can be estimated directly from the data in Appendix A Tables 62 and 63. For example, in the UK North Sea and Channel BDMPS (1,617,306 birds) there are estimated to be 684,920 adults from SPA colonies, so these represent 42% of the total birds present.

21.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Given the large number of SPA populations distributed through UK coasts, the SPA birds are likely to be well mixed with birds from non-SPA colonies and from overseas. In autumn shortly after dispersal from colonies there may be aggregations of SPA birds close to Flamborough Head & Bempton SPA, close to Farne Islands SPA, and close to Skokholm and Skomer SPA. These aggregations are likely to become less pronounced through the autumn as birds move offshore during winter, but may recur in late winter as adult birds move back towards breeding colonies. However, such aggregations appear to be very short-lived in the transition between breeding and non-breeding distributions. More research is needed to determine whether there are consistent 'hot-spots' where common guillemots aggregate during the brief post-breeding dispersal stage in late July.

22. RAZORBILL *Alca torda*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in migration seasons (August-October, and January-March) (adults and immatures)	Numbers in UK waters in winter (November-December) (adults and immatures)
Overseas	1,350,000	851,310	461,228
UK	357,000	347,478	98,816
Total	1,707,000	1,198,788	560,044

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Migration seasons BDMPS (August-October, and January-March)			
UK North Sea and Channel	591,874	434,431	157,443
UK Western waters	606,914	416,879	190,035
Winter BDMPS (November and December)			
UK North Sea and Channel	218,622	172,869	45,753
UK Western waters	341,422	288,359	53,063

Colour coding is amber for numbers of birds in the UK population in the biogeographic total and in UK waters and each BDMPS since the locations and sizes of colonies in the UK are well known. Only a few colonies have not been censused since Seabird 2000, and population monitoring by JNCC has meant that national and regional trends in numbers can be assessed. Dispersal and migratory movements of razorbills from UK colonies are broadly known based on ring recovery data, seawatching and at sea observations, although there may be long term changes in migration patterns that relate to changes in availability of small pelagic fish (as is more clearly known for common guillemot), and the details of post-breeding dispersal of males with chicks are not well understood at a local level where interactions with renewables might be an issue as birds disperse rapidly from breeding areas. Numbers of birds from overseas populations that visit UK waters are much less well known, and there is much more uncertainty about population sizes in many overseas populations and whether those numbers are changing. Therefore the data for overseas contributions to the biogeographic population and BDMPS are coded red. Because it

appears that total numbers are strongly influenced by these numbers from overseas, the totals are also coded red.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 64 to 67.

22.1 Breeding range and taxa

Razorbills breed around the North Atlantic. There are two subspecies; nominate *A. t. torda* breeds in eastern North America, Greenland, Bear Island, White Sea, Norway, Denmark, and Baltic Sea. Subspecies *islandica* breeds in in Iceland, Faroe, British Isles, Germany, and France. There is considerable variation in size with latitude of breeding colony (Hope Jones 1995; Barrett et al. 1997), providing an opportunity to assess origins of individuals sampled in winter. Although genetic differentiation between razorbills in different colonies was considered by Moum and Arnason (2001) to be moderately high, genetic comparisons do not seem to have been used to infer seasonal movements of razorbills.

22.2 Non-breeding component of the population

Razorbills start to breed when 4 years old (BTO Birdfacts). Adult survival rate is 0.9 (BTO Birdfacts; Chapdelaine 1997), juvenile survival 0.38 to 4 years old (BTO Birdfacts; Chapdelaine 1997) and mean productivity is 0.633 chicks per pair (JNCC database, n=87 measurements). To obtain a stable population, survival of immatures was adjusted to 0.6 for juveniles, 0.7 for 1-year olds, 0.8 for 2-year olds, and 0.9 for 3-year olds. The model population comprised 57% adults, 18% juveniles and 25% older immatures. There are 0.75 immatures per adult.

22.3 Phenology

Breeding colonies in the UK are deserted in August, with modal departure in July (Pennington et al. 2004; Forrester et al. 2007). Autumn dispersal/migration starts in July (Pennington et al. 2004), mid-July (Cramp et al. 1977-94), July-August (Wernham et al. 2002), or August (Forrester et al. 2007). Peak autumn migration occurs in late July in Shetland (Pennington et al. 2004), August-October (Cramp et al. 1977-94), September-October (Wernham et al. 2002; Forrester et al. 2007), and October-November in Belgium (Vanermen et al. 2013). Numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) are so small that no peak in autumn migration can be detected (Figure 22.1). Autumn migration is completed by mid-August in Shetland (Pennington et al. 2004), but by October in southern UK waters (Cramp et al. 1977-94), November (Forrester et al. 2007) or November-December (Wernham et al. 2002).

Spring migration starts in November-December (Cramp et al. 1977-94), or January (Pennington et al. 2004; Forrester et al. 2007). Peak spring migration occurs in January-February (Cramp et al. 1977-94), February-March (Pennington et al. 2004; Forrester et al. 2007), and February-April in Belgium (Vanermen et al. 2013). Peak numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in late January and early February (Figure 22.1). Spring migration is completed by March (Cramp et al. 1977-94) or April (Pennington et al. 2004; Forrester et al. 2007).

The first spring records of razorbill in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from January to March, and the last records were mostly in December. Peak autumn migration was not well defined and was reported in July to November in different areas and years, and peak spring migration was reported in January to April, but mostly in March. Birds re-occupy colonies from February, with modal return in late March or early April (Pennington et al. 2004; Forrester et al. 2007).

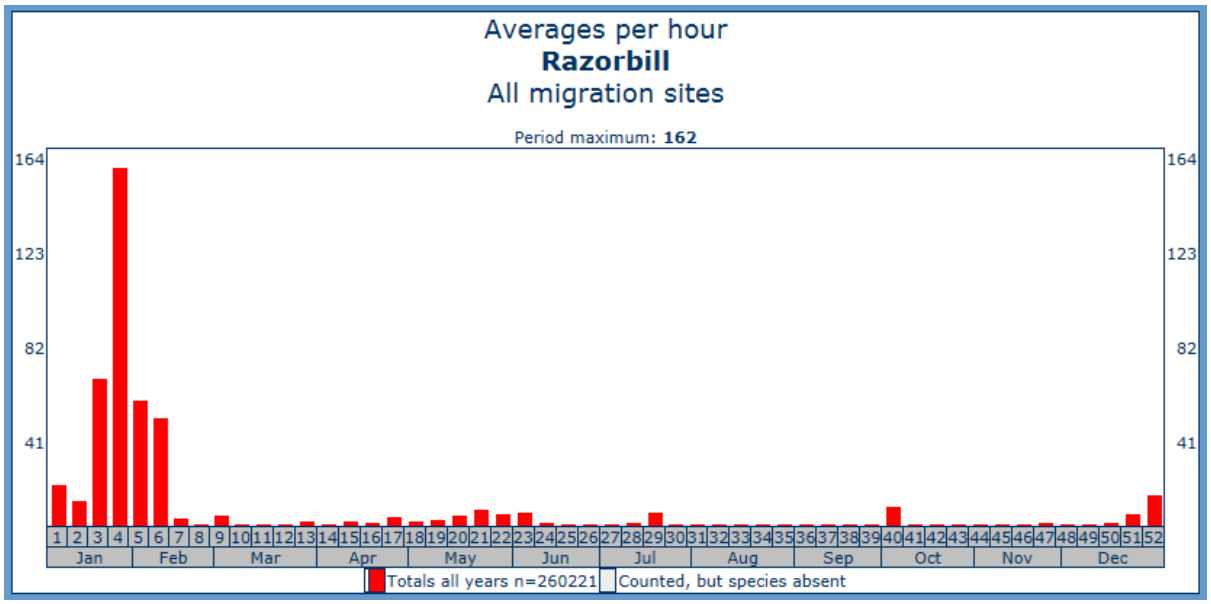


Figure 22.1. Average numbers of razorbills counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as May-June, non-breeding season October-April. However, from the data reviewed above, a more appropriate definition would be breeding season April-July, non-breeding season August-March.

22.4 Defined seasons:

- UK Breeding season — April-July
- Post-breeding migration in UK waters — August-October (**migration BDMPS**)
- non-breeding season — August-March
- Return migration through UK waters — January-March (**migration BDMPS**)
- Migration-free breeding season — April-June
- Migration-free winter season — November-December (**winter BDMPS**)

Apart from the breeding season, two seasonal BDMPS periods are considered to be appropriate for razorbill:

Migration seasons BDMPS (August-October, and January-March); and

Winter BDMPS (November-December).

22.5 Movements of birds from the UK population

During late summer and early autumn (July and August) when the fledged young are completing growth at sea and adults are undertaking their post-breeding moult, most recoveries of UK ringed adults and juveniles occur close to the colony, though by this time immature birds may be further afield (Wernham et al. 2002). During September, breeders and juveniles move predominantly southwards, with recoveries from southern Norway to Portugal, and predominantly in the southern North Sea, Celtic Sea, Channel or Bay of Biscay (Wernham et al. 2002). The majority of those ringed in the SW of Britain are recovered in autumn in the Channel, the southern North Sea, western France, Iberia, the western Mediterranean and northwest Africa. Razorbills from colonies in NW Britain are predominantly recovered from the North Sea, Channel, southern and western Britain and France. Birds from north Scotland and the northern isles tend to move east, to southwest

Norway and Denmark or to the southern North Sea with relatively few reaching France and Iberia. Skov et al. (2000) found that the distribution of razorbills in winter in the Skagerrak and Kattegat, some of which originate from UK colonies, correlated with the distribution of young herring. Too few birds have been ringed in east Britain to indicate their movement pattern. Immature birds, especially the youngest age classes, tend to travel further south in winter than adults, and may remain in wintering areas through the year, but older immatures tend to move back to breeding colonies in summer though some may visit areas beyond their natal colony such as Greenland, Iceland and Faroe. Adults return to their colonies in spring, with older immatures following later.

22.6 Movements of birds from overseas into UK waters

Only 26 razorbills ringed abroad have been recovered in Britain and Ireland; 14 of these were ringed in Iceland, 4 in Russia, 3 in Norway, 2 in France, and one each in Finland, Sweden and The Netherlands (Wernham et al. 2002). The birds from Russia, Norway, Finland and Sweden are from the subspecies *torda*, and these birds tend to be significantly larger than birds from the subspecies *islandica* which is found breeding in the UK, Iceland, Faroe, Ireland and France. Measurements of beached corpses of razorbills in winter have confirmed presence of birds of the subspecies *torda* at a frequency of up to 4% of beached razorbills in the British Isles in winter, suggesting that these larger birds from the nominate subspecies are present in UK waters in winter as a small minority of the razorbill population (Wernham et al. 2002). In Shetland, only very small numbers of birds with wing lengths indicative of the subspecies *torda* have been found in winter beached bird surveys, suggesting that rather few *torda* birds winter near to Shetland (Pennington et al. 2002). Anker-Nilssen et al. (1988) used biometrics of 308 razorbills (66% of which were adults) killed by oil in the Skagerrak in January 1981 to infer that 55% were probably from Scottish colonies, and 45% from Baltic colonies. Seabird 2000 reported populations as 126,400 pairs in UK, 17,000 pairs in Ireland, 380,000 pairs in Iceland (Gardarsson 2006 suggested this had decreased to 315,400 pairs by 2005-08), 4,500 pairs in Faroe (all these being populations of the subspecies *islandica*), 30,300 pairs in Norway, 3,500pairs in Russia, 10,000 pairs in Sweden, 6,000 pairs in Finland (all those being populations of the subspecies *torda*).

22.7 Numbers in UK waters

During post-breeding dispersal, about 220,000 birds are present in the North Sea (Tasker et al. 1987). Forrester et al. (2007) suggest that about 50,000 to 250,000 birds winter in Scottish waters, the high range indicating a low confidence in numbers. Higher numbers occur in English waters in winter, but a substantial (but uncertain) proportion of the UK population winters in southern Europe or in the eastern North Sea.

22.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *islandica* population, comprising 575,000 pairs. However, Mitchell et al. (2004) provided a revised estimate of this population as 530,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 1,950,000 individuals. Populations with connectivity to UK waters in migration or winter (Figure 22.2) include the UK (120,000 pairs), Iceland (315,000 pairs), Faroe (4,500 pairs), Norway (30,300 pairs), Russia (3,500 pairs), Sweden, Finland and Denmark (16,000 pairs), Ireland (17,000 pairs), and France (25 pairs). It is very uncertain what proportions of birds from these populations migrate through UK waters, or winter in UK waters. The biogeographic population with connectivity to UK waters comprises 1,707,000 birds (adults and immatures) with 357,000 of these from the UK population and 1,350,000 from overseas populations. Numbers estimated to be present in UK waters in the migration seasons (August to October, and January to March) are 1,197,000 birds in total, with 347,000 of these from the UK and 850,000 from overseas populations. Numbers

estimated to be present in UK waters in winter (November-December) are 559,000 birds in total, with 99,000 of these from the UK and 460,000 from overseas populations.

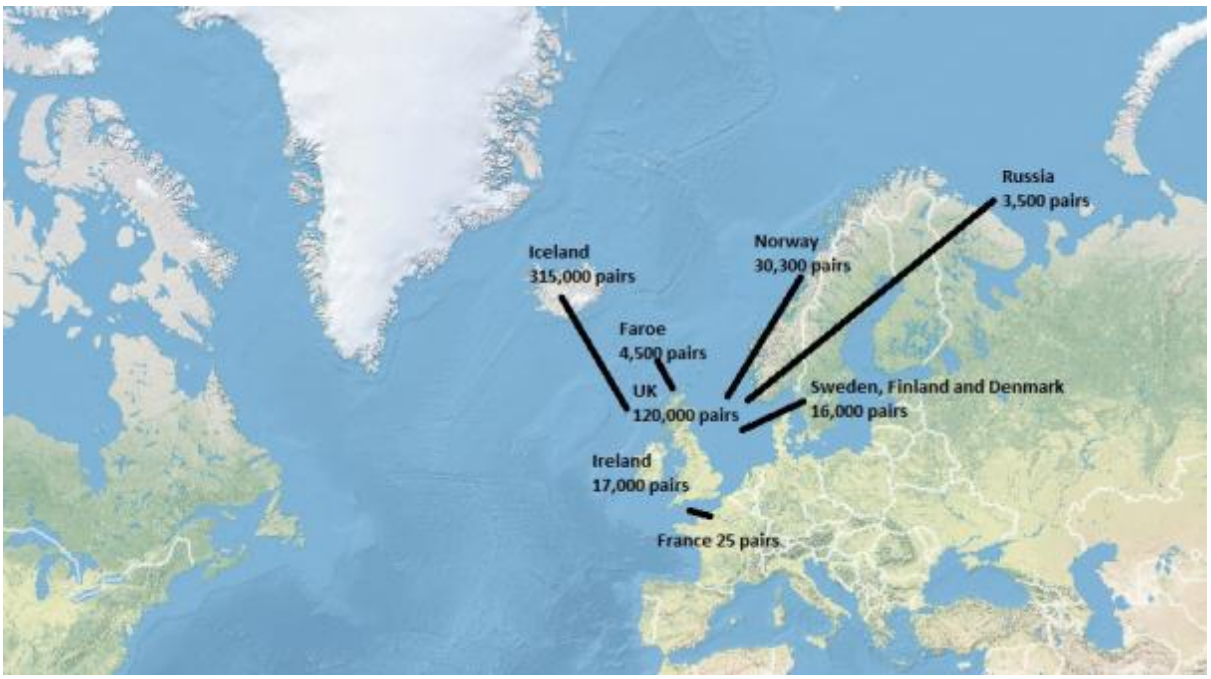


Figure 22.2. Breeding population origins of razorbills in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

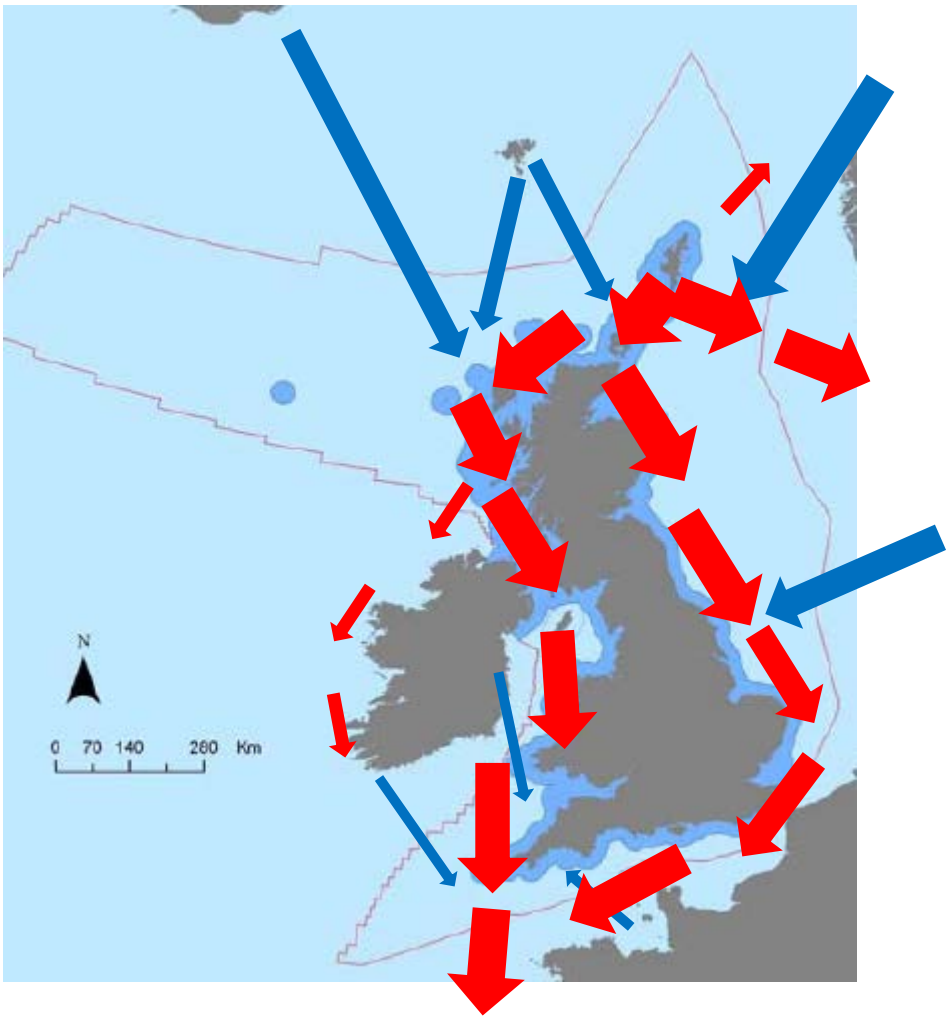


Figure 22.3. Main movements of razorbills from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

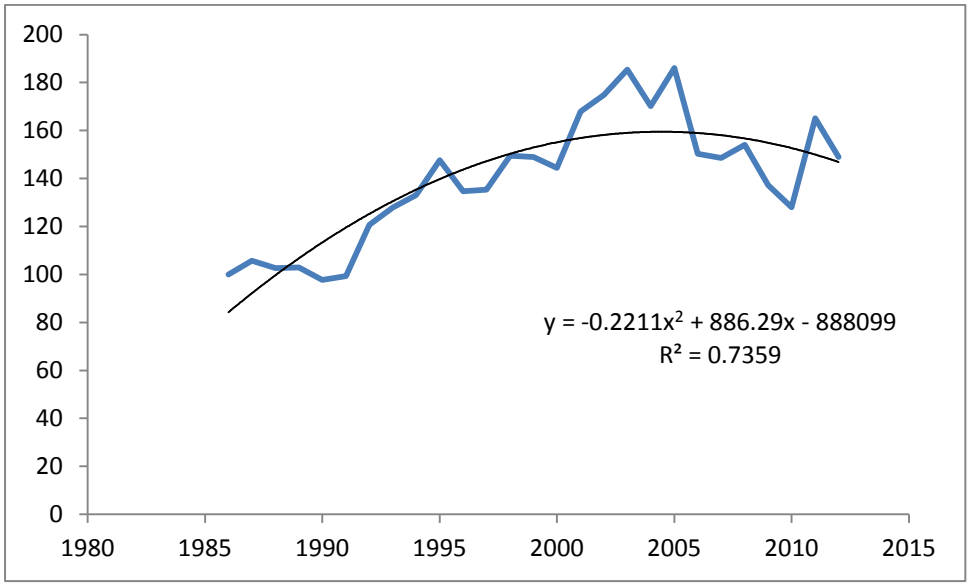


Figure 22.4. Trend in the razorbill breeding population index in UK from 1986-2012. Data from JNCC seabird population monitoring database.

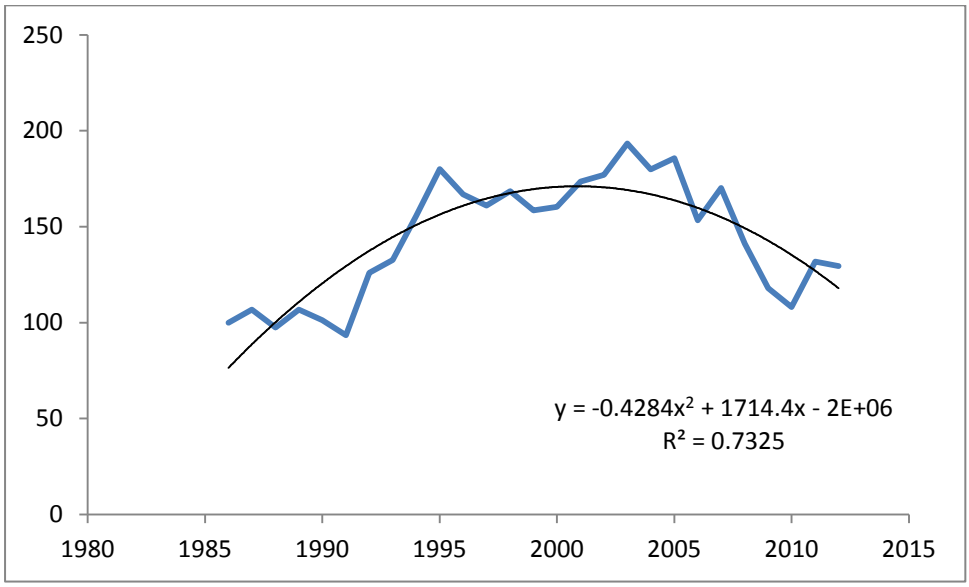


Figure 22.5. Trend in the razorbill breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

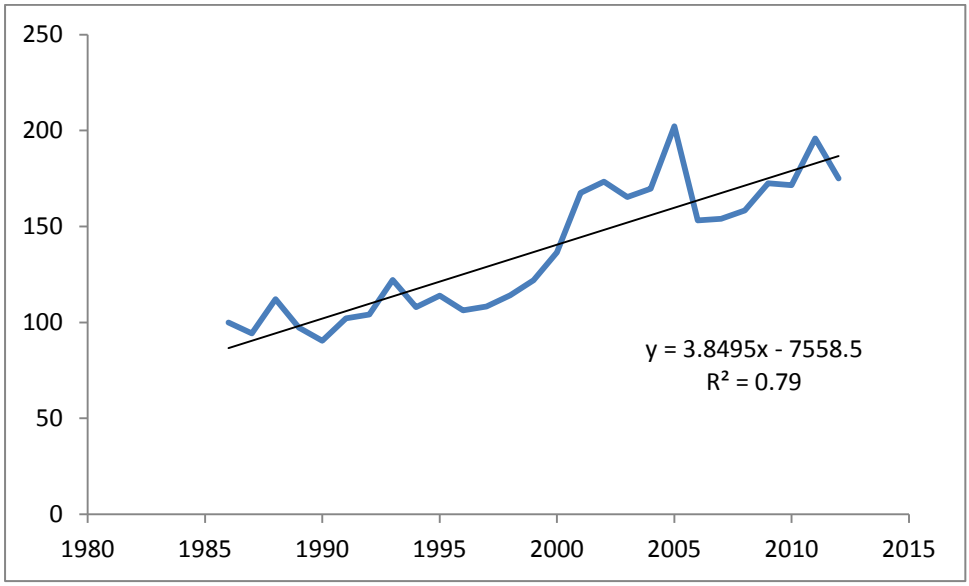


Figure 22.6. Trend in the razorbill breeding population index in Wales from 1986-2012. Data from JNCC seabird population monitoring database.

22.9 Proportion of BDMPS from UK breeding SPAs

The 19 SPAs with breeding razorbills as a feature together held 81,335 pairs at designation, estimated to represent ca. 76% of the British breeding population and ca. 26% of the all-Ireland breeding population (Stroud et al. 2001). From survey data in 1998-2011, Stroud et al. (2014) estimated that the 18 SPA populations designated in Britain held 92.9% of the British population, while the single SPA designated for razorbill in Northern Ireland held about 66% of the all-Ireland population.

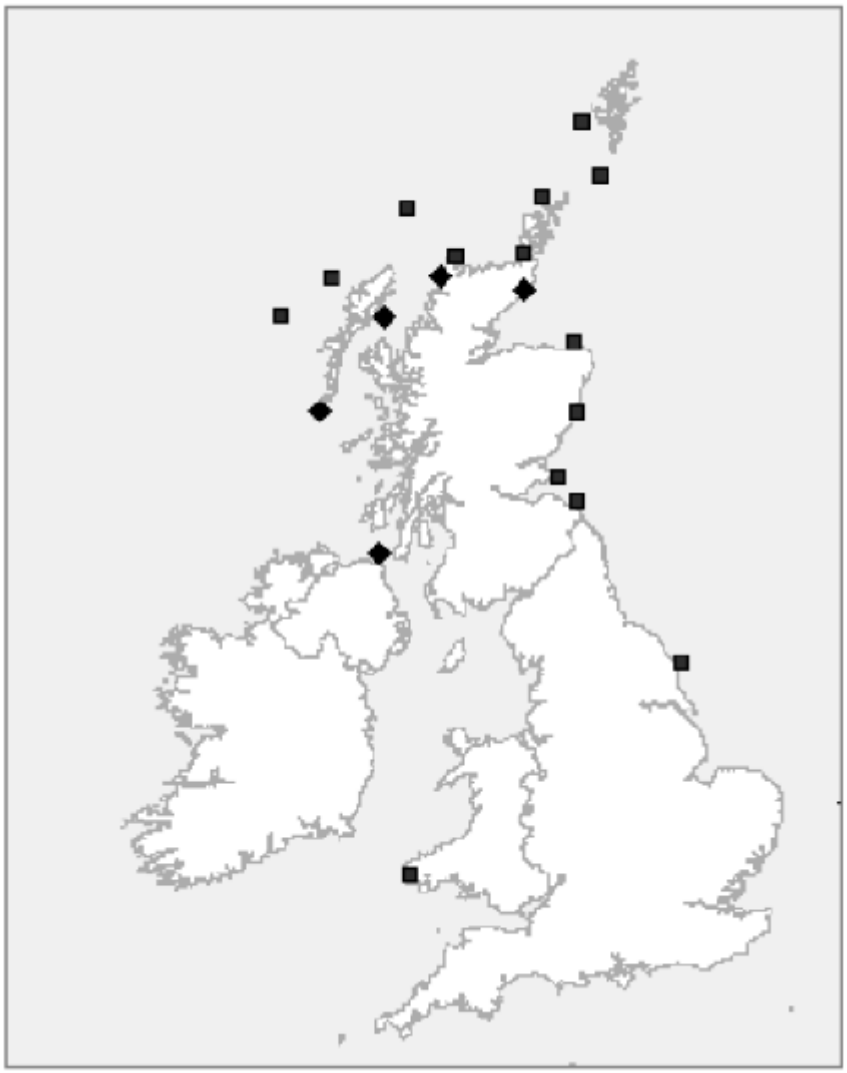


Figure 22.7. UK SPA suite for razorbill. These SPA populations are listed in Table 22.1.

Table 22.1. The UK SPA suite for breeding razorbills.

SPA	Location	Pairs	Year desig-nated	Site Condition Monitoring*	Recent count (pairs)	Year	Reference
UK North Sea & Channel							
Foula	Shetland	4,154	1995	Declined 2007	2,814 375	2000 2007	SMP database SMP database
Fair Isle	Shetland	2,044	1994	Maintained 2005	2,292 915	2005 2010	SMP database SMP database
West Westray	Orkney	1,307	1996	Maintained 2007	1,600 550	1999 2007	Seabird2000 Lewis et al. 2012
North Caithness Cliffs	N Scotland	2,212	1996	Declined 2000	1,700	2000	Seabird2000
East Caithness Cliffs	N Scotland	9,259 (1986)	1996	Maintained 1999	12,500	1999	Seabird2000
Troup, Pennan & Lion's Heads	NE Scotland	3,216 (1995)	1997	Declined 2007	3,237 1,743	2001 2007	SMP database SMP database

Fowlsheugh	NE Scotland	4,576	1992	Maintained 1999	4,263 2,868 3,103 3,524	1999 2006 2009 2012	SMP database SMP database SMP database SMP database
Forth Islands	E Scotland	1,400 (1985) Or 2,693 (Stroud et al. 2001)	1990	Maintained 2007	2,403 2,534 2,489 2,625	2009 2010 2011 2012	SMP database SMP database SMP database SMP database
St Abb's Head to Fast Castle	E Scotland	1,407	1997	Maintained 1998	1,483 1,486 1,130 1,219	1998 2003 2008 2013	SMP database SMP database SMP database SMP database
Flamborough Head & Bempton (to be subsumed into Flamborough and Filey Coast SPA)	E England	5,133 (1987)	1993		5,721 10,001	2000 2008	SMP database SMP database
Flamborough and Filey Coast	E England	10,570 (2008-2011)	Not yet				See row above
UK Western waters							
North Rona and Sula Sgeir	N Scotland	1,541 (1986)	2001	Declined 2012	1,089 North Rona only: 552 344	1998 1998 2012	SMP database SMP database SMP database
Cape Wrath	NW Scotland	1,206	1996	Maintained 2000	2,090	2000	Seabird2000
Handa	NW Scotland	10,432 (1997)	1990	Declining 2006	11,384 8,660 5,165	2001 2006 2010	SMP database SMP database SMP database
St Kilda	Western Isles	2,546	1992	Maintained 2000	1,700	1999	Seabird2000
Shiant Isles	Western Isles	7,337 (1986)	1992	Declined 2008	5,391 4,248	1999 2008	SMP database SMP database
Flannan Isles	Western Isles	2,117 (1988)	1992	Recovering 2013	1,051	1998	SMP database
Mingulay and Berneray	Western Isles	11,323 (1985)	1994	Declined 2009	15,343 22,633 10,111	1998 2003 2009	SMP database SMP database SMP database
Rathlin Island	N Ireland	5,978 (1985)	1999		13,976 7,158 15,393	1999 2007 2011	SMP database SMP database SMP database
Skomer and Skokholm	Wales	2,854 (1997)	1982		2,800 2,631 2,198 2,699 2,607 6,001	2008 2009 2010 2011 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

22.10 BDMPS

Two spatial BDMPS areas can be defined; the UK North Sea and Channel, and UK western waters. Birds from colonies in the UK North Sea tend to remain in the North Sea or to migrate south through the North Sea and Channel to reach winter quarters in southern Europe. Birds from colonies in UK western waters tend to migrate south through UK western waters, and very few from those colonies enter the North Sea. So these two BDMPS are fairly discrete populations. However, razorbills migrate further southwards than common guillemots, and relatively few razorbills from UK colonies remain in UK waters in winter, so there is a need to separate two distinct seasonal BDMPS periods; migration seasons (August-October, and January-March), and winter (November-December).

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 64 to 67.

Based on evidence reviewed in sections 22.5, 22.6 and 22.7, the UK North Sea and Channel non-breeding season BDMPS is estimated to hold 95% of adults and 90% of immatures from colonies in Shetland, Orkney and north Caithness, 100% of adults and 90% of immatures from colonies on the UK North Sea coast from Caithness to East Anglia, 2% of adults and 5% of immatures from colonies in UK western waters from NW Scotland to SW England, 5% of adults and 10% of immatures from Russia, 30% of adults and 40% of immatures from Iceland, 20% of adults and 50% of immatures from Norway, 10% of adults and 30% of immatures from Denmark, Finland and Sweden, 50% of birds from Faroe, 2% of adults and 5% of immatures from Ireland, 1% of adults and 2% of immatures from France. These proportions result in an estimated BDMPS for the migration seasons of 591,874 birds, 157,443 from UK and 434,431 from overseas populations (Appendix A Table 64).

Based on evidence reviewed in sections 22.5, 22.6 and 22.7, the UK western waters non-breeding season BDMPS is estimated to hold 5% of adults and immatures from colonies in Shetland, Orkney and north Caithness, 0% of adults and 2% of immatures from colonies on the UK North Sea coast from Caithness to East Anglia, 98% of adults and 90% of immatures from colonies in UK western waters from NW Scotland to SW England, 5% of adults and 10% of immatures from Russia, 30% of adults and 40% of immatures from Iceland, 10% of adults and 30% of immatures from Norway, 5% of adults and 10% of immatures from Denmark, Finland and Sweden, 50% of birds from Faroe, 10% of adults and immatures from Ireland, 5% of adults and immatures from France. These proportions result in an estimated BDMPS for the migration seasons of 606,914 birds, 190,035 from UK and 416,879 from overseas populations (Appendix A Table 65).

Based on evidence reviewed in sections 22.5, 22.6 and 22.7, the UK North Sea and Channel winter season BDMPS is estimated to hold 30% of adults and 10% of immatures from UK North Sea colonies, 10% of adults and 5% of immatures from colonies in UK western waters in Scotland, 5% of adults and no immatures from colonies in Northern Ireland, Wales and SW England, 1% of adults and 2% of immatures from Russia, 10% of adults and 20% of immatures from Iceland, 5% of adults and 10% of immatures from Norway, 2% of adults and 5% of immatures from Denmark, Finland and Sweden, 30% of birds from Faroe, 1% of adults and 2% of immatures from Ireland, 5% of adults and 5% of immatures from France. These proportions result in an estimated BDMPS for the winter season of 218,622 birds, 45,753 from UK and 172,869 from overseas populations (Appendix A Table 66).

Based on evidence reviewed in sections 22.5, 22.6 and 22.7, the UK western waters winter season BDMPS is estimated to hold 1% of adults and 2% of immatures from colonies in the UK North Sea coast, 40% of adults and 10% of immatures from colonies in UK western waters from NW Scotland to Northern Ireland, 30% of adults and 10% of immatures from

colonies in Wales and SW England, 1% of adults and 2% of immatures from Russia, 20% of adults and 30% of immatures from Iceland, 5% of adults and 10% of immatures from Norway, 2% of adults and 5% of immatures from Denmark, Finland and Sweden, 30% of birds from Faroe, 10% of adults and 10% of immatures from Ireland, 5% of adults and 5% of immatures from France. These proportions result in an estimated BDMPS for the winter season of 341,422 birds, 53,063 from UK and 288,359 from overseas populations (Appendix A Table 67).

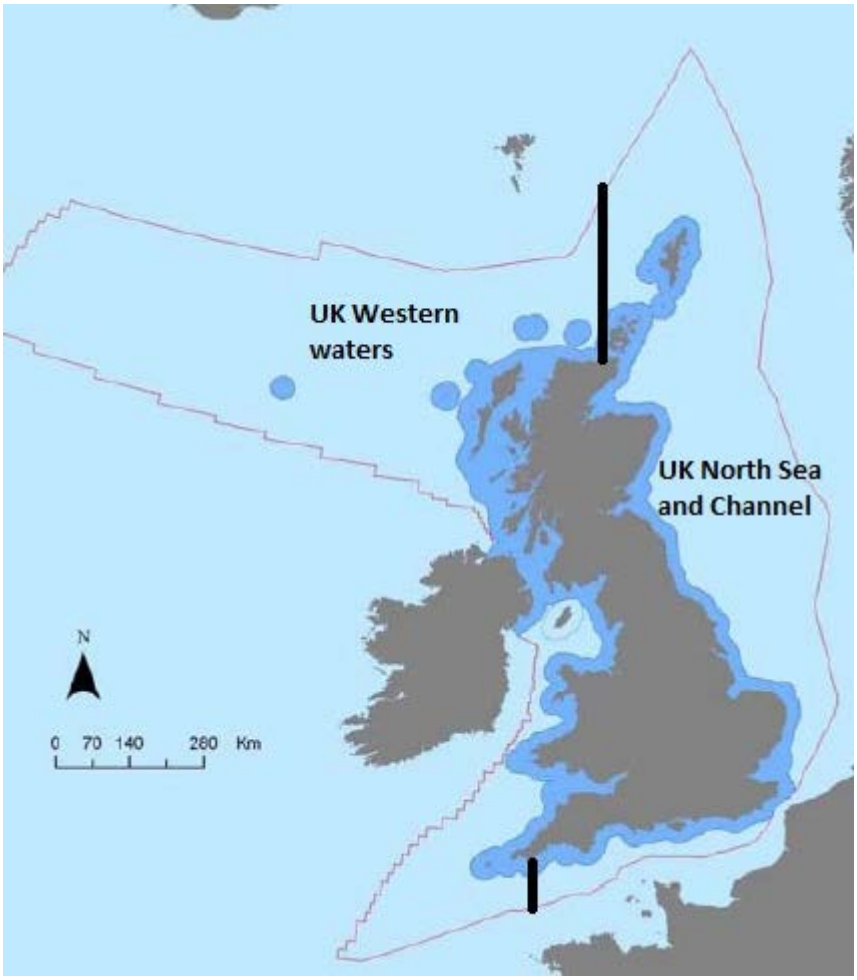


Figure 22.8. Two defined BDMPS spatial areas for razorbill: 'UK North Sea waters and Channel' and 'UK Western waters'.

22.11 Proportions of UK SPA birds in BDMPS

A very high proportion of razorbills in the UK are from UK SPA populations, estimated at around 90%. Given the large number of designated colonies and the high proportion of the total population in those sites, the proportion of the BDMPS that is from UK SPAs will mainly be determined by relative numbers of birds coming from overseas populations into these areas. Those numbers of overseas birds are very uncertain. Proportions of birds that are adults from UK SPA colonies in each BDMPS can be estimated directly from the data in Appendix A Tables 64 to 67. For example, in the UK North Sea and Channel migration seasons BDMPS (591,874 birds) there are estimated to be 71,824 adults from SPA colonies, so these represent 12% of the total birds present. In the UK western waters migration seasons BDMPS (606,914 birds) there are estimated to be 92,176 adults from SPA colonies, so these also represent 15% of the total birds present.

22.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Given the high mobility of razorbills, their relatively long distance migrations, and the large numbers of migrants from overseas passing through and wintering in UK waters, birds from UK SPA populations are likely to be very well mixed within each of the BDMPS populations in migration seasons and in winter.

23. BLACK GUILLEMOT *Cepphus grylle*

Black guillemot BDMPS is defined as the population of birds resident within a circle or buffer zone of 20 km radius around any focal site. There are 26,000 pairs in UK so 52,000 adults plus 1.32 immatures/adult. No birds from overseas populations are known to visit UK waters except as rare vagrants.

23.1 Breeding range and taxa

Black guillemot has an almost circumpolar breeding range in Arctic and sub-Arctic latitudes. There are five subspecies. *C. g. arcticus* breeds in Britain, eastern North America, southern Greenland, Denmark, SW Sweden and from Norway to the White Sea. Nominate *C. g. grylle* breeds only in the Baltic. Subspecies *faeroeensis* only in Faroe. Subspecies *islandicus* only in Iceland. Subspecies *mandtii* from northern Siberia to arctic Canada and northern Greenland. There appears to have been no assessment of whether biometrics would allow origins of individuals to be identified, but evidence indicates that hardly any birds from overseas have ever reached UK waters, so in view of the highly sedentary nature of this species within the British Isles and in nearby countries, there is unlikely to be any detectable numbers of birds from overseas reaching the UK.

23.2 Non-breeding component of the population

Black guillemots start to breed when 4 years old (BTO Birdfacts). Adult survival rate is 0.87 (BTO Birdfacts), juvenile survival unknown (BTO Birdfacts) and mean productivity is 1.295 chicks per pair (JNCC database, n=58 measurements). To obtain a stable population, survival of immatures was adjusted to 0.5 for juveniles, 0.6 for 1-year olds, 0.77 for 2-year olds, and 0.87 for 3-year olds. The model population comprised 43% adults, 28% juveniles and 29% older immatures. There are 1.32 immatures per adult.

23.3 Phenology

Breeding colonies in the UK are deserted in September, with modal departure in August (Pennington et al. 2004; Forrester et al. 2007). Black guillemots in the UK do not migrate, and rarely disperse far from their colonies. The Trektellen seawatching UK sites (predominantly in south and east England) reported only extremely low numbers of birds per hour, with no clear seasonal patterns apart from a slightly higher mean number in autumn and winter than in spring or summer, suggesting a slight post-breeding dispersal in August (Figure 23.1). However, it is noteworthy that numbers of black guillemots reported were considerably lower than even the numbers of roseate terns at these seawatching sites. Birds re-occupy colonies from late March, with modal return in early April (Pennington et al. 2004; Forrester et al. 2007).

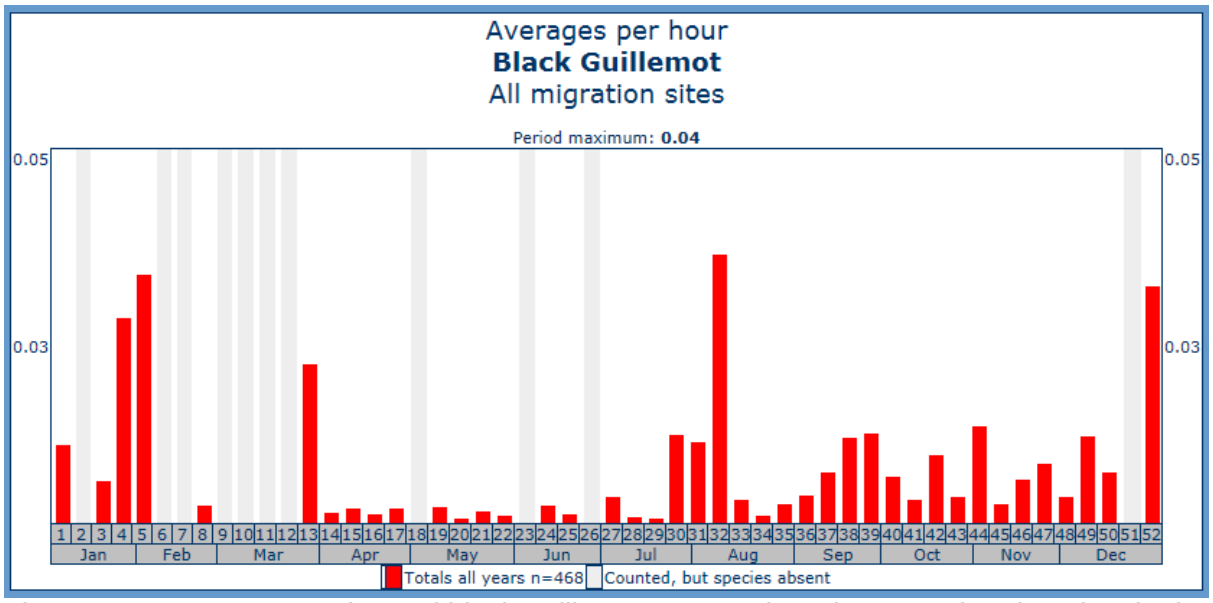


Figure 23.1. Average numbers of black guillemots counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) did not consider seasonality of black guillemot. From the data reviewed above, an appropriate definition would be breeding season April-August, non-breeding season September-March, but with negligible dispersal/migration occurring.

23.4 Defined seasons:

- UK Breeding season — April-August
- Post-breeding migration in UK waters — not evident
- **non-breeding season** — **September-March**
- Return migration through UK waters — not evident
- Migration-free breeding season — April-August
- Migration-free winter season — September-March

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for black guillemot:

Non-breeding season BDMPS (September-March).

23.5 Movements of birds from the UK population

Black guillemot populations in Britain and Ireland are considered to be sedentary, with no seasonal migration and negligible seasonal dispersal; no British ringed black guillemot has been recovered abroad (Wernham et al. 2002). However, there is evidence from counts at different times of year for birds moving away from particularly exposed coasts during winter to more sheltered coasts (e.g. from Foula and Fair Isle which are very exposed coastlines; Ewins and Kirk 1988; Pennington et al. 2004). Ring recoveries from Fair Isle include several birds that moved as far as Orkney or the north coast of Scotland and two cases where young birds were recovered in winter in east England (Wernham et al. 2002). However, Ewins and Kirk (1988) concluded that most black guillemots in Shetland never move more than 10-15 km from their natal site. Timing of such migration is difficult to assess, and probably occurs in response to severe weather so tends to occur in autumn and winter. The Trektellen seawatching data for UK, which mainly come from sites in Yorkshire, suggests that the few records of black guillemot occur mostly between late July and March, which fits in with the

idea that these birds are predominantly storm-driven juveniles seeking shelter. Shetland, Fair Isle, and Orkney Bird Reports provide very little indication of dispersal movements by black guillemots as the species is present throughout the year in those areas and there is little or no evident seasonal variation in numbers present.

23.6 Movements of birds from overseas into UK waters

Black guillemots in Faroe are also sedentary; no black guillemots ringed in Faroe have been recovered away from the archipelago (Hammer et al. 2013) and the same applies in Iceland, where only short-distance (longest documented movement 10.5 km) natal dispersal occurs (Frederiksen and Petersen 2000). The lack of movement between Iceland, Faroe and UK is also suggested by the fact that these three populations are classified into three distinct subspecies: *islandicus* in Iceland, *faeroeensis* in Faroe, and *arcticus* in UK. There are no records of *islandicus* or *faeroeensis* in Scotland (Forrester et al. 2007). Numbers of black guillemots arriving in UK waters from overseas are apparently most likely to be occasional birds from southern Norway (where there are thousands) and southern Sweden (where there are thousands) (Mitchell et al. 2004). In relation to resident populations on northern Scottish coasts (Shetland, Orkney, NE Scotland) the numbers of arrivals from Scandinavia are likely to be negligible, while along the English east coast and south-east coast of Scotland, where the species is not resident (Mitchell et al. 2004), the very small numbers that arrive there (the 2007-11 Atlas suggests some 19 records in those 5 years of survey; Balmer et al. 2013) are probably about as likely to originate from Scandinavia as from Scotland. There are two recoveries of young birds from southern Sweden recovered on the coast of east England (Wernham et al. 2002). The 2007-11 Atlas also shows 6 records in the 5 years of survey in SW England, where the species is also not resident, and those birds are likely to have originated from populations in Wales or Ireland; if exposed areas are the likely source then probably these birds moved from SW or S Ireland where there are large breeding numbers on relatively exposed coast. Apart from these very small numbers moving beyond normal breeding range, most areas hold the same population in winter as in the breeding season.

23.7 Numbers in UK waters

The black guillemot only occurs in English waters in extremely small numbers, mostly in autumn, although there are about 7 resident in Cumbria (Mitchell et al. 2014). The population in Wales is extremely small (Seabird 2000 suggested 28 resident individuals), while there are 602 at the Isle of Man (again resident so unlikely to move from there). Northern Ireland holds about 1,200 birds, Scotland about 37,000 to 38,000 birds (Mitchell et al. 2014). The Scottish population is distributed along all western and northern coasts, but is scarce in SW Scotland. In east Scotland, there are very few south of Caithness.

23.8 Biogeographic population

Stroud et al. (2001) did not define the biogeographic breeding population of this species as it is not relevant in terms of the Birds Directive because it is not migratory. However, Mitchell et al. (2004) provided an estimate of the population of the subspecies *arcticus* as 72,377-142,321 pairs. Kober et al. (2010) did not present an estimate for the biogeographic population of this species. Only UK birds and a very few from Ireland occur in UK waters, so the only populations with connectivity to UK waters are the 26,000 pairs in the UK and a very small fraction of the population in Ireland (which comprises about 2,200 pairs (Figure 23.2). No other overseas populations show significant connectivity with UK waters, although a handful of birds that reach the southern North Sea coast of England might possibly originate from Scandinavia as well as from Scotland. The biogeographic population with connectivity to UK waters can be defined as the populations of the UK and Ireland, a total of 28,200 pairs, so 56,400 adults plus 74,000 immatures. This indicates a total of 130,000 birds.



Figure 23.2. Breeding population origins of black guillemots in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

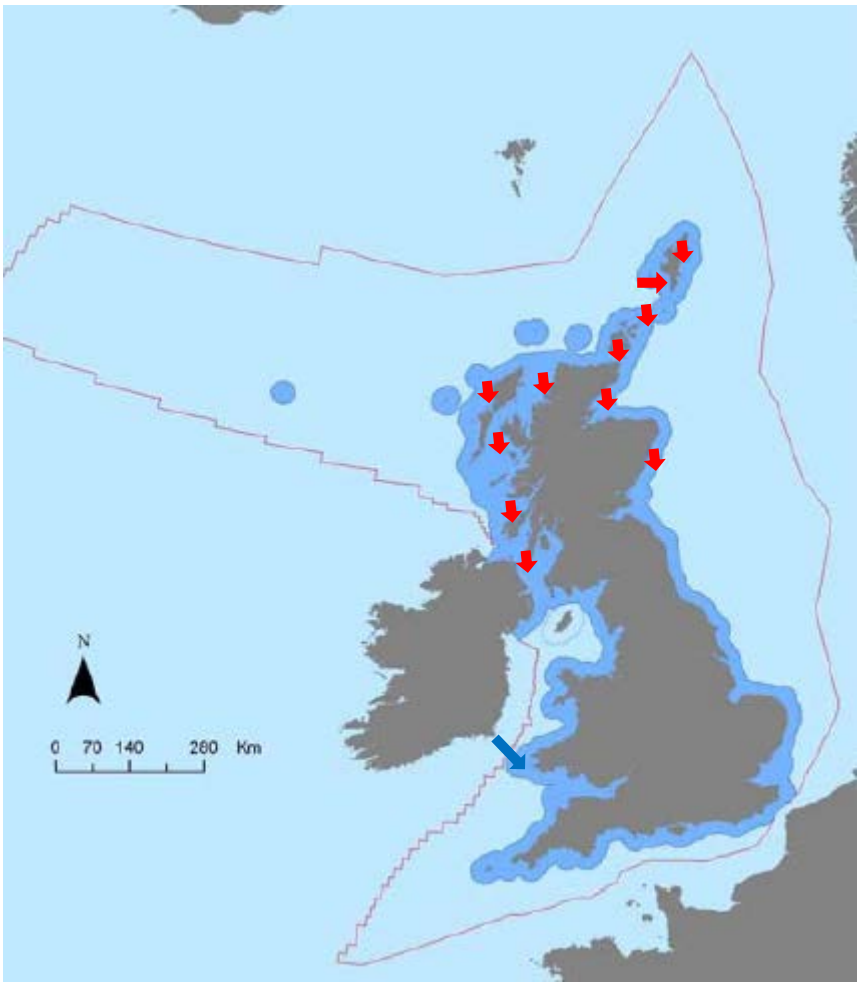


Figure 23.3. Main movements of black guillemots from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

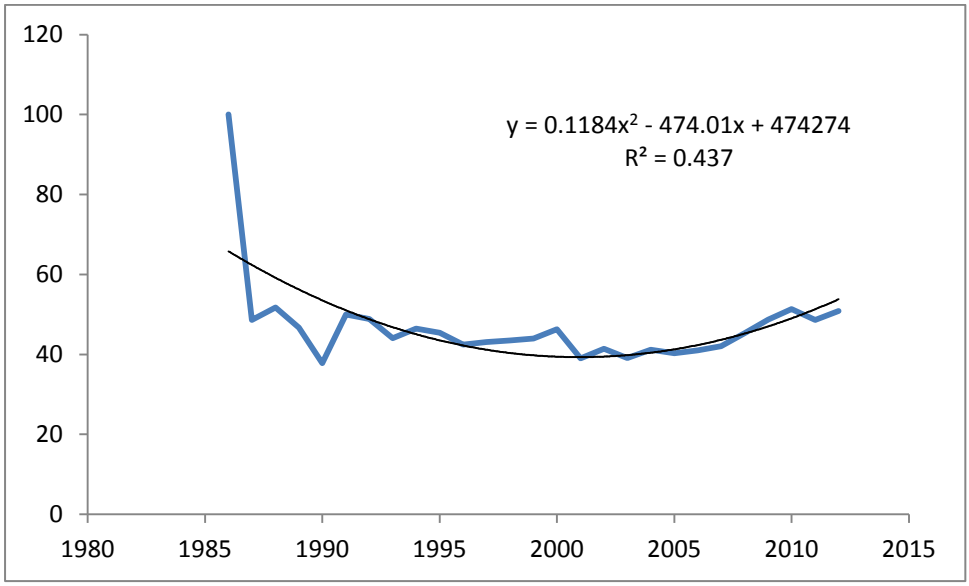


Figure 23.4. Trend in the black guillemot breeding population index in Scotland from 1986-2012. Data from JNCC seabird population monitoring database.

23.9 Proportion of UK population from UK breeding MPAs

There are no SPAs in the UK with black guillemot designated as a feature, since this species does not qualify as a migratory species. However, a number of sites are being considered for designation as Marine Protected Areas in Scottish waters with black guillemot as a designated feature. These include Clyde Sea Sill pMPA (>400 birds), East Caithness Cliffs pMPA (1,500 birds), Fetlar to Haroldswick pMPA (>2,000 birds), Monach Isles pMPA (820 birds), Papa Westray pMPA (>400 birds), and Small Isles pMPA (1,200 birds). These populations together sum to about 6,000 birds, so represent somewhere around 16% of the UK population.

23.10 BDMPS

Occasional birds that disperse exceptionally large distances (in this case exceptionally large means more than about 10-15 km) can be considered as truly exceptional. Since UK black guillemots only rarely move more than a maximum of 15 km from their natal site throughout their lifetime, almost all birds will have connectivity only with sites that are within about a 20 km radius. This allows a BDMPS to be defined as those birds found within 20 km of a specific site.

23.11 Proportions of UK MPA birds in BDMPS

This proportion will be zero for all locations except those that lie at least in part within 20 km of one of the six pMPA populations (recognising that the black guillemot feature in those pMPAs is not necessarily distributed throughout the boundary of that pMPA but may be found only in a small part of the pMPA if that is designated for multiple features rather than just for black guillemot).

23.12 Spatial distribution of UK MPA birds across the BDMPS

Within areas that overlap in their 20 km distance envelope with a pMPA black guillemot feature, the spatial distribution of MPA birds within the BDMPS is likely to be highly aggregated at the pMPA site.

24. ATLANTIC PUFFIN *Fratercula arctica*

	Biogeographic population with connectivity to UK waters (adults and immatures)	Numbers in UK waters in non-breeding season (mid-August to March) (adults and immatures)
Overseas	9,470,000	188,586
UK	2,370,000	347,928
Total	11,840,000	536,514

	Total number of birds in BDMPS (adults plus immatures)	Number from overseas populations (adults plus immatures)	Number from UK population (adults plus immatures)
Non-breeding season BDMPS (mid-August to March)			
UK North Sea and Channel	231,957	69,896	162,061
UK Western waters	304,557	118,690	185,867

Puffins are especially difficult to census because they are burrow-nesters and many of the very large colonies are partly or completely inaccessible, or in habitat where burrows cannot be identified (e.g. cliff fissures and boulder fields). Numbers of puffins are sometimes censused by counting birds on the colony surface, but such numbers fluctuate dramatically from hour to hour, day to day, and through the summer. As a result, the sizes of many puffin breeding populations are only very approximately known. This results in colour coding the estimated biogeographic population size as red. Puffins are also particularly difficult to count at sea because thyey are small, dark, spend much time underwater, and tend to dive as boats approach. So at sea surveys apparently underestimate puffin numbers. They disperse over huge areas of ocean at low densities. In addition, although large numbers have been ringed, the ring recovery rate is especially low, and probably presents a highly biased picture of where puffins die, never mind where they live during the non-breeding period. For all these reasons, the estimation of numbers of puffins in BDMPS populations is especially uncertain, so is coded red. There have been a few small projects deploying geolocators on breeding adult puffins which do provide some insights into their movements in the non-breeding season. Those studies found results that are rather divergent from the picture based on ring recovery data and at sea studies, and suggest that puffin migrations may well be changing over time in response to population density and food resources, but may also indicate large variations in behaviour between colonies, or between years. Much more deployment of geolocators, including at colonies of overseas populations would be necessary to provide higher confidence in puffin BDMPS population sizes and geographic distributions.

Calculations on which these summary tables are based, and contributions of individual SPA populations to each BDMPS, are tabulated in Appendix A Tables 68 and 69.

24.1 Breeding range and taxa

The Atlantic puffin has been split into three subspecies, nominate *arctica* in Iceland, north Norway, east Canada and most of Greenland, *naumanni* in the far north of Greenland and in Svalbard, and *grabae* in Faroe, Britain, Ireland, and southwest Norway (Wernham et al. 2002). However, the validity of these subspecies has been challenged and it is often treated as a monotypic species (e.g. Forrester et al. 2007). There is very considerable clinal variation in size, with birds from northern colonies very much larger (Barrett et al. 1985; Harris and Wanless 2011 Appendix 1). Birds from the Channel Islands have a mean wing length of 157.9 mm, while birds from Hornøya north Norway have a mean winglength of 177.6 mm and those from Spitsbergen a mean winglength over 184 mm. Such biometric variation could potentially be used to assess origins of birds sampled in winter. However, this could be complicated at a local scale where there can be significant differences in biometrics between colonies at similar latitudes. For example, puffins from St Kilda (winglength 158.2 mm) are significantly smaller than puffins from SE Scotland (winglength 161.8 mm).

24.2 Non-breeding component of the population

According to the BTO, Atlantic puffins start to breed when 5 years old (BTO Birdfacts; source of data not presented), and this value was initially used in the model, although Harris and Wanless (2011) found that the median age of first breeding on the Isle of May was at 7 years old. Adult survival rate is 0.924 (BTO Birdfacts; Harris et al. 1997), juvenile survival unknown (BTO Birdfacts) and mean productivity is 0.67 chicks per pair (JNCC database, n=94 measurements). Harris and Wanless (2011) point out that adult survival rate varied in the Isle of May population from high levels around 0.97 in the 1970s to about 0.9 in the 2000s, so adult survival is not a species-specific constant but is affected by environmental conditions. Survival rates of adults have been estimated at 0.93 in Skomer, 0.935 in Isle of May, Fair Isle, Rost and Hornoya (Harris and Wanless 2011). To obtain a stable population for a model based on the BTO data summaries, survival of adults was set at 0.924, survival of immatures was adjusted to 0.56 for juveniles, 0.66 for 1-year olds, 0.75 for 2-year olds, 0.9 for 3-year olds and 0.91 for 4-year olds. The model population comprised 55% adults, 18% juveniles and 27% older immatures. There are 0.82 immatures per adult. However, altering the age of first breeding to 7 years but retaining adult survival as 0.924 generates a model population with 1.08 immatures per adult. For the population based on Isle of May demographic data (taking average adult survival as 0.93 and age of first breeding as 7 years) there are 1.04 immatures per adult. This last scenario seems to be the most appropriate from these alternatives.

24.3 Phenology

Breeding colonies in the UK are deserted around mid-August, with modal departure in mid-July to early August (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007). Autumn dispersal/migration starts in early July (Forrester et al. 2007), late July (Pennington et al. 2004) or early August (Cramp et al. 1977-94; Wernham et al. 2002). Peak autumn migration occurs in late July (Forrester et al. 2007), early August (Pennington et al. 2004; Brown and Grice 2005), August (Wernham et al. 2002), or September-November throughout Europe (Cramp et al. 1977-94). Peak rate of change in numbers observed in autumn at Trektellen seawatching UK sites (predominantly in south and east England) occurred in July-early August, suggesting dispersal away from the coast in that period (Figure 24.1). Autumn migration is completed by August (Forrester et al. 2007), late-August (Wernham et al. 2002; Pennington et al. 2007) or December when considering the entire North Atlantic range (Cramp et al. 1977-94).

Spring migration starts in January (Cramp et al. 1977-94), February (Wernham et al. 2002; Forrester et al. 2007) or March in Shetland (Pennington et al. 2004). Peak spring migration occurs in February (Cramp et al. 1977-94), in March (Forrester et al. 2007), in March-April (Wernham et al. 2002) or in Shetland in mid-April (Pennington et al. 2004). Increase in

numbers observed in spring at Trektellen seawatching UK sites (predominantly in south and east England) occurred in March-April (Figure 24.1). Spring migration is completed by March (Cramp et al. 1977-94), April (Wernham et al. 2002; Forrester et al. 2007) or May in Shetland (Pennington et al. 2004).

The first spring records of Atlantic puffin in Shetland, Fair Isle, Orkney, and Argyll Bird Reports for 2007 to 2012 were from January to 24 April, but mostly in February or March, and the last records were from 23 August to 23 December, but mostly in October. Peak autumn migration was reported in July or August in most years, and peak spring migration was reported in April in most years. Birds re-occupy colonies from late February to late March, with modal return in March to mid-April (Pennington et al. 2004; Brown and Grice 2005; Forrester et al. 2007).

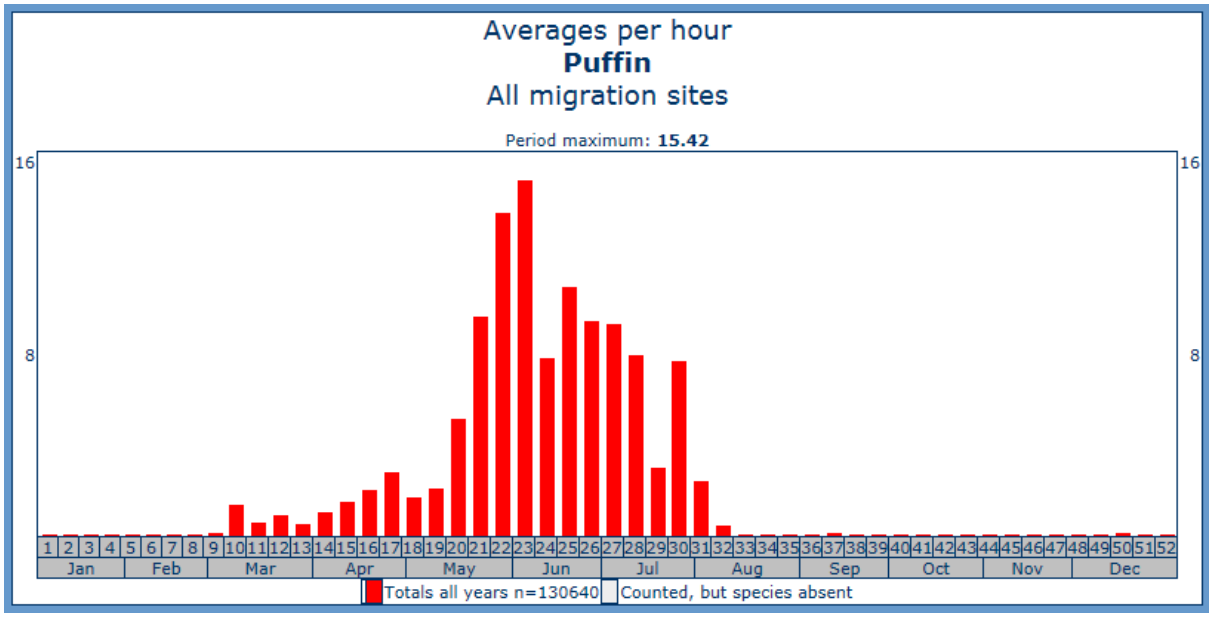


Figure 24.1. Average numbers of Atlantic puffins counted per hour at migration sites in the UK (which are mostly in south or east England). Data from Trektellen database accessed from the internet in January 2014.

Kober et al. (2010) defined breeding season as April-June, non-breeding season August-March. However, from the data reviewed above, a more appropriate definition would be breeding season April-early August, non-breeding season mid August-March.

24.4 Defined seasons:

- UK Breeding season — April-early August
- Post-breeding migration in UK waters — late July-August
- non-breeding season — mid-August-March (**non-breeding BDMPS**)
- Return migration through UK waters — March-April
- Migration-free breeding season — May-June
- Migration-free winter season — September-February

Apart from the breeding season, one seasonal BDMPS period is considered to be appropriate for Atlantic puffin:

Non-breeding season BDMPS (mid-August to March).

24.5 Movements of birds from the UK population

All puffins leave UK colonies and the immediately adjacent sea area by late August (Wernham et al. 2002; Harris and Wanless 2011). Birds apparently migrate rapidly away from breeding areas, fledglings travelling independently of adults (Harris and Wanless 2011). It used to be thought that adults undergo moult of flight feathers in mid-winter rather than immediately after chicks fledge (Harris and Yule 1977), although flightlessness in puffins due to moult has been found in all months between September and April (Harris and Wanless 2011). Recent data suggest that most adult puffins become flightless due to moult in October-November, and have generally completed renewal of primaries by December (Harris and Wanless 2011). The youngest age-classes of immature puffins apparently moult primaries in summer rather than in winter but details of how moult changes with age are rather unclear (Harris and Wanless 2011). Autumn migration takes puffins into the open sea or ocean, where they spread out thinly over huge areas. Ring recoveries come from Faroe and southern Norway to north Africa, from the western Mediterranean Sea to Newfoundland. It is thought that many puffins from UK colonies overwinter in the central North Atlantic (Wernham et al. 2002), although there is little evidence on this from ringing (Harris and Wanless 2011). All the ring recoveries of British puffins from Canadian waters were from juveniles. No adults are known from ringing to have wintered in the western North Atlantic (Wernham et al. 2002). However, geolocation data loggers deployed on breeding puffins at a colony in SW Ireland showed that most of these birds went to the Newfoundland-Labrador Shelf and remained there during August-September, moving in October back to the mid-Atlantic (Jessopp et al. 2013). This was interpreted as a strategy to exploit the abundant stock of capelin in Newfoundland waters in late summer which is seasonally concentrated in that area. That stock is the main food of puffins from local Newfoundland colonies in late summer (Hedd et al. 2010). It is possible that puffins from many colonies in the British Isles show this migration pattern, but Jessopp et al. (2013) also suggest the possibility that this might be a feature of the particular colony they studied rather than a widespread general pattern. Deployment of geolocators on breeding adult puffins at a colony in Wales (Guilford et al. 2011) also showed very rapid movement of birds westwards in August, with median positions of individuals in August from the Bay of Biscay to Newfoundland, but with most birds in an area between Newfoundland and waters south of Iceland. By October, median positions had moved to a large area between north of Iceland and west of Scotland, and by February birds were distributed widely, but much further south in an area from west of Scotland to the western Mediterranean (see figure 1 in Guilford et al. 2009). This suggests that an early migration to Newfoundland-Labrador in August may be typical for many adult puffins from British colonies, but that birds only stay in that area for a few weeks before moving eastwards, then southwards during the early winter. Guilford et al. (2009) suggest (speculatively) that this long distance but predominantly dispersive migration of puffins may be an exploratory response, rather than being based on genetic inheritance of compass instructions or cultural inheritance of traditional routes, since birds from their study colony became so widely dispersed over large areas that it is difficult to see how this would be under genetic control. Abundance of capelin in Newfoundland-Labrador waters varies enormously over the years as this is a short-lived fish which is affected by climate, and by abundance of predatory fish (especially cod) (Davoren and Montevecchi 2003; Gaston et al. 2010), so the extent to which puffins from British colonies visit Newfoundland-Labrador waters to exploit capelin in late summer may vary over years/decades as the biomass of this stock fluctuates. Ring recoveries had suggested that puffins from colonies in NE England and SE Scotland winter predominantly within the North Sea, with very few of those birds passing through the English Channel, so possibly those birds do not cross the Atlantic in the way that birds from SW Ireland and Wales have been shown to do. It had been suggested that a slight increase in numbers from North Sea colonies reaching France may reflect the increase in population size at UK North Sea colonies and so increased competition for food (Harris 1984). However, deployment of geolocators on breeding adult puffins at the Isle of May indicated that in August-December 2007 about one-third of these birds moved into the

east Atlantic, mostly off west Scotland and SW Ireland, rather than remaining in the North Sea, while most birds were distributed throughout the NW North Sea (Harris et al. 2010; 2013). This was interpreted by Harris et al. (2010) as supporting evidence from ringing that an increasing proportion of North Sea puffins were moving beyond the North Sea in response to increased population size and deteriorating conditions in the North Sea. A further deployment of geolocators on breeding adult puffins at the Isle of May in 2009 showed similar results. Interestingly, puffin survival was very poor in 2007-08 but was high in 2009-10, yet the distributions of birds overwinter in these two winters were very similar. Moving out of the North Sea into the Atlantic does not seem to correlate with over-winter survival. The geolocator data do suggest, however, that there may be substantial mixing of puffins from east and west Britain in waters west of Britain and Ireland in winter, though probably very few, if any, puffins from western colonies enter the North Sea to mix with local birds there (Harris and Wanless 2011). As with most other seabirds, ring recoveries indicate that young birds tend to travel further (south and west) from their colonies than do adults, although in the case of the puffin, the non-breeding range is not dramatically different between juveniles and adults (Wernham et al. 2002; Harris and Wanless 2011). In east Scotland, adult puffins may return to the colony in late February or March (Harris and Wanless 2011 Appendix 3), but elsewhere in the UK adults tend to return to colonies in late March or April (Wernham et al. 2002; see also Harris and Wanless 2011 Appendix 4 for Skokholm, Wales). Studies on the Isle of May indicate that about 50% of puffins reared there recruited back into that colony while 50% emigrated to breed elsewhere; birds ringed as chicks on the Isle of May have been found breeding in colonies all around the British Isles (Wernham et al. 2002). As immatures, puffins may visit several colonies before deciding where to settle to breed. These prospecting movements can take immatures to colonies hundreds of kilometres apart during the breeding season, although once a puffin has bred, which usually occurs first when 5 to 7 years old, they then remain highly faithful to their breeding site (Harris and Wanless 2011).

24.6 Movements of birds from overseas into UK waters

A total of 21 puffins ringed abroad have been recovered in the British Isles, 15 from Norway, one from Faroe, and 5 from France (Wernham et al. 2002). The one recovery of a puffin from Faroe was one of only four Faroese puffins recovered away from those islands, the others being found in France, Iceland and Greenland. So details of the migrations of Faroese puffins are unclear (Hammer et al. 2013). Although no Icelandic-ringed puffins have been recovered in the British Isles, three have been recovered in Faroe (Hammer et al. 2013) so it is reasonable to infer that some Icelandic puffins might visit UK waters during migration or winter. However, Petersen (1982, 1998) considered that SW Icelandic puffin adults most likely winter between Iceland, Greenland and Newfoundland, while those from N and E Iceland may winter from Iceland towards Norway and Faroe; there is therefore no reason to think that Icelandic puffins migrate through, or overwinter in, UK waters. According to Anker-Nilssen et al. (2000), puffins ringed in northern Norway (Barents Sea colonies) have been reported in winter from Iceland, Greenland and Newfoundland, but most recoveries have come from the southern part of the Norwegian Sea, especially around the Faroes, and in the northern part of the North Sea. However, it may be inappropriate to infer that larger numbers of recoveries in the Norwegian and North Sea imply that more puffins winter there than in the west Atlantic, since the probability of a bird being recovered may be dramatically different between these regions. Satellite tracking of five adult puffins immediately after breeding on Røst, Norway, showed all of those birds moving northwards into the Barents Sea, where densities of puffins in late summer are known to be very high (Anker-Nilssen and Aarvak 2009), suggesting that puffins from Norwegian colonies mainly disperse northwards post-breeding before moving westwards into the northern North Atlantic. Ringing data indicate that juvenile puffins from Norway are more likely to be recovered in the west Atlantic than are adults (Harris and Wanless 2011), but this may in part reflect differences in mortality risk rather than just differences in distribution between

age classes. Measurements of 98 puffins collected from beaches during a wreck in Shetland in winter 1990-91 indicated that almost all of those birds originated from colonies around the North Sea, with all age classes similarly affected; only two first-winter birds in that sample had wing lengths suggesting they came from the far north (Harris et al. 1991; Pennington et al. 2004).

24.7 Numbers in UK waters

Harris and Wanless (2011) report densities of puffins at sea in winter in the North Sea as around one bird per 20 km^2 and one bird per 5-10 km^2 in areas of the North Sea where puffins are seen regularly. European Seabirds at Sea (ESAS) data indicate a similar density in winter in waters to the west and northwest of Scotland, but somewhat lower density in waters SW of Scotland and west of Ireland, in the SE North Sea, and in the Irish and Celtic Seas (Harris and Wanless 2011). Although puffin distribution at sea in the North Sea during the breeding season reflects the distribution of colonies, birds quickly move away from colony areas in August, and form concentrations about 50 km offshore off south-east Scotland or north-east England (Harris and Wanless 2011). This concentration persists through September, but densities then decline slightly, until February-March when puffins move back to breeding sites (Harris and Wanless 2011). Fauchald and Tveraa (2009) estimated that between November and March, total numbers of puffins were 29,000 in the North Sea, 103,000 in the Norwegian Sea, and 31,000 in the Barents Sea. However, Harris and Wanless (2011) point out that if 75% of puffins from North Sea colonies are in the North Sea by January, as suggested by geolocator data from Isle of May puffins, then there should be at least 200,000 puffins in the North Sea at that time, rather than the 29,000 estimated by Fauchald and Tveraa (2009) based on the ESAS data. Harris and Wanless (2011) suggest that ESAS data may detect only about 20% or fewer of the puffins that are present, so that at-sea survey data seriously underestimate numbers of puffins dispersed over large areas of sea and ocean.

24.8 Biogeographic population

Stroud et al. (2001) defined the biogeographic breeding population as that of the subspecies *grabae* population, comprising 901,000 pairs. However, the validity of that subspecies is questionable. Mitchell et al. (2004) provided an estimate of the population of the subspecies *arcticus* (including birds of the supposed form *grabae*) as 5,500,000-6,600,000 pairs. Kober et al. (2010) presented an estimated biogeographic population of 13,500,000 individuals based on the appropriate biogeographic population being the subspecies *arcticus*. The biogeographic population with connectivity to UK waters includes populations from UK, Norway, Faroe, Ireland and France. These sum to 11,840,000 birds (adults and immatures) with 2,370,000 from UK and 9,470,000 from overseas populations. Total numbers in UK waters in the non-breeding season sum to an estimated 537,000 birds, 348,000 from the UK population and 189,000 from overseas populations, as most of the UK population moves rapidly out into the open North Atlantic across to Canada and southern Greenland rather than spending the non-breeding period in UK waters. However, we can have very little confidence in the accuracy of these estimates, and true totals may be very considerably different from these estimates. It does appear, however, that numbers present in UK waters in the non-breeding season are very small compared to the size of the biogeographic population.



Figure 24.2. Breeding population origins of puffins in UK waters during migrations and winter. Estimated numbers of breeding pairs in each population are given. Base map from OpenStreetMap www.openstreetmap.org ©OpenStreetMap contributors.

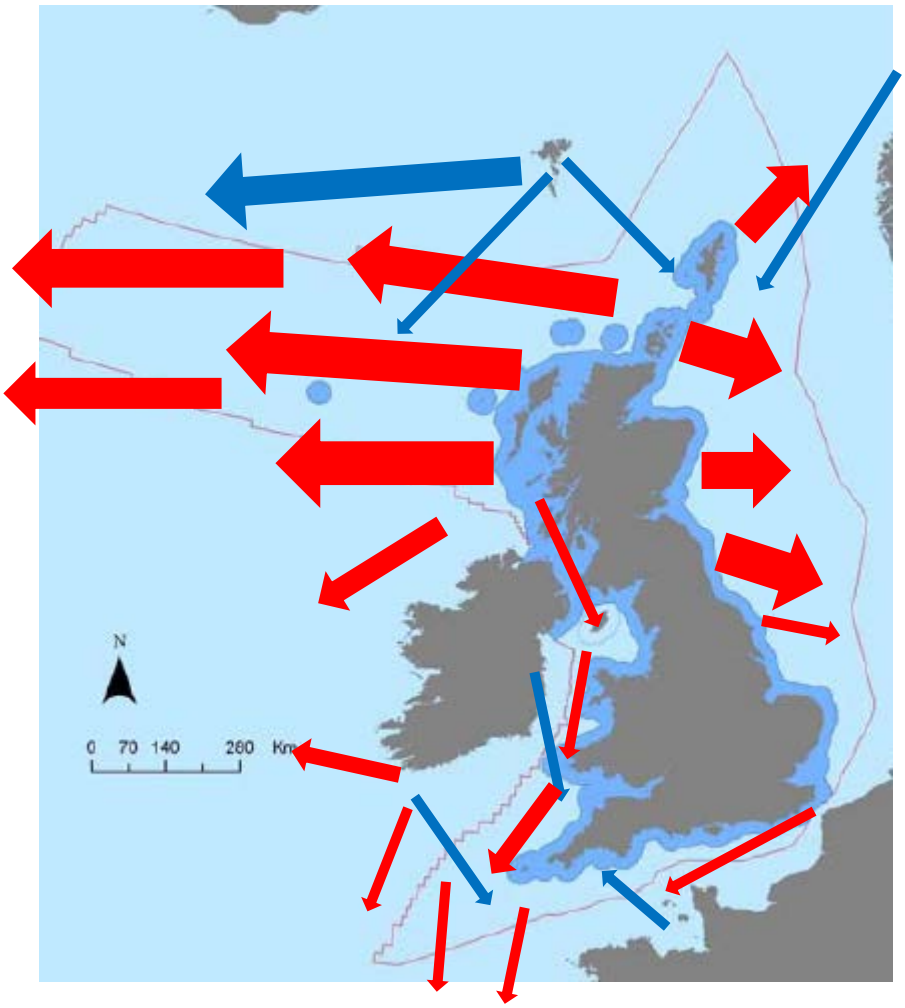


Figure 24.3. Main movements of puffins from UK breeding areas (red arrows) and from overseas populations (blue arrows) into UK waters during post-breeding dispersal/migration. Arrows imply general patterns of movement and should not be taken literally as indicating exact routes or exact starting and end points. Similarly, small numbers of birds occur in areas not marked by arrows and some birds may move in different directions from those broad patterns indicated. Movements probably tend to follow coastlines and arrows that cross land do not imply overland migration routes. As far as is known, spring return migration represents a reversal of the pattern shown in this figure.

24.9 Proportion of UK population from UK breeding SPAs

The 21 SPAs with breeding Atlantic puffins as a feature together held 470,284 pairs at designation, estimated to represent ca. 100% of the British breeding population and ca. 12% of the all-Ireland breeding population (Stroud et al. 2001). Based on survey data from 1997-2010, Stroud et al. (2014) estimated that the British SPA suite for puffin held 85.4% of the population, while the single SPA in Northern Ireland held 3.5% of the all-Ireland population.

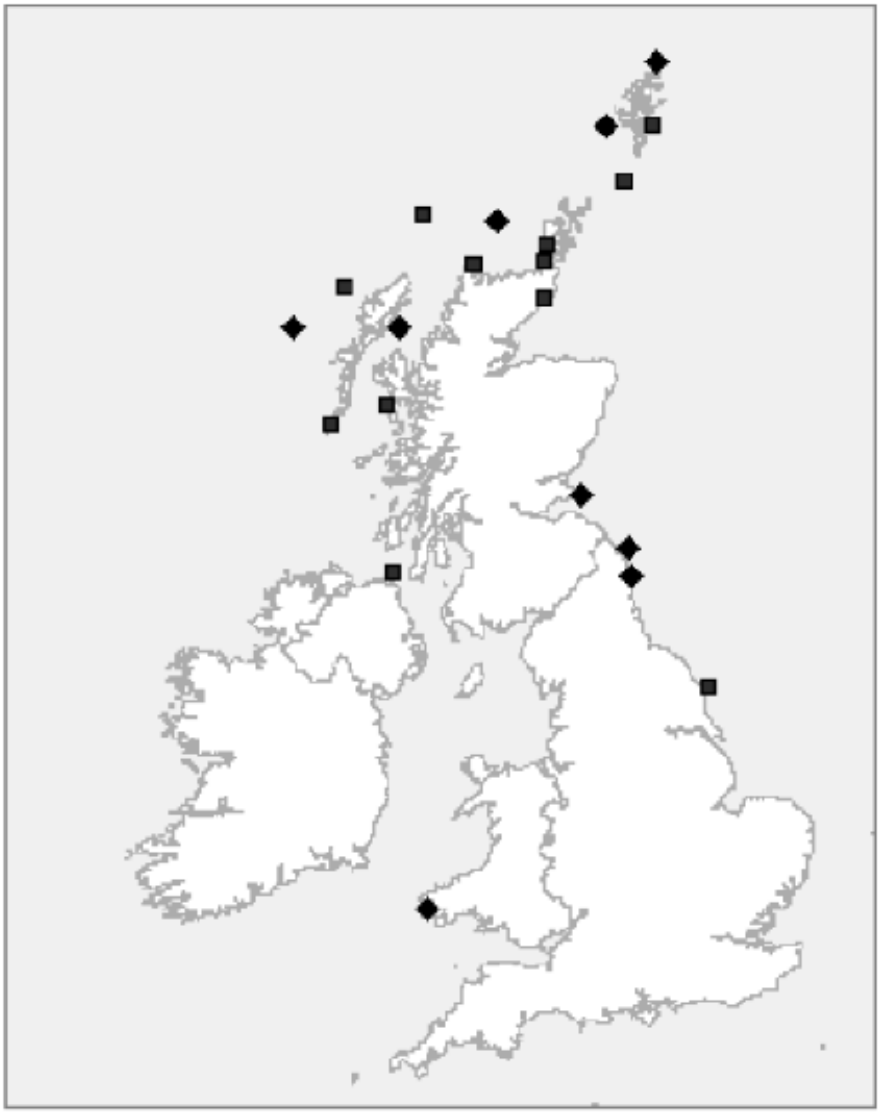


Figure 24.4. UK SPA suite for Atlantic puffin. These SPA populations are listed in Table 24.1.

Table 24.1. The UK SPA suite for breeding puffins.

SPA	Location	Pairs (or birds)	Year desig-nated	Site Condition Monitoring*	Recent count (pairs)	Year	Reference
UK North Sea & Channel							
Hermaness, Saxavord & Valla	Shetland	25,400	1994	Maintained 2002	28,300 23,661	1997 2002	Lewis et al. 2012 Lewis et al. 2012
Foula	Shetland	48,000 (1987)	1995	Declined 2007	22,500	2000	SMP database
Noss	Shetland	2,348	1996	Declined 2007	1,927 900 802	2006 2007 2007	SMP database Lewis et al. 2012 Stroud et al. 2014

Fair Isle	Shetland	8,700	1994	Declined 2009	20,244 42,500 42,000 80,000 54,000 16,700 7,278 10,706	1986 1989 1995 2000 2001 2007 2009 2012	SMP database SMP database SMP database SMP database SMP database SMP database SMP database SMP database
Hoy	Orkney	3,500	2000	Declined 2004	No recent count		No data in SMP
North Caithness Cliffs	N Scotland	(1,750) (1985-1986) in Stroud et al. 2001 but is not accurate	1996	Maintained 2000	976 7,045	2000 1999-2000	SMP database Stroud et al. 2014
East Caithness Cliffs	N Scotland	(1,750) (1985-86) in Stroud et al. 2001 but is not accurate	1996	Maintained 1999	274	1999	SMP database
Forth Islands	E Scotland	14,000 (1985) Or 21,000 (Stroud et al. 2001)	1990	Maintained 2003	21,000 62,500 83,000 50,500 62,231	1992 1998 2003 2009 2008-2010	SMP database SMP database SMP database SMP database Stroud et al. 2014
Farne Islands	NE England	34,710 (1993)	1985		55,674 36,835 39,962	2003 2008 2013	SMP database SMP database SMP database
Coquet Island	NE England	11,400 (1995)	1985		12,075 19,374 15,812 12,344	2004 2008 2009 2013	SMP database SMP database SMP database SMP database
Flamborough Head & Bempton	E England	3,473	1993		2,615 958	2000 2008	SMP database SMP database
UK Western waters							
Cape Wrath	NW Scotland	5,900	1996	Declined 2000	1,602	2000	SMP database
North Rona and Sula Sgeir	N Scotland	5,250	2001	No change 2012	5,442	2001	Mitchell et al. 2004
Sule Skerry and Sule Stack	N Scotland	43,380 (1993)	1994	Maintained 1998	59,471	1998	Seabird2000
St Kilda	Western Isles	155,000 (1989)	1992	Maintained 2000	142,264	2000	Seabird2000
Shiant Isles	Western Isles	76,100 (1970)	1992	Maintained 1999	65,170	2000	Seabird2000

Flannan Isles	Western Isles	5,500	1992	Maintained 1999	15,600	1998or 2001	SMP database
Canna and Sanday	W Scotland	1,225	1998	Maintained 1999	945	1999	SMP database
Mingulay and Berneray	Western Isles	4,000	1994	Maintained 2009	8,406 3,126	2003 2009	SMP database SMP database
Rathlin Island	N Ireland	2,398 (1985)	1999		1,579 731 695	1999 2007 2011	SMP database SMP database SMP database
Skomer and Skokholm	Wales	9,500 (mid-1980s)	1982		12,706 14,996 15,227 15,678 16,721 16,134 24,114	2003 2004 2005 2006 2007 2012 2013	SMP database SMP database SMP database SMP database SMP database SMP database SMP database

*Site Condition Monitoring data are taken from SNH Sitelink web entries for each SPA in Scotland. These data indicate the most recent formal assessment of the status of the designated feature.

24.10 BDMPS

UK birds from North Sea colonies mostly remain in winter in the North Sea, whereas western populations disperse across the North Atlantic. It is therefore appropriate to define two spatial BDMPS for puffin; UK North Sea and Channel waters, and UK western waters. Autumn dispersal is very rapid, so a single non-breeding season seems appropriate to consider, as many birds departing at the end of the breeding season spend very little time in UK waters so do not contribute to the BDMPS.

Apportioning of numbers from SPA populations, non-SPA colonies and from overseas populations is presented in Appendix A Tables 68 and 69.

Based on evidence reviewed in sections 24.5, 24.6 and 24.7, the UK North Sea and Channel non-breeding season BDMPS is estimated to hold 15% of adults and 2% of immatures from colonies in Shetland, Orkney and Caithness, 50% of adults and 2% of immatures from colonies on the east coast of the UK from Invernessshire to Humberside, 0.1% of adults and immatures from colonies in UK western waters, 0.1% of adults and 0.3% of immatures from Norway, 4% of adults and 1% of immatures from Faroe, no birds from Ireland, 5% of adults and 2% of immatures from France (Appendix A Table 68). These proportions result in an estimated non-breeding season BDMPS population of 231,957 birds, with 162,061 from the UK and 69,896 from overseas populations.

Based on evidence reviewed in sections 24.5, 24.6 and 24.7, the UK western waters non-breeding season BDMPS is estimated to hold 8% of adults and 2% of immatures from colonies in Shetland, Orkney and Caithness, 7% of adults and 2% of immatures from colonies on the east coast of the UK from Invernessshire to Humberside, 18% of adults and 2% of immatures from colonies in UK western waters, 0.2% of adults and 0.1% of immatures from Norway, 7% of adults and 2% of immatures from Faroe, 10% of birds from Ireland, 1% of birds from France (Appendix A Table 69). These proportions result in an estimated non-breeding season BDMPS population of 304,557 birds, with 185,867 from the UK and 118,690 from overseas populations.

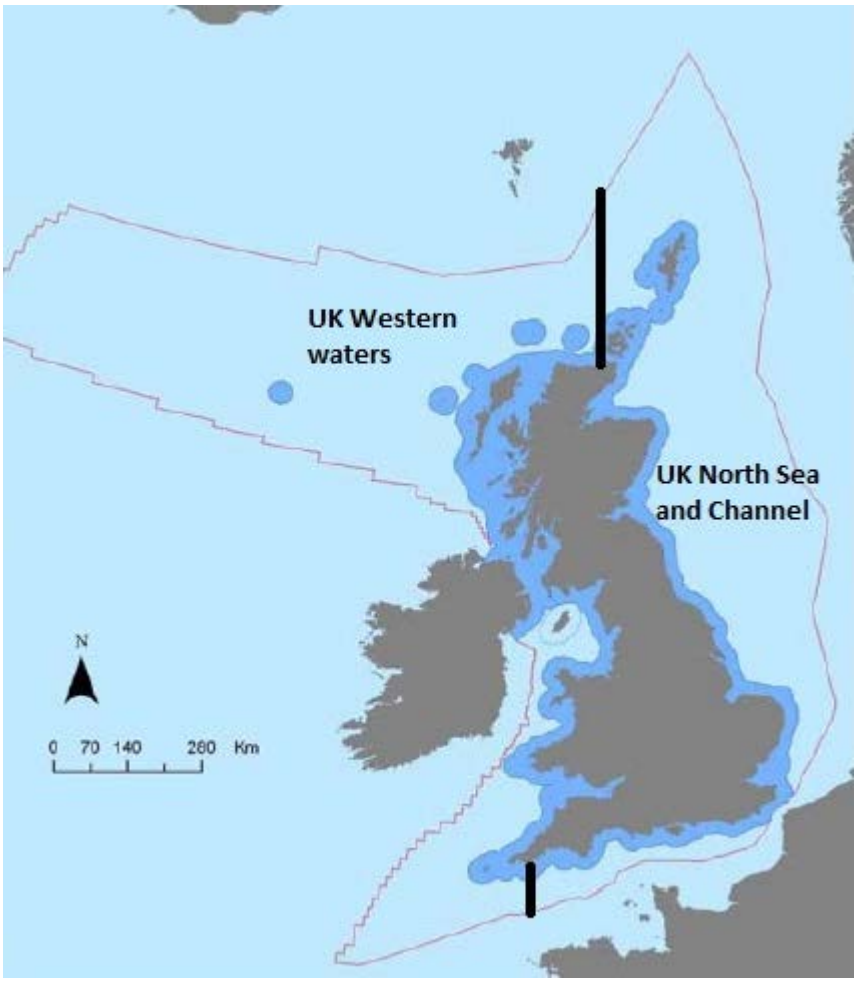


Figure 21.8. Two defined BDMPS spatial areas for Atlantic puffin: 'UK North Sea waters and Channel' and 'UK Western waters'.

24.11 Proportions of UK SPA birds in BDMPS

Proportions of birds that are adults from UK SPA colonies in each BDMPS can be estimated directly from the data in Appendix A Tables 68 and 69. For example, in the UK North Sea and Channel BDMPS (231,957 birds) there are estimated to be 134,858 adults from SPA colonies, so these represent 58% of the total birds present.

24.12 Spatial distribution of UK breeding SPA birds across the BDMPS

Given apparent high mobility of puffins, their long and rapid migrations, UK SPA birds at sea in UK waters are likely to be well mixed with birds from non-SPA colonies and from overseas.

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26. APPENDIX A.Contributions of individual SPA populations and of UK non-SPA populations and overseas populations to each BDMPS

Table 1. BDMPS for red-throated diver in winter season (December and January) in 'NW North Sea' area.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in NW North Sea waters in winter	Proportion immatures in NW North Sea waters in winter	NW N Sea Number adults	NW N Sea Number immatures	NW N Sea Total birds
Greenland	1990s	1000	2000	1480	0.05	0.05	100	74	174
Fennoscandia	1990s	5500	11000	8140	0.01	0.01	110	81	191
Hermaness, Saxavord	2013	16	32	24	0.5	0.2	16	5	21
Otterswick & Graveland	2006	25	50	37	0.5	0.2	25	7	32
Ronas Hill, North Roe	2006	50	100	74	0.5	0.2	50	15	65
Foula	2013	12	24	18	0.5	0.2	12	4	16
Orkney Mainland Moors	2007	28	56	41	0.5	0.2	28	8	36
Hoy	2007	60	120	89	0.5	0.2	60	18	78
Caithness & Sutherland	2006	46	92	68	0.5	0.2	46	14	60
Non-SPA UK North Sea	2005	600	1200	888	0.5	0.2	600	178	778
Lewis Peatlands	2006	80	160	118	0.05	0.05	8	6	14
Mointeach Scadabhaigh	2006	17	34	25	0.05	0.05	2	1	3
Rum	2013	11	22	16	0.05	0.05	1	1	2
Non-SPA UK western	2005	310	620	459	0.05	0.05	31	23	54
Overseas birds							210	155	365
UK birds							879	279	1,158
Total							1,089	434	1,523

Table 2. BDMPS for red-throated diver in winter season (December and January) in 'SW North Sea' area.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in SW North Sea waters in winter	Proportion of immatures in SW North Sea waters in winter	SW N Sea Number adults	SW N Sea Number immatures	SW N Sea Total birds
Greenland	1990s	1000	2000	1480	0.02	0.05	40	74	114
Fennoscandia	1990s	5500	11000	8140	0.4	0.6	4400	4884	9284
Hermaness, Saxavord	2013	16	32	24	0.2	0.3	6	7	14
Otterswick & Graveland	2006	25	50	37	0.2	0.3	10	11	21
Ronas Hill, North Roe	2006	50	100	74	0.2	0.3	20	22	42
Foula	2013	12	24	18	0.2	0.3	4.8	5	10
Orkney Mainland Moors	2007	28	56	41	0.2	0.3	11	12	24
Hoy	2007	60	120	89	0.2	0.3	24	27	51
Caithness & Sutherland	2006	46	92	68	0.2	0.3	18	20	39
Non-SPA UK North Sea	2005	600	1200	888	0.2	0.3	240	266	506
Lewis Peatlands	2006	80	160	118	0.05	0.05	8	6	14
Mointeach Scadabhaigh	2006	17	34	25	0.05	0.05	2	1	3
Rum	2013	11	22	16	0.05	0.05	1	1	2
Non-SPA UK western	2005	310	620	459	0.05	0.05	31	23	54
Overseas birds							4,440	4,958	9,398
UK birds							377	403	779
Total							4,817	5,361	10,177

Table 3. BDMPS for red-throated diver in winter season (December and January) in 'West of Scotland' area.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in West of Scotland waters in winter	Proportion immatures in West of Scotland waters in winter	West of Scotland Number adults	West of Scotland Number immatures	West of Scotland Total birds
Greenland	1990s	1000	2000	1480	0.02	0.05	40	74	114
Fennoscandia	1990s	5500	11000	8140	0	0.01	0	81	81
Hermaness, Saxavord	2013	16	32	24	0.05	0.1	2	2	4
Otterswick & Graveland	2006	25	50	37	0.05	0.1	2	4	6
Ronas Hill, North Roe	2006	50	100	74	0.05	0.1	5	7	12
Foula	2013	12	24	18	0.05	0.1	1	2	3
Orkney Mainland Moors	2007	28	56	41	0.05	0.1	3	4	7
Hoy	2007	60	120	89	0.05	0.1	6	9	15
Caithness & Sutherland	2006	46	92	68	0.05	0.1	5	7	11
Non-SPA UK North Sea	2005	600	1200	888	0.05	0.1	60	89	149
Lewis Peatlands	2006	80	160	118	0.4	0.2	64	24	88
Mointeach Scadabhaigh	2006	17	34	25	0.4	0.2	14	5	19
Rum	2013	11	22	16	0.4	0.2	9	3	12
Non-SPA UK western	2005	310	620	459	0.4	0.2	248	92	340
Overseas birds							40	155	195
UK birds							418	248	666
Total							458	403	861

Table 4. BDMPS for red-throated diver in winter season (December and January) in 'NW England and Wales' area.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in NW E & Wales in winter	Proportion immatures in NW E & Wales in winter	NW E & Wales Number adults	NW E & Wales Number immatures	NW E & Wales Total birds
Greenland	1990s	1000	2000	1480	0.1	0.3	200	444	644
Fennoscandia	1990s	5500	11000	8140	0.02	0.05	220	407	627
Hermaness, Saxavord	2013	16	32	24	0.02	0.05	1	1	2
Otterswick & Graveland	2006	25	50	37	0.02	0.05	1	2	3
Ronas Hill, North Roe	2006	50	100	74	0.02	0.05	2	4	6
Foula	2013	12	24	18	0.02	0.05	0	1	1
Orkney Mainland Moors	2007	28	56	41	0.02	0.05	1	2	3
Hoy	2007	60	120	89	0.02	0.05	2	4	7
Caithness & Sutherland	2006	46	92	68	0.02	0.05	2	3	5
Non-SPA UK North Sea	2005	600	1200	888	0.02	0.05	24	44	68
Lewis Peatlands	2006	80	160	118	0.2	0.2	32	24	56
Mointeach Scadabhaigh	2006	17	34	25	0.2	0.2	7	5	12
Rum	2013	11	22	16	0.2	0.2	4	3	8
Non-SPA UK western	2005	310	620	459	0.2	0.2	124	92	216
Overseas birds							420	851	1,271
UK birds							201	186	386
Total							621	1,037	1,657

Table 5. BDMPS for red-throated diver in winter season (December and January) in 'SW England and Channel' area.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in SW E & Channel in winter	Proportion immatures in SW E & Channel in winter	SW E & Channel Number adults	SW E & Channel Number immatures	SW E & Channel Total birds
Greenland	1990s	1000	2000	1480	0.1	0.2	200	296	496
Fennoscandia	1990s	5500	11000	8140	0.01	0.03	110	244	354
Hermaness, Saxavord	2013	16	32	24	0.02	0.05	1	1	2
Otterswick & Graveland	2006	25	50	37	0.02	0.05	1	2	3
Ronas Hill, North Roe	2006	50	100	74	0.02	0.05	2	4	6
Foula	2013	12	24	18	0.02	0.05	0	1	1
Orkney Mainland Moors	2007	28	56	41	0.02	0.05	1	2	3
Hoy	2007	60	120	89	0.02	0.05	2	4	7
Caithness & Sutherland	2006	46	92	68	0.02	0.05	2	3	5
Non-SPA UK North Sea	2005	600	1200	888	0.02	0.05	24	44	68
Lewis Peatlands	2006	80	160	118	0.1	0.2	16	24	40
Mointeach Scadabhaigh	2006	17	34	25	0.1	0.2	3	5	8
Rum	2013	11	22	16	0.1	0.2	2	3	5
Non-SPA UK western	2005	310	620	459	0.1	0.2	62	92	154
Overseas birds							310	540	850
UK birds							117	186	303
Total							427	726	1,153

Table 6. BDMPS for red-throated diver in migration seasons (September-November and February-April) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters in migration seasons	Proportion of immatures in UK North Sea waters in migration seasons	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Greenland	1990s	1000	2000	1480	0.08	0.15	160	222	382
Fennoscandia	1990s	5500	11000	8140	0.45	0.65	4950	5291	10241
Hermaness, Saxavord	2013	16	32	24	0.95	0.8	30	19	49
Otterswick & Graveland	2006	25	50	37	0.95	0.8	48	30	77
Ronas Hill, North Roe	2006	50	100	74	0.95	0.8	95	59	154
Foula	2013	12	24	18	0.95	0.8	23	14	37
Orkney Mainland Moors	2007	28	56	41	0.95	0.8	53	33	86
Hoy	2007	60	120	89	0.95	0.8	114	71	185
Caithness & Sutherland	2006	46	92	68	0.95	0.8	87	54	142
Non-SPA UK North Sea	2005	600	1200	888	0.95	0.8	1140	710	1850
Lewis Peatlands	2006	80	160	118	0.05	0.05	8	6	14
Mointeach Scadabhaigh	2006	17	34	25	0.05	0.05	2	1	3
Rum	2013	11	22	16	0.05	0.05	1	1	2
Non-SPA UK western	2005	310	620	459	0.05	0.05	31	23	54
Overseas birds							5,110	5,513	10,623
UK birds							1,632	1,022	2,654
Total							6,742	6,535	13,277

Table 7. BDMPS for red-throated diver in migration seasons (September-November and February-April) in 'UK western waters plus Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in migration seasons	Proportion of immatures in UK western waters & Channel in migration seasons	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Greenland	1990s	1000	2000	1480	0.25	0.6	500	888	1388
Fennoscandia	1990s	5500	11000	8140	0.05	0.1	550	814	1364
Hermaness, Saxavord	2013	16	32	24	0.05	0.2	2	5	6
Otterswick & Graveland	2006	25	50	37	0.05	0.2	2	7	10
Ronas Hill, North Roe	2006	50	100	74	0.05	0.2	5	15	20
Foula	2013	12	24	18	0.05	0.2	1	4	5
Orkney Mainland Moors	2007	28	56	41	0.05	0.2	3	8	11
Hoy	2007	60	120	89	0.05	0.2	6	18	24
Caithness & Sutherland	2006	46	92	68	0.05	0.2	5	14	18
Non-SPA UK North Sea	2005	878	1756	1299	0.05	0.2	88	260	348
Lewis Peatlands	2006	80	160	118	0.95	0.8	152	95	247
Mointeach Scadabhaigh	2006	17	34	25	0.95	0.8	32	20	52
Rum	2013	11	22	16	0.95	0.8	21	13	34
Non-SPA UK western	2005	400	800	592	0.95	0.8	760	474	1234
Overseas birds							1,050	1,702	2,752
UK birds							878	743	1,621
Total							1,928	2,445	4,373

Table 8. BDMPS for northern fulmar in winter (November) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters in winter	Proportion of immatures in UK North Sea waters in winter	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Iceland	2008	1,000,000	2000000	1240000	0.01	0.02	20000	24800	44800
Norway	1990s	386,000	772000	478640	0.01	0.02	7720	9573	17293
Faroe	1990s	600,000	1200000	744000	0.01	0.03	12000	22320	34320
Hermaness, Saxavord	2011	7,000	14000	8680	0.7	0.3	9800	2604	12404
Fetlar	2000	8,912	17824	11051	0.7	0.3	12477	3315	15792
Foula	2007	19,758	39516	24500	0.7	0.3	27661	7350	35011
Noss	2011	5,248	10496	6508	0.7	0.3	7347	1952	9299
Sumburgh Head	2009	233	466	289	0.7	0.3	326	87	413
Fair Isle	2011	29,649	59298	36765	0.7	0.3	41509	11029	52538
West Westray	2007	677	1354	839	0.7	0.3	948	252	1200
Calf of Eday	2002	1,842	3684	2284	0.7	0.3	2579	685	3264
Rousay	2009	1,030	2060	1277	0.7	0.3	1442	383	1825
Hoy	2007	19,586	39172	24287	0.7	0.3	27420	7286	34706
Copinsay	2008	1,630	3260	2021	0.7	0.3	2282	606	2888
North Caithness Cliffs	2000	14,250	28500	17670	0.7	0.3	19950	5301	25251
East Caithness Cliffs	1999	14,202	28404	17610	0.7	0.3	19883	5283	25166
Buchan Ness to Collieston	2007	1,367	2734	1695	0.7	0.3	1914	509	2422
Troup, Pennan & Lions Heads	2007	1,795	3590	2226	0.7	0.3	2513	668	3181
Fowlsheugh	2009	193	386	239	0.7	0.3	270	72	342
Forth Islands	2010	832	1664	1032	0.7	0.3	1165	310	1474
Flamborough & Filey Coast	2008	878	1756	1089	0.7	0.3	1229	327	1556
UK North Sea non-SPA	2000	129,000	258000	159960	0.7	0.3	180600	47988	228588
Cape Wrath	2000	2,115	4230	2623	0.02	0.03	85	79	163
Handa	2012	1,870	3740	2319	0.02	0.03	75	70	144
Flannan Isles	1998	7,328	14656	9087	0.02	0.03	293	273	566

North Rona & Sula Sgeir	2012	5,000	10000	6200	0.02	0.03	200	186	386
Shiant Isles	1999	4,387	8774	5440	0.02	0.03	175	163	339
St Kilda	1999	66,055	132110	81908	0.02	0.03	2642	2457	5099
Mingulay & Berneray	2009	9,046	18092	11217	0.02	0.03	362	337	698
Rathlin Island	2011	1,518	3036	1882	0.02	0.03	61	56	117
UK Western non-SPA	2000	97,000	194000	120280	0.02	0.03	3880	3608	7488
Overseas birds							39,720	56,693	96,413
UK birds							369,088	103,235	472,323
Total							408,808	159,928	568,736

Table 9. BDMPS for northern fulmar in winter (November) in 'UK western waters & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters & Channel in winter	Proportion of immatures in UK western waters & Channel in winter	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Iceland	2008	1,000,000	2000000	1240000	0.01	0.02	20000	24800	44800
Norway	1990s	386,000	772000	478640	0.01	0.02	7720	9573	17293
Faroe	1990s	600,000	1200000	744000	0.01	0.03	12000	22320	34320
Hermaness, Saxavord	2011	7,000	14000	8680	0.1	0.2	1400	1736	3136
Fetlar	2000	8,912	17824	11051	0.1	0.2	1782	2210	3993
Foula	2007	19,758	39516	24500	0.1	0.2	3952	4900	8852
Noss	2011	5,248	10496	6508	0.1	0.2	1050	1302	2351
Sumburgh Head	2009	233	466	289	0.1	0.2	47	58	104
Fair Isle	2011	29,649	59298	36765	0.1	0.2	5930	7353	13283
West Westray	2007	677	1354	839	0.1	0.2	135	168	303
Calf of Eday	2002	1,842	3684	2284	0.1	0.2	368	457	825
Rousay	2009	1,030	2060	1277	0.1	0.2	206	255	461
Hoy	2007	19,586	39172	24287	0.1	0.2	3917	4857	8775
Copinsay	2008	1,630	3260	2021	0.1	0.2	326	404	730
North Caithness Cliffs	2000	14,250	28500	17670	0.1	0.2	2850	3534	6384
East Caithness Cliffs	1999	14,202	28404	17610	0.1	0.2	2840	3522	6362
Buchan Ness to Collieston	2007	1,367	2734	1695	0.1	0.2	273	339	612
Troup, Pennan & Lions Heads	2007	1,795	3590	2226	0.1	0.2	359	445	804
Fowlsheugh	2009	193	386	239	0.1	0.2	39	48	86
Forth Islands	2010	832	1664	1032	0.1	0.2	166	206	373
Flamborough & Filey Coast	2008	878	1756	1089	0.1	0.2	176	218	393
UK North Sea non-SPA	2000	129,000	258000	159960	0.1	0.2	25800	31992	57792
Cape Wrath	2000	2,115	4230	2623	0.7	0.3	2961	787	3748
Handa	2012	1,870	3740	2319	0.7	0.3	2618	696	3314
Flannan Isles	1998	7,328	14656	9087	0.7	0.3	10259	2726	12985

North Rona & Sula Sgeir	2012	5,000	10000	6200	0.7	0.3	7000	1860	8860
Shiant Isles	1999	4,387	8774	5440	0.7	0.3	6142	1632	7774
St Kilda	1999	66,055	132110	81908	0.7	0.3	92477	24572	117049
Mingulay & Berneray	2009	9,046	18092	11217	0.7	0.3	12664	3365	16030
Rathlin Island	2011	1,518	3036	1882	0.7	0.3	2125	565	2690
UK Western non-SPA	2000	97,000	194000	120280	0.7	0.3	135800	36084	171884
Overseas birds							39,720	56,693	96,413
UK birds							323,663	136,291	459,954
Total							363,383	192,984	556,367

Table 10. BDMPS for northern fulmar in migration seasons (September & October, December to March) in 'UK North sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters in migration	Proportion of immatures in UK North Sea waters in migration	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Iceland	2008	1,000,000	2000000	1240000	0.02	0.04	40000	49600	89600
Norway	1990s	386,000	772000	478640	0.02	0.04	15440	19146	34586
Faroe	1990s	600,000	1200000	744000	0.02	0.06	24000	44640	68640
Hermaness, Saxavord	2011	7,000	14000	8680	0.9	0.8	12600	6944	19544
Fetlar	2000	8,912	17824	11051	0.9	0.8	16042	8841	24882
Foula	2007	19,758	39516	24500	0.9	0.8	35564	19600	55164
Noss	2011	5,248	10496	6508	0.9	0.8	9446	5206	14652
Sumburgh Head	2009	233	466	289	0.9	0.8	419	231	651
Fair Isle	2011	29,649	59298	36765	0.9	0.8	53368	29412	82780
West Westray	2007	677	1354	839	0.9	0.8	1219	672	1890
Calf of Eday	2002	1,842	3684	2284	0.9	0.8	3316	1827	5143
Rousay	2009	1,030	2060	1277	0.9	0.8	1854	1022	2876
Hoy	2007	19,586	39172	24287	0.9	0.8	35255	19429	54684
Copinsay	2008	1,630	3260	2021	0.9	0.8	2934	1617	4551
North Caithness Cliffs	2000	14,250	28500	17670	0.9	0.8	25650	14136	39786
East Caithness Cliffs	1999	14,202	28404	17610	1	0.8	28404	14088	42492
Buchan Ness to Collieston	2007	1,367	2734	1695	1	0.8	2734	1356	4090
Troup, Pennan & Lions Heads	2007	1,795	3590	2226	1	0.8	3590	1781	5371
Fowlsheugh	2009	193	386	239	1	0.8	386	191	577
Forth Islands	2010	832	1664	1032	1	0.8	1664	825	2489
Flamborough & Filey Coast	2008	878	1756	1089	1	0.8	1756	871	2627
UK North Sea non-SPA	2000	129,000	258000	159960	1	0.8	258000	127968	385968
Cape Wrath	2000	2,115	4230	2623	0	0.06	0	157	157
Handa	2012	1,870	3740	2319	0	0.06	0	139	139
Flannan Isles	1998	7,328	14656	9087	0	0.06	0	545	545

North Rona & Sula Sgeir	2012	5,000	10000	6200	0	0.06	0	372	372
Shiant Isles	1999	4,387	8774	5440	0	0.06	0	326	326
St Kilda	1999	66,055	132110	81908	0	0.06	0	4914	4914
Mingulay & Berneray	2009	9,046	18092	11217	0	0.06	0	673	673
Rathlin Island	2011	1,518	3036	1882	0	0.06	0	113	113
UK Western non-SPA	2000	97,000	194000	120280	0	0.06	0	7217	7217
Overseas birds							79,440	113,386	192,826
UK birds							494,201	270,475	764,676
Total							573,641	383,861	957,502

Table 11. BDMPS for northern fulmar in migration seasons (September & October, December to March) in 'UK western waters & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters & Channel in migration	Proportion of immatures in UK western waters & Channel in migration	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Iceland	2008	1,000,000	2000000	1240000	0.02	0.04	40000	49600	89600
Norway	1990s	386,000	772000	478640	0.02	0.04	15440	19146	34586
Faroe	1990s	600,000	1200000	744000	0.02	0.06	24000	44640	68640
Hermaness, Saxavord	2011	7,000	14000	8680	0.1	0.1	1400	868	2268
Fetlar	2000	8,912	17824	11051	0.1	0.1	1782	1105	2887
Foula	2007	19,758	39516	24500	0.1	0.1	3952	2450	6402
Noss	2011	5,248	10496	6508	0.1	0.1	1050	651	1700
Sumburgh Head	2009	233	466	289	0.1	0.1	47	29	75
Fair Isle	2011	29,649	59298	36765	0.1	0.1	5930	3676	9606
West Westray	2007	677	1354	839	0.1	0.1	135	84	219
Calf of Eday	2002	1,842	3684	2284	0.1	0.1	368	228	597
Rousay	2009	1,030	2060	1277	0.1	0.1	206	128	334
Hoy	2007	19,586	39172	24287	0.1	0.1	3917	2429	6346
Copinsay	2008	1,630	3260	2021	0.1	0.1	326	202	528
North Caithness Cliffs	2000	14,250	28500	17670	0.1	0.1	2850	1767	4617
East Caithness Cliffs	1999	14,202	28404	17610	0	0.1	0	1761	1761
Buchan Ness to Collieston	2007	1,367	2734	1695	0	0.1	0	170	170
Troup, Pennan & Lions Heads	2007	1,795	3590	2226	0	0.1	0	223	223
Fowlsheugh	2009	193	386	239	0	0.1	0	24	24
Forth Islands	2010	832	1664	1032	0	0.1	0	103	103
Flamborough & Filey Coast	2008	878	1756	1089	0	0.1	0	109	109
UK North Sea non-SPA	2000	129,000	258000	159960	0	0.1	0	15996	15996
Cape Wrath	2000	2,115	4230	2623	1	0.8	4230	2098	6328
Handa	2012	1,870	3740	2319	1	0.8	3740	1855	5595

Flannan Isles	1998	7,328	14656	9087	1	0.8	14656	7269	21925
North Rona & Sula Sgeir	2012	5,000	10000	6200	1	0.8	10000	4960	14960
Shiant Isles	1999	4,387	8774	5440	1	0.8	8774	4352	13126
St Kilda	1999	66,055	132110	81908	1	0.8	132110	65527	197637
Mingulay & Berneray	2009	9,046	18092	11217	1	0.8	18092	8974	27066
Rathlin Island	2011	1,518	3036	1882	1	0.8	3036	1506	4542
UK Western non-SPA	2000	97,000	194000	120280	1	0.8	194000	96224	290224
Overseas birds							79,440	113,386	192,826
UK birds							410,601	224,767	635,368
Total							490,041	338,153	828,194

Table 12. BDMPS for Manx shearwater in migration seasons (August to early October, late March to May) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK N Sea in migration	Proportion of immatures in UK N Sea in migration	UK North Sea number of adults	UK North Sea number of immatures	UK North Sea total birds
Iceland	1990s	8500	17000	14280	0	0.001	0	14	14
Faroe	2012	25000	50000	42000	0	0.001	0	42	42
Ireland	2000	32600	65200	54768	0	0.001	0	55	55
St Kilda	1999	4802	9604	8067	0	0.01	0	81	81
Rum	2001	120000	240000	201600	0	0.01	0	2016	2016
Aberdaron Coast & Bardsey	2001	16183	32366	27187	0	0.01	0	272	272
Skomer, Skokholm & Middleh	2011	350000	700000	588000	0	0.01	0	5880	5880
UK non-SPA colonies	2000	4000	8000	6720	0.01	0.01	80	67	147
Total overseas							0	111	111
Total UK							80	8,316	8,396
Total							80	8,427	8,507

Table 13. BDMPS for Manx shearwater in migration seasons (August to early October, late March to May) in 'UK western waters & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters & Channel in migration	Proportion of immatures in UK western waters & Channel in migration	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Iceland	1990s	8500	17000	14280	0.01	0.03	170	428	598
Faroe	2012	25000	50000	42000	0.01	0.03	500	1260	1760
Ireland	2000	32600	65200	54768	0.05	0.1	3260	5477	8737
St Kilda	1999	4802	9604	8067	1	0.7	9604	5647	15251
Rum	2001	120000	240000	201600	1	0.7	240000	141120	381120
Aberdaron Coast & Bardsey	2001	16183	32366	27187	1	0.7	32366	19031	51397
Skomer, Skokholm & Middleh	2011	350000	700000	588000	1	0.7	700000	411600	1111600
UK non-SPA colonies	2000	4000	8000	6720	0.8	0.6	6400	4032	10432
Total overseas							3,930	7,165	11,095
Total UK							988,370	581,430	1,569,800
Total							992,300	588,595	1,580,895

Table 14. BDMPS for northern gannet in autumn (September to November) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in autumn	Proportion immatures in UK North Sea & Channel waters in autumn	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	2010	28500	57000	46170	0.3	0.3	17100	13851	30951
Norway	2010	4500	9000	7290	0.3	0.3	2700	2187	4887
Faroe	2012	2500	5000	4050	0.3	0.3	1500	1215	2715
Hermaness, Saxavord	2008	24353	48706	39452	0.8	0.8	38965	31561	70526
Noss	2008	9767	19534	15823	0.8	0.8	15627	12658	28285
Fair Isle	2013	3924	7848	6357	0.8	0.8	6278	5086	11364
Forth Islands	2009	55482	110964	89881	1	0.9	110964	80893	191857
Flamborough & Filey	2012	11061	22122	17919	1	0.9	22122	16127	38249
UK North Sea non-SPA colonies	2004	6000	12000	9720	1	0.9	12000	8748	20748
Sule Skerry & Sule Stack	2004	4675	9350	7574	0.1	0.2	935	1515	2450
North Rona & Sula Sgeir	2004	9225	18450	14944	0.1	0.2	1845	2989	4834
St Kilda	2004	59622	119244	96588	0.1	0.2	11924	19318	31242
Ailsa Craig	2004	27130	54260	43951	0	0.1	0	4395	4395
Grassholm	2009	39292	78584	63653	0	0.1	0	6365	6365
UK western non-SPA colonies	2004	5000	10000	8100	0	0.1	0	810	810
Ireland	2004	36000	72000	58320	0	0.1	0	5832	5832
Germany	2013	632	1264	1024	0.3	0.4	379	410	789
Total overseas							21,679	23,495	45,174
Total UK							220,661	190,464	411,125
Total							242,340	213,959	456,299

Table 15. BDMPS for northern gannet in autumn (September to November) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in autumn	Proportion immatures in UK western waters in autumn	UK west Number adults	UK west Number immatures	UK west Total birds
Iceland	2010	28500	57000	46170	0.2	0.3	11400	13851	25251
Norway	2010	4500	9000	7290	0.2	0.3	1800	2187	3987
Faroe	2012	2500	5000	4050	0.2	0.3	1000	1215	2215
Hermaness, Saxavord	2008	24353	48706	39452	0.2	0.1	9741	3945	13686
Noss	2008	9767	19534	15823	0.2	0.1	3907	1582	5489
Fair Isle	2013	3924	7848	6357	0.2	0.1	1570	636	2205
Forth Islands	2009	55482	110964	89881	0	0.1	0	8988	8988
Flamborough & Filey	2012	11061	22122	17919	0	0.1	0	1792	1792
UK North Sea non-SPA cols	2004	6000	12000	9720	0	0.1	0	972	972
Sule Skerry & Sule Stack	2004	4675	9350	7574	0.9	0.7	8415	5301	13716
North Rona & Sula Sgeir	2004	9225	18450	14944	0.9	0.7	16605	10461	27066
St Kilda	2004	59622	119244	96588	0.9	0.7	107320	67611	174931
Ailsa Craig	2004	27130	54260	43951	1	0.8	54260	35160	89420
Grassholm	2009	39292	78584	63653	1	0.8	78584	50922	129506
UK western non-SPA cols	2004	4500	9000	7290	1	0.8	9000	5832	14832
Ireland	2004	36000	72000	58320	0.2	0.3	14400	17496	31896
Germany	2013	632	1264	1024	0	0	0	0	0
Total overseas							28,600	34,749	63,349
Total UK							289,401	193,204	482,605
Total							318,001	227,953	545,954

Table 16. BDMPS for northern gannet in spring (December to March) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in spring	Proportion immatures in UK North Sea & Channel waters in spring	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	2010	28500	57000	46170	0.1	0.1	5700	4617	10317
Norway	2010	4500	9000	7290	0.2	0.2	1800	1458	3258
Faroe	2012	2500	5000	4050	0.2	0.2	1000	810	1810
Hermaness, Saxavord	2008	24353	48706	39452	0.7	0.4	34094	15781	49875
Noss	2008	9767	19534	15823	0.7	0.4	13674	6329	20003
Fair Isle	2013	3924	7848	6357	0.7	0.4	5494	2543	8036
Forth Islands	2009	55482	110964	89881	0.7	0.4	77675	35952	113627
Flamborough & Filey	2012	11061	22122	17919	0.7	0.4	15485	7168	22653
UK North Sea non-SPA cols	2004	6000	12000	9720	0.7	0.4	8400	3888	12288
Sule Skerry & Sule Stack	2004	4675	9350	7574	0	0	0	0	0
North Rona & Sula Sgeir	2004	9225	18450	14944	0	0	0	0	0
St Kilda	2004	59622	119244	96588	0	0	0	0	0
Ailsa Craig	2004	27130	54260	43951	0	0	0	0	0
Grassholm	2009	39292	78584	63653	0	0	0	0	0
UK western non-SPA cols	2004	5000	10000	8100	0	0	0	0	0
Ireland	2004	36000	72000	58320	0	0.1	0	5832	5832
Germany	2013	632	1264	1024	0.3	0.3	379	307	686
Total overseas							8,879	13,024	21,903
Total UK							154,822	71,660	226,482
Total							163,701	84,684	248,385

Table 17. BDMPS for northern gannet in spring (December to March) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in spring	Proportion immatures in UK western waters in spring	UK west Number adults	UK west Number immatures	UK west Total birds
Iceland	2010	28500	57000	46170	0.2	0.2	11400	9234	20634
Norway	2010	4500	9000	7290	0.2	0.2	1800	1458	3258
Faroe	2012	2500	5000	4050	0.3	0.3	1500	1215	2715
Hermaness, Saxavord	2008	24353	48706	39452	0.3	0.3	14612	11836	26447
Noss	2008	9767	19534	15823	0.3	0.3	5860	4747	10607
Fair Isle	2013	3924	7848	6357	0.3	0.3	2354	1907	4261
Forth Islands	2009	55482	110964	89881	0.3	0.3	33289	26964	60253
Flamborough & Filey	2012	11061	22122	17919	0.3	0.3	6637	5376	12012
UK North Sea non-SPA cols	2004	6000	12000	9720	0.3	0.3	3600	2916	6516
Sule Skerry & Sule Stack	2004	4675	9350	7574	1	0.8	9350	6059	15409
North Rona & Sula Sgeir	2004	9225	18450	14944	1	0.8	18450	11956	30406
St Kilda	2004	59622	119244	96588	1	0.8	119244	77270	196514
Ailsa Craig	2004	27130	54260	43951	1	0.8	54260	35160	89420
Grassholm	2009	39292	78584	63653	1	0.8	78584	50922	129506
UK western non-SPA cols	2004	4500	9000	7290	1	0.8	9000	5832	14832
Ireland	2004	36000	72000	58320	0.3	0.3	21600	17496	39096
Germany	2013	632	1264	1024	0	0	0	0	0
Total overseas							36,300	29,403	65,703
Total UK							355,240	240,945	596,185
Total							391,540	270,348	661,888

Table 18. BDMPS for great cormorant in non-breeding season (September to March) in 'UK NW North Sea'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK NW North Sea waters in non-breeding season	Proportion of immatures in UK NW North Sea waters in non-breeding season	UK NW N Sea Number adults	UK NW N Sea Number immatures	UK NW N Sea Total birds
Denmark	1990s	40000	80000	93600	0	0.001	0	94	94
Netherlands	1990s	20000	40000	46800	0	0.0001	0	5	5
Ireland	2000	4100	8200	9594	0	0	0	0	0
France	1990s	1500	3000	3510	0	0	0	0	0
Calf of Eday	2012	181	362	424	1	1	362	424	786
East Caithness Cliffs	2013	52	104	122	1	1	104	122	226
Forth Islands	2013	80	160	187	0.6	0.5	96	94	190
UK non-SPA NW N S	2000	1200	2400	2808	0.8	0.8	1920	2246	4166
Farne Islands	2013	87	174	204	0.1	0.2	17	41	58
Abberton Reservoir	2005	216	432	505	0	0	0	0	0
UK non-SPA SW N S	2000	2200	4400	5148	0.05	0.05	220	257	477
Sheep Island NI	2013	112	224	262	0	0.001	0	0	0
UK non-SPA W Scotland	2000	2570	5140	6014	0	0.001	0	6	6
Puffin Island Wales	2013	448	896	1048	0	0.001	0	1	1
UK non-SPA Wales SW E	2000	1750	3500	4095	0	0.001	0	4	4
Overseas total							0	98	98
UK total							2,719	3,195	5,914
Total							2,719	3,293	6,012

Table 19. BDMPS for great cormorant in non-breeding season (September to March) in 'UK SW North Sea & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK SW North Sea & Channel waters in non-breeding season	Proportion of immatures in UK SW North Sea & Channel waters in non-breeding season	UK SW N Sea & Channel Number adults	UK SW N Sea & Channel Number immatures	UK SW N Sea & Channel Total birds
Denmark	1990s	40000	80000	93600	0	0.005	0	468	468
Netherlands	1990s	20000	40000	46800	0.001	0.01	40	468	508
Ireland	2000	4100	8200	9594	0	0.01	0	96	96
France	1990s	1500	3000	3510	0	0.01	0	35	35
Calf of Eday	2012	181	362	424	0	0	0	0	0
East Caithness Cliffs	2013	52	104	122	0	0	0	0	0
Forth Islands	2013	80	160	187	0.4	0.5	64	94	158
UK non-SPA NW N S	2000	1200	2400	2808	0.2	0.2	480	562	102
Farne Islands	2013	87	174	204	0.9	0.8	157	163	319
Abberton Reservoir	2005	216	432	505	0.8	0.7	346	354	699
UK non-SPA SW N S	2000	2200	4400	5148	0.8	0.7	3520	3604	7124
Sheep Island NI	2013	112	224	262	0	0.001	0	0	0
UK non-SPA W Scotland	2000	2570	5140	6014	0	0.001	0	6	6
Puffin Island Wales	2013	448	896	1048	0	0.001	0	1	1
UK non-SPA Wales SW E	2000	1750	3500	4095	0	0.001	0	4	4
Overseas total							40	1,067	1,107
UK total							4,566	4,787	9,353
Total							4,606	5,854	10,460

Table 20. BDMPS for great cormorant in non-breeding season (September to March) in 'UK West of Scotland waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK West of Scotland waters in non-breeding season	Proportion of immatures in UK west of Scotland waters in non-breeding season	UK West of Scotland Number adults	UK west of Scotland Number immatures	UK west of Scotland Total birds
Denmark	1990s	40000	80000	93600	0	0.0005	0	47	47
Netherlands	1990s	20000	40000	46800	0	0	0	0	0
Ireland	2000	4100	8200	9594	0	0.001	0	10	10
France	1990s	1500	3000	3510	0	0	0	0	0
Calf of Eday	2012	181	362	424	0	0	0	0	0
East Caithness Cliffs	2013	52	104	122	0	0	0	0	0
Forth Islands	2013	80	160	187	0	0	0	0	0
UK non-SPA NW N S	2000	1200	2400	2808	0	0	0	0	0
Farne Islands	2013	87	174	204	0	0	0	0	0
Abberton Reservoir	2005	216	432	505	0	0	0	0	0
UK non-SPA SW N S	2000	2200	4400	5148	0	0	0	0	0
Sheep Island NI	2013	112	224	262	0.8	0.6	179	157	336
UK non-SPA W Scotland	2000	2570	5140	6014	0.7	0.5	3598	3007	6605
Puffin Island Wales	2013	448	896	1048	0	0.01	0	10	10
UK non-SPA Wales SW E	2000	1750	3500	4095	0	0.01	0	41	41
Overseas total							0	56	56
UK total							3,777	3,216	6,993
Total							3,777	3,272	7,049

Table 21. BDMPS for great cormorant in non-breeding season (September to March) in 'UK Wales & SW England waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in Wales & SW E waters in non-breeding season	Proportion immatures in Wales & SW E waters in non-breeding season	Wales & SW E Number adults	Wales & SW E Number immatures	Wales & SW E Total birds
Denmark	1990s	40000	80000	93600	0	0.0001	0	9	9
Netherlands	1990s	20000	40000	46800	0	0.0001	0	5	5
Ireland	2000	4100	8200	9594	0	0.02	0	192	192
France	1990s	1500	3000	3510	0	0.001	0	4	4
Calf of Eday	2012	181	362	424	0	0	0	0	0
East Caithness Cliffs	2013	52	104	122	0	0	0	0	0
Forth Islands	2013	80	160	187	0	0	0	0	0
UK non-SPA NW N S	2000	1200	2400	2808	0	0	0	0	0
Farne Islands	2013	87	174	204	0	0	0	0	0
Abberton Reservoir	2005	216	432	505	0	0	0	0	0
UK non-SPA SW N S	2000	2200	4400	5148	0	0	0	0	0
Sheep Island NI	2013	112	224	262	0.2	0.4	45	105	150
UK non-SPA W Scotland	2000	2570	5140	6014	0.3	0.5	1542	3007	4549
Puffin Island Wales	2013	448	896	1048	0.6	0.4	538	419	957
UK non-SPA Wales SW E	2000	1750	3500	4095	0.6	0.4	2100	1638	3738
Overseas total							0	209	209
UK total							4,224	5,169	9,393
Total							4,224	5,378	9,602

Table 22. BDMPS for European shag in non-breeding season (September to January) in 'UK NW North Sea'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK NW North Sea in non-breeding season	Proportion immatures in UK NW North Sea in non-breeding season	UK NW N Sea Number adults	UK NW N Sea Number immatures	UK NW N Sea Total birds
Hermaness, Saxavord	2002	41	82	107	1	1	82	107	189
Foula	2013	200	400	524	1	1	400	524	924
Fair Isle	2013	204	408	534	1	1	408	534	942
East Caithness Cliffs	1999	1056	2112	2767	1	1	2112	2767	4879
Buchan Ness to Collieston	2007	331	662	867	1	1	662	867	1529
Forth Islands	2013	850	1700	2227	1	0.9	1700	2004	3704
St Abbs Head to Fast Castle	2011	160	320	419	1	0.8	320	335	655
UK NW N Sea non-SPA	2000	6000	12000	15720	1	1	12000	15720	27720
Farne Islands	2013	582	1164	1525	0.3	0.4	349	610	959
UK SW N Sea non-SPA	2000	500	1000	1310	0	0	0	0	0
Sule Skerry & Sule Stack	2011	200	400	524	0	0	0	0	0
Shiant Islands	1999	506	1012	1326	0	0	0	0	0
Canna & Sanday	2013	255	510	668	0	0	0	0	0
Mingulay & Berneray	2009	115	230	301	0	0	0	0	0
UK West of Scotld non-SPA	2000	7000	14000	18340	0	0	0	0	0
Isles of Scilly	2006	1296	2592	3396	0	0	0	0	0
UK Wales & SW E non-SPA	2000	1500	3000	3930	0	0	0	0	0
Ireland	2000	2000	4000	5240	0	0	0	0	0
Overseas total							0	0	0
UK total							18,033	23,469	41,503
Total							18,033	23,469	41,503

Table 23. BDMPS for European shag in non-breeding season (September to January) in 'UK SW North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK SW North Sea & Channel waters in non-breeding season	Proportion of immatures in UK SW North Sea & Channel waters in non-breeding season	UK SW N Sea & Channel Number adults	UK SW N Sea & Channel Number immatures	UK SW N Sea & Channel Total birds
Hermaness, Saxavord	2002	41	82	107	0	0	0	0	0
Foula	2013	200	400	524	0	0	0	0	0
Fair Isle	2013	204	408	534	0	0	0	0	0
East Caithness Cliffs	1999	1056	2112	2767	0	0	0	0	0
Buchan Ness to Collieston	2007	331	662	867	0	0	0	0	0
Forth Islands	2013	850	1700	2227	0	0.1	0	223	223
St Abbs Head to Fast Castle	2011	160	320	419	0	0.2	0	84	84
UK NW N Sea non-SPA	2000	6000	12000	15720	0	0	0	0	0
Farne Islands	2013	582	1164	1525	0.7	0.6	815	915	1730
UK SW N Sea non-SPA	2000	500	1000	1310	1	1	1000	1310	2310
Sule Skerry & Sule Stack	2011	200	400	524	0	0	0	0	0
Shiant Islands	1999	506	1012	1326	0	0	0	0	0
Canna & Sanday	2013	255	510	668	0	0	0	0	0
Mingulay & Berneray	2009	115	230	301	0	0	0	0	0
UK West of Scotland non-SPA	2000	7000	14000	18340	0	0	0	0	0
Isles of Scilly	2006	1296	2592	3396	0	0	0	0	0
UK Wales & SW E non-SPA	2000	1500	3000	3930	0	0	0	0	0
Ireland	2000	2000	4000	5240	0	0	0	0	0
Overseas total							0	0	0
UK total							1,815	2,531	4,346
Total							1,815	2,531	4,346

Table 24. BDMPS for European shag in non-breeding season (September to January) in 'UK West of Scotland waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK west of Scotland waters in non-breeding season	Proportion of immatures in UK west of Scotland waters in non-breeding season	UK west of Scotland Number adults	UK west of Scotland Number immatures	UK west of Scotland Total birds
Hermaness, Saxavord	2002	41	82	107	0	0	0	0	0
Foula	2013	200	400	524	0	0	0	0	0
Fair Isle	2013	204	408	534	0	0	0	0	0
East Caithness Cliffs	1999	1056	2112	2767	0	0	0	0	0
Buchan Ness to Collieston	2007	331	662	867	0	0	0	0	0
Forth Islands	2013	850	1700	2227	0	0	0	0	0
St Abbs Head to Fast Castle	2011	160	320	419	0	0	0	0	0
UK NW N Sea non-SPA	2000	6000	12000	15720	0	0	0	0	0
Farne Islands	2013	582	1164	1525	0	0	0	0	0
UK SW N Sea non-SPA	2000	500	1000	1310	0	0	0	0	0
Sule Skerry & Sule Stack	2011	200	400	524	1	1	400	524	924
Shiant Islands	1999	506	1012	1326	1	1	1012	1326	2338
Canna & Sanday	2013	255	510	668	1	1	510	668	1178
Mingulay & Berneray	2009	115	230	301	1	1	230	301	531
UK West of Scotland non-SPA	2000	7000	14000	18340	1	1	14000	18340	32340
Isles of Scilly	2006	1296	2592	3396	0	0	0	0	0
UK Wales & SW E non-SPA	2000	1500	3000	3930	0	0	0	0	0
Ireland	2000	2000	4000	5240	0	0.01	0	52	52
Overseas total							0	52	52
UK total							16,152	21,159	37,311
Total							16,152	21,211	37,363

Table 25. BDMPS for European shag in non-breeding season (September to January) in 'UK Wales & SW England waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in Wales & SW E waters in non-breeding season	Proportion immatures in Wales & SW E waters in non-breeding season	UK Wales & SW E Number adults	UK Wales & SW E Number immatures	UK Wales & SW E Total birds
Hermaness, Saxavord	2002	41	82	107	0	0	0	0	0
Foula	2013	200	400	524	0	0	0	0	0
Fair Isle	2013	204	408	534	0	0	0	0	0
East Caithness Cliffs	1999	1056	2112	2767	0	0	0	0	0
Buchan Ness to Collieston	2007	331	662	867	0	0	0	0	0
Forth Islands	2013	850	1700	2227	0	0	0	0	0
St Abbs Head to Fast Castle	2011	160	320	419	0	0	0	0	0
UK NW N Sea non-SPA	2000	6000	12000	15720	0	0	0	0	0
Farne Islands	2013	582	1164	1525	0	0	0	0	0
UK SW N Sea non-SPA	2000	500	1000	1310	0	0	0	0	0
Sule Skerry & Sule Stack	2011	200	400	524	0	0	0	0	0
Shiant Islands	1999	506	1012	1326	0	0	0	0	0
Canna & Sanday	2013	255	510	668	0	0	0	0	0
Mingulay & Berneray	2009	115	230	301	0	0	0	0	0
UK West of Scotland non-SPA	2000	7000	14000	18340	0	0	0	0	0
Isles of Scilly	2006	1296	2592	3396	1	1	2592	3396	5988
UK Wales & SW E non-SPA	2000	1500	3000	3930	1	1	3000	3930	6930
Ireland	2000	2000	4000	5240	0	0.03	0	157	157
Overseas total							0	157	157
UK total							5,592	7,326	12,918
Total							5,592	7,483	13,075

Table 26. BDMPS for Arctic skua in autumn migration season (August to October) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in autumn	Proportion of immatures in UK North Sea & Channel waters in autumn	UK N Sea & Channel waters Number adults	UK N Sea & Channel waters Number immatures	UK N Sea & Channel waters Total birds
High Arctic tundra	1990s	50,000	100000	71000	0.01	0.01	1000	710	1710
Iceland	1990s	7500	15000	10650	0.02	0.02	300	213	513
Fennoscandia	1990s	8000	16000	11360	0.1	0.1	1600	1136	2736
Faroe	2012	750	1500	1065	0.1	0.1	150	106	256
Fetlar	2002	83	166	118	0.6	0.4	100	47	147
Foula	2013	35	70	50	0.6	0.4	42	20	62
Fair Isle	2013	19	38	27	0.6	0.4	23	11	34
West Westray	2010	27	54	38	0.6	0.4	32	15	48
Papa Westray	2012	22	44	31	0.6	0.4	26	12	39
Hoy	2010	12	24	17	0.6	0.4	14	7	21
Rousay	2010	37	74	53	0.6	0.4	44	21	65
UK non-SPA North Sea colonies	2000*	450	900	639	0.6	0.4	540	256	796
UK non-SPA western colonies	2000*	200	400	284	0	0	0	0	0
Total overseas							3,050	2,166	5,216
Total UK							822	389	1,211
Total							3,872	2,555	6,427

*updated to 2012 using trend reported in Foster and Marrs (2012)

Table 27. BDMPS for Arctic skua in autumn migration season (August to October) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in autumn	Proportion of immatures in UK western waters in autumn	UK western Number adults	UK western Number immatures	UK western Total birds
High Arctic tundra	1990s	50,000	100000	71000	0.01	0.01	1000	710	1710
Iceland	1990s	7500	15000	10650	0.02	0.02	300	213	513
Fennoscandia	1990s	8000	16000	11360	0.05	0.05	800	568	1368
Faroe	2012	750	1500	1065	0.1	0.1	150	106	256
Fetlar	2002	83	166	118	0.4	0.3	66	35	102
Foula	2013	35	70	50	0.4	0.3	28	15	43
Fair Isle	2013	19	38	27	0.4	0.3	15	8	23
West Westray	2010	27	54	38	0.4	0.3	22	12	33
Papa Westray	2012	22	44	31	0.4	0.3	18	9	27
Hoy	2010	12	24	17	0.4	0.3	10	5	15
Rousay	2010	37	74	53	0.4	0.3	30	16	45
UK non-SPA North Sea colonies	2000*	450	900	639	0.4	0.3	360	192	552
UK non-SPA western colonies	2000*	200	400	284	1	0.7	400	199	599
Total overseas							2,250	1,598	3,848
Total UK							948	491	1,439
Total							3,198	2,089	5,287

*updated to 2012 using trend reported in Foster and Marrs (2012)

Table 28. BDMPS for Arctic skua in spring migration season (April-May) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in spring	Proportion of immatures in UK North Sea & Channel waters in spring	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
High Arctic tundra	1990s	50,000	100000	71000	0.002	0.001	200	71	271
Iceland	1990s	7500	15000	10650	0.005	0.001	75	11	86
Fennoscandia	1990s	8000	16000	11360	0.01	0.005	160	57	217
Faroe	2012	750	1500	1065	0.005	0.001	8	1	9
Fetlar	2002	83	166	118	0.4	0.1	66	12	78
Foula	2013	35	70	50	0.4	0.1	28	5	33
Fair Isle	2013	19	38	27	0.4	0.1	15	3	18
West Westray	2010	27	54	38	0.4	0.1	22	4	25
Papa Westray	2012	22	44	31	0.4	0.1	18	3	21
Hoy	2010	12	24	17	0.4	0.1	10	2	11
Rousay	2010	37	74	53	0.4	0.1	30	5	35
UK non-SPA North Sea colonies	2000*	450	900	639	0.4	0.1	360	64	424
UK non-SPA western colonies	2000*	200	400	284	0	0	0	0	0
Total overseas							442	140	582
Total UK							548	97	645
Total							990	237	1,227

*updated to 2012 using trend reported in Foster and Marrs (2012)

Table 29. BDMPS for Arctic skua in spring migration season (April-May) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in spring	Proportion of immatures in UK western waters in spring	UK western Number adults	UK western Number immatures	UK western Total birds
High Arctic tundra	1990s	50,000	100000	71000	0.01	0.01	1000	710	1710
Iceland	1990s	7500	15000	10650	0.01	0.01	150	106	256
Fennoscandia	1990s	8000	16000	11360	0.05	0.03	800	341	1141
Faroe	2012	750	1500	1065	0.05	0.02	75	21	96
Fetlar	2002	83	166	118	0.6	0.5	100	59	159
Foula	2013	35	70	50	0.6	0.5	42	25	67
Fair Isle	2013	19	38	27	0.6	0.5	23	13	36
West Westray	2010	27	54	38	0.6	0.5	32	19	52
Papa Westray	2012	22	44	31	0.6	0.5	26	16	42
Hoy	2010	12	24	17	0.6	0.5	14	9	23
Rousay	2010	37	74	53	0.6	0.5	44	26	71
UK non-SPA North Sea colonies	2000*	450	900	639	0.6	0.5	540	320	860
UK non-SPA western colonies	2000*	200	400	284	1	0.7	400	199	599
Total overseas							2,025	1,179	3,204
Total UK							1,222	685	1,907
Total							3,247	1,864	5,111

*updated to 2012 using trend reported in Foster and Marrs (2012)

Table 30. BDMPS for great skua in autumn migration season (August to October) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in autumn	Proportion of immatures in UK North Sea & Channel waters in autumn	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1980s	5400	10800	15336	0.1	0.05	1080	767	1847
Norway	2010	360	720	1022	0.1	0.05	72	51	123
Faroe	2012	500	1000	1420	0.1	0.05	100	71	171
Hermaness, Saxavord	2013	979	1958	2780	0.6	0.3	1175	834	2009
Fetlar	2002	585	1170	1661	0.6	0.3	702	498	1200
Ronas Hill, North Roe	2002	189	378	537	0.6	0.3	227	161	388
Foula	2007	1657	3314	4706	0.6	0.3	1988	1412	3400
Noss	2013	465	930	1321	0.6	0.3	558	396	954
Fair Isle	2013	266	532	755	0.6	0.3	319	227	546
Hoy	2010	1346	2692	3823	0.6	0.3	1615	1147	2762
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0.6	0.3	3600	2556	6156
Handa	2013	135	270	383	0	0	0	0	0
St Kilda	2012	181	362	514	0	0	0	0	0
UK Non-SPA western colonies	2000	100	200	284	0	0	0	0	0
Total overseas							1,252	889	2,141
Total UK							10,184	7,231	17,415
Total							11,436	8,120	19,556

Table 31. BDMPS for great skua in autumn migration season (August to October) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in autumn	Proportion of immatures in UK western waters in autumn	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1980s	5400	10800	15336	0.2	0.05	2160	767	2927
Norway	2010	360	720	1022	0.1	0.05	72	51	123
Faroe	2012	500	1000	1420	0.3	0.05	300	71	371
Hermaness, Saxavord	2013	979	1958	2780	0.4	0.2	783	556	1339
Fetlar	2002	585	1170	1661	0.4	0.2	468	332	800
Ronas Hill, North Roe	2002	189	378	537	0.4	0.2	151	107	259
Foula	2007	1657	3314	4706	0.4	0.2	1326	941	2267
Noss	2013	465	930	1321	0.4	0.2	372	264	636
Fair Isle	2013	266	532	755	0.4	0.2	213	151	364
Hoy	2010	1346	2692	3823	0.4	0.2	1077	765	1841
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0.4	0.2	2400	1704	4104
Handa	2013	135	270	383	1	0.4	270	153	423
St Kilda	2012	181	362	514	1	0.4	362	206	568
UK Non-SPA western colonies	2000	100	200	284	1	0.4	200	114	314
Total overseas							2,532	889	3,421
Total UK							7,622	5,293	12,915
Total							10,154	6,182	16,336

Table 32. BDMPS for great skua in winter (November to February) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in winter	Proportion of immatures in UK North Sea & Channel waters in winter	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1980s	5400	10800	15336	0.01	0.001	108	15	123
Norway	2010	360	720	1022	0.01	0.001	7	1	8
Faroe	2012	500	1000	1420	0.01	0.001	10	1	11
Hermaness, Saxavord	2013	979	1958	2780	0	0	0	0	0
Fetlar	2002	585	1170	1661	0	0	0	0	0
Ronas Hill, North Roe	2002	189	378	537	0	0	0	0	0
Foula	2007	1657	3314	4706	0	0	0	0	0
Noss	2013	465	930	1321	0	0	0	0	0
Fair Isle	2013	266	532	755	0	0	0	0	0
Hoy	2010	1346	2692	3823	0	0	0	0	0
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0	0	0	0	0
Handa	2013	135	270	383	0	0	0	0	0
St Kilda	2012	181	362	514	0	0	0	0	0
UK Non-SPA western colonies	2000	100	200	284	0	0	0	0	0
Total overseas							125	18	143
Total UK							0	0	0
Total							125	18	143

Table 33. BDMPS for great skua in winter (November to February) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in winter	Proportion of immatures in UK western waters in winter	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1980s	5400	10800	15336	0.1	0.001	1080	15	1095
Norway	2010	360	720	1022	0.1	0.001	72	1	73
Faroe	2012	500	1000	1420	0.05	0.001	50	1	51
Hermaness, Saxavord	2013	979	1958	2780	0.01	0	20	0	20
Fetlar	2002	585	1170	1661	0.01	0	12	0	12
Ronas Hill, North Roe	2002	189	378	537	0.01	0	4	0	4
Foula	2007	1657	3314	4706	0.01	0	33	0	33
Noss	2013	465	930	1321	0.01	0	9	0	9
Fair Isle	2013	266	532	755	0.01	0	5	0	5
Hoy	2010	1346	2692	3823	0.01	0	27	0	27
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0.01	0	60	0	60
Handa	2013	135	270	383	0.01	0	3	0	3
St Kilda	2012	181	362	514	0.01	0	4	0	4
UK Non-SPA western colonies	2000	100	200	284	0.01	0	2	0	2
Total overseas							1,202	18	1,220
Total UK							178	0	178
Total							1,380	18	1,398

Table 34. BDMPS for great skua in spring migration (March-April) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in spring	Proportion of immatures in UK North Sea & Channel waters in spring	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1980s	5400	10800	15336	0.05	0.02	540	307	847
Norway	2010	360	720	1022	0.05	0.02	36	20	56
Faroe	2012	500	1000	1420	0.05	0.02	50	28	78
Hermaness, Saxavord	2013	979	1958	2780	0.3	0.1	587	278	865
Fetlar	2002	585	1170	1661	0.3	0.1	351	166	517
Ronas Hill, North Roe	2002	189	378	537	0.3	0.1	113	54	167
Foula	2007	1657	3314	4706	0.3	0.1	994	471	1465
Noss	2013	465	930	1321	0.3	0.1	279	132	411
Fair Isle	2013	266	532	755	0.3	0.1	160	76	235
Hoy	2010	1346	2692	3823	0.3	0.1	808	382	1190
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0.3	0.1	1800	852	2652
Handa	2013	135	270	383	0	0	0	0	0
St Kilda	2012	181	362	514	0	0	0	0	0
UK Non-SPA western colonies	2000	100	200	284	0	0	0	0	0
Total overseas							626	356	982
Total UK							5,092	2,410	7,503
Total							5,718	2,766	8,485

Table 35. BDMPS for great skua in spring migration (March-April) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in spring	Proportion of immatures in UK western waters in spring	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1980s	5400	10800	15336	0.3	0.05	3240	767	4007
Norway	2010	360	720	1022	0.2	0.05	144	51	195
Faroe	2012	500	1000	1420	0.4	0.05	400	71	471
Hermaness, Saxavord	2013	979	1958	2780	0.7	0.3	1371	834	2205
Fetlar	2002	585	1170	1661	0.7	0.3	819	498	1317
Ronas Hill, North Roe	2002	189	378	537	0.7	0.3	265	161	426
Foula	2007	1657	3314	4706	0.7	0.3	2320	1412	3732
Noss	2013	465	930	1321	0.7	0.3	651	396	1047
Fair Isle	2013	266	532	755	0.7	0.3	372	227	599
Hoy	2010	1346	2692	3823	0.7	0.3	1884	1147	3031
UK Non-SPA North Sea colonies	2000	3000	6000	8520	0.7	0.3	4200	2556	6756
Handa	2013	135	270	383	1	0.4	270	153	423
St Kilda	2012	181	362	514	1	0.4	362	206	568
UK Non-SPA western colonies	2000	100	200	284	1	0.4	200	114	314
Total overseas							3,784	889	4,673
Total UK							12,714	7,704	20,417
Total							16,498	8,593	25,090

Table 36. BDMPS for lesser black-backed gull in autumn migration (August-October) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in autumn	Proportion of immatures in UK North Sea & Channel waters in autumn	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1990s	25000	50000	34000	0.2	0.1	10000	3400	13400
Norway	1990s	30000	60000	40800	0.3	0.1	18000	4080	22080
Faroe	2012	9000	18000	12240	0.4	0.2	7200	2448	9648
Sweden	1990s	18000	36000	24480	0.1	0.05	3600	1224	4824
Denmark	1990s	4400	8800	5984	0.1	0.05	880	299	1179
Ireland	2000	3800	7600	5168	0.1	0.05	760	258	1018
Netherlands	2012	80000	160000	108800	0.05	0.025	8000	2720	10720
Forth Islands	2005-09	1608	3216	2187	1	0.7	3216	1531	4747
Alde-Ore Estuary	2012	640	1280	870	1	0.7	1280	609	1889
UK North Sea non-SPA cols	2000	13000	26000	17680	1	0.7	26000	12376	38376
Ailsa Craig	2010	183	366	249	0.5	0.4	183	100	283
Rathlin Island	2011	107	214	146	0.5	0.4	107	58	165
Lough Neagh & Lough Beg	2000	493	986	670	0.5	0.4	493	268	761
Bowland Fells	2008-12	4575	9150	6222	0.5	0.4	4575	2489	7064
Morcambe Bay	2012	4987	9974	6782	0.5	0.4	4987	2713	7700
Ribble & Alt Estuaries	2012	8267	16534	11243	0.5	0.4	8267	4497	12764
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.3	0.3	5784	3933	9717
Isles of Scilly	2006	3400	6800	4624	0.1	0.05	680	231	911
UK Western non-SPA colonies	2000	40000	80000	54400	0.5	0.4	40000	21760	61760
Total overseas							48,440	14,430	62,870
Total UK							95,572	50,565	146,137
Total							144,012	64,995	209,007

Table 37. BDMPS for lesser black-backed gull in autumn migration (August-October) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in autumn	Proportion immatures in UK western waters in autumn	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1990s	25000	50000	34000	0.2	0.1	10000	3400	13400
Norway	1990s	30000	60000	40800	0.1	0.05	6000	2040	8040
Faroe	2012	9000	18000	12240	0.4	0.2	7200	2448	9648
Sweden	1990s	18000	36000	24480	0.05	0.02	1800	490	2290
Denmark	1990s	4400	8800	5984	0.05	0.02	440	120	560
Ireland	2000	3800	7600	5168	0.4	0.2	3040	1034	4074
Netherlands	2012	80000	160000	108800	0.025	0.01	4000	1088	5088
Forth Islands	2005-09	1608	3216	2187	0	0.1	0	219	219
Alde-Ore Estuary	2012	640	1280	870	0	0.1	0	87	87
UK North Sea non-SPA cols	2000	13000	26000	17680	0	0.1	0	1768	1768
Ailsa Craig	2010	183	366	249	0.5	0.4	183	100	283
Rathlin Island	2011	107	214	146	0.5	0.4	107	58	165
Lough Neagh & Lough Beg	2000	493	986	670	0.5	0.4	493	268	761
Bowland Fells	2008-12	4575	9150	6222	0.5	0.4	4575	2489	7064
Morcambe Bay	2012	4987	9974	6782	0.5	0.4	4987	2713	7700
Ribble & Alt Estuaries	2012	8267	16534	11243	0.5	0.4	8267	4497	12764
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.7	0.4	13496	5244	18740
Isles of Scilly	2006	3400	6800	4624	0.9	0.6	6120	2774	8894
UK Western non-SPA cols	2000	40000	80000	54400	0.5	0.4	40000	21760	61760
Total overseas							32,480	10,619	43,099
Total UK							78,228	41,977	120,205
Total							110,708	52,596	163,304

Table 38. BDMPS for lesser black-backed gull in winter (November to February) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in winter	Proportion immatures in UK North Sea & Channel waters in winter	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1990s	25000	50000	34000	0.05	0	2500	0	2500
Norway	1990s	30000	60000	40800	0.05	0	3000	0	3000
Faroe	2012	9000	18000	12240	0.05	0	900	0	900
Sweden	1990s	18000	36000	24480	0.01	0	360	0	360
Denmark	1990s	4400	8800	5984	0.01	0	88	0	88
Ireland	2000	3800	7600	5168	0.01	0	76	0	76
Netherlands	2012	80000	160000	108800	0.005	0	800	0	800
Forth Islands	2005-09	1608	3216	2187	0.5	0.05	1608	109	1717
Alde-Ore Estuary	2012	640	1280	870	0.5	0.05	640	44	684
UK North Sea non-SPA cols	2000	13000	26000	17680	0.5	0.05	13000	884	13884
Ailsa Craig	2010	183	366	249	0.1	0.01	37	2	39
Rathlin Island	2011	107	214	146	0.1	0.01	21	1	23
Lough Neagh & Lough Beg	2000	493	986	670	0.1	0.01	99	7	105
Bowland Fells	2008-12	4575	9150	6222	0.1	0.01	915	62	977
Morcambe Bay	2012	4987	9974	6782	0.1	0.01	997	68	1065
Ribble & Alt Estuaries	2012	8267	16534	11243	0.1	0.01	1653	112	1766
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.1	0.01	1928	131	2059
Isles of Scilly	2006	3400	6800	4624	0.1	0.01	680	46	726
UK Western non-SPA cols	2000	40000	80000	54400	0.1	0.01	8000	544	8544
Total overseas							7,724	0	7,724
Total UK							29,578	2,011	31,590
Total							37,302	2,011	39,314

Table 39. BDMPS for lesser black-backed gull in winter (November to February) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in winter	Proportion immatures in UK western waters in winter	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1990s	25000	50000	34000	0.05	0	2500	0	2500
Norway	1990s	30000	60000	40800	0.02	0	1200	0	1200
Faroe	2012	9000	18000	12240	0.05	0	900	0	900
Sweden	1990s	18000	36000	24480	0.01	0	360	0	360
Denmark	1990s	4400	8800	5984	0.01	0	88	0	88
Ireland	2000	3800	7600	5168	0.2	0.05	1520	258	1778
Netherlands	2012	80000	160000	108800	0.005	0	800	0	800
Forth Islands	2005-09	1608	3216	2187	0	0	0	0	0
Alde-Ore Estuary	2012	640	1280	870	0	0	0	0	0
UK North Sea non-SPA cols	2000	13000	26000	17680	0	0	0	0	0
Ailsa Craig	2010	183	366	249	0.2	0.05	73	12	86
Rathlin Island	2011	107	214	146	0.2	0.05	43	7	50
Lough Neagh & Lough Beg	2000	493	986	670	0.2	0.05	197	34	231
Bowland Fells	2008-12	4575	9150	6222	0.2	0.05	1830	311	2141
Morcambe Bay	2012	4987	9974	6782	0.2	0.05	1995	339	2334
Ribble & Alt Estuaries	2012	8267	16534	11243	0.2	0.05	3307	562	3869
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.2	0.05	3856	656	4511
Isles of Scilly	2006	3400	6800	4624	0.2	0.05	1360	231	1591
UK Western non-SPA cols	2000	40000	80000	54400	0.2	0.05	16000	2720	18720
Total overseas							7,368	258	7,626
Total UK							28,661	4,872	33,533
Total							36,029	5,130	41,159

Table 40. BDMPS for lesser black-backed gull in spring migration (March-April) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in spring	Proportion immatures in UK North Sea & Channel waters in spring	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Iceland	1990s	25000	50000	34000	0.1	0.05	5000	1700	6700
Norway	1990s	30000	60000	40800	0.3	0.1	18000	4080	22080
Faroe	2012	9000	18000	12240	0.2	0.1	3600	1224	4824
Sweden	1990s	18000	36000	24480	0.1	0.05	3600	1224	4824
Denmark	1990s	4400	8800	5984	0.1	0.05	880	299	1179
Ireland	2000	3800	7600	5168	0.1	0.05	760	258	1018
Netherlands	2012	80000	160000	108800	0.05	0.025	8000	2720	10720
Forth Islands	2005-09	1608	3216	2187	1	0.7	3216	1531	4747
Alde-Ore Estuary	2012	640	1280	870	1	0.7	1280	609	1889
UK North Sea non-SPA cols	2000	13000	26000	17680	1	0.7	26000	12376	38376
Ailsa Craig	2010	183	366	249	0.5	0.4	183	100	283
Rathlin Island	2011	107	214	146	0.5	0.4	107	58	165
Lough Neagh & Lough Beg	2000	493	986	670	0.5	0.4	493	268	761
Bowland Fells	2008-12	4575	9150	6222	0.5	0.4	4575	2489	7064
Morcambe Bay	2012	4987	9974	6782	0.5	0.4	4987	2713	7700
Ribble & Alt Estuaries	2012	8267	16534	11243	0.5	0.4	8267	4497	12764
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.3	0.3	5784	3933	9717
Isles of Scilly	2006	3400	6800	4624	0.1	0.05	680	231	911
UK Western non-SPA cols	2000	40000	80000	54400	0.5	0.4	40000	21760	61760
Total overseas							39,840	11,506	51,346
Total UK							95,572	50,565	146,137
Total							135,412	62,071	197,483

Table 41. BDMPS for lesser black-backed gull in spring migration (March-April) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in spring	Proportion immatures in UK western waters in spring	UK western Number adults	UK western Number immatures	UK western Total birds
Iceland	1990s	25000	50000	34000	0.2	0.1	10000	3400	13400
Norway	1990s	30000	60000	40800	0.1	0.05	6000	2040	8040
Faroe	2012	9000	18000	12240	0.4	0.2	7200	2448	9648
Sweden	1990s	18000	36000	24480	0.05	0.02	1800	490	2290
Denmark	1990s	4400	8800	5984	0.05	0.02	440	120	560
Ireland	2000	3800	7600	5168	0.4	0.2	3040	1034	4074
Netherlands	2012	80000	160000	108800	0.025	0.01	4000	1088	5088
Forth Islands	2005-09	1608	3216	2187	0	0.1	0	219	219
Alde-Ore Estuary	2012	640	1280	870	0	0.1	0	87	87
UK North Sea non-SPA	2000	13000	26000	17680	0	0.1	0	1768	1768
Ailsa Craig	2010	183	366	249	0.5	0.4	183	100	283
Rathlin Island	2011	107	214	146	0.5	0.4	107	58	165
Lough Neagh & L. Beg	2000	493	986	670	0.5	0.4	493	268	761
Bowland Fells	2008-12	4575	9150	6222	0.5	0.4	4575	2489	7064
Morcambe Bay	2012	4987	9974	6782	0.5	0.4	4987	2713	7700
Ribble & Alt Estuaries	2012	8267	16534	11243	0.5	0.4	8267	4497	12764
Skokholm, Skomer, Mholm	2013	9640	19280	13110	0.7	0.4	13496	5244	18740
Isles of Scilly	2006	3400	6800	4624	0.9	0.6	6120	2774	8894
UK Western non-SPA cols	2000	40000	80000	54400	0.5	0.4	40000	21760	61760
Total overseas							32,480	10,619	43,100
Total UK							78,228	41,977	120,205
Total							110,708	52,596	163,305

Table 42. BDMPS for herring gull in non-breeding season (September to February) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters non-breeding season	Proportion immatures in UK North Sea & Channel waters non-breeding season	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Barents Sea	2000	126000	252000	274680	0.2	0.3	50400	82404	132804
Faroe	2012	1500	3000	3270	0.2	0.3	600	981	1581
Ireland	2000	5000	10000	10900	0.02	0.05	200	545	745
East Caithness Cliffs	1999	3393	6786	7397	0.99	0.95	6718	7027	13745
Troup, Pennan & Lions	2007	1597	3194	3481	0.99	0.95	3162	3307	6469
Buchan Ness to Collieston	2010	3114	6228	6789	0.99	0.95	6166	6449	12615
Fowlsheugh	2012	259	518	565	0.99	0.95	513	536	1049
Forth Islands	2005-09	2827	5654	6163	0.99	0.95	5597	5855	11452
St Abbs Head/ Fast Castle	2013	239	478	521	0.99	0.95	473	495	968
Flamborough & Filey Coast	2010	495	990	1079	0.99	0.95	980	1025	2005
Alde-Ore Estuary	2006	800	1600	1744	0.99	0.95	1584	1657	3241
UK North Sea non-SPA cols	2000	65000	130000	141700	0.99	0.95	128700	134615	263315
Canna & Sanday	2011	63	126	137	0.05	0.1	6	14	20
Ailsa Craig	2013	129	258	281	0.05	0.1	13	28	41
Rathlin Island	2011	28	56	61	0.05	0.1	3	6	9
Morecambe Bay	2012	1734	3468	3780	0.05	0.1	173	378	551
UK western non-SPA cols	2000	50000	100000	109000	0.05	0.1	5000	10900	15900
Total overseas							51,200	83,930	135,130
Total UK							159,089	172,292	331,381
Total							210,289	256,222	466,511

Table 43. BDMPS for herring gull in non-breeding season (September to February) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters non-breeding season	Proportion immatures in UK western waters non-breeding season	UK western Number adults	UK western Number immatures	UK western Total birds
Barents Sea	2000	126000	252000	274680	0.001	0.005	252	1373	1625
Faroe	2012	1500	3000	3270	0.2	0.3	600	981	1581
Ireland	2000	5000	10000	10900	0.3	0.4	3000	4360	7360
East Caithness Cliffs	1999	3393	6786	7397	0.001	0.001	7	7	14
Troup, Pennan & Lions	2007	1597	3194	3481	0.001	0.001	3	3	7
Buchan Ness to Collieston	2010	3114	6228	6789	0.001	0.001	6	7	13
Fowlsheugh	2012	259	518	565	0.001	0.001	1	1	1
Forth Islands	2005-09	2827	5654	6163	0.001	0.001	6	6	12
St Abbs Head/ Fast Castle	2013	239	478	521	0.001	0.001	0	1	1
Flamborough & Filey Coast	2010	495	990	1079	0.001	0.001	1	1	2
Alde-Ore Estuary	2006	800	1600	1744	0.001	0.001	2	2	3
UK North Sea non-SPA cols	2000	65000	130000	141700	0.001	0.001	130	142	272
Canna & Sanday	2011	63	126	137	0.8	0.7	101	96	197
Ailsa Craig	2013	129	258	281	0.8	0.7	206	197	403
Rathlin Island	2011	28	56	61	0.8	0.7	45	43	88
Morecambe Bay	2012	1734	3468	3780	0.8	0.7	2774	2646	5420
UK western non-SPA cols	2000	50000	100000	109000	0.8	0.7	80000	76300	156300
Total overseas							3,852	6,714	10,566
Total UK							83,282	79,451	162,733
Total							87,134	86,165	173,299

Table 44. BDMPS for great black-backed gull in non-breeding season (September to March) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters non-breeding season	Proportion of immatures in UK North Sea waters non-breeding season	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Barents Sea	1990s*	33000	66000	83160	0.3	0.5	19800	41580	61380
Faroe	2012	1000	2000	2520	0.3	0.3	600	756	1356
Ireland	2000	2000	4000	5040	0	0	0	0	0
Calf of Eday	2006	281	562	708	1	1	562	708	1270
Copinsay	2010	218	436	549	1	1	436	549	985
Hoy	2011	60	120	151	1	1	120	151	271
East Caithness Cliffs	1999	175	350	441	1	1	350	441	791
UK North Sea non-SPA colonies	2000	5000	10000	12600	1	1	10000	12600	22600
North Rona & Sula Sgeir	2012	191	382	481	0.01	0.1	4	48	52
Isles of Scilly	2006	901	1802	2271	0.01	0.1	18	227	245
UK western non-SPA colonies	2000	9000	18000	22680	0.01	0.1	180	2268	2448
Total overseas							20,400	42,336	62,736
Total UK							11,670	16,993	28,663
Total							32,070	59,329	91,399

*updated to 2012 by R.T. Barrett pers. comm.

Table 45. BDMPS for great black-backed gull in non-breeding season (September to March) in 'UK west of Scotland waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in west of Scotland waters non-breeding season	Proportion of immatures in UK west of Scotland waters non-breeding season	west of Scotland Number adults	west of Scotland Number immatures	west of Scotland Total birds
Barents Sea	1990s*	33000	66000	83160	0.01	0.08	660	6653	7313
Faroe	2012	1000	2000	2520	0.1	0.3	200	756	956
Ireland	2000	2000	4000	5040	0.1	0.2	400	1008	1408
Calf of Eday	2006	281	562	708	0	0	0	0	0
Copinsay	2010	218	436	549	0	0	0	0	0
Hoy	2011	60	120	151	0	0	0	0	0
East Caithness Cliffs	1999	175	350	441	0	0	0	0	0
UK North Sea non-SPA colonies	2000	5000	10000	12600	0	0	0	0	0
North Rona & Sula Sgeir	2012	191	382	481	0.99	0.8	378	385	763
Isles of Scilly	2006	901	1802	2271	0	0	0	0	0
UK western non-SPA colonies	2000	9000	18000	22680	0.7	0.5	12600	11340	23940
Total overseas							1,260	8,417	9,677
Total UK							12,978	11,725	24,703
Total							14,238	20,142	34,380

*updated to 2012 by R.T. Barrett pers. comm.

Table 46. BDMPS for great black-backed gull in non-breeding season (September to March) in 'UK south-west & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK south-west & Channel waters non-breeding season	Proportion of immatures in UK south-west & Channel waters non-breeding season	UK south-west & Channel Number adults	UK south-west & Channel Number immatures	UK south-west & Channel Total birds
Barents Sea	1990s*	33000	66000	83160	0	0.02	0	1663	1663
Faroe	2012	1000	2000	2520	0	0.2	0	504	504
Ireland	2000	2000	4000	5040	0.1	0.3	400	1512	1912
Calf of Eday	2006	281	562	708	0	0	0	0	0
Copinsay	2010	218	436	549	0	0	0	0	0
Hoy	2011	60	120	151	0	0	0	0	0
East Caithness Cliffs	1999	175	350	441	0	0	0	0	0
UK North Sea non-SPA colonies	2000	5000	10000	12600	0	0	0	0	0
North Rona & Sula Sgeir	2012	191	382	481	0	0.1	0	48	48
Isles of Scilly	2006	901	1802	2271	0.9	0.7	1622	1589	3211
UK western non-SPA colonies	2000	9000	18000	22680	0.2	0.3	3600	6804	10404
Total overseas							400	3,679	4,079
Total UK							5,222	8,441	13,663
Total							5,622	12,120	17,742

*updated to 2012 by R.T. Barrett pers. comm.

Table 47. BDMPS for black-legged kittiwake in autumn migration (August to December) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters in autumn	Proportion of immatures in UK North Sea waters in autumn	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Russia	2000	140000	280000	246400	0.1	0.1	28000	24640	52640
Norway	2010	700000	1400000	1232000	0.1	0.1	140000	123200	263200
Faroe	2012	200000	400000	352000	0.1	0.1	40000	35200	75200
Germany	2010	6000	12000	10560	0.1	0.1	1200	1056	2256
France	2010	4000	8000	7040	0.05	0.05	400	352	752
Ireland	2000	20000	40000	35200	0.05	0.05	2000	1760	3760
Hermaness, Saxavord	2009	391	782	688	0.6	0.4	469	275	744
Foula	2013	327	654	576	0.6	0.4	392	230	623
Noss	2010	507	1014	892	0.6	0.4	608	357	965
Sumburgh Head	2013	210	420	370	0.6	0.4	252	148	400
Fair Isle	2013	771	1542	1357	0.6	0.4	925	543	1468
West Westray	2007	12055	24110	21217	0.6	0.4	14466	8487	22953
Calf of Eday	2006	747	1494	1315	0.6	0.4	896	526	1422
Marwick Head	2013	526	1052	926	0.6	0.4	631	370	1002
Rousay	2009	1764	3528	3105	0.6	0.4	2117	1242	3359
Copinsay	2012	666	1332	1172	0.6	0.4	799	469	1268
Hoy	2007	397	794	699	0.6	0.4	476	279	756
North Caithness Cliffs	2000	10150	20300	17864	0.6	0.4	12180	7146	19326
East Caithness Cliffs	1999	40410	80820	71122	0.6	0.4	48492	28449	76941
Troup, Pennan & Lions Heads	2007	14896	29792	26217	0.6	0.4	17875	10487	28362
Buchan Ness to Collieston	2007	12542	25084	22074	0.6	0.4	15050	8830	23880
Fowlsheugh	2012	9337	18674	16433	0.6	0.4	11204	6573	17778
Forth Islands	2013	3100	6200	5456	0.6	0.4	3720	2182	5902
St Abbs Head to Fast Castle	2013	3403	6806	5989	0.6	0.4	4084	2396	6479
Farne Islands	2013	3443	6886	6060	0.6	0.4	4132	2424	6555

Flamborough and Filey	2008	37617	75234	66206	0.6	0.4	45140	26482	71623
UK North Sea non-SPA colonies	2000*	70000	140000	123200	0.6	0.4	84000	49280	133280
Cape Wrath	2000	10344	20688	18205	0.01	0.05	207	910	1117
North Rona & Sula Sgeir	2012	1253	2506	2205	0.01	0.05	25	110	135
Handa	2013	1872	3744	3295	0.01	0.05	37	165	202
St Kilda	2008	957	1914	1684	0.01	0.05	19	84	103
Flannan Isles	1998	1392	2784	2450	0.01	0.05	28	122	150
Shiant Isles	2008	549	1098	966	0.01	0.05	11	48	59
Canna & Sanday	2013	820	1640	1443	0.01	0.05	16	72	89
Rum	2000	788	1576	1387	0.01	0.05	16	69	85
Mingulay & Berneray	2009	2228	4456	3921	0.01	0.05	45	196	241
North Colonsay & Western Cliffs	2000	5563	11126	9791	0.01	0.05	111	490	601
Ailsa Craig	2013	489	978	861	0.01	0.05	10	43	53
Rathlin Island	2011	7922	15844	13943	0.01	0.05	158	697	856
Skomer, Skokholm, Middleholm	2013	1045	2090	1839	0.01	0.05	21	92	113
UK Western non-SPA colonies	2000*	30000	60000	52800	0.01	0.05	600	2640	3240
Total overseas							211,600	186,208	397,808
Total UK							269,215	162,914	432,129
Total							480,815	349,122	829,937

*updated to 2012 using trend in Foster & Marrs 2012 and JNCC database

Table 48. BDMPS for black-legged kittiwake in autumn migration (August to December) in 'UK western waters & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters (including Channel) in autumn	Proportion of immatures in UK western waters (including Channel) waters in autumn	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Russia	2000	140000	280000	246400	0.1	0.1	28000	24640	52640
Norway	2010	700000	1400000	1232000	0.15	0.15	210000	184800	394800
Faroe	2012	200000	400000	352000	0.2	0.2	80000	70400	150400
Germany	2010	6000	12000	10560	0.05	0.05	600	528	1128
France	2010	4000	8000	7040	0.1	0.1	800	704	1504
Ireland	2000	20000	40000	35200	0.3	0.2	12000	7040	19040
Hermaness, Saxavord	2009	391	782	688	0.2	0.2	156	138	294
Foula	2013	327	654	576	0.2	0.2	131	115	246
Noss	2010	507	1014	892	0.2	0.2	203	178	381
Sumburgh Head	2013	210	420	370	0.2	0.2	84	74	158
Fair Isle	2013	771	1542	1357	0.2	0.2	308	271	580
West Westray	2007	12055	24110	21217	0.2	0.2	4822	4243	9065
Calf of Eday	2006	747	1494	1315	0.2	0.2	299	263	562
Marwick Head	2013	526	1052	926	0.2	0.2	210	185	396
Rousay	2009	1764	3528	3105	0.2	0.2	706	621	1327
Copinsay	2012	666	1332	1172	0.2	0.2	266	234	501
Hoy	2007	397	794	699	0.2	0.2	159	140	299
North Caithness Cliffs	2000	10150	20300	17864	0.2	0.2	4060	3573	7633
East Caithness Cliffs	1999	40410	80820	71122	0.2	0.2	16164	14224	30388
Troup, Pennan & Lions Heads	2007	14896	29792	26217	0.2	0.2	5958	5243	11202
Buchan Ness to Collieston	2007	12542	25084	22074	0.2	0.2	5017	4415	9432
Fowlsheugh	2012	9337	18674	16433	0.2	0.2	3735	3287	7021
Forth Islands	2013	3100	6200	5456	0.2	0.2	1240	1091	2331

St Abbs Head to Fast Castle	2013	3403	6806	5989	0.2	0.2	1361	1198	2559
Farne Islands	2013	3443	6886	6060	0.2	0.2	1377	1212	2589
Flamborough and Filey	2008	37617	75234	66206	0.2	0.2	15047	13241	28288
UK North Sea non-SPA colonies	2000*	70000	140000	123200	0.2	0.2	28000	24640	52640
Cape Wrath	2000	10344	20688	18205	0.6	0.4	12413	7282	19695
North Rona & Sula Sgeir	2012	1253	2506	2205	0.6	0.4	1504	882	2386
Handa	2013	1872	3744	3295	0.6	0.4	2246	1318	3564
St Kilda	2008	957	1914	1684	0.6	0.4	1148	674	1822
Flannan Isles	1998	1392	2784	2450	0.6	0.4	1670	980	2650
Shiant Isles	2008	549	1098	966	0.6	0.4	659	386	1045
Canna & Sanday	2013	820	1640	1443	0.6	0.4	984	577	1561
Rum	2000	788	1576	1387	0.6	0.4	946	555	1500
Mingulay & Berneray	2009	2228	4456	3921	0.6	0.4	2674	1569	4242
North Colonsay & Western Cliffs	2000	5563	11126	9791	0.6	0.4	6676	3916	10592
Ailsa Craig	2013	489	978	861	0.6	0.4	587	344	931
Rathlin Island	2011	7922	15844	13943	0.6	0.4	9506	5577	15083
Skomer, Skokholm, Middleholm	2013	1045	2090	1839	0.6	0.4	1254	736	1990
UK Western non-SPA colonies	2000*	30000	60000	52800	0.6	0.4	36000	21120	57120
Total overseas							331,400	288,112	619,512
Total UK							167,570	124,503	292,074
Total							498,970	412,615	911,586

*updated to 2012 using trend in Foster & Marrs 2012 and JNCC database

Table 49. BDMPS for black-legged kittiwake in spring migration (January to April) in 'UK North Sea waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea waters in spring	Proportion of immatures in UK North Sea waters in spring	UK N Sea Number adults	UK N Sea Number immatures	UK N Sea Total birds
Russia	2000	140000	280000	246400	0.05	0.07	14000	17248	31248
Norway	2010	700000	1400000	1232000	0.05	0.07	70000	86240	156240
Faroe	2012	200000	400000	352000	0.05	0.07	20000	24640	44640
Germany	2010	6000	12000	10560	0.15	0.25	1800	2640	4440
France	2010	4000	8000	7040	0.05	0.1	400	704	1104
Ireland	2000	20000	40000	35200	0.01	0.01	400	352	752
Hermaness, Saxavord	2009	391	782	688	0.6	0.3	469	206	676
Foula	2013	327	654	576	0.6	0.3	392	173	565
Noss	2010	507	1014	892	0.6	0.3	608	268	876
Sumburgh Head	2013	210	420	370	0.6	0.3	252	111	363
Fair Isle	2013	771	1542	1357	0.6	0.3	925	407	1332
West Westray	2007	12055	24110	21217	0.6	0.3	14466	6365	20831
Calf of Eday	2006	747	1494	1315	0.6	0.3	896	394	1291
Marwick Head	2013	526	1052	926	0.6	0.3	631	278	909
Rousay	2009	1764	3528	3105	0.6	0.3	2117	931	3048
Copinsay	2012	666	1332	1172	0.6	0.3	799	352	1151
Hoy	2007	397	794	699	0.6	0.3	476	210	686
North Caithness Cliffs	2000	10150	20300	17864	0.6	0.3	12180	5359	17539
East Caithness Cliffs	1999	40410	80820	71122	0.6	0.3	48492	21336	69828
Troup, Pennan & Lions Heads	2007	14896	29792	26217	0.6	0.3	17875	7865	25740
Buchan Ness to Collieston	2007	12542	25084	22074	0.6	0.3	15050	6622	21673
Fowlsheugh	2012	9337	18674	16433	0.6	0.3	11204	4930	16134
Forth Islands	2013	3100	6200	5456	0.6	0.3	3720	1637	5357
St Abbs Head to Fast Castle	2013	3403	6806	5989	0.6	0.3	4084	1797	5880
Farne Islands	2013	3443	6886	6060	0.6	0.3	4132	1818	5950

Flamborough and Filey	2008	37617	75234	66206	0.6	0.3	45140	19862	65002
UK North Sea non-SPA colonies	2000*	70000	140000	123200	0.6	0.3	84000	36960	120960
Cape Wrath	2000	10344	20688	18205	0.01	0.02	207	364	571
North Rona & Sula Sgeir	2012	1253	2506	2205	0.01	0.02	25	44	69
Handa	2013	1872	3744	3295	0.01	0.02	37	66	103
St Kilda	2008	957	1914	1684	0.01	0.02	19	34	53
Flannan Isles	1998	1392	2784	2450	0.01	0.02	28	49	77
Shiant Isles	2008	549	1098	966	0.01	0.02	11	19	30
Canna & Sanday	2013	820	1640	1443	0.01	0.02	16	29	45
Rum	2000	788	1576	1387	0.01	0.02	16	28	43
Mingulay & Berneray	2009	2228	4456	3921	0.01	0.02	45	78	123
North Colonsay & Western Cliffs	2000	5563	11126	9791	0.01	0.02	111	196	307
Ailsa Craig	2013	489	978	861	0.01	0.02	10	17	27
Rathlin Island	2011	7922	15844	13943	0.01	0.02	158	279	437
Skomer, Skokholm, Middleholm	2013	1045	2090	1839	0.01	0.02	21	37	58
UK Western non-SPA colonies	2000*	30000	60000	52800	0.01	0.02	600	1056	1656
Total overseas							106,600	131,824	238,424
Total UK							269,215	120,177	389,392
Total							375,815	252,001	627,816

*updated to 2012 using trend in Foster & Marrs 2012 and JNCC database

Table 50. BDMPS for black-legged kittiwake in spring migration (January to April) in 'UK western waters & Channel'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters (including Channel) in spring	Proportion of immatures in UK western waters (including Channel) waters in spring	UK western waters & Channel Number adults	UK western waters & Channel Number immatures	UK western waters & Channel Total birds
Russia	2000	140000	280000	246400	0.05	0.1	14000	24640	38640
Norway	2010	700000	1400000	1232000	0.05	0.1	70000	123200	193200
Faroe	2012	200000	400000	352000	0.1	0.1	40000	35200	75200
Germany	2010	6000	12000	10560	0.05	0.05	600	528	1128
France	2010	4000	8000	7040	0.1	0.1	800	704	1504
Ireland	2000	20000	40000	35200	0.3	0.2	12000	7040	19040
Hermaness, Saxavord	2009	391	782	688	0.3	0.2	235	138	372
Foula	2013	327	654	576	0.3	0.2	196	115	311
Noss	2010	507	1014	892	0.3	0.2	304	178	483
Sumburgh Head	2013	210	420	370	0.3	0.2	126	74	200
Fair Isle	2013	771	1542	1357	0.3	0.2	463	271	734
West Westray	2007	12055	24110	21217	0.3	0.2	7233	4243	11476
Calf of Eday	2006	747	1494	1315	0.3	0.2	448	263	711
Marwick Head	2013	526	1052	926	0.3	0.2	316	185	501
Rousay	2009	1764	3528	3105	0.3	0.2	1058	621	1679
Copinsay	2012	666	1332	1172	0.3	0.2	400	234	634
Hoy	2007	397	794	699	0.3	0.2	238	140	378
North Caithness Cliffs	2000	10150	20300	17864	0.3	0.2	6090	3573	9663
East Caithness Cliffs	1999	40410	80820	71122	0.3	0.2	24246	14224	38470
Troup, Pennan & Lions Heads	2007	14896	29792	26217	0.3	0.2	8938	5243	14181
Buchan Ness to Collieston	2007	12542	25084	22074	0.3	0.2	7525	4415	11940
Fowlsheugh	2012	9337	18674	16433	0.3	0.2	5602	3287	8889
Forth Islands	2013	3100	6200	5456	0.3	0.2	1860	1091	2951

St Abbs Head to Fast Castle	2013	3403	6806	5989	0.3	0.2	2042	1198	3240
Farne Islands	2013	3443	6886	6060	0.3	0.2	2066	1212	3278
Flamborough and Filey	2008	37617	75234	66206	0.3	0.2	22570	13241	35811
UK North Sea non-SPA colonies	2000*	70000	140000	123200	0.3	0.2	42000	24640	66640
Cape Wrath	2000	10344	20688	18205	0.8	0.4	16550	7282	23833
North Rona & Sula Sgeir	2012	1253	2506	2205	0.8	0.4	2005	882	2887
Handa	2013	1872	3744	3295	0.8	0.4	2995	1318	4313
St Kilda	2008	957	1914	1684	0.8	0.4	1531	674	2205
Flannan Isles	1998	1392	2784	2450	0.8	0.4	2227	980	3207
Shiant Isles	2008	549	1098	966	0.8	0.4	878	386	1265
Canna & Sanday	2013	820	1640	1443	0.8	0.4	1312	577	1889
Rum	2000	788	1576	1387	0.8	0.4	1261	555	1816
Mingulay & Berneray	2009	2228	4456	3921	0.8	0.4	3565	1569	5133
North Colonsay & Western Cliffs	2000	5563	11126	9791	0.8	0.4	8901	3916	12817
Ailsa Craig	2013	489	978	861	0.8	0.4	782	344	1127
Rathlin Island	2011	7922	15844	13943	0.8	0.4	12675	5577	18252
Skomer, Skokholm, Middleholm	2013	1045	2090	1839	0.8	0.4	1672	736	2408
UK Western non-SPA colonies	2000*	30000	60000	52800	0.8	0.4	48000	21120	69120
Total overseas							137,400	191,312	328,712
Total UK							238,311	124,503	362,814
Total							375,711	315,815	691,526

*updated to 2012 using trend in Foster & Marrs 2012 and JNCC database

Table 51. BDMPS for Sandwich tern in migration seasons (July-September and March-May) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters migration	Proportion of immatures in UK North Sea & Channel waters on migration	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Norway & Sweden	1990s	700	1400	882	0.1	0.1	140	88	228
Denmark	1990s	4500	9000	5670	0.1	0.1	900	567	1467
Germany	1990s	9700	19400	12222	0.1	0.1	1940	1222	3162
Netherlands	1990s	14500	29000	18270	0.1	0.1	2900	1827	4727
Belgium	2000	1550	3100	1953	0.1	0.1	310	195	505
Ireland	2000	1800	3600	2268	0	0	0	0	0
Loch of Strathbeg	2013	0	0	0	1	0.7	0	0	0
Ythan Estuary	2013	565	1130	712	1	0.7	1130	498	1628
Forth Islands	2013	0	0	0	1	0.7	0	0	0
Farne Islands	2013	824	1648	1038	1	0.7	1648	727	2375
Coquet Island	2013	670	1340	844	1	0.7	1340	591	1931
North Norfolk Coast	2012	4135	8270	5210	1	0.7	8270	3647	11917
Alde-Ore Estuary	2009	2	4	3	1	0.7	4	2	6
Foulness	2006	0	0	0	1	0.7	0	0	0
Chichester & Langstone Harb	2013	6	12	8	1	0.7	12	5	17
Solent & Southampton Water	2008	0	0	0	1	0.7	0	0	0
UK North Sea non-SPA colonies	2000	3500	7000	4410	1	0.7	7000	3087	10087
Carlingford Lough	2013	0	0	0	0	0	0	0	0
Larne Lough	2013	257	514	324	0	0	0	0	0
Strangford Lough	2012	771	1542	971	0	0	0	0	0
Morecambe Bay	2011	1	2	1	0	0	0	0	0
Duddon Estuary	2012	1	2	1	0	0	0	0	0
Ynys Feurig, Cemlyn Bay	2009	0	0	0	0	0	0	0	0
UK Western non-SPA colonies	2000	1500	3000	1890	0	0	0	0	0

Total overseas	6,190	3,900	10,090
Total UK	19,404	8,557	27,961
Total	25,594	12,457	38,051

Table 52. BDMPS for Sandwich tern in migration seasons (July-September and March-May) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters on migration	Proportion of immatures in UK western waters on migration	UK western Number adults	UK western Number immatures	UK western Total birds
Norway & Sweden	1990s	700	1400	882	0.05	0.05	70	44	114
Denmark	1990s	4500	9000	5670	0.03	0.03	270	170	440
Germany	1990s	9700	19400	12222	0.02	0.02	388	244	632
Netherlands	1990s	14500	29000	18270	0.01	0.01	290	183	473
Belgium	2000	1550	3100	1953	0.01	0.01	31	20	51
Ireland	2000	1800	3600	2268	0.3	0.3	1080	680	1760
Loch of Strathbeg	2013	0	0	0	0	0	0	0	0
Ythan Estuary	2013	565	1130	712	0	0	0	0	0
Forth Islands	2013	0	0	0	0	0	0	0	0
Farne Islands	2013	824	1648	1038	0	0	0	0	0
Coquet Island	2013	670	1340	844	0	0	0	0	0
North Norfolk Coast	2012	4135	8270	5210	0	0	0	0	0
Alde-Ore Estuary	2009	2	4	3	0	0	0	0	0
Foulness	2006	0	0	0	0	0	0	0	0
Chichester & Langstone Harb	2013	6	12	8	0	0	0	0	0
Solent & Southampton Water	2008	0	0	0	0	0	0	0	0
UK North Sea non-SPA colonies	2000	3500	7000	4410	0	0	0	0	0
Carlingford Lough	2013	0	0	0	1	0.7	0	0	0
Larne Lough	2013	257	514	324	1	0.7	514	227	741
Strangford Lough	2012	771	1542	971	1	0.7	1542	680	2222
Morecambe Bay	2011	1	2	1	1	0.7	2	1	3
Duddon Estuary	2012	1	2	1	1	0.7	2	1	3
Ynys Feurig, Cemlyn Bay	2009	0	0	0	1	0.7	0	0	0
UK Western non-SPA colonies	2000	1500	3000	1890	1	0.7	3000	1323	4323

Total overseas	2,129	1,341	3,470
Total UK	5,060	2,231	7,291
Total	7,189	3,572	10,761

Table 53. BDMPS for roseate tern in migration seasons (August-September and late-April-May) in 'UK East Coast & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK east coast & Channel waters on migration	Proportion of immatures in UK east coast & Channel waters on migration	UK east coast & Channel Number adults	UK east coast & Channel Number immatures	UK east coast & Channel Total birds
Germany, Netherlands, Belgium	2010	3	6	4	0.05	0.1	0	0	1
Ireland	2010	750	1500	1125	0.002	0.003	3	3	6
Forth Islands	2005-09	3	6	4	1	0.6	6	3	9
Farne Islands	2011	0	0	0	1	0.6	0	0	0
Coquet Island	2011	78	156	117	1	0.6	156	70	226
North Norfolk Coast	2010	0	0	0	1	0.6	0	0	0
Solent & Southampton Water	2009	0	0	0	1	0.6	0	0	0
UK North Sea non-SPA colonies	2010	3	6	4	1	0.6	6	3	9
Larne Lough	2011	0	0	0	0	0	0	0	0
Ynys Feurig, Cemlyn Bay & Skerries	2011	0	0	0	0	0	0	0	0
UK western non-SPA colonies	2010	0	0	0	0	0	0	0	0
Total overseas							3	4	7
Total UK							168	76	244
Total							171	80	251

Table 54. BDMPS for roseate tern in migration seasons (August-September and late-April-May) in 'north and west Scottish waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in N & W Scottish waters on migration	Proportion of immatures in N & W Scottish waters on migration	N & W Scottish Number adults	N & W Scottish Number immatures	N & W Scottish Total birds
Germany, Netherlands, Belgium	2010	3	6	4	0	0.001	0	0	0
Ireland	2010	750	1500	1125	0.0005	0.003	1	3	4
Forth Islands	2005-09	3	6	4	0	0	0	0	0
Farne Islands	2011	0	0	0	0	0	0	0	0
Coquet Island	2011	78	156	117	0	0	0	0	0
North Norfolk Coast	2010	0	0	0	0	0	0	0	0
Solent & Southampton Water	2009	0	0	0	0	0	0	0	0
UK North Sea non-SPA colonies	2010	3	6	4	0	0	0	0	0
Larne Lough	2011	0	0	0	0	0	0	0	0
Ynys Feurig, Cemlyn Bay & Skerries	2011	0	0	0	0	0	0	0	0
UK western non-SPA colonies	2010	0	0	0	0	0	0	0	0
Total overseas							1	3	4
Total UK							0	0	0
Total							1	3	4

Table 55. BDMPS for roseate tern in migration seasons (August-September and late-April-May) in 'Wales and west England waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in Wales & West England waters on migration	Proportion of immatures in Wales & West England waters on migration	Wales & West England Number adults	Wales & West England Number immatures	Wales & West England Total birds
Germany, Netherlands, Belgium	2010	3	6	4	0	0.001	0	0	0
Ireland	2010	750	1500	1125	0.95	0.6	1425	675	2100
Forth Islands	2005-09	3	6	4	0	0	0	0	0
Farne Islands	2011	0	0	0	0	0	0	0	0
Coquet Island	2011	78	156	117	0	0	0	0	0
North Norfolk Coast	2010	0	0	0	0	0	0	0	0
Solent & Southampton Water	2009	0	0	0	0	0	0	0	0
UK North Sea non-SPA colonies	2010	3	6	4	0	0	0	0	0
Larne Lough	2011	0	0	0	1	0.6	0	0	0
Ynys Feurig, Cemlyn Bay & Skerries	2011	0	0	0	1	0.6	0	0	0
UK western non-SPA colonies	2010	0	0	0	1	0.6	0	0	0
Total overseas							1,425	675	2,100
Total UK							0	0	0
Total							1,425	675	2,100

Table 56. BDMPS for common tern in migration seasons (late July-early September and April-May) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters on migration	Proportion of immatures in UK North Sea & Channel waters on migration	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Norway	1990s	15000	30000	20100	0.3	0.3	9000	6030	15030
Finland	1990s	50000	100000	67000	0.3	0.3	30000	20100	50100
Sweden	1990s	22000	44000	29480	0.3	0.3	13200	8844	22044
Baltic States	1990s	12750	25500	17085	0.3	0.3	7650	5126	12776
Germany & Denmark	1990s	10000	20000	13400	0.25	0.25	5000	3350	8350
Netherlands	1990s	19000	38000	25460	0.25	0.25	9500	6365	15865
Ireland	2000	2700	5400	3618	0.2	0.2	1080	724	1804
Cromarty Firth	2010	68	136	91	0.7	0.5	95	46	141
Inner Moray Firth	2013	0	0	0	0.7	0.5	0	0	0
Ythan Estuary, Sands of Forvie	2010	4	8	5	0.7	0.5	6	3	8
Forth Islands	2011	26	52	35	0.7	0.5	36	17	54
Imperial Dock Lock	2010	818	1636	1096	0.7	0.5	1145	548	1693
Farne Islands	2013	94	188	126	0.7	0.5	132	63	195
Coquet Island	2013	1041	2082	1395	0.7	0.5	1457	697	2155
The Wash	2013	221	442	296	0.7	0.5	309	148	457
North Norfolk Coast	2012	198	396	265	0.7	0.5	277	133	410
Breydon Water	2013	92	184	123	0.7	0.5	129	62	190
Foulness	2008	25	50	34	0.7	0.5	35	17	52
Dungeness to Pett Level	2013	79	158	106	0.7	0.5	111	53	164
Poole Harbour	2013	163	326	218	0.7	0.5	228	109	337
Solent & Southampton Water	2007	280	560	375	0.7	0.5	392	188	580
UK North Sea non-SPA colonies	2000	5500	11000	7370	0.7	0.5	7700	3685	11385
Glas Eileanan	2012	22	44	29	0.1	0.1	4	3	7
Carlingford Lough	2013	119	238	159	0.1	0.1	24	16	30

Larne Lough	2013	231	462	310	0.1	0.1	46	31	77
Lough Neagh & Lough Beg	2013	78	156	105	0.1	0.1	16	10	26
Strangford Lough	2013	352	704	472	0.1	0.1	70	47	118
The Dee Estuary	2013	165	330	221	0.1	0.1	33	22	55
Ribble & Alt Estuaries	2008	111	222	149	0.1	0.1	22	15	37
Ynys Feurig, Cemlyn Bay & Skerries	2011	178	356	239	0.1	0.1	36	24	59
UK western non-SPA colonies	2000	2100	4200	2814	0.1	0.1	420	281	701
Total overseas							75,430	50,539	125,969
Total UK							12,724	6,218	18,942
Total							88,154	56,757	144,911

Table 57. BDMPS for common tern in migration seasons (late July-early September and April-May) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters on migration	Proportion of immatures in UK western waters on migration	UK western waters Number adults	UK western waters Number immatures	UK western waters Total birds
Norway	1990s	15000	30000	20100	0.2	0.2	6000	4020	10020
Finland	1990s	50000	100000	67000	0.1	0.1	10000	6700	16700
Sweden	1990s	22000	44000	29480	0.1	0.1	4400	2948	7348
Baltic States	1990s	12750	25500	17085	0.1	0.1	2550	1708	4258
Germany & Denmark	1990s	10000	20000	13400	0.1	0.1	2000	1340	3340
Netherlands	1990s	19000	38000	25460	0.05	0.05	1900	1273	3173
Ireland	2000	2700	5400	3618	0.4	0.4	2160	1447	3607
Cromarty Firth	2010	68	136	91	0.3	0.2	41	18	59
Inner Moray Firth	2013	0	0	0	0.3	0.2	0	0	0
Ythan Estuary, Sands of Forvie	2010	4	8	5	0.3	0.2	2	1	3
Forth Islands	2011	26	52	35	0.3	0.2	16	7	23
Imperial Dock Lock	2010	818	1636	1096	0.3	0.2	491	219	710
Farne Islands	2013	94	188	126	0.3	0.2	56	25	82
Coquet Island	2013	1041	2082	1395	0.3	0.2	625	279	904
The Wash	2013	221	442	296	0.3	0.2	133	59	192
North Norfolk Coast	2012	198	396	265	0.3	0.2	119	53	172
Breydon Water	2013	92	184	123	0.3	0.2	55	25	80
Foulness	2008	25	50	34	0.3	0.2	15	7	22
Dungeness to Pett Level	2013	79	158	106	0.3	0.2	47	21	69
Poole Harbour	2013	163	326	218	0.3	0.2	98	44	141
Solent & Southampton Water	2007	280	560	375	0.3	0.2	168	75	243
UK North Sea non-SPA colonies	2000	5500	11000	7370	0.3	0.2	3300	1474	4774
Glas Eileanan	2012	22	44	29	0.9	0.6	40	18	57
Carlingford Lough	2013	119	238	159	0.9	0.6	214	96	310
Larne Lough	2013	231	462	310	0.9	0.6	416	186	602

Lough Neagh & Lough Beg	2013	78	156	105	0.9	0.6	140	63	203
Strangford Lough	2013	352	704	472	0.9	0.6	634	283	917
The Dee Estuary	2013	165	330	221	0.9	0.6	297	133	430
Ribble & Alt Estuaries	2008	111	222	149	0.9	0.6	200	89	289
Ynys Feurig, Cemlyn Bay & Skerries	2011	178	356	239	0.9	0.6	320	143	464
UK western non-SPA colonies	2000	2100	4200	2814	0.9	0.6	3780	1688	5468
Total overseas							29,010	19,437	48,447
Total UK							11,206	5,005	16,212
Total							40,216	24,442	64,659

Table 58. BDMPS for Arctic tern in migration seasons (July-early September and late April-May) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters on migration	Proportion of immatures in UK North Sea & Channel waters on migration	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Fennoscandia	1990s	131000	262000	151960	0.2	0.15	52400	22794	75194
Faroe	2012	7600	15200	8816	0.2	0.15	3040	1322	4362
Baltic States	1990s	8000	16000	9280	0.1	0.1	1600	928	2528
Ireland	2000	2500	5000	2900	0	0	0	0	0
Fetlar	2012	21	42	24	0.9	0.6	38	15	52
Foula	2013	20	40	23	0.9	0.6	36	14	50
Papa Stour	2000	1172	2344	1360	0.9	0.6	2110	816	2925
Mousa	2013	18	36	21	0.9	0.6	32	13	45
Sumburgh Head	2000	203	406	235	0.9	0.6	365	141	507
Fair Isle	2013	29	58	34	0.9	0.6	52	20	72
West Westray	2009	500	1000	580	0.9	0.6	900	348	1248
Papa Westray	2011	176	352	204	0.9	0.6	317	122	439
Rousay	2006	60	120	70	0.9	0.6	108	42	150
Auskerry	2013	750	1500	870	0.9	0.6	1350	522	1872
Pentland Firth Islands	2007	0	0	0	0.9	0.6	0	0	0
Forth Islands	2012	265	530	307	1	0.7	530	215	745
Farne Islands	2013	1921	3842	2228	1	0.7	3842	1560	5402
Coquet Island	2013	1224	2448	1420	1	0.7	2448	994	3442
UK North Sea non-SPA colonies	2000	26000	52000	30160	0.9	0.6	46800	18096	64896
Outer Ards	2013	60	120	70	0	0	0	0	0
Strangford Lough	2013	164	328	190	0	0	0	0	0
Ynys Feurig, Cemlyn Bay, Skerries	2011	550	1100	638	0	0	0	0	0
UK western non-SPA colonies	2000	15000	30000	17400	0	0	0	0	0

Total overseas	57,040	25,044	82,084
Total UK	58,928	22,917	81,846
Total	115,968	47,961	163,930

Table 59. BDMPS for Arctic tern in migration seasons (July-early September and late April-May) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters on migration	Proportion of immatures in UK western waters on migration	UK western waters Number adults	UK western waters Number immatures	UK western waters Total birds
Fennoscandia	1990s	131000	262000	151960	0.03	0.03	7860	4559	12419
Faroe	2012	7600	15200	8816	0.1	0.1	1520	882	2402
Baltic States	1990s	8000	16000	9280	0.02	0.02	320	186	506
Ireland	2000	2500	5000	2900	0.3	0.3	1500	870	2370
Fetlar	2012	21	42	24	0.1	0.1	4	2	7
Foula	2013	20	40	23	0.1	0.1	4	2	6
Papa Stour	2000	1172	2344	1360	0.1	0.1	234	136	370
Mousa	2013	18	36	21	0.1	0.1	4	2	6
Sumburgh Head	2000	203	406	235	0.1	0.1	41	24	64
Fair Isle	2013	29	58	34	0.1	0.1	6	3	9
West Westray	2009	500	1000	580	0.1	0.1	100	58	158
Papa Westray	2011	176	352	204	0.1	0.1	35	20	56
Rousay	2006	60	120	70	0.1	0.1	12	7	19
Auskerry	2013	750	1500	870	0.1	0.1	150	87	237
Pentland Firth Islands	2007	0	0	0	0.1	0.1	0	0	0
Forth Islands	2012	265	530	307	0	0.05	0	15	15
Farne Islands	2013	1921	3842	2228	0	0.05	0	111	111
Coquet Island	2013	1224	2448	1420	0	0.05	0	71	71
UK North Sea non-SPA colonies	2000	26000	52000	30160	0.1	0.1	5200	3016	8216
Outer Ards	2013	60	120	70	1	0.7	120	49	169
Strangford Lough	2013	164	328	190	1	0.7	328	133	461
Ynys Feurig, Cemlyn Bay, Skerries	2011	550	1100	638	1	0.7	1100	447	1547
UK western non-SPA colonies	2000	15000	30000	17400	1	0.7	30000	12180	42180
Total overseas							11,200	6,496	17,696

Total UK	37,338	16,364	53,702
Total	48,538	22,860	71,398

Table 60. BDMPS for little tern in migration seasons (late July to early September, and mid-April to May) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters on migration	Proportion of immatures in UK North Sea & Channel waters on migration	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Ireland	2000	200	400	224	0	0	0	0	0
Ythan Estuary, Sands of Forvie	2013	40	80	45	1	0.6	80	27	107
Firth of Tay & Eden Estuary	2007	1	2	1	1	0.6	2	1	3
Lindisfarne	2011	8	16	9	1	0.6	16	5	21
Northumbria Coast	2000	38	76	43	1	0.6	76	26	102
Teesmouth & Cleveland Est	2011	84	168	94	1	0.6	168	56	224
Gibraltar point	2011	12	24	13	1	0.6	24	8	32
Humber Flats, Marshes & Coast	2011	29	58	32	1	0.6	58	19	77
The Wash	2009	0	0	0	1	0.6	0	0	0
North Norfolk Coast	2011	409	818	458	1	0.6	818	275	1093
Alde-Ore Estuary	2009	0	0	0	1	0.6	0	0	0
Minsmere-Walberswick	2010	30	60	34	1	0.6	60	20	80
Great Yarmouth North Denes	2011	5	10	6	1	0.6	10	3	13
Foulness	2005	0	0	0	1	0.6	0	0	0
Dungeness to Pett Level	2013	11	22	12	1	0.6	22	7	29
Medway Estuary & Marshes	2009	18	36	20	1	0.6	36	12	48
Benacre to Easton Bavents	2011	45	90	50	1	0.6	90	30	120
Blackwater Estuary	2000	99	198	111	1	0.6	198	67	265
Colne Estuary	2011	0	0	0	1	0.6	0	0	0
Hamford Water	2011	45	90	50	1	0.6	90	30	120
Chesil Beach	2011	19	38	21	1	0.6	38	13	51
Chichester Harbour	2011	60	120	67	1	0.6	120	40	160
Pagham Harbour	2011	6	12	7	1	0.6	12	4	16
Solent & Southampton Water	2007	0	0	0	1	0.6	0	0	0

UK N Sea & Channel non-SPA colonies	2000	360	720	403	1	0.6	720	242	962
Monach Isles	2001	2	4	2	0	0	0	0	0
South Uist Machair & Lochs	2002	17	34	19	0	0	0	0	0
The Dee Estuary	2011	126	252	141	0	0	0	0	0
Morecambe Bay	2011	62	124	69	0	0	0	0	0
UK western non-SPA colonies	2000	200	400	224	0	0	0	0	0
Total overseas							0	0	0
Total UK							2,638	886	3,524
Total							2,638	886	3,524

Table 61. BDMPS for little tern in migration seasons (late July to early September, and mid-April to May) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters on migration	Proportion of immatures in UK western waters on migration	UK western waters Number adults	UK western waters Number immatures	UK western waters Total birds
Ireland	2000	200	400	224	0.95	0.6	380	134	514
Ythan Estuary, Sands of Forvie	2013	40	80	45	0	0	0	0	0
Firth of Tay & Eden Estuary	2007	1	2	1	0	0	0	0	0
Lindisfarne	2011	8	16	9	0	0	0	0	0
Northumbria Coast	2000	38	76	43	0	0	0	0	0
Teesmouth & Cleveland Est	2011	84	168	94	0	0	0	0	0
Gibraltar point	2011	12	24	13	0	0	0	0	0
Humber Flats, Marshes & Coast	2011	29	58	32	0	0	0	0	0
The Wash	2009	0	0	0	0	0	0	0	0
North Norfolk Coast	2011	409	818	458	0	0	0	0	0
Alde-Ore Estuary	2009	0	0	0	0	0	0	0	0
Minsmere-Walberswick	2010	30	60	34	0	0	0	0	0
Great Yarmouth North Denes	2011	5	10	6	0	0	0	0	0
Foulness	2005	0	0	0	0	0	0	0	0
Dungeness to Pett Level	2013	11	22	12	0	0	0	0	0
Medway Estuary & Marshes	2009	18	36	20	0	0	0	0	0
Benacre to Easton Bavents	2011	45	90	50	0	0	0	0	0
Blackwater Estuary	2000	99	198	111	0	0	0	0	0
Colne Estuary	2011	0	0	0	0	0	0	0	0
Hamford Water	2011	45	90	50	0	0	0	0	0
Chesil Beach	2011	19	38	21	0	0	0	0	0
Chichester Harbour	2011	60	120	67	0	0	0	0	0
Pagham Harbour	2011	6	12	7	0	0	0	0	0
Solent & Southampton Water	2007	0	0	0	0	0	0	0	0
UK N Sea & Channel non-SPA colonies	2000	360	720	403	0	0	0	0	0

Monach Isles	2001	2	4	2	1	0.6	4	1	5
South Uist Machair & Lochs	2002	17	34	19	1	0.6	34	11	45
The Dee Estuary	2011	126	252	141	1	0.6	252	85	337
Morecambe Bay	2011	62	124	69	1	0.6	124	42	166
UK western non-SPA colonies	2000	200	400	224	1	0.6	400	134	534
Total overseas							380	134	514
Total UK							814	274	1,088
Total							1,194	408	1,602

Table 62. BDMPS for common guillemot in non-breeding season (August to February) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in non-breeding season	Proportion of immatures in UK North Sea & Channel waters in non-breeding season	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Faroe Islands	c2000	100,000	200,000	148000	0.1	0.2	20000	29600	49600
Norway	c2000	100,000	200,000	148000	0.05	0.2	10000	29600	39600
Hermaness, Saxavord & Valla Field SPA	2009	4620	9,240	6838	0.7	0.6	6468	4103	10571
Foula SPA	2007	16615	33,230	24590	0.7	0.6	23261	14754	38015
Noss SPA	2009	14783	29,566	21879	0.7	0.6	20696	13127	33824
Sumburgh SPA	2010	4762	9,524	7048	0.7	0.6	6667	4229	10896
Fair Isle SPA	2010	13066	26,132	19338	0.7	0.6	18292	11603	29895
West Westray SPA	2007	33900	67,800	50172	0.7	0.6	47460	30103	77563
Calf of Eday SPA	2006	6300	12,600	9324	0.7	0.6	8820	5594	14414
Rousay SPA	2009	6200	12,400	9176	0.7	0.6	8680	5506	14186
Marwick Head SPA	2012	11097	22,194	16424	0.7	0.6	15536	9854	25390
Hoy SPA	2007	6300	12,600	9324	0.7	0.6	8820	5594	14414
Copinsay SPA	2012	5607	11,214	8298	0.7	0.6	7850	4979	12829
North Caithness Cliffs SPA	2000	47000	94,000	69560	0.7	0.6	65800	41736	107536
East Caithness Cliffs SPA	1999	106500	213,000	157620	0.7	0.6	149100	94572	243672
Troup, Pennan & Lion's Heads SPS	2007	10938	21,876	16188	0.7	0.6	15313	9713	25026
Buchan Ness to Collieston Coast SPA	2007	12928	25,856	19133	0.8	0.7	20685	13393	34078
Fowlsheugh SPA	2012	30100	60,200	44548	0.8	0.7	48160	31184	79344
Forth Islands SPA	2011	14674	29,348	21718	0.9	0.8	26413	17374	43787
St Abb's Head to Fast Castle SPA	2013	22103	44,206	32712	0.9	0.8	39785	26170	65955
Farne Islands SPA	2013	33532	67,064	49627	0.9	0.8	60358	39702	100059

Flamborough and Filey Coast pSPA	2008	39641	79,282	58669	0.9	0.8	71354	46935	118289
Germany and Denmark	2005	5,000	10,000	7400	0.2	0.4	2000	2960	4960
UK North Sea non-SPA populations	2000	147000	294,000	217560	0.8	0.6	235200	130536	365736
Sule Skerry & Sule Stack SPA	1998	7633	15,266	11297	0.05	0.1	763	1130	1893
North Rona & Sula Sgeir SPA	2012	5000	10,000	7400	0.05	0.1	500	740	1240
Cape Wrath SPA	2000	27359	54,718	40491	0.05	0.1	2736	4049	6785
Handa SPA	2011	37993	75,986	56230	0.05	0.1	3799	5623	9422
Shiant Isles SPA	2008	5148	10,296	7619	0.05	0.1	515	762	1277
Flannan Isles SPA	1999	9807	19,614	14514	0.05	0.1	981	1451	2432
St Kilda SPA	1999	15700	31,400	23236	0.05	0.1	1570	2324	3893
Canna & Sanday SPA	1999	3913	7,826	5791	0.05	0.1	391	579	970
Rum SPA	2000	1644	3,288	2433	0.05	0.1	164	243	408
Mingulay & Berneray SPA	2009	13527	27,054	20020	0.05	0.1	1353	2002	3355
North Colonsay & western cliffs SPA	2000	13500	27,000	20000	0	0.05	0	1000	1000
Ailsa Craig SPA	2013	5247	10,494	7766	0	0.05	0	388	388
Rathlin Island SPA	2011	87398	174,796	129349	0	0.05	0	6467	6467
Skomer & Skokholm SPA	2013	16300	32,600	24124	0.05	0.1	1630	2412	4042
UK West coast non-SPA populations	2000	79000	158,000	116920	0.03	0.08	4740	9354	14094
Total overseas							32,000	62,160	94,160
Total UK							923,860	599,286	1,523,146
Total							955,860	661,446	1,617,306

Table 63. BDMPS for common guillemot in non-breeding season (August to February) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in non-breeding season	Proportion of immatures in UK western waters in non-breeding season	UK western waters number of adults	UK western waters number of immatures	UK western waters Total birds
Faroe Islands	c2000	100,000	200,000	148000	0.05	0.1	10000	14800	24800
Norway	c2000	100,000	200,000	148000	0.01	0.05	2000	7400	9400
Hermaness, Saxavord & Valla Field SPA	2009	4620	9,240	6838	0.02	0.05	185	342	527
Foula SPA	2007	16615	33,230	24590	0.02	0.05	665	1230	1894
Noss SPA	2009	14783	29,566	21879	0.02	0.05	591	1094	1685
Sumburgh SPA	2010	4762	9,524	7048	0.02	0.05	190	352	543
Fair Isle SPA	2010	13066	26,132	19338	0.02	0.05	523	967	1490
West Westray SPA	2007	33900	67,800	50172	0.02	0.05	1356	2509	3865
Calf of Eday SPA	2006	6300	12,600	9324	0.02	0.05	252	466	718
Rousay SPA	2009	6200	12,400	9176	0.02	0.05	248	459	707
Marwick Head SPA	2012	11097	22,194	16424	0.02	0.05	444	821	1265
Hoy SPA	2007	6300	12,600	9324	0.02	0.05	252	466	718
Copinsay SPA	2012	5607	11,214	8298	0.02	0.05	224	415	639
North Caithness Cliffs SPA	2000	47000	94,000	69560	0.02	0.05	1880	3478	5358
East Caithness Cliffs SPA	1999	106500	213,000	157620	0	0	0	0	0
Troup, Pennan & Lion's Heads SPS	2007	10938	21,876	16188	0	0	0	0	0
Buchan Ness to Collieston Coast SPA	2007	12928	25,856	19133	0	0	0	0	0
Fowlsheugh SPA	2012	30100	60,200	44548	0	0	0	0	0
Forth Islands SPA	2011	14674	29,348	21718	0	0	0	0	0
St Abb's Head to Fast Castle SPA	2013	22103	44,206	32712	0	0	0	0	0
Farne Islands SPA	2013	33532	67,064	49627	0	0	0	0	0
Flamborough and Filey Coast pSPA	2008	39641	79,282	58669	0	0	0	0	0
Germany and Denmark	2005	5,000	10,000	7400	0	0	0	0	0
North Sea UK non-SPA populations	2000	147000	294,000	217560	0.01	0.02	2940	4351	7291

Sule Skerry & Sule Stack SPA	1998	7633	15,266	11297	0.95	0.9	14503	10167	24670
North Rona & Sula Sgeir SPA	2012	5000	10,000	7400	0.95	0.9	9500	6660	16160
Cape Wrath SPA	2000	27359	54,718	40491	0.95	0.9	51982	36442	88424
Handa SPA	2011	37993	75,986	56230	0.95	0.9	72187	50607	122793
Shiant Isles SPA	2008	5148	10,296	7619	0.95	0.9	9781	6857	16638
Flannan Isles SPA	1999	9807	19,614	14514	0.95	0.9	18633	13063	31696
St Kilda SPA	1999	15700	31,400	23236	0.95	0.9	29830	20912	50742
Canna & Sanday SPA	1999	3913	7,826	5791	0.95	0.9	7435	5212	12647
Rum SPA	2000	1644	3,288	2433	0.95	0.9	3124	2190	5313
Mingulay & Berneray SPA	2009	13527	27,054	20020	0.95	0.9	25701	18018	43719
North Colonsay and western cliffs SPA	2000	13500	27,000	20000	1	0.95	27000	19000	46000
Ailsa Craig SPA	2013	5247	10,494	7766	1	0.95	10494	7377	17871
Rathlin Island SPA	2011	87398	174,796	129349	1	0.95	174796	122882	297678
Skomer & Skokholm SPA	2013	16300	32,600	24124	0.9	0.8	29340	19299	48639
West coast UK non-SPA populations	2000	79000	158,000	116920	0.95	0.9	150100	105228	255328
Total overseas							12,000	22,200	34,200
Total UK							644,156	460,864	1,105,020
Total							656,156	483,064	1,139,220

Table 64. BDMPS for razorbill in migration seasons (August to October, and January to March) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in migration	Proportion of immatures in UK North Sea & Channel waters in migration	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Russia	1990s	3500	7000	5250	0.05	0.1	350	525	875
Iceland	2008	315400	630800	473100	0.3	0.4	189240	189240	378480
Norway	1990s	30300	60600	45450	0.2	0.5	12120	22725	34845
Denmark, Finland, Sweden	1990s	16000	32000	24000	0.1	0.3	3200	7200	10400
Faroe	2012	4500	9000	6750	0.5	0.5	4500	3375	7875
Foula	2007	375	750	562	0.95	0.9	712	506	1219
Fair Isle	2010	915	1830	1372	0.95	0.9	1738	1235	2974
West Westray	2007	550	1100	825	0.95	0.9	1045	742	1788
North Caithness Cliffs	2000	1700	3400	2550	0.95	0.9	3230	2295	5525
East Caithness Cliffs	1999	12500	25000	18750	1	0.9	25000	16875	41875
Troup, Pennan & Lions	2007	1743	3486	2614	1	0.9	3486	2353	5839
Fowlsheugh	2012	3524	7048	5286	1	0.9	7048	4757	11805
Forth Islands	2012	2625	5250	3938	1	0.9	5250	3544	8794
St Abbs to Fast Castle	2013	1219	2438	1828	1	0.9	2438	1646	4084
Flamborough & Filey	2008	10001	20002	15002	1	0.9	20002	13501	33503
UK North Sea non-SPA colonies	2000	10000	20000	15000	1	0.9	20000	13500	33500
North Rona & Sula Sgeir	1998	1089	2178	1634	0.02	0.05	44	82	125
Cape Wrath	2000	2090	4180	3135	0.02	0.05	84	157	240
Handa	2010	5165	10330	7748	0.02	0.05	207	387	594
St Kilda	1999	1700	3400	2550	0.02	0.05	68	128	196
Shiants	2008	4248	8496	6372	0.02	0.05	170	319	489
Flannan Islands	1998	1051	2102	1576	0.02	0.05	42	79	121
Mingulay & Berneray	2009	10111	20222	15166	0.02	0.05	404	758	1163
Rathlin Island	2011	15393	30786	23090	0.02	0.05	616	1154	1770

Skomer & Skokholm	2013	6001	12002	9002	0.02	0.05	240	450	690
UK Western non-SPA colonies	2000	10000	20000	15000	0.02	0.05	400	750	1150
Ireland	2000	17000	34000	25500	0.02	0.05	680	1275	1955
France	2000	25	50	38	0.01	0.02	0	1	1
Total overseas							210,090	224,341	434,431
Total UK							92,224	65,219	157,443
Total							302,314	289,560	591,874

Table 65. BDMPS for razorbill in migration seasons (August to October, and January to March) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in migration	Proportion of immatures in UK western waters in migration	UK western waters number of adults	UK western waters number of immatures	UK western waters Total birds
Russia	1990s	3500	7000	5250	0.05	0.1	350	525	875
Iceland	2008	315400	630800	473100	0.3	0.4	189240	189240	378480
Norway	1990s	30300	60600	45450	0.1	0.3	6060	13635	19695
Denmark, Finland, Sweden	1990s	16000	32000	24000	0.05	0.1	1600	2400	4000
Faroe	2012	4500	9000	6750	0.5	0.5	4500	3375	7875
Foula	2007	375	750	562	0.05	0.05	38	28	66
Fair Isle	2010	915	1830	1372	0.05	0.05	92	69	160
West Westray	2007	550	1100	825	0.05	0.05	55	41	96
North Caithness Cliffs	2000	1700	3400	2550	0.05	0.05	170	128	298
East Caithness Cliffs	1999	12500	25000	18750	0	0.02	0	375	375
Troup, Pennan & Lions	2007	1743	3486	2614	0	0.02	0	52	52
Fowlsheugh	2012	3524	7048	5286	0	0.02	0	106	106
Forth Islands	2012	2625	5250	3938	0	0.02	0	79	79
St Abbs to Fast Castle	2013	1219	2438	1828	0	0.02	0	37	37
Flamborough & Filey	2008	10001	20002	15002	0	0.02	0	300	300
UK North Sea non-SPA colonies	2000	10000	20000	15000	0	0.02	0	300	300
North Rona & Sula Sgeir	1998	1089	2178	1634	0.98	0.9	2134	1470	3605
Cape Wrath	2000	2090	4180	3135	0.98	0.9	4096	2822	6918
Handa	2010	5165	10330	7748	0.98	0.9	10123	6973	17096
St Kilda	1999	1700	3400	2550	0.98	0.9	3332	2295	5627
Shiants	2008	4248	8496	6372	0.98	0.9	8326	5735	14061
Flannan Islands	1998	1051	2102	1576	0.98	0.9	2060	1419	3479
Mingulay & Berneray	2009	10111	20222	15166	0.98	0.9	19818	13650	33467
Rathlin Island	2011	15393	30786	23090	0.98	0.9	30170	20781	50951
Skomer & Skokholm	2013	6001	12002	9002	0.98	0.9	11762	8101	19863

UK Western non-SPA colonies	2000	10000	20000	15000	0.98	0.9	19600	13500	33100
Ireland	2000	17000	34000	25500	0.1	0.1	3400	2550	5950
France	2000	25	50	38	0.05	0.05	2	2	4
Total overseas							205,152	211,727	416,879
Total UK							111,776	78,259	190,035
Total							316,928	289,986	606,914

Table 66. BDMPS for razorbill in winter (November and December) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in winter	Proportion of immatures in UK North Sea & Channel waters in winter	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Russia	1990s	3500	7000	5250	0.01	0.02	70	105	175
Iceland	2008	315400	630800	473100	0.1	0.2	63080	94620	157700
Norway	1990s	30300	60600	45450	0.05	0.1	3030	4545	7575
Denmark, Finland, Sweden	1990s	16000	32000	24000	0.02	0.05	640	1200	1840
Faroe	2012	4500	9000	6750	0.3	0.3	2700	2025	4725
Foula	2007	375	750	562	0.3	0.1	225	56	281
Fair Isle	2010	915	1830	1372	0.3	0.1	549	137	686
West Westray	2007	550	1100	825	0.3	0.1	330	82	412
North Caithness Cliffs	2000	1700	3400	2550	0.3	0.1	1020	255	1275
East Caithness Cliffs	1999	12500	25000	18750	0.3	0.1	7500	1875	9375
Troup, Pennan & Lions	2007	1743	3486	2614	0.3	0.1	1046	261	1307
Fowlsheugh	2012	3524	7048	5286	0.3	0.1	2114	529	2643
Forth Islands	2012	2625	5250	3938	0.3	0.1	1575	394	1969
St Abbs to Fast Castle	2013	1219	2438	1828	0.3	0.1	731	183	914
Flamborough & Filey	2008	10001	20002	15002	0.3	0.1	6001	1500	7501
UK North Sea non-SPA colonies	2000	10000	20000	15000	0.3	0.1	6000	1500	7500
North Rona & Sula Sgeir	1998	1089	2178	1634	0.1	0.05	218	82	299
Cape Wrath	2000	2090	4180	3135	0.1	0.05	418	157	575
Handa	2010	5165	10330	7748	0.1	0.05	1033	387	1420
St Kilda	1999	1700	3400	2550	0.1	0.05	340	128	468
Shiants	2008	4248	8496	6372	0.1	0.05	850	319	1168
Flannan Islands	1998	1051	2102	1576	0.1	0.05	210	79	289
Mingulay & Berneray	2009	10111	20222	15166	0.1	0.05	2022	758	2781
Rathlin Island	2011	15393	30786	23090	0.05	0	1539	0	1539

Skomer & Skokholm	2013	6001	12002	9002	0.05	0	600	0	600
UK Western non-SPA colonies	2000	10000	20000	15000	0.1	0.05	2000	750	2750
Ireland	2000	17000	34000	25500	0.01	0.02	340	510	850
France	2000	25	50	38	0.05	0.05	2	2	4
Total overseas							69,862	103,007	172,869
Total UK							36,321	9,432	45,753
Total							106,183	112,439	218,622

Table 67. BDMPS for razorbill in winter (November and December) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in winter	Proportion of immatures in UK western waters in winter	UK western waters number of adults	UK western waters number of immatures	UK western waters Total birds
Russia	1990s	3500	7000	5250	0.01	0.02	70	105	175
Iceland	2008	315400	630800	473100	0.2	0.3	126160	141930	268090
Norway	1990s	30300	60600	45450	0.05	0.1	3030	4545	7575
Denmark, Finland, Sweden	1990s	16000	32000	24000	0.02	0.05	640	1200	1840
Faroe	2012	4500	9000	6750	0.3	0.3	2700	2025	4725
Foula	2007	375	750	562	0.01	0.02	8	11	19
Fair Isle	2010	915	1830	1372	0.01	0.02	18	27	46
West Westray	2007	550	1100	825	0.01	0.02	11	16	28
North Caithness Cliffs	2000	1700	3400	2550	0.01	0.02	34	51	85
East Caithness Cliffs	1999	12500	25000	18750	0.01	0.02	250	375	625
Troup, Pennan & Lions	2007	1743	3486	2614	0.01	0.02	35	52	87
Fowlsheugh	2012	3524	7048	5286	0.01	0.02	70	106	176
Forth Islands	2012	2625	5250	3938	0.01	0.02	52	79	131
St Abbs to Fast Castle	2013	1219	2438	1828	0.01	0.02	24	37	61
Flamborough & Filey	2008	10001	20002	15002	0.01	0.02	200	300	500
UK North Sea non-SPA colonies	2000	10000	20000	15000	0.01	0.02	200	300	500
North Rona & Sula Sgeir	1998	1089	2178	1634	0.4	0.1	871	163	1035
Cape Wrath	2000	2090	4180	3135	0.4	0.1	1672	314	1986
Handa	2010	5165	10330	7748	0.4	0.1	4132	775	4907
St Kilda	1999	1700	3400	2550	0.4	0.1	1360	255	1615
Shiants	2008	4248	8496	6372	0.4	0.1	3398	637	4036
Flannan Islands	1998	1051	2102	1576	0.4	0.1	841	158	998
Mingulay & Berneray	2009	10111	20222	15166	0.4	0.1	8089	1517	9605
Rathlin Island	2011	15393	30786	23090	0.4	0.1	12314	2309	14623
Skomer & Skokholm	2013	6001	12002	9002	0.3	0.1	3601	900	4501

UK Western non-SPA colonies	2000	10000	20000	15000	0.3	0.1	6000	1500	7500
Ireland	2000	17000	34000	25500	0.1	0.1	3400	2550	5950
France	2000	25	50	38	0.05	0.05	2	2	4
Total overseas							136,002	152,357	288,359
Total UK							43,181	9,882	53,063
Total							179,183	162,239	341,422

Table 68. BDMPS for Atlantic puffin in non-breeding season (mid-August to March) in 'UK North Sea & Channel waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK North Sea & Channel waters in non-breeding season	Proportion of immatures in UK North Sea & Channel waters in non-breeding season	UK N Sea & Channel Number adults	UK N Sea & Channel Number immatures	UK N Sea & Channel Total birds
Norway	2000	1750000	3500000	3640000	0.001	0.003	3500	10920	14420
Faroe	2012	550000	1100000	1144000	0.04	0.01	44000	11440	55440
Ireland	2000	20000	40000	41600	0	0	0	0	0
France	2000	257	514	535	0.05	0.02	26	11	36
Hermaness, Saxavord	2002	23661	47322	49215	0.15	0.02	7098	984	8083
Foula	2000	22500	45000	46800	0.15	0.02	6750	936	7686
Noss	2007	802	1604	1668	0.15	0.02	241	33	274
Fair Isle	2012	10706	21412	22268	0.15	0.02	3212	445	3657
Hoy	2000	3500	7000	7280	0.15	0.02	1050	146	1196
North Caithness Cliffs	2000	976	1952	2030	0.15	0.02	293	41	333
East Caithness Cliffs	1999	274	548	570	0.15	0.02	82	11	94
Forth Islands	2008-10	62231	124462	129440	0.5	0.02	62231	2589	64820
Farne Islands	2013	39962	79924	83121	0.5	0.02	39962	1662	41624
Coquet Island	2013	12344	24688	25676	0.5	0.02	12344	514	12858
Flamborough & Filey	2008	958	1916	1993	0.5	0.02	958	40	998
UK N Sea non-SPA colonies	2000	35000	70000	72800	0.25	0.02	17500	1456	18956
Cape Wrath	2000	1602	3204	3332	0.001	0.001	3	3	7
North Rona & Sula Sgeir	2001	5442	10884	11319	0.001	0.001	11	11	22
Sule Skerry & Sule Stack	1998	59471	118942	123700	0.001	0.001	119	124	243
St Kilda	2000	142264	284528	295909	0.001	0.001	285	296	580
Shiant Isles	2000	65170	130340	135554	0.001	0.001	130	136	266
Flannan Isles	2001	15600	31200	32448	0.001	0.001	31	32	63
Canna & Sanday	1999	945	1890	1966	0.001	0.001	2	2	4
Mingulay & Berneray	2009	3126	6252	6502	0.001	0.001	6	7	13

Rathlin Island	2011	695	1390	1446	0.001	0.001	1	1	3
Skomer &Skokholm	2013	24114	48228	50157	0.001	0.001	48	50	98
UK western non-SPA colonies	2000	45000	90000	93600	0.001	0.001	90	94	184
Overseas total							47,526	22,371	69,896
UK total							152,448	9,613	162,061
Total							199,974	31,984	231,957

Table 69. BDMPS for Atlantic puffin in non-breeding season (mid-August to March) in 'UK western waters'.

Population	Most recent count	Pairs	Breeding adults	Immatures	Proportion of adults in UK western waters in non-breeding season	Proportion of immatures in UK western waters in non-breeding season	UK western waters Number adults	UK western waters Number immatures	UK western waters Total birds
Norway	2000	1750000	3500000	3640000	0.002	0.001	7000	3640	10640
Faroe	2012	550000	1100000	1144000	0.07	0.02	77000	22880	99880
Ireland	2000	20000	40000	41600	0.1	0.1	4000	4160	8160
France	2000	257	514	535	0.01	0.01	5	5	10
Hermaness, Saxavord	2002	23661	47322	49215	0.08	0.02	3786	984	4770
Foula	2000	22500	45000	46800	0.08	0.02	3600	936	4536
Noss	2007	802	1604	1668	0.08	0.02	128	33	162
Fair Isle	2012	10706	21412	22268	0.08	0.02	1713	445	2158
Hoy	2000	3500	7000	7280	0.08	0.02	560	146	706
North Caithness Cliffs	2000	976	1952	2030	0.08	0.02	156	41	197
East Caithness Cliffs	1999	274	548	570	0.08	0.02	44	11	55
Forth Islands	2008-10	62231	124462	129440	0.07	0.02	8712	2589	11301
Farne Islands	2013	39962	79924	83121	0.07	0.02	5595	1662	7257
Coquet Island	2013	12344	24688	25676	0.07	0.02	1728	514	2242
Flamborough & Filey	2008	958	1916	1993	0.07	0.02	134	40	174
UK N Sea non-SPA colonies	2000	35000	70000	72800	0.07	0.02	4900	1456	6356
Cape Wrath	2000	1602	3204	3332	0.18	0.02	577	67	643
North Rona & Sula Sgeir	2001	5442	10884	11319	0.18	0.02	1959	226	2186
Sule Skerry & Sule Stack	1998	59471	118942	123700	0.18	0.02	21410	2474	23884
St Kilda	2000	142264	284528	295909	0.18	0.02	51215	5918	57133
Shiant Isles	2000	65170	130340	135554	0.18	0.02	23461	2711	26172
Flannan Isles	2001	15600	31200	32448	0.18	0.02	5616	649	6265
Canna & Sanday	1999	945	1890	1966	0.18	0.02	340	39	380
Mingulay & Berneray	2009	3126	6252	6502	0.18	0.02	1125	130	1255

Rathlin Island	2011	695	1390	1446	0.18	0.02	250	29	279
Skomer &Skokholm	2013	24114	48228	50157	0.18	0.02	8681	1003	9684
UK western non-SPA colonies	2000	45000	90000	93600	0.18	0.02	16200	1872	18072
Overseas total							88,005	30,685	118,690
UK total							161,891	23,976	185,867
Total							249,896	54,661	304,557

Hornsea Offshore Wind Farm

Project Two

Joint response from SNCBs to Marine Scotland Science Avoidance Rate Paper – 25 November 2014

Appendix Y to the Response submitted for Deadline I

Application Reference: EN010053



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SMart Wind

Joint Response from the Statutory Nature Conservation Bodies to the Marine Scotland Science Avoidance Rate Review

25th November 2014

1. Summary of recommendations

This joint response from the Statutory Nature Conservation Bodies (SNCBs)[1] is intended to provide recommendations on how the Offshore Wind Farm (OWF) industry could appropriately apply findings from the Marine Scotland Science Avoidance Rate Review[2] (hereafter 'the report') to the impact assessment process. This section provides a summary of our recommendations on best practise impact assessment using Collision Risk Modelling (CRM) in light of the report. The rationale for these recommendations is outlined within the main body of the paper.

Basic Band model (Options 1 and 2) recommendations

Whenever the Basic Band model (Options 1 or 2) are used for collision mortality estimation:

- Collision mortality estimates should be presented using the mean total avoidance rate (as detailed in Table 1 below) as well as a range of avoidance rates that reflects the variability and uncertainty linked to it (i.e. ±2SD).

Basic Band model (Option 2) recommendations

Whenever the Basic Band model (Option 2) is used for collision mortality estimation:

- Collision mortality estimates should be presented using the mean total avoidance rate (as detailed in Table 1 below) as well as a range of avoidance rates that reflects the variability and uncertainty linked to it (i.e. ±2SD).

Furthermore, the following information should also be provided:

- Presentation and comparison of both site-specific and generic flight height data (including median and confidence limits).
- A range of collision mortality estimates using the lower and upper confidence limits of the generic modelled flight distribution.

Extended Band model (Option 3) recommendations

It is **not appropriate** to use the **Extended Band model** in predicting collisions for **northern gannet** or **black-legged kittiwake**, at the current time.

Whenever the Extended Band model (Option 3) is used for **large gull** collision mortality estimation:

- Collision mortality estimates should be presented using the mean total avoidance rate (as detailed in Table 2 below) as well as a range of avoidance rates that reflects the variability and uncertainty linked to it (i.e. ±2SD).

[1] To be read as comprising the Joint Nature Conservation Committee (JNCC), Natural England (NE), Natural Resource Wales (NRW), Northern Ireland Environment Agency (NIEA), Scottish Natural Heritage (SNH).

[2] Cook, A.S.C.P., Humphries, E.M., Masden, E.A., and Burton, N.H.K. 2014. The avoidance rates of collision between birds and offshore turbines. BTO research Report No 656 to Marine Scotland Science.

Furthermore, the following information should also be provided:

- Presentation and comparison of both site-specific and generic flight height data (including median and upper and lower confidence limits).
- Presentation of both Basic Band model outputs (Options 1 and 2) with the measures of confidence outlined in **Section 3.4**, in addition to Extended Band model outputs.
- A range of Extended Band model collision mortality estimates using lower and upper confidence limits of the generic flight distribution.

2. Introduction

The SNCBs welcome this important piece of work and congratulate Marine Scotland Science (MSS) for taking the initiative to commission this report and the British Trust for Ornithology (BTO) for conducting such a thorough review.

We note that a key finding of the report is the absence of studies of collision mortality and avoidance rates at offshore wind farms. The report concludes that the bulk of avoidance rate studies are from onshore or coastal wind farms. Having reviewed this body of work the report concludes that for many species (or groups of species) there are insufficient empirical data to derive meaningful avoidance rates at micro-, meso- or macro-scales. To a large degree, this inability to quantify these separate components of overall avoidance rates was due to lack of spatial resolution in empirical data and/or technical capacity to separate these components of overall avoidance.

The lack of empirical data from offshore wind farms contributing to the report's conclusions must be considered in the future applicability of recommended avoidance rates in an offshore context. Nevertheless, with many offshore projects at critical junctures in the decision-making process, we support some of the report's findings for use in offshore wind farm collision risk modelling, until such time as more empirical data are available.

This joint SNCB position represents a considerable shift in advice on avoidance rates for use with collision risk modelling in light of the report. This reflects the obligation on SNCBs to amend their advice as the best available evidence continues to evolve. However, it must be recognised that further empirical data on bird avoidance, flight heights and activity at offshore wind farms will continue to accrue and may alter our understanding of the likelihood of seabird collisions in the future. Therefore, the SNCBs position on avoidance rates may, as the current response bears testimony, be subject to change as more empirical data become available, e.g. ORJIP study (refer to section 6).

The following advice is applicable only to collision risk modelling for the five priority species and other gull species covered by the report. For other seabirds (e.g. skuas) and waterbirds (e.g. divers, seaducks, etc.) the report does not conduct an analysis or provide recommended avoidance rates for any version of the Band model. In light of this, the SNCBs continue to recommend the basic Band model, in conjunction with a default 98% avoidance rate, for predicting collisions of species other than those detailed here, until such time as further species-specific work has been undertaken.

3. General Statements of Agreement

3.1 Avoidance rates for use with the Basic Band model

The SNCBs support the recommended avoidance rates (AR) presented in the report in relation to four of the five priority species (the exception being black-legged kittiwake) as we consider these rates to be the best available evidence regarding the average avoidance rates for use with these

species (Table 1 below). However, it should be noted that in several instances these are not derived from species-specific information and as such represent avoidance rates for species groupings (e.g. 'large gulls') rather than for an individual species.

The SNCBs also recommend that the estimated variance in empirically derived estimates of within windfarm avoidance rates, as presented within the report, be acknowledged and explored in any application of these total avoidance rates in future collision risk modelling.

Collision mortality estimates should be presented using the mean total avoidance rate as well as a range of avoidance rates that reflects the variability and uncertainty linked to it (i.e. ±2SD).

Table 1. Basic Band avoidance rates derived from MSS avoidance rate report Table 7.2. This table represents new avoidance rates (± 2SD) supported by the SNCBs for use in impact assessment collision risk modelling.

Species (rate used)	Basic Band model avoidance rate (2SD)
Northern gannet (all gull avoidance rate)	**0.989** (± 0.002)
Black-legged kittiwake (~~small~~ all gull avoidance rate)	~~0.992~~ **0.989** (± 0.002)*
Lesser black-backed gull (large gull avoidance rate)	**0.995** (± 0.001)
Herring gull (species-specific avoidance rate)	**0.995** (± 0.001)
Great black-backed gull (large gull avoidance rate)	**0.995** (± 0.001)

** Note: 'strike-through' data as presented in Table 7.2 of the report; data in 'bold' as recommended by SNCBs (see section 4.1 below for further explanation).*

3.2 Northern Gannet avoidance rates for Basic Band model

We note that the northern gannet avoidance rate represents, in reality, an 'all gull' avoidance rate, due to the absence of species-specific within windfarm avoidance data. We agree it is inappropriate to combine a within wind farm avoidance rate for this species based on the rates established for gulls with the gannet-specific macro-avoidance rate of 0.64, as this would result in a non-evidence based total avoidance rate higher than for any of the other groups considered. However, we agree that, without a within windfarm avoidance component for gannets, and acknowledging their more marked tendency to exhibit macro-avoidance behaviour; it is reasonable to ascribe to gannets the lowest of the total avoidance rates determined for any of the other groups (i.e. the 'all gull' category). In the absence of gannet-specific data for all elements of avoidance, this is also appropriately precautionary.

3.3 Use of avoidance rates to 3 decimal places

The SNCBs advise that, following recommendations in the report, practitioners of collision risk modelling now use avoidance rates to three decimal places as outlined above rather than rounding figures to two as typically done previously (e.g. 0.98). The report presents within windfarm avoidance rates to 4 decimal places (Table 7.1) but given the inherent uncertainty in the data the final recommended total avoidance rates are presented to only 3 decimal places (Table 7.2). The SNCBs agree with the recommendation in the report to use avoidance rates to three decimal places, until such time as improvements are made to the characterisation of uncertainty within the models, avoidance rates and flight height distributions used.

3.4 Recommended avoidance rates for use with Band model Option 2

We acknowledge that Options 1 and 2 of the Band model are mathematically identical (the Basic Band model) and consequently that it is appropriate to use the same predictive avoidance rate for both options. But the estimates of avoidance rates within section 5.4 of the report derived using Option 2 were in every case lower than using Option 1.

The SNCBs accept that this reflects the mismatch between the observed site-specific values of the proportion of birds recorded flying at predicted collision risk height (PCH) and the equivalent values derived using generic modelled flight height distribution data, and hence that the lower avoidance rates derived under Option 2 are anomalous.

We accept the recommendation that the higher avoidance rates derived using Option 1 should be used with the Basic Band model. For any future application of these recommended Basic Band model avoidance rates in combination with generic modelled flight height distribution data (i.e. use of Option 2), we advise the following is included:

- Presentation and comparison of both site-specific and generic flight height data (including median and confidence limits).
- A range of collision mortality estimates using the lower and upper confidence limits of the generic modelled flight distribution.
- A range of collision mortality estimates reflecting the empirically derived range of uncertainty around the mean avoidance rate (as detailed in Table 1 above).

This is to ensure due consideration is given to the uncertainty surrounding the generic flight height distribution and its applicability to the wind farm in question and the uncertainty around the avoidance rate itself.

4. Areas of Disagreement or Uncertainty

4.1 Kittiwake avoidance rates for Basic Band model

The SNCBs consider that the principles applied to northern gannet avoidance rate recommendations in the face of lack of species-specific data (i.e. application of the lowest “all gull” alternative rate derived by the review) should also be applied to black-legged kittiwake avoidance rates. The report includes kittiwake within the ‘small gull’ category, the data for which are predominantly derived from common gulls and black-headed gulls. Indeed, no species-specific data for kittiwakes are represented within the ‘small gull’ category at all.

While the report provides a theoretical argument towards the inclusion of kittiwakes within the ‘small gull’ category, there are equally arguments that could be put forward in support of their treatment as part of the ‘large gull’ category (i.e. typical flight speeds and generally more marine behaviour). Consequently, we feel these somewhat subjective arguments should be discounted in favour of a more consistent and precautionary approach with regards the treatment of other species lacking species-specific within windfarm avoidance rate data (namely gannets).

Therefore, we recommend that, until such time as it is possible to calculate a species-specific avoidance rate for kittiwakes, they are classed under the more generic (and precautionary) ‘all gull’ category.

4.2 Applicability of Extended Band model avoidance rates

The SNCBs highlight that the report makes no recommendation regarding avoidances rates for use with the Extended Band model for northern gannets and black-legged kittiwakes due to a lack of species-specific data.

This means it is not appropriate to use the Extended Band model in predicting collision figures for these species at the current time.

For the other three priority species covered by the report (see Table 2 below), we note that while we accept the work undertaken to derive avoidance rates for use with Option 3; we remain concerned over the use of the Extended Band model. In particular, we have concerns regarding its sensitivity to flight height distribution data, and the uncertainty this component introduces to variation in estimates of collision.

Table 2. Extended Band avoidance rates taken from MSS avoidance rate report Table 7.2.

Species (rate used)	**Extended Band model avoidance rate (2SD)**
Northern gannet	Not available
Black-legged kittiwake	Not available
Lesser black-backed gull (large gull avoidance rate)	**0.989** (± 0.002)
Herring gull (species-specific avoidance rate)	**0.990** (± 0.002)
Great black-backed gull (large gull avoidance rate)	**0.989** (± 0.002)

We advise those wishing to present Extended Band model predictions for those species/groupings where sufficient data on appropriate avoidance rates has been compiled within the report (i.e. those noted in Table 2 above), that the following information must also be provided:

- Presentation and comparison of both site-specific and generic flight height data (including median and upper and lower confidence limits).
- Presentation of both Basic Band model outputs (Options 1 and 2) with the measures of confidence outlined in **Section 3.4**, in addition to Extended Band model outputs.
- A range of collision mortality estimates reflecting the empirically derived range of uncertainty around the mean avoidance rate applicable to the output of the extended Band model (as detailed in Table 2 above).
- A range of Extended Band model collision mortality estimates using lower and upper confidence limits of the generic flight distribution.

Presentation of uncertainty around both flight heights and avoidance rates and incorporation into the analysis in this way, will provide clarity over the range of possible collision mortality outcomes and which collision risk model outputs are most appropriate for the assessment of the wind farm(s) in question.

5. Further Detailed Explanation of SNCB Positioning

5.1 Constraints on the wider applicability of Extended Band model avoidance rates

The report highlights, in many instances, significant differences between the observed proportion of birds at PCH (within the studies used to derive the avoidance rate estimates) and the proportion predicted to be at collision risk height derived from generic modelled distributions of flight heights. The latter estimates are almost invariably lower than the former.

In the case of 'small gulls' this discrepancy is so great that the report concludes it would be inappropriate to use avoidance rates derived for the Extended Band model for this group. Similar discrepancies, although less marked, also occur in the case of 'all gulls', 'large gulls' and 'herring gull'. Therefore, while accepting that the greater discrepancy in the case of 'small gulls' is such that the resultant extended model avoidance rate for that group (0.9027) and for 'all gulls' (which includes small gulls) (0.9672) are so unreliable as to be of no practical use, we can accept the use of the Extended Band model ARs derived for herring gulls and the other two larger species of gulls (Table 2 above), provided this is accompanied by acknowledgement of uncertainty around the underlying flight height data, and provided that equivalent Basic Band model AR outputs are presented for consideration alongside those from the extended Band model.

5.2 Need for on-going exploration of other aspects of uncertainty within the collision risk modelling framework

The SNCBs acknowledge that the Extended Band model is a more refined mathematical model than the Basic Band model in that it allows consideration of the fine-scale variation in the distribution of flight heights of birds flying within the rotor swept height band, and the variation as a function of height within that risk band in the probability of: i) passing within the perimeter of the rotating disc and ii) being hit during that passage. This Extended Band model is therefore a more advanced tool with which to derive estimates of the non-avoidance collision mortality.

However, the use of Option 3 in collision risk modelling is dependent upon; i) the availability of appropriate non-avoidance rates to apply to its non-avoidance estimate of collision mortality and ii) the degree of uncertainty around and confidence in the general applicability of the modelled flight height distribution on which it is based.

The report presents two pieces of evidence that highlight the significance of having robust estimates of the proportion of birds at PCH. These are:

- Deriving an Extended Band model AR for 'small gulls' was thwarted by the consistent mismatch between generic modelled flight height distributions and the observed proportion of birds flying at PCH in the empirical studies from which ARs were being derived. This may be because the empirical studies used within the report to derive ARs were all onshore, while the suite of studies used to model generic flight height distributions included more offshore data. In any event, this mismatch indicates extreme caution is needed when applying the generic flight height distribution required of the Extended Band model.

- The exploration of the sensitivity of the non-avoidance rate to variation in several key parameters indicates that the non-avoidance rate predicted by the Extended Band model can be highly sensitive to variation in the simulated flight height distribution. Although this appears not to be a consistent issue, it occurs sufficiently often to support the assertion

above that extreme caution is needed in application of the generic flight height distributions to different sites.

Finally, there remains the issue of whether the derivation of collision mortality estimates using the Extended Band model is or is not more sensitive to errors in the attribution of birds to differing flight height bands in the field. Irrespective of the relative sensitivity of the Basic Band model and the Extended Band model in this respect, it is clear that errors in height estimation is another factor which needs to be considered in applying any estimate of flight height in collision risk modelling.

5.3 Issues limiting applicability of the correction factor g

The SNCBs note that the report shows in Annex 1 how the avoidance rates for use with the Basic and Extended Band models are related. The Basic model gives an estimate of no avoidance collision mortality, if information is available on turbine and bird parameters and the number of bird flights at risk height. The Extended model refines this estimate to take account of the distribution of flight heights, if detailed information on the latter is also available. The ratio between the Extended Band model estimate of collision rate and that from the Basic Band model, **if the same height distribution data are used in the latter to calculate the proportion of flights at collision risk height**, is termed the *g* factor.

Annex 1 of the report shows that if both models are applied to a reference windfarm, working back from an observed collision rate such as to derive the avoidance rate appropriate for each model, the non-avoidance rate for use with the Extended model **must be** *1/g* times the non-avoidance rate for the Basic model. This non-avoidance rate may then be used in estimating collision mortality at any new windfarm, using the Extended model, **if the flight height distribution at the new windfarm site is known**. **Thus to make use of the Extended model requires knowledge of the flight height distribution at both the reference site and at the new windfarm site**.

g factors have been estimated in Appendix 7 of the report, by comparison of the non-avoidance collision mortality estimates from the Basic and Extended Band models, both being based on assumed generic flight height distributions. It is clear, though, that there is a substantial mismatch between the observed values of the proportion of birds at collision risk height (PCH) and the proportion at risk height calculated from the generic modelled flight height distributions. The SNCBs consider it likely that estimates based on the latter are in many cases unreliable. The current review indicates that there is very little site-based information on the flight height distribution at the 'reference' windfarms reviewed, such as to enable *g* factors to be derived at each of these reference sites on the basis of site-specific data.

Until detailed flight height distributions are derived on a site-specific basis for a reference windfarm (or the applicability of a generic flight height distribution confirmed), the **SNCBs advise that the *g* factors presented in Appendix 7 should not be used to derive a windfarm avoidance rate for use with the Extended model at any new offshore windfarm**. In particular it would be wholly wrong to use avoidance rates appropriate for the Basic Band model, but based on observed values of the proportion of flights at risk, in conjunction with the *g* factors in Appendix 7 of the report which are calculated based on the generic flight distributions.

Where the report recommends use of avoidance rates for use with the Extended Band model, these are based on the assumed generic flight height distributions and hence may also be inaccurate. However, for these reference windfarms, the generic flight height distributions almost always predict a substantially smaller proportion of bird flights at risk height than have been observed in the site data. A correspondingly greater proportion of birds must be deemed not to take

avoiding action in order to match the observed rate of collision at each reference windfarm. Hence the avoidance rates so calculated are precautionary, that is to say the true avoidance rates are most likely to be greater. **For those species for which they are quoted, the SNCBs accept the use of these avoidance rates with the Extended Band model (Table 2 above), subject to the qualifications set out in the report and presentation of the additional information as set out in section 4.2 above.**

The SNCBs acknowledge that as more detailed flight height information is acquired, it may prove possible to derive more reliable estimates of the non-avoidance rates for use with the Extended Band model, and the associated *g* factors. Nonetheless we advise that even then, any future application of the Extended Band model in collision risk mortality estimation should take account of the degree of uncertainty in all aspects of the underlying flight height data used, and present a range of possible outputs which reflect the degree of uncertainty around the assumed flight height distribution.

6. Next Steps

As outlined, this joint SNCB position reflects the obligation on SNCBs to amend their advice as the best available evidence continues to evolve. Consequently, this SNCB position statement will be subject to review as more empirical data become available (e.g. ORJIP study). Further to this, we advise that:

1. A review of this position statement will be undertaken by the SNCBs once ongoing work to quantify error and uncertainty in flight height distributions and collision risk modelling reports are completed. A NERC funded project, undertaken by Dr Liz Masden[3] , is expected to address some of these outstanding questions by spring 2015.

2. A strategic data collection programme should be drawn-up and agreed between all interested parties to supplement data collected under ORJIP. This should be aimed at gathering additional species-specific avoidance behaviour data (particularly for gannets and kittiwakes) to allow derivation of more refined avoidance rates than those recommended in the MSS report. Implementation of the programme should be overseen by regulatory bodies in recognition of their key role in the consenting process and formulation of licence conditions.

[3] Environmental Research Institute, University of Highlands and Islands, Thurso.

From:	Taylor, Jessica (NE)
To:	Norfolk Vanguard
Subject:	RE: EN010079 Norfolk Vanguard Natural England Written Representation (Ref: 264171) E-mail 2
Date:	16 January 2019 18:29:34
Attachments:	EN010079_264171_Natural England_All Other Documents.zip EN010079_264171_Natural England_SSSI_Documents.zip

Dear Sirs,

Please accept this e-mail as Part 2 (of 3) of Natural England's Written Representation in relation to the Norfolk Vanguard Offshore windfarm Application. The attached folders contain some of the documents referenced within Natural England's Written Representations.

Best wishes,
Jessica Taylor

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Natural England Offshore wind cabling: ten years experience and recommendations

July 2018

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Natural England: Offshore wind cabling: ten years experience and recommendations

Summary

This note documents the experience Natural England has gained from advising on the environmental impacts of power cable installation over the last ten years, and to highlight where issues have arisen with both installation and maintenance that have caused concern for nature conservation. Annex 1 provides some detail of cases where impacts have occurred. In many cases the works resulted in habitat disturbance and loss/ change within MPAs that had not been assessed as part of the application, requiring additional work by the developer, regulator and advisors. Due to the experience we have gained relating to the actual impacts on the ground, we regularly find ourselves disagreeing with, or questioning developers' assessments of likely impacts of cabling works. This note provides evidence for our current advice to industry and regulators on offshore wind cabling activities and explains where our current concerns with regards to impacts from cable installation have stemmed from. It seeks to emphasise that better solutions can and should be found for both the environment and for the offshore wind industry, which should also result in time savings for all parties post consent.

In particular it makes recommendations for the industry to: avoid cabling in sensitive/protected habitats; to change the way impact assessments are carried out so that they are more rigorous in the data collected and the emphasis placed on the likely range and scale of likely impacts through the lifetime of a cable; to be more realistic about the evidence gaps and the limitations in installation technology avoiding over-optimistic engineering predictions that are unable to be delivered on the ground; to invest in greater levels of detail in information collection and project design at earlier stages of the project; to consider mitigation at much earlier stages of a project planning and for monitoring to improve the evidence base on cable installation impacts and the recovery from these.

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1. Introduction

The offshore wind industry has grown in the UK over the last 15 years from initial installations of 30 turbines at Scroby Sands and Kentish Flats to the more recently consented projects at Dogger Bank of up to 400 turbines. Related to this there has been a step change in the amount of cabling activity to much higher numbers and lengths of inter-array and export cables needed to service these projects. This has necessarily led to interactions of cables with a wider range of substrates and associated habitats and species, and the need for differing installation techniques, successful or not.

At the same time as this period of offshore wind development there has been a large increase in the number of Marine Protected Areas (MPAs) designated (from around 16% of inshore English waters designated in 2009 to 38% by 2016) leading to much greater interactions between cabling activities and designated sites.

The limitations in availability of grid connection on land has led to cables from more than one project coming into the same or nearby areas leading to increased pressure on the habitats and species in those locations.

2. Offshore wind cable history and evolution

In the early offshore windfarms with small numbers of turbines located close to shore there were multiple export cables transmitting at 33kV. With the development of larger windfarms further from shore the use of offshore substations to step up voltage has become standard and transmission is now at 130 -150kV HVAC (High Voltage Alternating Current). The table below gives figures for the cables from some sample developments to illustrate the change in scale of cabling associated with offshore windfarm development.

Windfarm	**Year of operation**	**Number of turbines**	**Number of export cables**	**Export cable length per cable (km)**	**Inter array cable length (km)**	**Area of seabed impacted m^2**
Scroby Sands	2004	30	3	4.2	20	
Kentish Flats	2005	30	4	9.4	21	136,000 export 80,000 inter-array
Greater Gabbard	2012	140	3	45	175	
Hornsea 1	2019	332	3	142	450	6,000,000 export 4,500,000 Inter-array

Projects currently in pre planning (e.g. Hornsea 3) are proposing to use 6 export cables per project. Thus it can be seen that there has been a significant increase in the length of cable

installed in the marine environment in relation to offshore wind in the last 10 years with many more to come as those Round 3 projects consented and in planning move into construction.

HVDC (High Voltage Direct Current) cable technology becomes more viable with increased distance from installation to shore. It has yet to be used for offshore wind in the UK due to costs (although there are applications being submitted using this technology) but could result in overall benefits to the environment. Although its use would potentially require more offshore infrastructure due to the need for collector and conversion stations and larger onshore converter substations, depending on the project design there is potential for fewer cables to be required offshore in a HVDC system which would be of benefit in reducing interaction with the marine environment and thus potentially negative impacts.

3. Impacts from cable installation and related concerns for nature conservation

It is usual for an Environmental Statement to assess at a high level the impact of cable installation by a possible four methods: ploughing, jetting, trenching/ cutting and vertical injector with either simultaneous lay and burial of the cable or laying of the cable by a surface vessel and then subsequent burial using another device. Cable installation tools are either towed by a surface vessel or self-propelled. Prior to cable laying, grapnel runs are carried out and boulder and UXO (unexploded ordnance) clearance may be necessary to clear the route for the installation tool/ vessel. More recent applications have assessed sandwave clearance, which may be required to reduce the slope/ flatten the seabed to achieve more optimum burial and enable installation tools to operate. Cable protection in the form of concrete mattresses, rock placement, grout or sand bags or frond mattresses is essential at cable crossings and may be required in other areas where optimum burial depth cannot be achieved (even after repeated attempts to bury the cable). All this information is used to calculate the area of seabed that may be impacted by the worst case scenario installation method (usually that with the biggest footprint). A description of the typical cable installation process can be found in the Offshore Wind Programme Board Overview of the offshore transmission cable installation process in the UK.

Cables associated with the early Round 1 windfarms were typically installed by plough in soft sediment environments (mud and sands). Advice from Natural England was that cabling was a one off activity leading to temporary disturbance of the sediment and habitat and that due to the nature of these habitats, which are generally tolerant to disturbance, there would be recovery of the sediment and associated fauna within relatively short timescales (less than a year). However, experience gained over the last 10 years has shown that cable installation is often not a one off activity, (with maintenance and repair works, cable reburial, additional cable protection or even replacement of cables/cable sections now frequently needed), and additionally that the installation techniques proposed in Environmental Statements are often found not to be feasible once ground conditions are better understood and contractors are on-board. With the increase in scale of cable installation, many different habitats are being impacted that have less potential for recovery/slower recovery rates than those more robust sediments of the earlier installations. This has led to greater impacts on marine and coastal habitats and species than those assessed at the time of consenting, effectively rendering the assessments in the Environmental Statement inadequate.

Dealing with these issues post consent when a project is going into construction has led to difficulties and frustration on the part of advisors, regulators and developers. At this stage

supply chains are often in place leading to relatively few options to change or minimise environmental impacts due to cables, contractors and vessels already being procured. Additionally, developers are under pressure to meet contractual timescales for installation leading to changes to proposals occurring in tight time frames, which passes the pressure on to regulators and their advisors. There may be a requirement for new Habitats Regulations Assessments or Marine Conservation Zone (MCZ) assessments to be undertaken at short notice[1]. Where works may now lead to a significant impact, potential adverse effect or hindering of the conservation objectives[2] of an MPA it can be challenging to find solutions that enable cables to be installed within the time constraints while avoiding the detrimental impacts. This has led to great impacts than were considered at the consenting stage, and a risk of failing to protect designated MPA features. Better outcomes could be gained for the project and environment through more realistic consideration of the issues at the consenting stage. We recognise that at the consenting stage it is outlined to the developer that any deviations from that which is consented is at the developer's risk, but in reality the risk is shared across all interested parties including government.

4. Pressures and impacts from cable installation

Information on feature specific pressures exerted by cable installation can be found in the advice on operations for the relevant MPA. An example for Margate and Long Sands Special Area of Conservation (SAC) can be found here:

The key pressures of concern in relation to cable installation are:

- Abrasion/disturbance of the substrate on the surface of the seabed
- Changes in suspended solids (water clarity)
- Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
- Smothering and siltation rate changes (Light)
- Physical loss (to land or freshwater habitat)
- Physical change (to another sediment or seabed type)

In harder substrate environments there may be loss of habitat due to the cable installation. Additionally where sandwave clearance or cable protection are proposed or used there are additional pressures relating to dredging of large volumes of material or loss of/ modification to habitat under hard rock placement. In an MPA designated for a species e.g. birds there are additional considerations relating to the disturbance caused to the species as well as any habitat they may rely on. Other pressures are associated with the infrastructure used for

[1] An appropriate assessment may be required under regulation 63 of The Conservation of Habitats and Species Regulations 2017, or an MCZ assessment under the Marine and Coastal Access Act if the activity is likely to have anything other than an insignificant impact on an MPA and these impacts have not previously been assessed or sufficiently assessed as part of the consenting process.

[2] If an activity is deemed to have an adverse effect on an SAC or SPA or hinder the conservation objectives of an MCZ then that activity cannot be permitted unless it can be shown that there are no alternatives, that it has imperative reasons of overriding public interest and that suitable compensation or measures of equivalent environmental benefit for the damage can be implemented. To avoid these levels of impact operations must be carried out in a manner, with suitable reduction, avoidance and mitigation of impacts so as not to cause an adverse impact on an SAC or SPA or hindering of the conservation objectives of an MCZ.

cable installation such as anchor placement of vessels, beaching of vessels nearshore and requirements for boulder and UXO clearance along cable routes.

The impact of these pressures on an MPA, and Natural England's level of concern regarding them, then relates to:

- the magnitude of the pressure (e.g. number of cables to be installed and footprint of the installation method)
- the duration of the pressure (how long cable installation will realistically take as well whether the impacts from the operation are temporary)
- timing of the installation in relation to sensitive periods
- and the sensitivity and recoverability of the habitat or species in question.

For example ploughing a cable into highly mobile sands and chalk bedrock may have the same footprint, but the two habitats will recover very differently. The highly mobile sand habitat will be less sensitive and recover more quickly than the chalk bedrock which may take much longer to recolonise due to the species present and does not have the ability to recover morphologically.

5. Experience gained from cable installation to date

As discussed above, there are several reasons why cabling activities and our advice relating to them has evolved over the last ten years. This is largely due to the experience that has been gained post consent when projects move into construction. At this point it has regularly been found that different or previously unknown impacts arise that have not been assessed, or sufficiently assessed, as part of the consenting process. This results from over confidence of the applicant in their ability to install cables, over optimistic expectations of engineering solutions to complex problems or a lack of understanding of the complex marine substrate and ground conditions. In many cases changes to cable installation techniques, remedial works and additional cable protection have resulted in habitat disturbance and loss/ modification within MPAs that had not been assessed as part of the application, requiring additional work by the developer, regulator and advisors. It is therefore imperative that assessments are improved at the consenting stage in order that regulators and advisors are confident that a deliverable installation method has been proposed and a realistic level of impacts has been assessed in order to avoid these issues arising later. As highlighted in the Offshore Wind Programme Board paper (Overview of the offshore transmission cable installation process in the UK), earlier involvement of the right expertise for cable installation and burial planning would help to alleviate some of these issues by ensuring that more accurate methods statements are submitted, leading to consents that have considered the full potential range of situations that may be encountered for that project. This should be complemented by detailed survey data to inform decisions related to ground conditions ("past experience of installation issues resulting from unexpected seabed conditions serves to underline the importance of effective and early survey planning"). Feedback from insights gained on previous projects is also a fundamental requirement currently receiving insufficient attention by the sector.

The following list highlights some of the key issues that have arisen, which are explained in more detail in Annex 1 with examples. Although we understand that some of these issues

may have been unavoidable, with current knowledge they should be assessed and mitigated for if needed at application stage.

- Changes to assessed cable installation methods due to more information becoming available post consent/ techniques not working in the field
- Predicted range of impacts/quantities, even after post consent revision, still not fit for purpose when compared to actual installation impacts
- Cable installation in a wider range of substrate types/ habitats
- Insufficient cable burial depth achieved in practise
- Cables becoming exposed and free spanning cables
- Secondary scour around cable protection and at cable crossings
- Need for additional cable protection due to above 3 reasons
- Installation/ repair timetable falling behind/ over running requiring work in sensitive periods for certain species
- Additional need for jointing pits/ flotation pits
- UXO/ boulder clearance with the actual number of UXO targets often far exceeding that assessed
- Pre-sweeping/ sandwave clearance
- Need for cable repair/ replacement
- Annex 1/Saltmarsh impacts – subject of another paper

6. Content of an assessment of cable impacts

The following points are made in the National Policy Statement for Renewable Energy Infrastructure EN-3 (section 2.6.113) and must be considered along with the additional detail below:

'Where necessary, assessment of the effects on the subtidal environment should include:

- *loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes;*
- *environmental appraisal of inter-array and cable routes and installation methods;*
- *habitat disturbance from construction vessels' extendible legs and anchors;*
- *increased suspended sediment loads during construction; and*
- *predicted rates at which the subtidal zone might recover from temporary effects.'*

Natural England advise that a full assessment in an application sh**ould include:**

- Detailed information on ground conditions and clear evidence of the likelihood of success of proposed burial techniques in those conditions. Currently these are usually provided in a cable installation plan post construction which can be too late in the process where sensitive habitats and species are likely to be impacted. There needs to be a *very* realistic worst case scenario (WCS) based on engineering knowledge and experience and an alternative installation plan/technique should the ground conditions be unsuitable for the preferred method. Although this might mean a wider cable installation envelope and a '*worse'* WCS, there is a need to be more precautionary as a result of negative experience with a number of existing projects. Should the developer wish to have a more defined WCS – ground investigations and

associated data need to be presented at the application stage rather than post-consent. (This also relates to the next point below).

- Changes to assessed cable installation methods due to more information becoming available post consent/ techniques not working in the field. The Offshore Wind programme board paper states '*Contingency measures should also include plans for approvals of necessary changes to the installation methodology as, in the past, projects have needed to make late changes in response to unforeseen seabed conditions or weather changes while the vessel is on-site*.'

- Impacts related to bringing vessels inshore (associated beaching or floatation pits)

- An assessment of likely post-construction issues including the potential for cable exposures, scour, secondary scour and an assessment of the expected WCS for associated remedial work as a contingency to future proof applications. This should include any needed change to installation techniques for this work as detailed above.

- Assessment of impacts of realistic number of cable repairs or replacements using information gained from previous developments

- Realistic predictions of the amount of cable protection (including height, width, length) and the type of cable protection to be used along with an assessment of the impact on habitats and species at the required locations. Consideration should be given as to whether this leads to habitat loss and whether it will be conditioned to be removed on decommissioning. The assessment should include the proposed locations of cable protection rather than a generic amount along the route with specific assessment of the impacts of areas on habitats within MPAs. An assessment of potential impacts to physical processes should also be undertaken to look at potential impacts to sediment transport which may impact habitat extent and quality.

- A realistic assessment of the number and impact of cable grapnel runs, UXO, boulder and sandwave clearance where relevant with a clear indication of the temporal nature of these impacts.

- Realistic worst case scenario predictions of area of each relevant habitat type/ species impacted along with realistic assessment of recovery. Evidence from developments of similar scale and in a similar habitat should be analysed and presented. The assessment should also refer to sensitivity and recoverability information that is provided in the most up to date Conservation Advice for each feature.

- An assessment of how the above predictions relate to the conservation objectives of any relevant MPA

- Proposals for monitoring and remediation/ alternatives, particularly where installation techniques and their impacts on designated features are unclear. Where monitoring is required to inform remediation the methodology should be agreed with relevant bodies to ensure the future surveys are fit for purpose.

7. Mitigation[3]

Cabling can have low environmental impacts if the operation is carefully planned and appropriate mitigation is put in place. The standard approach of 'avoid, reduce, mitigate' should apply where firstly impacts, particularly on a sensitive feature, should be avoided. If this is not possible then impacts should be reduced by selection of appropriate methods and finally any remaining impacts should be mitigated for. Mitigation for benthic impacts in the National Policy Statement for Renewable Energy Infrastructure EN-3 (section 2.6.119) includes the following points:

'Construction and decommissioning methods should be designed appropriately to minimise effects on subtidal habitats, taking into account other constraints. Mitigation measures which the IPC should expect the applicants to have considered may include:

- *surveying and micrositing of the export cable route to avoid adverse effects on sensitive habitat and biogenic reefs;*
- *burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state;'*

There are a variety of ways to minimise or mitigate impacts of cable installation and routing including:

- Micro-siting/routing, modification to the route to minimise interaction with sensitive features is important and commonly done either directly by developers or after consultation with Natural England. For micro routing to be successful post-consent it is necessary to ensure there is sufficient cable to do so, which can be an issue in relation in terms of timing of surveys to inform procurement and also taking into account technical logistics of bending a cable.
  Examples of where route selection has worked successfully are at two windfarms which needed to address the impacts of bringing cables ashore through areas supporting reef habitat in and outside of MPAs. At the first windfarm, during the pre-examination phase there were a number of cable options which were reduced down to the preferred option. Part of this options review process was to undertake habitat surveys of the cable routes followed by a review of the habitat sensitivity to assist with route selection. One of the main reasons for not choosing one option was the presence of stony reef. The other project had a large cable corridor consented and the habitats were surveyed within the full cable corridor to identify presence of reef habitats with the intention of micrositing/positioning the cable around reef. In the end, whilst the only reef found was not located along the preferred cable route and therefore impacts were avoided.

- Carefully selecting techniques for burial to reduce sediment plumes or avoid features can be very helpful. Horizontal directional drilling (HDD) can be used in some circumstances to fully avoid sensitive areas. For HDD to be considered as viable, pre-consent geotechnical investigations are required to confirm what is achievable. Undertaking these investigations will require a Marine licence and/or planning

[3] Adapted from Natural England Submarine Cables Handbook – internal document

consent.

- Avoiding sensitive times of the year can completely avoid a potential impact. For example, avoiding nesting and overwintering periods for birds, or times of the year when the feature is present.

- When cable protection is needed, materials can be selected to match the environment (when on mixed sediment or cobbles, rock of similar diameter and material as the receiving environment should be used as an alternative to the current blanket approach of sourcing granite from Norway).

- Where cable protection is needed it is also important to pay attention to the sand wave field in the area surrounding the rock amouring/placement location. The rippling in the sand in the wider area can show how mobile the area is and the sediment transport direction. Where possible, cable protection in a dynamic environment should not be placed perpendicular to the sediment transport (i.e. the long side of the rock protection should not run at angles close to parallel with the ripple crests) as this can result in large scour pits. If this is considered necessary then the associated issues highlighted above should be considered and addressed as part of the application. Similarly the placement of cable protection at 90 degrees to near shore sediment transport pathways is to be avoided as it can affect downstream sediment transport. The report undertaken for one windfarm projects showed that cable protection within the 10m depth contour could cause disruption to longshore sediment transport such that it may cause a breach at Spurn Point.

- Sandwave clearance is undertaken to avoid exposure of the cables in the future, but there is currently insufficient evidence as to the impacts and effectiveness. Its use therefore needs to be carefully considered, and where possible avoided in an MPA as in many cases the volumes dredged can be very large. As with any activity the 'avoid, reduce, mitigate' hierarchy should apply. Early discussion with Natural England is recommended as our advice will depend on the location. Depositing of any dredged material should be at a location that enables it to remain within the sediment system. We advise that any sediment extracted should be deposited up stream of cable trenches to encourage natural backfill.

8. Recommendations

Natural England therefore consider that cable installation, repair and maintenance have the potential to impact the natural environment in a significant way and have the following recommendations:

i) Cables should be routed away from sensitive habitats wherever possible e.g. those in which damage due to installation would be permanent, recovery slow or the habitats and species are rare or of high environmental value such as *Sabellaria spinulosa* reef, saltmarsh and chalk reef.

ii) The number of cables per project should be minimised through project design.

iii) Cabling in dynamic mobile sediment environments should be carefully considered (in project design) to avoid cable exposures occurring and subsequent additional cable protection being required.

iv) Cabling should not be assessed as a one off activity and a full assessment should take place at consenting stage of the cumulative impacts of cable installation and maintenance including the impacts of related cable protection and remedial/ repair works once operational.

v) Every effort should be made to use (or gain where there is a concern) pre-application geotechnical information to inform a realistic assessment of cable burial tools and options and their impacts as part of the consenting process. This should avoid the need for changes to the methods assessed in the Environmental Statement when a project moves into construction.

vi) Where there is any doubt as to the feasibility of installation this should be clearly communicated, particularly where there is interaction with an MPA. In this situation it may be useful to consider a wider range of techniques or other possibilities in order to ensure the worst case scenario is fully covered and impacts on the MPA can be assessed. Based on previous experience Natural England will take a precautionary approach in its advice on consenting in sensitive habitats where there is uncertainty around the impacts.

vii) Taking account of worst case scenarios and gathering the necessary level of information at the point of application may be at considerable cost to the developer but can be offset by the reduced risk post consent of having to develop bespoke techniques/kit at very short notice. Additionally there is a large time cost (with associated financial implications) post consent to all parties through consultation on changes which could be saved.

viii) Conditions and discussions relating to cable installation and maintenance, with the detail behind them, should be clearly documented through the consenting process in order that the understanding and background is retained into construction of a project through any personnel changes in all parties.

ix) Where it is not possible to avoid an MPA and impacts are likely to be significant, early consideration of Imperative Reasons of Overriding Public Interest (IROPI) and compensation or measures of equivalent environmental benefit may well be the best option for the environment and project.

x) If we consider that insufficient information has been provided or inadequate assessment of the potential range of impacts, Natural England may advise that the application is inadequate and not fit for submission

xi) Monitoring of the impacts of and recovery from cable installation and repair has not been sufficient in many sediments/ habitats to provide an evidence base to advise on the impacts to sensitive habitats with confidence. Therefore until this evidence base is improved monitoring of export and inter-array cable installation impacts and recover should be implemented as a marine license condition.

9. Annex 1: Examples of impacts from cable installation and operations and maintenance

A1 Insufficient cable burial depth achieved in practice

At a number of windfarms it has not been possible to achieve the burial depth proposed in the Environmental Statement due to a combination of local ground conditions and inability of the tools to operate effectively in those conditions. In some cases this does not cause problems i.e. reburial attempts are successful or, as in other cases, the cables are left without further remedial work to bury the cables. However, in many areas this has led to repeated attempts to bury cables using the same or different tools, or the need for remedial cable protection due to risks to the cables and other sea users. In an MPA or a sensitive area the consequences of this can be repeated abrasion and disturbance to a habitat for which only one off disturbance was assessed and similarly further increases in suspended sediment. Where the habitats and species are sensitive to these pressures then prolonged disturbance increases the magnitude of the effects beyond that assessed at consenting. Impacts of additional cable protection are covered in Annex 2.

Examples:
At one site it was proposed to use stone bags in areas of insufficient burial to provide further protection to cables and a marine license was subsequently granted for this although ultimately the stone bags were not used.
At another offshore windfarm it was initially attempted to bury the inter-array cables using a plough which was not sufficiently successful. Following this a jetting tool was used, although this was also not sufficiently successful after a number of passes. Ultimately rock placement was required to ensure the integrity of the cables.
Elsewhere a mass flow excavator (extreme jetting tool) was used with some success to rebury cables. This posed more of a challenge in mixed sediments (presenting a harder substratum) than in softer sediments. Additional cable protection within an MPA that was not assessed at the time of application has subsequently been requested at this site.
At another site optimum burial depth was forgone in recognition that by cutting into the chalk bedrock to install the cable the bedrock provided appropriate protection to both cable and other sea users.
Two interconnector cables have applied for additional cable protection in MPAs that was not assessed at the time of application due to insufficient data being collected and used to predict burial depths and therefore ground conditions in reality differing to those that were assumed.

A2 Cables becoming exposed

Cables can become exposed either due to initial insufficient burial as detailed above or due to burial in mobile sediments which then migrate leaving the cables exposed. Impacts are similar to above where either reburial or additional cable protection is required. In the last couple of years sandwave clearance has been proposed and used in mobile sediment environments. This is covered in a separate section below.

Examples:
Since installation at x windfarm the majority of the export and inter array cable located within

the sandbank system have been exposed and free spanning and in other areas buried to depths >9m.This is due to the migration of the sand bank system south eastwards into the North Sea. However, nothing has been done to address the exposed cables.
At several windfarms cable exposures occurred requiring rock armouring in places. At one development surveys showed 16 exposures on export cable route and 29 on inter-array cables which required some remedial cable protection. At another a number of short exposures were observed. Additional jetting was required to remediate this with rock placement on exposed sections of the export cable. At a third site 77m export cable became exposed this was not considered a large impact and no remediation was required.

A3 Scour and secondary scour around cable protection and at cable crossings
Scour and secondary scour are of concern due to the potential to cause further destabilisation of the sediments and thus the further requirement for more remedial work. By their nature they will lead to additional abrasion, disturbance and impact on form and function of a habitat that has not been assessed as part of an application.

Examples:
At the crossing of a windfarm export cable and an interconnector cable, the cables became exposed due to their installation close to the edge of a dynamic sandbank. Remedial works were undertaken using locally sourced sand and gravel but were unsuccessful in keeping the cables buried. Further works were undertaken using rock armouring which then required an additional phase of works due to scour around the edge of the rock amouring. All of these works resulted in habitat disturbance and loss/ modification within MPAs that had not been assessed as part of the application, requiring additional work by the developer, regulator and advisors.
In a different location significant scouring of the seabed has occurred as a result of rock armouring placed over the export cable, with scour pits occurring which are deeper and cover a wider area than originally predicted (one pit is over 5m deep and 200m in length). Large areas of free spanning cable are also exposed. A cable scour remediation project has been implemented since the 2015 surveys were undertaken, resulting in rock placement around many of the shallow buried and exposed cable areas
Monitoring has shown that the level of impact from scour protection is influenced by its orientation in relation to local sediment transport patterns. In this instance the rock berm was placed perpendicular to the local sediment transport field (parallel to existing ripples) leading to the creation of scour pits several orders of magnitude larger than the rock berm. This in turn leads to greater than predicted impacts in terms of further habitat loss and disturbance. These impacts could be minimised whilst still protecting the cable by orientating the scour protection differently in line with local sediment transport patterns. As described in a previous section where this is not possible due to the cable orientation then the secondary impacts should be considered, assessed and addressed where necessary.

A4 Need for additional cable protection due to above 3 issues

Impacts of additional cable protection are covered in Annex 2.

A5 Changes to cable installation technique

This occurs where either new geotechnical information becomes available post consent and it is discovered that the techniques assessed at the time of consenting are now not sufficient

to bury the cable, or new technology has come along since consenting that is more appropriate to the cable and the environment in which it is being installed. Where the impacts from the change to technique are within the parameters of those assessed at the time of consenting the change may not be problematic (although still requires time on the part of developers, regulators and advisors). Issues can arise where the change in technique impacts on an MPA, further assessment and potentially mitigation is required depending on the level of effects. As highlighted earlier the Offshore Wind programme board paper states '*Contingency measures should also include plans for approvals of necessary changes to the installation methodology as, in the past, projects have needed to make late changes in response to unforeseen seabed conditions or weather changes while the vessel is on-site*.'

Examples:
As described previously, at one site the installation technique was changed to using a mass flow excavator for the second cable installation which has wider and deeper impacts than those assessed under jetting in the ES. There was also remedial burial for the first cable using a mass flow excavator where the original techniques did not achieve optimum burial depth. The mass flow excavator had a 15m impact width, three times greater than the cable corridor width assessed in the ES. Use of the tool also raised concerns about increased suspended sediment concentrations, loss of fines when backfilling the material, impacts of stockpiling material and backfilling techniques and subsequent recovery of the habitat. Lack of evidence on the impacts of the technique meant that a greater level of monitoring of recovery was required, some of this showed persistent grooves in the seabed where stockpiled material was dredged up and non uniform recovery.
At another site the installation technique was changed from a plough to a cutter to enable cable installation in the chalk.
To install the export cable at another windfarm a mass flow excavator was used which was different in impacts to the original project installation and assessment.

A6 Installation/ repair timetable falling behind/ over running requiring work in sensitive periods for certain species

To mitigate for impacts on species in sensitive periods, such as feeding or roosting birds or migrating and spawning fish, timing restrictions may be included as a marine license condition. Where changes occur to the application prior to commencing construction, installation works over run or run into sensitive periods then disturbance is caused to these species that was not assessed as part of the original application, or was assessed and thought not to require mitigation measures. This leads to difficult decisions for advisors and regulators, and potentially long construction delays for developers, where works need to be completed whilst avoiding detrimental impacts on the species.

Examples:
At a windfarm the developer needed to reinstall their cable in the inter-tidal during the seasonal restriction for over-wintering birds in a Special Protection Area (SPA). A new appropriate assessment was required as this had not been previously assessed and there were large numbers of birds using the areas. Consequently a package of mitigation measures was agreed to enable the repairs to go ahead. This included minimising vehicle movements, marking a limited working corridors, no night working /lighting, cold weather restrictions and no coastal working practices 2 hours either side high tide. In addition to the

mitigation measures the developer aimed to reduce overall disturbance in the site by reducing recreational disturbance in the area, including making educational signs and leaflets and funding an extension of the local natural ambassadors programme where people were present on the foreshore to educate people on the impacts of bird disturbance.
At another windfarm the cable installation took longer than predicted, over running the end of the consented working window. Emergency real time judgments and assessments had to be made, in relation to whether or not the installation work in the intertidal could be completed or halted with the cable tied off until the following consent window. It was determined at that time that both options would be significant, and this put everyone under considerable pressure. In the end, the fair weather conditions meant that completion of the installation was the least impacting option.
Similar issues were encountered at two more windfarms where construction windows over ran or additional work was needed requiring works to impinge on restricted periods.

A7 Pre-sweeping/ sandwave clearance

As discussed above, in areas where there are sandwaves and megaripples it may be difficult to achieve optimum burial depth and slopes may be too steep for cable installation machines to operate on (>15 degrees). The technique involves dredging the tops of the sandwaves (usually using a trailer hopper suction dredger or mass flow excavator) in order to install cables in a flatter area where machines can operate and cables are less likely to become exposed. Local levelling of smaller features by dragging a plough across the area has also been proposed. Dredged material is disposed of in a licensed area. To put it in context the figures proposed for dredging at a windfarm site are similar to those extracted from a medium sized aggregate extraction area in a year, therefore the proposed operations are not insignificant volumes (one windfarm applied for 541 600m^3 for dredging over inter-array and export cables – an aggregate extraction license can be from around 83 000m^3/year to 1 000 000m^3/year). However the difference in impacts between aggregate extraction and sandwave clearance are that aggregate is extracted in a discrete area and removed from the system, whilst sandwave clearance may be over a larger area if it includes an export cable route and the material can be retained within the system depending on how and where it is disposed of.

As these works have only been proposed and carried out relatively recently there is currently no evidence on how well this technique works, whether cables remain buried thus avoiding the need for additional cable protection, and how quickly dredged areas recover. A number of projects have applied to undertake sandwave clearance post consent, however forthcoming projects should fully assess the impacts of any likely sandwave clearance at the time of application in order for the application to be complete. Full consideration needs to be given to the volumes to be dredged, areas for disposal of dredged material and impacts on the benthos and sediment transport. Natural England advise that, until further evidence is available on its efficacy as a technique and the timescales for recovery, sandwave clearance should be avoided within MPAs due to the potential impacts. Additionally, in any sandwave clearance assessment we advise that it is best practise to deposit the material upstream of the extraction site to enable natural processes to work the material into the area as quickly as possible and reduce impacts.

A8 Floatation pits

Floatation pits have been required at one offshore windfarm to enable the cable installation barge to get close to shore. It is usual for a vessel to be brought in close to shore and often to beach on nearshore or intertidal soft sediments. In this instance it was not possible to find a vessel that could beach on the harder substrate close to shore. Therefore, to enable the installation vessel to operate in the shallow water near to the cable landfall an application was made to dig 6 floatation pits (each 160m x 45m and 3m deep) with an excavator, which allowed the installation vessel to remain floating at low tide and avoid being beached/grounded on the harder seabed surface. Once cable installation works are completed the pits will be infilled with the material that was excavated, however as excavation was in chalk bedrock the habitat is unable to recover geologically, although it may recolonise in a similar manner to what existed previously. Ongoing monitoring should inform the extent of the impact and recovery and thus any similar future situations. These activities were not assessed as part of the original application. This case occurred outside an MPA – within an MPA it may well have been difficult to avoid an adverse effect or hindering of the conservation objectives of the site. The consequences of this level of impact on a designated site are that the features are damaged and thus less resilient to further impacts. This may in turn lead to impacts from future activities being assessed with increased caution and considered unacceptable or less acceptable as well as impacting on the condition of the feature or site (e.g. the feature may become in unfavourable condition).

A9 Jointing pits /HDD exit pits

Horizontal directional drilling (HDD) is often chosen as the cable installation method at landfall. Although normally more expensive than other methods it can be a useful tool to avoid sensitive intertidal areas or minimise disturbance during construction. HDD cable installation usually starts on land and follows seawards, where the installation tool has an exit pit at the seabed in shallow water. In order to bring the tools back to the surface and to join the cable to its offshore portion an area of seabed needs to be cleared and levelled so excavation works may be required. In one recent windfarm consultation, the size of one such exit pit was estimated at 1500 m^2 with the depth of excavation of up to 4 m. Taking into account that there may be multiple cables installed for a project, the total area subject to habitat loss and disturbance may be quite large. The impact longevity will depend on the nature of the seabed material and sediment transport processes in the area. The significance of impact will depend on the conservation status of the area and sensitivity of the habitats. Similar impacts could be expected from jointing pits where sections of a cable or multiple cables are connected. The impacts from clearing and excavating large areas for the purposes of cable jointing works need to be carefully assessed alongside other cable installation impacts at the time of application.

Example:
At one windfarm, following detailed design of the joint pit requirements the developer identified the need to increase the maximum dimensions of the joint pit for the second cable from approximately 250m in length to up to 600m. This was necessary in order to provide a sufficient grade in / grade out area at the point that the cable enters and exits from the pit, taking account of operational constraints such as water depth and the technical limitations of the cable burial process. With a width of 25m, the estimated seabed footprint of the joint pit excavation increased from 8,899m^2 to 18,750m^2, including a 25% contingency.
Overall NE were content that given the location and temporary nature of the effects of using Mass Flow Excavation (MFE) for the joint, that the proposed variation request would not

have a significantly greater impact on the Annex I features of the SAC, from those previously considered in the Appropriate Assessment; even with the increased footprint. We noted concerns with the use of MFE leaving grooves that do not uniformly recover and required further info on number of passes etc.

A10 UXO Clearance

UXO investigation and clearance may be required within the cable corridor to ensure safety during construction operations. As the detailed information regarding number of targets and size is only collected prior to construction, it can be difficult for a full assessment to be undertaken during consenting. This can be problematic as UXO clearance is a noisy activity and assessments need to be undertaken of impacts on marine mammals both alone and in-combination with other activities such as piling. In some cases the actual number of UXO found post-consent is far greater than the predicted number originally assessed.

Example:
At one windfarm, the predictions and assessment had to be revisited several times with much higher numbers of targets involving further Appropriate Assessments, delays and frustration to all parties.

A 11 Boulder Clearance

This takes place where there is a need to remove boulders (typically greater than 300mm in any direction) from the cable installation route in order to enable safe and effective passing of the installation tools and thus achieve sufficient burial of the cables. Boulder clearance can lead to additional disturbance to sensitive habitats and therefore should be fully assessed as part of the application to enable all the impacts to be considered. Natural England's preference is that where necessary boulders should be moved to the side, rather than relocated to a new area, in order to keep the seabed habitat as similar as possible to unimpacted conditions. There are two main methods of boulder clearance – using a grab or plough – of these the use of a grab has much less of an impact on the seabed and should be used as the method of choice, particularly in sensitive habitats. Use of the plough can create a 25cm berm on either side of the plough. Where there are sensitive habitats, or indeed the boulders are part of a feature of an MPA, further consideration needs to be carefully given to the impacts of boulder relocation. As with a number of the other activities associated with cable installation, a lack of full information to allow a realistic assessment during consenting can lead to greater difficulties finding workable solutions later on.

A12 Monitoring and recovery

Where monitoring data is available for a similar level of impact in a similar habitat this is very useful in informing an assessment, particularly in relation to extent of impact and timescales for recovery. As these are both key issues that inform the level of impact on an MPA, and uncertainty around them is often part of the problem, there is a need to continue to collect targeted monitoring data on impacts and recovery in different environments.

Example:
At a windfarm site the cable route was found to go through areas of non-designated cobble reefs and micrositing was agreed around some distinct elevated cobble ridges to avoid the

worst impacts to the reef. It was necessary to go through some less good areas of potential reef and a comprehensive monitoring program was instated to look at the impact and any recovery along these areas of the cable route. In the monitoring report it is possible to clearly see the edges of the cable corridor (10-20m wide) on the multibeam, therefore it is possible to confidently ascribe 'impacted' to 'non impacted' habitat in the Drop Down Video. Assessment of the monitoring data indicated that the areas that were trenched are not expected to recover to the former habitat as it is now flat and it is possible to see patches of exposed clay in some spots. This clearly demonstrated that recovery will not take place in this kind of habitat and therefore micro siting is an important mitigation tool in such areas. What remains interesting is to what extent there will be colonisation of what currently looks a very sparse and damaged seabed, with little living there. The resulting uniformity of the seabed is leading to colonisation of communities with similar characteristics rather than the diversity that previously existed. There are patches of disturbed cobble and stone, which may be recolonized by similar species, however the exposed clay is likely to be colonised by something very different. We are interested in how this damaged habitat evolves and what it turns into physically and in terms of its biology.

A13 Saltmarsh impacts

These are the subject of another paper

A14 Cable repairs

Export and inter-array cables repairs have been necessary at a number of operational windfarms with a wide variety of impacts occurring. These can be particularly problematic where the initial works were close to causing an adverse effect or hindering the conservation objectives of an MPA and therefore any additional works are close to or may cause unacceptable impacts. At least two windfarms have found it necessary to consider fully replace their export cables. One of the key impacts that should be taken into account in assessing cable repairs/ replacement is that of repeated disturbance to the habitat (or species), thus hindering and impeding timescales for recovery or causing additional disturbance to an area that has recovered. Whilst these impacts may be within the footprint of those that occurred during construction they are additional and therefore need to be assessed cumulatively.

At 12 operational windfarms long term maintenance marine licenses have been granted for emergency cable repairs. This enables a certain number of cable repairs to be carried out using the specified methodology within the remaining lifetime of the project (usually 10-25 years). This demonstrates the operator's opinion that cable repairs are likely and indeed a number of repairs have been carried out under these licenses since they were granted. As part of the long term maintenance license applications, impacts on the marine environment from the proposed number of repairs are fully assessed, with Habitats Regulations or MCZ assessments where required, and conditions applied where necessary for mitigation. All long term maintenance licenses have a 5 yearly review period as a condition enabling a review of what works have taken place under the license and whether there have been any changes that may require modification of the license. Whilst this has been necessary for early developments, those that are going through consenting now should thoroughly assess the impact of cable repairs and replacement, in order for an assessment to be complete and the full impacts of the project to be considered at the time of application. As stated in the

Offshore Wind Programme Board paper '*Contingency plans to cover critical paths in the installation process should be incorporated into the overall execution plan. This includes not only contingency timelines, as mentioned in the previous section, but also operational contingency plans, such as for cable abandonment and cable repair*.'

In a recent marine license application a windfarm has submitted a request to repair 4km of cable immediately after installation. This may increase impacts as where there is disturbed ground they may choose to cut the cable off and install a new section alongside increasing the impact. If immediate repairs are thought to be necessary then their impacts should be assessed as part of the application along with all other impacts of installation, repair and maintenance.

10. Annex 2: Cable protection

Natural England have ongoing concerns around the use of cable protection in the marine environment. We are lacking in data regarding the full extent of cable and scour protection within the marine environment both within and outside marine protected areas and the potential impacts of this on the natural functioning of the environment. In addition there is little coordination of the data on the amount and location or cable and scour protection installed in relation to that consented across all industries. Natural England is concerned about the levels of existing and proposed scour and cable protection because the environmental impacts include;

- Loss of/ modification to habitat through the introduction of different material
- Impacts on recoverability of soft sediment communities
- Current and tidal flow disturbance
- Interruption of and changes to sediment (bedload) transport therefore affecting both near-shore geomorphological processes and ecosystem functionality.
- Increase in scour
- Creation of a substrate for marine communities which would not naturally occur in a particular region.
- Facilitation of the spread of species associated with hard substrates around the coastline, particularly non-natives, and in response to climate change.

Within an MPA these concerns are particularly pertinent and require assessment against the conservation objectives for the site. Issues can be compounded where cable protection, that may have a relatively small footprint, impacts on features that are already under pressure due to other activities such as foundation installation, aggregate extraction and fishing. In soft sediment environments there are particular concerns around changes to natural functioning of the habitat – in harder substrates there may be more opportunity to design scour protection which functions similarly to the natural environment.

Due to a lack of sufficient information regarding rock amouring from oil and gas decommissioning in North Norfolk Sandbanks and Saturn Reef SAC, Pidduck *et al* 2017 concludes that it is not possible to quantify or qualify the movement of sandbanks around or over existing or applied rock amouring. Theoretically, the mobile sandbanks may cyclically cover applied rock armouring and there is the potential for scour to be induced if an appropriate design is not chosen. Without further information on rock berm design, monitoring studies and numerical modelling of such behaviour, the short-term and long-term implications of both theoretical behaviours are difficult to determine. The report also concludes that the effects of decommissioning methods of oil and gas infrastructure have the potential to delay or even hamper the achievement of the conservation objectives of protected features designated under the Habitats Directive (92/43/EEC) and the integrity of the designated site.

Due to the above concerns, Natural England recommends that cable protection is kept to a minimum, that any use is fully justified and that where possible consideration is given to techniques that minimise the environmental impact including the use of material similar in size and composition to the natural material (e.g. in stony reef areas) and the use of material that is removable on decommissioning. However cable protection usually defaults to rock protection (almost always granite quarried in Norway) or concrete mattressing. There

remains a lack of evidence around the removability of these methods on decommissioning with different answers from different developers. Repair work on the export cable at one offshore windfarm found that the rock protecting the cable was not removable and a new section of cable had to be spliced in around the rock protected section. With concrete mattressing developers often cite degradation in the ropes and links holding the mattresses together as a potential health and safety issue and barrier to removal on decommissioning. Anecdotal evidence from developers has highlighted that mattresses are easily moved or flipped by anchors. These structures have not been designed to be removed and are expected to pose some challenges in general with area specific differences as described by Jee Ltd., Zero Waste Scotland and Decom North Sea (2016).

Additionally every effort should be made to realistically assess the need for cable protection as part of the application in order for issues to be fully considered and mitigated where necessary at consenting stage. This is also of benefit to the developer as highlighted in the Offshore Wind Programme Board Paper *'Remedial works may be needed where cable protection levels are deemed insufficient. For example, for rock placement or mattress installation work, additional permits and licenses may be required, which will take time to obtain.*' The assessment, particularly in an MPA, should use (and gather where necessary) detailed information on the substrate along the cable route to inform likely areas of insufficient burial and need for cable protection. Cable protection should then be selected that works best with and minimises impacts on the particular substrate and there should then be an assessment of the impacts of the cable protection on each habitat type/ feature. Generic assessments and licensing of total amounts of cable protection across the entire cable routes have proved unhelpful in the past and led to the need for further assessment post consent, particularly where proposals are within an MPA. Additionally in a large number of cases additional cable protection has been required post consent due to cable burial issues discussed above. Lessons should also be learnt from earlier cable installation in planning and assessing cable routes. For example experience at an offshore windfarm and nearby interconnector cable has shown that sufficient cable burial is rarely achieved in chalk. At the windfarm there was a need to install over 200km of post construction cable protection due to insufficient burial depths. The interconnector cable project has also applied for post installation cable protection that was not considered at the time of application. Subsequent to the initial draft of this document a further interconnector cable and windfarm have applied for cable protection within MPAs that was not assessed at the time of application – in both these cases the operator agreed to no cable protection in the MPA at the time of consenting and has come back with license variations to place cable protection in the MPAs, effectively rendering the original assessment and consent incomplete.

As discussed under mitigation and scour elsewhere in the document, where cable protection is needed it is also important to pay attention to the sand wave field in the area surrounding the rock armouring location. The rippling in the sand in the wider area can show how mobile is the area and the sediment transport direction. Where possible the cable protection in a dynamic environment should not be placed perpendicular to the sediment transport (i.e. the long side of the rock protection should not run at angles close to parallel with the ripple crests) as this can result is large scour pits. If this is considered necessary then the associated issues highlighted should be considered and addressed as part of the application.

11. References:

Jee Ltd., Zero Waste Scotland and Decom North Sea, 2016. Mattress Solutions

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NATURAL
ENGLAND

Other Conservation Designations within the AONB

The appendix covers the various conservation designations that apply within the AONB. Some areas of land, most notably in the coastal strip, may be included under more than one of these designations, and sometimes under several.

The appendix is arranged in two groups – nature conservation and cultural heritage – in descending order of significance i.e. sites of global - European - national - local importance. However the strength of protection a site receives does not always increase in proportion with its apparent importance. For example the European nature conservation designations have stronger protection under UK law than the globally important Ramsar sites.

Registered common land is also included in the appendix. Although not a conservation designation, common land makes an important contribution to the landscape, wildlife and cultural heritage of the area, because of its character and how it is managed, including constraints on development and changes of land use.

Ramsar Site

The Convention on Wetlands of International Importance, especially as Wildfowl Habitat, was adopted at a meeting of countries held at Ramsar, Iran in 1971. The UK Government signed the convention in 1973 and became a contracting party in 1976 and in so doing accepted a commitment to promote both the conservation and the wise use of wetlands within its territory through local, regional and national actions and international co-operation, as a contribution towards achieving sustainable use of wetlands and their resources throughout the world. By 2009, there were 159 'contracting parties', with 1870 sites covering nearly 184 million hectares covered by the designation.
For further information visit: http://www.ramsar.org

Ramsar Sites wholly within the AONB are: Dersingham Bog, North Norfolk Coast
Ramsar Sites overlapping the AONB are: Broadland, The Wash

Biosphere Reserve

Biosphere reserves are nominated by national governments and designated under the Man and the Biosphere (MAB) programme of the United Nations Educational, Scientific, and Cultural Organisation (UNESCO). There are 553 sites worldwide in 107 countries. The 9 sites in the UK are almost entirely on existing National Nature Reserves and all have other national, European, or international conservation designations. They comprise core, buffer and transition zones.

Biosphere reserves wholly within the AONB are:

North Norfolk Coast (based on Holme Dunes, Scolt Head, Holkham and Blakeney National Nature Reserves) – designated in 1976

The original objectives of designation were for conservation, international research, monitoring and education and for demonstrating land, water and environmental development research. In the 1990s, the objectives were revised to apply to areas which innovate and demonstrate approaches to conservation and sustainable development. The North Norfolk Coast Biosphere Reserve, in common with some other UK sites, seems likely to lose the designation under the new criteria. For further information visit: http://www.unesco.org/mab/

Special Area of Conservation (SAC)

The UK Government has an obligation to designate and protect SACs under the European Commission Habitats Directive 1992. They are protected under the same Regulations as SPAs (see below) because of their international importance for specific species and habitats. In England, designation of terrestrial SACs has been based on selected sites already designated as SSSIs (see below), although SACs can also extend below mean low water mark. 169 habitat types and 623 species are considered in most need of conservation at European level. 76 of these habitat types occur in the UK of which 23 have priority status. There are currently 615 SACs in the UK. If a proposed development is likely to have a significant effect on a SAC an 'Appropriate Assessment' must be conducted to determine what impacts may arise, and possible means of mitigation. For further information visit: http://jncc.defra.gov.uk/page-23

SACs wholly within the AONB are:

Overstrand Cliffs, Paston Great Barn

SACs overlapping the AONB are:

The Broads, Norfolk Coast and Gibraltar Point Dunes (terrestrial), Roydon Common and Dersingham Bog, The Wash & North Norfolk Coast (marine), Winterton & Horsey Dunes

Special Protection Area (SPA)

The UK Government has an obligation to designate and protect SPAs under the European Commission Directive on Wild Birds 1979. The sites are internationally important for specific bird species. As for SPAs (see above), site selection has been based on existing SSSIs and 'Appropriate Assessments' are required for proposed developments that may have an impact on the relevant bird species. There are 270 SPAs in the UK at present. For further information visit: http://jncc.defra.gov.uk/page-162

SPAs wholly within the AONB are:

North Norfolk Coast

SPAs overlapping the AONB are:

Broadland, Great Yarmouth and North Denes, The Wash

National Nature Reserve (NNR)

Some of the best SSSIs (see below) are designated as NNRs by Natural England under the National Parks and Access to the Countryside Act 1949. They include the best examples of biological and geographical sites and are managed by Natural England or other approved conservation bodies. Initially established to protect sensitive features and to provide 'outdoor laboratories' for research, their purpose has widened from managing some of our most pristine habitats, our rarest species and our most significant geology to include providing opportunities to the public as well as schools and specialist audiences to experience England's natural heritage.

There are over 224 NNRs in England covering over 800 square kilometres, the largest being The Wash NNR at nearly 8,800 ha. For further information visit: https://www.gov.uk/government/collections/national-nature-reserves-in-england

NNRs wholly within the AONB are:

Blakeney Point, Dersingham Bog, Holkham, Holme Dunes, Scolt Head Island

NNRs overlapping the NNR are:

Winterton Dunes

Site of Special Scientific Interest (SSSI)

Designated by Natural England under the Wildlife and Countryside Act 1981. Sites are protected legally under the Act but positive conservation management relies mainly on the co-operation of landowners. Designation is on biological and/or geological grounds. For further information visit: https://www.gov.uk/protected-or-designated-areas

SSSIs wholly within the AONB, with approximate areas, are:

- Bilsey Hill (NE of Langham) (2.5 ha)
- Briton's Lane Gravel Pit (Sheringham) (21 ha)
- Cockthorpe Common (7 ha)
- Dersingham Bog (159 ha)
- Felbrigg Woods (165 ha)
- Glandford (Hurdle Lane) (9 ha)
- Glandford (Letheringsett Road) (1 ha)
- Holkham Brick Pit (0.5 ha)
- Hunstanton Park Esker (17 ha)
- Kelling Heath (90 ha)
- Morston Cliffs (1 ha)
- Mundesley Cliffs (29 ha)
- North Norfolk Coast (7860 ha)
- Overstrand Cliffs (58 ha)
- Paston Great Barn (1 ha)
- Ringstead Downs (7 ha)
- Sheringham and Beeston Regis Commons (24 ha)
- Sidestrand and Trimingham Cliffs (117 ha)
- Snettisham Carstone Quarry (11 ha)
- Stiffkey valley (44 ha)
- Warham Camp (5 ha)
- Wells Chalk Pit (4 ha)
- Weybourne Cliffs (42 ha)
- Weybourne Town Pit (0.6 ha)
- Wiveton Downs (29 ha)

SSSIs overlapping with the AONB are:

- Upper Thurne Broads and Marshes (small overlap with AONB)
- The Wash (over 62,200 ha overall, overlaps with W parts of the AONB)
- Winterton–Horsey Dunes (427 ha total, majority in AONB)

Local Nature Reserve (LNR)

Local authorities have powers to acquire, declare and manage LNRs in consultation with Natural England, under the National Parks and Access to the Countryside Act 1949. To qualify for LNR status, a site must be of importance for wildlife, geology, education or public enjoyment. Some are also nationally important Sites of Special Scientific Interest.

LNRs must be controlled by the local authority through ownership, lease or agreement with the owner. The main aim must be to care for the natural features which make the site special. For further information visit:
https://www.gov.uk/create-and-manage-local-nature-reserves

LNRs within the AONB are:

- Wiveton Downs

County Wildlife Site (CWS)

These are recognised as the most significant wildlife sites in a county outside SSSIs, which contain locally distinctive and important habitats and species, with most sites in private ownership. Although not a statutory designation, local authorities have adopted County Wildlife Sites into the planning process and Local Plans / Local Development Frameworks recognise them and contain policies to protect them. In Norfolk the CWS system is managed by Norfolk Wildlife Trust in conjunction with Norfolk County Council and Natural England. For further information visit:
www.norfolkwildlifetrust.org.uk/protectingwildlife/cws

There are 82 County Wildlife Sites in the Norfolk Coast AONB (2009). Site numbers, names and grid references are listed below.
NB County Wildlife Sites do not normally have public access.

West Norfolk

440 Ling Common (TF 652240)
441 Fowlers Plantation (TF 676241)
443 Relict Heath (TF 649275)
444 Wootton Carr (TF 653250)
445 Castle Rising Wood (TF 668252)
446 Penny Wood (TF 682256)
447 Mill House Wood (TF 676251)
450 Wolferton Wood (TF 668272)
451 Cat's Bottom Heath (TF 676275)
452 The Carr and Slash Wood (TF 695298)
453 Wild Wood (TF 685284)
454 Wild Wood (TF 685286)
455 Boggs Whins (TF 678297)
456 Dersingham Meadow (TF 685298)
457 Dersingham Closed Common (TF 687295)
458 Dersingham Open Common (TF 686298)
459 Cat's Bottom Heath (TF 678274)
461 N. of Cat's Bottom (TF 673275)
463 Woodcock Wood (TF 685280)
464 Brick Kiln Covert (TF 686277)
465 Sandringham Park (TF 692281)
466 Wolferton Picnic Area (TF 665282)
467 Dersingham-Wolferton Railway (TF 660285)
468 Jocelyn's Wood (TF 682289)
469 Sandringham Warren (TF 675283)
470 Boathouse Wood (TF 660307)
476 Snettisham Common (TF 673337)
479 Ken Hill Wood (TF 675345)
481 Eaton Meadows (TF 701362)
484 Whin Covert (TF 692385)
485 South Hill Wood (TF 692399)
570 Barrow Common (TF 788433)
571 Ringstead Common (TF 726406)
1319 Thorpe Common and Fen (TF 845424)
1320 Burnham Norton Extension (TF 832436)
2034 Catlane Wood (TG 702388)

North Norfolk

1091 South of Hull Wood (TG 042398)
1096 Bush Wood (TG 050398)
1100 Cley Park (TG 070405)
1101 Cat Pits Wood (TG 089403)
1102 Adj. The Hangs (TG 084409)
1103 The Wing (TG 051412)
1104 The Hangs (TG 063427)
1106 Muckleburgh Hill (TG 100431)
1107 Kelling Hard (TG 098438)
1108 Langham Lane Meadow (TG 017405)
1109 Saxlingham Heath (TG 040403)
1110 Glandford Mill Meadow (TG 046415)
1111 Land at Cley (TG 044438)
1112 Morston Marshes (TG 005443)
1113 Hull Wood (TG 045401)
1143 Felbrigg Hall Estate (TG 189390)
1144 Metton Carrs (TG 200381)
1145 Gibbet and Marlpit Plantations (TG 155409)
1146 Pretty Corner and The Plains (TG 155415)
1147 Roman Camp and Beeston Regis Heath (TG 178418)
1148 Incleborough Hill (TG 188423)
1149 West Runton Common (TG 183422)
1150 Kelling Heath Park (TG 110417)
1152 Sheringham Wood and Park (TG 134415)
1154 Oak Wood (TG 134427)
1156 Beach Lane (TG 109437)
1192 Smith's Rough (TG 206401)
1196 Templewood Estate (TG 260384)
1197 Overstrand Disused Railway (TG 255400)
1199 Hall Wood (TG 213416)
1231 Waxham Sands Holiday Park (TG 458247)
1232 Fords Farm Pasture (TG 475225)
1246 Lambridge Covert (TG 432259)
1247 Marram Hills (TG 430277)
1248 Nr. French's Farm (TG 441257)
1271 Holkham Lake (TF 883435)
1316 Stiffkey Meadows (TG 958429)
1317 Wells-Walsingham Railway (TG 936400)
1318 Wells Meadow (TF 913447)
2017 Salthouse Heath (TG 073424)
2073 Old Pollard Wood (TG 077400)
2077 Sheringham Old Wood (TG 159412)

Great Yarmouth

1436 Winterton PCC Land (TG 491198)
1437 West Coverts and Home Broad (TG 480200)
1438 Decoy Wood and South Wood (TG 484210)
1440 North Wood (TG 481220)

A map showing sites and reference numbers can be found at http://www.norfolkbiodiversity.org/countywildlife/Map%20of%20Designated_wildlifesites2011_reduced.pdf

Roadside Nature Reserves
A non-statutory designation. RNRs are managed to conserve their locally significant flora.

RNRs West Norfolk
35 Docking Road, Ringstead
76 Peddars Way, Ringstead

RNRs North Norfolk
41 Stiffkey Road, Wells-next-the-Sea
44 Gravel Pit Hill, Cley-next-the-Sea
50 Wellspring Road, Southrepps
51 C303, Felbrigg
81 Lion's Mouth, Felbrigg
101 Warham Road, Binham
108 Glandford Road, Wiveton

Further information on RNRs can be found at:
https://www.google.co.uk/url?url=https://www.norfolkwildlifetrust.org.uk/documents/a-living-landscape/wildlife-advice/community/nwt-roadside-nature-reserves

A list of sites in Norfolk can be found at:
http://www.nbis.org.uk/sites/default/files/documents/Roadside_Nature_Reserves_2011.pdf

Scheduled Monument
The Ancient Monuments and Archaeological Areas Act 1979, building on legislation dating back to 1882, provides for nationally important archaeological and built heritage sites to be statutorily protected as Scheduled Monuments. There are currently around 19,000 entries in the Schedule, covering 35,000 sites ranging from prehistoric standing stones and burial mounds to Roman forts and medieval villages, and include some more recent structures such as collieries and wartime pill-boxes. The scheduling of a monument means that permission - 'scheduled monument consent' - is required for works to or affecting that monument. Historic England oversees and advises Government on scheduling and consents.
For further information on the sites below visit:
http://www.historicengland.org.uk/listing/the-list

There are currently 61 Scheduled Monuments in the Norfolk Coast AONB:
Aylmerton - wayside cross S of village
Babingley – medieval settlement (two sites)
Babingley - Butler's Cross,
Babingley - St Felix's Church
Binham Priory
Blakeney Guildhall (medieval undercroft)
Blakeney Chapel (site, N of Cley)
Blakeney Downs – two bowl barrows
Bodham – oval barrow / bowl barrow, Howes Hill
Brancaster – 'Branodunum' Roman fort (two sites)
Burnham Market - bowl barrow and pill box, Westgate Hall
Burnham Market – St Mary's Friary and Holy Well
Burnham Overy - village cross
Burnham Overy – Roman barrow E of village
Castle Rising - castle and 11th century church
Castle Rising – motte castle, Keeper's Wood

Castle Rising - standing cross, the Green
Castle Rising - bowl barrow, bank and ditch, Mill House
Castle Rising - bowl barrow and mound, Old Fen
Cockthorpe – village cross
Eaton (nr Sedgeford) - Roman villa
High Kelling – oval Barrow, Bodham Wood
Holkham – Iron Age fort WNW of village
Kelling – bowl barrow N side Muckleburgh Hill
Kelling Heath bowl barrow
Langham airfield dome trainer
Paston Great Barn
Ringstead - St Peter's Church tower
Roughton Heath (including Hare's Hill and Two Hills) – tumuli (five sites)
Salthouse Heath – barrow cemetery (complex of over thirty barrows, mainly bowl barrows, on and around Salthouse Heath)
Snettisham - remains of tower, Lodge Hill (SW of village)
Southrepps – Stump Cross (wayside cross)
Stiffkey - tumulus, Warborough Hill
Thornham - Roman signal station (SW of village)
Titchwell - village cross
Warham Camp – small multivallate fort S of village (two sites)
Warham – iron age ditched enclosure NE of Warham Camp
Warham – bowl barrow, Fiddler's Hill SE of village
Warham - Hale's Manor moated site and earthworks E of village
Waxham site of manorial complex (incl. Great Waxham Tythe Barn)
Weybourne Priory
Weybourne – moated site, Rosedale Farm
Weybourne Heath – bowl barrow
Wighton - Crabb's Castle, medieval castle site W of village
Wighton – medieval settlement N of Grove Farm
Wiveton Bridge

Historic Parks and Gardens

Since the 1980s, there has been a national record of the historic parks and gardens that make such a rich and varied contribution to our landscape. This record, known as the *Register of Parks and Gardens of Special Historic Interest in England* and now containing nearly 1450 sites, was established, and is maintained by, Historic England. The Register is divided into three grade bands. The majority of the sites are Grade II, indicating their national importance. Around 30% of all sites are considered to be of exceptional historic interest and are awarded a star giving them Grade II* status. A further 10% are of international importance, and are classified as Grade I.
For further information on the sites below visit:
http://www.historicengland.org.uk/listing/the-list

Registered Historic Parks and Gardens within the AONB are:
Felbrigg Hall (II*), Holkham Hall (I), Hunstanton Hall (II), Sandringham Hall (II*), Sheringham Hall (II*), Stiffkey Hall (II), Voewood (II*)

Building Conservation Areas

A Conservation Area is an area of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance. Consequently, Conservation Areas are of many different kinds. They vary widely in size and content in the Norfolk Coast AONB, from the traditional medieval settlement cores to extensive rural landscapes

such as the Glaven Valley. However, the majority of Conservation Areas relate to the built environment of villages and towns. These may be large or small, and range from whole town centres to terraces and smaller groups of buildings. They will often be centred upon Listed Buildings. Important groups of other buildings, open spaces, trees, historic street patterns and village greens can all contribute to the special character of an area, which merits designation as a Conservation Area. Conservation areas designated by the local planning authorities are contained in their respective Local Plans (Local Development Frameworks).For further information contact District / Borough Council Conservation and Design Sections.

Conservation areas within the AONB or overlapping the boundary are:

In North Norfolk District (29):

Binham (part), Blakeney, Cley-next-the-Sea, East Runton (part), Felbrigg, Gimingham, Glandford, Glaven Valley (part), Holkham, Kelling, Langham (part), Letheringsett, Morston, Northrepps, Overstrand (part), Salthouse, Sidestrand, Southrepps Lower (part), Southrepps Upper, Stiffkey, Trimingham, Trunch (part), Upper Sheringham, Warham, Wells-next-the-Sea, West Runton (part), Weybourne, Wighton (part), Wiveton

For further information see: http://www.northnorfolk.org/planning/12803.asp

In the Borough of King's Lynn & West Norfolk (14):

Brancaster, Burnham Market, Burnham Norton, Burnham Overy Mills, Burnham Overy Town, Burnham Overy Staithe, Burnham Thorpe, Castle Rising, Holme-next-the-Sea, Old Hunstanton (part), Ringstead, Sedgeford (most), Thornham, Titchwell,

For further information see: http://www.west-norfolk.gov.uk/default.aspx?page=24481

In Great Yarmouth Borough (2):

East and West Somerton (part)
Winterton (small part)

For further information see:
http://www.great-yarmouth.gov.uk/sport-leisure/heritage/conservation/index.htm

Listed buildings

Buildings of special architectural or historic interest are designated by the Secretary of State, advised by English Heritage, under the Planning (Listed Buildings and Conservation Areas) Act 1990. Listed Buildings include all buildings built before 1700 that survive in anything like their original state, selected buildings built between 1700 and 1840, and buildings of a definite quality and character built between 1840 and 1914. After 1914 only those buildings of the highest quality are selected and buildings less than 30 years old are only selected if they are of outstanding quality and under threat. It is the age, quality and distinctiveness of a building that qualifies it for listing.

There are 849 listed buildings (43 Grade I, 65 grade II*and 741 Grade II) in the AONB; information about particular listed buildings can be obtained from the relevant District / Borough Council.

Alternatively, the location and brief details of listed buildings can be found on the MAGIC web site http://www.magic.gov.uk/MagicMap.aspx under 'historic statutory designations' and further information on named listed buildings via:
http://www.historicengland.org.uk/listing/the-list/

Registered Common Land

Many areas of 'common land' i.e. land on which members of the community had rights of use, have disappeared as the rural economy has changed. Common land appearing now on County registers is that which has been recognised as such under the 1965 Registration of Commons Act. Common land usually, but not always, has a recognised owner and may or may not have specified common rights registered in association with it.

Registered areas of common land (* with common rights) in the AONB are:

Parish	**Registration no. and area if recorded**	**Name / description**
North Wootton	CL173* (55 ha)	Marsh Common – 4 parcels of land to the W and NW of the village
	CL313* (5 ha)	North Wootton Common (W of village)
Dersingham	CL226 (61 ha)	Dersingham Common – 3 adjoining parcels of land S of village
Snettisham	CL378* (58 ha)	Snettisham Beach Shingle Fields – strip of land parallel to coast
	CL64 (9 ha)	Snettisham Common (W of village)
Sedgeford	CL81 (0.04 ha)	Sedgeford Village Pound
Holme-next-the-Sea	CL132*	three small pieces of land adjoining Holme Common, to NW of village
	CL32*	substantial area of coastal and intertidal land to N and NW of village
	CL441*	Parish sand pit (small site)
Thornham	CL56*	Low Common - multiple intertidal areas with substantial overall area, N of village
	CL41* (225 ha)	Thornham Common – complex area N of village
	CL198 (0.4 ha)	New Road Chalk Pit
	CL121 (0.4 ha)	Choseley Road Chalk Pit
Titchwell	CL122* (15 ha)	foreshore and saltings
Brancaster	CL124*	Brancaster Marshes - large intertidal area to n of Brancaster and Brancaster Staithe
	CL161*	intertidal area to N of CL124
	CL162*	small area N of village
	CL65*	Scolt Head Island (incl. Parts of Burnham Norton, Burnham Overy etc marshes) – v large overall area
	CL159* (33 ha)	Barrow Common (S of Brancaster Staithe)
Burnham Norton	CL9 (0.6 ha)	small area to N of village
Burnham Thorpe	CL84* (3 ha)	Thorpe Common (NW of village)
Stiffkey	CL425 (0.4 ha)	The Common (W of village)
	CL426	Gravel Pit (w of village)
	CL428 (0.05 ha)	Little Hill (NW of village)
Morston	CL191 (0.9 ha)	Morston Quay
	CL193 (0.3 ha)	Cold Blow Pit - by Langham Road
Blakeney	CL269 (0.005 ha)	triangle of land outside Red House
	CL270	Small triangle of land at junction of Langham Road and A149
Cley-next-the-Sea	CL284 (0.5 ha)	Cley Green

Salthouse	CL283 (0.25 ha)	Triangle of land near Gravel Pit Hill
Weybourne	CL153	gravel pit S of station (0.1 ha)
Upper Sheringham	CL54 (0.5 ha)	Upper Sheringham Common (nr. Howe's Hill, SW of village)
Beeston Regis	CL85 (3.7 ha)	Beeston Hall Common
Runtons	CL5	Incleborough Hill, West Runton Common incl. Cooper's Common, Station Common and the Hurne, Town Hill, Congham Hill, greens Common, Abbs Common, Sparrow Park
Roughton	CL89 (0.8 ha)	Surveyor's Pit (N of village)
Southrepps	CL390 (0.4 ha)	Drove Hill (Lower Street)

Joint SNCB[1] Interim Displacement Advice Note

Advice on how to present assessment information on the extent and potential consequences of seabird displacement from Offshore Wind Farm (OWF) developments

January 2017

Summary of input requirements for displacement assessment

Inputs required:

- Full details of survey techniques.
- Site-based density estimates to include birds on water and in flight.
- Proportions of different age classes of birds (where possible).
- Monthly population estimates presented for minimum two years[2] pre-consent monitoring.
- Raw count data to be included in report appendices.
- Counts to be assessed as mean seasonal peaks[3] (averaged over the years of survey).
- Population estimates for the development footprint and also for the development footprint plus a standard displacement buffer. Buffer of 2km for all species with the exception of divers and sea ducks where a 4km displacement buffer is recommended.
- Full details of the development (with worst case and typical scenarios) including size of development footprint alone and size plus appropriate outer buffer – usually 2km [4]. (Abundance estimates will be required for site with and without buffer zone).

[1]SNCB – Statutory Nature Conservation Bodies in this case comprising Natural Resources Wales (NRW), Department of Agriculture, Environment and Rural Affairs / Northern Ireland Environment Agency (DAERA/NIEA), Natural England (NE), Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC)

[2]Lower level of data provision may be agreed in some cases (e.g. 18 months ensuring 2 breeding season periods covered if other baseline data available).

[3] Mean seasonal peaks – the mean of the peak counts for each season assessed. If season is April – July and monthly counts of 338, 720, 418 and 552 are recorded the season peak is 720. If three repeat seasons are assessed and the peak counts from the three seasons are 720, 979 and 501 the mean seasonal peak value is the mean of these three counts i.e. 733.

[4] 2km for most species, 4km for sensitive species (e.g. red-throated diver).

Summary of data treatment for displacement assessment

Data manipulation and assessment criteria:

- A 'power analysis' should be used to identify the probability of being able to detect specified levels of change in abundance associated with varying survey effort. Surveys should provide complete seasonal coverage.
- Any count adjustment and correction to be fully documented (e.g. for availability bias, distance sampling effects).
- Species to be assessed should be selected based on sensitivity scores and local observation or empirical data.
- Breeding season[5] assessment to be done against an appropriate regional population scale, as agreed with SNCBs (but likely to cover total colony counts[6] within mean-max foraging range[7]).
- Non-breeding season assessment done against appropriate population scale (e.g. Furness 2015), as agreed with SNCBs.
- Use published indices of disturbance (e.g. Furness *et al*. 2013) to assign a range of displacement levels for each species individually. The SNCBs note that further evidence is emerging that may confirm or suggest modifications to these scores and likely displacement levels (e.g. Wade *et al. 2016).*
- Use published indices of habitat flexibility (e.g. Furness *et al*. 2013), other empirical evidence if available, and discussions with SNCBs; to agree appropriate levels of likely adult mortality associated with particular displacement levels, for each species individually (acknowledging data very limited at this time).
- Use above two metrics to compile a 'Matrix Approach' table (i.e. representing proportions of birds potentially displaced/dying as a result of OWF development). Table should be presented from 0-100%, in 10% increments for displacement levels. Percentage increments for mortality should also be presented between 0-100%, but including smaller increments at lower values (e.g. 0%, 1%, 2%, 5%, 10%, 20%…..). At this time impacts to breeding success, although plausible are not being considered, unless site specific information exists. The approach here assesses mortality of full grown individuals connected to the development site.
- Impacts to be assessed for a minimum of two seasons (i.e. breeding and non-breeding season). For some species more than two seasons may be appropriate (e.g. based on post-breeding dispersal periods for auks or migration seasons defined for species in Furness 2015), on discussion with SNCBs.
- Seasonal impacts should be summed across seasons. While acknowledged that this could result in birds being assessed in more than one season, and thus double counted, the precautionary approach is required in absence of empirical information on seasonal turnover on development sites.
- Displacement impacts and collision impacts will be added together for assessment of total impacts. This is acknowledged to involve some degree of double counting, but is adopted as a precautionary approach in the absence, at present, of being able to distinguish between birds which might be subject to collision and those that may be displaced.

[5]Potentially suitable seasons/periodicity can be found in Furness (2015), but can vary by location so should also be agreed with SNCBs.
[6] JNCC Seabird Monitoring Programme a good source of most recent UK colony count data.
[7]See Thaxter *et al.* (2012), although more recent tracking data to be used, in discussion with SNCBs, if more up-to-date.

1. Aim of document

This interim displacement advice note replaces an earlier NE and JNCC joint advice note from 2012 (NE and JNCC 2012). It updates the previous note to take account of potential areas of disparity in approaches that have arisen in casework since the original note was issued. It also follows on from a Displacement Workshop (6-7 May 2015), run by JNCC and the Marine Renewables Ornithology Group (MROG) and funded by The Crown Estate, which sought to make progress towards developing a more refined best practice approach to assessing displacement impacts.

Following recommendations made at the workshop, it was agreed that this Joint SNCB interim displacement advice note would contribute towards achieving one of the recommendations (i.e. the creation of a short-term SNCB advice position). This document is intended to address critical areas of clarification and SNCB positioning. It will not attempt to cover (or make progress towards) the more complex issues of displacement assessment at this time. Nor will it cover the expert elicitation recommendation that came out of the displacement workshop, as it was agreed at a meeting of the SNCBs in June 2015 that this could more realistically be produced against a medium-term objective, in a further round of SNCB guidance.

SNCB advice and positioning on displacement assessment methods and approaches will be an iterative process, with at least three stages expected (see Displacement Workshop report 'Next Steps' section, for more details).

The key changes to this document since the earlier advice note are:

- A clearer definition of displacement and barrier terms.
- Further clarity on the application of the 'Matrix Approach'.
- Further clarity on the use of sensitivity scores in relation to the 'Matrix Approach' (based on evidence obtained since the original NE and JNCC advice note (NE and JNCC 2012)).

In addition, this interim advice note aims to provide:

- Advice on how to present information to enable comparable and transparent assessment of the magnitude and potential impacts of seabird displacement from OWFs.
- A method to enable displacement impacts to be compared and potentially combined across multiple sites/projects/activities, with an eye to improving Cumulative Impact Assessment (CIA) approaches for this impact.

Future revision of this advice note is anticipated when new empirical evidence of displacement levels and associated population-level impacts (e.g. changes to productivity or mortality levels) becomes available. Currently our recommendations are aimed at capturing the full range of potential impacts, while encouraging developers to present any species-specific evidence to further refine this as part of both Habitat Regulations Assessment (HRA) and Environmental Impact Assessment (EIA) processes. It is anticipated we will be able to narrow down predicted range of impacts as more results from post-consent monitoring and other studies are produced.

2. Background

Individual species react differently to the construction, operation and decommissioning of OWFs (and other offshore developments). Several species groups display avoidance of operational OWFs. However, for all development types during operation, construction and decommissioning, activities such as towing, pile driving or presence of maintenance/service vessels in the vicinity may cause disturbance (Fox and Petersen 2006; Krijgsveld *et al*. 2011; Vanermen *et al*. 2014). Displacement (see definitions below) can pose a potential ecological threat to seabirds as it can result in habitat loss, in the form of foraging or rafting areas. For adaptive species this may not be a problem, but for

less adaptive or constrained species/individuals (e.g. during breeding season) this may result in ecological and/or population level consequences.

3. Definitions of disturbance, displacement, and barrier effects

Disturbance

Disturbance exists when a bird's normal pattern of activity is interrupted by an anthropogenic activity. Birds using a given area of sea for a range of activities e.g. feeding, resting, commuting etc. may be disturbed by the occurrence of human activities or artifacts in or near those areas. Birds may choose to avoid such sources of disturbance (e.g. by swimming or flying away during the disturbance event to continue their activity elsewhere) and may not return until sometime later. The duration of return times coupled with the frequency of disturbing events, may combine to result in longer term and potentially continual reductions of numbers in an area of impact (i.e. displacement) which may be partial or total.

Displacement

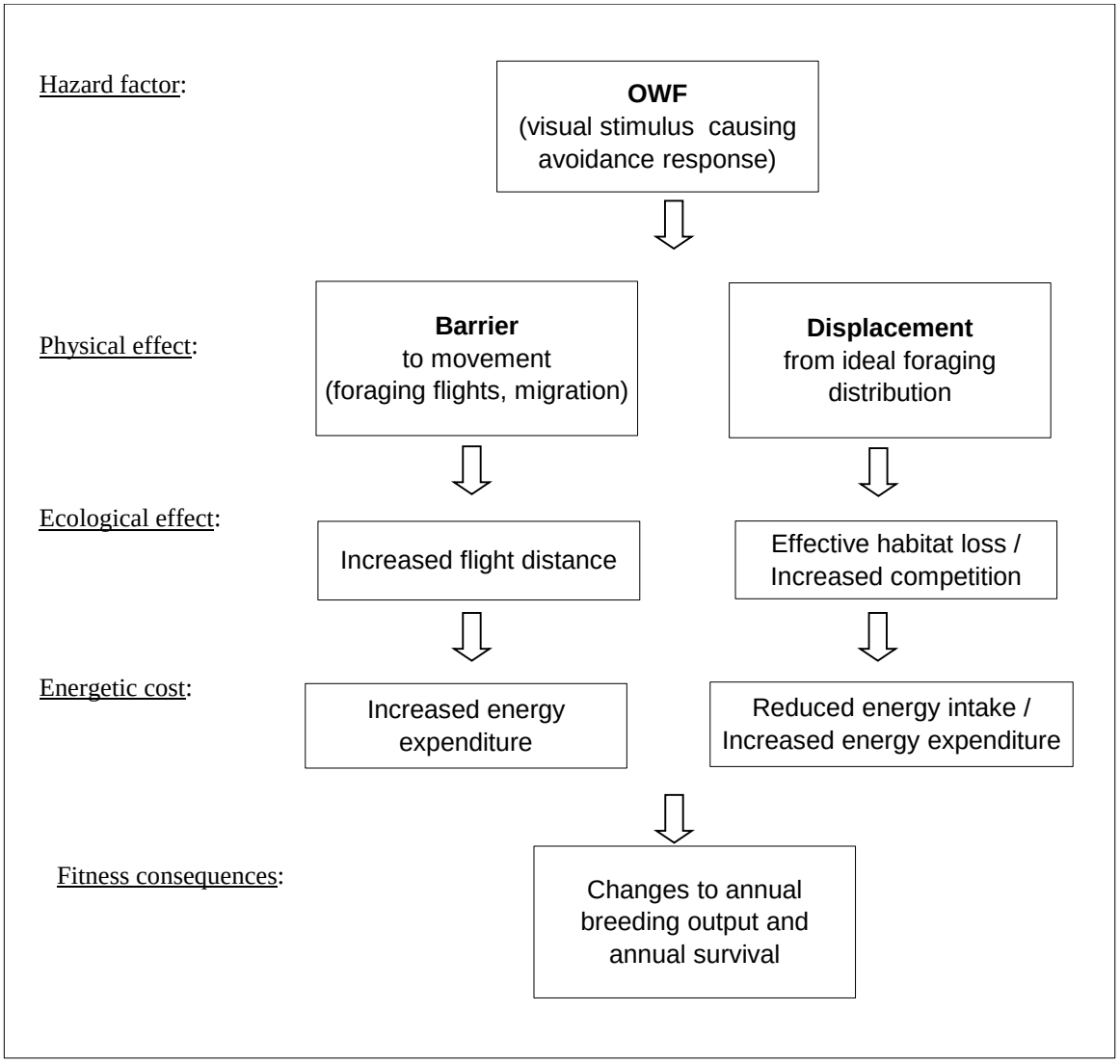
In relation to offshore wind farm development, Furness *et al*. (2013) define displacement as 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm'. Displacement, as an effect, may occur both in the area of the disturbance or development and to some distance beyond it – known as a 'buffer' (e.g. Mendel *et al*. 2014). The degree of displacement, both in terms of length of time and proportion of the original source population affected, may vary seasonally and between species. We define **displacement as affecting birds present both in the air and on the water**. This is in contrast to the definition in Cook *et al*. (2014) which included only birds on the water as capable of being displaced (birds in flight which were deterred from entering the wind farm are considered to form the component of 'macro-avoidance'), but while these birds are not at risk of collision they are potentially at risk of impacts arising from their displacement from wind farm areas. Birds that would have previously passed through the footprint of the disturbance area to a more distant feeding, resting or nesting area, but now choose either to stop short or detour around the location are said to be affected by barrier impacts (see below).

Barrier

A barrier is a physical factor that limits the migration, or free movement of individuals or populations, thus requiring them to divert from their intended path in order to reach their original destination. This effect is expected to increase the energy expenditure of birds if they have to fly around the area in question in order to reach their goal. Birds experiencing barrier effects are typically in flight, but not necessarily always so. For the purposes of this description, however, **we interpret barrier effects to mean applying to birds in flight**. Barrier effects are more likely to result in individual/population level impacts, if they occur during the breeding season (and at colonies close to an OWF). Individuals may repeatedly deviate from their normal foraging trajectories at this crucial stage in their annual cycle. Individuals are less constrained during the non-breeding season (i.e. no longer central-placed foragers). Therefore, increases to overall flight costs due to barrier effects while on migration are likely to be very small (Topping and Petersen 2011).

A key distinction between barrier and displacement is that birds experiencing barrier effects typically travel longer distances (i.e. to some point beyond the OWF) and did not intend to forage/utilise the OWF site itself, but some area beyond it. However, it is hard to define where an individual may have intended to travel to, even using tracking data. Therefore, in this advice note we do not provide specific recommendations on the treatment/assessment of barrier effects. As and when technological advances allow for quantitative distinction between these two effects, it may be possible to separate these two impacts within future Displacement Assessment Frameworks (DAFs).

Figure 1. Barrier and displacement effects illustrated (adapted from Petersen *et al*. 2006).



SNCB advice section – barrier and displacement effects

It is recognised that a proportion of the birds recorded in wind farm areas may be transiting through the site (and therefore potentially affected by barrier effects, rather than displacement from the wind farm area) and that this is more likely to be the case for flying birds. However, at present we do not have enough evidence to separate these impacts out and apportion to the two groups. Therefore it is assumed that total numbers of birds on site (flying and on water) are subject to displacement impacts. However, as remote tracking of seabirds continues to expand our knowledge on seabird behavior it may be possible to provide further information on the relative impacts of both issues – this position will be kept under review.

4. Data recording and presentation

In order to address displacement impacts for offshore wind developments, developers should present the following minimum level of data collected in the manner described in guidance documents elsewhere (see Appendix 1). That information should include:

- Full details of survey techniques (platform, transects, temporal and spatial extent of surveys) and how density estimates (and derived abundance estimates) have been calculated.
- Details of if/how density estimates have been corrected to account for availability bias and detection probabilities.
- Accurate information on size of OWF area plus appropriate buffer area calculations.
- Total abundance estimates of birds on water and in flight (and summed). This should be presented separately for the OWF site plus appropriate buffer area, with the extent of buffer area clearly indicated (see Section 6).
- Age or age-class of birds (where this can be determined).

SNCBs recommend **assessing impacts of displacement based on the overall mean seasonal peak numbers of birds (averaged over the years of survey)** in the development footprint and appropriate buffer (see Section 6 on defining appropriate buffer zones). This is a combined estimate of the **number of birds on the water** (corrected for survey coverage and distance analysis/diving species availability bias, if appropriate) and of the **number of birds in flight** (corrected for survey coverage). Methods for estimating birds at sea, both on the water and in flight, have advanced dramatically in recent years. However, standard methodologies for correcting for diving species availability bias are still in development. Hence, decisions made with regards to these components of input data (both for Collision Risk Models (CRM) and displacement) should be discussed and agreed with SNCBs at the time.

Where possible, the ratio of detected age classes should be reported. Age class ratios may differ seasonally and regionally, and ratios obtained from on-site survey data are preferred (if of sufficient quality). Where site specific data on age class ratios are not available there may be other sources of evidence that can be used such as other offshore datasets, colony studies of age ratios or ratios from stable age structures generated from population models. While separation of age classes is not directly used in the 'Matrix Approach' (the matrix should include abundance figures that relate to all birds in the project area, across all age classes), it can be crucial for later stages in the assessment process (e.g. when applying appropriate biologically relevant population scales and making assessments of population-level impacts).

SNCBs advise that at least two full years of monthly survey data should be collected pre-construction. This should be considered the bare minimum for assessment purposes. However, a more appropriate approach is to initially conduct a power analysis to confirm how many years survey data are required to adequately characterise any potential changes to bird abundances (on a species-by-species basis) in response to future OWF development. The number of years survey effort is likely to vary between species, site, and data collection method (e.g. digital aerial versus boat-based observers). Ideally, survey programmes should commence at the beginning of a clearly defined biological season, such that the period of survey will provide complete seasonal coverage in terms of data collection (without the need to combine incomplete data for seasons across different years, when calculating mean seasonal peak abundance estimates).

Data should be provided in a format that allows the calculation of **mean seasonal peak population estimates based on several years data**. For example, for a species with a breeding season from April to July, this requires the average of the peak count between April and July in year one, and the peak count between April and July in a second year. This may require the counts to originate from

different months in the two years (e.g. May in the first year and June in the second year). In practice this requires consistent monthly abundance estimates for each year of survey. This allows for year-to-year variation in the precise time (and magnitude) of peak abundance estimates to be taken into account in arriving at a mean peak population estimate. To allow recalculation of values, best practice requires presentation of monthly values in summary and full data from all surveys in an appendix to any report.

5. Selection of species for displacement assessment

Sensitivity to displacement differs considerably between seabird species. To focus impact assessment, SNCBs recommend that consideration is given to each species observed within a development site and informed by:

i) Species presence at the development site (or development sites in the case of in-combination assessments).

ii) Susceptibility to disturbance and habitat specialisation scores for species found in Scottish waters (Furness *et al.* 2013), and the expanded list for wider UK waters (Bradbury *et al.* 2014), covering additional species not previously included in Furness *et al.* (2013).

Furness *et al*. (2013) assessed seabird species occurring in Scottish waters by; 1) scoring species for sensitivity to disturbance by wind farm structures, ship and helicopter traffic, and 2) the degree of habitat specialisation. These two metrics together give an indication of which species are expected to be most susceptible to displacement impacts. The same scoring system and scores were used by Bradbury *et al*. (2014), although they expanded the species list to account for additional species that occur in English waters. Reference to these values will help developers and SNCBs determine the most relevant species for assessment at the site-specific level.

SNCB advice section – screening species for displacement assessment

It is recognised that, regardless of these scores, it is unlikely that cormorant and gull species will need to be routinely assessed for displacement, as a number of empirical studies have demonstrated these species can also be attracted as well as display no noticeable reaction to the presence of OWFs (e.g. Leopold *et al*. 2013; Vanermen *et al.* 2014; Petersen *et al.* 2006; Mendel *et al.* 2014). **The priority species for assessment of displacement effects will typically be diver and sea duck species, guillemot, razorbill, puffin and gannet.**

As a general guide, any species scoring 3 or more under either category ('*Disturbance Susceptibility*' or '*Habitat Specialization'*) in Table 1, and which is present in the OWF site or buffer should be progressed to the matrix stage unless there is strong empirical evidence to the contrary. Gannet, with a score of 2, is an obvious exception to this general guide as there are empirical studies demonstrating they are sensitive to displacement and barrier effects (Krijgsveld *et al*. 2011, Vanermen *et al.* 2013). The scores for this species have been revised in a recent publication by Wade *et al. (2016.)*.

Table 1. 'Disturbance Sensitivity' and 'Habitat Specialization' scores from Bradbury *et al*. (2014) (expanded from Furness *et al.* 2013). No 'real' value is implied by these scores, although species with higher scores are considered more sensitive to displacement. (Grey content = species with scores of 3 or higher in either category).

Species	Scientific name	Disturbance Susceptibility	Habitat Specialization
Common scoter[$]	*Melanitta nigra*	5	4
Red-throated diver[$]	*Gavia stellata*	5	4
Black-throated diver[$]	*Gavia arctica*	5	4
White-billed diver[$]	*Gavia adamsii*	5	4
Velvet scoter[$]	*Melanitta fusca*	5	3
Great northern diver[$]	*Gavia immer*	5	3
Greater scaup[$]	*Aythya marila*	4	4
Common goldeneye[$]	*Bucephala clangula*	4	4
Goosander[$]	*Mergus merganser*	4	4
Great cormorant[†]	*Phalcrocoax carbo*	4	3
Common eider[$]	*Somateria mollisima*	3	4
Long-tailed duck[$]	*Clangula hymalis*	3	4
Red-breasted merganser[$]	*Mergus serrator*	3	4
Great-crested grebe	*Podiceps cristatus*	3	4
Slavonian Grebe	*Podiceps auritus*	3	4
Black guillemot*	*Cepphus grylle*	3	4
Shag	*Phalacrocorax aristoltelis*	3	3
Common guillemot	*Uria aalge*	3	3
Razorbill	*Alca torda*	3	3
Little tern	*Sternula albifrons*	2	4
Sabine's gull*	*Xena sabini*	2	3
Black tern	*Childonias niger*	2	3
Sandwich tern	*Sterna sandivicensis*	2	3
Roseate tern	*Sterna dougalii*	2	3
Arctic tern	*Sterna paradisaea*	2	3
Atlantic puffin	*Fratecula arctica*	2	3
Mediterranean gull*	*Larus melanocephalus*	2	2
Common gull*	*Larus canus*	2	2
Great black-backed gull*	*Larus marinus*	2	2
Black-legged kittiwake*	*Rissa tridactyla*	2	2
Little auk	*Alle alle*	2	2
Northern gannet[&]*	*Morus bassanas*	2	1
Lesser black-backed gull*	*Larus fuscus*	2	1
Herring gull*	*Larus argentatus*	2	1
Iceland gull*	*Larus glaucoides*	2	1
Glaucous gull*	*Larus hyperboreus*	2	1

Species	Scientific name	Disturbance Susceptibility	Habitat Specialization
Black-headed gull*	*Chroicocephalus ridibundus*	1	3
Grey phalarope	*Phalaropus fulicarius*	1	2
Red-necked phalarope	*Phalaropus lobatus*	1	2
Pomarine skua	*Stercorarius pomarinus*	1	2
Arctic skua	*Stercorarius parasiticus*	1	2
Great skua	*Stercorarius skua*	1	2
Long-tailed skua	*Stercorarius longicaudus*	1	2
Northern fulmar	*Fulmaris glacialis*	1	1
Cory's shearwater	*Calonectris diomedea*	1	1
Great shearwater	*Puffinus gravis*	1	1
Sooty shearwater	*Puffinus griseus*	1	1
Manx shearwater	*Puffinus puffinus*	1	1
Balearic shearwater	*Puffinus mauretanicus*	1	1
Wilson's storm petrel	*Oveanites oceanites*	1	1
European storm petrel	*Hydrobates pelagicus*	1	1
Leach's storm petrel	*Oceanodroma leucorhoa*	1	1

[&] Species to be progressed to 'Matrix Approach' regardless of scores, due to more recent empirical data (see main text for references).

† Species not usually to be progressed to 'Matrix Approach', due to more recent empirical data demonstrating frequent attraction to OWFs (see main text for references).

* Species where some age class differentiation is expected in survey counts.

[$] Species where buffer distance for assessment would be 4 km (2 km being the default for others).

In previous SNCB advice on displacement assessment (NE and JNCC 2012), a 1% threshold of regional population scales was given as a guide for species to be taken forward to quantitative displacement assessment, with the exception of those species with a significant element of turnover (i.e. passage migrants, which might be undercounted). This is no longer recommended as a suitable guide due to the potential for species to be screened out of predictive displacement impact assessments at an individual project level, which might otherwise have been flagged as an issue at the CIA level.

There is an issue with how to appropriately treat species that are more likely to be encountered in development areas as passage migrants (i.e. likely to be transiting through the area and where there may be a high degree of turnover of individuals at a particular site). For these types of species (e.g. skuas and shearwaters) it might be predicted that, as individuals are using the development area only briefly and rarely, they might be more realistically examined solely from the perspective of barrier effects. However, as there is no standardised method for examining barrier effects (albeit some developers have developed useful passage migrant models to predict impacts, largely for collision, on these types of species) we recommend that if turnover is thought to be an issue for a given species at a particular site, this be considered on a site-by-site basis.

6. Displacement buffers

Seabirds showing avoidance reactions to OWF areas may not only be displaced from the footprint itself, but may also be displaced (possibly to a lesser degree) from the surrounding area (or buffer zone). This additional area must be considered, alongside the OWF site footprint, and included in any displacement assessment.

SNCBs recommend for most species a **standard displacement buffer of 2 km** with the exception of the species groups of divers and sea ducks. Divers and sea ducks have been assessed as being the most sensitive species groups to offshore development and associated boat and helicopter traffic. **Therefore for divers and sea ducks a 4 km displacement buffer** is recommended. This is based on evidence of displacement distances which extend beyond 2km for those species groups (e.g. Percival 2010; Kaiser 2002; Percival 2014; Petersen *et al*. 2006; Fox & Petersen 2006; Petersen *et al.* 2013).

The SNCBs acknowledge that the evidence for displacement effects leading to reduced densities post-construction beyond 2km from operational wind farms in these sensitive species is mixed but note that there is some evidence of displacement effects up to at least 3km (Percival 2010), and even up to 13km (Petersen *et al.* 2014). Extrapolation of the evidence from Percival (2010) suggests an effect that may radiate out to 5.5km before post-construction densities match those pre-construction. While this is an extrapolation, this effect is considerably less than the extent of significant reductions in diver density reported around Horns Rev (Petersen *et al.* 2013). SNCBs acknowledge that in reality there is likely to be a gradient in the reduction of density with increasing distance from OWF site, but the evidence regarding the slope of this gradient beyond 2km is limited. Until further evidence is gathered, it is recommended that a standard displacement level (%) is applied out to 4km for these more sensitive species groups.

SNCB advice section – use of buffer zones for Offshore Wind Farms

All species taken forward to the matrix stage of displacement assessment should be assessed against impacts to development site plus appropriate buffer. For most species the buffer should be 2km outside the OWF footprint. Exceptions for more sensitive species (i.e. divers and sea ducks) require a 4km buffer zone be applied. In both cases no gradient of impact of displacement level should be applied to the buffer zone, as there is not sufficient evidence to underpin any such gradient application on a species-by-species basis. However, as displacement levels in some instances may exceed 4km, the SNCBs feel this flat application of displacement level across the OWF site plus buffer is sufficiently precautionary.

7. Displacement levels

There is a small but increasing evidence-base on species-specific displacement levels from post-construction monitoring of OWFs. However, at present the published evidence remains sparse and often contradictory. SNCBs consequently need to ensure adequate precaution while at the same time taking due account of emerging evidence. Therefore, developers are encouraged to seek and present emerging sources of empirical evidence to provide support for their displacement assessment.

In the face of limited empirical evidence regarding the percentage of individuals likely to be displaced from an OWF footprint and buffer, SNCBs recommend that the full range of potential displacement (from 0% to 100% of the mean seasonal peak bird numbers observed pre-construction) is presented within a 'Matrix Approach' (see Section 12 for further details). The values should be presented in 10% intervals. Matrix tables should be presented with and without appropriate buffer data included, to allow for future changes in understanding regarding buffer zones and effects.

Presentation of 0-100% displacement levels in a matrix is a necessary step for all species taken forward to this stage of the assessment, in the face of current levels of uncertainty. However, it may be appropriate to highlight particular sections within the matrix where displacement levels are most likely to fall (i.e. through interpretation of the 'Disturbance Susceptibility' scores and/or reliable empirical data for a given species). Sufficient evidence should be presented to support selection of any highlighted area within the matrix on a species-by-species basis. Moreover, presentation of the full range of figures should not be interpreted as an indication that the SNCBs will inevitably focus their attention and formulate their advice on the most precautionary scenario.

The use of the collected age class data does not occur at the matrix stage, where the total number of full-grown birds is used. Later stages of the process may use the age data to refine what the impacts to sub-sets of the development site population will be.

8. Translating 'Disturbance Susceptibility' scores into displacement levels for 'Matrix Approach'

The 'Disturbance Susceptibility' scores from ship and helicopter traffic (and to a lesser extent OWF) in Bradbury *et al.* (2014) (Table 1) give a possible indication of potential displacement levels that may be exhibited by each species. Without any additional evidence it is assumed that the scores give a crude, but useful, approximation of the levels of displacement that may be experienced by seabirds and can be used to inform the most likely range of displacement for a given species). However, the SNCBs would note that further evidence is emerging that may confirm or suggest future modification to these scores and likely displacement levels (e.g. Wade *et al. 2016*).

SNCB advice section – translating 'Disturbance Susceptibility' scores

The SNCBs intend to use 'Disturbance Susceptibility' scores as a general guide to appropriate displacement levels on a species-by-species basis, rather than to prescriptively read across to particular levels of displacement. That said, for those species lacking in empirical data on likely displacement levels resulting from OWF construction, there is potential utility in using the scores in order to maintain consistency of approach across different developments (where appropriate). For example, for auk species the SNCBs would typically advise a displacement level of 30-70% (Guillemot and Razorbill have a 'Disturbance Susceptibility' score of 3). For diver species a displacement level of 90-100% is likely to be advised (red-throated diver has a 'Disturbance Susceptibility' score of 5 and empirical studies report high levels of displacement). Some species with 'Disturbance Susceptibility' scores of 1 (e.g. northern fulmar) may not be displaced or hardly displaced. If assessment of these species is recommended in a particular case, usually a displacement level of 10% or less is assumed.

9. Displacement impacts - adult mortality and productivity

Displaced individuals, and other individuals with which displaced birds subsequently interact and compete, may experience fitness consequences (i.e. changes to their likelihood of survival and level of reproductive output). Individual fitness may be impacted due to immediate increases in energy expenditure and/or reduced energy intake as a result of relocating to other foraging grounds and experiencing increased competition (an indirect impact resulting from localised habitat loss). Individual fitness may thus be impacted over longer time frames due to negatively affected energy budgets if birds have to relocate to alternative habitat. This impact might operate through increased intra/inter-specific competition due to a higher density of individuals competing for the same resources and/or through a lower quality/quantity of prey (e.g. Burton *et al*. 2006; Durell *et al*. 2001, 2000). This would result in an increase in the energetic cost of average foraging bouts and

consequently to a change in daily energy and time budgets (McDonald *et al.* 2012; Searle *et al.* 2014). During the breeding season this in turn could lead to reduced chick provisioning rates and therefore reduced reproductive success. Young birds fledging at lower weights may also have reduced survival. The increased stress on adult birds that are provisioning chicks means they may end the breeding season in poorer condition than they otherwise would have. This might be expected to have consequences on adult survival during the rest of the year, particularly over winter.

However, there is a lack of empirical evidence on the consequence of displacement to seabirds, in terms of both their mortality and productivity. For other types of birds, e.g. waders, it has been established that displaced individuals are more likely to die than other individuals (Burton *et al.* 2006). Behaviour-based computer simulation models of waders, geese and sea ducks have also demonstrated that displacement can, through changes to the energy budgets of individuals, lead to changes to mortality levels (Pettifor *et al.* 2000; West *et al.* 2003; Kaiser *et al.* 2002). However, Topping and Petersen's model showed no such effects on wintering divers (Topping and Petersen 2011). Searle *et al.* (2014) have recently developed a simulation model that predicts changes to seabird productivity and adult survival arising from simulated displacement and barrier effects associated with OWFs in the Forth & Tay regions of Scotland. However, whether an impact on demographic rates is predicted by such models is highly dependent upon the particulars of the case being modeled and no simple generalities can be drawn.

It seems probable that the fitness consequences of displacement (in terms of productivity and mortality) might vary between stages of the annual life cycle. However, once again, empirical data on this is lacking. Until supporting data can be collected this is considered theoretically plausible but unproven.

SNCB advice section – productivity impacts not assessed

Due to the large degree of uncertainty regarding the impact of displacement on different components of seabird demography (for example, impacts on chick survival arising from displacement effects experienced by adult birds) the SNCBs currently advise that only **mortality of individuals displaced from the development site (plus buffer)** be considered in the 'Matrix Approach' at this time.

10. Selecting appropriate mortality levels for the 'Matrix Approach'

As highlighted in Section 9, Searle *et al.* (2014) demonstrated through simulation modelling, that displacement and barrier effects could impact both breeding season productivity and adult mortality throughout the year. However, as this model operated at an individual-based and colony level, it is not possible to directly translate percentages (of productivity and mortality) from this study into useful application with the 'Matrix Approach' as the latter is based on site-based abundance estimates.

Bird species showing limited flexibility in habitat use will be expected to experience greater fitness consequences from displacement compared to those species that are more generalised (at least in non-marine habitats e.g. Colles *et al*. 2009; Duraes *et al*. 2013). Therefore, the scores of species-specific 'Habitat Specialisation' (Table 1) can be used to provide an indication of the relative scale of mortality arising from displacement for each species. Species considered less flexible in their habitat use, are likely to be more vulnerable to displacement from favoured habitats. A high score for specialisation would therefore be expected to indicate a higher level of potential mortality.

Although it appears to be a sound principle, there is very little, if any, evidence connecting 'Habitat Specialization' scores (Bradbury *et al.* 2014) of individual species with potential mortality levels as a consequence of displacement. Therefore the SNCBs do not advise a standardised translation of these scores across to mortality percentages within the matrix. **It is recommended that the presentation of 0-100% mortality of displaced birds for all species taken forward to the matrix stage. Once again, this should be presented in 10% increments.** However, in acknowledgement that for some less constrained species (e.g. shearwaters) the level of both adult mortality and reduced productivity resulting from displacement are likely to be in the lower range (i.e. 1-10%) it is appropriate to have a finer gradation of percentage mortality impacts at the lower range of the scale (see Table 3).

While the SNCBs do not recommend a direct translation of the 'Habitat Specialisation' score into a specific mortality level, this information is still useful, when combined with expert opinion, as to the likely range of possible mortality impacts resulting from particular levels of displacement.

Finally, it is important to recognise and (qualitatively) account for the quality of habitat being lost at an OWF site and its importance relative to alternative available habitat, which displaced birds may reasonably utilise instead. Expert opinion on mortality levels should take account of site-specific characteristics in coming to a judgement on likely mortality levels. In future it is hoped that, with more empirical evidence linking displacement levels to mortality/productivity consequences, a more quantitative approach can be developed.

SNCB advice section – mortality and productivity

At present the 'Matrix Approach' should only be applied, in relation to **predicted adult mortality levels for birds present on the site (plus buffer)** for each defined season. In other words, a separate productivity matrix is not required at this time. However, this is something which may be revised in subsequent advice should suitable methods be developed along with an improved evidence-base. Appropriate **mortality levels** should be selected based on **expert opinion and in discussion with SNCBs**. The selected mortality levels should be appropriately precautionary, given it is currently intended to (qualitatively) address the potential population level impacts of displacement on both mortality and productivity combined.

As with displacement levels, **mortality levels should be presented for the full range of 0-100%**. However, for mortality the assessment should be presented at **10% increments, as well as 1% increments from 0-5%**, with expert opinion focusing in on highlighting likely potential ranges within this complete range.

11. Seasonality

In addition to the complexity introduced by the uncertainty over likely impacts to different demographic parameters (i.e. mortality versus productivity), there is also the potential for displacement levels and impacts to vary according to season. Given there is currently no empirical evidence on the impacts of displacement to seabirds, the SNCBs do not view it as appropriate at this time to apply varying mortality levels by season. This is because the theoretical arguments, as highlighted in previous sections, regarding breeding versus non-breeding season impacts, could be made in either direction. Therefore, the SNCBs recommend that, for the time being, seasonality in the assessment process, in terms of predicted impacts, should be treated consistently. However, the same need not apply to the treatment of varying abundance estimates for the OWF site (plus buffer) by season.

SNCBs recommend that mean seasonal peak abundance be used to produce, as a minimum, two seasonal matrices (breeding and non-breeding season). However, for a number of species there may be evidence to support an additional breakdown of the non-breeding period to account for periods when distribution, activity or population mix are distinctly different (for example post-breeding aggregations of some auk and sea duck species associated with flightless periods, migration periods etc.). Furness (2015) provides a guide to suggested seasonal divisions for a range of species based on evidence for distribution and abundance of species in UK offshore waters at different times of the year.

The ecology of several species supports a need to consider additional seasons (e.g. the post-breeding season) as a distinct period in their annual cycle, during which the impact of displacement may differ from other periods. A lack of empirical evidence requires that the full range of potential mortality (0 – 100%) be presented (albeit with a selected likely range of percentages being highlighted, according to the sensitivity score proxies, for example).

The predicted mortality levels should be summed across seasons. SNCBs acknowledge that this is a precautionary approach, as it is clearly possible that the same bird may be assessed more than once. However, since a large proportion of the birds present in the non-breeding season are often predicted to be different individuals from those present in the breeding season, assessing against different populations for each season is justified. The relevant SNCB should be contacted for advice on the appropriate population scale to use for each season. Therefore, in apportioning impacts back to SPA colonies (e.g. for HRA), only a small number of mortalities in the non-breeding season will be attributed to a particular colony decreasing the likelihood that these will be the same individuals that were assessed during the breeding season. Similarly, in assessing displacement impacts at a wider population scale (e.g. in EIA), it is assumed that individuals present in the project area in the breeding season will be dispersed over a much larger area during the non-breeding season. This reduces the probability that individuals present at the project site at that time will be the same individuals present in the breeding season. Methods that do not consider mortality impacts on populations across all seasons may result in potential impacts being underestimated.

SNCB advice section – seasonality and summing across seasons

The 'Matrix Approach' should be applied to a minimum of two seasons (breeding and non-breeding season) using mean seasonal peak abundance estimates for the OWF site (plus buffer). Where appropriate, additional matrix tables should be created for other discrete seasons (e.g. post breeding and migration periods for relevant species). However, decisions regarding how to treat seasonality in any displacement assessment should be made on a site and species-specific basis, in discussion with SNCBs.

When a multi-season assessment is taking place, the predicted mortalities from these various tables should be summed across seasons, **where the relevant geographical range and population scale remains the same or where the assessment involves apportioning back to an SPA colony**. However, an alternative approach for EIA may have to be taken where the appropriate population scale varies with each season. In these instances, the assessment of potential impacts may need to be undertaken against the most appropriate population scale, for each season in turn, although the default position is to assess the summed annual mortality against the largest population scale in the annual cycle for EIA.

12. 'Matrix Approach'

Data on predicted displacement of seabirds from an OWF site should be presented in the form of a gridded matrix table (or tables) as shown below (Table 3). While presenting the full range of potential displacement and mortality impacts, SNCBs encourage developers to indicate their interpretation of the most likely displacement levels and mortality scenarios by highlighting a range of cells within the matrix, and simultaneously to provide sufficient empirical/modelling evidence to support any highlighted subset of cells.

SNCBs also advise that a range of displacement values are taken through to the assessment of population impacts and not a single figure. The range of population impacts can then also be presented as a matrix so that those levels of displacement which might exceed a particular level of population impact can be easily identified and evaluated. But if only a single figure can be taken forward, this in most cases should be the more precautionary of the sub-set selected (e.g. 20% displaced, 50% mortality, in the below example).

Table 3. Example of Matrix Approach. Cell entries present the estimated number of birds of a given species predicted to be at risk of adult mortality following displacement during a particular season given; i) the seasonal mean peak population within the impacted area (5,000 individuals in this example) ii) the proportion of those birds assumed to be displaced from the impact area; and iii) the assumed proportion of those birds deemed to be at risk of adult mortality as a result of displacement. Cells which are considered, in the light of empirical evidence, to represent the more realistic scenarios can be colour-coded with increasing intensity (shades of green in this instance).

Species (season)	**Mortality Level (% of displaced birds that die)**												
Displacement Level (% of all birds on site)		0%	1%	2%	3%	4%	5%	10%	15%	20%	30%	50%	80%	100%
	0%	0	0	0	0	0	0	0	0	0	0	0	0	0
	10%	0	5	10	15	20	25	50	75	100	150	250	400	500
	20%	0	10	20	30	40	50	100	150	200	300	500	800	1000
	30%	0	15	30	45	60	75	150	225	300	450	750	1200	1500
	40%	0	20	40	60	80	100	200	300	400	600	1000	1600	2000
	50%	0	25	50	75	100	125	250	375	500	750	1250	2000	2500
	60%	0	30	60	90	120	150	300	450	600	900	1500	2400	3000
	70%	0	35	70	105	140	175	350	525	700	1050	1750	2800	3500
	80%	0	40	80	120	160	200	400	600	800	1200	2000	3200	4000
	90%	0	45	90	135	180	225	450	675	900	1350	2250	3600	4500
	100%	0	50	100	150	200	250	500	750	1000	1500	2500	4000	5000

Note: This matrix table would need to be replicated for each screened-in species, each season, and for the OWF site with and without buffer zones included (in terms of total abundance estimates).

In order to determine whether the figures presented in tables (e.g. Table 3 above) are likely to lead to population level effects (i.e. changes to population abundance) it will be necessary to determine which reference population scale(s) (or BDMPS) it is appropriate to relate these predicted displacement impacts to. This will vary between EIA and HRA processes as well as sites and seasons and may range from the breeding population of a species at a single designated site to a north-west European biogeographic migratory or wintering population of a species, possibly even wider. Note that

in the case of HRA, where displacement effects take place within areas that are known to be used or likely to be used by birds associated with particular SPAs, assessment of the overall figures must be made at the scale of the populations of each of those individual SPAs (apportioned where necessary between SPAs). The relevant SNCB should be contacted for advice on the appropriate population scale for a given season. For project proposals in English, Irish or Welsh waters the respective SNCBs recommend consideration should be given to the Natural England and JNCC advice on Habitats Regulations Assessment (HRA) screening for seabirds in the breeding season (NE & JNCC 2013) and the non-breeding season populations of seabirds in UK waters report by Furness (2015), when considering appropriate population scales for a given season, for an HRA. For project proposals in Scottish waters, advice should be sought from Scottish Natural Heritage (SNH) on the appropriate population scale to use for each season.

Therefore, unless one particular population scale can be identified as being the only one appropriate to consider for a particular species/season/site combination, the numbers presented in the tables outlined above are thereafter considered in the context of a range of possible reference populations (but see separate guidance on these elements).

13. Combining collision impacts and displacement impacts

The number of birds at risk of reduced individual fitness (i.e. mortality and productivity losses) as a result of displacement is based on the numbers of birds present within a development area and buffer both on the water and in flight. Assessment of the number of birds at risk of mortality as a result of collisions (e.g. with wind turbines) is based on the number of birds present within a development area that are in flight only. The mortality impacts estimated from CRM are assumed to be in addition to any mortality caused by displacement impacts. Productivity impacts due to displacement would be a further addition (but this is not currently quantitatively accounted for under existing methods/advice).

Therefore, at present, the SNCBs regard the **two impacts (collision and displacement) as additive and advise that they should be summed**. In summing the predicted mortalities that arise via these two mechanisms, there is a risk of some degree of double counting as a bird that collides with a turbine cannot be displaced and vice versa. Thus, it is acknowledged that this simplistic approach will therefore incorporate a degree of precaution. The level of precaution is difficult to gauge, but will be highest when the number of birds recorded flying at turbine height (and therefore the predicted number of collisions) is greatest.
SNCBs are seeking further evidence from ongoing and proposed studies into avoidance rates that will help clarify the relationship between collision risk, displacement and so called 'macro' avoidance. A recent review of avoidance rates has been completed by the BTO on behalf of Marine Scotland (Cook *et al.* 2014). At some point in the future it is possible that SNCB advice may revisit this additive approach, in light of more advanced techniques for discriminating between birds in flight and birds on the water (in terms of pre-construction abundance data) and between barrier, macro-avoidance and displacement effects.

14. Cumulative impact assessment for displacement

While there is currently no established standardised method for undertaking a CIA process for displacement (or for collision), the **SNCBs recommend that a similar approach be taken to additively combining multiple project's displacement impacts, to that undertaken for a single project.** In other words, for projects undertaking a CIA for displacement across multiple projects, provided density information and OWF site footprint data (plus appropriate buffer zones) are available, it should be feasible to standardise displacement assessment approaches across even historic projects. Ideally, historic projects will have conducted a displacement assessment along similar lines to those laid out in this interim displacement advice note. However, it is recognised that there are likely to be

discrepancies, in terms of variation in displacement levels used for different species, as well as likely mortality levels, and seasons presented, etc.

Several North Sea developers have now undertaken cumulative and in-combination displacement impact assessments for a range of species. Moreover, they have also applied a method to calculate predicted displacement impacts for historic projects that did not present displacement figures for particular species – See:

http://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010051/2.%20Post-Submission/Representations/ExA%20Questions/20-11-2014%20-%20ExA%20Second%20Written%20Questions/Forewind%20-%20Final%20HRA%20In-combination%20ornithology%20tables.pdf

Use of such methods (or refinement of displacement assessments from historic projects required to feed into CIA for future OWF development applications) should be done in consultation with the SNCBs. Finally, it is not within the scope of this displacement advice note to address all aspects of cumulative assessment. Guidance is available to assist with this elsewhere (King *et al*. 2009).

SNCB advice section – assessing cumulative displacement impacts

In broad terms, displacement impacts from different OWF development sites (plus appropriate buffer zones) should be considered cumulatively (i.e. additively). Any differences in assumptions about species sensitivity to displacement or habitat flexibility between individual project sites should be clearly identified, explained and agreed with SNCBs prior to further analysis. All areas should be assumed to be at carrying capacity, unless there is specific evidence to the contrary. Where displacement assessments may have varied between historic and more recent projects, efforts should be made to standardise approaches. If necessary historic assessments and matrices should be revisited to re-analyse site-based abundance data and bring it into line with current thinking on likely displacement levels, mortality rates, seasons and buffer zones for relevant species.

15. Future development of a 'Displacement Assessment Framework '(DAF)

Several areas of displacement (and barrier) impact assessment remain problematic and there is a need for further investigation and gathering of empirical evidence to support decisions. Nearly all aspects of the assessment of displacement and barrier impacts would benefit from robust and rigorous post-consent monitoring.

The SNCBs recognise that, in several areas, the current document outlines an approach that incorporates high levels of uncertainty. As a consequence aspects of the advised method may be somewhat precautionary (although this does depend on the selection of appropriate displacement and mortality levels within the matrix tables).

Displacement assessment methods are an area of active interest for industry, SNCBs and regulators and needs to be reflected in post-consent monitoring where displacement effects remain uncertain. This joint SNCB interim displacement advice note will be reviewed and updated when new information or approaches are brought to light.

As captured in recommendations from a recent Displacement Workshop (May 2015) organised by JNCC and the MROG, this joint SNCB advice note is intended to address only a short-term gap in advice

provision and standardisation of DAF methods within the OWF industry sector. It is anticipated that further steps, with regards to both medium and long-term displacement method development and advice, will follow the publication of this note. Recommendations from the Displacement Workshop are currently being progressed through MROG and SNCB discussions with industry. It is anticipated that further displacement advice revisions may be produced by the SNCBs jointly in the next year.

This advice note was prepared by the Marine Industry Group for ornithology (MIG-Birds), with contributions from Joint Nature Conservation Committee, Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage

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Appendix 1: - Links to guidance on associated topics.

SNH Guidance

Recommendations for the presentation and content of interim marine bird, mammal and basking shark survey reports for marine renewable energy developments. **Available at <**http://www.snh.gov.uk/docs/A1325759.pdf > Accessed 23 March 2016.

Guidance on Methods for Monitoring Bird Populations at Onshore Wind Farms. Available at <http://www.snh.gov.uk/docs/C205417.pdf> Accessed 23 March 2016.

The Crown Estate Guidance

Guide to an onshore wind farm. Available at <http://www.thecrownestate.co.uk/media/5408/ei-a-guide-to-an-offshore-wind-farm.pdf> Accessed 23 March 2016

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COWRIE reports

Available at <http://www.thecrownestate.co.uk/media/5491/cowrie_reports_held_by_the_crown_estate.pdf > Accessed 23 March 2016

RSPB Information

Offshore wind farms and birds : Round 3 zones . Available at <http://www.rspb.org.uk/Images/langston_2010_tcm9-203501.pdf> Accessed 23 March 2016

SOSS Projects

Available at <http://www.bto.org/science/wetland-and-marine/soss/projects > Accessed 23 March 2016

Citation

County: **Suffolk** **Site name:** **Alde-Ore Estuary**
District: Suffolk Coastal

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: Suffolk County Council
Suffolk Coastal District Council

National grid reference: from TM 394 757 **Area:** 2,554.3 (ha) 6,311.7 (acres)
to TM 358 402

Ordnance Survey sheet: **1 : 50,000**: 156, 159 **1:10,000:** TM 45 SE, TM 44 NW, TM 34 SE, TM 45 SW, TM 34 NE, TM 35 SW, TM 44 NE, TM 45 NE, TM /45 NW

Date notified (Under 1949 Act): 1952 **Date of last revision:** 1980

Date notified (under 1981 Act): 1985 **Date of last revision:** 1992

Other information

The site has been extended at the 1992 revision. It includes the Orfordness-Havergate NNR (part of which is designated as a Special Protection Area), and previously named Orfordness-Havergate SSSI and part of the previously named Snape Warren and Blackheath Wood SSSI. Orfordness and Gedgrave Cliff are listed as being of national importance in the Geological Conservation Review.

Description and reasons for notification

This site stretches along the coast from Bawdsey to Aldeburgh and inland to Snape. It includes Orfordness, Shingle Street, Havergate Island, and the Butley, Ore and Alde Rivers.

The scientific interests of the site are outstanding and diverse. The shingle structures of Orfordness and Shingle Street are of great physiographic importance whilst the cliff at Gedgrave is of geological interest. The site also contains a number of coastal formations and estuarine features including mud-flats, saltmarsh, vegetated shingle and coastal lagoons which are of special botanical and ornithological value.

Geomorphology

Orfordness, together with Shingle Street, is one of three major shingle landforms in the British Isles and is the only one which combines a shingle spit with a cuspate foreland. This large feature comprises a complex sequence of shingle ridges deposited over a long period of time which record stages in the evolution of the landform. The distal end of the spit is still

subject to rapid changes and is dynamically related to events at Shingle Street on the mainland shore. This well documented site is of the highest educational and research value.

Geology

The cliff at Gedgrave is a small but renowned exposure of Coralline Crag about 3 m in height. Here the sandwave facies, which is characterised by large-scale cross stratification, overlies highly fossiliferous silty crag with marked unconformity. Clasts of the lower facies can be found in the sandwave facies and are evidence of contemporaneous erosion. A rich shell fauna is present in the lower facies which includes many species of molluscs and bryozoan. The site is also notable for the occasional occurrence of articulated specimens of the brachiopod *Terebratula maxima*, the world's largest species of terebratulid. The site is of great historical as well as palaeontological interest and is one of the only Coralline Crag localities to show the lower erosional contact of the sandwave facies.

Botany

The botanical interest of this site is enriched by the variety of habitats present, including mudflats, saltmarsh, brackish lagoons, shingle beach, reedbeds, grassland, freshwater and brackish ditches.

Mudflats of mixed clay, silt and shingle border the Ore, Butley and Alde rivers and Havergate Island within a tidal range of up to 2 metres. In places this supports the rare inter-tidal flowering plant *Zostera angustifolia*. Narrow fringes of saltmarsh occur along the length of the rivers with wider expanses at Shingle Street, Havergate Island, Stony Ditch, the upper reaches of the Butley river and in places by the Alde river. These are mostly dominated by sea purslane *Halimione portulacoides* and sea lavender *Limonium vulgare*, but a wide range of other saltmarsh species also occur, including sea-heath *Frankenia laevis*, glasswort *Salicornia pusilla*, small cord-grass *Spartina maritima* and Borrer's saltmarsh-grass *Puccinellia fasciculata*. It is representative of the *Halimione portulacoides* community as described in the National Vegetation Classification. Saltmarsh elements also occur around the lagoons and borrowpits on Shingle Street, Havergate Island and the Kings and Lantern Marshes on Orfordness. These also contain the rare tasselpondweeds *Ruppia spiralis* and *R. maritima.*

The site contains the second largest and best preserved area of vegetated shingle in Britain. This is a nationally rare and delicate habitat which supports a highly specialised flora. Species typical of exposed, shifting shingle such as sea pea *Lathyrus japonicus* and sea kale *Crambe maritima* are abundant whilst extensive areas of sea campion *Silene maritima* and stonecrops *Sedum acre* and *S. anglicum* occur on more stable ground. Orfordness contains one of the best examples of zonation in the shingle vegetation. Above the high water mark *Rumex crispus* and *Glaucium flavum* give a highly distinctive character to the mainly bare shingle, with *Lathyrus japonicus* becoming much more abundant within the matrix further inland. This vegetation gives way in turn to grassland dominated by *Arrhenatherum elatius* and *Silene maritima*. A wide range of rare or local species also occur including yellow vetch *Vicia lutea* and the dwarf clovers *Trifolium suffocatum*, *T. glomeratum, T. striatum, T. scabrum* and bur medick *Medicago minima*. Lichen communities are also well developed here with extensive areas of *Cladonia* heath. A unique feature for East Anglia beach formations is the abundance on the ground of normally epiphytic lichens *Parmelia caperata* and *Evernia prunastre*.

Higher saltmarsh blending to neutral grassland, dominated by sea couch grass, *Elymus pungens*, occurs on former grazing marsh on Havergate Island and Orfordness and on the extensive system of clay embankments throughout the site. There are small areas of reedbed at the head of the Butley River and at Iken.

Ornithology

The site is of national importance for its birdlife. Havergate Island holds the largest breeding colony of avocets in Britain, and they also feed in large numbers of Hazelwood Marshes and the Alde mudflats. Other breeding birds on the Island and elsewhere on the site include gadwall, shoveler, oystercatcher, ringed plover, common tern, Arctic tern, sandwich tern and little tern, common gull, short-eared owl, wheatear and marsh harrier. There are also very large breeding colonies of black-headed gull, lesser-black-backed gull and herring gull on Orfordness.

In winter and during migration the site is visited by nationally important numbers of wildfowl and shore-birds, including Bewick's swan, shelduck, teal, wigeon, redshank and avocet.

Invertebrates

The lagoons at Shingle street are notable for a number of brackish water species particularly the rare anthozoan *Nematostella vectensis* and the site is also noted for a number of rare spiders. Several nationally rare and scarce insects are found within ditches running through Hazelwood Marshes.

COUNTY: Norfolk SITE NAME: BADLEY MOOR, DEREHAM

DISTRICT: Breckland

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Breckland District Council

National Grid Reference: TG 013117 Area: 18.1 (ha) 44.7 (ac)

Ordnance Survey Sheet 1:50,000: 133 1:10,000: TG 01 SW

Date Notified (Under 1949 Act): - Date of Last Revision: -

Date Notified (Under 1981 Act): 1986 Date of Last Revision: -

Other Information:
A new site.

Description and Reasons for Notification:
This site consists of a large area of spring-fed valley fen and grassland situated in the valley of the River Tud. Chalk springs emerge from the valley side and are marked by clearly developed tufa formations where deposition of calcium carbonate has created a series of flushed hummocks. These structures are probably the finest tufa formations in Britain and an exceptionally rich calcareous fen community with a bryophyte (moss) carpet occurs on the flushed slopes. This community has remained undisturbed and is an excellent example of a very localised habitat and includes many uncommon plants.

The rich, short-sward fen communities are of the type that is dominated by Black Bog-rush *Schoenus nigricans* and Blunt-flowered Rush *Juncus subnodulosus*. Many uncommon species are present in abundance and include Common Butterwort *Pinguicula vulgaris*, Great Sundew *Drosera anglica*, Marsh Helleborine *Epipactis palustris*, Grass of Parnassus *Parnassia palustris* and Bog Pimpernel *Anagallis tenella*. These basic flushes grade into a zone of taller mixed fen vegetation dominated by Purple Moor-grass *Molinia caerulea* and Reed *Phragmites australis* with frequent Common Cotton-grass *Eriophorum angustifolium*, Bogbean *Menyanthes trifoliata*, Southern Marsh Orchid *Dactylorhiza praetermissa* and Marsh Lousewort *Pedicularis palustris*. Further down the valley slope this mixed fen grades into a small reedbed.

Marshy grassland on poorly-drained soils is dominated by either Blunt-flowered Rush or Sharp-flowered Rush *Juncus acutiflorus* with abundant Marsh Marigold *Caltha palustris*, Meadowsweet *Filipendula ulmaria* and Pennywort *Hydrocotyle vulgaris*. Small areas of a drier, low-growing grassland also occur and are characterised by Glaucous Sedge *Carex flacca*, Quaking Grass *Briza media* and Yellow-rattle *Rhinanthus minor*.

A large part of the site consists of rather species-poor damp neutral grassland maintained by occasional grazing. Much of this area is included because changes in the water levels through drainage would affect the sensitive fen communities. Although the grassland is generally dominated by Cock's-foot *Dactylis glomerata* and Oat-grass *Arrhenatherum elatius* some scarce species are present including Cowslip *Primula veris*, Green-winged Orchid *Orchis morio* and Twayblade *Listera ovata*. A large population of Adder's Tongue *Ophioglossum vulgatum* occurs on part of the site.

Several overgrown dykes are present on the valley-floor with a flora that includes Narrow-leaved Water-parsnip *Berula erecta* and Water Dropwort *Oenanthe fistulosa*.

The site is also of ornithological interest and breeding birds include Snipe.

COUNTY: Norfolk SITE NAME: BOOTON COMMON

DISTRICT: Broadland

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Broadland District Council

National Grid Reference: TG 113230 Area: 7.73 (ha) 19.10 (ac)

Ordnance Survey Sheet 1:50,000: 133 1:10,560: TG 12 SW

Date Notified (Under 1949 Act): 1954 Date of Last Revision: 1971

Date Notified (Under 1981 Act): 1984 Date of Last Revision: –

Other Information:
Managed as a nature reserve by the Norfolk Naturalists' Trust.

Reasons for Notification:
Booton Common lies in the valley of a tributary of the River Wensum, about 1 mile east of Reepham. The principal interest of the site is associated with a mosaic of wet calcareous fen grassland and acid heath communities which have developed due to the naturally undulating ground. Areas of tall fen and a strip of valley alder woodland occupy the lower ground adjacent to the stream.

The wet hollows are floristically rich and support abundant Bog-rush *Schoenus nigricans* and Blunt-flowered Rush *Juncus subnodulosus*. Notable associated species include Grass of Parnassus *Parnassia palustris,* Common Cotton-grass *Eriophorum angustifolium,* Common Butterwort *Pinguicula vulgaris,* Marsh Helleborine *Epipactis palustris,* Fragrant Orchid *Gymnadenia conopsea,* Adder's Tongue Fern *Ophioglossum vulgatum* and the rare Marsh Fern *Thelypteris thelypteroides*.

The ridges between the hollows support a type of wet heathland with Heather *Calluna vulgaris* and Purple Moor-grass *Molinia caerulea* as the principal species. Gorse *Ulex europaeus* and Tormentil *Potentilla erecta* are also present.

Reed *Phragmites australis* dominates the tall fen vegetation and typical associates include Hemp Agrimony *Eupatorium cannabinum,* Marsh Pennywort *Hydrocotyle vulgaris,* Yellow Iris *Iris pseudacorus* and Marsh Marigold *Caltha palustris*.

Additional interest is provided by the alder woodland. This contains some Ash with a ground flora of Yellow Iris, Bittersweet *Solanum dulcamara* and nettles.

A variety of breeding birds are present including Snipe, Woodcock, Grasshopper Warbler and Lesser Whitethroat.

COUNTY: Norfolk SITE NAME: BUXTON HEATH

DISTRICT: Broadland

Status: Site of Special Scientific Interest [SSSI] notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Broadland District Council

National Grid Reference: TG 175218 Area: 67.03 [ha] 165.63 [ac]

Ordnance Survey Sheet 1:50,000: 133 1:10,000: TG 12 SE

Date Notified [Under 1949 Act]: 1955 Date of Last Revision: -

Date Notified [Under 1981 Act]: 1986 Date of Last Revision: -

Other Information:
The site is listed in "A Nature Conservation Review" [Ratcliffe 1977, Cambridge University Press]. The boundary has been amended at the '85 Revision.

Reasons for Notification:
Buxton Heath is a diverse heath-with-fen area situated in a basin of glacial sands which, together with Roydon Fen, form the best examples of this rare habitat type in Norfolk. The valley mire is floristically rich and there is a rapid transition from calcareous to acidic plant communities with dry acidic heathland on higher ground. These communities have remained undisturbed for a long period of time and a number of rare relict mosses, liverworts and fungi occur on the site. Several uncommon invertebrates have also been recorded including one species new to Britain.

The principal interest is centred on a valley mire which has developed along the length of a small stream. A complex series of communities have developed in response to variations in acidity and drainage of the underlying peats. The stream carries alkaline waters and a narrow band of calcareous fen occurs on either side of its course. This community is dominated by Blunt-flowered Rush *Juncus subnodulosus* and Quaking Grass *Briza media* with a discontinuous bryophyte carpet. Other species of interest include Grass of Parnassus *Parnassia palustris*, Marsh Lousewort *Pedicularis palustris*, Southern Marsh Orchid *Dactylorhiza praetermissa*, Marsh Helleborine *Epipactis palustris* and the locally uncommon Marsh Fern *Thelypteris thelypteroides*. A small reedbed *Phragmites australis* is also present with the Meadowseet *Filipendula ulmaria*, Ragged Robin *Lychnis flos-cuculi* and Bogbean *Menyanthes trifoliata*.

The calcareous fen grades into acidic flush communities on the valley sides. Purple Moor-grass *Molinia caerulea* is dominant with a variety of mosses including thick carpets of bog moss *Sphagnum* spp. This species-rich community includes Common Butterwort *Pinguicula vulgaris*, Marsh Gentian *Gentiana pneumonanthe*, Meadow Thistle *Cirsium dissectum* and Bog Pimpernel *Anagallis tenella*. Marshy grassland is present on drier ground around the source of the stream. Purple Moor-grass is again dominant but Cross-leaved Heath *Erica tetralix* is frequent. Alder *Alnus glutinosa* forms carr woodland with abundant Common Sallow *Salix cinerea* in places by the stream.

A zone of wet heathland surrounds the mire and is dominated by Cross-leaved Heath with Purple Moor-grass, Common Cotton-grass *Eriophorum angustifolium*, Round-leaved Sundew *Drosera rotundifolia*, Heather *Calluna vulgaris* and Bog Mosses.

Dry acidic heathland covers the remainder of the site. Large areas are dominated by Heather and the locally scarce Western Gorse *Ulex gallii*. Bracken *Pteridium aquilinum* and Gorse *U. europaeus* occur on other parts of the heath and there are scattered, young trees of

Pedunculate Oak *Quercus robur* and Silver Birch *Betula pendula*. Encroachment by scrub and secondary woodland is prevented by regular, though accidental fires.

SITE NOTIFIED TO THE SECRETARY OF STATE ON THE 21ST JULY 1989

COUNTY: NORFOLK SITE NAME: DEREHAM RUSH MEADOW

DISTRICT: BRECKLAND

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

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Local Planning Authority: Breckland District Council

National Grid Reference: TF 976140 Area: 20.6 (ha.) 50.9 (ac.)

Ordnance Survey Sheet 1:50,000: 132 1:10,000: TF 91 SE

Date Notified (Under 1949 Act): – Date of Last Revision: –

Date Notified (Under 1981 Act): 1989 Date of Last Revision: –

Other Information:

Description and Reasons for Notification:
This site comprises an area of winter-flooded meadowland and alder carr along the valley of a small tributary of the River Wensum, and exhibits a wide range of grassland and woodland communities which are particularly unusual in Norfolk. The stream has been diverted to a new cut further up the valley-side and a distinctive series of wet, unimproved grassland communities has developed in the old valley basin. These diverse communities are maintained by a traditional management of light grazing by horses.

The lowest-lying ground, by the old stream-course, is shallowly flooded and dominated by bogbean *Menyanthes trifoliata*, tubular water dropwort *Oenanthe fistulosa* and narrow-leaved water-parsnip *Berula erecta*. This is a particularly diverse area and other notable plants include blunt-flowered rush *Juncus subnodulosus*, southern marsh orchid *Dactylorhiza praetermissa*, marsh valerian *Valeriana dioica*, marsh arrow-grass *Triglochin palustris*, marsh cinquefoil *Potentilla palustris*, ragged robin *Lychnis flos-cuculi* and lesser spearwort *Ranunculus flammula*.

On slightly higher ground, with seasonal flooding, is a large area dominated by marsh marigold *Caltha palustris*, yellow iris *Iris pseudacorus* and creeping buttercup *Ranunculus repens*. Characteristic species of this community are water mint *Mentha aquatica*, jointed rush *Juncus articulatus* and creeping bent *Agrostis stolonifera*.

These wet, grazed communities grade into areas of tall fen vegetation dominated by common reed *Phragmites australis* with reed sweet-grass *Glyceria maxima*, greater tussock sedge *Carex paniculata*, meadowsweet *Filipendula ulmaria* and angelica *Angelica sylvestris*.

On the eastern area of the valley floor one of the few areas of sump alder *Alnus glutinosa* woodland in west Norfolk has developed. Alder and grey willow *Salix cinerea* dominate over a ground flora characterised by large bitter-cress *Cardamine amara*, gipsywort *Lycopus europaeus*, lesser pond sedge *Carex acutiformis* and the uncommon marsh fern

Thelypteris palustris. In contrast carr woodland further downstream is influenced by the movement of slightly calcareous groundwater, giving rise to the presence of bird cherry *Prunus padus* and guelder rose *Viburnum opulus* in the shrub layer. Dog's mercury *Mercurialis perennis* dominates much of the ground layer and associates include opposite-leaved golden saxifrage *Chrysosplenium oppositifolium*, small teasel *Dipsacus pilosus*, pendulous sedge *Carex pendula* and nettle-leaved bellflower *Campanula trachelium.*

The site is also of interest for its breeding bird population including snipe, lapwing, sedge warbler and reed warbler, and winter floods are periodically used by waterfowl.

COUNTY: NORFOLK SITE NAME: DILLINGTON CARR, GRESSENHALL

DISTRICT: BRECKLAND

Status: Site of Special Scientific Interest [SSSI] notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: Breckland District Council

National Grid Reference: TF 971158 Area: 49 (ha.) 121 (ac.)

Ordnance Survey Sheet 1:50,000: 132 1:10,000: TF 91 NE

Date Notified (Under 1949 Act): – Date of Last Revision: –

Date Notified (Under 1981 Act): 1986 Date of Last Revision: –

Other Information:
A new site.

Description:
This site is an extensive area of carr woodland and open water occupying the valley floor and sides of a small tributary of the River Wensum. The wettest areas of carr are probably the best example of sump alder woodland in west Norfolk, closely resembling the carr woodlands found in Broadland. The site also includes extensive stands of the nationally rare lowland bird cherry-alder woodland. Irrigation reservoirs have been created within the carr and these flooded areas of former woodland support the freshwater component of an outstanding assemblage of breeding birds including several uncommon species.

The drier parts of the site, on light, acidic soils, support bird cherry-alder woodland with scattered plantings of conifers and poplars. Trees and shrubs associated with this community include frequent downy birch *Betula pubescens*, rowan *Sorbus aucuparia*, hazel *Corylus avellana*, ash *Fraxinus excelsior* and common sallow *Salix cinerea* in addition to abundant alder *Alnus glutinosa* and bird-cherry *Prunus padus*. Although large areas are secondary woodland with a disturbed round flora, there are stands of possible ancient woodland on the site. Here the ground flora is richer and includes dog's mercury *Mercurialis perennis*, honeysuckle *Lonicera periclymenum*, opposite-leaved golden saxifrage *Chrysosplenium oppositifolium*, wood sorrel *Oxalis acetosella*, bluebell *Hyacinthoides non-scripta* and wood anemone *Anemone nemorosa*.

The sump alder carr occurs in low-lying swampy areas on the valley-floor. Alder forms extensive stands with guelder rose *Viburnum opulus*, dogwood *Cornus sanguinea* and common sallow. The semi-liquid muds support a mixed ground flora which includes yellow flag *Iris pseudacorus*, angelica *Angelica sylvestris*, lesser pond sedge *Carex acutiformis*, marsh marigold *Caltha palustris* and meadowsweet *Filipendula ulmaria*.

The irrigation reservoirs contain shallow waters with some extensive stands of reedswamp. Water-plants are not well-represented but there are small patches of yellow water-lily *Nuphar lutea*, water violet *Hottonia palustris* and mare's-tail *Hippuris vulgaris*.

The freshwater habitats support a wide range of breeding birds including gadwall, pochard, teal, tufted duck, shoveler, great crested grebe and kingfisher. The surrounding woodland is also rich in breeding species, the more notable being barn owl, little owl, lesser spotted woodpecker, willow tit, nuthatch, nightingale and garden warbler.

COUNTY: Norfolk SITE NAME: FELBRIGG WOODS

DISTRICT: North Norfolk

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: North Norfolk District Council

National Grid Reference: TG 196401 Area: 162.5 (ha) 401.5 (ac)

Ordnance Survey Sheet 1:50,000: 133 1:10,000: TG 14 SE, 13 NE, 23 NW, 24 SW

Date Notified (Under 1949 Act): 1971 Date of Last Revision: –

Date Notified (Under 1981 Act): 1987 Date of Last Revision: N/A

Other Information:
This site is listed in 'A Nature Conservation Review'. Part of the site is under a forestry dedication agreement with the Forestry Commission.

Reasons for Notification:
Felbrigg Woods are situated on the edge of the Cromer Ridge on a plateau that slopes to the south. The Great Wood is one of only two known sites for acid Beech stands in Norfolk and probably represents an outlying native population of Beech *Fagus sylvatica* at the edge of its range. The ancient trees within the woodland and old deer park carry an interesting and diverse lichen flora including several East Anglian rarities. The site is also of considerable entomological and ornithological interest.

The natural Beech stands have been pollarded in the distant past and the resulting stools and boles are massive. The Beech pollards probably originated on medieval commonland when they were unlikely to have been planted and there is old documentary evidence for Beech in this part of Norfolk. There are few other tree species present with the Beech and the ground flora under the Beeches is poor, consisting chiefly of moss species. Maiden trees of Beech occur throughout the wood with frequent Pedunculate Oak and Sweet Chestnut. Most of these trees were planted in the 19th century but there are some old trees from earlier plantings. Bramble *Rubus fruticosus* and Bracken *Pteridium aquilinum* dominate the ground flora here with Honeysuckle *Lonicera periclymenum* and Creeping Soft-grass *Holcus mollis*. In locally flushed zones, Dog's Mercury *Mercurialis perennis*, Sanicle *Sanicula europaea* and Enchanter's Nightshade *Circaea lutetiana* occur. There is no shrub layer over much of the wood but it is well developed in an area of recently invaded parkland just north of Felbrigg Hall with Hazel *Corylus avellana*, Holly *Ilex aquifolium*, Elder *Sambucus nigra* and Sallow *Salix caprea*.

Many of the rides are narrow but they support occasional Wood Sorrel *Oxalis acetosella* and Yellow Pimpernel *Lysimachia nemorum*. Acidic grassland has developed on some of the wider woodland rides and is dominated by Sheep's Fescue *Festuca ovina* and Creeping Soft-grass with Heather *Calluna vulgaris* and Sheep's Sorrel *Rumex acetosella*.

The ancient trees in the park and woodland support over 50 species of lichen, a large total for East Anglia including species such as *Graphis elegans* and *Parmelia purlata* that are more commonly found in western and southern Britain. Many of the species are also indicators of ancient undisturbed woodland and provide further evidence for the continuity of old Beech forest.

The fungi and invertebrates are also probably of great interest but they have been little studied to date. Two rare flies have been recorded however, *Triphleba excisa* and *Mycetophila lubomirski*.

The wood supports a wide range of breeding birds including Wood Warbler and Redstart.

Date Notified: 26 Nov 1986

County: Humberside and North Yorkshire **Site Name: Flamborough Head**

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act, 1981, as amended.

Local Planning Authority: East Yorkshire Borough Council, Scarborough Borough Council

National Grid Reference: TA 143764–1995682
(extremities of site)

Ordnance Survey Sheets 1:50,000: 101 **1:25,000:** TA 16, 17, 26, 27

Area: 224.1 (ha) 553.8 (ac) (E. Yorkshire)
91.1 (ha) 225.1 (ac) (Scarborough)
315.2 (ha) 778.9 (ac) (Total)

First Notified: 1952 * **Date of Revision:** 1986

Description:
The site comprises the coastal cliffs of Flamborough Head between Reighton and Sewerby, composed of chalk and softer sedimentary rocks. The cliff line exposes a variety of geological features and the chalk, which reaches 130 m at Bempton, has been eroded to form impressive stacks and caves between North Cliff and Castlemere Hole. These rock exposures are also of interest in supporting important breeding bird colonies, whilst the cliff tops support interesting plant communities.

The internationally important geological site has numerous features of interest within a rock sequence spanning the Upper Jurassic period, about 140 million years before the present (MYBP) to the top of the Cretaceous about 70 MYBP, overlain by Pleistocene deposits less than 1 million years old. The site is also important for studies of coastal geomorphology. It is particularly notable, as one of a suite of chalk coastlines, in being within the North Sea wave climate rather than subject to the Atlantic swell or English Channel wave climates, and as the only chalk site extensively overlain by glacial deposits.

Below Speeton Cliff, the exposure of Upper Jurassic Kimmeridge Clay is the only site in Yorkshire showing this portion of the geological column and the only site between Dorset and the Moray Firth showing the autissiodorensis-elegans zonal boundary. The Speeton Clay, which here forms the Lower Cretaceous sequence, rests uncomformably on middle Kimmeridge Clay; the sequence exposed here is unique in the British Isles, in that it exposes, in one section, marine strata spanning the time interval between the Upper Berriasian and the Barremian Stage. The Speeton Clay here contains a series of marine fossils, including diagnostic ammonite and belemnite fauna which make it possible to correlate these rocks with strata in western Europe and the USSR. The section here is of importance for the international correlation of Lower Cretaceous rocks, and this is one of Britain's most important stratigraphical localities. Above this is found the finest exposure in North East England of Red Chalk, deposited during the Albian stage at the end of the Lower Cretaceous.

The chalk cliffs on the headland are of Upper Cretaceous age and form the only coastal exposures in Britain exhibiting a complete sequence of the North Sea Basin deposits for this period (100–70 MYBP), comprising the Ferriby, Welton, Burnham and Flamborough Chalk

formations. This is of considerable importance in comparing and dating similar chalk deposits elsewhere, particularly the succession off-shore in the North Sea Basin. Particular features of the chalk are the rich lithistid sponge fauna at Sewerby Cliff and spectacular contortions of the bedding at Scale Nab resulting from later faulting.

A major feature of Pleistocene origin is the cross section of a cliff line and beach formed during the Ipswichian interglacial, about 100,000 years ago, which can be seen at Sewerby Rocks. This former marine beach has been dated by the fossil remains of mammals, including spotted hyena, hippopotamus and straight tusked elephant, which are found within it. A sequence of glacial tills, deposited during the following, Devensian, glaciation overlies this feature. These comprise the clays and gravels of the present Sewerby cliffs and also overlie the chalk cliffs of the headland. Speeton is also a classic Pleistocene site for the Speeton Shell Bed, a fossiliferous sequence of gravels, sands and silts containing a temperate estuarine assemblage of marine molluscs.

In geomorphological terms the northern cliffs are relatively simple, both in plan and profile, and feed small quantities of flint to their fringing beaches. Around Flamborough some excellent examples of caves, arches and stacks have been created, associated with faulting and jointing within the cliffs. Where overlying till has collapsed into caves intersecting the chalk-till junction a number of blow holes have developed. Shore platforms are well developed both in this area and along the southern shoreline where the beaches are mainly of sand or chalk pebbles, with few flints fed from the cliffs. The influence of marine processes varies around the headland and these southern cliffs are less actively eroded than those to the north.

The north facing cliffs support internationally important colonies of breeding seabirds with about 80,000 pairs of kittiwakes, 6,600 pairs of guillemots, 2,000 pairs of razorbill, 1,000 pairs of puffins and 830 pairs of fulmar, the largest colonies being found at Bempton and Breil Nook. Bempton Cliffs are particularly noted as the only mainland gannetry in the country, with a population of 370 pairs in 1984.

The cliff-top vegetation is characterised by both a maritime influence, and by the calcareous influence of the chalk underlying the surface boulder clay. Thus sea cliff species such as thrift *Armeria maritima* and sea plantain *Plantago maritima* grow alongside herbaceous species more typical of chalk grassland such as kidney vetch *Anthyllis vulneraria*. Where the undercliff has slipped and is flushed by calcareous run-off northern marsh-orchid *Dactylorhiza purpurella* and grass of Parnassus *Parnassia palustris* may be found, with saltmarsh species such as common saltmarsh-grass *Puccinellia maritima*, sea arrowgrass *Triglochin maritima* and sea-milkwort *Glaux maritima*. Common reed *Phragmites australis* with associated freshwater marsh species forms significant stands in flushed cliff areas.

Other Information:

1. The site was formerly known as ‘Speeton and Flamborough Coast SSSI’.

2. During the 1986 revision the boundary of the site has been amended both to include land not previously notified* and to exclude land previously notified*.

3. This site is listed under the name ‘Bempton/Speeton Cliffs’ in ‘A Nature Conservation Review’, edited by D A Ratcliffe (1977). Cambridge University Press.

4. Bempton Cliffs fulfils the criteria for designation under the terms of the European Community Directive 79/409/EEC on the Conservation of Wild Birds as a Special Protection Area,

5. The site is identified as being of international importance in the Geological Conservation Review, under the following Blocks:

Cenomanian – Maastrichtian	Coastal Geomorphology of England
Aptian – Albian	Pleistocene/Quaternary of E. England (North)
Vertebrate palaentology	
Berriasian – Barremian	Kimmeridgian

6. Part of the site is managed as a nature reserve by the Royal Society for the Protection of Birds.

7. The Headland is designated as Heritage Coast by the Countryside Commission.

* Under Section 23 of the National Parks and Access to the Countryside Act, 1949.

COUNTY: Norfolk SITE NAME: HOLLY FARM MEADOW, WENDLING

DISTRICT: Breckland

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Breckland District Council

National Grid Reference: TF 936131 Area: 2.5 (ha) 6.17 (ac)

Ordnance Survey Sheet 1:50,000: 132 1:10,000: TF 91 SW

Date Notified (Under 1949 Act): N/A Date of Last Revision: N/A

Date Notified (Under 1981 Act): 1984 Date of Last Revision: –

Other Information:
A new site.

Reasons for Notification:
This site which is situated in the valley of a small tributary of the River Wensum, is a valuable example of a calcareous spring-line meadow with gradations between wet and dry conditions. It supports an area of species-rich unimproved fen grassland which is maintained by seasonal grazing.

Wet marshy grassland occurs in the central area of the meadow and is dominated by Blunt-flowered Rush *Juncus subnodulosus* and Carnation Sedge *Carex panicea* with frequent Marsh Marigold *Caltha palustris*, Marsh Pennywort *Hydrocotyle vulgaris*, Marsh Valerian *Valeriana dioica* and Southern Marsh Orchid *Dactylorhiza praetermissa*.

Unimproved neutral grassland with frequent anthills is present on the drier soils. Sweet Vernal-grass *Anthoxanthum odoratum*, Red Fescue *Festuca rubra* and Tufted Hair-grass *Deschampsia caespitosa* are dominant with Quaking-grass *Briza media*, Adder's Tongue *Ophioglossum vulgatum*, cowslip *Primula veris*, Hoary Plantain *Plantago media* and Common Twayblade *Listera ovata*.

A diverse short-sward community occurs where the dry grassland grades into marsh. Here, Glaucous Sedge *Carex flacca* is dominant with frequent Blunt-flowered Rush, Sweet Vernal-grass and Bog-rush *Schoenus nigricans*. A number of uncommon species are present including Fragrant Orchid *Gymnadenia conopsea var densiflora*, Marsh Helleborine *Epipactis palustris* and Common Spotted Orchid *Dactylorhiza fuchsii*.

Additional interest is provided by tall herb vegetation which surrounds the open areas. This is dominated by Meadowsweet *Filipendula ulmaria* and Great Willow-herb *Epilobium hirsutum* with Oat-grass *Arrhenatherum elatius* and Great Horsetail *Equisetum telmateia*. Hawthorn scrub has developed on the driest ground and has spread from thick boundary hedges.

COUNTY: NORFOLK SITE NAME: PASTON GREAT BARN

DISTRICT: NORTH NORFOLK

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: North Norfolk District Council

National Grid Reference: TG 322344 Area: 0.95 (ha.)

Ordnance Survey Sheets 1:50000: 133 1:10000: TG 33 SW

Date Notified (Under 1949 Act): Not Applicable

Date Notified (Under 1981 Act): 23 December 1999

Reasons for Notification:
This site is notified as it supports the only barbastelle bat maternity roost in Norfolk and one of only three known in the UK.

General Description:
Paston Great Barn is a large medieval thatched barn, built of flint and limestone, situated about one kilometre from the coastal cliffs of north Norfolk. It holds one of the few known maternity colonies of barbastelle bat *Barbastella barbastellus* in the UK.

The barbastelle bat is listed as a rare and threatened species in the European and British Red Data Books of rare and endangered animal species. From historical accounts it always appears to have been rare nationally. It is apparently thinly distributed over England and Wales but is most frequently reported from East Anglia and South-west England. Whilst most other British species are considered to be on the edge of their ranges in Britain and therefore relatively more common in southern Europe, barbastelles are an exception to this generality in being considered rare in a European context.

Barbastelles are medium-sized bats whose precise requirements are still not frilly known. The known maternity colonies in Britain are either in old trees (often beech) or old buildings. At Paston they mostly utilise large relatively exposed crevices in timber lintels over the large barn doors, though during the season they may move to other parts of the barn on occasions. At dusk they also fly inside the building and appear to use the adjoining open cattle sheds when they leave the building, possibly to avoid predation from birds. Research so far suggests that the coastal cliffs are an important feeding area for the colony.

The colony was discovered in 1996 and regular counts over the last three years have confirmed the site's importance as a maternity roost. The barn also supports colonies of natterer's *Myotis nattereri*, brown long-eared *Plecotus auritus* and pipistrelle *Pipistrellus pipistrellus* bats.

Other Information:
A new site for barbastelle bats. Within an Area of Outstanding Natural Beauty (AONB). Barbastelle bats are protected under the following legislation. Annex II of the EC Habitats & Species Directive (92/43/EEC), Appendix II of the Bonn Convention (and is included in the Convention's Agreement on the Conservation of Bats in Europe). Appendix II of the

Bern Convention, Schedule 2 of the Conservation (Natural Habitats, etc …) regulations 1994 (Regulation 38) and Schedule 5 of the Wildlife & Countryside Act 1981 (as amended). It is also a species for which a Biodiversity Action Plan has been produced. The whole of the site is listed as Grade 2* by English Heritage and the Great Barn itself is a Scheduled Ancient Monument. The cliffs are in part notified for their geolocical interest as Mundesley Cliffs SSSI.

COUNTY: Norfolk SITE NAME: POTTER AND SCARNING FENS

DISTRICT: Breckland

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Breckland District Council

National Grid Reference: TF 982120 Area: 5.53 (ha) 13.66 (ac)

Ordnance Survey Sheet 1:50,000: 132 1:10,000: TF 91 SW

Date Notified (Under 1949 Act): 1959 Date of Last Revision: 1971

Date Notified (Under 1981 Act): 1984 Date of Last Revision: –

Other Information:
Part of this site (Scarning Fen) is of international importance and has been recommended for inclusion in the list of wetlands of international importance under the Ramsar Convention.
Part of this site is owned by the Norfolk Naturalists' Trust. There has been a small boundary adjustment to exclude land taken for the Dereham Bypass.

Reasons for Notification:
Potter and Scarning Fens are small calcareous valley fens on shallow peat and are among the finest of their type in Britain. The site grades from bryophyte-dominated communities on the open, wet parts of the site, through calcareous fen, to heathland on the drier ground. The flora is exceptionally diverse and a number of uncommon mosses and liverworts are present. The site has great entomological interest and supports a rare species of damsel-fly.

The central, open area of the fen is dominated by bryophytes, Bog Rush *Schoenus nigricans* and Blunt Flowered Rush *Juncus subnodulosus*. Such plant communities are now rare in Britain. The range of flowering plants is exceptional and includes Grass of Parnassus *Parnassia palustris*, Great Sundew *Drosera anglica*, Common Butterwort *Pinguicula vulgaris*, Marsh Helleborine *Epipactis palustris*, Common Twayblade *Listera ovata* and Bogbean *Menyanthes trifoliata*. A tall calcareous fen community surrounds the central area and is dominated by Reed *Phragmites australis*, Meadowsweet *Filipendula ulmaria* and Blunt Flowered Rush. A number of interesting plants are present including Marsh Orchid *Dactylorhiza sp.*, Marsh Lousewort *Pedicularis palustris*, Marsh Pennywort *Hydrocotyle vulgaris*, Common Quaking Grass *Briza media* and Ragged Robin *Lychnis flos-cuculi*.

On the highest ground is an area of grassy heath with much Gorse *Ulex europaeus* and some Heather *Calluna vulgaris*. The calcareous soils are reflected in a number of the species present including Common Quaking Grass, and Heath Speedwell *Veronica officinalis*.

Alder *Alnus glutinosa* carr, has grown up on parts of the site and is gradually reducing the remaining open areas of Potter Fen. Reed, Meadowsweet, Yellow Iris *Iris pseudacorus* and Marsh Marigold *Caltha palustris* are present in the ground flora.

The nationally rare small red Damsel-Fly *Ceriagrion tenellum* is present on the site.

Date of Notification: 4 February 1993

COUNTY: Norfolk SITE NAME: RIVER WENSUM

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981, section 17 of the Water Resources Act 1991, Section 4 of the Water Industry Act 1991 and Section 13 of the Land Drainage Act 1991.

National Rivers Authority Region: Anglian

International Drainage Board: River Wensum

Water Company: Anglian Water Plc

Local Planning Authorities: North Norfolk District Council, Norfolk County Council, Kings Lynn & West Norfolk District Council, South Norfolk District Council, Breckland District Council, Broadland District Council

National Grid Reference: TF 942246 to TG 250078

Length of River SSSI: Approx 71km Area: 393.31 (ha) 971.9 (ac)

Ordnance Survey Sheet 1:50,000: 132 133 134 1:10,000: TF 82 SE NE NW, TF 93 SE, TF 92 SE NE NW, TF 83 SE, TG 01 NE NW, TG 02 SW, TG 11 SE SW NW

Date of Notification (under 1981 Act): 1993

Other Information:
New site.

Description and Reasons for Notification:
Key features
The Wensum has been selected as one of a national series of rivers of special interest as an example of an enriched, calcareous lowland river. With a total of over 100 species of plants, a rich invertebrate fauna and a relatively natural corridor, it is probably the best whole river of its type in nature conservation terms, although short stretches of other similar rivers may show a slightly greater diversity of species.

The upper reaches are fed by springs that rise from the chalk and by run-off from calcareous soils rich in plant nutrients. This gives rise to dense beds of submerged and emergent vegetation characteristic of a chalk stream. Lower down, the chalk is overlain with boulder clay and river gravels, resulting in aquatic plant communities more typical of a slow-flowing river on mixed substrate. Diversity of plant species is further enhanced by mills and weirs; upstream the river slows to produce characteristic deep water plant communities, whilst below the barriers they are replaced by species tolerant of swirling and turbulent water.

Unusually for a lowland river in England, much of the adjacent land is still traditionally managed for hay crops and by grazing, giving a wide spectrum of grassland habitats some of which are seasonally inundated. The mosaic of meadow and marsh habitats, including one of the most extensive reedbeds in the country outside the Broads, provide niches for a wide variety of specialised plants and animals.

The River itself supports an abundant and diverse invertebrate fauna including the native freshwater crayfish *Austropotamobius pallipes* as well as a good mixed fishery. Brown trout *Salmo trutta fario* form the major component of the fish community of the upper

Wensum, whilst the middle and lower reaches are dominated by chub *Leuciscus cephalus*, pike *Esox lucius*, eel *Anguilla anguilla* and barbel *Barbus barbus*. Kingfisher *Alcedo attthis* and little grebe *Tachybaptus ruficollis* breed along the River, whilst the adjacent wetlands have good populations of reed warblers *Acrocephalus scirpaceus*, sedge warblers *Acrocephalus schoenobaenus* and barn owls *Tyto alba*.

Flora

In the upper reaches on gravel substrates lesser water-parsnip *Berula erecta* and the brook water-crowfoot *Ranunculus penicillatus* form a large component of the flora. Where silt has been deposited, spiked water milfoil *Myriophyllum spicatum*, blue water-speedwell *Veronica anagalis-aquatica*, opposite leaved pondweed *Groenlandia densa*, willow moss *Fontinalis antipyretica* and the nationally rare short-leaved starwort *Callitriche truncata* occur.

The middle and lower stretches of the river are characterised by rich lowland plant communities. The dominants are yellow water-lily *Nuphar lutea*, flowering rush *Butomus umbellatus*, fennel pondweed *Potamogeton pectinatus*, perfoliate pondweed *Potamogeton perfoliatus*, arrowhead *Sagittaria sagittifolia* and unbranched bur-reed *Sparganium erectum*. Variations in the aquatic plant community reflect the alternation of fast-flowing shallows with deep slow-moving water. Other species with widespread distribution along the Wensum include rigid hornwort *Ceratophyllum demersum*, spiked water-milfoil *Myriophyllum spicatum*, fan-leaved water-crowfoot *Ranunculus circinatus*, branched bur-reed *Sparganium erectum*, common club-rush *Scirpus lacustris*, horned pondweed *Zannichellia palustris* and the nationally scarce river water-dropwort *Oenanthe fluviatilis*.

The marginal and bankside communities are typical of lowland rivers. Often there are dense and continuous stands of reeds or sedges. Reed sweet-grass *Glyceria maxima* is dominant in the lower reaches. Elsewhere stands of reed canary-grass *Phalaris arundinacea*, greater pond-sedge *Carex riparia*, reedmace *Typha latifolia* and common reed *Phragmites australis* are widespread. Where edges are not dominated by tall emergents, stragling or low-growing herbs such as fool's water-cress *Apium nodiflorum*, water-mint *Mentha aquatica*, water forget-me-not *Myosotis scorpioides* and brooklime *Veronica becaabunga* occur.

Of the semi-natural habitats associated with the River, the most frequently occurring are acidic or neutral unimproved wet grasslands. The flora of these grasslands is typified at Helhoughton and Turf Common by bogbean *Menyanthes trifoliata*, marsh marigold *Caltha palustris*, yellow rattle *Rhinanthus minor*, ragged robin *Lychnis flos-cuculi*, southern marsh orchid *Dactylorhiza praetermissa*, common spotted orchid *Dactylorhiza fuchsii*, water mint *Mentha aquatica* and yellow iris *Iris pseudacorus*.

Elsewhere the land is seasonally inundated so that grazing is restricted; extensive areas of reedbed and tall mixed fen communities have developed which provide valuable breeding and hunting grounds for birds such as the barn owl *Tyto alba* and hen harrier *Circus cyaneus*. Examples include Guist Common which is reed dominated; Goggs Mill Reserve near Fakenham which has a mixed fen community with species such as meadowsweet *Filipendula ulmaria*, angelica *Angelica sylvestris* and meadow rue *Thalictrum flavum*, and Sculthorpe Moor, which although gradually being invaded by willow *Salix* spp. scrub has a fen community of saw sedge *Cladium mariscus* and black bog-rush *Schoenus nigricans*. Although there are several areas of alder swamp interspersed with the above communities, Guist Carr forms the main example of wet woodland within the SSSI.

All of the habitats within the SSSI are intrinsically linked to and dependent on the River for their continued existence. Appropriately, in times of drought, these adjacent wetlands have a vital role in buffering the river against low flows; in wetter periods they absorb river flood waters and become swamp-like in nature.

Two tributaries have been included in the SSSI, the Tat and the Langor Drain. They are both major flow contributors to the main river; historically, the Tat may have been the

original Wensum. The Langor valley comprises an extensive area of semi-natural habitat which is dominated by fen vegetation. The specific composition ranges from almost exclusively reed to a mixture of meadowsweet and sedge species. Parts of Little Ryburgh Common are grazed, having bittersweet *Solanum dulcamara,* branched bur-reed *Sparganium erectum,* water cress *Rorippa nasturtium-aquaticum,* greater tussock sedge *Carex paniculata,* lesser water parsnip *Berula erecta,* water mint *Mentha aquatica,* and marsh marigold *Caltha palustris* as elements in their flora. The vegetation of the drier areas of Little Ryburgh Common includes bracken *Pteridium aquilinum,* honeysuckle *Lonicera periclymenum,* field scabious *Knautia arvensis,* harebell *Campanula rotundifolia* and soft rush *Juncus effusus*.

Invertebrates

The Wensum has an abundant and diverse mollusc fauna which includes the nationally rare, small snail *Vertigo moulinsiana,* which is associated with aquatic vegetation at the river edge. Two other aquatic molluscs which occur, *Valvata piscinalis* and *Gyraulus albus,* have a localised distribution in England. Water beetles are well represented; *Brychnus elevatus,* of localised distribution in England, is found in deep slow-flowing sections of the river. The mayflies *Ephemerella ignita, Caenis luctuosa, Centroptilium luteolum* and *Centroptilium pennulatum* are also of local distribution. There is a species of stonefly, *Amphinemura standfussi,* more usually associated with upland rivers. The flatworm *Crenobia alpina* is of note, being a relict in southern England where it is confined to cold-water springs.

SITE NOTIFIED TO THE SECRETARY OF STATE ON 25TH JULY 1990

COUNTY: NORFOLK SITE NAME: SOUTHREPPS COMMON

DISTRICT: NORTH NORFOLK

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981 as amended.

Local Planning Authority: North Norfolk District Council

National Grid Reference: TG 261350 Area: 5.3 (ha.) 13.1 (ac.)

Ordnance Survey Sheet 1:50,000: 133 1:10,000: TG 23 NE & TG 23 SE

Date Notified (Under 1949 Act): – Date of Last Revision: –

Date Notified (Under 1981 Act): 1990 Date of Last Revision: –

Other Information:

Description:
Southrepps Common is situated in the upper valley of the River Ant and supports a variety of damp grassland and calcareous valley fen types. Such undrained river valley sites are now uncommon throughout much of Norfolk, and this site supports very local fen communities largely restricted to East Anglia.

On the lower area of the northern valley slope an intricate mosaic of vegetation types has developed, with blunt-flowered rush *Juncus subnodulosus* dominating. Calcareous fen species, several of which are particularly uncommon in the county, are present here including grass of parnassus *Parnassia palustris*, bog pimpernel *Anagallis tenella*, marsh arrowgrass *Triglochin palustris*, common quaking grass *Briza media* and flea sedge *Carex pulicaris*. Associated low hummocks support species more characteristic of acid conditions including meadow thistle *Cirsium dissectum*, heather *Calluna vulgaris*, heath woodrush *Luzula multiflora*, mat grass *Nardus stricta*, heath grass *Danthonia decumbens* and common cotton-grass *Eriophorum angustifolium*.

The southern valley side has developed an open bed of reed *Phragmites australis* under much of which blunt-flowered rush again dominates. Exceptionally large colonies of the uncommon marsh helleborine *Epipactis palustris* and fragrant orchid *Gymnadenia conopsea* var *densiflora* are present throughout, together with marsh valerian *Valeriana dioica* and occasional long-stalked yellow sedge *Carex lepidocarpa* and bogbean *Menyanthes trifoliata*. Small areas of open bryophyte carpets occur very sporadically, and these support the low-growing calcicole species characteristic of the northern valley side together with marsh lousewort *Pedicularis palustris*, eyebright *Euphrasia officinalis* (agg) and few-flowered spikerush *Eleocharis quinqueflora*. Around the margins of this area reed has become dominant, and these reedbeds support sedge warbler and reed bunting.

On the higher valley slopes, mainly to the north, damp grassland replaces the fen communities. Fescues (*Festuca rubra* and *F. ovina*) and Yorkshire fog *Holcus lanatus* dominate, and herbs include yellow rattle *Rhinanthus minor* (agg), southern marsh orchid *Dactylorhiza praetermissa* and ragged robin

Lychnis flos-cuculi. Further diversity is provided by scrub areas and a strip of alder *Alnus glutinosa* carr along the river.

A number of rare and notable diptera (true flies) characteristic of undisturbed wetlands have been recorded from this site, most notably *Pteromicra glabricula* and *Colobaea distincta*, flies whose larvae are parasitic on snails.

COUNTY: Norfolk SITE NAME: WHITWELL COMMON

DISTRICT: Broadland

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authority: Broadland District Council

National Grid Reference: TG 088206 Area: 19.17 (ha) 47.36 (ac)

Ordnance Survey Sheet 1:50,000: 133 1:10,560: TG 02 SE

Date Notified (Under 1949 Act): 1954 Date of Last Revision: –

Date Notified (Under 1981 Act): 1984 Date of Last Revision: –

Other Information:
Established as a Local Nature Reserve in 1984.

Reasons for Notification:
Whitwell Common lies in the valley of a tributary of the R Wensum and supports a wide range of wetland plant communities characteristic of peat-based soils. Calcareous flushes are present in low-lying hollows created by past peat cutting and a variety of interesting plants are associated with this uncommon habitat type. Wet valley alder wood, fen communities and unimproved neutral grassland are also represented on the site.

The calcareous flushes are of the type dominated by Black Bog-rush *Schoenus nigricans*, Blunt-flowered Rush *Juncus subnodulosus*, bryophytes and other low-growing species. The water-table is high throughout the year and plants of interest include Common Spotted Orchid *Dactylorhiza fuchsii*, Southern Marsh Orchid *D. praetermissa*, Twayblade *Listera ovata*, Marsh Valerian *Valeriana dioica*, Lesser Spearwort *Ranunculus flammula* and Ragged Robin *Lychnis flos-cuculi*.

The flushes grade into areas of fen grassland that are characterised by Sweet Vernal-grass *Anthoxanthum odoratum*, Yorkshire Fog *Holcus lanatus* and Sheep's Fescue *Festuca ovina* with some Blunt-flowered Rush. This community is also found on sloping ground around the fen and notable species include Yellow Rattle *Rhinanthus minor*, Adder's Tongue *Ophioglossum vulgatum*, Glaucous Sedge *Carex flacca* and Hairy Sedge *C. hirta*.

Dry fen, dominated by Meadowsweet *Filipendula ulmaria* occupies a substantial area. This includes such characteristic species as Angelica *Angelica sylvestris*, Yellow Flag *Iris pseudacorus*, Great Hairy Willow-herb *Epilobium hirsutum* and Great Reedmace *Typha latifolia*. There are several permanently wet hollows with standing water and abundant Bogbean *Menyanthes trifoliata*, Marsh Cinquefoil *Potentilla palustris*, Marsh Marigold *Caltha palustris* and Water Dropwort *Oenanthe fistulosa* occur. The fen grades into an area dominated by Reed *Phragmites australis* on wetter ground.

Damp grassland and tall herb communities occur on surrounding higher ground. Brown Bent-grass *Agrostis canina* is dominant with Yarrow *Achillea millefolium*, Tormentil *Potentilla erecta* and an unusual abundance of Giant Horsetail *Equisetum telmateia*.

Wet valley alder carr on neutral soils occupies the northern part of the site. Alder *Alnus glutinosa* is dominant with some Pedunculate Oak *Quercus robur* and Ash *Fraxinus excelsior*. The ground flora includes Yellow Flag, Lesser Pond Sedge *Carex acutiformis* and Meadowseet with Dog's Mercury *Mercurialis perennis* and Yellow Archangel *Lamiastrum galeobdolon* on drier ground.

NATURA 2000 – STANDARD DATA FORM

Special Protection Areas (SPAs) classified under Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version), also known as the 'Birds Directive'

and

Special Areas of Conservation (SACs) (includes candidate SACs, Sites of Community Importance (SCIs) and designated SACs) designated under Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, also known as the 'Habitats Directive'

Each Natura 2000 site in the United Kingdom has its own Standard Data Form containing site-specific information.

The information provided here follows the officially agreed site information format for Natura 2000 sites, as set out in the Official Journal of the European Union recording the Commission Implementing Decision of 11 July 2011 (2011/484/EU).

The Standard Data Forms are generated automatically for all of the UK's Natura 2000 sites using the European Environment Agency's Natura 2000 software. The structure and format of these forms is exactly as produced by the EEA's Natura 2000 software (except for the addition of this coversheet and the end notes). The content matches exactly the data submitted to the European Commission.

Please note that these forms contain a number of codes, all of which are explained either within the data forms themselves or in the end notes.

Further technical documentation may be found here:
http://bd.eionet.europa.eu/activities/Natura_2000/reference_portal

In December 2015, several sections of the UK's previously published Standard Data Forms were updated. For details of the approach taken by the UK in this submission please refer to the following document:
http://jncc.defra.gov.uk/pdf/Natura2000_StandardDataForm_UKApproach_Dec2015.pdf.
These changes formed part of the UK Submission to the European Commission on 22/12/2015.

More general information on Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) in the United Kingdom, including in Gibraltar, is available from the SPA homepage and SAC homepage on the JNCC website. These webpages also provide links to Standard Data Forms for all Natura 2000 sites in the UK.

Date Standard Data Form generated by the Joint Nature Conservation Committee:	14th November 2017 (UK Tranche 56)

NATURA 2000 - STANDARD DATA FORM

For Special Protection Areas (SPA),
Proposed Sites for Community Importance (pSCI),
Sites of Community Importance (SCI) and
for Special Areas of Conservation (SAC)

SITE **UK0030369**

SITENAME **Haisborough, Hammond and Winterton**

TABLE OF CONTENTS

- 1. SITE IDENTIFICATION
- 2. SITE LOCATION
- 3. ECOLOGICAL INFORMATION
- 4. SITE DESCRIPTION
- 6. SITE MANAGEMENT
- 7. MAP OF THE SITE

1. SITE IDENTIFICATION

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1.1 Type	1.2 Site code
B	UK0030369

1.3 Site name

Haisborough, Hammond and Winterton

1.4 First Compilation date	1.5 Update date
2010-08	2017-11

1.6 Respondent:

Name/Organisation: Joint Nature Conservation Committee

Address: Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY

Email:

Date site proposed as SCI:	2010-08
Date site confirmed as SCI:	2011-11
Date site designated as SAC:	2017-09
National legal reference of SAC designation:	Regulations 11 and 13-15 of the Conservation of Habitats and Species Regulations 2010 (http://www.legislation.gov.uk/uksi/2010/490/contents/made), and Regulations 11, 16 and 17 of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (http://www.legislation.gov.uk/uksi/2007/1842/contents/made).

2. SITE LOCATION

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2.1 Site-centre location [decimal degrees]:

Longitude	Latitude
1.966	52.841

2.2 Area [ha]:

146759.0

2.3 Marine area [%]

100.0

2.4 Sitelength [km]:

0.0

2.5 Administrative region code and name

NUTS level 2 code	Region Name
UKZZ	Extra-Regio

2.6 Biogeographical Region(s)

Atlantic (100.0 %)

3. ECOLOGICAL INFORMATION

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3.1 Habitat types present on the site and assessment for them

Annex I Habitat types						Site assessment			
Code	PF	NP	Cover [ha]	Cave [number]	Data quality	A|B|C|D	A|B|C		
						Representativity	Relative Surface	Conservation	Global
1110			66892.75		M	A	C	B	B
1170			88.06		P	A	C	B	A

- **PF:** for the habitat types that can have a non-priority as well as a priority form (6210, 7130, 9430) enter "X" in the column PF to indicate the priority form.
- **NP:** in case that a habitat type no longer exists in the site enter: x (optional)
- **Cover:** decimal values can be entered
- **Caves:** for habitat types 8310, 8330 (caves) enter the number of caves if estimated surface is not available.
- **Data quality:** G = 'Good' (e.g. based on surveys); M = 'Moderate' (e.g. based on partial data with some extrapolation); P = 'Poor' (e.g. rough estimation)

3.2 Species referred to in Article 4 of Directive 2009/147/EC and listed in Annex II of Directive 92/43/EEC and site evaluation for them

Species					Population in the site						Site assessment			
G	Code	Scientific Name	S	NP	T	Size		Unit	Cat.	D.qual.	A|B|C|D	A|B|C		
						Min	Max				Pop.	Con.	Iso.	Glo.
M	1364	Halichoerus grypus			p				P	DD	D			
M	1351	Phocoena phocoena			p				P	DD	D			

- **Group:** A = Amphibians, B = Birds, F = Fish, I = Invertebrates, M = Mammals, P = Plants, R = Reptiles
- **S:** in case that the data on species are sensitive and therefore have to be blocked for any public access enter: yes
- **NP:** in case that a species is no longer present in the site enter: x (optional)
- **Type:** p = permanent, r = reproducing, c = concentration, w = wintering (for plant and non-migratory species use permanent)
- **Unit:** i = individuals, p = pairs or other units according to the Standard list of population units and codes in accordance with Article 12 and 17 reporting (see reference portal)
- **Abundance categories (Cat.):** C = common, R = rare, V = very rare, P = present - to fill if data are deficient (DD) or in addition to population size information
- **Data quality:** G = 'Good' (e.g. based on surveys); M = 'Moderate' (e.g. based on partial data with some extrapolation); P = 'Poor' (e.g. rough estimation); VP = 'Very poor' (use this category only, if not even a rough estimation of the population size can be made, in this case the fields for population size can remain empty, but the field "Abundance categories" has to be filled in)

4. SITE DESCRIPTION

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4.1 General site character

Habitat class	% Cover
N01	100.0
Total Habitat Cover	100

Other Site Characteristics

General site characteristics: Gravelly sand. Sand. Non-vegetated. Full salinity. Intermediate coastal influence. Headland associated. Sabellaria spinulosa biogenic reef. Circalittoral. Moderate energy.

4.2 Quality and importance

Sandbanks which are slightly covered by sea water all the time for which this is considered to be one of the best areas in the United Kingdom. Reefs for which this is considered to be one of the best areas in the United Kingdom.

4.3 Threats, pressures and activities with impacts on the site

The most important impacts and activities with high effect on the site

Negative Impacts			
Rank	Threats and pressures [code]	Pollution (optional) [code]	inside/outside [i|o|b]
H	C02		B
L	D03		B
H	F02		I
L	D02		I
L	C01		B

Positive Impacts			
Rank	Activities, management [code]	Pollution (optional) [code]	inside/outside [i|o|b]

L	H03		B

Rank: H = high, M = medium, L = low
Pollution: N = Nitrogen input, P = Phosphor/Phosphate input, A = Acid input/acidification,
T = toxic inorganic chemicals, O = toxic organic chemicals, X = Mixed pollutions
i = inside, o = outside, b = both

4.5 Documentation

For further information on this site, including its features, conservation objectives, advice on operations and management, please see Natural England's Designated Sites System and JNCC's Site Information Centres via the links below. See also the UK Approach document for more information (link via the JNCC website).

Link(s): http://jncc.defra.gov.uk/page-6534
http://jncc.defra.gov.uk/pdf/Natura2000_StandardDataForm_UKApproach_Dec2015.pdf

https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030369&SiteName=Haisborou

6. SITE MANAGEMENT

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6.1 Body(ies) responsible for the site management:

Organisation:	Natural England
Address:	
Email:	

Organisation:	For information about relevant management bodies contact the Joint Nature Conservation Committee and see Section 4.5 for site management progress
Address:	
Email:	

6.2 Management Plan(s):

An actual management plan does exist:

- [ ] Yes
- [ ] No, but in preparation
- [X] No

6.3 Conservation measures (optional)

For available information, including on Conservation Objectives, see Section 4.5.

7. MAP OF THE SITES

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INSPIRE ID:

Map delivered as PDF in electronic format (optional)

- [ ] Yes
- [X] No

Reference(s) to the original map used for the digitalisation of the electronic boundaries (optional).

EXPLANATION OF CODES USED IN THE NATURA 2000 STANDARD DATA FORMS

The codes in the table below are also explained in the official European Union guidelines for the Standard Data Form. The relevant corresponding page number is shown in the table below.

1.1 Site type

CODE	DESCRIPTION	PAGE NO
A	SPA (classified Special Protection Area)	53
B	cSAC, SCI or SAC (candidate Special Area of Conservation, Site of Community Importance, designated Special Area of Conservation)	53
C	SPA area/boundary is the same as the cSAC/SCI/SAC i.e. a co-classified/designated site (Note: in the UK Natura 2000 submission, this is only used in Gibraltar)	53

3.1 Habitat representativity

CODE	DESCRIPTION	PAGE NO
A	Excellent representativity	57
B	Good representativity	57
C	Significant representativity	57
D	Non-significant presence	57

3.1 Habitat code

CODE	DESCRIPTION	PAGE NO
1110	Sandbanks which are slightly covered by sea water all the time	57
1130	Estuaries	57
1140	Mudflats and sandflats not covered by seawater at low tide	57
1150	Coastal lagoons	57
1160	Large shallow inlets and bays	57
1170	Reefs	57
1180	Submarine structures made by leaking gases	57
1210	Annual vegetation of drift lines	57
1220	Perennial vegetation of stony banks	57
1230	Vegetated sea cliffs of the Atlantic and Baltic Coasts	57
1310	Salicornia and other annuals colonizing mud and sand	57
1320	Spartina swards (Spartinion maritimae)	57
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	57
1340	Inland salt meadows	57
1420	Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)	57
2110	Embryonic shifting dunes	57
2120	Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")	57
2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	57
2140	Decalcified fixed dunes with Empetrum nigrum	57
2150	Atlantic decalcified fixed dunes (Calluno-Ulicetea)	57
2160	Dunes with Hippophaë rhamnoides	57
2170	Dunes with Salix repens ssp. argentea (Salicion arenariae)	57
2190	Humid dune slacks	57
21A0	Machairs (* in Ireland)	57
2250	Coastal dunes with Juniperus spp.	57
2330	Inland dunes with open Corynephorus and Agrostis grasslands	57
3110	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	57
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	57
3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	57
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	57

CODE	DESCRIPTION	PAGE NO
3160	Natural dystrophic lakes and ponds	57
3170	Mediterranean temporary ponds	57
3180	Turloughs	57
3260	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	57
4010	Northern Atlantic wet heaths with Erica tetralix	57
4020	Temperate Atlantic wet heaths with Erica ciliaris and Erica tetralix	57
4030	European dry heaths	57
4040	Dry Atlantic coastal heaths with Erica vagans	57
4060	Alpine and Boreal heaths	57
4080	Sub-Arctic Salix spp. scrub	57
5110	Stable xerothermophilous formations with Buxus sempervirens on rock slopes (Berberidion p.p.)	57
5130	Juniperus communis formations on heaths or calcareous grasslands	57
6130	Calaminarian grasslands of the Violetalia calaminariae	57
6150	Siliceous alpine and boreal grasslands	57
6170	Alpine and subalpine calcareous grasslands	57
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)	57
6230	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)	57
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)	57
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	57
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	57
6520	Mountain hay meadows	57
7110	Active raised bogs	57
7120	Degraded raised bogs still capable of natural regeneration	57
7130	Blanket bogs (* if active bog)	57
7140	Transition mires and quaking bogs	57
7150	Depressions on peat substrates of the Rhynchosporion	57
7210	Calcareous fens with Cladium mariscus and species of the Caricion davallianae	57
7220	Petrifying springs with tufa formation (Cratoneurion)	57
7230	Alkaline fens	57
7240	Alpine pioneer formations of the Caricion bicoloris-atrofuscae	57
8110	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)	57
8120	Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)	57
8210	Calcareous rocky slopes with chasmophytic vegetation	57
8220	Siliceous rocky slopes with chasmophytic vegetation	57
8240	Limestone pavements	57
8310	Caves not open to the public	57
8330	Submerged or partially submerged sea caves	57
9120	Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer (Quercion robori-petraeae or Ilici-Fagenion)	57
9130	Asperulo-Fagetum beech forests	57
9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli	57
9180	Tilio-Acerion forests of slopes, screes and ravines	57
9190	Old acidophilous oak woods with Quercus robur on sandy plains	57
91A0	Old sessile oak woods with Ilex and Blechnum in the British Isles	57
91C0	Caledonian forest	57
91D0	Bog woodland	57
91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	57
91J0	Taxus baccata woods of the British Isles	57

3.1 Relative surface

CODE	DESCRIPTION	PAGE NO
A	> 15%-100%	58
B	> 2%-15%	58
C	≤ 2%	58

3.1 Degree of conservation

CODE	DESCRIPTION	PAGE NO
A	Excellent conservation	59
B	Good conservation	59
C	Average or reduced conservation	59

3.1 Global assessment

CODE	DESCRIPTION	PAGE NO
A	Excellent value	59
B	Good value	59
C	Significant value	59

3.2 Population (abbreviated to 'Pop.' in data form)

CODE	DESCRIPTION	PAGE NO
A	> 15%-100%	62
B	> 2%-15%	62
C	≤ 2%	62
D	Non-significant population	62

3.2 Degree of conservation (abbreviated to 'Con.' in data form)

CODE	DESCRIPTION	PAGE NO
A	Excellent conservation	63
B	Good conservation	63
C	Average or reduced conservation	63

3.2 Isolation (abbreviated to 'Iso.' in data form)

CODE	DESCRIPTION	PAGE NO
A	Population (almost) Isolated	63
B	Population not-isolated, but on margins of area of distribution	63
C	Population not-isolated within extended distribution range	63

3.2 Global assessment (abbreviated to 'Glo.' or 'G.' in data form)

CODE	DESCRIPTION	PAGE NO
A	Excellent value	63
B	Good value	63
C	Significant value	63

3.3 Assemblages types

CODE	DESCRIPTION	PAGE NO
WATR	Non-breeding waterbird assemblage	UK specific code
SBA	Breeding seabird assemblage	UK specific code
BBA	Breeding bird assemblage (applies only to sites classified pre 2000)	UK specific code

4.1 Habitat class code

CODE	DESCRIPTION	PAGE NO
N01	Marine areas, Sea inlets	65
N02	Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins)	65
N03	Salt marshes, Salt pastures, Salt steppes	65
N04	Coastal sand dunes, Sand beaches, Machair	65
N05	Shingle, Sea cliffs, Islets	65
N06	Inland water bodies (Standing water, Running water)	65
N07	Bogs, Marshes, Water fringed vegetation, Fens	65
N08	Heath, Scrub, Maquis and Garrigue, Phygrana	65
N09	Dry grassland, Steppes	65
N10	Humid grassland, Mesophile grassland	65
N11	Alpine and sub-Alpine grassland	65
N14	Improved grassland	65
N15	Other arable land	65
N16	Broad-leaved deciduous woodland	65
N17	Coniferous woodland	65
N19	Mixed woodland	65
N21	Non-forest areas cultivated with woody plants (including Orchards, groves, Vineyards, Dehesas)	65
N22	Inland rocks, Screes, Sands, Permanent Snow and ice	65
N23	Other land (including Towns, Villages, Roads, Waste places, Mines, Industrial sites)	65
N25	Grassland and scrub habitats (general)	65
N26	Woodland habitats (general)	65

4.3 Threats code

CODE	DESCRIPTION	PAGE NO
A01	Cultivation	65
A02	Modification of cultivation practices	65
A03	Mowing / cutting of grassland	65
A04	Grazing	65
A05	Livestock farming and animal breeding (without grazing)	65
A06	Annual and perennial non-timber crops	65
A07	Use of biocides, hormones and chemicals	65
A08	Fertilisation	65
A10	Restructuring agricultural land holding	65
A11	Agriculture activities not referred to above	65
B01	Forest planting on open ground	65
B02	Forest and Plantation management & use	65
B03	Forest exploitation without replanting or natural regrowth	65
B04	Use of biocides, hormones and chemicals (forestry)	65
B06	Grazing in forests/ woodland	65
B07	Forestry activities not referred to above	65
C01	Mining and quarrying	65
C02	Exploration and extraction of oil or gas	65
C03	Renewable abiotic energy use	65
D01	Roads, paths and railroads	65
D02	Utility and service lines	65
D03	Shipping lanes, ports, marine constructions	65
D04	Airports, flightpaths	65
D05	Improved access to site	65
E01	Urbanised areas, human habitation	65
E02	Industrial or commercial areas	65

CODE	DESCRIPTION	PAGE NO
E03	Discharges	65
E04	Structures, buildings in the landscape	65
E06	Other urbanisation, industrial and similar activities	65
F01	Marine and Freshwater Aquaculture	65
F02	Fishing and harvesting aquatic resources	65
F03	Hunting and collection of wild animals (terrestrial), including damage caused by game (excessive density), and taking/removal of terrestrial animals (including collection of insects, reptiles, amphibians, birds of prey, etc., trapping, poisoning, poaching, predator control, accidental capture (e.g. due to fishing gear), etc.)	65
F04	Taking / Removal of terrestrial plants, general	65
F05	Illegal taking/ removal of marine fauna	65
F06	Hunting, fishing or collecting activities not referred to above	65
G01	Outdoor sports and leisure activities, recreational activities	65
G02	Sport and leisure structures	65
G03	Interpretative centres	65
G04	Military use and civil unrest	65
G05	Other human intrusions and disturbances	65
H01	Pollution to surface waters (limnic & terrestrial, marine & brackish)	65
H02	Pollution to groundwater (point sources and diffuse sources)	65
H03	Marine water pollution	65
H04	Air pollution, air-borne pollutants	65
H05	Soil pollution and solid waste (excluding discharges)	65
H06	Excess energy	65
H07	Other forms of pollution	65
I01	Invasive non-native species	65
I02	Problematic native species	65
I03	Introduced genetic material, GMO	65
J01	Fire and fire suppression	65
J02	Human induced changes in hydraulic conditions	65
J03	Other ecosystem modifications	65
K01	Abiotic (slow) natural processes	65
K02	Biocenotic evolution, succession	65
K03	Interspecific faunal relations	65
K04	Interspecific floral relations	65
K05	Reduced fecundity/ genetic depression	65
L05	Collapse of terrain, landslide	65
L07	Storm, cyclone	65
L08	Inundation (natural processes)	65
L10	Other natural catastrophes	65
M01	Changes in abiotic conditions	65
M02	Changes in biotic conditions	65
U	Unknown threat or pressure	65
XO	Threats and pressures from outside the Member State	65

5.1 Designation type codes

CODE	DESCRIPTION	PAGE NO
UK00	No Protection Status	67
UK01	National Nature Reserve	67
UK04	Site of Special Scientific Interest (UK)	67
UK05	Marine Conservation Zone	67
UK06	Nature Conservation Marine Protected Area	67
UK86	Special Area (Channel Islands)	67
UK98	Area of Special Scientific Interest (NI)	67
IN00	Ramsar Convention site	67
IN08	Special Protection Area (SPA, EC Birds Directive)	67
IN09	Special Area of Conservation (SAC, EC Habitats Directive)	67

EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name:	Norfolk Valley Fens
Unitary Authority/County:	Norfolk
SAC status:	Designated on 1 April 2005
Grid reference:	TL937960
SAC EU code:	UK0012892
Area (ha):	616.21
Component SSSI:	Badley Moor, Dereham SSSI, Booton Common SSSI, Buxton Heath SSSI, Coston Fen, Runhall SSSI, East Walton Common and Adcock's Common SSSI, Flordon Common SSSI, Foulden Common SSSI, Great Cressingham Fen SSSI, Holt Lowes SSSI, Potter and Scarning Fens SSSI, Sheringham and Beeston Regis Common SSSI, South Repps Common SSSI, Swangey Fen, Attleborough SSSI, Thompson Water, Carr and Common SSSI

Site description:

This site comprises a series of valley-head spring-fed fens. Such spring-fed flush fens are very rare in the lowlands. The spring-heads are dominated by the small sedge fen type, mainly referable to black-bog-rush – blunt-flowered rush (*Schoenus nigricans – Juncus subnodulosus*) mire, but there are transitions to reedswamp and other fen and wet grassland types. The individual fens vary in their structure according to intensity of management and provide a wide range of variation. There is a rich flora associated with these fens, including species such as grass-of-Parnassus *Parnassia palustris*, common butterwort *Pinguicula vulgaris*, marsh helleborine *Epipactis palustris* and narrow-leaved marsh-orchid *Dactylorhiza traunsteineri*.

In places the calcareous fens grade into acidic flush communities on the valley sides. Purple moor-grass *Molinia caerulea* is often dominant with a variety of mosses including thick carpets of bog-moss *Sphagnum* spp. Marshy grassland may be present on drier ground and purple moor-grass is again usually dominant but cross-leaved heath *Erica tetralix* can be frequent. Alder *Alnus glutinosa* forms carr woodland in places by streams. Wet and dry heaths and acid, neutral and calcareous grassland surround the mires.

Within the Norfolk Valley Fens there are a number of marginal fens associated with pingos – pools that formed in hollows left when large blocks of ice melted at the end of the last Ice Age. These are very ancient wetlands and several support strong populations of Desmoulin's whorl snail *Vertigo moulinsiana* as part of a rich assemblage of rare and scarce species in standing water habitat. At Flordon Common a strong population of narrow-mouthed whorl snail *Vertigo angustior* occurs in flushed grassland with yellow iris *Iris pseudacorus*.

Qualifying habitats: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Alkaline fens. (Calcium-rich springwater-fed fens)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). (Alder woodland on floodplains)*
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*. (Calcium-rich fen dominated by great fen sedge (saw sedge))*
- European dry heaths
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*). (Purple moor-grass meadows)
- Northern Atlantic wet heaths with *Erica tetralix*. (Wet heathland with cross-leaved heath)
- Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*). (Dry grasslands and scrublands on chalk or limestone)

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Narrow-mouthed whorl snail *Vertigo angustior*
- Desmoulin's whorl snail *Vertigo moulinsiana*

Annex I priority habitats are denoted by an asterisk (*).

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0012892
Date of registration: 14 June 2005
Signed: [redacted]
On behalf of the Secretary of State for Environment, Food and Rural Affairs

European Site Conservation Objectives for Norfolk Valley Fens Special Area of Conservation
Site Code: UK0012892

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H4010. Northern Atlantic wet heaths with *Erica tetralix*; Wet heathland with cross-leaved heath

H4030. European dry heaths

H6210. Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*); Dry grasslands and scrublands on chalk or limestone

H6410. *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*); Purple moor-grass meadows

H7210. Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*; Calcium-rich fen dominated by great fen sedge (saw sedge)*

H7230. Alkaline fens; Calcium-rich springwater-fed fens

H91E0. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*); Alder woodland on floodplains*

S1014. *Vertigo angustior*; Narrow-mouthed whorl snail

S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail

* denotes a priority natural habitat or species (supporting explanatory text on following page)

*** Priority natural habitats or species**

Some of the natural habitats and species for which UK SACs have been selected are considered to be particular priorities for conservation at a European scale and are subject to special provisions in the Habitats Regulations. These priority natural habitats and species are denoted by an asterisk (*) in Annex I and II of the Habitats Directive. The term 'priority' is also used in other contexts, for example with reference to particular habitats or species that are prioritised in UK Biodiversity Action Plans. It is important to note however that these are not necessarily the priority natural habitats or species within the meaning of the Habitats Regulations.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

European Site Conservation Objectives: Draft Supplementary advice on conserving and restoring site features

Paston Great Barn Special Area of Conservation (SAC) UK0030235



Date of Publication: 11 January 2019

About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to Paston Great Barn SAC.

This advice should therefore be read together with the SAC Conservation Objectives available here.

This advice is draft pending comments from the site's stakeholders. In the interim, you should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England when developing, proposing or assessing an activity, plan or project that may affect this site.

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute.

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email HDIRConservationObjectivesNE@naturalengland.org.uk

About this site

European Site information

Name of European Site	Paston Great Barn Special Area of Conservation (SAC)
Location	Norfolk
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1st April 2005
Qualifying Features	See section below
Designation Area	0.95ha
Designation Changes	N/A.
Feature Condition Status	Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	Paston Great Barn SSSI
Relationship with other European or International Site designations	N/A

Site background and geography

The site is located in the North East Norfolk and Flegg Natural Character Area; a sparsely wooded, gently undulating landscape characterised by small to medium-scale fields. A dense network of lanes provides connectivity between the many farmsteads and small nucleated villages, the majority of which have large medieval churches.

Paston Great Barn is one of the best preserved, and few remaining, Great Barns left in England. It is located in northwest Norfolk and is situated 13km to the south east of Cromer, just outside the village of Paston.

The barn is the largest building of a complex of closely linked vernacular agricultural buildings, which were erected over a period spanning 300 years between 1580 and 1870. The Great Barn itself is a designated Scheduled Ancient Monument. With the exception of the open-fronted southern boundary barn, the complex of buildings attached to the Great Barn are listed as Grade II* buildings.

The Great Barn measures approximately 70 metres long, by 9 metres wide and 16 metres high at its apex. The walls are primarily constructed of coursed, unknapped flint, averaging about 1m in thickness and tapering with height.

It has a complex roof structure that contains a multitude of voids. Many of these provide suitable roosting locations for bats. The walls also contain many cracks and crevices that support roosting bats. The thick walls help to regulate the temperature inside the barn and the barn's north-south orientation helps to ensure that in the winter, the western side maintains the constant cool conditions required by hibernating bats whilst, in the summer, the east facing side provides the warmth required by the maternity colonies for raising their young.

In addition to using the barn as a roosting location, bats also forage inside the barn, as well as using it as a mating site in the autumn.

Paston Great Barn supports an exceptional assemblage of bat species and represents one of the few known maternity roosts of Barbastelle bat *Barbastella barbastellus* in the UK (as well as one of the only confirmed Barbastelle maternity roosts in a building in the UK). In total, five species of bat are known to have used the buildings: Barbastelle, Brown Long-eared *Plecotus auritus*, Common Pipistrelle *Pipistrellus pipistrellus*, Soprano Pipistrelle *Pipistrellus pygmaeus,* Nathusius' Pipistrelle *Pipistrellus nathusii* and Natterer's *Myotis nattereri*. In addition, a further two species have been recorded from around the buildings: Noctule *Nyctalus noctula* and Daubenton's Bat *Myotis daubentonii*.

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying Species:

The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- **S1308. Barbastelle bat *Barbastella barbastellus***

The Barbastelle is a medium-sized bat by British standards, with a forearm length of between 35-43mm and a body weight of between 6-13 grams. They are a distinctive looking species with creamy/golden-tipped blackish fur. Their short, broad ears are joined in the centre of their forehead, giving them a 'pug-like' expression.

The species is found from Morocco to southern Britain and eastward to the Caucasus. However, it is absent from much of southern Europe. The species is considered to be a rare and declining species throughout Western Europe and is listed as endangered or vulnerable in most European countries. Barbastelle bats are one of the UK's rarest mammals. The Barbastelle is listed in the European and British Red Data Book (RDB) as a rare and threatened species. The UK Biodiversity Action Plan estimated the UK population to be approximately 5,000 individuals and states that the overall population trend is unknown.

Paston Great Barn SAC has been selected for classification as an example of a Barbastelle bat maternity colony however studies have shown that Barbastelle bats use Paston Great Barn throughout the year with activity recorded in every month. On occasions, Barbastelle bats have been found roosting within the Great Barn and surrounding sheds. Activity in the autumn suggests that the species may also use the building for mating. However, nothing is known about how many bats hibernate at the site or how they use the building outside of the breeding season.

All species of bat present in the UK, including the Barbastelle, are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and Schedule 2 of the Conservation of Habitats and Species Regulations 2017, making it a 'European Protected Species'. A Licence may therefore be required for any activities likely to harm or disturb individual bats at any time of year.

Further information can be found in Annex 1.

Table A: Site-specific seasonality of SAC feature

The table below highlights in grey those months in which significant numbers of each mobile qualifying feature are most likely to be present at the SAC during a typical calendar year. This table is provided as a general guide only.

Unless otherwise indicated, the months shown below are primarily based on information relating to the general months of occurrence of the feature in the UK. Where site-based evidence is available and has been used to indicate below that significant numbers of the feature are typically present at this SAC outside of the general period, the site-specific references have been added to indicate this.

Applicants considering projects and plans scheduled in the periods highlighted in grey would benefit from early consultation with Natural England given the greater scope for there to be likely significant effects that require consideration of mitigation to minimise impacts to qualifying bat features during the principal periods of site usage by those features. The months which are *not* highlighted in grey are not ones in which the features are necessarily absent, rather that features may be present in less significant numbers in typical years. Furthermore, in any given year, features may occur in significant numbers in months in which typically they do not. Thus, applicants should not conclude that projects or plans scheduled in months not highlighted in grey cannot have a significant effect on the features. There may be a lower likelihood of significant effects in those months which nonetheless will also require prior consideration.

Any assessment of potential impacts on the features must be based on up-to-date count data and take account of population trends evident from these data and any information. Additional site-based surveys may be required.

Feature	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Site-specific references where available
Barbastelle	Breeding													

Table 1: Supplementary Advice for Qualifying Features: S1308. *Barbastella barbastellus*; Barbastelle bat

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population of Barbastelle	Population abundance - maternity colony	Maintain or increase the breeding population at, or above, 28 females (the baseline at notification)	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be considered in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available. The population at Paston is measured through analysis of video recordings timed to capture the peaks in pre and post-parturition maternity colony numbers. Population numbers require careful interpretation and should be assessed in conjunction with other data pertaining to the site/population. The likelihood that the barbastelle maternity roost also uses locations as yet unknown in the roof structure (or outside of the Great Barn) significantly limits our ability to interpret the results of the monitoring data. Barbastelle bats regularly move roosts and colonies tend to split and coalesce depending upon the prevailing environmental conditions. Radio-tracking studies carried out by the Norfolk Barbastelle Study Group have shown that during the maternity season colonies tend to occupy several roost locations simultaneously - a main maternity roost, as well as numerous outlying 'satellite' roosts **(1, 4)**. If this situation is mirrored at Paston Great Barn, then the bats present in the main door lintels may only represent a small proportion of the overall colony using the barn. In addition, core roosts observed elsewhere have been shown to vary considerably in size during the maternity period as satellite clusters split from or coalesce with them. The uncertainty that exists over what proportion of the overall colony uses the main door lintels at any one time is a major constraint to interpreting the annual count data and reduces confidence in the reliability of population trends based on these data. The colony count data from 1996 to 2007 suggest that, in Paston Great Barn, colony size decreases once peak counts reach 45 to 50 bats. Splinter groups from the maternity colony may use alternative roosts either inside or outside Paston Great Barn.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			More information is required on how the metapopulation at/around Paston functions in order to allow the results of monitoring of the lintels in the barn to be accurately interpreted.	
Supporting habitat: extent and distribution	Distribution of supporting habitat	Maintain the distribution and continuity of potential roost sites within the site, the spatial distribution of window openings/ventilation slots and entry/exit points and the distribution of plant communities surrounding the barn used for foraging.	Changes in the spatial distribution of the Barbastelle bat throughout the site (resulting from changes to the buildings and/or surrounding habitat) will reduce the species' resilience to future environmental changes e.g., climate change **(4).** Changes to the distribution of external openings will affect air flow, temperature, noise and dust levels in the interior of the buildings. Such changes may adversely impact on the species' viability at this site. Any alteration to the distribution of the surrounding habitat may also affect the species' ability to survive at the site by altering prey species abundance/species composition, air flows and temperature. Changes to vegetation structure may reduce the availability of darkened flyways which, in turn, may reduce the species' ability to avoid predators in the period following emergence or before returning to roost.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.
Supporting habitat: extent and distribution	Extent of supporting habitat	Maintain the quantity of varied, suitable roost locations within the buildings, the number of window openings/ventilation slots and entry/exit points, the internal volume available for flyways and the extent of rough grassland surrounding the barn used for foraging.	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review considering improvements in data. Paston Great Barn and the adjoining buildings support a multitude of roost sites Barbastelle bats. The earliest annual observations of the barbastelle colony have consistently been in the north large door lintel, and the colony has always moved to the south large door lintel later in the maternity season, either before or during the young being born.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			In addition, the colony has been observed in 18 other locations within the barn; mainly gaps in the timbers over the window slits and the roof timbers. A detailed visual inspection of the lower level roof timbers by Ash Murray in February and March 2009 recorded droppings (barbastelle, Natterer's, brown-long eared and pipistrelle) in many of the joints. There are also numerous other potential roosting sites in the roof which are inaccessible for inspection and difficult to view for emergence surveys. The number of roost sites inside the barn used by barbastelles is likely to be much greater than the 18 which have been identified so far. Also, the extent to which different roosts are in simultaneous use is yet to be determined. The colony count data from 1996 to 2007 suggest that, in Paston Great Barn, colony size decreases once peak counts reach 45 to 50 bats. Splinter groups from the maternity colony may use alternative roosts either inside or outside Paston Great Barn. It is not known to what extent the barbastelles using Paston Great Barn are limited by roost site availability. Radio-tracking studies carried out elsewhere by the NBSG and others have shown that barbastelle bats regularly change roost locations throughout the maternity season in woodland. If the barbastelle bats at Paston Great Barn were limited in their choice of suitable alternative roost sites, then this may account for the larger than average peak roost counts noted above **(1)**. To date, no roost locations for the maternity colony have been identified outside the barn, either in the adjoining cartsheds or in trees or buildings away from the site.	
Supporting habitat: structure/ function	External condition of building - maternity colony	Maintain the structural integrity and weatherproofing of roof, walls and rainwater goods, with no significant shading of the main roost area by trees/vegetation or	Damp, draught and increases in light levels are likely to have a negative effect on the temperature and humidity of the roost **(4)**.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		man -structures.		
Supporting habitat: structure/ function	Flight lines from roost into surrounding habitat and foraging areas	Maintain the presence, structure and quality of any linear landscape features which function as flight lines. Flight lines should remain unlit, functioning as dark corridors.	Barbastelles feed mainly on small moths, some flies and beetles. They forage up to 5-7 km from their roosts, although some individuals in less favourable habitat may forage further to reach suitable feeding grounds (Greenaway, 2001). Generally forages within woodland canopy and margins, though will feed in more open areas i.e., orchards, suburban parks. Barbastelle bats commute and forage along linear landscape features such as woodland edge, waterways, tree or hedge-fringed roads, hedgerows etc., though will cross extensive open areas (i.e., arable fields) to reach foraging grounds and may feed to a certain extent within these more open areas. Flight lines will extend beyond the designated site boundary into the wider local landscape. Such flight-lines should remain dark, unlit and well-connected to roosting and feeding areas. Radiotracking studies **(1, 2, 3)** have demonstrated the importance of linear habitat features surrounding this site. These should be maintained and, where possible, improved to ensure a continuity of cover (trees/hedges), a diverse mix of tree and shrub species are present and that hedges are allowed to grow tall and broad.	Please refer to References . Number in brackets in supporting notes text refers to the relevant reference.
Supporting habitat: structure/ function	Internal condition of building - maternity	Maintain appropriate light levels, humidity, temperature and ventilation.	The requirements of these species vary greatly throughout the maternity period and they will shift their roost sites accordingly. There is currently insufficient information available in the academic press to provide specific targets on humidity, temperature, light levels and ventilation preferred by the species during the hibernation and maternity period. Relative humidity and temperature data within the roost site have been collected since 1996 **(1, 2, 3, 4)**. Specific data for this site can be provided by contacting Natural England.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.
Supporting habitat: structure/ function	Roost access	Maintain the number of access points to the roost at an optimal size and in an unlit and unobstructed state, with surrounding vegetation providing	This will prevent any negative internal climatic changes within the roost and maintain the ability of bats to freely enter and leave the roost as necessary **(1, 4)**.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		sheltered flyways without obstructing access.		
Supporting habitat: structure/ function	Woodland site - maternity colony	Restore the extent and structural diversity of supporting woodland habitat used for feeding and foraging.	The structural diversity of supporting habitat will be important to maintain optimal feeding and foraging conditions near maternity roosts; key aspects of woodland structure will include good canopy cover (typically 50-90%), an abundance of standing and fallen dead wood, areas of permanent and open space and the retention of open water and/or wetland features. Paston Great Barn supports a young, small stand of sycamore. This provides cover for bats as they emerge from the barn and should be maintained **(4)**. The area surrounding the site supports several small parcels of woodland. These should be managed to ensure that their extent and structural diversity is maintained. Where possible, additional woodland (strips or blocks) should be planted in the surrounding area.	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.
Supporting processes (on which the Barbastelle bat maternity roost and/or its supporting habitat relies)	Water quantity/quality	Restore water quality and quantity to a standard which provides the necessary conditions to support the Barbastelle colony.	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can directly affect individuals within the colony (alterations to drinking water supply) and indirectly through changes to the supporting habitats (changing species composition and abundance). Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but, in some cases, more stringent standards may be needed to reflect the ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC. The Barbastelle bat is often described as a species preferring riparian woodland. In Norfolk, Barbastelle bat colonies exist in a variety of woodland types, including both wet and dry woodland. However, in most situations, the woodland supporting the maternity roost is near water (either ponds, streams or other wetland habitats). There are a number of	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			possible reasons for the Barbastelle's general association with water. The most obvious, direct link is that they require water for hydration, especially whilst lactating. However, wetland habitats are also important for foraging, supporting a range and abundance of suitable food species. Linear wetland habitats, such as streams, provide corridors, along which Barbastelles can forage and move through the countryside. In addition, wetland habitats often support large amounts of dead, dying or damaged trees that provide suitable roost sites for this species (e.g., delaminated bark slabs, collars of bark around dead branches, cracks and crevices). In contrast to most other Barbastelle maternity roosts in Norfolk, the colony at Paston is not near wetland habitats. The closest streams are over one mile away: Mundesley Beck is located 1.7 kms to the NW and a tributary of the Dilham Canal is located 2.7 kms to the SW. In addition, Paston village has a permanent pond, located 0.6 kms to the NW. Paston Hall used to have a swimming pool which the Barbastelles used to drink from upon emerging from the roost, but this is no longer in existence. The grounds to the barn have two infilled ponds that would once have served as drinking ponds for livestock and work horses. One of these was re-excavated in 2005 but developed a leak and has since failed to consistently hold water **(4)**.	
Supporting processes (on which the feature and/or its supporting habitat relies)	Adaptation and resilience	Maintain the ability of the Barbastelle colony and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site.	This recognises the increasing likelihood of supporting habitat features to absorb or adapt to wider environmental changes. Resilience may be described as the ability of an ecological system to cope with and adapt to environmental stress and change whilst retaining the same basic structure and ways of functioning. Such environmental changes may include changes in precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of the Barbastelle bat colony within this site. The vulnerability and response of Barbastelle bats to such changes will vary. Using best available information, any necessary or likely adaptation or adjustment by the feature and its	Please refer to References. Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			management in response to actual or expected climatic change should be allowed for, as far as practicable, in order to ensure the feature's long-term viability. No information on the direct effect of environmental changes on barbastelle bats is known. The overall vulnerability of this particular SAC to climate change has been assessed by Natural England (5) as being low, taking into account the sensitivity, fragmentation, topography and management of its supporting habitats; this means the site is considered to be vulnerable overall but are a lower priority for further assessment and action. Individual species may be more or less vulnerable than their supporting habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable	
Supporting processes (on which the feature and/or its supporting habitat relies)	Air quality	Restore concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	Broad-leaved woodland is ley supporting habitat for the Barbastelle bat colony at Paston Great Barn and is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition (including food-plants), changing invertebrate species diversity and abundance; In turn, reducing supporting habitat quality and population viability of the Barbastelle bat colony. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH3), oxides of nitrogen (NOx) and sulphur dioxide (SO2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales. Currently (July 2018) the Air Pollution Information System (APIS) shows that deposition of both nitrogen and acidity in this area is above the critical load, indicating that these pollutants will be affecting the woodland habitat of the barbastelle bats outside of this SAC. No data are available on the significance of this effect at this site level, or if there is any direct effect on the bats themselves.	
Supporting processes (on which the feature and/or its supporting habitat relies)	Conservation measures	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the Barbastelle colony and its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. Radiotracking studies at this site have shown that the bats using Paston Great Barn travel several kilometres to forage **(2, 3)**. Thus, conservation measures outside the boundary of the SAC are also critical for the continued survival of the colony e.g., planting new woodlands to provide additional roosts for the future, managing hedges appropriately, establishing flower-rich grasslands, restoring/creating ponds etc. Tracking studies in the surrounding area have also confirmed the presence of other maternity roosts and, whilst no cross-over has been found to date, it is highly likely that the Barbastelle bats at Paston Great Barn form part of a larger metapopulation. Tracking of Barbastelle bats elsewhere in Norfolk (e.g., Ken Hill Woods, nr Snettisham) has confirmed the presence of satellite colonies in the vicinity of maternity roosts and has shown that	Please refer to References. Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			individual females move between different maternity roost loci within the wider area. It is likely that this is also the case at Paston. If so, then the survival of the colony at Paston may well be reliant upon the continued survival of other colonies within the wider area.	
Supporting processes (on which the feature and/or its supporting habitat relies)	Disturbance from human activity	Control and minimise human access to roost sites.	Site should be secured against unauthorised access, which can result in disturbance to bats at critical times of year and which can affect their population viability and use of the site. Doors on site access points should be kept locked and maintained **(4).**	Please refer to References. Number in brackets in supporting notes text refers to the relevant reference.
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: Attributes relating to **Hibernation roost** have been removed as although bats may be present all year round, the SAC is selected as an example of a maternity roost for this species. All species of bat present in the UK, including the Barbastelle, are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and Schedule 2 of the Conservation of Habitats and Species Regulations 2017, making it a 'European Protected Species'. A Licence may therefore be required for any activities likely to harm or disturb individual bats at any time of year. Attribute on **Soils, substrate and nutrient cycling** removed, as not relevant at this site. Target on population abundance of maternity roost modified to fit this site.				

References

1. Harris, J. 2013. Paston Great Barn NNR. Review of Barbastelle Maternity Roost Colony Monitoring 1996-2012.

2. Harris, J. 2014. Paston Great Barn NNR. Barbastelle Colony Monitoring and Radiotracking Report 2014

3. Harris, J. 2017. Paston Great Barn NNR. Barbastelle Colony Monitoring Report.

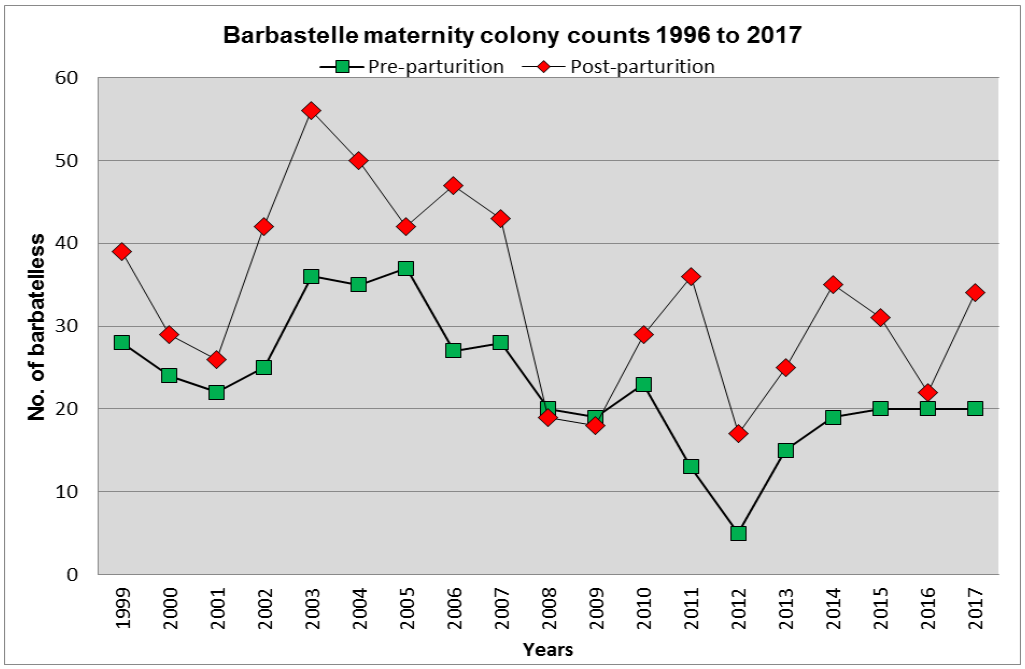
4. Murray, A.R. 2015. Paston Great Barn Management Plan 2015-2020.

5. Natural England, 2015. Climate Change Theme Plan and supporting National Biodiversity Climate Change Vulnerability assessments (NBCCVAs) assessments for SACs and SPAs in England. Available at http://publications.naturalengland.org.uk/publication/4954594591375360

Annex 1: The Barbastelle colony at Paston Great Barn

The Barbastelle colony at Paston Great Barn was first discovered in 1996 and has been the subject of various research and monitoring studies that have provided a great deal of information about roost sites, the size and behaviour of the Barbastelle colony and commuting and foraging activity.

Figure 1: Barbastelle maternity colony counts 1996 to 2017 (*taken from Harris, J. 2017*)



Monitoring of the maternity cluster shows that it has supported approximately 5 and 37 adult females between 1996 and 2017. The counts of Barbastelle bats (adults and adults and young) undertaken since 1996 are presented in Table 1 below.

Table 1. Summary of colony counts since observations started in 1996 (*taken from Harris, J. 2017*)

Year	Adults	Number of Obs.	Mean	S.D.	Adults & young	Number of Obs.	Mean	S.D.
1996	unknown				40(±10%) *			
1997	unknown				50(±10%) *			
1998	30 *				60(±10%) *	43 #		
1999	28 #	4	26	3.5	39 #	5	34	6.84
2000	24 #	10	23	2.37	29 #	4	28	2
2001	22 ~				26 ~			
2002	25 #	10	24	2.3	42 #	9	38	3.28
2003	36#	5	31	2.88	56#	5	51	8
2004	35#	4	34	0.5	50#	5	44	7.44
2005	37#	4	34	1.89	42#	8	35	4.71
2006	27#	3	27	0	47#	6	44	2.84
2007	28#	3	23	9.24	43#	4	33	10.14
2008	20#	2	19	1.41	19#	1**		
2009	19#	3			18#	1**		
2010	23#	3	21	0	29 ~			
2011	13**	2			37#	3	34	2
2012	5*				17#	4	15	
2013	15^				25^			
2014	19^				35^			
2015	20^				31^			
2016	20^				22^			
2017	20^				34^			

* maximum numbers counted by visual observation of colony

\# maximum numbers counted emerging from colony on video tape

~ single count from video tape

** some recordings unsuccessful

^ continuous nightly video recording

Use of the Great Barn by Barbastelles:

Observations made during monitoring between 1996 and 2017 indicate that the Great Barn is used as a maternity roost and as a hibernation roost. Radio tracking also suggests that the Great Barn may also be used for mating purposes. The Great Barn and adjacent buildings are therefore vital to the survival of the Barbastelle colony providing suitable roosting habitat throughout the year.

The Barbastelles roost in many different parts of the Great Barn often moving from one roosting location to another. They select open roost sites and are therefore more likely to be vulnerable to disturbance than other species such as Natterer's bat, which occupies internal crevices in beams.

In total, Barbastelles have been recorded from 19 different roost locations within the Great Barn. The main breeding clusters are usually located between the large oak lintels over the cargo doors, but on a number of occasions, the clusters could not be found suggesting they are using other parts of the barn yet to be identified, possibly higher in the roof structure.

In general terms, the breeding clusters form in early May (earliest date 28th April in 2007 & 2010) and remain well into September, or sometimes persisting until early October (latest recorded dispersal date 25th October) . After September, Barbastelle bats have either been seen in roost sites or recorded on bat detectors throughout the winter period. It is considered likely that Barbastelles are roosting in the Great Barn throughout the whole winter period and are active at different times throughout the winter.

Table 2. Barbastelle maternity cluster arrival and dispersal dates.

Year	Maternity colony formed	First young born	First young flying	Maternity group dispersed (not seen in door lintels)	Total days present
1999	13-May	#	26-Jul – 01 Aug	26-Aug	106
2000	24-May	#	07 Aug – 14 Aug	06-Sep	106
2001	01-Jun	#	#	04-Oct	126
2002	28 -May	01 Jul – 07 Jul	24-Jul –30 Jul	22-Sep	118
2003	28 -May	#	#	23-Sep	119
2004	22-May	#	#	21-Sep	123
2005	27-May	17 Jul – 20 Jul	#	28-Sep	124
2006	4-May	#	#	28-Aug	117
2007	30-April	26 Jun – 28 Jun	16 Jul – 19 Jul	5-Aug	98
2008	23-May	#	#	29-Aug	99
2009	1-May	#	#	10-Aug	102
2010	30-April	#	#	11-Aug	104
2011		#	#		
2012	9-June	#		25-Oct	138
2013	3-May^	20 July	6 – 16 Aug	30-Sept	152
2014	18-May^	24 Jun – 29 Jun	13 – 21 Jul	13-Aug	91
2015	4-May^	3 Jul – 10 Jul	26 Jul – 3 Aug	5-Oct	155
2016	8-June^	7 Jul – 11 Jul?	28 Jul – 7 Aug	22-Aug	75
2017	23-June^	6 Jul -13 July	24 – 28th July	30-Aug	68

All figures are estimates
 # insufficient observations to make estimate
^ Continual emergence counts allowing more accurate determination of peak numbers

The likelihood that the barbastelle maternity roost also uses locations as yet unknown in the roof structure (or outside of the Great Barn) significantly limits our ability to interpret the results of the monitoring data. Barbastelle bats regularly move roosts and colonies tend to split and coalesce depending upon the prevailing environmental conditions. Radiotracking studies carried out by the Norfolk Barbastelle Study Group have shown that during the maternity season colonies tend to occupy several roost locations simultaneously - a main maternity roost, as well as numerous outlying 'satellite' roosts. More information is required on how the metapopulation at/around Paston functions in order to allow the results of monitoring of the lintels in the barn to be accurately interpreted.

Emergence of Barbastelle bats from maternity clusters:
Barbastelles leave their roost site in the Great Barn approximately twenty minutes before emerging from the barn. During this time they fly around inside the barn checking other roost sites and interacting with other bats present.

The emergence from the Great Barn itself appears to coincide with the light levels inside the barn being roughly equivalent to external light levels. This behaviour is reported at woodland Barbastelle sites where the bats fly inside the dark tree canopy for about the same period as the bats stay in the barn at Paston.

Early in the breeding season, juvenile bats remain in the roost, as they are unable to fly. As soon as they are able to fly, however, they also leave the roost. Early in the breeding season bats come and go throughout the hours of darkness, but from approximately August onwards the bats stay away from the roost for most of the hours of darkness.

Barbastelle commuting and foraging activity:

Radio tracking studies and video monitoring of the barn indicate that Barbastelles currently leave the barn through two principal entrances: over the top of the large southern threshing door and window Slit 5 into the central covered shed on the east side of the Great Barn. Other exit routes are used in addition to the aforementioned.

Upon leaving the Great Barn, the Barbastelle bats have been recorded flying beneath the open-fronted sheds on the eastern side and to the south of the Great Barn before dispersing to feeding areas. Barbastelles also fly around the sheds prior to dawn before returning to the roost site. The covered sheds are thought to provide important cover from predators and an area used for social interaction between individual bats.

Results of radio tagging in 2000 of a female and a male Barbastelle bat indicate that the preferred feeding area of the female included areas around Stow windmill and along the cliffs south of Mundesley. Both male and female foraged along the cliffs when the wind was not off the sea. The male, however, predominantly foraged to the south of the site along woodland rides, hedges, roads and paths enclosed by overhanging trees. The male never roosted during the day in the barn, but did visit in the evenings. It was located roosting in three different places under bark of dead or dying trees. Two near Bacton Wood and one by the road side at Paston Green.

More recently, in 2013, 2014 and 2015, a significant amount of radio tracking has been carried out by Jane Harris. This has greatly improved our understanding of how the bats using Paston Great Barn forage in the wider area.

The total number of adult female barbastelle bats tracked in 2013 and 2014 and the tracking period are summarised in table 3 below.

Table 3. Summary of radio tracking in 2013 & 2014 (*taken from Harris, J. 2014*)

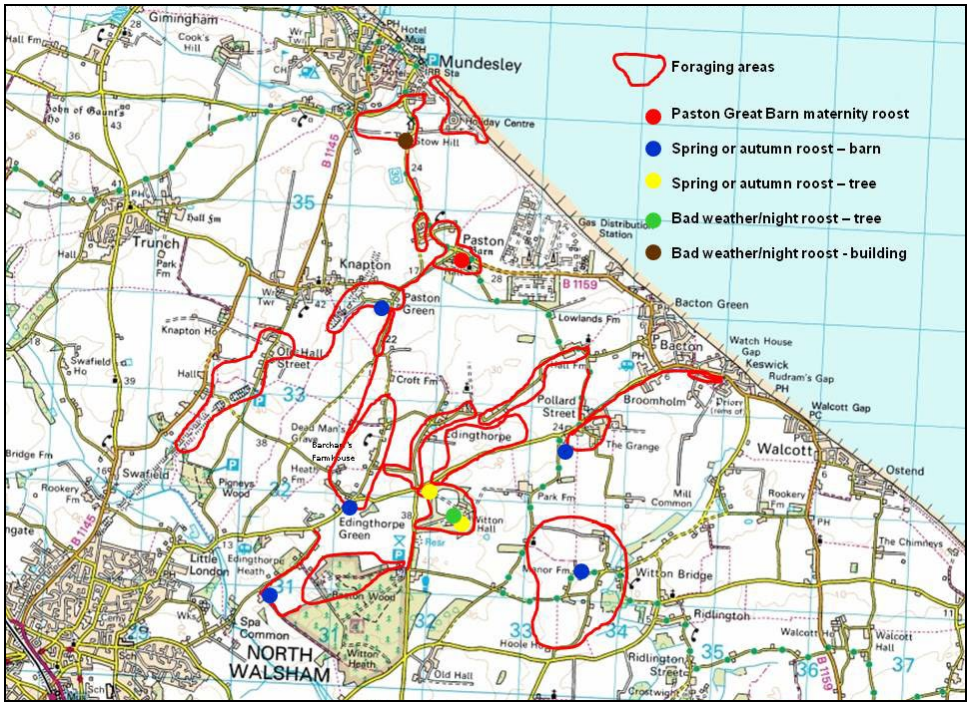
Tracking period	**No. of bats tracked**	
	2013	**2014**
May	-	2
Mid-July to August	3	3
September to October	2	2
Total	5	7 (included 2 bats tagged in 2013)
Colony count (adult females)	15	19
% of colony tagged	33	37

Apart from several barbastelle bats ringed in 2000, no further ringing has been carried out and there is been no way of identifying which animals have been trapped in previous years, except where evidence of fur clipping was apparent. In 2014, two female barbastelle bats were caught and tagged which showed signs of fur clipping. These were judged to have been tagged in the previous autumn. These have provided information on inter-annual differences in foraging and roosting behaviour.

All sites regularly used for foraging during 2013 & 2014 were within 4km of the Great Barn. So far, it appears that the coast is only used for foraging during the maternity period.

All females had alternative inland foraging areas and, in some cases, shared foraging locations. Both the coast and inland foraging areas may be used in the same night, sometimes on multiple occasions each night.

Map 1: Summary of Barbastelle radio tracking in 2013 & 2014 (taken from Harris, J. 2014. Paston Great Barn NNR. Barbastelle Colony Monitoring and Radiotracking Report 2014).



The recent radio tracking has highlighted the importance of undeveloped barns as favoured roost sites for female barbastelle bats dispersing from the maternity colony at the Great Barn. Whilst tagged bats from the NNR have also been recorded using trees for roosting, the number of suitable woodlands for in the area is limited, perhaps increasing the importance of barns as post maternity roosting locations.

Refer to Harris, J. 2015 Barbastelle Colony Monitoring and Radiotracking Report 2014 for a map detailing foraging locations for these radio tracking surveys.

Barbastelle metapopulation research:

A key reason for setting up the Norfolk Barbastelle Study Group was to instigate research into the species that would help to further our understanding of how isolated or otherwise the barbastelle colony at Paston is (and other colonies across Norfolk).

In 2014, Natural England commissioned Jane Harris and the John Innes Centre to carry out a trial project to test the validity of using faecal matter as the source material for DNA extraction, amplification and sequencing. This project proved successful and demonstrated the efficacy of using faecal matter for this purpose, thus negating the need to rely on wing punches. This non-invasive technique provides significant opportunities for increasing our understanding of barbastelle metapopulation dynamics and, therefore, conserving the species in the long term.

The phylogenetic tree that was created using the data from the study showed a level of genetic variation in Norfolk populations; with the Paston haplotypes (which also include the Witton, Felbrigg and Watlington females) separating from the Lenwade, Blickling, Sheringham and Barningham haplotypes. The continuation of this project will enable the development of a better 'library' of mitochondrial material for analysis.

EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name: Paston Great Barn

Unitary Authority/County: Norfolk

SAC status: Designated on 1 April 2005

Grid reference: TG322345

SAC EU code: UK0030235

Area (ha): 0.95

Component SSSI: Paston Great Barn SSSI

Site description:
Paston Great Barn is the only known example of a maternity roost of barbastelle bats *Barbastella barbastellus* in a building. The Barn is a 16th century thatched barn with associated outbuildings. A maternity colony of barbastelles utilises a range of cracks and crevices in the roof timbers for roosting.

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Barbastelle bat *Barbastella barbastellus*

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0030235
Date of registration: 14 June 2005
Signed: [redacted]
On behalf of the Secretary of State for Environment, Food and Rural Affairs

European Site Conservation Objectives for Paston Great Barn Special Area of Conservation Site code: UK0030235

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of the habitats of qualifying species**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

S1308*. Barbastella barbastellus*; Barbastelle bat

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the “Habitats Regulations”). They must be considered when a competent authority is required to make a ‘Habitats Regulations Assessment’, including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term ‘favourable conservation status’ is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name: River Wensum

Unitary Authority/County: Norfolk

SAC status: Designated on 1 April 2005

Grid reference: TG022176

SAC EU code: UK0012647

Area (ha): 381.74

Component SSSI: River Wensum SSSI

Site description:
The Wensum is a naturally enriched, calcareous lowland river. The upper reaches are fed by springs that rise from the chalk and by run-off from calcareous soils rich in plant nutrients. This gives rise to beds of submerged and emergent vegetation characteristic of a chalk stream. Lower down, the chalk is overlain with boulder clay and river gravels, resulting in aquatic plant communities more typical of a slow-flowing river on mixed substrate. Much of the adjacent land is managed for hay crops and by grazing, and the resulting mosaic of meadow and marsh habitats, provides niches for a wide variety of specialised plants and animals.

Ranunculus vegetation occurs throughout much of the river's length. Stream water-crowfoot *R. penicillatus* ssp. *pseudofluitans* is the dominant *Ranunculus* species but thread-leaved water-crowfoot *R. trichophyllus* and fan-leaved water-crowfoot *R. circinatus* also occur in association with the wide range of aquatic and emergent species that contribute to this vegetation type. The river supports an abundant and rich invertebrate fauna including the native freshwater crayfish *Austropotamobius pallipes* as well as a diverse fish community, including bullhead *Cottus gobio* and brook lamprey *Lampetra planeri*. The site has an abundant and diverse mollusc fauna which includes Desmoulin's whorl-snail *Vertigo moulinsiana*, which is associated with aquatic vegetation at the river edge and adjacent fens.

Qualifying habitats: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. (Rivers with floating vegetation often dominated by water-crowfoot)

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*
- Bullhead *Cottus gobio*
- Brook lamprey *Lampetra planeri*
- Desmoulin's whorl snail *Vertigo moulinsiana*

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0012647
Date of registration: 14 June 2005
Signed: [redacted]
On behalf of the Secretary of State for Environment, Food and Rural Affairs



Harbour Porpoise (*Phocoena phocoena)* possible Special Area of Conservation:

Southern North Sea

<u>Draft</u> Conservation Objectives and Advice on Activities

January 2016

Advice under Regulation 18 of The Offshore Marine Conservation (Natural Habitats, *etc*.) Regulations 2007 (as amended), and Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended).

Further information

This document is available as a pdf file on the JNCC website for download if required (www.jncc.defra.gov.uk).

Please return comments or queries to:

Marine Species Advice Team

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Inverdee House

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AB11 9QA

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Summary of Conservation Objectives and Advice on Activities

The Conservation Objectives and Advice on Activities are set out for the Southern North Sea possible SAC (pSAC) for the Annex II species harbour porpoise (*Phocoena phocoena*). The site covers both inshore (within 12 nautical miles of coast) and offshore (beyond 12 nautical miles of coast) waters where Natural England (NE) and the Joint Nature Conservation Committee (JNCC) have respective advisory responsibilities.

The general objective of achieving or maintaining Favourable Conservation Status (FCS) for all species and habitat types listed in Annexes I and II of the Habitats Directive needs to be translated into site-level Conservation Objectives. These describe the condition to be achieved by species and habitat types within the sites in order for the site to contribute in the best possible way to achieving FCS at the national, bio-geographical and European level. The Conservation Objectives have been developed for the feature (harbour porpoise) throughout the recommended possible SAC network to ensure coherence across the network. This is also appropriate for a wide ranging, mobile and continuous population. The Advice on Activities is site-specific but based on a broad assessment of the sensitivity of the harbour porpoise to man-made pressures at a UK scale. The advice has been developed using the best-available scientific information and expert interpretation as at November2015. The advice provided here will be subject to change as our knowledge about the site and the impacts of human activities improve.

The site should be managed in a way that ensures that its contribution to the maintenance of the harbour porpoise population at FCS is optimised. This may require management of human activities occurring in or around the site if they are likely to have an adverse impact on the site's Conservation Objectives either directly or indirectly identified through the assessment process. Management of activities that may affect processes on which the harbour porpoise is dependent, e.g. recruitment of prey species from supporting habitats, cannot be considered at present due to insufficient (often no) evidence linking habitat characteristics to prey of the harbour porpoise. There is some information on the prey of harbour porpoises, but their prey preferences whilst within the sites are not well known. It should be noted that as European Protected Species under Annex IV of the Habitats Directive, harbour porpoise are already strictly protected wherever they are in European waters. As such several management measures are already in place in the UK.

To fulfil the Conservation Objectives for the Southern North Sea harbour porpoise site, the relevant[1] and competent[2] authorities should consider human activities within their remit which might affect the integrity of the site.

[1] Relevant authorities are those who are already involved in some form of relevant marine regulatory function and would therefore be directly involved in the management of a marine site.

[2] A competent authority is any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office.

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1 Introduction

1.1 Background

A potential network of eight sites was identified within UK waters for harbour porpoise (*Phocoena phocoena*). Sites were identified within the UK portions of Management Units (MUs) defined for the species (ICES, 2014; IAMMWG, 2015a). The Welsh and Northern Ireland Governments, along with Defra on behalf of England and offshore waters, gave approval for sites within their areas of jurisdiction to proceed to consultation. The resulting five sites are shown in Figure 1.

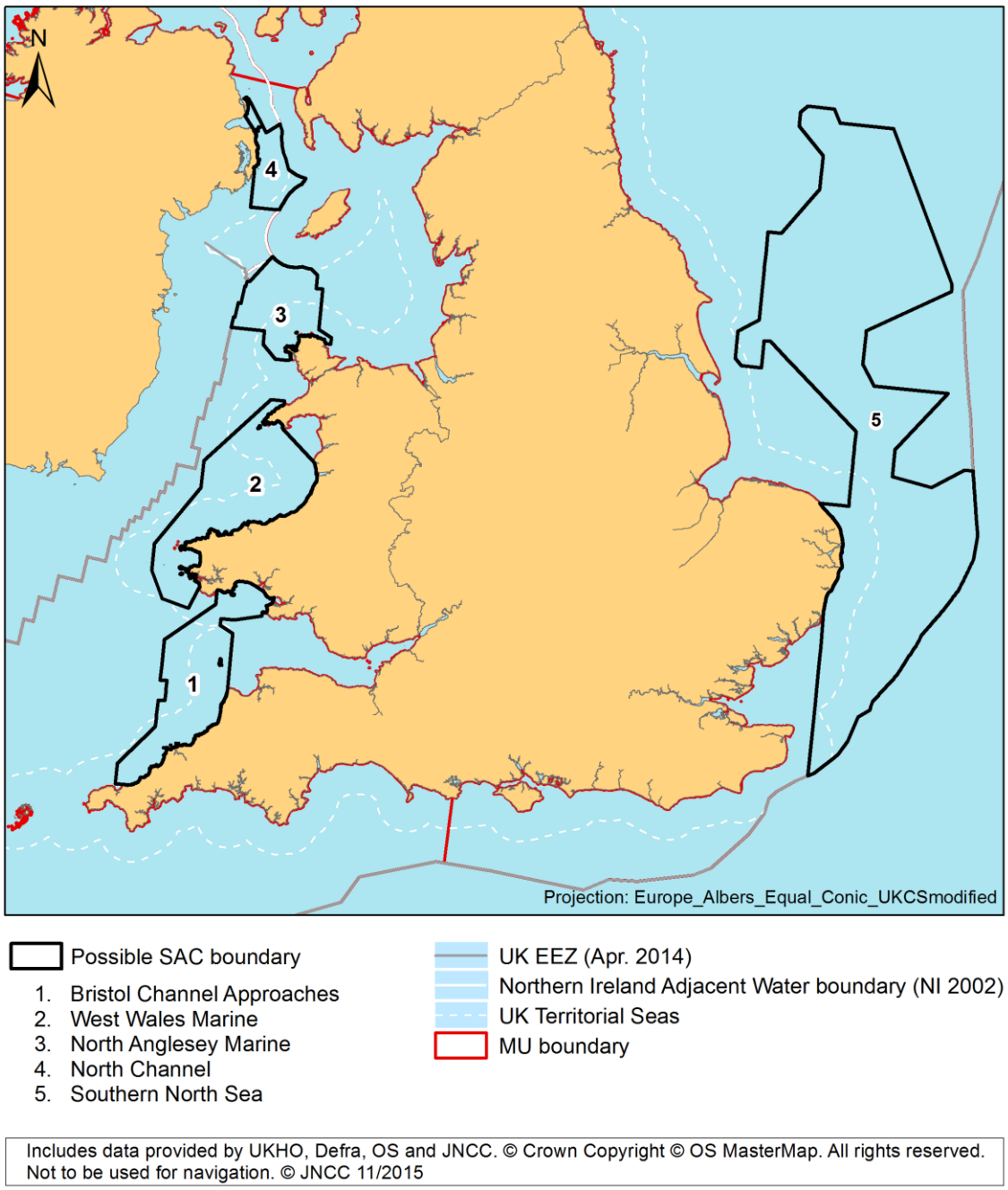


Figure 1: Possible Special Areas of Conservation for the harbour porpoise, *Phocoena phocoena* identified in Northern Ireland, England, Wales and offshore waters. The MU boundary refers to management units North Sea and Celtic and Irish Seas.

This advice is for the Southern North Sea site (Figure 2) which is subject to protection under the Habitats Directive as transposed by the Conservation of Habitats and Species Regulations 2010[3] and the Offshore Marine Conservation Regulations (Natural Habitats, *etc*.) Regulations 2007[4] (as amended). The advice is given in fulfilment of the duty of the Statutory Nature Conservation Bodies (SNCBs) under the Habitats Regulations to inform Relevant and Competent Authorities as to (a) the Conservation Objectives for the site; and (b) any activities which may negatively impact the feature [harbour porpoise] for which the site is designated. The SNCBs aim to ensure that the Conservation Objectives are up-to-date, accessible and allow the assessment of the impact of proposed developments against them.

2 Responsibilities of Relevant and Competent Authorities

The Habitats Regulations require Relevant and Competent Authorities to exercise their functions so as to secure compliance with the Habitats Directive. Competent Authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on the site. This may include consideration of issues outside the boundary of the SAC, if the impact of these occurs within the site boundaries. Relevant and Competent Authorities are not required to undertake any actions or ameliorate changes in the condition of the site if it is shown that the changes result wholly from natural causes.

The natural variability of harbour porpoise distribution and abundance within sites is likely to be large due to the mobility and wide ranging nature of this species. Apparent deterioration of harbour porpoise presence at the site must be contextualised in terms of the natural variability in abundance and distribution patterns at the population level (i.e. Management Unit level). SNCBs will work with Relevant and Competent Authorities and others to agree a protocol to guide assessments, and this will require consideration for the population at the wider scale MU population. It is essential that any assessment for the site reflect the natural variation of the species, including assessments in the condition of the site.

3 Conservation Objectives for harbour porpoise SACs

3.1 The role of Conservation Objectives

Site level Conservation Objectives are a set of specified objectives that must be met to ensure that the site contributes to maintaining or achieving Favourable Conservation Status (FCS) of the designated site feature(s) at the national and biogeographic level (EC, 2012). Conservation Objectives constitute a necessary reference for identifying site-based conservation measures and for carrying out Habitat Regulations Assessments of the implications of plans or projects. The purpose of the Habitat Regulations Assessment is to determine whether a plan or project adversely affects a site's integrity. The critical consideration in relation to site integrity is not the extent or degree of an impact, or whether an impact is direct or indirect, but whether the implications of any activities affecting a site, either individually or in combination with other plans or projects, affect the site's ability to achieve its conservation objectives and favourable conservation status.

Harbour porpoise are protected everywhere in European waters under the provisions of Annex IV and Article 12 of the Habitats Directive. The harbour porpoise in UK waters is considered part of a wider European population and the mobile nature of this species means that the concept of a 'site population' may not be appropriate for this species. Site based

[3] http://www.legislation.gov.uk/uksi/2010/490/pdfs/uksi_20100490_en.pdf
[4] http://www.legislation.gov.uk/uksi/2007/1842/pdfs/uksi_20071842_en.pdf

conservation measures will complement wider ranging measures that are in place for the harbour porpoise.

3.2 Background to Conservation Objectives

The Conservation Objectives are designed to ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely. Therefore, the focus of the Conservation Objectives for harbour porpoise sites is on addressing pressures that affect site integrity and would include:

- killing or injuring significant numbers of harbour porpoise (directly or indirectly);
- preventing their use of significant parts of the site (disturbance / displacement);
- significantly damaging relevant habitats; or
- significantly reducing the prey base.

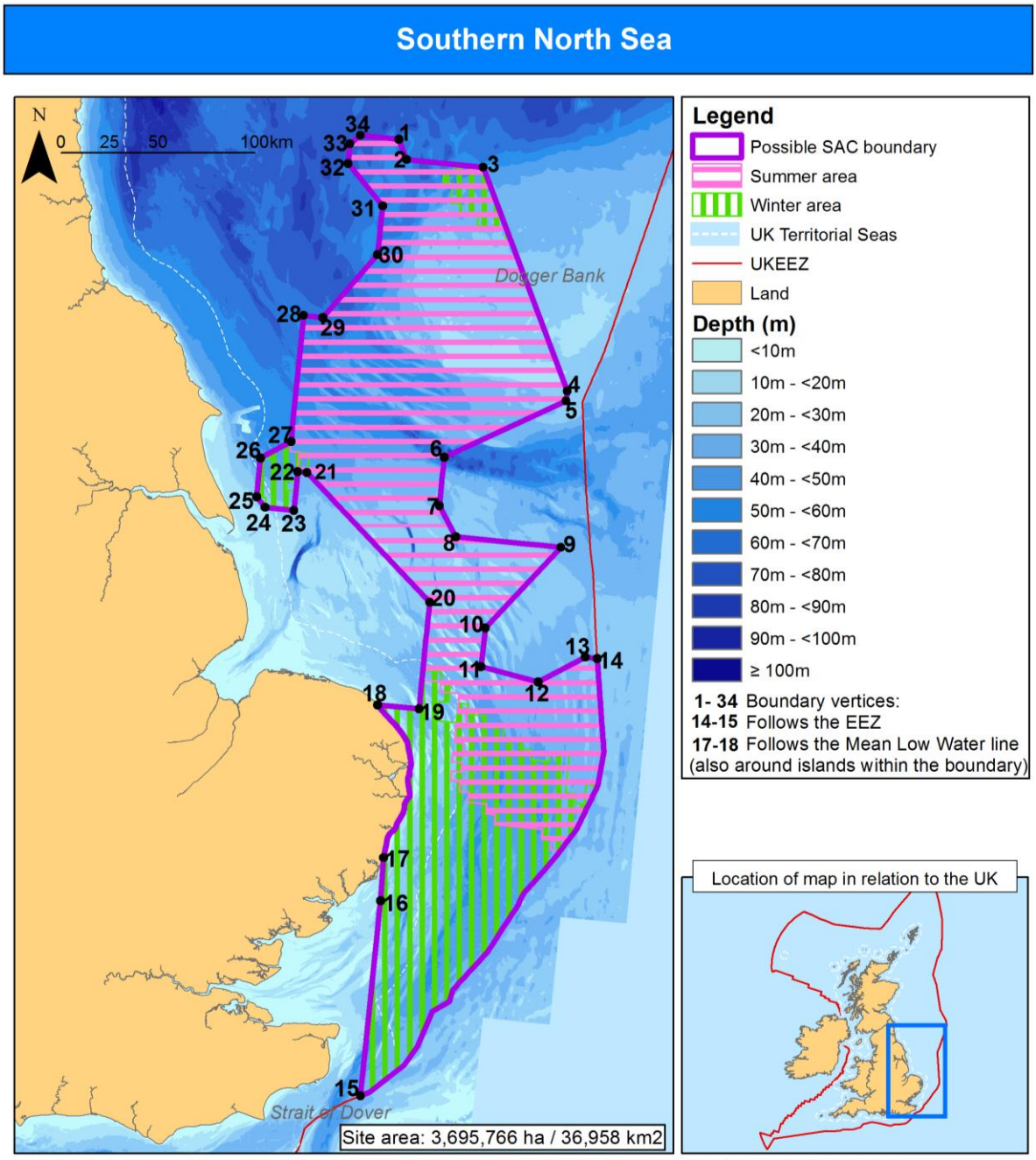
This Conservation Objectives document includes both a statement of the actual Conservation Objectives and supplementary advice with regard their intent and interpretation specific to the site. The Objectives have been set taking account of European Commission guidance (EC, 2012). Further guidance on their specific application to certain casework will also be provided at a later stage.

3.3 The Southern North Sea pSAC Conservation Objectives

The Southern North Sea pSAC is the largest of the possible SACs proposed for the conservation of harbour porpoise (Figure 2). The qualifying feature of the site is the Habitats Directive Annex II species:

- harbour porpoise (*Phocoena phocoena*)

Seasonal differences in the relative use of the site have been identified based on the analyses of Heinänen and Skov (2015) which shows that harbour porpoise occur in elevated densities in some parts of the site compared to others during summer and winter (Figure 2).The seasonality in porpoise distribution should be considered in the assessment of impacts and proposed management.



Includes data provided by UKHO, Defra, OS and JNCC. © Crown Copyright © OS MasterMap. All rights reserved.
Not to be used for navigation. © JNCC 09/2015

ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	55° 28' 53.1'' N	01° 02' 24.8'' E	10	53° 17' 32.9'' N	02° 11' 31.6'' E	19	52° 53' 06.4'' N	01° 45' 21.9'' E	28	54° 37' 0.5'' N	00° 27' 44.8'' E
2	55° 23' 34.2'' N	01° 07' 24.8'' E	11	53° 06' 45.7'' N	02° 11' 43.8'' E	20	53° 22' 42.4'' N	01° 44' 22.2'' E	29	54° 37' 11.8'' N	00° 37' 01.8'' E
3	55° 24' 03.2'' N	01° 45' 17.6'' E	12	53° 04' 11.8'' N	02° 38' 38.6'' E	21	53° 54' 05.6'' N	00° 39' 29.7'' E	30	54° 56' 28.6'' N	00° 59' 18.7'' E
4	54° 25' 05.4'' N	02° 37' 56.9'' E	13	53° 12' 19.1'' N	02° 59' 22.3'' E	22	53° 54' 0.3'' N	00° 35' 04.2'' E	31	55° 09' 56.9'' N	00° 58' 38.1'' E
5	54° 22' 23.6'' N	02° 37' 58.3'' E	14	53° 12' 19.0'' N	03° 04' 57.1'' E	23	53° 43' 17.2'' N	00° 35' 41.1'' E	32	55° 20' 23.2'' N	00° 39' 10.7'' E
6	54° 03' 07.5'' N	01° 43' 06.7'' E	15	51° 04' 38.9'' N	01° 39' 44.1'' E	24	53° 42' 60.0'' N	00° 22' 03.6'' E	33	55° 25' 46.4'' N	00° 38' 51.5'' E
7	53° 49' 40.4'' N	01° 43' 32.5'' E	16	51° 59' 04.9'' N	01° 38' 08.0'' E	25	53° 45' 35.5'' N	00° 17' 20.7'' E	34	55° 28' 33.4'' N	00° 43' 26.4'' E
8	53° 41' 38.9'' N	01° 52' 54.2'' E	17	52° 10' 54.3'' N	01° 37' 11.0'' E	26	53° 56' 22.0'' N	00° 16' 38.8'' E			
9	53° 41' 57.7'' N	02° 42' 50.7'' E	18	52° 52' 51.4'' N	01° 26' 06.8'' E	27	54° 02' 03.1'' N	00° 30' 01.3'' E			

Figure 2: The Southern North Sea possible Special Area of Conservation for harbour porpoise showing summer and winter areas.

The Conservation Objectives for the site are:

To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise.

To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term:

1. The species is a viable component of the site.

2. There is no significant disturbance of the species.

3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

These Conservation Objectives are common across all sites proposed for this species to ensure coherence across the network (EC, 2012). These Conservation Objectives are based on considerations of the ecological requirements of the species within the site, yet their interpretation is contextualised in their contribution to maintaining FCS at a wider scale (EC, 2012). With regard the Southern North Sea site, harbour porpoise need to be maintained rather than restored. Maintain implies that, based on our existing understanding, the feature is regarded as being in favourable condition and will, subject to natural change, remain in this condition after designation.

1. The species is a viable component of the site:

Harbour porpoises are considered to be a 'viable component' of the site if they are able to survive and live successfully within it. The Southern North Sea site has been selected primarily on the basis of its long-term, preferential use by harbour porpoise in contrast to other areas of the North Sea. The implication is that this site provides good foraging habitat and it may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies, there is not an exact number of animals within the site above which the species is viable or below which it will become unviable.

For that reason, the intent of this objective is to minimise the risk posed by activities within the site to the species viability. Activities that kill, injure or significantly disturb harbour porpoise have the potential to affect species viability within the site.

The harbour porpoise is a European Protected Species (EPS) listed on Annex IV of the Habitats Directive and as such is protected under Article 12 from deliberate killing (or injury), capture and disturbance throughout its range. However, the relevant/competent authorities are reminded of these provisions and their application to the site as an integral part of the species' range. The Habitats Directive Article 12 guidance[5] proposes the following definition of deliberate: "*deliberate actions are to be understood as actions by a person who knows, in the light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action*".

The meaning of 'deliberately injure' should be taken from the definition under regulations 41(1)(a) and 39(1)(a) of the Conservation (Natural Habitats *etc*.) Regulations 1994 and its

[5] http://ec.europa.eu/environment/nature/conservation/species/guidance/pdf/guidance_en.pdf

amendments consolidated in The Conservation of Habitats and Species Regulations 2010 for England and Wales

The disturbance under Article 12(1)(b) must be deliberate and not accidental. The definition of 'deliberate disturbance' is given in 39(1)(b) of Offshore Marine Conservation (Natural Habitats, *etc*.) Regulations 2007 (Offshore Marine Regulations, OMR, as amended in 2009 and 2010). It is an offence under these Regulations to deliberately disturb EPS in such a way as to: a) impair their ability to survive, to breed or reproduce, or to rear or nurture their young or b) to affect significantly the local distribution or abundance of that species. Further guidance as to the interpretation of and what constitutes 'deliberate' and 'significant disturbance' is given in the JNCC EPS guidance[6]. These definitions of types of disturbance are for the purposes of assessing the need for an EPS licence and apply throughout UK waters.

Bycatch of harbour porpoise in fishing nets is not deliberate but incidental killing. Article 12 (4) of the Habitats Directive applies and states that Member States '*shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned*'. Consideration must be given to the effect of bycatch on the conservation status of harbour porpoise at the population level. The impacts of bycatch within a site contribute to impacts from bycatch outside the site and thus may affect the conservation status of harbour porpoise. Bycatch, therefore, poses a risk to the viability of the population and therefore could be deemed to affect the integrity of the site. Measures may be needed to minimise the risk of bycatch to porpoises using the site.

2. There is no significant disturbance of the species within the site

Disturbance of harbour porpoise generally, but not exclusively, originates from activities that cause underwater noise (section 4). Responses to noise can be physiological and/or behavioural. JNCC has produced guidelines to minimise the risk of physical injury to cetaceans from various sources of loud, underwater noise[7]. However, disturbance is a behavioural (non-injurious) response to noise and may lead to harbour porpoises being displaced from the area affected.

Within sites, the immediate effects of disturbance are in the loss (usually temporary) of habitat available to harbour porpoise. The Southern North Sea site has been identified on the basis of having persistent higher densities of harbour porpoises (Heinänen and Skov 2015) when compared to other areas of the UK's North Sea continental shelf which is linked to the habitats within the site that likely promote good feeding opportunities. Therefore, activities within the site should be managed to ensure access to the site; any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Case Work Advice Guidance in relation to various activities is being developed and expands this supplementary advice to define 'significant portion and period' in the context of impacting site integrity.

This Conservation Objective aims to ensure that the site contributes, as best it can, to maintaining the Favourable Conservation Status of the wider harbour porpoise population. As such, how the impacts within the site translate into effects on the North Sea Management Unit population are of greatest concern.

[6] http://jncc.defra.gov.uk/PDF/consultation_epsGuidanceDisturbance_all.pdf
[7] http://jncc.defra.gov.uk/page-4273

3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.

The harbour porpoise is a species that is highly dependent on a year-round proximity to food sources and its distribution and condition may strongly reflect the availability and energy density of its prey (Brodie 1995 in Santos & Pierce, 2003). The densities of porpoise using the site are likely linked to the availability (and density) of prey within this site. Porpoise eat a variety of prey including gobies, sandeel, whiting, herring and sprat (which all have spawning grounds within the Southern North Sea site). However, the diet of porpoises specifically when using the site is unknown. The activity which potentially risks the achievement of this CO is commercial fishing; although environmental variability also plays a role in determining the status of fish stocks. However, currently there is no evidence to suggest that competition for prey species with commercial fisheries is having an impact on the conservation status of the harbour porpoise.

The delineation of the Southern North Sea site is based on the prediction of 'harbour porpoise habitat' within the North Sea (Heinänen and Skov 2015). Habitat, in this context, means the characteristics of the seabed and water column. Peaks in density of harbour porpoise in the Southern North Sea site vary seasonally (Figure 2). At the Management Unit scale, for both the summer and winter seasons the distribution of harbour porpoise is related to water depth and variables within the water column (Heinänen & Skov 2015). Harbour porpoise density peaked in stable stratified waters (based on vertical differences in temperature) with lower gradients of eddy activity (turbulence); higher densities were also found in areas with current speeds of 0.4-0.6m/s. The analysis indicated a preference for water depths between 30 and 50m throughout the year. In general, in both seasons, harbour porpoise preferred coarser seabed sediments (sand/gravel). How these environmental characteristics of the site influence the prey of harbour porpoise or other aspects of their life directly (e.g. breeding/calving) is currently unknown.

4 Advice on Activities

4.1 Purpose of advice

This section details the advice on human activities specifically occurring within or close to the Southern North Sea pSAC that would be expected to impact the site. Initial assessments were done at UK scale, with subsequent site level assessment detailing our understanding of impacts occurring with potential to affect harbour porpoise when using the site (Section 5 & 6). Advice is only given where pressures[8] may act at the site level and therefore, may require management if the Conservation Objectives are to be met. Wide-spread pressures may also act to affect the overall status of harbour porpoise, but such effects are not restricted to specific sites. Such pressures are best dealt with through broader measures. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy (DETR, 2000) has been in place for harbour porpoise since 2000. In light of a recent conservation literature review (IAMMWG *et al* 2015b), this strategy will be reviewed and updated where necessary.

The advice identifies activities with potential to affect harbour porpoise using the site (site level impacts) as well as (where possible) its supporting habitats in UK waters which may impact the species' capacity to maintain FCS. This advice should also be used to help identify the extent to which existing activities are, or can be made, consistent with the conservation objectives, and thereby focus the attention of Relevant and Competent Authorities and surveillance programmes to areas that may need management measures.

[8] See Annex A for definition of key terms

This draft advice on activities will be updated and supplemented through further discussions with the Relevant and Competent Authorities and any advisory groups formed for the site.

4.2 Background

In compiling this advice on activities, the SNCBs have considered the pressures that may be caused by human activities and the sensitivity of the qualifying feature, harbour porpoise, to those pressures. The advice is generated through a broad grading of sensitivity and exposure of the harbour porpoise to pressures associated with activities in order to gain an understanding of how vulnerable the species is to each activity at a UK level. The activities and their associated pressures to which the harbour porpoise is deemed vulnerable at UK level are then considered at site level in order to inform possible management needs necessary for the site to meet the conservation objectives. Annex A details the approach taken to identify the significant impacts on harbour porpoise from pressures, and the relative sensitivity and current exposure of harbour porpoise to those pressures at a UK wide scale.

This document is guidance only and activities and their management will be considered in the context of Habitats Regulations Assessments/Appropriate Assessment and where applicable through other environmental assessment processes (e.g. EIA).

5 Activity assessments at UK scale

The assessments have been carried out using all available evidence as of November 2015. As further information becomes available, assessments may be subject to alteration in line with the new evidence to support the change, and further improving the understanding of the vulnerability of harbour porpoise to activities occurring in UK waters. This advice is made without prejudice to any assessment that may be required for specific proposals to be considered by a Relevant Authority. The level of any impact will depend on the location, timing and intensity of the relevant activity. This advice is provided to assist and focus the Relevant Authorities in their consideration of the management of these activities.

The harbour porpoise is a wide-ranging species and occurs throughout the UK Continental Shelf area (JNCC, 2013). It does occur in deeper waters but in very low densities, and perhaps only seasonally. As a predominantly shelf species, it is exposed to a wide range of pressures, that are both ubiquitous (e.g. pollution) and patchy (e.g. bycatch) in nature, and the list of anthropogenic activities leading to these pressures is long. Based on current available information, the activities with the most notable impact on UK harbour porpoise are shown in Table 1.

The definitions of the pressures as applied within harbour porpoise SAC advice can be found in Annex B

Activities which currently pose a low risk to porpoises at the UK level (Annex A, Table A2) have not been considered in this advice. The exposure to the pressures associated with these activities is currently very limited and poses no significant threat to the maintenance of harbour porpoise FCS. Non-anthropogenic impacts are also not considered, such as attack and predation from other marine mammal species, that have the potential to impact harbour porpoise populations.

The full list of assessed activities and key references can be found in Annex A, Table A3. Updates to the assessments will occur as more evidence becomes available.

Table 1: Key activities and the relative risk of impacts on harbour porpoise throughout UK waters. Those pressures ranked 'high' are known to have the greatest impact relative to other pressures on the population of UK harbour porpoises.

Activities	Pressures	Impacts	Current relative level of impact
Commercial fisheries with bycatch of harbour porpoise (predominantly static nets)	**Removal of non-target species**	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**	• Affects on water and prey quality • Bioaccumulation through contaminated prey ingestion • Health issues (e.g. on reproduction)	High
Shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	**Anthropogenic underwater sound**	• Mortality • Internal injury • Disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising)	Medium
Shipping, recreational boating, tidal energy installations	**Death or injury by collision**	• Mortality • Injury	Medium/Low
Commercial fisheries (reduction in prey resources)	**Removal of target species**	• Reduction in food availability • Increased competition from other species • Displacement from natural range	Medium

Removal of non-target species (harbour porpoise bycatch)

Bycatch of harbour porpoise in fishing gear is one of the most significant anthropogenic pressures impacting on the population. The relevant commercial fisheries with harbour porpoise bycatch are certain bottom set nets. The areas where bycatch is of greatest concern is off southwest England and the southern North Sea. Mitigation of bycatch through the use of acoustic deterrent devices ('pingers') is required under EU Regulation 812/2004[9] on setnet vessels of 12m or over. However, smaller set net vessels (<12m) comprise the majority of the fleet and are the major source of harbour porpoise bycatch in UK waters. Where the bycatch/risk of bycatch within porpoise SACs threatens the sites' integrity, mitigation maybe required.

Contaminants

The latest evidence (Law *et al* 1992-2005 & 2009; Law *et al* 2008; ASCOBANS, 2011; Murphy *et al* 2015) shows that there is still a significant pollution issue for at least some cetacean species in European waters, which includes harbour porpoise and organochlorines (e.g. Polychlorinated biphenyls [PCBs]). Monitoring and investigation will continue to be important, and research in this field should not remain focused on 'old' compounds and

[9] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:150:0012:0031:EN:PDF

contaminants. Careful consideration is required to ensure we also monitor historical contaminant impacts as well as any current or emerging issues.

Anthropogenic underwater sound

Harbour porpoise use sound for foraging, navigation, social activities and predator detection. Changes in underwater noise therefore have the potential to interrupt these behaviours. The peak frequency of echolocation pulses produced by harbour porpoise is 120–130 kHz, corresponding to their peak hearing sensitivity although hearing occurs throughout the range of ~1 and 180 kHz (Southall *et al* 2007). A range of activities emit sound that falls within the hearing sensitivities of porpoise, including shipping, pile driving, Acoustic Deterrent Devices and military activities. The exact frequency, intensity and longevity of the sound will determine the response. The impact on the porpoise is also mediated through individual behaviour, and perhaps quality of its immediate habitat, at the time of exposure.

Death or injury by collision

Post-mortem evidence indicates that few collisions between harbour porpoise and vessels occur and is not a significant pressure for this species.

Research surrounding wet renewables shows potential risk of harbour porpoise collision with sub-marine turbines, although there is no evidence of such collisions to date.

Removal of target species (harbour porpoise prey)

Porpoise diet within UK waters includes a wide variety of fish and they will generally focus on the most abundant local species (De Pierrepont *et al* 2005; Camphuysen *et al* 2006). The predominant prey type in general appears to be whiting, gobies and sandeel, although shoaling fish such as mackerel and herring are also taken. In the north-east Atlantic, a long term shift from predation on clupeid fish (mainly herring) to predation on sandeels and gadoid fish, possibly related to the decline in herring stocks since the mid-1960s has been observed. Porpoise diets overlap extensively with diets of other piscivorous marine predators (notably seals) and many of the main prey species are also taken by commercial fisheries, although porpoises tend to take smaller fish than those targeted by fisheries (Santos and Pierce 2003).

6 Site specific considerations: Southern North Sea pSAC

6.1 Sensitivity of harbour porpoise to existing activities within or impacting on the site

The Southern North Sea site spans territorial and offshore waters and covers a large geographical area. A summary of the site can be found in the Selection Assessment Document[10]. Precise information on many activities within the boundary is not currently available due to lack of targeted data collection to date. Assessing exposure carries certain assumptions about the spatial extent, frequency and intensity of the pressures associated with marine activities. Therefore site based exposure and resulting current level of impact has not been assessed at this stage.

[10] SAC Selection Assessment Document:

http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf

Table 2 is an overview of activities occurring within or in proximity to the Southern North Sea site to which the harbour porpoise has a current level of impact risk of High or Medium at UK level (Table 1) and therefore may require further consideration concerning options for management. This was derived from spatial data as GIS layers and a review of the literature, and includes all available data at time of writing.

Management measures are the responsibility of the relevant regulatory bodies, which consider the SNCBs' advice and hold appropriate discussions with the sector concerned, but the scale and type of mitigation is decided by the Regulators. Where consent is required and the activity (if considered a plan or a project) is likely to significantly affect a European Marine site, Article 6(3) of the Habitats Directive requires that an Appropriate Assessment is carried out. Assessments under Article 6(3) of the Directive are often referred to in the UK as "Habitat Regulations Assessments" (HRA). The HRA is a case-specific assessment made in view of the Conservation Objectives for the affected site. Each HRA requires case-specific, unbiased advice from the SNCB but is the responsibility of the regulatory body concerned.

In 2012 the UK Government adopted a revised approach to the management of fishing activities within European marine sites (EMS) in England. The revised approach is designed to ensure the consistency of the management of fishing activities with Article 6 of the Habitats Directive. Risk based prioritisation of managing the fishing activities of UK and non UK vessels has been applied to relevant European marine site features and sub features within the UK 12nm territorial limit. For EMS outside of 12nm, or sites outside 6nm where there are access rights for other Member States, management measures designed to ensure adequate protection are to be proposed to and agreed by the European Commission in accordance with the Common Fisheries Policy (CFP).

Table 2: Activities occurring within/near to the Southern North Sea site to which the harbour porpoise is considered sensitive.

Activities	**Pressure**	**Comment on current level of activity**	**Management considerations**
Commercial fisheries (with harbour porpoise bycatch)	Removal of non-target (bycatch) species	UK registered vessels >12m: Negligible effort of Vessel Monitoring System (VMS) registered vessels using static net gears within the site[11] UK registered vessels <12m: current exposure is unknown EU registered vessels: higher effort of static net setting than UK vessels with two concentrated areas. Effort in the south east appears to have increased between 2009 and 2013.	Where management measures are required, the development of these would be undertaken via discussion with fishing interests and fishery managers and informed by any detailed information about fishing activity that can be made available. Detailed measures, if required, will be developed by the relevant regulator (European Commission/MMO/IFCA/Defra) The use of pingers as a mitigation measure is required on static nets deployed by vessels >12m in length in specified areas through EU Regulation 812/2004. Through derogation, this part of the UK fleet currently utilise the DDD. Because bycatch most often occurs in bottom set nets deployed from vessels <12m, and the use of pingers

[11] The fisheries data are aggregated VMS data collected between 2006 and 2013.

			is not mandatory under Regulation 812/2004, one option for management could be to extend the pinger requirement to further vessels. The risk of bycatch from this sector in the context of the Conservation objectives of the site will need to be established . Such a requirement may have a seasonal component. However, further work is needed to understand the scale of disturbance that would be caused by wide-spread deployment of the different types of pinger.
Discharge/run-off from land-fill, terrestrial/ offshore industries	Contaminants	Current exposure within/near the site is unknown	This pressure cannot be managed effectively at the site level. Most of the relevant pollutants have been effectively phased out of use by action under the OSPAR Convention and, more recently, the EU (e.g. PCBs). However, their chemical stability will lead to them remaining in the marine environment for some time and, consequently, human activities such as dredging may cause the re-release of these chemicals into the environment or introduce other contaminants of which the impacts are poorly known. Any novel sources of potential contamination associated with a new plan or project may be assessed under HRA. It is recognised that further efforts to limit or eliminate PCB discharges to the marine environment may still be needed.
Shipping	Anthropogenic underwater sound	Several large ports along the East coast of England resulting in large vessel shipping routes throughout the site.	The underwater sounds created by large ships are unlikely to cause physical trauma, but could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). However, additional management is unlikely to be required given current levels within the site and elevated densities of porpoises in this area.
Oil and gas drilling		Areas licensed for oil and gas extraction in the northern and central parts of the site	This is a highly regulated industry. Existing and inactive (exploratory and dry) wells and oil and gas licensed blocks occur within the suite of proposed sites and any future applications would be subject to an HRA.
Dredging and disposal		Capital dredging and disposal sites in the southern portion of the	Dredging and disposal can cause disturbance leading to physical and acoustic behavioural changes.

		site	However, the risk is considered relatively low and additional management is unlikely to be required
Aggregate extraction		Extensive existing licensed and active areas within the site	Aggregate extraction can cause disturbance leading to physical and acoustic behavioural changes. However, the risk is considered relatively low and additional management is unlikely to be required
Pile driving		Current and licensed areas for offshore wind, including construction and maintenance phases within the site	A European Protected Species (EPS) licence is already required for any construction activity which carries the risk of significant disturbance or injury As a minimum, developers are required to follow the 'Statutory Nature Conservation Agency protocol for minimising the risk of injury to marine mammals from piling noise'. (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50006/jncc-pprotocol.pdf). A Habitats Regulations Assessment (HRA) will be considered for all new developments (coastal and marine) using pile driving within the site **or** within 26km (see Dahne *et al* 2013; Tougaard *et al* 2014) of site boundaries. If additional mitigation (to that required under EPS licence) is required, planning and management of pile driving activities may be needed within the site to ensure the Conservation Objectives are met. There is potential for a reduction or limitation of the disturbance/displacement effects by varying the schedule of piling, particularly if several developments are constructing at the same time and pile driving footprints do not overlap (i.e maximising area from which porpoise are excluded). Limited spatio-temporal restrictions may be needed. Other examples of mitigation include the use of sound dampers, methods that create a barrier to sound transfer (e.g. bubble curtains) and, more effectively, the use of alternative foundation types (e.g. gravity foundations, suction cups, floating turbines, drilling). Scheduling of activities may minimise cumulative exclusion from areas.
Acoustic (including		Seismic exploration	Some geophysical surveys within 5km of site boundary may require consent

seismic) surveys		activity occurs in the site	and be subject to HRA. Seismic surveys are likely to require an EPS licence which may specify conditions. As a minimum, it is expected that developers will adhere to the *JNCC Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (updated August 2010; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50005/jncc-seismic-guide.pdf)
Recreational boating activity		Royal Yachting Association (RYA) cruising routes across the extent of the site, focussed along the coast	Adherence to wildlife codes of conduct is already advocated (e.g the WiSe scheme http://www.wisescheme.org). No further management measures are likely to be required.
Acoustic deterrent/ mitigation devices		Unknown, no consistent areas of usage but maybe used as a mitigation tool during pile driving.	See pile driving.
Pinger devices		31 UK registered >12m setnet boats of which 4 use pingers in the area of the site. Use in North Sea on vessels under 12m is unknown but likely low.	See 'Fisheries (commercial and recreational) with harbour porpoise bycatch' The use of pingers is low/not needed in the site.
Shipping	Death or injury by collision	Several large ports along the East coast of England resulting in busy shipping routes throughout the site, with the highest level of activity in the south.	Post mortem investigations of harbour porpoise deaths have revealed death caused by trauma (potentially linked with vessel strikes) is not currently considered a significant risk and no additional management is therefore required.
Recreational boating activity		RYA cruising routes cross the site, most are coastal	See 'Shipping' (with death or injury by collision). Boats conducting recreational activity should adhere to wildlife codes of conduct (e.g the WiSe scheme http://www.wisescheme.org/).
Commercial fisheries	Removal of target (prey) species	Fisheries targeting prey species such as whiting, herring, mackerel, sandeel and sprat throughout their ranges in the North Sea, fished by UK and EU fisheries.	Commercial species are managed at the larger scale through the CFP. .

6.2 Limitations of the evidence

It is important to note that the information used to catalogue activities occurring within the site is not complete. The available data are drawn from existing monitoring programmes (e.g. the UK's bycatch of protected species monitoring and other European datasets linked to VMS monitoring of fishing vessels) but these have limitations including availability and accessibility at the time of preparing this advice. Caveats with how the data have been collected also need to be understood in order to correctly interpret the information. This can result in the use of expert judgement where sufficient evidence is lacking, but risk is implied. Below are some points to consider alongside the above table in order to ensure the information is not taken out of context:

- **Data availability**
    - Globally, the marine environment is generally far behind the evidence levels of that on land, particularly in offshore areas, mainly due to scale and cost.
    - Sensitivities surround data that has been gathered by industry, and some data are not available for use for advice and management purposes. Often these data become available eventually, but not in time to inform management decisions.

- **Fishing: Limitations of fishing Vessel Monitoring System (VMS) data**
    - VMS positional data are transmitted at approximately 2 hour intervals. There is no information transmitted regarding precise vessel activity, therefore assumptions on its activity are often made using the location of the vessel and its speed profile.
    - Fishing vessels under 12m, (and until 2013, vessels under 15m long) are not required to use the VMS, and therefore VMS data tells us nothing regarding the activity of this segment of the fleet. However, relevant data can be obtained from Association of Inshore Fisheries and Conservation (IFCAs) and will be used to develop more detailed guidance to assist with identification of any management measures.

- **Contaminants**
    - Although use of many substances that have contaminated the environment is now illegal, re-suspension or reintroduction of pollutants that were used historically occurs. It is also difficult to identify sources of contamination when dealing with highly mobile species.

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8 Annex A: Assessment process to establish the significant threats to UK harbour porpoise populations

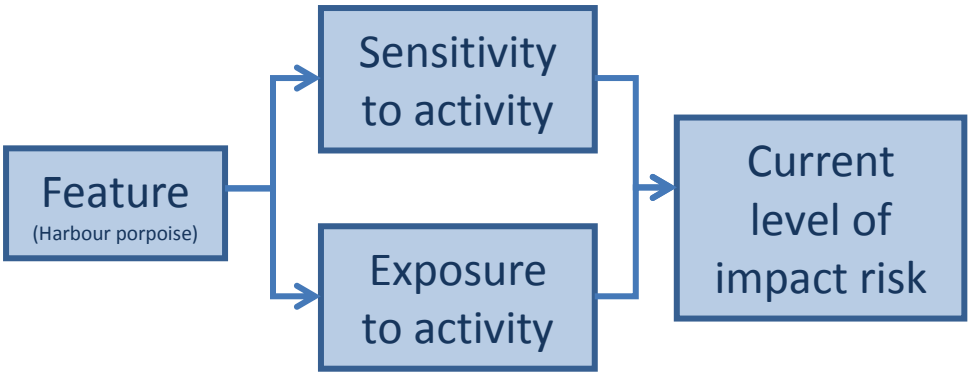
The sensitivity and vulnerability of harbour porpoise was assessed at UK level against the *pressure themes* identified by OSPAR's Intersessional Correspondence Group on Coordination of Biodiversity Assessment and Monitoring (ICG-COBAM)[12] which have been adapted slightly in order to suit the application of a highly mobile species. See Annex B for the definitions of pressures as used for the harbour porpoise assessments.

Definition of key terms

Term	Definition
Pressure theme	A group of like-pressures defined by ICG-COBAM
Sensitivity	A measure of tolerance (or intolerance) to changes in environmental conditions
Vulnerability	Vulnerability is a measure of the degree of exposure of a receptor to a pressure to which it is sensitive.
Pressure	The mechanism through which an activity has an effect on any part of the ecosystem'. The nature of the pressure is determined by activity type, intensity and distribution.
Impact	The effects (or consequences) of a pressure on a component.
Impact Risk	The current risk of impact
Exposure	The action of a pressure on a receptor, with regard to the extent, magnitude and duration of the pressure.
Activity	Human social or economic action or endeavours that may create pressures on the marine environment.

Source: jncc.defra.gov.uk/page-6515

Determining the level of impact risk of harbour porpoise to an activity



Sensitivity

Harbour porpoises were assessed as sensitive to a pressure when viability of an individual (including physiological stress, reduced fecundity, reduced growth) would be negatively affected and recovery did not take place rapidly (within weeks). The assessment incorporated expert judgement where required and adopted a single threshold to differentiate only between 'sensitive' and 'not sensitive'. The pressures that harbour porpoise are deemed sensitive to are listed in Table A1.

[12] OSPAR 20011: https://ospar.basecamphq.com/projects/6526112-icg-cobam/log

Table A1: Pressures to which harbour porpoise may be sensitive.

Pressure Theme	Pressures	Direct or Indirect impact
Pollution and other chemical changes	Contamination	Indirect – prey and habitat
	Enrichment	Indirect - habitat
Other physical pressures	Litter	Direct
	Anthropogenic underwater sound	Direct
	Barrier to species movement	Direct
	Death or injury by collision	Direct
Biological pressures	Introduction of microbial pathogens	Direct
	Removal of target species	Direct
	Removal of non-target species	Direct

Exposure

The list of pressures to which harbour porpoise is sensitive was combined with evidence of general exposure to these pressures in UK waters to get an understanding of the current level of impact risk; it combined expert knowledge on the overlap in spatial and temporal distributions of activities contributing towards a pressure and harbour porpoise densities, with direct evidence of impact as reported in the literature and from the UK Cetacean Strandings Investigation Programme[13].

Current level of impact risk

Caution was applied throughout the assessment process where there was a lack of direct evidence of exposure to an activity; a pressure to which a species was sensitive, was assumed to overlap with that species unless a case could be made to the contrary. In this sense, lack of direct evidence of exposure does not imply the species is not currently at risk. The current level of impact risk of harbour porpoise has not been assessed on a site basis due to uncertainties in exposure, driven by incomplete evidence to support the assessment at the site scale. The following level of impact scores were chosen to represent harbour porpoise vulnerability to activities within UK waters:

Scores	Criteria for overlap in space & time between pressure & species	Evidence of impact
Low	None or limited	No direct evidence in UK waters
Medium	Some	Some evidence of an impact occurring in UK waters
High	Widespread	Good evidence of a significant impact

The evidence used to assess the current level of impact is summarised in Table A3 and subsequent reference list.

Activities with a level of impact risk of 'low' have not been considered in the site assessments unless there is evidence to support a significant vulnerability despite the criteria described in the table above. This assessment, although inclusive of expert judgement in order to arrive at the assessment outcomes at UK level, provide a base from which to apply weighting to site based sensitivity assessments, using all available activity data.

[13] UK Cetacean Strandings Investigation Programme: http://ukstrandings.org/

Table A2: Full assessment of level of impact of activities on harbour porpoise in UK waters.

Activities	**Pressures**	**Impacts**	**Current level of impact risk**
Commercial fisheries with bycatch (predominantly static nets)	Removal of non-target species	• Mortality through entanglement/bycatch	High
Discharge/run-off from land-fill, terrestrial and offshore industries	Contaminants	• Affects on water and prey quality • bioaccumulation through contaminated prey ingestion • health issues (e.g. on reproduction)	High
Noise from shipping, drilling, dredging and disposal, aggregate extraction, pile driving, acoustic surveys, underwater explosion, military activity, acoustic deterrent devices and recreational boating activity	Anthropogenic underwater sound	• Mortality • Internal injury • disturbance leading to physical and acoustic behavioural changes (potentially impacting foraging, navigation, breeding, socialising)	Medium
Shipping, recreational boating, renewable energy installations	Death or injury by collision	• Mortality • Injury	Medium/ Low
Commercial fisheries, bycatch	Removal of target species	• Reduction in food availability • increased competition from other species • displacement from natural range	Medium
Agriculture, aquaculture, sewage	Nutrient enrichment	• Affects on water quality • increased risk of algal blooms may present health issues	Low
Agriculture, aquaculture, sewage	Organic enrichment	• Affects on water quality • increased risk of algal blooms may present health issues	Low
Waste disposal - navigational dredging (capital, maintenance)	Physical change (to another seabed type)	• Changes in availability of prey species	Low
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Water flow (tidal current) changes - local	• Changes in location of prey species Displacement of harbour porpoise	Low
Terrestrial and at-sea 'disposal'	Litter	• Mortality through entanglement Ingestion	Low
Bridges, tunnels, dams, installations, presence of vessels (shipping, recreation)	Barrier to species movement	• Habitat inaccessible potential physiological effects	Low
Sewage	Introduction of microbial pathogens	• Increased risk of disease	Low

Table A3: Evidence used to assess exposure to each pressure to which harbour porpoise is considered sensitive.

Example activities linked to each pressure are listed.

Key activities linked to pressures	Pressures	Evidence		Key references
		Spatial overlap (species & pressure)	Post-mortem examination	
Discharge/run-off from land-fill, terrestrial and offshore industries	**Contaminants**		✓	Jepson *et al* 2005; Deaville & Jepson, 2011; ICES, 2015a; Van De Vijver *et al* 2003; Law *et al* 2012; Pierce *et al* 2008; Murphy *et al* 2015.
Agriculture, aquaculture, sewage	**Nutrient enrichment**	✓	✓	Craig *et al* 2013
Agriculture, aquaculture' sewage	**Organic enrichment**	✓		Craig *et al* 2013
Terrestrial and at-sea 'disposal'	**Litter**	✓	✓	Deaville and Jepson, 2011
Marine renewable energy	**Electromagnetic changes**	✓		WGMME, 2012, ICES 2015a
Shipping, drilling, dredging, pile driving, military sonar, seismic surveys	**Anthropogenic underwater sound**	✓		Deaville & Jepson, 2011; Stone & Tasker, 2006; Stone, 2015; Jepson *et al* 2005; Fernandez *et al* 2005; Würsig & Richardson, 2009; WGMME, 2012.
Bridges, tunnels, dams, installations	**Barrier to species movement**	✓		WGMME., 2012; ICES 2015a
Shipping, recreational boating, renewable energy devices	**Death or injury by collision**	✓	✓	Deaville & Jepson, 2011; Dolman *et al* 2006; ICES 2015a
Sewage	**Introduction of microbial pathogens**		✓	Harvell *et al* 1999; Gulland and Hall, 2007; Van Bressem *et al* 2009
Commercial fisheries	**Removal of target species**		✓	Simmonds and Isaac, 2007; OSPAR QSR 2010; MacLeod *et al* 2007a, b; Thompson *et al* 2007; Santos and Pierce, 2003; Pierce *et al* 2007; ICES 2015a
Commercial fisheries with by-catch	**Removal of non-target species**	✓	✓	Deaville and Jepson, 2011; Morizur *et al* 1999; Read *et al* 2006; Northridge, S. and Kingston, A. 2010; Northridge *et al* 2013; ICES 2015b

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9 Annex B: Definitions of Pressures as applied within harbour porpoise SAC Advice on Activities

Pressures	Definition in the context of harbour porpoise advice
Removal of non-target species	The removal of species not targeted by the fishery; in this case the bycatch (and probable mortality) of harbour porpoise
Contaminants	Introduced material capable of contaminating harbour porpoise, prey or habitat important to harbour porpoise, with a negative impact directly or indirectly on porpoises
Anthropogenic underwater sound	Introduced noise in a frequency with the potential to cause injury or displace harbour porpoise from their natural range
Death or injury by collision	Introduction of physical objects; mobile or immobile, that may collide with or result in potential collision of harbour porpoise resulting in injury or mortality
Removal of target species	Removal of harbour porpoise prey, resulting in increased competition amongst porpoise and other species, and/or displacement from their natural range

European Site Conservation Objectives for River Wensum Special Area of Conservation Site Code: UK0012647

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot

S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail

S1092. *Austropotamobius pallipes*; White-clawed (or Atlantic stream) crayfish

S1096. *Lampetra planeri*; Brook lamprey

S1163. *Cottus gobio*; Bullhead

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the “Habitats Regulations”). They must be considered when a competent authority is required to make a ‘Habitats Regulations Assessment’, including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term ‘favourable conservation status’ is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

Inshore and Offshore Special Area of Conservation: Southern North Sea

SAC Selection Assessment Document



January 2017

Further information

This document is available as a pdf file on the JNCC website for download if required (www.jncc.gov.uk).

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Recommended citation: JNCC (2017) SAC Selection Assessment: Southern North Sea. January, 2017. Joint Nature Conservation Committee, UK. Available from: http://jncc.defra.gov.uk/page-7243

1. Introduction

This document provides detailed information about the Southern North Sea site proposed for designation for the Annex II species harbour porpoise (*Phocoena phocoena*) and evaluates this interest feature according to the Habitats Directive[1] selection criteria and guiding principles. This is a single feature site, proposed to be designated solely for the purpose of aiding the management of harbour porpoise populations throughout UK waters, in accordance with EU legislation. The site includes parts of both territorial waters (out to 12 nautical miles from the baseline) and offshore waters (from 12 nautical miles from the coast out to 200 nautical miles or to the UK Continental Shelf limit), and is therefore a joint responsibility between the Joint Nature Conservation Committee (JNCC) and Natural England (NE).

The Conservation of Habitats and Species Regulations 2010[2] (as amended) transpose the Habitats Directive into law on land and in territorial waters of England and Wales. The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007[3] (as amended in 2010) transpose the Habitats Directive into law for UK offshore waters.

The advice contained in the present document is produced to enable the Secretary of State to decide whether he/she proposes to submit the Southern North Sea site to the European Commission as a site eligible for designation as a Special Area of Conservation (SAC), in accordance with Regulation 10 of the Conservation of Habitats and Species Regulations 2010 (as amended), and Regulation 7 of the Offshore Marine Conservation (Natural Habitats &c) Regulation 2007 (as amended). JNCC and NE have been asked by Defra to provide this advice.

The Habitats Directive aims to conserve biodiversity by maintaining or restoring Annex I habitats and Annex II species to a favourable conservation status. Member States are required to contribute to a coherent European ecological network of protected sites through designation of SACs for natural habitats and wild species listed on the Annexes of the Directive. Sites eligible for designation as marine SACs are selected on the basis of the criteria set out in Annex III (Stage 1) of the Habitats Directive and relevant scientific information. Sites are considered only if they host a Habitats Directive Annex I habitat or Annex II species. For Annex II aquatic species that range over wide areas, sites must clearly identify areas that represent the physical and biological factors essential to these species' life and reproduction. Socio-economic factors are not taken into account in the identification of sites to be proposed to the European Commission.

While some wide-ranging highly mobile aquatic species have clearly-defined breeding/nurturing/feeding areas (i.e. areas 'essential to their life and reproduction'), the harbour porpoise is a naturally widely-distributed cetacean in European North Atlantic waters, and relatively little is known about its breeding behaviour. In addition, there are few obvious natural site boundaries for mobile species in the open sea. In practice, therefore, Article 4 of the Habitats Directive, which requires Member States to propose sites for Annex II species, and Annex III (site selection criteria) have proved difficult to apply to this species.

To address this problem, the European Commission (EC) held a workshop involving experts in December 2000 and published guidance on the designation of SACs for harbour porpoise in 2007 (EC, 2007). The guidance states that '*it is possible to identify areas representing crucial factors for the life cycle of this species. These areas would be identifiable on the basis of:*

- *the continuous or regular presence of the species (although subject to seasonal variations);*
- *good population density (in relation to neighbouring areas);*
- *high ratio of young to adults during certain periods of the year and*

[1] http://www.central2013.eu/fileadmin/user_upload/Downloads/Document_Centre/OP_Resources/HABITAT_DIRECTIVE_92-43-EEC.pdf
[2] http://www.legislation.gov.uk/uksi/2010/490/pdfs/uksi_20100490_en.pdf
[3] http://www.legislation.gov.uk/uksi/2007/1842/pdfs/uksi_20071842_en.pdf

- *other biological elements are characteristic of these areas, such as very developed social and sexual life.'*

The guidance also states that '*defining boundaries for 'sites' in offshore waters which support a given percentage of the national population of some mobile species may be difficult due to the lack of obvious natural boundaries (such as coast, topographical boundaries, etc.) in the open sea. This criterion is also challenging to use in the offshore marine environment where populations may often be distributed across several national boundaries.'* Therefore, the application of these additional criteria has also proven difficult.

In addition to information on the Annex II species hosted within the site, this document contains;

i) a map of the site;
ii) its name, location and extent;
iii) the data resulting from application of the criteria specified in Annex III (Stage 1) to the Habitats Directive.

In preparing this document, JNCC and NE have taken into consideration the format established by the European Commission, under which the Member States are required to provide site information to the Commission when proposing candidate SACs. This format is set out in the 'Natura 2000 Standard data form'[4] (prepared by the European Topic Centre for Biodiversity and Nature Conservation on behalf of the European Commission to collect standardised information on SACs throughout Europe).

[4] The Standard Data Form template is available here: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011D0484&from=EN

2. Background to identification of harbour porpoise Special Areas of Conservation in UK waters

The Joint Cetacean Protocol (JCP) was created in 2004 and is amongst the largest collation of standardised survey data on harbour porpoise in the world, comprising 39 data sources with data from at least 545 distinct survey platforms (ships and aircraft) representing over 1.05 million km of survey effort (coverage) over an 18-year period from 1994-2011. DHI Water Environments (UK) Ltd (DHI) were contracted by JNCC to undertake an analysis of these data in order to determine if persistent areas of high harbour porpoise density were present in the wider UK seas (Heinänen and Skov, 2015). This study will hereafter be referred to as the DHI analysis/model.

Partly to ensure geographic representation, UK waters were divided into three Management Units (MUs)[5] identified by the Interagency Marine Mammal Working Group (IAMMWG): the North Sea (NS), the Celtic and Irish Seas (CIS) and West Scotland (WS). These MUs align with the UK parts of the Assessment Units[6] proposed for the harbour porpoise by the International Council for the Exploration of the Sea (ICES) in their advice to OSPAR. The Management Units were selected to combine what we understand of the ecology of harbour porpoise with the practicality of managing human activities.

The DHI analysis modelled the relationship between environmental variables and the observed harbour porpoise distribution to develop distribution models in each MU. These models described discrete areas of predicted high porpoise density and captured the year-to-year variation within the different locations. Areas within the MUs that were identified to persistently have the top 10% of predicted high densities of harbour porpoise were considered in detail in the analysis. Areas of Search (AoS), within which the final SAC boundaries would be identified, were selected based on these top 10% of predicted high density areas. The top 10% areas were filtered by model confidence and areas of less than 500km^2 were removed on the grounds that such small areas are ineffective for harbour porpoise conservation in relation to the much larger AoS identified in the Management Units. Sites within the AoS were restricted to higher confidence areas only7.

Sufficiency, seasonality and geographic spread of sites were considered in order to identify a network of recommended draft SACs (rdSACs). Sufficiency thresholds of 20% of the nominal UK harbour porpoise abundance and 10-14% of the UK habitat for the species[7] within the rdSACs of each MU were met.

A UK network of sites for harbour porpoise was submitted to Government as draft SACs (dSACs) in June 2015. Once the sites gain approval from Governments to go to consultation, the classification changes from dSACs to possible SACs (pSACs), once submitted to the European Commission they are classed as candidate SACs (cSACs). The Governments of Wales and Northern Ireland, and Defra on behalf of England and offshore decided to proceed to consultation with five of the sites (Figure 1), subject to an adjustment to the North Channel SAC boundary. This adjustment reflected the decision by Scottish Ministers not to proceed with pSACs in their waters at that time. Together with the existing Skerries & Causeway SAC (grade C for harbour porpoise), these five sites cover 10.3% of the UK habitat and 18.7% of the UK population[8] of harbour porpoises, and are distributed in territorial and offshore waters throughout the North Sea MU and the Celtic and Irish Seas MU. In addition, there are 34 UK SACs which already list harbour porpoise as a non-qualifying feature (grade D) in UK waters. The five sites consulted on were submitted to the European Commission as cSACs on 30th January 2017.

[5] IAMMWG, 2015. Management Units for cetaceans in UK waters (January 2015). JNCC Report No. 547, JNCC Peterborough. 37pp.
[6] ICES. 2014 available from http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2014/WGMME/wgmme_2014.pdf
[7] IAMMWG, 2015. The use of harbour porpoise sightings data to inform the development of draft Special Areas of Conservation in UK waters. JNCC Report No. 565, JNCC Peterborough. 29pp.
[8] UK habitat for harbour porpoise is considered the UK continental shelf which is approximated by waters of 200m depth or less.

Along with all other Member States, the UK has legal obligations to protect harbour porpoises throughout the territory over which it exercises sovereignty. The network of protected sites will contribute towards maintaining the favourable conservation status of the wider population of harbour porpoise. Alongside and in addition to the identification of the network of harbour porpoise sites, an overarching conservation strategy[9] has been in place for harbour porpoise since 2000. This was further reviewed in 2009 and will continue to be reviewed and updated when necessary.

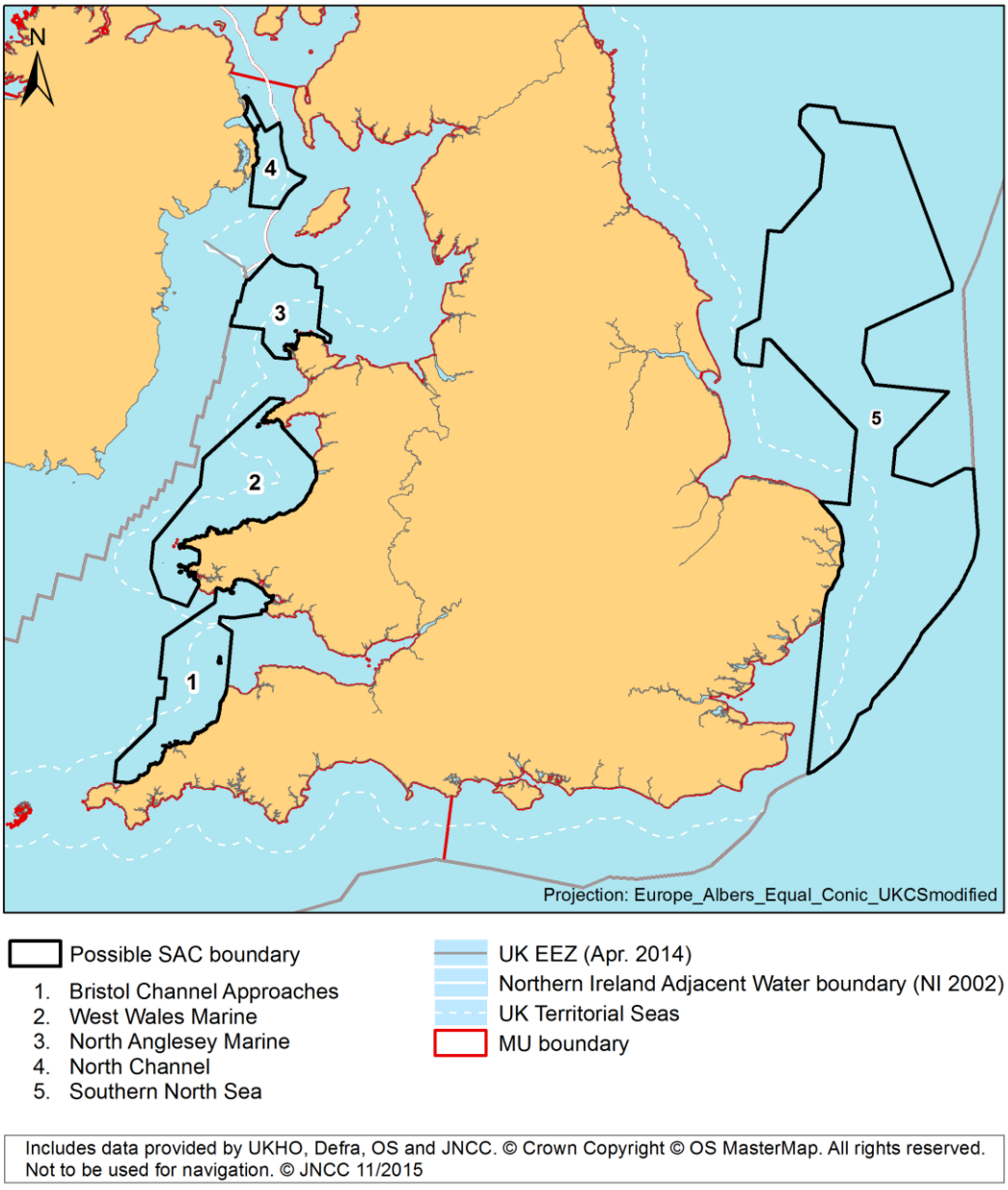


Figure 1: A network of five possible SACs (pSACs) for harbour porpoise in Wales, England, Northern Ireland and offshore waters**.**

[9] DETR. 2000. A UK conservation strategy for the harbour porpoise (*Phocoena phocoena*). Department for the Environment Transport and the Regions; Ministry of Agriculture, Fisheries and Food; Scottish Executive Rural Affairs Department; Department of Agriculture and Rural Development (Northern Ireland); National Assembly for Wales Environment Division; Department of the Environment in Northern Ireland

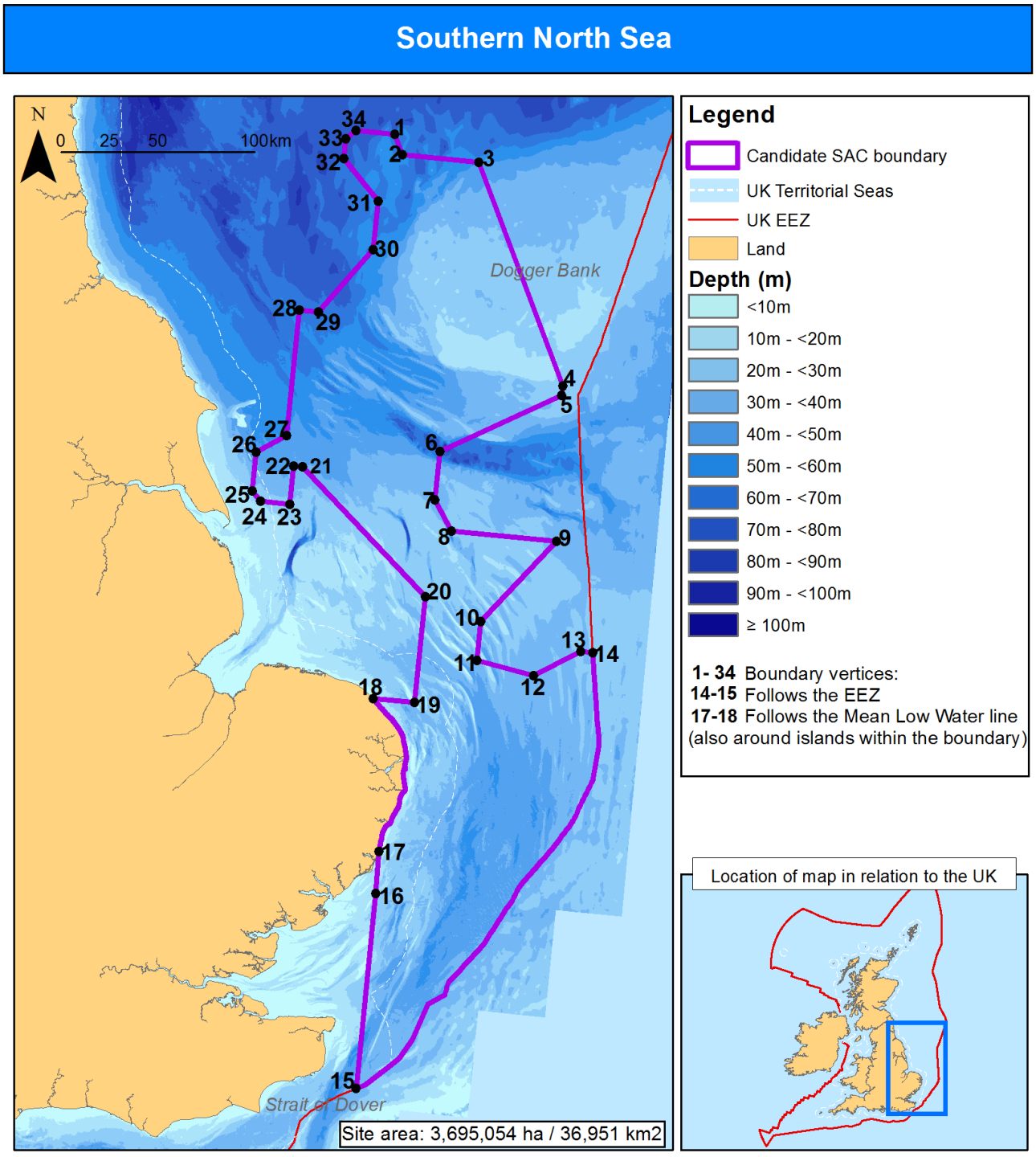
3. Southern North Sea SAC: Selection Assessment

Site name Southern North Sea	**Site centre location** 53º33'03.6"N, 01º47'59.6"E (Datum: WGS 1984)
Site surface area 3,695,054ha / 36,951km^2 (Datum: Europe Albers Equal Area modified to UK, calculated in ArcGIS)	**Biogeographic region** Atlantic
Administrative Region UK offshore waters (JNCC) English inshore waters (NE)	**Percentage cover within region** Offshore waters: 88% English inshore waters: 12%

4. Interest features under the EU Habitats Directive

1351: Harbour porpoise (*Phocoena phocoena*)

5. Map of site



Includes data provided by UKHO, Defra, OS and JNCC. © Crown Copyright © OS MasterMap. All rights reserved.
Not to be used for navigation. © JNCC 01/2017

ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	55° 28' 53.1" N	01° 02' 24.8" E	10	53° 17' 32.9" N	02° 11' 31.6" E	19	52° 53' 06.4" N	01° 45' 21.9" E	28	54° 37' 00.5" N	00° 27' 44.8" E
2	55° 23' 34.2" N	01° 07' 24.8" E	11	53° 06' 45.7" N	02° 11' 43.8" E	20	53° 22' 42.4" N	01° 44' 22.2" E	29	54° 37' 11.8" N	00° 37' 01.8" E
3	55° 24' 03.2" N	01° 45' 17.6" E	12	53° 04' 11.8" N	02° 38' 38.6" E	21	53° 54' 05.6" N	00° 39' 29.7" E	30	54° 56' 28.6" N	00° 59' 18.7" E
4	54° 25' 05.4" N	02° 37' 56.9" E	13	53° 12' 19.1" N	02° 59' 22.3" E	22	53° 54' 00.3" N	00° 35' 04.2" E	31	55° 09' 56.9" N	00° 58' 38.1" E
5	54° 22' 23.6" N	02° 37' 58.3" E	14	53° 12' 19.0" N	03° 04' 57.1" E	23	53° 43' 17.2" N	00° 35' 41.1" E	32	55° 20' 23.2" N	00° 39' 10.7" E
6	54° 03' 07.5" N	01° 43' 06.7" E	15	51° 04' 38.9" N	01° 39' 44.1" E	24	53° 43' 00.0" N	00° 22' 03.6" E	33	55° 25' 46.4" N	00° 38' 51.5" E
7	53° 49' 40.4" N	01° 43' 32.5" E	16	51° 59' 04.9" N	01° 38' 08.0" E	25	53° 45' 35.5" N	00° 17' 20.7" E	34	55° 28' 33.4" N	00° 43' 26.4" E
8	53° 41' 38.9" N	01° 52' 54.2" E	17	52° 10' 53.8" N	01° 37' 10.6" E	26	53° 56' 22.0" N	00° 16' 38.8" E			
9	53° 41' 57.7" N	02° 42' 50.7" E	18	52° 52' 51.5" N	01° 26' 06.6" E	27	54° 02' 03.1" N	00° 30' 01.3" E			

6. Site summary

The Southern North Sea site is located in the North Sea MU and has been recognised as an area with predicted persistent high densities of harbour porpoise. The main area included within the site covers important winter and summer habitat, which emerged as part of the top 10% persistent high density areas for these seasons within the UK. Approximately two thirds of the site, the northern part, is recognised as important for porpoises during the summer season, whilst the southern part is more important during the winter.

The Southern North Sea site is very large and covers an area of 36,951km^2 stretching from the central North Sea north of the Dogger Bank southwards to the Strait of Dover. The water depths within the site range between 10m and 75m, with the majority of the site shallower than 40m. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment (Eunis level 3, EUSeaMap). The boundary of the Southern North Sea site crosses four other Special Areas of Conservation. The four SACs, the Dogger Bank SAC, Margate and Long Sands SAC, the North Norfolk Sandbanks and Saturn Reef SAC and Haisborough, Hammond and Winterton SAC, are all classified for their Annex I habitat of 'Sandbanks which are slightly covered by sea water all the time' and the latter two are also designated for 'Reef'.

Defining habitats of cetaceans is problematic; this is primarily due to their highly mobile nature and their distribution being driven mainly by the distribution and availability of their prey. In the absence of prey data, relationships between habitat variables (such as depth, water temperature, seabed sediment etc) are often used as proxies of prey distribution (e.g. Marubini *et al,* 2009; Skov & Thomsen, 2008; Embling *et al,* 2010). Regional variation in these relationships between habitat variables occurs and was evident between the Management Units in the analyses undertaken by DHI.

The analyses undertaken by DHI used several different environmental variables and modelled them against observed density of harbour porpoise for each MU. In all MUs, the coarseness of the seabed sediment was important, with porpoises showing a preference for coarser sediments (such as sand/gravel) rather than fine sediments (e.g. mud). Similar habitat associations have been made in the eastern part of the North Sea (Skov *et al,* 2014). Sandeels (*Ammodytidae*), which are known prey for harbour porpoises, exhibit a strong association with particular surface sediments (Benke & Siebert, 1996; Santos, 1998). Fine particle fractions have been demonstrated to limit the distribution of the lesser sandeel (*Ammodytes marinus*) around the Shetland Isles (Wright *et al,* 2000). Harbour porpoise feed on a wide variety of fish and generally focus on the most abundant local species. The predominant prey type appears to be bottom-dwelling fish, although shoaling fish such as mackerel (*Scomber scombrus*) and herring (*Clupea harengus*) are also taken (Santos & Pierce, 2003; Pierce *et al,* 2007).

For the North Sea MU the DHI model results for both the summer and winter seasons show water depth and variables within the water column are the most important physical factors that increase the probability of presence and density of harbour porpoise. The harbour porpoise density in the North Sea MU peaked in stable waters (based on vertical differences in temperature) with lower gradients of eddy activity (turbulence); higher densities were also found in areas with current speeds of 0.4-0.6m/s. The analysis indicated a preference for water depths between 30 and 50m throughout the year. There was a negative relationship with increasing levels of traffic beyond a threshold of approximately 80 ships per day.

The physical characteristics of the Southern North Sea site are well aligned to the environmental variables determining the probability of presence and the density of harbour porpoise. The majority of the site incorporates shallow depths of around 40m (see section 5). The seabed energy layer of EU SeaMap[10] indicates that the energy levels, including current and wave energy, are predominantly medium across the majority of the site.

7. Site boundary

To date, the guidance developed by JNCC for defining SAC boundaries for marine sites away from the coast has focused on habitat features; largely from modelled data. The harbour porpoise sites are also, in part, based on modelled data and the outputs predict areas with expected high densities of harbour porpoise. The outputs from this approach and that for habitat features are similar. Therefore, the guidelines are largely transferable to consideration of boundaries for harbour porpoise sites:

1. As a general principle, site boundaries should be drawn closely around the qualifying feature for which the sites have been selected, taking into account the need to ensure that the site operates as a functional whole for the conservation of the feature;
2. Where possible, the seaward boundaries of the sites should be drawn using straight lines to ensure ease of identification on charts and at sea (and thereby minimising the number of nodes in the boundary where feasible);
3. However, a balance is needed between more complex site shapes drawn more tightly around the feature and simple square/rectangular boundaries so that the area of 'non-interest-feature' included within the site boundary is minimised, but this should not be to the detriment of the structural and functional integrity of the interest feature;
4. Site boundary coordinates be provided in degrees, minutes, seconds.

The nature of the boundaries for the recommended draft SAC were 'blocky' due to their emergence from the 25km^2 gridded model output of the DHI analysis (5km x 5km grid squares). Additional principles for creating boundaries for the harbour porpoise sites were also needed:

5. Diagonal runs of pixels (the DHI grid squares) should be straightened by a line that approximates the centre of the diagonal;
6. Vertical and horizontal lengths of more than two pixels of the sites were maintained whenever possible to preserve overall shape;
7. Modifications of the boundary of each recommended draft SACs should not alter the total area of the site by more than approximately 5%;
8. Candidate SACs will not extend into rivers;
9. Estuaries are excluded where the width of the entrance is ≤2km and the model did not indicate the area was included;
10. The 'coastal' edge of sites is defined by the Mean Low Water (MLW) tide line;
11. In England, small ports and harbours, which have enclosed inner harbours areas, have been excluded.
12. Site boundaries were aligned with the EEZ boundary where they were closely aligned.

[10] Phase 1 energy layers are available for download from EUSeaMap: http://www.emodnet-seabedhabitats.eu/default.aspx?page=1953

8. Assessment of interest feature against selection criteria

8.1. Harbour porpoise (*Phocoena phocoena*)

Annex III selection criteria for Annex II Species: Stage 1B

Stage 1 of Annex III of the Habitats Directive refers to the assessment at national level of the relative importance of sites based on:

(a) Size and density of the population of the species present on the site in relation to the populations present within national territory.
(b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities.
(c) Degree of isolation of the population present on the site in relation to the natural range of the species.
(d) Global assessment of the value of the site for conservation of the species concerned.

As UK waters are divided into Management Units to ensure geographic coverage and to facilitate management for harbour porpoise, each site has been assessed in relation to the MU rather than at the national level.

a) Proportion of UK part of the North Sea Management Unit population[11]

Abundance estimates calculated for each site were used directly to grade criterion iii a) *Size and density of the population of the species present on the site in relation to the populations present within national territory.* The identification of SACs for harbour porpoise has been driven by assessments at the scale of national territory within Management Units to ensure sites constitute a geographically *representative* network; the criterion has been applied at this scale.

The explanatory notes to the Natura 2000 standard data form suggest the following ranking to grade the sites based on the size of the population in the site relative to the population in the national territory (criterion III (a)) and for the purpose of harbour porpoise candidate SACs, relative to the relevant UK management unit:

Grade A: >15% to 100% of the relevant UK management unit population
Grade B: >2% to 15% of the relevant UK management unit population
Grade C: >0% to 2% of the relevant UK management unit population

The candidate SACs are '*clearly identifiable'* based on the modelling and persistence analyses undertaken by DHI. The analytical approach taken by DHI incorporated some of the sub-criteria of the European Commission guidance for identifying sites for marine mobile species (EC, 2007), such as sub-criteria *'Continuous or regular presence of the species (although subject to seasonal variations', 'Good population density (in relation to neighbouring areas)'* and some elements of sub-criteria *'Other biological elements that are characteristics, such as very developed social and sexual life'*. All of the sites have regular presence of harbour porpoise, whilst some show seasonal variation. It was not possible to assess the ratio of young to adults because data have not been collected consistently at an appropriate scale. The abundance within the candidate SACs can be estimated from existing survey data (Hammond *et al,* 2013) and thereby Criterion III (a) can be applied directly for the purposes of grading the site.

The Southern North Sea site was identified as being within the top 10% of persistent high density areas for harbour porpoise in UK waters for both winter and summer seasons (Heinänen and Skov, 2015). Due to the large area of the Southern North Sea site, the population supported is substantial in the UK and

[11] UK MU population is defined throughout this document as 'the UK portion of the MU where water depths are 200m or less'.

European context. It is estimated (based on the SCANS-II survey which took place in July 2005 only) that the site supports approximately 18,500 individuals (95% Confidence Interval: 11,864 - 28,889) for at least part of the year, as seasonal differences are likely to occur, and represents approximately 17.5% of the population within the UK part of the North Sea MU. It should be noted that because this estimate is from a one-month survey in a single year it cannot be considered as a specific population number for the site. It is therefore not appropriate to use site population estimates in any assessments of effects of plans or projects (i.e. Habitats regulation Assessments), as these need to take into consideration population estimates at the MU level, to account for daily and seasonal movements of the animals.

Although survey effort was not constant for all months of the year, the DHI analysis showed high confidence in the modelling across the majority of the site during the winter and the summer season, indicating a year round presence of raised densities of harbour porpoise within the site.

Therefore the Southern North Sea site has been identified as an important area for harbour porpoise during both seasons and, based on the figure of 17.5% of the North Sea MU population, the Southern North Sea site would be graded A on the basis of the EC standard data form (A = >15% to 100% of the UK part of the MU population).

b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities

The five sites (Figure 1) cover approximately 10.3% of available porpoise habitat (continental shelf) and porpoise densities within this network are amongst the highest modelled for the population as indicated by the DHI analysis. This supports the notion that these areas, relative to the rest of the continental shelf, include the best habitat for harbour porpoises and have been used persistently over the last two decades. It is assumed that the preference for these habitats is associated with good feeding opportunities and prey aggregations. The available evidence indicates that the conservation status of the UK harbour porpoise population is currently Favourable[12]. Therefore, it is considered that the conservation of the feature in all the sites is graded as II (elements are well conserved), and 'restoration possibilities' do not have to be considered. Therefore, the overall grade for this criterion is at least grade B. We do not know which features of the habitat are the most important drivers of the association with prey; nor do we know what the main prey species of porpoise within the sites are. Until this is known, the quality of the habitat (good or excellent) cannot be determined, so a grade of A/B has been awarded.

Therefore, with respect to the degree of conservation of the features of the habitat important for the harbour porpoise, the Southern North Sea site would be graded A/B ('Excellent'/'Good conservation') overall, without the necessity for consideration of restoration possibilities.

c) Degree of isolation of the population present on the site in relation to the natural range of the species

As a wide-ranging species, the animals within the site cannot be considered isolated in relation to the rest of the population. Animals within the site are part of the wider MU population.

Therefore, with respect to isolation, the Southern North Sea site would be graded C: population not isolated within extended distribution range.

d) Global assessment

The global assessment is weighted towards the grade awarded to the site for its size and density, given that the conservation of features is not clearly understood and the sites are all equal in quality with regard to their 'degree of isolation'.

[12] http://jncc.defra.gov.uk/pdf/Article17Consult_20131010/S1351_UK.pdf

Therefore, the Southern North Sea site is considered to have a global grade A, i.e. within the context of the UK North Sea management unit. It contains a significant proportion of both the UK MU (17.5%) and European population of harbour porpoises and it covers important and persistent high density areas for both summer and winter season.

Summary of grades for Stage 1B criteria

	Proportion of UK MU Population (a)	**Conservation of features (b)**	**Isolation of population (c)**	**Global assessment (d)**
Southern North Sea	A	A/B	C	A

9. Supporting scientific documentation

The process leading to the selection of the Southern North Sea site was based on a combination of observed data and predictive modelling (Heinänen and Skov, 2015). The study investigated whether persistent high density areas of harbour porpoise could be identified in UK waters, using 18 years (1994 to 2011) of sea-based Joint Cetacean Protocol (JCP) data covering the entire UK EEZ.

The JCP assembled disparate effort-related cetacean sightings datasets from European / north-east Atlantic waters and included those from all major UK sources e.g. 'Small Cetacean Abundance in the North Sea and adjacent waters' SCANS & SCANS-II from 1994 and 2005 respectively (Hammond *et al,* 2002; Hammond *et al,* 2013); 'Cetacean Offshore Distribution and Abundance in European Atlantic' CODA surveys from 2007 (CODA, 2009); European Seabirds At Sea (ESAS), which collected and collated seabird and cetacean data from the majority of countries with a north-west European coastline between 1979 and 1999, with ad hoc surveys beyond 1999; Sea Watch Foundation (SWF; i.e. NGO led surveys); Atlantic Research Coalition (ARC); and from other non-governmental and marine renewable industry sources.

The DHI report addressed challenges, such as variable survey coverage in different parts of the UK EEZ within the study period, by developing statistical distribution models capable of predicting seasonal and yearly means. Where there were sufficient data, models were run for two seasons: summer and winter for each MU.

Data on concentrations of prey of harbour porpoises were not available for the entire EEZ at a fine spatial scale (5km). Therefore, physical oceanographic properties of currents, water masses and the seafloor were used as variables in the model. It is assumed that these variables affect the probability of harbour porpoises encountering prey. Mean shipping intensity was also included in the model to account for some anthropogenic disturbance.

The DHI model results indicate that densities of harbour porpoises are influenced by both oceanographic and pressure variables. The degree of influence of these factors varies in different parts of UK waters and with the different seasons. Analyses of the persistency of high density areas integrated evaluations of the number of years that high densities were predicted for an area, with evaluations of the degree of recent high densities as predicted by the distribution models. Due to the uneven survey effort over the period, the uncertainty in modelled distributions varied greatly. Robust model predictions (based on relative standard errors) were found in all shelf waters of the North Sea north of the Channel.

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EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name:	The Broads
Unitary Authority/County:	Norfolk, Suffolk
SAC status:	designated on 1 April 2005
	Anisus vorticulus added*:* 11 February 2011
Grid reference:	TG438209
SAC EU code:	UK0013577
Area (ha):	5865.60
Component SSSI:	Alderfen Broad SSSI, Ant Broads and Marshes SSSI, Barnby Broad and Marshes SSSI, Broad Fen, Dilham SSSI, Bure Broads and Marshes SSSI, Burgh Common and Muckfleet Marshes SSSI, Calthorpe Broad SSSI, Cantley Marshes SSSI, Crostwick Marsh SSSI, Damgate Marshes, Acle SSSI, Decoy Carr, Acle SSSI, Ducan's Marsh, Claxton SSSI, Geldeston Meadows SSSI, Hall Farm Fen, Hemsby SSSI, Halvergate Marshes SSSI, Hardley Flood SSSI, Limpenhoe Meadows SSSI, Ludham to Potter Heigham Marshes SSSI, Poplar Farm Meadows, Langley SSSI, Priory Meadows, Hickling SSSI, Shallam Dyke Marshes, Thurne SSSI, Smallburgh Fen SSSI, Sprat's Water and Marshes, Carlton Colville SSSI, Stanley and Alder Carrs, Aldeby SSSI, Trinity Broads SSSI, Upper Thurne Broads and Marshes SSSI, Upton Broad and Marshes SSSI, Yare Broads and Marshes SSSI

Site description:

The Broads in East Anglia contain several examples of naturally nutrient-rich lakes. Although artificial, having been created by peat digging in medieval times, these lakes and the ditches in areas of fen and drained marshlands support relict vegetation of the original Fenland flora, and collectively this site contains one of the richest assemblages of rare and local aquatic species in the UK. The stonewort – pondweed – water-milfoil – water-lily (*Characeae – Potamogeton – Myriophyllum – Nuphar*) associations are well-represented, as are club-rush – common reed *Scirpo – Phragmitetum* associations. The dyke (ditch) systems support vegetation characterised by water-soldier *Stratiotes aloides*, whorled water-milfoil *Myriophyllum verticillatum* and broad-leaved pondweed *Potamogeton natans* as well as being a stronghold of little whirlpool ram's-horn snail *Anisus vorticulus* and Desmoulin's whorl snail *Vertigo moulinsiana* in East Anglia. The range of wetlands and associated habitats also provides suitable conditions for otters *Lutra lutra*.

The Broads is the richest area for stoneworts (charophytes) in Britain. The core of this interest is the Thurne Broads and particularly Hickling Broad, a large shallow brackish lake. Within the Broads examples of *Chara* vegetation are also found within fen pools (turf ponds) and fen and marsh ditch systems. The Broads supports a number of rare and local charophyte species, including *Chara aspera*, *C. baltica*, *C. connivens*, *C. contraria*, *C. curta*, *C. intermedia*, *C. pedunculata*, *Nitella mucronata*, *Nitellopsis obtusa*, *Tolypella glomerata* and *T. intricata*.

The complex of sites contains the largest blocks of alder *Alnus glutinosa* wood in England. Within the complex complete successional sequences occur from open water through reedswamp to alder woodland, which has developed on fen peat. There is a correspondingly wide range of flora, including uncommon species such as marsh fern *Thelypteris palustris*.

This site contains the largest example of calcareous fens in the UK. The great fen-sedge *Cladium mariscus* habitat occurs in a diverse set of conditions that maintain its species-richness, including small sedge mires, and areas where great fen-sedge occurs at the limits of its ecological range. The habitat type forms large-scale mosaics with other fen types, fen-meadows (with purple moor-grass *Moilinia caerulea*), open water and woodland, and contains important associated plants such as fen orchid *Liparis loeselii*, marsh helleborine *Epipactis palustris*, lesser tussock-sedge *Carex diandra*, slender sedge *C. lasiocarpa* and fibrous tussock-sedge *C. appropinquata*. There are also areas of short sedge fen (both black bog-rush – blunt-flowered rush *Schoenus nigricans – Juncus subnodulosus* mire and bottle sedge – moss *Carex rostrata – Calliergon cuspidatum/giganteum* mire), which in places form a mosaic with common reed – milk-parsley *Phragmites australis – Peucedanum palustris* fen. The Broads also contain examples of transition mire, that are relatively small, having developed in re-vegetated peat-cuttings as part of the complex habitat mosaic of fen, carr and open water.

Qualifying habitats: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Alkaline fens. (Calcium-rich spring water-fed fens)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*). (Alder woodland on floodplains)*
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*. (Calcium-rich fen dominated by great fen sedge (saw sedge))*
- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (Calcium-rich nutrient-poor lakes, lochs and pools)
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*). (Purple moor-grass meadows)
- Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation. (Naturally nutrient-rich lakes or lochs which are often dominated by pondweed)
- Transition mires and quaking bogs. (Very wet mires often identified by an unstable 'quaking' surface)

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Desmoulin's whorl-snail *Vertigo moulinsiana*
- Little whirlpool ram's-horn snail *Anisus vorticulus*
- Fen orchid *Liparis loeselii*
- Otter *Lutra lutra*

Annex I priority habitats are denoted by an asterisk (*).

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0013577
Date of registration:11 February 2011

Signed: [redacted]

On behalf of the Secretary of State for Environment, Food and Rural Affairs

European Site Conservation Objectives for The Broads Special Area of Conservation Site Code: UK0013577

With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- **The extent and distribution of qualifying natural habitats and habitats of qualifying species**
- **The structure and function (including typical species) of qualifying natural habitats**
- **The structure and function of the habitats of qualifying species**
- **The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely**
- **The populations of qualifying species, and,**
- **The distribution of qualifying species within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

H3140. Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.; Calcium-rich nutrient-poor lakes, lochs and pools

H3150. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation; Naturally nutrient-rich lakes or lochs which are often dominated by pondweed

H6410. *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*); Purple moor-grass meadows

H7140. Transition mires and quaking bogs; Very wet mires often identified by an unstable `quaking` surface

H7210. Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*; Calcium-rich fen dominated by great fen sedge (saw sedge)*

H7230. Alkaline fens; Calcium-rich springwater-fed fens

H91E0. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*); Alder woodland on floodplains*

S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail

S1355. *Lutra lutra*; Otter

S1903. *Liparis loeselii*; Fen orchid

S4056. *Anisus vorticulus*; Little whorlpool ram's-horn snail

* denotes a priority natural habitat or species (supporting explanatory text on following page)

*** Priority natural habitats or species**

Some of the natural habitats and species for which UK SACs have been selected are considered to be particular priorities for conservation at a European scale and are subject to special provisions in the Habitats Regulations. These priority natural habitats and species are denoted by an asterisk (*) in Annex I and II of the Habitats Directive. The term 'priority' is also used in other contexts, for example with reference to particular habitats or species that are prioritised in UK Biodiversity Action Plans. It is important to note however that these are not necessarily the priority natural habitats or species within the meaning of the Habitats Regulations.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment', including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where available) will also provide a framework to inform the measures needed to conserve or restore the European Site and the prevention of deterioration or significant disturbance of its qualifying features.

These Conservation Objectives are set for each habitat or species of a Special Area of Conservation (SAC). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving Favourable Conservation Status for that species or habitat type at a UK level. The term 'favourable conservation status' is defined in regulation 3 of the Habitats Regulations.

Publication date: 27 November 2018 (version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the consolidation of the Habitats Regulations in 2017.

European Site Conservation Objectives for Alde–Ore Estuary Special Protection Area Site Code: UK9009112

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure 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 population of each of the qualifying features, and,**
- **The distribution of the qualifying features within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

A081 *Circus aeruginosus*; Eurasian marsh harrier (Breeding)
A132 *Recurvirostra avosetta*; Pied avocet (Non-breeding)
A132 *Recurvirostra avosetta*; Pied avocet (Breeding)
A151 *Philomachus pugnax*; Ruff (Non-breeding)
A162 *Tringa totanus*; Common redshank (Non-breeding)
A183 *Larus fuscus*; Lesser black-backed gull (Breeding)
A191 *Sterna sandvicensis*; Sandwich tern (Breeding)
A195 *Sterna albifrons*; Little tern (Breeding)

This is a European Marine Site

This SPA is a part of the Alde Ore & Butley European Marine Site (EMS). These Conservation Objectives should be used in conjunction with the Regulation 35 Conservation Advice document for the EMS. For further details about this please visit the Natural England website at: http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/europeansites.aspx or contact Natural England's enquiry service at enquiries@naturalengland.org.uk or by phone on 0845 600 3078.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2010 (the "Habitats Regulations") and Article 6(3) of the Habitats Directive. They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment' including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where this is available) will also provide a framework to inform the management of the European Site under the provisions of Articles 4(1) and 4(2) of the Wild Birds Directive, and the prevention of deterioration of habitats and significant disturbance of its qualifying features required under Article 6(2) of the Habitats Directive.

These Conservation Objectives are set for each bird feature for a Special Protection Area (SPA). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving the aims of the Wild Birds Directive.

Publication date: 30 June 2014 (Version 2). This document updates and replaces an earlier version dated 29 May 2012 to reflect Natural England's Strategic Standard on European Site Conservation Objectives 2014. Previous references to additional features identified in the 2001 UK SPA Review have also been removed.

EC Directive 79/409 on the Conservation of Wild Birds: Special Protection Areas

Alde-Ore Estuary (Suffolk)

The Alde-Ore Estuary proposed Special Protection Area (pSPA) is situated on the east coast of Suffolk between Aldeburgh in the north and Bawdsey in the south. The site comprises the estuary complex of the rivers Alde, Butley and Ore, including Havergate Island and Orfordness. The variety of habitats important for breeding and wintering birds includes vegetated shingle, intertidal mudflats, semi-improved grazing marsh, saltmarsh and saline lagoons.

The site includes the entire Alde-Ore Estuary SSSI, notified in 1985 (revised in 1992 under the Wildlife and Countryside Act, 1981). The Alde-Ore Estuary SSSI includes the Orfordness-Havergate NNR, the English Nature owned part of which has already been designated as Orfordness-Havergate SPA.

The site qualifies under Article 4.1 of the EC Birds Directive by sustaining nationally important numbers of the following Annex 1 species, marsh harrier *Circus aeruginosus* (breeding), avocet *Recurvirostra avosetta* (wintering and breeding) ruff *Philomachus pugnax* (wintering), sandwich tern *Sterna sandvicensis* (breeding) and little tern *Sterna albifrons* (breeding). Further Annex 1 species winter on site, including, bittern *Botaurus stellaris*, Bewick's Swan *Cygnus columbianus*, hen harrier *Circus cyaneus*, golden plover *Pluvialis apricaria*, and short-eared owl *Asio flammeus*. Mediterranean gull *Larus melanocephalus*, common tern *Sterna hirundo* and Arctic tern *Sterna paradisaea* breed on Havergate Island.

The site qualifies under Article 4.2 of the Directive by regularly supporting internationally important numbers of two migratory species. The Orfordness colony of breeding lesser black-backed gull *Larus fuscus graellsii*, represented in 1995, 12% of the British population and 8% of the world population of the *graellsii* race. The five year wintering peak mean 1989/90 to 1993/94 for redshank *Tringa totanus*, was 1,662 birds, representing 1.5 % of the British population and 1.1% of the east Atlantic flyway population.

The site supports over 1% of the British wintering population of the following (calculated from five year winter peak means 1989/90 to 1993/94), shelduck *Tadorna tadorna*, wigeon *Anas penelope*, teal *Anas crecca*, black-tailed godwit *Limosa limosa*. In addition, the site supports over 1% of the British breeding population of, Gadwall *Anas strepera*, shoveler *Anas clypeata* and herring gull *Larus argentatus*.

The site also supports a notable assemblage of breeding and wintering wetland birds, in addition to the species mentioned above. Breeding species include, oystercatcher *Haematopus ostralegus*, ringed plover *Charadrius hiaticula*, lapwing *Vanellus vanellus* (also winter) black headed gull *Larus ridibundus* and barn owl *Tyto alba*. Wintering species include, cormorant *Phalacrocorax carbo*, European white-fronted goose *Anser abifrons albifrons*, brent goose *Branta bernicla*, pintail *Anas acuta*, grey plover *Pluvialis squatarola*, dunlin *Calidris alpina* and curlew *Numenius arquata*.

This citation / map relates to a site entered in the Register of European sites for Great Britain
Register reference number UK9009112
Date of registration 25 AUG 1998
Signed [redacted]
on behalf of the Secretary of State for the Environment

SPA Citation
January 1996

NATURA 2000

STANDARD DATA FORM

FOR SPECIAL PROTECTION AREAS (SPA)
FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)
AND
FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:

1.1 Type J

1.2 Site code UK9009112

1.3 Compilation date 199610

1.4 Update 199803

1.5 Relationship with other Natura 2000 sites

U	K	0	0	1	4	7	8	0

1.6 Respondent(s) International Designations, JNCC, Peterborough

1.7 Site name **Alde–Ore Estuary**

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	
date confirmed as SCI	
date site classified as SPA	199610
date site designated as SAC	

2. Site location:

2.1 Site centre location

longitude	**latitude**
01 33 03 E	52 04 58 N

2.2 Site area (ha) 2416.87

2.3 Site length (km)

2.5 Administrative region

NUTS code	Region name	% cover
UK403	Suffolk	100.00%

2.6 Biogeographic region

Alpine	Atlantic	Boreal	Continental	Macaronesia	Mediterranean
	X				

3. Ecological information:

3.1 Annex I habitats

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment

3.2 Annex I birds and regularly occurring migratory birds not listed on Annex I

		Population					Site assessment		
		Resident	Migratory						
Code	Species name		Breed	Winter	Stage	Population	Conservation	Isolation	Global
A081	*Circus aeruginosus*		>3 P			C		B	
A183	*Larus fuscus*		14070 P			A		C	
A151	*Philomachus pugnax*			3 I		C		C	
A132	*Recurvirostra avosetta*			766 I		A		B	
A132	*Recurvirostra avosetta*		104 P			A		B	
A195	*Sterna albifrons*		48 P			C		C	
A191	*Sterna sandvicensis*		170 P			C		C	
A162	*Tringa totanus*			1919 I		C		C	

4. Site description:

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	50.0
Salt marshes. Salt pastures. Salt steppes	20.0
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	25.0
Inland water bodies (standing water, running water)	
Bogs. Marshes. Water fringed vegetation. Fens	5.0
Heath. Scrub. Maquis and garrigue. Phygrana	
Dry grassland. Steppes	
Humid grassland. Mesophile grassland	
Alpine and sub-alpine grassland	
Improved grassland	
Other arable land	
Broad-leaved deciduous woodland	
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Screes. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	**100%**

4.1 Other site characteristics

Soil & geology:

Mud, Nutrient-rich, Sedimentary, Shingle

Geomorphology & landscape:

Coastal, Estuary, Intertidal sediments (including sandflat/mudflat), Lagoon, Lowland, Shingle bar

4.2 Quality and importance

ARTICLE 4.1 QUALIFICATION (79/409/EEC)

During the breeding season the area regularly supports:

Circus aeruginosus	at least 1.9% of the GB breeding population 5 year mean, 1993-1997

Recurvirostra avosetta (Western Europe/Western Mediterranean - breeding)	23.1% of the GB breeding population 5 year mean, 1990-1994
Sterna albifrons (Eastern Atlantic - breeding)	2% of the GB breeding population 5 count mean, 1993-4,1996-8
Sterna sandvicensis (Western Europe/Western Africa)	1.2% of the GB breeding population 5 year mean, 1992-1996
Over winter the area regularly supports:	
Philomachus pugnax (Western Africa - wintering)	0.4% of the GB population 5 year peak mean 1991/92-1995/96
Recurvirostra avosetta (Western Europe/Western Mediterranean - breeding)	60.3% of the GB population 5 year peak mean 1991/92-1995/96

ARTICLE 4.2 QUALIFICATION (79/409/EEC)

During the breeding season the area regularly supports:

Larus fuscus (Western Europe/Mediterranean/Western Africa)	11.3% of the breeding population 5 year mean 1994-1998
Over winter the area regularly supports:	
Tringa totanus (Eastern Atlantic - wintering)	1.1% of the population 5 year peak mean 1991/92-1995/96

4.3 Vulnerability

The area is vulnerable to sea-level rise and coastal squeeze. These issues are being addressed through The Environment Agency Local Environment Action Plan, the estuary Management Plan and possibly managed retreat. Human disturbance from recreation is minimal as this is a reasonably robust system. Flood defence policy will need to take into account risks to the site from flooding and of flood control alleviation measures. Shooting is controlled through a management plan. A considerable part of the site is managed sympathetically by Suffolk Wildlife Trust, National Trust, Royal Society for the Protection of Birds and English Nature.

5. Site protection status and relation with CORINE biotopes:

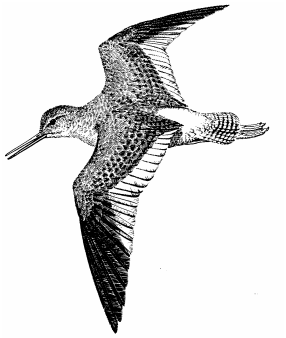
5.1 Designation types at national and regional level

Code	% cover
UK01 (NNR)	4.5
UK04 (SSSI/ASSI)	100.0

ENGLISH NATURE

Alde-Ore Estuary
European marine site

English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994



Issued 25 May 2001

English Nature's advice for Alde-Ore Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

Preface

This document provides English Nature's advice to other relevant authorities as to (a) the conservation objectives and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for the Alde-Ore Estuary European marine site. This advice is being prepared to fulfill our obligations under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

The Alde-Ore Estuary European marine site comprises a Special Protection Area (Alde-Ore Estuary) and a candidate Special Area of Conservation (Orfordness to Shingle Street) and our advice within this document is being prepared to cover the marine elements of both the SPA and SAC interests.

European marine sites are defined in the Conservation (Natural Habitats &c.) Regulations 1994 as any part of a European site covered (continuously or intermittently) by tidal waters or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters. European sites include Special Areas of Conservation (designated under the Habitats Directive, which support certain natural habitats and species of European importance), and Special Protection Areas (designated under the Birds Directive which support significant numbers of internationally important wild birds). In many instances these designations may coincide and our advice is being prepared to cover both the SAC and SPA interests where this occurs.

This 'Regulation 33 package' is designed to help relevant and competent authorities, who have responsibilities to implement the Habitats Directive, to:

- understand the international nature conservation importance of the site, underlying physical processes and the ecological requirements of the habitats and species involved;

- advise relevant authorities as to the conservation objectives for the site and operations which may cause deterioration or disturbance

- set the standards against which the condition of the site's interest features can be determined and undertake compliance monitoring to establish whether they are in favourable condition; and

- develop, if deemed necessary, a management scheme to ensure that the features of the site are maintained.

In addition, the Regulation 33 package will provide a basis to inform on the scope and nature of 'appropriate assessment' required in relation to plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). English Nature will keep this advice under review and may update it every six years or sooner, depending on the changing circumstances of the European marine site. In addition, we will provide more detailed advice to competent

and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered. If as a result of the European Union's moderation process or the UK SPA Network Review (led by JNCC) interest features are added to this European marine site or the site boundaries change, English Nature will amend this advice, as appropriate.

Tim Bines
General Manager
English Nature
25 May 2001

English Nature's advice for Alde-Ore Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

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English Nature's advice for Alde-Ore Estuary European marine site given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994

1. Introduction

1.1 Natura 2000

The European Union Habitats[1] and Birds[2] Directives are international obligations which set out a number of actions to be taken for nature conservation. The Habitats Directive aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements, and sets out measures to maintain or restore, natural habitats and species of European Union interest at favourable conservation status[3]. The Birds Directive protects all wild birds and their habitats within the European Union, and there are special measures for migratory birds and those that are considered rare or vulnerable.

The Habitats and Birds Directives include requirements for the designation of conservation areas. In the case of the Habitats Directive these are Special Areas of Conservation (SACs) which support certain natural habitats or species, and in the Birds Directive, Special Protection Areas (SPAs) which support wild birds of European Union interest. These sites will form a network of conservation areas across the EU to be known as "Natura 2000". Where SACs or SPAs consist of areas continuously or intermittently covered by tidal waters or any part of the sea in or adjacent to Great Britain up to the limit of territorial waters, they are referred to as European marine sites.

Further guidance on European marine sites is contained in the Department of the Environment Transport and Regions/Welsh Office document: *European marine sites in England & Wales: A guide to the Conservation (Natural Habitats &c.) Regulations 1994 and to the preparation and application of management schemes.*

1.2 English Nature's role

The Conservation (Natural Habitats &c.) Regulations 1994 translate the Habitats Directive into law in Great Britain. It gives English Nature a statutory responsibility to advise relevant authorities as to the conservation objectives for European marine sites in England and to advise relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the sites have been designated. This information will be a key component of any of the management schemes which may be developed for these sites.

This document is English Nature's advice for the Alde-Ore Estuary European marine site issued in fulfilment of Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 (the 'Regulation 33 package'). Copies of key references quoted in this

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1 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

2 Council Directive 79/409/EEC on the conservation of wild birds

3 A habitat or species is defined as being at favourable conservation status when its natural range and the areas it covers within that range are stable or increasing and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future.

document are held at the English Nature local office, Suffolk Team, Regent House 110 Northgate Street, Bury St Edmunds, Suffolk, IP33 1HP.

In addition to providing such advice, the Regulation 33 package informs on the scope and nature of 'appropriate assessment' which the Directive requires to be undertaken for plans and projects (Regulations 48 & 50 and by English Nature under Regulation 20). English Nature may also provide more detailed advice to competent and relevant authorities to assess the implications of any such plans or projects.

1.3 The role of relevant authorities

The Conservation (Natural Habitats &c.) Regulations 1994 require all competent authorities to exercise their functions so as to secure compliance with the Habitats Directive. This European marine site is managed through existing SSSI mechanisms under the Wildlife and Countryside Act 1981, as amended 1985. However, relevant authorities may, if deemed necessary, draw up a management scheme under Regulation 34 for the European marine site. If such a management scheme is developed, it will provide the framework through which relevant authorities exercise their functions so as to secure compliance with the Habitats Directive and must be based on the advice in this package. Irrespective of this decision, relevant authorities must, within their areas of jurisdiction, have regard to both direct and indirect effects on an interest feature of the site as well as cumulative effects. This may include consideration of features and issues outside the boundary of the European marine site and above the highest astronomical tide.

Relevant authorities should ensure that all plans for the area integrate with any management scheme for the European marine site. Such plans may include shoreline management plans, CHaMPs (Coastal Habitat Management Plans), local Environment Agency plans, SSSI management plans, local BAP plans and sustainable development strategies for estuaries. This must occur to ensure that there is only a single management scheme through which all relevant authorities exercise their duties under the Conservation (Natural Habitats &c.) Regulations 1994.

Relevant authorities also need to have regard to changing circumstances of the SPA and SAC and may therefore need to modify the way in which they exercise their functions so as to maintain the favourable condition of interest features concerned in the long term. There is no requirement for relevant authorities to take any actions outside their statutory functions.

Under certain circumstances, where another relevant authority is unable to act for legal reasons, or where there is no other relevant authority, English Nature is empowered to use its bylaw-making powers for Marine Nature Reserves (MNR) for use in European marine sites.

1.4 Activity outside the control of relevant authorities

Nothing within this Regulation 33 package will require relevant authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that the changes result wholly from natural causes[4]. This also applies if the changes, although causing deterioration or disturbance to the interest features, are the result of human or natural events

[4] Determination of what constitutes natural change will be based on the best available information and scientific opinion at the time.

outside their control. Having issued Regulation 33 advice for European marine sites, English Nature will work with relevant authorities and others to agree, within a defined time frame, a protocol for evaluating all observed changes to baselines and to develop an understanding of natural change and provide further guidance as appropriate and possible.

On the Alde-Ore Estuary European marine site a management group is being set up and, once established, should be used to alert all the relevant authorities to such issues so that they may be assessed and any appropriate measures taken. This does not, however, preclude relevant authorities from taking action to prevent deterioration to the interest features, for example by introducing or promoting codes of practice through the Steering Group.

1.5 Responsibilities under other conservation designations

In addition to its SPA and candidate SAC status, parts of Alde-Ore Estuary are also designated and subject to agreements under other conservation legislation (eg. SSSIs notified under the Wildlife and Countryside Act 1981 as amended 1985). The obligations of relevant authorities and other organisations under such designations are not affected by the advice contained in this document.

1.6 Role of conservation objectives

Section 5 of this document sets out the conservation objectives for the Alde-Ore Estuary European marine site. They are the starting point from which management schemes and monitoring programmes may be developed as they provide the basis for determining what is currently or may cause a significant effect, and for informing on the scope of appropriate assessments of plans or projects. The conservation objectives set out what needs to be achieved and thus deliver the aims of the Habitats Directive.

1.7 Role of advice on operations

The advice on operations set out in Section 7 provides the basis for discussion about the nature and extent of the operations taking place within or close to the site and which may have an impact on its interest features. It is given on the basis of the working assumption that sites were in favourable condition at the time they were identified. In the 2000-2006 reporting period an assessment of the condition of the site will be made to support this assumption, and ensure that favourable condition is being maintained. The advice should also be used to identify the extent to which existing measures of control, management and use are, or can be made, consistent with the conservation objectives and thereby focus the attention of relevant authorities and surveillance to areas that may need management measures.

This operations advice may need to be supplemented through further detailed discussions with any management and advisory groups for the European marine site.

2. Identification of interest features under the EU Birds and Habitats Directives

The boundary of the Alde-Ore Estuary Special Protection Area (SPA) is shown in Figure 1. The boundary of Orfordness to Shingle Street Special Area of Conservation is shown in Figure 2

2.1 SPA interest features under the EU Birds Directive

Alde-Ore Estuary SPA qualifies under Article 4.1 of the EU Birds Directive by supporting:

- Internationally important populations of regularly occurring bird species listed on Annex 1 of the Bird Directive.

- It also qualifies under Article 4.2 of the EU Birds Directive in that it supports:

- Internationally important populations of regularly occurring migratory bird species

Qualifying species of Alde-Ore Estuary SPA that utilise habitats above highest astronomical tide and hence outside the European marine site are internationally important breeding populations of marsh harrier *Circus aeruginosus* and lesser black-backed gull *Larus fuscus graellsii*. Marsh harriers are unlikely to make significant use of the habitats within the European marine site and no objectives are included in this advice package. Within the Alde-Ore Estuary SPA marsh harriers breed in locally abundant areas of rough vegetation on dyke edges and river walls and lesser black-backed gulls nest on medium to tall vegetated shingle. Objectives to maintain these aspects of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

Alde-Ore Estuary SPA citation was written in January 1996 and was classified as an SPA on 25 August 1998 and it is that citation on which this advice is based. Alde-Ore Estuary was also listed in October 1996 as a Ramsar site under the Ramsar convention for its internationally important wetland status.

2.2 SAC interest feature under the EU Habitats Directive

Orfordness to Shingle Street candidate SAC, as designated under the EU Habitats Directive, qualifies as a SAC for the following Annex 1 habitat:

- Annual vegetation of drift lines

Orfordness to Shingle Street candidate SAC also qualifies for the Annex I habitats **perennial vegetation of stony banks** and **lagoons**. However, these habitats do not occur within the European marine site as they occur above highest astronomical tide. As a consequence there are no specific conservation objectives within this document for these habitats. Objectives to maintain coastal shingle outside the reach of waves (perennial vegetation of stony banks) and

lagoons in favourable condition are identified within English Nature's conservation objectives for the relevant SSSIs within the SAC boundary and will be dealt with through procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994.

The features on this site are inextricably linked so that, for example, as the system accretes or erodes the exact location of saline lagoons may change and the area of perennial vegetation of stony banks will alter but it will always be fronted by a fringe of annual vegetation of drift lines. It is important therefore to maintain the systems that maintain these features and relevant authorities will need to have regard to such adjacent interests as they may be affected by activities taking place within, or adjacent to the site.

3. SPA interest features of the European marine site

This section describes and explains the importance of the SPA interest features of the Alde-Ore Estuary European marine site.

The Alde-Ore Estuary SPA includes both marine areas (ie. land covered continuously or intermittently by tidal waters) and land which is not subject to tidal influence. The marine part of the SPA is termed a European marine site. The extent of the Alde-Ore Estuary European marine site is illustrated in Figure 3. The seaward boundary of the European marine site is concurrent with that of the SPA. The landward boundary of the European marine site is the upper boundary of the SPA, or where that extends above land covered continuously or intermittently by tidal waters it is at the limit of the marine habitats.

Where SPA qualifying species occur within the European marine site they are referred to as interest features. Sub-features (habitats) have also been identified to highlight the ecologically important components of the European marine site for each interest feature. The interest features and sub-features for the Alde-Ore Estuary European marine site are described below and the sub-features are mapped at Figure 4 to show their distribution and extent.

3.1 Background and context

A major aim of the Birds Directive is to take special measures to conserve the habitats of qualifying birds in order to ensure their survival and reproduction within the European Union. A key mechanism in achieving this is the classification by Member States of the most suitable sites as SPAs.

English Nature's conservation objectives at a site level focus on maintaining the condition of the habitats used by the qualifying species. Habitat condition will be delivered through appropriate site management including the avoidance of damaging disturbance. In reporting on Favourable Conservation Status, account will need to be taken both of habitat condition and the status of the birds on the SPA.

Accordingly, English Nature will use annual counts, in the context of five year peak means for qualifying species, together with available information on population and distribution trends, to assess whether an SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species. Count information will be assessed in combination with information on habitat condition, at the appropriate time within the reporting cycle, in order to report to the European Commission.

English Nature's advice focuses on the qualifying species for which the SPA was originally classified despite the fact that numbers and species composition may have changed on this site since that time. Such population and species composition changes are being documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes required in SPA citations. Depending on the review and decisions from DETR, English Nature may reissue this advice.

In addition to focusing on avoiding deterioration to the habitats of the qualifying species, the Habitats Directive also requires that actions are taken to avoid significant disturbance to the

species for which the site was designated. Such disturbance may include alterations in population trends and/or distribution patterns. Avoiding disturbance to species requirements is mentioned in the favourable condition table underpinning the conservation objectives for the SPA. In this context, five year peak mean information on populations will be used as the basis for assessing whether disturbance is damaging.

Attention is, however, also directed to the inclusion of disturbance in the advice on operations provided in Section 7. Where disturbance is highlighted in such advice, relevant authorities need to avoid damaging disturbance to qualifying species when exercising their functions under the Directive.

3.2 Reductions in organic inputs

Under the Urban Waste Water Treatment (UWWT) Directive all coastal discharges above a certain volume must have secondary treatment installed by the end of 2000. Secondary treatment of sewage will significantly reduce organic loading and to a lesser extent reduce concentrations of dissolved nutrients. The effects of these reductions on coastal features and the birds they support are difficult to predict. On the one hand, it might be expected that there would be a redistribution of feeding birds or a reduction in the overall capacity of a coastal area to support bird populations. On the other hand, where bird populations are currently adversely affected by eutrophication, cleaner discharges may contribute to improving site condition.

English Nature supports the cleaning up of coastal discharges. On balance, the overall ecological benefits of cleaner discharges are likely, in general, to outweigh any subsequent local decline in bird numbers, although there is presently insufficient knowledge to accurately predict the effects in general or for individual SPA sites. Consequently, English Nature, with input from the Countryside Council for Wales and the Environment Agency, is commissioning a related research project to study the relationship between birds and organic nutrient levels, the overall effects on the ecosystem and thereby the effects of the clean-up programme under the UWWT and Bathing Water Directives.

Under the Habitats Regulations, if significant effects are likely from such activities, the competent authority (in this case the Environment Agency) will be required to undertake an appropriate assessment to determine whether there is an adverse effect on site integrity.

3.3 General description

In recognition that bird populations may change as a reflection of national or international trends or events, this advice on the bird interests of the European marine site focuses on the condition of the habitats necessary to support the bird populations. Sub-features are identified which describe the key habitats within the European marine site necessary to support the birds that qualify within the SPA. Detailed information and targets for habitat condition are listed in the favourable condition table in Section 6. Bird usage of the site varies seasonally, with different areas being favoured over others at certain times of the year. However, annual counts for qualifying species will be used by English Nature, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

Bird communities are highly mobile and exhibit patterns of activity related to tidal water movements and many other factors. Different bird species exploit different parts of a marine area and different prey species. Changes in the habitat may therefore affect them differently. The important bird populations at this site require a functional estuary which is capable of supporting intertidal habitat for feeding and roosting. The most important factors related to this are:

- Current extent and distribution of suitable feeding and roosting habitat (eg saltmarsh, mudflats);
- Sufficient prey availability (eg small fish, crustaceans and worms);
- Levels of disturbance consistent with maintaining conditions for bird feeding and roosting;
- Water quality necessary to maintain intertidal plant and animal communities; and
- Water quantity and salinity gradients necessary to maintain saltmarsh conditions suitable for bird feeding and roosting.

3.4 Internationally important populations of the regularly occurring Annex 1 species

The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable. Annex 1 species that regularly occur at levels over 1% of the national population meet the SPA qualifying criteria. The qualifying species of the Alde-Ore Estuary SPA that occur in the European marine site are breeding and wintering avocets *Recurvirosta avosetta,* wintering ruff *Philomachus pugnax,* breeding Sandwich tern *Sterna sandvicensis* and little tern *Sterna albifrons.*

Some of the habitat required for terns to nest - bare and sparsely vegetated shingle, occurs within the European marine site, however, many birds nest above highest astronomical tide. Likewise ruff are, to varying degrees, dependent on non-intertidal as well as intertidal habitats. These non-intertidal habitats do not occur within the European marine site, as they occur above the highest astronomical tide. Objectives to maintain these aspects of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Some of the feeding habitat for terns - coastal waters above intertidal mud and sand - does occur within the European marine site and an objective is included within this advice package, however terns will also exploit feeding habitat below mean low water, outside the boundary of both the SPA and the European marine site. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

3.4.1 Key sub-features

Shingle areas - The strip of shingle along the Suffolk Coast is highly mobile and longshore drift, coupled with the action of the waves, results in the constant movement of material along the coast. Because of this mobility, vegetation has little chance to establish on the shingle and these sparsely vegetated shingle areas are an important nesting area for the little terns on Orfordness in the Alde-Ore Estuary European marine site. The size of the shingle

varies from coarse material to finer sands. Little terns, which nest in a shallow scrape in the sand or shingle, prefer areas with little vegetation so that they can see any approaching predators. The terns tend to nest around the transient annual vegetation such as yellow horned poppy and they sometimes use sea pea as a nest marker. The main nesting areas for the little terns are along the spit of Orfordness on the seaward side in the splash zone. Sandwich terns have not been known to breed on the Ness since 1996 although they do breed on Havergate Island.

Shallow coastal water - The shallow waters of the Suffolk coast provide an important feeding area for the little and Sandwich terns. The main prey items include sprats, sandeels and the small fry of other fish. The terns feed both within the estuary and along the coastal strip within the European marine site. They also feed further out to sea along the coast. Little terns will also feed on small crustaceans, molluscs and marine worms.

Intertidal mudflat - There are extensive areas of intertidal mudflats exposed in the estuary at low tide. The mudflats provide an important feeding and roosting area for avocet and ruff. Both species feed and roost along the estuary from Snape to North Weir Point. They feed communally on a range of organisms but in particular on the ragworm, *Nereis diversicolor, Corophium* and *Hydrobia.* Both ruff and avocet have been seen feeding and roosting on the estuary in association with black-tailed godwit.

Saltmarsh communities - Narrow fringes of saltmarsh occur along the length of the estuary with wider expanses at Shingle Street, Havergate Island, Stony Ditch, the upper reaches of the Butley river and in places by the Alde river. These are mostly dominated by sea purslane, *Halimione portulacoides* and sea lavender, *Limonium vulgare,* but a wide range of other saltmarsh species also occur including sea heath, *Frankenia laevis,* glasswort, *Salicornia pusilla* and small cord grass, *Spartina maritima.* Higher saltmarsh grading into neutral grassland, dominated by sea couch grass, *Elymus pungens*, occurs on Havergate Island and Orfordness and on the extensive system of clay embankments throughout the site. These habitats provide important roosting areas for avocets and ruff.

3.5 Internationally important populations of regularly occurring migratory bird species

The Alde-Ore estuary supports internationally important populations of two migratory species; lesser black-backed gull *Larus fuscus graellsii* and redshank *Tringa totanus*.

The nesting habitat for lesser black backed gull - medium to tall vegetated shingle does not occur within the European marine site. Lesser black-backed gulls are also dependent on non-intertidal as well as intertidal habitats. These non-intertidal habitats do not occur within the European marine site, as they occur above the highest astronomical tide. Objectives to maintain these aspects of bird interest in favourable condition are found within English Nature's conservation objectives for the relevant SSSI within the SPA boundary and will be dealt with through relevant procedures outlined in the Conservation (Natural Habitats &c.) Regulations 1994. Relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

Some of the feeding habitat for lesser black-backed gull - coastal waters above intertidal mud and sand - does occur within the European marine site and an objective is included within this

advice package. However, gulls will predominantly exploit feeding habitat below mean low water, out to sea where they eat squid, fish and scraps from boats. The pig rearing units on the mainland are also an important food source for the gulls, although currently there are no pigs in the area as a result of the recent swine fever outbreak.

These habitats are outside the boundary of both the SPA and the European marine site and relevant authorities need to have regard to such adjacent European interests, as they might be affected by activities taking place within, or adjacent to the European marine site.

3.5.1 Key sub-features

Shallow coastal water - The shallow waters of the Suffolk coast provide a feeding area for lesser black-backed gulls. They are generalists, feeding in a variety of habitats. The combination of these habitats is required to maintain the internationally important breeding population. For this reason, shallow coastal waters have been identified as a sub-feature. The lesser black-backed gull's diet will include a range of species or items that they can catch or scavenge within the coastal strip of the European marine site.

Intertidal mudflat - There are extensive areas of intertidal mudflats exposed in the estuary at low tide. The mudflats provide an important feeding and roosting area for redshank and lesser black-backed gulls. The redshank feed in the estuary and in Stony Ditch. They feed predominantly on ragworm and lugworm, largely on the tideline, following the tide in and out. The lesser black-backed gulls feed throughout the estuary on various prey items.

Saltmarsh communities - Narrow fringes of saltmarsh occur along the length of the estuary with wider expanses at Shingle Street, Havergate Island, Stony Ditch, the upper reaches of the Butley river and in places by the Alde river. These are mostly dominated by sea purslane, *Halimione portulacoides* and sea lavender, *Limonium vulgare,* but a wide range of other saltmarsh species also occur including sea heath, *Frankenia laevis,* glasswort, *Salicornia pusilla* and small cord grass, *Spartina maritima.* Higher saltmarsh grading into neutral grassland, dominated by sea couch grass, *Elymus pungens*, occurs on Havergate Island and Orfordness and on the extensive system of clay embankments throughout the site. These habitats provide important breeding and roosting areas for redshank. Compared to other wading birds, redshank will feed on the higher areas of intertidal mudflat, in muddy creeks found within saltmarsh and on the saltmarsh itself. In addition, areas of saltmarsh are occasionally used by feeding lesser black-backed gulls.

4. SAC interest features of the European marine site

The Orfordness to Shingle Street SAC includes both marine areas (ie. land covered continuously or intermittently by tidal waters) and land which is not subject to tidal influence. The marine part of the SAC is termed a European marine site. The extent of the Orfordness to Shingle Street European marine site is illustrated in Figure 3.

The Alde-Ore Estuary European marine site includes an interest feature qualifying under Annex I of the Habitats Directive. This section describes and explains the importance of this SAC interest feature. The interest feature is mapped in Figure 4.

4.1 Annual vegetation of drift lines

4.1.1 General description

Approximately a third of the coastline of the UK is fringed by a shingle or sand/shingle beach, but much of this is devoid of vegetation. Sites where drift line vegetation does occur may have vegetative cover one year, but not another. Therefore, although widespread in terms of total area, sites where this habitat type is persistent are rare. The habitat is dominated by annual vegetation which grows each summer, lying at or above mean high water spring tides of shingle and sandy beaches. It is important to note that this interest feature is very dynamic. The extent and location of the vegetation depends upon the naturally occurring processes of erosion and accretion of the substrate. Therefore, mobility is an over-riding consideration, and colonising species are able to withstand periodic disturbance, which may involve the total removal of the surface by storms.

Alde-Ore Estuary European marine site has been chosen to reflect the more constant occurrence of the vegetation in association with larger, more stable areas of stony banks. The site exhibits good conservation of structure and function (ie they are relatively unmodified and are less prone to human disturbance) and represents variation in the habitat type in terms of substrate type.

At this site the annual vegetation occurs on the shingle lying at or above mean high water spring tides. Varying amounts of sand are interspersed in the shingle matrix and the type found at the Alde-Ore Estuary European marine site generally lies at the higher end of the size range of shingle. The pebbles are flint and have been derived from offshore sources and from erosion of glacial cliffs in East Anglia.

The spit of Orfordness is composed of a series of ridges which have been deposited almost parallel to the coast and have resulted in the formation of an extensive area of stable shingle fringed by a dynamic coastal ridge. The area is in dynamic equilibrium with cycles of accretion and erosion. Shingle Street is located opposite the distal end of Orfordness on the west bank of the Rive Ore. There is an accumulation of shingle on the seaward side of the sea wall in the northern part of the village. It comprises of a series of shingle ridges which have been deposited on top of London Clay. The vegetation on the coastal ridges is ephemeral, composed of annual or short-lived perennial species, and is very distinctive. Species are also tolerant of saltwater inundation, as the beaches are often over-topped by the tide or subject to spray from waves breaking over the beach (Brown and others 1997).

4.1.2 Importance at Alde-Ore Estuary European marine site

This area of annual vegetation of drift lines is one of only four outstanding localities in the UK. This interest feature is considered to be rare as its total extent in the UK is thought to be less than 100 hectares.

This site includes long shingle banks (some 15km in length) at Orfordness and Shingle Street which have been subject to relatively little human intervention. It has been selected as one of two representatives of this habitat type on the east coast of England, the other being Minsmere-Walberswick. The shingle bank of Orfordness supports extensive drift line vegetation dominated by sea kale *Cakile maritima*, sea beet *Beta vulgaris* subsp. *maritima,* sea pea, *Lathryus japonicus,* yellow horned poppy, *Glaucium flavum* and orache *Atriplex* spp.. Shingle Street supports an open *Lathyrus japonicus* dominated community with *Arrhenatherum elatius*, *Rumex crispus* and *Crepis vesicaria.*

5. Conservation objectives for European marine site interest features

Under Regulation 33(2)(a) of the Conservation (Natural Habitats &c.) Regulations 1994, English Nature has a duty to advise other relevant authorities as to the conservation objectives for the European site. The conservation objectives for the Alde-Ore Estuary European marine site interest features are provided below and should be read in the context of other advice given in this package, particularly:

- the attached maps showing the extent of the sub-features;
- summary information on the interest of each of the features; and
- the favourable condition table, providing information on how to recognise favourable condition for the feature and which will act as a basis for the development of a monitoring programme

5.1 SPA interest features

5.1.1 The conservation objective for the internationally important populations of the regularly occurring Annex 1 bird species

Subject to natural change, maintain in favourable condition[5] the habitats for the **internationally important populations of the regularly occurring Annex 1 bird species**, under the Birds Directive, in particular:

- **Shingle areas**
- **Intertidal mudflats**
- **Saltmarsh communities**
- **Shallow coastal waters**

Numbers of bird species using these habitats are given in Table 1

5.1.2 The conservation objective for the internationally important populations of regularly occurring migratory bird species

Subject to natural change, maintain in favourable condition[5] the habitats for the **internationally important populations of regularly occurring migratory bird species**, under the Birds Directive, in particular:

- **Intertidal mudflats**
- **Saltmarsh**
- **communities**
- **Shallow coastal waters**

Numbers of bird species using these habitats are given in Table 1

5 For a detailed definition of how to recognise favourable condition see attached table (Section 6)

Note: These SPA conservation objectives focus on habitat condition in recognition that bird populations may change as a reflection of national or international trends or events. Annual counts for qualifying species will be used by English Nature, in the context of five year peak means, together with available information on UK population and distribution trends, to assess whether this SPA is continuing to make an appropriate contribution to the Favourable Conservation Status of the species across Europe.

Table 1 Information on populations of internationally important species of birds under the Birds Directive using the Alde-Ore Estuary European marine site at the time the SPA was classified.

Internationally important populations of regularly occurring Annex 1 species.

Breeding populations

Species	Population (5 yr mean)*	
Avocet (*Recurvirostra avosetta*)	104 birds	(1989 - 1993/4)
Sandwich tern (*Sterna sandvicensis)*	169 pairs	(1989 - 1993/4)
Little tern (*Sterna albifrons*)	155 pairs	(1989 - 1993/4)

Wintering populations

Species	Population (5 yr peak mean for 1989/90 - 1993/94)*
Avocet (*Recurvirostra avosetta*)	749 birds
Ruff *(Philomachus pugnax)*	12 birds

Internationally important populations of regularly occurring migratory bird species.[6]

Importance	Population (5 yr mean for 1989/90 - 1993/94)*
Redshank (*Tringa totanus*)	1662 birds
Lesser black-backed gull (*Larus fuscus graellsii*)	8223 birds

* SPA citation dated January 1996 held on Register of European marine sites for Great Britain/ WeBs Counts/ JNCC Seabirds Group seabird colony register/ Suffolk county bird report

6 Alde-Ore Estuary is regularly used by 1% or more of the biogeographical population of a regularly occurring species (other than those listed on annex 1) in any season (Cranswick and others 1995).

5.2 SAC interest feature

5.2.1 The conservation objective for annual vegetation of drift lines

Subject to natural change, maintain the **annual vegetation of drift lines** in favourable condition[5]

6. Favourable condition table

The favourable condition table is supplied as an integral part of English Nature's Regulation 33 advice package. It is intended to supplement the conservation objectives only in relation to management of activities and reporting requirements on monitoring the condition of the site and its features. The table **does not by itself** provide a comprehensive basis on which to assess plans and projects as required under Regulations 20 and 48-50, but it does provide a basis to inform the scope and nature of any 'appropriate assessment' that may be needed. It should be noted that appropriate assessments are, by contrast, a separate activity to condition monitoring requiring consideration of issues specific to individual plans or projects. English Nature will provide more detailed advice to competent and relevant authorities to assess the implications of any given plan or project under the Regulations, where appropriate, at the time a plan or project is being considered.

The favourable condition table is the principle source of information that English Nature will use to assess the condition of an interest feature and as such comprises indicators of condition. On many terrestrial European sites, we know sufficient about the preferred or target condition of qualifying habitats to be able to define measures and associated targets for all attributes to be assessed in condition monitoring. Assessments as to whether individual interest features are in favourable condition will be made against these targets. In European marine sites we know less about habitat condition and find it difficult to specify favourable condition. Individual sites within a single marine habitat category are also all very different, further hampering the identification of generic indicators of condition. Accordingly, in the absence of such information, condition of interest features in European marine sites will be assessed against targets based on the existing conditions, which may need to be established through baseline surveys in many cases.

The assumption that existing interest features on European marine sites are in favourable condition will be tested in the 2000 - 2006 reporting period and the results subsequently fed back into our advice and site management. Where there is more than one year's observations on the condition of marine habitats, all available information will need to be used to set the site within long-term trends in order to form a view on favourable condition. Where it may become clear that certain attributes are a cause for concern, and if detailed studies prove this correct, restorative management actions will need to be taken to return the interest feature from unfavourable to favourable condition. It is the intention of English Nature to provide quantification of targets in the favourable condition table during the 2000 - 2006 reporting period.

This advice also provides the basis for discussions with management and advisory groups, and as such the attributes and associated measures and targets may be modified over time. The aim is to produce a single agreed set of attributes that will then be monitored in order to report on the condition of features. Monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site. To meet UK agreed common standards, English Nature will be committed to reporting on each of the attributes subsequently listed in the final version of the table, although the information to be used may be collected by other organisations through agreements.

The table will be an important, but not the only, driver of the site monitoring programme. Other data, such as results from compliance monitoring and appropriate assessments, will

also have an important role in assessing condition. The monitoring programme will be developed as part of the management scheme process through discussion with the relevant authorities and other interested parties. English Nature will be responsible for collating the information required to assess condition and will form a judgement on the condition of each feature within the site, taking into account all available information and using the favourable condition table as a guide.

Box 1	**Glossary of terms used in the favourable condition table**
Interest feature	The habitat or species for which the site has been selected.
Sub-feature	An ecologically important sub-division of the interest feature.
Attribute	Selected characteristic of an interest feature/sub-feature which provides an indication of the condition of the feature to which it applies.
Measure	What will be measured in terms of the units of measurement, arithmetic nature and frequency at which the measurement is taken. This measure will be attained using a range of methods from broad scale to more specific across the site.
Target	This defines the desired condition of an attribute, taking into account fluctuations due to natural change. Changes that are significantly different from the target will serve as a trigger mechanism through which some further investigation or remedial action is taken.
Comments	The rationale for selection of the attribute.

Table 2 Favourable Condition Table for Alde-Ore Estuary European marine site

Numbers of bird species using these habitats are given in Table 1

NB - Many of the attributes will be able to be monitored at the same time or during the same survey. The frequency of sampling for many attributes may need to be greater during the first reporting cycle in order to characterise the site and establish the baseline.

Feature	Sub - Feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring Annex 1 bird species	All sub features: shingle, saltmarsh intertidal mudflat, shallow coastal waters.	Disturbance	Reduction or displacement of birds	No significant reduction in numbers or displacement from an established baseline[7], subject to natural change.	All qualifying species. Breeding terns are particularly vulnerable to disturbance.
		Extent and distribution of habitat	Area (ha) measured once during reporting cycle	No decrease in extent from an established baseline[7], subject to natural change.	Shingle is important for nesting terns, saltmarsh is important for roosting waders, intertidal mudflat is important for feeding waders and shallow coastal waters are important for feeding terns.
	Shingle	Vegetation characteristics	Predominantly open ground with sparse vegetation and bare surfaces, measured periodically, frequency to be determined.	Vegetation cover <10% and the remainder bare during the breeding season, subject to natural change.	In areas used by breeding little and Sandwich terns. Areas of largely bare shingle important for nesting little and Sandwich terns
	Saltmarsh	Vegetation characteristics	Open, short vegetation or bare ground predominating in areas used for roosting measured periodically, frequency to be determined.	Vegetation height throughout areas used for roosting should not deviate from an established baseline[7], subject to natural change.	Vegetation of <10cm is required at roost sites by avocets and ruff.

7 Baselines to be determined during the first reporting cycle.

Feature	Sub - Feature	Attribute	Measure	Target	Comments
Internationally important populations of regularly occurring Annex 1 bird species	Intertidal mudflat	Food availability	Abundance of fish, insects, worms, crustaceans and molluscs measured periodically, frequency to be determined.	Average biomass during the winter should not deviate significantly from an established baseline level[7] subject to natural change.	Important feeding areas for wintering avocets may occasionally be used by ruff. Prey items include *Gammarus, Corophium*, flies, beetles, *Nereis, Hydrobia, Cardium*, and gobies
	Saltmarsh and Intertidal mudflat	Absence of obstruction to viewlines.	Openness of terrain unrestricted by obstructions, measured periodically, frequency to be determined.	No increase in obstruction to existing bird viewlines, subject to natural change.	Avocets and ruff require unrestricted views over >200m to allow early detection of predators when feeding and roosting.
	Shallow coastal waters	Food availability	Presence and abundance of fish, small crustaceans, molluscs and worms measured periodically, frequency to be determined.	Presence and abundance of prey species should not deviate significantly from an established baseline level[7], subject to natural change.	Sandeel and sprats are important for Sandwich tern. Crustaceans, annelids, sandeel, sprats and *Clupeidae* are important for little terns.
Internationally important populations of regularly occurring migratory bird species	All sub features: Saltmarsh, Intertidal mudflat and Shallow coastal waters.	Disturbance	Reduction or displacement of birds.	No significant reduction in numbers or displacement from an established baseline[7], subject to natural change.	Applicable to redshank and lesser-black backed gull.
		Extent and distribution of habitat	Area (ha) measured once during reporting cycle	No decrease in extent from an established baseline[7], subject to natural change.	Redshank and lesser black-backed gulls
		Food availability	Presence and abundance of fish, mammals, birds, ground-surface and aquatic invertebrates measured periodically, frequency to be determined.	Presence and abundance of prey species should not deviate significantly from an established baseline[7], subject to natural change.	Voles, waders, sandeel, cod, herring and invertebrates are an important food source for lesser black-backed gulls during the breeding season.
	Saltmarsh	Vegetation	Open, short vegetation	Vegetation height	Vegetation of >10cm is required at roost sites by

Feature	Sub - Feature	Attribute	Measure	Target	Comments
		characteristics	or bare ground predominating in areas used for roosting measured periodically, frequency to be determined.	throughout areas used for roosting should not deviate significantly from an established baseline[7], subject to natural change.	redshank.
	Saltmarsh and Intertidal mudflat	Absence of obstruction to viewlines	Openness of terrain unrestricted by obstructions, measured periodically, frequency to be determined.	No increase in obstruction to existing bird viewlines, subject to natural change.	Redshank require unrestricted views over >200m to allow early detection of predators when feeding and roosting.
		Food availability	Presence and abundance of worms, crustaceans and molluscs measured periodically, frequency to be determined.	Presence and abundance of prey species should not deviate significantly from an established baseline[7] level, subject to natural change.	*Hydrobia, Macoma* and *Corophium* are the main food source for redshank during the non-breeding season.
Annual vegetation of drift lines		Extent	Linear extent of annual vegetation of drift lines and the geomorphological structures that support this feature, measured once per reporting cycle in late summer (July-September)	No decrease in linear extent from an established baseline[7], subject to natural change. Extent must take account of natural variation of this habitat as a result of dynamic coastal processes. Indicative target is for 10% of vegetation maintained seasonally over structure that could support it.	This attribute is dependent on there being sufficient shingle available through coastal processes to maintain the form of the shingle bank in its short and long-term development. Judgements in changes to linear extent will have to take particular care to distinguish changes as a result of natural functions, from those caused by anthropogenic actions because of the highly variable nature of this habitat. As there is likely to be significant seasonal variations in the area covered, assessment of the average width may be valuable. The 10% is an initial estimate which may be modified as a result of monitoring.
		Mobility	Percentage of extent of substrate suitable for colonisation by annual vegetation of drift lines not immediately	No increase in extent constrained by introduced structures, landforms or operations.	An important aspect of this habitat is its ability to modify its distribution in response to natural dynamic coastal processes. Introduction of physical constraints or operations such as shingle recycling would reduce the extent and quality of

Feature	Sub - Feature	Attribute	Measure	Target	Comments
			constrained by introduced structures, landforms or operations measured once per reporting cycle.		this community and affect the overall structure of the drift line communities.
		Coastal processes	Number and location of coastal defence operations within sediment cell influencing coastal processes. Measured once per reporting cycle.	Maintain sediment supply to and within the site through naturally operating coastal processes to allow a balance of accretion and erosion. A net balanced sediment budget should prevail, subject to natural change.	Sediment budget within the site is, in part, influenced by sediment supply into the site from long shore drift within the sediment cell, which also forms a significant part of natural sediment recycling within the site. If coastal processes are operating freely there should be a balance of erosion and accretion which will help to maintain the shingle structures which support the annual vegetation of drift lines interest feature. Information on coast processes should be available from SMPs.
		Substrate composition	Presence of shingle and fine matrix in combination with surface or buried organic material	Maintain substrate composition through natural processes with sufficiently low levels of human-induced disturbance to allow drift line vegetation to complete its vegetation cycle. As an indicative target, drift line organic materials should be present along at least 10% of length surveyed, with artificial (non-organic) debris not at levels restricting or suppressing vegetation establishment and growth. Targets appropriate to site should not deviate significantly from an	The combination of inorganic and organic substrate is an important precursor to development of annual vegetation of drift lines. Substrate supply should be regulated by natural coastal processes. Drift line organic materials (tidal-derived seaweed, driftwood etc.) on the surface of and in combination with the shingle matrix are important sources of nutrients and anchoring points essential for vegetation development and survival and may play a part in maintaining a seed bank.

Feature	Sub - Feature	Attribute	Measure	Target	Comments
				established baseline[7], subject to natural change.	
		Characteristic species of annual vegetation of drift lines	Presence of characterising species, particularly *Cakile maritima, Lathyrus japonicus, Crambe maritima* and including *Glaucium flavum, Beta vulgaris* ssp *maritima* and *Atriplex* spp. Assessments will need to be made during late summer (July-Sept) at least once per reporting cycle.	Maintain the presence and broad distribution of stands of *Cakile maritima* (sea rocket), *Crambe maritima* (sea kale),*Glaucium flavum* (Yellow horned poppy) and *Lathyrus japonicus* (sea pea) and other local variants of drift line vegetation across the feature, allowing for natural variation. These communities can be very variable, but should not be lower than 10% of the extent of shingle structure that could be colonised. Targets appropriate to site should not deviate significantly from an established baseline[7], subject to natural change.	These communities are found in a narrow strip at the extreme high water mark. Changes in the frequency and abundance of these species should be expected to occur seasonally as a result of natural disturbance by storm events, but the communities are sensitive to disturbance by human activities. Some communities do not fit well into the NVC but are nevertheless an important part of the regional variation. The NVC is currently under review. Primarily annual plants, but perennials may occur in areas with greater stability.

NB. Extreme events (such as storms reducing or increasing salinities, exceptionally cold winters or warm summers) also need to be recorded as they may be critical in influencing ecological issues in the Alde-Ore Estuary and may well be missed by routine monitoring.

7. Advice on operations

English Nature has a duty under Regulation 33(2)(b) of the Conservation (Natural Habitats &c.) Regulations 1994 to advise other relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated. Information on how English Nature has developed this advice is given in Section 7.2, and on how it may be reviewed and updated in the future, in Section 7.4.

The advice is provided in summary form in Table 3 and Section 7.5 and 7.6 and with more detail in Table 5 and Section 7.9, including advice in relation to specific interest features and their sub-features.

7.1 Purpose of advice

The aim of this advice is to enable all relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threat to the favourable condition of interest features on the Alde-Ore Estuary European marine site. The advice is linked to the conservation objectives for interest features and will help provide the basis for detailed discussions within the management group to formulate and agree a management scheme to agreed timescales for the site. The advice given here will inform on, but is without prejudice to, any advice given under Regulation 48 or Regulation 50 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

7.2 Methods for assessment

To develop this advice on operations English Nature has used a three step process involving:

- an assessment of the **sensitivity** of the interest features or their component sub-features to operations;
- an assessment of the **exposure** of each interest feature or their component sub-features to operations; and
- a final assessment of **current vulnerability** of interest features or their component sub-features to operations.

This three step process builds up a level of information necessary to manage activities in and around the European marine site in an effective manner. Through a consistent approach, this process enables English Nature to both explain the reasoning behind our advice and identify to competent and relevant authorities those operations which pose the most current threats to the favourable condition of the interest features on the European marine site.

All the scores of relative sensitivity, exposure and vulnerability are derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of our knowledge and understanding of the marine environment.

Information has been gathered from a range of sources including reports such as ABP Research (1999).

7.2.1 Sensitivity assessment

The sensitivity assessment used is an assessment of the relative sensitivity of the interest features or the component sub-features of the Alde-Ore Estuary European marine site to the effects of broad categories of human activities. In relation to this assessment, sensitivity has been defined as the intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor (Hiscock, 1996). The sensitivity has been assessed in relation to the use of habitats by birds. As an example, wintering birds are highly sensitive to loss of their roosting or feeding grounds.

The sensitivity assessments of the interest features or their component sub-features of the Alde-Ore Estuary European marine site are based upon a series of scientific review documents. These include reports produced for the UK Marine SAC LIFE project (Davison & Hughes 1998; Elliott and others 1998), the Countryside Council for Wales Science Report (Holt and others 1995) and the Marine Habitats Reviews (Jones and others 2000.).

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. In particular, English Nature and Scottish Natural Heritage have commissioned the Marine Biological Association of the UK, through its Marine *Life* Information Network (MarLIN) to provide detailed sensitivity information to underpin this advice, over the next three years, and available to all over the World Wide Web (www.marlin.ac.uk).

7.2.2 Exposure assessment

This has been undertaken for the Alde-Ore Estuary European marine site by assessing the relative exposure of the interest features or their component sub-features to the effects of broad categories of human activities currently occurring on the site. This was done through a series of workshops with relevant and competent authorities and stakeholders and may be subject to further refinement in the future. The exposure has been assessed in relation to the use of habitats by birds. As an example, wintering birds' feeding and roosting grounds may be considered highly exposed to toxic contamination from synthetic compounds due to the locations and intensity of discharges into an area.

7.2.3 Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component sub-features to operations. This is an integration of sensitivity and exposure. Only if a feature is both sensitive and exposed to a human activity will it be considered vulnerable. In this contact therefore, 'vulnerability' has been defined as the exposure of a habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive (Hiscock, 1996). The process of deriving and scoring relative vulnerability is provided in Appendix I.

7.3 Format of advice

The advice is provided within six broad categories of operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species. This approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;

- provides a consistent framework to enable relevant authorities in England to assess the effects of activities and identify priorities for management within their areas of responsibility; and

- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by English Nature.

These broad categories provide a clear framework against which relevant authorities can assess activities under their responsibility. The more detailed information in Table 5 provides relevant authorities with a context against which to consider an assessment of 'significant effect' or any plans or projects which may affect the site and a basis to inform on the scope and nature of appropriate assessments required in relation to plans and projects. It is important to note that this advice is only a starting point for assessing impacts. It does not remove the need for the relevant authorities to consult English Nature formally over individual plans and projects where required to do so under the Regulations.

7.4 Update and review of advice

Information as to the operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, is provided in light of what English Nature knows about current activities and patterns of usage at the Alde-Ore Estuary European marine site. English Nature expects that the information on current activities and patterns of usage (which was used to derive Table 4) will be supplemented as part of the process of developing the management of the site through further discussion with the relevant authorities. The option of zoning this information may be appropriate. As such, it is important that future consideration of this advice by relevant authorities and others takes account of changes in the usage patterns that have occurred at the site, over the intervening period, since the advice was issued. In contrast, the information provided in this advice on the sensitivity of interest features or sub-features (Table 5) is relatively stable and will only change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. Advice for sites will be kept under review and may be periodically updated through discussion with relevant authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

7.5 Summary of advice on operations for the SPA interest features

7.5.1 Internationally important populations of regularly occurring Annex 1 species

In pursuit of the conservation objective for 'habitats supporting internationally important populations of regularly occurring Annex 1 species' (Section 5.1.1), the relevant and competent authorities for Alde-Ore Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration or significant disturbance to habitats or species for which the site has been selected, through any of the following:

- Physical loss from removal
- Physical damage from abrasion
- Non-physical disturbance through noise and/or visual presence
- Toxic contamination from the introduction of synthetic and/or non-synthetic compounds
- Non-toxic contamination through changes in nutrient and organic loading
- Biological disturbance through the selective extraction of species

7.5.2 Internationally important populations of regularly occurring migratory bird species

In pursuit of the conservation objective for 'habitats supporting the internationally important populations of regularly occurring migratory bird species' (Section 5.1.2), the relevant and competent authorities for Alde-Ore Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Physical loss from removal
- Non-physical disturbance through noise and/or visual presence
- Toxic contamination from the introduction of synthetic and non-synthetic compounds
- Non-toxic contamination through changes in nutrient and organic loading

7.6 Summary of advice on operations for the SAC interest feature

7.6.1 Annual vegetation of drift lines

In pursuit of the conservation objective for annual vegetation of drift lines (Section 5.2.1), the relevant and competent authorities for Alde-Ore Estuary European marine site are advised to manage human activities within their remit such that they do not result in deterioration or disturbance to habitats or species for which the site has been selected, through any of the following:

- Physical loss through removal
- Physical damage resulting from abrasion
- Toxic contamination through the introduction of non-synthetic compounds

7.7 Plans and Projects

Under Regulation 48(1), an appropriate assessment must be undertaken in respect of any plan or project which:

a. either alone or in combination with other plans or projects is likely to have a ***significant effect*** on a European Site; and
b. is not directly connected with or necessary to the management of the site for nature conservation.

This legal requirement applies to all European sites. Regulation 48 is also applied, as a matter of Government policy, to potential SPAs, candidate SACs and listed Ramsar sites.

English Nature's 'Habitats regulations guidance note 1: The Appropriate Assessment (Regulation 48)', is at Appendix II for further information.

Tables 4 and 5 provide relevant authorities with a guide against which to initiate an assessment of the 'significance' of any plans or projects (and ongoing operations or activities) proposed for the site although this will only be the starting point for assessing impacts and does not remove the need for relevant authorities to formally consult English Nature over individual plans and projects where required under the Regulations.

7.8 Review of consents

Regulation 50 of the Conservation (Natural Habitats, &c.) Regulations 1994 requires a competent authority to undertake a review of any existing consent or permission to which Regulation 48(1) would apply if were being reconsidered as of the date on which the site became a European site. Where a review is required under these provisions it must be carried out as soon as reasonably practicable. This will have implications for discharge and other consents, which will need to be reviewed in light of these objectives and may mean that lower targets for background levels of contaminants etc. will need to be set.

Table 3 Showing operations which may cause deterioration or disturbance to the Alde-Ore Estuary European marine site interest features at current levels of use[8]

The advice below is not a list of prohibitions but rather a checklist for operations for discussion with the management group, which may need to be subject to some form of management measure(s) or further measures where actions are already in force. Examples of activities under relevant authority jurisdiction are also provided. Operations marked with a ✓ indicate those features that are considered to be highly or moderately vulnerable to the effects of the operations.

Standard list of categories of operation which may cause deterioration or disturbance	SPA INTEREST FEATURES		SAC INTEREST FEATURE
	Internationally important populations of regularly occurring Annex 1 birds	Internationally important populations of regularly occurring migratory bird species	Annual vegetation of drift lines
Physical loss Removal Smothering	✓	✓	✓
Physical damage Siltation Abrasion Selective extraction	✓		✓
Non-physical disturbance Noise Visual	✓ ✓	✓ ✓	
Toxic contamination Introduction of synthetic compounds Introduction of non-synthetic compounds Introductionof radionuclides	✓ ✓	✓ ✓	✓
Non-toxic contamination Changes in nutrient loading Changes in organic loading Changes in thermal regime Changes in turbidity Changes in salinity	✓ ✓	✓ ✓	

Standard list of categories of operation which may cause deterioration or disturbance	SPA INTEREST FEATURES		SAC INTEREST FEATURE
	Internationally important populations of regularly occurring Annex 1 birds	Internationally important populations of regularly occurring migratory bird species	Annual vegetation of drift lines
Biological disturbance Introduction of microbial pathogens Introductiion of non-native species & translocation Selective extraction of species	✓		

[8]This advice has been developed using best available scientific information and informed scientific interpretation and judgement (as at July 2000). This process has used a coarse grading of relative sensitivity, exposure and vulnerability of each interest feature to different categories of operation based on the current state of our knowledge and understanding of the marine environment. This is shown in the sensitivity and vulnerability matrices at Table 4. The advice is indicative only, and is given to guide relevant authorities and others on particular operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the site has been designated. The advice, therefore, is not a list of prohibitions but rather a check list for operations which may need to be subject to some form of management measure(s) or further measures where actions are already in force.

The precise impact of any category of operation occurring on the site will be dependant upon the nature, scale, location and timing of events. More detailed advice is available from English Nature to assist relevant authorities in assessing actual impacts and cumulative effects. Assessment of this information should be undertaken in the development of management of the site and through wider consultation.

In accordance with Government policy guidance, the advice on operations is feature and site specific, and provided in the light of current activities and patterns of usage at the site as at July 2000. As such, it is important that future consideration of this advice by relevant authorities, and others, takes account of changes in usage patterns that have occurred at the site over the intervening period. Advice for sites will be kept under review and may be periodically updated through discussions with relevant authorities, and others, to reflect significant changes in our understanding of sensitivity together with the potential effects of plans or projects on the marine environment. The provision of the statutory advice given here, on operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, under Regulation 33(2), is provided without prejudice to specific advice given under Regulation 48(3) or Regulation 50 on individual operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

7.9 Interest feature and sub-feature specific advice on operations for the Alde-Ore Estuary European marine site

This section provides information to help relate general advice to each of the specific interest features of the Alde-Ore Estuary European marine site.

This advice relates to the vulnerability of the interest features and sub-features of the Alde-Ore Estuary European marine site as summarised in Table 3 and set out in more detail in Table 5. An explanation of the sensitivity of the interest features or sub-features follows with an explanation of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links between the categories of operation and the ecological requirements of the European marine site=s interest features, as set out in Section 3 and 4, to be made.

7.9.1 SPA interest features

Internationally important populations of regularly occurring Annex 1 species

i) Physical Loss

- The Alde-Ore Estuary provides roosting and feeding habitats for internationally important populations of avocets and ruff. The estuary also provides roosting, feeding and nesting habitats for internationally important populations of Sandwich and little tern. Birds are sensitive to habitat loss through removal and current exposure levels are considered to be high for saltmarsh and medium for mudflats. Operations or activities such as shingle recycling that result in the physical loss of the shingle habitat may adversely affect the Annex 1 species. The shingle is used by the birds as a roosting area and as a nesting site by the little terns. However, the exposure score to removal of the shingle habitat has been described as low due to the limited area where shingle recycling is occurring. These exposures, combined with the high sensitivity scores leads to high and moderate vulnerabilities.

- Much of the saltmarsh in the estuary has been lost due to erosion, possibly as a result of sea level rise and this is being investigated by the Environment Agency.

- The Environment Agency have recently produced a flood defence strategy for the estuary which proposes managed realignment in several areas. Careful consideration will be required before this is implemented to ensure that it will not further increase erosion of the intertidal areas. The Environment Agency, as a competent authority is required to consult English Nature under Regulation 48 in relation to possible effects on the European site of any proposals for managed retreat in the estuaries.

ii) Physical Damage

- The habitats of Alde-Ore Estuary and their associated food supplies, support the avocet, Sandwich tern, little tern and ruff populations. Any operations or activities that would adversely affect these habitats may be detrimental to the species. The current exposure levels to physical damage for the whole estuary are considered to be low. However, there are a small number of areas where this category of operation is

occurring, mainly through abrasion from trampling by people and dogs. Also, nest destruction by vandals, particularly when off road bikes are driven over nests has been a problem at this site. However, it now appears to be minimal, but will require continued monitoring and control.

The high sensitivity of the shingle area leads to a moderate vulnerability. This high sensitivity, along with the moderate sensitivity of the saltmarsh to abrasion means that this activity will need continued monitoring.

iii) Non-physical Disturbance

- Avocets, Sandwich and little tern and ruff are disturbed by unpredictable movements of objects and increases in noise disturbance. This can displace the birds from their nesting, roosting or feeding grounds. Disturbance can prevent the birds from feeding and in response they either a) decrease their energy intake at their present (disturbed) feeding site through displacement activity, or b) move to an alternative less favoured feeding site. Such a response affects energy budgets and thus survival. Breeding terns are particularly vulnerable to disturbance. The little terns are a target for egg thieves and also vandals who have been known to drive off-road bikes over the nests. During the breeding season this may result in disturbance to the nesting little terns causing eggs or chicks to be abandoned. Boats sailing up and down the estuary are not considered a problem in terms of visual disturbance to the birds. At present, the issues contributing to the high vulnerabilities of the birds to this category of operation appear to be boats landing and taking off on Orfordness and associated disturbance from people and uncontrolled dogs. There may also be some disturbance from military helicopters flying over the site. The impact of all these activities needs further investigation.

iv) Toxic contamination

- Avocets, little terns, Sandwich terns and ruff are sensitive to the accumulation of toxins through the food chain or through direct contact with toxic substances when feeding. Their ability to feed can also be affected by changes in the palatability or abundance of prey items caused by toxic contamination. It is recognised that diffuse agricultural pollution occurs in the Alde-Ore and so there is a possibility of synthetic compounds such as pesticides entering the estuary via this route. Although there is no evidence to suggest this is having a detrimental affect on bird numbers it is an issue which will need to be assessed.

- Birds can also be exposed to another source of toxic contamination through the re-mobilisation of contaminants such as TBT in the mudflats/sandflats. Activities such as bait digging which could contribute to this category of operation will need further investigation.

- Avocet, little tern, Sandwich tern and ruff are moderately sensitive to toxic contamination and the exposure is currently believed to be medium. This results in a moderate vulnerability score for the introduction of synthetic and non-synthetic compounds.

v) Non-toxic contamination

- Organic or nutrient enrichment can reduce the availability of food for birds by increasing growth of algal mats on the intertidal area. It can also cause a reduction in water clarity, thereby reducing the visibility of prey items. On the other hand, a reduction in nutrient levels may cause a reduction in the biomass of invertebrates. There is a perception amongst estuary users (anecdotal) that agricultural run-off, particularly that associated with pigs, is a problem. However, there are currently no pigs in the area as a result of the recent swine fever outbreak.

- Birds are moderately sensitive to changes in nutrient and organic levels in the intertidal mudflats and shallow coastal waters. The mudflats used by the birds have a medium exposure to changes in organic and nutrient levels, thus leading to a moderate vulnerability score. This will require ongoing assessment.

vi) Biological disturbance

- Bait digging can result in the selective extraction of species from the intertidal area. This may result in a localised reduction of food availability for feeding birds. The quantitative impacts of bait collection are unclear at present.

- Wildfowling also occurs on the estuary but is, to a large extent well managed and unlikely to be impacting on the Annex 1 species.

- Little terns nest on the shingle and are highly sensitive to the site specific activities of egg collection. Although the exposure score is low, it combines with the high sensitivity to give a moderate vulnerability score.

Internationally important populations of regularly occurring migratory bird species.

1) Physical loss

- The Alde-Ore Estuary provides roosting and feeding habitats for internationally important populations of lesser black-backed gull and redshank. Birds are sensitive to any habitat loss through removal and current exposure levels are considered to be high for saltmarsh and medium for intertidal mudflats. These exposures, combined with the high sensitivity leads to high vulnerability scores for these sub-features.

- Much of the saltmarsh in the estuary has been lost due to erosion, possibly as a result of sea level rise and this is being investigated by the Environment Agency.

- The Environment Agency have recently produced a flood defence strategy for the estuary which proposes managed realignment in several areas. Careful consideration will be required before this is implemented to ensure that it will not further increase erosion of the intertidal areas. The Environment Agency, as a competent authority is required to consult English Nature under Regulation 48 in relation to possible effects on the European site of any proposals for managed retreat in the estuaries.

ii) Physical Damage

- The habitats of Alde-Ore Estuary and their associated food supplies support internationally important populations of lesser black-backed gull and redshank. Therefore, any operations or activities that would adversely affect these habitats may be detrimental to the species. The current exposure levels to physical damage for the whole estuary are considered to be low. However, there are a small number of areas where this category of operations is occurring, mainly through abrasion from trampling by people and dogs and this will require further investigation.

- The moderate sensitivity of the saltmarsh and intertidal mudflats to physical damage mean these activities will need continued monitoring.

iii) Non-physical Disturbance

- Water birds are disturbed by unpredictable movements of objects and increases in noise disturbance. This can displace the birds from their roosting or feeding grounds. Disturbance can prevent the birds from feeding and in response they either a) decrease their energy intake at their present (disturbed) feeding site through displacement activity, or b) move to an alternative less favoured feeding site. Such a response affects energy budgets and thus survival. At present, the issues contributing to the medium exposures on the intertidal mudflats and saltmarsh to noise and visual disturbance, appear to be boats landing and taking off on Orfordness, and associated disturbance from people and uncontrolled dogs. There may also be some disturbance from military helicopters flying over the site. The impact of all these activities needs further investigation. Boats sailing up and down the estuary are not considered a problem in terms of visual disturbance to the birds. The exposure scores, together with the high sensitivities result in high vulnerability scores for noise and visual disturbance.

iv) Toxic contamination

- Water birds are sensitive to the accumulation of toxins through the food chain or through direct contact with toxic substances when feeding. Their ability to feed can also be affected by changes in the palatability or abundance of prey items caused by toxic contamination. It is recognised that diffuse agricultural pollution occurs in the Alde-Ore Estuary, and so there is a large possibility of synthetic compounds such as pesticides and other chemicals entering the estuary via this route. Although there is no evidence to suggest this is having a detrimental affect on bird numbers it is an issue which requires ongoing assessment.

- Birds can also be exposed to another source of toxic contamination through the re-mobilisation of contaminants such as TBT in the mudflats/sandflats. Activities such as bait digging which could contribute to this category of operation will need further investigation.

- Redshank and lesser black-backed gulls are moderately sensitive to toxic contamination and the exposure is currently believed to be medium. This gives a moderate vulnerability score for the introduction of synthetic and non-synthetic compounds for all sub-features.

v) Non-toxic contamination

- Organic or nutrient enrichment can reduce the availability of food for birds by increasing growth of algal mats on the intertidal area. It can also cause a reduction in water clarity, thereby reducing the visibility of prey items. There is a perception amongst estuary users (anecdotal) that agricultural run-off, particularly that associated with pigs, is a problem, although there are currently no pigs in the area as a result of the recent swine fever outbreak. On the other hand, a reduction in nutrient levels may cause a reduction in the biomass of invertebrates Birds are moderately sensitive to changes in nutrient and organic levels in the intertidal mudflats and shallow coastal waters. The intertidal mudflats used by the birds have a medium exposure to this type of non-toxic contamination, thus leading to moderate vulnerability scores. This will require ongoing assessment.

vi) Biological disturbance

- Bait digging can result in the selective extraction of species from the intertidal area. This may result in a localised reduction of food availability for feeding birds and the intertidal mudflats are moderately sensitive to this operation. The quantitative impacts of bait collection are unclear at present. There is also well established mariculture on the Butley River but this is not perceived as a problem.

- Wildfowling occurs on the estuary but neither the gulls nor the redshank are target species.

7.9.2 SAC interest feature

Annual vegetation of drift lines

i) Physical Loss

- Deterioration or disturbance by physical removal can be the result of either one-off events or the cumulative effect of continuous activities. Coastal defence measures both on and off site have the potential to change erosional and depositional patterns of the shoreline and so could impact on this type of vegetation.

- Shingle recycling for coastal defence works is carried out at the northern end of Orford Ness. Shingle is removed from within the site and placed further north near Slaughden which is outside the SAC. As a result of the removal of the substrate and other activities associated with the coastal defence works the annual vegetation is unable to establish on this part of the SAC. The shingle recycling is being considered as part of the Environment Agency review of consents under the Habitats Regulations.

- The physical loss of the substrate may also lead to a reduction in the extent of the interest feature through the eradication of the seed bank. This will also impact on the recolonisation of adjacent areas. In addition, smothering can prevent seed germination and interrupt the annual cycle of vegetation.

- Annual vegetation of drift lines are highly sensitive to physical loss through removal and smothering. The current level and location of the shingle recycling on the Alde-Ore European marine site results in a high exposure of the annual vegetation to removal. This results in high vulnerability score.

ii) Physical damage

- Annual vegetation is highly sensitive to abrasion through excessive, long term, trampling. Shingle Street is widely used for recreation and there is localised trampling of vegetation. However, there is limited public access to Orfordness and so trampling of this feature is not considered a problem here.

- The annual vegetation may be also be damaged through abrasion from lorries which drive onto the site as part of the shingle recycling operations.

- The annual vegetation is highly sensitive to physical damage through abrasion. The current level of trampling at Shingle Street and damage from lorries results in a moderate vulnerability score for abrasion.

iii) Toxic contamination

- Oil or chemical spills could have a direct impact on this low growing vegetation which occurs at the top of the shore. The dispersants which are sometimes used in oil spills would also be likely to cause damage to growth and recovery rates. However, current levels of oil and chemical spills do not present a significant risk of this occurring.

- Although there is a low exposure to the introduction of non-synthetic compounds, the high sensitivity of the annual vegetation results in a moderate vulnerability.

iv) Non-toxic contamination

- Changes in salinity or nutrient and organic availability could reduce the ability of this type of vegetation to out-compete more vigorous plant growth of more common species. However, at present there is no risk of this occurring.

Table 4 Assessment of the relative exposure of interest features and sub-features of Alde-Ore Estuary European Marine site to different categories of operations based on current level of activities (December 2000)

Key: High = High exposure Med = Medium exposure Low = Low exposure None = No exposure

	SPA INTEREST FEATURES							SAC INTEREST FEATURE
Categories of operation which may cause deterioration or disturbance	**Internationally important populations of regularly occurring Annex 1 species**				**Internationally important populations of regularly occurring migratory bird species**			**Annual vegetation of drift lines**
	Shingle	Intertidal mudflat	Saltmarsh	Shallow coastal waters	Intertidal mudflat	Saltmarsh	Shallow coastal waters	
Physical loss								
Removal	Low	Med	High	None	Med	High	None	High
Smothering	Low	Low	Low	None	Low	Low	None	None
Physical damage								
Siltation	Low	Low	Low	None	Low	Low	None	Low
Abrasion	Low	Low	Low	None	Low	Low	None	Low
Selective extraction	None	Low	Low	None	Low	Low	None	None
Non-physical disturbance								
Noise	Med	Med	Med	Low	Med	Med	Low	None
Visual	Med	Med	Med	Low	Med	Med	Low	None
Toxic contamination								
Introduction of synthetic compounds	Low	Med	Med	Med	Med	Med	Med	Low
Introduction of non-synthetic compounds	Low	Med	Med	Med	Med	Med	Med	Low
Introduction of radionuclides	None	Low	Low	Low	Low	Low	Low	None
Non-toxic contamination								
Changes in nutrient loading	Low	Med	Med	Low	Med	Med	Low	Low
Changes in organic loading	Low	Med	Med	Low	Med	Med	Low	Low
Changes in thermal regime	None	None	None	None	None	None	None	None

	SPA INTEREST FEATURES							SAC INTEREST FEATURE
Categories of operation which may cause deterioration or disturbance	**Internationally important populations of regularly occurring Annex 1 species**				**Internationally important populations of regularly occurring migratory bird species**			**Annual vegetation of drift lines**
	Shingle	Intertidal mudflat	Saltmarsh	Shallow coastal waters	Intertidal mudflat	Saltmarsh	Shallow coastal waters	
Changes in turbidity	None	Low	Low	Low	Low	Low	Low	None
Changes in salinity	None	Low	Low	Low	Low	Low	Low	Low
Biological disturbance								
Introduction of microbial pathogens	Low	Low	Low	None	Low	Low	None	None
Introduction of non-native species & translocation	Low	Low	Low	Low	Low	Low	Low	None
Selective extraction of species	Low	Low	Low	Low	Low	Low	Low	None

Table 5. Assessment of the relative vulnerability of interest features and sub-features of Alde-Ore Estuary European Marine site to different categories of operations. Categories of operations to which the features or sub-features of the site are highly or moderately vulnerable are indicated by shading. Table also incorporates relative sensitivity scores used in part to derive vulnerability.[9]

Key

	High vulnerability	●●●●	High sensitivity
	Moderate vulnerability	●●●	Moderate sensitivity
		●●	Low sensitivity
		●	No detectable sensitivity

	SPA INTEREST FEATURES							SAC INTEREST FEATURE
Categories of operations which may cause deterioration or disturbance	**Internationally important populations of regularly occurring Annex 1 species**				**Internationally important populations of regularly occurring migratory bird species**			**Annual vegetation of drift lines**
	Shingle area	**Intertidal mudflat**	**Saltmarsh**	**Shallow coastal waters**	**Intertidal mudflats**	**Saltmarsh**	**Shallow coastal waters**	
Physical Loss								
Removal	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Smothering	●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●●●
Physical Damage								
Siltation	●●	●●	●●	●●	●●	●●	●●	●●●
Abrasion	●●●●	●●	●●●	●●	●●	●●●	●●	●●●●
Selective extraction	●●●●	●●●	●●	●●	●●●	●●	●●	●●●●
Non-physical disturbance								
Noise	●●●●	●●●●	●●●●	●●●	●●●●	●●●●	●●	●
Visual presence	●●●●	●●●●	●●●●	●●	●●●●	●●●●	●●	●
Toxic contamination								
Introduction of synthetic compounds	●	●●●	●●●	●●●	●●●	●●●	●●●	●●
Introduction of non-synthetic compounds	●	●●●	●●●	●●●	●●●	●●●	●●●	●●●●

	SPA INTEREST FEATURES							SAC INTEREST FEATURE
Categories of operations which may cause deterioration or disturbance	**Internationally important populations of regularly occurring Annex 1 species**				**Internationally important populations of regularly occurring migratory bird species**			**Annual vegetation of drift lines**
	Shingle area	**Intertidal mudflat**	**Saltmarsh**	**Shallow coastal waters**	**Intertidal mudflats**	**Saltmarsh**	**Shallow coastal waters**	
Introduction of radionuclides	●	●●	●●	●●	●●	●●	●●	●
Non-toxic contamination								
Changes in nutrient loading	●	●●●	●●	●●●	●●●	●●	●●●	●●●
Changes in organic loading	●	●●●	●●	●●●	●●●	●●	●●●	●●●
Changes in thermal regime	●	●	●	●●	●	●	●●	●
Changes in turbidity	●	●	●	●●●	●	●	●●●	●●
Changes in salinity	●	●●	●	●●●	●●	●	●●●	●●●
Biological disturbance								
Introduction of microbial pathogens	●	●●	●	●●	●●	●	●●	●
Introduction of non-native species & translocation	●	●●●	●●●	●●	●●●	●●●	●●	●●
Selective extraction of species	●●●●	●●●	●●●	●●●	●●●	●●●	●●●	●●

[9] English Nature's advice on operations is derived from an assessment combining relative sensitivity of the features or sub-features with information on human usage of the site as at December 2000 , to identify relative vulnerability to categories of operations. In accordance with Government policy guidance this advice is provided in the light of current activities and patterns of usage at the site. It is important therefore that future consideration of this advice by relevant authorities, and others, takes account of changes in the usage patterns at the site. In contract the sensitivity of interest features, or sub-features, is relatively stable with alterations reflecting improvement in our scientific knowledge and understanding. To this end, information on sensitivity has been included in this table to assist the management and advisory groups with the future management of the site.

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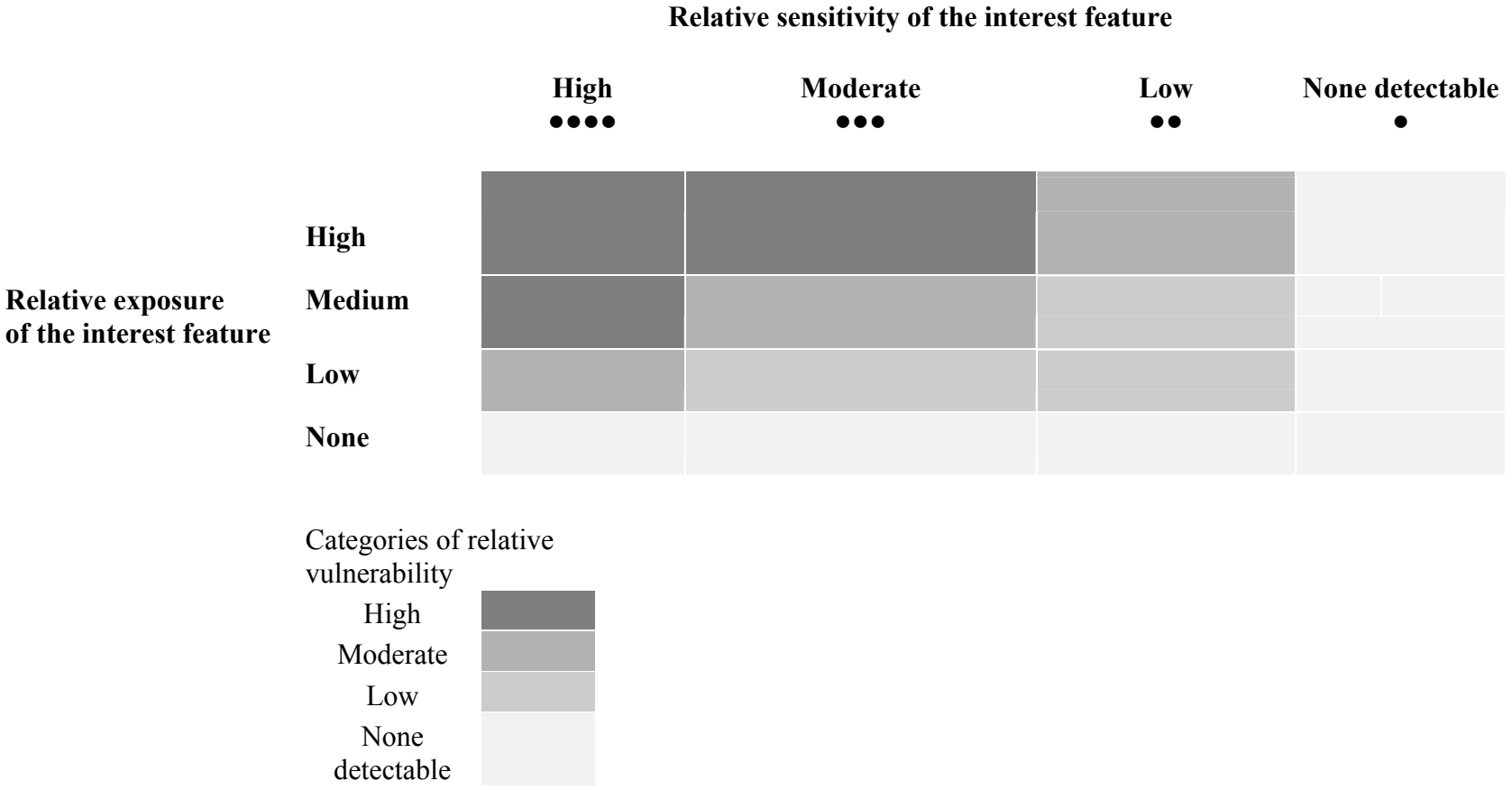
9. Glossary

Advisory Group	The body of the representatives from local interests, user groups and conservation groups, formed to advise the management group
Annex 1 Bird species	The species listed in Annex 1 of the Birds Directive are the subject of special conservation measures concerning their habitat. These measures ensure the survival and reproduction of the birds in their area of distribution. Species listed on Annex 1 are in danger of extinction, rare or vulnerable
Annex I habitat type(s)	A natural habitat(s) listed in Annex I of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex II species	A species listed in Annex II of the Habitats Directive for which Special Areas of Conservation can be selected.
Annex V	The listing, in the Habitats Directive, of the animal and plant species whose taking in the wild and exploitation may be subject to management measures.
Assemblage	A collection of plants and/or animals characteristically associated with a particular environment.
Attribute	Characteristic of an interest feature/sub-feature which provides an indication of the condition of the feature or sub-feature to which it applies.
BAP	Biodiversity Action Plan.
Benthos	Those organisms attached to, or living on, in or near, the seabed, including that part which is exposed by tides.
Biotope	The physical habitat with its biological community; a term which refers to the combination of physical environment and its distinctive assemblage of conspicuous species.
Biodiversity	The total variety of life on earth. This includes diversity within species, between species and ecosystems.
Characteristic	Special to, or especially abundant in, a particular situation or biotope. Characteristic species should be immediately conspicuous and easily identified.
Circalittoral	The rocky subtidal zone below that which is dominated by algae (Animal dominated subtidal zone).
Community	A group or organisms occurring in a particular environment, presumably interacting with each other and with the environment, and identifiable by means of ecological survey from other groups.
Competent authority	Any Minister, government department, public or statutory undertaker, public body or person holding a public office that exercises legislative powers.
Conservation objective	A statement of the nature conservation aspirations for a site, expressed in terms of the favourable condition that we wish to see the species and/or habitats for which the site has been selected to attain. Conservation objectives for European marine sites relate to the aims of the Habitats Directive.
Eulittoral	The main part of the intertidal zone characterised by limpets, barnacles, mussels, fucoid algae and with red algae often abundant on the lower part.
Epifauna	Benthic animals living on the seabed.
European Marine Site	A European site which consists of, or in so far as it consists of, areas covered intermittently or continuously by seawater.
European Site	A classified SPA, designated SAC, site of Community importance (a site selected as a candidate SAC, adopted by the European Commission but not yet designated), a candidate SAC (in England only) or a site hosting a priority species in respect of which Article 5 of the Habitats directive applies.
Favourable conservation status	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function throughout the EC in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.

Favourable condition	A range of conditions for a natural habitat or species at which the sum of the influences acting upon that habitat or species are not adversely affecting its distribution, abundance, structure or function within an individual Natura 2000 site in the long term. The condition in which the habitat or species is capable of sustaining itself on a long-term basis.
Habitat	The place in which a plant or animal lives.
Habitats Directive	The abbreviated term of *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora*. It is the aim of this Directive to promote the conservation of certain habitats and species within the European Union.
Halophilous	Plants which thrive in, or tolerate the presence of saline conditions.
Infauna	Benthic animals which live within the sediment.
Infralittoral	The subtidal zone in which upward facing rocks are dominated by erect algae, typically kelps.
Interest feature	A natural or semi-natural feature for which a European site has been selected. This includes any Habitats Directive Annex I habitat, or any Annex II species and any population of a bird species for which and SPA has been designated under the Birds Directive.
Maintain	The action required for an interest feature when it is considered to be in favourable condition.
Management group	The body of relevant authorities formed to manage the European marine site.
Management scheme	The framework established by the relevant authorities at a European marine site under which their functions are exercised to secure, in relation to that site, compliance with the requirements of the Habitats Directive.
Nationally scarce/rare	For marine purposes, these are regarded as species of limited national occurrence.
Natura 2000	The European network of protected sites established under the Birds Directive and the Habitats Directive.
Notable species	A species that is considered to be notable due to its importance as an indicator, and may also be of nature conservation importance, and which is unlikely to be a 'characteristic species'
Operations which may cause deterioration or disturbance	Any activity or operation taking place within, adjacent to, or remote from a European marine site that has the potential to cause deterioration to the natural habitats for which the site was designated, or disturbance to the species and its habitats for which the site was designated.
Plan or project	Any proposed development that is within a relevant authority's function to control, or over which a competent authority has a statutory function to decide on applications for consents, authorisations, licences or permissions.
Peak mean counts (5 yr)	Alde-Ore Estuary is broken down into count sectors. Over the winter months WeBs volunteers count all the birds which are visible within each sector. The yearly figures for each species in Alde-Ore Estuary are then averaged over a five year period to give the 5 yr peak mean count.
Relevant authority	The specific competent authority which has powers or functions which have, or could have, an impact on the marine environment, or adjacent to, a European marine site.
Restore	The action required for an interest feature when it is not considered to be in a favourable condition.
Sensitivity	The intolerance of a habitat, community or individual species to damage from an external force.
Sub-feature	An ecologically important sub-division of an interest feature.
Vulnerability	The exposure of a habitat, community or individual of a species to an external factor to which it is sensitive.
WeBS	Wetland Bird Survey: a collaborative national surveillance scheme of the UK's waterfowl based on counts undertaken once per month outside of the breeding season.

Appendix I Matrix of relative vulnerability -

The relative vulnerability of an interest feature or sub-feature is determined by combining the relative sensitivity and exposure assessments according to the table below.



Appendix II English Nature's 'Habitats regulation guidance note 1: The Appropriate Assessment (Regulation 48)'

Issued 25 May 2001

ENGLISH NATURE

Habitats regulations guidance note

NATURA 2000

HRGN 1

Issued by Greg Smith, Environmental Impacts Team, English Nature. Tel: 01733 455210

The Appropriate Assessment (Regulation 48) The Conservation (Natural Habitats &c) Regulations, 1994

Introduction

1. This Guidance Note has been prepared to assist competent authorities and English Nature staff when undertaking the ***"appropriate assessment"*** required by Regulation 48 of the *Habitats Regulations 1994* implementing Article 6(3) of the *Habitats Directive* (92/43/EEC). Only the Courts can provide authoritative interpretation of the Regulations, but these notes have been developed in the light of practical experience and a close examination of the Regulations, the Habitats Directive and central government guidance, particularly in PPG 9.

When Does An 'Appropriate Assessment' Need To Be undertaken?

Types of Proposal

2. Under Regulation 48(1), an appropriate assessment needs to be undertaken in respect of any plan or project which:

a. either alone or in combination with other plans or projects would be likely to have a ***significant effect*** on a European Site, and
b. is not directly connected with the management of the site for nature conservation.

3. Appropriate assessment is required by law for all European Sites (Regulation 48). A European Site is any classified SPA and any SAC from the point where the Commission and the Government agree the site as a Site of Community Importance. Appropriate assessment is also required, as a matter of Government policy, for potential SPAs, candidate SACs and listed Ramsar Sites for the purpose of considering development proposals affecting them. (PPG 9 paras 13 and C7).

Timing of the Assessment

4. An appropriate assessment needs to be undertaken in respect of a plan or project described above **before** any ***"competent authority"***:

a. decides to undertake the plan or project, in cases where no consent, permission or other authorisation is required. (Reg. 48(1));
b. decides to give any consent, permission or other authorisation for the plan or project. (Regs. 48(1) *et al*);
c. reviews the decision to undertake a plan or project or reviews consents, permissions or other authorisations for plans or projects that are incomplete. (Regs. 50(2) *et al* - see also English Nature Habitats Regulations Guidance Note No. 2);
d. decides whether to approve an application for development that would otherwise be permitted development. (Reg. 62(6)).

Significant Effects

5. The plan or project does not have to be located within the designated area. Significant effects may occur even if the plan or project is some distance away and even outside any consultation area defined by English Nature (PPG 9 paras 30-32). The effects may be direct or indirect, temporary or permanent, beneficial or harmful to the site, or a combination of these.

6. The initial determination of likely significance is intended to ensure that all relevant plans and projects likely to have a material effect on these internationally important sites are subject to an appropriate assessment. In all but the most clear cut cases, competent authorities are likely to need advice. English Nature will advise, on request, as to whether any particular plan or project may be likely to have a significant effect on any of these sites. If the decision as to whether or not the development would have a significant effect on the designated site is inconclusive, on the information available, the competent authority should make a fuller assessment; in doing so they may ask the developer or other parties for more information. (PPG 9 para C10).

Who Undertakes The Appropriate Assessment?

7. The appropriate assessment must be undertaken by the *competent authority*, as defined in Regulation 6(1) of the Habitats Regulations, which includes any Minister, Government Department, public or statutory undertaker, public body of any description or person holding a public office. The developer or proposer of the plan or project is required to provide relevant information. English Nature must be consulted, during the course of the assessment, but it is the duty of the competent authority to undertake the assessment itself.

8. Most competent authorities will not have the technical expertise "in house" to assess the effects of the plan or project on the international nature conservation interests. Most will need to rely heavily on the advice, guidance and recommendations of English Nature, at each stage, including the scope and content of the assessment, the site's conservation objectives, the information required from the developer or proposer and the effects on the integrity of the site, all of which are discussed below. The appropriate assessment, in many cases, is likely to be an iterative process. In the simplest cases a general statement in a single consultation response from English Nature may suffice to enable the competent authority to complete the assessment. However, in most cases, it is envisaged that a more detailed response from, and dialogue with, English Nature is likely to be necessary.

What is an 'Appropriate Assessment'

9. It is a self contained step in a wider decision making process, required by the Habitats Regulations and described more fully in PPG 9, Annex C. Its conclusions must be based only on the scientific considerations under steps laid out in the Habitats Regulations. The assessment should not be influenced by wider planning or other considerations.

10. The Regulations do not specify how the assessment should be undertaken but describe it simply as "an appropriate assessment". This is taken to mean that the assessment must be appropriate to its purpose under the Regulations (and also the Directive, which originated the use of the term). Its purpose is to assess the implications of the proposal in respect of the site's "***conservation objectives***". The conclusions of the assessment should enable the competent authority to ascertain whether the proposal would adversely affect the integrity of the site.

Scope and Content

11. PPG 9 indicates that the scope and content of an appropriate assessment will depend on the location, size and significance of the proposed plan or project (PPG 9 box C10). The PPG indicates that English Nature will advise on a case-by-case basis. According to the nature conservation interests of the site, English Nature will identify particular aspects that the appropriate assessment should address. Examples given are hydrology, disturbance and land-take, but there are clearly many other potential matters that may need to be addressed in particular cases.

12. Procedures under the Habitats Regulations should be confined to the effects on the internationally important habitats or species for which the site is or will be internationally designated or classified, including any indirect effects on these interests, for example, via their supporting ecosystems and natural processes. Notwithstanding a favourable assessment in respect of the plan or project's effects on the international nature conservation interests for which the site was classified or designated, decisions to undertake or give consent to the plan or project may need to take account of other international, national, regional or local nature conservation interests in the light of other policy and legislative provisions. (PPG 9 paras 4, 18 and 27).

Environmental Assessment

13. The appropriate assessment is not the same as an environmental assessment under the provisions of the various *Environmental Assessment (EA) Regulations* (1988-95), in compliance with the Directive 85/337/EEC. In many cases, plans or projects that will be subject to an appropriate assessment will need an Environmental Statement (ES) to be prepared under the EA Regulations. (PPG 9 paras 38 and 39).

14. The ES will address all significant environmental effects. It will be appropriate to use the information assembled for the ES when carrying out the appropriate assessment under the Habitats Regulations. In view of this it would be helpful if the relevant ES clearly identified, under a specific subject heading, the likely significant effects on the internationally important habitats and/or species.

How is an Appropriate Assessment Undertaken?

Key Steps

15. Having established that an appropriate assessment is required, the following conclusions may be drawn (from the foregoing considerations and Government guidance) in respect of how it should be undertaken.

The Key Steps in an Appropriate Assessment

The competent authority:

I

Must consult English Nature

II

May consult the general public

III

Should clearly identify and understand the site's conservation objectives having regard to the advice of English Nature

IV

Should require the applicant to provide such information as may reasonably be required for the purposes of the assessment

V

Should identify the effects of the proposal on the habitats and species of international importance and how those effects are likely to affect the site's conservation objectives

VI

Should decide whether the plan or project, as proposed, would adversely affect the integrity of the site in the light of the conservation objectives

VII

Should consider the manner in which the plan or project is proposed to be carried out, whether it could be modified, or whether conditions or restrictions could be imposed, so as to avoid adverse effects on the integrity of the site

VIII

Should conclude whether the proposal, as modified by conditions or restrictions, would adversely affect the integrity of the site

IX

Should record the Assessment and notify English Nature of the conclusions

The key steps explained

These key steps are explained in more detail below.

I. Consulting English Nature

16. Under Regulation 48(3) the competent authority must consult English Nature and must have regard to any representations made by English Nature. It may be inferred from PPG 9 (box C10 and para C9) that the competent authority would be expected to follow the advice of English Nature and normally to decide the case "*in accordance with the recommendations of English Nature*". If it does not do so, the competent authority should be prepared to explain its reasons. In cases where it proposes to agree to a plan or project notwithstanding a negative assessment, the competent authority is required to notify the Secretary of State in advance of any decision.

II. Consulting the General Public

17. Under Regulation 48(4) the competent authority may (if it considers it appropriate) take the opinion of the general public, on the implications of the proposal for the site's conservation objectives, using whatever steps they consider necessary. This may usefully include taking the opinion of others with relevant knowledge or expertise.

III. The Site's Conservation Objectives

18. The Regulations do not define what is meant by the site's conservation objectives but PPG 9 box C10 describes them as:

"*the objectives.... / the reasons for which the site was classified or designated*"

English Nature will be able to give a clear statement of the site's conservation objectives in the light of its European Site Register entry (compiled by Government under Regulation 11), its citation, its reasons for recommendation, English Nature's knowledge of the site, national and international objectives for the international nature conservation interests (such as may be contained in the UK Biodiversity Action Plan) and any Management Plan or Management Statement for the site in so far as they relate to the interests for which the site was selected.

19. The site may also host habitats and/or species of Community interest (see Article 1 of the Habitats Directive) which are not mentioned in the European Site Register, the citation or the reasons for recommendation because they were not, at the time, a reason for classification or designation. Such features are not relevant to the appropriate assessment itself. Nevertheless their presence may be material to the decision as to whether or not to undertake or to consent to the plan or project.

IV. Requiring Further Information

20. The competent authority, taking the advice of English Nature where necessary, should require the applicant to provide such information as the competent authority may reasonably require for the purposes of making the assessment (Reg.48(2)). The information required may relate to any environmental information, or information about the proposal, relevant to the assessment and may include:

i. information already available, or
ii. new information from surveys that may need to be carried out, or
iii. data analysis, predictions, comparisons or assessments of a technical nature.

V. Identifying the Effects

21. Having regard to English Nature's advice and other consultation responses and, where relevant, taking account of the ES or any other information supplied by the developer/proposer, or otherwise available, the competent authority should identify what the effects of the proposal are likely to be. The effects considered should be those of the plan or project, either alone or in combination with other plans or projects, on the habitats and species of international importance and how those effects are likely to affect the site's conservation objectives. This will involve considering, for example, the nature, scale, geographic extent, timing, duration and magnitude of direct and indirect effects; considering the degree of certainty in the prediction of effects; considering all mitigating measures already contained in the proposal and the extent to which these measures are likely to avoid, reduce or ameliorate adverse effects on the international nature conservation interests. It is the residual effects, after mitigation, that are considered at this stage.

VI. Integrity of the Site

22. Having regard to English Nature's advice, other consultation responses and any other information available, the competent authority should decide whether the plan or project, as proposed, would adversely affect the integrity of the site, in the light of its conservation objectives. That is, whether the plan or project would adversely affect the "*coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified*" (PPG 9 box C10). An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation.

23. The form of words used in Regulation 48(5) implies that a precautionary approach should be taken in considering effects on integrity, in line with the Government's principles for sustainable development (see *Sustainable Development: the UK strategy* page 33). Regulation 48(5) says that (subject to Regulation 49) projects may only proceed if the competent authority has ascertained that it **will not adversely affect** the integrity of the European site.

VII. Considering How To Avoid Adverse Effects

24. If the proposal would adversely affect the integrity of the site then, having regard to English Nature's advice, the competent authority should consider the manner in which it is proposed to be carried out and whether the plan or project could be modified, or whether conditions or restrictions could be imposed, so as to avoid the adverse effects. This may include, for example, changes to the siting, layout, timing or use of the proposal and the use of obligations or legal agreements. (Reg. 48(6)).

25. Compensatory measures that may be offered in the proposal at this stage, seeking to redress but not remove

residual harm to the international interests (such as the provision of land for habitat creation purposes), should not be considered in the appropriate assessment, but may be considered later in the decision making process. (See Reg. 53).

VIII. Conclusion on Effects In The Light of Conditions and Restrictions

26. The competent authority should reassess the conclusions in the light of any such modifications, conditions or restrictions that may be agreed or imposed.

IX. Recording the Assessment

27. It would be advisable for this conclusion, and the reasons for it, to be recorded. English Nature should be notified of the conclusion of the appropriate assessment and the authority's decision as to the effects on the integrity of the site, before the authority undertakes the plan or project or issues any permission, consent or other authorisation (PPG 9 para 30).

28. The subsequent courses of action open to a competent authority are set out in Regulations 48(5) - (7), 49 and 54(3). The Regulations prohibit a competent authority from undertaking or giving consent to any plan or project unless the appropriate assessment concluded that it would not have an adverse effect on the integrity of the site, or specific criteria are met and the Secretary of State has been informed.

Good Practice Outline of an Appropriate Assessment Record

29. A suggested model or good practice outline record of an appropriate assessment is set out below. It may be contained in, for example, a planning officer's committee report or the minutes of a competent authority's decision. In other cases it may be a file note, clearly recording compliance with the Regulations. The record may take many different forms because each assessment needs to be appropriate to the type, scale, location and significance of the proposal and to the relevant nature conservation interests. It is provided here as a guide to assist competent authorities and English Nature staff, not as an authoritative legal formula. Any record made of an appropriate assessment should be copied to English Nature and to any other parties who were consulted on the assessment.

Title of Plan or Project/Application
Location of Plan or Project/Application
[With location plan attached showing relationship to the international designation]
International Nature Conservation Site
Nature/Description of Plan or Project/Application
[Including brief description of manner in which plan or project is proposed to be carried out]
Date Appropriate Assessment Recorded

This is a record of the appropriate assessment, required by Regulation 48 of the Habitats Regulations 1994, undertaken by [name of competent authority] in respect of the above plan/project, in accordance with the Habitats Directive (Council Directive 92/43/EEC). Having considered that the plan or project would be likely to have a significant effect on the [name of international site] and that the plan or project was not directly connected with or necessary to the management of the site, an appropriate assessment has been undertaken of the implications of the proposal in view of the site's conservation objectives.

*English Nature was consulted under Regulation 48(3) on [date] and their representations, to which this authority has had regard, are attached at Annex 1. The conclusions of this appropriate assessment * are/are not in accordance with the advice and recommendations of English Nature.*

**The applicant was required to submit further information reasonably necessary for this assessment on [date] under Reg.48(2) * and replied with the information on [date]/but did not supply the information.*

** The opinion of the general public was taken under Reg. 48(4) by way of *public advertisement/further consultation etc and the views expressed (attached at Annex 2) have been taken into account.*

The site's conservation objectives have been taken into account, including consideration of the citation for the site and information supplied by English Nature (see Annex 1). The likely effects of the proposal on the international nature conservation interests for which the site was designated may be summarised as:
[List of Effects]

The assessment has concluded that:
a) the plan or project **as proposed would not adversely affect the integrity of the site,*
or
b) the plan or project **as proposed would adversely affect the integrity of the site.*
[If (b):]
The imposition of conditions or restrictions on the way the proposal is to be carried out has been considered and it is ascertained that:
**a) conditions or restrictions cannot overcome the adverse effects on the integrity of the site.*
or
**b) the following conditions and/or restrictions would avoid adverse effects on the integrity of the site. [list conditions/restrictions]*

Signed ..... Date ..... (delete as appropriate)*
Annexes to also include relevant correspondence, minutes or meetings with English Nature, the applicant etc.

Appendix III List of Relevant Authorities

English Nature - Ms H Smith, Conservation Officer, English Nature, 110 Northgate Street, Bury St Edmunds, Suffolk IP33 1HP

Environment Agency - Ms M Leeds, Conservation Officer, Environment Agency, Cobham Road, Ipswich, Suffolk IP3 9JE

Eastern Sea Fisheries Joint Committee - Mr R Gay, Sea Fisheries Officer, Eastern Sea Fisheries Joint Committee, 6 North Lynn Business Village, Bergen Way, Kings Lynn, Norfolk PE30 2JG

Suffolk County Council - Mr J Hindle, Countryside Manager, Suffolk County Council, Environment and Transport, St Edmund House, County Hall, Ipswich, Suffolk IP4 1LZ

Waveney District Council - Mr P Patterson, Engineer, Waveney District Council, Town Hall, Mariners Street, Lowestoft. Suffolk NR32 1JT

Suffolk Coastal District Council - Mr J Davies, Countryside Recreation Manager, Suffolk Coastal District Council, Melton Hill, Woodbridge, Suffolk IP12 1AU

Anglian Water - Ms L Taylor, Catchment Planner, Anglian Water Services Ltd., Endurance House, Chivers Way, Histon, Cambridgeshire CB4 9ZY

Middle Alde, Lower Alde Internal Drainage Boards - Mr I Hart, Clerk to Norwich Group of IDBs, The Old School House, 4 Church Walk, Shelfanger, Diss IP22 2DU

Alderton, Hollesley & Bawdsey Internal Drainage Boards - Rebecca Barrington-Phillips, Clerk to the IDB, Alderton, Hollesley & Bawdsey IDB, High House, Bawdsey, Woodbridge, Suffolk IP12 3AW

Trinity House - Ms A Thorogood, Trintiy House, Tower Hill, London EC3N 4DH

Orford Town Trust, c/o Mr K. Bennett, Avocets, 63, Quay St, Orford, Woodbridge, Suffolk IP12 2NV

Figure 1 Location map of Alde-Ore Estuary SPA

(Note: Orfordness-Havergate SPA has been subsumed within the Alde-Ore Estuary SPA)

EC Directive 2009/147/EC on the Conservation of Wild Birds Special Protection Area (SPA)

Name: Flamborough and Filey Coast

Counties/Unitary Authorities: The coastal section of the SPA covers a slender strip of cliffs and hinterland along the coastline of the counties of North Yorkshire and the East Riding of Yorkshire between Bridlington and Scarborough. The marine portion of the site lies entirely in UK territorial waters adjacent to the aforementioned coastal strip.

Boundary of the SPA: 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.

Size of SPA: The SPA covers an area of 7857.99 hectares.

Site description:

Flamborough and Filey Coast SPA is located on the Yorkshire coast between Bridlington and Scarborough. It 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. The cliffs of Flamborough Head rise to 135 metres and are composed of chalk and other sedimentary rocks. These soft cliffs have been eroded into a series of bays, arches, pinnacles and gullies with an extensive system of caves at sea-level. The cliffs from Filey Brigg to Cunstone Nab comprise a range of sedimentary rocks including shales and sandstones. The cliff top vegetation comprises maritime grassland vegetation growing alongside species more typical of chalk grassland. The intertidal area below the cliffs is predominantly rocky and part of a series of reefs that extend into the subtidal area. The adjacent sea out to 2 km off Flamborough Head as well as Filey Brigg to Cunstone Nab is characterised by reefs supporting kelp forest communities in the shallow subtidal and faunal turf communities below 2 metre water depths. The southern side of Filey Brigg shelves off gently from the rocks to the sandy bottom of Filey Bay.

Qualifying species: The site qualifies under article 4.2 of the 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.

Species	Count (period)	% of subspecies or population (pairs)
Black-legged kittiwake *Rissa tridactyla*	44,520 pairs[1] 89,040 breeding adults[2] (2008-2011)	2% North Atlantic[3]

[1] Data from: Seabird Monitoring Programme (SMP) for original SPA (2008); RSPB counts for terrestrial extension (2009-2011), unpublished; black-legged kittiwakes are counted as “apparently occupied nests” (AONs); 1 AON equates to 1 breeding pair.
[2] Pairs multiplied by 2 to arrive at breeding adults; this rule applies to all species listed within the table.
[3] Data from: AEWA (2012); 6,600,000 Ind. translated to pairs by dividing by 3 and compared to pairs reported for the revised SPA to derive % population.

Northern gannet *Morus bassanus*	8,469 pairs[4] 16,938 breeding adults (2008-2012)	2.6% North Atlantic[5]
Common guillemot *Uria aalge*	41,607 pairs[6] 83,214 breeding adults (2008-2011)	15.6% (*Uria aalge albionis*)[7]
Razorbill *Alca torda*	10,570 pairs[8] 21,140 breeding adults (2008-2011)	2.3% *(Alca torda islandica)*[9]

	Count period	**Average number of individuals**
Seabird Assemblage	2008-2012	216,730

References:

AEWA – African-Eurasian Waterbird Agreement (2012): Report on the Conservation Status of Migratory Waterbirds in the Agreement Area. Fifth Edition. AEWA, Bonn.
Available here: http://www.unep-aewa.org/meetings/en/stc_meetings/stc7docs/info_docs_pdf/stc_inf_7_4_csr5.pdf

Aitken, D., Clarkson, K., Kendall, I., Wightman, S. (2012): Flamborough Head and Bempton Cliffs SPA Seabird Monitoring Programme. 2012 Report, Bempton.

Harris, M.P. (1989): Variation in the correction factor used for converting counts of individual Guillemots Uria aalge into breeding pairs. IBIS 131, pp. 85-93.
Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1474-919X.1989.tb02747.x/abstract

Status of the SPA:

1. Flamborough Head and Bempton Cliffs was classified as an SPA on 5 March 1993.

2. The site was extended and renamed Flamborough and Filey Coast SPA on 23rd August 2018

[4] Data from: SMP for original SPA (2008, 2009); RSPB counts for original SPA (2012), (Aitken et al. 2012); northern gannets are counted as AONs; 1 AON equates to 1 breeding pair.
[5] Data from: AEWA (2012); 967,000 Ind. translated to pairs by dividing by 3 and compared to pairs reported for the revised SPA to derive % population.
[6] Data from: SMP for original SPA (2008); RSPB counts for terrestrial extension (2009-2011), unpublished; common guillemots are counted as "individuals on land" (62,100 individuals on land (mean of counts 2008-2011)); individuals on land are multiplied by a correction factor of 0.67 (Harris 1989) to translate to breeding pairs.
[7] Data from: AEWA (2012); 800,000 Ind. translated to pairs by dividing by 3 and compared to pairs reported for the revised SPA to derive % population.
[8] Data from: SMP for original SPA (2008); RSPB counts for terrestrial extension (2009-2011), unpublished; razorbills are counted as "individuals on land" (15,776 individuals on land (mean of counts 2008-2011)); individuals on land are multiplied by a correction factor of 0.67 (Harris 1989) to translate to breeding pairs.
[9] Data from: AEWA (2012); 1,380,000 Ind. translated to pairs by dividing by 3 and compared to pairs reported for the revised SPA to derive % population.

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK000610
Date of registration: 25 August 1998
Date amended: 23 August 2018

Signed: 

On behalf of the Secretary of State for Environment, Food and Rural Affairs

Directive 2009/147/EC on the Conservation of Wild Birds
Special Protection Area (SPA)

Name: Greater Wash SPA

Counties/Unitary Authorities: East Riding of Yorkshire, Lincolnshire, Norfolk, Suffolk

Boundary of the SPA:

The landward boundary of the SPA covers the coastline from Bridlington Bay in the north (at the village of Barmston), to the existing boundary of the Outer Thames Estuary SPA in the south. Along this stretch of coast, the boundary will come to Mean High Water (MHW). Across the mouth of the Humber Estuary, the boundary abuts the boundary of the Humber Estuary SPA, except where neither the little tern foraging zone or the red-throated diver Maximum Curvature Analysis (MCA) density threshold reaches the SPA. The landward boundary abuts the seaward boundary of The Wash SPA except where the former overlaps the latter to encompass the foraging area of Sandwich tern.

The seaward boundary lies approximately 14 nautical miles (nm) from the shore at its furthest extent and is driven by the distribution of red-throated diver along the length of the SPA, with a small length off the north Norfolk Coast driven by the area used by foraging Sandwich tern.

Size of SPA: The SPA covers an area of 353,578 ha or 3,536 km^2.

Site description:

The Greater Wash SPA is located in the mid-southern North Sea between Bridlington Bay in the north and the Outer Thames Estuary SPA in the south. To the north, off the Holderness coast in Yorkshire, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. Offshore, soft sediments dominate, with extensive areas of subtidal sandbanks off The Wash as well as north and east Norfolk coasts. Closer inshore at The Wash and north Norfolk coast, sediments comprise a mosaic of sand, muddy sand, mixed sediments and coarse sediments, as well as occasional Annex I reefs. The area off the Suffolk coast continues the mosaic habitats mostly dominated by soft sediment.

Qualifying species:

The site qualifies under **Article 4.1** of the Directive 2009/147/EC by regularly supporting populations of national importance of the Annex I species:

Species	**Count (period)**	**% of subspecies or population**	**SPA selection guideline**
Red-throated diver *Gavia stellata*	1,407 individuals (MoP 2002/03 - 2005/06)	8.3% GB non-breeding population	1.1
Little gull *Hydrocoloeus minutus*	1,255 individuals (MoP 2004/05 –2005/06)	No current GB population estimate	1.4
Sandwich tern *Sterna sandvicensis*	3,852 pairs (5 year MoP 2010-14)	35.0% of GB breeding population	1.1
Common tern *Sterna hirundo*	510 breeding pairs (5 year MoP 2010-2014)	5.1% of GB breeding	1.1
Little tern *Sternula albifrons*	798 pairs (5 year MoP 2009-2013)	42.0% of GB breeding population	1.1

In addition, the site qualifies under **Article 4.2** of the Directive 2009/147/EC by regularly supporting a population of international importance of the migratory species:

Species	Count (period)	% of subspecies or population	SPA selection guideline
Common scoter *Melanitta nigra*	3,449 individuals (MoP 2002/03, - 2007/08)	0.6% biogeographic population [1]	1.4

Mean of Peak (MoP) for non-breeding populations[2], breeding populations taken from various sources and are summed across the relevant site-specific population estimates. GB populations derived from Musgrove *et al*. (2013)[3] unless otherwise stated.

Principal bird data sources:

Populations on non-breeding waterbirds from:
MoP non-breeding populations for red-throated diver, common scoter and little gull were calculated by Natural England using Area of Search (AoS) data reported by Lawson *et al.* 2015a (Appendix 4).
Colony counts for Sandwich and common tern from:
JNCC Seabird Monitoring Programme contributed by colony managers from: National Trust, Natural England (North Norfolk Coast SPA) and RSPB (Breydon Water SPA).
Colony counts for little tern from:
RSPB for EU LIFE+ Little Tern Recovery Project contributed by site managers from: Easington Little Tern Protection Scheme (Humber Estuary SPA); Lincolnshire Wildlife Trust (Gibraltar Point SPA); RSPB, National Trust, Norfolk Wildlife Trust, Natural England (North Norfolk Coast SPA); and RSPB (Great Yarmouth North Denes SPA).

Status of SPA:
Greater Wash SPA was classified under Directive 2009/147/EC on 28th March 2018

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK9020329
Date of registration: 28 March 2018

Signed: [redacted]

On behalf of the Secretary of State for Environment, Food and Rural Affairs

[1] Common scoter biogeographic population from Waterbird Population Estimates online database (http://wpe.wetlands.org/) accessed 26/01/2016)
[2] MoP (Mean of Peaks) non-breeding populations for red-throated diver, common scoter and little gull were calculated by Natural England using AoS data reported by Lawson *et al.* 2015 (http://jncc.defra.gov.uk/page-7104).
[3] Musgrove *et al.* (2013) collates population estimates of birds in Great Britain and the UK, by extrapolation of previous estimates using recognised trend measures, new surveys and novel analytical approaches (https://www.britishbirds.co.uk/wp-content/uploads/2010/12/APEP3.pdf).

Departmental brief:

Outer Thames Estuary potential Special Protection Area

Natural England and JNCC

November 2015

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Summary

Outer Thames Estuary potential Special Protection Area (pSPA) detailed in this Departmental Brief is proposed to protect important areas of coast and sea used for a variety of purposes by the qualifying features. The new pSPA enlarges the existing Outer Thames Estuary SPA (classified solely for non-breeding red-throated divers *Gavia stellata*) to include three new areas identified for foraging terns breeding at other (already classified) SPAs on shore; these are parts of the Rivers Yare and Bure, a small riverine section at Minsmere, and both estuarine and marine areas around Foulness. The pSPA therefore comprises areas for foraging breeding seabirds and non-breeding waterbirds. The feature of the existing SPA is retained, and new qualifying features are added based on a review of up-to-date bird abundance information. The total area of the Outer Thames Estuary pSPA is approx. 391,910 ha (392km^2).

The two species of tern relevant to the pSPA are common tern *Sterna hirundo* and little tern *Sternula albifrons*. From north to south, the adjacent SPAs with these tern species as qualifying features (all little tern unless stated) are: Great Yarmouth North Denes SPA; Breydon Water SPA (common tern only); Benacre to Easton Bavents SPA; Minsmere – Walberswick SPA; Alde-Ore Estuary SPA; Foulness SPA (common tern and little tern); and Thanet Coast & Sandwich Bay SPA. In addition to these, common and little terns breeding at Scroby Sands, a sand bank completely contained within the pSPA, and other coastal nesting locations functionally linked to terrestrial SPAs, are included in determining the abundance of terns at the site.

However, Sandwich terns at the Alde-Ore Estuary and Foulness SPAs are not included in determining the details of the pSPA because the feature has been absent at these SPAs for too long to merit influencing the size and shape of the site (Wilson *et al*. 2014). Marine extensions to Hamford Water SPA are the subject of a separate Departmental Brief and do not influence the Outer Thames Estuary pSPA, whilst small numbers of little terns at Colne Estuary, Blackwater Estuary and Medway Estuary and Marshes SPAs are not expected to forage within the marine pSPA based on generic foraging models (Parsons *et al*. 2015).

This Departmental Brief makes use of the most recent available estimates of the population sizes of these species at these sites to derive the populations of birds supported by the pSPA. However, in respect of the existing classified (terrestrial) SPAs, this Departmental Brief does not make any proposal to add or remove qualifying features, amend baseline population figures, or alter site boundaries.

This Departmental Brief sets out the scientific case for the classification of the Outer Thames Estuary pSPA. This site qualifies under Article 4 of the Birds Directive (2009/147/EC) for the following reasons (summarised in Table 1):

The site regularly supports more than 1% of the Great Britain breeding populations of three species listed in Annex I of the Birds Directive. Therefore, the site qualifies for SPA classification in accordance with the UK SPA selection guidelines (stage 1.1).

Table 1 Summary of qualifying ornithological interest in Outer Thames Estuary pSPA

Species	Count (period)	% of subspecies or population	Interest type	Selection criteria	Status of feature
Little tern *Sternula albifrons* (in breeding season)	746 individuals (2011 – 2015)	19.64% of GB population	Annex 1	Stage 1.1	New
Common tern *Sterna hirundo* (in breeding season)	532 individuals (2011 – 2015)	2.66% of GB population	Annex 1	Stage 1.1	new
Red-throated diver *Gavia stellata* (in non- breeding season)	6,466 individuals (1989 – 2006/07)[1]	38.0% of GB population	Annex 1	Stage 1.1	From existing SPA

[1] Citation value from original Outer Thames Estuary SPA classification, 2010

1. Assessment against SPA selection guidelines

The UK SPA selection guidelines require that SPA identification should be determined in two stages (Stroud *et al*. 2001). The first stage is intended to identify areas that are likely to qualify for SPA status. The second stage further considers these areas using one or more of the judgements in Stage 2 to select the most suitable areas in number and size for SPA classification (Stroud *et al*. 2001).

1.1. Stage 1

Under stage 1 of the SPA selection guidelines (JNCC, 1999), sites eligible for selection as a potential SPA must demonstrate one or more of the following:

1) an area is used regularly by 1% or more of the Great Britain (or in Northern Ireland, the all-Ireland) population of a species listed in Annex I of the Birds Directive (2009/147/EC) in any season;

2) an area is used regularly by 1% or more of the biogeographical population of a regularly occurring migratory species (other than those listed in Annex I) in any season;

3) an area is used regularly by over 20,000 waterbirds (waterbirds as defined by the Ramsar Convention) or 20,000 seabirds in any season;

4) an area which meets the requirements of one or more of the Stage 2 guidelines in any season, where the application of Stage 1 guidelines 1, 2 or 3 for a species does not identify an adequate suite of most suitable sites for the conservation of that species.

Outer Thames Estuary pSPA qualifies under stage 1(1) because it regularly supports greater than 1% of the GB population of three Annex I species; two in the breeding season (little tern, common tern) and one in the non-breeding season (red-throated diver).

1.2. Stage 2

Outer Thames Estuary pSPA is assessed against Stage 2 of the SPA selection guidelines in Table 2. It should be noted that in applying the SPA selection guidelines, Stroud *et al.* (2001) note that a site which meets only one of these Stage 2 judgments is not considered any less preferable than a site which meets several of them, as the factors operate independently as indicators of the various different kinds of importance that a site may have. The pSPA meets most of the Stage 2 criteria indicating the different kinds of importance the site holds.

Table 2. Assessment of the bird interest against stage 2 of the SPA selection guidelines.

Feature	Qualification	Assessment
1. Population size & density	✓	The site supports comfortably the largest aggregation of red-throated divers in the UK (O'Brien *et al*. 2008). It also supports foraging areas for nearly 20% of the GB population of little terns, and nearly 3% of the GB population of common terns.
2. Species range	✓	The pSPA is the main non-breeding area for red-throated divers in the UK, and is the most south-easterly of sites classified or under consideration. Similarly, south east England supports the bulk of the UK's breeding little terns (Mitchell *et al*. 2004) and the pSPA provides for foraging in this crucial part of their range.
3. Breeding success	✓	Little tern productivity at some colonies contributing to the pSPA has exceeded the UK average of 0.51 chicks per pair (Cook & Robinson 2010) occasionally (e.g. Winterton 2012, 2013; Benacre to Easton Bavents 2014: RSPB data). Common tern productivity is estimated to fluctuate nationally between an average 0.7 and 0.3 (Wilson *et al.* 2014); productivity at Breydon Water SPA exceeds this average in most years (RSPB data) and is likely to be especially high

		(perhaps 1.7 chicks per pair) at Foulness SPA. The pSPA directly contributes to productivity, as food resources are contained within it.
4. History of occupancy	✓	Large aggregations of red-throated divers began to be discovered through a programme of aerial surveys between 2001 and 2006 (O'Brien *et al*. 2008). Therefore there is a history of occupancy dating back almost 15 years, although it is highly likely divers were present before our knowledge developed. Breeding little terns and common terns have bred at locations adjacent to the pSPA for many years, meaning several sites were classified as SPAs from the early 1990s. There is every reason to believe the foraging areas within the pSPA would have been used for an equal period, given the foraging ranges of the relevant terns are unlikely to have changed significantly.
5. Multi-species area	✓	Three features qualify in total.
6. Naturalness	N/A	No longer applicable, following ruling from the SPA & Ramsar Scientific Working Group.
7. Severe weather refuge	**?**	No data are available to determine whether the pSPA acts as a severe weather refuge for red-throated divers. Numbers of divers within the pSPA do fluctuate, but the reasons are imperfectly understood.

2. Rationale and data underpinning site classification

In 1979, the European Community adopted Council Directive 79/409/EC on the conservation of wild birds (EEC, 1979) known as the 'Birds Directive'. This has been amended subsequently as Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. This provides for protection, management and control of naturally occurring wild birds within the European Union through a range of mechanisms. One of the key provisions is the establishment of an ecologically coherent network of protected areas. Member States are required to identify and classify the most suitable territories in size and number for rare or vulnerable species listed in Annex I (Article 4.1) and for 'regularly occurring migratory species' under Article 4.2 of the Directive. These sites are known as Special Protection Areas (SPAs) in the UK. Guidelines for selecting SPAs in the UK were derived from knowledge of common international practice and based on scientific criteria (JNCC, 1999).

According to Stroud *et al.* (2001), the task of identifying a coherent network of terrestrial sites in the UK is largely complete, comprising of 243 sites of which some include areas used by inshore non-breeding waterbirds, for example in estuaries. However, the JNCC's SPA Selection Guidelines do not review requirements of birds using the wholly offshore environment in which many birds access resources that are critical for their survival and reproduction. Johnston *et al*. (2002) describe a process consisting of three strands by which SPAs might be identified for marine birds under the Birds Directive *i.e*. the identification of:

Strand 1: seaward extensions of existing seabird breeding colony SPAs beyond the low water mark;
Strand 2: inshore feeding areas used by concentrations of birds (e.g. seaduck, grebes and divers) in the non-breeding season; and
Strand 3: offshore areas used by marine birds, probably for feeding but also for other purposes.

Since then, a fourth strand was added to the work conducted by the Joint Nature Conservation Committee (JNCC) to address the need for:

Strand 4: other types of SPA (JNCC, 2011) that would identify some important areas for marine birds that may not be included within the above three categories and will be considered individually

To implement conservation measures under **Strand 1**, the JNCC produced generic guidance (McSorley *et*

al. 2003, 2005, 2006; Reid & Webb 2005) to extend the seaward extent of SPA boundaries from seabird colonies. The seaward extensions of existing boundaries in these cases include waters vital for ensuring that some of the essential ecological requirements of the breeding seabird populations are met (e.g. preening, bathing, displaying and potentially local foraging). The distance of the extension is dependent upon the qualifying species breeding within the SPA. However, these generic boundary extensions are not influenced by or meant to encompass the principal foraging areas used by the species for which they are identified or any other species at the colonies concerned. Generic seaward extensions to the boundaries of existing SPAs have been implemented at 31 sites in Scotland and are under consideration at the Flamborough and Filey Coast pSPA (Natural England 2014). However, in line with the recommendations of Reid & Webb (2005), generic extensions have only been implemented at sites holding certain seabird species, none of which occur as breeding birds within the existing SPAs which border the Outer Thames Estuary pSPA. Reid & Webb (2005) note that no evidence has been found that any of the five species of tern which breed regularly in Great Britain make significant use of waters around their colony for maintenance activity (McSorley *et al.* 2003) and conclude that generic guidance for extension of colony SPAs for this purpose is not appropriate in the case of terns.

The original Outer Thames Estuary SPA was classified under **Strand 2** in 2010. Classification was for the marine area supporting a peak mean value of 6,466 red-throated divers in the non-breeding season (JNCC, 2011). As no boundary changes are proposed for this species, and as insufficient contemporary data are available to revise the citation value, this Departmental Brief will not focus on the scientific case for inclusion of this species. The starting position is that this original feature is retained, and all further justification relates to tern foraging areas (which mainly overlap red-throated diver non-breeding areas).

All five species of tern that regularly breed in the UK (Arctic tern *Sterna paradisaea*, common tern *S. hirundo,* Sandwich tern *S. sandvicensis,* roseate tern *S. dougallii* and little tern *Sternula albifrons*) are listed on Annex I of the EU Birds Directive and thus are subject to special conservation measures including the classification of Special Protection Areas (SPAs). Within the UK there are currently 57 breeding colony SPAs for which at least one species of tern is protected. However, additional important areas for terns foraging at sea have yet to be identified and classified as marine SPAs to complement the existing terrestrial suite. Since 2007, the JNCC has been working with the four Statutory Nature Conservation Bodies (SNCBs) towards the identification of such areas under **Strand 4** as, given the likely extent of these areas, these cannot be addressed by application of the generic maintenance extensions approach and are not covered by the work on identifying inshore non-breeding aggregations or important offshore areas due to difficulties in identification of terns and to limited survey coverage closer to shore (terns have limited foraging ranges compared to other seabird species).

In the process by which a site becomes fully classified as an SPA, Ministerial approval has to be given to undertake formal consultation on the proposal to classify the site. At this stage in the process a site becomes known as a potential SPA (pSPA). Within this Departmental Brief, and others being prepared at the same time, sites currently under consideration include both new sites (such as Solent & Dorset Coast pSPA) and existing sites (such as Hamford Water SPA) which are being extended and/or having new features added. For the purpose of clarity in this and other Departmental Briefs, sites are referred to as SPAs when referring to existing classified sites. Where reference is made to an entirely new site, or to an extended site, or to a site including new features being proposed (such as Outer Thames Estuary), it will be referred to as pSPA since the site (if new), or any additional extent or feature is not yet fully classified.

This Departmental Brief sets out information supporting the identification of the qualifying features of the Outer Thames Estuary pSPA and definition of its proposed boundaries. This is based upon the areas of sea identified as being most important to the tern populations that comprise the qualifying features of this new marine SPA, i.e. terns breeding at the existing Great Yarmouth North Denes, Breydon Water, Benacre to Easton Bavents, Minsmere – Walberswick, Alde-Ore Estuary, Foulness and Thanet Coast & Sandwich Bay SPAs, as well as some functionally linked nesting locations.

SPA site selection guidelines have been applied to the most up to date data for the site.

2.1. Data collection – defining the suite of breeding features and numbers supported by the Outer Thames Estuary pSPA

The size of each of the populations of terns supported by the Outer Thames Estuary pSPA, and which exceed the SPA qualifying thresholds, have been derived as the sum of the numbers of those species at

each of the existing SPAs from which the individuals recorded at sea within the pSPA are most likely to originate. Citation figures from existing SPAs have not been used to calculate the Outer Thames Estuary pSPA population. These figures are considered out of date and therefore inappropriate for use in defining the sizes of the populations of these species supported by the entirely new pSPA. Therefore, for each of the source SPAs, the numbers are the most recently available from the Seabird Monitoring Programme (SMP) database (i.e. within the last five years), unless otherwise indicated. Where necessary and possible, this dataset has been augmented by information requested directly from colony managers, from relevant reports (Parsons *et al*. 2015; Norfolk Bird & Mammal Reports), from the national bird ringing scheme, and from the LIFE+ little tern project.

The pSPA population calculation excluded: i) numbers of any terns that may forage within Outer Thames Estuary pSPA, but derive from breeding colonies that are situated outside of existing SPAs, apart from those with strong evidence of functional linkage between SPAs and alternate nesting locations; ii) numbers of terns at existing SPAs which are not qualifying features of these sites and not currently present in numbers exceeding SPA selection criteria thresholds at those sites; iii) numbers of terns at existing SPAs which, although qualifying features of those sites are no longer present in such numbers at those particular sites, and do not meet selection criteria when summed across all source SPAs that might contribute to the pSPA (e.g. Sandwich tern). These exclusions were made to ensure that the size and shape of the pSPA were determined by the foraging requirements of the large numbers of birds originating from the principal source colonies and not unduly influenced by the inclusion of areas of sea that might be used only by relatively small numbers of birds from colonies that do not meet SPA selection criteria thresholds.

2.2. Defining the boundary of Outer Thames Estuary pSPA

The overall boundary of the Outer Thames Estuary pSPA is largely unchanged from the existing SPA, defined according to the distribution of non-breeding red-throated divers (O'Brien *et al*. 2012). However, some additional nearshore areas are proposed to allow for tern foraging requirements. The work done to identify important areas for little and larger tern species differed and was conducted separately (Wilson *et al*. 2014; Parsons *et al*. 2015). These separate pieces of work are described in brief in the following two sub-sections. The overall site boundary was drawn as a composite of the separate species-specific boundaries and this is described in section 3.4.

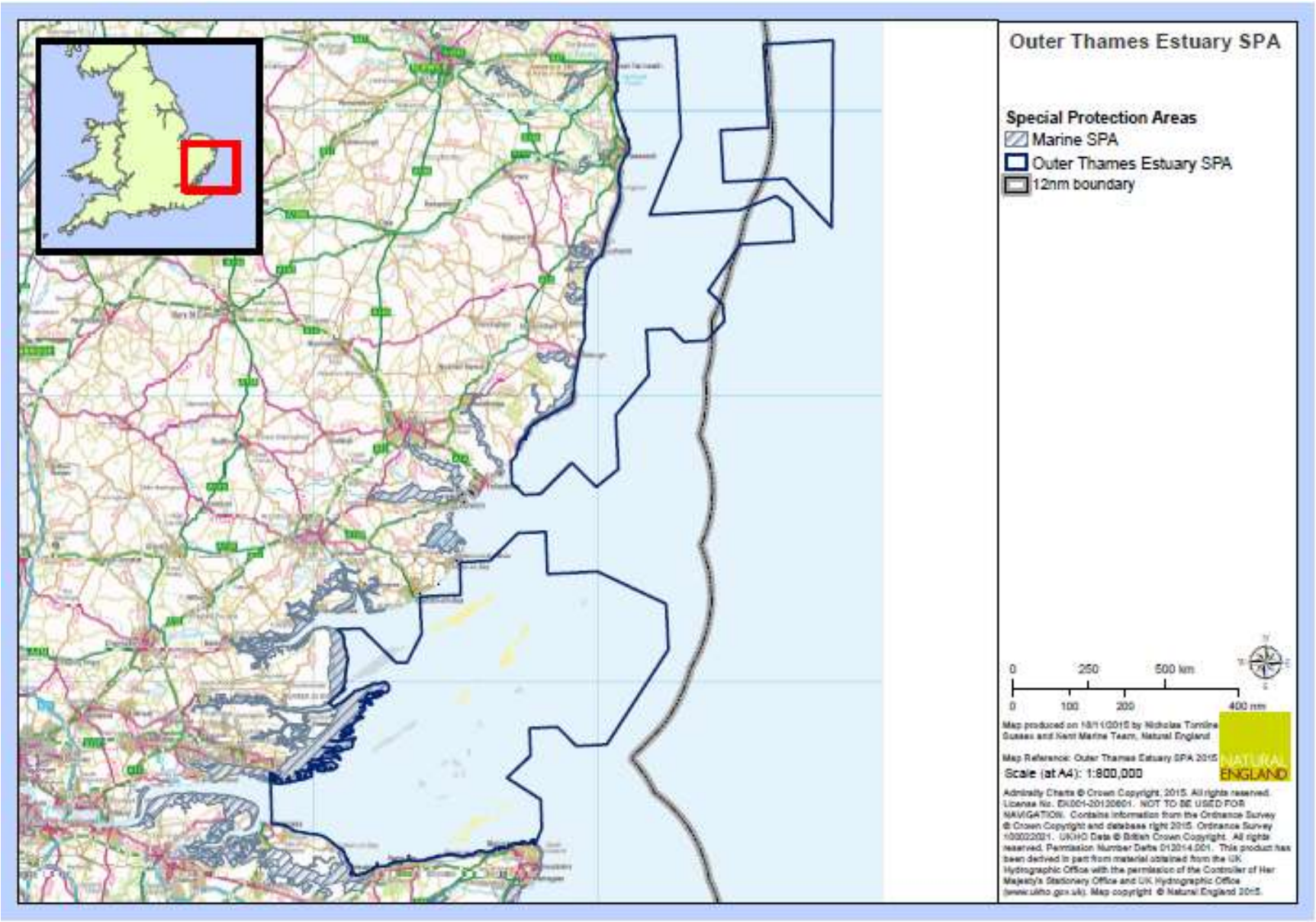
3. Site Status and Boundary

3.1. Existing Boundary

The total area of the existing Outer Thames Estuary SPA is approx. 379,268 ha (379km^2).and is divided into three main areas (refer to Figure 1):

- The outer estuary (east of a line north from Sheerness, Kent to Shoebury Ness, Essex);
- A separate area extending south along the coast from East Norfolk (from Caister-on-Sea) to Woodbridge, Suffolk; and
- An area lying offshore slightly further north.

Figure 1. Existing Outer Thames Estuary SPA boundary



Generally, the landward boundary of the existing SPA follows the Mean Low Water (MLW) mark or the seaward boundaries of existing coastal SPAs along most of its length (whichever is the further seaward). The coastal SPAs which directly abut the site from north to south are:

- Great Yarmouth North Denes SPA
- Benacre to Easton Bavents SPA
- Minsmere-Walberswick SPA
- Alde-Ore Estuary SPA
- Crouch and Roach Estuaries SPA
- Dengie SPA
- Foulness SPA
- Southend and Benfleet Marshes SPA
- Thames Estuary and Marshes SPA
- Medway Estuary and Marshes SPA
- The Swale SPA, and
- Thanet Coast and Sandwich Bay SPA

Intertidal mudflats and sandbanks separated from the mainland coast by subtidal areas at MLW are within the existing SPA boundary, except where they are within the boundaries of existing coastal SPAs.

The offshore boundary of the site is largely within the 12 nautical mile (nm) zone; however a significant component of the northern section does extend beyond the 12 nm limit. The total area of the existing Outer Thames Estuary SPA is currently approx.. 379,268 ha (379km^2).

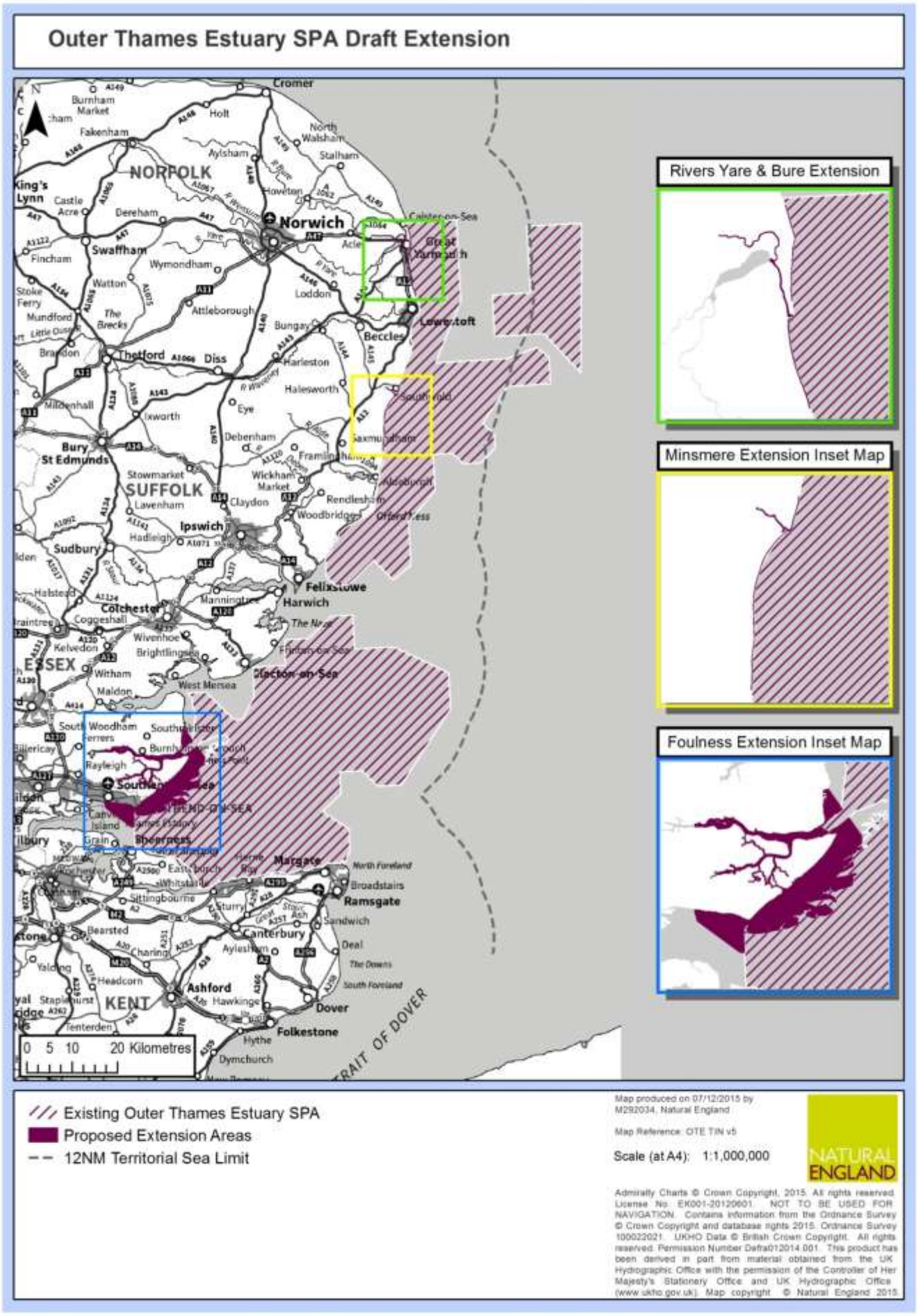
3.2. Outer Thames Estuary pSPA boundary

The total area of the Outer Thames Estuary pSPA is approx.391,909 ha (392km^2) - refer to Figure 1a.

The proposed boundary changes to the existing Outer Thames Estuary SPA are based upon projected foraging areas of common terns and little terns breeding within several qualifying coastal SPAs.

The proposed boundary change has been drawn to encompass the qualifying foraging areas of tern species overlaid with maximum curvature derived limits, and has excluded areas that do not support qualifying densities.

Figure 1a - map showing the existing Outer Thames Estuary and the three proposed extensions



3.3. Seaward boundary of the pSPA

There will be no changes to the existing eastern seaward boundary of the Outer Thames Estuary SPA in proposing the boundary extension. The boundary is proposed to extend seaward southwards from the Southend coast driven by the distribution of common terns (Annex 1a). Further information on the extension will be discussed below in section 3.4.

3.4. Landward boundary of the pSPA

The proposed landward boundary of the pSPA is driven by the distribution of both common and little terns which extends in places into the inter-tidal zone (Annex 1a).

Further information on the extension locations are discussed below.

3.4.1. Identification of important marine areas for little terns

Of the five species of tern which regularly breed in Great Britain, little tern is the smallest and has the most limited foraging range: mean range of 2.1 km, mean of recorded maxima of 6.3 km and maximum ever recorded in the literature being 11 km (Thaxter *et al.* 2012). In light of this evidence, JNCC, in agreement with all of the Statutory Nature Conservation Bodies (SNCBs), decided that the most effective method to determine the extent of the area's most heavily used for foraging by breeding little terns would be to undertake a programme of shore based observations and of boat-based transects around colonies and to use the resultant distribution data directly in setting the alongshore and seaward boundaries respectively.

Accordingly, between 2009 and 2013 JNCC coordinated a programme of survey work to identify important foraging areas for little terns at a number of UK little tern colonies. These surveys were conducted during the chick rearing period in each year and comprised repeated shore-based counts of little terns seen at a series of observation stations at increasing distances from the colony locations, and repeated boat based surveys along transects across the waters around colonies. These surveys sought to establish the distances both alongshore and offshore that little terns were travelling to feed.

In total, 70 shore-based surveys were undertaken at 14 little tern colonies around the UK with a total of 7,006 little tern observations. Twenty three boat-based transect surveys were undertaken across waters near eight colonies around the UK with a total of 781 little tern observations.

The following sub-sections summarise survey work and boundaries identified at little tern colonies that are qualifying features of SPAs located adjacent to the Outer Thames Estuary pSPA. Further general information on the little tern survey programme is presented in Parsons *et al*. (2015) and Annex 4.

3.4.1.1. Great Yarmouth North Denes SPA

Three shore-based surveys were undertaken in 2013 which collected 937 little tern observations. Two boat-based surveys were also completed in 2013 and recorded 202 little tern observations. These data were supplemented by radio-tracking data collected at the site in preceding years (Perrow & Skeate 2010; Parsons *et al*. 2015). The total number of observations for both shore and boat-based surveys was judged to be sufficient to justify a site-specific approach to boundary definition. The alongshore foraging extent for this colony was set to be 5 km to the north and 4 km to the south. The mean of maximum seaward foraging extents for this colony of little terns was 2.43 km (Figure 2; Parsons *et al*. 2015).

The little tern foraging area is mostly contained within the existing Outer Thames Estuary SPA boundary with the exception of the coastal areas up to Mean High Water (MHW) and therefore the proposed pSPA boundary will be extended to incorporate this area (Annex 1b). However, the northern extent of the foraging areas from Great Yarmouth North Denes SPA overlaps with the proposed Greater Wash pSPA. Because of the tendency for little terns to switch nesting preferences between two colonies within the Great Yarmouth North Denes SPA (at Winterton and North Denes), and because it is not possible to definitively assign foraging areas exclusively to one pSPA, birds at this colony contribute to totals for both pSPAs. This recognises that they could be foraging in either marine pSPA area at any given time.

3.4.1.2. Minsmere - Walberswick SPA

No data were collected for this SPA, as breeding terns were absent during the study period (Parsons *et al*. 2015). It was therefore not possible to apply a site-specific foraging boundary, and instead a generic approach was applied. The alongshore and seaward foraging extents for this colony were set to be the generic values derived from all of the surveys at all of the colonies, i.e. 3.9 km alongshore and 2.18 km seaward (Figure 3). This generic foraging area is mostly contained by the existing Outer Thames Estuary SPA boundary, although the pSPA boundary is proposed to extend inland along the River Blyth to encompass Blythburgh Water, a tidal lagoon directly adjacent to northern parts of the Minsmere – Walberswick SPA. A further expansion along the coast to MHW northwards to Southwold and southwards to Leiston is proposed to incorporate the foraging area (Annex 1c).

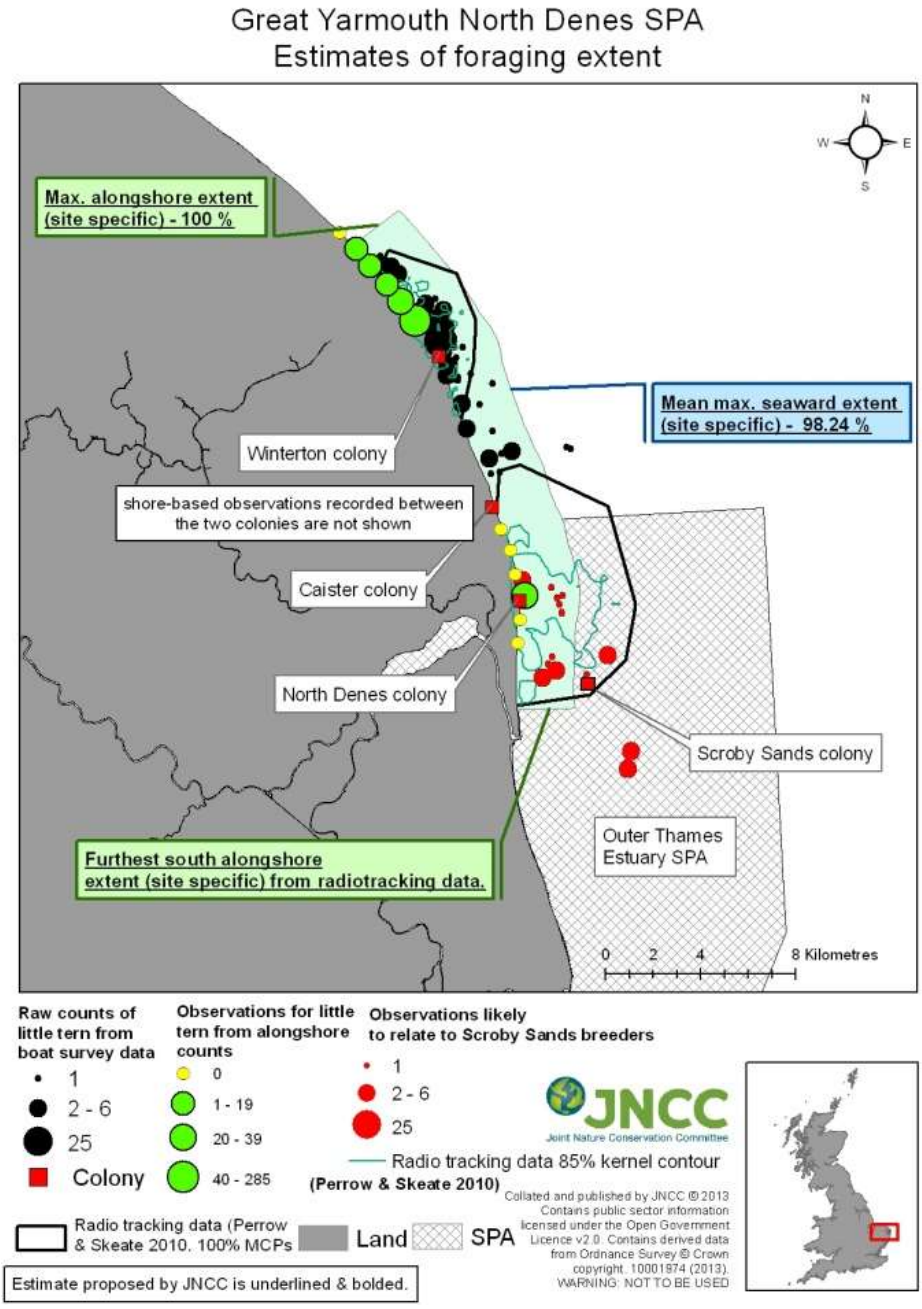


Figure 2. Application of site-specific alongshore and seaward extents to define boundaries for little tern foraging areas around colonies within Great Yarmouth North Denes SPA

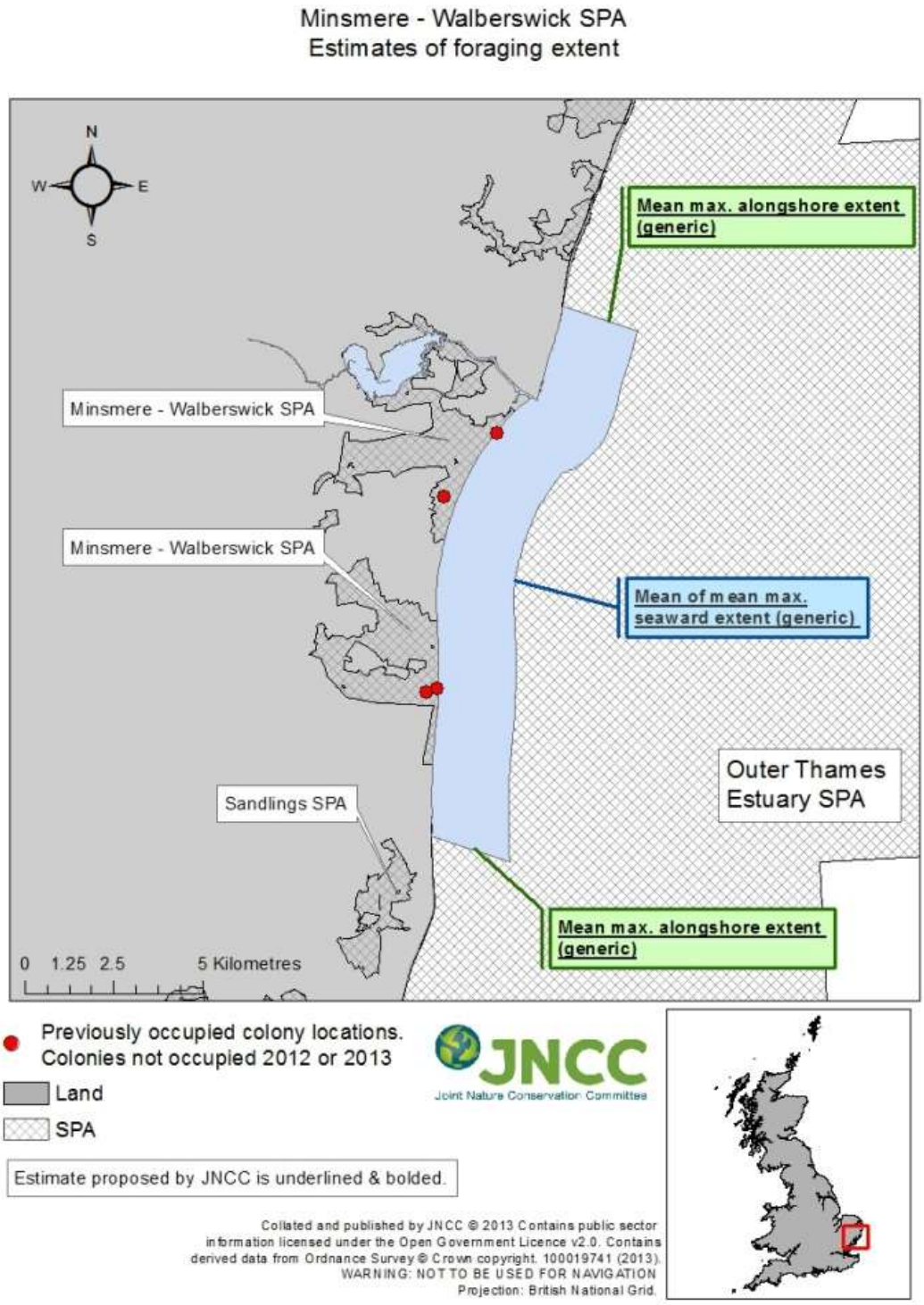


Figure 3. Application of generic alongshore and seaward extents for Minsmere – Walberswick SPA.

3.4.1.3. Alde-Ore Estuary, Benacre to Easton Bavents, Foulness and Thanet Coast & Sandwich Bay SPAs

The Alde-Ore Estuary, Benacre to Easton Bavents, Foulness and Thanet Coast & Sandwich Bay SPAs were amongst a group of sites listed as not regularly occupied (defined as supporting an average of 1% of the GB population in the most recent five year period: Parsons *et al*. 2015). Consequently, no attempt was made to collect data at these sites, or to fit models of expected foraging areas. However, the Outer Thames Estuary pSPA boundary directly abuts these existing SPAs, and therefore the foraging areas of little terns at these sites are by default within the pSPA. Thus, whilst tern foraging areas do not alter the boundary of the pSPA, any terns breeding at these sites do contribute to the abundance total within the site.

3.4.1.4. Scroby Sands

In addition to the above SPAs, the Outer Thames Estuary pSPA contains a breeding colony not currently protected within any SPA citation; Scroby Sands. This is an exposed sand bank lying approximately 6 km offshore from Great Yarmouth, south of the Scroby Sands Offshore Wind Farm, in an area known as South Scroby. There is some evidence that breeding little terns interchange between Great Yarmouth North Denes SPA and South Scroby (section 5.2), meaning Scroby Sands may be considered functionally linked land, and justifying the extension of protection to the Outer Thames Estuary pSPA. When breeding at this offshore site, the foraging area used by little terns is highly likely to be entirely contained within the Outer Thames Estuary pSPA, based on foraging range (Thaxter *et al*. 2012; Parsons *et al*. 2015).

The proposal is that terns at this colony should contribute to the Outer Thames Estuary pSPA abundance total and be recognised as part of the pSPA, because it is contained entirely within the existing SPA boundary and because of the likely connectivity with Great Yarmouth North Denes SPA.

3.4.1.5. Hamford Water, Blackwater Estuary, Colne Estuary and Medway Estuary & Marshes SPAs

Parsons *et al*. (2015) identified Hamford Water SPA as supporting enough terns (between 30 and 45 pairs) to include in their survey programme. Five boat-based surveys took place over 2012 and 2013, with three shore-based surveys also in 2013. Sufficient data were collected to derive a site-specific foraging tern boundary around the SPA, and this is the subject of a separate Departmental Brief.

The Blackwater Estuary, Colne Estuary and Medway Estuary & Marshes SPAs were amongst the group of sites listed as not regularly occupied (Parsons *et al*. 2015). Consequently, no attempt was made to collect data at these sites, or to fit models of expected foraging areas.

When applying the maximum extent of the generic models (3.9 km) in an arc around the location of tern colonies within these SPAs (Old Hall Marshes / Tollesbury Wick; Colne Point; and Deadman's Island, respectively), there is either no overlap or only negligible overlap with the Outer Thames Estuary pSPA boundary. Little terns at these sites are thus not expected to routinely forage within the Outer Thames Estuary pSPA boundary and therefore do not contribute to the abundance total of the pSPA.

3.4.2. Identification of important marine areas for larger terns

The four larger species of tern (common, Arctic, Sandwich and roseate) which breed regularly in Great Britain have recorded mean foraging ranges between 4.5 km and 12.2 km and maximum recorded foraging ranges between 15.2 km and 49 km (Thaxter *et al*. 2012). JNCC, in agreement with all of the SNCBs, decided that the most effective method to determine the extent of the area's most heavily used by larger breeding terns would be different to that employed for little terns. In this case, the approach was to undertake a programme of boat-based visual tracking of foraging birds. The resultant information on foraging locations chosen by the birds was combined with information on the habitat characteristics of those locations relative to other areas available to construct habitat association models of tern usage. These models were used to predict species specific tern usage patterns around breeding colony SPAs. Usage predictions were made out to the maximum recorded foraging range from each colony. This process of producing usage predictions around colonies for which tracking data had been gathered had colony (and species) specific analysis which produced a smoothed map of foraging usage around the colony. In Phase 2, analysis of pooled data across colonies (species specific) produced generic models which allowed production of maps of smoothed foraging usage around colonies for which no (or insufficient) data were available.

In order to draw a boundary around the most important foraging areas for terns from each colony of interest, a cut-off or threshold value of usage has to be found and only those areas in which usage exceeds that cut-off value included within a possible SPA boundary. An objective and repeatable method to identifying a threshold value, based on the law of diminishing returns, is maximum curvature (O'Brien *et al.* 2012). This method identifies a threshold value below which disproportionately large areas would have to be included within the boundary to accommodate any more increase in, in this case, foraging tern usage. Further details of this work are given in Annex 5.

To gather the empirical data necessary for the modelling, JNCC coordinated a programme of visual

tracking work between 2009 and 2011 to identify important foraging areas at a number of UK colonies. These surveys were conducted during the chick rearing period in each year and comprised repeated days of observations of individual terns whose tracks were followed by boat as they left the colony to forage.

Visual tracking was carried out or commissioned by JNCC at 10 of 32 colony SPAs which were deemed to be recently regularly occupied (Wilson *et al.* 2014). Survey effort was prioritised at these 10 sites on the basis of several considerations including: maximising geographical coverage across each species' range, logistical ease of boat-based work, and maximising likely sample sizes (e.g. larger/multi-species colonies with recent successful breeding seasons). As a result no boat-based tracking work was undertaken on the south coast of England.

The total number of tracks obtained was 1,004 including 55 tracks (6%) for roseate tern (2 SPAs), 184 tracks (18%) for arctic tern (6 SPAs, 1 non-SPA), 381 tracks (38%) for common tern (7 SPAs, 1 non-SPA) and 384 tracks (38%) for Sandwich tern (5 SPAs, 1 non-SPA), with multiple years of data collected at five of the ten JNCC study colony SPAs. In addition, visual tracking data were obtained through a data-sharing agreement with ECON Ecological Consultancy Ltd for two SPAs: Ynys Feurig, Cemlyn Bay and The Skerries SPA (136 Sandwich, 2 common and 1 Arctic tern tracks, all collected in 2009) and North Norfolk Coast SPA (108 Sandwich and 24 common tern tracks collected 2006-2008). This gave a total of 1,275 tracks available to the project, although not all data were used in the modelling; incomplete tracks or those which recorded no foraging behaviour were excluded.

The following three sub-sections summarise the application of generic boundaries, derived from the modelling of tracking data at other UK tern colonies, to each of the two relevant larger tern colonies within the Outer Thames Estuary pSPA. Further general information on these surveys is presented in Annex 5.

3.4.2.1. Breydon Water SPA

Breeding common terns are qualifying features of Breydon Water SPA. Generic models of foraging behaviour, generated from pooled data obtained from surveys of tern colonies across the UK as described in section 3.4.2, were used to generate boundaries around the SPA. The predictor variables used in the generic models to generate usage patterns of common tern at this SPA were: i) distance to colony, ii) distance to shore, and iii) bathymetry. These variables predicted highest usage around the colony, generally decreasing with increasing distance from it. This means that for the common tern nesting colony located at Breydon Water, only the lower River Yare and part of the River Bure are predicted by the model to be used for foraging by the terns.

The model-generated predictions of relative usage by common terns, together with the boundary drawn around all of the areas in which predicted usage exceeded the threshold identified by application of the maximum curvature approach (to define a limit to the extent of the most important areas) are shown in Figures 4 and 5. The extent of the area of prediction was defined by the limit of the dark blue circles shown (Fig. 4). This reflects the constraint imposed on the modelling by use of a radius the size of the global mean maximum foraging distance from colony derived from tracking data held by JNCC, ECON Ecological Consultancy Ltd (for Scolt Head, Blakeney Point and Cemlyn Bay only) and Thaxter *et al.* (2012). It can be seen in every case that very substantial areas of sea within that wider area which are distant to the colony and/or distant from the shore are predicted to have very little or no usage by foraging terns.

The predicted usage boundaries largely sit within the existing boundaries of the Outer Thames Estuary pSPA, and thus do not influence it greatly, except along the coast northward to Caister-on-Sea and southward to South of Corton, where the boundary is extended to incorporate the gap between MLW (where the existing Outer Thames Estuary SPA boundary is currently drawn to) and MHW. Also, the Outer Thames Estuary pSPA boundary will be extended inland along the River Yare to meet the existing Breydon Water SPA boundary, and along the lower part of the River Bure approximately to Runham, thus providing no gap in protection across the predicted usage area (Annex 1b).

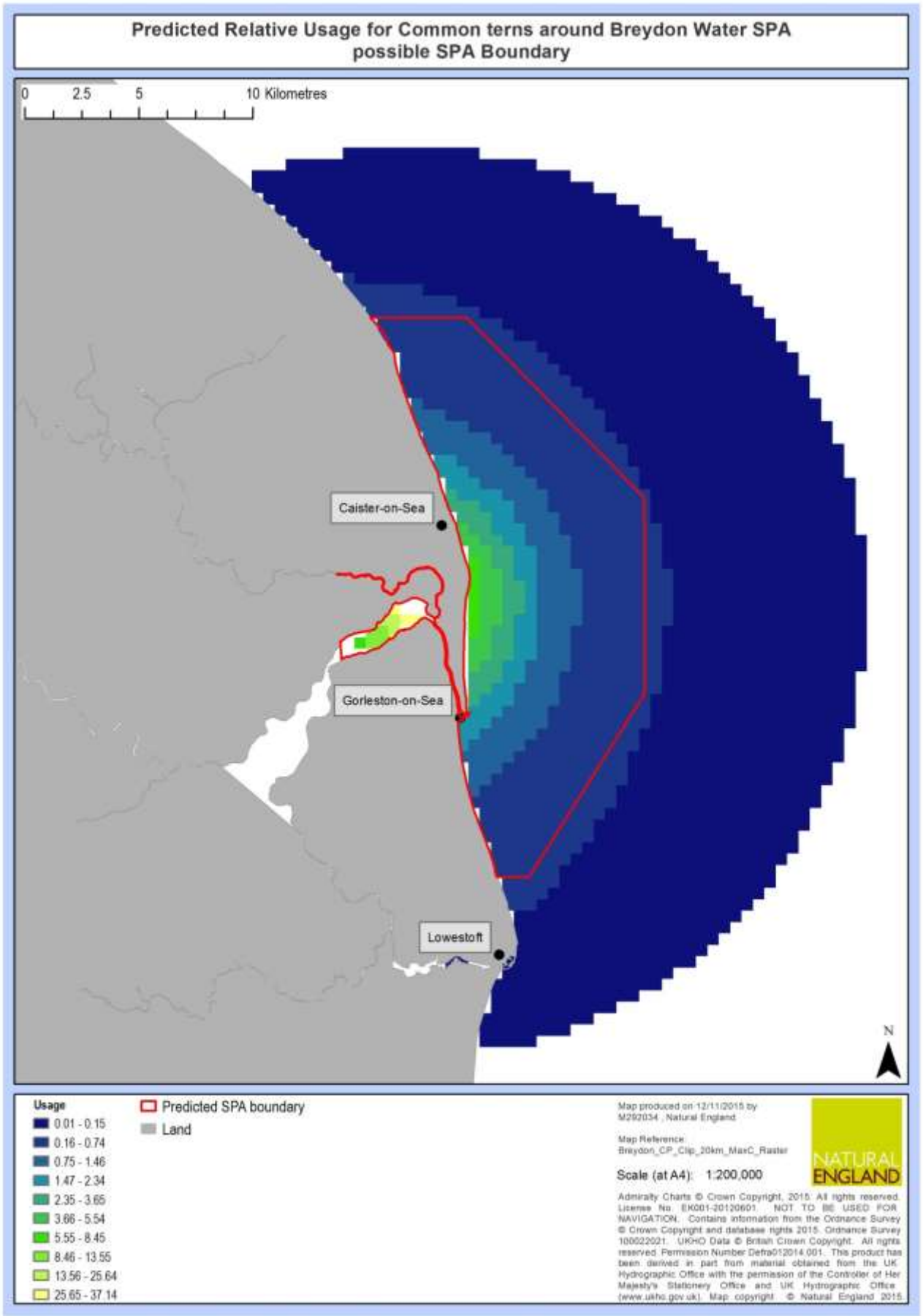


Figure 4. Model predictions of common tern usage overlaid with maximum curvature derived limits to areas of most importance around the Breydon Water SPA. Source: Win *et al.* (2015).

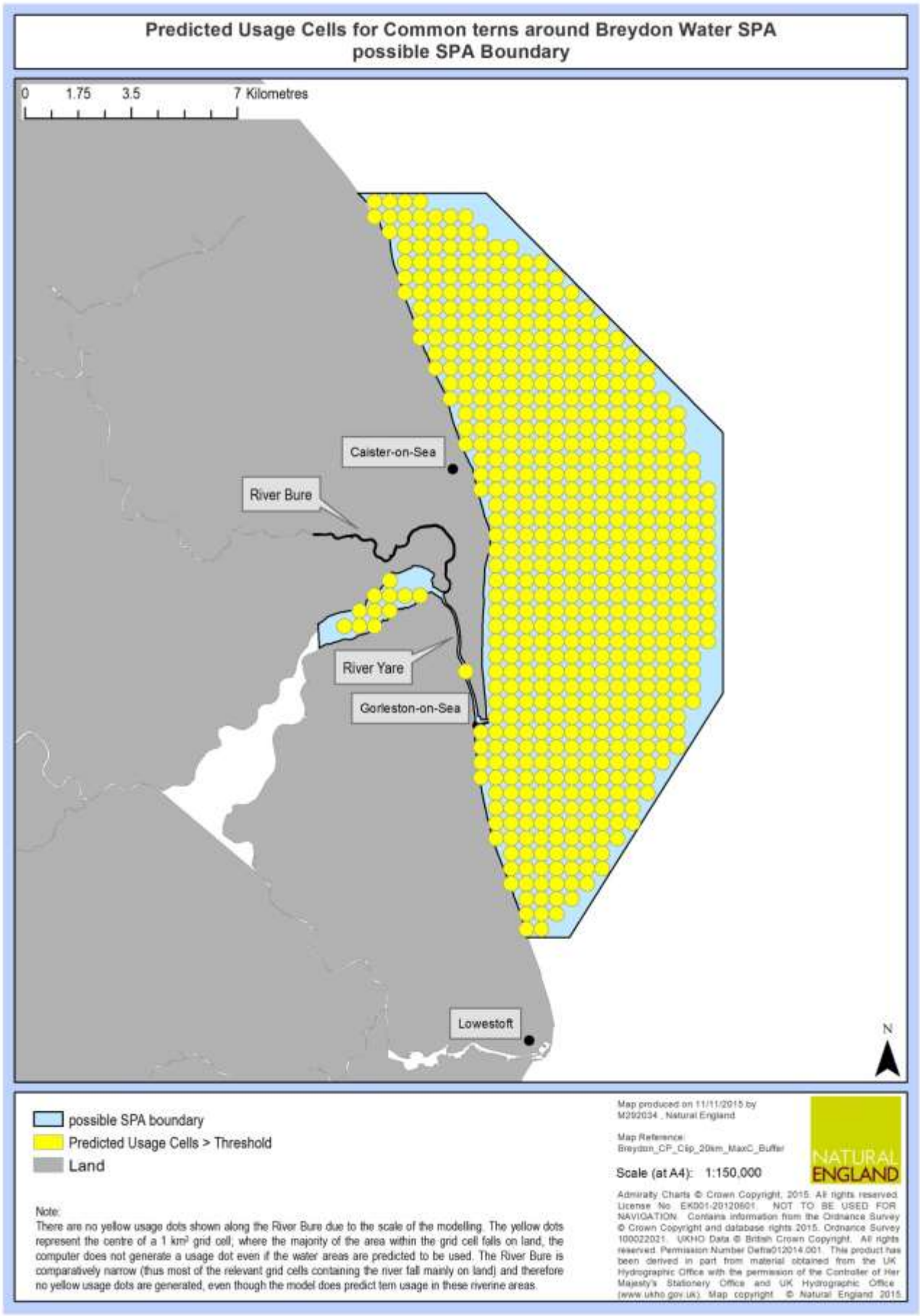


Figure 5 Proposed boundary drawn around the cells within which predicted usage levels by common terns, exceeded the threshold level identified by application of the maximum curvature methodology to the predicted usage surfaces (see Annex 5). Source: Win *et al.* (2015).

3.4.2.2. Foulness SPA

Breeding common terns are qualifying features of Foulness SPA. Generic models of foraging behaviour, generated from pooled data obtained from surveys of tern colonies across the UK, were used to generate boundaries around the SPA. The predictor variables used in the generic models to generate usage patterns of both species of tern at this SPA were: i) distance to colony, ii) distance to shore, and iii) bathymetry. Predicted usage levels for both species were highest around the colony, generally decreasing with increasing distance from each colony.

The model-generated predictions of relative usage by common terns, together with the boundary drawn around all of the areas in which predicted usage exceeded the threshold identified by application of the maximum curvature approach (to define a limit to the extent of the most important areas), are shown in Figures 6 and 7. The extent of the area of prediction was defined by the limit of the dark blue circles shown (Figure 6). This reflects the constraint imposed on the modelling by use of a radius the size of the global mean maximum foraging distance from colony derived from tracking data held by JNCC, ECON Ecological Consultancy Ltd (for Scolt Head, Blakeney Point and Cemlyn Bay only) and Thaxter *et al.* (2012). It can be seen in every case that very substantial areas of sea which are distant to the colony and/or distant from the shore are predicted to have very little or no usage by foraging terns, therefore these areas have not been included in the proposed boundary.

The predicted usage boundaries largely sit within the existing boundaries of the Outer Thames Estuary SPA, but the pSPA boundary is influenced by the new predicted foraging area. Firstly, it includes the estuarine areas (up to Mean High Water) of the Crouch and Roach Estuaries SPA, approximately as far inland as South Fambridge. As common terns are not a feature of this SPA, which extends down to MLW, the Outer Thames Estuary pSPA will overlap with the Crouch and Roach Estuaries SPA in the relevant intertidal areas (Figure 6). Additionally, the Outer Thames Estuary pSPA boundary will extend seaward to the south and west, overlapping with part of Benfleet & Southend Marshes SPA and then northwards where it will overlap Dengie SPA (none have common terns as a qualifying feature) and also parts of Foulness SPA itself (which does have common terns as a qualifying feature); this is necessary to provide protection in all of the predicted foraging usage areas. Finally, the predicted usage model extends the existing Outer Thames Estuary SPA boundary to the west as far as Westcliffe-on-sea along the Southend coast (Annex 1d).

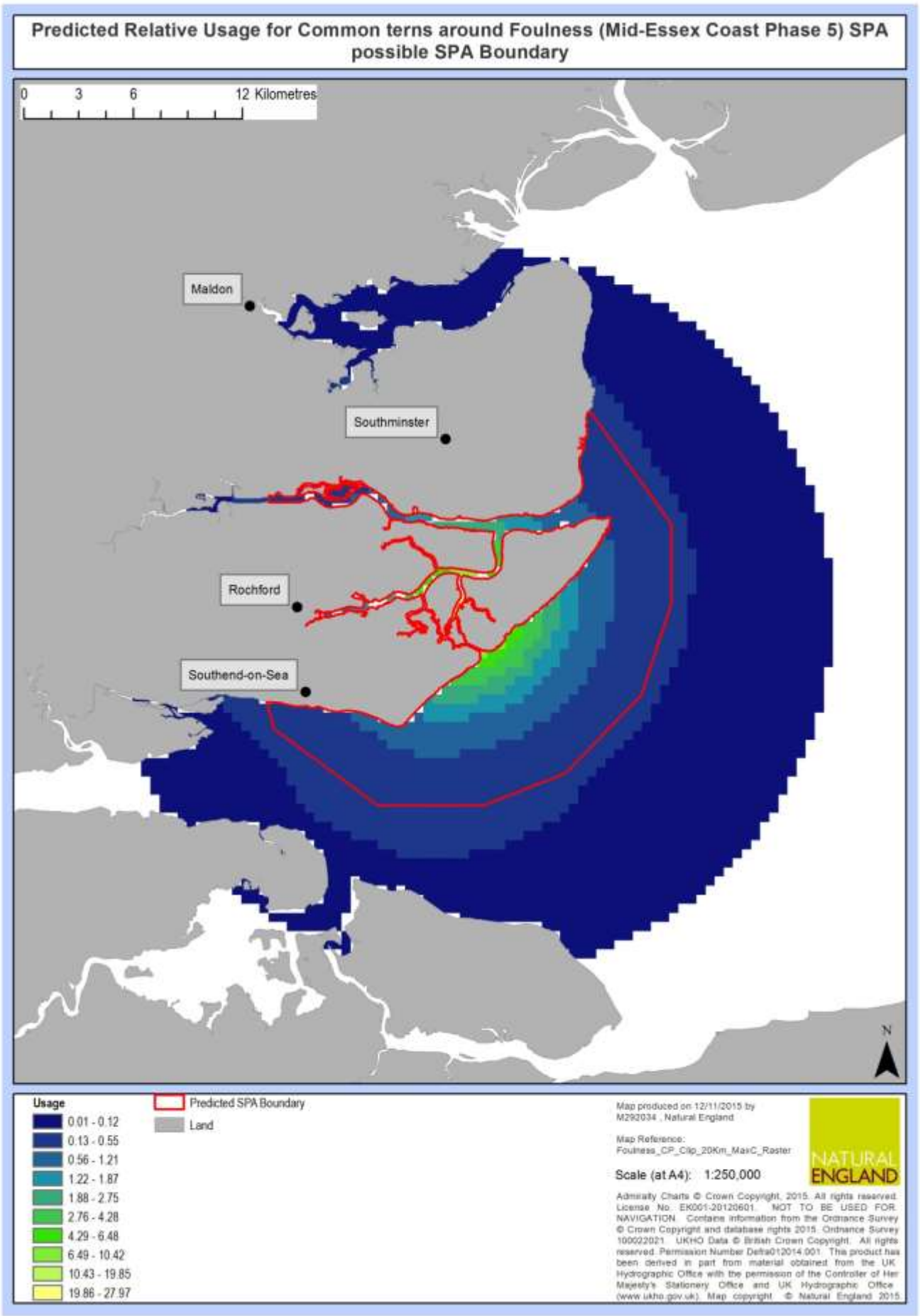


Figure 6. Model predictions of common tern usage overlaid with maximum curvature derived limits to areas of most importance around Foulness SPA. Source: Win *et al.* (2015).

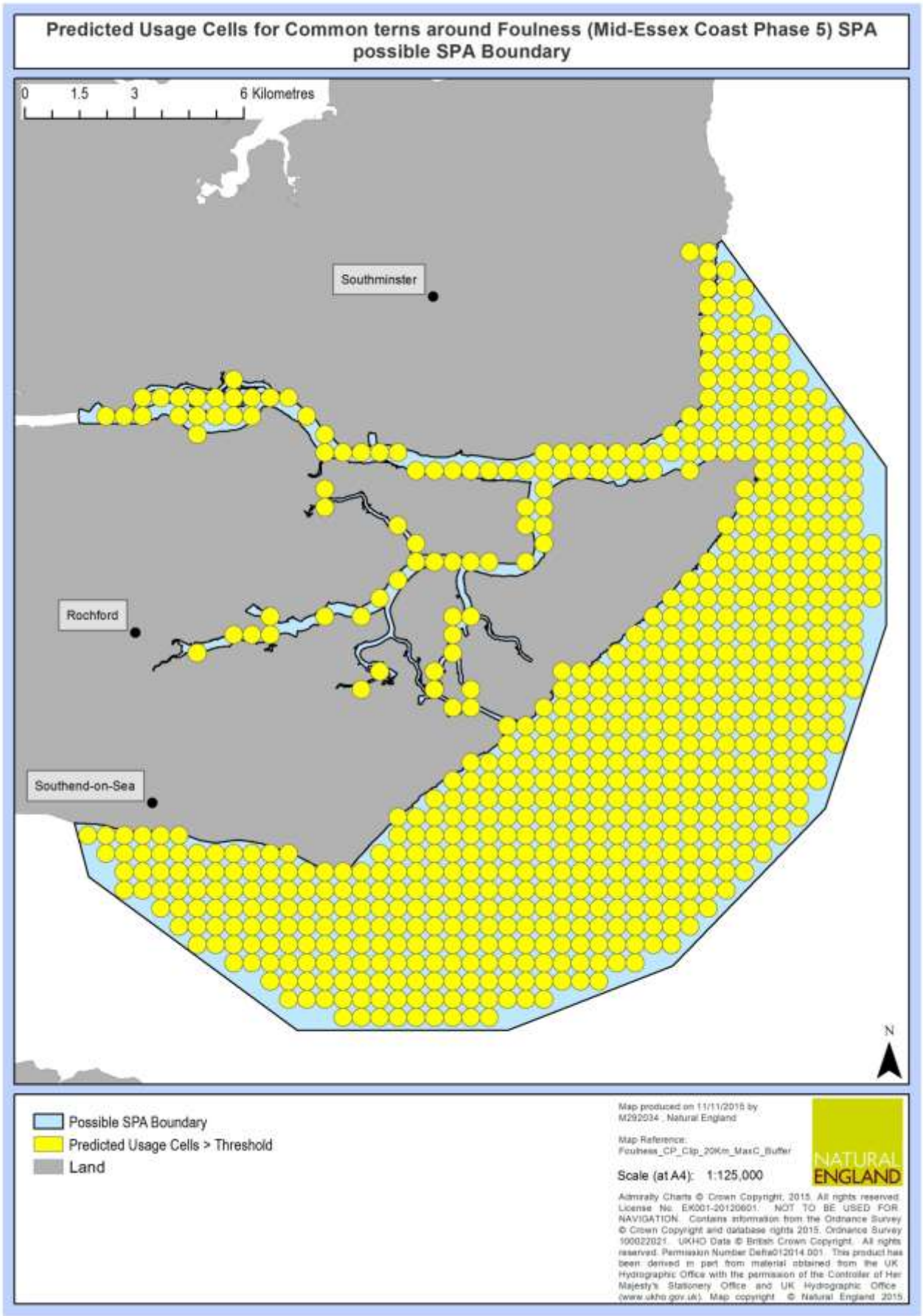


Figure 7. Proposed boundary drawn around the cells within which predicted usage levels by common terns, centred on the source colony, exceeded the threshold level identified by application of the maximum curvature methodology to the predicted usage surfaces (see Annex 5). Source: Win *et al.* (2015).

3.4.2.3. Sandwich terns – Alde-Ore Estuary and Foulness SPAs

Breeding Sandwich terns are a feature of these SPAs, but they are not considered to be regularly occupied in recent years (Wilson *et al*. 2014). Generic foraging models have not been applied to their parent SPA colonies, and so they do not influence the pSPA boundary; likewise they do not contribute to the total number of terns which the pSPA is expected to support; neither do the Sandwich terns sporadically breeding at Scroby Sands.

3.4.3. Composite boundary of Outer Thames Estuary pSPA

The seaward and alongshore extent of the Outer Thames Estuary pSPA (Annex 1a) is almost entirely determined by the boundaries of the existing Outer Thames Estuary SPA, defined according to the distribution of non-breeding red-throated divers (O'Brien *et al*. 2012). The new areas are:

a. The inclusion of the River Blyth to encompass Blythburgh Water, a tidal lagoon directly adjacent to the northern parts of Minsmere-Walberswick SPA in addition to include MHW areas up the coast (to Southwold) and down the coast (to Leiston) to provide continuous coverage for little terns foraging from this SPA.
b. The inclusion of the River Yare channel, to abut the eastern boundary of the existing Breydon Water SPA, and the lower River Bure, to provide continuous SPA coverage for common terns foraging from this SPA;
c. The inclusion of coastal areas up to MHW up the coast (to Caister-on-Sea) to provide coverage for little terns from Great Yarmouth North Denes foraging from this SPA, and common terns foraging from Breydon Water SPA.
d. The inclusion of coastal areas up to MHW down the coast (to just south of Corton) to provide coverage for common terns from Breydon Water foraging from this SPA.
e. The inclusion of the estuarine areas up to Mean High Water within the Crouch and Roach Estuaries, overlapping the existing Crouch and Roach Estuaries SPA in the intertidal area, to provide SPA coverage for common terns foraging from the existing Foulness SPA;
f. The inclusion of a small additional marine area along the south Essex coast and overlapping part of the Foulness SPA, to the west of the existing Outer Thames Estuary SPA boundary, to provide coverage for common terns foraging from the existing Foulness SPA.

In total, the additional area encompasses 12,642 ha, an increase of 3.3% from the existing SPA area.

Given that the parts of the proposed boundary of the pSPA listed above are determined on the basis of predictions of common tern usage patterns generated by a generic model, rather than a model based on observations of common terns in the Outer Thames Estuary, it is appropriate to consider the reliability of that evidence base. Annex 5 describes the process of cross-validation by which the robustness of each generic model was assessed using standard statistical criteria. This assessment involved assessing the ability of each species-specific, generic model to predict the observed distribution of terns of the species of interest at colonies which were (in the cross-validation process) excluded in turn from building the model. This demonstrated that of the three species-specific, generic models, the Sandwich tern model was the most reliable, with an average test statistic for this cross-validation process that was classed as indicative of the model being "excellent". By the same measure, the generic common tern model was judged to be "good" i.e. better than other possible classes of "moderate", "poor" or "unsuccessful". This analysis indicated that there is reasonable consistency between colonies around the UK in the characteristics of sea areas which hold the highest relative densities of foraging common terns. Accordingly, there is a correspondingly high degree of confidence that the boundary of this pSPA, being partly dependent upon the predicted usage patterns of common terns, is founded on a reliable evidence base, albeit not one derived directly from birds at the colonies in question.

4. Location and habitats

The Thames Estuary is located in the southern part of the North Sea on the east coast of England, between the counties of Essex (on the north side) and Kent (on the south) and extends as a broad opening into the North Sea. The Outer Thames Estuary extends northwards to Caister-on-Sea in Norfolk.

The Outer Thames Estuary pSPA consists of areas of shallow and deeper water (ranging from 0-50 m below sea level), high tidal current streams and a range of mobile sediments. Large areas of mud, silt and

gravelly sediments form the deeper water channels, the main ones representing the approach route to the ports of London and as such being continually disturbed by shipping and maintenance dredging. Sand in the form of sandbanks separated by troughs predominates in the remaining areas and the crests of some of the banks are exposed at MLW; Cross Sand, Scroby Sands, Helm Sand, Newcombe Sand, Aldeburgh Napes, Aldeburgh Ridge, North Ship Head and Bawdsey Bank; in the southern part of the site the main sandbanks are Kentish Flats, West and East Barrow, Ray Sand, Foulness Sands, Maplin Sands, Chapman Sands, Southend Sands and Yantlet Flats, Long Sand, Margate Sand and Kentish Knock.

The proposed boundary overlaps various other sites which have been notified or designated under either British or European conservation legislation, such as SSSIs and SPAs. The proposed boundary will overlap with the following coastal SPAs;

- Crouch and Roach Estuaries SPA;
- Dengie SPA;
- Foulness SPA; and
- Benfleet & Southend Marshes SPA

These overlapping areas comprise of inter-tidal mud, sand and saltmarsh in addition to creeks which are key areas where the terns forage. The Outer Thames Estuary pSPA also overlaps with several existing SACs including from north to south;

- Essex Estuaries SAC: designated for a wide range of characteristic marine and estuarine sediment communities; subtidal areas have rich invert fauna.The SAC also has extensive mudflats and sandflats with extensive growths of eelgrass *Zostera spp.* on the open coast.
- Thanet Coast SAC: designated for chalk, having the longest continuous stretch of coastal chalk in the UK with subtidal chalk reefs which extend into the intertidal zone.

Furthermore, the boundary overlaps the following MCZs:

- Blackwater, Crouch, Roach and Colne Estuaries MCZ which is primarily designated for native oyster and native oyster beds.
- Thames Estuary rMCZ which is recommended for designation of the intertidal and subtidal sediments as well as species such as tentacle lagoon worm, European eel and Smelt.
- Medway Estuaries MCZ, which is primarily designated for intertidal and subtidal mud.
- Swale Estuary pMCZ; which is subject to public consultation by Defra. The pMCZ is primarily being recommended for subtidal habitats (mud and mixed sediments).
- Thanet Coast MCZ which is primarily designated for further extensions of chalk reef, intertidal *Sabellaria spinulosa* and also the stalked jellyfish (*Lucernoriopsis cruxmelitensis*).

The seabed in the area of the Norfolk and Suffolk coast is of a similar composition to that in the main estuary with large shallow areas of mud, sand, silt and gravely sediments but, in the absence of main port areas with approaches inside the SPA, there are consequently fewer disturbances through shipping or dredging.

5. Assessment of ornithological interest

5.1. Survey Information and summary

SPA site selection guidelines have been applied to the most up to date information for the site.

Counts of breeding seabirds (and / or young) at the colonies within the existing SPAs (which are also those most likely to be the origin of birds within the marine foraging areas of the pSPA) are from the national Seabird Monitoring Programme (SMP). This dataset has been augmented by information from colony managers and the LIFE+ little tern project (all through RSPB), the Foulness Area Bird Survey Group, data collected for the national bird ringing scheme (administered by the British Trust for Ornithology) by the ringing group at Foulness, and relevant editions of the Norfolk Bird & Mammal Report.

Parameters adopted in transforming numbers of young common terns ringed into numbers of breeding adult pairs at Foulness SPA are outlined in Annex 7.

Details of the work carried out to characterise the foraging areas used by breeding adult terns within the Outer Thames Estuary pSPA are above in sections 2 and 3 and in Annexes 4 and 5.

Data on non-breeding red-throated divers are unchanged from the Outer Thames Estuary SPA citation and the N2K standard data form (JNCC, 2011), outlined in O'Brien *et al*. (2012).

5.2. Annex I species

5.2.1. Breeding season

5.2.1.1. Little tern *Sternula albifrons*

The breeding population of little terns in Great Britain is estimated to be 1,900 pairs (Musgrove *et al*. 2013), representing about 10.3% of the Eastern Atlantic breeding population (18,500 pairs derived by division by 3 of the upper estimate of 55,500 individuals: AEWA 2012). Breeding occurs in scattered colonies along much of the east and west coasts of Britain, from the north of Scotland to (and including) the south coast of England (Mitchell *et al.* 2004). The greater part of the population occurs in south and east England from Dorset to Norfolk (Mitchell *et al.* 2004). All British little terns nest on the coast, utilising sand and shingle beaches and spits, as well as tiny islets of sand or rock close inshore (Mitchell *et al.* 2004).

Little terns are a qualifying feature of Great Yarmouth North Denes, Benacre to Easton Bavents, Minsmere – Walberswick, Alde-Ore Estuary, Foulness and Thanet Coast and Sandwich Bay SPAs. Little terns are notoriously transitory in their nesting habits (Brown & Grice 2005) and may move between different colonies in response to factors including disturbance and predation. Because of this habit, the estimates for Great Yarmouth North Denes SPA include figures from Caister (< 1 km from the SPA boundary), Eccles and Scroby Sands (both approximately 6 km from the SPA boundary), all of which are thought to be functionally linked to colonies protected within the Great Yarmouth North Denes SPA. This view is supported on the basis of little variation between the summed totals from year to year (Figure 5.2a), particularly between 2011 and 2014, when little terns were all but absent from North Denes, instead breeding predominantly at Winterton and Scroby Sands. If the Benacre – Easton Bavents SPA is also considered, including an apparently functionally linked site at nearby (< 1 km from SPA boundary) Kessingland, the collective number of little tern pairs averages 392, with a standard deviation of just 40 pairs (2009 – 2015). This provides strong evidence of functional linkage between this group of sites, and provides justification for including data from each of them within the total number of little terns expected to use the Outer Thames Estuary pSPA. Recent shifts to Benacre and Kessingland may reflect a response to targeted site management here, and possibly beach accretion.

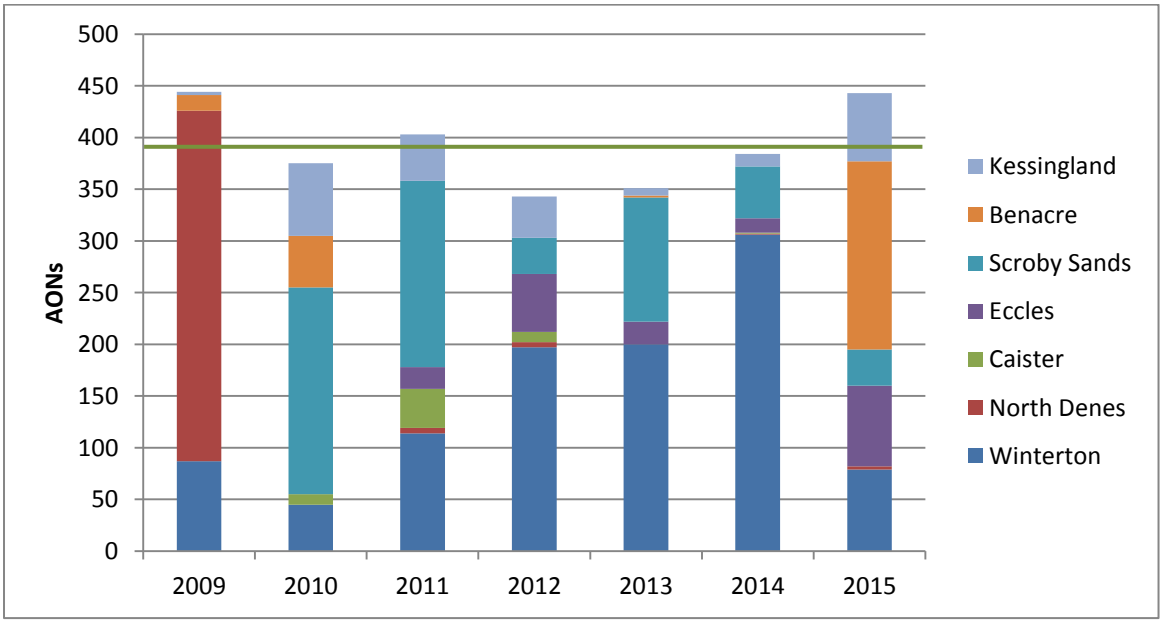


Figure 8. Little tern numbers (Apparently Occupied Nests, AONs, equivalent to adult pairs) at five locations either within or thought to be functionally linked to the Great Yarmouth North Denes SPA (Winterton, North Denes, Caister, Eccles and Scorby Sands) and two either within or thought to be functionally linked to the

Benacre to Easton Bavents SPA (Benacre, Kessingland). Green horizontal line shows average for period 2009 – 2015.

Although there is a suggestion of similar functional linkage between little terns breeding within the Alde-Ore Estuary SPA and the sandbanks at the mouth of the River Deben (known as the Deben Knolls), current data suggest only sporadic breeding and do not allow comparable demonstration of linkage with sufficient confidence.

Combined, the SPAs listed and their associated functionally linked nesting sites currently contribute a five year average of 373 pairs (Table 3). This represents 19.64% of the GB population. The pSPA will thus offer protection of foraging areas to a very significant proportion of little terns breeding in Great Britain.

5.2.1.2. Common tern *Sterna hirundo*

The breeding population of common terns in Great Britain is estimated to be 10,000 pairs (Musgrove *et al.* 2013), representing at least 15% of the Southern & Western European breeding population (67,000 pairs derived by division by 3 of the upper estimate of 200,000 individuals and rounded to nearest 1,000: AEWA 2012). A significant proportion of the British population breeds in Scotland. Coastal colonies in England are concentrated in the north-east, East Anglia, at a few localities along the south coast, and in the north-west (Mitchell *et al*. 2004). Common terns breed not only around coasts but, unlike the other tern species which breed in the UK, also breed frequently beside inland freshwater bodies.

Common terns are a qualifying feature of Foulness and Breydon Water SPAs. The species still nests at both sites. At Foulness SPA, the five year mean (2011 – 2015) of 17.5 pairs derives from counts of adult pairs and counts of ringed young breeding at New England Creek (Annex 7). The five year mean at Breydon Water SPA for the same period is 104 pairs.

Common terns also breed on the sandbanks at Scroby Sands, along with little terns. It is likely that the common terns nesting here are functionally linked to the Breydon Water SPA population; as numbers at Breydon Water have declined since Scroby Sands has become exposed, numbers at Scroby Sands have generally increased (Figure 9). The average number of common tern pairs for the two areas combined is 235, with a standard deviation of 54.5 pairs (2009 – 2015). This suggests annual variation is limited, especially with the apparently anomalous large count in 2013, and provides evidence of functional linkage between Breydon Water SPA and Scroby Sands. This provides justification for including data from each of them within the total number of common terns expected to use the Outer Thames Estuary pSPA.

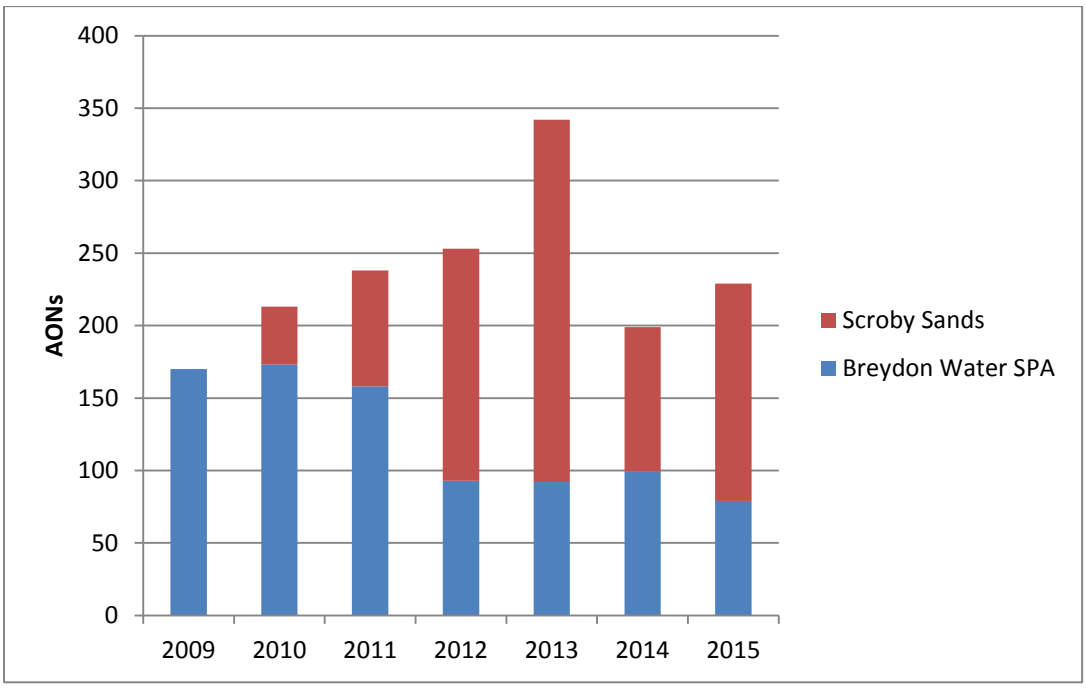


Figure 9 Common tern numbers (Apparently Occupied Nests, AONs) at Scroby Sands and Breydon Water SPA 2009 – 2015.

Combined, Foulness SPA, Breydon Water SPA, and the associated functionally linked nesting site at Scroby Sands currently contribute a five year average of 266 pairs (Table 5.2). This represents 2.66% of the GB population. The pSPA will thus offer protection of foraging areas to a significant proportion of common terns breeding in Great Britain.

5.2.2. Comparison of counts for breeding sites

Current data used for the pSPA total are presented here, alongside values from SPA citation forms and N2K Standard Data Forms (Table 3). These are for comparison purposes within this Brief; it is the current data that informs the classification of the site.

Table 3. Counts of terns (pairs) contributing to the Outer Thames Estuary pSPA total, and current five-year means (2011 – 2015), including likely functionally linked breeding sites within SPA totals. Sandwich terns presented for information only (see section 4.2.4). Grey cells indicate where the species is not a feature of the SPA.

	Little tern			**Common tern**			**Sandwich tern**		
SPA	*Current*	*SPA citation*	*N2K data form*	*Current*	*SPA citation*	*N2K data form*	*Current*	*SPA citation*	*N2K data form*
Great Yarmouth North Denes	314	277	220						
Breydon Water				252.2	155	155			
Benacre to Easton Bavents	57.6	39	21						
Minsmere-Walberswick	0.8	32	28						
Alde-Ore Estuary	0.8	No data	48				No data	No data	170
Foulness	0	73	>24	17.5	186	220	0	267	320
Thanet Coast and Sandwich Bay	0	30	6						
Current five-year mean (sum)	373.2			266.2					

5.2.3. Non-breeding season

5.2.3.1. Red-throated diver *Gavia stellata*

The non-breeding population of red-throated divers in Great Britain is estimated to be 17,000 individuals (Musgrove *et al.* 2013), mostly distributed in marine areas in the south east of England (O'Brien *et al*. 2008). The original Outer Thames Estuary SPA boundary was determined for red-throated divers, using visual aerial survey data, Kernel Density Estimation and Maximum Curvature Analysis (Natural England 2010 (http://publications.naturalengland.org.uk/publication/3233957); O'Brien *et al*. 2012).

The Outer Thames Estuary pSPA boundary remains largely unchanged from the original SPA classification, and the peak mean value of 6,466 individuals is also unchanged.

5.2.4. Species not currently meeting SPA selection guidelines

Although Sandwich terns are a breeding feature of the existing Alde-Ore Estuary and Foulness SPAs, their continued absence at these sites means their foraging requirements were neither directly measured nor modelled, and they make no contribution to the Outer Thames Estuary pSPA total. Although Sandwich terns are recorded sporadically on Scroby Sands, the species is not present regularly in abundances exceeding the stage 1.1 selection guideline (four year peak mean 70.5 pairs *cf*. 1% GB population

threshold of 110 pairs (Musgrove *et al*. 2013); derived from counts of 0 (2012), 2 (2013), 250 (2014) and 30 (2015): data source – RSPB). Thus Sandwich terns are not currently a feature of the Outer Thames Estuary pSPA. This may require review in future if populations recover at the terrestrial breeding sites.

6. Comparison with other sites in the UK

Breeding season

A comparison of the numbers of terns within the Outer Thames Estuary pSPA, derived by summing the most recent five year colony counts from the source colonies, with the most recent populations supported by other SPAs in the UK which also have these same species as named qualifying features in their own right, is presented in Table 6. As the source colony SPAs continue to exist in their own right, they are included in this table. This leads to duplication of numbers of birds with those tabulated for Outer Thames Estuary pSPA (acknowledging the difference in time periods between derivation of these numbers).

Table 6. Comparison of the average numbers of individuals (and pairs) of each of the features of the Outer Thames Estuary pSPA (2011 – 2015) with those at other SPAs identified (Stroud *et al*. 2001) as supporting those features.

Species	**Site**	**Individuals (pairs)[2]**	**Rank[3][4]**	**Comments**
Common tern *Sterna hirundo*	Dungeness to Pett Level SPA	532 (266)	=11th of 23	
	Outer Thames Estuary pSPA	532 (266)	=11th of 23	
	Ythan Estuary, Sands of Forvie and Meikle Loch SPA	530 (265)	13th of 23	
Little tern *Sternula albifrons*	Outer Thames Estuary pSPA	779 (389)	1st of 28	
	North Norfolk Coast	754 (377)	2nd of 28	
	Great Yarmouth North Denes	440 (220)	3rd of 28	

Non-breeding season

The Outer Thames Estuary SPA, when classified, supported 38% of the GB population (five year peak mean of 6,466 birds); the only other classified SPA in the UK (Liverpool Bay SPA) supported 5.4% (five year peak mean of 922 birds). The only other SPA for the species in the UK is the Firth of Forth SPA, supporting 90 individuals.

The Outer Thames Estuary pSPA is therefore the highest ranked site in the UK.

7. Conclusion

The evidence presented in this Departmental Brief sets out the scientific case for SPA classification, based on peer-reviewed models of tern foraging requirements and red-throated diver distributional data. The proposed boundary changes only slightly in comparison to the original Outer Thames Estuary SPA, and is still largely determined by aggregations of red-throated divers.

[2] Stroud *et al. (2001)* notes: Data from the JNCC/RSPB/ Seabird Group's Seabird Colony Register have been used. These comprised the best available, whole colony counts for the period 1993-1997 or earlier. These data have been supplemented with additional census data for some sites provided by country agencies (especially in Scotland) and/or as a result of more recent surveys of particular species.

[3] Note that these rankings should only be considered indicative of the relative importance of the pSPA as they are based on comparison of the sum of the most recent 5 year mean populations of each species at the source SPAs with the historical populations of each species at each SPA in the UK as listed in Stroud *et al.* (2001). The number of sites ranked is based on the number of sites listed for each species in Stroud *et al*. (2001) and included from that list are SPAs contributing to the total presented for the Outer Thames Estuary pSPA, and adding one site to account for the pSPA itself.

[4] These rank orders to not take account of numbers currently being considered in the context of other pSPAs in the United Kingdom.

The pSPA is internationally important for three species. It will remain the most abundant site in the UK for red-throated divers, and will provide foraging habitat for a combined total of little terns exceeding the single most abundant breeding colony total (being comprised of birds from six source SPA colonies). Also, it will support internationally important numbers of foraging common terns from two source SPA colonies.

In conclusion, the site qualifies as per the original Outer Thames Estuary SPA, with the addition of little tern and common tern features to protect the marine foraging areas used by birds breeding along the adjacent coastline.

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Annex 1 Site Citation

EC Directive 79/409 on the Conservation of Wild Birds

potential Special Protection Area (SPA)

Name: Outer Thames Estuary pSPA

Counties/Unitary Authorities:

Norfolk, Suffolk, Essex, Kent

Boundary of the pSPA:

The pSPA is divided into three main areas: the main part of the site is the outer part of the estuary, located between a line eastwards just north of Walton on the Naze, Essex in the north, to approximately Foreness Point seaward in the south, reflecting the existing SPA boundary. This area however extends inland to Westcliffe-on-sea along the Southend coast and down the River Roach and as far west as South Fambridge on the River Crouch. A separate area extends south along the coast of east Norfolk from Caister-on Sea in the north to offshore Felixstowe, Suffolk reflecting the existing SPA boundary. However the site extends down the River Bure to approximately Runham, and the River Blythe to encompass Blythburgh Water in the west. This area lies mainly within the 12 nautical mile (nm) zone, except for two small areas which extend slightly into the 12nm zone offshore from about Lowestoft, and a third area lying slightly further north and partly within 12nm, but also with a larger area extending well beyond the 12nm zone.

The landward boundary of the pSPA will mainly follow the existing Outer Thames Estuary SPA boundary which was drawn to Mean Low Water (MLW) or the seaward boundaries of existing SPAs, whichever is furthest seaward and based on red-throated diver survey data. The boundary is extending to Mean High Water (MHW) in places to encompass the foraging areas for little tern (*Sternula albifrons*) and common tern (*Sterna hirundo*) identified from qualifying SPAs.

The seaward boundary lies partly within the 20 m depth contour and marginally (along the outer eastern edge) within the 20-50 m depth contour.

Size of pSPA: The pSPA covers an area of 391,909.65 ha.

Site description:

The Outer Thames Estuary pSPA is located on the east coast of England between the counties of Norfolk (on the north side) and Kent (on the south side) and extends into the North Sea. The site comprises areas of shallow and deeper water, high tidal current streams and a range of mobile mud, sand, silt and gravely sediments extending into the marine environment, incorporating areas of sand banks often exposed at low tide. Intertidal mud and sand flats are found further towards the coast and within creeks and inlets inland down the River Yare, Bure, Blyth and Roach and Crouch estuaries. The diversity of marine habitats and associated species is reflected in existing statutory protected area designations, some of which overlap or abut the pSPA.

Qualifying species:

SPA site selection guidelines have been applied to the most up to date information for the site. Red-throated divers were a feature of the existing Outer Thames Estuary SPA and remain as part of the new pSPA.

The site qualifies under **article 4.1** of the Directive (2009/147/EC) as it is used regularly by 1% or

more of the Great Britain populations of the following species listed in Annex I in any season:

Species	Season	Count (Period)	% of population
Red-throated diver *Gavia stellata*	Non-breeding	6,466 individuals (1989 – 2006/07)[5]	38.0% of GB population
Little tern *Sternula albifrons*	Breeding	746 individuals (2011 – 2015)	19.64% of GB population
Common tern *Sterna hirundo*	Breeding	532 individuals (2011 – 2015)	2.66% of GB population

Assemblage qualification:

The site does not qualify under SPA selection stage 1.3.

Principal bird data sources:

Colony counts from JNCC Seabird Monitoring Programme, Norfolk Bird & Mammal Reports, Foulness Area Bird Survey Group and contributed by colony managers from RSPB. Data on ringed common terns from national bird ringing scheme. Red-throated diver data from aerial surveys 1989 – 2006/07, as per Natural England (2010) and O'Brien *et al*. (2012).

[5] Value retained from original Outer Thames Estuary SPA standard data form (http://publications.naturalengland.org.uk/publication/3233957)

Annex 2 Sources of bird data

Source of Data	Data provider	Subject	Date produced	Method of data collection	Verification
JNCC larger tern survey report	JNCC	Empirical survey data on the foraging locations of breeding terns tracked from several UK colonies and the identification of important foraging areas around colonies using habitat association models	2009-2011	Visual tracking of individual terns from boat-based survey platform	Verification by JNCC and external peer review of final report
JNCC little tern survey report	JNCC	Empirical survey data on the sightings of little terns along the shore and at sea at several UK colonies and definition of alongshore and seaward limits to important foraging areas around colonies	2009-2013	Shore-based counts from fixed vantage points and boat-based transects at sea	Verification by JNCC and external peer review of final report
Seabird Monitoring Programme	JNCC and site managers	Breeding seabird data for relevant colonies contributing to Outer Thames Estuary pSPA	2011-2014	Standard methodology	Verified by site manager and JNCC and published on website
Norfolk Bird & Mammal Report		Breeding seabird data for relevant colonies contributing to Outer Thames Estuary pSPA	2010 - 2013	Standard methodology	Published document undergoing editorial scrutiny
Data from RSPB	RSPB	Breeding seabird data for relevant colonies contributing to Outer Thames Estuary pSPA	2011 - 2015	Standard methodology	Data collected and agreed by site managers
Data from Foulness Area Bird Survey Group	FABSG	Breeding seabird data Foulness contributing to Outer Thames Estuary pSPA	2011 - 2015	Standard methodology	Data collected by group, scrutinised by group leader and published on website
National bird ringing scheme	BTO / Foulness ringing group	Counts of young common terns ringed at Foulness SPA	2011	Counts of ringed birds	Contributed to national ringing scheme
JNCC red-throated diver report	JNCC	Data on red-throated diver distribution and abundance from aerial surveys; summarised by Webb *et al*. (2009), Natural England (2010), O'Brien *et al*. (2012)	1989 – 2006/07	Visual aerial surveys, Kernel Density Estimation, Maximum Curvature analysis	Published in peer-reviewed journal (O'Brien *et al*. 2012)

Annex 3 Defining little tern foraging areas and seaward boundary

1. Background and overview

All five species of tern that breed in the UK (Arctic *Sterna paradisaea*, common *S. hirundo,* Sandwich *S. sandvicensis,* roseate *S. dougallii* and little tern *Sternula albifrons*) are listed as rare and vulnerable on Annex I of the EU Birds Directive and thus are subject to special conservation measures including the classification of Special Protection Areas (SPAs). Little terns nest on sand or shingle beaches, islets and spits, often very close to the high water mark and are among the rarest seabird species breeding in the UK. There are currently 28 breeding colony SPAs designated within which little terns are protected. The marine areas they use while foraging to provide their young have not yet been identified and classified as SPAs to complement the existing terrestrial suite. Since 2009, the JNCC has been working with the four Statutory Nature Conservation Bodies (SNCBs) towards the identification of such areas.

This annex gives an overview of the survey and analytical work carried out by and on behalf of JNCC between 2009 and 2013 for the little tern. This work focussed on those colony SPAs which have been regularly occupied[6] by significant numbers of little tern pairs over the last 5-10 years (13 colony SPAs). Shore based and boat based survey work was undertaken which allowed characterisation of the distances that little terns fly from their colony in order to forage. Boundaries of important foraging areas were drawn based on the distances which little terns fly along the coast, and distances which they fly out to sea. A full and detailed description of the analysis can be found in the JNCC report on this work (http://jncc.defra.gov.uk/pdf/Report_548_web.pdf). A different approach was deemed appropriate for large terns as they search for food over a much wider area and further from the coast and breeding colony than little terns. An overview of that work is described in Annex 6 and a full and detailed description of that analysis can be found in the JNCC report on that work (http://jncc.defra.gov.uk/page-6644).

1. Data collection

The study aimed to provide three years of colony specific data for all regularly occupied breeding SPAs of little terns. However logistics, colony failure, and other factors meant the data coverage for each colony varied. Surveys were timed to coincide as far as possible with chick rearing, which is the period of greatest energetic demand to the species during the breeding season and therefore critical to the maintenance of the population.

Two types of survey (boat- and shore-based observations) were applied in order to estimate both seaward as well as alongshore (coastal) extent of little tern foraging areas.

1.1. Seaward extent of little tern distribution (boat-based survey)

Boat-based surveys were carried out to assess how far out at sea foraging little terns would range (*i.e*. to confirm their maximum seaward foraging extent). Surveys involved the boats travelling along a series of parallel lines through a survey area around each colony. These surveys extended to 6 km from the coast to approximate the mean maximum foraging range as revealed from the literature (e.g. Thaxter *et al.* 2012) and preliminary JNCC observations. Two methods of recording little terns along a transect line were employed: (i) Instantaneous counts undertaken systematically at pre-determined points (between 300 m and 1800 m apart). The instantaneous count area was an 180º arc either ahead of, or off one side of, the boat depending on viewing conditions. All birds seen within this arc (out to a maximum estimated distance of 300 m) were recorded, along with the distance and bearing of the sighting and information on behaviour; (ii) Continuous counts of any little terns observed between the instantaneous points were also recorded to provide an[7] index of

[6] 'Regularly occupied' was defined where the mean peak breeding numbers of the most recent five years at the time of assessment equalled or exceeded the 1% of the national population. Colony counts were provided by the Seabird Monitoring Programme (www.jncc.defra. gov.uk/page-1550) and direct from site managers.

relative abundance. Although observers recorded behaviour (foraging/flying), restricting the analysis to just foraging observations would have limited the sample size. Therefore, all records (foraging and not foraging) were included in the analyses.

1.2. Alongshore extent of little tern distribution (shore-based surveys)

Shore-based observations aimed to assess to what extent little terns forage away from their colony along the coastal strip. Observation points were chosen at 1 km intervals to either side of the colony, up to a distance of 6 km along the coast, according to the mean maximum foraging range indicated by the literature. If preliminary observations found birds going further than 6 km, more observation points were added at successive 1 km intervals. Birds were counted within a distance of 300 m to either side of the observation point (resulting in a 180° arc). The shore based counts recorded passage rate and foraging use and if possible snapshot counts at one minute or two minute intervals were also recorded. The aim of the snapshot counts was to provide information on the intensity of foraging at each observation point. Ideally, counts at different observation points were done concurrently, lasting at least 30 minutes at each observation point. This time is based on the mean foraging trip duration for little terns lasting 16–29 minutes according to Perrow *et al.* (2006). However, in some cases this was not possible due to time constraints and/or logistical difficulties. In order to account for this difference in effort between observation points the shore-based count data were standardised to the number of birds observed per minute at each observation point. Care was taken to cover a range of tidal states, as variations in water levels between the times of high and low water are likely to play a significant role in determining the foraging locations of terns.

To ensure that the data were comparable between sites the samples were analysed as a proportion of the total birds counted (per minute) at the first count point (usually 1 km) in either direction alongshore from the colony. Each side of the colony was analysed as a separate sample. This approach assumes that 100% of birds leaving the colony in a particular direction reach the first count point, and that all birds reaching subsequent count points have passed through (and had been counted at) point one on their way.

2. Data analysis

The density of little terns within each survey area was relatively small, leading to small numbers of observations within boat transects and shore based count points. This was particularly evident at the colonies with fewer breeding pairs. Given this, techniques successfully used for defining boundaries to areas of importance for other seabird and waterfowl species i.e. interpolation based on analyses of transect data to yield density maps (e.g. O'Brien *et al.* 2012) could not be used in this case. Furthermore, the small foraging range of the little terns precluded application of the habitat association modelling approach used in the case of the work on larger terns (Annex 6). Accordingly, JNCC developed a method for boundary delineation which would work with this type of data.

The approach developed to boundary setting was based on use of simple metrics that could be derived from the boat-based and shore-based survey data collected at each site. At colonies where sufficient data were available, site-specific survey data were used to determine the values of these metrics. Analysis found that colony size and density had only a weak effect on the extent of little tern foraging ranges, so in the case of colonies where there were insufficient or no data, averages of all the colony specific values were used to define seaward and alongshore boundaries. These options are set out in more detail below.

2.1 Site-specific options

For colonies with sufficient data to describe either or both seaward and alongshore extents, the following site-specific metrics were used to define boundaries:

A) Seaward extent

The **site-specific seaward** extent of foraging areas was determined by the **mean of the maximum extents** of little tern observations from repeated surveys at that site.

Using the mean of the maximum seaward observations across repeated surveys aims to represent the maximum foraging distance used by an average little tern on an average day. Within a given survey day maximum extent is used because there were relatively few survey data available and additional sampling effort would likely extend the observed maximum range. The mean of these maximum extents was used in order to express the variability of extents between samples. This approach avoids the risk of outliers dictating the extent, as would be the case if the 'maximum extent' ever observed at a site was used.

B) Alongshore extent

The **site-specific alongshore** extent of foraging areas was determined by the **maximum extent** of alongshore distribution at a site.

Using the maximum alongshore observation was considered appropriate to avoid a potential bias towards underestimation of the distances travelled alongshore that would have arisen from use of any other metric because there were: i) relatively few survey data available at each site, ii) a tendency for count points furthest away from the colony to receive slightly less counting effort, and iii) instances in which little terns were observed at the furthermost observation point alongshore. Furthermore, there appeared to be very few outliers in these datasets such that there was a lower risk of the alongshore extent being unduly influenced by outliers than in the case of the defining the seaward extent.

2.2 Generic options

For colonies with insufficient or missing data, generic options were applied to define either or both seaward and alongshore extents, based on the averages of the relevant values derived at each of the colonies for which sufficient data were available to determine site-specific values.

A) Seaward extent

The **generic seaward** extent of foraging areas was determined by the **mean** of the **mean maximum extent** obtained from site-specific datasets.

B) Alongshore extent

The **generic alongshore** extent of foraging areas was determined by the **mean** of the **maximum alongshore extent** obtained from site-specific datasets.

The validity of using these averages across sites to define the generic values for both seaward and alongshore extent at colonies with insufficient or missing data was explored by examination of the relationships between the cumulative numbers of little tern observations and increasing distance out to sea and alongshore, pooled across all sites (see next section).

2.3 Derivation of site specific and generic seaward and alongshore extents

A summary of the seaward extents as estimated from boat-based transect surveys at each colony, together with the generic seaward foraging extent derived from these values is set out in Table 1.

Table 1. Values of the maximum seaward observation of little terns on each survey at each SPA surveyed. The number of values in the 2nd column indicates the number of boat-based surveys yielding independent estimates of maximum seaward extent of occurrence at each colony. The values in the 3rd column are the site specific average of the values in the 2nd column. The value in the final row is the average of the site specific mean values.

SPA colony	Maximum seaward observation per survey (m)	Mean of maximum seaward observations (m)

Teesmouth and Cleveland Coast	1564,5661,4504,1357,4153	3448
Solent & Southampton water	492, 1620	1056
North Norfolk Coast	2077, 2129, 1946	2051
Hamford Water	2487, 1065	1776
Great Yarmouth and North Denes	800[1], 3120[1], 3770[1], 1390[2], 1730[2], 3780[2]	2430
Northumbria Coast	2185, 3011	2598
Dee estuary	1674, 2070	1872
Generic (mean value) applied to sites with insufficient data	-	2176

1. Derived from birds breeding at the North Denes colony; 85% kernel contours.
2. Derived from bird breeding (radio-tracking; 85% kernel contours) or assumed to be breeding (boat transects) at
Winterton colony.

A summary of the alongshore extents as estimated from shore-based surveys at each colony, together with the generic alongshore foraging extent derived from these values is set out in Table 2.

Table 2. Values of the distance of the observation point furthest alongshore (in each direction) from each colony at which little terns were observed on any survey at that colony in any year. The value in the final row is the average of the site specific values.

SPA colony	Maximum alongshore extent from the colony in each direction (km)
Ythan Estuary, Sands of Forvie and Meikle Loch	2, 5.35
Dee Estuary	3, 3
Northumbria Coast	5, 6
Humber Estuary	6, 6
North Norfolk Coast	7, 7
Teesmouth & Cleveland Coast	5, 5
Gibraltar Point	2, N/A
Great Yarmouth North Denes	5, 4
Hamford Water	4, 3
Solent & Southampton water	1, N/A
Morecambe Bay	7, 2
Lindisfarne	3, 4
Chesil Beach and The Fleet	1, 0.5, 1
Generic (mean value) applied to sites with insufficient data	3.9

The relationships between the cumulative numbers of little tern observations with increasing distance out to sea and alongshore, pooled across all sites are presented in Figures 1 and 2. These have been used to assess the appropriateness and degree of precaution associated with the use of the generic values of 2.2 km offshore and 3.9 km alongshore to define the boundaries in the case of colonies with insufficient or missing data.

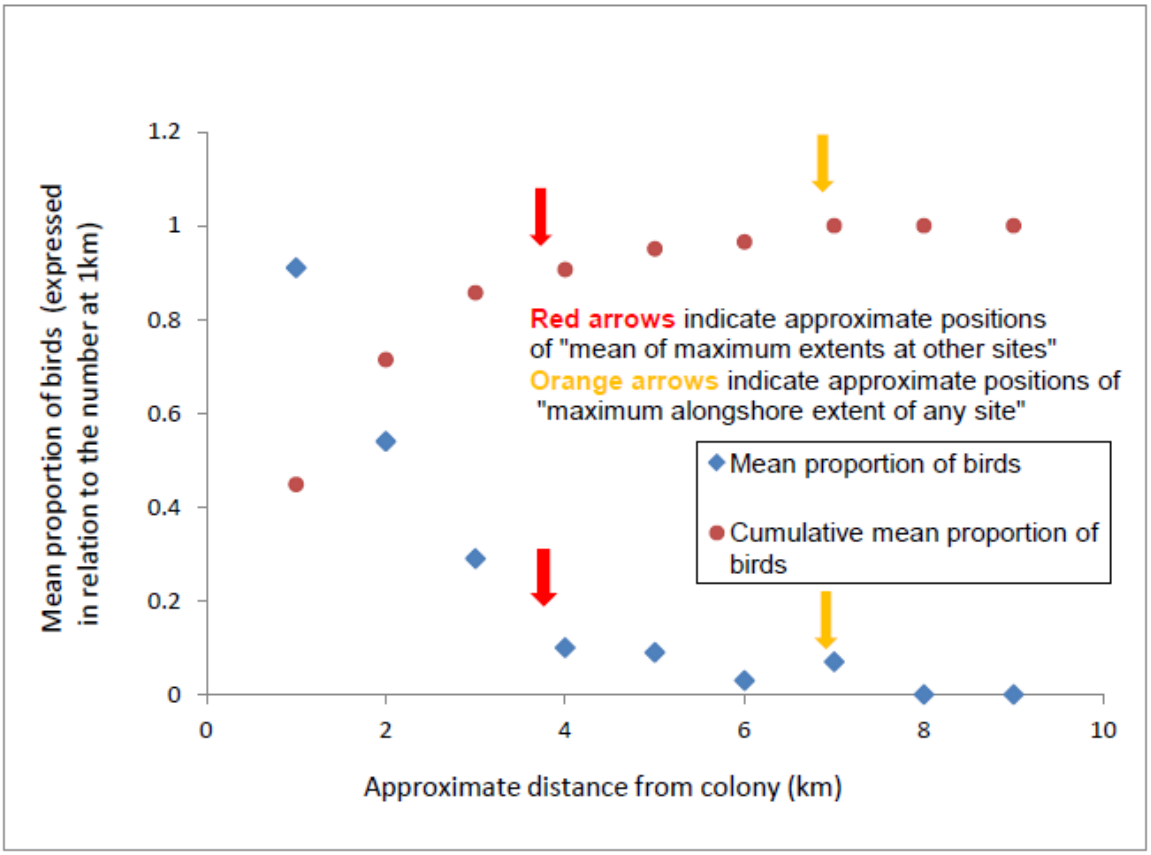


Figure 1: Mean proportion (blue dots) and cumulative mean proportion (red dots) of little terns at increasing distances alongshore from the colony. Each blue point represents the mean proportional usage at each distance band from the colony averaged across colonies. The proportion at each distance (blue dots) is expressed relative to the number at the 1 km mark. The mean proportion of birds at 1 km is less than 1.0 because, in a few cases, no birds were observed at 1 km. The red arrows indicate the values at the generic mean of the maximum site-specific alongshore extent (3.9 km) whereas the yellow arrows indicate the values at the greatest site-specific maximum alongshore extent recorded (7 km at North Norfolk Coast and Morecambe Bay). Source: Parsons *et al.* (2015).

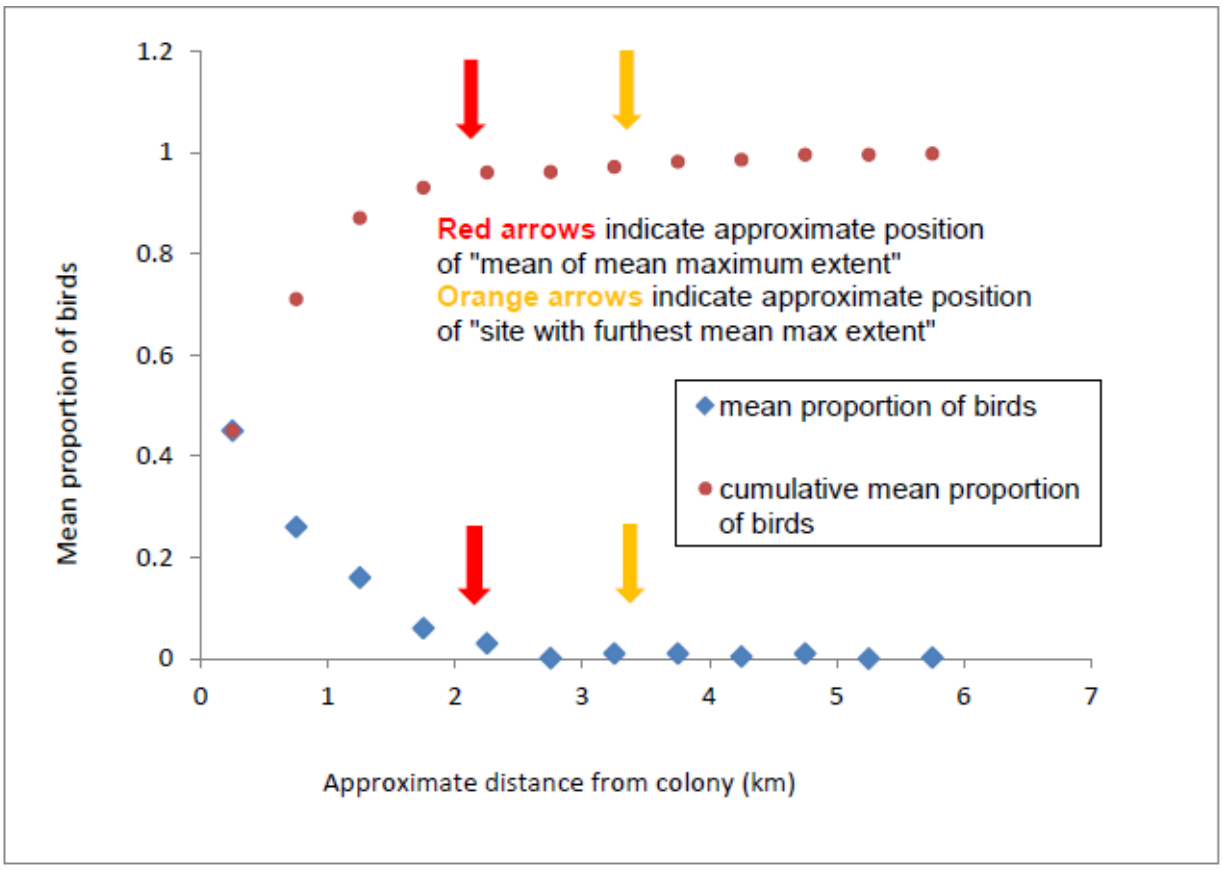


Figure 2: Mean proportion (blue dots) and cumulative mean proportion (red dots) of little terns at increasing seaward distances from mean high water mark. Each blue point represents the mean proportional usage at each distance band from mean high water mark averaged across colonies. The red arrows indicate the values at the generic mean of the mean maximum site-specific seaward extent (2.2 km) whereas the yellow arrows indicate the values at the greatest of the site specific mean maximum seaward extents (3.4 km at Teesmouth and Cleveland Coast). Source: Parsons *et al.* (2015).

These figures demonstrate the nature of the relationship of increasing cumulative usage with increasing distance from colony. For alongshore (Figure 1) approximately 0.86 of all recorded usage occurred within 3.9 km from the colony, this being the mean of maximum extents at other sites and used as the generic value to define alongshore boundaries at colonies with insufficient or missing data. In comparison, at 7 km from the colony (i.e. the maximum distance of any observation station from any colony) all recorded usage was encompassed. For offshore extent (Figure 2), approximately 0.97 of all recorded usage occurred within 2.18 km of the coast, this being the "mean of the site specific mean maximum extents" at other sites and used as the generic value to define seaward boundaries at colonies with insufficient or missing data. In comparison, at 3.4 km which is the greatest of the site specific mean maximum seaward extents, 0.99 of all recorded usage at all sites was encompassed.

From these analyses it can be seen that in order to capture all recorded usage in an alongshore direction (1.0 at 7 km) and almost all recorded usage in a seaward direction (0.99 at 3.4 km) there would need to be a considerable increase in the distances being considered for defining the generic boundaries over those proposed (i.e. a further 3.1 km alongshore in each direction and a further 1.2 km offshore). On the simplifying assumption that alongshore and seaward limits define a rectangle lying parallel to the coast and with the landward edge centred on the colony, the sea area encompassed by these greater limits would be approximately 2.8 times that encompassed by the narrower limits proposed. The analyses suggest, however, that the gain in terms of the inclusion of additional areas of significant little tern activity would be relatively modest as the proportion of bird observations included within the narrower generic boundaries proposed already

capture 0.86 and 0.97 of recorded usage alongshore and offshore respectively. It would seem to be overly precautionary for an estimate of foraging extent to encompass all or nearly all observations, given that at any one site this would probably result in significant areas of very low tern usage being included in the estimate. Therefore, the average of the site specific maximum alongshore extents (3.9 km) and the average of the site specific mean maximum seaward extents (2.2 km) have been adopted for a generic estimation of foraging extent at colonies with insufficient or missing data. Use of these values is, on the basis of the analyses, likely to encompass areas of high to moderate use by breeding adult little terns during chick-rearing while excluding areas which are likely to have very low usage at that stage of the season.

3 Boundary delineation

At each colony SPA, an assessment was made on the quality and quantity of data available for defining seaward extent and alongshore extent. If the quality or quantity was felt to be insufficient (eg no data or low numbers of birds observed, or few surveys, or data from only one year), then the generic option was applied at that colony. Judgement was applied rather than strict adherence to numerical thresholds for quantity of data. If the data at a site was felt to be sufficient, then the site-specific options, as described above, were applied at that colony.

Alongshore boundaries for little tern foraging areas were simply drawn as straight lines perpendicular to the coast at the distances of the site specific or generic alongshore extent on each side of the colony. Site specific alongshore boundaries were allowed to differ between the shores on either side of a colony if the data indicated this to be appropriate, whereas generic alongshore boundaries were drawn equidistant on both sides of a colony. These lines were then joined up using a line parallel to the coast and drawn at a distance defined either by the site specific or generic seaward extent. Observations indicated that little terns forage both in the intertidal zone and subtidal zone, so the landward limit of foraging extents has been taken to Mean High Water.

An example of a potential boundary around little tern foraging areas based on the approach described above is shown in Figure 3.

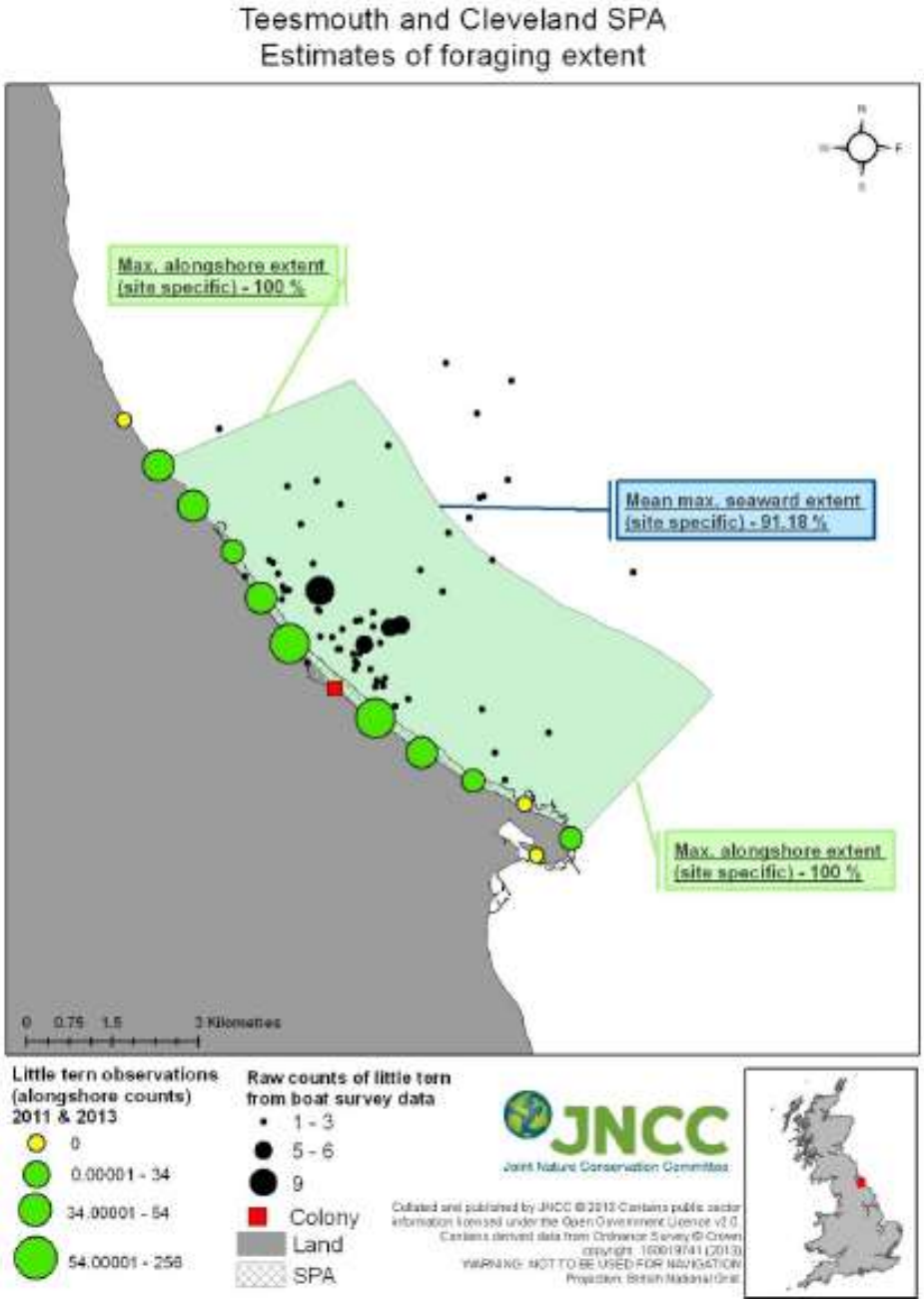


Figure 3. An example of the application of site specific alongshore and site specific seaward extents to define the boundaries to little tern foraging areas at the Teesmouth and Cleveland SPA. The % values given in the labels indicate the site specific % of little tern observations within the shore-based (alongshore) dataset and boat-based (seaward) dataset captured within the alongshore and seaward boundaries.

4 Conclusion

The aim of this work was to quantify usage of the marine environment by little terns around their breeding colony SPAs in the UK. The foraging extents identified by this study derive from information gathered over multiple years using site-specific information where possible. Most information derives from data collected between 2009 and 2013, a combination of shore-based observation (to determine the alongshore extent of use) and boat-based transect surveys (to establish the seaward extent). At one SPA - Great Yarmouth North Denes – these data were supplemented by information from radio tracking, collected in 2003-6 (Perrow and Skeate 2010).

Collection of site-specific data was attempted at most currently occupied SPAs, though in many cases data on seaward or alongshore extent could not be collected, and at others, no or few usable data were collected, either due to colony failure (caused by tidal inundation, predation or disturbance) or simply too few breeding pairs for sufficient observations to be detected by surveys.

Therefore, methods were required which aim to quantify foraging extent under a range of cases of data availability: i) where there are good data for both parameters; ii) where there are no site-specific survey data; iii) where data on seaward and/or alongshore extent are deficient.

For colonies with sufficient data on seaward extent, the mean of the maximum seaward extent of little tern observations from repeat surveys at that site has been used. Using the mean of repeat surveys aims to represent average usage and is therefore moderately conservative, and avoids the risk of outliers having a large influence on extent, as would be the case if the alternative – maximum distance offshore at which a single little tern was ever observed at a site – were used. For colonies with sufficient data on alongshore extent, the maximum distance alongshore at which terns were observed has been used, on the basis that because there are relatively few survey data at each site, and the tendency for furthest count points to have received slightly less effort on average, further survey would probably have extended the estimates of range. Because of this, it was judged that choosing the maximum extent at a site would not be excessively precautionary nor would the influence of outliers pose significant risk of over-estimation of extent.

For colonies with no or insufficient data, a method to derive generic extents was developed, based on data collected at other colonies. This aimed to weigh the risks of being overly precautionary (over-estimate foraging extent) or overly conservative (under-estimate foraging extent). Analyses indicated that use of the average across sites of the site specific means of the maximum recorded seaward extents captured 0.97 of all recorded tern observations, while use of the average across sites of the site specific maximum recorded alongshore extent captured 0.86 of all recorded tern observations. This suggested that use of these values at colonies with insufficient data to derive site-specific boundaries to little tern foraging areas would be likely to encompass areas of high to moderate use while excluding areas which are likely to have very low usage during the chick-rearing period.

The colony SPAs selected for study were those assessed to be currently occupied. This, however leaves a number of SPAs where little tern is a feature, where it was judged that little terns are no longer regularly breeding in significant numbers (as well as those currently occupied SPAs where no or few data could be collected). The assessment of occupation of such sites may change with time. This study has provided generic extents that could be applied following changed assessments.

The methods to estimate foraging extents are derived from field surveys and analyses of a nature appropriate to the data and the ecology of the little tern. Habitat modelling, such as that undertaken for the larger tern species (Annex 6) is not appropriate for the little tern, due to the combined effects of their more restricted inherent foraging range and the limited availability of habitat data at a suitable resolution or inshore locations.

The foraging extents of little tern estimated in this study fall within the range identified for little tern in a recent review of foraging ranges (Thaxter *et al.* 2012). That study identified the mean extent of the three studies included in the review as 2.1 km, with the mean of maxima across studies as 6.3 km. The work by JNCC, on a larger number of colonies, gave a mean maximum extent of 2.2 km, with a range of 1.1-3.4 km (for seaward extent) and a mean maximum of 3.9 km, with a range of 0.5-7 km (for alongshore extent). Eglington (2013), in a literature review of foraging ecology of terns, concluded that most studies, including those citing anecdotal information, reported a foraging radius less than 4 km from the colony, which accords with the results of JNCC's work.

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Abstract available at: http://www.researchgate.net/publication/236034521_Seabird_foraging_ranges_as_a_preliminary_tool_for_identifying_candidate_Marine_Protected_Areas/file/3deec515ec5e3a2218.pdf

Annex 4 Defining larger tern foraging areas and seaward boundary

1. Background and overview

All five species of tern that breed in the UK (Arctic *Sterna paradisaea*, common *S. hirundo,* Sandwich *S. sandvicensis,* roseate *S. dougallii* and little tern *Sternula albifrons*) are listed as rare and vulnerable on Annex I of the EU Birds Directive and thus are subject to special conservation measures including the classification of Special Protection Areas (SPAs). Within the UK there are currently 57 breeding colony SPAs for which at least one species of tern is protected. However, additional important areas for terns at sea have yet to be identified and classified as marine SPAs to complement the existing terrestrial suite. Since 2007, the JNCC has been working with the four Statutory Nature Conservation Bodies (SNCBs) towards the identification of such areas.

The work described here aimed to detect and characterise marine feeding areas used by terns breeding within colony SPAs. Given that at least one of five species of terns occur as an interest feature within 57 colony SPAs spread across the UK, it was recognised that resource and time constraints would preclude the detailed site-specific surveys at all colony SPAs over several years that, in an ideal world, would provide the most robust empirically based characterisation of marine feeding areas used by terns breeding within every colony SPA. Accordingly a statistical modelling approach was adopted which used data collected from a sub-sample of colonies to a) characterise the types of marine environment that are used by foraging terns, and b) use this information to identify potential feeding areas around all colony SPAs.

This annex gives an overview of the survey and analytical work carried out by and on behalf of JNCC between 2009 and 2013 for the four larger tern species (*Sterna* species). A full and detailed description of the analysis can be found in the JNCC report on this work (http://jncc.defra.gov.uk/page-6644). A different approach was deemed appropriate for little terns as they search for food in a much more restricted area closer to the coast and to the breeding colony. An overview of that work is described in Annex 5 and a full and detailed description of that analysis can be found in the JNCC report on that work (http://jncc.defra.gov.uk/pdf/Report_548_web.pdf). For the modelling analysis aspect of the project, JNCC worked collaboratively with Biomathematics and Statistics Scotland (BioSS)[8].

2. Data collection

To acquire information on the at-sea foraging distributions of breeding terns, three years of targeted data collection were carried out or commissioned by JNCC around selected tern colonies from 2009 to 2011, using the visual-tracking technique[9] (see BOX 1 for details). The majority of the data were collected during the chick-rearing period (June to early July), a highly demanding period for breeding adult terns due to food gathering for chick feeding and rearing. The need to regularly return to the colony results in a higher number of foraging trips within a generally more restricted foraging range. Accordingly, areas used during this period are considered as crucial for overall survival and are thus high priority for site-based conservation.

[8] BioSS are one of the Main Research Providers for strategic research in environmental, agricultural and biological science funded by the Scottish Government's Rural and Environment Science and Analytical Services Division.

[9] PERROW, M. R., SKEATE, E. R. and GILROY, J. J. (2011). Visual tracking from a rigid-hulled inflatable boat to determine foraging movements of breeding terns. *Journal of Field Ornithology*, 82(1), 68-79.

BOX 1.
Observers on-board a rigid-hulled inflatable boat (RIB) followed individual terns during their foraging trips. An on-board GPS recorded the boat's track, which was used to represent the track of the bird. Observations commenced immediately adjacent to the SPA colony. The actual starting position was varied to capture the full range of departure directions of the birds. Observers maintained constant visual contact with the bird (by maintaining the RIB c.50-200 m from the bird*) and recorded any incidence of foraging behaviours, along with their associated timings. Behaviours could then be assigned to a distinct location within the GPS track by matching the timings.
* This distance was found to be optimal in terms of maintaining visual contact whilst minimising disturbance to the bird

Existing information on tern foraging ranges (Thaxter *et al.* 2012) suggest that the larger terns are capable of foraging as far as 30 km (Arctic, common and roseate terns) or 54 km (Sandwich terns) from their colonies. Accordingly, models were used to generate predicted distributions out to these maximum foraging ranges around the colonies of interest. To do so, information on habitat conditions across these areas was gathered from various sources to be fed into the habitat models as environmental covariates (information on environmental conditions at an appropriate scale and extent). Such environmental covariates were chosen for their potential to explain the observed tern distribution data. Due to a lack of information on actual prey distributions (e.g. sandeels, clupeids such as herring and sardine, zooplankton), environmental covariates which could relate to the occurrence or availability of these prey species such as water depth, temperature, salinity, current and wave energy, frontal features, chlorophyll concentrations, seabed slope and type of sediment as well as distance to colony (as a proxy for energetic costs) were used instead.

3. Data preparation and analysis

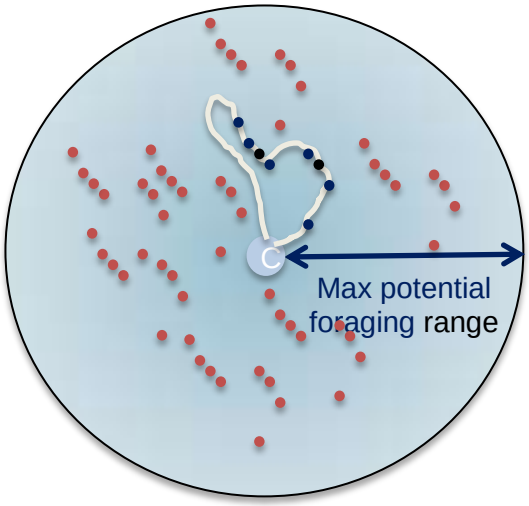
Prior to analysis within the habitat models, data had to be prepared and processed into a suitable format. Each track of a tern comprised periods of time when the bird was clearly not engaged in either actively searching for prey or in active foraging but appeared to be in transit to or from the colony or between areas of search at sea. As the aim of this work was to characterise important foraging areas and inclusion in the modelling of locations passed over in transit would dilute the power of the analysis to identify important habitat relationships and therefore foraging areas. In addition, because terns are central place foragers (meaning they must travel to and from their nest site on each trip), it would almost certainly lead to a bias towards high usage of areas close to the colony, data from commuting periods (i.e. parts of the bird track where no foraging behaviour[10] was recorded) were removed from the modelling analysis.

In order to identify the preferred type of area used for feeding, the environmental conditions found at foraging locations had to be compared with conditions found at locations which were not used for foraging. The analysis therefore compared observed foraging presence locations with foraging absence locations (see Box 2 for more detail on how these were defined) to characterise the kind of environment used for foraging by the terns.

[10] Foraging behaviour was defined as an instance of circling slowly actively searching for food in the water below, diving into the water, or dipping into the water surface.

Box 2.

Given that the data is collected by tracking individual birds rather than from transect surveys, we do not have a comprehensive picture of where the terns did not forage, but instead we do know where a particular bird did forage throughout a feeding trip. During that trip, it did not (choose to) feed anywhere else. There is an infinite number of possible 'non-foraging locations' where that tern could have gone to forage, so to provide something meaningful for the comparison analysis, we took a sample of non-foraging locations to which that individual might have gone from within the maximum published foraging range of each species.



The figure shows an example of the observed foraging locations (blue) along one bird track. Although an individual can (choose to) conduct a foraging trip to anywhere within the maximum foraging range, each location at which it forages on a given trip (i.e. the blue dots) is at least partly dependent upon the locations at which it has already foraged while on that trip i.e. one location follows another – the bird does not move about at random across the entire foraging range between successive foraging events on any given trip. Accordingly, to retain this within trip structure in the comparison of "presence " locations with "absence" locations, for each trip, matching sets of "absence " locations (red dots) were generated at random starting points within the maximum published foraging range of each species[11], These matching tracks therefore retained the number and spatial structure of observed foraging locations within each bird's track. 'Absence' locations represented areas available to the foraging bird but where the bird was absent at the time of recording. Twelve replicate "absence tracks" were generated for each actual trip. Subsequently, the resulting data sets to be used in the habitat models consisted of both 'foraging' and matching sets of 'absence' points for each individual foraging trip, as well as respective X and Y co-ordinates and values of the environmental covariates associated with each point

The environment that the terns use for foraging was characterised by analysis of the presence and matching absence data in relation to a suite of environmental covariates (see BOX 3 for details). This analysis was then 'reversed' and the modelled relationships between tern usage and the environmental covariates used, in conjunction with maps of environmental conditions or habitats around tern colonies, to identify those areas with characteristics suggesting that they are likely to be used for foraging, either by other terns at the same colony, or by terns at other colonies (see Figure 1).

[11] Species specific maximum foraging range from our own data and those identified in THAXTER, C.B., LASCELLES, B., SUGAR, K., COOK, A.S.C.P., ROOS, S., BOLTON, M., LANGSTON, R.H.W. & BURTON, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation*. **156**: 53-61.

Box 3.

Extensive investigative analysis showed that logistic Generalised Linear Models (GLMs) were the appropriate statistical tool to identify habitat preferences of foraging terns based on observational data, and to generate predicted foraging distributions around colonies where data were missing. GLMs quantify the relationship between environmental covariates and tern foraging locations within a defined area, and by simply reversing this relationship, they are able to calculate the relative likelihood of a tern foraging (or not) at any location based on the values of the environmental covariates at that location.

As part of the development of the final GLMs used in the analysis, we ascertained that the relationship between tern foraging usage and environmental covariates was consistent between years, warranting the combination of data from all years of the study in the final models. Moreover, environmental covariates were ranked based on their biological meaningfulness, while also taking into account of the suitability and robustness of the data sets for making predictions of foraging use. Selection of which environmental covariates were included in the final model was based on this ranking combined with a standard statistical approach which trades off model complexity with goodness-of-fit to the underlying data.

In order to make a smoothed map of predicted foraging distribution, a 500 m by 500 m grid was created to cover the published foraging range for each colony of interest. Predictions of foraging likelihood were then made to each grid-cell based on the environmental conditions at the centre points of each cell. These predictions were then rescaled to provide a measure of relative foraging density within each grid-cell.

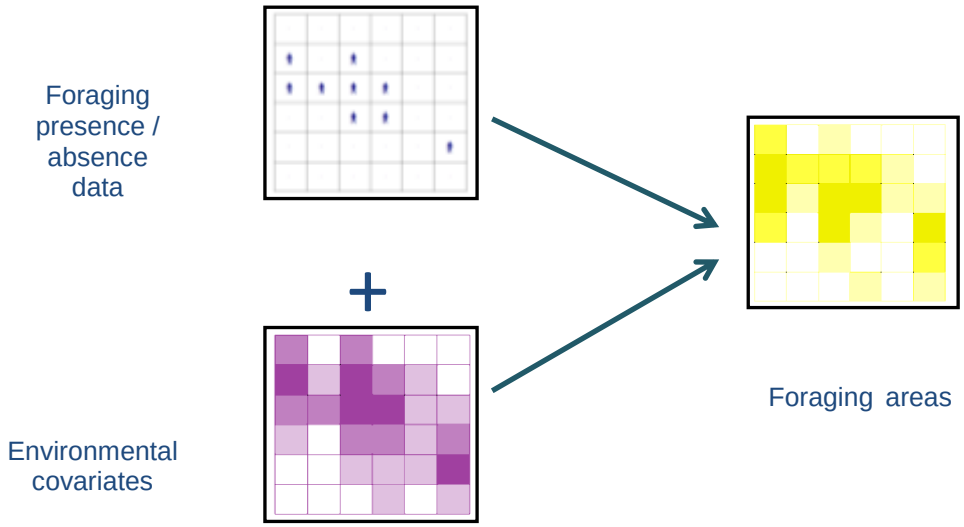


Figure 1. Simplified, schematic representation of the process of modelling distributions based on environmental information, using a single covariate distribution map in the example.

For each species of tern, there were two types of analysis: for colonies where we had collected sufficient data, the data from that colony only was used in the analysis, providing a colony-specific relative foraging density map (phase 1 analysis in Figure 2).

For colonies where we had insufficient data to produce a colony-specific relative foraging density map, all data for that species was combined to produce a UK wide analysis which could be used to produce foraging density maps around any tern colony in the UK, based on the environment and habitat conditions around those colonies (phase 2 analysis in Figure 2).

The process of analysis in this way involves creating a statistical model, and it is this model which characterises the environment that the terns use for foraging.

PHASE 1: colony specific bird data

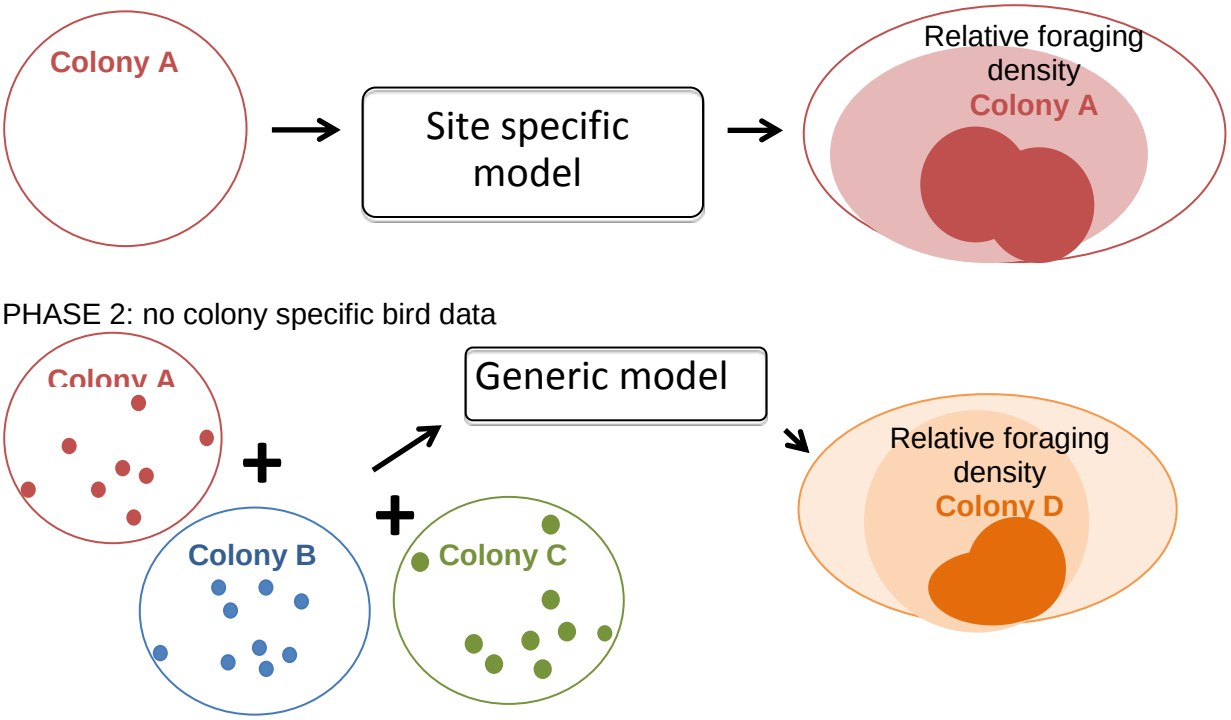


Figure 2. Simplified, schematic representation of the process whereby empirical observations of tern foraging locations around a colony were either: used to build predictive, site-specific models of tern usage that generated relative foraging density maps around that colony (phase 1 analyses); or combined with observations of tern foraging locations around other study colonies to build predictive, generic models of tern usage that generated relative foraging density maps around poorly studied or unstudied colonies (phase 2 analyses).

In order to have confidence in the robustness of the habitat association model predictions of tern usage, which are based on samples of tern tracks, it is important to consider the degree to which the sample datasets on which the models are based can be considered representative of all of the foraging locations which would have been visited across all foraging trips by all birds from a colony across an entire chick-rearing period.

Accordingly, an analysis was carried out to assess whether sufficient birds had been tracked to capture the foraging areas of the populations at individual colonies (although as discussed below this was not the primary objective of the tracking work). This analysis was conducted on data derived from three years of tracking from the Coquet Island colony of Arctic, Sandwich and roseate terns and two years of tracking from the common tern colony at the Imperial Dock (Leith). A recently published and peer-reviewed method for assessing the sufficiency of tracking sample size was used for the analysis (see Soanes *et al*. 2013). This method takes subsamples of the available data to examine how sample size influences estimates of the home range (the size of the area used) by the whole colony, based on the time spent in individual predefined grid cells. All of the cells within a home range represent the total area of use, whilst other fractions of the total area of use, determined by ranking the cells within the home range in order of the amount of time spent within them were also examined i.e. the area of active use (95%) and the core foraging area (50%).

These areas are derived for samples of the pooled track data to produce results based on the use by 1 individual, 2 individuals, 3 individuals, etc… randomly sampled from the pool of available tracks in the dataset. Models are then fitted to the resulting data to examine the relationship between sample size and the total area of use, area of active use and the core foraging area. Parameters derived from these models can then be used to estimate the numbers of tracks required to capture different percentages of the area of interest (e.g. 50%, 75% and 95% of the total, active and core areas of use) given a specific colony size, thus providing an indication of how sufficient the sampling is.

The full details of the analyses are presented in Harwood & Perrow (2013). In summary, the analyses revealed that the available samples of tracks described between 45% and 68% of the total area of use, 50% and 73% of the area of active use and between 72% and 83% of the core foraging area for the four species (Table 1).

Table 1. Percentages of the predicted total (100%), active (95%) and core foraging (50%) areas based on colony size, resulting from the actual sample sizes achieved. Source: Harwood & Perrow (2013)

Tern species	Sample size (number of tracks)	% of total area of use (CI)	% of area of active use (CI)	% of core foraging area (CI)
Common (Leith)	121	68.1 (66.4-69.8)	72.7 (71.1-74.3)	73.8 (72.0-75.6)
Arctic (Coquet)	91	44.8 (40.3-49.2)	49.9 (45.5-54.0)	72.4 (68.6-75.9)
Sandwich (Coquet)	117	51.4 (48.3-54.4)	54.8 (51.7-57.7)	71.9 (69.1-74.6)
Roseate (Coquet)	50	67.9 (62.8-72.5)	72.2 (67.4-76.5)	83.3 (78.4-87.5)

Thus, although the sampling effort captured no more than 68.1% of the total area of use in any case, it should be noted that the total area of use is unlikely to be described fully by any reasonable amount of tracking effort; as this would require every movement of every individual in a colony to be constantly monitored. However, the surveys did provide sufficient data to account for a large proportion of the core foraging area, which is a key metric for investigating habitat association. This provides reassurance that, even when a relatively small proportion of the colony population is sampled, the data are likely to represent well the core foraging areas of the colony population as a whole.

Furthermore, it should be borne in mind that the objective of the tracking work was not to gather a comprehensive body of tracks from which to determine directly a potential boundary around important foraging locations. Rather, the goal was to gather a representative sample of tracks from which to construct a habitat association model to identify areas with the characteristics of important foraging locations i.e. to identify not just those locations where foraging was observed within the necessarily limited empirical dataset on which the models were based, but also to identify other locations (including at other colonies where it was not possible to sample) where relatively high levels of usage by foraging terns might be expected based on their characteristics. In other words, the habitat models allow us to fill gaps in sampling effort, both at sampled colonies and at unsampled colonies.

With that in mind, for each model produced, an assessment was made of how good this model would be at making predictions of tern foraging around the same colony (for colony specific analysis) or around other colonies (for UK wide analysis). This assessment was made using a technique called cross-validation.

Cross-validation involves omitting a sub-set of data (the validation set), and refitting the chosen model to the remaining data (the training set). Predictions, in this case of tern foraging locations, generated by models based on each training set are then compared with the validation set – which in this case comprises the actual tern foraging locations not used in building the model. Comparisons can be done by various scoring methods; three were used to avoid reliance on a single method, but for simplicity only one of these i.e. the Area Under the Curve (AUC) score, is

presented in this annex. The AUC score represents the discriminatory ability of a model as follows: > 0.9, excellent; 0.8-0.9, good; 0.7-0.8, moderate; 0.6-0.7, poor; and 0.5-0.6, unsuccessful (Swets 1988).

Phase 1 model performance was assessed in two ways: by investigating how well each site and species specific model predicted: (i) validation data for omitted individuals and (ii) validation data for omitted years. The former analyses were conducted for any species/colonies with at least 50 tracks that could be sub-sampled while the latter analyses were conducted for any species/colonies with more than one year of data with at least five tracks in each.

The main concern regarding the use of Phase 2 models was ensuring the models performed well when extrapolated to new areas. Therefore, model selection for Phase 2 was based on the ability of models to predict data from new colonies. The predictive ability of models consisting of all combinations of the candidate covariates was tested using cross-validation, by omitting each colony in turn and developing a model using data from the remaining colonies. Using a UK wide analysis based on data from three tern colonies (such as colonies A, B and C in Figure 2) as an example: The cross validation analysis is undertaken, creating a model which predicts tern foraging locations, based on data from only two of the three colonies, which is then used to make predictions of tern foraging locations around the third colony. Those model predictions are compared with the data that were actually collected around the third colony to see how similar they are; how well does the prediction match what the data tells us (Figure 3). This process is repeated with all possible combinations of two colonies going into the analysis, and testing the output on the third, or 'left-out', colony, to give an overall estimate of how well the model performs when making predictions to a 'new' colony.

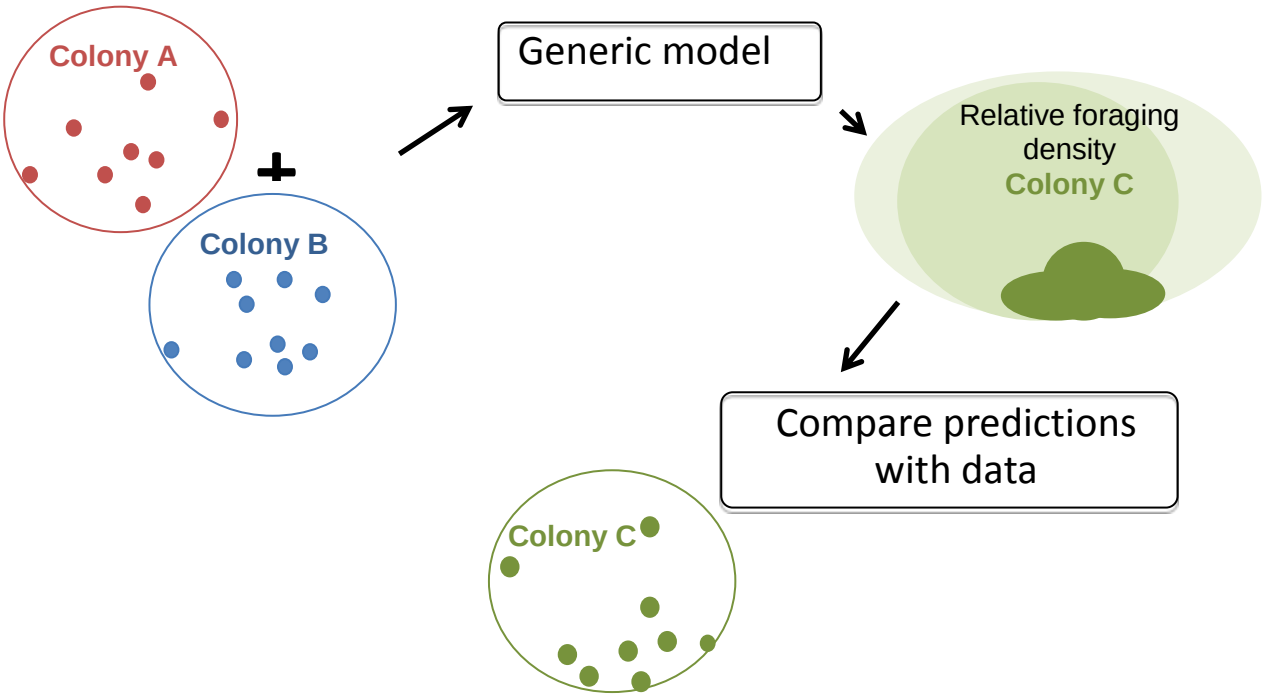


Figure 3. Schematic representation of the cross-validation process, using an example where we have data for three colonies A, B and C, of which data from two at a time (A and B in this diagram) are used to build a predictive model, the predictions of which are then tested by comparison with empirical data from the other colony (C in this case).

The cross-validation results for testing the ability of the Phase 1 models to predict validation data from individuals omitted from the models are shown in Table 2, while the results for testing the ability of the models to predict validation data from omitted years are shown in Table 3. On the basis of the average AUC scores of the Phase 1 models tested, two models performed moderately well, two were good and two were excellent in their ability to predict validation data for omitted individuals (Table 2). Of those tested for their ability to predict validation data for omitted years,

based on the average AUC score, one performed poorly, two performed moderately well, three were good and two were excellent (Table 3). The cross-validation results for the Phase 2 models are summarised in Table 4. They showed that, when predicting data from new colonies, the final Arctic tern generic models performed moderately well, common tern generic models were good, and Sandwich tern generic models were excellent. For all species, the final Phase 2 models performed better than simple models containing only distance to colony.

Table 2. The results of cross-validation of Phase 1 models, testing the ability of the models to predict validation data from omitted individuals tracked at the same colony.

Species	SPA Colony	Average AUC score
Arctic tern	Coquet Island	0.796
Common tern	Coquet Island	0.845
	Imperial Dock Lock	0.741
Sandwich tern	Coquet Island	0.915
	North Norfolk	0.884
	Ynys Feurig, Cemlyn Bay and The Skerries	0.939
	Ythan Estuary, Sands of Forvie and Meikle Loch	0.990

Table 3 The results of cross-validation of Phase 1 models, testing the ability of the models to predict validation data from a different year of survey omitted from the model building phase.

Species	SPA colony	Number of combinations of years that comprised either training or test datasets	Average AUC score
Arctic tern	Coquet Island	9 (2009, 2010 & 2011)	0.71
	Outer Ards	4[1] (2009, 2010 & 2011)	0.72
Common tern	Coquet Island	9 (2009, 2010 & 2011)	0.84
	Imperial Dock Lock	2 (2009 & 2010)	0.68
	Larne Lough	4[1] (2009, 2010 & 2011)	0.87
Roseate tern	Coquet Island	4[1] (2009, 2010 & 2011)	0.84
Sandwich tern	Coquet Island	9 (2009, 2010 & 2011)	0.92
	Larne Lough	9 (2009, 2010 & 2011)	0.98

[1] In these cases there were insufficient tracks in 2010 for this year to be used as a test dataset or as a training dataset on its own.

Table 4. The results of cross-validation of Phase 2 models based on the AUC score for (a) Arctic, (b) common and (c) Sandwich terns. For each species the final model chosen (based on all three different cross-validation scores, rather than just the AUC score) is shown in bold. In addition, a model containing only distance to colony and the model which maximised the AUC score are shown for comparison. Note that the selection of the final models was based not just on these relative AUC scores but also their performance when judged using two alternative metrics. For the full cross-validation results for all the other models tested, and for all three scores, see Potts *et al*. 2013c.

(a)

Arctic terns	AUC score for each test colony			
Model	Coquet Island	Farne Islands	Outer Ards	Average AUC
Distance to colony	0.790	0.753	0.700	0.747
Distance to colony, bathymetry	**0.789**	**0.762**	**0.713**	**0.755**
Distance to colony, bathymetry, shear stress current	0.786	0.774	0.713	0.758

(b)

Common terns	AUC score for each test colony						
Model	North Norfolk	Coquet Island	Cemlyn	Larne Lough	Imperial Dock Lock	Glas Eileanan	Average AUC
Distance to colony	0.923	0.801	0.916	0.819	0.655	0.746	0.810
Distance to colony, bathymetry, distance to shore	**0.931**	**0.813**	**0.913**	**0.788**	**0.665**	**0.761**	**0.812**
Distance to colony, slope	0.930	0.805	0.908	0.853	0.670	0.749	0.819

(c)

Sandwich terns	AUC score for each test colony						
Model	North Norfolk	Coquet Island	Larne Lough	Sands of Forvie	Farne Islands	Cemlyn	Average AUC
Distance to colony	0.877	0.850	0.963	0.898	0.889	0.866	0.884
Distance to colony, bathymetry	0.878	0.899	0.979	0.962	0.956	0.907	0.920
Distance to colony, bathymetry, distance to shore	**0.821**	**0.911**	**0.979**	**0.973**	**0.970**	**0.907**	**0.916**

4. Boundary Delineation

The maps created from outputs of the GLM models in Phases 1 and 2 are essentially a series of grid squares, each with an associated measure of relative foraging density, and indicates how likely the area within that square is to be used by feeding terns compared to other squares. There is no clear threshold in these relative density values to distinguish between 'important' and 'not important'. This kind of problem occurs in most of the marine SPA analysis JNCC has undertaken and details on how this problem has been tackled is in http://jncc.defra.gov.uk/pdf/SAS_Defining_SPA_boundaries_at_sea. In order to identify important foraging areas for terns and draw a boundary around them, a cut-off or threshold value has to be found and only those grid squares with a usage value above this cut-off would be included within an SPA boundary. One well established way of doing this is to generate a list of every grid cell within an area of interest, ranked in decreasing order by its predicted level of usage and from that list generate a cumulative relationship between the level of bird usage captured within an area and the size of that area as, starting with the most heavily used grid cell each one in turn is added. This process invariably leads to a cumulative curve which, provided a sufficient area has been surveyed and includes some areas of relatively limited usage, gradually approaches an asymptote *i.e*. exhibits gradually diminishing returns in terms of levels of bird usage captured as the area considered increases. An objective and repeatable method to identifying a threshold value of diminishing returns on such cumulative curves is called maximum curvature (O'Brien *et al.* 2012). This method identifies at what point on the cumulative curve disproportionately large areas would have to be included within the boundary to accommodate any more increase in, in this case, foraging tern usage.

As the maximum curvature technique is sensitive to the size of the area to which it is applied, the analysis was based on a common area unit for each species. A species-specific mean maximum foraging range (*i.e*. the furthest that an average individual forages from a colony) was determined

using all available data[12], resulting in 30km for Arctic, 20km for common, 32km for Sandwich and 21 km for roseate tern. Any grid cells outside the mean maximum foraging ranges were excluded prior to maximum curvature analysis.

An example of a maximum curvature boundary drawn tightly around the modelled usage distribution of common terns from Foulness SPA is shown in Figure 4.

[12] The global mean maximum foraging range was calculated using all available tracking data (those collated for Thaxter *et al*. 2012, JNCC's tern project data, and data collected by Econ Ecological Consultancy Ltd). THAXTER, C.B., LASCELLES, B., SUGAR, K., COOK, A.S.C.P., ROOS, S., BOLTON, M., LANGSTON, R.H.W. & BURTON, N.H.K. 2012. Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation*. **156**: 53-61.

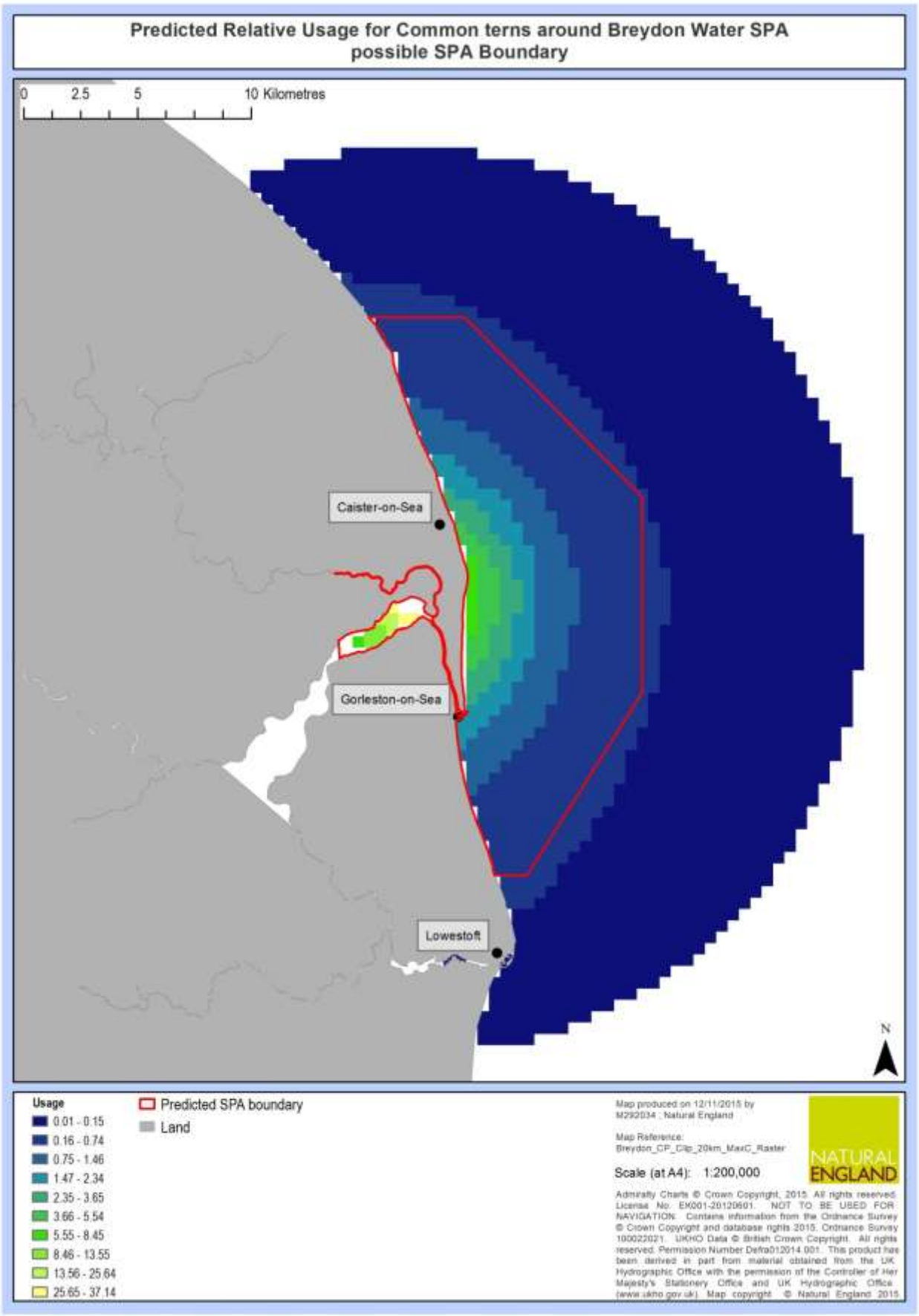


Figure 4 Maximum curvature derived boundary (red line) overlaid on map of model predictions of usage by common terns around Foulness SPA. The extent of the dark blue circle of model

predictions of usage is 20 km - the global mean maximum distance to colony, calculated using tracking data held by JNCC; ECON Ecological Consultancy Ltd and Thaxter *et al.* 2012. These values were used to constrain the usage data used before Maximum curvature analysis was applied. Source: Win et al (2015).

Finally, boundaries were then drawn, in as simple a way as possible, around all the cells within which tern usage exceeded the maximum curvature threshold, as described in http://jncc.defra.gov.uk/pdf/SAS_Defining_SPA_boundaries_at_sea..

In several pSPAs, boundaries are composites derived by application of maximum curvature methods to model predictions of usage of several interest features. In such cases, the composite boundary to the pSPA is derived by the combination of those stretches of the feature specific boundaries which together ensure that all of the important areas identified within the feature-specific boundaries are included within the whole.

5. Conclusion

Delineation of the boundaries around areas of sea that are most heavily used by seabirds have, in several existing marine SPAs, been based on maps of the relative density of birds derived directly from empirical at sea surveys of bird distribution. However, such an approach was not followed in the current project for a number of reasons. First, with tern foraging being predominantly close to shore and with the need to consider colonies all around the United Kingdom, existing data sources eg the European Seabirds at Sea (ESAS) database (http://jncc.defra.gov.uk/page-1547) were not fit for purpose. For this approach to have been followed, a significant programme of bespoke, near-shore at sea transect surveys around the UK would have been required. Furthermore, as the objective of the work was to identify foraging areas of importance to birds originating from existing SPA colonies it was necessary that survey methods could identify the origin of each bird seen at sea. Conventional at sea transect surveys cannot provide this information with any certainty, particularly when considering sightings of birds in sea areas that may be many kilometers from possible source colonies. Accordingly, a programme of boat-based tracking of breeding terns was identified as being the most suitable approach to gathering the necessary information on at sea tern foraging distributions. In an ideal world, such tracking would have been carried out on each species at every colony of interest around the UK with the intention of collating sufficiently large numbers of tracks to allow delineation of a boundary to important areas of use of each species at each colony directly from maps of relative intensity of occurrence. However, given the scale of the task (41 breeding colony SPAs have one or more of the larger tern *Sterna* species as a feature) and the inevitable limitations to survey effort that could be deployed, it was recognized that a targeted survey programme leading to development of predictive models would be the most pragmatic, cost-effective and indeed reliable approach to this project.

This project collected and collated a substantial amount of data on the distributions of terns at sea and to our knowledge represents the largest available resource of tracking data for breeding terns. The data collected/collated consisted of up to three years of survey around eleven colony SPAs and a total of almost 1300 tracks were available to the project across the four species. Geographical coverage across the UK was maximised within the constraints of the time available, logistics and resources. This ensured that data were obtained across a large range of covariate values, and that inter-colony variation could be captured as much as possible for the generic models.

The datasets collected and modelling carried out within this project allowed the development of site-specific models for 16 species/SPAs as well as generic models for each species that were used to extrapolate geographically for 30 species/SPAs. Thus the project delivered predictions of relative distributions of the larger tern species around the full complement of 32 colony SPAs in the UK which were deemed to be recently regularly occupied (46 species/SPA models in total).

Distributions predicted by the Phase 1 models generally matched the underlying data well, but also occasionally identified areas of use which were not captured by the tracking data. This is one of the key advantages of using a habitat modelling approach as it allows extrapolation into areas which were not sampled, but which are predicted to be used based on the suitability of the environment. Interpolation based only on raw data would risk overlooking the potential importance of some areas if they had not happened to be used at the time of tracking by the individuals that were sampled. A habitat modelling approach also allowed us to apply generic models which benefit from pooling data across multiple colonies, gaining strength from increased sample sizes which are able to identify broad, consistent preference relationships across multiple colonies.

All of our models predicted highest usage around the colony, with usage generally declining with increasing distance from the colony. This pattern accords well with what we might expect from central place foragers. For Arctic and common terns, the pattern of usage generally radiated out from the colony in all directions out to sea. For Sandwich terns, usage was in most cases confined to a relatively narrow coastal area either side of the colony. In all cases, there was negligible use of areas distant from the colony; more than half of the maximum potential foraging range was predicted to be virtually unused. The majority of usage was also confined to an area less than that encompassed by the mean maximum foraging ranges (as recorded in this study as well as those in Thaxter *et al.* (2012)). So although a simple approach such as applying a mean maximum foraging range radius around the colony, would correctly identify areas being used (and be a simpler method to explain) and could have been used in boundary setting, it would also include large areas of relatively low importance. The habitat modelling approach, although relatively complex, provides more realistic estimates of the relative importance of the areas within the maximum and mean maximum foraging ranges.

It might be considered that boundaries determined directly from empirically derived maps of the distributions of terns around each colony would have had a smaller degree of uncertainty associated with them than ones derived, as in this project, on the basis of model predictions of bird usage patterns, which in the case of some species and colonies are derived entirely from models of the association between bird usage and environmental covariates which have been derived elsewhere. However, this need not be the case. As noted above, the modelling approach has the advantage of allowing extrapolation of predicted usage levels into sea areas which may not be seen to be sampled (by the birds) in what will always be a necessarily limited sample dataset. Furthermore, the cross-validation of both site specific and generic models has indicated that the pooling of data across years and colonies has allowed models of tern usage to be built which are relatively robust to variations in tern foraging behaviour in time and space. For these reasons it is considered that this project has generated proposed boundaries which have degrees of uncertainty that are acceptable, and certainly need not be considered to be any worse than if it had been possible to apply more conventional approaches.

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Annex 5 Implementation of Natural England Evidence Standards

Decision-making processes within Natural England are evidence driven and the Natural England strategic evidence standard, and supporting guidance were followed. In particular, the four principles for the analysis of evidence set out in the Natural England Standard *Analysis of Evidence* have been adhered to. These two standards documents can be downloaded from the following web-links:

Strategic Evidence Standard:
http://publications.naturalengland.org.uk/publication/7699291?category=3769710

Analysis of Evidence Standard:
http://publications.naturalengland.org.uk/publication/7850003?category=3769710

An explanation follows as to how the principles within the *Analysis of Evidence* standard have been applied in defining the set of qualifying features and boundary of the Outer Thames Estuary pSPA.

1.) The evidence used is of a quality and relevance appropriate to the research question or issue requiring advice or decision

Quantification of qualifying feature population sizes

In order to determine the suite of species present within the pSPA which meet the SPA selection guidelines (JNCC 1999), most relevant bird count data were used, either pertaining to the current five year period (2011-2015 for breeding terns; 1989 - 2006/07 for non-breeding red-throated divers, as per the original SPA citation (Natural England 2010, O'Brien *et al*. 2012).

1. Data from JNCC's Seabird Monitoring Programme (SMP) (http://jncc.defra.gov.uk/smp/) Count data for breeding terns were taken from the national database wherever possible.

2. Data from colony managers and local expert groups (Foulness Area Bird Survey Group, Foulness ringing group) supplemented the SMP data where this was not available, for both little and common terns.

3. The Norfolk Bird & Mammal Report was used to provide data where neither SMP nor RSPB data were available.

The count data taken from the SMP database is the best available information. In addition, the 2013 SMP data has been checked by JNCC. The count data which were obtained directly from the colony managers is source information that will in due course become part of the SMP database. As such, it too is the best available information. Ringing data is submitted to the national ringing scheme, again providing most suitable available information.

Establishment of extent of marine pSPAs using tern tracking data

Webb & Reid (2004) provide a series of guidelines for the selection of marine SPAs for aggregations of inshore non-breeding waterbirds. This guidance does not directly consider the evidence requirements for the selection of marine SPAs focussed on the principal foraging areas used by breeding seabirds. However, a number of the issues and principles covered in Webb & Reid (2004) nonetheless have some relevance in this context. Accordingly, the following section describes in broad terms a comparison of the quality and relevance of the tern evidence base with the guidelines produced by Webb & Reid (2004).

Webb & Reid (2004) note that the guidelines for selecting SPAs in the United Kingdom are described in Stroud *et al*. (2001), and are adequate and competent for application to site selection in the inshore environment for inshore non-breeding waterbird aggregations. However, given that the type and quality of data which underpins the Outer Thames Estuary pSPA differs from those used in identifying sites for terrestrial birds and aggregations of non-breeding waterbirds, it is necessary to consider their adequacy and relevance.

Webb & Reid (2004) set out seven criteria to assess the adequacy of count data. Although not all of direct relevance in the current case these criteria are set out in Table 1 with accompanying comments regarding the tern tracking and modelling work.

Table 1 Criteria for inshore SPA data adequacy.

Criterion	Adequacy of JNCC led larger tern surveys	Adequacy of JNCC led little tern surveys
Experience of observers	All tracking of terns was undertaken either by JNCC staff or experienced contractors commissioned by JNCC to do the work.	All observations of terns was undertaken either by JNCC staff or experienced contractors commissioned by JNCC or volunteer counters who received training in the shore-based observation techniques.
Systematic surveys	Tern tracking was conducted in as systematic a way as possible. Tracking at each colony was carried out during well-defined periods of the breeding season (chick-rearing) in one or more years. Tracking was undertaken in accordance with a field protocol established by JNCC. In the context of tern tracking, the movements of birds is an essential component of the technique and not a source of systematic bias in the survey results as it may be in conventional transect surveys.	Boat-based survey work followed systematic transect survey designs that were appropriate to each colony and were followed on repeated surveys. Shore based survey work used systematic series of observation stations and a standard recording protocol which was used repeatedly at each colony.
Completeness	The aim of the tracking survey method was not to cover all of the areas sea to consider for inclusion in the pSPA, but to ensure that the tracking effort was sufficient to capture tern usage across a representative proportion of that area on the basis of which reliable habitat association models could be constructed and used to predict tern usage patterns across the wider area – including those areas in which no direct observations of terns were made.	Boat-based transects extended up to 6km offshore and alongshore survey stations were positioned at 1km intervals up to at least 6km in either direction from the colony (and where necessary, further). With the mean maximum foraging range reported to be 6.3km, the survey areas gave virtual complete coverage of the likely areas of greatest importance.
Counting method	The larger tern tracking work did not involve counting of birds or use of such information to derive population estimates for the pSPA. However, the modelling is based on samples of tracks of relatively few individual terns from each colony rather than surveys of the distribution of terns (of unknown origin) around the colony. Cross-validation tests of the models' predictions and analysis of sample adequacy both suggest that the results of the models, although based on the samples of tracks, are robust.	At sea observations included instantaneous counts at predetermined distances along transects at which all terns in flight within 300 m in an 180º arc of the boat were recorded. Between these points, continuous records of all little terns seen were also made to provide an index of relative abundance. During shore-based observations, terns recorded within 300 m of the observation point were recorded during timed observation periods. Counts at each station were standardised to birds/minute and expressed as proportions of the value recorded at the 1 km observation station to standardise across sites.
Quality of sampling	Cross-validation tests of the models' predictions and analysis of sample size adequacy both suggest that the results of the models based on the samples of tracks are robust.	This was affected by the low numbers of birds at many colonies and the frequent breeding failures. At colonies with 5 or more shore-based surveys yielding records of 200 or more terns, this was deemed sufficient to derive site-specific along shore boundaries. At colonies with at least 2 boat-based surveys yielding at least 20 tern sightings this was deemed sufficient to derive site-specific

		seaward boundaries. At colonies where these criteria were not met, a generic approach was used by pooling sample data across sites to yield better-evidence based estimates of limits.
Robustness of population estimate	Not applicable as the tern tracking work was not used to generate a population estimate	Not applicable as the tern observation work was not used to generate a population estimate
External factors affecting the survey	Tracking was constrained by weather, e.g. tracking could not take place with sea state ≥3 and during rain. Thus, tracking data were gathered only under favourable weather conditions.	Although the aim was to collect data from most currently occupied SPAs, in many cases data on seaward or alongshore extent could not be collected due to colony failure (caused by tidal inundation, predation or disturbance) or simply too few breeding pairs for sufficient observations to be detected by surveys. Accessibility to count points in all parts of the possible extent of a foraging area limited the ability to provide site-specific alongshore extents in some cases.

Webb & Reid (2004) also discuss the issue of establishing sufficient evidence in the case of marine SPAs to establish regularity of use, which is a key element of the SPA selection guidelines. The tern tracking work was never intended to establish regularity of use of certain sea areas by particular species around particular colonies. The aim of that work was simply to capture sufficient representative information on tern foraging behaviour to allow reliable habitat association models to be constructed and used to generate maps of areas of principal usage. The results of the cross validation of those models' predictions, in which data from different years were used as test datasets, suggests a relatively high degree of consistency in usage patterns between years i.e. regularity of use of those most important areas (Wilson *et al.* 2015). However, no formal tests of the regularity of use of the sea areas within the pSPA boundary have been made. Regularity of use of the pSPA has been reasonably inferred from the continued existence of the site's named features in qualifying numbers in each of the existing coastal SPAs from which birds within the marine SPA are most likely to originate.

Webb & Reid (2004) discuss the issue of boundary placement. They note that the principles for defining boundaries for terrestrial SPAs in the UK are described in Stroud *et al.* (2001) thus (emphasis added):

*"The first stage of boundary determination involves **defining the extent of area required by the qualifying species concerned**. These scientific judgements are made in the light of the ecological requirements of the relevant species that may be delivered by that particular site, and the extent to which the site can fulfil these requirements. This follows a **rigorous assessment of the best-available local information regarding distribution, abundance and movements of the qualifying species**. It may also involve the **commissioning of special surveys** where the information base is weak. Following this stage, every attempt is made to define a boundary that is identifiable on the ground and can be recognised by those responsible for the management of the site. This **boundary will include the most suitable areas for the qualifying species** identified in the first stage……"*

The larger tern tracking and little tern observations were conducted to define the extent of the area required by these species on the basis of specially commissioned surveys that generated the best available local information regarding distribution, abundance and movements of these qualifying species.

Webb & Reid (2004) discuss the principles of setting both landward and seaward boundaries of marine SPAs.

In regard of setting landward boundaries they note that "*Where the distribution of birds at a site is likely to meet land, a boundary should usually be set at the mean high water mark (MHW)…….*

unless there is evidence that the qualifying species make no use of the intertidal region at high water."

The landward boundary of the pSPA has been drawn at MHW along the River Yare, Bure, and Crouch and Roach Estuaries, Benfleet and Southened SPA in the light of model predictions of the usage of such areas by foraging common terns from Foulness SPA. Additionally, the landward boundary of the pSPA has been drawn to MHW along the Blythe River in light of the model predictions of the usage of such areas by foraging little terns from Minsmere-Walberswick SPA.

Webb & Reid (2004) set out a recommended method for defining the seaward boundary of SPAs for inshore non-breeding waterbirds on the basis of analysing bird data from aerial or boat-based sample surveys using spatial interpolation combined with spatial analysis. They note exceptions to this method which include the case in which "*habitat data are also used in combination with bird distribution data to determine boundaries*". A combination of these approaches have been used in determining the seaward boundary of this pSPA; the former for parts of the boundary drawn for red-throated diver distribution, and the latter for areas added for foraging terns.

Webb & Reid (2004) describe spatial interpolation methods by which survey sample data can be used to generate maps of species probability of occurrence or abundance. This involves use of a "….*suite of modelling techniques in which the probability of bird occurrence or the total number of birds present is estimated at unsampled locations (usually in grid cells) using information on the presence or absence, or the number of birds recorded at sampled locations*". This is the principle underlying the modelling of the tern tracking data, albeit that the nature of the statistical models used is somewhat different to those considered by Webb & Reid (2004). As such, the principle of the method which has been used to define the seaward boundary of the pSPA is entirely in line with the recommendation of Webb & Reid (2004).

Webb & Reid (2004) conclude by discussing the method by which a boundary should be drawn around the parts of a site identified as being most important. They refer to Webb *et al.* (2003) which sets out a method for classifying grid cells so that the most important ones for a species on any given survey are highlighted. In that method, the grid cells are ranked from lowest predicted bird abundance to highest, and the cumulative population calculated from lowest ranked grid cell to highest. The highest ranking grid cells were selected such that they comprised 95% of the total population. The analytical approach which has been applied to the grid-based, modelled predictions of tern usage to define the most important areas to include within the pSPA boundary (Win *et al.* 2015) follows the basic ranking principle outlined by Webb *et al.* (2003). However, the application of the maximum curvature technique to such cumulative usage curves in the current case (Win *et al*. 2015) reflects the advances in the details of this analytical method by JNCC since then (O'Brien *et al.* 2012).

Thus, in summary, although Webb & Reid (2004) does not directly address the issue of data requirements in regard of establishing marine SPAs for breeding seabirds, many aspects of the collection and analysis of the tern tracking work which has been used to define the location and extent of the Outer Thames Estuary pSPA can be seen to be in accord with the guidelines set out in that document.

Establishment of the extent of Outer Thames Estuary pSPA

The extent of the pSPA boundary is determined almost entirely by the distribution of red-throated divers as per the classification of the Outer Thames Estuary SPA. The smaller new part of the extent is based on model-generated predictions of which areas of sea are most heavily used by foraging terns originating from two source colonies. The boundary of the pSPA is a composite of non-breeding feature distribution and breeding feature predicted foraging areas.

All species and colony-specific areas of use have been derived from models based on at-sea records of the foraging locations of the particular species but at other colonies around the UK i.e. generic models (e.g. Sandwich terns at the Farne Islands). The quality and relevance of the evidence provided in both of these ways is discussed in the following section.

The adequacy and relevance of these various models and of the modelling approach in general, was addressed by JNCC in three ways (Wilson *et al.* 2015):

i) Cross-validation of site specific models
ii) Cross-validation of generic models
iii) Adequacy of sample size data

A summary of the results of the cross-validation of both site specific and generic models of larger tern usage is presented in Annex 5, as is a summary of the analysis addressing the adequacy of the sample sizes.

2.) The Analysis carried out is appropriate to the evidence available and the question or issue under consideration

The other major analyses which underpin the pSPA are: i) the boat-based and shore-based observations of little terns, ii) the habitat-association based modelling of larger tern usage patterns and ii) identification of threshold levels of predicted larger tern usage which were used to define the site boundary.

The very restricted foraging range of little terns precluded the use of the predictive habitat association modelling approach that was used for the larger terns. Accordingly, it was appropriate to gather empirical evidence on little tern distributions from which to determine directly the boundaries to the areas of greatest usage by foraging birds at each colony. At colonies where evidence was lacking or insufficient it was considered appropriate to make use of data gathered at other colonies to determine "generic" boundaries which, comparison with all available data indicated, would capture a very significant proportion of total usage (see Annex 4).

The habitat association modelling approach is a novel one which has not been used in defining the extent or boundaries of any marine SPA to date. However, the decision to adopt a habitat association modelling approach was the subject of discussion between JNCC and all other statutory nature conservation bodies over many years and agreement to follow this approach informed the design of the survey programme coordinated by JNCC since 2009. For the modelling analysis part of the project JNCC worked collaboratively with their statistical advisors Biomathematics and Statistics Scotland (BioSS).

Although the method by which the grid-cell based maps of predicted bird distribution were drawn up in this case differed in detail from more conventional spatial interpolation and spatial analysis considered by Webb & Reid (2004), the way in which the resultant maps of predicted bird distribution were analysed to determine threshold levels of predicted tern usage, and hence to define the site boundary, (i.e. maximum curvature analysis) represents application of an established method used at other marine SPAs (O'Brien *et al.* 2012) and is thus entirely appropriate to the evidence available.

Following completion of the work on both larger terns and little terns, JNCC commissioned external peer review of both pieces of work. Those peer reviews did not highlight any significant issues with the appropriateness of the analyses which were not resolved by subsequent discussion between the reviewers and JNCC. Further details of the external peer review are provided in section 5 of this Annex.

Analysis of non-breeding red-throated diver distribution has been published in a peer-reviewed journal (O'Brien *et al*. 2012)

3.) ***Conclusions are drawn which clearly relate to the evidence and analysis***

The conclusions regarding the list of features and their reference population sizes within the pSPA are based on application of the SPA selection guidelines issued by JNCC (JNCC 1999) to the best and most recent count data, or to count data originating from the time of original classification. As such the conclusions in this respect clearly relate to the best available evidence.

The conclusions regarding the drawing of parts of the landward boundary of the pSPA inland at MHW are based upon the evidence provided in the form of a model of predicted usage by foraging common tern. In this instance, the generic model was used which included distance from shore as a significant covariate with a negative coefficient indicative of highest use being closest to shore and therefore in many instances inclusive of intertidal areas. That the use of such areas by larger tern species is also likely is supported by information in the scientific literature. A review of tern foraging ecology (Eglington 2013) notes that larger tern species including Sandwich tern routinely forage in areas of shallow water. There is no reason on the basis of that review to consider it likely that common terns will not forage over intertidal areas. Accordingly, in this respect too, the conclusions clearly relate to the best available evidence.

The conclusions regarding the drawing of the seaward boundary of the pSPA are based upon the evidence provided in the form of models of predicted usage by foraging larger tern species and non-breeding divers through the application of a standard analytical method, already well-established for use in marine SPA boundary setting i.e. maximum curvature (O'Brien *et al*. 2012), to the models' outputs. The validity and robustness of the outputs of the site specific and generic models used to underpin the boundary analysis of the pSPA have been established by the process of cross-validation described in Annex 5. Thus, the conclusions in this respect clearly relate to the best available analysis of the best available evidence.

Since the modelling work was completed by JNCC, the Department of the Environment, Northern Ireland (DoENI) commissioned in 2014 a programme of land-based and at-sea surveys to verify the extents of tern foraging activity at three sites in Northern Ireland i.e. Larne Lough, Strangford Lough and Carlingford Lough. At each of these sites, the same generic predictive models, as already described in this Departmental Brief, had also been used to generate relative usage maps for at least one species of larger tern (and in some cases for all species) and hence to determine proposed site boundaries. In summary, this work (Allen & Mellon Environmental Ltd 2015) confirmed the presence of terns (mainly Sandwich) to the furthermost alongshore limits of the areas searched and in one case beyond the limit of the modelled alongshore boundaries. The work provided some evidence that the larger terns do feed further out to sea than the limits of the modelled boundaries. However, the use of the threshold setting approach to the predicted relative usage maps does not deny that terns may forage beyond that limit. The work also provided some evidence that the very intense use of localised hotspots of activity recorded in or close to the entrances to the loughs were not as clearly identified as such by the models. However, the proposed boundaries in each of the three sites did contain the hotspots within the lough entrances. Thus, these verification surveys provide: confirmation that hotspots of usage near colonies are contained within modelled boundaries, some evidence that proposed boundaries, based on model predictions, may be somewhat conservative in regard of their seaward limits, and no evidence that their alongshore or seaward extents are in any way excessive.

4.) Uncertainty arising due to the nature of the evidence and analysis is clearly identified, explained and recorded.

Count data

The UK SMP is an internationally recognised monitoring scheme coordinated by JNCC in partnership with others (e.g. statutory nature conservation bodies, the RSPB and other colony managers as data providers, etc.). It collects data according to standardised field methods (Walsh *et al.* 1995). SMP data are verified by the JNCC seabird team. Therefore, there is high confidence in SMP data. The majority of the data which has been used in determining the size of the populations of each of the species considered for inclusion as features of the pSPA is based on counts which are on the SMP database and so justify high confidence.

RSPB survey data are verified and quality assured by the RSPB count coordinator and site manager. RSPB is a professional organisation with long-standing experience of seabird monitoring, and surveys are conducted by trained surveyors. There is therefore high confidence in RSPB survey data. Accordingly, such data referred to in this Departmental Brief can be considered to justify high confidence . Similarly, the Foulness Area Bird Survey Group are an organised

collective with unrivalled local ornithological knowledge and experience. The data collected by the group also justify high confidence.

Ringing data (counts of numbers of birds ringed) are not subject to uncertainty. However, the method applied to estimate numbers of adult pairs will be. To account for this, several scenarios are presented, with selection of the scenario considered to be realistic (based on conversations with local site experts) informing the calculations of numbers of pairs of common terns breeding at Foulness SPA (Annex 7).

Any uncertainties with aerial survey data collected for red-throated divers are assumed to have been adequately addressed in classifying the original Outer Thames Estuary SPA.

Landward boundary

The issue regarding the confidence in the evidence base upon which the decision to draw the landward boundary of the pSPA to MHW along parts of the coast has been made, is discussed in the previous section.

Seaward boundary

The position of the seaward boundary of the pSPA has largely been quality assured to the highest level (O'Brien *et al*. 2012). The position of the small additional extension to the seaward boundary has been determined on the basis of outputs of statistical models which are based on tern behaviour at colonies in other parts of the UK. Accordingly, it is almost inevitable that there is a greater degree of uncertainty regarding the robustness of the boundary location than if it had been derived directly from a comprehensive site-specific set of observations of tern foraging locations. However, provided the models are empirically evidence based, and shown to be robust via cross validation, the modelling approach brings with it a robustness which may exceed that which might be achieved from reliance on a limited empirical dataset of tern foraging locations. It is considered that the cross-validation analyses and sample-size sufficiency analyses indicate that proposed boundaries generated by the modelling approach have degrees of uncertainty that are acceptable, and certainly need not be considered to be any worse than if it had been possible to apply more conventional approaches. This issue is discussed fully in Annex 5.

5.) Independent expert review and internal quality assurance processes

Independent expert review

Natural England's standard in quality assurance of use of evidence, including peer review, (http://www.naturalengland.org.uk/images/operationalstandardsforevidence_tcm6-28588.pdf) has been followed in determining the level of independent expert review and internal quality assurance required in relation to Natural England's analysis of the evidence for this site and the way that the boundary has been drawn up. Independent expert review is to be adopted where there is a high novelty or technical difficulty to the analysis.

O'Brien *et al*. (2012) describes the process of boundary setting for red-throated divers, which determines the vast majority of the pSPA boundary. As a peer-reviewed publication in a scientific journal, this work was subject to the highest level of independent review.

The derivation of the alongshore extent and seaward boundary to the pSPA is based on a novel approach, never used before in SPA designation, and has entailed considerable technical difficulty in the analyses. In recognition of this, JNCC commissioned independent expert review of both the larger tern and little tern programmes of work. A representative of Natural England, along with those of all other country statutory nature conservation bodies, was involved by JNCC in setting the terms of reference for the review work, in nominating potential reviewers for JNCC to consider approaching, and in the selection of those who carried out the reviews.

The larger tern modelling work was reviewed by two independent scientists (Dr Mark Bolton of the British Trust for Ornithology and Dr Norman Ratcliffe of the British Antarctic Survey). In summary,

both reviewers raised two primary issues with the data collection and its analyses. These related to: i) the focus of the tern tracking work during the chick-rearing phase of the breeding season and ii) to the details of the way in which control points denoting tern absence were generated to match track locations where terns were recorded and the use of that information to determine terns' preference for each location and the conversion of that preference pattern into a pattern of tern usage. In regard to the first issue, JNCC acknowledged that the focus of the tracking work was only on the chick-rearing period, partly in order to ensure that sufficient data were gathered during that one period, but also in recognition of the need to focus attention on the identification and protection of those sea areas which are of most importance to the birds when their ability to buffer themselves against adverse environmental conditions by foraging further from the colony is most limited by time and energy constraints and their need to provision their chicks. The report (Wilson *et al*. 2015) was amended to acknowledge the fact that the modelled boundaries are unlikely to fully capture areas of importance during the incubation phase of the breeding cycle. The second point of concern raised by the reviewers led to extended discussion between the reviewers, JNCC and BiOSS. As part of this process, independent advice was sought from Dr Geert Aarts (AEW Wageningen University). In summary, the conclusion of those discussions, agreed by all, was that the methods used by JNCC and BioSS were sound and appropriate, but that further clarification was needed in the text of the report. As a result of these discussions, the relevant section of the report (Box 1 in Wilson *et al.* 2015) was amended.

The reports on the little tern field work methodology and results and subsequent boundary setting work were also put out to independent peer review by JNCC. One main point made by the peer reviewer(s) was that the boat and shore-based observations should have been corroborated more extensively with data from radio tracking or even habitat modelling. JNCC did in fact use radio tracking, at one site, where it confirmed the results of their techniques. JNCC did not consider it to be necessary or even practicable to apply this approach more widely. JNCC considered that habitat modelling was not possible, given the small range of the species and the limited availability of environmental data over that range. JNCC noted that it would have been prohibitively expensive to collect their own environmental data, even at a few sites, and with unknown chance of "success". The other main point made by the peer reviewers (in accord with the same suggestion made by the peer reviewers of the larger tern work) was for data to have also been collected during the incubation period. However, as noted above in regard of work on larger terns, it was decided at the outset of the work that the priority should be on the chick-rearing period, because it is probably at this time when little terns face the greatest energetic demands. The focus was on chick-rearing for biological reasons but also logistical ones; JNCC noted that there would have been a risk of obtaining too few data during both incubation and chick-rearing if both periods were studied. One reviewer asked for greater reference to the findings of other studies but JNCC considered this aspect to be sufficient. A number of improvements were made to text, tables and figures by JNCC, on the recommendation of the reviewer, and some additional text was included in the Discussion to serve as a Conclusion to the report.

In the light of Natural England's involvement with the review process conducted by JNCC and in the light of its outcomes, Natural England did not consider it necessary to initiate its own independent expert review of the reports prepared by JNCC.

Internal peer review and quality assurance

A representative of Natural England has been involved in the entire history of the larger and little tern monitoring and modelling work programme since its inception. Since late 2009, this role was fulfilled by Dr Richard Caldow (Senior Environmental Specialist: Marine Ornithology). Accordingly, Natural England has, in conjunction with Scottish Natural Heritage (SNH), Natural Resources Wales (NRW) and Department of the Environment Northern Ireland (DoENI), been in a position to review and provide quality assurance of the programme of JNCCs work and its findings from start to finish as detailed below.

JNCC evidence reports relating to marine SPA identification go through an extensive internal and external QA process. This has applied to all of the main strands of analysis (ESAS analyses to identify offshore hotspots of usage, inshore wintering waterbird work, larger tern work, and little

tern work).

The general approach and survey methods are subject to internal and external discussion, often in workshop format. External discussion can involve organisations such as SNCBs who will use the outputs, academics and other researchers in the field. Once an approach and survey method has been agreed and data collection has started, interim reports are prepared which are subject to internal and SNCB review. Analysis of data is subject to discussions (and workshops if appropriate) internally and with academics and statistical contractors if appropriate. For particularly challenging analyses (such as larger tern modelling work) statistical contractors may undertake significant portions of exploration and development work, and/or of final analysis. Finally, once all the data has been collected and analysed, JNCC prepare an extensive report which has contributions from several JNCC staff, undergoes several rounds of JNCC and SNCB comment, and is finally signed off at JNCC Grade 7 level. At this stage it goes to SNCBs for use in their own work in parallel with going to external peer review, where a minimum of 2 reviewers are sought. Reviewers are usually sought with knowledge of the species ecologies and/or statistical and technical understanding, with reviewers sought to complement each other (for example with differing expertise, from differing types of organisation). JNCC then respond to peer reviews, making changes to 'final' reports if appropriate. Only if peer review comments are significant and fundamental is further grade 7 sign off sought before publishing as part of the JNCC report series.

The first version of this Departmental Brief was drawn up by Alex Banks (Marine Ornithologist) and with input from Catherine Laverick.

Departmental Briefs are drafted by an ornithologist with support from the site lead who provides the local site specific detail. This document is then quality assured by the marine N2K National Project Management team as well as selected members of the Project Board. The brief is then circulated for external comments from Defra Marine Policy Officer, JNCC senior seabird ecologists, Marine Protected Area Technical Group (MPATG) and UK Marine Biodiversity Policy Steering Group (UKMBPSG). The briefs are also sent to Natural England Board members for early sight of SPA proposals. The amended briefs are then reviewed and approved by the Marine N2K Project Board, Marine Director and relevant Area Managers and subsequently by the Natural England Chief Scientist in accordance with our Quality Management Standard. The brief is then signed off as required by our Non-Financial Scheme of Delegation by a representative of the Senior Leadership Team with delegated authority before being submitted to Defra.

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Annex 6 Common terns breeding at Foulness SPA

This annex presents relevant data for common terns breeding at Foulness SPA. Data are kindly supplied by Foulness Area Bird Survey Group and the Foulness ringing group. Treatment of data focuses on the main breeding area (New England Creek) within the SPA, and does not include the handful of pairs known to usually or occasionally breed at other scattered locations within the SPA, largely because of the patchy nature of available data on these locations.

Available data for the past six years are displayed in Table 1 below.

Table 1: count data for common terns at Foulness SPA in pairs / AON. Brackets show juveniles ringed. NC = No Count.

	New England raft	**East Newlands**
2010	Bred (72)	
2011	Bred (58)	
2012	25	
2013	NC	
2014	9	
2015	2	2-3

From Table 1, the past six years of data for Foulness (using data from New England Creek and ignoring small numbers of pairs elsewhere within the SPA) gives two years in which common terns 'bred', one with no count, and three years with counts of adults totalling 25, 9 and 2 pairs. Common tern numbers are thought to fluctuate partly in response to black-headed gull *Chroicocephalus ridibundus* abundance at the breeding location, with lower numbers likely reflecting lack of management intervention to discourage gull nesting. In years when this is possible (e.g. 2010, 2011), common terns numbers increase. We expect future management to lead to the same increases in commn tern nesting numbers.

Estimating adults from ringed young

In 2010 and 2011, the number of juvenile birds ringed suggests that numbers of adult common tern pairs were likely to have been greater than the value of 25 pairs used by JNCC to prioritise sites supporting regular breeding (as common terns produce two eggs per pair and numbers of young exceeded 50). In some other years, figures suggest that adult pairs may be underestimated (or that some years birds are extremely productive); for example, 134 pairs and 102 young in 2000; 33 pairs and 56 young in 2007.

No ringing data for 2012, 2014 or 2015 are available and so counts of adults are all that can be used, accepting that they may be undercounted. There are no data for 2013 of any type.

In order to estimate the number of adult pairs from juveniles, we can make some assumptions about productivity and thus calculate the number of pairs that are likely to have been present to produce the resulting number of young. Two ways to do this are to use national (UK) average productivity levels across time, or average productivity levels (for England) in the years in question (2010 and 2011) as a proxy for productivity at Foulness SPA. We assume that terns with fledged chicks do not make repeat attempts to breed within the same breeding season, likely a fair

assumption based on tern ecology.

Horswill & Robinson (2015)[13] provide demographic rates for seabirds breeding in the UK. For common terns, 24 colonies in the UK (16 in England) are analysed and a mean is derived from these. This value is 0.764 chicks per pair (standard deviation = 0.470), assessed as a 'good' quality estimate (the highest category available). As the mean is provided with the standard deviation, it is possible to calculate an upper estimate of productivity, based on mean productivity plus two standard deviations. Within a normal distribution, 95% of individual colony productivity average values should lie within two standard deviations of the mean. The upper 95% value derived in this way equates to a productivity level that is seldom exceeded and so provides a very conservative estimate of the number of pairs that might produce a certain number of fledged young.

JNCC also provide information on annual seabird productivity, with plots summarising this by country within the UK. In England, estimated average common tern productivity in 2010 and 2011 was 0.57 and 0.45 chicks per pair respectively (JNCC 2014: http://jncc.defra.gov.uk/page-3201).

Table 2 displays the various estimated numbers of adult common terns. Five year means are shown relating to these estimated and counted totals of adult pairs. When using the most optimistic estimate of productivity (national average plus two standard deviations) to estimate the numbers of pairs present in 2010 and 2011, the five year mean 2010 – 2014 is 27.6 pairs and 17.5 pairs 2011 - 2015. Using alternative assumptions regarding productivity to estimate numbers of pairs in 2010 and 2011 gives greater five year means; 51.0 and 28.0 pairs (using national average productivity over the two five year periods) and 71.0 and 41.2 pairs (using average productivity in England 2010 and 2011).

In the opinion of the Foulness ringing group, based on casual observations of adult pairs at the time of ringing and observations of productivity, the most realistic estimates of adults are those based on the national average plus two standard deviations (42 pairs in 2010 and 34 in 2011). Foulness SPA is thus a very productive colony for common terns, when manangement intervention discourages black-headed gull nesting and allows the terns to breed.

Table 2: Five year mean population size for common terns at Foulness SPA based on estimated and actual counts of adult pairs. 2010 and 2011 values estimated according to: national average productivity, upper estimates of national productivity, and estimated average productivity in England in 2010 and 2011.

	National average	**Upper national**	**England**
2010	*94*	*42*	*126*
2011	*76*	*34*	*129*
2012		25	
2013		No data	
2014		9	
2015		2	
Five year mean (2010 – 2014)	51.0	27.6	71.0
Five year mean (2011 – 2015)	28.0	17.5	41.2

[13] Horswill, C. & Robinson R. A. 2015. Review of seabird demographic rates and density dependence. *JNCC Report No. 552*. Joint Nature Conservation Committee, Peterborough.

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STANDARD DATA FORM

FOR SPECIAL PROTECTION AREAS (SPA)
FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)
AND
FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:

1.1 Type J

1.2 Site code UK9020309

1.3 Compilation date 201008

1.4 Update 201102

1.5 Relationship with other Natura 2000 sites

U	K	0	0	1	3	6	9	0
U	K	0	0	3	0	3	7	1

1.6 Respondent(s) International Designations, JNCC, Peterborough

1.7 Site name **Outer Thames Estuary**

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	
date confirmed as SCI	
date site classified as SPA	201008
date site designated as SAC	

2. Site location:

2.1 Site centre location

longitude	**latitude**
01 32 41 E	51 54 58 N

2.2 Site area (ha) 379268.14

2.3 Site length (km)

2.5 Administrative region

NUTS code	Region name	% cover
0	Marine	100.0%

2.6 Biogeographic region

Alpine	Atlantic	Boreal	Continental	Macaronesia	Mediterranean
	X				

3. Ecological information:

3.1 Annex I habitats

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment

3.2 Annex I birds and regularly occurring migratory birds not listed on Annex I

		Population				Site assessment			
		Resident	Migratory						
Code	Species name		Breed	Winter	Stage	Population	Conservation	Isolation	Global
A001	*Gavia stellata*			6466 I		A		C	

4. Site description:

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	100.0
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	
Salt marshes. Salt pastures. Salt steppes	
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	
Inland water bodies (standing water, running water)	
Bogs. Marshes. Water fringed vegetation. Fens	
Heath. Scrub. Maquis and garrigue. Phygrana	
Dry grassland. Steppes	
Humid grassland. Mesophile grassland	
Alpine and sub-alpine grassland	
Improved grassland	
Other arable land	
Broad-leaved deciduous woodland	
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Screes. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	**100%**

4.1 Other site characteristics

Soil & geology:

Gravel, Mud, Sand

Geomorphology & landscape:

Range of mobile sediments, Tidal current stream

4.2 Quality and importance

ARTICLE 4.1 QUALIFICATION (79/409/EEC)

Over winter the area regularly supports:

Gavia stellata (North-western Europe - wintering)	38% of the population in Great Britain peak mean over the period 1989-2006/07

ARTICLE 4.2 QUALIFICATION (79/409/EEC)

4.3 Vulnerability

The northernmost extent of the SPA contains some areas licenced for aggregate extraction and other prospecting areas. The site contains several constructed or consented offshore windfarms. There are proposals for extensions to several such windfarms. Furthermore, there is the possibility that new windfarms will be consented under Round 3. Certain shipping channels within the site have been and will continue to be subject to maintenance dredging. There may be a requirement for capital dredging in association with newly developed and future port developments. The Thames supports important commercial fisheries (as well as estuarine and marine recreational angling). There is also a well-established cockle harvesting industry. The potential impacts of many of these existing or future activities will be addressed through the relevant licence requirements and under the provision of the Habitats Regulations (including the review of consents process). Ongoing research associated with offshore windfarm development will improve understanding of the environmental factors influencing red-throated diver distribution and the extent of apparently suitable seabed habitat within the site.

Red throated divers are highly sensitive to non-physical disturbance by noise and visual presence during the winter. Locally, significant disturbance and displacement effects are predicted to arise from noise and visual impacts from wind farm construction, maintenance traffic and visually from the turbines themselves. Disturbance and displacement effects may also arise from shipping (including recreational boating) and boat movements associated with marine aggregate and fishing activities. Marine aggregates activities tend to be temporary and localised. Dredging and shipping activities are expected to be confined to existing shipping channels, which are already known to be avoided by divers. In all these cases it is expected that activity will be lowest during the winter months (when the birds are present) due to the limitations imposed by poor weather conditions. Prince's Channel (which runs through the southern area of the outer Thames SPA) carries a significant amount of vessel traffic in and out of ports in the inner Thames Estuary. Fisherman's Gat is also an active commercial shipping channel. In addition, smaller vessels use the shallower inshore channels across the site. The impacts of many of these existing or future activities will be addressed through the relevant licence requirements and under the provision of the Habitats Regulations. (including the review of consents process).

A number of operators discharge effluent into freshwater input sources upstream of the site and directly into coastal waters adjacent to the site. Direct discharges into the site include low levels of radionuclides and heavy metals. Deterioration of invertebrate and small fish populations as a result of large oil and chemical spills can have a significant impact on important food resources . Oil on the surface and in the water column would present a threat to diving and feeding seabirds. There is a considerable amount of shipping traffic within the site, mostly confined within recognise shipping channels. A small level of contamination will exist as a result of normal shipping activities. There is however, always the risk of a catastrophic spillage event from normal shipping traffic and there is in additional issue of ship-to-ship (s-t-s) oil transfers just off Southwold within 12nm.

Discharges to the freshwater environment upstream of the site will be subject to the requirements of relevant licencing. All major ports such as the Port of London will have oil spill contingency plans to deal with catastrophic events. All s-t-s transfers are well managed by the Maritime and Coastguard Agency (MCA).

Fishing activities within the site include: suction dredging for cockles, set and drift-net tramelling, drift gill netting, potting and a limited amount of beam trawling. Removal of fish and larger molluscs can have a significant impact on the structure and functioning of benthic communities. Mechanisms for these activities to impact on red-throated divers may be a direct on indirect reduction in food availability. However, the overall level of exposure of red-throated divers to prey species depletion from biological disturbance is currently considered low. Any future significant changes to the way in which certain fishing activities, such as cockle suction dredging, are conducted (eg total catch, timing etc) will be assessed under the provision of the Habitats Regulations, and will in any case likely be subject to licence arrangements and by-law restrictions overseen by the Marine Management Organisation and/or local Inshore Fishery and Conservation Authority.

Entanglement in static fishing nets is an important cause of death for red-throated divers in the UK waters. Thus, static/passive fishing gear methods such as set gillnets and drift netting represent potentially the most serious direct risk from fishing activity to the birds themselves. Netting is widespread across the sandbanks, however this is seasonally focussed and occurs primarily at times of year outwith the period when the red-throated diver population is at its peak. The scale of the by-catch within the site is unknown. Therefore, consideration of any fishery management measures will need to be preceded by monitoring of the scale of the by-catch problem within the site itself.

5. Site protection status and relation with CORINE biotopes:

5.1 Designation types at national and regional level

Code	% cover
UK00 (N/A)	100.00

Outer Thames Estuary Special Protection Area

Draft advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended) and Regulation 18 of The Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended)



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Cover photograph illustrates red-throated diver in winter.

Version 3.7 (March 2013)

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Document version control

Version and date	Amendments made	Issued to and date
Thames SPA Cons Obs AOO 190509 .doc	Changes to tables 2.1 and 2.4; additions of Bas-corbiere ruling; changes to sensitivity assessment section; changes to physical loss and physical damage sections; changes to toxic contamination and biological disturbance sections	Internal draft for comment July 3rd 2009
Thames SPA Cons Obs AOO 080709	RTD data collection footnote added; changes to physical damage and non-selective extraction sections; additional references	Internal draft for comment 8th July 2009
Thames SPA Cons Obs AOO 130709	Changes to section 2.2; addition to table 2.2; changes to table 3.1; changes to selective and non-selective extraction; additions to appendix B	JNCC Comments incorporated on 13th July
Thames SPA Cons Obs AOO170709	Changes to Cons Obj table: added habitats and species; added terms used section; changes to sensitivity assessment section; format of advice section changes; physical loss and damage changes; added non-toxic contamination; divided selective and non-selective extraction	Internal draft for comment 17th July 2009
Thames SPA Cons Obs AOO 300709	Added species and habitats to section 2.2.1; example added to 3.4.1; physical damage and loss related to habitat; biological disturbance related to RTD; changes to toxic and non-toxic contamination section and selective and non-selective extraction sections.	JNCC returned 30th July 2009
Thames SPA Cons Obs AOO 310709	Minor changes and addition of references and section	Internal draft for comment July 31st 2009
Thames SPA Cons Obs AOO 050809	All changes and version for proof reading	Internal draft for comment August 5th
Thames SPA Cons Obs AOO 090909	Final (draft) version 2009	Issued for consultation September 2009
Thames SPA Cons Obs CWversion forRAs	Draft version 2011 for QA from Evidence Team, stakeholders comments not included as comments within the text	Final draft version 2011
Thames SPA Cons Obs CWMARCH2011	Final revision post workshop, standardised approach which mirrors Liverpool Bay SPA COs, following discussions with R Caldow and JNCC	Final version March 2011
ThamesSPAConsObsVersion 3.1	Following discussions re FCT and thresholds with RC & JNCC	Final version August 2011
ThamesSPAConsObsVersion 3.2 FINAL	Final version for circulation to relevant authorities	Final version August 2011
TamesSPAConsObsVersion 3.3	Further amendments following JNCC discussions and internal advice. Removal of section 3.2.1 and re-ordering of pagination following this – M	Final Version April 2012

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	Knollys	
ThamesSPAConsObsVersion 3.4 FINAL FOR RAs	Final amendments before submitting to technical review panel	August 2012
ThamesSPAConsObsVersion 3.5 FINAL FOR RAs	Final with panel comment amendments	Nov 2012
ThamesSPAConsObsVersion 3.6 FINAL FOR WEB	Final draft document incorporating all comments	Jan 2013
ThamesSPAConsObsVersion 3.7 FINAL FOR WEB	Final document for NE and JNCC website	March 2013

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Summary of draft Conservation Objectives and Advice on Operations for the Outer Thames Estuary Special Protection Area (SPA)

This advice is based on information on the Special Protection Area (SPA) presented in Natural England's and the Joint Nature Conservation Committee's (JNCC) 'Departmental Brief: Outer Thames Estuary SPA document (Version May 2010)[1]. Natural England and JNCC's conservation objectives and advice on operations is site and feature specific, and has been developed using the best available scientific information and expert interpretation as at July 2012. The advice is generated through a coarse grading of sensitivity and exposure of the site's interest feature and its supporting habitat to physical, chemical and biological pressures associated with human activity. Sensitivity and exposure have been combined to provide a measure of the vulnerability of the interest feature to operations which may cause damage or deterioration, and therefore may require management.

The exact impact of any operation will be dependent upon the nature, scale, location and timing of events. This advice on operations for the Outer Thames Estuary SPA site will be kept under review and will be periodically updated to reflect changes in both sensitivity and exposure.

The conservation objective for the Outer Thames Estuary Special Protection Area is, subject to natural change[2], maintain[3] or enhance the red-throated diver population (*Gavia stellata*) and its supporting habitats in favourable condition[4]

The interest feature red-throated diver will be considered to be in favourable condition only when both of the following two conditions are met:

(i) The size of the red-throated diver population is at, or shows only non-significant fluctuation around the mean population at the time of designation of the SPA to account for natural change;

(ii) The extent of the supporting habitat within the site is maintained.
Management actions should enable the **Annex I feature *Gavia stellata* (wintering red-throated diver) and its supporting habitat in the Outer Thames Estuary** to

[1] http://www.naturalengland.org.uk/Images/Thames-brief_tcm6-21728.pdf

[2] Natural change" means changes in the species or habitat which are not a result of human influences. Human influence on the red-throated diver population is acceptable provided that it is proved to be/can be established to be compatible with the achievement of the conditions set out under the definition of favourable condition. A failure to meet these conditions, which is entirely a result of natural process will not constitute unfavourable condition, but may trigger a review of the definition of favourable condition.

[3] Maintain" is used here because existing evidence suggests the feature to be in favourable condition, and the objective is for it to remain so. Existing activities are deemed to be compatible with the conservation objectives if current practices are continued at current levels and in the absence of evidence that current activities are significantly affecting the red-throated diver population or its habitat. However, it must be borne in mind that gradually damaging activities can take time to show their effects. If evidence later shows an activity to be undermining the achievement of the conservation objectives, then the red-throated diver population will be deemed to be in unfavourable condition.

[4] Favourable Condition – Relates to the maintenance of the structure, function, and typical species for that feature within the site.

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maintain or enhance its population and extent of supporting habitat for the foreseeable future. This will require assessment and management of human activities likely to affect these adversely, and of activities likely to impact the functioning of natural processes upon which the feature is dependent.

To fulfil the conservation objectives for the **Annex I feature *Gavia stellata* and its supporting habitat**, the relevant and competent authorities for this area are advised to manage human activities within their remit such that they do not result in deterioration or disturbance, or impede the restoration of this feature through any of the following:

i) **Physical loss** of habitat by removal (e.g. capital dredging, harvesting, coastal and marine development)

ii) **Physical damage** by physical disturbance or abrasion of habitat (e.g. extraction)

iii) **Non-physical disturbance** through noise or visual disturbance (e.g. shipping, wind turbines)

iv) **Toxic contamination** by introduction of synthetic and/or non-synthetic compounds (e.g. polychlorinated biphenyls (PCBs), pollution from oil and gas industry, shipping);

v) **Non-toxic contamination** to prey species only by changes in e.g. turbidity (e.g. capital and maintenance dredging);

vi) **Biological disturbance** by selective extraction of species (e.g. commercial fisheries) and non selective extraction (eg entanglement with netting and wind turbine strike)

The advice describes the above impacts and activities for both the habitat and prey species of the red-throated divers and on the red-throated divers themselves.

During 2011/12 Government instigated a review of the implementation of the Habitats and Wild Birds Directive. The review concluded that all conservation objectives (marine and terrestrial) should be up-to date, accessible and allow applicants to assess the impact of their proposed development against them. The report[5] requested Natural England with JNCC to develop a new approach to improve the information contained in conservation objectives. Natural England and JNCC published their intended approach in June 2012. Natural England has committed to review and update its conservation objectives for all European Marine Sites to make them more definitive and explicit from 2013 onwards, on a prioritised basis. We will use this review to update the advice contained within this document, to take account of new evidence that subsequently becomes available, and improved scientific understanding.

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[5] http://www.defra.gov.uk/publications/2012/03/22/pb13724-habitats-wild-birds-directives/

Outer Thames Estuary Special Protection Area

Draft advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 and Regulation 18 of The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended)

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1. Introduction

The Outer Thames Estuary has been classified by the UK Government as a Special Protection Area (SPA) and the European Commission has been notified. The site now forms part of the Natura 2000[6] network. The Outer Thames Estuary SPA lies across both English territorial waters and UK offshore waters.

The Outer Thames Estuary SPA is subject to full protection under the Habitats and Birds Directive[7] (transposed through The Conservation of Habitats and Species Regulations 2010 (as amended)[8] and The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended)[9] (referred to in this document respectively as the 'Habitats Regulations' and the 'Offshore Regulations'). Amongst other things, the Habitats Regulations and the Offshore Regulations place an obligation on relevant authorities and competent authorities respectively to put in place measures to protect the sites from damage or deterioration.

This advice is given in fulfilment of the duty of Natural England and JNCC under Regulations 35(3)[10], and 18[11] of the respective Habitats Regulations (referred to in this document as "Regulation 35/18 advice"), to provide relevant and competent authorities as to (a) the conservation objectives for the Outer Thames Estuary SPA: and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the Outer Thames Estuary SPA has been designated.

This advice constitutes one element of NE's/JNCC's advisory role in relation to this site. The current information must be used by relevant authorities[12] to explore and put in place management measures (if required), and by competent authorities[13] to fulfil their duties under the Habitats Regulations in making the necessary determinations on the impact of activities on the site. Developers may also use this advice when operating within a site, and when providing information to relevant/competent authorities as part of an application for new plans and projects. However, should relevant or competent authorities or others require any further advice, they are not limited to taking account of the conservation advice contained here, and would be expected to make further enquiries as required in order to make determinations or implement management measures. Further information/reference should be made to the Departmental Brief for the Outer Thames Special Protection Area[14].

An independent review of Natural England's marine SAC selection process carried out in 2011 made a number of recommendations as to how Defra and Natural England should modify their approach to future evidence based work[15]. This resulted

[6] as defined under Regulation 3 of The Conservation of Habitats and Species Regulations 2010

[7] Council Directive 79/409/EEC on the conservation of wild birds

[8] http://www.legislation.gov.uk/uksi/2010/490/contents/made

[9] http://www.legislation.gov.uk/uksi/2010/491/contents/made

[10] http://www.legislation.gov.uk/uksi/2010/490/regulation/35/made

[11] http://www.legislation.gov.uk/uksi/2007/1842/regulation/18/made

[12] as defined under Regulation 7 of The Conservation of Habitats and Species Regulations 2010

[13] http://www.legislation.gov.uk/uksi/2007/1842/regulation/23/made

[14] http://www.naturalengland.org.uk/Images/Thames-brief_tcm6-21728.pdf

[15] http://www.defra.gov.uk/publications/files/pb13598-graham-bryce-independent-review-marine-sacs-110713.pdf

in Natural England adopting the Government Chief Scientific Adviser"s (GCSA) guidelines on using evidence[16] through the development of a suite of Evidence Standards[17]. Implementation of these standards has included Natural England working with JNCC to develop a protocol[18], which has been subject to independent expert review, setting out the processes and requirements for the development of conservation advice packages, to ensure that these fully comply with the GCSA's guidelines. Whilst the conservation advice provided here was developed prior to the finalisation of the protocol, it has been assessed for compliance with the protocol and a detailed report can be found on the Natural England website[19]

During 2011/12 Government instigated a review of the implementation of the Habitats and Wild Birds Directive. The review concluded that all conservation objectives (marine and terrestrial) should be up-to date, accessible and allow applicants to assess the impact of their proposed development against them. The report[20] requested Natural England with JNCC to develop a new approach to improve the information contained in conservation objectives. Natural England and JNCC published their intended approach in June 2012, with Natural England committing to review and update its conservation objectives for all European Marine Sites to make them more definitive and explicit. We will be consulting with stakeholders on the approach, as well as how we can make our Regulation 35/18 advice more accessible and easier to use. The review of conservation advice will then begin in 2013 on a prioritised basis. We will use this review to update the advice contained within this document, to take account of new evidence that subsequently becomes available, and improved scientific understanding.

2. Roles and Responsibilities

2.1 The role of Natural England and JNCC

The Conservation of Habitats and Species Regulations 2010 (as amended) transpose the Habitats Directive into law on land and in territorial waters of Great Britain (out to 12 nautical miles from the baseline). The Regulations give Natural England a statutory responsibility to advise relevant and competent authorities on the conservation objectives and operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species for which the sites have been designated, for European marine sites in England.

The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended) transpose the Habitats Directive into law for UK offshore waters (from 12 nautical miles from the coast out to 200 nm or the UK Continental Shelf). These Regulations give JNCC a statutory responsibility to advise competent authorities of the conservation objectives for offshore Special Areas of Conservation and to advise them of operations which may adversely affect the integrity of the site.

[16] http://www.bis.gov.uk/assets/goscience/docs/g/10-669-gcsa-guidelines-scientific-engineering-advice-policy-making.pdf
[17] http://www.naturalengland.org.uk/ourwork/research/default.aspx
[18] http://www.naturalengland.org.uk/ourwork/marine/sacconsultation/default.aspx
[19] http://publications.naturalengland.org.uk/publication/3233957?category=3212324

This advice is also required under the Offshore Petroleum Activities 2001 (Conservation of Habitats) Regulations (as amended); and the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended).

Natural England and JNCC will provide additional advice for each site to Relevant and competent authorities in order for them to fulfil their duties under the Habitats Regulations, for example when a Competent Authority wishes to assess the implications of any plans or projects on a candidate Special Area of Conservation (cSAC), Special Area of Conservation (SAC), or Special Protection Area (SPA).

2.2 The role of relevant and competent authorities

2.2.1 Inshore (0 – 12 nautical miles):

The Habitats Regulations require relevant and competent authorities to exercise their functions so as to secure compliance with the Habitats Directive. Under Regulation 36[21] of the Habitats Regulations relevant authorities may use this advice to draw up a management scheme for the SPArelevant authorities must, within their areas of competence, have regard to both direct and indirect effects on interest features of the site. This may include consideration of issues outside the boundary of the site.

2.2.2 Offshore (12 – 200 nautical miles):

Regulations 22, 23, 25 and 27[22] of the Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended) outline the responsibilities of competent authorities to ensure compliance with the Habitats Directive. Regulation 22 requires competent authorities to consider appropriate conservation measures for Annex I habitats and Annex II species present within the SAC. Regulation 23 requires competent authorities to take appropriate steps to avoid the deterioration or disturbance of interest features for which the Offshore SAC is designated. Regulation 25 requires competent authorities to consider if a plan or project could be likely to have a significant effect on a European Offshore Marine Site and, if necessary, undertake an appropriate assessment for the plan or project. Regulation 27 requires competent authorities to review existing consents, permissions or authorisations and if necessary, affirm, modify or revoke them, undertaking an appropriate assessment where necessary. Competent authorities must, within their areas of competence, have regard to both direct and indirect effects on interest features of the site. This may include consideration of issues outside the boundary of the SAC.

2.2.3 Activity outside the control of relevant/competent authorities

Nothing within Regulation 35/18 advice will require relevant authorities to undertake any actions or ameliorate changes in the condition of interest features if it is shown that the changes result wholly from natural causes. Having issued Regulation 35/18 advice for this site, Natural England and JNCC will work with relevant and competent authorities and others to agree, within a defined time frame, a protocol for evaluating observed changes in the site's condition and to develop an understanding of natural change and provide further guidance as appropriate and possible. This does not, however, preclude relevant and competent authorities from taking any appropriate action to prevent deterioration to the interest features, and indeed such actions should be undertaken when required.

[21] http://www.legislation.gov.uk/uksi/2010/490/regulation/36/made
[22] http://www.legislation.gov.uk/uksi/2007/1842/contents/made

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2.3 The role of conservation objectives

The conservation objectives set out what needs to be achieved for the site to make the appropriate contribution to the conservation status of the features for which the site is designated and thus deliver the aims of the Habitats and Birds Directives.

Conservation objectives are the starting point from which management schemes and monitoring programmes may be developed as they provide the basis for determining what is currently or may cause a significant effect, and they inform the scope of appropriate assessments.

In addition to providing such advice, this advice will inform the scope and nature of any 'appropriate assessment' which the Directive requires to be undertaken for plans and projects (Regulations 61 and 63 and by Natural England under Regulation 21 of the Habitats Regulations).

2.4 The role of advice on operations

The advice on operations set out in Section 4 of this document provides the basis for discussion about the nature and extent of the operations taking place within or sufficiently close to have an impact on the site and which may have an impact on its interest features. The advice should also be used to help identify the extent to which existing measures of control, management and forms of use are, or can be made, consistent with the conservation objectives, and thereby focus the attention of relevant authorities and surveillance to areas that may need management measures.

This advice on operations may need to be supplemented through further discussions with the relevant authorities and any advisory groups formed for the site.

2.5 Precautionary principle

All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences. Moreover, it is important, when considering whether the information available is sufficient, to take account of the associated balance of likely costs, including environmental costs, and benefits (DETR & the Welsh Office, 1998).

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3. Conservation objectives

3.1 Background to conservation objectives

The conservation objectives and definitions of favourable condition for features on the site may inform the scope and nature of any 'appropriate assessment' under the Habitats Regulations[23,24]. An appropriate assessment will also require consideration of issues specific to the individual plan or project.

The scope and content of an appropriate assessment will depend upon the location, size and significance of the proposed project. Natural England and JNCC will advise on a case by case basis.

Following an appropriate assessment, competent authorities are required to ascertain the effect on the integrity of the site. The integrity of the site is defined in paragraph 20 of ODPM (Office of the Deputy Prime Minister) Circular 06/2005 (DEFRA Circular 01/2005)[25] as the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified. The determination of favourable condition is separate from the judgement of effect upon integrity. For example, there may be a time-lag between a plan or project being initiated and a consequent adverse effect upon integrity becoming manifest in the condition assessment. In such cases, a plan or project may have an adverse effect upon integrity even though the site remains in favourable condition, at least in the short term.

The conservation objectives for this site are provided in accordance with paragraph 17 of ODPM Circular 06/2005 (DEFRA Circular 01/2005) which outlines the appropriate assessment process. The entry on the Register of European Sites gives the reasons for which a site was classified or designated.

The target for population size is set to take account of the way in which populations fluctuate naturally and the degree of uncertainty in estimating population size. This is done so that in future condition monitoring, a population size estimate that falls within the known natural fluctuations in population size, or has a degree of uncertainty around it that renders it indistinct from the estimate of population size at the time of classification (i.e. the baseline population), can be distinguished from one that does not. This distinction serves to identify those circumstances in which the evidence is consistent with an interpretation that any apparent decline in a population below that at classification is simply a reflection of margins of error in measurement and/or due to a natural fluctuation which is part of a normal and established pattern which can be attributed to natural phenomena such a food availability, weather conditions etc.. In such circumstances it would be inappropriate to trigger further investigation into the causes of the apparent decline or the implementation of remedial actions to reverse it. In contrast, where the decline is of a magnitude that takes it beyond these limits then it is quite possible that, being beyond "expected variation", there is a non-natural cause. Classification of the feature as being in unfavourable condition would then trigger investigation of the cause of the population decline and perhaps trigger

[23] The Conservation of Habitats and Species Regulations 2010: Regulation 61 and 63 by a competent authority and Regulation 21 by Natural England.
[24] Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended): Regulation 25 and 27 by a competent authority.
[25] http://www.communities.gov.uk/documents/planningandbuilding/pdf/147570.pdf

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remedial management actions if the decline can be attributed to a particular cause (or causes) that can be managed so as to reduce their impact in the future.

This assessment is distinct from that carried out when considering the significance of a specific anthropogenic impact which can be shown to (or is predicted to) reduce a population from its baseline value to a new lower level.

3.2 Outer Thames Estuary SPA conservation objectives

The formal conservation objectives (as at July 2011) for Outer Thames Estuary SPA interest features are provided below. These are high-level objectives for the site features, and Natural England and JNCC may refine them in the future as our understanding of the features improves and further information becomes available, such as survey work.

They should be read in the context of other advice given, particularly:

(i) the Departmental Brief[26] which provides more detailed information about the site and evaluates its interest features according to the Birds Directives selection criteria and guiding principles;

(ii) the favourable condition table (Appendix A) providing information on how to recognise favourable condition for each of the features and which will act as a basis from which the monitoring programme will be developed; and

(iii) the attached maps (Appendix B) which show the known locations of the interest features

3.2.1 Red-throated diver – *Gavia stellata*

Red-throated diver is listed in Annex I to the Birds Directive and is assessed against stage 1(1) of the SPA selection guidelines (Stroud *et al.* 2001)[27]; using the relevant national population estimate the wintering population of red-throated divers in Great Britain is estimated to be 17,116 individuals (O'Brien et al. 2008), representing between 10-19% (depending on the areas included) of the NW Europe non-breeding population. The Great Britain population estimate is derived from shore-based observations together with more specific aerial surveys. Surveys from aeroplanes (and boats) have been responsible for identifying much larger numbers wintering in British coastal waters than previously known (O'Brien *et al*. 2008). Recent evolution of aerial survey methods, using both High Resolution still photography and High Definition video, has revealed that previous estimates of red-throated diver numbers are likely to be under-estimates (APEM 2010).

In the UK, wintering red-throated divers are associated with inshore waters, often occurring within sandy bays, firths and sea lochs, although open coastline is also frequently used (Skov *et al*., 1995; Stone *et al.*, 1995). Knowledge of red-throated diver distribution in the UK was transformed during the 2000s following the advent of aerial and boat surveys for offshore development, particularly renewables development (e.g. Percival *et al.*, 2004; O'Brien *et al*. 2008). The bulk of the UK distribution is in east England, the area between Kent and North Yorkshire supporting 59% of the UK total estimate; 44% of the UK total is in the Greater Thames alone (O'Brien *et al.* 2008), with variable distribution between surveyed sites (APEM 2011).

[26] http://publications.naturalengland.org.uk/file/3264082
[27] http://jncc.defra.gov.uk/page-1405

Liverpool Bay is currently the only other marine area in the UK classified as a SPA for red-throated divers.

Red-throated divers use the Outer Thames Estuary SPA in wintering numbers of European importance (6,466 individuals, 38% of the GB population, 1989 – 2006/07).

Table 3.1 The conservation objectives for the Outer Thames Estuary SPA interest feature: internationally important population of the regularly occurring Birds Directive Annex I species: red-throated diver (*Gavia stellata*)

Subject to natural change[28], maintain[29] or enhance the red-throated diver population and its supporting habitats in favourable condition[30] Relevant habitats include shallow coastal waters and areas in the vicinity of sub-tidal sandbanks The number of red-throated diver using these habitats is given in Table 3.2 below.

The interest feature red-throated diver will be considered to be in favourable condition only when both of the following two conditions are met:

(i) The size of the red-throated diver population is at, or shows only non-significant fluctuation around the mean population at the time of designation of the SPA to account for natural change;

(ii) The extent of the supporting habitat within the site is maintained.

> The favourable condition table (Appendix A) further defines favourable condition for the interest features of the site.

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[28] Natural change" means changes in the species or habitat which are not a result of human influences. Human influence on the red-throated diver population is acceptable provided that it is proved to be/can be established to be compatible with the achievement of the conditions set out under the definition of favourable condition. A failure to meet these conditions, which is entirely a result of natural process will not constitute unfavourable condition, but may trigger a review of the definition of favourable condition.

[29] Maintain" is used here because existing evidence suggests the feature to be in favourable condition, and the objective is for it to remain so. Existing activities are deemed to be compatible with the conservation objectives if current practices are continued at current levels and in the absence of evidence that current activities are significantly affecting the red-throated diver population or its habitat. However, it must be borne in mind that gradually damaging activities can take time to show their effects. If evidence later shows an activity to be undermining the achievement of the conservation objectives, then the red-throated diver population will be deemed to be in unfavourable condition.

[30] Favourable Condition **–** Relates to the maintenance of the structure, function, and typical species for that feature within the site.

Table 3.2 Information on the population of red-throated diver that qualifies the Outer Thames Estuary as an SPA under the Birds Directive.

Internationally important populations of regularly occurring Birds Directive Annex 1 species	
Species	**Wintering population**
Red-throated diver *Gavia stellata*	6,466 individuals[31]

3.2.2 Explanatory information for the red-throated diver conservation objectives

Key supporting habitats and distribution

In the UK, wintering red-throated divers are associated with shallow inshore waters (between 0-20m deep and less frequently in depths of around 30m), often occurring within sandy bays, firths and sea lochs, although open coastline is also frequently used (Skov *et al*., 1995; Stone *et al.*, 1995). There is some evidence of association with areas of salinity change (e.g. where low salinity river water meets higher salinity sea water: Skov & Prins 2001; Skov *et al.* 2011). Such areas tend to fluctuate with state of tide, volume of river flow and wind conditions.

Other physical and hydrographic factors determining the distribution of red-throated divers have been established for part of the Outer Thames Estuary SPA (Skov *et al.* 2011). This modelling work identified different areas of high habitat quality at different tidal flow phases with variables including current velocity, water levels, eddies, upwellings and shipping found to be important at different tidal stages. As an active fish-feeder (Guse *et al.* 2009 and references therein), the distribution and concentrations of red-throated divers will at least partly be determined by the presence, abundance, and availability of their prey species, which is likely to be linked to at least some of the environmental parameters tested by Skov *et al.* (2011).

Key food

The red-throated diver is considered to be an opportunistic feeder and dietary studies have revealed several different fish species are consumed depending upon the area studied, including members of the cod family, herring, gobies and sand eels (Guse *et al*. 2009 and references therein). The sandbanks of the Outer Thames Estuary

[31] The wintering population estimate was generated from aerial survey data, collected mainly by WWT (Wildfowl and Wetlands Trust) Consulting, commissioned by a number of organisations including UK Government and a consortium of wind energy companies. Other data were collected by the JNCC Marine SPA Team, and by the Natural Environmental Research Institute, Denmark. Data were collected between the months of October to March in 1988/89, and 2002-2007. **JNCC has absolute confidence in the integrity of the data provided.** Population estimates within the boundary are calculated using spatial analysis to estimate RTD density in 1km grid squares. This is the revised figure following the re-drawing (shrinking) of the boundary as a result of the public consultation.

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support the nursery and feeding grounds for many fish species, including the small fish that red-throated divers feed on.

Behaviour and Impacts

In a review of the sensitivity of 26 species of 'seabird' to the development of offshore windfarms, Garthe & Huppop (2004) found that red-throated divers had the second highest species sensitivity index score. Furness & Wade (2012) similarly ranked the species of primary concern with regard to disturbance /displacement from offshore wind farms. There is evidence that red-throated divers are displaced from the footprint of offshore windfarms and surrounding sea areas up to 2km distant from the outermost turbines due most likely to the presence of the turbines and the activities of maintenance vessels. Petersen *et al*. (2006) showed a marked post construction avoidance of the Horns Rev offshore windfarm, including also the 2km and 4km zones around it. A similar, though less pronounced avoidance response to the Nysted offshore windfarm by red-throated divers was also recorded (Petersen *et al.* 2006), and emerging data from Kentish Flats offshore wind farm suggest a decreasing displacement effect with distance from the turbine footprints (Percival 2010). Inappropriately sited developments could displace significant numbers of the GB wintering population. Other forms of renewable energy, such as tidal barrages, could also impact on the species' wintering numbers and distribution for disturbance and habitat loss reasons.

Red-throated divers are especially sensitive to disturbance at sea (Garthe & Huppop 2004; Furness & Wade 2012) and usually avoid boats (Schwemmer *et al.* 2011).

Red-throated divers are highly sensitive to the effects of disturbance associated both directly with marine aggregate extraction, and also the resultant increases in shipping activity. As Red-throated divers are highly exposed to marine aggregate extraction areas, they have been assessed as being highly vulnerable to changes to turbidity, sedimentation and impacts to the benthos or associated fish communities (Cook & Burton 2010).

Red-throated divers moult their flight feathers during September and October when they may become flightless for a short period and are vulnerable to oil pollution at this time (Camphuysen, C.J. 1989, Williams et al 1994).

Red-throated diver populations are vulnerable to increased adult mortality as it is a long-lived species with low breeding productivity. Studies have shown entanglement in various types of static fishing gear, netting and marine litter as one of the most frequently identified causes of death in NW European and GB waters (Okill 2002, Erdmann *et al.* 2005, Weston & Caldow 2010). However early indications from a 2011/12 study by Natural England and the Kent and Essex IFCA in the Outer Thames Estuary SPA suggest that occurrence of red-throated diver entanglement in fishing gear is low. Further data is being collected over the 2012/13 winter. At a broader geographic scale, bycatch of red-throated divers in the Baltic Sea and North Sea is estimated to be of the order of 'hundreds' from a population of >100,000 (Zydelis *et al.* 2009).

Herring are key prey species for the red-throated diver (Guse *et al.* 2009). The species may thus also be sensitive to aspects of dredging activity that negatively impact on herring populations, such as increases in sediment deposition (Cook & Burton 2010).

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Commercial extraction of the red-throated diver's main fish prey species, as target and/or bycatch species, could impact the birds, but again the extent of this in the Outer Thames Estuary SPA is not well understood.

3.3 Background to favourable condition table

The favourable condition table is the principle source of information that Natural England and JNCC will use to monitor and assess the condition of an interest feature and as such comprises indicators of condition. The favourable condition table can be found at Appendix A.

On many terrestrial European sites, we know sufficient information about the required condition of qualifying habitats to be able to define favourable condition with confidence. In contrast, understanding the functioning of large, varied, dynamic marine and estuarine sites, which experience a variety of pressures resulting from historic and current activities, is much more difficult, consequently it is much harder to define favourable condition so precisely in such sites. In general the conservation objectives provided are based on a *working* assumption that the *current* condition of the features is favourable for most attributes.

Where there are more than one year's observations on the condition of marine features, all available information will need to be analysed to determine, where possible, any natural environmental trends at the site. This will provide the basis for judgements of favourable condition to be determined in the context of natural change. Where it becomes clear that certain attributes may indicate a cause for concern, and if further investigation indicates this is justified, restorative management actions will need to be taken. The aim of such action would be to return the interest feature to favourable condition from any unfavourable state. Future editions of the advice within this document will revise the current assumptions about feature condition in light of ongoing and future monitoring. This will be linked with any developments in our understanding of the structure and functioning of features and the pressures they are exposed to.

This advice also provides the basis for discussions with relevant authorities, and as such the attributes and associated measures and targets may be modified over time. The aim is to have a single agreed set of attributes that will be used as a basis for monitoring in order to report on the condition of features. Condition monitoring of the attributes may be of fairly coarse methodology, underpinned by more rigorous methods on specific areas within the site. Common Standards Monitoring (JNCC 2004) requires mandatory monitoring of some attributes of a designated feature, while other attributes are considered discretionary (or site-specific) and are incorporated to highlight local distinctiveness. Monitoring of both bird populations and the extent of habitats are fundamental to assessing the condition of bird features (JNCC 2004), and are therefore identified as "**mandatory attributes"** in the Favourable Condition Tables (Appendix A). It is not possible to make a robust assessment of the condition of a feature without assessing the mandatory attributes. **For bird features the general rule is that all mandatory attributes must meet their targets for the feature to be in favourable condition**. Priority will be given to measuring attributes that are at risk from anthropogenic pressure and for which changes in management may be necessary. This information may be generated by Natural England/JNCC or collected by other organisations through agreements.

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The condition monitoring programme will be developed through discussion with the relevant / competent authorities and other interested parties, ideally as part of the management scheme process. Natural England and JNCC will be responsible for collating the information required to assess condition, and will form a judgement on the condition of each feature within the site.

Targeted monitoring of the attributes identified in the favourable condition table will be an important, but not the only, basis for assessing the condition of the features. Additional sources of information may also be selected to inform our view about the integrity and condition of the site. For example, a part of risk based monitoring activity data (as collected by the relevant/competent authorities and their statutory advisers) could give an indication as to the levels of pressure that may impact on the site features. Any other relevant data, such as data on site integrity, results from compliance monitoring, (for example assessing the conduct of activities in relation to regulations and licence conditions), together with data obtained to inform appropriate assessments, licence applications etc. will also have an important role in informing assessments of feature condition.

Information about the size of the red-throated diver population on the site will also need to be interpreted in the context of any wider changes in the population of this species at a national or biogeographic region level.

4. Advice on operations

4.1 Background

Natural England and JNCC have a duty under Regulation 35(3)(b) of the Habitats Regulations and 18 of the Offshore Marine Conservation Regulations to advise other relevant authorities as to any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated.

The process of deriving and scoring relative vulnerability is provided at Appendix C. A summary of the operations which may cause deterioration or disturbance is given at Appendix D, and detailed in Appendix E. Further explanation of the sensitivity of the interest features follows with examples of their exposure and therefore their vulnerability to damage or disturbance from the listed categories of operations. This enables links to be made between the categories of operation and the ecological requirements of the features.

4.2 Purpose of advice

The aim of this advice is to enable all relevant authorities to direct and prioritise their work on the management of activities that pose the greatest potential threat to the favourable condition of interest features at Outer Thames Estuary SPA. The advice is linked to the conservation objectives for interest features and will help provide the basis for detailed discussions between relevant authorities enabling them to formulate and agree a management scheme for the site should one be deemed necessary.

The advice given here will inform, but is given without prejudice to, any advice provided under Regulation 61 or Regulation 63 on operations that qualify as plans or projects within the meaning of Article 6 of the Habitats Directive.

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4.3 Methods for assessment

To develop this advice on operations Natural England has used a three step process involving:

- an assessment of the **sensitivity** of the interest features or their component sub-features to operations;

- an assessment of the **exposure** of each interest feature or their component sub-features to operations; and

- a final assessment of **current vulnerability** of interest features or their component sub-features to operations.

This three step process builds up a level of information necessary to manage activities in and around the site in an effective manner. Through a consistent approach, this process enables Natural England to both explain the reasoning behind our advice and identify to competent and relevant authorities those operations which pose the most current threats to the favourable condition of the interest features on the site.

All the scores of relative sensitivity, exposure and vulnerability are derived using best available scientific information and informed scientific interpretation and judgement. The process uses sufficiently coarse categorisation to minimise uncertainty in information, reflecting the current state of our knowledge and understanding of the marine environment.

Six broad Pressure 'Categories of Operation' which may cause i) deterioration of natural habitats or the habitats of species, or ii) disturbance of species, (either alone or in-combination), are considered in this document:

- Physical Loss
- Physical Damage
- Non-physical disturbance
- Toxic contamination
- Non-toxic contamination
- Biological disturbance

Example sources of pressures are provided (Appendix D), although these examples are not inclusive of all potentially detrimental activities.

4.3.1. Sensitivity assessment

The sensitivity assessment used is an assessment of the relative sensitivity of the interest features and their supporting habitat in the Outer Thames Estuary SPA to the effects of six broad categories of human activities.

In relation to this assessment, sensitivity has been defined as the "intolerance of a habitat, community or individual (or individual colony) of a species to damage, or death, from an external factor and the time taken for its subsequent recovery" (Hiscock 1996, MarLIN, 2003). For example, a very sensitive species or habitat is

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one that is very adversely affected by an external factor arising from human activities or natural events (killed/destroyed, 'high' intolerance) and is expected to recover only over a very long period of time, i.e. >10 or up to 25 years ('low' recoverability). In the case of the SPA, this assessment considers the sensitivity of the red-throated diver population as well as the species and habitats on which that population depends. This includes its prey species and supporting habitats e.g. the condition of the sandbanks is important because they support the food chain on which the divers depend.

The sensitivity assessments are based on current information but may develop with improvements in scientific knowledge and understanding. The sensitivity of interest features or sub-features (and scientific understanding of sensitivity) may change over time; hence an operation that is not currently considered to have a negative effect may be identified as having one in the future. For example the dependence on a particular prey species may change if that species' abundance declines and the birds switch prey species. The subsequent shift may mean dependence on another prey species not previously assessed.

4.3.2. Exposure assessment

This has been undertaken for the Outer Thames Estuary SPA by assessing the relative exposure of the interest features and their supporting habitat on the site to the effects of broad categories of human activities currently occurring on the site (as at July 2012). These assessments were made on the best available information and advice but should be reviewed in light of additional information on activities in the area.

4.3.3. Vulnerability assessment

The third step in the process is to determine the vulnerability of interest features or their component sub-features to operations. This is an integration of sensitivity and exposure. Only if a feature is both sensitive *and* exposed to a human activity is it considered vulnerable (see Appendix C). In this context, therefore, 'vulnerability' has been defined as the exposure of the habitat, community or individual (or individual colony) of a species to an external factor to which it is sensitive (Hiscock, 1996). An assessment of the interest feature's vulnerability (Appendix E) helps to guide site management decisions by highlighting potentially detrimental activities that may need to be managed (or continue to be managed) by the competent authorities.

The vulnerability of the SPA Annex I feature to climate change is not considered in the annexes below, given the uncertainties surrounding the effects of global change on the oceans.

4.4 Format of advice

The advice is provided within six broad categories of operations that may cause deterioration of natural habitats or the habitats of species, or disturbance of species. This approach therefore:

- enables links to be made between human activities and the ecological requirements of the habitats or species, as required under Article 6 of the Habitats Directive;[32]

[32] For full a background summary to the Natura 2000 see http://necmsstage/ourwork/marine/sacconsultation/default.aspx and

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- provides a consistent framework to enable relevant authorities to assess the effects of activities and identify priorities for management within their areas of responsibility; and

- is appropriately robust to take into account the development of novel activities or operations which may cause deterioration or disturbance to the interest features of the site and should have sufficient stability to need only infrequent review and updating by Natural England and JNCC.

These broad categories provide a clear framework against which relevant and competent authorities can assess activities under their responsibility.

4.5 Update and review of advice

Information as to the operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated, is provided in light of what Natural England knows about current and recent activities and patterns of usage at Outer Thames Estuary SPA. Natural England and JNCC expects that the information on activities and patterns of usage will be refined as part of the process of developing the management scheme and through discussion with the relevant and competent authorities. As part of this process the option of identifying a number of spatial zones with different activity levels may be appropriate. It is important that future consideration of this advice by relevant authorities and others takes account of changes in the usage patterns that have occurred at the site, over the intervening period, since the information was gathered. In contrast, the information provided in this advice on the sensitivity of interest features or sub-features is relatively stable and will only change as a result of an improvement in our scientific knowledge, which will be a relatively long term process. Advice for sites will be kept under review and will be periodically updated through discussions with relevant and competent authorities and others to reflect significant changes in our understanding of sensitivity together with the potential effects of plans and projects on the marine environment.

5. Specific advice on operations for the Outer Thames Estuary SPA

The following sections provide information to help relate general advice regarding the sensitivity and exposure of the specific interest feature (the overwintering population of red-throated diver, *Gavia stellata*) and its supporting habitat to operations and activities within and adjacent to the Outer Thames Estuary SPA.

This advice relates to the vulnerability of the interest features and sub-features of the Outer Thames SPA to current levels of human usage, as summarised in Appendix D and detailed in Appendix E.

Further explanation of the sensitivity of the interest feature and supporting habitats follows, with examples of its exposure and therefore its vulnerability to damage or disturbance from the listed categories of pressures. This enables links to be made between the categories of operation and the ecological requirements of the features.

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the Departmental brief: http://www.naturalengland.org.uk/Images/Thames-brief_tcm6-11044.pdf

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Information regarding the current commercial activities in and around the SPA can be found in the Departmental Brief[33] for the Outer Thames Estuary SPA.

5.1. Detailed advice for the Outer Thames Estuary SPA features

5.1.1. Physical loss of supporting habitat

In the UK, wintering red-throated divers are associated with shallow (between 0-20m deep (less frequently in depths of around 30m)) inshore waters, often occurring within sandy bays, firths and sea lochs, although open coastline is also frequently used (Skov *et al*., 1995; Stone *et al.*, 1995). Red-throated divers are known to be associated with sandbank features, although the exact use of different habitats within the Outer Thames Estuary is complex, and related to both physical and hydrographic variables (Skov *et al.* 2011).

The link between the birds and benthic habitats is not well understood but it probably reflects the association between some of their prey species (small fish such as gadoids, sprat, herring and sandeel between approximately 10 and 25 cm in length; Guse *et al 2009.*, and references therein) and sandbanks (Kaiser *et al*. 2004). Sandbanks may have a functional role (as nursery, spawning, or feeding grounds or in providing shelter) in supporting these fish species. Eddies and upwellings, perhaps reflecting biologically productive components of the marine environment and thus attractive to fish, have been shown to be important on certain tidal phases for explaining red-throated diver distribution in the Outer Thames Estuary (Skov *et al.* 2011).

Physical loss by removal or by smothering of any of the habitats on which red-throated divers depend may result in the loss of foraging sites and therefore the reduction of the food resource for the overwintering population. This would consequently be detrimental to the favourable condition of the interest feature. **Thus the overwintering population is considered to be highly sensitive to physical removal of habitat and moderately sensitive to smothering.** The sensitivity for smothering is considered moderate rather than high because habitats can recover after time with smothering whereas physical removal is likely to destroy the habitat.

Offshore development construction, marine aggregates extraction, capital and maintenance dredging of shipping channels all undertake physical removal of sand from within the SPA boundary. The northernmost extent of the SPA boundary (Norfolk) crosses the 12nm zone and contains some aggregates licences (from 2008) and prospecting areas. The environmental statement for the London Array Windfarm located in the southern area of the SPA (partially overlapping Margate & Long Sands SAC) considered that the resulting habitat loss from the development is very small, and is not considered significant in the context of habitat availability for divers within the SPA and the Thames Estuary as a whole (RPS Group PLC 2005).

The Round 3 development programme for offshore wind farms includes an area overlapping with the northern extent of the SPA. The Crown Estate has awarded a lease to develop the Norfolk Zone (Zone 5) to a consortium known as East Anglia Offshore Wind. This consortium will be required to undertake a zonal assessment of their combined proposals followed by an environmental impact assessment and make an application through the Planning Inspectorate for each windfarm proposal.

[33] http://www.naturalengland.org.uk/Images/Thames-brief_tcm6-11044.pdf

An approximate calculation of turbine base diameter relative to the entire extent of the SPA, indicates that direct physical loss of habitat due to the footprint of windfarm turbines (taking into account Kentish Flats, Gunfleet Sands, Scroby Sands, London Array and the Round 3 zone off Suffolk) would be substantially less than 0.01% of the total SPA area. Whilst this figure does not take into account habitat loss due to scour protection around the turbines or over inter-array and grid connection cables, in the context of the SPA area the total figure for direct habitat loss due to turbine footprints and scour protection is still likely to fall below 1% of the total SPA area (the total area of the Outer Thames Estuary SPA is 379,268.14 ha). Direct loss due to the turbine footprint must be considered alongside 'effective' or indirect loss of habitat (which could be temporary), due to divers avoiding the windfarm area. This is addressed under non physical disturbance in section 5.1.3.

Furthermore, although net habitat loss may be small, it is important to recognise that some habitat areas will be of more importance to red-throated divers than others. Within the Outer Thames Estuary area, Kentish Flats and London Array offshore wind farms are situated in habitat typically described as being of 'high' or 'very high' quality (Skov *et al.* 2011). Displacement from such habitat may lead to density-dependent effects (e.g. increased feeding competition) elsewhere within the SPA.

Black Deep and Fisherman's Gat have never been dredged; the Princes Channel was dredged in 2008 for the first time in 40 years and there will be an ongoing maintenance dredging requirement. Maintenance and / or capital dredging is likely to increase if shipping activity and ship sizes increases. Capital dredging within the site is planned for Shellhaven, a new container port that is being developed on the site of a former oil refinery. In addition planned capital dredging of the Medway Approach Channel will fall partly within the site.

Based on the overall extent of supporting sandbank habitat and the distribution and extent of activities the overall exposure to physical loss due to removal can be considered to be low. This is because although the impacts described above may be relatively geographically dispersed, when considered cumulatively they represent only a small area of the SPA habitat. However, the quality of supporting habitat, as determined by modelling of environmental predictor variables against known diver distributions, is a key consideration in the ultimate effect of such habitat removal (Skov *et al.* 2011). The existing and prospective aggregate extraction areas within the site as well as ongoing maintenance dredging requirements of shipping lanes and potential future capital dredging means that **exposure to physical loss due to smothering can be considered to be moderate.**

Overall the **vulnerability of the Annex I species** within the Outer Thames Estuary SPA and associated habitats to **physical loss** due to both physical removal and smothering is considered to be **low to moderate**.

5.1.2. Physical damage to their supporting habitat

Benthic sandbank communities are in general relatively resilient to physical damage. However, repeated damage to the habitats (through changes in suspended sediment or physical disturbance caused by selective extraction, anchoring or bottom-towed fishing gear) could adversely affect the ability of the habitats to recover, leading to permanent damage and ultimately to loss of prey species. This may result in a reduction in the value of sandbank habitats as foraging sites for the overwintering population of red-throated diver. Therefore, **the overall sensitivity of the red-throated divers to damage to their supporting habitat is considered to be moderate**.

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Few ships anchor in the Outer Thames. Marine aggregate extraction activities are mostly in the northern extent of the SPA with some new licence areas in the northerly part of the southern section. Activities are not expected to significantly reduce habitat availability for divers as the areas worked are typically limited spatially and temporally. Commercial fishing activity within the SPA includes: suction dredging for cockles, set and drift-net trammelling, otter trawling, drift gill netting, potting, long-lining and a limited amount of beam trawling for demersal species. While the capacity for the majority of these gear types to cause physical damage to the seabed habitat is low, the interaction between suction dredging, beam trawling and to a lesser extent demersal otter trawling gear components and the seafloor can result in physical disturbance and potentially damage, depending on the intensity of the activity and sediment composition of the habitat (JNCC and Natural England 2011). Significant long-term changes in bathymetry caused by bottom-towed fishing gear that could render habitat unavailable for foraging divers are not anticipated. **The site is therefore considered to have low exposure to physical damage.**

Overall the **vulnerability of the Annex I species** within the Outer Thames Estuary SPA and associated habitats to physical damage is considered to be **low** for siltation, abrasion and selective extraction.

5.1.3. Non physical disturbance of red-throated diver

Red-throated divers are highly sensitive to non-physical disturbance by noise and visual presence during the winter (Garthe & Huppop 2004). They can be disturbed by wind turbine rotors, boat movements, and general activity. Disturbance can cause birds to reduce or cease feeding in a given area or to fly away from an area (i.e. be displaced). Either response could decrease their energy intake rate at their present (disturbed) feeding site or alternative feeding site, which may be less favoured. The latter response would also increase energy expenditure during flight and perhaps during subsequent foraging in less favourable habitat (or favourable habitat with greater intra-specific competition). Both disturbance and displacement can in principle affect the energy budgets and possibly survival of birds. Stillman *et al*. (2007) note that the impacts of disturbance during the non-breeding season on migratory wildfowl should be measured in terms of its effects on two factors: i) the storage of fat reserves needed to fuel migration in spring and to breed successfully after the birds have reached the breeding grounds; and ii) the number of birds that die during the non-breeding season. Impacts on both factors are likely to be a particular problem for diving birds which engage in an energetically expensive mode of foraging (de Leeuw 1997). **Sensitivity can be considered high.**

Disturbance and displacement of prey species arising from construction noise from wind farms could cause disruption to their lifecycles, as herring and sprat are thought to be a prey resource and are sensitive to noise. Benthopelagic fish species have some sensitivity to both construction and operational noise from windfarms. However, the level of certainty regarding the zone of impact and precise response is limited, with estimates of physiological responses, injury and death reported at varying distances from construction/operation. These appear to be more significant as a result of construction noise than operation, within 150m of the source, although impacts may occur up to 1000m away.[34]

[34] http://www.offshorewindfarms.co.uk/Assets/BIOLAReport06072006FINAL.pdf

Locally, significant disturbance and displacement effects are predicted to arise from noise and visual impacts from wind farm construction, maintenance traffic and visually or aurally from the turbines themselves. The calculation for the areas of the consented windfarm footprints relative to the area of the SPA shows that 3.5% of the SPA area could be made unavailable through displacement.[35] If the entire consented London Array development is included this increases to 282.5 km^2 or 7.2% of the SPA area which could potentially be unavailable to red-throated diver. The development of London Array beyond phase 1 is subject to the satisfactory outcome of an ornithological review process demonstrating that there would be no adverse effect on the red-throated diver population from the second phase of the development. Red-throated divers may habituate to wind turbines and therefore any habitat loss due to displacement may diminish over time. However, as yet, survey work has provided little or no evidence of habituation by divers (Petersen & Fox 2007; Percival 2010).

Disturbance and displacement effects may also arise from shipping (including recreational boating) and boat movements associated with marine aggregate and fishing activities (Cook & Burton 2010). Marine aggregates activities tend to be temporary and localised. Dredging and shipping activities are expected to be confined to existing shipping channels, which are already known to be avoided by divers. In the majority of cases it is expected that activity will be lowest during the winter months (when the birds are present) due to the limitations imposed by poor weather conditions (RPS Group PLC 2005). Prince's Channel (which runs through the southern area of the Outer Thames Estuary SPA) carries a significant amount of vessel traffic in and out of ports in the inner Thames Estuary. Fisherman's Gat is also an active commercial shipping channel. In addition, smaller vessels use the shallower inshore channels across the site.

Overall current exposure is considered to be medium.

Overall the **vulnerability of the Annex I species** within the Outer Thames Estuary SPA to **non-physical disturbance** is considered to be **high**.

5.1.4. Toxic contamination of red-throated diver and their supporting habitats

Synthetic compounds such as PCBs can bioaccumulate/ biomagnify through the food chain in the tissues of marine organisms and concentrations could be considerable once they reach the fish on which red-throated divers feed. Thus, **sensitivity to synthetic chemicals such as PCBs is considered moderate.**

Hotspots for synthetic compounds include industrial estuaries and sandy environments offshore, but **as PCBs are currently banned, exposure can be considered low.** If marine pollution were to occur there is the potential for exposure to PCBs to change.

Large oil and chemical spills affecting shallow sandbank habitats can have a detrimental effect on bird populations. Deterioration of invertebrate and small fish populations can have a significant impact on important food sources. Oil on the surface and in the water column would present a direct threat to diving and feeding seabirds particularly during their moulting times, when they are less mobile and

[35] Scroby Sands, Kentish Flats, Gunfleet Sands 1 & 2 plus London Array Phase 1 occupy a total area of 137.5 km^2 equivalent to 3.5% of SPA area

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remain at sea. Oil on the feathers of birds could lead to loss of insulation, reduced buoyancy and possible drowning. Consequently red-throated divers may suffer the inability to feed, resulting in starvation and death. Dispersants used to disperse the oil may also be harmful to the species. **Sensitivity to non-synthetic compounds is therefore considered to be high.**

Prince's Channel (which runs through the southern area of the Outer Thames Estuary SPA) carries a significant amount of vessel traffic in and out of ports in the inner Thames Estuary. Fisherman's Gat is also an active commercial shipping channel. In addition, smaller vessels use the shallower inshore channels across the site. This additional small vessel activity means that the risk of contamination by accidental spillages of fuel or cargo is increased, and a small level of contamination will exist as a result of normal shipping activities. Large ports in the area also increase the risk of exposure.

Although the *risk* of a catastrophic event due to vessel traffic (oil tankers, ships with toxic contaminants, etc.) exists, the probability of such an event occurring as a result of "normal" vessel traffic is considered to be very low; in addition the 'background level' of toxic contamination to which the site is exposed in also considered to be low.

However, there are ship-to-ship oil transfers occurring just off Southwold within 12nm. Ship-to-ship (s-t-s) transfers consist of a transfer of a cargo of oil (heavy fuel oil or crude oil, etc.) from one vessel to another. Large tankers are unable to gain access to the Russian/Baltic states and hence smaller tankers bring oil from the region and transfer this oil to larger tankers. From here the large tankers ship the oil internationally. Approximately 15-20 of these s-t-s operations occur annually. Although the Maritime and Coastguard Agency manage the s-t-s operations very well, accidental oil spills can happen at any time and due to the proximity of the s-t-s operations to the SPA it may be considered that there is an elevated risk from an oil spill at this location.

Overall the **vulnerability of the Annex I species (red-throated diver)** within the Outer Thames Estuary SPA to **toxic contamination** is considered to be **low-moderate**.

5.1.5. Non-toxic contamination of red-throated divers and their supporting habitats

Non-toxic contamination through nutrient loading, organic loading and changes to the thermal regime could impact on prey species and distribution. **The sensitivity** of the prey species of red-throated diver, and therefore of the divers themselves**, to non-toxic contamination is considered moderate.**

The dilution effect for this form of contamination (which could also include increased turbidity and changes to the salinity) may reduce the **exposure, which is considered low.**

Overall the **vulnerability** of the prey species and **of the Annex I species (red-throated diver)** within the Outer Thames SPA to non-toxic contamination is considered to be **low**.

5.1.6. Biological disturbance

Introduction of microbial pathogens and non-native species

Sensitivity to the introduction of microbial pathogens and non-native species is considered to be low for red-throated divers, as is their exposure to them in the Outer Thames Estuary SPA. **Vulnerability is therefore low.**

Selective extraction of prey species

Within the site, a variety of fishing gears are used with variable intensity to harvest different quota and non-quota species (CEFAS 2006; des Clers 2010; MMO 2012). Fishing activities include: suction dredging for cockles, set and drift-net trammelling, drift gill netting, potting, and a limited amount of beam and otter trawling for demersal species (mainly in troughs). Limited long-lining and pair-trawling also occurs within the site. Removal of fish species and larger molluscs can have significant impacts on the structure and functioning of benthic communities over and above the physical effects of fishing methods on the seabed, particularly as some fish species fill upper roles in the trophic web (Jennings & Kaiser 1998; Kaiser *et al*. 2006). Moreover, certain types of fishing have the potential to directly remove divers' prey species, either as target species or as bycatch. Thus, the mechanisms for these pressures to impact on red-throated divers may be an indirect or direct reduction in food availability for the overwintering population. **Red-throated divers are judged to be moderately sensitive to biological disturbance through selective extraction of prey species,** as they are known to be 'opportunistic feeders' taking a broad range of fish species, and their diet compositions seem to depend on availability rather than on food specialisation (Guse *et al*., 2009).

The exposure to selective extraction of red-throated divers' prey species by fishing (i.e. the amount of their prey species taken by fishing vessels as target or bycatch) is not clearly understood but **in general is considered low** due to differences in the average size composition of the fish eaten by divers and caught in commercial quantities by fishers, making **vulnerability to selective extraction low.**

Non-selective extraction of red-throated divers

The primary potential causes of non-selective extraction of divers are entanglement in static fishing gear or wind turbine strike.

Entanglement in static nets, fishing lines and general marine litter (of a wide variety) is a major cause of known mortality of red-throated divers (Okill 2002; Schirmeister 2003; Camphuysen 2008). In a study by Okill (2002), the mortality of 35.7% of all recovered ringed red-throated divers could be related to a particular cause of death: 53% of these 'attributable' deaths were caused by accidental capture in fishing nets (fish farms, discarded netting and static nets set for a variety of fish including herring, salmon and skate). It was concluded that 18.9% of all deaths of ringed red-throated divers were attributable to entanglement. Although the sample sizes on which these percentages were based are small, these figures, coupled with the relatively frequent occurrence of red-throated divers amongst netting casualties in other studies (Manville 2005) suggests that their **sensitivity to entanglement can be considered high.**

The three principal fishing methods for the inshore fishery within the SPA are suction dredging, single and multi-rig otter trawling and static netting. Static/passive fishing

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gear methods (such as set gill nets and drift netting), which are used throughout the estuary therefore pose the most serious risk to the birds themselves.

Kent and Essex IFCA in partnership with Natural England have been carrying out observations on red-throated diver bycatch within the Outer Thames Estuary SPA. Results from the first winter of monitoring (2011/12) showed that drift netting in the area was not a significant source of mortality for red-throated divers; zero bycatch of the species was recorded. IFCA observations showed that fishing effort for drift netting was low over winter and that fixed netting was not common practice in the area. Further observations are to be carried out over the 2012/13 winter period to increase the evidence base on bycatch and fishing methods within the area.

Information from other sources (e.g. CEFAS 2006; des Clers 2010) indicates that most netting activity, which is widespread across sandbanks, occurs in the summer and autumn, beginning in June and extending into December. In contrast, the wintering red-throated divers are most prevalent from November to March, with peak numbers occurring in January and February[36]. In light of current evidence, **exposure, and subsequently vulnerability, of red-throated divers within the site to non-selective extraction by fishing gear is therefore considered low**

There are many studies which have documented that birds which collide with rotating wind turbine blades are highly likely to be severely injured or killed (reviewed in Drewitt & Langston 2008). Red-throated diver populations are sensitive to increased adult mortality as it is a long-lived species with relatively low annual adult mortality and low breeding productivity. Thus, **sensitivity to non selective extraction through wind turbine strike can be considered high.**

Impacts to red-throated diver may result from collision with wind turbines, if they fly at a height above 20m. It has been observed, however, that they generally fly below the height at which they would be at risk of colliding with rotating turbine blades (Garthe & Huppop, 2004; RPS GROUP PLC 2005; Environmentally Sustainable Systems Ltd, 2008). Cook *et al.* (2012) modelled red-throated diver altitudes from 19 study sites, concluding only 2% of birds in flight were at collision risk height, with high confidence in the result.

In addition, exposure to collision risks is likely to be lowered due to the displacement of red-throated divers from windfarm footprints due to non-physical disturbance (section 5.1.3). These studies, coupled with the current size of the windfarm footprint areas in comparison to the area of the SPA, indicate that the **exposure to non-selective extraction through wind turbine strike is currently low. Vulnerability is therefore moderate.** Any habituation of divers to offshore windfarms in the future or further expansion of such developments may alter this assessment.

Overall the **vulnerability of the Annex I species (red-throated diver)** within the Outer Thames Estuary SPA to **biological disturbance** is considered to be **low-moderate.**

[36] They can be high in December too but tend to be lower in October and November (see Webb et al 2009, JNCC report on the Outer Thames http://www.jncc.gov.uk/page-4923)

6. Risk Assessment

JNCC and Natural England consider ‘risk’ to be the likelihood of deterioration of the feature due to an activity. It is the vulnerability of the feature to an activity, assessed against the level of management of that activity.

High-risk activities are those to which the feature is highly or moderately vulnerable, and for which there is insufficient management. For example, industries or activities which are not location specific and not subject to prior consent procedures or reliable enforcement are more likely to cause damage/disturbance to the interest feature. These industries include fishing. However, clearly not all activities associated with these industries are detrimental to interest features.

Low-risk activities will be those where there is no feature vulnerability (i.e. the activity does not interact with the feature) or where the moderate or high vulnerability is mitigated by management measures. For example, industries that are location specific are always subject to prior consent (often including explicit environmental impact assessment) and have clear reliable methods of enforcement; there is generally a lower likelihood of causing damage or disturbance to interest features.

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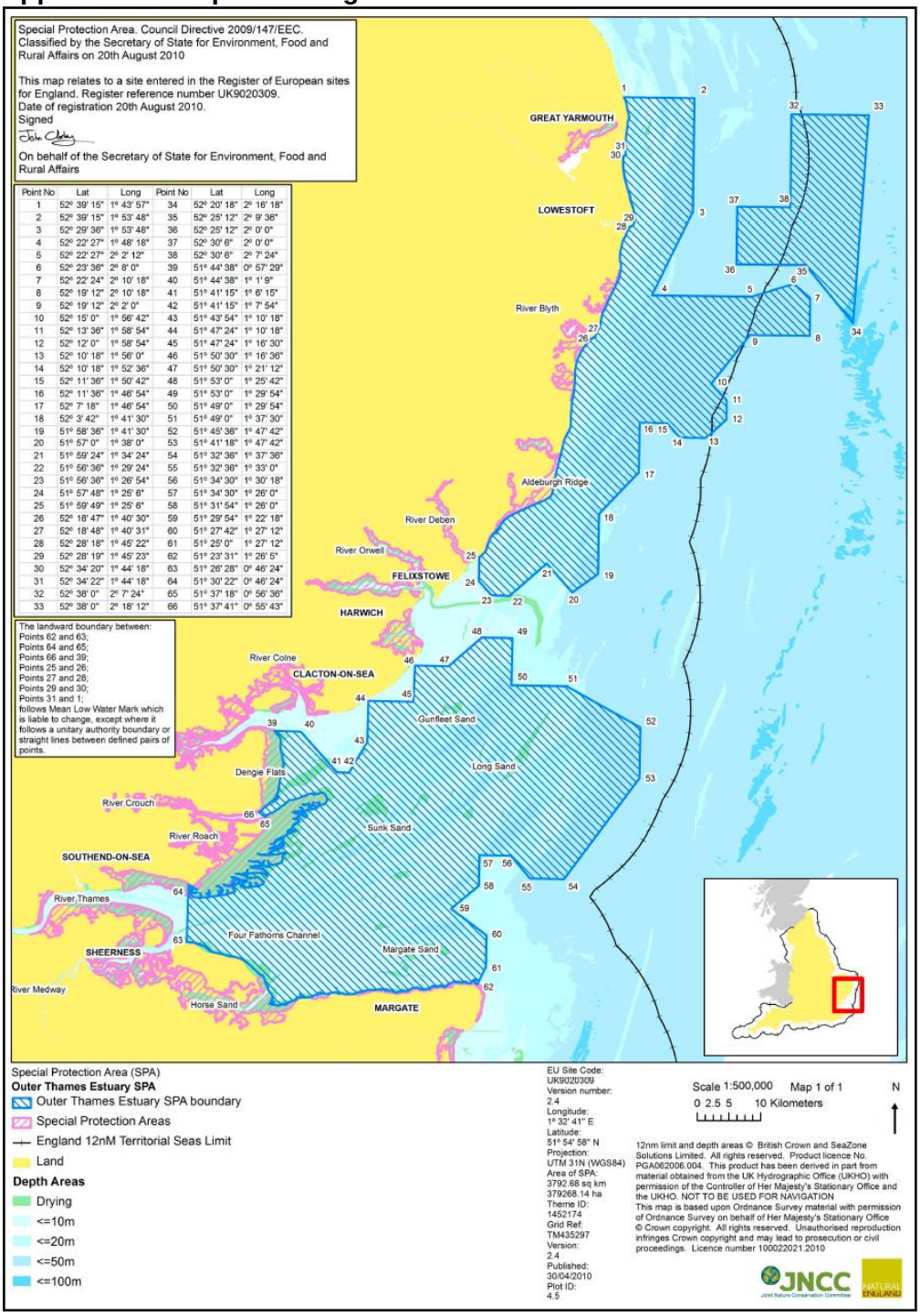
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Appendix A
Favourable Condition Table (FCT) for Outer Thames Estuary SPA

Attributes	Measure	Targets	Comments
Red-throated diver population size (Mandatory attribute)	Estimated population size derived from standardised site condition monitoring programme	Maintain population on the site subject to natural fluctuations. There should be no permanent decline, only non-significant fluctuation around the mean to account for natural change: where the limits of natural fluctuations are not well known maintain the population above 50% of that at designation; loss of 50% or more is unacceptable	Survey data used as the basis for deriving the SPA population comprised many incomplete surveys covering different sections of the final SPA boundary in different winters between the months of October to March in 1988/89, and 2002-2007. Derivation of the SPA population size required these partial datasets to be combined. Accordingly, there is limited understanding of the magnitude of inter-annual natural variation in population size across the entire SPA. In the absence of good knowledge of natural fluctuation in population size, the threshold for favourable condition is set, in line with standard practice, as being a population that exceeds 50% of the designated wintering population size. This target will be used to inform future assessments of favourable condition. Improved understanding of the natural dynamics of this population over time will be used to refine the target population size.
Habitat extent (Mandatory attribute)	Area of supporting habitat	No significant decrease in the extent of supporting habitat available for red-throated diver.	Changes in extent will need to take account of the dynamic nature of the sandbank, but a trend of reduction in extent may indicate long-term changes in the physical conditions influencing the feature, whether it be natural processes or anthropogenically driven. Further studies of diver distribution within the site, building on Skov *et al.* (2011) will inform understanding of the habitat usage by the species and help refine the measure and target in future.

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Appendix B : Maps showing interest features of the Outer Thames Estuary SPA



Point No	Lat	Long	Point No	Lat	Long
1	52° 39' 15"	1° 43' 57"	34	52° 20' 18"	2° 16' 18"
2	52° 39' 15"	1° 53' 48"	35	52° 25' 12"	2° 9' 36"
3	52° 29' 36"	1° 53' 48"	36	52° 25' 12"	2° 0' 0"
4	52° 22' 27"	1° 48' 18"	37	52° 30' 6"	2° 0' 0"
5	52° 22' 27"	2° 2' 12"	38	52° 30' 6"	2° 7' 24"
6	52° 23' 36"	2° 8' 0"	39	51° 44' 38"	0° 57' 29"
7	52° 22' 24"	2° 10' 18"	40	51° 44' 38"	1° 1' 9"
8	52° 19' 12"	2° 10' 18"	41	51° 41' 15"	1° 6' 15"
9	52° 19' 12"	2° 2' 0"	42	51° 41' 15"	1° 7' 54"
10	52° 15' 0"	1° 56' 42"	43	51° 43' 54"	1° 10' 18"
11	52° 13' 36"	1° 58' 54"	44	51° 47' 24"	1° 10' 18"
12	52° 12' 0"	1° 58' 54"	45	51° 47' 24"	1° 16' 30"
13	52° 10' 18"	1° 56' 0"	46	51° 50' 30"	1° 16' 36"
14	52° 10' 18"	1° 52' 36"	47	51° 50' 30"	1° 21' 12"
15	52° 11' 36"	1° 50' 42"	48	51° 53' 0"	1° 25' 42"
16	52° 11' 36"	1° 46' 54"	49	51° 53' 0"	1° 29' 54"
17	52° 7' 18"	1° 46' 54"	50	51° 49' 0"	1° 29' 54"
18	52° 3' 42"	1° 41' 30"	51	51° 49' 0"	1° 37' 30"
19	51° 58' 36"	1° 41' 30"	52	51° 45' 36"	1° 47' 42"
20	51° 57' 0"	1° 38' 0"	53	51° 41' 18"	1° 47' 42"
21	51° 59' 24"	1° 34' 24"	54	51° 32' 36"	1° 37' 36"
22	51° 56' 36"	1° 29' 24"	55	51° 32' 36"	1° 33' 0"
23	51° 56' 36"	1° 26' 54"	56	51° 34' 30"	1° 30' 18"
24	51° 57' 48"	1° 25' 6"	57	51° 34' 30"	1° 26' 0"
25	51° 59' 49"	1° 25' 6"	58	51° 31' 54"	1° 26' 0"
26	52° 18' 47"	1° 40' 30"	59	51° 29' 54"	1° 22' 18"
27	52° 18' 48"	1° 40' 31"	60	51° 27' 42"	1° 27' 12"
28	52° 28' 18"	1° 45' 22"	61	51° 25' 0"	1° 27' 12"
29	52° 28' 19"	1° 45' 23"	62	51° 23' 31"	1° 26' 5"
30	52° 34' 20"	1° 44' 18"	63	51° 26' 28"	0° 46' 24"
31	52° 34' 22"	1° 44' 18"	64	51° 30' 22"	0° 46' 24"
32	52° 38' 0"	2° 7' 24"	65	51° 37' 18"	0° 56' 36"
33	52° 38' 0"	2° 18' 12"	66	51° 37' 41"	0° 55' 43"

Appendix C: Methods deriving vulnerability.

Sensitivity	
None	-
Low	•
Moderate	••
High	•••

Exposure	
None	-
Low	+
Medium	++
High	+++

Vulnerability
None detectable
Low
Moderate
High

Additional Category for insufficient information = DD (Data Deficient)

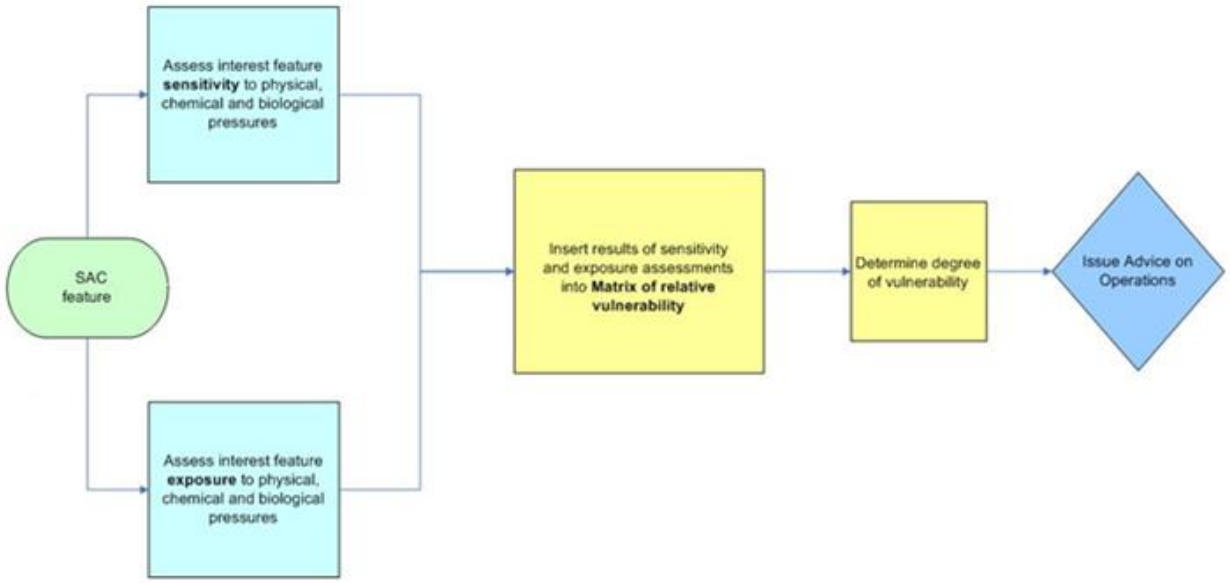
The relative vulnerability of an interest feature or sub-feature is determined by multiplying the scores for relative sensitivity and exposure, and classifying that total into categories of relative vulnerability.

		Relative sensitivity of the interest feature			
		High (3)	**Moderate (2)**	**Low (1)**	**None detectable (0)**
Relative exposure of the interest feature	**High (3)**	9	6	3	0
	Medium (2)	6	4	2	0
	Low (1)	3	2	1	0
	None (0)	0	0	0	0

Categories of relative vulnerability	
High	6-9
Moderate	3-5
Low	1-2
None detectable	0

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An assessment of interest features' vulnerability helps to guide site management decisions by highlighting potentially detrimental activities that may need to be managed (or continue to be managed) by the relevant authorities.



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Appendix D. Summary of operations/pressures that may cause deterioration or disturbance of red-throated diver s and their supporting habitat and prey species in the Outer Thames Estuary SPA at current levels of use

The advice below is not a list of prohibitions but rather a checklist for operations/pressures that may need to be subject to some form of management measure(s) or further measures where actions are already in force. Examples of activities under relevant authority jurisdiction are also provided. Operations marked with a ✓ indicate those to which red throated divers are considered to be **vulnerable** either directly or indirectly as a result of effects on their prey species and supporting habitat.

Operations (pressures) which may cause deterioration or disturbance with example activities	**red-throated diver - Outer Thames Estuary SPA**	**Supporting habitats and prey species - Outer Thames Estuary SPA**
Physical loss of supporting habitat		
Removal of habitat feature (e.g. offshore development, capital dredging, 'active dredging zones')		✓
Smothering (e.g. by artificial structures, disposal of dredge spoil)		✓
Physical damage to their habitats		
Siltation (e.g. run-off, channel dredging, outfalls)		✓
Abrasion (e.g. anchoring, cables)		✓
Selective extraction (e.g. aggregate dredging)		✓

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Operations (pressures) which may cause deterioration or disturbance with example activities	red-throated diver - Outer Thames Estuary SPA	Supporting habitats and prey species - Outer Thames Estuary SPA
Non-physical disturbance		
Noise (e.g. boat activity)	✓	✓
Visual (e.g. recreational activity)	✓	
Toxic contamination		
Introduction of synthetic compounds (e.g. pesticides, TBT, PCBs)	✓	✓
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	✓	✓
Introduction of radionuclides	✓	✓
Non-toxic contamination		
Changes in nutrient loading (e.g. agricultural run-off, outfalls)		✓
Changes in organic loading (e.g. mariculture, outfalls)		✓
Changes in thermal regime (e.g. power stations)		✓

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Operations (pressures) which may cause deterioration or disturbance with example activities	red-throated diver - Outer Thames Estuary SPA	Supporting habitats and prey species - Outer Thames Estuary SPA
Changes in turbidity (e.g. run-off, dredging)		✓
Changes in salinity (e.g. water abstraction, outfalls)		✓
Biological disturbance		
Introduction of microbial pathogens		
Introduction of non-native species and translocation		✓
Non-selective extraction / removal of bird species (e.g. accidental turbine strike)	✓	
Non-selective extraction / removal of bird species (e.g. entanglement or bycatch)	✓	
Selective extraction and removal of prey species (e.g. commercial and recreational fishing)		✓

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Appendix E Assessment of the relative vulnerability of interest features / Annex I Species and its supporting habitat for the Outer Thames Estuary SPA to different categories of operation (for key see appendix C). This aims to provide a 'high level' view of the operations which occur in the Outer Thames SPA and the likely vulnerability of the site's features to these activities. A more detailed assessment of each activity that is likely to occur in the site is provided in the Outer Thames SPA risk review.

Operations which may cause deterioration or disturbance	**internationally important populations of the Annex I species and their supporting habitat and prey species**		
	red-throated diver (Gavia stellata)		
	Sensitivity	Exposure	Vulnerability
Physical loss of supporting habitat			
Removal (e.g. harvesting,offshore development)	•••	+	Moderate
Smothering (e.g. by artificial structures, disposal of dredge spoil)	••	++	Moderate
Physical damage to habitat			
Siltation (e.g. run-off, channel dredging, outfalls)	••	+	Low
Abrasion (e.g. boating, anchoring,)	••	+	Low
Selective extraction (e.g. aggregate dredging)	••	+	Low
Non-physical disturbance			
Noise (e.g. boat activity)	•••	++	High
Visual (e.g. recreational activity)	•••	++	High
Toxic contamination			
Introduction of synthetic compounds (e.g. pesticides, TBT, PCBs)	••	+	Low
Introduction of non-synthetic compounds (e.g. heavy metals, hydrocarbons)	•••	+	Moderate
Introduction of radionuclides	**DD**	**DD**	**DD**

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Operations which may cause deterioration or disturbance	internationally important populations of the Annex I species and their supporting habitat and prey species		
Non-toxic contamination			
Changes in nutrient loading (e.g. agricultural run-off, outfalls)	••	+	Low
Changes in organic loading (e.g. mariculture, outfalls)	••	+	Low
Changes in thermal regime (e.g. power stations)	••	+	Low
Changes in turbidity (e.g. run-off, dredging)	••	+	Low
Changes in salinity (e.g. water abstraction, outfalls)	••	+	Low
Biological disturbance			
Introduction of non-native species and translocations	•	+	Low
Selective extraction of prey species (e.g. commercial & recreational fishing)	••	+	Low
Non-selective extraction (through entanglement with static gear)	•••	+	Moderate
Non-selective extraction (through wind-turbine strike)	•••	+	Moderate
Introduction of microbial pathogens	•	+	Low

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European Site Conservation Objectives for Flamborough and Filey Coast Special Protection Area Site Code: UK9006101

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure 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 population of each of the qualifying features, and,**
- **The distribution of the qualifying features within the site.**

This document should be read in conjunction with the accompanying Supplementary Advice document (where available), which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

A016 *Morus bassanus*; Northern gannet (Breeding)

A188 *Rissa tridactyla*; Black-legged kittiwake (Breeding)

A199 *Uria aalge*; Common guillemot (Breeding)

A200 *Alca torda;* Razorbill (Breeding)

Seabird assemblage

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 (as amended from time to time (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment' including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where this is available) provide a framework to inform the management of the European Site, and the prevention of deterioration of habitats and significant disturbance of its qualifying features.

These Conservation Objectives are set for each bird feature for a Special Protection Area (SPA). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving the aims of the Wild Birds Directive.

Publication date: 23 November 2018 (Version 3). This document updates and replaces an earlier version dated 30 June 2014 to reflect the extension and re-naming of the Flamborough Head and Bempton Cliffs SPA (classified as an SPA on 5 March 1993).

European Site Conservation Objectives for Greater Wash Special Protection Area Site Code: UK9020329

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure 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 population of each of the qualifying features, and,**
- **The distribution of the qualifying features within the site.**

Qualifying Features:

A001 *Gavia stellata;* Red-throated diver (Non-breeding)
A065 *Melanitta nigra;* Common scoter (Non-breeding)
A177 *Hydrocoloeus minutus*; Little gull (Non-breeding)
A191 *Sterna sandvicensis*; Sandwich tern (Breeding)
A193 *Sterna hirundo*; Common tern (Breeding)
A195 *Sternula albifrons*; Little tern (Breeding)

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2017 (the "Habitats Regulations"). They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment' including an Appropriate Assessment, under the relevant parts of this legislation.

These site-level Conservation Objectives are issued by Natural England only.

These Conservation Objectives, and the accompanying Supplementary Advice (when this becomes available), provide a framework to inform the management of the European Site, and the prevention of deterioration of habitats and significant disturbance of its qualifying features.

These Conservation Objectives are set for each bird feature for a Special Protection Area (SPA). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving the aims of the Wild Birds Directive.

This is a European Marine Site

This site is a part of the Greater Wash European Marine Site (EMS). These conservation objectives should be used in conjunction with the Regulation 35 Conservation Advice subsequently provided for the EMS.

This is a cross border site

This site lies within both the inshore and offshore waters of England. The advice of the Joint Nature Conservation Committee (JNCC) should therefore be sought separately.

Publication date: 12 April 2018 (v2). This updates and replace an earlier version dated 7 November 2016 following the classification of the SPA.